PEE DEE RIVER BASIN PLAN 2024

Table of Contents

Chapter 3 Water Resources of the Pee Dee River Basin

Chapter 4 Current and Projected Water Demand

Chapter 5 Comparison of Water Resource Availability and Water Demand

Chapter 6 Water Management Strategies

Chapter 7 Water Management Strategy Recommendations

Chapter 8 Drought Response

Chapter 9 Policy, Legislative, Regulatory, Technical, and Planning Process Recommendations

Chapter 10 River Basin Plan Implementation

Appendices

List of Figures

List of Tables

Acknowledgements

The Pee Dee River Basin Council (RBC) consists of the following volunteer stakeholders representing eight different water-interest categories. These individuals spent two years sharing their diverse perspectives and offering their expertise, culminating in the development of this River Basin Plan.

Name and Organization

Everett Allen, Keep It Green/Inlet Bay & Stewards
Michael Bankert, Legends Golf Course
Tim Brown, Grand Strand Sewer and Water
Cliff Chamblee, Sonoco Products Company - Hartsville
John Crutchfield, Duke Energy
Jason Gamble, Gamble Family Farms
Michael Hemingway, City of Florence
Megan Hyman, International Paper
Eric Krueger, The Nature Conservancy
Frances McClary, Williamsburg Soil and Water Conservation
Douglas Newton, Newton Farms
Hughes Page, Pee Dee Land Trust
Bob Perry, Water & Land Solutions
Lindsay Privette (Vice Chair), Pee Dee Regional Council of Governments
Buddy Richardson II (Chair), USDA-Farm Service Agency
John Rivers, Riverdale Farms, Inc.
Debra Buffkin, Winyah Rivers Alliance
Jeff Steinmetz, Francis Marion University
Cynthia Walters, Santee Cooper

South Carolina Department of Environmental Services

Dr. Joseph Ballenger
Brooke Czwartacki
Scott Harder
Joe Koon
Jason Marsik
Bill Marshall
Hope Mizzell
Leigh Anne Monroe
Priyanka More
Alex Pellett
Dr. Elliot Wickham

South Carolina Office of Resilience

Alex Butler

The Nature Conservancy

Eric Krueger

United States Geological Survey

Toby Feaster
Andrea Hughes

Clemson University

Dr. Luke Bower
Dr. Kendall Kirk
Dr. Joe Mruzek
Dr. Brandon Peoples
Dr. Nathan Smith
Dr. Thomas Walker III

Duke Energy

John Crutchfield
Jeff Lineberger

Waccamaw Regional Council of Governments

Leigh Kane

City of Florence

Michael Hemingway

Grand Strand Water and Sewer Authority

Tim Brown

Georgetown Water and Sewer District

Michael Yip

North Carolina Dept. of Environmental Quality

Linwood Peale

Yadkin-Pee Dee Water Management Group

Aubrey Lofton

CDM Smith

John Boyer

Brown and Caldwell

Jane McDonough
Matt Lindburg
Stephanie Alimena
Beth Albrecht
JD Solomon (JD Solomon Solutions)

Acronyms

ACP	Atlantic Coastal Plain
AEP	Annual Exceedance Probability
AIW	Atlantic Intracoastal Waterway
AMI	advanced metering infrastructure
AMR	automated meter reading
ARI	Annual Recurrence Interval
ASR	aquifer storage and recovery
AWWA	American Water Works Association
BRIG	Building Resilient Infrastructure and Communities
cfs	cubic feet per second
CMOR	Condition Monitoring Observer Reports
CUA	Capacity Use Area
CWWMG	Catawba-Wateree Water Management Group
DMA	Drought Management Area
DRC	Drought Response Committee
EIA	Energy Information Agency
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FSA	Farm Service Agency
GIS	geographic information system
GDP	gross domestic product
gpm	gallons per minute
GSWSA	Grand Strand Water and Sewer Authority
GWMP	Groundwater Management Plan
HMGP	Hazard Mitigation Grant Program
IRA	Inflation Reduction Act
LEED	Leadership in Energy and Environmental Design
LIP	Low Inflow Protocol
MGD	million gallons per day
MGM	million gallons per month
MIF	Minimum Instream Flow
MRLC	Multi-Resolution Land Characteristics Consortium
NCDEQ	North Carolina Department of Environmental Quality
NDMC	National Drought Mitigation Center
NLCD	National Land Cover Database

NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
PFAS	per- and polyfluoroalkyl substances
PPAC	Planning Process Advisory Committee
P&R	Permitted and Registered
RBC	River Basin Council
REAP	Regional Economic Analysis Project
SCDA	South Carolina Department of Agriculture
SCDES	South Carolina Department of Environmental Services
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCO	State Climatology Office
SC ORFA	South Carolina Office of Revenue and Fiscal Affairs
SPI	Standard Precipitation Index
SWAM	Simplified Water Allocation Model
UIF	unimpaired flows
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
WMA	Wildlife Management Area
WIFIA	Water Infrastructure Finance Information Act
YPD-DMAG	Yadkin-Pee Dee Drought Management Advisory Group

Chapter 1 Introduction

1.1 Background

The South Carolina Water Resources Planning and Coordination Act mandates that the South Carolina Department of Natural Resources (SCDNR) develop a comprehensive water resources policy for the state of South Carolina. SCDNR developed the first state water plan—the *South Carolina Water Plan*—in 1998. The plan was updated in 2004 following what is recognized as one of the worst multi-year droughts on record, which ended in 2002. One of the recommendations from the *South Carolina Water Plan, Second Edition* was forming advisory committees to develop comprehensive water resource plans for each of the state's four major river basins—the Ashepoo-Combahee-Edisto, Pee Dee, Santee, and Savannah. In 2014, when the development of surface water quantity models to support the planning process began, SCDNR and the South Carolina Department of Health and Environmental Control (SCDHEC), now the South Carolina Department of Environmental Services (SCDES)[1], further subdivided the basins based on SCDES's delineations used for the Water Quality Assessments. The eight planning basins are the Broad, Catawba, Edisto, Pee Dee, Lower Savannah-Salkehatchie, Saluda, Santee, and Upper Savannah, as shown in Figure 1-1. In 2016, SCDNR began working with the United States Geological Survey (USGS) to update the Coastal Plain Groundwater Model—another important tool to support development of water resource plans.

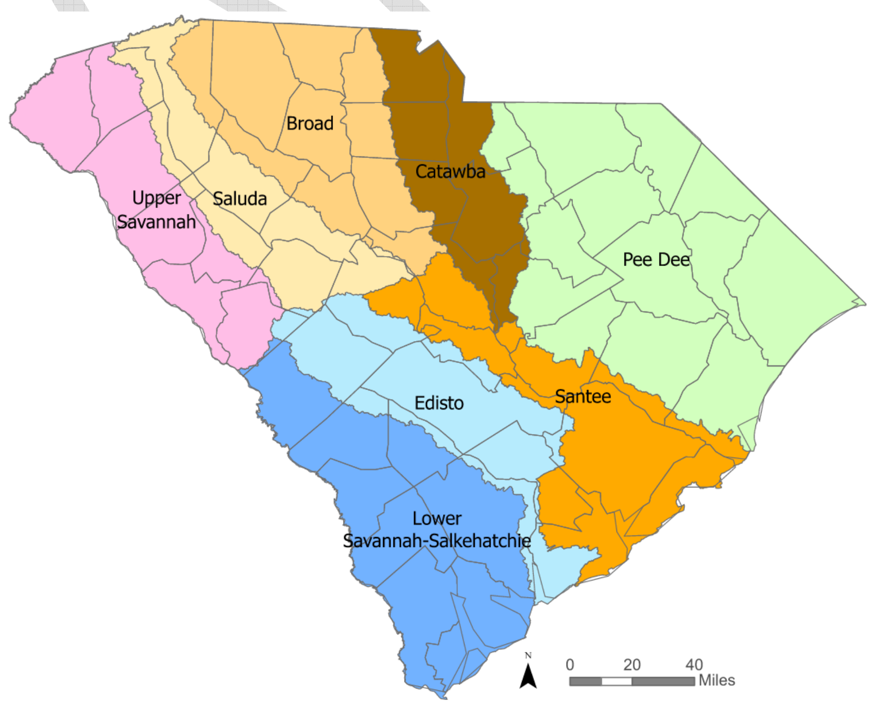


Figure 1-1. Planning basins of South Carolina.

Each of these water resource plans is called a River Basin Plan, which is defined in the *South Carolina State Water Planning Framework* (SCDNR

[1] [1] "Under state law, the South Carolina Department of Health and Environmental Control (SCDHEC) became two separate agencies on July 1, 2024. The two new agencies are the South Carolina Department of Environmental Services (SCDES) and South Carolina Department of Public Health (DPH)" (DHEC Restructuring. | SCDHEC). Activities carried out by the aforementioned DHEC, now SCDES, will be described under the new organizational structure of SCDES throughout this Plan.

2019; referred to hereafter as the Planning Framework) as "a collection of water management strategies supported by a summary of data and analyses designed to ensure the surface water and groundwater resources of a river basin will be available for all uses for years to come, even under drought conditions." The next update to the State Water Plan will build on the analyses and recommendations developed in the eight River Basin Plans.

River basins are seen as a natural planning unit for water resources since surface water in each basin is relatively isolated from water in other basins by natural boundaries. Each River Basin Plan will include data, analysis, and water management strategies to guide water resource development in the basin for a planning horizon of 50 years.

In each river basin, a River Basin Council (RBC) is established and tasked with developing a plan that fairly and adequately addresses the needs and concerns of all water users following a cooperative, consensus-driven approach. River basin planning is expected to be an ongoing, long-term process, and this plan will be updated every 5 years.

A River Basin Plan answers four questions:

1. What is the basin's current available water supply and demand?
2. What are the current permitted and registered water uses within the basin?
3. What will be the water demand in the basin throughout the planning horizon, and will the available water supply be adequate to meet that demand?
4. What water management strategies will be employed in the basin to ensure the available supply meets or exceeds the projected demand throughout the planning horizon?

The Edisto River basin was the first of the eight river basins to begin and complete the process. The Pee Dee River basin is the third to develop a River Basin Plan, and the plan is presented in this document.

1.2 Planning Process

The river basin planning process in South Carolina formally began with the development of the eight surface water quantity models starting in 2014 and the update of the Coastal Plain Groundwater Model in 2016. In March 2018, SCDNR convened the Planning Process Advisory Committee (PPAC). Over the next year and a half, SCDNR and the PPAC collaboratively developed the Planning Framework, which defines river basin planning as the collective effort of the numerous organizations and agencies performing various essential responsibilities, as described below. A more complete description of the duties of each entity are provided in Chapter 3 of the Planning Framework.

- **River Basin Council**: A group of a maximum of 25 members representing diverse stakeholder interests in the basin. Each RBC includes at least

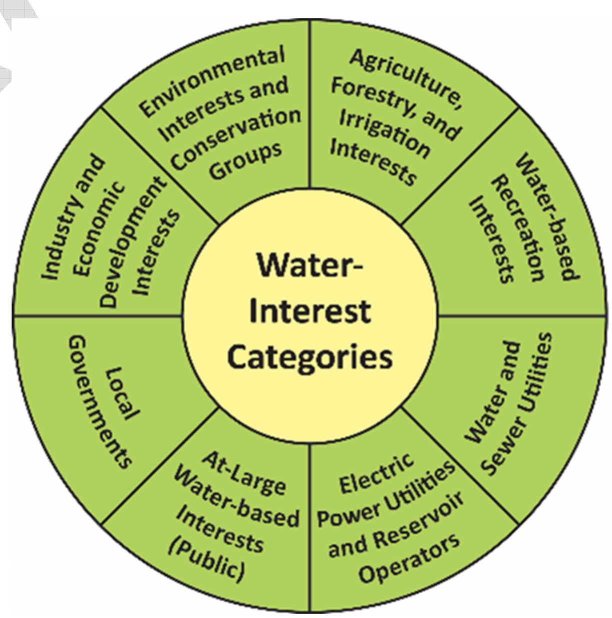


Figure 1-2. RBC water-interest categories.

one representative from each of the eight broadly defined stakeholder interest categories shown in Figure 1-2. The RBC is responsible for developing and implementing the River Basin Plan, communicating with stakeholders, and identifying recommendations for policy, legislative, regulatory, or process changes.

- **Planning Process Advisory Committee**: The PPAC is a diverse group of water resource experts established to develop and help implement the Planning Framework for state and river basin water planning. The PPAC will amend the Planning Framework as needed, review draft and final River Basin Plans, ensure consistency between the eight River Basin Plans, and advise SCDES on developing the new State Water Plan.
- **State and Federal Agencies**:
  - SCDES is the primary oversight agency for the river basin planning processes. Key duties of SCDES include appointing members to the PPAC and RBCs; educating RBC members on critical background information; providing RBCs and contractors with data, surface water models, and groundwater models; hiring contractors; and reviewing and approving the final River Basin Plans. SCDES is the regulatory agency that administers laws regarding water quality and use within the state. Key duties of SCDES include ensuring recommendations are consistent with existing laws and regulations and serving as an advisor for recommended changes to existing laws and regulations.
  - Other State Agencies: Representatives from other state agencies such as the Department of Natural Resources, Department of Agriculture, Department of Commerce, Forestry Commission, Rural Infrastructure Authority, and the Energy Office may be asked to attend RBC meetings in an advisory role.
  - Federal Agencies: Representatives from federal agencies such as the USGS, United States Army Corps of Engineers (USACE), and the Southeastern Power Administration (SEPA) may be asked to attend RBC meetings as formal advisors. Representatives from other federal agencies may be asked to attend RBC meetings in an advisory role.
- **Contractors**: SCDES will hire contractors to perform administrative, facilitative, technical, authorship, and public outreach functions. Specific roles include:
  - Coordinator: Performs administrative functions. Coordination of Pee Dee RBC meetings and other activities has collectively been shared by representatives from Brown and Caldwell and Clemson University. Brown and Caldwell, Clemson University, SCDES, the USGS, and CDM Smith collectively formed the Planning Team, which met at least monthly between RBC meetings.
  - Technical Contractor: Provides specific technical guidance. The USGS and CDM Smith served as technical contractors for the groundwater and surface water modeling, respectively.
  - Facilitator and Author: Guides RBC meetings in a neutral manner to encourage participation and provides River Basin Plan authorship services. Brown and Caldwell, along with JD Solomon, served in these roles for the Pee Dee RBC.
  - Public Outreach Coordinator: Engages stakeholders and the public in the planning process. JD Solomon served in this role for the Pee Dee RBC.

- **Groundwater and Surface Water Technical Advisory Committees**: SCDES-appointed groups with specific technical expertise intended to enhance the scientific and engineering aspects of the planning process.

- **Subcommittees and Ad Hoc Groups**: The Pee Dee RBC formed a subcommittee for each chapter of the River Basin Plan to contribute to and oversee the development of plan content. Chairs were elected for each subcommittee.

- **The Public and Stakeholders**: The public was invited to attend and provide comments at RBC meetings and designated public meetings. Additional detail on public participation is described in Section 1.4.

The creation of the Pee Dee RBC began with two public meetings organized by SCDNR on March 21 and 22, 2022, in the City of Conway and City of Darlington, respectively. The goals of these meetings were to describe the need and process for river basin planning to stakeholders and solicit applications to join the Pee Dee RBC. SCDNR accepted applications through April 2022 and selected RBC appointees in May 2022 based on their credentials, knowledge of their interest category, and their connection to the basin (i.e., RBC members must live, work, or represent a significant interest in the water resources of the Pee Dee River basin). The diverse membership of the RBC is intended to foster a variety of perspectives during development of the River Basin Plan. Pee Dee RBC members are listed with their affiliations and term lengths in Table 1-1. Term lengths are staggered to ensure continuity in the planning process.

Table 1-1. Pee Dee RBC members and affiliations.

Name	Organization	Position	Interest Category	Term Length (Years)
Everett Allen	Keep It Green/Inlet Bay & Stewards	Advisory Council & Member	At-Large	4
Michael Bankert	Legends Golf Course	Dir. Of Agronomy	Agriculture, Forestry, and Irrigation	2
Tim Brown	Grand Strand Sewer and Water	Chief of Plant Operations	Water and Sewer Utilities	3
Cliff Chamblee	Sonoco Products Company - Hartsville	Senior Environmental Engineer	Industry and Economic Development	3
John Crutchfield	Duke Energy	Hydro Compliance Manager	Electric-Power Utilities	2
Jason Gamble	Gamble Family Farms	Owner	Agriculture, Forestry, and Irrigation	3
Michael Hemingway	City of Florence	Utility Planning and Economic Development Director	Local Government	4
Megan Hyman	International Paper	Environmental Engineer	Industry and Economic Development	2
Eric Krueger	The Nature Conservancy	Director of Science	Environmental Interests	3
Frances McClary	Williamsburg Soil and Water Conservation	Chair	Water-Based Recreation	3

Name	Organization	Position	Interest Category	Term Length (Years)
Douglas Newton	Newton Farms	Owner	Agriculture, Forestry, and Irrigation	3
Hughes Page	Pee Dee Land Trust	Land Conservation Associate	Environmental Interests	3
Bob Perry	Water & Land Solutions	Senior Strategist	Environmental Interests	3
Lindsay Privette (Vice Chair)	Pee Dee Regional Council of Governments	Economic Development Director	Industry and Economic Development	2
Buddy Richardson II (Chair)	USDA-Farm Service Agency	RE Appraiser	At-Large	4
John Rivers	Riverdale Farms, Inc.	Vice President	Agriculture, Forestry, and Irrigation	2
Debra Buffkin	Winyah Rivers Alliance	Executive Director	Environmental Interests	2
Dr. Jeff Steinmetz	Francis Marion University	Director of the Freshwater Ecology Center	At-Large	4
Cynthia Walters	Santee Cooper	Senior Engineer	Electric-Power Utilities	2

For an up-to-date list of Pee Dee RBC members, see: https://www.des.sc.gov/programs/bureau-water/hydrology/water-planning/river-basin-planning/pee-dee-basin-planning/pee-dee-river-basin-council

The Pee Dee RBC began meeting in June 2022. The meetings were held as hybrid meetings with attendees participating both in person and via Zoom. Meetings were held monthly.

The planning process was completed in four phases, as specified in the Planning Framework:

- **Phase 1**: During the mostly informational Phase 1, RBC members heard presentations on topics such as water legislation and permitting; hydrology, monitoring, and low-flow characteristics; climatology; the South Carolina Drought Response Act; saltwater and freshwater aquatic resources; groundwater resources; surface and groundwater modeling; and the relationships between streamflow and ecologic conditions and diversity. Subject matter experts that presented information were from SCDNR, SCDES, USGS, the University of South Carolina, Clemson University, North Carolina Department of Environmental Quality (NCDEQ), the Yadkin-Pee Dee Watershed Management Group, Duke Energy, The Nature Conservancy, CDM Smith, and Brown and Caldwell.

- **Phase 2**: Phase 2 of the planning process focused on assessing past, current, and future surface water and groundwater availability. The RBC reviewed historical, current, and projections of future water use; 50-year planning scenario results from the surface water quantity model (referred to as the Simplified Water Allocation Model or SWAM); and groundwater trends identified using South Carolina's network of groundwater monitoring wells (the groundwater model was not fully updated at the time the River Basin Plan was completed). Potential water shortages and issues were identified and discussed.

- **Phase 3**: During Phase 3, water management strategies to address water availability issues were identified, evaluated, selected, and prioritized by the RBC based on their effectiveness, as determined by modeling and feasibility criteria such as cost, environmental impact, and socioeconomic impact.
- **Phase 4**: Legislative, policy, technical, and planning process recommendations were considered during Phase 4 of the planning process, which culminated in developing this River Basin Plan.

In the Pee Dee River basin, Phases 2 and 3 overlapped and were conducted in parallel to foster more strategic thinking around potential solutions and observed needs as well as interactively coupling the modeling and strategy formation. Figure 1-3 illustrates the process:

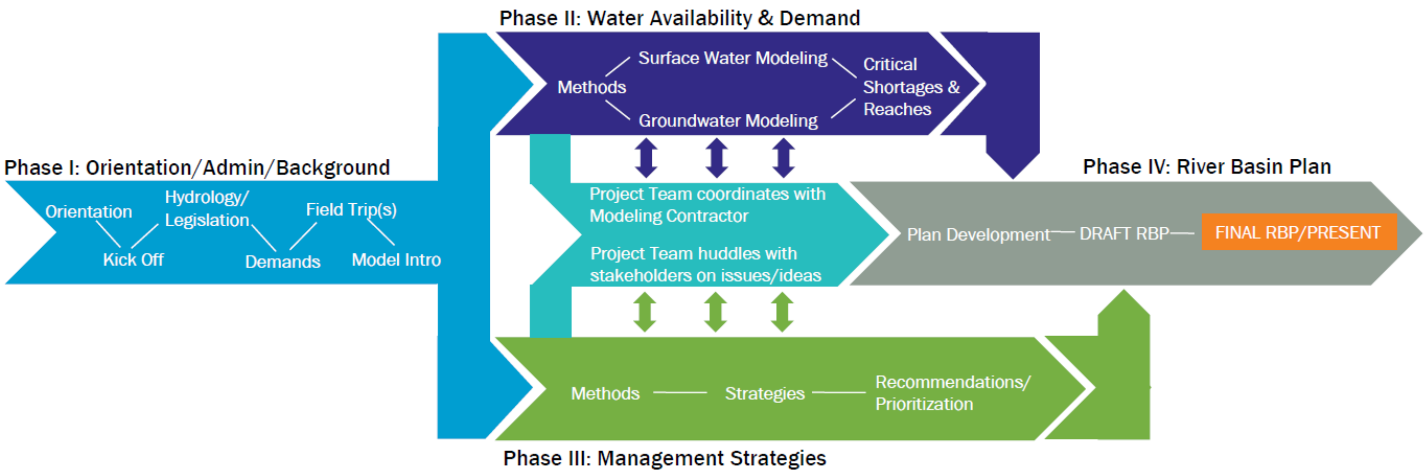


Figure 1-3. Structure of phased planning process used by the Pee Dee RBC.

RBC meeting at Clemson Pee Dee Research and Education Center in Darlington, SC, February 2023.
(Photo credit: JD Solomon)

Pee Dee RBC members participated in three field trips in the fall 2022, spring 2023, and summer 2024 to better understand the Pee Dee River and how water is withdrawn and used to support agriculture and public water supply needs.

- In October 2022, the RBC toured the Sumter Water Plant and learned about water use, water legislation, and permitting.
- In May 2023, the RBC visited Woodard Farms agricultural facility near Darlington, SC to better understand the importance and diversity of agricultural water uses.
- In July 2024, the RBC visited Sonoco's facility in Hartsville, SC to better understand industrial water uses.

RBC tour of Woodard Farms agricultural facility in May 2023.
(Photo credit: JD Solomon)

1.3 Mission Statement, Vision, and Goals

During Phase 1 of the planning process, the Pee Dee RBC developed a mission statement identifying the RBC's purpose, a vision statement establishing the desired outcome of the planning process, and actionable goals supporting their vision for the Pee Dee River basin. During the development process, the Pee Dee RBC discussed alternative language for the mission, vision, and goals, and selected the versions that best fit the RBC's preferences. The final mission statement, vision statement, and goals are listed in Table 1-2.

Table 1-2. Pee Dee RBC mission statement, vision statement, and goals.

Mission Statement
To develop, implement, monitor, and periodically revise a river basin plan for the surface and groundwater resources in the Pee Dee River basin.
Vision Statement
To make sure water is available for all in the Pee Dee River basin.
Goals
1. Develop and approve the River Basin Plan by June 1, 2024. 2. Review and update the River Basin Plan at least once every five years or amend it as needed. 3. Regularly communicate with stakeholders throughout the river basin. 4. Recommend policy, legislative, regulatory, or process changes.

1.4 Public Participation

Public participation is a vital component of the river basin planning process. All RBC meetings are open to the public. To promote visibility and encourage participation, meeting notices are posted on the SCDES Water Planning web page (https://www.des.sc.gov/programs/bureau-water/hydrology/water-planning) and are distributed to an email list. Meeting agendas, minutes, summaries, presentations, and recordings are posted on the SCDES website and are available to the public.

In addition to the RBC meetings, dedicated public meetings were held to distribute information and solicit feedback.

- The first two public meetings were held on March 21 and 22, 2022, in Conway and Darlington, respectively. At these meetings, the public was informed of the basin planning process and the plan for public participation. RBC membership applications were solicited at this meeting. There were 28 attendees at the March 21 meeting in Conway, and 53 attendees at the March 22 meeting in Darlington.

- The third public meeting was held after the release of the draft River Basin Plan. The draft plan was released on ___________, 2024, and the third public meeting was held on ____________, 2024, in __________________. A summary of the plan was provided to attendees and a public comment period was opened, which included a verbal comment period at the meeting followed by a 30-day written comment period. There were __ attendees at the third public meeting.

- The fourth public meeting was held after the River Basin Plan was finalized and released on _____________, 2024. The fourth public meeting was held on ____________, 2024, in __________________. At this meeting, the public was informed of changes made to the draft plan. There were __ attendees at the fourth public meeting.

1.5 Previous Water Planning Efforts

1.5.1 Groundwater Management Plans

The Groundwater Use and Reporting Act (S.C. Code Ann. §49-5-10 et seq.) establishes conditions for the designation of Capacity Use Areas (CUAs) where excessive groundwater withdrawal may have adverse effects on natural resources; may pose a threat to public health, safety, or economic welfare; or may pose a threat to the long-term integrity of the groundwater source. Once a CUA is designated, a Groundwater Management Plan must be developed to study the area's groundwater availability and demand and offer strategies to promote the sustainability of the resource. The plan must balance both the current and potential future competing needs and interests of the area. In addition, all users within the CUA withdrawing more than 3 million gallons of groundwater in any month must obtain a groundwater permit. The Pee Dee River basin covers parts of three CUAs: the Santee-Lynches, the Pee Dee, and the Waccamaw, as shown in Figure 1-4.

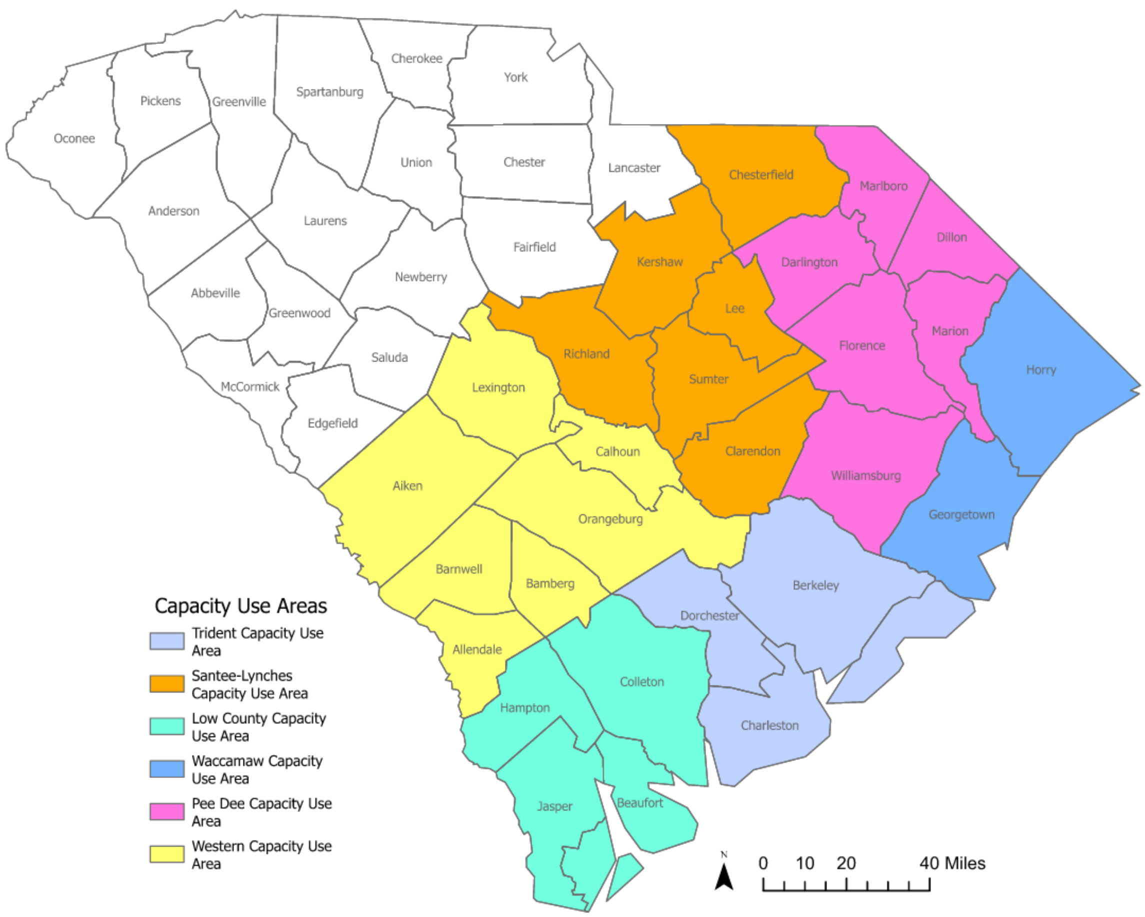


Figure 1-4. Capacity Use Areas.

- The Santee-Lynches CUA was defined in July 2021, and the Groundwater Management Plan was approved in August 2022.
- The Pee Dee CUA was designated in 2004, and the Initial Groundwater Management Plan was approved in 2018, with the latest Groundwater Evaluation Report in 2020.
- The Waccamaw CUA was defined in June 1979, and the Initial Groundwater Management Plan is dated August 2017.

In preparing the initial plans, SCDES convened stakeholder workgroups and solicited public comments. The plans describe current best practices for groundwater management. They are intended to be updated as more data are collected and following the application of the USGS Coastal Plain Groundwater Model of South Carolina.

For more information on Groundwater Management Plans, see:
https://des.sc.gov/programs/bureau-water/groundwater-management-planning

1.5.2 Drought Planning

The South Carolina State Climatology Office is responsible for drought planning in the state. The South Carolina Drought Response Act and supporting regulations establish the South Carolina Drought Response Committee (DRC) as the drought decision-making entity in the state. The DRC is composed of state agencies and local members representing various stakeholder interests. Local members are organized into one of four drought management areas (DMAs). The Pee Dee River basin spans the Northeast and Central DMAs. The DRC monitors drought indicators, issues drought status updates, determines nonessential water use, and issues declarations for water curtailment as needed. In addition to establishing the DRC, the South Carolina Drought Response Act also requires all public water suppliers to develop and implement their own drought plans and ordinances. Drought management plans developed by the public water suppliers in the Pee Dee River basin are further discussed in Chapter 8.

For more information on Drought Planning and the DRC, see: http://scdrought.com/committee.html

1.5.3 Watershed-Based Plans

Watershed-based plans have been developed for various watersheds throughout South Carolina to document sources of pollution and present a plan to protect and improve water quality within a watershed. While this first iteration of the Pee Dee River Basin Plan focuses on water quantity issues, previous planning efforts with the Pee Dee River basin that addressed water quality are worth noting. Water quality considerations may be more fully developed in future updates to the Pee Dee River Basin Plan.

In 1992, SCDES initiated its Watershed Water Quality Management program to better coordinate river basin planning and water quality management. Watershed-based management allows SCDES to address Congressional and Legislative mandates and improve communication with stakeholders on existing and future water quality issues. In the Pee Dee River basin, Watershed Water Quality Assessments (WWQA) were completed in

For more information on Watershed-Based Plans, see:
https://des.sc.gov/programs/bureau-water/watersheds-program/grant-funded-watershed-plans

1997, 2000, 2007, and 2015. The WWQAs of the Pee Dee River basin describe, at the watershed level, water quality related activities that may potentially have an adverse impact on water quality. The Pee Dee River basin was subdivided into 47 watersheds or hydrologic units. As of 2016, the WWQAs have been replaced by the South Carolina Watershed Atlas (https://des.sc.gov/programs/bureau-water/watersheds-program/sc-watershed-atlas), which allows users to view watershed information, add data, create layers from selected features, and export data for use outside of the application.

1.5.4 State Scenic River Management Plans

Segments of the Lynches, Little Pee Dee, and Black River have all been designated as State Scenic Rivers. As a part of this designation, a local advisory council was appointed for each segment, and this group developed River Management Plans for each waterbody. The plans were each developed with an engagement process, are non-regulatory in nature, and seek to identify local public values for the waterbodies, objectives and goals for stewardship of the waterbodies, and consensus-driven management solutions. Table 1-3 highlights the key components of the three major plans in this watershed.

Table 1-3. Scenic River Management Plan components.

Component	Lynches Scenic River	Little Pee Dee Scenic River	Black Scenic River
Year of Scenic River Designation	1994	2005	2001
Year of Management Plan Publication	2003	2008	2020
Length of Designated Segment	54 miles	48 miles	75 miles
Key Plan Categories	Water quality Recreational opportunities Maintaining the scenic quality of the river corridor Fisheries Wildlife and habitat management Community involvement	Land use and development Water quality and streamflow Recreational use and access Fish, wildlife, and habitat protection	History and cultural resources Land use Wildlife resources Water quality and streamflow Recreational and public access

> *"The mission of the Little Pee Dee Scenic River Advisory Council is to promote stewardship of the river for the benefit and enjoyment of present and future generations. Our focus will be conservation, utilization, awareness, protection and enhancement of the river's resources."* *Little Pee Dee Scenic River Management Plan*

The key plan categories are unique to each plan; however, there is consistency in what each region deems important. Water quality, recreational opportunities, stewardship of land development, and preservation of habitat are all examples of key objectives that are consistent across each of the plans. Through ongoing partnerships with the landowners, community groups, and other leaders, these plans aim to preserve and protect the scenic rivers.

1.5.5 Water Use and Quality Studies for Yadkin-Pee Dee River Hydroelectric Project Relicensing

A water quality and quantity assessment of the Pee Dee River was undertaken during the Federal Energy Regulatory Commission (FERC) relicensing process for the Yadkin-Pee Dee Hydroelectric Project (FERC No. 2206) in the Pee Dee River basin. The hydroelectric project, owned and operated Duke Energy Progress, LLC (Duke Energy, formerly Progress Energy), consists of two developments: Tillery and Blewett Falls. The hydroelectric operations of the two developments are connected – the Tillery Development operates to meet on-peak, load-following, and transmission system support needs, and the Blewett Falls Development is operated using block loading as a peaking facility. As shown in the excerpted map in Figure 1-5, both these developments and associated dams are located along the Yadkin-Pee Dee River in North Carolina, which forms the Pee Dee River at the confluence of the Yadkin and Uwharrie rivers in Lake Tillery headwaters.

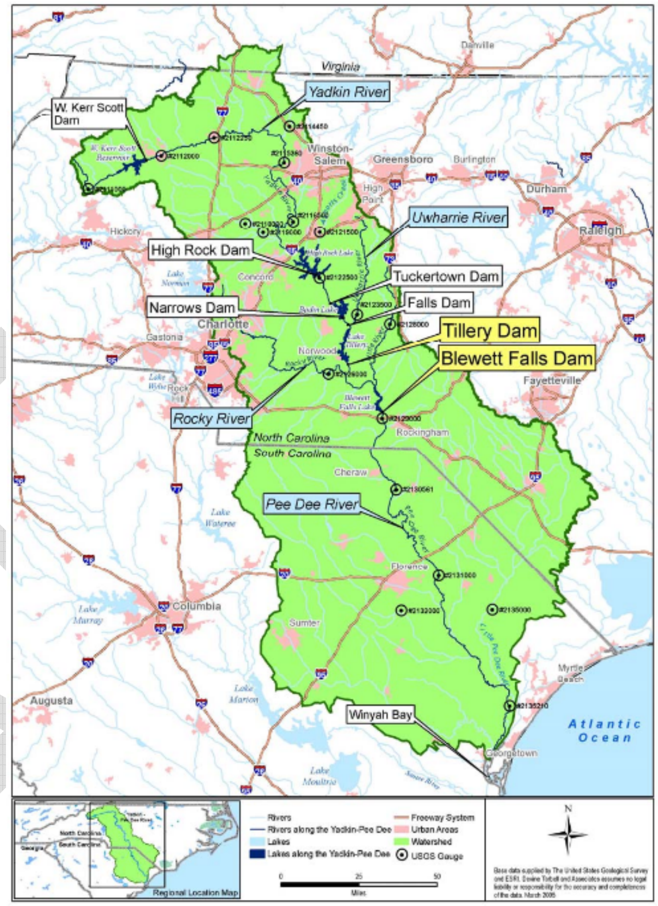


Figure 1-5. Map of the Yadkin-Pee Dee River basin showing location of Yadkin-Pee Dee and Yadkin Hydroelectric Developments.

Comprehensive relicensing water quality and habitat quality (instream flow) studies, published in 2006 as part of the federal relicensing application, were conducted to identify specific water and aquatic habitat quality impacts from the hydroelectric project. Studies were conducted during the relicensing process for the two developments to ensure they would comply with flow requirements, not disrupt migratory fish passage, and would mitigate water quality concerns in the river. Specifically, some reaches of the river below the developments had seasonal low dissolved oxygen (DO) impairments. The studies identified seasonal low DO concerns and impacts on habitat quality and wildlife due to regulated flow releases, they and developed solution pathways to incorporate in the new federal operating license for the Project. The relicensing reports summarized water quality sampling and instream flow modeling performed, as well as the design conditions of the two developments. Duke Energy developed a water quality assessment program during relicensing to mitigate the seasonal low DO impairments to meet state water quality standards. The program conducted from 2006 to 2011 included monitoring, assessment, and implementation of permanent DO enhancement equipment at both developments.

Duke Energy was issued a new 40-year FERC license on April 1, 2015 to operate the Yadkin-Pee Dee Hydroelectric Project, which specifically included license requirements for a seasonal flow release schedule to provide for riverine aquatic habitat, scheduled recreation flow releases and other instream flow needs, a Low Inflow Protocol (LIP) to address drought conditions in the river basin, and DO enhancement measures to ensure compliance with the applicable North Carolina water quality standards.

Cube Yadkin, which operates four hydroelectric developments (High Rock, Tuckertown, Narrows, and Falls) immediately upstream of the Yadkin-Pee Dee Hydroelectric Project also received a new FERC license for its Yadkin Project (FERC No. 2197) on September 22, 2016. The Cube Yadkin License also includes requirements for instream flow releases downstream of the Project, a LIP for drought management, and DO enhancement measures to meet state water quality standards.

1.6 Organization of this Plan

The Planning Framework outlines a standard format that all River Basin Plans are intended to follow, providing consistency in the organization and content. Consistency between River Basin Plans will facilitate the eventual update of the State Water Plan. Following the format outlined in the Planning Framework, the Pee Dee River Basin Plan is divided into 10 chapters as described below.

- **Chapter 1: Introduction** – Chapter 1 provides an overview of the river basin planning purpose and process. Background on the basin-specific history and vision for the future is presented. The planning process is described, including the appointment of RBC members and the roles of the RBC, technical advisory committees, subcommittees, ad hoc groups, state and federal agencies, and contractors.

- **Chapter 2: Description of the Basin** – Chapter 2 presents a physical and socioeconomic description of the basin. The physical description includes a discussion of the basin's land cover, geography, geology, climate, natural resources, and agricultural resources. The socioeconomic section describes the basin's population, demographics, land use, and economic activity, as these factors influence the use and development of water resources in the basin.

- **Chapter 3: Water Resources of the Basin** – Chapter 3 describes the surface and groundwater resources of the basin, and the modeling tools used to evaluate their availability. Monitoring programs, current projects, issues of concern, and trends are noted.

- **Chapter 4: Current and Projected Water Demand** – Chapter 4 summarizes the current and projected water demands within the basin. Demands for public water supply, thermoelectric power, industry, agriculture, and other uses are presented along with their permitted and registered withdrawals. The chapter outlines the methodology used to develop demand projections and the results of those projections.

- **Chapter 5: Comparison of Water Resource Availability** – Chapter 5 describes the methodology and results of the basin's surface water and groundwater availability analysis. This chapter presents planning scenarios that were developed and the performance measures used to evaluate them. Any water shortages, reaches of interest, or Groundwater Areas of Concern identified through this analysis are described. The shortages and areas of concern identified in this chapter serve as the basis for the water management strategies presented in Chapter 6.

- **Chapter 6: Water Management Strategies** – Chapter 6 presents the water management strategies developed as potential solutions to the shortages and areas of concern presented in Chapter 5. For each surface water or groundwater strategy considered, Chapter 6 includes a description of the measure, results from a technical evaluation (as simulated in the appropriate model, if applicable), feasibility for implementation, and a cost-benefit analysis.

- **Chapter 7: Water Management Strategy Recommendations** – Chapter 7 presents the final recommendations for water management strategies based on the analysis and results presented in Chapter 6. The chapter discusses the selection, prioritization, and justification for each of the recommended strategies. Any remaining shortages or concerns are also discussed in this chapter.

- **Chapter 8: Drought Response** – Chapter 8 presents existing and proposed drought management plans. The first part of the chapter discusses existing drought management plans, ordinances, and drought management advisory groups. The second part presents drought response initiatives developed by the RBC.

- **Chapter 9: Policy, Legislative, Regulatory, Technical, and Planning Process Recommendations** Chapter 9 presents overall recommendations intended to improve the planning process and/or the results of the planning process. Recommendations to address data gaps encountered during the planning process are presented along with recommendations for revisions to the state's water resources policies, legislation, and agency structure.

- **Chapter 10: River Basin Plan Implementation** – Chapter 10 presents a 5-year implementation plan and long-term planning objectives. The 5-year plan includes specific objectives, action items to reach those objectives, detailed budgets, and funding sources. The long-term planning objectives include other recommendations from the RBC that are less urgent than those in the implementation plan. Future iterations of this plan will include a chapter that details progress made on planning objectives outlined in previous plans.

Forested waterway in the Pee Dee River basin.
(Photo credit: JD Solomon)

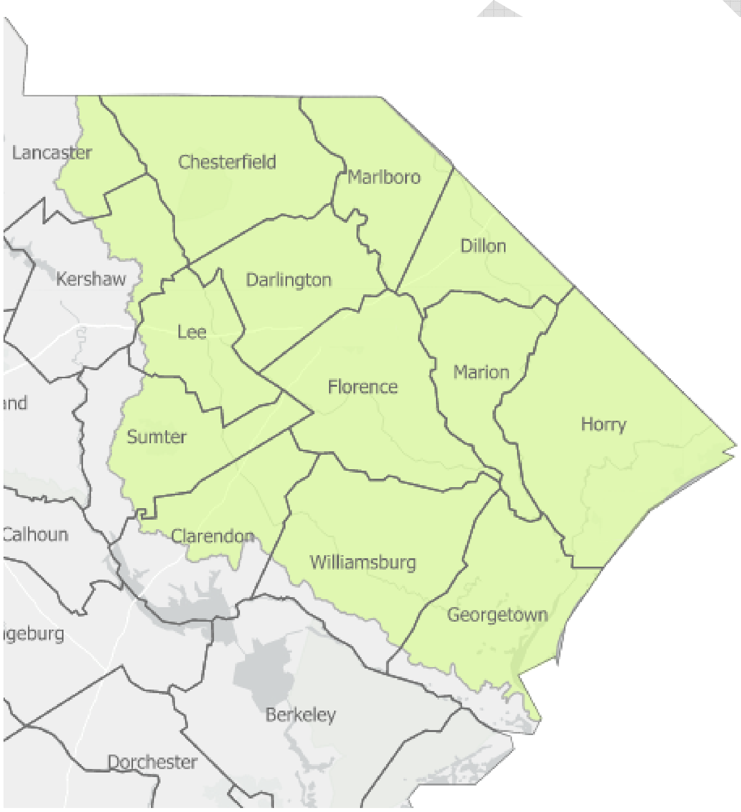
Chapter 2
Description of the Basin

2.1 Physical Environment

2.1.1 Geography

The Pee Dee River basin covers approximately 7,855 square miles making up 25 percent of the state's total land area. The basin covers the northeastern portion of the state between the border with North Carolina and the Atlantic Ocean. The basin is approximately pentagonal in shape.

The Pee Dee River basin overlays fourteen counties, fully encompassing seven. The counties present in the basin are shown in Figure 2-1.



County	Area in Pee Dee River Basin (sq. mi.)
Chesterfield	803
Clarendon	380
Darlington	562
Dillon	409
Florence	807
Georgetown	728
Horry	1,142
Kershaw	216
Lancaster	195
Lee	389
Marion	490
Marlboro	494
Sumter	447
Williamsburg	793
Total	7,855

Figure 2-1. Counties in the Pee Dee River basin and their area within the basin.

Figure 2-2 shows the major rivers, cities, and public lands in the Pee Dee River basin.

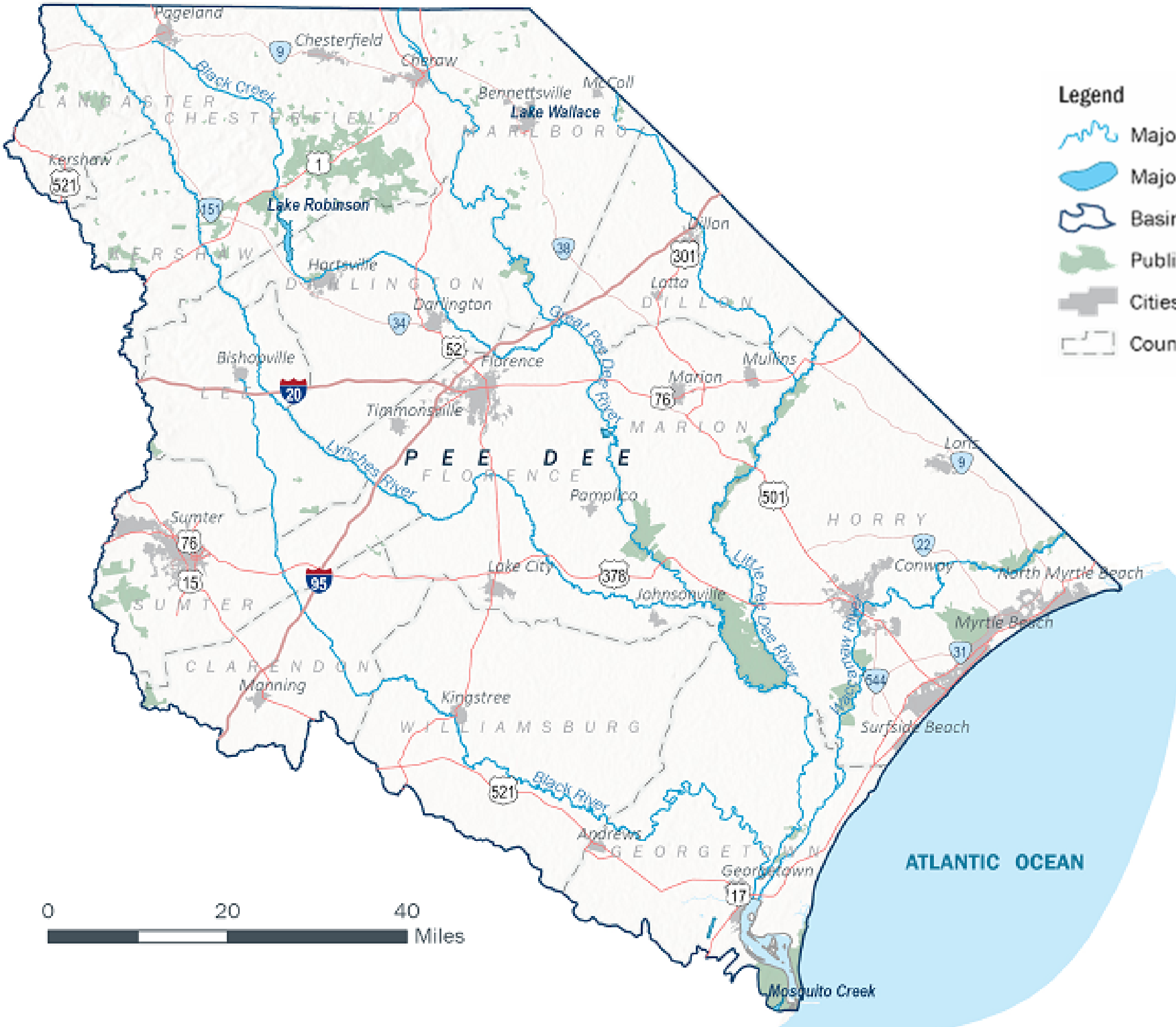


Figure 2-2. Pee Dee River and geographical features in South Carolina.

Five major rivers drain the Pee Dee River basin

- The **Great Pee Dee River** (or Pee Dee River) makes up the main stem, which originates in North Carolina as the Yadkin-Pee Dee River. Crossing into South Carolina, the Great Pee Dee River converges with four smaller rivers before discharging into Winyah Bay and the Atlantic Ocean in the southern part of the basin. A 70-mile reach of the Pee Dee River from the U.S. 378 bridge to Winyah Bay was designated as a State Scenic River in 2002. Black Creek is one of the tributaries to the Great Pee Dee River, and it has two major reservoirs along its length.
- The **Lynches River** drains the northwestern portion of the basin and flows into the Pee Dee River in Florence County. The Lynches River has the longest segment in the state that has been designated as a State Scenic River at 111 miles.

- To the east, the **Little Pee Dee River** originates in North Carolina and then traverses Dillon, Marion, and Horry counties before converging with the Pee Dee River. As is typical of Coastal Plain rivers, much of the Little Pee Dee River mainstem and tributaries flows through swamplands. Several segments of the Little Pee Dee River have been designated as State Scenic Rivers.
- Near the mouth of the river in Winyah Bay, the **Black River** and **Waccamaw River** (originating in North Carolina) both join, draining the southwest and southeast portions of the watershed, respectively. The Black River is associated with swamplands and includes a 75-mile segment designated as a State Scenic River. The Waccamaw River runs along the Coastal Plain, and its headwaters and half of its drainage area is in North Carolina.

The Pee Dee River in South Carolina is free flowing. However, reservoirs in North Carolina that produce hydropower influence flows in the Pee Dee River, particularly during low flows. A map showing the origins of the Pee Dee River in North Carolina, and the five major subbasins described above, is shown in Figure 2-3. About 42 percent of the Pee Dee River basin is located within South Carolina, and the majority of the rest of the basin is located in North Carolina with a small sliver located in Virginia. The mainstem of the river runs over 400 miles and traverses many different geographies.

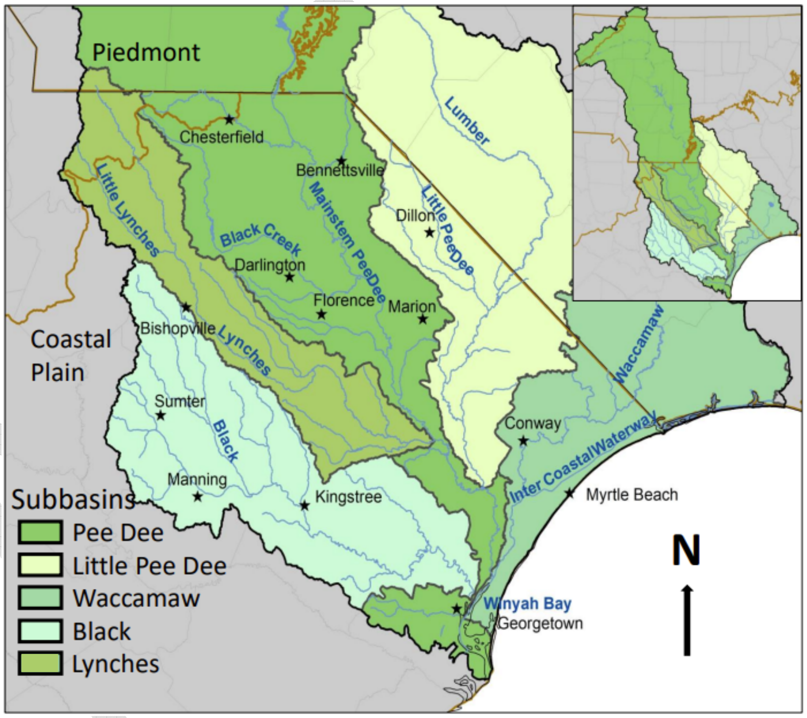


Figure 2-3. Pee Dee River and subbasins.

2.1.2 Land Cover

The Pee Dee River basin is largely made up of wetland, agricultural and wooded areas. A summary of land use types, taken from the Multi-Resolution Land Characteristics Consortium (MRLC), is presented in Figure 2-4. The MRLCs National Land Cover Database (NLCD) was used to develop a summary of land use types in the basin and a description of changes in land cover area from 2001 to 2019 (see Table 2-1). Since 2001, woodlands have decreased by around 146 square miles and is the land use category with the largest decline over that time period. Agricultural land has also decreased. Developed land has increased by approximately 73 square miles. Shrublands – which are areas dominated by shrubs less than five meters tall – have increased the most, gaining 128 square miles.

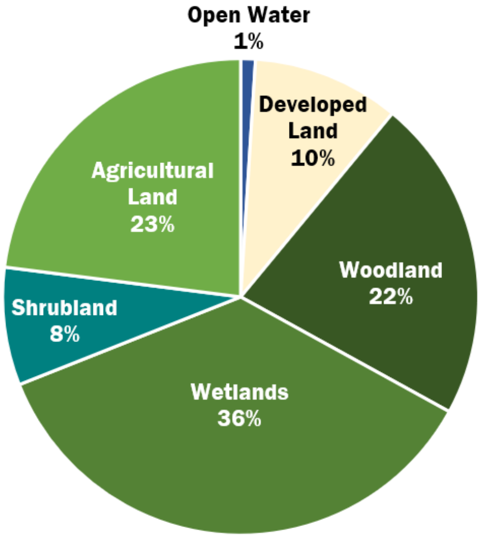


Figure 2-4. Pee Dee River basin land cover.

Table 2-1. Pee Dee River basin land cover and trends.

NLCD Land Cover Class	2001 Area (sq. miles)	2019 Area (sq. miles)	Change from 2001 to 2019 (sq. miles)
Open Water	105	107	2
Developed Land	707	780	73
Woodland	1,886	1,740	-146
Wetlands	2,826	2,823	-4
Shrubland	501	630	128
Agricultural Land	1,830	1,776	-53
Total Land Area	7,856	7,856	0

Forested area in the Pee Dee watershed.
(Photo credit: Matt Lindburg)

2.1.3 Geology

South Carolina's geology is described by the rock and sediment types present in a given location. The Pee Dee River basin spans multiple geologic units, which are illustrated in Figure 2-5. While many different geologic units are present across the state and basin, five major categories make up the majority of the basin: (1) Carolina Terrane, (2) Upper Cretaceous, (3) Pliocene, (4) Pleistocene, and (5) Holocene. Summaries of these units as described by SCDNR are provided in Table 2-2.

Table 2-2. Basin geology descriptions.

Geologic Map Unit	Description
Carolina Terrane	The lower part contains intermediate to felsic pyroclastic rocks that are collectively greater than 3 km thick, and it has been interpreted as a sequence of ash flow tuffs, possibly deposited in a sub-aerial environment. The upper part is predominantly clastic rocks. Separate from North America during Late Proterozoic and Cambrian time according to the fossil evidence.
Upper Cretaceous	Mostly micaceous, kaolinitic sands, with lenses of clay of variable thickness. Sands are mostly coarse sand to granule size, angular to subangular and poorly sorted, but some fine-grained, fairly well-sorted sand does occur. These sediments represent fluvial or upper delta-plain environments.
Pliocene	Marine sediments which are widely distributed from the coast to the Fall Line but are preserved at the surface below the Orangeburg Scarp. Documents the last major transgression of the sea over the Coastal Plain.
Pleistocene	Contains recent fluvial sands, backbarrier muds (i.e., marsh), and barrier beach sands that are less than 3 million years.
Holocene	Active deposition along the shore, behind the shore, and in stream valleys with an approximate maximum elevation of 10 feet at the ocean margin, where Holocene sediments overlap, overlie, or abut sediments of the Silver Bluff terrace. Most of the Carolina low country is covered by a 5- to 10-m thick blanket of unconsolidated Quaternary marine and fluvial deposits, which lie on semi-lithified Tertiary sediments. The oldest beach deposits are farthest inland and at the highest elevations; younger beach deposits are progressively closer to the ocean and at lower elevations.

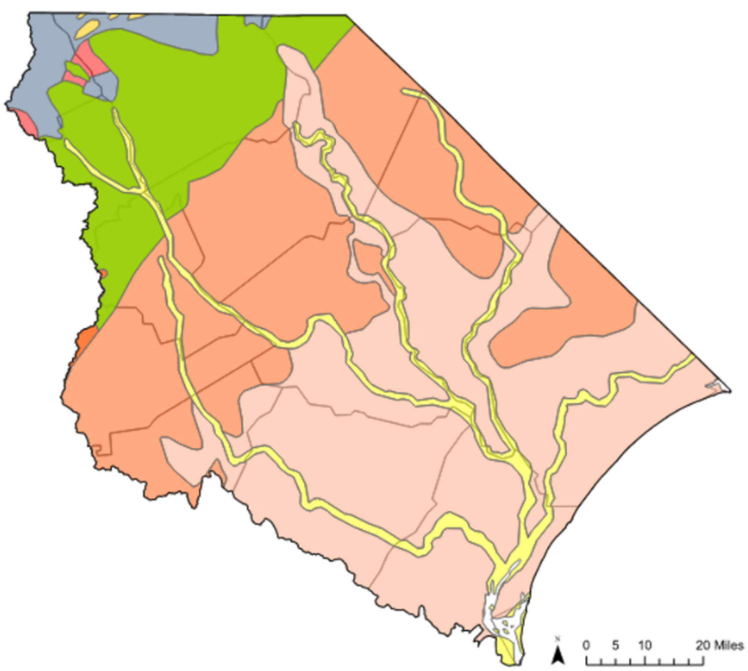


Figure 2-5. Generalized geologic map of the Pee Dee River basin (SCDNR).

2.2 Climate

2.2.1 General Climate

Much like the rest of the Carolinas, the South Carolina portion of the Pee Dee River basin's climate is humid subtropical with hot summers and mild winters. **Figure 2-6** shows the average annual temperature and the annual average precipitation for both the entire Yadkin-Pee Dee River basin and the South Carolina portion of the Pee Dee River basin, based on the current climate normals (1991-2020).

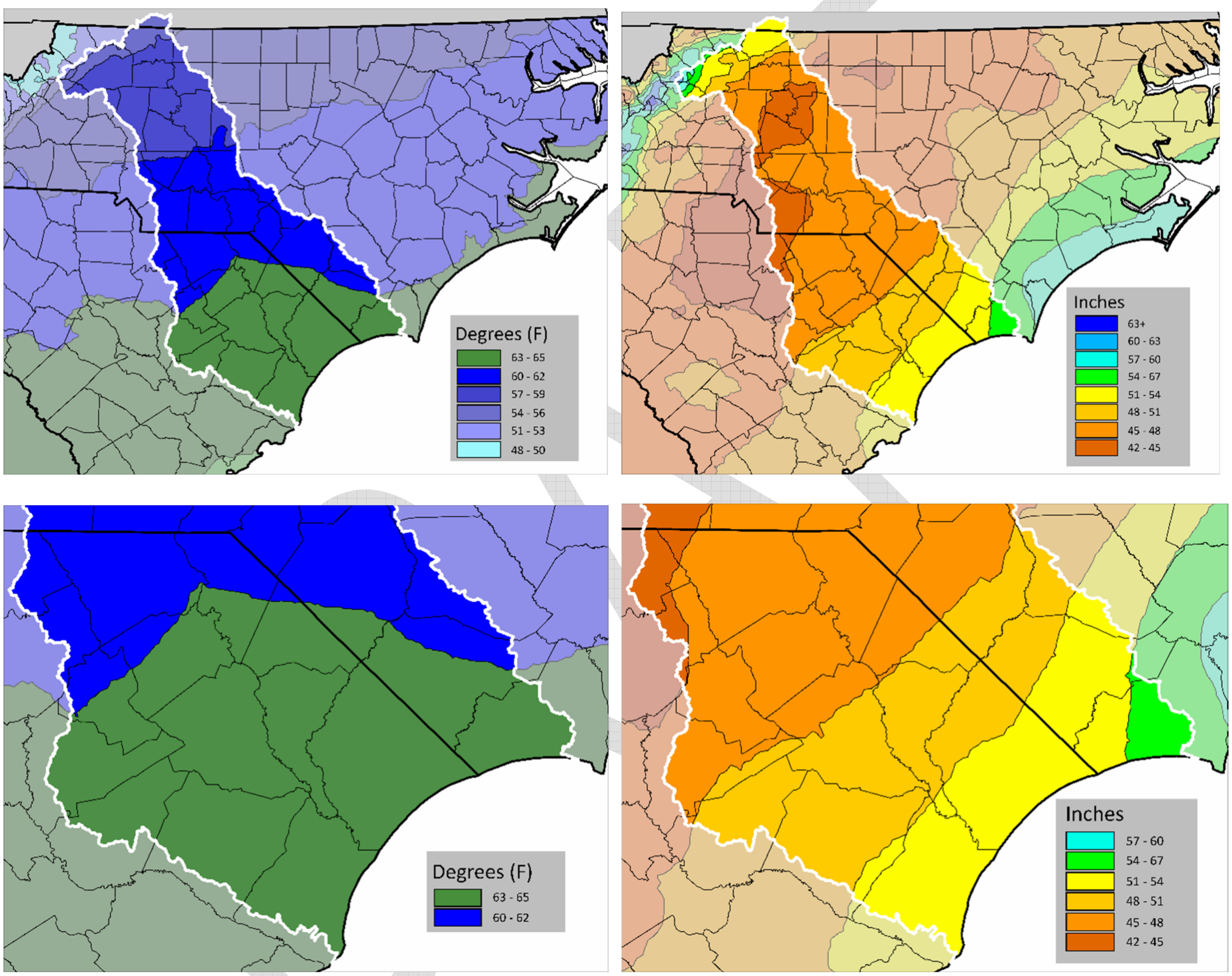


Figure 2-6. Normal annual average temperature and precipitation (1991-2020) for the entire Yadkin-Pee Dee River basin and the Pee Dee River basin within South Carolina.

In Figure 2-6, the temperature and precipitation data outside the basin are semi-transparent, and the coloration is slightly different than the legend. While the legend is applicable for the entire area in the figure, please reference it specifically for the basin.

The current climate normals maps for all of South Carolina for the parameters of temperature (average, maximum, and minimum) and precipitation at annual, seasonal, and monthly time steps are available on the South Carolina State Climatology Office's "Climate" webpage:

https://www.dnr.sc.gov/climate/sco/ClimateData/cli_sc_climate.php

The average annual temperature in the Yadkin-Pee Dee River basin ranges from 54 to 65 degrees Fahrenheit (F), with temperature increasing from the upper basin to the lower basin. Annual average precipitation for the entire basin ranges from 42 to 63 inches (in), with higher precipitation totals in the upper portions of the basin and along the coast, while the middle of the basin receives less precipitation. The annual average temperature for the South Carolina portion of the Pee Dee River basin ranges from 60 to 65 degrees F. The annual average precipitation for the South Carolina portion of the basin ranges from 42 in to over 54 in, with rainfall increasing towards the bottom of the basin.

Temperature and precipitation values vary both geographically and throughout the year. Figure 2-7 and Figure 2-8 show the monthly variation in temperature and precipitation at the meteorological stations "Statesville 2NNE," in Iredell County (NC) and "Florence Regional Airport," in Florence County (SC). For both Statesville 2NNE and Florence Regional Airport, temperature oscillates throughout the year, with July generally being the warmest month for both stations (average monthly temperature of 77.1 and 81.2 degrees F, respectively) and January being the coldest month (average monthly temperature of 38.5 and 45.4 degrees F, respectively). The average monthly temperatures at the Statesville 2NNE station are 4 to 8 degrees F cooler than Florence Regional Airport.

Precipitation also varies throughout the year for Statesville 2NNE and Florence Regional Airport. The wettest month for Statesville 2NNE is August (average monthly precipitation of 4.47 in) and July for Florence Regional Airport (average monthly precipitation of 5.61 in). For both Statesville 2NNE and Florence Regional Airport, the driest month is November (average monthly precipitation of 3.23 and 2.49 in, respectively). Statesville 2NNE has more consistent rainfall totals from month to month than Florence Regional Airport, which has higher monthly precipitation totals from June to September.

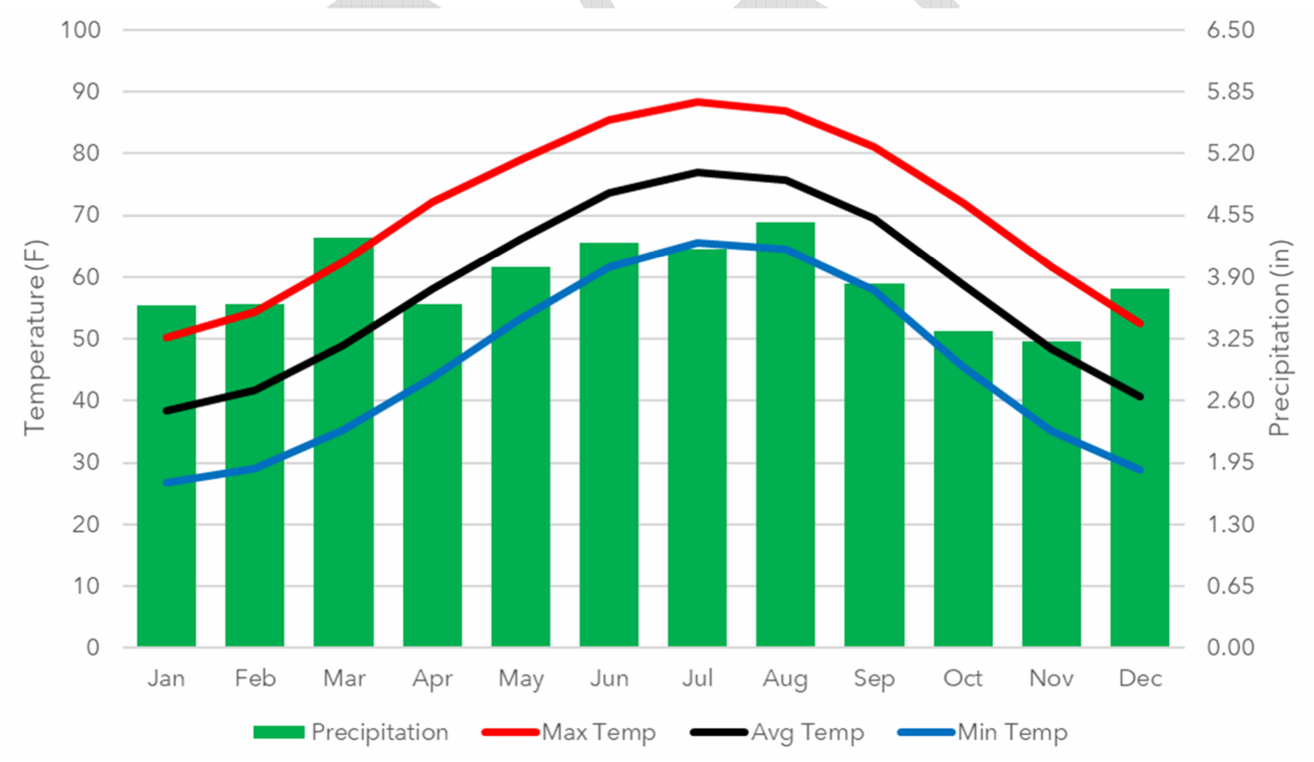


Figure 2-7. Statesville 2NNE (NC) monthly climate averages from 1948 to 2022 (SCDNR State Climatology Office 2023).

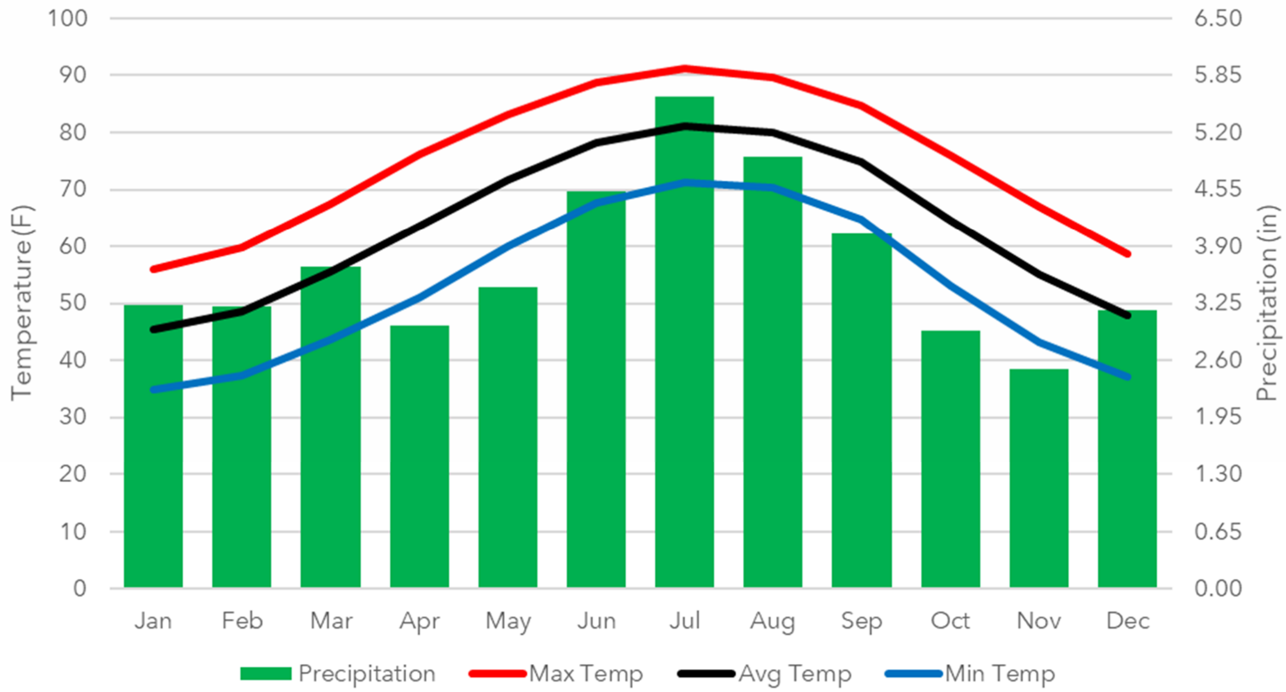


Figure 2-8. Florence Regional Airport (SC) monthly climate averages from 1948 to 2022 (SCDNR State Climatology Office 2023).

Through time, the annual average temperature and precipitation for the Carolinas and the Yadkin-Pee Dee River basin have varied (National Oceanic and Atmospheric Administration [NOAA], 2023; SCNDR State Climatology Office 2023). Figure 2-9 shows the annual average temperature for the 1948 to 2002 time period as well as the overall average annual temperature for that period. Through this period, Statesville 2NNE has an annual average temperature of 58.1 degrees F (Figure 2-9), and Florence Regional Airport has an annual average temperature of 63.9 degrees F (Figure 2-10). Table 2-3 shows the warmest and coldest five years for both stations. None of the top 5 warmest or coldest years are shared between the stations.

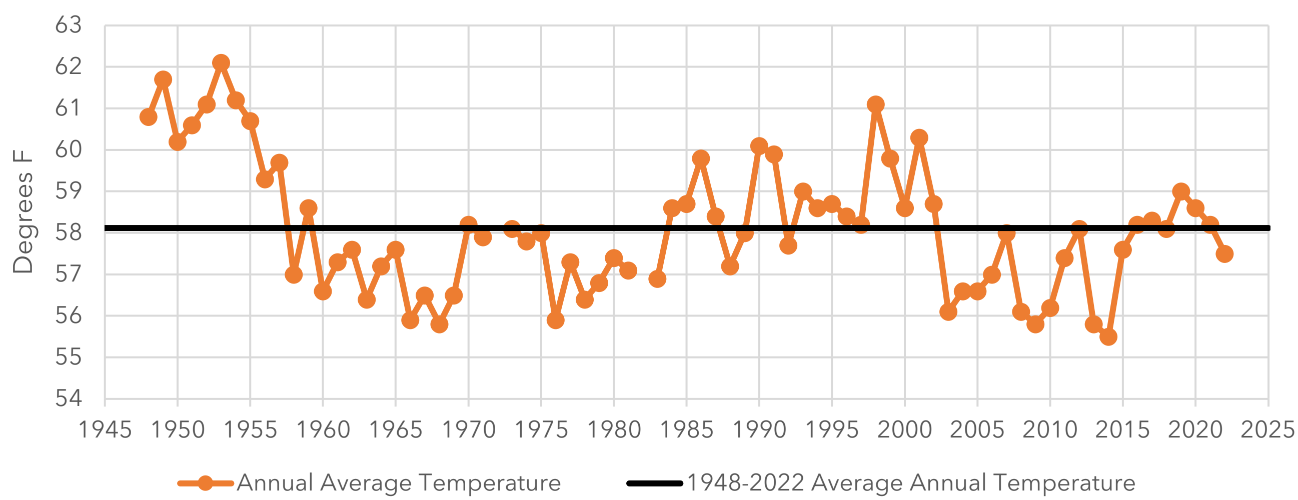


Figure 2-9. Annual average temperature for Statesville 2NNE, 1948 to 2022 (SCNDR State Climatology Office 2022).

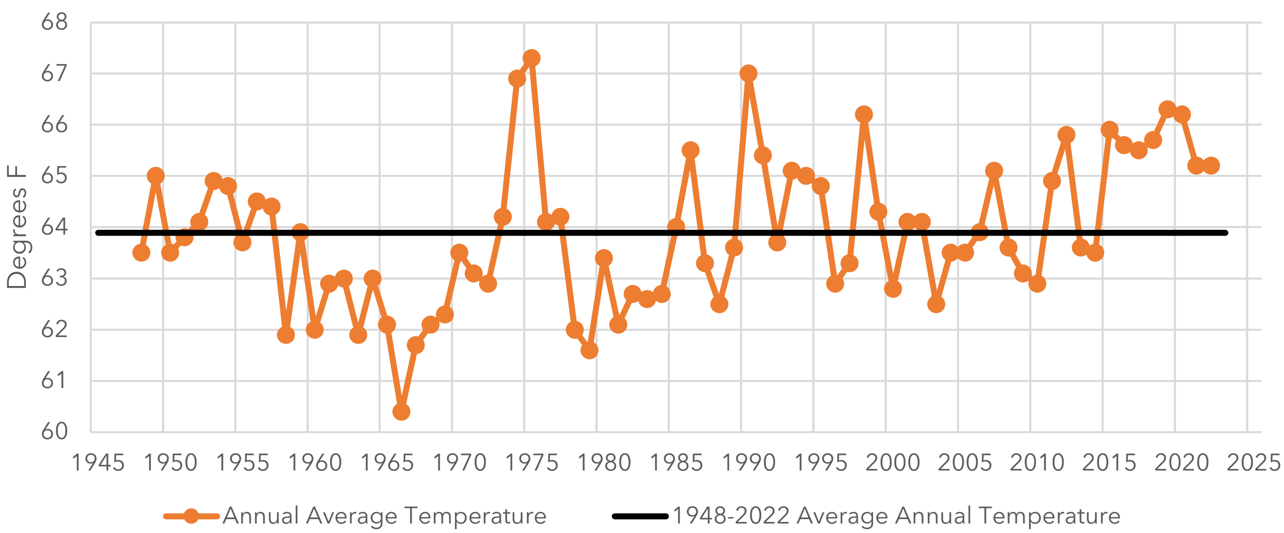


Figure 2-10. Annual average temperature for Florence Regional Airport, 1948 to 2022 (SCNDR State Climatology Office 2022).

Table 2-3. Five warmest and coldest years for Statesville 2NNE and Florence Regional Airport from 1948 to 2022 (SCNDR State Climatology Office 2023).

	Warmest		Coldest	
	Statesville 2NNE	**Florence R.A.**	**Statesville 2NNE**	**Florence R.A.**
1	1953 (62.1 F)	1975 (67.3 F)	2014 (55.5 F)	1966 (60.4 F)
2	1949 (61.7 F)	1990 (67.0 F)	1968 (55.8 F)	1979 (61.6 F)
3	1954 (61.2 F)	1974 (66.9 F)	2009 (55.8 F)	1967 (61.7 F)
4	1952 (61.1 F)	2019 (66.3 F)	2013 (55.8 F)	1963 (61.9 F)
5	1998 (65.1 F)	2020 (66.2 F)	1976 (55.6 F)	1958 (61.9 F)

Figure 2-11 shows the annual precipitation from 1948 to 2022 for Statesville 2NNE and Figure 2-12 shows the same for the Florence Regional Airport station as well as the annual average precipitation over that time period. Through this period Statesville 2NNE has an average annual precipitation of 46.21 inches and Florence Regional Airport has an average annual precipitation of 44.22 inches.

Table 2-4 shows the driest and wettest five years for both stations. While the wettest and driest years for the two stations are generally inconsistent, they both share 2001 as one of their driest years and share 2018 and 2020 as two of their wettest years. Specifically for Florence Regional Airport, the driest year on record (1954) matches South Carolina's driest year on record, which was part of the 1950s drought. The 2nd and 3rd driest years on record at Florence Regional Airport were also parts of notable droughts in South Carolina history, the 2010 to 2012 drought and 1998 to 2002 drought, respectively. Contrastingly, the 4th wettest year on record at Florence Regional Airport is 1964, which is the wettest year on record for the state of South Carolina. The 3rd and 5th wettest years (2016 and 2018, respectively) are due to heavy rains from tropical systems (Hurricane Matthew in 2016 and Hurricane Florence in 2018), both of which caused extensive flooding in the Pee Dee River basin.

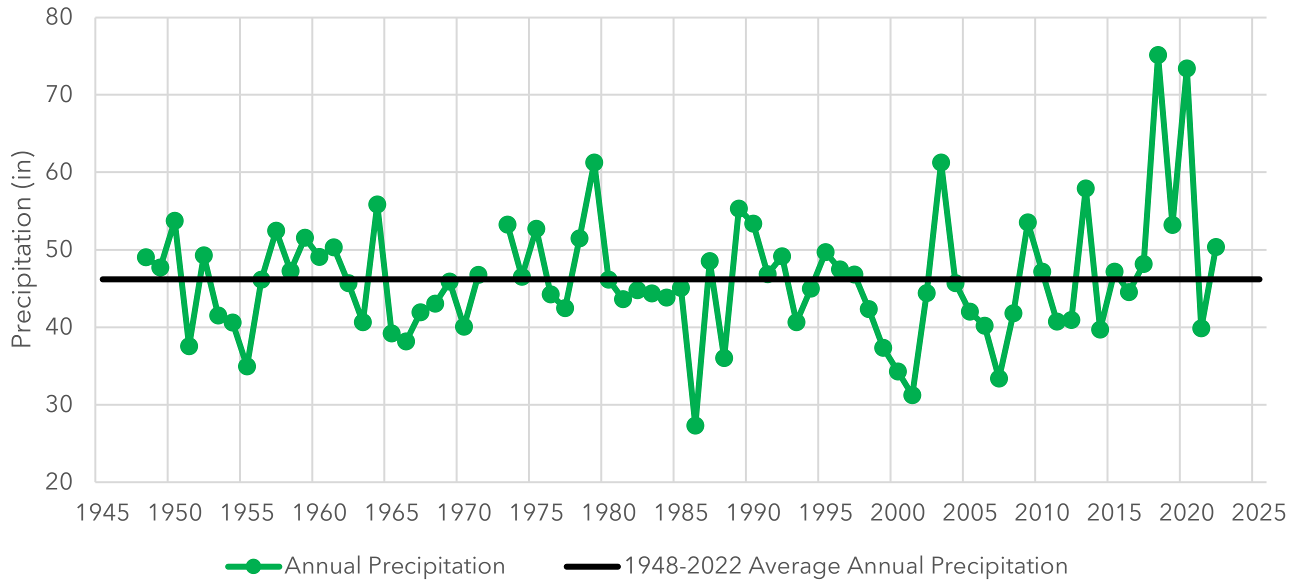


Figure 2-11. Annual precipitation for Statesville 2NNE, 1948 to 2022 (SCNDR State Climatology Office 2023).

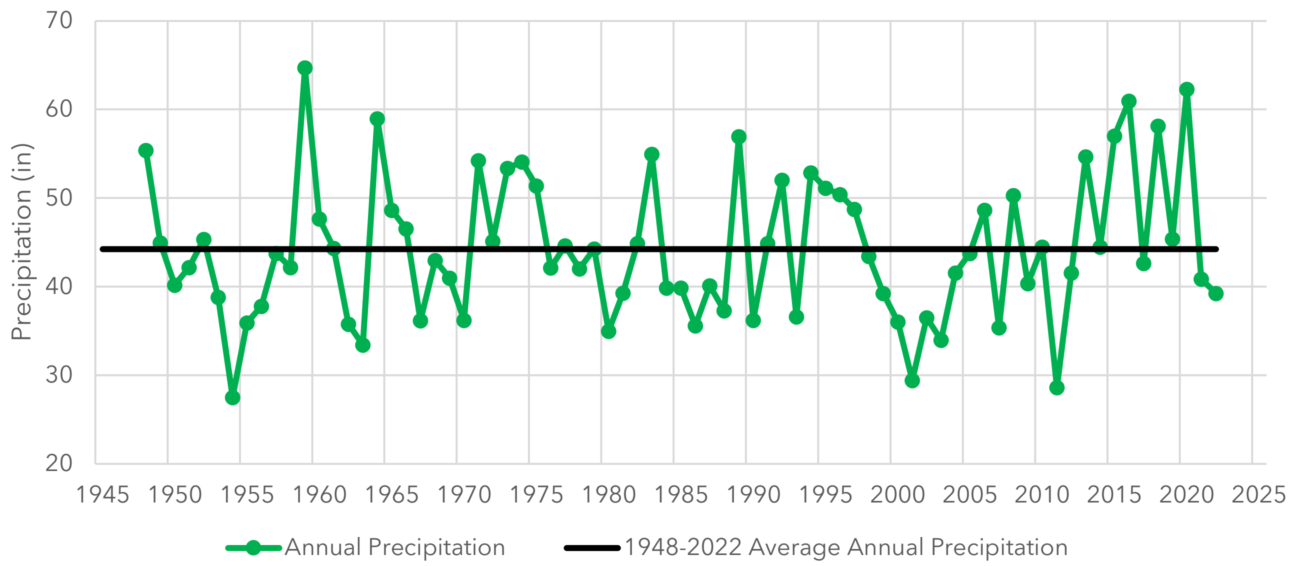


Figure 2-12. Annual precipitation for Florence Regional Airport, 1948 to 2022 (SCNDR State Climatology Office 2023).

Table 2-4. Five wettest and driest years Statesville 2NNE and Florence Regional Airport from 1948- 2022 (SCNDR State Climatology Office 2023).

	Driest		Wettest	
	Statesville 2NNE	**Florence R. A.**	**Statesville 2NNE**	**Florence R. A.**
1	1986 (27.31 in)	1954 (27.50 in)	2018 (75.12 in)	1959 (64.71 in)
2	2001 (31.22 in)	2011 (28.63 in)	2020 (73.40 in)	2020 (62.31 in)
3	2007 (33.37 in)	2001 (29.42 in)	1979 (61.24 in)	2016 (60.96 in)
4	1955 (34.29 in)	1963 (33.42 in)	2003 (61.24 in)	1964 (58.97 in)
5	1988 (34.95 in)	2003 (33.95 in)	2013 (57.91 in)	2018 (58.13 in)

Notes about climate data: The two stations were selected due to their long-term records (Statesville 2NNE: 1901 to present; Florence Regional Airport: 1948 to present), and they show the climatological differences in the upper and lower portions of the basin. Statesville 2NNE is in the middle of the entire basin, whereas Florence Regional Airport is in the lower portion of the entire basin and in the middle of the South Carolina portion of the Pee Dee River basin. While there are some stations in the basin that have longer periods of record, they were not presented here due to quality of data collection through time (SCDNR State Climatology Office 2023). The Statesville 2NNE station has two years of missing temperature data (1972 and 1982) and one year of missing precipitation data (1972). The missing annual values are due to one month of missing data during each of those years, which affects the annual average for that specific year. Florence Regional Airport does not have any missing data. It is also worth noting that the annual average values of temperature and precipitation for each station may not match their locations on the basin climatology images of Figure 2-6 due to differences in the period of records of the data. The long-term station data ranges from 1948 to 2022, while the data used for Figure 2-6 is based on the current climate normals (1991 to 2020).

2.2.2 Severe Weather

Severe weather, including thunderstorms, tornadoes, and tropical cyclones, can impact some or all portions of the Pee Dee River basin.

2.2.2.1 Severe Thunderstorms and Tornadoes

While the Pee Dee River Basin Plan focuses on low flows, long term water supplies, water demands, and the factors that drive them, severe weather events help characterize the climate of the Pee Dee River basin and is provided for reference only.

Between 45 and 63 thunderstorm days occur across the Pee Dee River basin annually, with typically more thunderstorm days occurring in the lower part of the basin than the upper part (NOAA 2023 https://www.noaa.gov/jetstream/thunderstorms). Although the number of thunderstorm days varies across the basin, the potential impact from each storm is equal across the basin. While thunderstorms occur throughout the year, severe thunderstorms are more common during spring (March, April, May) and summer (June, July, and August). For a thunderstorm to be considered severe, it must produce wind gusts of at least 58 miles per hour (mph), hailstones of 1 inch diameter or larger, or a tornado.

Tornadoes are violently rotating columns of air that descend from thunderstorms and contact the ground. Most of South Carolina's tornadoes are short-lived EF0 and EF1 tornadoes, the lowest strengths on the Enhanced Fujita (EF) Scale, with winds between 65 and 110 mph. However, even a tornado with the lowest intensity rating is dangerous and poses a significant risk to lives and property. Table 2-5 shows the number of tornadoes by intensity ranking, confirmed within the basin between 1950 and 2022. The counts are based on tornadoes that formed within one of the counties in the basin or the first county in the basin that the tornado crossed into if it formed outside the basin (so as to not "double count" any tornadoes that may have passed through multiple counties). Most of the basin's tornadoes rated EF0 and EF1. For reference, the EF-Scale became operational in 2007 and replaced the original Fujita scale (F-scale) used since 1971. The basin experienced 269 tornadoes between 1950 and 2022, with 51 of them being of significant strength (EF2 or higher). By county, Horry County has had the most tornadoes in in the basin (57) followed by Florence County (36) and Darlington County (28). Horry County has also had the most significant tornadoes (EF2 or higher) in the basin (11). Marlboro County has had the most EF4 tornadoes in the basin (3). No part of the Pee Dee River basin, nor South Carolina has experienced an EF5 tornado.

The South Carolina State Climatology Office collected the tornado figures from NOAA National Centers for Environmental Information (NCEI) Storm Events Database (https://www.ncdc.noaa.gov/stormevents/) as well as National Weather Service (NWS) Greenville-Spartanburg's (GSP) Historic Tornadoes in the Carolina and Northeast Georgia Database (https://www.weather.gov/gsp/tornado).

Table 2-5. Count of Tornadoes in the Pee Dee River basin by intensity ranking 1950 to 2022 (SCDNR State Climatology Office 2023).

Enhanced Fujita Scale	Wind Speed	Count
EF0	65-85 mph	101
EF1	86-110 mph	117
EF2	111-135 mph	40
EF3	136-165 mph	5
EF4	166-200 mph	6
EF5	200+ mph	0
Total number of Tornadoes in the Basin:		269

2.2.2.2 Tropical Cyclones

South Carolina has an 80 percent chance of being affected by a tropical cyclone (meaning tropical depression, tropical storm, or hurricane) each year and about a 3 percent chance for a major hurricane (a Category 3 storm with winds of 115 mph or higher) each year.

With an average size of approximately 300 miles in diameter, tropical cyclones can have far-reaching hazards, including storm surge, damaging wind, precipitation-induced flooding (flash flooding and riverine flooding), and tornadoes. For example, tornadoes produced by tropical cyclones form in the outer rainbands, which can be hundreds of miles from the storm's center. The remnants of Hurricane Jeanne (2004) passed through the South Carolina Upstate and upper portions of the Yadkin-Pee Dee River basin (NC) as a tropical depression. Jeanne spawned 17 tornadoes in South Carolina with 5 forming in the Pee Dee River basin.

Since 1851, 122 tropical cyclones have tracked through the Yadkin-Pee Dee River basin. For the entire basin, 61 were unnamed storms (pre-1951) and 61 were named storms (the naming of tropical storms and hurricanes started in 1951). The first named storm was Hurricane Able (1952), which reached Category 4 status but affected the basin with the strength of tropical storm. The most recent named storm to hit the basin was Hurricane Ian (2022), which affected the basin as a Category 1 hurricane. In just the South Carolina portion of the Yadkin-Pee Dee River basin, 88 tropical cyclones have tracked through the basin since 1851. Of these 88 tropical cyclones, 42 were unnamed storms (pre-1951) and 46 were named (since 1951). The first named storm to track into the Pee Dee River basin was hurricane Hazel (1954), which reached Category 4 status and hit the basin at that strength, making landfall at the South Carolina – North Carolina state line. The last storm to hit the Pee Dee River basin was Hurricane Ian (2022), affecting the basin as a Category 1 hurricane. Table 2-6 shows the number of hurricane strength storms to affect the basin by category. The Carolinas have not had a Category 5 strength hurricane track through it. The number of tropical cyclones used here only accounts for when the center of the storm tracked through a portion of the Yadkin-Pee Dee River basin. Due to the spatial extent of tropical cyclones, many systems have affected the Yadkin-Pee Dee River basin, but the storms' centers did not track through the basin.

Table 2-6. Number of tropical cyclones at hurricane-strength that tracked through the Yadkin-Pee Dee River basin (1851 to 2022).

Category	Windspeed	Entire Yadkin-Pee Dee	SC portion of Pee Dee
1	74-95 mph	17	15
2	96-110 mph	8	5
3	111-129 mph	2	1
4	130-156 mph	3	4
5	157+ mph	0	0
Total number of Hurricane Strength Storms		30	25

The last major hurricane (Category 3 or higher) to make landfall in South Carolina was Hurricane Hugo in September 1989 at Category 4 strength. While Hugo made landfall at Sullivan's Island (Santee River Basin), it tracked through the western edge of Sumter County, inside the Pee Dee River basin. Hugo caused significant impacts to much of the state, including the Pee Dee River basin, where storm surge along the coast and strong winds caused damage to personal property and infrastructure, as well as agricultural loss throughout the basin. Hugo significantly impacted the timber industry in the Pee Dee River basin.

Hurricane Matthew (2016) and Hurricane Florence (2018) were the most recent tropical systems to cause major impacts to the Pee Dee River basin. These impacts were primarily riverine flooding due to widespread, excessive rainfall. Multiple stations in the Pee Dee River basin received rainfall totals that were less than the 1 percent Annual Exceedance Probability (AEP) (Figure 2-13 and Table 2-7). The AEP is the percent chance that an event will happen each year. This is referred to as the Annual Recurrence Interval (ARI), which is a probability given in years, such as a 100-year event (which is the same as a 1 percent AEP). Below is a brief description of both Hurricane Matthew and Hurricane Florence. Each has a figure showing the ARI gridded map, as well as a station list with ARI value and total precipitation accumulation for the event.

Hurricane Matthew made landfall near McClellanville as a Category 1 hurricane. The remnants of Matthew dumped 10 to 17 inches of rain from Savannah, Georgia, through Florence, South Carolina, and into a wide area of eastern North Carolina. The most widespread heavy rain fell in the Pee Dee River basin and into North Carolina, where significant flooding occurred. Rainfall totals across portions of the Pee Dee surpassed the record rains of the Charleston Hurricane in 1916 and Hazel in 1954.

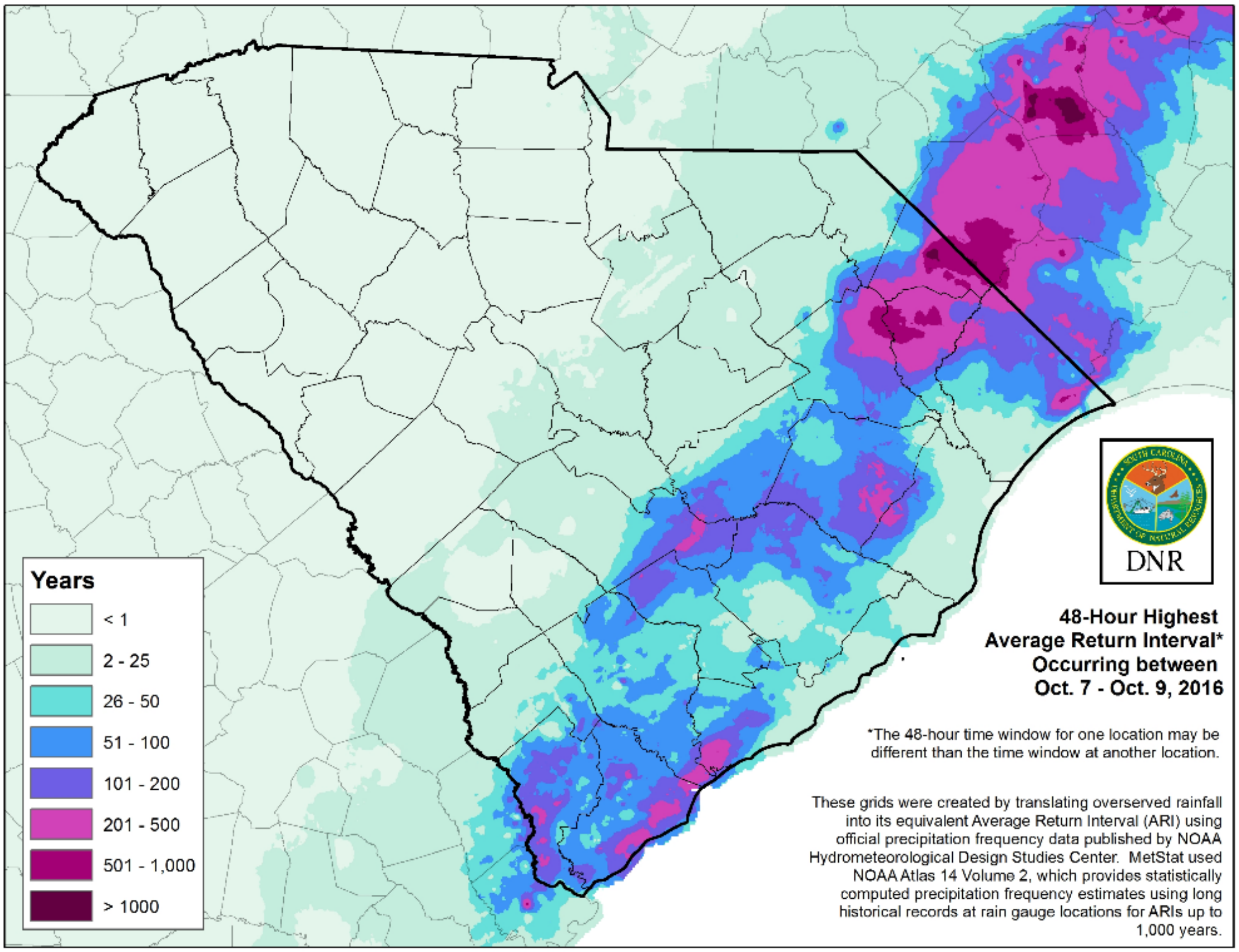


Figure 2-13. 48-hour ARI values in South Carolina from Hurricane Matthew (SCDNR State Climatology Office 2023).

Table 2-7. Pee Dee station 48-hour rainfall totals and annual exceedance probability from Hurricane Matthew (SCDNR State Climatology Office 2023).

October 7th – 9th, 2016		
Station	**Total precipitation**	**48- hour AEP (ARI)**
Marion	15.10 in	0.2% chance (500-year)
Manning	13.07 in	0.5% chance (200-year)
Florence	12.76 in	0.5% chance (200-year)

Tropical Storm Florence was a Category 1 Hurricane when it made landfall near Wrightsville Beach, North Carolina on September 14, 2018. It then weakened to a tropical storm, stalled, and remained nearly stationary for an entire day before it began a slow turn to the southwest, which is not a typical movement for tropical cyclones. It traveled across South Carolina at a speed of 2 to 3 mph. The slow-moving system dropped over 30 inches of rain across portions of eastern North Carolina and over 20 inches in Chesterfield and Horry counties over four days. These totals equate to a 1,000-year event, which, in terms of AEP, equals a 0.1 percent probability of occurring in any given year. Additional stations in the Pee Dee River basin measured rainfall totals that ranged between 0.1percent and 1 percent AEP, or the 1,000- to 100-year event (Figure 2-14 and Table 2-8).

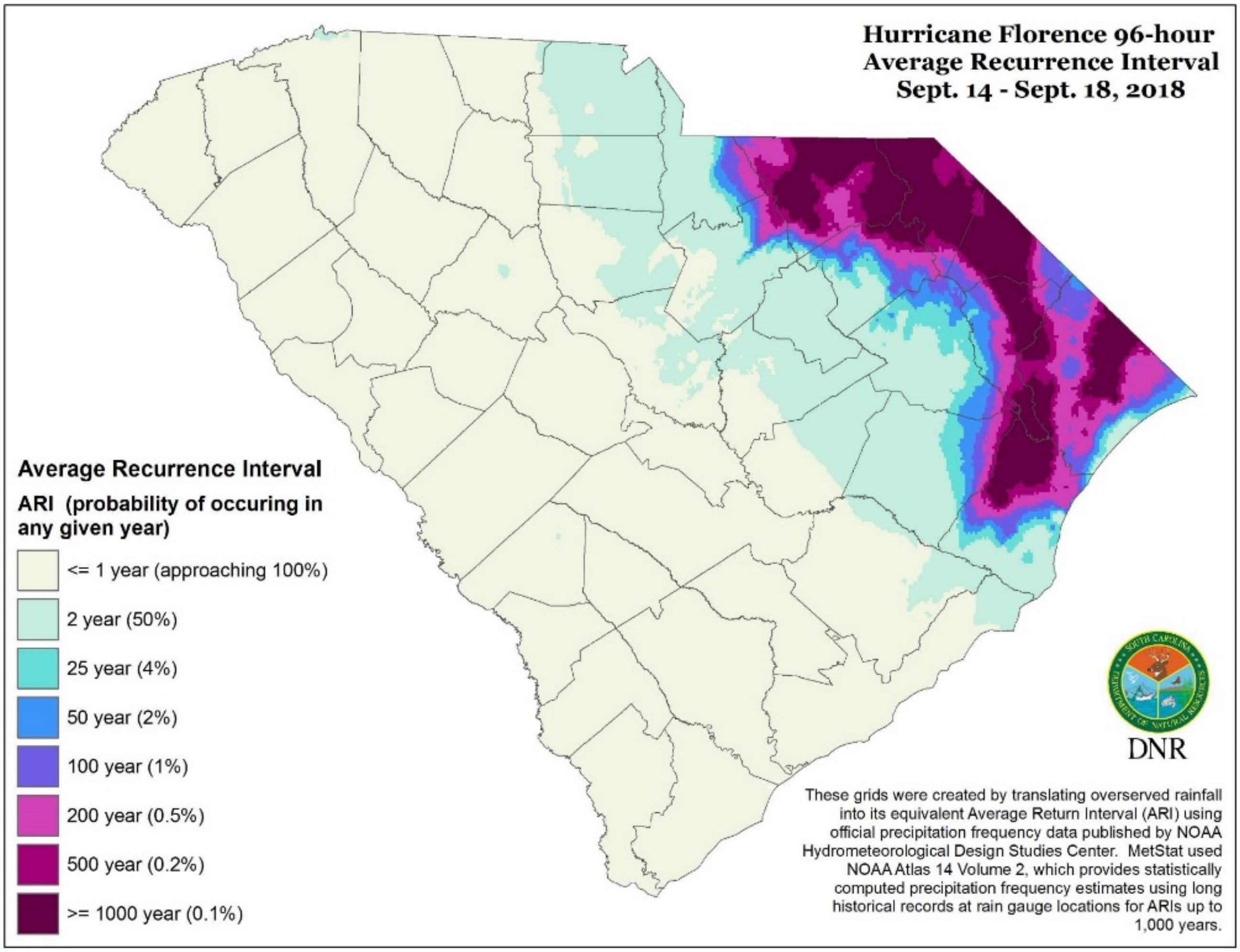


Figure 2-14. 96-hour (4-day) ARI values in South Carolina from Hurricane Florence (SCDNR State Climatology Office 2023).

Table 2-8. Pee Dee station 96-hour (4-day) rainfall totals and AEP from Hurricane Florence (SCDNR State Climatology Office 2023).

September 14th – 18th, 2018		
Station	**Total precipitation**	**96-hour AEP (ARI)**
Cheraw	22.81 in	0.1% chance (1000-year)
Chester	17.11 in	0.1% chance (1000-year)
Marion	13.45 in	0.5% chance (200-year)
Hartsville	11.23 in	1% chance (100-year)
Darlington	11.14 in	1% chance (100-year)

For more information about tropical cyclones that have affected South Carolina, please visit the South Carolina State Climate Office's "Hurricane and Tropical Storms Database"

https://www.dnr.sc.gov/climate/sco/hurricanes/

2.2.2.3 Winter Storms

The Pee Dee River basin has been impacted by winter weather events, such as winter precipitation (snow, sleet, ice accumulation, and freezing rain accretion) and extreme cold. The South Carolina portion of the basin has a 20 to 50 percent chance of a snow event each year, with average annual snow accumulations ranging from trace amounts to 2 inches. Annual snow probability and average annual snowfall both decrease from the upper portions of the basin towards the coast. The largest snow accumulation in the basin occurred in 1973 between February 9th and 11th, with Manning (Clarendon County) and Florence (Florence County) receiving 21.0 inches and 17.0 inches, respectively. Other events, such as December 1989, February 2014, and January 2018 have also produced significant snow totals in the basin. Extreme cold affects a portion of the basin about every two to three years. Multiple noteworthy cold events have occurred in the Pee Dee River basin, including December 1985, January 1986, December 1989, January 2003, and most recently December 2022. During these events, minimum temperatures fell to single digits in the upper portion of the basin and into the teens in the lower portion of the basin.

Winter weather events are usually high-impact situations in South Carolina because of their infrequent sub-seasonal, seasonal, and annual occurrence. Winter precipitation mainly impacts travel and transportation; however, heavy snow accumulations and ice accretions have caused impacts to trees, power lines, and built structures. It only takes 0.5 in of ice accretion to cause these types of impacts. January 11 to 12, 2014 is a more recent event of ice accumulation and impacts in South Carolina, specifically in the Pee Dee River basin. While snow did fall in portions of the basin, ice accumulation was the major source of impact in the basin. Ice accumulation ranged from 0.1 to 1.0 inches. Marion, SC reported 1.0 inches of ice accumulation. Tree damage from this storm was comparable to the damage from Hurricane Hugo in September 1989. The impacts of this storm were significant enough that Dillon, Florence, Georgetown, Horry, Marion, and Williamsburg counties were declared in a federal "major disaster area."

Extreme cold events cause impacts as well. Water lines that are above ground or shallowly buried are most susceptible to freezing, due to cold temperatures. Water lines that freeze typically burst, which can cause water loss and flooding inside structures. While these types of events have occurred on a more localized scale through time, these types of impacts occurred on a large scale in the Pee Dee River basin during cold events in December 1985, January 1986, December 1989, January 2003, and most recently in December of 2022. During the December 1989 event, the extreme cold caused multiple water lines to burst, particularly along the coastal portion of the Pee Dee River basin, causing many residents to be without water. The impacts of this winter storm came just three months after Hurricane Hugo, where residents who were in the process of recovering and rebuilding then had to manage days without running water. The timing of these two events demonstrates how two unrelated hazards can have compounding impacts to affected communities. The most recent extreme cold event, December 23 to 26, 2022, caused many water lines to freeze and burst, which was a significant issue in homes and businesses that were vacant due to holiday travel. Beyond the internal water damage to homes and buildings, the number of line breaks caused some water systems to experience a significant drop in water supplies. This extreme cold event highlights how other natural hazards besides drought can cause issues to water supplies, infrastructure, and delivery.

For more information about winter weather events that have affected South Carolina, please visit the South Carolina State Climate Office's "Winter Weather Database"

https://experience.arcgis.com/experience/7ae9e53751d547cabe5c1dbaa74b2336

2.2.2.4 Flooding

The general definition of a flood is the temporary condition of a partial or complete inundation of typically dry land. Fluvial flooding, also known as riverine flooding, is the flooding of typically dry areas caused by an increased water level of an established lake, river, or stream when the water overflows its banks. The damage from fluvial flooding can be widespread, extending miles away from the original body of water. This type of flooding is caused by excessive runoff from a severe or prolonged rain event.

While the Pee Dee River basin has experienced significant flooding in the past, such as the flood of 1928, more recent, notable floods in the basin are the 2015 flood, Hurricane Matthew (2016), and Hurricane Florence (2018). These three flood events were caused by excessive rainfall. Figure 2-15 below shows the areas in the Pee Dee River basin that experienced 1 percent, 0.5 percent, 0.2 percent and 0.1 percent AEP for rainfall multiple times between 2015 and 2018.

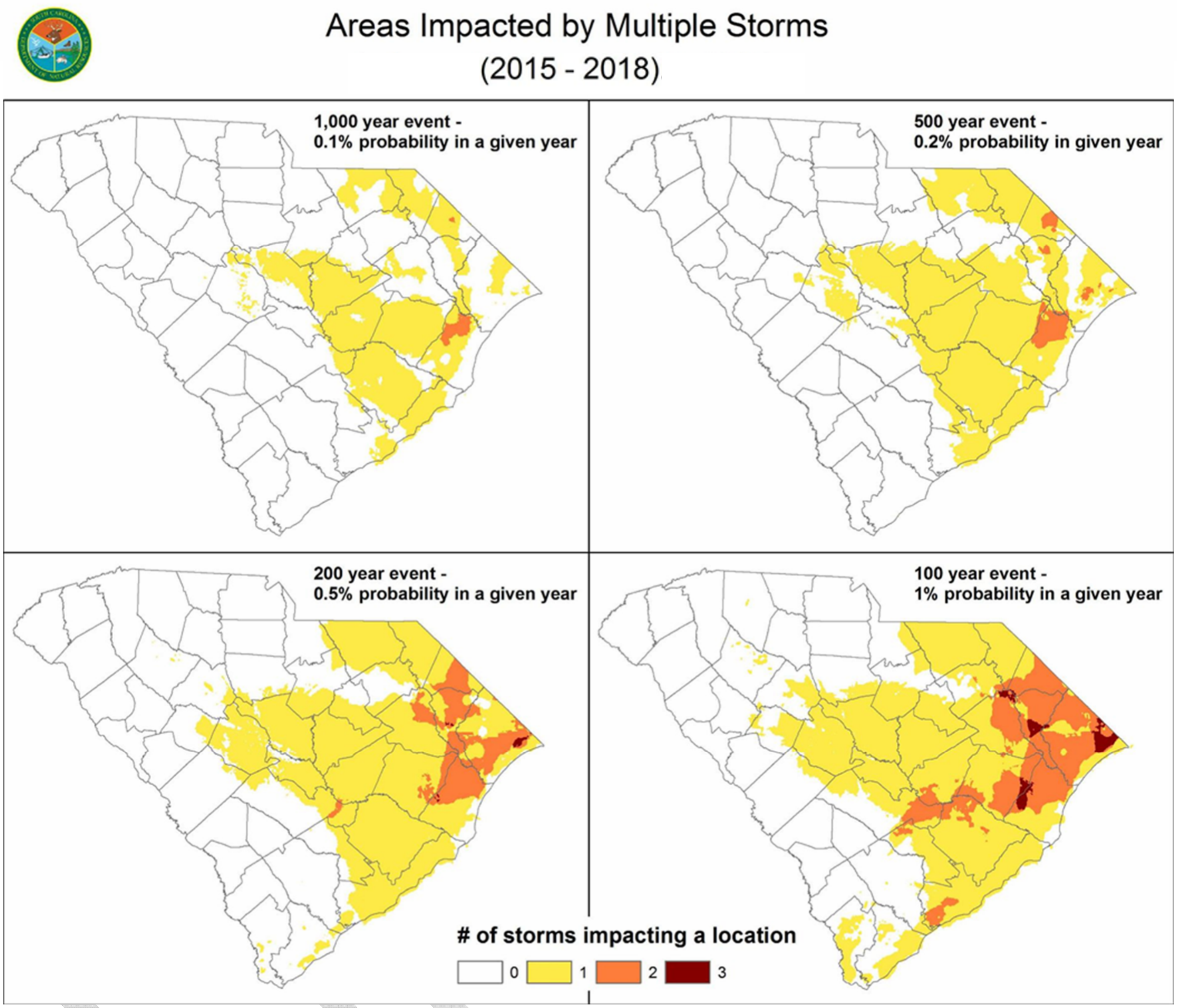


Figure 2-15. Areas impacted by multiple storms.

A record-setting and historic rainfall event occurred from October 1 to 5, 2015, producing widespread and significant flooding across much of South Carolina. The event's heavy rains and precipitation toward the end of September resulted in catastrophic flooding in some portions of the state. On October 1, a cold front swept across the state and stalled offshore for the next five days. This boundary tapped into deep tropical moisture over the Gulf of Mexico as it sat offshore of the Lowcountry. At the same time, Hurricane Joaquin rapidly strengthened over the Bahamas and interacted with the stalled coastal front, providing additional moisture into the region. All–time precipitation records were shattered, with rainfall totals ranging from 10 to over 26 inches from the Midlands to the coast (Figure 2-16 and Table 2-9). Streams and creeks swelled out of their banks. Seventeen USGS gages reached record peaks, including the Black River at Kingstree, which reported a crest of 22.65 ft., and a streamflow value of 83,700 cubic feet per second (cfs), surpassing the previous records set in 1973.

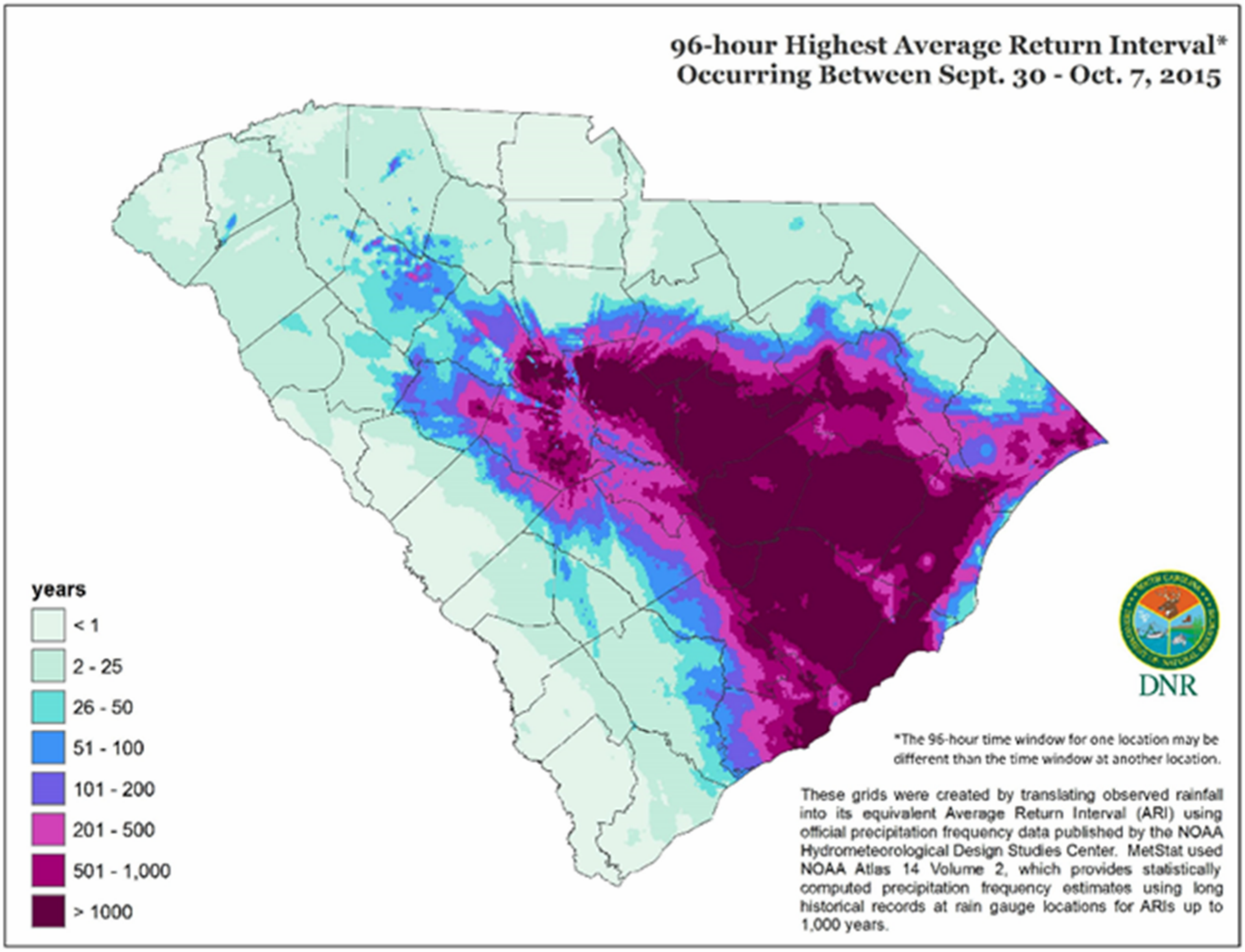


Figure 2-16. 96-hour (4-day) ARI values in South Carolina during the 2015 Flood event (SCDNR State Climatology Office 2023).

Table 2-9. Pee Dee station 96-hour (4-day) rainfall totals and AEP during the 2015 Flood event (SCDNR State Climatology Office 2023).

September 30th – October 7th, 2015		
Station	**Total precipitation**	**96-hour AEP (ARI)**
Georgetown	20.75 in	0.1% chance (1000-year)
Andrews	18.15 in	0.1% chance (1000-year)
Manning	12.71 in	0.5% chance (200-year)
Florence	10.59 in	1% chance (100-year)

Excessive rainfall for Hurricane Matthew and Hurricane Florence (described in Section 2.2.2.2) also created significant flooding conditions. Due to the excessive rain in Hurricane Matthew, the Lumber, Little Pee Dee, and Waccamaw rivers had swelled to a "Major Flood Stage" and were still rising on October 9, 2016. On October 12, the Little Pee Dee River at Galivants Ferry rose to 17.10 feet. Floodwaters from the

Lumber and Little Pee Dee rivers inundated the town of Nichols. The Waccamaw River near Conway reached a record stage of 17.89 feet on October 18, surpassing the flood of September 1928. Many non-elevated homes were flooded, and docks and decks, private or state-owned, were swept away. On November 2, after 25 days at or above minor flood stage (11 feet), the Waccamaw River near Conway dropped to below flood stage.

Hurricane Florence caused unprecedented flooding, as a portion of the excessive rainfall measured in North Carolina fell in the Yadkin-Pee Dee River watershed. Flooding plagued most of the Pee Dee River basin weeks after the initial landfall, significantly impacting the Black, Pee Dee, Little Pee Dee, Lumber, Lynches, and Waccamaw rivers and their tributaries. Many river gages reached crest values that fell within their locations' top five highest measured crests, while several of the rivers set new record crest values. The Pee Dee River at Peedee reached a height of 31.83 ft., 1.5 ft. lower than the historic crest of 33.3 ft. in 1945. During this event, gages along the Waccamaw exceeded previous record crests by three or more feet. While the impacts from Florence on their own were severe, it came two years after the extreme flooding from Hurricane Matthew, impacting many areas that were still recovering.

2.2.3 Drought

Drought is a normal part of climate variability that occurs in every climate. Drought results from a lack of precipitation over an extended period, often resulting in a water shortage for some activity, sector, or the environment. In contrast to other environmental hazards, droughts develop slowly over weeks, months, or years. While drought is driven by a lack of precipitation, multiple factors such as temperature, evapotranspiration, reservoir releases (where applicable), and water demands also need to be considered when evaluating how drought periods will impact stream and river flows in the basin. Severe drought conditions can contribute to diminished water and air quality, increased public health and safety risks, and reduced quality of life and social well-being. Because drought causes a lack of expected water across multiple sectors at different time frames, it is essential to plan for drought so water demands can be adequately met and managed before and during the next severe drought period.

Figure 2-17 and Figure 2-18 show the annual Standard Precipitation Index (SPI) value for Statesville 2NNE and Florence Regional Airport from 1948 to 2021 (the latest SPI data available for these stations). The SPI is a drought index that compares accumulated rainfall over a given period (here, 12 months) to the historical average, where the index values are standard deviations from the mean. Anything equal to or less than -1.0 is considered a drought. The lower the index value, the more severe the drought. The lowest SPI value was -2.69 for Statesville 2NNE in 1986 and -2.31 for Florence Regional Airport in 1954, matching each station's driest year on record. In the last decade (2012 to 2021), Statesville 2NNE has had a mix of both dry and wet years, while Florence Regional Airport has had more wet conditions, with 5 of past 10 years having a SPI value of over 1.0, indicating excessively wet conditions. It should be noted that annual SPI values do not show short-term conditions, such as monthly or seasonal conditions. During a year with a negative annual SPI value, there can be months or seasons with positive SPI values, and vice versa. While the annual SPI time series is provided here for reference, it is not the only method for looking at wet and dry periods over time. Furthermore, the SPI only accounts for precipitation accumulation and does not consider wetness or dryness in terms of evapotranspiration, soil moisture, streamflow, or groundwater.

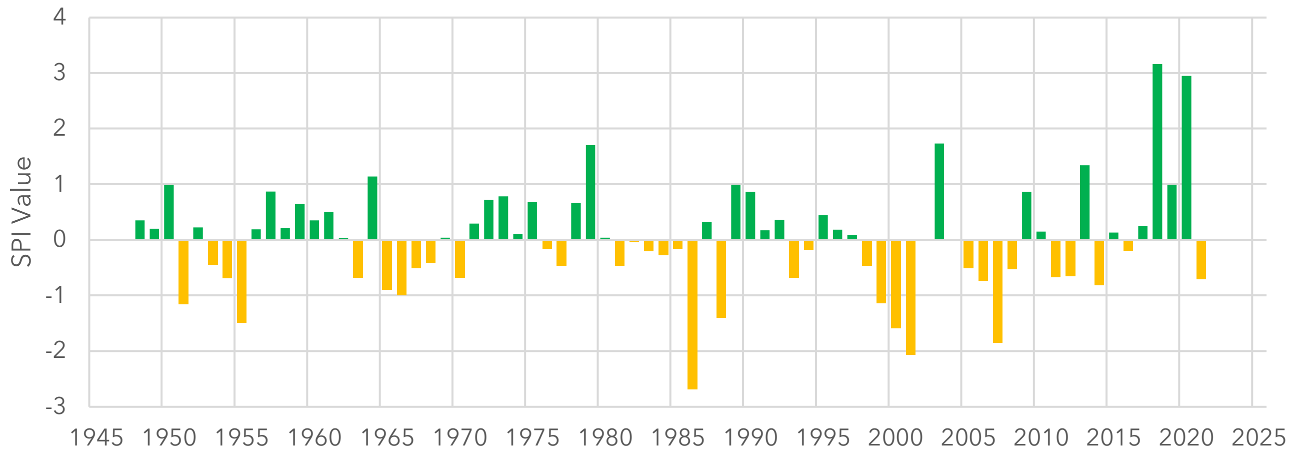


Figure 2-17. Annual Standard Precipitation Index (SPI) values for Statesville 2NNE 1948 to 2021 (SCDNR State Climatology Office 2023).

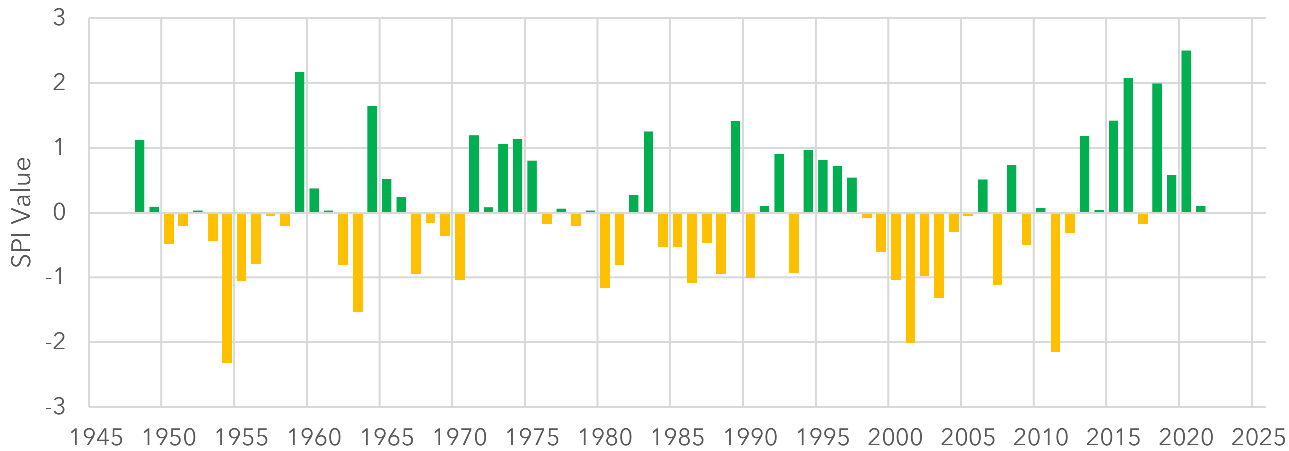


Figure 2-18. Annual Standard Precipitation Index (SPI) values for Florence Regional Airport 1948 to 2021 (SCDNR State Climatology Office 2023).

The impact of drought on streamflow in the basin was analyzed using four USGS streamflow gages, one for each of the major rivers in the South Carolina portion of the Pee Dee River basin. The four stations are Pee Dee River at Peedee, Lynches River at Effingham, Little Pee Dee River at Galivants Ferry, and Waccamaw River near Longs. Beyond the spatial component, these four stations were used due to their consistent long-term record. The period used was 1951 to 2022, as 1951 was the first year that the Waccamaw River near Longs station had a full year of data. While the other three stations have recorded data reaching back to the 1930s, the period of 1951 to 2022 was used to provide consistency for analyzing low flows among the four stations.

Table 2-10 shows lowest monthly average flow, which year it occurred, and the long-term average monthly flow for each month for the four stream gages. Table 2-10 also shows the year with the lowest average annual flow and the long-term average annual flow. Among these four stations, there are similarities and differences for which years the lowest average monthly flow was recorded. However, these lowest average monthly flows all took place during significant drought periods. The Lynches River at Effingham and the Little Pee Dee River at Galivants Ferry experienced their lowest average monthly flow in July of 2022. Contrastingly, the Pee Dee River at Peedee experienced its record lowest monthly average flow in November 2001, and the Waccamaw River near Longs experienced its lowest monthly average flow in September of 1954. Although these four stations didn't experience record low monthly or annual average flows during the same time, they all experienced record low average flows during the 1998-2002 drought.

Table 2-10. Year of lowest monthly and annual average flow compared to the long-term average for the each of the four stream gages between 1951 – 2022.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pee Dee River at Peedee (USGS 02131000)													
Year of Minimum Flow	1956	2001	2017	2006	2002	2002	2002	2002	2007	2001	2001	2001	2001
Lowest Avg Flow (cfs)	3,268	4,042	4,669	3,898	2,355	2,079	1,682	1,107	1,366	984	773	1,916	3,368
Long-term Avg Flow (cfs)	12,835	14,913	16,252	13,482	9,060	7,530	5,975	6,160	5,798	6,670	7,008	9,295	9,950
Lynches River at Effingham (USGS 02132000)													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Year of Minimum Flow	1956	2012	2002	2006	2002	2002	2002	2002	2007	2007	2007	2001	2002
Lowest Avg Flow (cfs)	387	427	464	328	206	107	88	103	109	114	156	213	397
Long-term Avg Flow (cfs)	1,508	1,735	1,870	1,403	774	623	597	642	624	706	680	1,021	1,015
Little Pee Dee River at Galivants Ferry (USGS 02135000)													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Year of Minimum Flow	2012	2012	2002	1981	2002	2002	2002	2002	1954	2007	2001	2007	2002
Lowest Avg Flow (cfs)	881	1,169	1,396	962	392	180	104	104	212	184	300	461	950
Long-term Avg Flow (cfs)	4,176	5,132	5,247	3,959	2,094	1,862	1,680	1,960	2,350	2,293	1,834	2,754	2,959
Waccamaw River near Longs (USGS 2160700)													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Year of Minimum Flow	2008	2012	2022	2002	2002	2002	1952	1954	1954	1983	1983	2007	2002
Lowest Avg Flow (cfs)	62	190	268	186	29	15	13	15	4	5	6	9	308
Long-term Avg Flow (cfs)	1,706	2,222	2,240	1,545	670	623	754	1,062	1,525	1,213	671	878	1,259

The driest hydrological year on record is 2002 and is the most significant drought the Pee Dee River basin has experienced in recent history. Severe impacts occurred across multiple sectors, including agriculture, recreation, forestry, and public water supply. Agricultural impacts included reduction of crop yields or yield loss, costs for digging new wells for irrigation, ponds going dry, as well as decreases in pasture productivity and the ability to adequately feed livestock. Low flows exposed hazards to boats and negatively affected business that rely on river recreation for income. Forestry delt with cascading impacts.

The potential for fire grew, leading to outdoor burn bans, while the reduced water availability stressed the trees. This stress allowed for increased susceptibility to the southern pine beetle, which caused billions in losses to the timber industry.

The summer and fall of 2002 were hydrologically the most intense portion of the 1998 to 2002 drought for the Pee Dee River basin. From June 2002 to November 2002, the South Carolina Drought Response Committee (DRC) declared the entire basin was in severe to extreme drought, with the entire basin being in extreme drought from July 2002 to September 2002. This is compared to the two prior years, when the basin was in incipient drought from May 2000 to May 2001 and in moderate drought from May 2001 to June 2002. During the summer and fall of 2002, the record low hydrologic conditions caused issues for public water supply in the basin. Multiple water systems called for voluntary water use reductions, with some implementing mandatory water restrictions. The Georgetown County Water System reported increasing salinity in their water supply. While normal river flows generally keep saline water far enough from the supply intakes in the river, the saline water was able to migrate upstream towards the intake due to the record low river flows. Luckily, the intense hydrologic drought conditions across the basin eased in November when much-needed rainfall helped to improve drought-stricken conditions in the basin.

Deep Hole Swamp in Florence County during August 2008 drought.
(Photo credit: http://scdrought.com/)

2.3 Natural Resources

2.3.1 Soils and Vegetation

Six land resource areas were defined by the Natural Resources Conservation Service (NRCS) based on soil conditions, climate, and land use. These areas are defined based on soil characteristics and their supported land use types, and they generally follow the boundaries of the physiographic provinces. The land use areas are shown in Figure 2-19.

The Pee Dee River basin includes portions of five land resource areas. The extents, names, and descriptions as presented in the South Carolina State Water Assessment (SCDNR, 2009) are shown in the figure below:

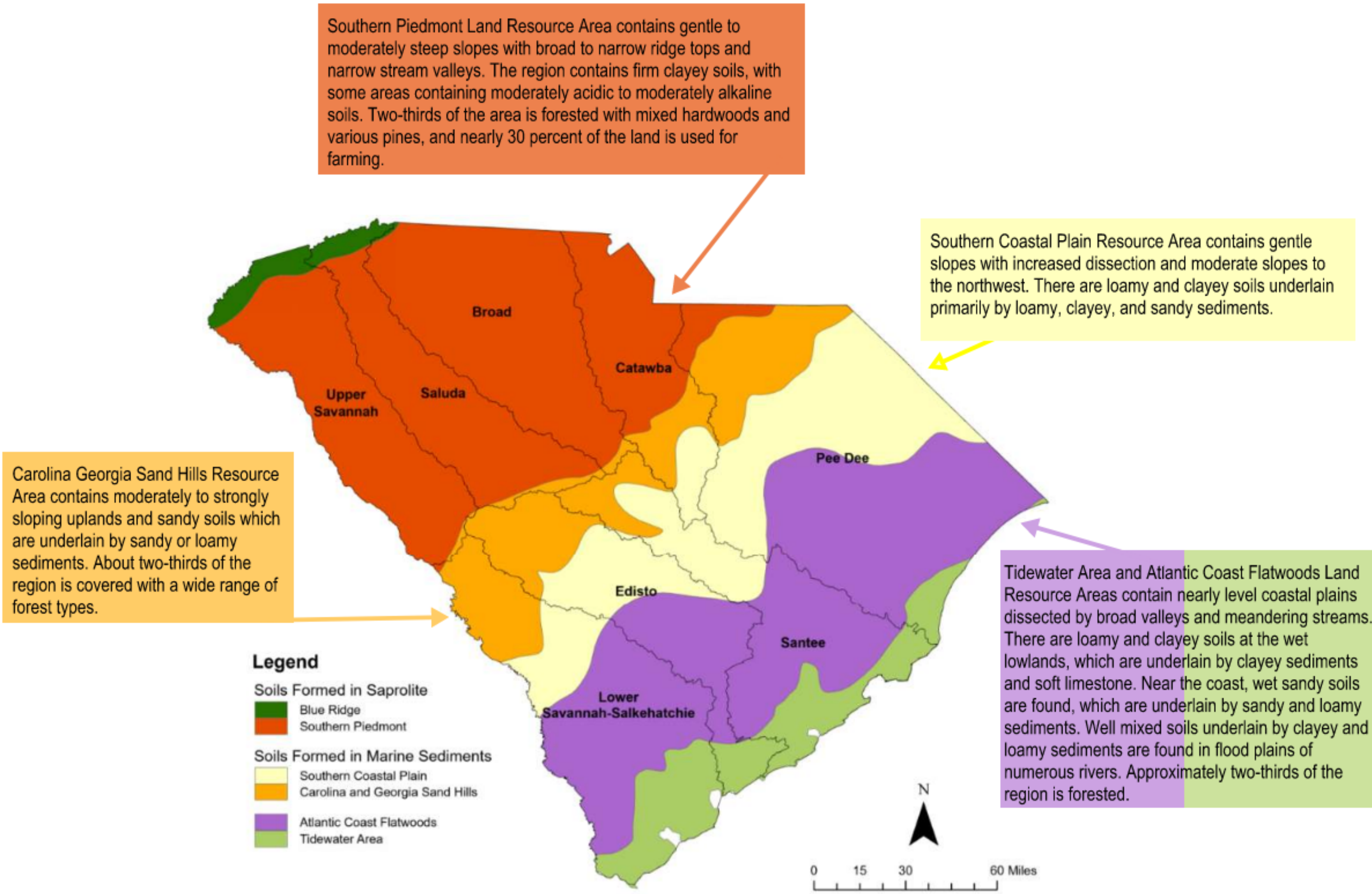


Figure 2-19. Generalized land resource soils map of South Carolina with descriptions.

2.3.2 Minerals

As of June 2023, the Pee Dee River basin has 145 active mines, which is about 30 percent of mines in the entire state (491 total). The majority within the Pee Dee River basin are sand and clay mines, with additional limestone, kaolin, shale, and gold mines present in the basin as well. According to the 2018 USGS Minerals Yearbook, South Carolina produced at least $975 million in nonfuel minerals in 2018.

2.3.3 Fish and Wildlife

According to a presentation by SCDNR on "Aquatic Resources of the Pee Dee Basin," 102 native fish species are in the Pee Dee River basin as well as 10 introduced non-native species representing a diverse assemblage.

[Recreation and Access in the Great Pee Dee River](#) according to SCDNR:

> *"Those who fish the Great Pee Dee are known to seek a variety of species throughout the length of the river in a mix of fresh and saltwater environments. Freshwater fishes sought by anglers include various catfish, bass, bream, and shad species, also bowfin, carp, and gar. Saltwater fishes include red drum, black drum, seatrout, mullet, and flounder, as well as shrimp and blue crab."*

Figure 2-20. Subset of freshwater fish sought by anglers (Freshwater Fish Identification (sc.gov)).

Twenty-nine species of freshwater mussels are in South Carolina, and 20 of these are present in the Pee Dee River basin. The health and presence of mussels can act as an indicator of ecosystem health, as they behave as filters for algae, bacteria, and fine particulate organic matter. Threats to mussel health include increased sediments, pollution from stormwater runoff, heavy metals and ammonia, and flow alterations.

The Pee Dee River basin provides habitat to numerous rare, threatened, and endangered species. In the counties with at least a portion of their areas in the Pee Dee River basin, there are 9 federally endangered species, 8 federally threatened species, and 18 at-risk species. Additionally, 46 species are protected by the Migratory Bird Treaty Act. The bald eagle, protected by the Bald and Golden Eagle Protection Act, has been noted in one county in the Pee Dee River basin. The basin is home to 9 state-listed endangered species, 9 state-listed threatened species, and 8 state-listed regulated species. State and federal endangered and threatened species in the counties covering the basin are listed in Table 2-11.

Table 2-11. Federal- and State-listed endangered and threatened species in Pee Dee River basin counties.

Federal Endangered	Federal Threatened	State Endangered	State Threatened
Shortnose Sturgeon	Seabeach Amaranth, Dwarf Amaranth	Shortnose Sturgeon	Loggerhead Sea Turtle
Atlantic Sturgeon	Loggerhead Sea Turtle	Piping Plover	Wilson's Plover
Red-Cockaded Woodpecker	Piping Plover	Rafinesque's Big-Eared Bat	Spotted Turtle
Schweinitz's Sunflower	Smooth Purple Coneflower	Red-Cockaded Woodpecker	Pine Barrens Treefrog
Carolina Heelsplitter	Pool-Sprite, Snorkelwort	Swallow-Tailed Kite	Carolina Pygmy Sunfish
Southern Spicebush, Pondberry	Black Rail	Pinewoods Darter	Bald Eagle
Pocosin Loosestrife, 'Roughleaf Loosestrife'	Wood Stork	Carolina Gopher Frog	Southern Hog-Nosed Snake
Northern Long-Eared Bat	Florida Manatee	Wood Stork	Broadtail Madtom
Canby's Cowbane		Florida Manatee	Least Tern

2.3.4 Natural and Cultural Preserves

Natural and cultural resources in South Carolina are protected by the SCDNR through two distinct programs: the Heritage Trust Program and the Wildlife Management Area (WMA) Program. According to SCDNR, the Heritage Trust Program was created in 1976 to "stem the tide of habitat loss by protecting critical natural habitats and significant cultural sites."

Ten natural preserves are in the Pee Dee River basin, and there are no cultural preserves. Additionally, six state parks are present within the basin. The locations of the sites are shown in Figure 2-21.

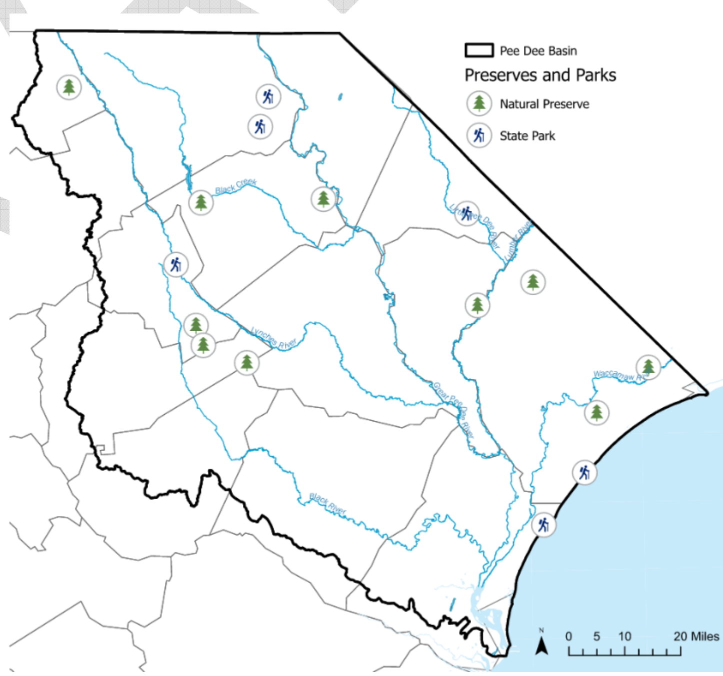


Figure 2-21. Natural preserves and state parks.

2.3.5 Land Protection

As South Carolina's population grows and land uses change, it will be important to preserve habitat, natural areas, historical sites, sites of unique ecological significance, forests, farmlands, wetlands, watersheds, open space, and urban parks. These land uses help maintain water quantity and quality as well as environmental attributes, recreational opportunities, and cultural assets.

Land protection provides a multitude of benefits to landowners and the public. From a water quantity perspective, preserved lands can maintain or enhance recharge to aquifers (both deep aquifers and alluvial aquifers) which help maintain groundwater supplies and can help attenuate flood flows. Preserved lands that maintain the historical function of wetland habitat can filter runoff, attenuate flood flows, and help maintain water quality for both habitat and also downstream water users (thus reducing treatment costs). Protected lands also prevent habitat degradation as well as preserve greenways and open space.

The South Carolina Conservation Bank began evaluating ways to use open and protected land to enhance and protect water quality and watershed health back in 2000 through the Land Legacy Initiative. The initiative identified that offsetting urban lands with the preservation of greenways, open space, and parks help to "promote balanced growth and to promote the well-being and quality of life in South Carolina" (South Carolina Conservation Bank). Landscape-level land protection mechanisms such as conservation easements or State acquisition of real estate interests from willing sellers can preserve the historical attributes, uses, and functions of significant land areas and provide both ecological and human benefits at local and regional scales.

The Nature Conservancy maintains a database of lands that have been protected across South Carolina. Figure 2-22 shows the lands in the Pee Dee River basin that have been protected as of March 2024 through ownership by local, state, or federal agencies, conservation easements, and other mechanisms.

As indicated in Figure 2-22, protected lands in the Pee Dee River basin are owned and protected by a variety of entities and mechanisms. Table 2-12 summarizes the number of acres protected in the Pee Dee River basin by county, and Table 2-13 by owner or protection mechanism.

Table 2-12. Protected lands in each county of the Pee Dee River basin as of March 2024.

County	Area of Protected Land (acres)
Chesterfield	103,996
Clarendon	18,121
Darlington	19,901
Dillon	4,572
Florence	9,026
Georgetown	103,333
Horry	61,340
Kershaw	1,721
Lancaster	5,608
Lee	13,651
Marion	43,669
Marlboro	8,726
Sumter	24,497
Williamsburg	30,861
Total:	449,021

Table 2-13. Protected lands by category the Pee Dee River basin as of March 2024.

Category	Area of Protected Land (acres)
State	169,432
Private	157,717
Federal	103,197
Other Managed Land*	12,222
Local Government	6,453
Total:	449,021

* Other Managed Lands include lands held by non-traditional protection groups such as U.S. Dept. of Defense, U.S. Dept. of Energy, U.S. Army Corps of Engineers, or private entities

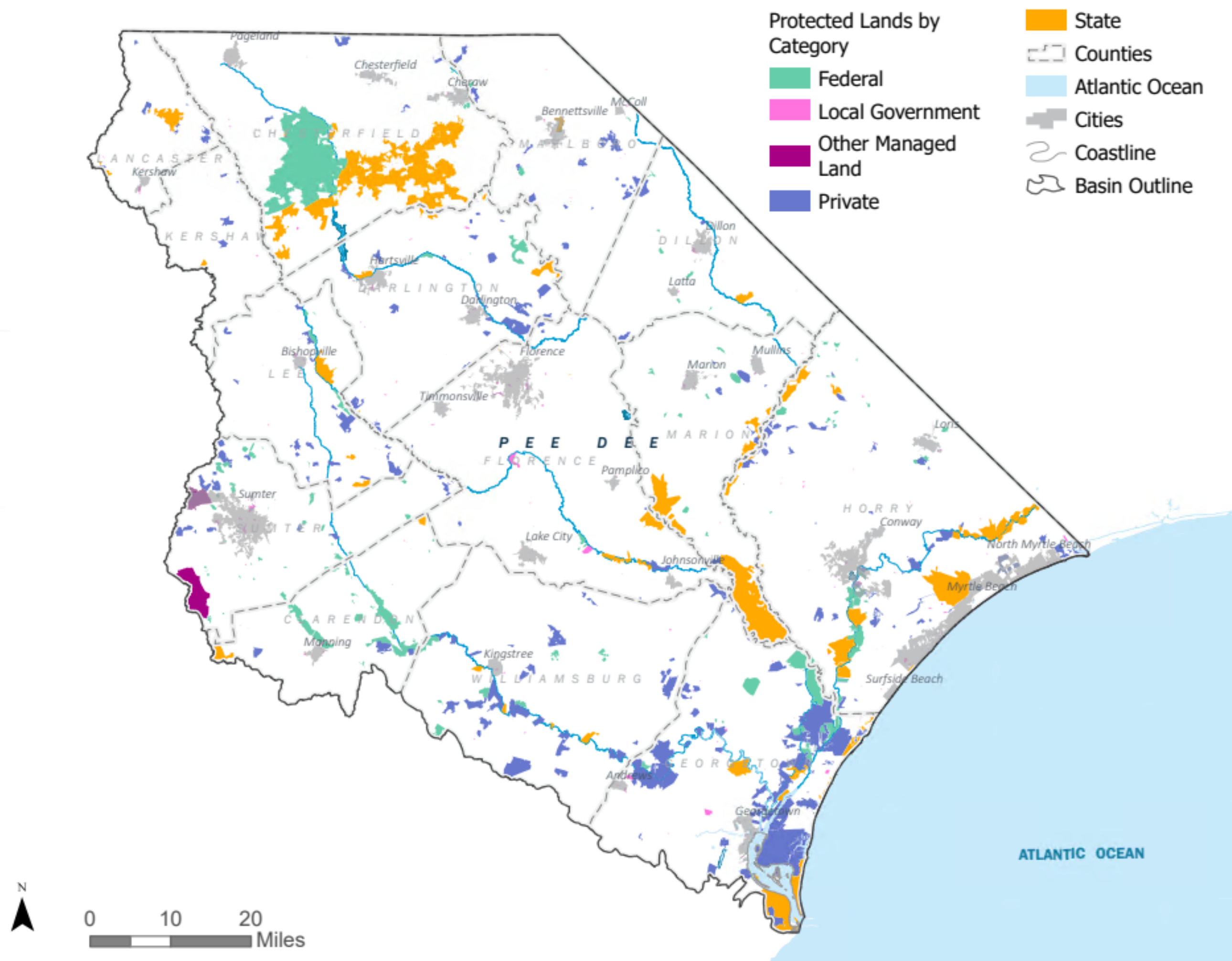


Figure 2-22. Protected Lands in the Pee Dee River basin as of March 2024.

The amount of protected land varies across the Pee Dee River basin, with some watersheds containing more protected land than others. Figure 2-23 illustrates the percentage of protected land by each of the HUC10 watersheds in the basin. While some watersheds have significant protected land areas, others contain less than 1.5 percent by area.

Figure 2-22 and Figure 2-23 along with Tables 2-12 and 2-13 show that lands have been protected throughout the Pee Dee River basin with concentrations in the northern end of the basin, coastal areas, and along major waterways including the Black River, Lynches, Little Pee Dee, and Waccamaw. Protection of lands in the northern part of the basin helps maintain the quality of the recharge that supplies the aquifers that provide groundwater for a variety of uses throughout the basin. Land protection along waterways enhances habitat for fish and wildlife while protecting the quantity and quality of surface water supplies.

.

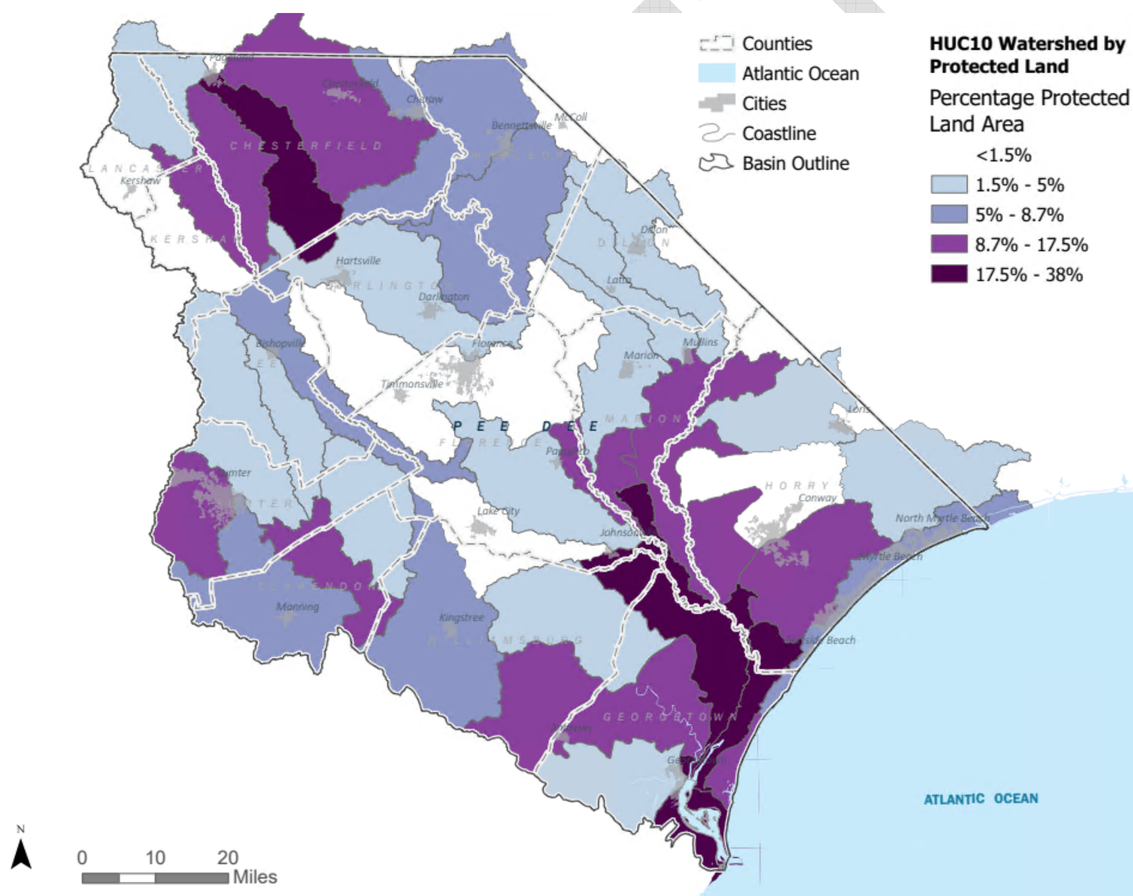


Figure 2-23. Protected land areas by HUC10 watershed.

The State of South Carolina has been actively working to preserve vital land areas across the state. In 2002, legislation was passed to form the South Carolina Conservation Bank. The bank pursues its mission of conserving significant sites through working with landowners who voluntarily sell their property or enter into conservation easements that retain the historical use of the land.

More information on the bank and their statewide conservation priorities can be found at:

https://sccbank.sc.gov/

2.4 Agricultural Resources

2.4.1 Agriculture and Livestock

Farmland makes up a significant portion of the Pee Dee River basin, and agricultural production is integral to the basin's economy. Figure 2-24 shows areas of the basin that are suitable for farmland as inventoried by the NRCS. While the northwest section of the basin has fewer areas suitable for farmland, the southern half of the basin is largely represented as farmland. Prime farmland is defined as the land with the best combinations of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, a water supply that is dependable and of adequate quality, is not excessively erodible or saturated with water for long periods, and has slopes mainly ranging from 0 to 6 percent. Farmland of statewide importance is land that nearly meets the requirements of prime farmland and that can economically produce high-yield crops when treated and managed with acceptable farming methods. The distribution of the farmland types across the basin is shown in Figure 2-24 and Table 2-14.

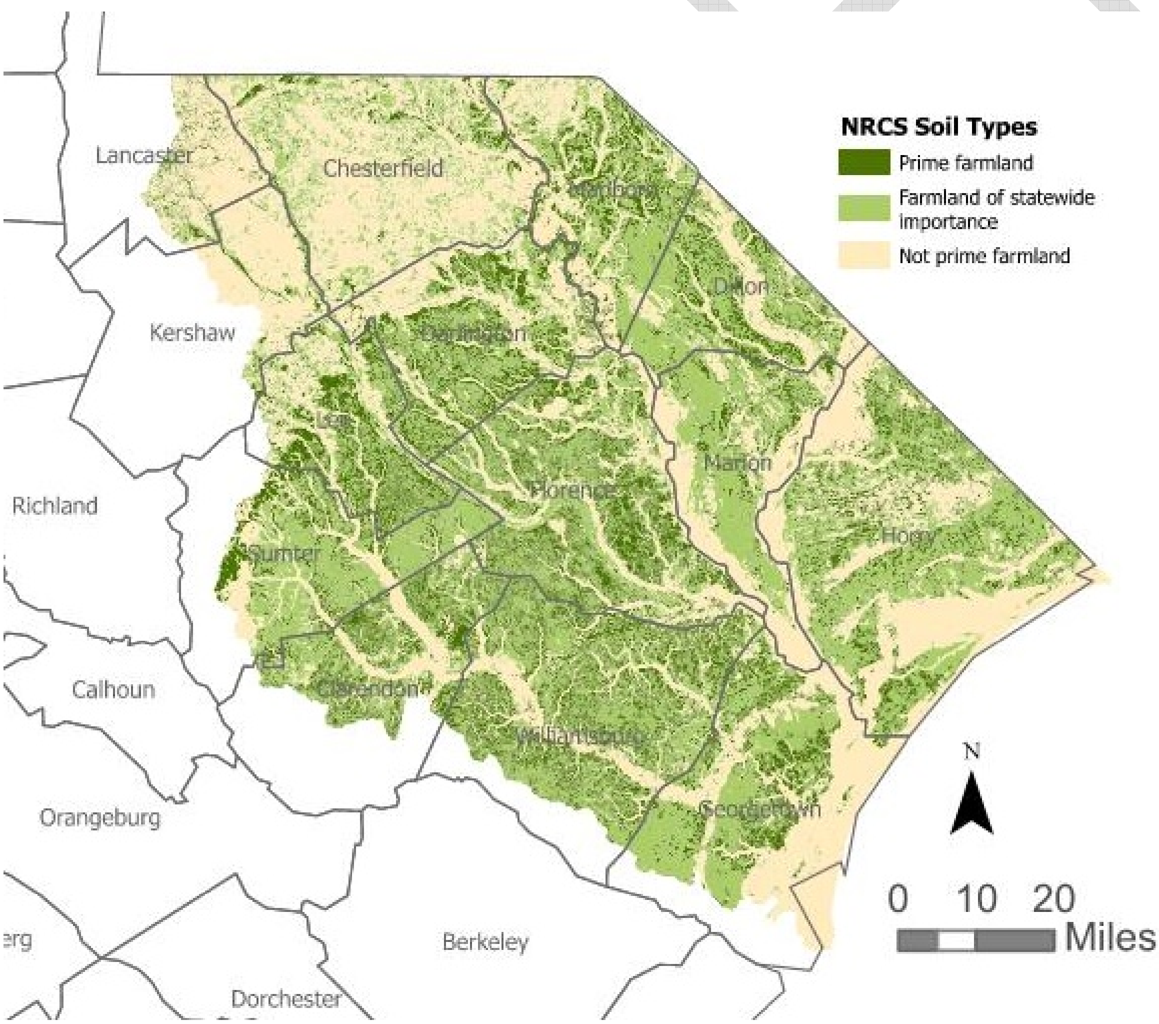


Figure 2-24. Location of NRCS-categorized farmland in the Pee Dee River basin.

Table 2-14. Area of NRCS-categorized farmland in the Pee Dee River basin.

Farmland Type	Area (acres)	Area (sq mi)	Percent of Basin
Prime farmland	1,253,833	1,959	24.9%
Prime farmland if drained	279,618	437	5.6%
Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	10,037	16	0.2%
Prime farmland if protected from flooding or not frequently flooded during the growing season	18,848	29	0.4%
Farmland of statewide importance	1,750,379	2,735	34.8%
Not Prime Farmland	1,714,678	2,679	34.1%
Total	5,027,393	7,855	100%

The Pee Dee River basin also contains significant livestock operations throughout the basin, which are shown in Figure 2-25 (SCDES).

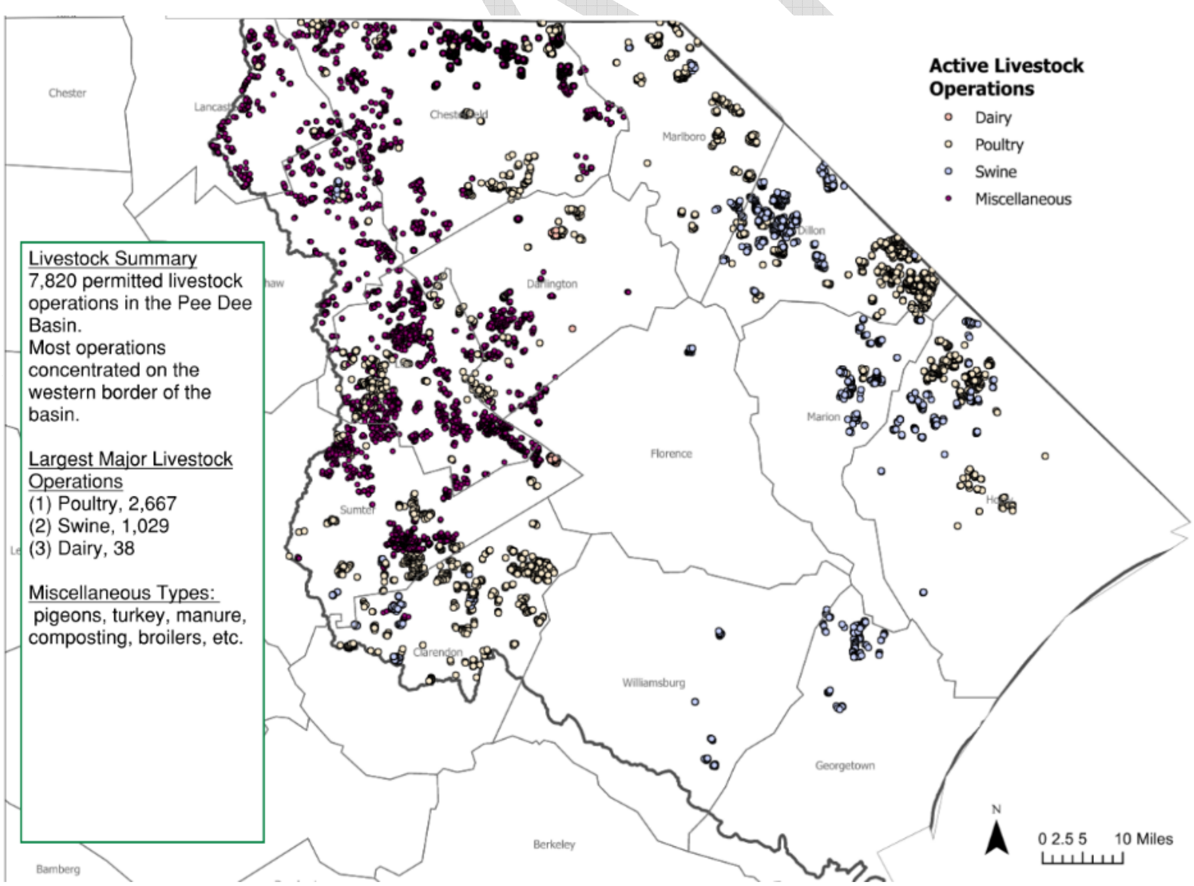


Figure 2-25. Livestock operations summary.

The number of farms in the state has generally increased since 1992, but growth has slowed and tapered since 2007. While the growth of farms has been variable and begun to decline slightly, irrigation has steadily increased. A comparison of these two trends is shown in Figure 2-26.

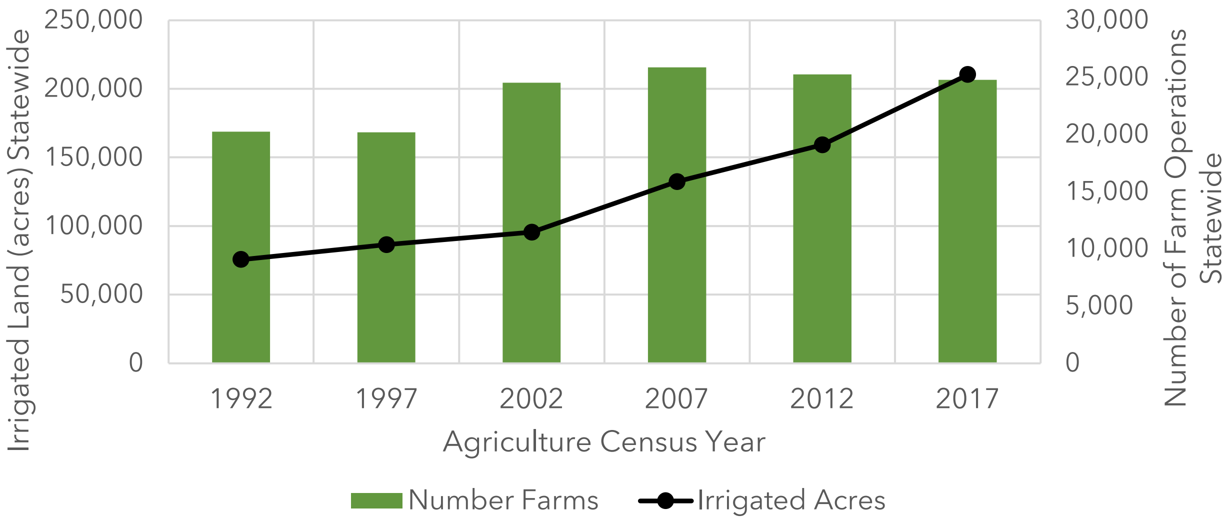


Figure 2-26. Number of farm operations and irrigated acreage statewide.

Table 2-15 shows the irrigated area for each of the fourteen counties in the basin. While not all of these counties are fully contained within the basin, the table provides context into the approximate magnitude of irrigation present in the Pee Dee River basin. Sumter County and Lee County, while not fully contained in the basin, both have the largest irrigated areas. As shown in Figure 2-25, the highest concentrations of active livestock operations are in those counties. Darlington County, which has the fourth highest irrigated acreage overall in Table 2-15, has the most irrigated acreage of the counties fully contained in the basin.

Table 2-15. 2017 Irrigated areas by county in the Pee Dee River basin.

County	2017 Irrigated Land (acres)
Chesterfield*	1,584
Clarendon	8,871
Darlington*	6,102
Dillon*	353
Florence*	1,324
Georgetown	196
Horry*	2,278
Kershaw	386
Lancaster	519
Lee	15,602
Marion*	490
Marlboro*	3,494
Sumter	19,133
Williamsburg	2,638

* County fully contained within the watershed

More specific data from the Census of Agriculture is presented in Figure 2-27 for three example counties within the Pee Dee River basin: Florence, Chesterfield, and Darlington. Figure 2-27 shows the number of farms and the irrigated acreage in these counties. In addition to Darlington, which was described above as having the largest irrigated acreage of the fully-contained counties, Florence and Chesterfield are two large counties contained within the basin, which both contain relatively average irrigated area for the watershed. The irrigation trends in Chesterfield and Florence are relatively steady over time, while Darlington's irrigated acreage significantly increased from 2002 through 2012. However, while the large changes in irrigated acreage occurred in Darlington, the figure shows that the number of farms remained relatively constant over the reporting period.

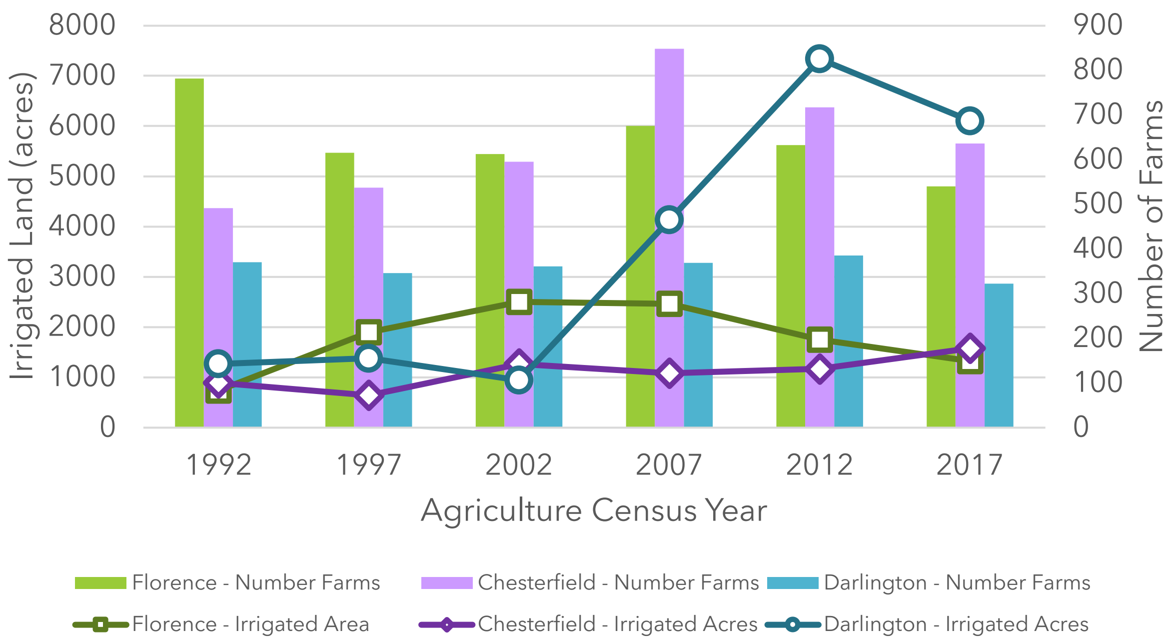


Figure 2-27. Number of farms and irrigated acreage in Florence, Chesterfield, and Darlington Counties.

Figure 2-28 shows farmland in the basin by general crop type as well as other land cover types. Similar to trends with livestock operations and irrigated lands, the central-western side of the basin and the northeastern side along the border with North Carolina both contain significant areas of cropland. The various crop types are relatively well distributed throughout the agricultural areas across the basin.

Cotton field in the Pee Dee River basin.
(Photo credit: Matt Lindburg)

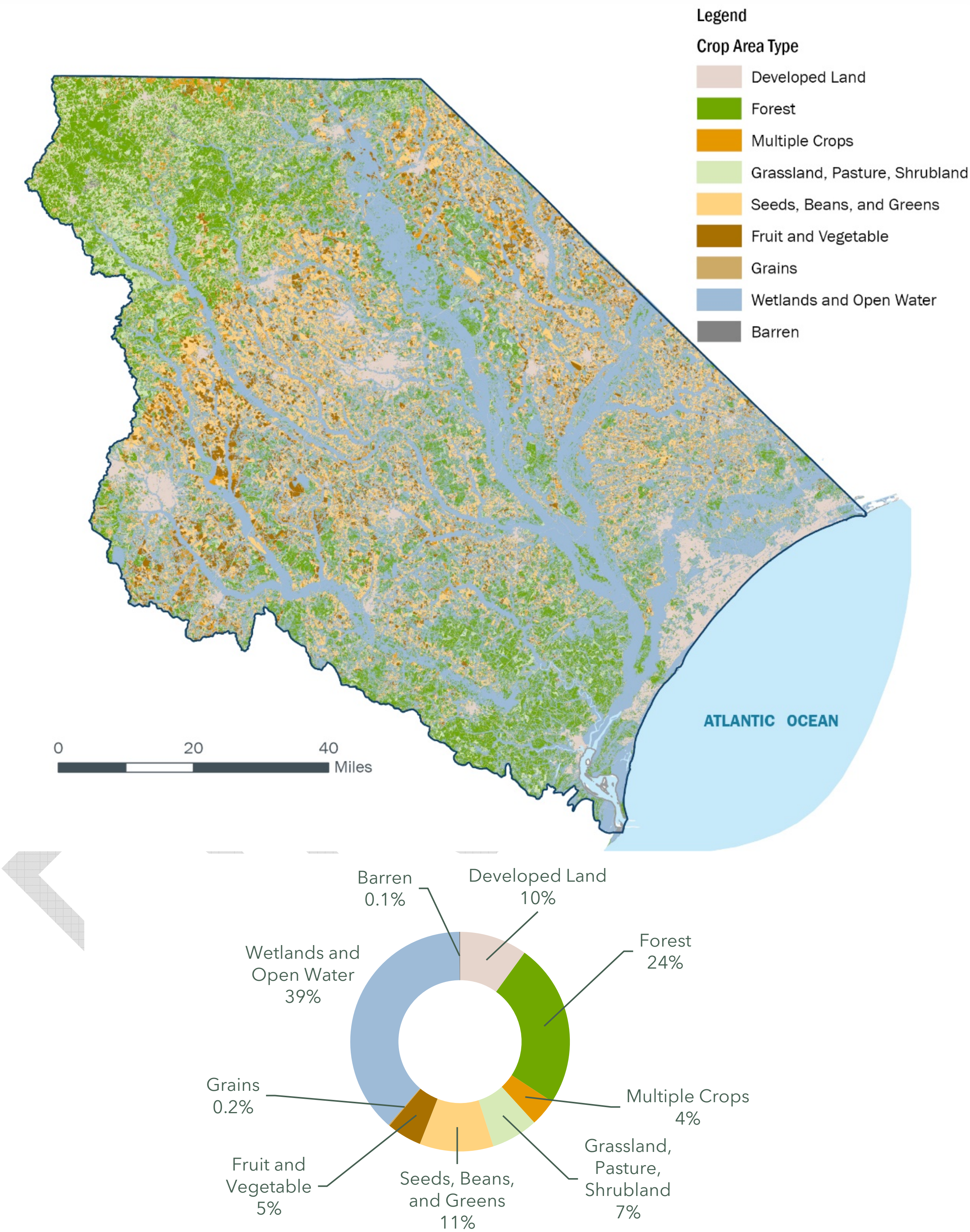


Figure 2-28. Crop areas (and other land uses) and associated percentages in the basin.

Irrigation surveys conducted by Clemson University from 1997 to 2000 identified several types of irrigation methods used in Pee Dee River basin counties, including sprinkler systems, gravity and flood systems, and low-flow or drip systems. The irrigation surveys provided a more comprehensive picture of the types of irrigation technologies used relative to other data sets. In the Pee Dee River basin, sprinkler systems are most numerous; specifically, center pivot irrigation systems are present throughout the basin. The percentage of sprinkler systems as compared to other types of irrigation, from 1997 to 2000, is shown in Figure 2-29. Note that basin wide information was computed using county-specific data. Irrigation systems in counties not fully within the Pee Dee River basin were assumed be distributed equally in areas within and outside of the basin.

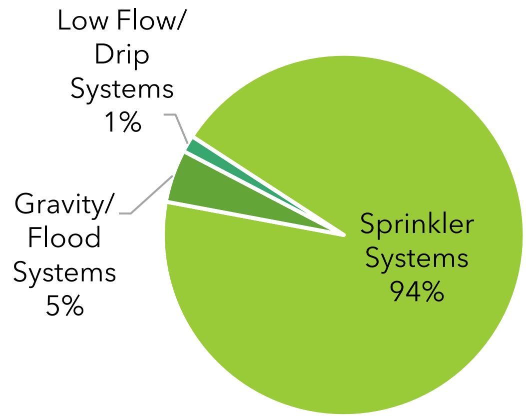


Figure 2-29. Irrigation system types in the Pee Dee River basin.

Figure 2-30 shows the location of center pivot irrigation systems throughout the basin (Pellet, 2020; Sekaran and Payero, 2023), which are most densely concentrated in Lee and Sumter counties.

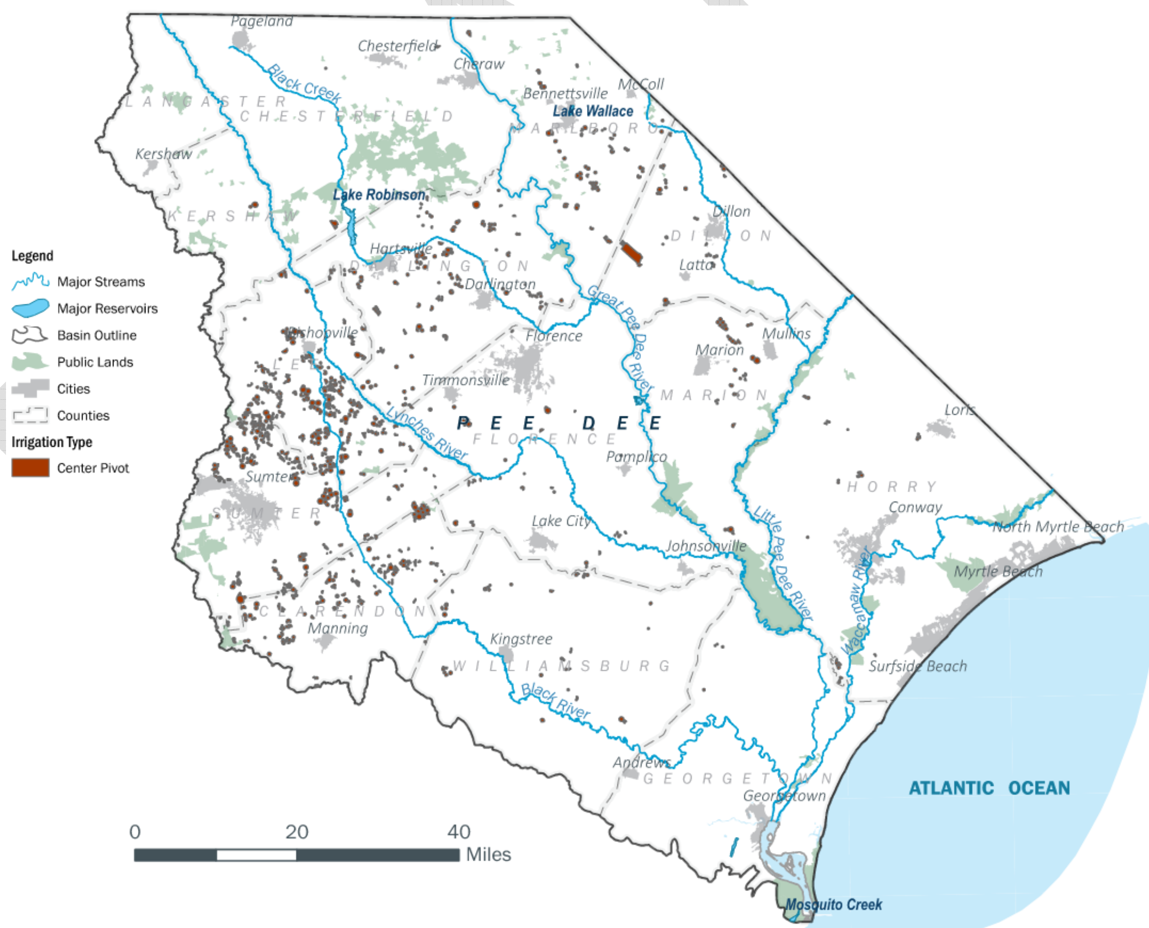


Figure 2-30. Location of center pivot irrigation systems in Pee Dee River basin.

2.4.2 Silviculture

Silviculture is a foundational component of South Carolina's economy. It contributes $21.2 billion annually to the economy and ranks first in jobs, second in labor income, and third in direct economic output compared to other leading industries in the state.

Table 2-16 shows harvested timber values for counties that are within or overlap the Pee Dee River basin. The Pee Dee River basin includes counties that overlap the basin and rank in the top 5 in South Carolina in terms of the value of harvested timber (Georgetown County at 2nd and Williamsburg County at 4th). Horry County and Chesterfield County, which are wholly within the basin, rank in the top 10 statewide.

Table 2-16. Value of timber delivered to South Carolina mills, 2017.

County	Acres of Forestland	Percent Forest	Harvested Timber Value		Statewide Rank
			Stumpage**	Delivered***	
Chesterfield*	372,982	73%	$16,353,705	$32,730,172	8
Clarendon	227,130	58%	$12,057,156	$26,252,963	15
Darlington*	159,574	45%	$9,485,720	$20,920,742	25
Dillon*	144,098	56%	$7,815,811	$15,583,687	34
Florence*	338,394	64%	$13,642,304	$28,966,817	13
Georgetown	416,817	73%	$26,171,471	$57,399,379	2
Horry*	468,514	63%	$14,573,239	$32,149,733	9
Kershaw	338,966	72%	$11,014,911	$25,364,228	16
Lancaster	266,882	76%	$8,838,992	$20,253,991	27
Lee	122,038	47%	$8,060,780	$17,244,602	30
Marion*	251,237	52%	$7,431,757	$14,789,467	35
Marlboro*	227,272	69%	$12,339,560	$25,197,815	17
Sumter	275,647	64%	$11,857,570	$26,948,229	14
Williamsburg	407,098	71%	$23,138,222	$48,877,501	4

* County fully contained within the watershed

** Stumpage is the value of standing trees or "on the stump"

*** Delivered is the value of the trees when they are delivered to the mill and considers all costs associated with cutting, preparing, and hauling timber to the plant.

2.4.3 Aquaculture

The 2017 Census of Agriculture ranks each county in the state by aquaculture production. Some counties were listed as having no aquaculture, while the remaining are assigned a rank. Seven out of the 14 counties in the watershed were listed as containing aquaculture, and Table 2-17 presents the ranks for these counties.

Table 2-17. Counties in the Pee Dee River basin with aquaculture and their relative rank in terms of production.

County	State Rank (out of 22)
Chesterfield	6
Lancaster	7
Horry	9
Darlington	11
Sumter	15
Clarendon	16
Kershaw	22

2.5 Socioeconomic Development

2.5.1 Population and Demographics

The Pee Dee River basin contains a mix of rural and urban areas. Large portions of the basin are rural in nature, and cities like Florence, Sumter, and Myrtle Beach contain more highly developed, urban, and population-dense areas. The 2020 population of the Pee Dee River basin was 1,089,700. Figure 2-31 shows the population density throughout the basin.

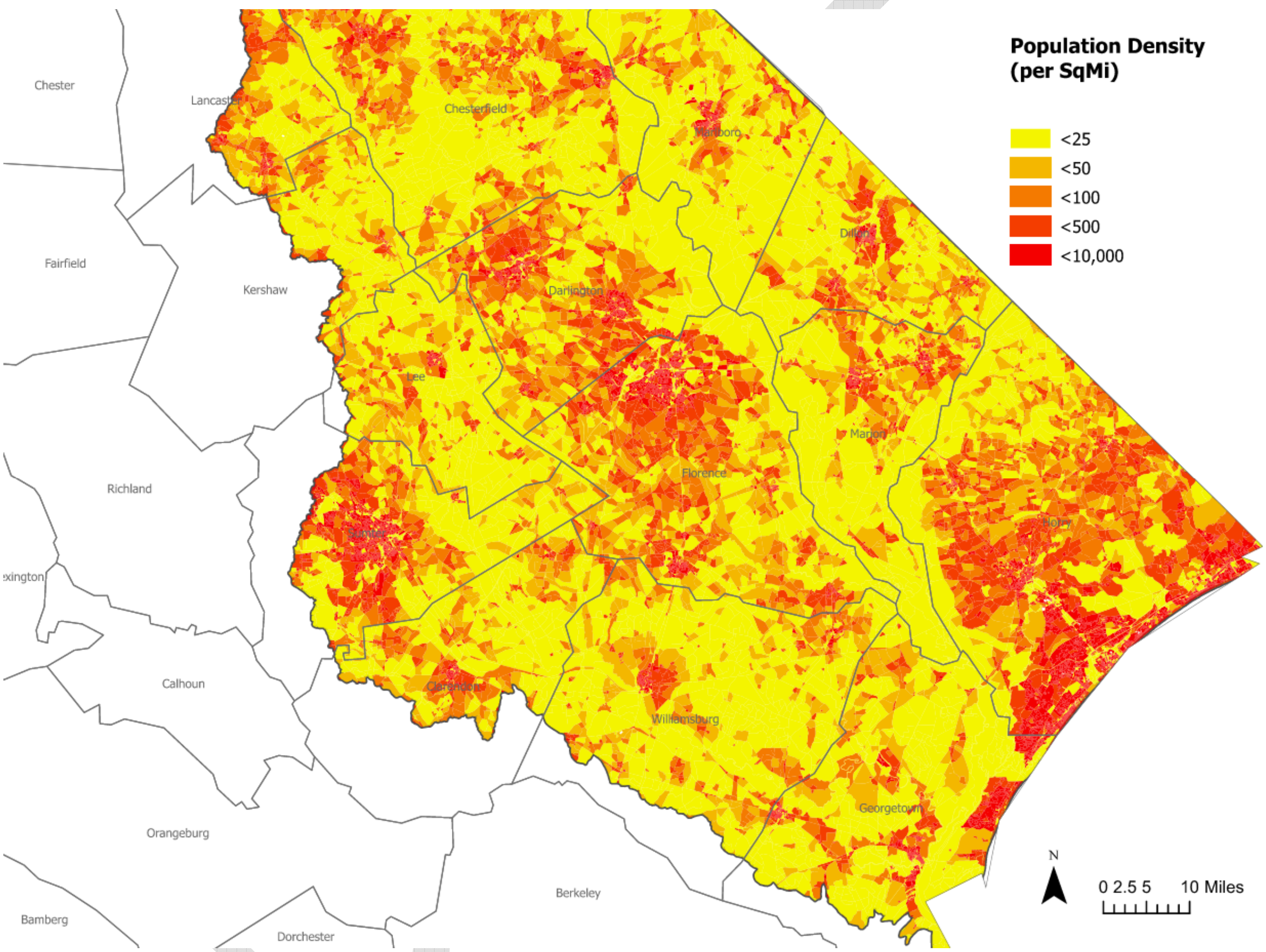


Figure 2-31. Population density of Pee Dee River basin (U.S. Census Bureau 2020).

According to the U.S. Bureau of Labor Statistics, the annual per capita income in South Carolina in 2022 was $57,836. The average per capita income across the fourteen counties in the Pee Dee River basin is approximately $50,100, which is below the statewide average. Chesterfield has the lowest per capita income in the basin of $39,047, and the highest is in Georgetown County, with an average per capita income of $63,946.

The population centers of the Pee Dee River basin have evolved over the past decade, as depicted in Figure 2-32. Most of the basin has stayed relatively consistent, if not decreasing in population slightly over the decade, while more urbanized areas experienced more growth, particularly Horry County and the Myrtle Beach area.

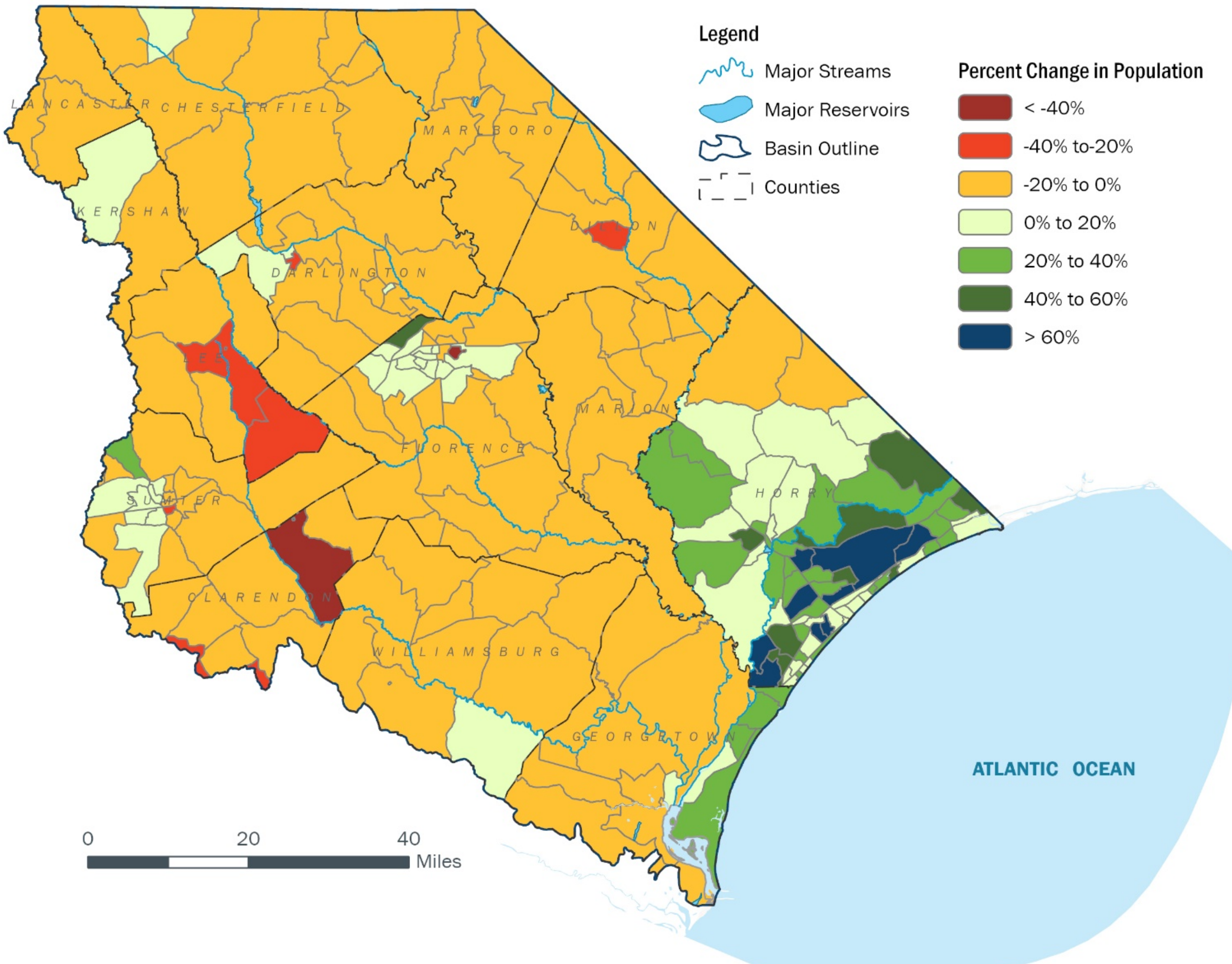


Figure 2-32. Population change in the Pee Dee River basin from 2010 to 2020 (U.S. Census Bureau).

2.5.2 Economic Activity

The 2021 gross domestic product (GDP) associated with a variety of sectors was collected from the South Carolina Regional Economic Analysis Project (REAP) and is shown in Figure 2-33. Data describing GDP was provided for each county by industry. Basin wide information was aggregated by assuming that the GDP is directly proportional to the area of a county present in the basin. For example, 55% of Clarendon County is located in the Pee Dee River basin. Therefore, the 55% of the county-wide GDP for Clarendon was attributed to the Pee Dee River basin.

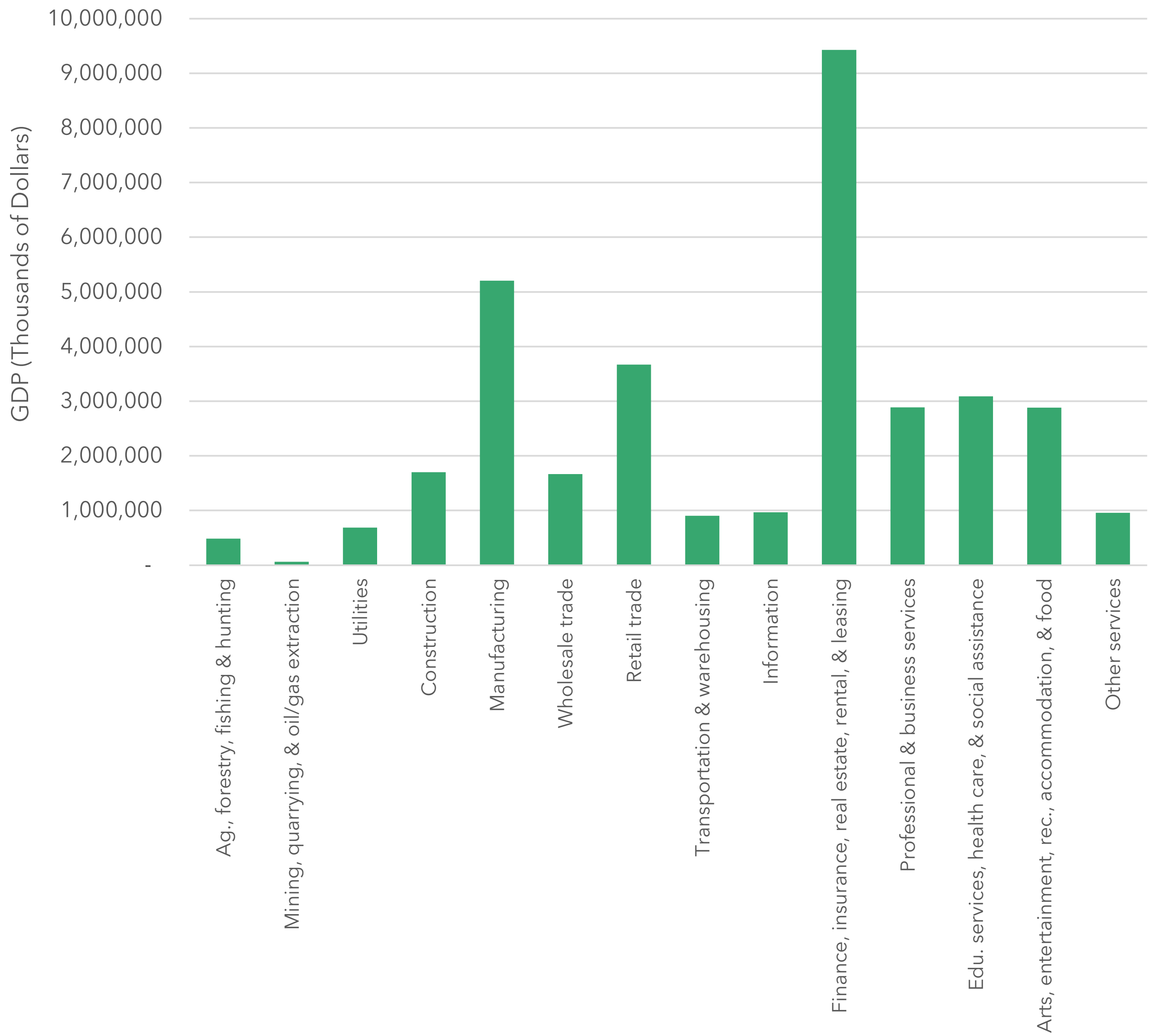


Figure 2-33. Gross domestic product by category for entire Pee Dee River basin.

Chapter 3
Water Resources of the Pee Dee River Basin

3.1 Surface Water Resources

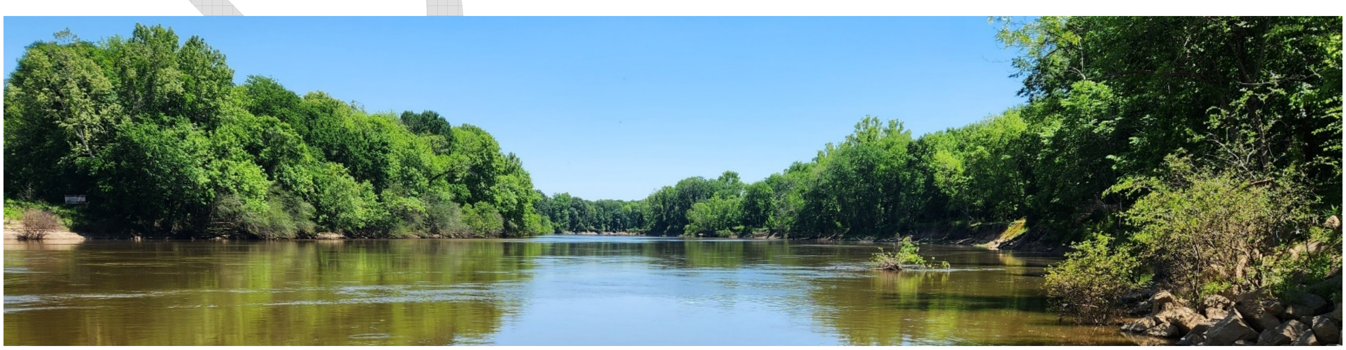
3.1.1 Major Rivers and Lakes

The mainstem of the Great Pee Dee River (Pee Dee River) is the dominant hydrologic feature of the basin. As shown in Figure 2-3, the river originates in North Carolina and receives most of its flow from drainage in North Carolina (SCDNR 2009). Other major rivers that flow into the Pee Dee River include the Little Pee Dee River, Lynches River, Black River, and Waccamaw River.

Streams in the upper part of the basin originate in or traverse the upper Coastal Plain. These streams, such as Black Creek and Cedar Creek, exhibit steady flows that are maintained by discharge from groundwater storage, particularly during periods of low rainfall. Most streams in this basin are associated with extensive swamp areas and follow indistinct channels that often divide and recombine. Lower Coastal Plain streams, such as Catfish Canal, exhibit more variable flow and typically are more dependent on rainfall and runoff than on groundwater discharge to support flows (SCDNR 2009).

Although the Pee Dee River in South Carolina is free-flowing, in North Carolina it is regulated by a series of six large reservoirs, the last of which, Blewlett Falls Lake, is located 15 miles upstream of the state border. The Pee Dee River basin has experienced limited surface-water development in South Carolina, consisting primarily of small-scale flood-control projects. The largest reservoir, Lake Robinson, is located on Black Creek and is owned and operated by Duke Energy Progress, LLC (SCDNR 2009).

Figure 3-1 shows the location of the major subbasins, the major estuarine and riverine wetlands, and small lakes and ponds in the Pee Dee River basin from the U.S. Fish and Wildlife Service (USFWS). Near the coast, the basin is dominated by estuarine and marine deepwater and wetlands, which are influenced by saltwater streams from border marshes and creeks. Freshwater emergent wetlands are present immediately upstream, and freshwater forested/shrub wetlands dominate the upper Coastal Plain.



The Great Pee Dee River.
(Photo credit: Matt Lindburg)

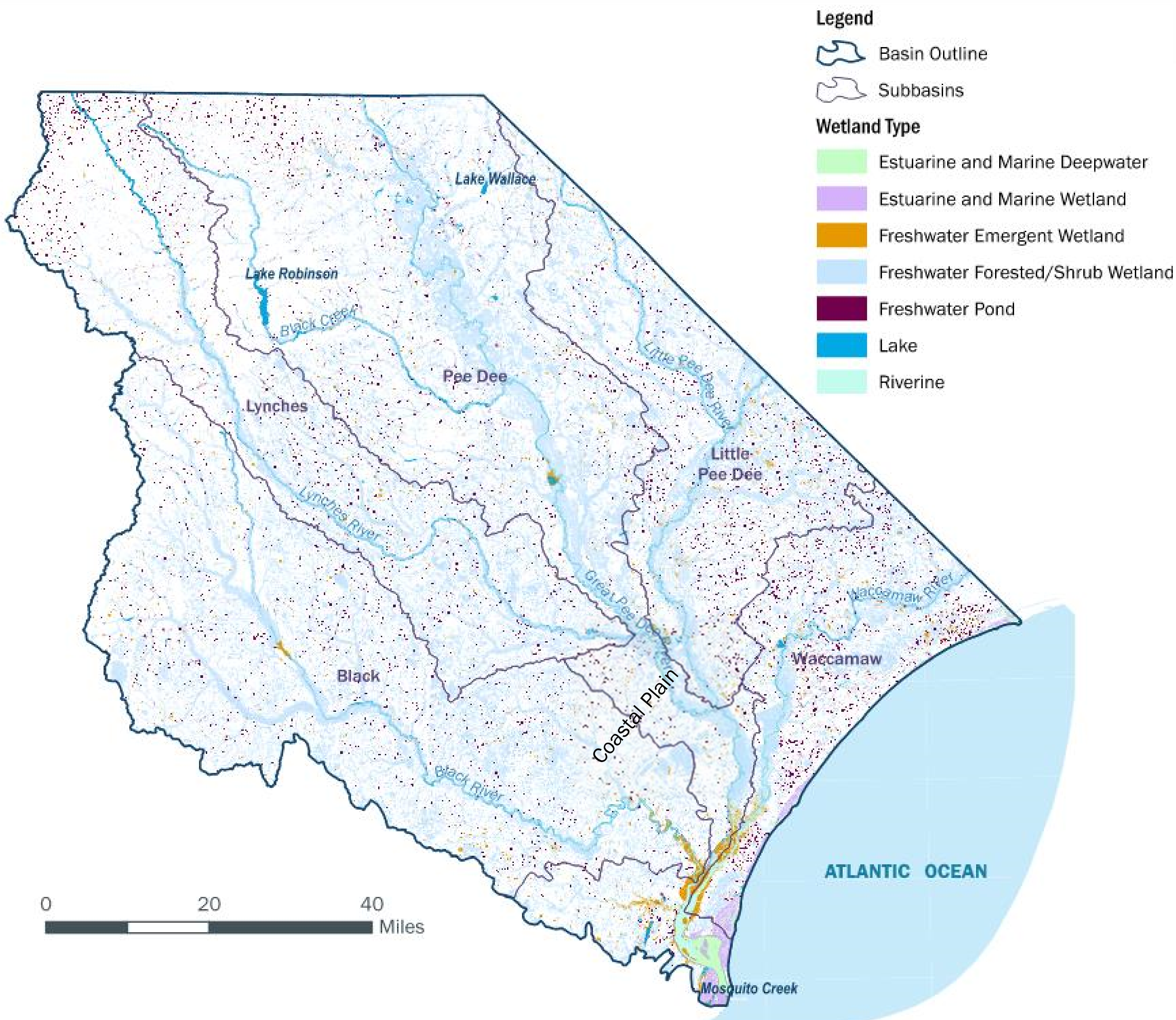


Figure 3-1. Wetland types of the Pee Dee River basin (USFWS 2023).

3.1.2 Surface Water Monitoring

Forty-seven USGS streamflow monitoring sites are active throughout the basin in South Carolina, encompassing the Pee Dee River, Little Pee Dee River, Black Creek, Black River, Lynches River, Little Lynches River, Waccamaw River, and Atlantic Intracoastal Waterway (AIW). A gaging station on the Pee Dee River outside the state near Cordova, NC, also provides useful flow data. Figure 3-2 shows a map with the active gaging stations in the Pee Dee River basin.

In addition, Table 3-1 summarizes streamflow characteristics at select stream gages. At these stream gages, median flows are lower than mean flows due to the influence of occasional short duration flood events which exceed the mean daily flows.

Figure 3-2. USGS streamflow gaging stations.

** Active Gage (selected) indicates gages that have streamflow characteristics summarized in Table 3-1.*

Table 3-1. Streamflow characteristics at USGS gaging stations in the Pee Dee River basin.*

Gaging Station Name	Station Number	Period of Record	Minimum Daily Flow (cfs), (year)	Median Daily Flow (cfs)	Average Daily Flow (cfs)	75th percentile (cfs)	Maximum Daily Flow (cfs), (year)
Pee Dee River near Bennettsville	02130561	1990-2023	48 (2000)	5,060	7,934	9,340	173,000 (2018)
Pee Dee River at Peedee, SC	02131000	1938 - 2023	653 (2007)	6,820	9,504	12,100	217,000 (1945)
Pee Dee River at Hwy 701 NR Bucksport, SC	02135200	2001 - 2023	637 (2007)	9,670	13,285	16,450	137,000 (2018)
Little Pee Dee River at Galivants Ferry, SC	02135000	1942 -2023	73 (2002)	1,990	2,955	3,810	64,000 (2018)
Black River at Kingstree, SC	02136000	1929 – 2023	2 (1954)	462	945	1160	78,200 (2015)
Lynches River near Bishopville, SC	02131500	1942 - 2023	33 (2002)	459	701	824	27,300 (2003)
Waccamaw River Near Longs, SC	02110500	1950 – 2023	1 (1954)	700	1246	1610	53,700 (2018)

*Data gathered from USGS National Water Information System for data through June 23, 2023 to calculate statistics.

Duration hydrographs showing streamflow throughout the year at select gaging stations in the Pee Dee, Little Pee Dee, Lynches, Black, and Waccamaw subbasins are shown in Figure 3-3.

The hydrographs show similar seasonal patterns with normal flows at their highest in February through April, and the lowest flows in July through September. Flows along the Pee Dee River and Lynches River show more variability.

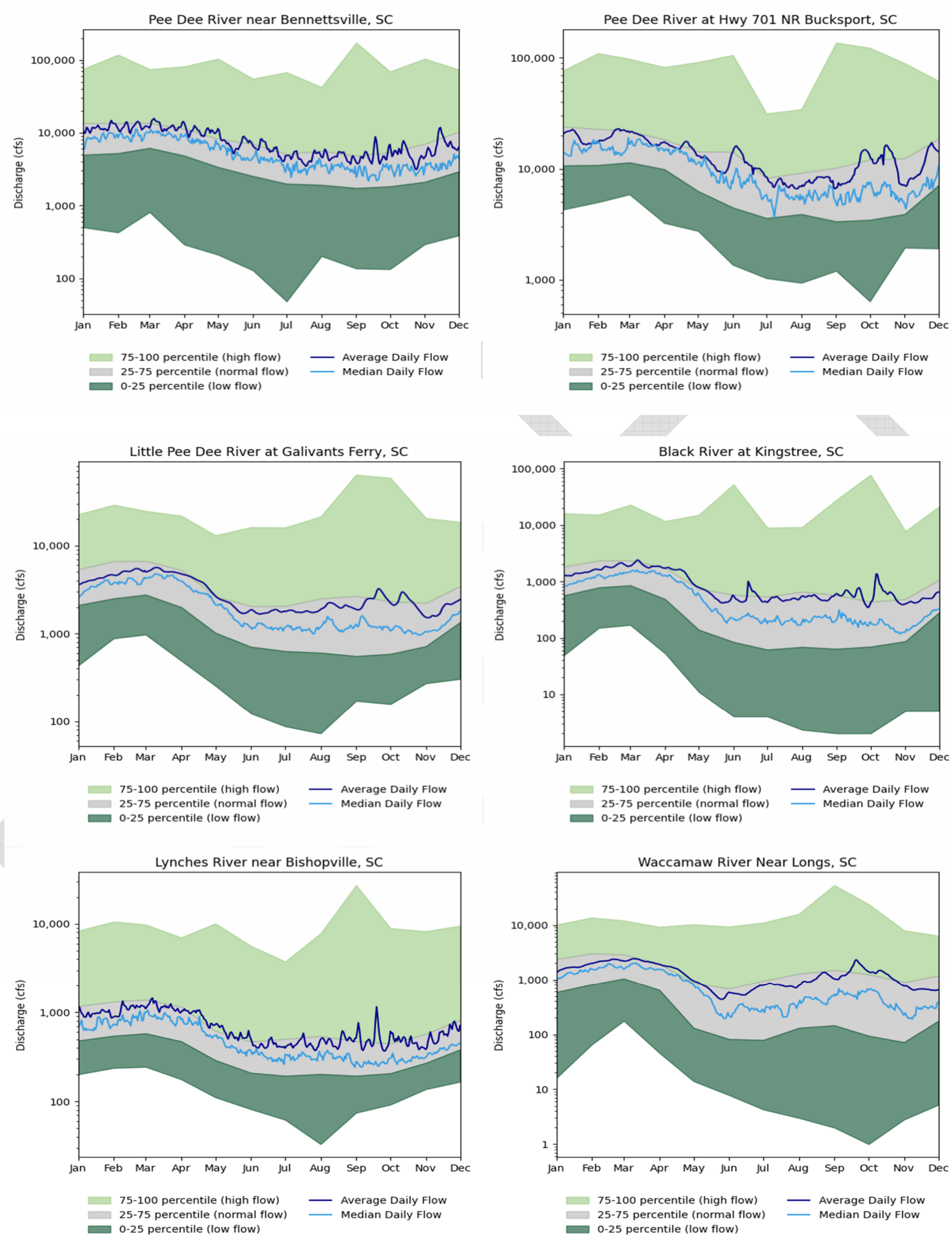
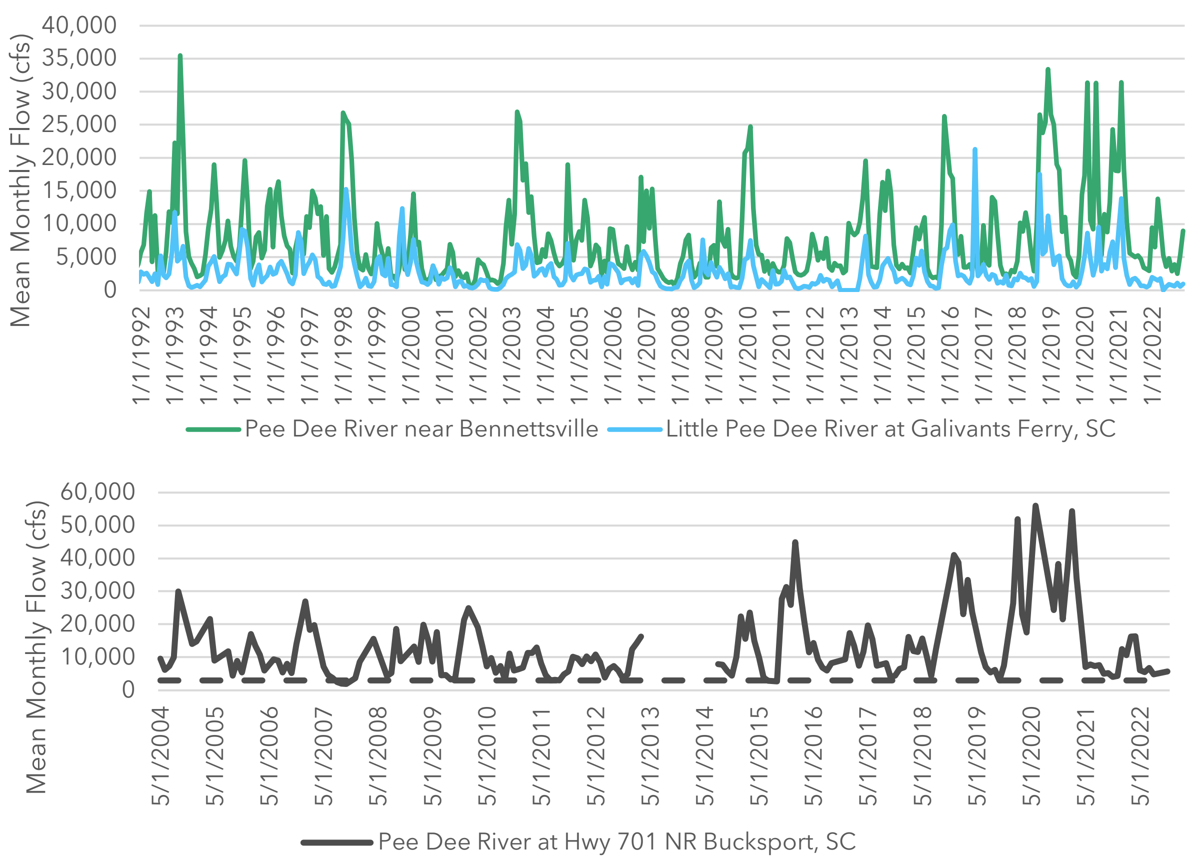


Figure 3-3. Duration hydrographs for select gaging stations on the Pee Dee River basin.

Although the Pee Dee River is free flowing in South Carolina, it is heavily regulated by a series of six reservoirs in North Carolina. The reservoirs, operated primarily for hydroelectric power generation, strongly influence flows in the Pee Dee River in South Carolina, particularly during low-flow periods (SCDNR 2009).

In 2015 and 2016, Duke Energy Progress, LLC and Cube Yadkin Generation, LLC received new Federal Energy Regulatory Commission (FERC) operating licenses for the Yadkin-Pee Dee Hydro Project (Tillery and Blewett Falls developments) and Yadkin Hydro Project (High Rock, Tuckertown, Narrows, and Falls developments), respectively. Both hydro projects are in North Carolina with the lowermost Blewett Falls Development providing regulated flows downstream into the South Carolina portion of the Pee Dee River. These new licenses reflected a collaborative effort to address a wide variety of stakeholder relicensing interests including instream flow requirements, power production, fish passage, water quality, recreation, endangered species, and cultural resources. Minimum flow requirements for downstream needs and drought-focused low inflow protocols were developed that have resulted in more stable downstream flows (Duke Energy, 2022).

Mean monthly flows at a few select gages are shown in Figure 3-4. The Little Pee Dee River at Galivants Ferry, SC and Pee Dee River near Bennettsville show similar patterns, with significant seasonal and annual variation and higher flows along the Pee Dee River throughout the 20-year period. The mean monthly flows at Pee Dee River at Hwy 701 NR Bucksport, SC include the 5th percentile of mean average flow. Low flows indicate drought periods and can result in saltwater intrusion in streams near the coast.



**Streamflow records were not available for April 2013 to July 2014.*

Figure 3-4. Mean monthly flows at select gaging stations in the Pee Dee River basin.

In addition to the USGS gaging stations, South Carolina Department of Environmental Services (SCDES) collects water quality data at 53 sites throughout the Pee Dee River basin as a part of their ongoing Ambient Surface Water Physical and Chemical Monitoring Program to assess the water's suitability for aquatic life and recreational use. The program includes ongoing fixed-location monitoring and statewide statistical survey monitoring. The fixed-location monitoring includes monthly collection and analysis of water from Base Sites in a uniform manner for the purpose of providing solid baseline water quality data. Figure 3-5 below shows the Base Sites in the Pee Dee River basin as of 2023. The Statistical Survey Sites are sampled once per month for one year and moved from year to year (SCDES 2023).

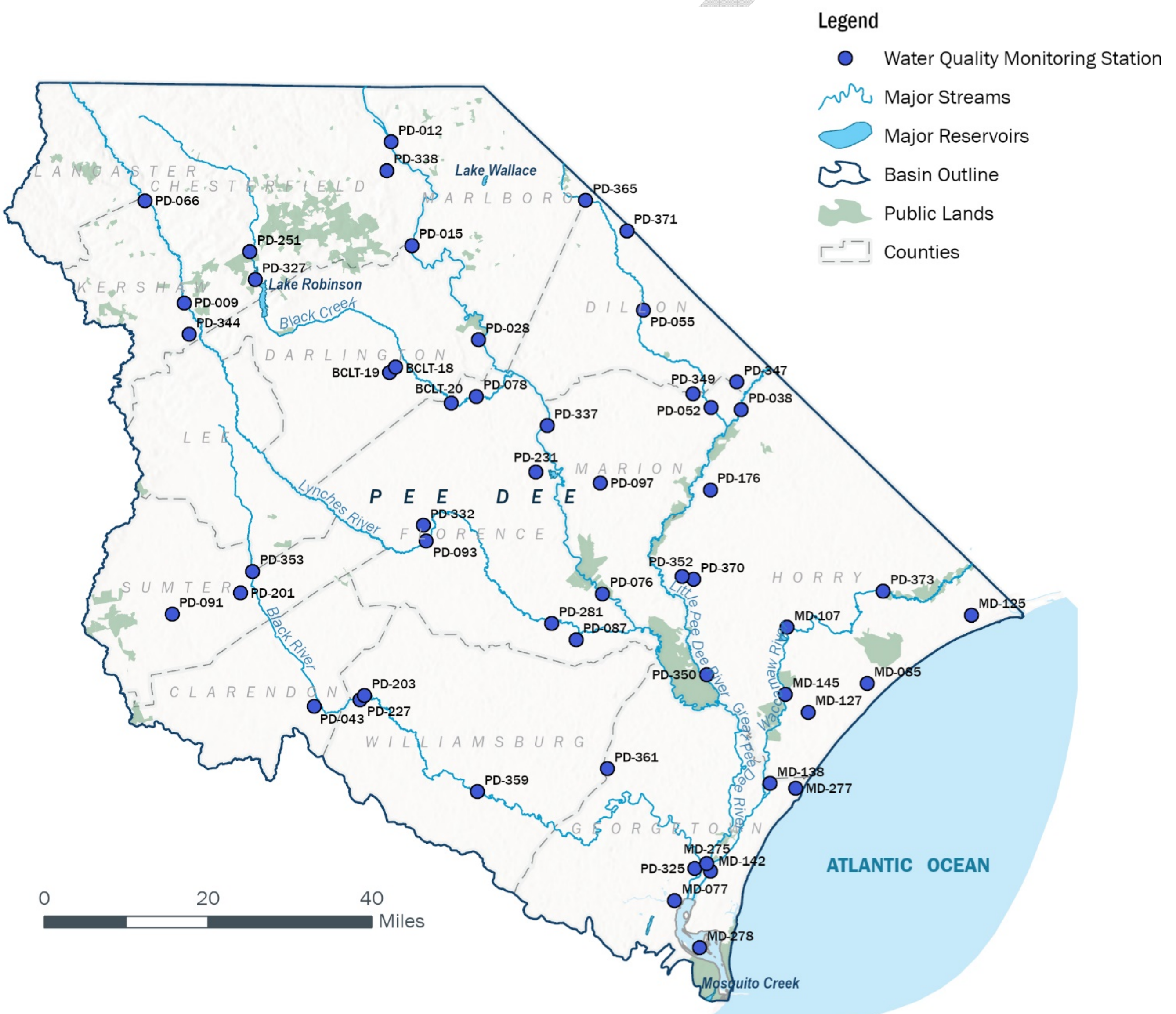


Figure 3-5. Active water quality monitoring sites in the Pee Dee River basin.

3.1.3 Surface Water Development

The Pee Dee River basin has experienced limited surface-water development in South Carolina, consisting primarily of small-scale flood-control projects. There are no active U.S. Army Corps of Engineers (USACE) navigation projects in the basin; howeverthe NRCS and USACE have completed several flood-control, drainage, and erosion projects in the basin (SCDNR 2009). Table 3-2 shows the number of regulated dams in the Pee Dee River basin categorized by flood hazard classification, and Figure 3-6 shows the locations of regulated dams throughout the basin.

Table 3-2. Regulated dams in the Pee Dee River basin.

Dam Type	Number of Dams	Description
High Hazard, Class 1	61	Structure where failure will likely cause loss of life and/or serious damage to infrastructure
Significant Hazard, Class 2	42	Structure where failure will not likely cause loss of life but infrastructure may be damaged
Low Hazard, Class 3	252	Structure where failure may cause limited property damage
Total	355	

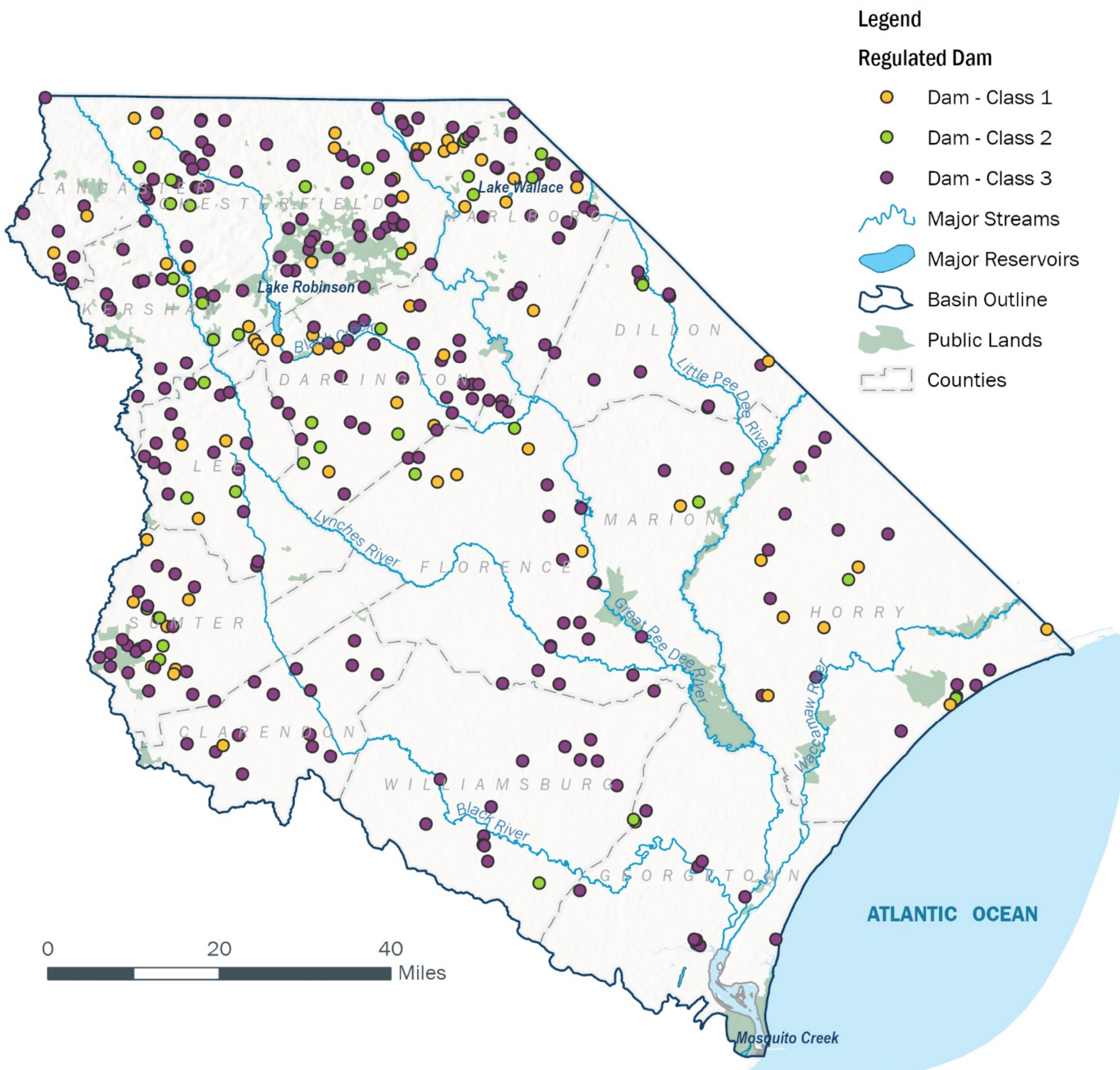


Figure 3-6. Regulated dams in the Pee Dee River basin.

3.1.4 Surface Water Concerns

The Lynches, Pee Dee, Little Pee Dee, and Waccamaw Rivers originate in North Carolina. The Black River originates in South Carolina. Flows on the Pee Dee River may be quite variable on a weekly basis due to hydropower discharges upstream in North Carolina; however, discharges from hydropower facilities in addition to groundwater support from the Upper Coastal Plain sustain relatively steady long-term flows (SCDNR 2009).

The water bodies in the Pee Dee Basin, except for Winyah Bay, are designated “freshwater.” Winyah Bay is designated “tidal saltwater” (SCDNR 2009).

Stream and river reaches that do not meet water quality standards and do not support designated uses are a concern. The 2022 Section §303(d) Clean Water Act list of impaired waters documents 272 impaired waters in the basin. A summary of the designated uses, impairments, and causes is shown in Table 3-3. The cyclical nature of SCDES's permitting, monitoring, and data analysis results in a dynamic §303(d) listing that is updated biannually. As new waters are monitored, new impaired sites may be identified which require listing (SCDES 2022).

Table 3-3. 2022 303(d) Pee Dee River basin impairment summary.

Designated Use	Number of Stations with Impairments	Causes of Impairments (Number of Impairments)
Aquatic Life	118	Macroinvertebrate (7) Dissolved Oxygen (64) Turbidity (13) Ammonia-nitrogen (1) Chlorophyll-a, Total Phosphorus (2) pH (27) Metals (Lead, Mercury, Zinc, or Nickel) (9)
Fish Consumption	66	Mercury (62) Mercury, PCB (4)
Recreational Use	93	Escherichia coli (66) Enterococci (27)
Shellfish Harvesting	23	Fecal Coliform Bacteria (23)

** 27 stations had multiple impairments*

In breakout discussions at the June 27, 2023, RBC Meeting, participants identified surface water concerns and challenges. RBC members were interested in integrating water quality considerations with quantity-based surface water assessments and modeling. Water quality is becoming a bigger concern, and the Pee Dee RBC needs to understand its impacts to environment and recreation, both at high and low flows. In addition, development in coastal communities is continuing at a rapid pace, and the RBC expressed concern that surface water modeling tools do not extend to coastal areas with tidal influences.

3.2 Surface Water Assessment Tools

3.2.1 SWAM Model

The SWAM model was used to assess current and future surface water availability and to evaluate the effectiveness of proposed water management strategies. From 2014 to 2017, all eight South Carolina surface water quantity models were built in the SWAM platform, including the Pee Dee River basin model. The Pee Dee River basin SWAM model was updated in 2020. Updates included extending the period of record to 2018, adding new permits and registrations, and removing inactive users.

SWAM uses a framework composed of a network of river reaches, impoundments, withdrawals, and returns, in which water is routed hydrologically between nodes. The model focuses principally on mainstem rivers, along with primary and secondary tributaries, and often does not include smaller order tributaries, whose flows are aggregated into flow estimates for primary and secondary tributaries. The model simulates basin hydrology at a daily or monthly timestep.

Inputs to the model include:

- Calculated and estimated "unimpaired flows" for the headwaters of the mainstem and tributaries included in the model. Unimpaired flows were calculated by mathematically removing historical influence of storage, withdrawals, and return flows from measured flow at USGS streamflow gaging stations. This allows the model to simulate either historical or hypothetical water use patterns for evaluating future conditions. Many of the unimpaired flow records were synthesized using standard statistical techniques where measured data were not explicitly available for river reaches or time periods.
- Reach Gain/Loss Factors, which are calibrated values used to increase flow as it moves downstream based on additional drainage area or decrease flow for losing river reaches.
- Locations of all withdrawals, return flows, and interbasin transfers (values of which are user-adjusted variables).
- Reservoir characteristics, such as capacity, bathymetry, constraints, and flexible operating rules.
- USGS daily flow records are embedded in the model for comparative purposes – simulation results can be compared with historical records.

Model variables, which can be modified by users to explore future conditions, include:

- Withdrawal targets (municipal, industrial, thermoelectric, agricultural, golf courses, hatcheries)
- Consumptive use, wastewater discharge, and other return flows (which can be estimated automatically)
- Interbasin transfers
- Reservoir operating rules and storage characteristics, if applicable
- Environmental flow targets

Using this information, the SWAM model calculates available water (physically available based on full simulated flows, and legally available based on permit conditions and other uses), withdrawals, storage, consumption, and return flows at user-defined nodes. The flow from the main river stem, as well as major branches and tributaries, are discretely quantified. Figure 3-7 shows the Pee Dee River basin SWAM model framework.

The model can be used to simulate current and future demands based on defined scenarios and identify potential shortages in water availability when compared to demands for withdrawals or instream flow targets. The scenarios that were evaluated specifically for the Pee Dee River basin are discussed in further detail in Chapter 4 - Current and Projected Water Demand and Chapter 5 - Comparison of Water Resource Availability and Water Demand.

As with all eight of the SWAM models for South Carolina, the Pee Dee model was calibrated and then tested to demonstrate reasonable ability to recreate historical hydrology and operational conditions. Historical water uses were added into the model to alter the estimated unimpaired flows, and simulated versus gaged flows were compared at key locations throughout the basin. An example verification test result is shown in Figure 3-8. Full verification results and methods are discussed in the South Carolina Surface Water Quantity Models: Pee Dee Basin Model report (CDM Smith 2017).

While the SWAM model is capable of quantifying water balance calculations for free-flowing streams and reservoirs based on a number of inputs, it does have limitations. The model is not capable of performing rainfall-runoff or hydraulic routing calculations and cannot be used (by itself) to calculate natural flow in tidally-influenced reaches. Groundwater and its impacts are not explicitly modeled by the SWAM model; however, groundwater inputs and losses to streams and rivers are implicitly accounted for through incorporation of gage records and model calibration and verification. Water quality metrics also cannot be modeled by SWAM. Future climate scenarios can be explored with SWAM by adjusting the tributary input flows.

The model, as well as its Users Guide and the full report on the Pee Dee Basin Model development and calibration are publicly available for download at SCDES's website.

For more information on the models and associated documentation, see:

https://www.des.sc.gov/programs/bureau-water/hydrology/surface-water-program/surface-water-models/simplified-water-allocation-models-swam

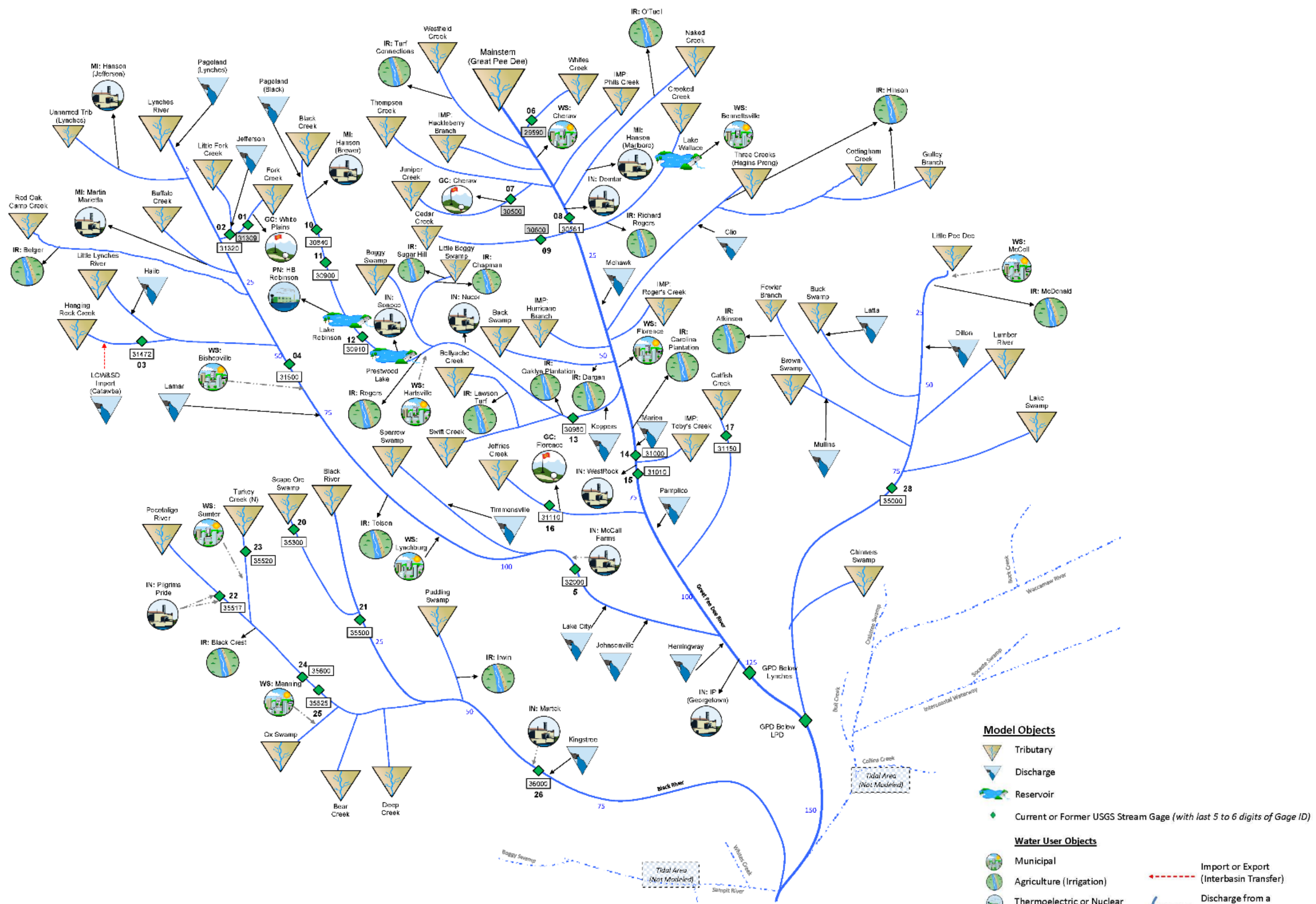
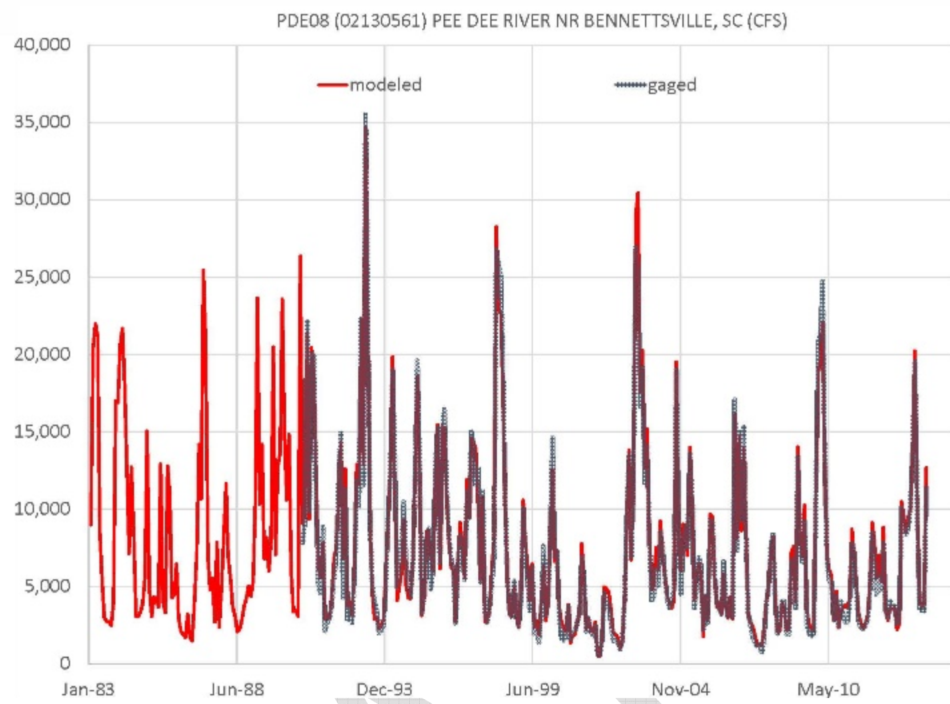


Figure 3-7. SWAM Model network for the Pee Dee River basin.



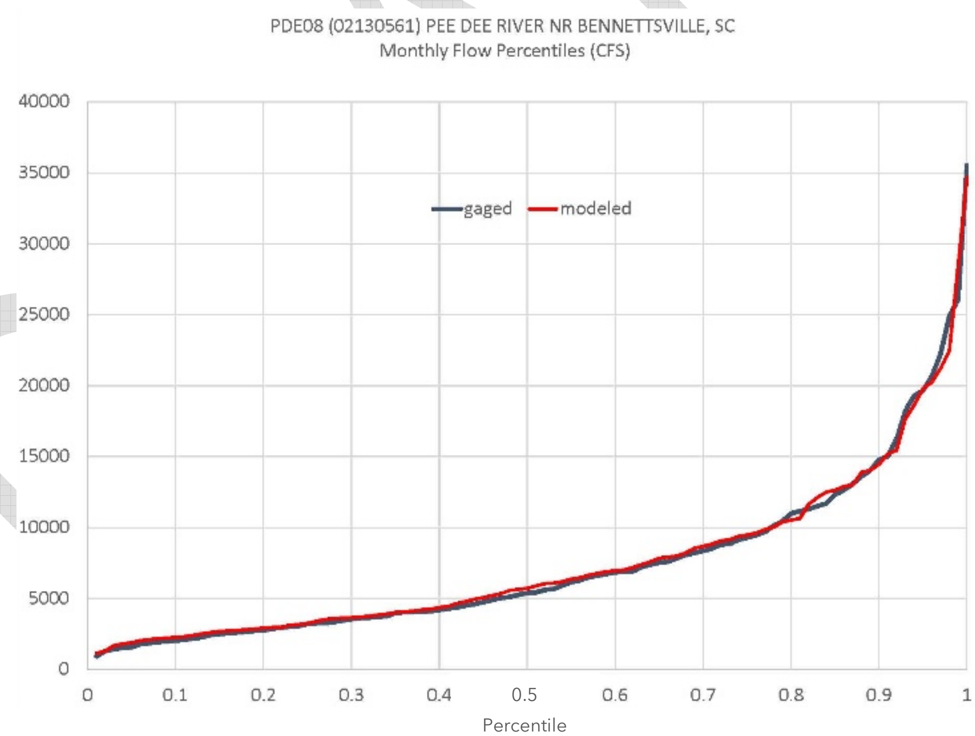


Figure 3-8. Representative Pee Dee River basin SWAM model verification graphs (CDM Smith 2017).

3.2.2 Other Surface Water Analyses

While the SWAM models focus on the hydrology of larger mainstem rivers and primary tributaries in the Pee Dee River basin and other South Carolina basins, other work has focused on the hydrology and flow characteristics in smaller headwater streams, specifically those that are classified as "wadeable." In part of an effort to formulate relationships between hydrologic metrics (flow patterns, statistics, and variability in these streams for both pulses and long-term averages) with ecological suitability metrics, daily rainfall/runoff modeling of small headwater streams throughout the state was accomplished with the WaterFALL® model (Watershed Flow ALLocation model), as described in Eddy et al (2022) and Bower et al (2022). The WaterFall® model is a semi-distributed rainfall runoff model that simulates daily streamflows at the catchment resolution, allowing for the simulation of the local watershed contribution at each stream segment.

Separately, as discussed in Bower et al (2022), biological response metrics were developed and combined with the hydrologic metrics from WaterFALL® to identify statistically significant correlations between flow characteristics and ecological suitability for fish and macroinvertebrates. The framework can be used to inform instream flow management and assess effects of flow alterations on riverine assemblages. Thus, the results are intended to help guide scientific decisions on maintaining natural hydrologic variations while also supporting consumptive water withdrawals.

As a component in the analysis, the WaterFALL® hydrologic modeling results augment the SWAM modeling results by providing similar hydrologic understanding of the smaller headwater streams not simulated explicitly or individually in SWAM.

3.3 Groundwater Resources

3.3.1 Groundwater Aquifers

The Pee Dee River basin, which includes South Carolina, North Carolina, and a small portion of Virginia, is underlain by aquifers belonging to the Coastal Plain and Piedmont – Blue Ridge crystalline rock aquifer systems. In South Carolina, the Pee Dee River basin is predominately underlain by the Coastal Plain aquifer system with a small portion of the Piedmont crystalline rock aquifer present in Chesterfield County (SCDNR 2022). The Coastal Plain aquifers are composed of permeable sands or limestone separted by clay confining units arranged in a wedge that begins at the Fall Line and thickens towards the coast, as shown in Figure 3-9. The most important aquifers in the Pee Dee River basin are the surficial, Crouch Banch, and McQueen Branch aquifers, which are seperated by confining units of the same name.

Surficial Aquifer

The surficial aquifer is unconfined and is referred to as the water-table aquifer. The surficial aquifer is comprised of quartz, gravel, sand, silt, clay, and shelly sand (Gellici and Lautier 2010). The flow direction and flow rate of groundwater in the surficial aquifer largely follow the ground surface topography (SCDNR 2009). Because the aquifer is unconfined, water levels fluctuate due to seasonal weather changes. The thickness of the surficial aquifer is typically tens of feet and the sediments are generally fine-grained near the coast. Well depths range from 20 to 100 feet, and well yields are generally low, ranging from 5 to 20 gallons per minute (gpm) due to the limited amount of available drawdown (SCDNR 2009). The surficial aquifer is most commonly used for domestic, light commercial, and small agricultural operations.

Crouch Branch Aquifer

The Crouch Branch aquifer underlies the surfical aquifer in the Pee Dee River basin. It is an important source of water for public supply and crop irrigation, and it is also used for industry and power production. The Crouch Branch aquifer covers the majority of the South Carolina Coastal Plain and consists of unconsolidated quartz sand and clay throughout (Figure 3-10). In the Pee Dee River basin, the top of the aquifer occurs at or near the surface in Chesterfield, Marlboro, and Darlington Counties and reaches a depth of over 700 feet in coastal Georgetown County. Aquifer thickness ranges from 0 feet near the Fall Line to about 400 feet at the coast. In locations close to the Fall Line, the aquifer is unconfined and the surficial aquifer and the Crouch Branch aquifer are connected. The presence of laminated sand and clay beds divide the aquifer into three aquifer zones, but the zones are assumed to be hydraulically connected to one another (Wachob and others 2017). The coarse sediments in the upper and middle basin become more fine-grained as the aquifer dips toward the coast, resulting in a wide range of yields from wells completed in the aquifer. In Darlington, Dillon, Florence, Marion, and Marlboro Counties the average well yield is approximately 700 gpm (Rodriguez and others 1994), whereas along the coast in Horry and Georgetown Counties, yields typically are between 100 to 500 gpm (Pelletier 1985). Recharge to the Crouch Branch aquifer occurs from rainfall within the unconfined portion of the aquifer in Marlboro, Chesterfield, and Lee Counties.

McQueen Branch Aquifer

The McQueen Branch aquifer underlies the Crouch Branch aquifer and is the most heavily used aquifer in the basin. The aquifer is primarily used for public water supply, crop irrigation, and industrial use. It consists of unconsolidated fine to coarse quartz sand and clay, and it covers most of the Coastal Plain and Pee Dee River basin (Figure 3-10). The aquifer outcrops near the Fall Line in Chesterfield and Kershaw Counties, and is recharged in its unconfined area when rainfall moves downward through the Crouch Branch aquifer to recharge the McQueen Branch. The top of the aquifer occurs close to the surface to near its outcrop and reaches a depth of over 950 feet in Georgetown County, with an aquifer thickness of about 200 feet in Horry and Georgetown Counties. Well yields in Darlington, Dillon, Florence, Marion, and Marlboro Counties average approximately 950 gpm (Rodriguez and others 1994). Yields generally decrease eastward (700 gpm in Williamsburg County) as the aquifer composition becomes more fine grained and less permeable (Pelletier 1985).

Charleston and Gramling Aquifers

The Charleston aquifer underlies the McQueen Branch aquifer and is composed of unconsolidated sand, clayey sand, and clay. In the Pee Dee River basin, the top of the Charleston aquifer occurs at depths ranging from 8 to 1,200 feet, and the aquifer is up to 100 feet thick. The Gramling aquifer lies beneath the Charleston aqufier, at the base of the Coastal Plain aquifer system in South Carolina and is composed of unconsolidated clayey sand with silt and clay that can inhibit water use. Because the Charleston and Gramling aquifers do not outcrop at the surface, they are recharged from the overlying McQueen Branch aquifer, and these aquifers experience much slower recharge than the Crouch Branch and McQueen Branch aquifers. Well yields of the Charleston aquifer are approximately 500 gpm (Gellici and Lautier 2010), but few wells in the Pee Dee River basin are completed soley in the Charleston aquifer; wells screened in the Charleston aquifer often are also screened in the McQueen Branch aquifer. Because of its depth and relatively low ability to yield water, few wells are completed in the Gramling aquifer in the Pee Dee River basin (SCDNR 2022).

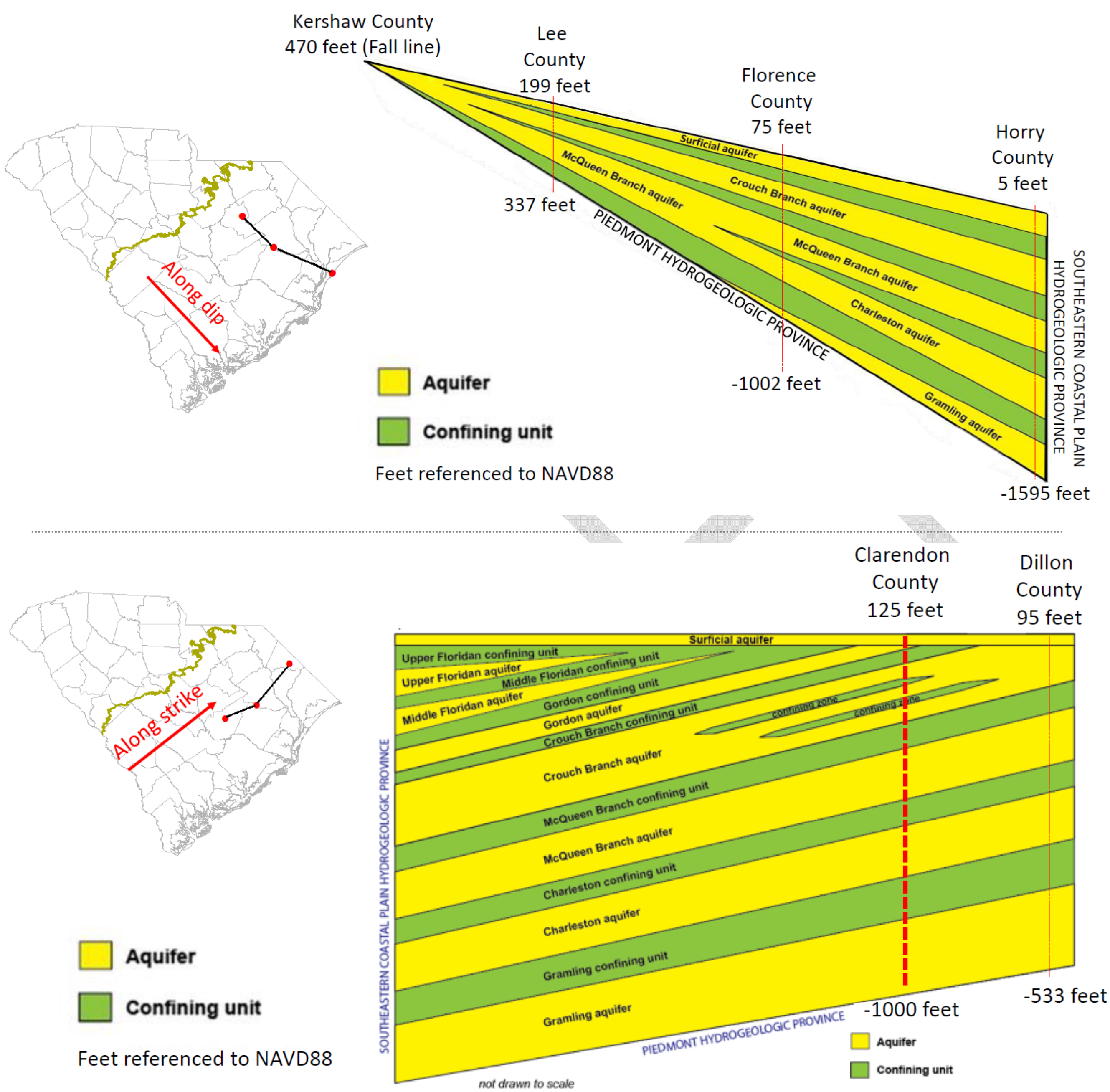


Figure 3-9. Coastal Plain aquifer system schematic cross sections (SCDNR 2022).

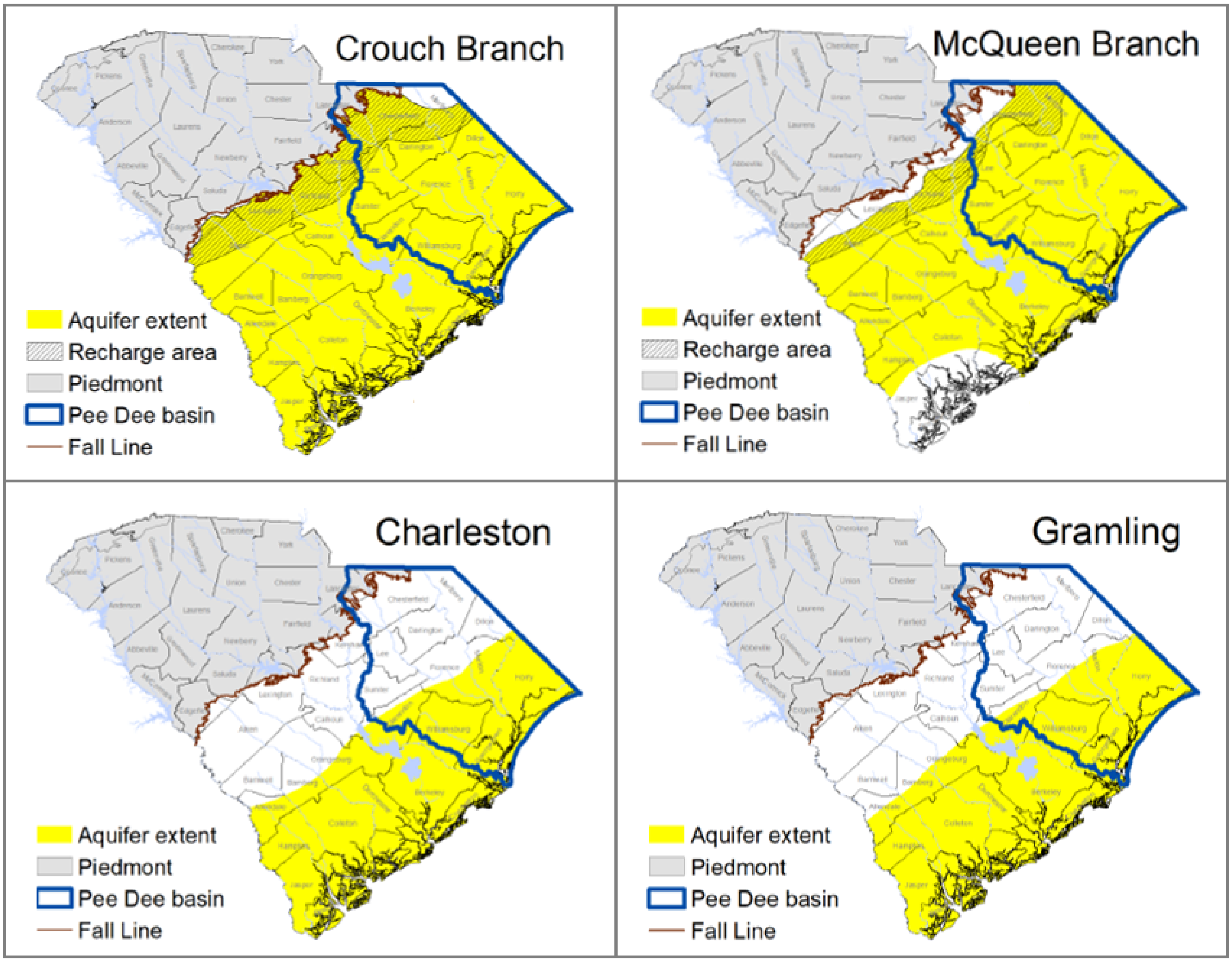


Figure 3-10. Aquifers underlying the Pee Dee River basin (SCDNR 2022).

3.3.2 Groundwater Monitoring

Groundwater monitoring is performed by the USGS and SCDES. Statewide, the groundwater monitoring network operated by SCDES has more than 180 wells as of 2022. The majority of the monitoring wells are in the Coastal Plain. Most wells have hourly data automatically recorded, and others are measured manually four to six times per year (SCDNR 2022c). The USGS maintains a groundwater-level monitoring network of an additional 21 wells in South Carolina. Groundwater monitoring wells are used to identify short- and long-term trends in groundwater levels and aquifer storage, and to monitor drought conditions. The majority of the wells have water level records dating to the 1990s with some dating back to 1955 (SCDNR 2022c).

The Pee Dee River basin has 54 monitoring wells, principally in the Crouch Branch and McQueen Branch aquifers (SCDES 2024). The locations of the wells monitoring groundwater levels in each aquifer are shown in Chapter 5 (see Section 5.4).

SCDES[1] routinely measures water levels in other, non-network wells in order to develop potentiometric maps for the major Coastal Plain aquifers. A potentiometric map is a contour map that illustrates the elevation to which groundwater will rise in a well open to a particular aquifer. Unlike monitoring wells, which provide continuous records of changing aquifer conditions at specific points, potentiometric maps provide "snapshots" of aquifer conditions over the full extent of the aquifer at one moment in time. Areas of relatively significant groundwater level declines are indicated on potentiometric maps by relatively lower potentiometric elevations, often seen as concentric loops of contours lines known as a cone of depression. Typically, SCDES produces new potentiometric maps for the Crouch Branch aquifer and the McQueen Branch aquifer every three years.

Examples of monitoring well hydrographs and potentiometric maps that can be created using monitoring well data are shown in Figure 3-11 and Figure 3-12, respectively. More detailed descriptions monitoring well data and potentiometric maps are included in Chapter 5.

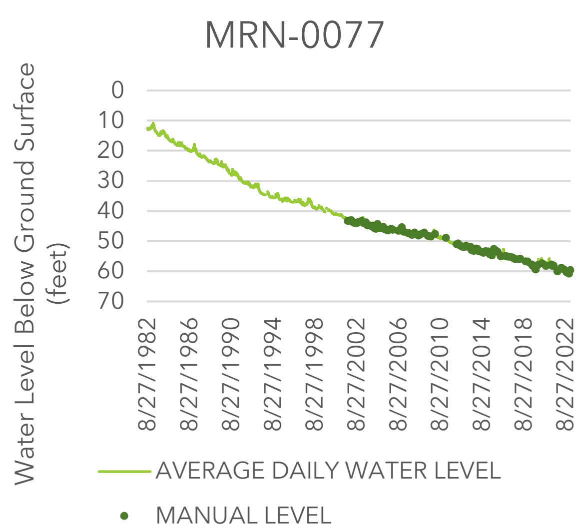


Figure 3-11. Example monitoring well hydrograph showing groundwater level trends in the Crouch Branch aquifer in Marion County.

For more information on Potentiometric Mapping, see:
https://des.sc.gov/programs/bureau-water/hydrology/groundwater-program/potentiometric-mapping

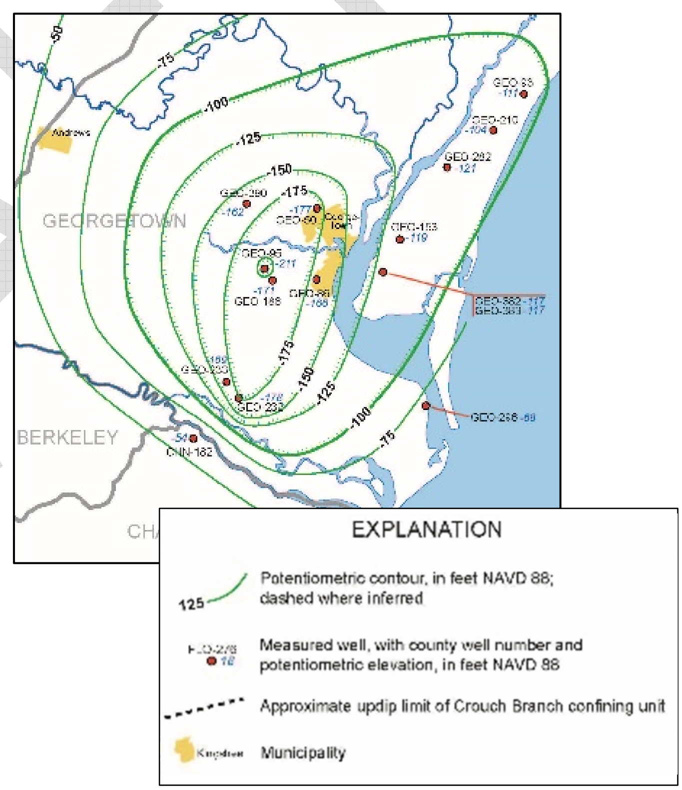


Figure 3-12. Example map showing the potentiometric surface of the Crouch Branch aquifer near Georgetown.

[1] The state agency responsible for collecting and assessing groundwater level data recently changed. Water level data collected before July 1, 2024, was obtained by the SCDNR Hydrology Section. Water level data collected on or after July 1, 2024, was obtained by the SCDES Hydrology Section. In 2023, Senate Bill 399 (S.399) was enacted, effective July 1, 2024, leading to, among other things, the establishment of the SC Department of Environmental Services (SCDES). Furthermore, the Hydrology and Aquatic Nuisance programs of SCDNR were incorporated as sections within SCDES, conserving and consolidating the relevant powers and duties of the preceding agencies.

Over pumping of groundwater creates localized cones of depression that disrupt natural groundwater flow and can allow saltwater to move into aquifers along the coast. Saltwater intrusion has become a problem for some coastal areas.

SCDES manages a network of 10 coastal monitoring wells to measure and track saltwater intrusion. In the Pee Dee River basin, coastal monitoring wells are near Georgetown and Myrtle Beach. For more information, see:

https://des.sc.gov/programs/bureau-water/hydrology/groundwater-program/saltwater-intrusion-monitoring-network

3.3.3 Groundwater Development

Groundwater supplies have been developed in the Pee Dee River basin to serve municipalities, agriculture, industry, golf courses, and the energy sector. Currently, the average withdrawal of groundwater for all uses is approximately 111.9 million gallons per day (MGD) (or 40.9 billion gallons per year). This does not include relatively minor withdrawals from domestic and other wells which are below the reporting limit of 3 million gallons per month (MGM).

The public water supply sector is the largest user of groundwater, with current withdrawals averaging 65.7 MGD (or 24.0 billion gallons per year). Agricultural uses of groundwater average 34.3 MGD (12.5 billion gallons per year), and industrial uses of groundwater averge 9.4 MGD (3.4 billion gallons per year). Golf courses are supplied by groundwater sources, but their use is relatively small compared to other sectors at 1.5 MGD (0.5 billion gallons per year). Finally, the HB Robinson nuclear power plant uses approximately 1.0 MGD (0.3 billion gallons per year), though the vast majority of their water use is supplied from surface water sources.

Many of the Pee Dee River basin's municipal water providers, such as Sumter and a host of smaller communities are solely dependent on groundwater supplies. Some water providers like Florence, Grand Strand Water and Sewer Authority, and Georgetown use groundwater supplies but also have access to surface water supplies. Groundwater supplies have also been developed to serve industrial water users like Sonoco, McCall Farms (for canning and freezing operations), and Nan Ya Plastics Corporation. Some industries in the Pee Dee River basin depend solely on groundwater supplies while some, like Sonoco and NUCOR, use both groundwater and surface water supplies.

Some municipal water providers have implemented conjunctive water management strategies that use surface water supplies alongside groundwater supplies in an effort to mitigate aquifer level declines. For example, conjuctive water management strategies in Florence County have been successful at stabilizing groundwater level declines in the local aquifer and are described further in Chapter 6. In essence, surface water has been developed and utilized to support additional municipal water demand that has occurred since the mid-2000s. Groundwater withdrawals have remained relatively steady since that time. In another example, Grand Strand Water and Sewer Authority (GSWSA) has implemented an aquifer storage and recovery strategy to store surface water in aquifers when municipal usage is low and extract the stored water when demands are high.

3.3.4 Groundwater Concerns

Years of groundwater pumping from wells in the Pee Dee and neighboring basins have resulted in regional groundwater-level declines (SCDNR 2009). Although some areas have experienced recovery of groundwater levels, groundwater level declines are a concern. Three cones of depression are in the Pee Dee Basin, as indicated in potentiometric surface maps and as shown as blue dots in Figure 3-13. The severity of the cones is more prominent in the coastal region. When groundwater levels are at or below sea level, aquifers can experience saltwater intrusion. Declining groundwater levels can also reduce yields, and in extreme cases, can result in compaction and land subsidence.

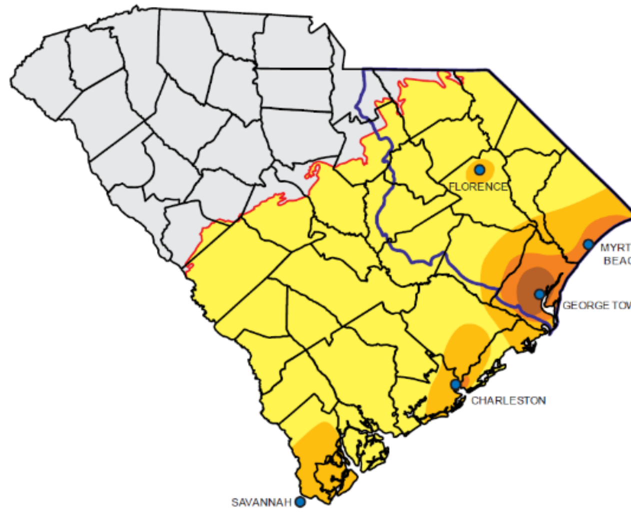


Figure 3-13. Cones of Depression in South Carolina (SCDNR 2022).

Three Capacity Use Areas (CUA) cover the basin (as described in Section 3.3.5). The groundwater management plans for those areas contain goals around the sustainable development of the groundwater resource by managing withdrawals, protecting groundwater from saltwater intrusion, and monitoring quality and quantity to evaluate changing conditions (SCDHEC 2023).

In breakout discussions at the June 27, 2023 RBC meeting, attendees identified groundwater concerns and challenges.

- Water supplies are generally adequate, but drought conditions create water supply risks. Planning for drought and managing limited water resources is important.
- Agriculture, which often relies on groundwater, is vulnerable to drought.
- Coastal regions continue to develop even though groundwater levels are declining.

3.3.5 Capacity Use Areas

In South Carolina, groundwater is managed and monitored by the South Carolina Department of Environmental Services (SCDES) within areas of the state designated as CUAs. According to the Groundwater Use and Reporting Act (Chapter 5, Section 49-5-60), a CUA is defined as an area where excessive groundwater withdrawal may adversely affect natural resources or pose a threat to public health, safety, or economic welfare, or where there is a significant threat to the long-term integrity of the groundwater resource. Within a designated CUA, groundwater users withdrawing three (3) million gallons or more of groundwater per month from a single well or from multiple wells within a one-mile radius must apply for and obtain a Groundwater Withdrawal Permit.

There are currently six designated CUAs in the Coastal Plain of South Carolina, the region east of the Fall Line to the coast, three of which are partially located within the Pee Dee River basin: the Waccamaw, Pee

Dee, and Santee-Lynches (see Table 3-4). For each CUA, SCDES, in collaboration with various stakeholders, has developed a Groundwater Management Plan (GWMP).

Table 3-4. Capacity Use Areas within the Pee Dee River basin.

Capacity Use Area	Year Designated	Counties
Waccamaw	1979	Georgetown and Horry
Pee Dee	2004	Darlington, Dillon, Florence, Marion, Marlboro, and Williamsburg
Santee-Lynches	2021	Chesterfield, Kershaw, Richland, Clarendon, Lee, and Sumter

The GWMPs for the Waccamaw and Pee Dee CUAs share the following goals:

1. Ensure sustainable development of the groundwater resource by management of groundwater withdrawals
2. The protection of groundwater quality from salt-water intrusion
3. Monitoring of groundwater quality and quantity to evaluate conditions

The goals of the Santee-Lynches GWMP are:

1. Ensure sustainable use of the groundwater resource by management of groundwater withdrawals
2. Monitor groundwater conditions to evaluate availability
3. Promote educational awareness of the resource and its conservation

The first goal described in the Waccamaw, Pee Dee, and Santee-Lynches GWMPs is achieved through SCDES's groundwater permitting cycles. Groundwater permits have a duration of five years, with a review and renewal in the fifth year. In the fourth year of the cycle, the CUA is evaluated to inform the upcoming renewal cycle. CUA evaluations analyze groundwater sources and use, aquifer conditions, and growth projections to issue recommendations for permitting. These recommendations are followed by SCDES staff when issuing new permits and renewals in the CUA.

Waccamaw CUA

The Waccamaw CUA, the first CUA to be designated, was established on June 22, 1979. It is comprised of Georgetown County and Horry County, both of which are entirely within the Pee Dee River basin. The Waccamaw CUA was established in response to several observed problems with groundwater supply, including declines in monitoring well water levels, saltwater intrusion, and dry wells. Water levels have declined since 1900 in all aquifers below the Waccamaw CUA, but of particular concern is the enduring cone of depression in the Crouch Branch aquifer and Middendorf Aquifer System below Andrews and Georgetown in southern Georgetown County. Groundwater monitoring wells near this cone document a decline of approximately 2 feet per year in the Crouch Branch aquifer (Kemmer and Wyant 2023). An additional concern is saltwater intrusion into freshwater zones of the aquifers as a result of the cone of depression lowering the pressure surface of the aquifer and concentrated, high-capacity water supply pumping. Water supply is the major water use (81 percent) in the Waccamaw CUA, followed by golf course irrigation (9 percent).

Pee Dee CUA

The Pee Dee CUA was designated on February 12, 2004. It includes most of the inland coastal plain counties in the Pee Dee River basin, including Marlboro, Dillon, Marion, Florence, Darlington, and Williamsburg Counties. Groundwater conditions vary based on location and aquifer; groundwater levels in the western area of the CUA have remained relatively stable, while groundwater levels in the eastern region have seen considerable decline. In particular, the Crouch Branch aquifer has declined across Dillon, Florence, Marion, and Williamsburg Counties, and the McQueen Branch aquifer has declined in Dillon, Florence, and Williamsburg Counties. A cone of depression developed in Florence County due to significant groundwater pumping. As of 2022, it had recovered by 70 feet from its lowest level at 92 feet below sea level, in large part due to conjunctive surface water use. Groundwater in the Pee Dee CUA is primarily used for water supply (65 percent) and agricultural irrigation (18 percent).

Santee-Lynches CUA

The Santee-Lynches CUA is the most recent CUA to be established; it was designated on July 15, 2021. The Santee-Lynches CUA overlaps with the Pee Dee River basin in the northeast parts of Clarendon and Sumter Counties, most of Lee County, and parts of Chesterfield and Kershaw Counties. This CUA was established in response to observations of declining groundwater levels. Beneath Sumter and Clarendon Counties, groundwater levels have fallen by at least 60 feet in the Crouch Branch aquifer and by 80 feet in the McQueen Branch aquifer. Groundwater in the Santee-Lynches CUA is used for water supply (49 percent) and agricultural irrigation (41 percent).

For more information on the Capacity Use Areas, see:

- https://www.des.sc.gov/index.php/programs/bureau-water/groundwater-management-planning/groundwater-withdrawal-permitting-capacity-use-areas

3.4 Groundwater Assessment Tools

The primary tools used for the Pee Dee River Basin Plan to evaluate current and future groundwater supply conditions are the groundwater monitoring data and information, potentiometric maps, and current/projected groundwater use data described in Section 3.3 above.

Groundwater models are useful tools for simulating current and future groundwater level and supply trends as well as potential effects of groundwater management strategies. A regional groundwater model has been developed, and a localized version of the regional groundwater model focused on aquifers in the Pee Dee River basin is currently being developed (see Section 3.4.1 below for more information). Once completed the localized groundwater model can be used by the Pee Dee RBC to further evaluate groundwater supply issues and management strategies to mitigate supply risk.

3.4.1 Coastal Plain Groundwater Model

To support water planning in the river basins extending into the Coastal Plain of South Carolina, the USGS with assistance from SCDES is updating and re-calibrating the three-dimensional numerical groundwater flow model of the Atlantic Coastal Plain (ACP) aquifers and confining units. The original model, documented in the 2010 USGS report Groundwater Availability in the Atlantic Coastal Plain of North and South Carolina (USGS 2010), is a MODFLOW-2000 model that simulates groundwater flow in three dimensions by using a block-centered, finite-difference method. The model covers approximately 70,500 square miles including the entire South Carolina Coastal Plain and extends into North Carolina and Georgia (see Figure 3-14). Numerous updates and improvements are being made to support water availability assessments and river basin planning in South Carolina. The major model updates include:

- Activating the entire surficial aquifer model layer
- Incorporating recharge from the Soil-Water Balance Model
- Updating the hydrogeologic framework and adding groundwater-related data collected from 2005 to 2020
- Refining the model grid from approximately 2 by 2 miles spacing to 2,000 by 2,000 foot spacing
- Incorporating a more detailed representation of the Fall Line area
- Incorporating new MODFLOW packages, including the Newton Formulation and Multi-Node Well Package
- Extending the stress periods that were originally from 1900 to 2004, to 2070

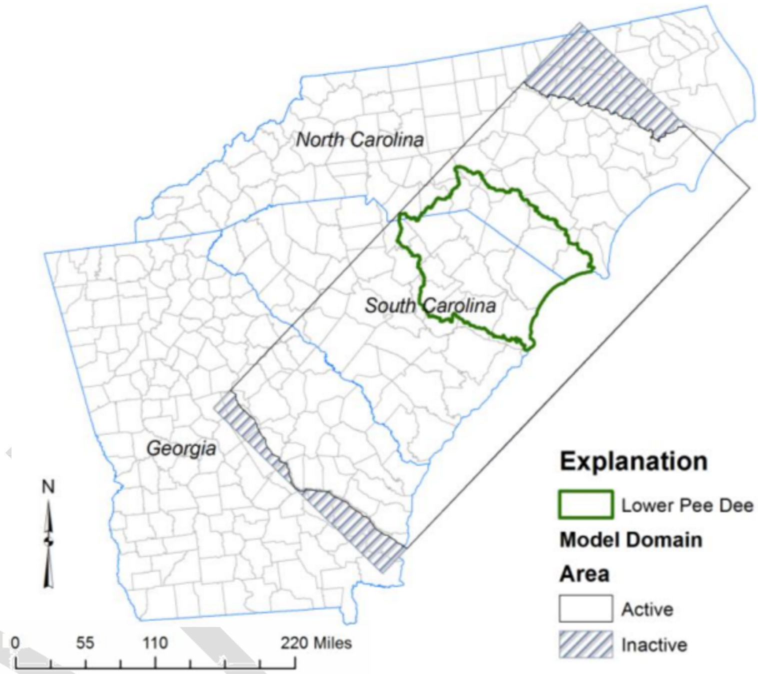


Figure 3-14. Coastal Plain groundwater model boundary and grid outline (SAWSC 2023).

For the Pee Dee River basin, the USGS with assistance from SCDES is transferring the model from MODFLOW-NWT to MODFLOW 6. The model transfer and updates include:

- Local grid refinement (smaller cell size)
- All groundwater use, water-level, stream baseflow, and recharge updated through 2022
- Shorter time steps
- Calibration using parameter estimation (PEST++ Version 5)
- Calibration period from 2002 to 2022 to take advantage of highest quality groundwater withdrawal and water-level data

Chapter 4
Current and Projected Water Demand

This chapter summarizes current and projected water demands over the 50-year planning horizon from 2020 to 2070 in the Pee Dee River basin. Demand projections are based on historical demands and published projection datasets for variables that influence water demand including population, economic development, and irrigated acreage. A statistical model was built to develop demand projections for each permitted and registered water withdrawer using reported withdrawals and, when available, driver variables. Two demand projection scenarios were developed: a Moderate Demand Scenario using median rates of water use and moderate growth, and a High Demand Scenario using high rates of water use and high growth. The demand projections were used to assess future water availability in the surface water model and in the groundwater evaluation as summarized in Chapters 5 and 6. The demands presented in this chapter include all demands, surface and groundwater.

4.1 Current Water Demand

Current water demands reflect the most recent withdrawal data, as reported to SCDES, that were available at the time of the analysis.

The withdrawals used for the demand estimates were reported to SCDES by permitted and registered water users in the Pee Dee River basin as required by state regulation. All users withdrawing more than 3 million gallons of surface water or groundwater in any month must either obtain a permit or register their use and report withdrawals to SCDES annually. Users withdrawing less than this threshold are not required to report their withdrawals; however, they may choose to report voluntarily. For surface water withdrawals over the threshold, agricultural water users must register their use while all other users must permit their use in accordance with SCDES's Regulation 61-119, Surface Water Withdrawal, Permitting, Use and Reporting. For groundwater withdrawals over the threshold, users withdrawing within a CUA must permit their use, while those withdrawing outside of a CUA must only register their use. Most groundwater users in the Pee Dee River basin are within CUAs and must therefore permit their use.

Surface Water Demands

Surface water demands were developed for the entire Pee Dee River basin. Some of the surface water demand occurs in river segments that were included in the SWAM model, while some occur in coastal communities along rivers that are tidally influenced and are beyond the SWAM model's downstream extent. The SWAM model, further described in Chapter 5, models surface water allocation across water use categories based on water availability in non-tidally influenced stream reaches. As a result, SWAM does not consider surface water intakes for coastal communities are in tidally influenced stream reaches. Current surface water demands (presented in Table 4-1) were summarized based on whether they were included in the SWAM model or whether they are for coastal communities with tidally influenced surface water intakes.

Groundwater Demands

Groundwater demands were generated for the groundwater model that is currently being updated by the USGS. Groundwater demands were developed for the entire Pee Dee River basin across the various water use sectors. Total current basinwide groundwater demands by sector are presented in Table 4-1. A portion of the total groundwater demand is incorporated in the SWAM model for communities or industries that use significant groundwater and discharge the return flow into surface streams. These groundwater demands include municipal and industrial water users such as Bishopville, Hartsville, Lynchburg, Manning, McColl, Sumter, McCall Farms, Martek, and Pilgrim's Pride.

Current Water Demands

The total current water demands in the Pee Dee River basin are approximately 1,028.8 MGD on average. Of this withdrawal, 111.9 MGD is from groundwater and 916.9 MGD is from surface water. About 217 MGD (21 percent) of the water is consumptively used, and 811.8 MGD (79 percent) is returned to the river after its use.

The nuclear power sector accounts for 72.5 percent of of the overall water demand. The water supply and industry sectors account for 13.9 percent and 9.4 percent of the total, respectively. The agriculture sector accounts for 3.6 percent of withdrawals, and the golf course and mining sectors account for 0.6 percent and less than 0.1 percent, respectively. The distribution by sector is summarized in Table 4-1 and shown in Figure 4-1. The distribution by sector, excluding nuclear, is shown in Figure 4-2. Appendix A includes a table of all water users along with the user's source (surface water or groundwater), including coastal water users, withdrawals, and discharges. For surface water modeling purposes, consumptive use percentages (i.e., the amount of water withdrawn that is not returned to surface water or groundwater) for each water user were calculated by comparing withdrawal and discharge amounts as reported to SCDES. In many instances, NPDES permit discharge locations associated with a unique water use were lumped together due to close proximity to one another. It is assumed that all golf course and agricultural irrigation is compsumptively used (no return flows).

Table 4-1. Current water demand in the Pee Dee River basin.

Water Use Category	Surface Water (MGD)			Groundwater (MGD)	Total (MGD)
	SWAM[1]	Coastal[2]	Total		
Agriculture	2.1	0.5	2.6	34.3	36.9
Golf	0.2	3.9	4.2	1.5	5.7
Industry	79.5	7.7	87.2	9.4	96.6
Mining	0.2	--	0.2	0.0	0.2
Nuclear	745.3	--	745.3	1.0	746.3
Water Supply	18.8	58.7	77.5	65.7	143.2
Total Demand	**846.2**	**70.8**	**916.9**	**111.9**	**1,028.8**

[1]Surface water demands considered in the SWAM model.

[2]Surface water demands for coastal communities downstream of SWAM model extent.

Note: Current water demands were based on the most up to date and available data at the time of analysis; 2022 for surface water demands and 2023 for groundwater demands.

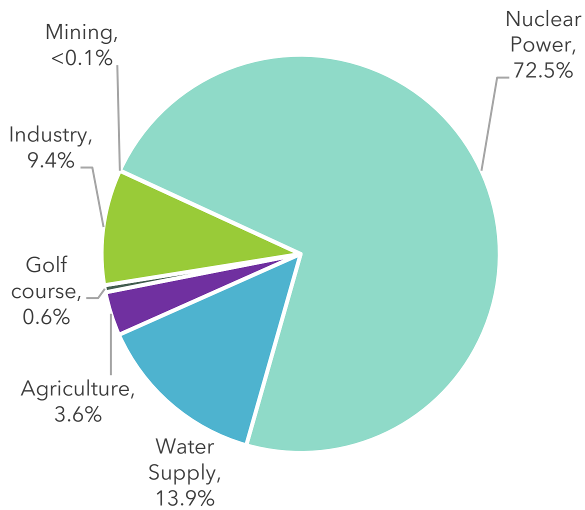


Figure 4-1. Current water use category percentages of total demand.

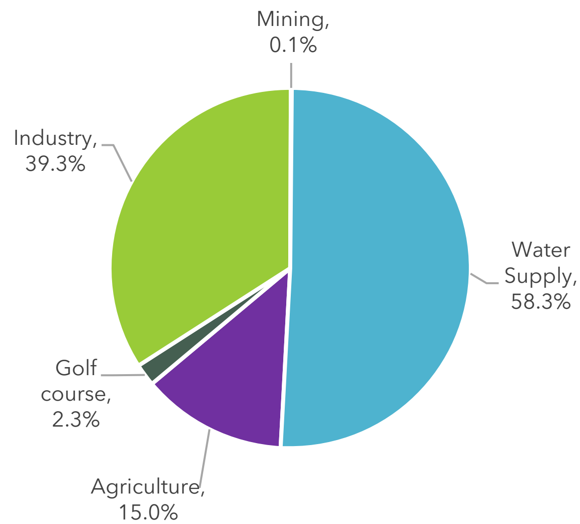


Figure 4-2. Current water use category percentages of total demand without nuclear power.

4.2 Permitted and Registered Water Use

In the Pee Dee River basin,1,452.5 MGD of surface water is permitted or registered as of March 2024. Of this total, 863.7 MGD is permitted or registered for nuclear power and 588.8 MGD has been permitted for other uses. Figure 4-3 shows the location of all permitted and registered surface water intakes and groundwater wells in the basin.

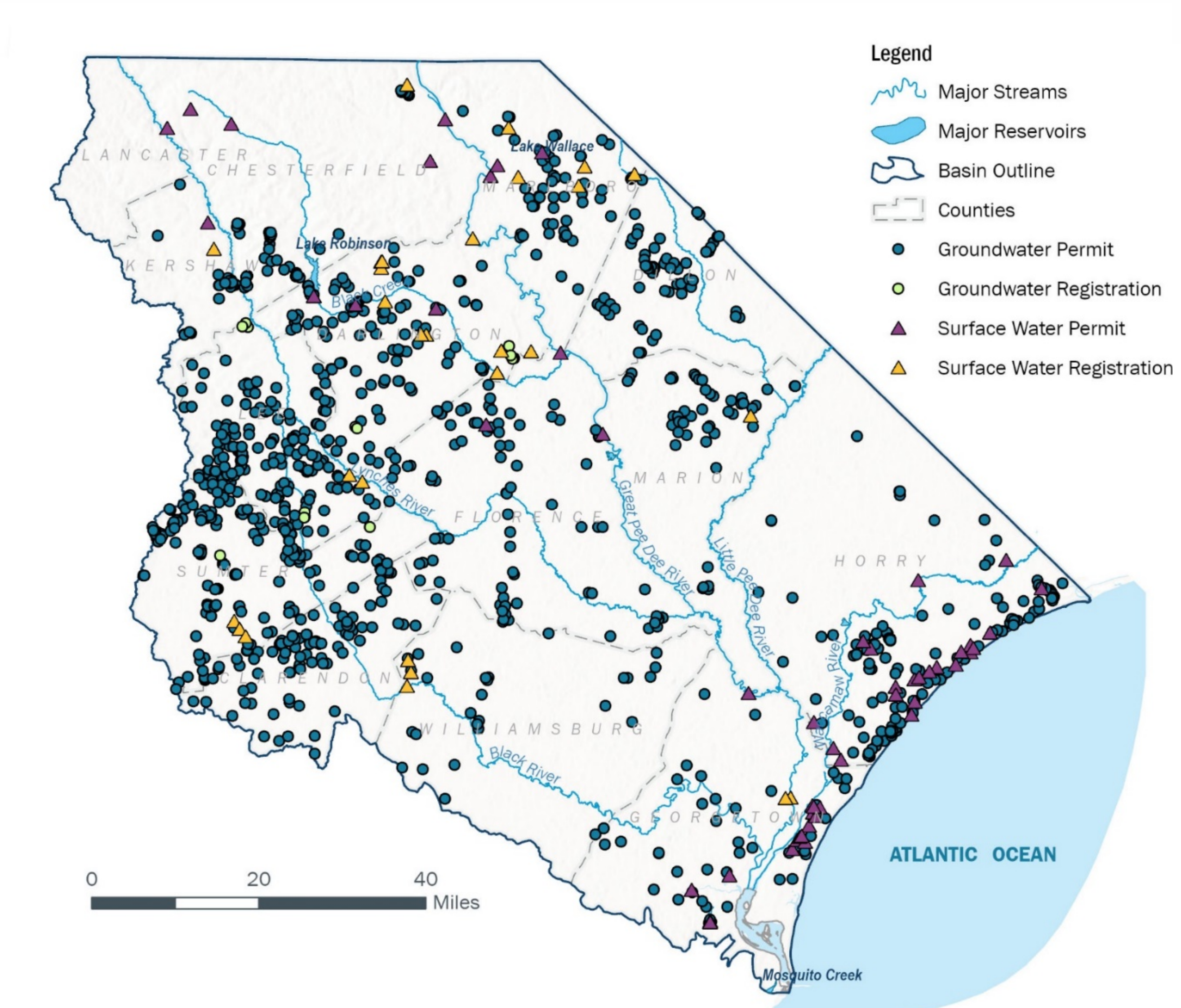


Figure 4-3. Locations of permitted and registered surface water intakes and groundwater wells in the Pee Dee River basin.

Since nearly all users are within CUAs, almost all groundwater use has been permitted. There are 10 agricultural, one golf course, and two water supply groundwater withdrawal registrations within the Pee Dee River basin. Permitted and registered groundwater withdrawals in the basin total 190.5 MGD.

Currently, only 63 percent (916.9 MGD) of the total permitted and registered surface water amount is withdrawn, and 59 percent (111.9 MGD) of the total permitted and registered groundwater amount is withdrawn. These low percentage use rates are in part due to the fact that agricultural surface water registrations and existing (prior to the enactment of Surface Water Regulation 61-119 in 2011) nonagricultural surface water permits do not require the user to demonstrate that the withdrawal is “reasonable” for the use. Such registrations and permits were granted prior to the river basin planning efforts, which represent an attempt to better understand and balance the actual availability of resources with the needs of current users and for future growth. Comparatively, new surface water permits and all groundwater permits must demonstrate reasonable use for the permitted withdrawal amount. Additionally, agricultural surface water registrations have no review period and are granted in perpetuity.

Comparatively, surface water permits are reviewed every 20 to 50 years and groundwater permits are reviewed every 5 years. The lack of reasonable use criteria and authority to revisit registered surface water withdrawals has resulted in permitted and registered withdrawal amounts that greatly exceed current use rates. Scenarios for both the current use patterns and the fully allocated river basin are explored with the modeling exercises discussed in Chapter 5, as are scenarios that represent moderate to substantial demand growth within this range. Details of the permitting and registration process for withdrawals in South Carolina can be found in Table 9-1 in Chapter 9.

Table 4-2 summarizes permitted and registered surface water withdrawals by water use category, and the percent of total permitted and registered water currently in use is shown in Table 4-3. Appendix A includes a table of all permitted or registered withdrawals for each user.

Table 4-2. Permitted and registered surface water totals by category in the Pee Dee River basin.

Water Use Category	Surface Water (MGD)			Groundwater (MGD)			Total (MGD)		
	Permit	Regis-tration	Total	Permit	Regis-tration	Total	Permit	Regis-tration	Total
Agriculture	184.5	16.8	201.3	82.5	0.4	83.0	267.1	17.2	284.3
Golf	52.6	0.0	52.6	3.2	0.0	3.2	55.7	0.0	55.7
Industry	126.9	0.0	126.9	18.0	0.0	18.0	144.9	0.0	144.9
Mining	15.3	0.0	15.3	0.0	0.0	0.0	15.3	0.0	15.3
Nuclear	863.7	0.0	863.7	1.8	0.0	1.8	865.5	0.0	865.5
Water Supply	192.8	0.0	192.8	84.5	0.0	84.5	277.4	0.0	277.4
Total	**1,435.7**	**16.8**	**1,452.5**	**190.0**	**0.4**	**190.5**	**1,625.8**	**17.2**	**1,643.0**

[1]The agriculture water use category includes one permitted groundwater user for aquaculture.

Table 4-3. Percent of total permitted and registered water currently in use.

Water Use Category	Surface Water	Groundwater	Total
Agriculture	1%	12%	13%
Golf	8%	3%	10%
Industry	69%	6%	67%
Mining	1%	0%	1%
Nuclear	86%	0%	86%
Water Supply	40%	24%	52%
Total	**63%**	**59%**	**63%**

4.3 Projection Methodology

The methodology to calculate demand projections followed the guidance in *Projection Methods for Off-Stream Water Demand in South Carolina* (SCDNR 2019). SCDNR developed this document over several years in collaboration with the South Carolina Water Resources Center at Clemson University and the U.S. Army Corps of Engineers, with additional input from stakeholders including:

- South Carolina Water Works Association Water Utility Council
- South Carolina Farm Bureau Water Committee
- South Carolina Chamber of Commerce Environmental Committee
- South Carolina Water Quality Association
- PPAC

Following the guidance in the statewide projections report, SCDES developed demands for the Pee Dee River basin with only minor deviations from the framework. In the Pee Dee River basin, demand projections were developed for the agricultural, golf, industry, mining, nuclear, and water supply sectors. Golf courses and mining have minimal withdrawals and are assumed to remain at current levels over the planning horizon.

For the water use categories with projected increases in demands, the projection methodology varies by water use category. Each water use category has an associated driver variable that influences demand growth, as shown in Table 4-4. Projections for these driver variables come from a variety of published sources. Published values were extrapolated to 2070 to match the planning horizon of the River Basin Plan.

Table 4-4. Driver variables for each water use category.

Water Use Category	Driver Variable	Driver Variable Data Source	Moderate Scenario	High Demand Scenario
Agriculture	Irrigated acreage	Irrigated areas polygons	0.65% increase per year	0.73% increase per year
Industry	Economic production	Subsector growth rates from the U.S. Energy Information Agency (EIA)	Industry/manufacturing subsector growth with the minimum adjusted to 0% through 2035 and 0.3% beyond 2035	Industry/manufacturing subsector growth with the minimum adjusted to 2.1%[1]
Nuclear	Not applicable	Not applicable	Assumed constant	Assumed constant
Water Supply	Population	South Carolina Office of Revenue and Fiscal Affairs	Extend straight-line growth or assume constant population if the population projection is negative	Project using statewide or countywide growth rate, increased by 10%
Golf Course	Not Applicable	Not applicable	Assumed constant	Assumed constant
Mining	Not applicable	Not applicable	Assumed constant	Assumed constant

[1]2.1% is the total overall EIA economic growth projection increased by 10% (1.9% + 10% x 1.9% = 2.1%)

Two demand projections were developed: (1) the Moderate Water Demand Scenario (Moderate Demand Scenario) and (2) the High Water Demand Scenario (High Demand Scenario). The Moderate Demand Scenario was originally referred to as the Business-as-Usual Scenario in the Planning Framework. The Moderate Demand Scenario is based on median rates of water use and moderate growth projections, while the High Demand Scenario is based on the maximum monthly rates of water use in recent reporting and high growth projections. While it is unlikely that the conditions of the High Demand Scenario would occur for an extended time or universally across the basin, the scenario is useful for establishing an upper bound for the projected demand. The following subsections present additional details on the calculation of demand for each water use category.

High Growth Groundwater Demands

Although the High Demand Scenario for groundwater demands is presented in this chapter, it may be unrealistic to maintain the High Demand Scenario every single year for decades on end. Thus, a "High Growth" Scenario was developed using the Moderate calibration (median monthly demands) and the High Demand growth projections (for population, economic sectors, and irrigated area). The High Growth Scenario may be used or mixed with High Demand on alternating years for groundwater model simulations.

4.3.1 Agriculture Demand Projection Methodology

Agricultural surface water and groundwater demands were developed for the Pee Dee River basin. Multiple datasets indicate agricultural demands will increase over time, including National Agricultural Statistics Service data and State pumping records.

To assess where future additional irrigation may occur, a multi-step approach was used (Pellett 2024).

- First, irrigated fields/areas (i.e. polygons in GIS) were developed for the Pee Dee River basin. The irrigated areas are based on registered irrigation water withdrawal intake locations, and irrigated areas were visually identified at these locations using Google Earth and NAIP aerial imagery.
- Then, the irrigated areas were assessed for suitability to expand. It is assumed these lands would be irrigated via center pivot. Areas for potential expansion were constrained by several spatial characteristics that would limit future irrigation, such as:
  - Wetlands present
  - Slopes greater than 5 percent
  - Parcels less than 30 acres
  - Protected areas present
  - Developed areas present
  - Morphological opening/closing (not condusive to center pivot installation)
- The polygons were then ranked based on their proximity to existing irrigated areas and their overlap on existing cultivated agriculture. The highest-ranking polygons were selected for "projected growth". Other polygons that met some of the criteria, but were not highly ranked due to their lack of proximity to existing irrigated land and agriculture were labeled as "other opportunity".

Figure 4-4 shows the irrigated areas, projected growth, and other opportunities. The High Demand Scenario was used as an upper limit for the expansion of irrigated areas, and the Moderate expansion of irrigated areas was set lower than this. Although irrigated areas are projected to increase at a consistent rate per year for the Moderate and High Demand Scenarios, this does not necessarily correlate to an equivalent increase in water demand due to variation in irrigation practices and cropping patterns.

> Areas of projected growth for irrigation are estimates only and reflect assumptions made for the purposes of the River Basin Plan regarding conditions that might foster growth. Projected growth areas and other opportunities areas do not indicate recommended locations for future growth nor do they indicate locations where irrigation may or may not be viable.

Note that members of the Pee Dee RBC had suggestions for future improvements to projecting additional lands that may be irrigated in the future, including conducting outreach with irrigators and irrigation equipment manufacturers (specifically, center pivot manufacturers).

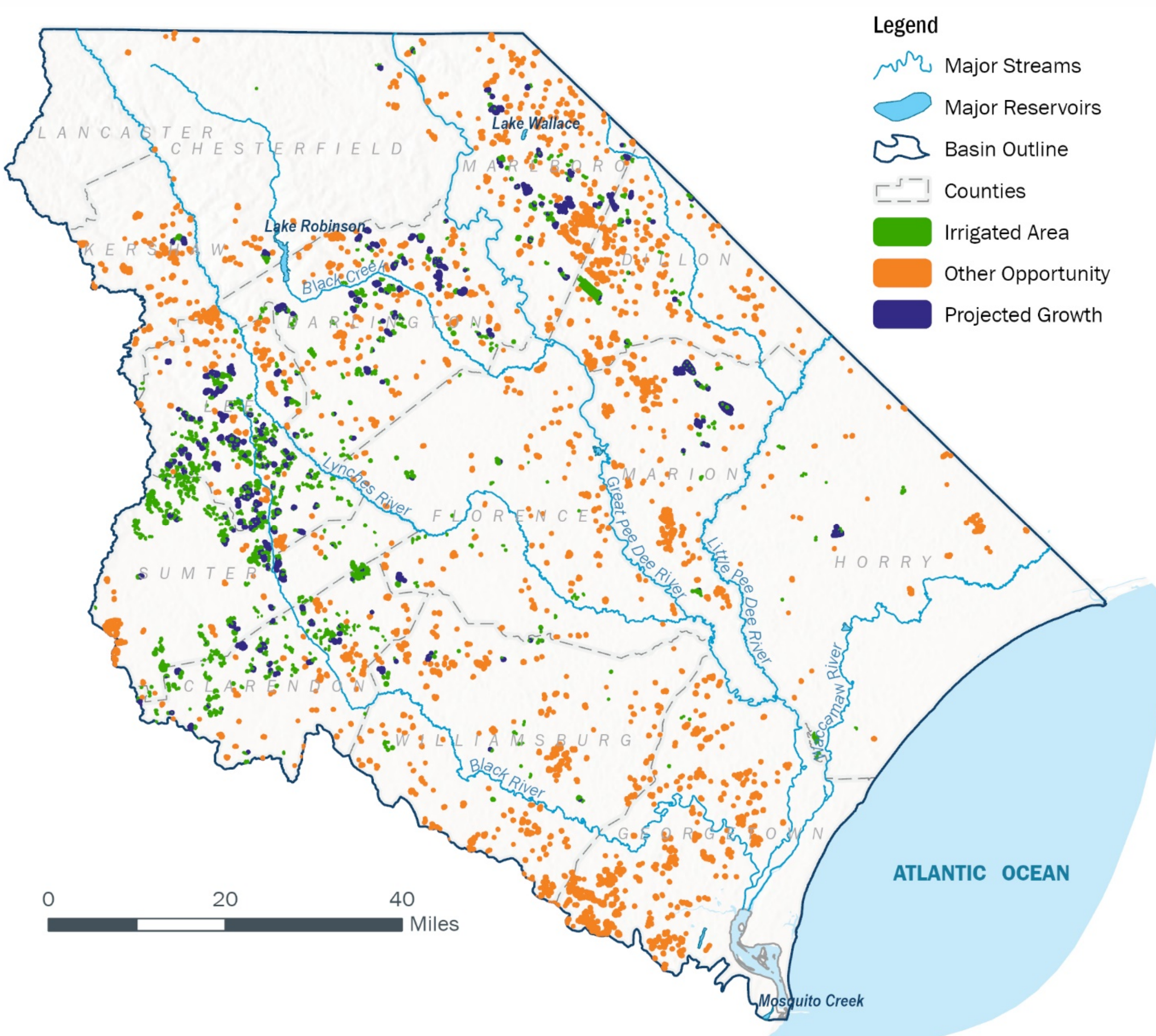


Figure 4-4. Irrigated areas, projected growth, and other opportunities in the Pee Dee River basin.

4.3.2 Public Supply Demand Projections Methodology

Public supply is the second largest water use sector in the Pee Dee River basin. Approximately 19 percent of public supply withdrawals are met with surface water. Demand projections for public supply were developed based on county-level population and water use projections. Population projections for the Moderate Scenario were taken from the South Carolina Office of Revenue and Fiscal Affairs (SC ORFA). These projections, which end in 2035, were extended to 2070. For the Moderate Demand Scenario, projections are extended linearly. If SC ORFA projections indicate a decline in population, then the extension to 2070 was flatlined at 2035 levels. For the High Demand Scenario, populations were projected to grow exponentially. If SC ORFA projected growth, then the exponential growth rate was increased by 10 percent. If the SC ORFA projection for a county was less than the statewide average, then the high scenario population projection was set at the state average plus 10 percent. As shown in Figure

4-5, some counties are projected to experience population declines while others may experience substantial growth in both the Moderate and High Demand Scenarios.

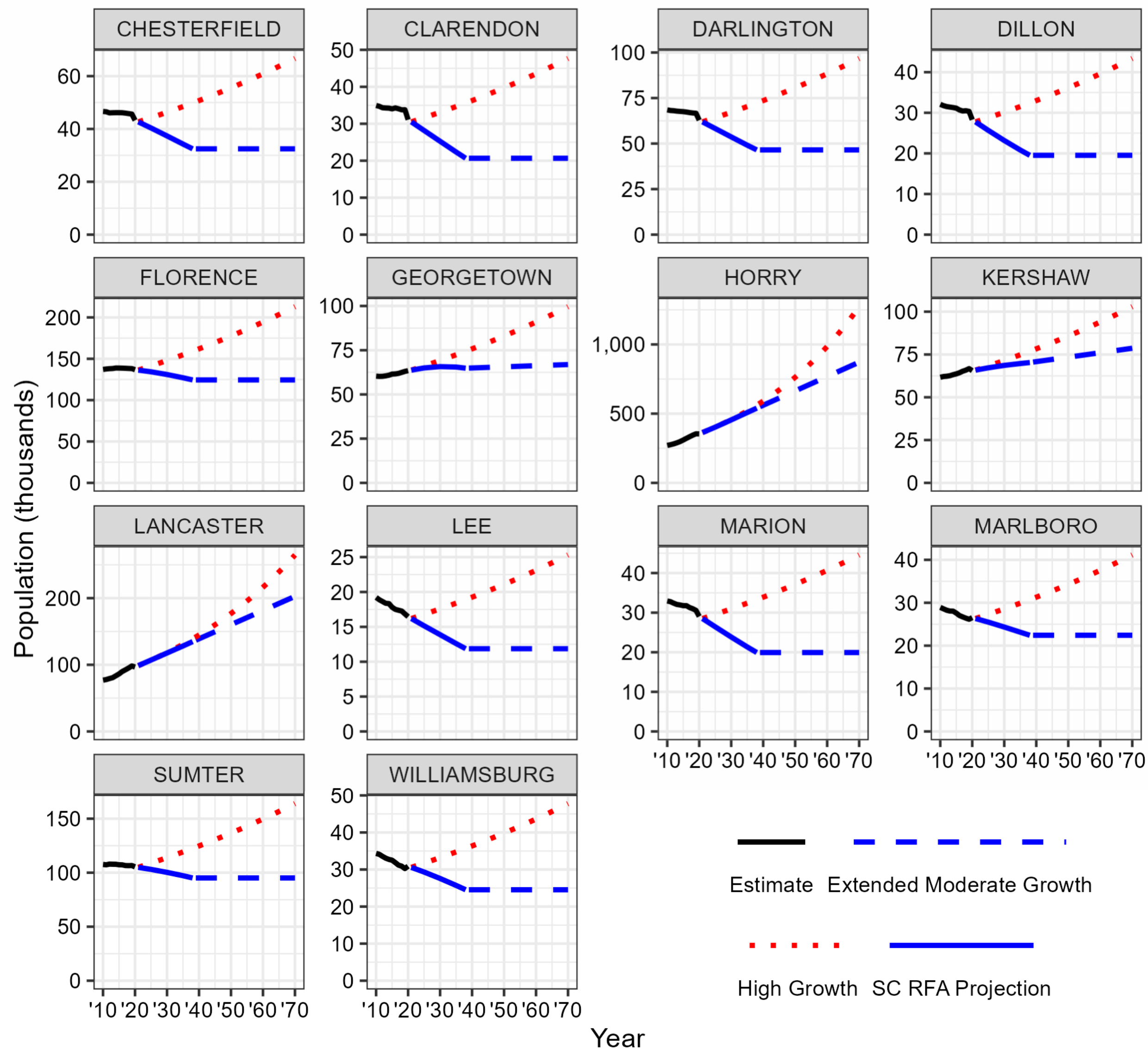


Figure 4-5. Population projections to 2070 for counties withdrawing from the Pee Dee River basin.

4.3.3 Industry Demand Projections Methodology

Industrial water supplies are used in the Pee Dee River basin to produce paper, packaging, and other paper-related products; manufacture and recycle steel; produce lumber, food products, and bottled water; and manufacture chemicals, among other uses. Surface water is used by industrial water users such as International Paper and Domtar. Groundwater supplies have been developed to serve industrial water users like Pilgrims Pride (food products), McCall Farms (for canning and freezing operations), and Nan Ya Plastics Corporation. Some industries use both groundwater and surface water supplies, like Sonoco, NUCOR, and West Rock Co.

Industrial demand projections were based on projected subsector growth rates from the U.S. Energy Information Agency (EIA), which ranged from -0.4 to 2.5 percent for the sectors present in the Pee Dee River basin (EIA 2020). For the Moderate Demand Scenario, negative projected growth rates were set to zero percent through 2035, and growth rates were set to a minimum of 0.3 percent beyond 2035; resulting in an overall growth rate less than 0.3 percent for those cases. For the High Demand Scenario, annual growth rates were set to a minimum of 2.1 percent, and annual growth rates higher than 2.1 percent were multiplied by 1.1 to increase them by 10 percent. The adjusted annual growth rates were applied for the entire projection period.

4.3.4 Other Projections Methodology

Other water withdrawals in the Pee Dee River basin support golf course irrigation and mining. Historically, golf has been in decline in the basin, and mining has been stable. Water use for these categories is low and assumed relatively constant into the future. Mining is projected to be 1.3 MGD and 2.0 MGD for the Moderate Demand and High Demand Scenarios, respectively. Golf course is projected to increase in coastal areas, with approximately 5.2 MGD for the Moderate Demand Scenario and 13.8 to 14.3 MGD for the High Demand Scenario.

Nuclear power is also projected to remain relatively constant into the future. The H.B. Robinson Nuclear Plant renewed their 40-year permit with no anticipated changes in use.

4.4 Projected Water Demand

From 2025 to 2070, total withdrawals are projected to increase by 12 percent (117.6 MGD) under the Moderate Demand Scenario and 34 percent (417.2 MGD) under the High Demand Scenario. In the Moderate Demand Scenario, groundwater and surface water demands are projected to increase 26.5 MGD and 91.1 MGD respectively. In the High Demand Scenario, groundwater demands are projected to increase 117.9 MGD, and surface water demands are projected to increase 299.3 MGD.

Table 4-5 and Figure 4-6 summarize projected surface water and groundwater demands over the planning horizon. Figure 4-6 represents a stacked area graph where total demand is shown as a thick black line and shaded areas show which portion of that demand comes from groundwater or surface water. Although the majority of the demands under both scenarios are attributable to surface water demands, it is projected that groundwater demands will increase at a higher rate than surface water demands.

In the Pee Dee basin scenarios, as in other basins, there are some differences between the Moderate Growth Projection Scenario and the Current Use Scenario. The Current Use Scenario is based on long-term average (mean) withdrawals. This is a reasonable way to represent the status quo, but mean averages can be biased by outliers and may not reflect recent efficiency improvements.

The Moderate Demand Scenario is based on recent median withdrawals. Median averages, the middle value of a set, are less affected by outlier values compared with mean averages. The High Demand scenario is based on the maximum monthly withdrawal, and it represents an extreme case when applied across all users in the basin.

Projected demands by water use category are summarized in Figure 4-7 and further described in the subsections that follow. Figure 4-8 shows projected demands, excluding nuclear power.

Table 4-5. Projected surface water and groundwater demands.

	Moderate Demand Scenario (MGD)			High Demand Scenario (MGD)		
Year	**Surface Water**	**Groundwater**	**Total**	**Surface Water**	**Groundwater**	**Total**
2025	892.8	102.1	994.9	1,032.8	177.6	1,210.4
2030	902.0	103.2	1,005.2	1,053.4	187.2	1,240.6
2035	910.8	104.4	1,015.2	1,076.4	197.6	1,274.0
2040[1]	917.9	106.3	1,024.2	1,099.6	208.8	1,308.4
2050	940.7	113.2	1,053.9	1,162.5	233.2	1,395.7
2060[1]	959.9	120.9	1,080.8	1,235.5	262.3	1,497.8
2070	983.9	128.6	1,112.5	1,332.1	295.5	1,627.6
% Change 2025-2070	**10%**	**26%**	**12%**	**29%**	**66%**	**34%**

[1]2040 and 2060 are leap years. When projections are constant into the future; the projected results may show some variation accounting for number of days in the year.

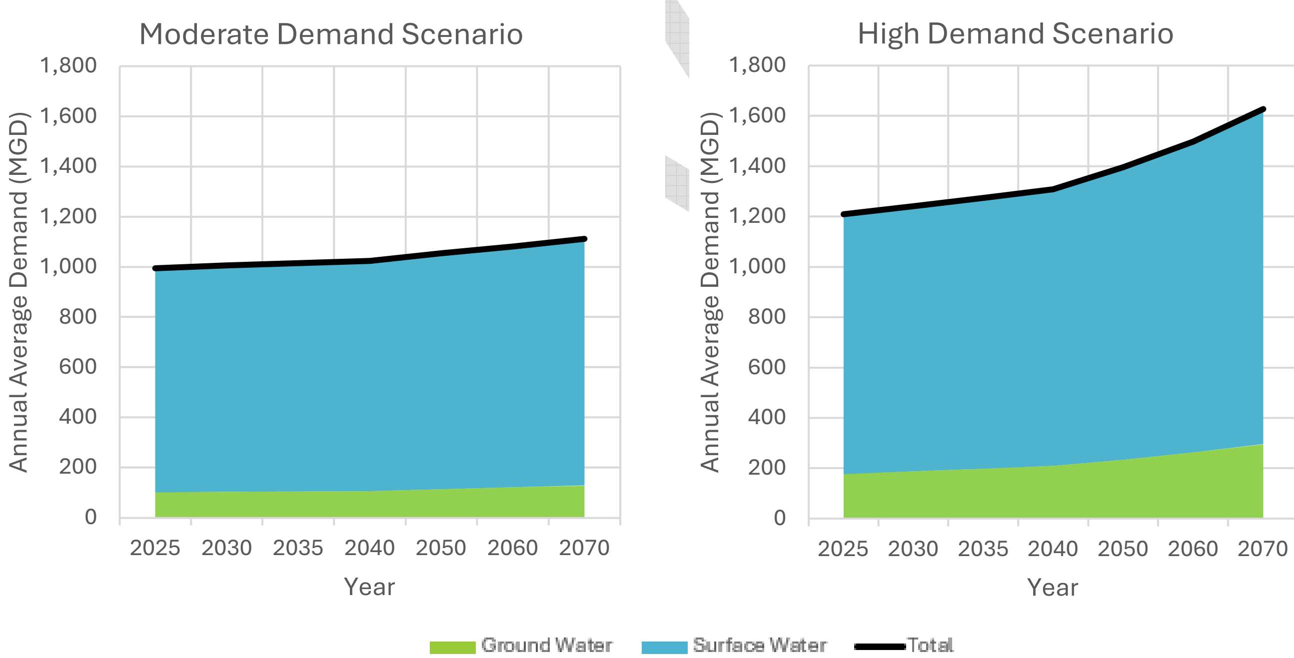


Figure 4-6. Demand projections by water source.

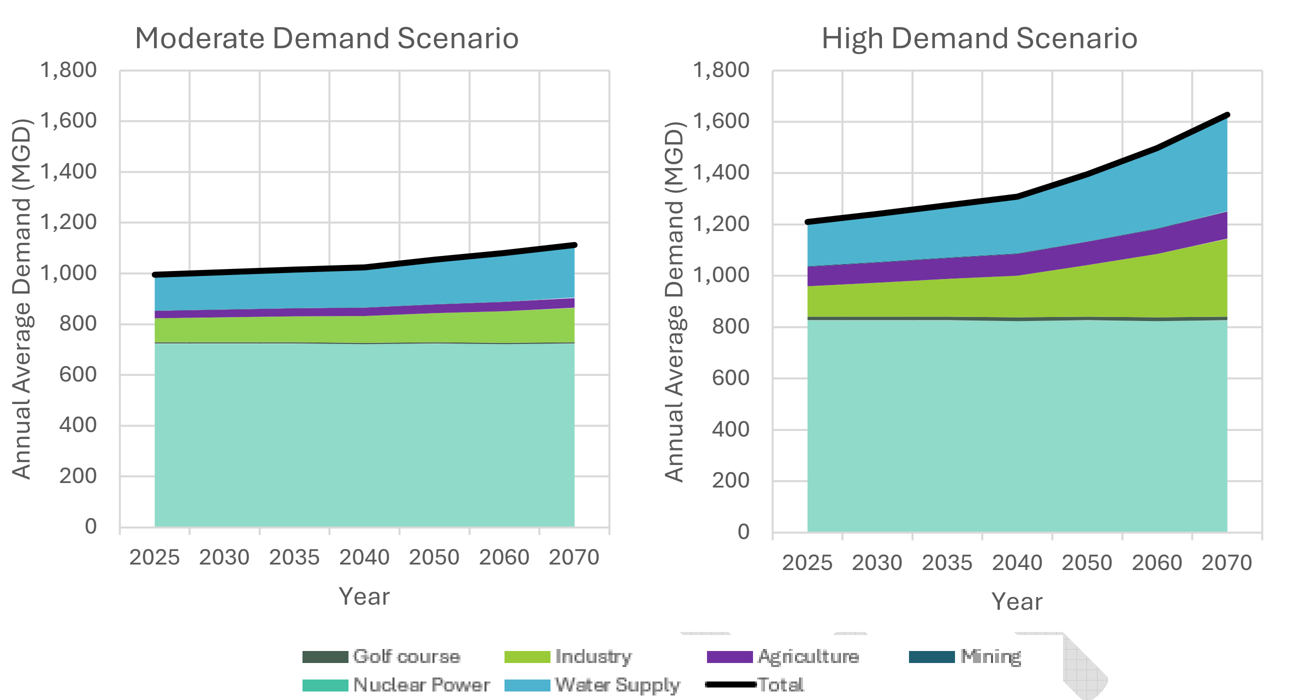


Figure 4-7. Demand projections by water use category.

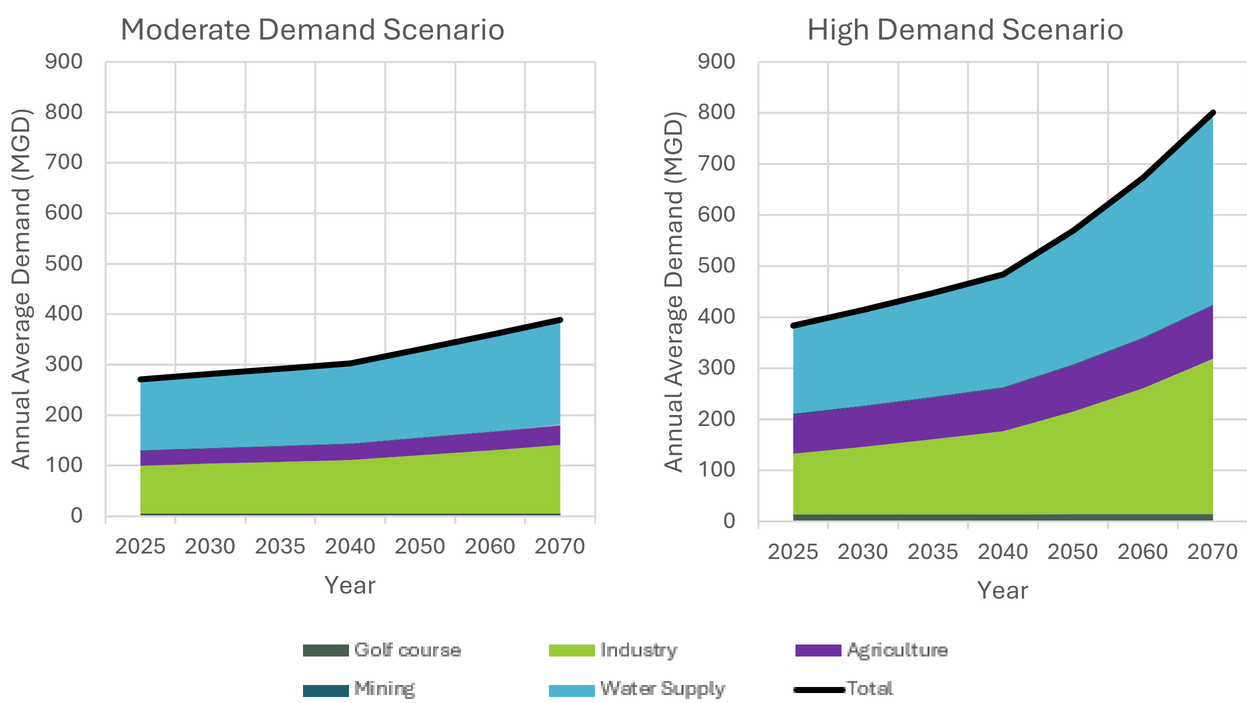


Figure 4-8. Demand projections by water use category without nuclear power.

4.4.1 Agriculture Demand Projections

Agricultural water demands are projected to increase by 34 percent between 2025 and 2070 (29.2 MGD to 39.1 MGD) in the Moderate Demand Scenario. In the High Demand Scenario, the agricultural water demands are projected to increase by 38 percent between 2025 and 2070 (76.0 MGD to 104.9 MGD). Groundwater demands account for most of the total projected agricultural demands. Agricultural demand projections by water source are shown in Figure 4-9 and Table 4-6.

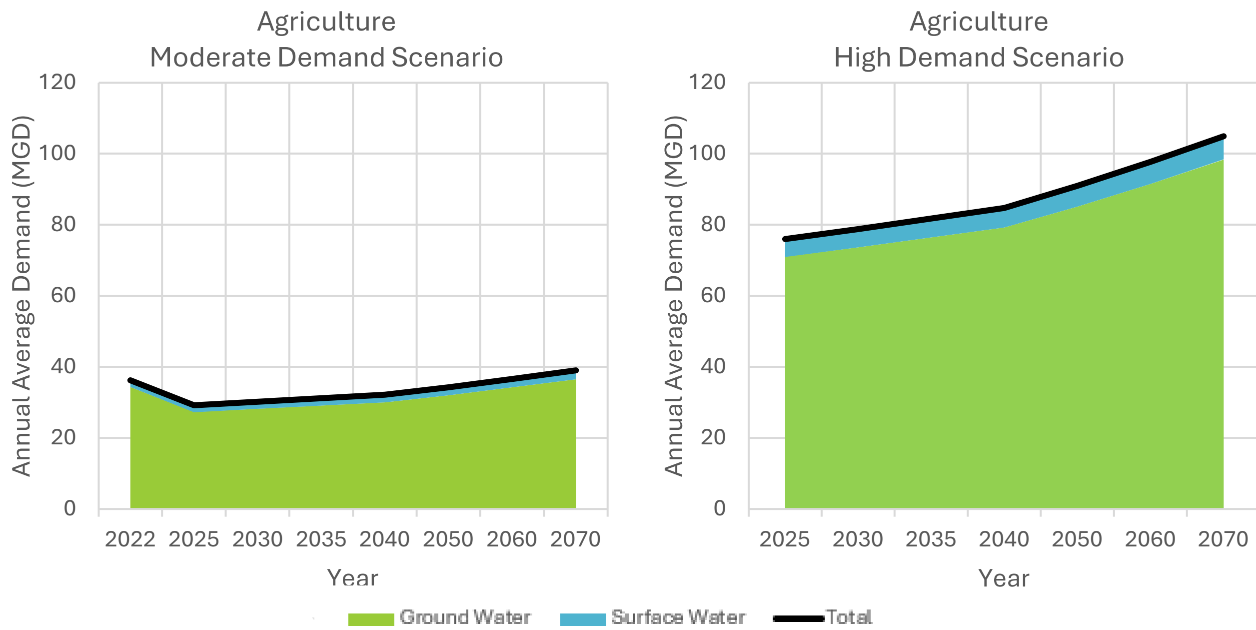


Figure 4-9. Projected agricultural water demands.

Table 4-6. Projected agricultural water demands.

	Moderate Demand Scenario (MGD)			High Demand Scenario (MGD)		
Year	**Surface Water**	**Groundwater**	**Total**	**Surface Water**	**Groundwater**	**Total**
2025	1.9	27.3	29.2	5.0	71.0	76.0
2030	2.0	28.2	30.2	5.2	73.6	78.8
2035	2.1	29.1	31.2	5.3	76.4	81.7
2040	2.1	30.0	32.1	5.5	79.2	84.7
2050	2.3	32.0	34.3	5.8	85.1	90.9
2060	2.4	34.2	36.6	6.1	91.5	97.6
2070	2.6	36.5	39.1	6.5	98.4	104.9
% Change 2025-2070	**31%**	**34%**	**34%**	**30%**	**39%**	**38%**

4.4.2 Public Supply Demand Projections

Public water supply demand is the second highest demand by sector in the Pee Dee River basin. Projected populations by county over time are presented in Table 4-7. In the Moderate Demand Scenario, public water supply demands are projected to increase by 47 percent from 2025 to 2070 (140.7 MGD to 207.6 MGD). In the High Demand Scenario, public water supply demands are projected to increase by 118 percent from 2025 to 2070 (172.6 MGD to 375.8 MGD). Approximately 33 percent and 38 percent of the total public water supply demand is projected to be supplied by groundwater in the Moderate and High Demand Scenarios, respectively, in 2070. Public water supply demand projections by water source are shown in Figure 4-10 and Table 4-8.

Table 4-7. Projected population increases (in thousands).

	County	2025	2030	2035	2040	2050	2060	2070
Moderate Demand Scenario	Chesterfield	40.4	37.3	34.3	32.5	32.5	32.5	32.5
	Clarendon	28.2	25.3	22.4	20.7	20.7	20.7	20.7
	Darlington	58.3	53.7	49.1	46.5	46.5	46.5	46.5
	Dillon	25.7	23.2	20.8	19.5	19.5	19.5	19.5
	Florence	134.3	131.0	127.0	124.4	124.4	124.4	124.4
	Georgetown	65.0	65.7	65.5	65.0	65.6	66.3	66.9
	Horry	402.4	454.6	508.0	560.4	664.2	768.0	871.8
	Kershaw	67.2	68.6	69.7	70.8	73.4	76.0	78.6
	Lancaster	107.2	117.7	128.3	139.1	160.3	181.5	202.7
	Lee	15.2	13.9	12.6	11.9	11.9	11.9	11.9
	Marion	26.4	23.8	21.4	19.9	19.9	19.9	19.9
	Marlboro	25.5	24.3	23.1	22.4	22.4	22.4	22.4
	Sumter	103.1	100.3	97.2	95.1	95.1	95.1	95.1
	Williamsburg	29.3	27.6	25.7	24.5	24.5	24.5	24.5
	Total	**1,128**	**1,167**	**1,205**	**1,253**	**1,381**	**1,509**	**1,637**
High Demand Scenario	Chesterfield	44.3	46.3	48.5	50.7	55.6	60.9	66.7
	Clarendon	31.6	33.1	34.7	36.3	39.7	43.5	47.7
	Darlington	64.2	67.2	70.3	73.6	80.6	88.3	96.7
	Dillon	28.8	30.1	31.5	33.0	36.2	39.6	43.4
	Florence	141.4	147.9	154.8	162.0	177.5	194.4	213.0
	Georgetown	66.1	69.2	72.4	75.8	83.0	90.9	99.6
	Horry	402.4	457.3	519.7	590.7	762.9	985.3	1,272.5
	Kershaw	68.3	71.5	74.8	78.3	85.8	94.0	102.9
	Lancaster	107.0	118.4	130.9	144.8	177.0	216.5	264.8
	Lee	16.8	17.6	18.4	19.3	21.1	23.1	25.3
	Marion	29.6	31.0	32.4	33.9	37.1	40.7	44.6
	Marlboro	27.3	28.6	29.9	31.3	34.3	37.6	41.1
	Sumter	108.8	113.9	119.2	124.8	136.7	149.7	164.0
	Williamsburg	31.7	33.2	34.7	36.4	39.8	43.6	47.8
	Total	**1,168**	**1,265**	**1,372**	**1,491**	**1,767**	**2,108**	**2,530**

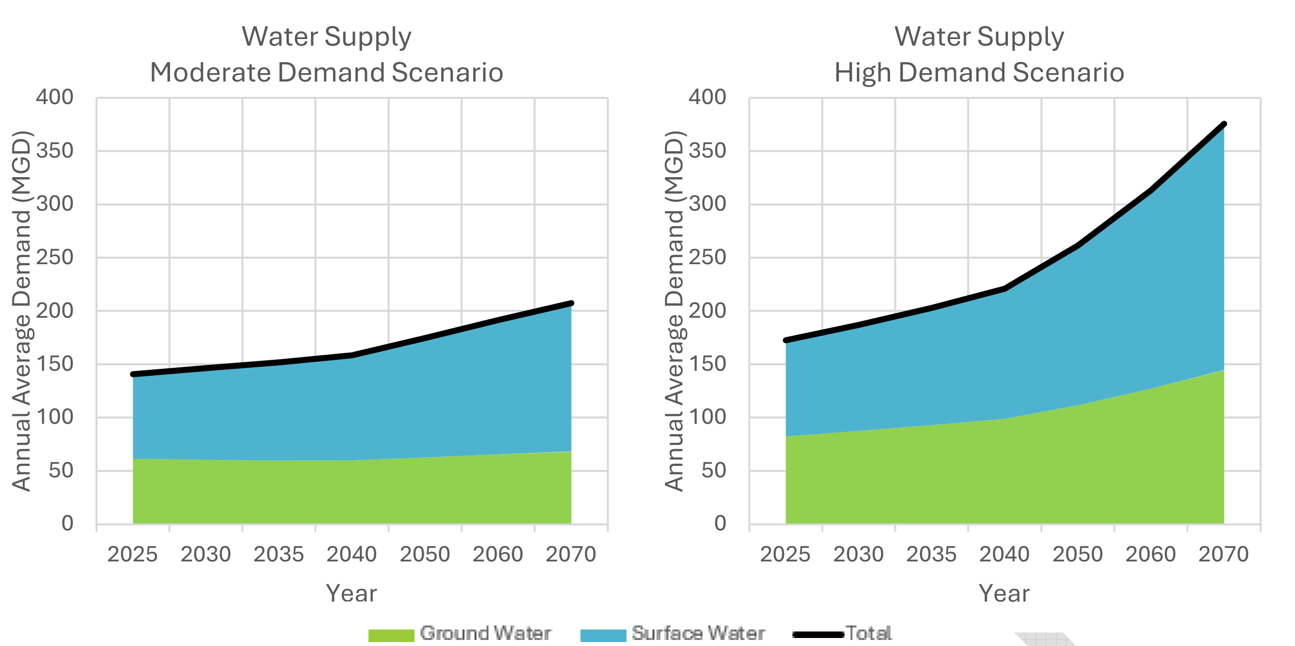


Figure 4-10. Projected public water supply demands.

Table 4-8. Projected public water supply demands.

	Moderate Demand Scenario (MGD)			High Demand Scenario (MGD)		
Year	**Surface Water**	**Groundwater**	**Total**	**Surface Water**	**Groundwater**	**Total**
2025	79.5	61.2	140.7	90.0	82.6	172.6
2030	85.9	60.4	146.3	99.4	87.6	187.0
2035	92.1	59.6	151.7	109.9	92.9	202.8
2040	98.7	59.7	158.4	121.9	98.9	220.8
2050	112.1	62.4	174.5	150.0	111.5	261.5
2060	126.0	65.5	191.5	186.2	127.0	313.2
2070	139.4	68.2	207.6	231.3	144.5	375.8
% Change 2025-2070	**75%**	**11%**	**47%**	**157%**	**75%**	**118%**

4.4.3 Industry Demand Projections

Industrial water demands are projected to increase by 43 percent from 2025 to 2070 in the Moderate Demand Scenario (94.8 MGD to 135.7 MGD). In the High Demand Scenario, industrial water demands are projected to increase by 155 percent from 2025 to 2070 (119.3 MGD to 303.8 MGD). While manufacturing has variable production day-to-day, the High Demand Scenario assumes maximum production and potential for new industries or facilities to develop. Industrial water demand projections by water source are shown in Figure 4-11 and Table 4-9.

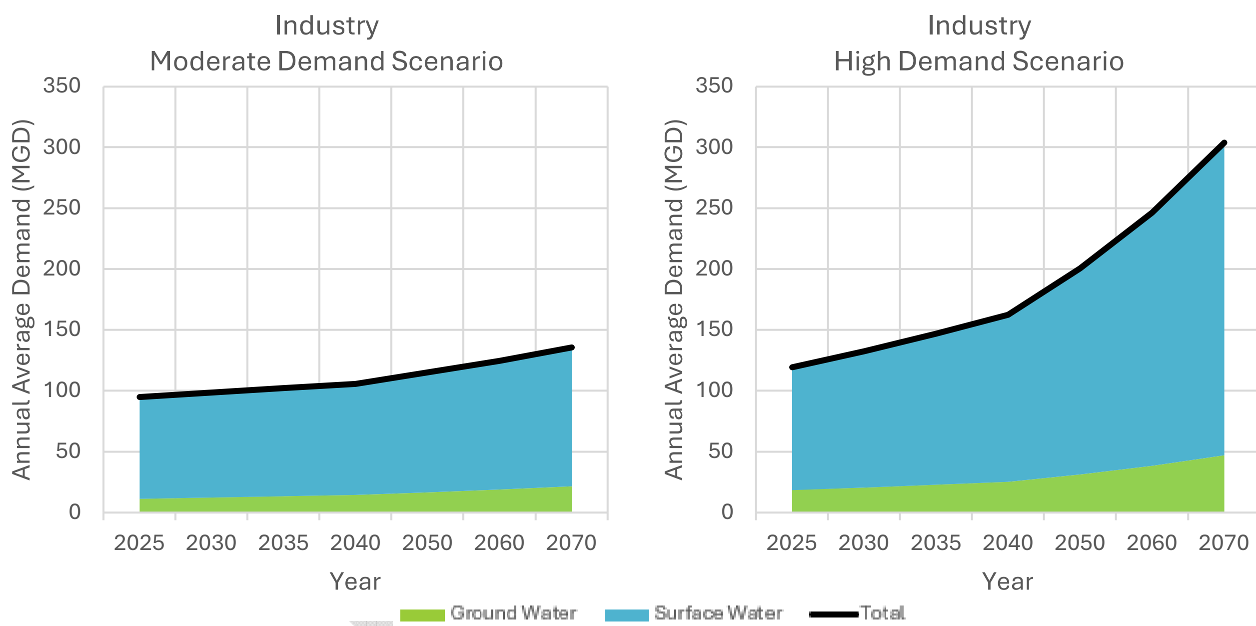


Figure 4-11. Projected industry water demands.

Table 4-9. Projected industry water demands.

	Moderate Demand Scenario (MGD)			High Demand Scenario (MGD)		
Year	**Surface Water**	**Groundwater**	**Total**	**Surface Water**	**Groundwater**	**Total**
2025	83.5	11.3	94.8	100.8	18.5	119.3
2030	86.3	12.3	98.6	111.8	20.5	132.3
2035	88.8	13.4	102.2	124.0	22.8	146.8
2040	91.2	14.3	105.5	137.3	25.2	162.5
2050	98.5	16.5	115.0	169.4	31.1	200.5
2060	105.6	18.9	124.5	208.0	38.3	246.3
2070	114.1	21.6	135.7	256.7	47.1	303.8
% Change 2025-2070	**37%**	**91%**	**43%**	**155%**	**155%**	**155%**

4.4.4 Other Demand Projections

Other demands are held constant into the future as described in Section 4.3.4. Mining demands are assumed to be 1.3 MGD and 2.0 MGD for the Moderate and High Demand Scenarios, respectively. All mining demands are projected to be met from surface water.

Golf course demands are approximately 5.2 to 5.3 MGD for the Moderate Demand Scenario and 13.8 to 14.3 MGD for the High Demand Scenario. Of these demands, approximately 77 percent of the demand is for surface water for the Moderate Demand Scenario, and 71 percent of demand is for surface water for the High Demand Scenario. Note that slight increases in golf course demand over the planning horizon were due to increases at a course that is associated with a drinking water permit (Founders Golf Club in Myrtle Beach).

In addition, nuclear power demands are assumed to be approximately 723.6 MGD and 826.7 MGD for the Moderate and High Demand Scenarios, respectively, with nearly 100 percent supplied by surface water. Other uses are too small to be reported and were not included in the demand projections.

Chapter 5
Comparison of Water Resource Availability and Water Demand

This chapter describes the methods used to assess surface water and groundwater availability in the Pee Dee River basin and underlying aquifers. A surface water model was used to evaluate water availability using current and projected water demands. Water availability was also assessed assuming surface water withdrawals at permitted and registered amounts. Groundwater was evaluated by examining historical water-level measurements and trends, potentiometric surface maps, reported water use, and projected water demand. The results of these assessments are presented and compared, and potential shortages, issues, and areas of concern are identified. Opportunities for mitigating issues and managing water supplies sustainably are described in subsequent chapters.

5.1 Methodology

5.1.1 Surface Water

Surface water planning scenarios were constructed and simulated using the previously developed Pee Dee River basin surface water quantity model (CDM Smith 2017). This model was developed with CDM Smith's SWAM software. It simulates river basin hydrology, water availability, and water use across a dendritic stream network and over an extended time series.

SWAM was designed to provide efficient planning-level analyses of surface water supply systems. Beginning with naturally occurring water flowing in the river reaches, it calculates physically and permitted or allowable water, diversions, storage, consumption, and return flows at user-defined nodes in a networked river system. A range of water user types can be represented in the model, including municipal water suppliers, agricultural irrigators, and industrial water users, with time-variable demands either prescribed by the user or, in some cases, calculated internally. Multiple layers of complexity are available as options in SWAM to allow for easy development of a range of systems, from the very simple to the more complex. As an example, SWAM's reservoir object can include only basic hydrology-dependent calculations (storage as a function of inflow, outflow, and evaporation) or can include operational rules of varying complexity: prescribed monthly releases, a set of prioritized monthly releases or storage targets, or a set of conditional release rules (dependent on hydrology). Municipal water conservation programs can similarly be simulated with sets of rules of varying complexity. The model user chooses the appropriate level of complexity given the modeling objectives and data availability.

The Pee Dee River basin SWAM model simulates 89 years of variable historic hydrology (October 1929 – December 2018) with either a monthly or daily user-specified calculation timestep (the surface water scenarios presented in this chapter represent monthly analyses, unless noted otherwise). It is designed for three primary purposes:

- Accounting of current and past basin inflows, outflows, and consumptive uses
- Simulating streamflow and lake storage (if applicable) across a range of observed historical climate and hydrologic conditions, given current water use and operations
- Simulating future "what if" scenarios associated with changes in basin water use, management, and/or operations

The Pee Dee River basin model includes 9 municipal, 8 industrial, 3 golf course, 1 thermoelectric, 4 mining, and 17 agricultural (irrigation) water users. Some of the included water users only withdraw groundwater but discharge to surface water, thus their inclusion in the model. All water users with permitted withdrawals greater than 0.1 million gallons per day (MGD) are represented, either explicitly or implicitly. In the model, which represents current conditions, monthly water use is set equal to the average of a recent 10-year period (2009 to 2018) of reported use, with several exceptions. Exceptions include new surface water users and surface water users with recent demands that are significantly different than demands in the early part of the 10-year period. Water use patterns can also be adjusted by model users to explore future water management scenarios, as discussed in this chapter.

A total of 48 "tributary objects" (rivers and streams) are represented discretely in the model, including the mainstem Great Pee Dee River. Boundary condition (headwater) flows for each tributary object are prescribed in the model based on external analyses (see CDM Smith 2017), which estimated naturally-occurring historical flows "unimpaired" by human uses. Historic, current, and/or future uses can then be simulated against the same natural hydrology of the basin. Hydrologic flow gains (or losses) for each tributary are simulated in SWAM using lumped gain (or loss) factors, which are set based on a model calibration exercise, using gaged flow data, and/or guided by changes in reach drainage area. While there is no direct linkage between the SWAM model and the groundwater model (discussed below), SWAM implicitly accounts for interaction between groundwater and surface water through the assignment of the gain/loss factors in each stream reach.

The Pee Dee River basin SWAM model was used to simulate current and potential future scenarios to evaluate surface water availability. Detailed descriptions of the surface water scenarios and their results are provided in Chapter 5.3.

Several key terms are used throughout this section when presenting results of the surface water modeling. These key terms are introduced and defined below.

- **Physically Available Surface Water Supply** – the maximum amount of water that occurs 100 percent of the time at a location on a surface water body with no defined Surface Water Conditions applied on the surface water body.
- **Reach of Interest** – a stream reach defined by the RBC which experiences undesired impacts, environmental or otherwise, determined from current or future water-demand scenarios or proposed water management strategies. Such reaches may or may not have identified surface water shortages. The RBC did not identify any Reaches of Interest in the Pee Dee River basin.

- **Strategic Node** – a location on a surface water body designated to evaluate the cumulative impacts of water management strategies for a given model scenario and which serves as a primary point of interest from which to evaluate a model scenario's Performance Measures. Strategic Nodes are defined by the RBC.

- **Surface Water Condition** – a limitation, defined by the RBC, on the amount of water that can be withdrawn from a surface water source and which can be applied to evaluate Surface Water Supply for planning purposes. The RBC did not establish a Surface Water Condition for any location in the Pee Dee River basin.

- **Surface Water Shortage** – a situation in which water demand exceeds the Surface Water Supply for any water user in the basin.

- **Regulatory Shortage** – for the purposes of the Pee Dee River Basin Plan, a situation in which water demand exceeds the permitted or registered amount of a specific user (note that this term and definition are not in the Planning Framework).

- **Surface Water Supply** – the maximum amount of water available for withdrawal 100 percent of the time at a location on a surface water body without violating any applied Surface Water Conditions on the surface water source and considering upstream demands.

5.1.2 Groundwater

The methodology for comparing groundwater availability with groundwater demand presented in the Planning Framework relies on the use of the USGS Coastal Plain groundwater-flow model to calculate water-level declines in aquifers for the four water-use scenarios described in the Planning Framework. For each scenario, the groundwater model would simulate water levels in each aquifer throughout the basin over the 50-year planning horizon, allowing the RBC to identify areas of potential groundwater problems. The groundwater model also could be used to evaluate the effectiveness of proposed groundwater management strategies by estimating the impacts of those strategies on aquifer water levels.

After the USGS developed the Coastal Plain groundwater flow model that was used for the 2023 Edisto River Basin Plan, they identified problems with some water-use data that was used during the model calibration. Correcting the data and subsequently recalibrating the model delayed the model's availability to the extent that it would not be ready for use during the Pee Dee basin planning process without significantly delaying the release of the Pee Dee River Basin Plan. After the USGS's initial and unsuccessful efforts to rapidly update the model and a project delay of six months, the Pee Dee RBC decided to complete the River Basin Plan without the benefit of having a groundwater model.

Without a groundwater model, groundwater availability assessments could not be conducted as described in the Planning Framework. A different approach was needed. The RBC relied only on empirical data to evaluate groundwater conditions in the basin.

Groundwater level measurements, primarily collected from the SCDES monitoring well network, provide information about historical and current conditions in the major aquifers, showing how groundwater conditions in the basin have changed during the past several decades. Water levels collected for potentiometric mapping projects include data for many other wells not in the dedicated monitoring network, and the potentiometric maps themselves offer insights into how aquifer conditions have changed over time. This collection of water-level data not only provides a good picture of current water-level conditions, but it also provides a good look at trends or changes in water levels over time.

In addition to water-level data, the RBC considered groundwater use throughout the basin as part of its groundwater availability assessment. Because groundwater withdrawals are the primary driver of groundwater-level declines, it is essential to understand both historical and current groundwater use, both quantitatively and spatially, to relate groundwater use to observed trends in groundwater levels. Reasonably good groundwater withdrawal data are available for most groundwater users in the basin for the past twenty years.

By reviewing both water-use and water-level data, the RBC identified areas within the basin where specific aquifers have already or are likely to see significant water-level declines that should be addressed through some management strategy. Similarly, the RBC identified other areas of the basin in which groundwater availability has not been negatively impacted by past water use.

Water-use projections for the standard four water-use scenarios described in the Planning Framework were still developed and will be ready for use in the groundwater model when it becomes available. Without the groundwater model, however, detailed descriptions of the impacts of each water-use scenario will not be available. Even without the model, however, the groundwater-use projections can inform planners of areas likely to see significant increases in groundwater use during the next several decades.

Without the groundwater model, the Pee Dee RBC relied on current and historical water-level and water-use data, as well as knowledge of aquifer hydrogeology, to identify Groundwater Areas of Concern and potential Groundwater Areas of Concern. A Groundwater Area of Concern is defined in the Planning Framework as "an area where current or future groundwater withdrawals from an aquifer are causing or are expected to cause unacceptable impacts to the resource or the public well-being". A "potential Groundwater Area of Concern" is similar to a Groundwater Area of Concern but is more speculative, in that it represents an area in which a problem is not yet known to occur but may develop or be confirmed in the future. Potential Groundwater Areas of Concern would be classified as Groundwater Areas of Concern if future groundwater modeling or field measurements substantiated the suspected problem.

Demand-side groundwater management strategies were developed and recommended by the RBC, but the effectiveness of those strategies cannot be tested with the groundwater model until a later date. Similarly, supply-side management strategies were developed and recommended, but without a technical evaluation, those recommendations are somewhat conceptual or generalized. Management strategies proposed by the RBC may be considered for inclusion in future iterations of Capacity Use groundwater management plans as well as the State Water Plan.

5.2 Performance Measures

Performance measures were developed as a means for comparing water resource impacts (negative and positive) of each scenario. A performance measure is a quantitative measure of change in a user-defined condition from an established baseline, used to assess the performance of a proposed water management strategy or combination of strategies. Performance measures establish an objective means with which to compare scenarios. Performance measures were selected collaboratively with the RBC.

5.2.1 Surface Water Performance Measures

Hydrologic-based Performance Measures

The hydrologic surface water performance measures used to evaluate and compare simulation results are presented in Table 5-1. For each simulated scenario, performance measures were calculated as a post-processing step in the modeling. All metrics were calculated for the entire simulation period. As noted above, changes in performance measures between scenarios were particularly useful for the planning process. The first set of performance metrics were calculated for model output nodes that were identified by the RBC as Strategic Nodes. These Strategic Nodes are distributed throughout the river basin. Strategic Nodes coincide with seven active streamflow gaging stations plus two additional locations on the Pee Dee River below the confluence with the Lynches River and below the confluence with the Little Pee Dee River. These Strategic Nodes were selected in collaboration with the RBC. All strategic node locations are shown in Figure 5-1.

Table 5-1. Surface water performance measures.

Strategic Node Metrics (generated for each Strategic Node)
Mean flow (cfs)
Median flow (cfs)
25th percentile flow (cfs)
10th percentile flow (cfs)
5th percentile flow (cfs)
Comparison to Minimum Instream Flows (MIFs)[1]
Basin-wide Metrics (generated in aggregate for the entire modeled river basin)
Total basin annual mean shortage (MGD) - Sum of the average shortage for all users over the simulation period
Maximum water user shortage (MGD) - The maximum monthly shortage experienced by any single user over the simulation period
Total basin annual mean shortage (% of demand) - Sum of the average shortage for all users over the simulation period divided by the sum of the average demand for all users over the simulation period
Average frequency of shortage (%) - The average frequency of shortage of all users who experience a shortage, where each user's frequency of shortage is calculated as the number of months with a shortage divided by the total months in the simulation (for a monthly timestep simulation)

[1] MIFs are discussed and used as performance measures in Chapter 6 – Water Management Strategies.

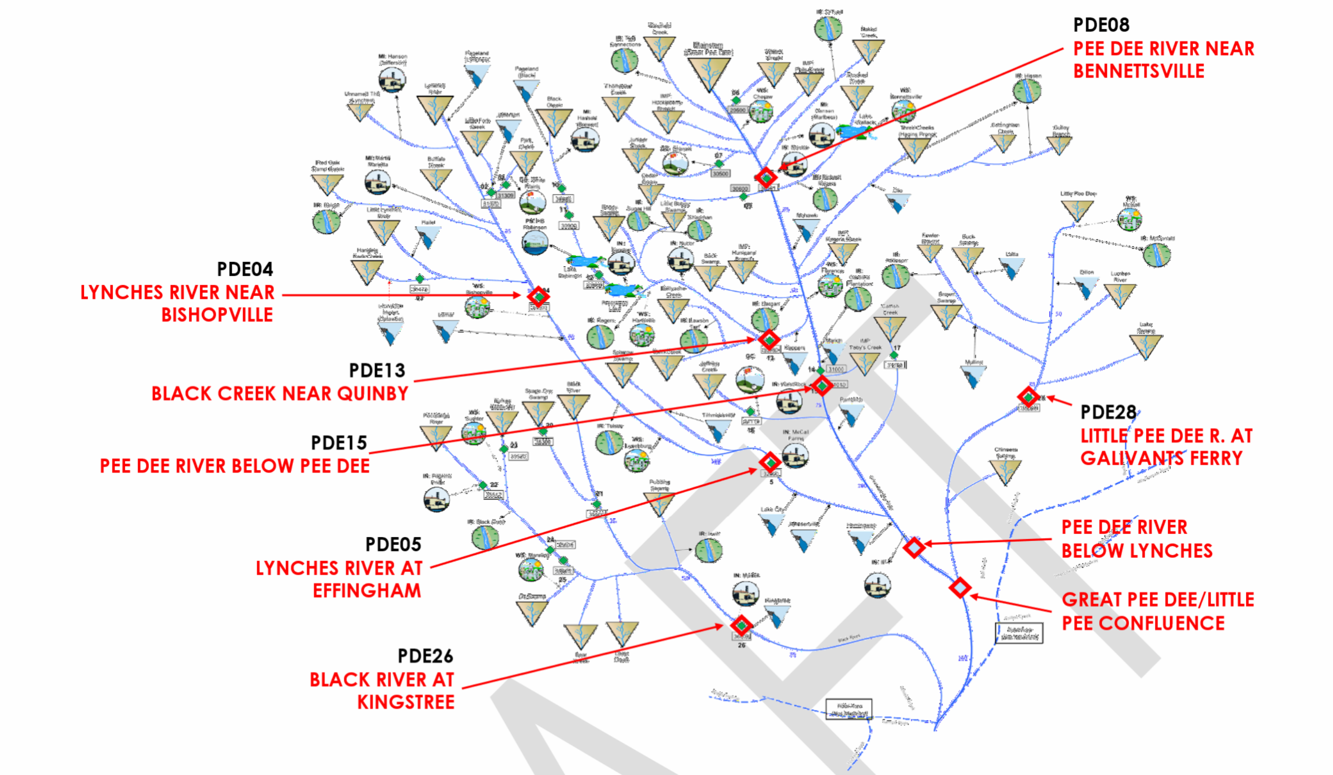


Figure 5-1. Strategic node locations.

Biological Response Metrics

As referenced in Chapter 3 and discussed in Bower et al. (2022) and The Nature Conservancy et al. (2023), biological response metrics were developed and combined with hydrologic metrics to identify statistically significant correlations between flow characteristics and ecological suitability for fish and macroinvertebrates. Select flow-ecology metrics (hydrologic metrics found to be most correlated to biological diversity) were used then as performance measures to help guide RBC discussions and recommendations for the Pee Dee River basin. This section provides discussion of the relevant, selected biological response metrics and related hydrologic metrics (sometimes referred to as the "flow-ecology metrics"), and Chapter 5.3.7 presents their values and interpretation in the context of the Pee Dee River basin.

The metrics were calculated at key downstream nodes in four of the primary tributaries to the Pee Dee River: Black Creek, Lynches River, Black River, and Little Pee Dee River. They represent a general assessment of how aquatic life will be impacted by changes in flow based on SWAM scenarios. Results should not be considered as necessarily uniform throughout each subbasin. Local conditions may vary along the length of streams. Metrics were based on flow-ecology relationships calculated using data from streams and small rivers with watershed areas equal to or less than 2,715 square miles. Because streams of this size comprise 86 percent of all surface water in South Carolina, results are broadly applicable across the basin. However, the results should not be extrapolated to large rivers or reservoirs.

Of the 14 biological response metrics identified in Bower et al. (2022), the following biological response metrics were used in the Pee Dee River basin because of the relevance and strong correlation to hydrologic statistics that could be readily extracted from the SWAM model (descriptions from The Nature Conservancy et al. 2023):

- **Species richness**: the number of fish and macroinvertebrate species found at a given site
- **Tolerant species**: the average tolerance index for taxa

Hydrologic statistics that correlated well to these biological metrics included four metrics that could be easily extracted from SWAM model results (The Nature Conservancy et al. 2023). These flow metrics, intended to support flow-ecology relationships, expand on the hydrologic metrics discussed in Chapter 5.2.1, which were used specifically for hydrologic comparisons. The four flow metrics that emerged as having the greatest impact on aquatic ecosystem health in the Pee Dee River basin are:

- **Mean daily flow** (MA1) is the mean (average) daily flow of the stream in cfs over the period of record.
- **Base flow** (ML17) is the seven-day minimum flow divided by mean annual daily flow averaged across all years.
- **Frequency of low flow** (FL1) is the annual average of the number of low events below the 25th percentile of all daily values over the period of record.
- **Timing of lowest observed flow** (TL1) is the (Julian) date of the annual minimum flow, converted to Julian date (a number from 1 to 365).

Mapped together, these hydrologic metrics were used to estimate changes in the biological response metrics, which characterized the ecological integrity of the subbasins. Table 5-2 helps illustrate the flow-ecology relationships for the Southeastern Plains Perennial Runoff (SE 1) and Mid-Atlantic Coastal Plains Perennial Runoff (M1) stream types, which are two of the three dominant stream types in the Pee Dee River basin (The Nature Conservancy et al. 2023). Chapter 5.3.7 presents and provides discussion of the application of the biological response metrics for the Pee Dee River basin.

Table 5-2. Relationship of hydrologic and biological response metrics.

Hydrologic Metric (Output from SWAM Scenarios)	Biological Response Metrics with High Conditional Importance (Bower et al. 2022)	Type of Evaluation
Mean Daily Flow	Fish Species Richness	Ecological Integrity
Base Flow	Macroinvertebrate Richness	Ecological Integrity
Frequency of Low Flow	Tolerant Fish Species and Fish Species Richness	Ecological Integrity and Tolerance
Timing of Low Flow	Tolerant Fish Species	Tolerance

5.2.2 Groundwater Performance Measures

As defined in the Planning Framework, performance measures are used to compare the results from various groundwater modeling simulations and to evaluate the effectiveness of potential groundwater management strategies. Examples of groundwater performance measures include changes in water levels in the major aquifers, groundwater levels falling below the top of a confined aquifer, changes in water budgets of the aquifers, and groundwater discharge to streams from the surficial aquifer.

Because this initial Pee Dee basin planning effort will not use a groundwater model, the Pee Dee RBC did not establish any specific groundwater performance measures.

5.3 Scenario Descriptions and Surface Water Simulation Results

Four scenarios were used to evaluate surface water availability and to identify anticipated surface water shortages: the Current Surface Water Use Scenario (Current Scenario); the Permitted and Registered Surface Water Use Scenario (P&R Scenario); the Moderate Water Demand Scenario (Moderate Scenario); and the High Water Demand Scenario (High Demand Scenario). The Moderate Scenario was originally referred to as the Business-as-Usual Scenario in the Framework. A fifth scenario, the Unimpaired Flow Scenario (UIF Scenario) was requested by the RBC and a model simulation was completed. The UIF Scenario removes all surface water withdrawals and discharges and simulates conditions prior to any surface water development. The scenarios described below were simulated over the approximately 89-year period of variable climate and hydrology spanning October 1929 to December 2018. All simulation results, except where noted, are based on model simulations using a monthly timestep.

5.3.1 Current Surface Water Use Scenario

The Current Scenario represents current operations, infrastructure, and water use in the Pee Dee River basin. Water demands were generally set based on reported water usage in the 10-year period spanning 2009 to 2018, with several minor exceptions. This simulation provides information on the potential for surface water shortages that could immediately result under a repeat of historic drought conditions in the basin and highlights the need for short-term planning initiatives including the development of strategies to mitigate shortages and/or increase surface water supply.

Simulation results for the Current Scenario are summarized in Table 5-3 through Table 5-5. Table 5-3 lists only the surface water users with one or more months of a simulated Surface Water Shortage over the 89-year (1,071-month) simulation. Also shown are the average annual demand for each water user; the minimum physically available (monthly average) flow at the point of withdrawal; the maximum (monthly average) shortage; and the frequency of shortage. The locations of these water users, as depicted on the SWAM model framework, are shown in Figure 5-2.

Table 5-3. Identified surface water shortages, Current Scenario.

Water User Name	Source Water	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
IR: Turf Connections	Westfield Creek	0.1	0.6	0.1	33.3%
IR: O'Tuel[1]	Naked Creek	0.2	0.4	0.3	0.4%
GC: Florence	Jeffries Creek	0.1	0.0	0.1	0.3%
GC: White Plains	Fork Creek	0.1	0.0	0.1	7.0%
MI: Hanson (Jefferson)	Unnamed Trib (Lynches)	0.04	0.0	0.05	6.1%
IR: Atkinson	Fowler Branch	0.01	0.0	0.05	1.2%

IR = agricultural (irrigation) water user; GC = golf course water user; MI = mining water user

[1] BFP Agriculture 4 recently took over IR: O'Tuel's property and has a new registration for a surface water withdrawal. The Current Use Scenario withdrawal was based on IR: O'Tuel's historical withdrawal amount.

Turf Connections (agricultural irrigator), which withdraws water from Westfield Creek, has a simulated regulatory shortage frequency of 33.3 percent and maximum simulated regulatory shortage of 0.1 MGD. While this user's water demand exceeds their registration amount one-third of the time, there is enough (physical) water in each month throughout the simulation's entire period of record to meet the water user's demand 100 percent of the time. Atkinson (agricultural irrigator) and two golf course water users (Florence and White Plains) withdraw water from small impoundments which are not included in the model; therefore, even during times when the stream is simulated to have low or no flow, the impoundment may provide enough stored water to prevent shortages. Because it is on an ungaged tributary with flows typically less than 1 MGD, there is significant uncertainty associated with the simulated stream flows that supplies water to the Hanson (Jefferson) mining operation.

Table 5-4 presents the mean flow, median flow, and Surface Water Supply at each strategic node. Also presented are the 25th, 10th, and 5th percentile flows, which are useful in characterizing low flows. Table 5-5 presents the basin wide performance metrics. As noted above, the model very likely over-predicts the number, degree, and frequency of surface water shortages on the small, ungaged tributaries, where multiple intake locations have been aggregated and where ponds, which are not simulated in the model, provide water storage that would often prevent a shortage. Table 5-5 provides a summary of the Current Scenario shortages in the basin overall, without groundwater users included.

Table 5-4. Surface water model simulation results at Strategic Nodes, Current Scenario.

Strategic Node	Mean Flow (cfs)	Median Flow (cfs)	Surface Water Supply (cfs)	Percentile Flows (cfs)		
				25th	10th	5th
PDE08 Pee Dee River near Bennettsville	7,935	6,154	991	3,707	2,548	2,020
PDE15 Pee Dee River below Pee Dee	9,463	7,384	1,105	4,510	3,058	2,437
Pee Dee River Below Lynches River Confluence	11,568	8,913	1,362	5,500	3,632	2,968
Great Pee Dee River below Little Pee Dee Confluence	14,795	11,521	1,670	7,093	4,637	3,778
PDE13 Black Creek near Quinby	527	452	56	279	191	151
PDE04 Lynches River near Bishopville	752	525	46	280	177	139
PDE05 Lynches River at Effingham	1,006	716	71	388	251	197
PDE28 Little Pee River at Galivants Ferry	2,917	2,190	190	1,223	745	599
PDE26 Black River at Kingstree	999	662	38	314	180	129

Table 5-5. Basin-wide surface water model simulation results, Current Scenario.

Performance Measure	Result[1]
Total basin annual mean shortage (MGD)	0.01 [2]
Maximum water user shortage (MGD)	0.3
Total basin annual mean shortage (% of demand)	0.03%
Percentage of water users experiencing shortage	18.8%
Average frequency of shortage (%)	1.5%

[1] Results shown do not include groundwater users.
[2] Includes only physical shortages and omits the regulatory shortage at Turf Connections.

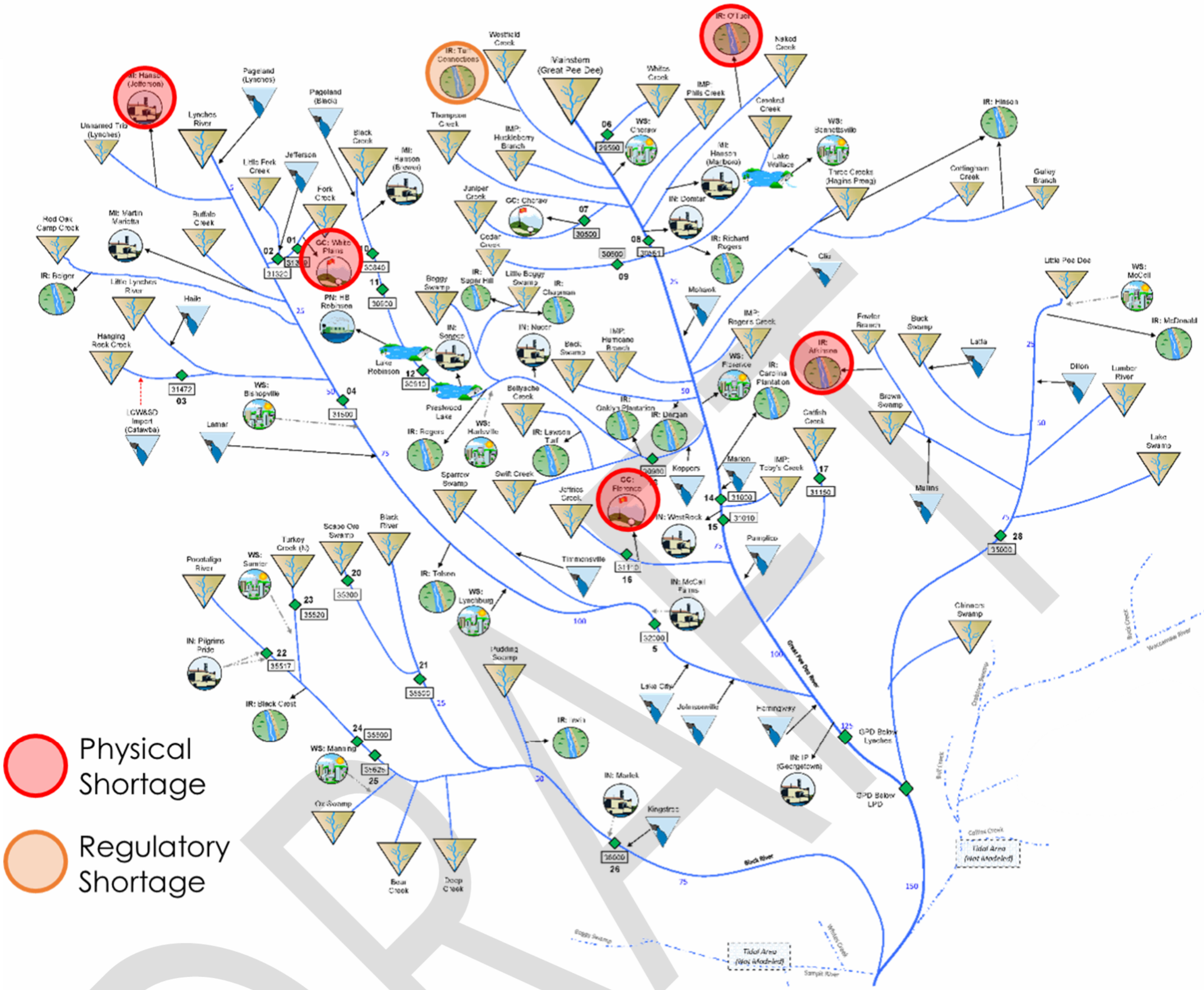


Figure 5-2. Water users with surface water shortages, Current Scenario.

5.3.2 Permitted and Registered Surface Water Use Scenario

In the P&R Scenario, modeled demands are set to permitted or registered values for all water users. In other words, this simulation explored the question of, “what if all water users used the full volume of water allocated through permits and registrations?” The scenario provides information to determine whether surface water is currently over-allocated in the basin. As such, it is a hypothetical scenario which does not necessarily reflect a projection of likely water use. The total permitted and registered amount of surface water (in the non-tidally influenced, modeled portion of the Pee Dee Basin) is 1,324 MGD, or more than twice the Current Use Scenario surface water demands of 576 MGD.

The P&R Scenario accounts for increased wastewater discharge for municipal and industrial surface water users with associated increases in simulated usage but does not account for the increase in wastewater discharges to surface water that might occur if all municipal and industrial groundwater users in the basin were withdrawing groundwater at their permitted or registered amount and returning the non-consumptively used portion (after treatment) to surface water. As such, the P&R scenario presents a worst-case simulation for surface water availability.

Simulation results for the P&R Scenario are summarized in Table 5-6 through Table 5-9. In this scenario, river flows are predicted to decrease, compared to the Current Scenario, throughout the basin, resulting in surface water shortages for approximately a third of the surface water users. Table 5-6 lists only the surface water users with one or more months of a simulated surface water shortage. The locations of these water users are shown on the SWAM model framework in Figure 5-3.

A recent surface water registration on Black Creek was issued by SCDHEC to Oaklyn Plantation (registered as an agricultural irrigator) for an amount of 5,400 million gallons per month (MGM) and 64,800 million gallons per year (MGY). To put the size of the registration in perspective, it is 42 percent larger than the three highest permitted or registered amounts in the Pee Dee River basin combined (which are IR: Sonoco, WS: Florence and IR: WestRock). Because Oaklyn Plantation has no reported use, this demand was only applied to the P&R Scenario and no demands were applied to the Current Use, 2070 Moderate Demand, or 2070 High Demand Scenarios. The P&R simulation results show that Oaklyn Plantation would have a frequency of shortage of 31.5 percent and a maximum shortage of 146.3 MGD.

Sonoco (industrial water user) is simulated to have a maximum shortage of 35.5 MGD under the P&R Scenario because of Prestwood Lake emptying during certain times in the simulation. No operating rules were included in the model for Lake Robinson to allow for larger releases from its dam and provide more water for Sonoco's intake on Prestwood Lake. Additional releases from the much larger Lake Robinson may be possible (without appreciably lowering its lake level) to maintain enough water in Prestwood Lake so that there are no shortages in this scenario.

The percent decrease in P&R Scenario flow statistics compared to the Current Scenario are shown in Table 5-8. Modeled reductions are most pronounced during low flow periods. Simulation results indicate that the P&R demand from the Oaklyn Plantation water user results in an approximately 95 percent reduction of flow on Black Creek during drought periods. Mean and median flows at the most downstream site of the mainstem (Great Pee Dee River below Little Pee Dee Confluence) are predicted to decrease by approximately 3 percent if all upstream (South Carolina) surface water users withdrew water at their permitted or registered amount. The impact of withdrawals at their fully permitted and registered amount on downstream water users is evident in the predicted increase in mean annual water shortage and the increase in the number and frequency of water users experiencing a shortage during the simulation period, as shown in Table 5-9. Despite the low likelihood of the P&R Scenario, the results demonstrate both the surface water resources of the basin are over-allocated based on existing permit and registration amounts.

Table 5-6. Identified surface water shortages, P&R Scenario.

Water User Name	Source Water	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
IR: O'Tuel[1]	Naked Creek	2.3	0.4	1.8	12.1%
MI: Hanson (Marlboro)	Naked Creek	4.4	0.4	3.9	23.2%
IR: Hinson	Gulley Branch	0.7	0.4	0.3	5.9%
MI: Hanson (Brewer)	Black Creek	6.8	2.1	4.5	7.3%
IN: Sonoco	Black Creek	42.6	0.0	35.5	4.4%
IR: Oaklyn Plantation	Black Creek	177.7	27.9	146.3	31.5%
GC: Florence	Jeffries Creek	1.6	0.0	1.6	0.7%
GC: White Plains	Fork Creek	1.6	0.0	1.6	81.2%
MI: Martin Marietta	Buffalo Creek	3.2	0.4	2.8	7.7%
IR: Belger	Red Oak Camp Creek	3.0	0.1	2.9	46.8%
MI: Hanson (Jefferson)	Unnamed Trib (Lynches)	0.9	0.0	0.9	84.1%
IR: Atkinson	Fowler Branch	0.3	0.0	0.3	40.6%

IR = agricultural (irrigation) water user; GC = golf course water user; MI = mining water user; IN = industrial water user

[1] BFP Agriculture 4 recently took over IR: O'Tuel's property and has a new registration for a surface water withdrawal. The Current Use Scenario withdrawal was based on IR: O'Tuel's historical withdrawal amount.

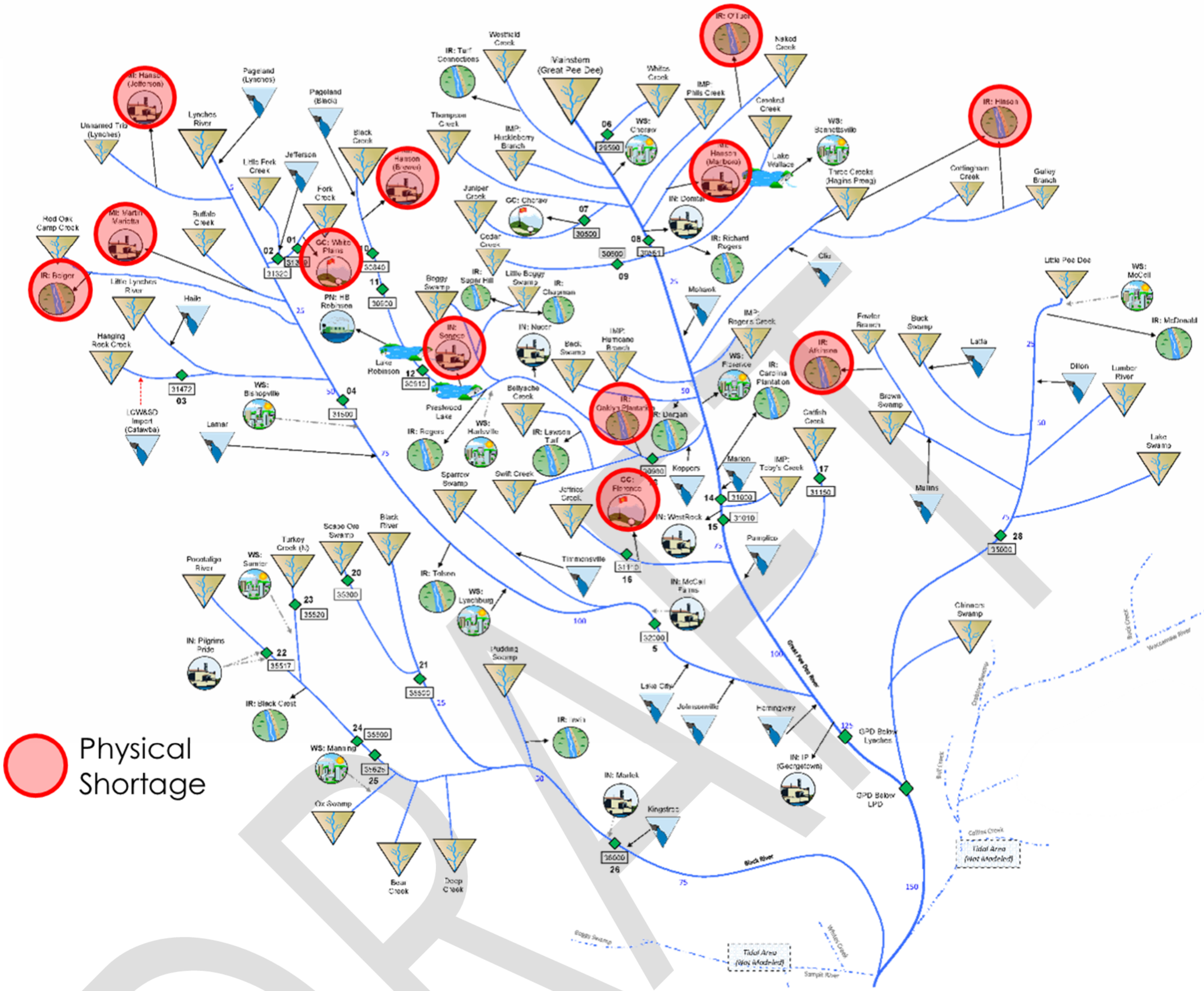


Figure 5-3. Water users with surface water shortages, P&R Scenario.

Table 5-7. Surface water model simulation results at Strategic Nodes, P&R Scenario.

Strategic Node	Mean Flow (cfs)	Median Flow (cfs)	Surface Water Supply (cfs)	Percentile Flows (cfs)		
				25th	10th	5th
PDE08 Pee Dee River near Bennettsville	7,921	6,141	984	3,692	2,533	2,009
PDE15 Pee Dee River below Pee Dee	9,029	6,935	901	4,078	2,687	2,107
Pee Dee River Below Lynches River Confluence	11,182	8,520	1,210	5,110	3,329	2,729
Great Pee Dee River below Little Pee Dee Confluence	14,446	11,157	1,549	6,750	4,359	3,520
PDE13 Black Creek near Quinby	249	141	2	12	9	7
PDE04 Lynches River near Bishopville	743	514	46	272	172	135
PDE05 Lynches River at Effingham	996	708	70	381	245	192
PDE28 Little Pee River at Galivants Ferry	2,917	2,189	190	1,222	744	598
PDE26 Black River at Kingstree	994	657	36	309	177	125

Table 5-8. Percent change in P&R Scenario flows at Strategic Nodes relative to Current Scenario flows.

Strategic Node	Mean Flow (cfs)	Median Flow (cfs)	Surface Water Supply (cfs)	Percentile Flows (cfs)		
				25th	10th	5th
PDE08 Pee Dee River near Bennettsville	-0.2%	-0.2%	-0.7%	-0.4%	-0.6%	-0.5%
PDE15 Pee Dee River below Pee Dee	-4.6%	-6.1%	-18.5%	-9.6%	-12.1%	-13.5%
Pee Dee River Below Lynches River Confluence	-3.3%	-4.4%	-11.2%	-7.1%	-8.3%	-8.0%
Great Pee Dee River below Little Pee Dee Confluence	-2.4%	-3.2%	-7.2%	-4.8%	-6.0%	-6.8%
PDE13 Black Creek near Quinby	-52.8%	-68.8%	-96.4%	-95.7%	-95.3%	-95.4%
PDE04 Lynches River near Bishopville	-1.2%	-2.0%	0.0%	-2.7%	-3.0%	-2.6%
PDE05 Lynches River at Effingham	-1.0%	-1.1%	-1.4%	-1.9%	-2.4%	-2.7%
PDE28 Little Pee River at Galivants Ferry	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%
PDE26 Black River at Kingstree	-0.5%	-0.8%	-5.3%	-1.5%	-1.5%	-3.2%

Table 5-9. Basin-wide surface water model simulation results, P&R Scenario.

Performance Measure	Result[1]
Total basin annual mean shortage (MGD)	21.5
Maximum water user shortage (MGD)	146.3
Total basin annual mean shortage (% of demand)	4.6%
Percentage of water users experiencing shortage	36.4%
Average frequency of shortage (%)	10.5%

[1] Results shown do not include groundwater users.

5.3.3 Moderate Water Demand Projection Scenario

For the Moderate Scenario, modeled demands were set to projected 2070 levels based on an assumption of moderate population and economic growth, as described in Chapter 4.3. Projected 2070 surface water demands for the Moderate Scenario are 846 MGD, which is equal to the Current Use Scenario surface water demands. The Moderate Scenario explores a plausible future where water demands increase with moderate population growth and agricultural expansion, and climate change impacts are negligible, in both the short and long term. For agricultural expansion, the specific locations for future new or expanded farms are not known, so a lumped spatial representation was applied in the model. Existing agricultural users' current demands were kept constant, and projected increases in demands for the agricultural sector were aggregated at the base of each subwatershed. The increase in demands was assigned proportionally to each subwatershed node according to the distribution of 2020 agricultural demands.

The Moderate Scenario simulation results for the 2070 planning horizon are summarized in Table 5-10 through Table 5-13. Table 5-10 lists only the surface water users with one or more months of a simulated Surface Water Shortage. The locations of these water users are shown on the SWAM model framework in Figure 5-4. The agricultural water users with shortages in the Current Scenario (Table 5-3) had the exact same shortages in the Moderate Scenario because their monthly demands were not increased. As noted above, new agricultural withdrawals were applied at the outlet to certain watersheds (not to existing agricultural water users). All new agricultural withdrawals are downstream of existing agricultural water users that experienced a simulated shortage. Furthermore, there are no non-agricultural withdrawals upstream of any of the agricultural water users that experienced a simulated shortage. The average annual demands from Sonoco (industrial water user) and Martin Marietta (mining water user) are larger in the Moderate 2070 scenario compared to current use, resulting in shortages for these water users.

Table 5-10. Identified surface water shortages, Moderate 2070 Scenario.

Water User Name	Source Water	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
IR: O'Tuel[1]	Naked Creek	0.2	0.4	0.3	0.4%
IN: Sonoco	Black Creek	21.0	0.0	9.2	0.3%
GC: Florence	Jeffries Creek	0.04	0.0	0.03	0.3%
GC: White Plains	Fork Creek	0.04	0.0	0.1	6.3%
MI: Martin Marietta	Buffalo Creek	1.2	0.4	1.1	1.0%
MI: Hanson (Jefferson)	Unnamed Trib (Lynches)	0.03	0.0	0.04	5.0%
IR: Atkinson	Fowler Branch	0.01	0.0	0.05	1.2%

IR = agricultural (irrigation) water user; IN = industrial water user; GC = golf course water user; MI = mining water user

[1] BFP Agriculture 4 recently took over IR: O'Tuel's property and has a new registration for a surface water withdrawal.

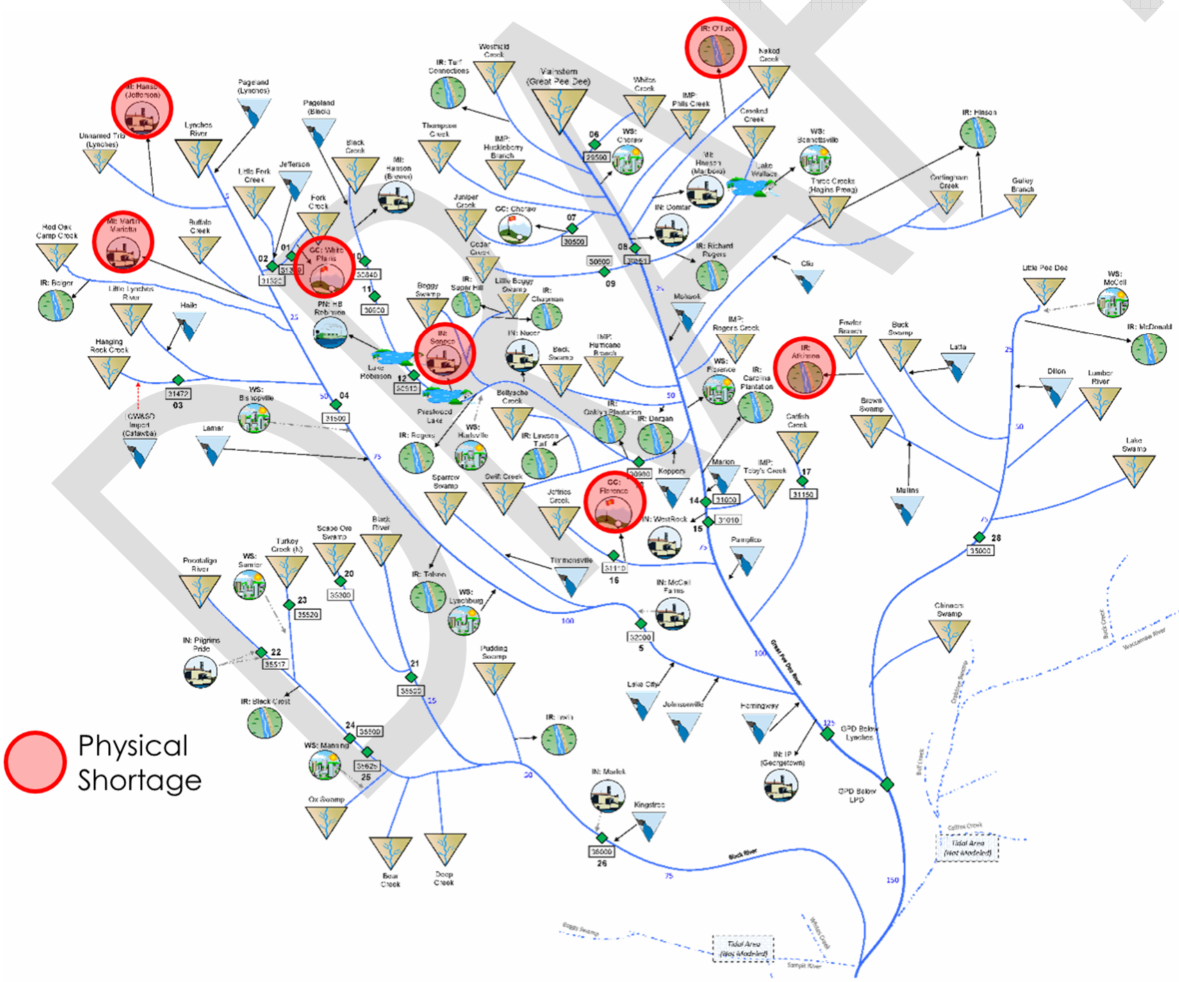


Figure 5-4. Water users with surface water shortages, Moderate 2070 Scenario.

In the Moderate Scenario, flows are predicted to decrease modestly, compared to the Current Use Scenario, throughout the basin. Modeled reductions are most pronounced during low flow periods. At the most downstream Strategic Node (Great Pee Dee River below Little Pee Dee Confluence), mean and median flows are predicted to decrease by approximately 1 percent, and low flows by about 3 percent, by 2070 if population and economic growth is moderate and climate change impacts are negligible. Calculated water user shortages remain essentially unchanged, relative to the Current Scenario. The percent of users experiencing a shortage decreases due to the addition of agricultural users in the model assigned at the 7 HUC outlets, which represent future increased agricultural demand in the basin. Given current climate conditions and existing basin management and regulatory structure, basin surface water supplies are predicted to be adequate to meet increased demands resulting from moderate economic and population growth, and assuming the continued use of farm ponds that, while not simulated, are likely to prevent many of the observed Current and Moderate Scenario agricultural shortages.

Table 5-11. Surface water model simulation results at Strategic Nodes, Moderate 2070 Scenario.

Strategic Node	Mean Flow (cfs)	Median Flow (cfs)	Surface Water Supply (cfs)	Percentile Flows (cfs)		
				25th	10th	5th
PDE08 Pee Dee River near Bennettsville	7,792	6,018	989	2,416	1,880	2,416
PDE15 Pee Dee River below Pee Dee	9,285	7,203	1,093	2,879	2,292	2,879
Pee Dee River Below Lynches River Confluence	11,391	8,717	1,351	3,435	2,785	3,435
Great Pee Dee River below Little Pee Dee Confluence	14,628	11,389	1,658	4,472	3,618	4,472
PDE13 Black Creek near Quinby	523	448	56	186	147	186
PDE04 Lynches River near Bishopville	751	524	46	176	137	176
PDE05 Lynches River at Effingham	1,004	714	70	248	196	248
PDE28 Little Pee River at Galivants Ferry	2,917	2,190	190	745	599	745
PDE26 Black River at Kingstree	997	661	36	177	128	177

Table 5-12. Percent change in Moderate 2070 Scenario flows at Strategic Nodes relative to Current Scenario flows.

Strategic Node	Mean Flow (cfs)	Median Flow (cfs)	Surface Water Supply (cfs)	Percentile Flows (cfs)		
				25th	10th	5th
PDE08 Pee Dee River near Bennettsville	-1.8%	-2.2%	-0.2%	-3.3%	-5.2%	-6.9%
PDE15 Pee Dee River below Pee Dee	-1.9%	-2.4%	-1.1%	-3.7%	-5.9%	-5.7%
Pee Dee River Below Lynches River Confluence	-1.5%	-2.2%	-0.8%	-3.1%	-5.4%	-6.1%
Great Pee Dee River below Little Pee Dee Confluence	-1.1%	-1.1%	-0.7%	-2.5%	-3.5%	-4.2%
PDE13 Black Creek near Quinby	-0.6%	-0.6%	1.8%	-0.8%	-1.7%	-1.6%
PDE04 Lynches River near Bishopville	-0.2%	-0.1%	0.0%	-0.6%	-0.8%	-1.2%
PDE05 Lynches River at Effingham	-0.2%	-0.2%	-1.4%	-0.6%	-1.2%	-0.7%
PDE28 Little Pee River at Galivants Ferry	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
PDE26 Black River at Kingstree	-0.2%	-0.2%	-5.3%	-0.6%	-1.5%	-0.9%

Table 5-13. Basin-wide surface water model simulation results, Moderate 2070 Scenario.

Performance Measure	Result[1]
Total basin annual mean shortage (MGD)	0.03
Maximum water user shortage (MGD)	9.2
Total basin annual mean shortage (% of demand)	0.02%
Percentage of water users experiencing shortage	17.5%
Average frequency of shortage (%)	0.4%

[1] Results shown do not include groundwater users.

5.3.4 High Water Demand Projection Scenario

For the High Demand Scenario, modeled demands are set to the 90th percentile of variability in reported withdrawals for each user, and the projections are based on aggressive growth within the range of uncertainty of the referenced driver variable projections, as described in Chapter 4. Projected 2070 surface water demands for the High Demand Scenario are 1,094 MGD and are 29 percent higher than the Current Use Scenario surface water demands of 846 MGD. This set of scenarios represents the combined impacts of all sectors experiencing high growth and all water users experiencing conditions of high water demand. These assumptions are intended to represent an unlikely maximum for total water demand; it is very unlikely these demands would occur month after month and year after year for all water users. The purpose of this scenario is to provide the RBC with information on which to base conservative management strategies. Other methods and assumptions used in constructing the High Demand Scenario were the same as for the Moderate Scenario.

The High Demand Scenario simulation results for the 2070 planning horizon are summarized in Table 5-14 through Table 5-17. The same water users with shortages in the Moderate Scenario (see Figure 5-4) also had shortages in the High Demand Scenario, and no additional users were simulated to have shortages under the High Demand Scenario.

Table 5-14. Identified surface water shortages, High Demand 2070 Scenario.

Water User Name	Source Water	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
IR: O'Tuel[1]	Naked Creek	0.2	0.4	0.3	0.4%
IN: Sonoco	Black Creek	29.8	0.0	21.0	1.3%
GC: Florence	Jeffries Creek	0.10	0.0	0.1	0.3%
GC: White Plains	Fork Creek	0.06	0.0	0.1	8.2%
MI: Martin Marietta	Buffalo Creek	1.4	0.4	1.1	1.3%
MI: Hanson (Jefferson)	Unnamed Trib (Lynches)	0.04	0.0	0.1	7.1%
IR: Atkinson	Fowler Branch	0.01	0.0	0.05	1.2%

IR = agricultural (irrigation) water user; IN = industrial water user; GC = golf course water user; MI = mining water user

[1] BFP Agriculture 4 recently took over IR: O'Tuel's property and has a new registration for a surface water withdrawal.

In the High Demand Scenario, river flows are predicted to decrease modestly, compared to the Current Scenario, throughout the basin. Modeled reductions are most pronounced during low flow periods. Mean and median flows at the most downstream site of the mainstem (Great Pee Dee River below Little Pee Dee Confluence) are predicted to decrease by approximately 3 percent, and low flows by 5 to 8 percent, by 2070. Calculated water user shortages increase slightly, in terms of both duration and intensity, for the 2070 planning horizon, compared to the Current Scenario results.

Table 5-15. Surface water model simulation results at Strategic Nodes, High Demand 2070 Scenario.

Strategic Node	Mean Flow (cfs)	Median Flow (cfs)	Surface Water Supply (cfs)	Percentile Flows (cfs)		
				25th	10th	5th
PDE08 Pee Dee River near Bennettsville	7,639	5,842	974	3,430	2,231	1,709
PDE15 Pee Dee River below Pee Dee	8,964	6,858	928	4,007	2,547	1,974
Pee Dee River Below Lynches River Confluence	11,122	8,447	1,236	5,067	3,139	2,500
Great Pee Dee River below Little Pee Dee Confluence	14,418	11,191	1,538	6,694	4,244	3,443
PDE13 Black Creek near Quinby	521	443	53	274	184	144
PDE04 Lynches River near Bishopville	750	523	46	278	176	137
PDE05 Lynches River at Effingham	1,005	715	71	387	249	196
PDE28 Little Pee River at Galivants Ferry	2,918	2,190	190	1,223	745	599
PDE26 Black River at Kingstree	1,011	674	47	325	189	141

Table 5-16. Percent change in High Demand 2070 Scenario flows at Strategic Nodes relative to Current Scenario flows.

Strategic Node	Mean Flow (cfs)	Median Flow (cfs)	Surface Water Supply (cfs)	Percentile Flows (cfs)		
				25th	10th	5th
PDE08 Pee Dee River near Bennettsville	-3.7%	-5.1%	-1.7%	-7.5%	-12.4%	-15.4%
PDE15 Pee Dee River below Pee Dee	-5.3%	-7.1%	-15.9%	-11.1%	-16.6%	-18.9%
Pee Dee River Below Lynches River Confluence	-3.8%	-5.2%	-9.2%	-7.8%	-13.5%	-15.7%
Great Pee Dee River below Little Pee Dee Confluence	-2.5%	-2.8%	-7.8%	-5.6%	-8.4%	-8.8%
PDE13 Black Creek near Quinby	-0.8%	-1.2%	-3.6%	-1.2%	-2.7%	-4.2%
PDE04 Lynches River near Bishopville	-0.3%	-0.3%	0.0%	-0.6%	-0.8%	-1.2%
PDE05 Lynches River at Effingham	-0.1%	-0.1%	0.0%	-0.3%	-0.8%	-0.7%
PDE28 Little Pee River at Galivants Ferry	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
PDE26 Black River at Kingstree	1.2%	1.8%	23.7%	3.6%	5.2%	9.2%

Table 5-17. Basin-wide surface water model simulation results, High Demand 2070 Scenario.

Performance Measure	Result[1]
Total basin annual mean shortage (MGD)	0.14
Maximum water user shortage (MGD)	21.0
Total basin annual mean shortage (% of demand)	0.05%
Percentage of water users experiencing shortage	17.5%
Average frequency of shortage (%)	0.5%

[1] Results shown do not include groundwater users.

5.3.5 Unimpaired Flow Scenario

The SWAM model was used to simulate unimpaired flows throughout the Pee Dee River basin. For this simulation, all water demands and discharges in the model were set to zero. Simulation results represent river hydrologic conditions without the impact of surface water withdrawals, discharges, and reservoirs, as modeled. In other words, results represent "naturalized" surface water conditions in the basin.

Inflows from North Carolina on the Pee Dee River and Lumber River were provided by HDR Inc., using the OASIS model, and were based on naturalized conditions (no reservoirs and no surface water use or discharges). The process used by the OASIS model to generate the unimpaired daily inflow timeseries for the Pee Dee River resulted in approximately 600 days (or 1.8 percent of the total days in the timeseries) with negative flows. Negative flows can be generated as part of the unimpairment process for several reasons. One example is when historical withdrawal and discharge data are only available on a monthly timestep but the data are applied to daily, gaged flows, and another is the travel time associated with large releases from upstream reservoirs. CDM Smith performed a simple correction of the negative daily flows by replacing them with flows based on a simple linear interpolation between the preceding and ensuing positive daily flows. The corrected daily flows were then used to calculate the monthly inflow time series used in the UIF Scenario.

UIF Scenario monthly simulation results are summarized in Table 5-18 and Table 5-19. Because of the negative flows in the UIF Scenario inflow dataset for the Pee Dee River (which were removed by CDM Smith, and replaced with positive, interpolated flows), the minimum flows on the Pee Dee River for the UIF scenario should be ignored, and no comparisons should be made to minimum flows of other scenarios.

The differences in performance measures at Strategic Nodes between the UIF Scenario and the Current Use Scenario are relatively small, indicating that current net withdrawals and discharges are not appreciably altering the current flow regime, compared to naturalized conditions. Current Use Scenario flows are larger than the UIF Scenario flows on the Lynches, Little Pee Dee, and Black Rivers because of water users that withdraw from ground water and discharge to surface water. There is also an import of water from the Catawba River Basin to the Lynches River. At the furthest downstream strategic node (Great Pee Dee River below Little Pee Dee Confluence), mean and median unimpaired flows are only approximately 0.5 percent higher than Current Scenario flows. At this same location, UIF low flows (10^{th} – 5^{th} percentile) are approximately 3 to 7 percent higher than Current Scenario flows.

Table 5-18. Surface water model simulation results at Strategic Nodes, UIF Scenario.

Strategic Node	Mean Flow (cfs)	Median Flow (cfs)	Surface Water Supply (cfs)	Percentile Flows (cfs)		
				25th	10th	5th
PDE08 Pee Dee River near Bennettsville	8,046	6,129	Minimum Flows Not Applicable Due to Correction of Negative Flows from NC Headwaters	3,703	2,699	2,229
PDE15 Pee Dee River below Pee Dee	9,673	7,457		4,638	3,263	2,796
Pee Dee River Below Lynches River Confluence	11,732	9,070		5,641	3,836	3,277
Great Pee Dee River below Little Pee Dee Confluence	14,892	11,561		7,065	4,787	4,051
PDE13 Black Creek near Quinby	540	463		294	207	165
PDE04 Lynches River near Bishopville	751	524		279	177	138
PDE05 Lynches River at Effingham	1,001	712		384	247	193
PDE28 Little Pee River at Galivants Ferry	2,883	2,162		1,197	721	577
PDE26 Black River at Kingstree	984	647		299	166	115

Table 5-19. Percent change in UIF Scenario flows at Strategic Nodes relative to Current Scenario flows.

Strategic Node	Mean Flow (cfs)	Median Flow (cfs)	Surface Water Supply (cfs)	Percentile Flows (cfs)		
				25th	10th	5th
PDE08 Pee Dee River near Bennettsville	1.4%	-0.4%	Minimum Flows Not Applicable Due to Correction of Negative Flows from NC Headwaters	-0.1%	6.0%	10.4%
PDE15 Pee Dee River below Pee Dee	2.2%	1.0%		2.8%	6.7%	14.7%
Pee Dee River Below Lynches River Confluence	1.4%	1.8%		2.6%	5.6%	10.4%
Great Pee Dee River below Little Pee Dee Confluence	0.7%	0.4%		-0.4%	3.2%	7.2%
PDE13 Black Creek near Quinby	2.4%	2.5%		5.1%	8.5%	9.2%
PDE04 Lynches River near Bishopville	-0.1%	-0.2%		-0.3%	-0.4%	-0.6%
PDE05 Lynches River at Effingham	-0.5%	-0.6%		-1.1%	-1.7%	-2.2%
PDE28 Little Pee River at Galivants Ferry	-1.2%	-1.3%		-2.1%	-3.2%	-3.7%
PDE26 Black River at Kingstree	-1.5%	-2.3%		-4.7%	-7.8%	-11.3%

5.3.6 Comparison of Low Flows

Model simulations using a daily timestep were performed to more closely evaluate the differences in simulated low flows between scenarios, compare to 7Q10 flows, and to support the application of biological response metrics described in Chapter 5.3.7.

The model's daily simulation results were first used to compare low flows simulated during the drought of record. In this instance, the drought of record is generally defined by the period of lowest recorded streamflow since data collection began. Streamflow in the Pee Dee Basin was typically lowest in the summer of 2002, and therefore it is generally considered as the drought of record for the basin. However, at some locations in the basin, streamflow was similarly low or lower during the early summer and fall of 2001.

The hydrographs in Figure 5-5 depict model-simulated daily streamflow for the Current Use, UIF, P&R, 2070 Moderate Demand, and 2070 High Demand Scenarios during the summer of 2002 at strategic nodes on the Little Pee Dee River, Black River, and Great Pee Dee River. Each hydrograph tells a slightly different story, as noted below.

- On the Little Pee Dee River (top hydrograph), simulated P&R Scenario flows are slightly lower (about 10 cfs) than Current Use, Moderate Demand 2070, and High Demand 2070 Scenario flows. There is no discernable difference in flows between the Current Use, Moderate Demand 2070, and High Demand 2070 Scenarios. The UIF flows are appreciably higher in the UIF Scenario, reflecting the larger difference in surface water withdrawals in the North Carolina portion of the basin for naturalized versus current-day and projected 2070 conditions.

- On the Black River (middle hydrograph), simulated UIF Scenario flows are the lowest of the four scenarios and the 2070 High Demand Scenario flows are the highest. This is because there are several municipal and industrial groundwater users upstream of this strategic node that discharge to surface water. Their increasing withdrawals from groundwater also equate to increasing wastewater discharges.

- On the Great Pee Dee River (bottom hydrograph), there is significant variability in the UIF Scenario flows because of the previously mentioned issues with negative flows in the UIF inflow timeseries that was provided for North Carolina. Accordingly, the daily UIF flows should generally be ignored. The P&R Scenario flows are approximately 100 cfs lower than the Current Use, Moderate Demand 2070, and High Demand 2070 Scenario flows. There is no discernable difference in the low flows of the Current Use, Moderate Demand 2070, and High Demand 2070 Scenario flows, reflecting the fact that the cumulative impact of surface water withdraws and returns (from both surface water and groundwater), do not appreciably alter the flow regime at the bottom of the basin, as represented by this Strategic Node.

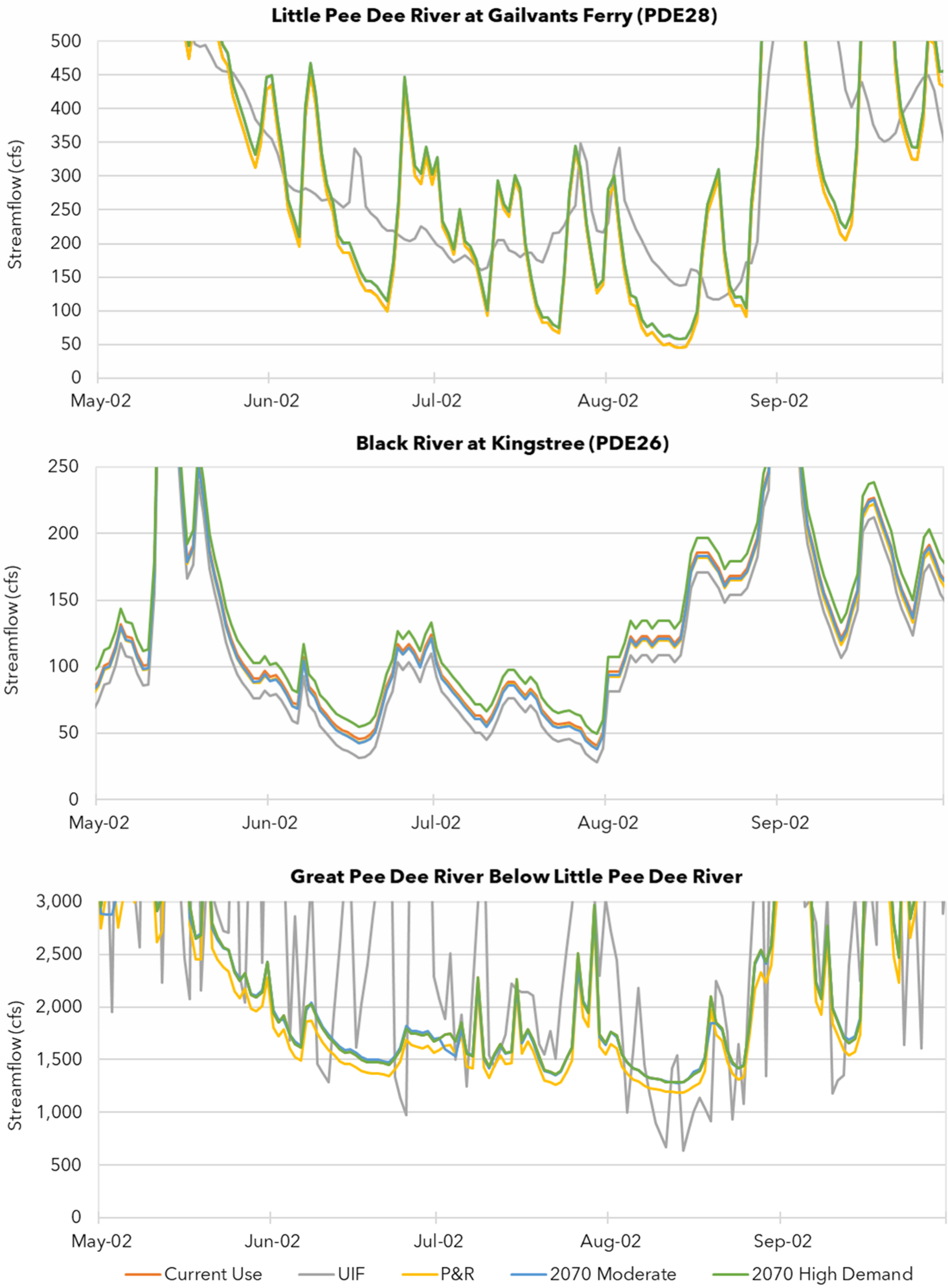


Figure 5-5. Comparison of daily timestep simulation results for all Scenarios during the drought of record at three Strategic Nodes.

The daily timestep simulations were also used to compare scenario flows to calculated 7Q10 flows. The 7Q10 flow is defined as the lowest 7-day average flow that occurs (on average) once every 10 years. 7Q10 flows are calculated from actual USGS gaging station records that correspond to the Strategic Nodes used in the SWAM model. The 7Q10 flow is a commonly used low-flow metric.

Table 5-20 shows the frequency (as a percentage) that simulated daily flows at each strategic node, for each scenario, were below the calculated 7Q10 flows. There is generally very little difference in the frequency of simulated flows below the calculated 7Q10 flow between scenarios, at most locations. One notable exception is at the Black Creek near Quinby (PDE13) Strategic Node. Here, P&R Scenario flows are considerably lower, with 45 percent of the days in the simulation experiencing a flow below the 7Q10 flow, compared to an approximately 1 percent frequency for the other scenarios. This is because of the very large (and unrealistic), upstream withdrawal representing the IR: Oaklyn Plantation registration. As previously noted, this water user has not reported any water use.

Table 5-20. Low-flow frequency comparison to 7Q10 flows.

Strategic Node	Gage Length of Record (years)	7Q10 (cfs)	UIF	Current	2070 Moderate Demand	2070 High Demand	Permitted and Registered
PDE08 Pee Dee River near Bennettsville	32.4	801	3.5%	0.0%	0.0%	0.0%	0.0%
PDE15 Pee Dee River below Pee Dee	26.5	1,061	2.3%	0.0%	0.1%	0.5%	0.6%
PDE13 Black Creek near Quinby	21.5	74	0.6%	1.1%	0.8%	0.6%	44.9%
PDE04 Lynches River near Bishopville	50.2	93	2.9%	2.8%	2.9%	3.0%	3.1%
PDE05 Lynches River at Effingham	93.6	117	1.8%	1.5%	1.6%	1.6%	1.6%
PDE28 Little Pee Dee River at Galivants Ferry	81.3	224	0.5%	0.6%	0.4%	0.4%	0.6%
PDE26 Black River at Kingstree	93.6	7.9	0.0%	0.0%	0.0%	0.0%	0.0%

5.3.7 Application of Biological Response Metrics

The biological response metrics developed by Bower et al. (2022) were correlated to model-simulated daily flows from the various planning scenarios to assess the potential for ecological risk, as described in The Nature Conservancy et al. (2023). Results of this assessment are not presented in their entirety, but rather illustrated by example for the various biological response metrics used.

The consistent methodology used is discussed in Bower et al. (2022) and summarized in this plan in Chapter 5.2.1. Fundamentally, the four selected hydrologic metrics (mean daily flow, base flow, frequency of low flow, and timing of low flow) are compared to current conditions and expressed as a percentage change relative to future demand scenarios. This percentage change is converted into a percentage change in the biological response metric using the pre-developed correlation relationships between these factors and plotted on a risk scale. Table 5-21 and Figure 5-6 illustrate the process.

Table 5-21. Example of calculating changes in the biological metrics at the Black Creek near Quinby Strategic Node.[1]

Demand Scenario	Current Scenario Flow (cfs)	Projected Demand Scenario Flow (cfs)	Percentage Change in Flow Metric	Biometric	Percentage Change in Biometric	Standard Error
UIF	537	550	2.34	Richness	1.63	0.107
Moderate 2070		533	-0.82	Richness	-0.57	0.107
High Demand 2070		531	-1.16	Richness	-0.81	0.107
P&R		267.3	-50.23	Richness	-35.0	0.107

[1]This table is one example, extracted from the analysis at the Black Creek near Quinby Strategic Node, and looks at the single hydrologic metric of mean daily flow (MA1) and its correlation with the single biological metric of species richness for fish taxa.

Once the changes in flow-ecology relationships are quantified via machine learning techniques, they are converted into a risk chart. The three risk categories, high, medium, and low, are determined by sudden and significant changes in biological health, driven by the change in the hydrologic metric, as shown in Figure 5-6.

Biological response metrics were applied at Strategic Nodes on four major tributaries to the Pee Dee River: Black Creek, Lynches River, Black River, and Little Pee Dee River. Figure 5-7 presents representative results for some of the combinations of hydrologic metrics and biological response metrics on the four major tributaries. These results do not constitute the full array of results for all locations and all metrics but are offered to help support understanding of the process, the results themselves as shared with the RBC, the consistency of results, and the interpretations that follow.

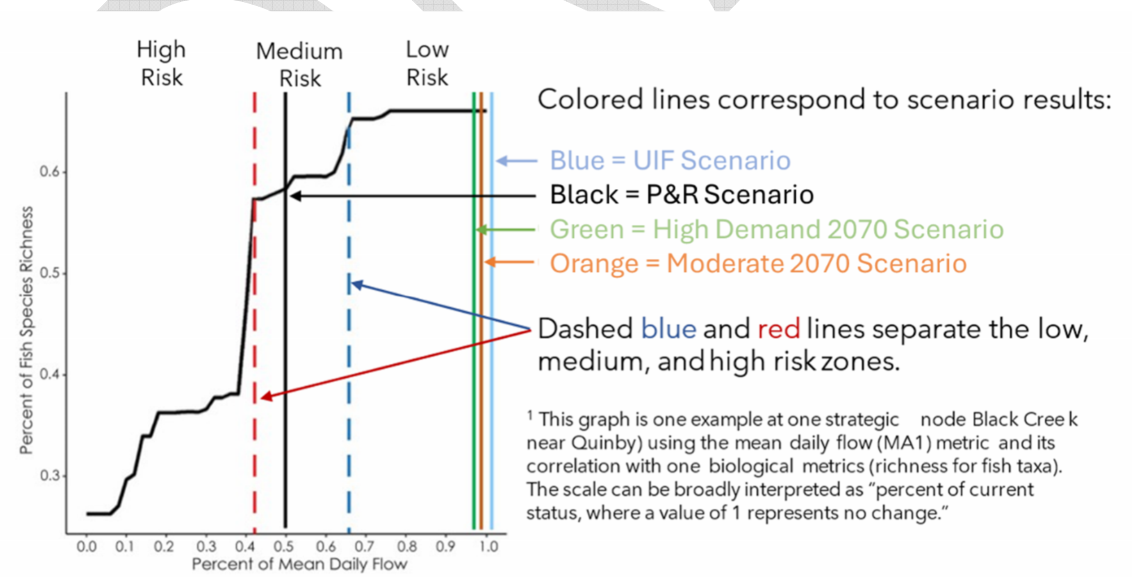


Figure 5-6. Example of the conversion of changes in biological metrics into risk[1].

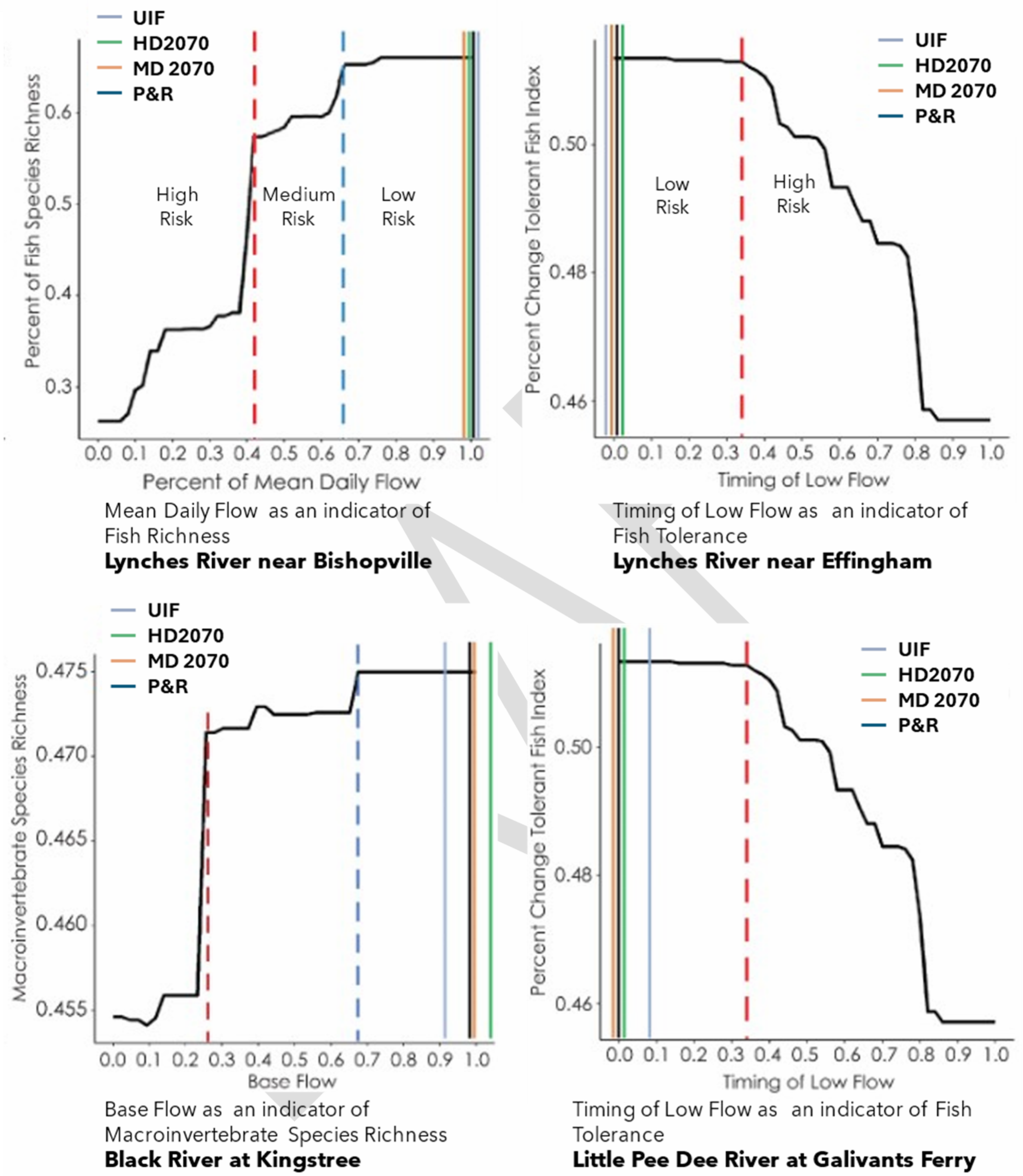


Figure 5-7. Selected biological risk level results for various biological metrics and Strategic Node locations (The Nature Conservancy et al. 2023).

As illustrated in Figure 5-6, a large change in mean daily flow for the P&R Scenario is predicted to reduce the number of fish species by 35 percent at the Black Creek near Quinby location. In no other locations was mean daily flow simulated to change significantly from the Current Use Scenario to the Moderate 2070 Scenario, High Demand 2070, or P&R Scenario.

Considering the timing of low flow (Figure 5-7, bottom right graph), the greatest change was projected under the unimpaired flow regime at the Little Pee Dee River at Galivants Ferry where the timing of low flow was altered by 7.5 percent relative to current conditions, resulting in a 16.7 percent reduction in the mean tolerant fish index. No other SWAM scenario projected large changes (>1 percent) in the timing of low flow, thus remaining in the low-risk zone.

Considering the metric of the frequency of low flow, the greatest shift was projected under unimpaired flow scenario at the Little Pee Dee River at Galivants Ferry. A reduction in low flow frequency was reduced 36.1 percent relative to current conditions, resulting in a 28.5 percent reduction in the mean tolerant fish index. No other SWAM scenario projected large changes (>1 percent) in the timing of low flow, thus remaining in the low-risk zone.

In general, these results suggest that while projected water use scenarios are a low risk to stream biodiversity, high water withdrawals, especially the fully permitted and registered allocation water use scenarios, could pose a medium to high risk to fish species and could result in large losses in the number of fish species. The findings do not rule out all potential risks to ecological integrity or aquatic biodiversity related to other metrics or flow alterations. For proper context, the following are some important limitations of the work:

- Biological response metrics and associated risks were only calculated at select nodes, principally at the downstream end of primary tributaries. There may be other locations in the river network that are more susceptible to flow changes or where changes in flow would result in significantly different conditions than existing. This could lead to more significant impacts to associated ecological integrity and tolerance in these unexamined locations.
- Processing biological samples from wadable sampling locations and hydrologic records throughout the Pee Dee River basin via machine learning techniques derived the relationships between hydrologic metrics and biological responses. Wadable access, while more limited downstream and in larger tributaries, is the most widespread form of surface water across the basin.
- The assessment was limited to the hydrologic and biological response metrics selected by the principal investigators, and for which biologically meaningful correlation had been established. This limited the use of these metrics to four hydrologic metrics and three biological metrics. The findings do not rule out potential risks for ecological integrity or tolerance related to other flow metrics or other forms of flow changes.
- Because the SWAM model focuses principally on primary and secondary tributaries, the study did not examine impacts on smaller headwater streams, which may be more vulnerable to flow management changes, but which are also less likely to be affected by large-scale changes in their flow regimes. Since the SWAM model includes all streams where significant flow management occurs (i.e., permitted and registered withdrawals and major discharges), the likelihood of significant flow alteration on non-modeled streams is low.

The demand scenarios are based solely on potential future changes on withdrawals, and do not consider other human impacts that affect instream flow. Increased development of the landscape from forest or agricultural land cover to suburban/urban development will continue to degrade the flow regime, which will exacerbate the effects of water withdrawals on the ecological integrity of streams and rivers in the basin. As such, the estimates of potential biodiversity loss are likely underestimated. Additionally, the flow metrics used to estimate flow-ecology relationships were estimated based on precipitation, temperature, land cover, etc. within a recent period of record. Future changes in these factors will affect the shape and magnitude of flow-ecology relationships. Accordingly, incorporating future climate and land use projections would likely alter our estimates of future water withdrawals impact on aquatic biodiversity.

5.4 Groundwater Conditions

Groundwater conditions in the Pee Dee River basin were evaluated based on available data from groundwater monitoring data, potentiometric mapping, and estimates of future water demand. A description of SCDES's groundwater monitoring and mapping program is included in Section 3.3.2.

In the Pee Dee River basin, groundwater monitoring data in the Crouch Branch and McQueen Branch aquifers show a general decline in groundwater levels over time due to groundwater extraction exceeding recharge rates. Declining groundwater levels are important because as of 2021, groundwater withdrawals from these aquifers represent 45 percent of the basin's reported water withdrawals (without consideration of withdrawals for energy generation). Public water supply and agricultural irrigation represent 89 percent of the use in the basin with well intakes distributed across the entire basin. Reported withdrawals between 2011 to 2023 generally showed an increasing trend but cannot be attributed to use alone due to better reporting in response to additional reporting regulations beginning in 2021 (SCDNR 2024).

Several wells completed in the Crouch Branch and McQueen Branch aquifers were selected to illustrate the major trends observed in the aquifers of the Pee Dee River basin. Figures 5-8 and 5-9 show the locations of trend network and synoptic network wells completed in each aquifer. Where spatial resolution of trend network wells (those with a daily average time series) were lacking, synoptic network wells (those with periodic manual measurements) are used together to create potentiometric maps. Evaluating these datasets together, along with reported water use and estimates of water demand projections, provide the basis for assessing current and historical groundwater conditions in the water source.

Water level trends in the Crouch Branch and McQueen Branch aquifers differ spatially from the upper to lower basin primarily due to distance from the recharge zone, the degree of confinement from the overlying geology, and aquifer characteristics. Recharge of the Crouch Branch and McQueen Branch occurs in the basin's upper reaches mainly in Marlboro, Chesterfield, and the northernmost portions of Darlington and Lee Counties. Water levels close to this highly permeable zone fluctuate with climate patterns. Where the aquifer is unconfined, water levels follow topography and interact with surface water bodies. Farther away from the recharge zone, the aquifers increase in depth but also in volume beneath confining units composed of clays.

Moving coastward, highly productive coarse grain sands grade to a finer grain sand and silt, with clay beds frequently occurring. These finer grain sediments reduce the aquifer's ability to transmit water. Therefore, recharge is slower and cases where groundwater extraction exceeds recharge, such as the cone of depression located at Georgetown County, become more likely.

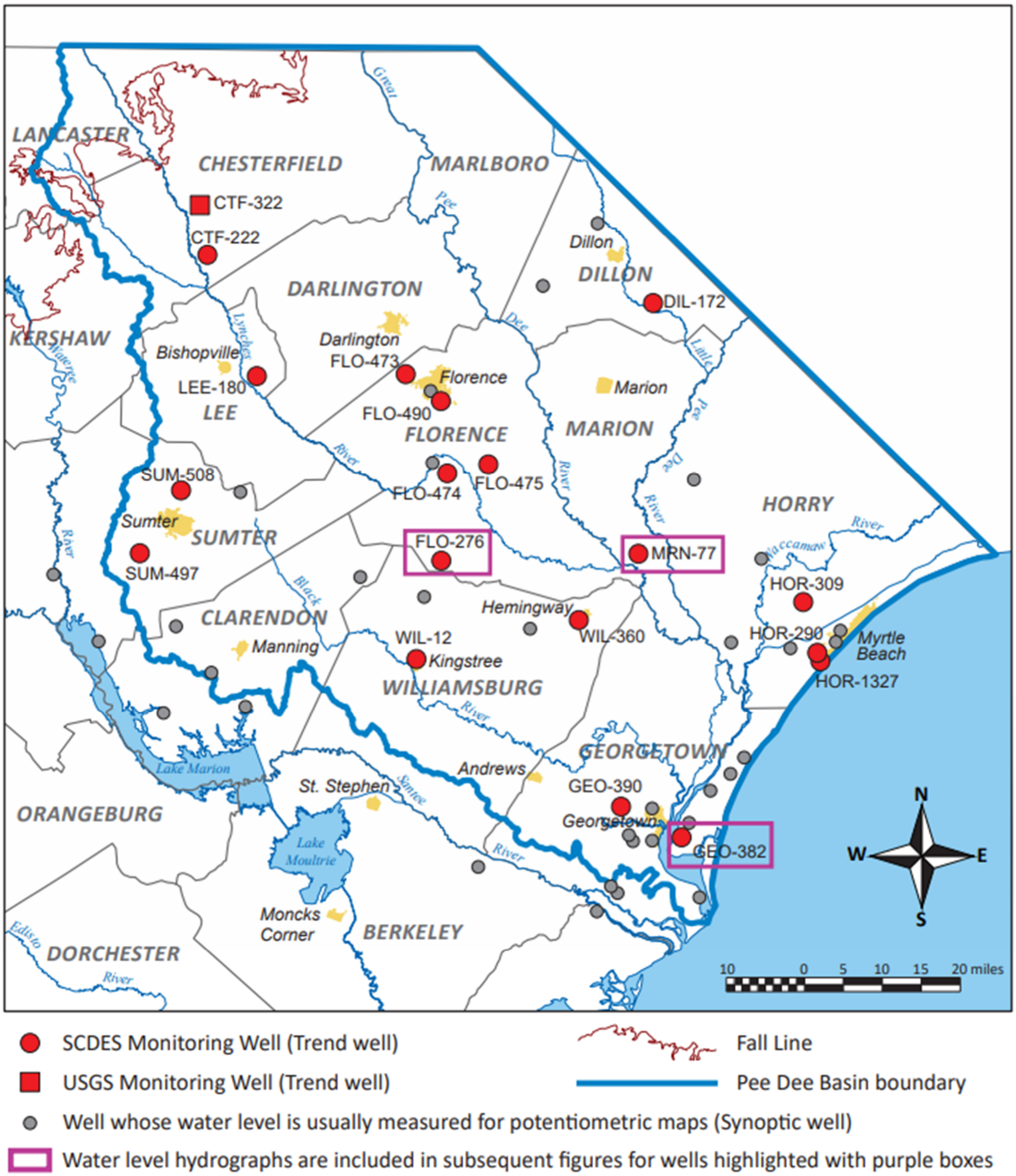


Figure 5-8. Locations of trend and synoptic wells completed in the Crouch Branch aquifer.

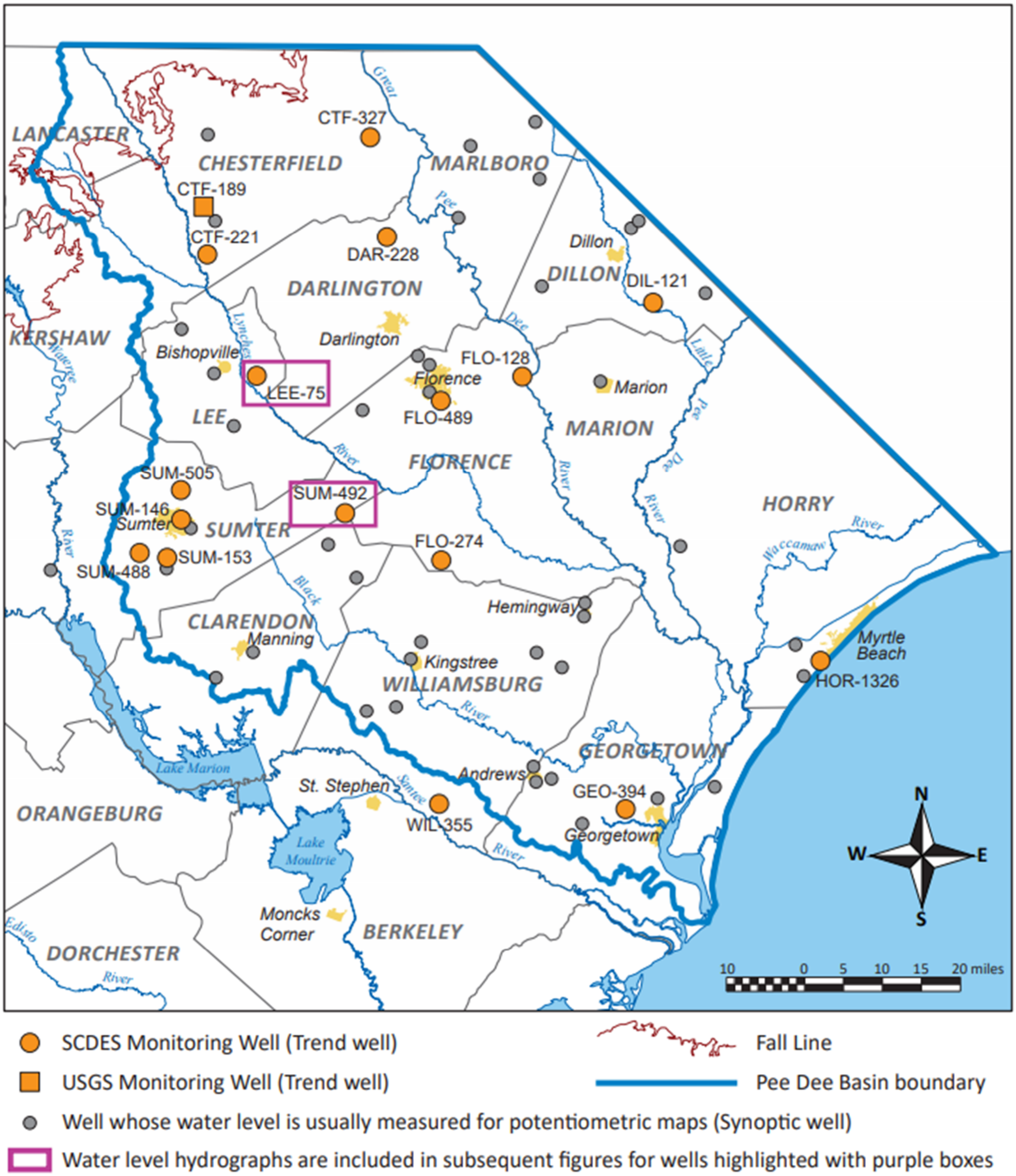


Figure 5-9. Locations of trend and synoptic wells completed in the McQueen Branch aquifer.

Groundwater levels in the Crouch Branch aquifer at monitoring sites in Florence County (FLO-0276) and Marion Country (MRN-0077) are shown in Figure 5-10. Both sites show a downward trend that is characteristic of the Crouch Branch in the Pee Dee River basin. Site FLO-0276 is located closer to the Fall

Line and receives more recharge. The site shows an irrigation well signal, with recharge in the winter and pumping in the summer; however, there is a steady decline in groundwater levels. Site MRN-0077 is located farther from the Fall Line, and the site shows less seasonal variability. Similarly, this site shows a downward trend in groundwater levels.

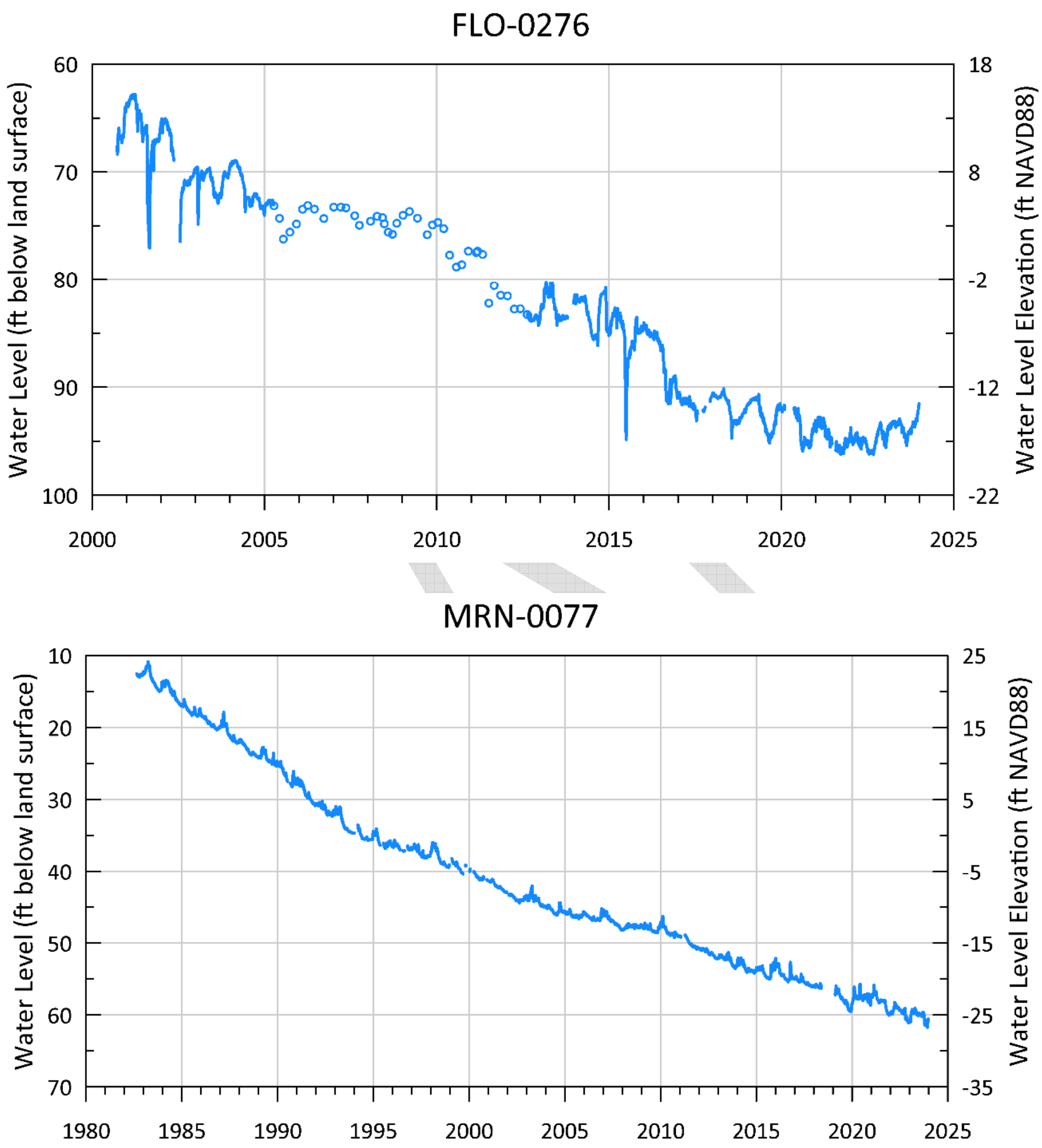
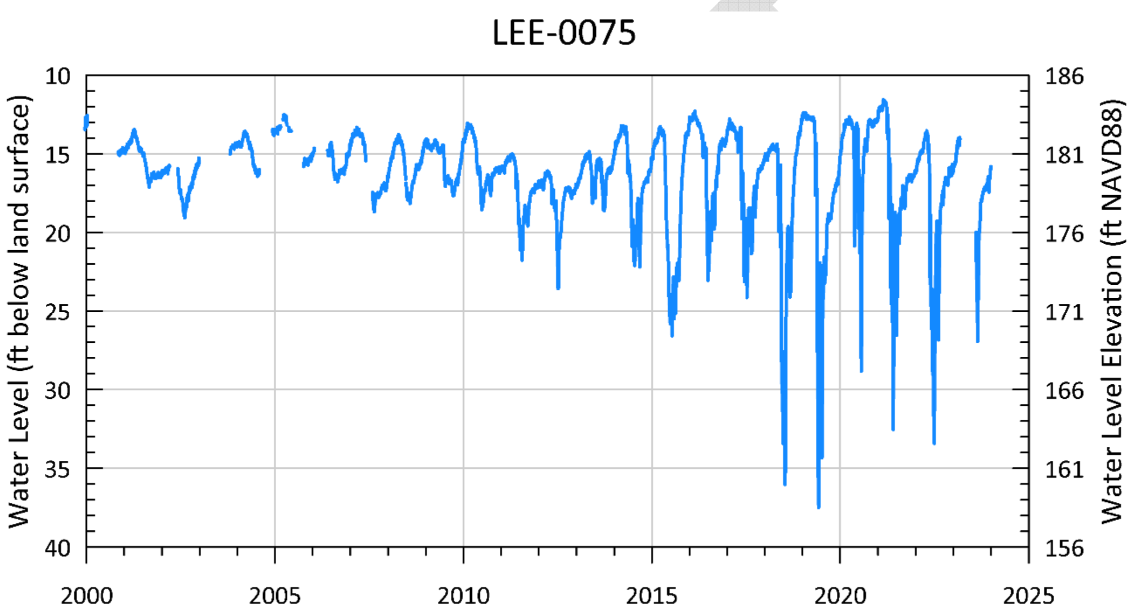


Figure 5-10. Groundwater levels in Crouch Branch aquifer in Florence and Marion counties.

Groundwater levels in the McQueen Branch aquifer at monitoring sites in Lee County (LEE-0075) and Sumter County (SUM-0492) are shown in Figure 5-11. The figure shows daily average and manual water level readings in feet below land surface. Both sites are in agricultural areas where groundwater is used for irrigation. Site LEE-0075 shows an irrigation well signal, where groundwater levels decline in the summer months due to irrigation pumping and then rise in the winter months due to recharge and less pumping. The increasing magnitude of summer drawdowns at LEE-0075 since 2014 indicate an increase in agricultural pumping in that area in recent years. Because LEE-0075 is close to the recharge area near the Fall Line, groundwater levels at this site recover each year. Site SUM-0492 also shows an irrigation well signal due to its proximity to several high-yielding irrigation wells.

Because the aquifer at SUM-0492 is deeper and is farther from the recharge zone than LEE-0075, the water level does not rebound to the level of the previous growing season, which results in a consistent downward trend. This reduction of head of about 1 foot per year since 2010 indicates a declining resource. Downward trends in groundwater levels are present aquifer-wide in areas not near the recharge zone.



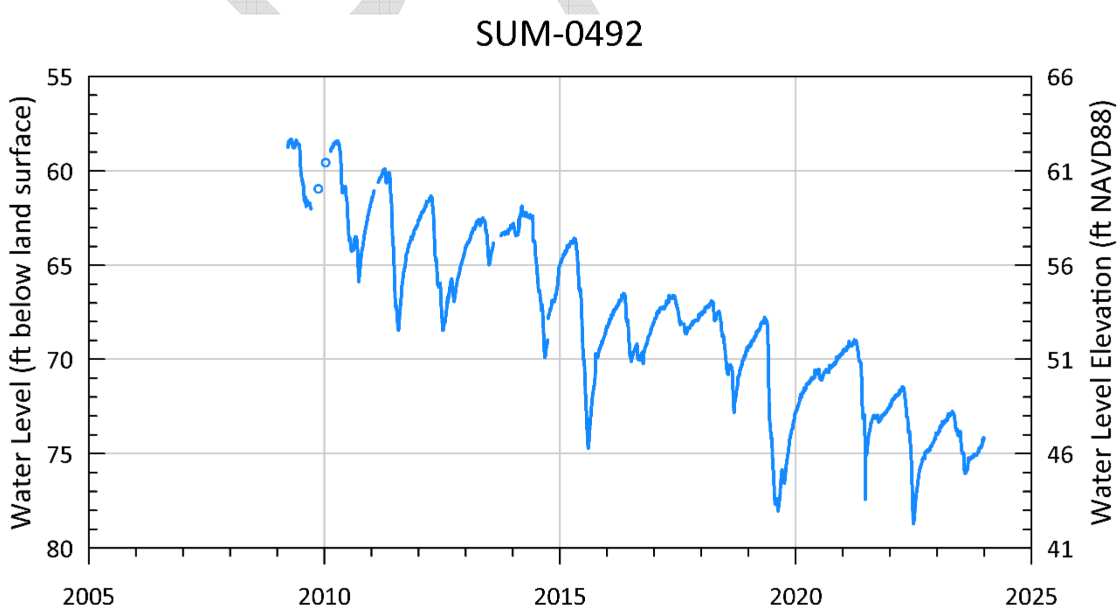


Figure 5-11. Groundwater levels in McQueen Branch aquifer in Lee and Sumter counties.

A majority of permitted agricultural irrigation wells are in the upper to middle portions of the Pee Dee Basin. Irrigation in these areas is projected to continue or increase over the planning horizon (see Figure 4-4). Agricultural water use is seasonal and tied to regional climate, which allows the aquifer to recover during the non-irrigation season and during wet years. While aquifer declines are observed with increasing distance from the recharge zone, it is expected that future declines in aquifer levels in these areas will not have the same severity as those in the lower portion of the basin.

Groundwater levels in a Crouch Branch aquifer well near Georgetown are shown in Figure 5-12. This well is located near the coast and shows a general decline in groundwater level associated with the large cone of depression in Georgetown County. Water levels have fallen at a rate of almost 2 feet a year between 2014 and 2023. Recovery in late 2023 may be the result of a reduction in pumping in Georgetown. This decline is consistent with declines observed in the aquifer for many years and is discussed in the following section. Declines are observed in both the Crouch Branch and McQueen Branch aquifers.

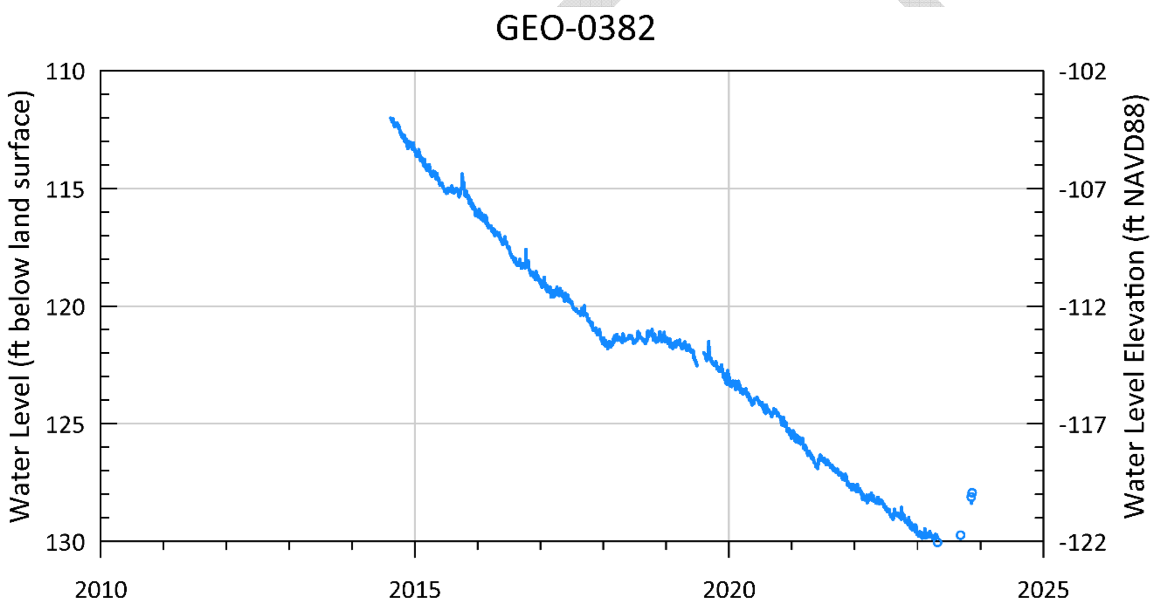


Figure 5-12. Groundwater levels in Crouch Branch aquifer in Georgetown County.

Potentiometric maps, which illustrate the surface elevation contours to which groundwater levels will rise in wells completed in the aquifer, indicate a general groundwater flow direction towards the coast. Potentiometric surfaces of the major aquifers present in the basin (and in South Carolina, overall) are shown in Figure 5-13 and Figure 5-14, based on interpretation of groundwater-level data collected in a campaign approach usually during the months of November and December. The resulting maps identify cones of depression where groundwater levels have declined. The greatest declines are centered at pumping wells, and the zone of influence can be narrow or spread out for tens of miles (SCDNR 2022). The largest cone of depression in the Pee Dee River basin is in Georgetown, and cones of depression are present in Myrtle Beach and Florence (SCDNR 2022). These cones of depression are discussed in more detail in the following sections, along with discussions of how future groundwater use may affect groundwater levels in these areas.

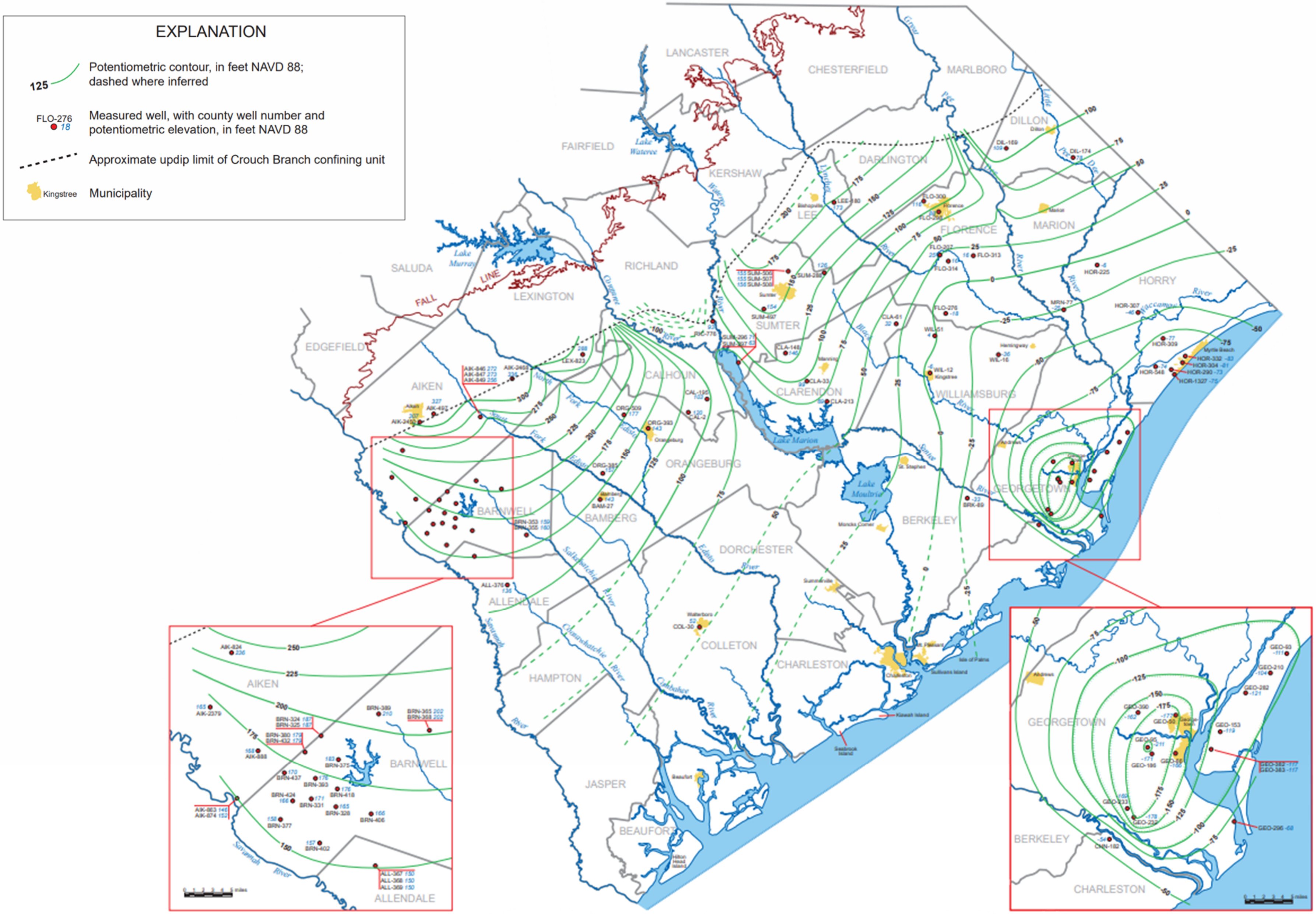


Figure 5-13. Potentiometric surface map of the Crouch Branch aquifer in November – December 2020.

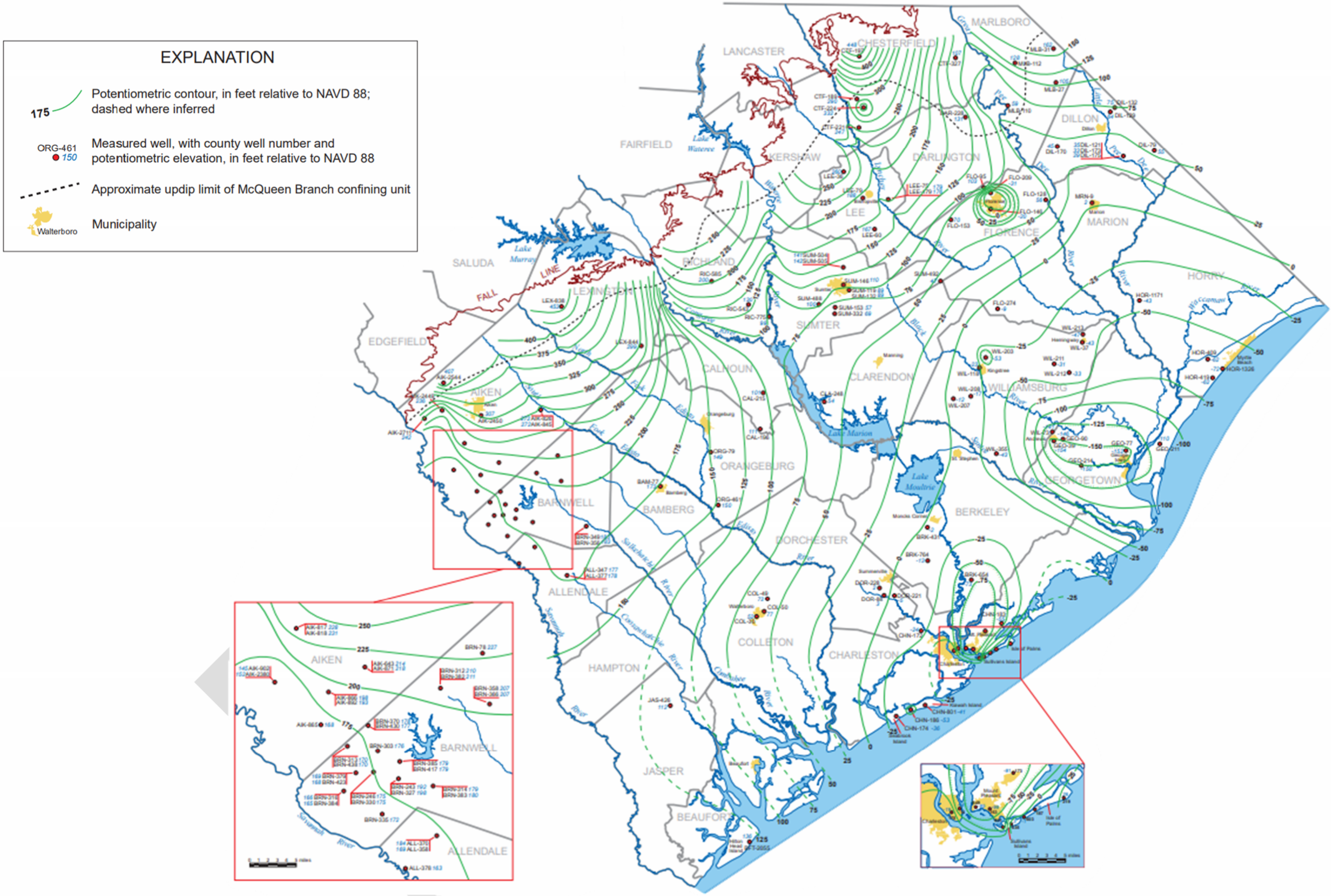


Figure 5-14. Potentiometric surface map of the McQueen Branch (and Charleston) aquifer, November – December 2022.

5.4.1 Coastal Cone of Depression

In the upper Coastal Plain, groundwater levels appear to be generally stable, and no significant long-term decline in aquifer water levels has been observed. In the lower Coastal Plain, however, there is a trend of groundwater levels declining at a rate of about one foot per year in Williamsburg and Horry counties, and as much as two feet per year in parts of Georgetown County. This decline is seen in both the Crouch Branch and McQueen Branch aquifers.

Much of the groundwater use in these counties is for public water supply. In 2022, reported withdrawals from water supply wells in Georgetown and Horry counties (Waccamaw CUA) was 81 percent of the overall annual reported groundwater use (3,139 million gallons out of an overall use of 3,866 million gallons). Water supply wells screened solely in the Crouch Branch and across both the Crouch Branch and McQueen Branch aquifers provide the largest portion supply followed by wells completed solely in the McQueen Branch aquifer. It is difficult to assess water use by aquifer in these areas due to this diversity of well construction.

Groundwater use for the water supply sector in Georgetown and Horry counties has remained relatively stable since 2013. The average county-wide reported water supply use between 2013 and 2023 was 2.8 MGD and 5.5 MGD for Georgetown and Horry counties, respectively (see Figure 5-15). During this same period, both continuous and periodic groundwater levels collected in the region declined at a rate of approximately 2 feet per year. Figure 5-12 illustrates this decline in a groundwater monitoring well in Georgetown County.

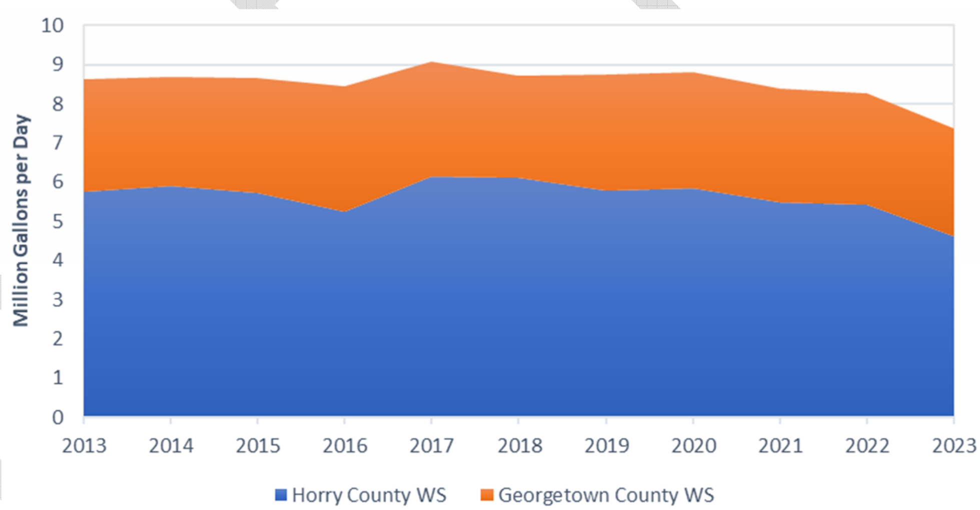
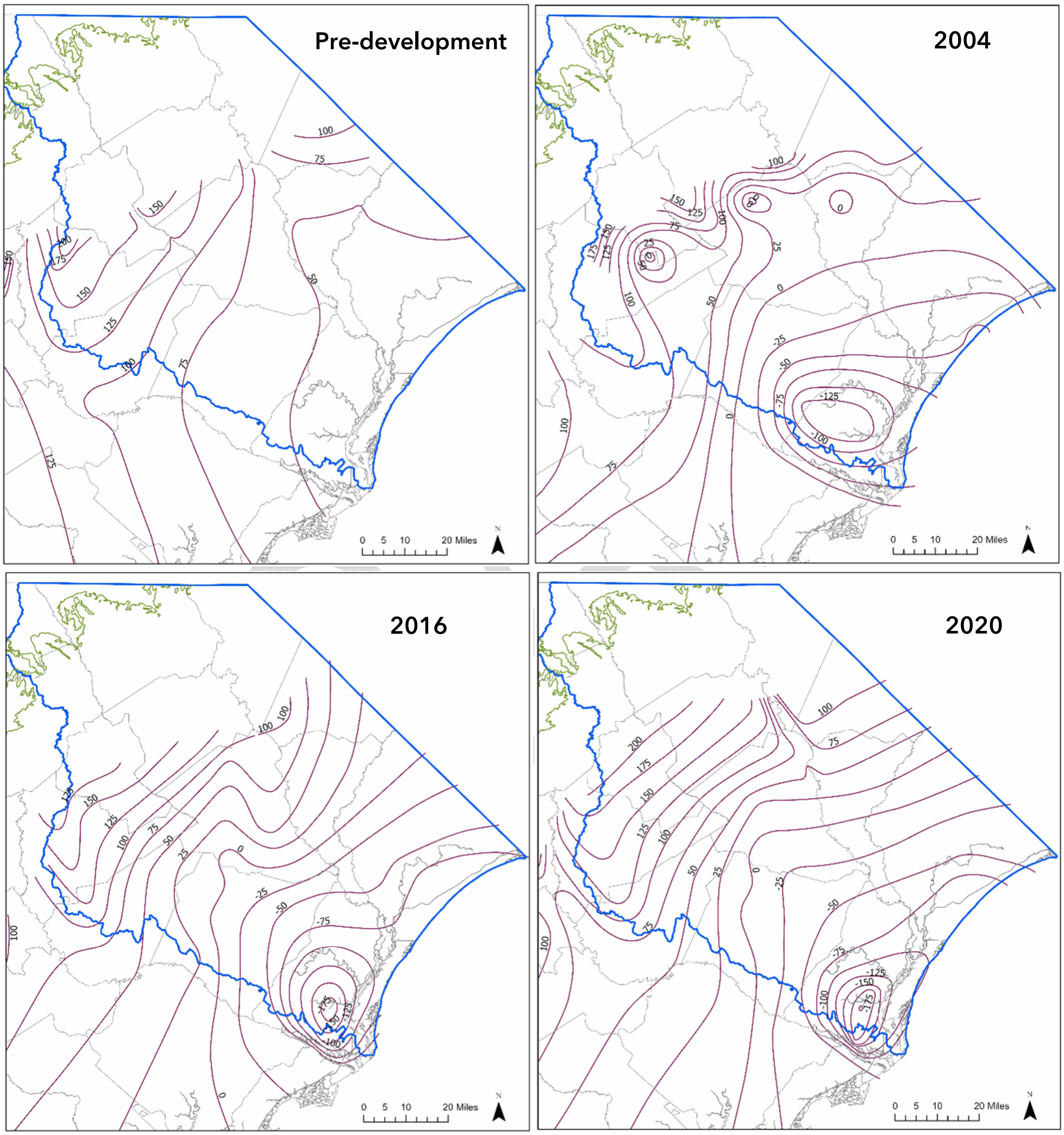


Figure 5-15. Reported groundwater use for water supply in the Waccamaw Capacity Use Area between 2013 and 2023.

The declining groundwater level in Figure 5-12 is symptomatic of a large cone of depression observed in the Crouch Branch and McQueen Branch aquifers that is centered over Georgetown County. The cone of depression has been forming for many years. In fact, potentiometric maps dated as early as 1975 show water level declines in the Crouch Branch aquifer of 125 feet when compared to predevelopment levels (Pelletier 1985). Since that time, subsequent water level maps constructed from water levels collected in 2004, 2016, and 2020 in the Crouch Branch aquifer have shown a steady decline in water levels near Georgetown to depths of approximately 250 feet below predevelopment levels. The cone has spread for tens of miles away from the pumping center due to finer sediments in the aquifer near the coast in contrast to the coarse-grained sediments in the upper basin further to the north and west.

While the cone of depression near Georgetown County is acute, the entire coastal region encompassing both Georgetown and Horry counties has seen lowered potentiometric pressure in the Crouch Branch aquifer with declines of around 100 feet or more. Figure 5-16 shows different depictions of the Crouch Branch potentiometric surface over time since pre-development and illustrates the historical declines in coastal groundwater pressure in the Crouch Branch aquifer. The McQueen Branch aquifer in the same region has experienced similar declines but not at the same rate and with less severity.



Crouch Branch aquifer potentiometric water level contour (elevation in feet referenced to NAD88)

Figure 5-16. Potentiometric surface maps of the Crouch Branch aquifer over time (prior to groundwater development, 2004, 2016, 2020).

Georgetown and Horry counties are expected to see additional growth in water demand driven by anticipated population increases along the coast. In Georgetown County, projections suggest that by 2070, water demand will increase by 105 percent under the Moderate Scenario. Current and projected Georgetown County water supply demands are shown in Figure 5-17. Reported use in 2023 was 42.1 MGD (39.3 MGD was from surface water sources, and 2.8 MGD was from groundwater). By 2070, the Moderate Scenario projects water demand to increases to 86.5 MGD (82 MGD from surface water and 4.5 MGD from groundwater). Most of the future demand (95 percent) is anticipated to be supplied by surface water sources. However, demands supplied by groundwater sources are anticipated to increase by 60 percent (from 2.8 MGD to 4.5 MGD) over the planning horizon.

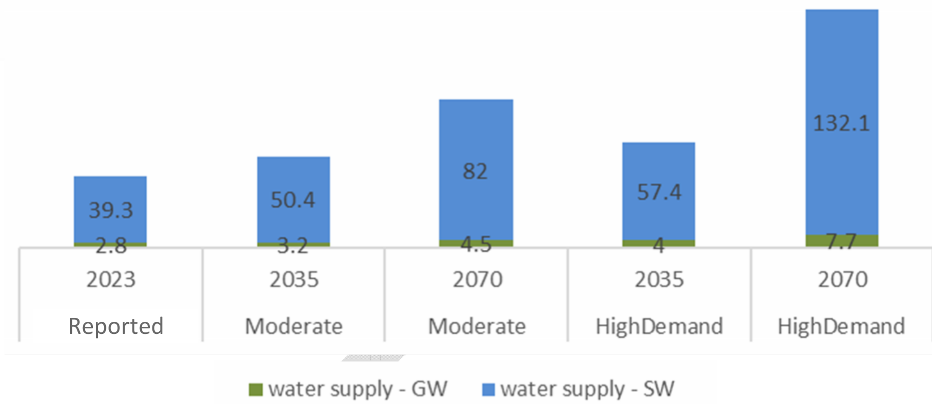


Figure 5-17. Water demand projections (in MGD) by source of supply for Georgetown County.

In Horry County, projections suggest that by 2070, water demand will increase by 109 percent under the Moderate Scenario. Current and projected Horry County water supply demands are shown in Figure 5-18. Reported use in 2023 was 25.4 MGD (19.4 MGD was from surface water sources, and 6 MGD was from groundwater. By 2070, the Moderate Scenario projects water demand to increases to 53 MGD (41 MGD from surface water sources and 12 MGD from groundwater). Most of the future demand (71 percent) will be supplied by surface water sources. Demands supplied by groundwater sources are anticipated to double (from 6 MGD to 12 MGD) over the planning horizon.

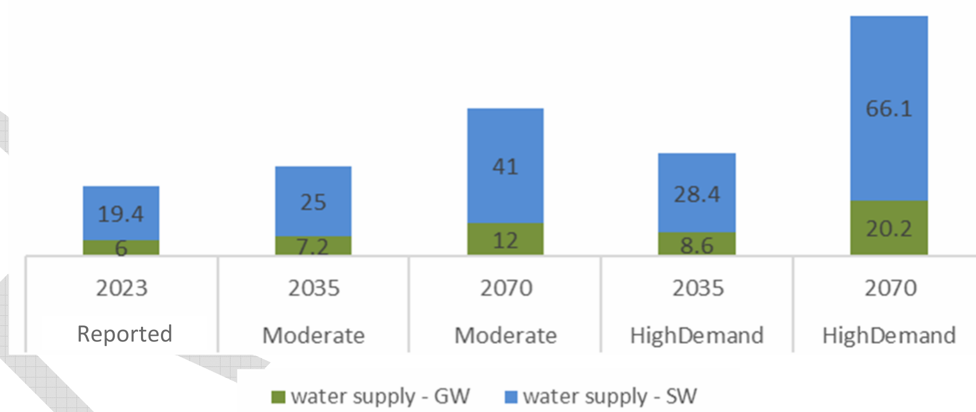


Figure 5-18. Water demand projections (in MGD) by source of supply for Horry County.

While much of the future growth in Georgetown and Horry counties will be supplied by surface water sources, increases in groundwater use could exacerbate existing declines in groundwater supplies. Water providers in Georgetown and Horry counties recognize the groundwater supply risk and have been implementing conjunctive surface water and groundwater management practices that utilize aquifer storage and recovery strategies.

If groundwater use continues at its current rate and distribution in the basin, this trend will likely continue, and over the 50-year planning horizon, groundwater levels in the major aquifers of Williamsburg County and Horry County will decline about 50 feet from current levels, and possibly as much as 100 feet in parts of Georgetown County. If that happens, water levels in the Crouch Branch aquifer in these counties will likely fall below the top of the aquifer, which could lead to irreversible damage to the aquifer as well as possible land subsidence. Because of its depth, water levels in the McQueen Branch aquifer would still be several hundred feet above top of that aquifer.

It is worth noting that the above discussion relates to static water levels. Because water levels in the vicinity of actively pumped wells may be significantly lower than the regional static water level, water levels in the Crouch Branch aquifer near pumping centers may reach critical levels years earlier than elsewhere in the basin.

5.4.2 Florence County Cone of Depression

Long-term use of groundwater from the McQueen Branch aquifer in Florence County has caused a cone of depression. The potentiometric contour maps of the McQueen Branch aquifer in Figure 5-14 and also in Chapter 6 (Figure 6-4) show a steeply contoured cone of depression in the potentiometric surface centered in Florence County. The cone of depression and high use of groundwater for municipal needs has been a cause of concern for stakeholders in the county.

It is unclear whether future groundwater uses in Florence County will impact the cone of depression. In Florence County under the Moderate Scenario, overall municipal water demand is anticipated to decrease by 18 percent due to potentially declining population. Reported municipal water use for Florence County in 2023 was 18.4 MGD (7 MGD for surface water and 11.4 MGD for groundwater). By 2070, the Florence County water demand is anticipated to decline to 15.1 MGD (5.4 MGD for surface water and 9.7 for groundwater) under the Moderate Scenario. While groundwater demand is expected to decrease by 15 percent in the Moderate Scenario, it will still be the primary source of supply (1.8 times more than surface water). In the High Demand Scenario, municipal water use in Florence County is anticipated to increase.

In contrast to potentially declining future municipal demands, industrial demand for surface and groundwater supplies is anticipated to increase by 53 percent by 2070 in the Moderate Scenario. Reported use for the industrial sector in 2023 was 14.8 MGD (13 MGD for surface water and 1.8 MGD for groundwater). By 2070, industrial water demand is anticipated to increase to 22.6 MGD (17.9 MGD for surface water and 4.7 MGD for groundwater) under the Moderate Scenario. Significantly more surface water than groundwater is used in the industry sector currently, but groundwater is anticipated to have a disproportional future increase in use. Over the planning horizon, the demand from surface water supplies is anticipated to increase by 37 percent, but the demand for groundwater supplies is anticipated to grow by 161 percent.

In the Moderate Scenario, a decline in municipal water demand for groundwater of 1.7 MGD will potentially be offset by an increase in demand for groundwater supplies by the industrial sector of 2.9 MGD. Impacts to the cone of depression, if any, will depend on the location of new groundwater use and the aquifer from which groundwater is extracted. In addition, a recently implemented conjunctive water management strategy involving greater use of surface water supplies to relieve stress on groundwater supplies has reversed long term aquifer declines in some parts of Florence County (see Chapter 6, Section 6.2.3 for more information). The RBC recommends that groundwater uses and aquifer levels continue to be monitored in the Florence County area to inform the potential need for additional water management strategies to mitigate groundwater supply risks, should they arise.

5.5 Summary of Water Availability Assessments

The application of the surface model using current and projected rates of water withdrawals resulted in the identification of several key observations and conclusions regarding the availability of surface water resources in the Pee Dee River basin. Several observations and conclusions were also identified for groundwater resources. Although lacking a model to simulate current and future groundwater demand scenarios, the approach of using current and historical water level and water use trends resulted in the identification of areas where water management strategies have been successfully employed through regulatory action that has maintained the current supply. Areas were also identified that are lacking information for a thorough assessment. The approach for evaluating groundwater resources was developed to be data-ready when the groundwater model becomes available.

The key conclusions from water availability assessments, presented below, led to the RBC identifying and evaluating a suite of water management strategies to protect surface water supply and maintain adequate river flows, especially during low flow conditions, as well as address potential groundwater issues. The evaluation and selection of water management strategies is presented in Chapter 6 – Water Management Strategies.

The results and conclusions are based on surface water modeling that assumed historical climate patterns. As stated earlier, groundwater-related results and conclusions were not based on modeling. In subsequent phases of river basin planning, the RBC may decide to evaluate potential impacts to water supply availability resulting from changing climate conditions such as increasing temperatures and more variable precipitation. In addition, the RBC intends to further evaluate groundwater-related issues using the groundwater model when it is complete.

5.5.1 Key Surface Water Observations and Conclusions

The surface water availability modeling suggests a minimal risk of water supply shortages under reasonable future demand scenarios. It suggests there could be shortages for agricultural users in small headwater streams that do not have storage ponds; however, these shortages would be infrequent.

Specific observations and conclusions relative to each planning scenario are presented below.

- Physical surface water shortages were identified in the Current Scenario for 2 agricultural water users, 2 golf courses, and a mining operation in the SWAM model, ranging in frequency from 0.3 to 7 percent of months of the 89-year simulation period. However, many if not all the simulated shortages in this scenario are likely to be significantly tempered or avoided because of the on-site storage available from existing ponds which were not included in the model. The ponds provide much-needed storage during low flow conditions that occur during a drought.

- In the P&R Scenario (i.e., surface water withdrawals at fully permitted and registered amounts), river flows are predicted to decrease compared to the Current Scenario resulting in surface water shortages for just over one-third of the surface water users. The total permitted and registered amount of surface water (in the non-tidally influenced, modeled portion of the Pee Dee Basin) is 1,324 MGD, or more than twice the Current Use Scenario surface water demands of 576 MGD. The P&R Scenario represents an unrealistic scenario; however, it demonstrates that the surface water resources of the basin are over-allocated based on existing permit and registration amounts.

- In the Moderate Scenario, river flows are predicted to decrease only slightly, compared to the Current Use Scenario, throughout the basin. Modeled reductions are most pronounced during low flow periods. Calculated water user shortages remain essentially unchanged, relative to the Current Scenario. Surface water supplies are predicted to be adequate to meet increased demands resulting from moderate economic and population growth.

- In the High Demand Scenario, river flows are also predicted to decrease modestly, compared to the Current Scenario, throughout the basin. Modeled reductions are most pronounced during low flow periods. Median flows in the Pee Dee River at the USGS gaging station below Pee Dee are predicted to decrease by 7.1 percent and minimum flows by up to 15.9 percent by 2070, compared to the Current Use Scenario flows if population and economic growth is high and given a hotter and drier climate. Calculated water user shortages increase only slightly, in terms of both duration and intensity, from the Moderate and Current Use Scenarios.

- The differences in performance measures (flow statistics) at Strategic Nodes between the UIF Scenario and the Current Use Scenario are relatively small, indicating that current net withdrawals and discharges are not appreciably altering the current flow regime, compared to naturalized conditions. Current Use Scenario flows are larger than the UIF Scenario flows on the Lynches, Little Pee Dee, and Black Rivers because of water users that withdraw from groundwater and discharge to surface water.

- The application of biological response metrics and the development of flow-ecology relationships at Strategic Nodes demonstrated that while projected water use of the Current, Moderate and High Demand Scenarios are a low risk to stream biodiversity, high water withdrawals, especially the fully permitted and registered allocation water use scenarios, could pose a medium to high risk to fish species and could result in large losses in the number of fish species. The findings do not rule out potential risks for ecological integrity or tolerance related to other metrics or flow changes.

5.5.2 Key Groundwater Observations and Conclusions

The groundwater evaluation demonstrates that both the Crouch Branch and McQueen Branch aquifers can transmit large volumes of groundwater to support water demand withdrawals in most regions of the Pee Dee River basin. In the absence of testing the demand scenarios with a calibrated groundwater model, it is difficult to predict if groundwater supply shortages will exist under reasonable future demand scenarios.

Specific observations and conclusions relative to the groundwater assessment are presented below.

- Water level trends in wells near the recharge areas of the Crouch Branch and McQueen Branch aquifers have remained stable over time despite groundwater pumping. This demonstrates a pattern of consistent and sufficient recharge to both aquifers. It is likely that no groundwater supply shortages will occur under modeled projected use scenarios.

- Groundwater levels decline moving farther toward the coast from the recharge zone, which is consistent in both the Crouch Branch and McQueen Branch aquifers. In most cases, water levels are declining approximately 1 foot a year. The declines in the Crouch Branch aquifer observed near Georgetown are about 2 feet year.

- Groundwater gradients in both aquifers are influenced by pumping at the coast. It is possible that recharge is not reaching the coast because it is withdrawn up dip (or further inland). Finer sediments in the coastal counties do not transmit water as easily, further exacerbating declines.
- The continued growth and expansion of a cone of depression in the potentiometric surfaces of groundwater in the Crouch Branch and McQueen Branch aquifers in Georgetown County has been monitored for years. While groundwater pumping is a driver, the specific reasons for the degree and nature of the decline are not fully understood and may include under or unreported withdrawals and geologic factors.
- At current rates of groundwater use, by 2070, groundwater levels in Williamsburg and Horry counties may decline an additional 50 feet, and in parts of Georgetown County, as much as 100 feet, bringing water levels in the Crouch Branch aquifer to critically low levels.
- Groundwater levels should be monitored routinely, particularly in the lower Coastal Plain and coastal counties. In addition to the measurement of static water levels, water levels in actively pumping wells should occasionally be measured.
- The updated Coastal Plain groundwater model is needed to make better projections of potential future groundwater levels and to evaluate strategies to mitigate groundwater supply risks.
- While not described in this chapter, Chapter 6 highlights conjunctive surface and groundwater management strategies that were implemented in Florence County and the resulting stabilization of groundwater levels.
- While conjunctive water management strategies have been very beneficial for slowing and reversing declining groundwater levels associated with the cone of depression in Florence County, groundwater levels should continue to be monitored to evaluate potential groundwater supply risks that may occur if future uses increase.

Chapter 6
Water Management Strategies

This chapter summarizes the evaluation of potential water management strategies identified by the Pee Dee RBC. The Framework identifies a two-step process to evaluate water management strategies. As a first step, proposed management strategies are simulated using the available models to assess their effectiveness in eliminating or reducing identified shortages or increasing surface water or groundwater supply. For strategies that are deemed to be effective, their feasibility for implementation is addressed during a second step. The Framework identifies multiple considerations for determining feasibility, including cost and benefits, consistency with state regulations, reliability, environmental and socioeconomic impacts, and potential interstate or interbasin impacts.

Under the Framework, a surface water management strategy is any water management strategy proposed to eliminate a surface water shortage, reduce a surface water shortage, or generally increase surface water supply to reduce the probability of future shortages. Strategies include demand-side management strategies that reduce supply gaps by reducing demands, as well as supply-side strategies that reduce supply gaps by directly increasing supply.

6.1 Overview of Strategies

The Pee Dee RBC reviewed and discussed a portfolio of various demand-side strategies consisting of agricultural water efficiency practices and municipal, industrial, and thermoelectric water conservation practices as listed in Tables 6-1 through 6-5, respectively. While these demand-side strategies were first identified and evaluated for surface water withdrawers, they also apply to groundwater withdrawers.

Table 6-1. Agricultural/Irrigation water efficiency practices.

Agricultural/Irrigation Conservation Practices	
Water Audits and Nozzle Retrofits	Crop Variety, Crop Type, and Crop Conversions
Irrigation Scheduling and Smart Irrigation	Irrigation Equipment Changes
Cover Cropping, Conservation Tillage, Mulch	Drip/Trickle Irrigation (for select crops)

Table 6-2. Golf course water efficiency practices.

Golf Course Conservation Practices	
Wetting Agents to Reduce Water Use	Soil Moisture Monitoring
Water Loss Control and Regular Maintenance	Low-Water Use Landscaping
Time of Day Watering Practices	

Table 6-3. Municipal water conservation and efficiency practices.

Municipal Conservation Practices	
Development, Update, and Implementation of Drought Management Plans	Residential Water Audits
Conservation Pricing Structures	Reclaimed Water Programs
Public Education on Water Conservation	Car Wash Recycling Programs
Leak Detection and Water Loss Control Program	Time of Day Watering Limits
Low Flow Fixtures, Toilets, and Appliances	Landscape Irrigation Programs and Codes
Water Efficiency Standards for New Construction	Xeriscaping

Table 6-4. Industrial water conservation and efficiency practices.

Industrial Conservation Practices	
Water Reuse and Recycling	Leak Detection and Water Loss Control Program
Water Efficient Processes	Low Flow Fixtures, Toilets, and Appliances
Drought Management Best Practice Collaboration	

Table 6-5. Thermoelectric water efficiency practices.

Thermoelectric Conservation Practices	
Reclaimed Water	Energy Saving Appliances
Switch to Combined-Cycle Natural Gas	

Surface water supply-side strategies reviewed and discussed by the RBC include conjunctive use of groundwater with surface water, increasing storage, water reclamation and reuse, conveyance, and desalination of seawater. Table 6-6 lists these strategies and example practices considered by the RBC. These strategies do not represent an exhaustive list of possible strategies that could be implemented by surface water users in the Pee Dee River basin. The most appropriate strategies for a water withdrawer will depend on their location, end use, water source, financial resources, and other constraints or opportunities.

Table 6-6. Supply-side strategies and example practices.

Supply-side Strategy and Practices
New or Increased Storage (new impoundments, reservoirs, and tanks; dredging to deepen impoundments; raising dam heights to expand impoundments; aquifer storage and recovery [ASR])
Water Reclamation (non-potable water reuse systems and stormwater capture and treatment)
Conjunctive Use (using groundwater to augment or replace surface water, especially during low flow periods)
Conveyance (interconnections with neighboring utilities, regional water systems, and interbasin transfers)
Desalination (desalination of seawater)

These strategies do not represent an exhaustive list of possible strategies that could be implemented by water users in the Pee Dee River basin. Similarly, not all these strategies will be applicable to all users in the basin. The most appropriate strategies for a water withdrawer will depend on their location, end use, water source, financial resources, and other constraints or opportunities.

The following sections present the surface water management strategies identified by the RBC, a technical evaluation of their potential effectiveness, and an assessment of their feasibility.

6.1.1 Demand-Side Strategies

6.1.1.1 Agricultural Water Efficiency Demand-Side Strategies

The agricultural water efficiency practices considered as part of the toolbox of strategies are further described below. These demand-side strategies also apply to groundwater users.

Water Audits and Nozzle Retrofits

Water audits monitor water use in an agricultural irrigation system to identify potential opportunities for water efficiency improvements. Water audits consider water entering the system, water uses, water costs, and existing water efficiency measures. They gather information on the size, shape, and topography of the agricultural field, depth to groundwater, vulnerability to flooding, pumping equipment, irrigation equipment, and past and present crop use and water use (Texas Water Development Board 2013).

Across the state, Clemson University Cooperative Extension Service specialists and researchers have held meetings to talk with farmers about center pivot irrigation and discuss the Clemson Center Pivot Irrigation Test Program, a type of water audit offered by the Clemson Extension Water Resources, Agronomic Crops, and Horticulture Teams. These audits measure irrigation uniformity—the consistency of irrigation depth across the irrigated area. Without irrigation uniformity, some crops may experience overirrigation and some may experience underirrigation, leading to wasted water and profit losses. The Center Pivot Irrigation Test Program can provide growers with a map of irrigation depths, observed issues such as leaks and clogs, estimated costs of over- or underwatering, estimated costs for nozzle retrofits, and design versus observed flow rates and system pressure (Clemson Cooperative Extension 2022a). After the audit, a report is provided that includes an estimated cost of under- and overirrigation based on crop types. This cost of suboptimal irrigation is compared to the estimated cost of a sprinkler retrofit.

The South Carolina Mobile Irrigation Laboratory pilot project is another example water audit program. This project was the result of a partnership with South Carolina Department of Agriculture (SCDA) and Aiken Soil and Water Conservation District. The audits identified areas of over- and underwatering, suggest energy savings opportunities, and recommend upgrades or operational changes (SCDNR 2019c). The project provided no-cost water and energy audits on 24 agricultural center pivot irrigation systems throughout South Carolina over 3 years (SCDNR 2020b).

Irrigation Scheduling and Smart Irrigation

Irrigation scheduling refers to the process of scheduling when and how much to irrigate crops based on the needs of the crops and the climatic/meteorological conditions. It ensures that crops are receiving the correct amount of water at the right time. The three main types of irrigation scheduling methods include soil water measurement, plant stress sensing, and weather-based methods. To measure soil water, farmers can use soil moisture sensors at varying depths. There are two different types of soil moisture sensors: (1) sensors that measure volumetric water content and (2) sensors that measure soil tension (University of Minnesota Extension 2024). Water application can be controlled and limited by identifying precise periods of time when irrigation is needed by using soil moisture measurements coupled with other factors such as soil temperature, crop growth stage, localized evapotranspiration, and even weather forecasts. For weather-based methods, farmers can research regional crop evapotranspiration reports to develop an irrigation schedule. Additionally, farmers can use thermal sensors to detect plant stress (Freese and Nichols, Inc. 2020). The use of thermal and/or moisture sensors to automatically schedule irrigation is referred to as *smart irrigation*. Advanced irrigation scheduling and use of sensors and smart irrigation technology may reduce water use by 15 percent on average (Smart Irrigation, 2019).

A Clemson study on Intelligent Water and Nutrient Placement (IWNP) combines smart watering strategies with smart fertilizer applications. IWNP uses smart sensing with model-based decision support systems to determine the irrigation water and nutrient application required by crops at a given time (Clemson College of Agriculture, Forestry and Life Sciences 2021). The IWNP systems are installed on existing overhead irrigation systems as a retrofit. The program first seeks to develop the system, then develop a training program to teach farmers how to use the system.

Feedback from the Pee Dee RBC on this strategy was that irrigation scheduling can be a useful tool, but it needs to be conducted correctly to be effective. Also, it is a strategy that can be used in both agricultural and municipal settings (though the specific approaches and technologies may be different).

Soil Management

Soil management includes land management strategies such as conservation tillage, furrow diking, and the use of cover crops in crop rotations. The USDA defines conservation tillage as "any tillage or planting system that covers 30 percent or more of the soil surface with crop residue, after planting, to reduce soil erosion by water" (USDA 2000). Conservation tillage can conserve soil moisture, increase water use efficiency, and can decrease costs for machinery, labor, and fuel. Types of conservation tillage include:

- No-Till – The soil is left undisturbed from harvest to planting except for nutrient injection. With this type of practice, planting is done in narrow seedbeds and a press wheel may be used to provide firm soil–seed contact (Janssen and Hill 1994).
- Strip Till – This practice involves tilling only the seed row prior to planting, disturbing less than one-third of the row width (CTIC 1999).
- Ridge Till – This practice involves planting into a seedbed prepared on ridges using sweeps, disk openers, coulters, or row cleaners. Residue is left on the surface between ridges to reduce soil loss (Janssen and Hill 1994).
- Mulch Till – This practice uses chisel flows, field cultivators, disks, sweeps, or blades to till soil in such a way that it does not invert the soil but leaves it rough and cloddy (Janssen and Hill 1994).
- Furrow Diking – The practice of creating small dams or catchments between crop rows to slow or prevent rainfall runoff and increase infiltration. Increased water capture reduces supplemental irrigation needed, resulting in a direct water savings. The RBC noted that this is a vendor-specific technology for certain types of crops, limiting its applicability within the Pee Dee River basin.

- Cover Crops – This practice involves planting cover crops, such as brassicas (either singly or in a mix) along with cereal grains or legumes, following the harvest of summer crops. Such cover crops use unused nutrients and protect against nutrient runoff and soil erosion. They can increase infiltration and water-holding capacity of the soil, which may indirectly result in water savings due to more efficient use of applied water.

Crop Variety, Crop Type, and Crop Conversion

Changing crop type from those that require a relatively large amount of water to crops that require less water can save significant amounts of irrigation water. Exact savings vary by crop but could potentially be on the order of 15.8 acre-inches per acre (Freese and Nichols, Inc. 2020). Switching the variety of a particular crop may also act as a water conservation strategy. For example, switching from full/mid-season corn to short-season corn could result in a 3.7 acre-inches per acre savings. However, such a change could also result in substantial yield loss, making it an unviable option for some growers (Freese and Nichols, Inc. 2020).

In South Carolina, transitioning away from corn and small grains, such as wheat, rye, oats, and barley, and increasing cotton crops can reduce water use. However, because the choice of crops is market-driven and certain machinery, infrastructure, and skills are specific to different crops, changing crop type may not make economic sense for growers, especially in the Pee Dee River basin. Conversion programs that offer growers incentives may be necessary.

Irrigation Equipment Changes and Drip/Trickle Irrigation

Changing from low efficiency irrigation equipment to higher efficiency equipment can reduce water use but requires significant financial investment. Irrigation methodologies may include mid-elevation, low elevation, low elevation precision application, or drip/trickle irrigation. These methodologies have application efficiencies of 78, 88, 95, and 97 percent, respectively (Amosson et al. 2011).

6.1.1.2 Golf Course Water Efficiency Demand Side-Side Strategies

The water efficiency practices for golf courses that are considered as part of the toolbox of strategies are further described below. These demand-side strategies also apply to golf courses that use groundwater for irrigation.

Wetting Agents to Reduce Water Use

Adding wetting agents can reduce the surface tension of water, allowing irrigation water to penetrate deeper into the root zone. Also known as soil surfactants, wetting agents can be applied for a number of different reasons including preventing localized dry spots, improving moisture uniformity, increasing water infiltration to the root zone, and improving moisture retention.

Water Loss Control and Regular Maintenance

Water loss control and irrigation system maintenance is a best management practice that reduces loss of water from irrigation system breaks and leaks. This can take the form of routine and frequent inspections of sprinkler heads and along irrigation system pipe routes to identify leaks. Sprinkler heads that are damaged by mowers or other equipment should be replaced immediately. Repairs, if not done correctly using proper materials, can result in recurring leaks.

Time of Day Watering Practices

Time of day watering practices limit water loss to evaporation, which is greatest during the middle part of the day and into the afternoons, when temperatures are at their highest. Generally, early morning watering is performed to minimize evaporation and prevent fungal growth that might occur after evening or nighttime watering.

Soil Moisture Monitoring

Irrigation efficiency of turfgrass can be improved by implementation of soil moisture sensors. Properly calibrated soil moisture sensors can help prevent over-irrigation, and if used properly, can help optimize the amount of water applied to turfgrass and provide a more consistent playing surface.

Low-Water Use Landscaping

Low water use landscaping is a best management practice for golf courses that can help limit the need for irrigation. Turfgrasses, groundcovers, shrubs, and trees can be specifically selected based on their water needs. Mulching around shrubs and in flower beds can reduce water loss through evaporation.

Low-water use, warm-season turfgrasses need to be drought tolerant while maintaining sufficient quality when mowed short to provide the playability needed by golfers. In a recent study of water requirements for warm-season turf grasses in several states, certain newer bermudagrass cultivars (TifTuf and Tahoma 31) showed increased drought resistance compared to older cultivars and outperformed other grasses in terms of lower irrigation requirement and acceptable turf quality. Newer and older cultivars of zoysiagrass were also evaluated and, in some cases, exhibited acceptable turf quality under drought conditions, but generally required more irrigation than bermudagrass varieties. The success and response of different turfgrass species are dependent on local climate and cultivar. Prior to selecting a low-water use turfgrass, the study recommended that golf courses establish test plots to assess the response of different species to less irrigation over a series of growing seasons (Serena, et al. 2023).

6.1.1.3 Municipal Water Efficiency and Conservation Demand-Side Strategies

Municipal water efficiency practices considered as part of the toolbox of strategies are further described in this subchapter. These demand-side strategies also apply to groundwater users.

Development, Update, and Implementation of Drought Management Plans

This strategy is already ongoing in the basin, because public suppliers were required to develop drought management plans as part of the Drought Response Act of 2000. Each drought management plan has a set of measurable triggers indicating when conditions have entered one of three phases of drought and corresponding response actions to reduce demand by a target percentage. Chapter 8 provides detailed description of the drought management plans in the Pee Dee River basin. The RBC recognizes the importance of these drought management plans for reducing demand and conserving water during critical low-flow periods. Under this strategy, public suppliers would continue to implement their drought management plans during drought conditions as well as keep their plans up to date to reflect any changes to the system.

Conservation Pricing Structures

Conservation pricing structures increase the unit cost of water as consumption increases. Utilities may have pricing structures that have a flat rate for customers, a unit use rate that varies with consumption, or some combination of the two. Conservation pricing sets higher unit use rates for customers whose usage exceeds set thresholds. This strategy assumes that consumers will curtail their personal use to avoid paying higher prices. The extent of demand reduction depends on the magnitude of the price increase as well as the local price elasticity of demand for water usage.

Under the Extreme Drought Phase of their Drought Management Plan, the City of Bennettsville has the option to implement an excessive use rate schedule if voluntary reductions in residential usage are not successful. These excessive use rates are tiered by usage, extending as high as three times the regular rate. The City's Drought Plan also outlines the option to implement a drought surcharge, which is a fee imposed on water use in excess of 7,500 gallons/household/month during a water supply shortage. The Town of Cheraw and Marlboro Water Company also have the option to implement an excessive use rate schedule and levy surcharges during drought conditions.

Public Education of Water Conservation

Water conservation education could occur through public schools, civic associations, or other community groups. Local governments could create informational handouts, social media campaigns, and/or include additional water conservation information on water utility bills. For this strategy to remain effective, public outreach would need to continued regularly to maintain public engagement and motivation.

Leak Detection and Water Loss Control Program

A water loss control program identifies and quantifies water uses and losses from a water system through a water audit. Once identified, sources of water loss can be reduced or eliminated through leak detection, pipe repair or replacements, and/or changes to standard program operations or standard maintenance protocols. Following these interventions, the water loss program can evaluate the success of the updates and adjust strategies as needed (EPA 2013).

Automated meter reading (AMR) and advanced metering infrastructure (AMI) are technologies that can assist with leak detection. AMR technology allows water utilities to automatically collect water-use data from water meters, either by walking or driving by the property. AMI systems automatically transmit water usage data directly to the utility, without requiring an employee to travel to the property. AMI systems collect data in real time. Both technologies reduce the staff time required to read meters and allow utilities to more frequently analyze actual consumption (as opposed to predicted usage based on less frequent manual meter readings). Higher than expected readings then can be noted and flagged as potential leaks. Because of their ability to collect data more frequently, AMI systems may detect consumption anomalies sooner than AMR. This allows for earlier detection of smaller leaks so that repairs can be made before major pipe breaks. AMI systems are more expensive to install than AMR systems and, therefore, may not be economical for smaller utilities. Hybrid systems on the market allow for future migration from AMR to AMI.

An example of a basin-wide water audit and water loss control program is that of the Catawba-Wateree Water Management Group (CWWMG), which is undertaking a significant water audit project to identify real (leaks) and apparent (meter inaccuracy) water losses throughout the basin. This project identified 17 billion gallons of non-revenue water that could be managed to increase utility revenue by $16.8 million (CWWMG n.d.). Subsequent phases involve conducting economic analyses and identifying water loss goals for each CWWMG member, and the entire group. A similar effort could be pursued within the Pee Dee River basin.

Georgia is one of the few states that have implemented statewide water loss control requirements. In 2010, the Georgia Water Stewardship Act was signed into law. The Act set water loss control requirements that apply to public water systems serving populations over 3,300 that include:

- Completing an annual water loss audit using American Water Works Association (AWWA) M36 methodology
- Developing and implementing a water loss control program
- Developing individual goals to set measures of water supply efficiency
- Demonstrating progress toward improving water supply efficiency

The Pee Dee RBC discussed some of the challenges that water providers may face in implementing water loss control programs. In some instances, inadequate metering data be a barrier to identifying specific locations where leaks and losses are occurring. If a water provider identifies needed repairs and upgrades to reduce water loss, funding may not be available to implement loss reduction work. Rate increases to fund loss reductions need to be implemented responsibly and in a manner that is affordable to customers. Federal and other funding assistance for water loss reduction activities should be investigated and used where appropriate.

Replacing Low Flow Fixtures, Toilets, and Appliances

Residents can be incentivized to replace household appliances and fixtures with low-flow alternatives that meet standards and requirements such as Leadership in Energy and Environmental Design (LEED) or the U.S. Environmental Protection Agency's (EPA) WaterSense. For example, toilet rebate programs offer rebates for applicants who replace old, inefficient toilets with water-efficient ones. If a toilet being replaced uses 3.5 gallons per flush (gpf) and the replacement toilet uses 1.28 gpf, there will be a savings of 2.22 gpf per rebate. Assuming a use rate of five flushes per day per person (DeOreo et al. 2016) and an average of 2.5 persons per household results in savings of 27.8 gallons per household per day for each rebate.

Water Efficiency Standards for New Construction

Local ordinances can require that renovations and new construction meet established water efficiency metrics. These ordinances may either be set by the local government or rely on existing water efficiency certification programs such as LEED or EPA's WaterSense. These programs have set water efficiency requirements for all household fixtures, such as a maximum rating of 2.5 gallons per minute (gpm) flow rate for showers and maximum rating of 1.6 gallons per flush for toilets (Mullen n.d.).

Residential Water Audits

Residential water audits allow homeowners to gain a better understanding of their personal water use and identify methods to reduce water use. Homeowners can perform these audits themselves using residential water audit guides or water utilities may provide free residential water audits to their customers. Residential water audits involve checking both indoor uses (e.g., toilets, faucets, showerheads) and outdoor uses (e.g., lawn sprinklers). Based on the results of the audit, homeowners may invest in low flow systems, repair leaks, and/or adjust certain personal water use behaviors.

Reclaimed Water Programs

Reclaimed water programs reuse highly treated wastewater for other beneficial purposes, reducing demands on surface water and groundwater. Water can be reclaimed from a variety of sources then treated and reused for beneficial purposes such as irrigation of crops, golf courses, and landscapes; industrial processes including cooling water; cooling associated with thermoelectric plants; and environmental restoration. The quality of reuse water would need to be matched with water quality requirements of the end use, and emerging contaminants of concern (e.g., per- and polyfluoroalkyl substances [PFAS] and microplastics) would need to be considered.

Car Wash Recycling Ordinances

In-bay automatic car wash systems use approximately 35 gallons of water per vehicle. Touch-free car wash systems, which rely solely on chemicals and high-pressure spray rather than on the gentle friction of a soft-touch wash, use approximately 70 gallons of water per vehicle. Assuming one bay and 100 customers per day, these two common types of systems use between 3,500 and 7,000 gallons of water per day. To reduce water usage, car wash recycling ordinances require all new car washes to be constructed to include recycled water systems. Recycled water systems allow for water used in washing or rinsing to be captured and reused. Ordinances can set a percentage of recycled water to total water used. Typical ordinances require at least 50 percent use of recycled water.

Time-of-Day Watering Limit

A time-of-day watering limit prohibits outdoor watering during the hottest part of the day, usually 10 a.m. to 6 p.m. This practice reduces water loss from evaporation.

Landscape Irrigation Program and Codes

Landscape irrigation programs or water-efficient landscaping regulations can encourage or require homeowners to adopt water-efficient landscaping practices. Such practices seek to retain the natural hydrological role of the landscape, promote infiltration into groundwater, preserve existing natural vegetation, and ultimately conserve water. Water-efficient landscaping may include the incorporation of native plants or low water–use plants into landscape design (City of Commerce, CA 2021).

Local governments can require the use of these water efficiency measures through municipal codes or encourage them through incentives or educational programs. Potential practices include:

- Smart Irrigation Controller Rebate – Utilities may offer rebates to homeowners who replace their existing irrigation controllers with smart irrigation controllers that adjust irrigation according to soil moisture levels (soil-moisture-based or SMS) and precipitation and/or evapotranspiration rates (weather-based or WBIC). Controllers can be WaterSense certified by meeting EPA criteria.

- Turf Replacement Rebate – Utilities may offer rebates to homeowners or businesses who replace irrigable turf grass with landscaping that requires minimal or no supplemental irrigation.
- Developer Turf Ordinance – Ordinances can be set that require new developments to have reduced irrigable turf grass area. Such development may be required to have low flow or microirrigation in plant beds, spray or rotor heads in separate zones for turf grass, or smart irrigation controllers to manage remaining turf area.
- Education Programs – Programs could be offered for homeowners to learn about water-efficient landscaping practices. Some examples of landscape irrigation improvements include:
  - Verifying the best irrigation schedule for the climate and soil conditions
  - Verifying the recommended nozzle pressure in sprinklers
  - Adjusting sprinkler locations to ensure water falls on lawns or gardens (not on sidewalks or other impervious surfaces)
  - Using a water meter to measure water used in landscape irrigation
  - Replacing high-water use landscape vegetation with native plants that naturally need less water and/or xeriscaping

Xeriscaping

Xeriscaping is a method of landscape design and maintenance that requires minimal water use. The principles of xeriscaping include using appropriate plants for the region, improving the soil to hold moisture, using mulches to limit evaporation, using no irrigation or efficient irrigation systems such as soaker hoses and drip systems.

6.1.1.4 Industrial Water Efficiency and Conservation Demand-Side Strategies

Industrial water efficiency practices considered as part of the toolbox of strategies are largely the same as the municipal efficiency practices. These practices include leak detection and water loss control programs; low flow fixtures, toilets, and appliances; and identification of drought-related best management practices. Although the Drought Response Act does not require the development of drought management plans for industrial surface water (or groundwater) users, implementation drought-related best management practices by industries would further extend surface water resources during times of drought at and downstream of industrial surface water withdrawals. While industry actively works to save water (and costs) during drought, sharing information among industrial water users regarding best management practices would be beneficial. Two additional strategies are further described in this subchapter. These demand-side strategies also apply to groundwater users.

Water Reuse and Recycling

Reclaimed water programs reuse highly treated wastewater for other beneficial purposes, reducing demands on surface water and groundwater. Water can be reclaimed from a variety of sources then treated and reused for beneficial purposes such as irrigation of crops, golf courses, and landscapes; industrial processes including cooling water; cooling associated with thermoelectric plants; and environmental restoration. The quality of reuse water would need to be matched with water quality requirements of the end use, and emerging contaminants of concern (e.g., per- and polyfluoroalkyl substances [PFAS] and microplastics) would need to be considered.

Water Efficient Processes

Industrial water users in the basin are generally thought to be efficient users of water supplies. Additional means for conservation should be explored, but their impact on the water supplies of the basin is limited due to the conservation practices by industrial users that are already in practice, and their efforts to minimize water losses. New industrial facilities in the Pee Dee River basin, especially large water users, would be expected to implement water efficient processes.

6.1.1.5 Thermoelectric Water Efficiency Strategies

Thermoelectric water efficiency practices considered as part of the toolbox of strategies largely relate to reducing thermoelectric energy demand. Reductions in energy demand reduce the cooling water withdrawals required to operate thermoelectric plants. Methods for reducing this demand include encouraging energy users to install energy-saving appliances, as well as switching to combined-cycle natural gas, solar power, or wind sources.

Another conservation approach is to use reclaimed water produced by upstream facilities as cooling water, in lieu of withdrawing directly from waterbodies. While this approach may reduce surface water withdrawals, it also reduces returns and therefore does not decrease the overall water use within the basin. It can provide a cooling water source of more constant temperature and quality, which can be more efficient in terms of cooling efficiency and therefore reduce energy losses (Ahlberg 2016).

6.1.2 Supply-Side Strategies

The Pee Dee RBC identified and considered five potential supply-side water management strategies: new or increased storage, water reclamation, conjunctive use, conveyance strategies, and desalination. These are discussed in this subchapter.

New or Increased Storage

Reservoirs and small impoundments add storage to improve resiliency to drought. An offline or online reservoir, which would divert and store water during high flow periods and release water to augment flows during low flow conditions in the Pee Dee River or major tributaries, was considered. Small impoundments are common in the Pee Dee River basin and provide storage needed to maintain (primarily agricultural) surface water intakes on small streams. There are currently 355 regulated dams in the basin that impound water, and countless smaller unregulated impoundments. Any dam constructed for a new reservoir or impoundment would be regulated by the State of South Carolina if it is 25 feet or greater in height, if it impounds 50 acre-feet or more of storage, or if its failure may cause loss of human life. Additional county-specific provisions may apply if a proposed dam could affect the designated floodplain of a river, or for other reasons, and USACE would have additional regulatory input on dams constructed in waters of the United States. The storage in existing reservoirs could also be expanded by raising dam heights, while smaller impounded pounds could be expanded through dredging.

Another method of increasing storage is aquifer storage and recovery (ASR). ASR technology allows for storing treated surface water underground during periods of low demand, to be used during peak consumption periods. This approach is especially valuable in areas where water demands or supplies fluctuate greatly. For example, in the Grand Strand area, summer tourists increase water demand well beyond the average daily demand. To provide additional water during these periods, the city of Myrtle Beach implemented an ASR program in the 1990s (SCDNR 2009). Under the program, periodically more surface water is treated than is needed to meet demand when demands are low, and the additional treated water is injected into the aquifer using ASR wells. When demands are high, the injected water is extracted for use. The additional treated water stored underground would have otherwise been discharged to the ocean and lost if not for the ASR program. The Grand Strand Water and Sewer Authority now operates this ASR program, which consists of 17 ASR wells in operation or under development (GSWSA 2023). Up to 11 MGD of treated water can be withdrawn from these ASR wells.

Water Reclamation

Water reclamation is the process of using wastewater or stormwater for a variety of purposes, both potable and non-potable. Water reuse systems were discussed earlier as an industrial demand-side strategy but can also be implemented to supplement water supplies for a variety of purposes, including agricultural and landscaping irrigation, boilers and cooling systems, and toilets.

Direct potable reuse involves treating wastewater to drinking water standards, rather than returning treated wastewater to the environment. This approach reduces nutrient loads on waterbodies and provides a safe drinking water source that is less dependent on weather conditions. South Carolina currently has no statutes or regulations related to direct (wastewater treatment to water treatment without an environmental buffer like a lake or river between) or indirect (using an environmental buffer like a lake before drinking water treatment) potable reuse (Payne 2017); however, a South Carolina Section of WateReuse was established in December 2021 to advance water recycling programs and regulations in the state. Several water utility representatives from the Pee Dee River basin currently serve as Director's At-Large of the South Carolina Section.

Stormwater capture and reuse reduces flooding and strain on stormwater collection systems, while providing an additional supply of water. It should be noted that stormwater (precipitation that reaches the ground) tends to require more advanced treatment than rainwater (precipitation that is collected prior to reaching the ground) due to contamination from roads and soil (WateReuse 2023).

Conjunctive Use

Conjunctive use is the combination of multiple sources of water to improve the resilience of the overall water supply. At the basin scale, conjunctive use of both groundwater and surface water is already occurring. Excluding water that is used for generating energy, about 56 percent of water withdrawn in the basin comes from surface water sources and 44 percent comes from groundwater sources (SCDNR, 2022). Types of conjunctive use include:

- **Full conjunctive use** is the ability of a water user to meet 100 percent of water demands from either groundwater or surface water.
- **Partial conjunctive use** is the ability of a water user to meet a portion of demands from either groundwater or surface water.

- **Noncentralized conjunctive use** occurs when a water user relies on surface and groundwater sources but does not have the ability to replace one with the other because of separate systems of delivery.

In the Pee Dee River basin, some municipal and agricultural surface water users also have one or more groundwater sources (wells). The City of Florence, for example, operates 29 wells which produce an average of about 10.5 MGD. This is supplemented by about 4.5 MGD of surface water from the Great Pee Dee River. For this basin planning process, the evaluation of conjunctive use focused on the use of groundwater to supplement surface water supplies during periods when stream flow is low as well as using surface water to supplement groundwater supplies where aquifers are declining.

The Pee Dee RBC noted that developing groundwater to supplement surface water sources can be beneficial for providing emergency supply during flooding conditions when surface water quality is poor or if surface water intakes are damaged.

Conveyance Strategies

Conveyance strategies can be used to supplement water supply when there are localized periods of high demand or interruptions to other water supply sources. Regional water systems and utility interconnections may provide additional supply to meet demand; however, the effectiveness of this approach is limited when water shortage is widespread impacting the entire region and/or all utilities in the area.

Establishing infrastructure and agreements for interbasin transfers provides the capability to source water from outside the basin. In South Carolina, permits are required for interbasin transfers and are conditioned on the availability of water in both the losing and receiving basins and if the transfer will negatively impact instream uses. Lake Marion Regional Water Authority/Santee Cooper is permitted to transfer up to 20 MGD from the Santee Basin to the Black (within the Pee Dee River basin), Edisto, and Combahee-Coosawhatchie subbasins (SCDNR 2009). There are no other interbasin transfers permitted for the Pee Dee River basin.

Desalination

Desalination treatment removes salt from seawater or brackish groundwater, enabling its use for freshwater applications. Technologies include distillation (boiling seawater and capturing the steam as condensate) and reverse osmosis (removing salt molecules using a semi-permeable membrane), which are both energy-intensive methods. Outside of the Pee Dee River basin, reverse osmosis has been used on Hilton Head Island to treat brackish groundwater which has begun to intrude the Upper Floridian Aquifer (Seacord 2015), and by Mount Pleasant Waterworks to treat brackish groundwater from the Charleston Aquifer.

6.2 Evaluation of Surface Water Strategies

The effectiveness of potential demand-side surface water management strategies in the Pee Dee River basin were simulated using the SWAM surface water model. No supply-side strategies were evaluated since no significant shortages were simulated in the Current Use, Moderate, or High Demand planning scenarios. Modeled shortages for the several agricultural and golf courses users in the planning scenarios were not expected to occur, or not expected to occur at a very high frequency because of the presence of impoundments and ponds that were not included in the model.

Nine demand-side scenarios (Scenarios 1, 2a, 2b, 2c, 3a, 3b, 3c, 4, and 5) were developed to evaluate a range of potential actions that could be used to reduce water demands and increase surface water flows. These scenarios are listed in Table 6-7 and described below. All nine scenarios were simulated using the High Demand 2070 Scenario water demand projections.

Table 6-7. Summary of surface water model scenarios evaluating demand-side water management strategies.

Scenario Name	Municipal Conservation?	Agricultural Conservation?	Industrial Conservation?	Supply-side Mitigation Measures
Scenario 1: Agricultural Conservation	No	Yes – 10% reduction	No	None
Scenario 2a: Municipal Surface Water Users Conservation (Low)	Yes – 10% reduction for surface water users	No	No	None
Scenario 2b: Municipal Surface Water Users Conservation (Medium)	Yes – 15% reduction for surface water users	No	No	None
Scenario 2c: Municipal Surface Water Users Conservation (High)	Yes – 20% reduction for surface water users	No	No	None
Scenario 3a: Municipal Surface Water and Groundwater Users Conservation (Low)	Yes – 10% reduction for surface water and groundwater users	No	No	None
Scenario 3b: Municipal Surface Water and Groundwater Users Conservation (Medium)	Yes – 15% reduction for surface water and groundwater users	No	No	None
Scenario 3c: Municipal Surface Water and Groundwater Users Conservation (High)	Yes – 20% reduction for surface water and groundwater users	No	No	None
Scenario 4: Industrial Conservation	No	No	Yes – 5% reduction for all industrial users except mining	None
Scenario 5: Agricultural Conservation; Municipal Surface Water and Groundwater Users Conservation (Low); and Industrial Conservation	Yes – 10% reduction for surface water and groundwater users	Yes – 10% reduction	Yes – 5% reduction for all industrial users except mining	None

The demand-side strategies were evaluated by assuming the projected municipal, industrial, and agricultural water demands would decrease because of implementing one or more strategies from the portfolio of demand-side strategies. There is high uncertainty regarding the effective reduction in demand for individual demand-side management strategies, as their effectiveness depends on the extent of implementation and the magnitude of impact for each instance of implementation. For example, water savings associated with irrigation equipment changes will depend on the number of water users who change their equipment, the level of efficiency of their existing equipment, the level of efficiency of the new equipment, the water demand of the crops to be irrigated, the irrigated acreage, and the individual's adjustment of irrigation scheduling in response to the increased efficiencies.

- **Scenario 1** evaluated the impact of agricultural conservation strategies that result in a 10 percent reduction in agricultural water demands. The 10 percent reduction was applied to both existing agricultural users and to future agricultural demands, as simulated at the outlet of select subbasins.
- **Scenarios 2a, 2b, and 2c** evaluated the impact of municipal conservation strategies that result in a 10, 15 or 20 percent reduction in municipal water demands from surface water. The percent reductions were applied to the three existing surface water users in the model domain (Bennettsville, Cheraw, and Florence).
- **Scenarios 3a, 3b, and 3c** evaluated the impact of municipal conservation strategies that result in a 10, 15 or 20 percent reduction in municipal demands from both surface water and groundwater. The percent reductions were applied to the three existing surface water users in the model domain (Bennettsville, Cheraw, and Florence) and to the 14 municipal groundwater users that discharge treated wastewater to surface water. The effect of demand reductions for municipal groundwater users is a reduction (by 10, 15 or 20 percent) in treated wastewater discharging to surface water. This will lower stream flows, and thus have the opposite of the intended effect, but may help improve groundwater levels and extend groundwater availability.
- **Scenario 4** evaluated the impact of industrial conservation strategies that result in a 5 percent reduction in industrial water demands, not including mining operations. The 5 percent reduction was applied to industries that withdrawal either surface water or groundwater.
- **Scenario 5** evaluated the cumulative impact of conservation strategies for all three water use sectors examined. A 10 percent reduction in agricultural water demands, 10 percent reduction in municipal demands, and 5 percent reduction in industrial demands was evaluated. The reductions in municipal and industrial demands were applied to both surface and groundwater users.

The effectiveness of the conservation strategies was examined at six Strategic Nodes identified in Figure 6-1. The nodes were selected to be representative cumulative impacts to flows along the Pee Dee River and its major tributaries. Table 6-8 provides the minimum, mean, and 5th percentile flows at the six Strategic Nodes for the High Demand 2070 Scenario. These flow statistics served as the basis for comparison to simulated flows in scenarios 1 through 9. Table 6-9 provides the minimum, mean, and 5th percentile flows at the six Strategic Nodes for all nine scenarios, and lists the percent difference of these flow statistics, compared to the High Demand 2070 Scenario flows in Table 6-8. A positive percent difference means that the flow statistic increased compared to the same High Demand 2070 Scenario flow statistic. These cells are shaded light green in the table. A negative percent difference means that a flow statistic decreased. These cells are shaded a light red in the table. No red or green shading indicates there was less than 0.1 percent difference in flow. Negative percent differences are a result of reductions in demand for municipal and/or industrial groundwater users which result in a similar decrease in treated wastewater discharge to surface water.

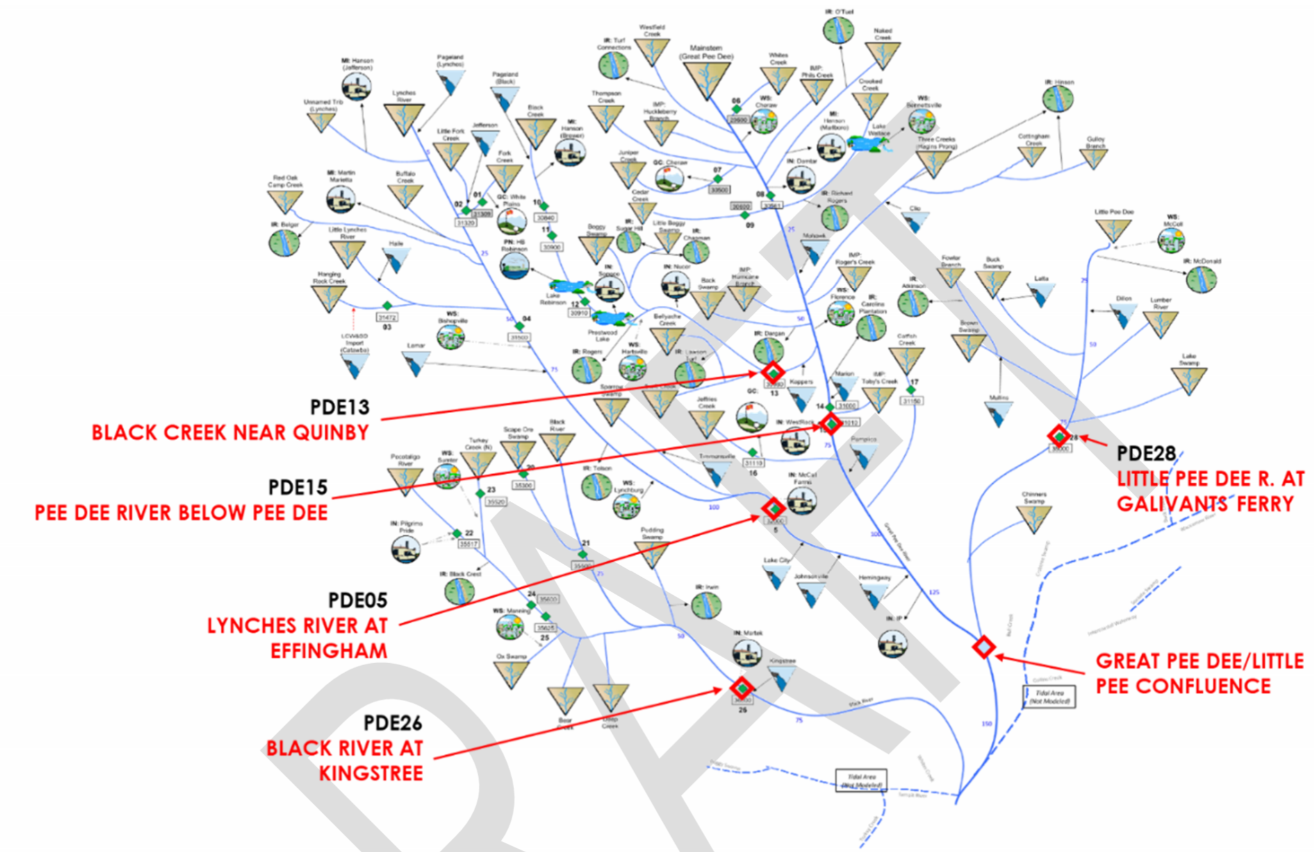


Figure 6-1. Location of Strategic Nodes used to evaluate stream flow following implementation of conservation strategies.

Table 6-8. Flow statistics for the High Demand 2070 Scenario.

Strategic Node	Minimum Flow (cfs)	5th Percentile Flow (cfs)	Mean Flow (cfs)
PDE15 Pee Dee River below Pee Dee, SC	928	1,974	8,964
Great Pee Dee / Little Pee Dee Confluence	1,547	3,464	14,450
PDE13 Black Creek near Quinby, SC	53	144	521
PDE05 Lynches River at Effingham, SC	71	196	1,005
PDE28 Little Pee Dee River at Galivants Ferry, SC	198	619	2,941
PDE26 Black River and Kingstree, SC	47	141	1,011

Table 6-9. Flow statistics for conservation scenarios and percent difference compared to the High Demand 2070 Scenario.

Strategic Node	Minimum Flow (cfs)	5th Perc. Flow (cfs)	Mean Flow (cfs)	Minimum Flow (% change)	5th Perc. Flow (% change)	Mean Flow (% change)
Scenario 1 - 10% Agriculture Demand Reduction						
PDE15 Pee Dee River below Pee Dee, SC	929	1,974	8,965	0.1%	0.0%	0.0%
Great Pee Dee / Little Pee Dee Confluence	1,548	3,464	14,451	0.1%	0.0%	0.0%
PDE13 Black Creek near Quinby, SC	54	145	521	0.5%	0.1%	0.0%
PDE05 Lynches River at Effingham, SC	71	196	1,005	0.1%	0.0%	0.0%
PDE28 Little Pee Dee River at Galivants Ferry, SC	198	619	2,941	0.0%	0.0%	0.0%
PDE26 Black River and Kingstree, SC	48	141	1,011	1.1%	0.0%	0.0%
Scenario 2a - 10% Municipal Demand Reduction (Surface Water Users Only)						
PDE15 Pee Dee River below Pee Dee, SC	932	1,978	8,968	0.4%	0.2%	0.0%
Great Pee Dee / Little Pee Dee Confluence	1,548	3,465	14,451	0.1%	0.0%	0.0%
PDE13 Black Creek near Quinby, SC	53	144	521	-0.5%	-0.2%	0.0%
PDE05 Lynches River at Effingham, SC	71	196	1,005	0.0%	0.0%	0.0%
PDE28 Little Pee Dee River at Galivants Ferry, SC	198	619	2,941	0.0%	0.0%	0.0%
PDE26 Black River and Kingstree, SC	47	141	1,011	0.0%	0.0%	0.0%
Scenario 2b - 15% Municipal Demand Reduction (Surface Water Users Only)						
PDE15 Pee Dee River below Pee Dee, SC	934	1,980	8,970	0.7%	0.3%	0.1%
Great Pee Dee / Little Pee Dee Confluence	1,549	3,466	14,452	0.2%	0.1%	0.0%
PDE13 Black Creek near Quinby, SC	53	144	520	-0.7%	-0.3%	-0.1%
PDE05 Lynches River at Effingham, SC	71	196	1,005	0.0%	0.0%	0.0%
PDE28 Little Pee Dee River at Galivants Ferry, SC	198	619	2,941	0.0%	0.0%	0.0%
PDE26 Black River and Kingstree, SC	47	141	1,011	0.0%	0.0%	0.0%

Table 6-9 (continued). Flow statistics for conservation scenarios and percent difference compared to the High Demand 2070 Scenario.

Strategic Node	Minimum Flow (cfs)	5th Perc. Flow (cfs)	Mean Flow (cfs)	Minimum Flow (% change)	5th Perc. Flow (% change)	Mean Flow (% change)
Scenario 2c - 20% Municipal Demand Reduction (Surface Water Users Only)						
PDE15 Pee Dee River below Pee Dee, SC	936	1,982	8,972	0.9%	0.4%	0.1%
Great Pee Dee / Little Pee Dee Confluence	1,550	3,466	14,452	0.2%	0.1%	0.0%
PDE13 Black Creek near Quinby, SC	53	144	520	-0.9%	-0.3%	-0.1%
PDE05 Lynches River at Effingham, SC	71	196	1,005	0.0%	0.0%	0.0%
PDE28 Little Pee Dee River at Galivants Ferry, SC	198	619	2,941	0.0%	0.0%	0.0%
PDE26 Black River and Kingstree, SC	47	141	1,011	0.0%	0.0%	0.0%
Scenario 3a - 10% Municipal Demand Reduction (Surface Water and Groundwater Users)						
PDE15 Pee Dee River below Pee Dee, SC	931	1,977	8,967	0.4%	0.2%	0.0%
Great Pee Dee / Little Pee Dee Confluence	1,546	3,463	14,449	0.0%	0.0%	0.0%
PDE13 Black Creek near Quinby, SC	53	144	520	-1.1%	-0.4%	-0.1%
PDE05 Lynches River at Effingham, SC	70	196	1,004	-0.6%	-0.2%	0.0%
PDE28 Little Pee Dee River at Galivants Ferry, SC	197	618	2,940	-0.3%	-0.1%	0.0%
PDE26 Black River and Kingstree, SC	45	139	1,008	-5.4%	-1.9%	-0.3%
Scenario 3b - 15% Municipal Demand Reduction (Surface Water and Groundwater Users)						
PDE15 Pee Dee River below Pee Dee, SC	933	1,979	8,969	0.6%	0.2%	0.1%
Great Pee Dee / Little Pee Dee Confluence	1,546	3,462	14,449	0.0%	0.0%	0.0%
PDE13 Black Creek near Quinby, SC	52	143	520	-1.7%	-0.6%	-0.2%
PDE05 Lynches River at Effingham, SC	70	196	1,004	-0.8%	-0.3%	-0.1%
PDE28 Little Pee Dee River at Galivants Ferry, SC	197	618	2,940	-0.4%	-0.1%	0.0%
PDE26 Black River and Kingstree, SC	43	137	1,007	-8.1%	-2.8%	-0.4%

Table 6-9 (continued). Flow statistics for conservation scenarios and percent difference compared to the High Demand 2070 Scenario.

Strategic Node	Minimum Flow (cfs)	5th Perc. Flow (cfs)	Mean Flow (cfs)	Minimum Flow (% change)	5th Perc. Flow (% change)	Mean Flow (% change)
Scenario 3c - 20% Municipal Demand Reduction (Surface Water and Groundwater Users)						
PDE15 Pee Dee River below Pee Dee, SC	935	1,980	8,970	0.8%	0.3%	0.1%
Great Pee Dee / Little Pee Dee Confluence	1,546	3,462	14,448	0.0%	0.0%	0.0%
PDE13 Black Creek near Quinby, SC	52	143	519	-2.2%	-0.9%	-0.3%
PDE05 Lynches River at Effingham, SC	70	196	1,004	-1.1%	-0.4%	-0.1%
PDE28 Little Pee Dee River at Galivants Ferry, SC	197	618	2,940	-0.5%	-0.2%	0.0%
PDE26 Black River and Kingstree, SC	42	136	1,005	-10.8%	-3.8%	-0.6%
Scenario 4 - 5% Industrial Demand Reduction (Surface Water and Groundwater Users)						
PDE15 Pee Dee River below Pee Dee, SC	939	1,986	8,976	1.3%	0.6%	0.1%
Great Pee Dee / Little Pee Dee Confluence	1,550	3,467	14,454	0.2%	0.1%	0.0%
PDE13 Black Creek near Quinby, SC	53	145	522	0.0%	0.3%	0.2%
PDE05 Lynches River at Effingham, SC	71	196	1,005	-0.1%	0.0%	0.0%
PDE28 Little Pee Dee River at Galivants Ferry, SC	198	619	2,941	0.0%	0.0%	0.0%
PDE26 Black River and Kingstree, SC	47	141	1,011	-0.1%	0.0%	0.0%
Scenario 5 - 10% Agricultural, 5% Industrial, and 10% Municipal Demand Reduction (Surface Water and Groundwater Users)						
PDE15 Pee Dee River below Pee Dee, SC	944	1,989	8,980	1.8%	0.8%	0.2%
Great Pee Dee / Little Pee Dee Confluence	1,551	3,467	14,453	0.3%	0.1%	0.0%
PDE13 Black Creek near Quinby, SC	53	144	521	-0.6%	0.0%	0.0%
PDE05 Lynches River at Effingham, SC	71	196	1,004	-0.5%	-0.2%	0.0%
PDE28 Little Pee Dee River at Galivants Ferry, SC	197	618	2,940	-0.3%	-0.1%	0.0%
PDE26 Black River and Kingstree, SC	45	139	1,008	-4.4%	-1.9%	-0.3%

In all conservation scenarios, increases in mean flows compared to the High Demand 2070 Scenario were very small, as would be expected given that only 5 to 20 percent reductions in demands were evaluated. At some Strategic Nodes, mean flows decreased for certain scenarios which assumed reductions in groundwater demands for municipal and industrial users and a corresponding decrease in wastewater discharges.

Changes in the 5th percentile flows (a low flow performance measure) were only slightly larger than changes in mean flows, when comparing the conservation strategy scenarios to the High Demand 2070 Scenario. The increase in 5th percentile flows was less than 1 percent at all Strategic Nodes. The Black Creek, Black River, Lynches River, and Little Pee Dee River Strategic Nodes' 5th percentile flows decreased in certain scenarios, owing to the reduction in groundwater demands and corresponding decrease in wastewater discharges.

Changes in the minimum flow (a low flow performance measure) simulated over the entire hydrologic period of record ranged from -10.8 percent (Scenario 3c, Black River Strategic Node) to 1.8 percent (Scenario 5, Pee Dee River Strategic Node). The -10.8 percent change in flow reflects the 20 percent reduction in groundwater demands for municipal users Sumter and Manning, and their corresponding 20 percent reduction in treated wastewater discharge to surface water. The largest, beneficial impacts to surface water flows from conservation strategies were observed in Scenario 5, which included conservation by agricultural, municipal, and industrial water users, but the impact was limited to the Strategic Nodes on the Pee Dee River. At that location, the Scenario 5 minimum flow was 944 cfs, compared to 928 cfs for the 2070 High Demand Scenario (a 1.8 percent increase).

While some reductions in stream flows may occur due to additional water conservation because of reduced wastewater discharges, the reductions in stream flow are very minor and would not be expected to pose additional risk to the ecological health of the streams. It's also worth noting that the assumed reduction in stream flows from lower discharges from groundwater-dependent communities is probably conservative given that conservation measures applied to outdoor water needs would not necessarily reduce wastewater discharges.

Benefits of Water Efficiency and Conservation Strategies

Although the level of conservation and water efficiency strategies evaluated resulted in relatively small impact on stream flows, these strategies are still worth pursuing for several important reasons:

- **Mitigate potential localized shortages:** Water users that withdraw surface water from small tributaries, and especially near the headwaters, may experience shortages during prolonged and/or severe drought, regardless of whether they have impoundments that provide storage. Implementing conservation strategies even before drought occurs will help extend their supply and reduce the risk of a water shortage.
- **Reduce water costs:** In an agricultural setting, water efficiency and conservation strategies can reduce costs of water for irrigation and possibly improve crop yields. In a municipal setting, they can lower costs of water for homeowners and reduce or delay a municipality's need to develop more water supplies.
- **Increase sustainability of groundwater supplies:** Conservation in groundwater dependent communities may be important for sustaining groundwater supplies.

6.2.1 Feasibility of Surface Water Management Strategies

The Pee Dee RBC assessed the feasibility of the water management strategies and practices described above with regard to consistency with regulations, reliability of water source, environmental impacts, socioeconomic impacts, potential interstate or interbasin impacts, and water quality impacts. This assessment is presented in Table 6-10 for demand side strategies and Table 6-11 for supply-side strategies. Agricultural/irrigation and golf course practices are presented first, followed by municipal, industrial, and thermoelectric practices which are generally evaluated as a single group of practices.

Color coding is used to identify an expected effect of the strategy within each category, ranging from moderate to high adverse effects to moderate to high positive effects. The selection of effects, whether it be adverse, neutral, or positive, was largely subjective and based on professional judgement and feedback from the RBC.

Color Coding for Assigning Expected Effects in Tables 6-10 and 6-11

Potential Moderate/High Adverse Effect	Potential Low Adverse Effect	Likely Neutral Effect (either no effect, or offsetting effects)	Potential Low Positive Effect	Potential Moderate/High Positive Effect

Table 6-10. Demand-side water management strategy feasibility assessment.

Water Management Strategy	Strategy Type	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Demand-Side Agricultural/Irrigation Practices							
Water Audits and Nozzle Retrofits	Demand-side - Agriculture	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated **Benefits:** Prevention of overwatering may limit runoff, erosion, and sedimentation	No to low anticipated effects – Financial gains from reduced delivery and pumping costs likely outweigh costs of audit and nozzle retrofits	No anticipated effects	See Environmental Benefits
Irrigation Scheduling and Smart Irrigation	Demand-side - Agriculture	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated **Benefits**: May reduce over fertilization and prevention of overwatering may limit runoff, erosion, and sedimentation	Low to moderate effects – Initial costs of advanced technology may be partially offset by savings from reduced water and nutrient use	No anticipated effects	See Environmental Benefits
Cover Cropping, Conservation Tillage, Mulch	Demand-side - Agriculture	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** Low anticipated impacts – Increase in herbicides may be required **Benefits:** May improve soil quality and reduce runoff	Low to moderate effects – Initial costs of new equipment plus training and O&M costs. Costs may be partially offset by reduction in soil, water, and nutrient loss	No anticipated effects	No to low anticipated impacts – Conservation tillage may increase potential leaching of nitrogen or pesticide to groundwater. See also Environmental Benefits

Table 6-10 (continued). Demand-side water management strategy feasibility assessment.

Water Management Strategy	Strategy Type	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Crop Variety, Crop Type, and Crop Conversions	Demand-side - Agriculture	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** Low anticipated impacts – Variation in chemical application for different crops must be considered	Medium to high anticipated effects – Potential profit loss from switching to lower demand crop or from a full season to short season crop	No anticipated effects	No anticipated impacts
Irrigation Equipment Changes, including Drip/Trickle Irrigation	Demand-side - Agriculture	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** Low anticipated impacts – Changing equipment may disturb environmentally sensitive areas	Low anticipated effects – Initial costs of equipment changes may be partially offset by water use savings. Investments in drip/trickle irrigation may not be economical for low value crops.	No anticipated effects	No anticipated impacts
Demand-Side Golf Course Practices							
Wetting Agents to Reduce Water Use	Demand-side – Golf Course	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None assuming bio-degradable and environmentally friendly surfactants are used. **Benefits**: Prevention of overwatering may limit runoff, erosion, and sedimentation	Low to no effects – Effective use of wetting agents can result in water and energy savings, reducing overall cost.	No anticipated effects	Low to none assuming bio-degradable and environmentally friendly surfactants are used

Table 6-10 (continued). Demand-side water management strategy feasibility assessment.

Water Management Strategy	Strategy Type	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Water Loss Control and Regular Maintenance	Demand-side - Golf Course	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated **Benefits**: Prevention of overwatering may limit runoff, erosion, and sedimentation	Low positive effects – Prevention and quick repair of leaks can result in water and energy savings, reducing overall cost.	No anticipated effects	No anticipated impacts
Time of Day Watering Practices	Demand-side - Golf Course	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated **Benefits**: Prevention of overwatering may limit runoff, erosion, and sedimentation	Low positive effects – Limiting evaporation results in less water use and lower water and energy cost	No anticipated effects	No anticipated impacts
Soil Moisture Monitoring	Demand-side - Golf Course	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated **Benefits**: Prevention of overwatering may limit runoff, erosion, and sedimentation	No to low positive effects – Initial costs of equipment plus training and O&M costs may be offset by reduction in water and energy cost	No anticipated effects	No anticipated impacts
Low-Water Use Landscaping	Demand-side - Golf Course	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated **Benefits**: Prevention of overwatering may limit runoff, erosion, and sedimentation. Use of native vegetation where appropriate can benefit pollinators and wildlife.	Low positive effects – Using landscaping that requires less water results on lower water and energy costs	No anticipated effects	No anticipated impacts

Table 6-10 (continued). Demand-side water management strategy feasibility assessment.

Water Management Strategy	Strategy Type	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Demand-Side Municipal, Industrial, and Thermoelectric Practices							
Conservation Pricing Structures	Demand-side - Municipal	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated	Moderate anticipated effects – Customers that cannot reduce water use may face economic hardship. Reduced billing revenue for utilities may cause financing issues or lead to further rate increases	No anticipated effects	No anticipated impacts
Public Education of Water Conservation	Demand-side - Municipal	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated	Low to no anticipated effects – Effects to utility revenue if demand reductions are substantial. Positive effect to residential users from reduced water bills (if billed at unit rate)	No anticipated effects	No anticipated impacts
Leak Detection and Water Loss Control	Demand-side – Municipal, Industrial, and Thermo-electric	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts**: None anticipated	Cost of program implementation could result in rate increase, no impact, or potential rate decrease, depending on circumstances. Rate increases should be made responsibly and consider customer affordability.	No anticipated effects	No anticipated impacts
Low Flow Fixtures, Toilets, and Appliances	Demand-side – Municipal, Industrial, and Thermo-electric	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** Low anticipated impacts – Minor additional waste from discarded inefficient toilets, fixtures, and appliances.	Low anticipated Effects – Positive benefit for homeowners from upgrading appliances for lower cost and reduced water billings (if billed at unit rate). Adverse effect due to need to hire implementation and compliance staff which would contribute to rate increase.	No anticipated effects	No anticipated impacts

Table 6-10 (continued). Demand-side water management strategy feasibility assessment.

Water Management Strategy	Strategy Type	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Water Efficiency Standards for New Construction	Demand-side - Municipal	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated	Low anticipated effects – Efficiency standards may make renovations or construction more expensive and limit access to renovate or build. The need to hire implementation and compliance staff would contribute to rate increase	No anticipated effects	No anticipated impacts
Residential Water Audits	Demand-side - Municipal	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated	No to low anticipated effects – Revenue effects to utility from reduced demand may be offset by lower delivery costs. Effects to homeowners from repairs may be offset by reduced water bills (if billed at unit rate). The need to hire implementation and compliance staff would contribute to rate increase	No anticipated effects	No anticipated impacts

Table 6-10 (continued). Demand-side water management strategy feasibility assessment.

Water Management Strategy	Strategy Type	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Reclaimed Water Programs/ Water Reuse and Recycling (a demand- and supply-side strategy)	Demand-side – Municipal, Industrial, and Thermo-electric	SCDES regulates reclaimed wastewater systems for irrigation use with public contact; there are no laws or regulations pertaining to indirect potable reuse or direct potable reuse	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** Low to moderate anticipated impacts: Depending on the extent of reclaim demand, reduced discharge from wastewater treatment facilities may reduce low flow levels **Benefits:** Depending on the extent of reclaim demand, reduced discharge from wastewater treatment facilities may results in improved receiving water quality	Moderate anticipated effects – Higher initial water bills to finance a reclaimed water program may be offset by long-term savings from postponing the need for new supplies and raw water treatment facilities. The need to hire operations staff could contribute to rate increase	No anticipated effects	See Environmental Benefits Need to match end use with quality of reclaimed water. Consider emerging contaminants of concern (e.g., PFAS and microplastics)
Car Wash Recycling Ordinances	Demand-side - Municipal	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** Low anticipated impacts – renovation or construction may impact sensitive areas **Benefits:** Positive environmental benefit of reduced pollutant runoff	Low anticipated effects – Financial burden to developer or owner of car wash for construction/renovation. The need to hire implementation and compliance staff would contribute to rate increase	No anticipated effects	See Environmental Benefits

Table 6-10 (continued). Demand-side water management strategy feasibility assessment.

Water Management Strategy	Strategy Type	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Time-of-Day Watering Limit	Demand-side - Municipal	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts**: None anticipated	The need to hire implementation and compliance staff would contribute to rate increase	No anticipated effects	No anticipated impacts
Landscape Irrigation Program and Codes	Demand-side - Municipal	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated **Benefits:** Water quality of receiving waters may be improved by reducing runoff from landscaping	Low anticipated effects – Mandates to meet standards may cause financial hardship for homeowners. No anticipated effects to homeowners from educational programs. The need to hire implementation and compliance staff would contribute to rate increase.	No anticipated effects	See Environmental Benefits
Xeriscaping	Demand-side - Municipal	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** None anticipated **Benefits:** Water quality of receiving waters may be improved by reducing runoff from landscaping. Use of native vegetation can benefit pollinators and wildlife.	No to low anticipated effects – Cost to retrofit a landscape and/or implement xeriscaping. Energy and water savings would be realized long-term.	No anticipated effects	See Environmental Benefits
Water Efficient Processes	Demand-side – Industrial	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts**: None anticipated	Low to moderate positive effects from long-term economic savings of reduced water pumping, treatment, and management	No anticipated effects	No anticipated impacts

Table 6-10 (continued). Demand-side water management strategy feasibility assessment.

Water Management Strategy	Strategy Type	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Energy Saving Appliances	Demand-side – Thermo-electric	Consistent	Strategy reduces energy demand and could lead to less residential water demand, extending supply and increasing water source reliability for other demands	**Impacts**: None anticipated	Low to no anticipated effects – Cost to purchase energy saving appliances falls on residents; however, rebates can help mitigate impact.	No anticipated effects	No anticipated impacts

Table 6-11. Supply-side water management strategy feasibility assessment.

Water Management Strategy	Strategy Type	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
New or Increased Storage	Supply-side	Consistent	Moderate to high reliability – Reliability depends on climatological factors like precipitation, evaporation, contributing stream flow, and seepage to groundwater	**Impacts:** Moderate to high anticipated impacts – Construction of new or increased storage may disturb existing stream habitat. Reductions in stream flow may adversely impact aquatic species. **Benefits**: New ponds and impoundments may create new habitat	Moderate anticipated effects – Costs of design, construction, and any permitting can be significant. Depending on dam size and classification, permitting requirements may be significant. Costs of inspections and maintenance in keeping with regulations and BMPs	No anticipated effects	Moderate anticipated impacts – Small impoundments may impact water quality of streams due to reduced stream flow. Algae growth may also be a concern

Table 6-11 (continued). Supply-side water management strategy feasibility assessment.

Water Management Strategy	Strategy Type	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Reclaimed Water Programs/ Water Reuse and Recycling (a demand- and supply-side strategy)	Demand-side – Municipal, Industrial, and Thermo-electric	SCDES regulates reclaimed wastewater systems for irrigation use with public contact; there are no laws or regulations pertaining to indirect potable reuse or direct potable reuse	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** Low to moderate anticipated impacts: Depending on the extent of reclaim demand, reduced discharge from wastewater treatment facilities may reduce low flow levels **Benefits:** Depending on the extent of reclaim demand, reduced discharge from wastewater treatment facilities may results in improved receiving water quality	Moderate anticipated effects – Higher initial water bills to finance a reclaimed water program may be offset by long-term savings from postponing the need for new supplies and raw water treatment facilities. The need to hire operations staff could contribute to rate increase	No anticipated effects	See Environmental Benefits Need to match end use with quality of reclaimed water. Consider emerging contaminants of concern (e.g., PFAS and microplastics)
Conjunctive Use	Supply-side	Consistent – Wells that withdraw more than 3 MGD on average are required to apply for a permit under CUA requirements	Expected High reliability but depends on the reliability of the groundwater supply which varies by location and depth of well.	**Impacts:** Low anticipated impacts – Expected to be temporary, but extensive and prolonged pumping may draw down groundwater levels potentially leading to aquifer compaction, reduction in well yield, and land subsidence **Benefits:** May increase flow in streams during low flow periods	Moderate anticipated effects – The cost of drilling a new groundwater supply well will vary with local conditions and depth. The effect on a specific operation will depend on its size and financial capacity. Cost is also associated with conveyance and treatment infrastructure to allow switching and or blending of the primary and conjunctive sources.	No anticipated effects	Low to moderate anticipated impacts – Extent of impact depends on quality of local groundwater. Acidic groundwater may not be ideal for crop growth. Hard groundwater may reduce life or irrigation equipment from mineral precipitation

Table 6-11 (continued). Supply-side water management strategy feasibility assessment.

Water Management Strategy	Strategy Type	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Conveyance	Supply-side	Consistent	Strategy does not impact reliability of the water source, but connects the use to a source	**Impacts:** Low to moderate anticipated impacts due to construction, especially if it occurs in sensitive environments.	Moderate anticipated effects – Higher initial water bills to finance a conveyance project may be offset by long-term savings from postponing the need for new supplies and raw water treatment facilities. The need to hire operations staff could contribute to rate increase	No anticipated effects	No anticipated impacts
Desalination	Supply-side	Consistent	Source reliability (seawater) is considered high	**Impacts:** Moderate to high anticipated impacts due to discharge of brine, which can be toxic, and alteration of seabed during pipeline construction. **Benefits:** Reduces demand on (fresh) surface and groundwater sources	Moderate to high – The cost of desalination can be a factor of 10 higher than treatment of freshwater sources.	No anticipated effects	Brine effluent will impact quality of the receiving seawater

6.2.2 Cost-Benefit Analysis of Surface Water Management Strategies

Available information related to costs and benefits in terms of potential savings of water or dollars for each strategy is summarized below. These are generalized values from literature or other locations and should be considered for planning-level assessment only, to help screen and understand the alternatives. Implementation planning would require more specific analysis. The information is presented for relative comparison purposes, so that the potential benefits, risks, and impacts of the alternatives can be understood more completely, and decision-makers can make more informed decisions about priorities.

6.2.2.1 Demand-Side Agricultural Strategies

Water Audits and Nozzle Retrofits

The cost of a Clemson Center Pivot Irrigation Test Program audit is $125.00 per pivot. Costs of other water audits vary significantly depending on whether they are conducted internally, by a consultant, or by a government entity. While the process of conducting a water audit does not alone provide benefits, if improvements such as nozzle retrofits are made, benefits can include increased water efficiency and energy savings. An approximately 15 percent reduction in water use could be expected from nozzle retrofits made following a center pivot sprinkler audit (Walther, pers. comm. 2021).

A sample audit report provided by Clemson Cooperative Extension estimates the cost of a retrofit sprinkler package at $5 per foot of pivot length (Clemson Cooperative Extension 2022b). In this example, the total cost to retrofit is estimated at $2,982. Using an assumed crop value, irrigation need, and cost of under- or overirrigation, the estimated suboptimal irrigation cost is $4.39/acre. With an irrigated area of 37.4 acres, this comes out to an estimated loss of $164. Over the estimated 23.6-year lifespan of the retrofit, this equates to $3,875 in savings compared to the total cost of $3,107 ($2,982 cost of the retrofit plus the $125 cost of the initial audit).

Irrigation Scheduling and Smart Irrigation

According to the 2021 Texas Panhandle Water Plan, the cost of a typical smart irrigation system ranges from $6.50 to $12.00 per acre and benefits amount to approximately 10 percent of the water used on each crop seasonally (Freese and Nichols, Inc. 2020). Other studies suggest that irrigation scheduling may reduce water use by 15 percent on average (Smart Irrigation 2019). The overall cost savings is hard to quantify, given the variability in irrigation rates, the cost of pumping, the potential increase in crop yield that results from optimizing irrigation, and other factors. A simple example assuming a center pivot irrigated area of 81 acres, a cost of $648 for a smart irrigation system ($8 per acre), and an annual cost of $1,374 ($16.96 per acre) for energy associated with pumping (NC State University 2007), suggests that if a smart irrigation system is able to reduce water use by 15 percent, then the $648 capital cost of the system will be recovered in just over 3 years.

Cover Cropping, Conservation Tillage, Mulch (Soil Management)

The 2021 Texas Panhandle Water Plan assumed a 1.75 acre-inches per acre of water savings from soil management strategies (Freese and Nichols, Inc. 2020). While conservation tillage may result in savings from reduced machine, fuel, and labor costs, depending on the conservation type implemented, it also has initial costs to transition from conventional to conservation tillage, including the purchase of new equipment and any chemical control costs (herbicides or pesticides). For example, ridge tilling requires specially designed equipment such as a ridge cultivator or ridge planter.

Implementing furrow diking can range from less than $2,000 to several thousand dollars. Per crop per season per acre estimates range from $5 to $30. The Texas Water Development Board estimates water savings of 3 inches per season (0.2 acre-feet per acre), but savings will vary by field and season. Using the irrigation of corn with a 113-day growing season as an example, a reduction in 3 inches per season would be expected to lower the seasonal irrigation need from 9.9 inches to 6.9 inches, assuming average seasonal precipitation of 16 inches, and an average seasonal corn crop watering need of 25.9 inches. The reduction of 3 inches would save approximately $10 per acre in irrigation system operating cost.

Crop Variety, Crop Type, and Crop Conversion

The cost of implementation and the actual reduction in irrigation water used will depend on numerous local factors including market pricing, cost of seed, cost of harvesting, and the value of crops.

If farmers are encouraged to switch from long season varieties to short season varieties, they may experience loss in yield and therefore revenue. However, they will also see a cost savings from reduced pumping and water use costs along with potential savings in product handling.

Irrigation Equipment Changes and Drip/Trickle Irrigation

Irrigation equipment changes may focus on lowering the elevation of nozzles on center pivot systems. Total replacement of a system (assumed 125-acre, 30-inch spacing) with a new 60-inch spacing system is estimated at $151.20 an acre, including labor and new hoses, heads, and weights. Conversion instead of full replacement of the same system is estimated at $44 per acre. Costs assume that the system is converting from low elevation spray application (LESA) or mid-elevation spray application (MESA) systems to low elevation precision application (LEPA) systems (Freese and Nichols, Inc. 2020). This transfer in irrigation practice may result in a 7 to 17 percent increase in irrigation efficiency and, consequently, decreased water usage. In most cases, irrigation equipment changes will be a combination of replacement and conversion.

Drip irrigation systems can cost between $500-$1,200 per acre (Simonne et al, 2024). Drip irrigation can improve the efficiency of both water and fertilizer applications, lowering the cost associated with pumping water and lowering fertilizer cost. Nutrient applications may also be better timed to meet plant needs. Drip systems can also be easily automated, lowering labor costs. One Texas cotton grower reported increasing their yield to 3 bales of cotton per acre using 16 inches of drip system water, compared to only 2.25 bales of cotton per acre using 16 inches of water from a center pivot system (Toro 2010). A Kansas corn grower who installed a drip system on 4,000 acres experienced a combined savings considering fuel, labor, chemical/fungicide, fertilizer, and cultivation of $160.05 per acre, compared to flood irrigation. At an initial capital cost of $1,200 per acre, the payback period for the drip system was 3.6 years (Toro 2007).

6.2.2.2 Demand-Side Golf Course Strategies

Wetting Agents to Reduce Water Use

Effective wetting agent programs can yield overall water savings. One study resulted in an approximately 20 percent savings the first season of application, and an average annual savings of $12,500 to $15,000 (USGA, 2024). Turfgrass loss during the summer was reduced to a level that allowed for the elimination of annual fairway overseeding, saving an additional $15,000 per year. The combined savings of water and seed completely offset the cost of the wetting agent program.

6.2.2.3 Demand-Side Municipal and Industrial Strategies

Conservation Pricing Structures

The implementation of conservation pricing structures is a cost-effective option for utilities as there are no direct costs to them to achieve a reduction in demand. However, reduction in billing revenue associated with decreased customer usage must be considered. On average, in the United States, a 10 percent increase in the marginal price of water in the urban residential sector can be expected to diminish demand by about 3 to 4 percent in the short run (Olmstead and Stavins 2009). An example application in the Texas Panhandle assumed 10 percent of households would respond and change their water consumption behavior resulting in 6,000 gallons saved per household per year (Freese and Nichols, Inc. 2020).

Public Education of Water Conservation

Building water conservation awareness will not only save water but will save money on operational and production costs. Savings are estimated at 5,000 gallons per household per year for 30 percent of households targeted. Public education and outreach costs more per person in smaller communities than in larger ones ($2.75 per person per year for communities less than 20,000 and $1.80 per person per year for communities with more than 20,000) (Freese and Nichols, Inc. 2020).

Leak Detection and Water Loss Control Program

EPA estimates that the average water loss in water systems is 16 percent, with up to 75 percent of the water loss potentially recoverable through a water loss control program (EPA 2013). Since 2010, Georgia's public water systems have reported, on average, between 13.5 and 17.4 percent water loss; however, 43 of 263 systems reported over 30 percent average annual water loss since 2010. Costs of a water loss control program would be associated with the time spent conducting the water audit and the costs of needed repairs, which would depend on the system. However, water audits have generally been proven to be cost-effective practices. The AWWA M36 Manual of Water Audits and Loss Control Programs includes an example of a utility with a $79,000 water audit cost, which, in 2022 dollars, translates to a unit cost $310/mile water main (AWWA 2016).

As another example, the Red Star Water District, a small water system in Leedey, Oklahoma conducted a water loss audit and found real loss levels of 28.9 million gallons per year, valued at $71,962 and representing 25.2 percent of total water supplied to the system. After identifying 29 leaks, the District adopted an aggressive program of leak repair, and was able to repair all leaks, saving the system 26 million gallons of water per year at a value of $71,000 annually (Oklahoma DEQ 2021).

Low Flow Fixtures, Toilets, and Appliances

Rebate programs to encourage use of low flow fixtures, toilets, and appliances have been used to lower residential water demand. The costs to the utility or local government are based on the rebate amount per fixture, toilet, or appliance, plus any program management costs. Reduced total water use in the community results in lower operating costs for the utility but may also result in lower billing revenue depending on the fee structure used.

An example of an existing rebate requires customers to purchase a toilet using 1.1 gallons per flush or less to receive a $75 rebate (Metropolitan North Georgia Water Planning District 2022). Metro Atlanta utilities have proven toilet rebate programs can be successful by replacing more than 150,000 toilets with low flow models between 2008 and 2019. Assuming an average water savings of just 2.4 gallons per flush, this equates to a savings of 360,000 gallons per flush. Since the average household flushed about 5 times per day, the combined water savings of these 150,000 low flow toilet replacements is a staggering 657 million gallons over the span of one year.

Toilets made prior to 1980 typically used 5.0 to 7.0 or high gallons per flush and toilets made from the early 1980s to 1992 typically used 3.5 gallons per flush or more. The current federal standard is 1.6 gallons per flush.

Water Efficiency Standards for New Construction

High efficiency toilets can save more than $100 per family per year (Mullen n.d.). EPA estimates that fixtures meeting the WaterSense requirements can save approximately 700 gallons of water per year per household (EPA 2021). The costs associated with implementing local ordinances outlining water efficiency standards is low. There are numerous examples that can be used to guide ordinance development and implementation.

Residential Water Audits

Residential water audits may result in the implementation of various strategies, retrofits, and other measures that save up to 20 to 30 gallons of water per day. Costs are associated with the cost of the water audit (if applicable) and the costs of replacements or repairs to the household system.

Reclaimed Water Programs

The benefits of water recycling and reuse programs include increased water supply, increased reliability, and reduced effluent disposal. Initial costs may be substantial and include construction/retrofit costs to wastewater facilities for full reuse capabilities and construction of distribution lines to end users. Benefits may result by lowering demand on highly treated potable water, thereby extending the source of supply and delaying the need for future upgrades to treatment processes or procuring additional water sources. The overall cost-benefit is dependent on the system, the end user, the cost of treatment, and many other factors. Utilities and others that have implemented reclaimed water programs have typically done so after careful analysis and planning to demonstrate the long-term financial viability of a reclaimed water program.

Car Wash Recycling Ordinances

Costs of this practice are associated with purchase and installation of a recycled water system by the car wash owner or developer. The initial cost for a water recycling system can range between $20,000 and $40,000 (in 2022 dollars) depending on the car wash size and requirements (Taylor 2013). Operating costs would be higher than a nonrecycled wash water system because of increased energy usage, replacement of filters and membranes, and other factors. Depending on whether the water was obtained from a public water system or (private) well, there would be a reduction in raw water costs since water demand would be reduced. Ordinances can set a percentage of recycled water to total water used. Typical ordinances require at least 50 percent use of recycled water.

Time-of-Day Watering Limit

Setting a time-of-day watering limit may save up to 1,000 gallons of water per household per year, depending on the amount of irrigated landscape. Costs are associated with enforcement and can vary depending on the size of the utility but are expected to be low. Utilities may benefit from reduced water use and a reduction in peak demands if a time-of-day water limit restricts usage before typical morning peak demands.

Landscape Irrigation Program and Codes

If water efficiency measures are required, costs would be associated with enforcement. If not required, costs will be associated with incentives or education programs. If programs include rebate offerings, the cost of the rebate itself and the administration of the program must be considered. Smart irrigation controllers with an EPA WaterSense certification are commercially available for between $120 and $280. These costs assume there is already a compatible irrigation system in place. Costs to the homeowner would be greater if irrigation system installation or renovation is required. Irrigation with a smart irrigation meter rather than a standard irrigation meter may result in a water use efficiency reduction of 30 percent. An example of a turf replacement rebate is from California's Metropolitan Water District, which offers a $2 per square foot rebate for up to 5,000 square feet. Ultimately, the cost to the utility or municipality would be dependent on the rebate rate and percent uptake by customers.

Xeriscaping

The cost of xeriscaping can vary substantially, depending on whether it is a new installation or retrofit of an existing landscape, the size, and the type and density of plants used. Professionally installed xeriscapes mat range between $5 and $20 per square foot, with a typical price range of about $15,120 to $18,400 (Caayao, 2024).

Water Efficient Processes

Industry has made the use of water efficient processes commonplace over the last several decades. Industrial water managers have realized that the cost of purchasing treated water and/or withdrawing and treating raw water can be minimized by using water efficiently. Retrofitting water-intensive processes to use less water, or treat and reuse water, is likely to result in long-term cost savings.

Energy Saving Appliances

While there are no specific studies documenting the net impact of energy saving appliances on lowering water demands associated with energy production, the cumulative impact of energy saving appliances undoubtedly reduces overall energy demand. It could be assumed that lower energy demand helps extend the time when new, potentially expensive, sources of energy are required.

6.2.2.4 Supply-Side Strategies

New or Increased Storage

As described in Chapter 3, the Pee Dee River in South Carolina is free flowing, though flows are regulated by upstream reservoirs in North Carolina. The Pee Dee River basin in South Carolina only has limited surface water development, consisting primarily of one large reservoir, small-scale flood control projects, and on-site storage ponds for agriculture and golf courses. The largest reservoir in the basin, Lake Robinson, is located on Black Creek and is operated by Duke Energy Progress, LLC. As described in

Chapter 5, small on-site storage ponds have been very useful in mitigating local surface water supply shortages in the past and will be useful for mitigating local shortages in the future.

Costs for building new water storage ponds, impoundments, or reservoirs or increasing the volume of existing storage can vary significantly, depending on the type and size of project. Some examples are provided below.

Estimated costs for raising the dam height of Lake Whelchel in Cherokee County, South Carolina by 3 and 5 feet were $27 million and $31 to $35 million, respectively (adjusted to 2022 dollars) (AECOM 2019). This estimate included earth excavation and fill, concrete spillway construction, bridge and roadway work, and engineering and permitting. This equates to approximately $182 per 1,000 gallons of additional raw water storage (assuming a 3-foot increase in dam height).

Costs to construct a new reservoir would include, but be not limited to, construction of an earth-filled dam embankment and spillways, transmission pipelines, and pump stations, as well as roadway and utility relocations, environmental mitigation, permitting, administration and operations, and land acquisition of the reservoir location and any transmission easements. The range of potential cost for developing a new water supply reservoir can vary significantly. The Texas Water Development Board has developed Regional Water Plans along with a list of proposed projects throughout the state, including an estimated capital cost for each (TWDB 2020). This list includes 45 projects categorized solely as new major reservoirs, with capital costs ranging from $3.3 million to $4.5 billion, as reported in 2020. Normalizing the capital cost to the raw water supply provided by each, the price per 1,000 gallons of raw water supplied is on the order of $1.50 to $3.00 during debt service and reduces to approximately $0.25 to $1.00 after debt service, in 2020 dollars.

Conjunctive Use

The 2021 Panhandle Regional Water Plan – Volume II estimated the cost of a 300-foot-deep, 350 gpm irrigation well and pump at just over $250,000 (Freese and Nichols, Inc 2020). Similar costs have been observed for production wells and their associated pumps and appurtenances in South Carolina (Walther, pers. comm, 2021). The cost-benefit of drilling a well and installing water conveyance will depend on the cost of obtaining water from other sources, such as a distant surface water source, or purchase of water from a nearby utility.

Conveyance

Conveyance costs can vary significantly, and depend on the size of pipe, the topography, the type of soils, the price of materials, the density of existing utilities and infrastructure along the pipeline route, and other factors. Evaluating the cost-benefit of conveyance requires specific assumptions appropriate for each project.

Desalination

Large-scale desalination plants which use reverse osmosis typically produce water for $1.90 to $7.60 per 1,000 gallons depending on energy sources, location, feed water quality, and other expenses (Herber, 2024). Comparatively, conventional freshwater treatment plants produce water for a $0.50 per 1,000 gallons. Operation costs can vary significantly depending on the cost of energy, feed water salinity, materials, and equipment lifecycle (e.g. membranes), size of the plant, and location.

6.3 Groundwater Management Strategies

Under the Framework, a groundwater water management strategy is any water management strategy proposed to address a Groundwater Area of Concern or groundwater shortage. Strategies may include demand-side management strategies that reduce supply gaps by reducing demands, and supply-side strategies that increase or augment supply. Examples of demand-side strategies include municipal and agriculture conservation and water use efficiency measures. Examples of supply-side strategies include ASR and relocating pumping from one aquifer to another.

6.3.1 Demand-Side Strategies

As presented in Tables 6-1 through 6-5, the Pee Dee RBC identified a portfolio of various surface water demand-side strategies consisting of agricultural, golf course, municipal, industrial, and thermoelectric water efficiency and conservation practices. These demand-side strategies also apply to groundwater withdrawers.

6.3.2 Supply-Side Strategies

The Pee Dee RBC identified and considered several potential supply-side water management strategies that could help mitigate potential groundwater supply issues. Some, like conjunctive water management and aquifer storage and recovery have already been used in the Pee Dee River basin to help mitigate or lessen groundwater supply challenges. Supply-side strategies discussed by the Pee Dee RBC are described in this subsection.

Drilling Wells into Lesser-Used Aquifer Formations

The Pee Dee River basin is underlain by the Coastal Plain aquifer system, which consists of multiple layers of permeable sands or limestone separated by clay confining units. Groundwater wells in the Pee Dee River basin primarily use groundwater from the surficial aquifer, the Crouch Branch aquifer, and the underlying McQueen Branch aquifer. For locations where wells are drilled into and are stressing groundwater supplies in a certain aquifer formation, the Pee Dee RBC discussed encouraging that new wells be drilled into lesser-used aquifer formations to avoid adding more groundwater demand to aquifer formations that are already stressed. The Pee Dee RBC also asserted that water users should take a thoughtful approach to this strategy to avoid over development in lesser-used aquifer formations or inducing seawater intrusion into aquifers near the coast.

Desalination

Desalination was described in Section 6.1.2 in the context of supply-side strategies for surface water (see that section for more information). In coastal communities with groundwater supply challenges, desalination of seawater or brackish groundwater could provide additional supply to supplement groundwater.

Conjunctive Use

Conjunctive water use was described as a supply-side surface water management strategy in Section 6.1.2, but it is also a supply-side strategy for groundwater management. In the context of groundwater management, surface water supplies can be developed and used to reduce the need to pump groundwater in areas where aquifer levels have declined. The City of Florence case study described in Section 6.1.2 is an excellent example of conjunctive surface and groundwater management.

Water Reclamation

Water reclamation was described in Section 6.1.2 in the context of supply-side strategies for surface water (see that section for more information). The Pee Dee RBC identified several types of water reclamation that could be beneficial for reducing groundwater supply risk. Reclamation strategies discussed include reuse of wastewater for both potable and non-potable use, using reclaimed supplies as a source for aquifer storage and recovery, and capturing/treating stormwater for either potable or non-potable uses.

Aquifer Storage and Recovery

Section 6.1.2 describes ASR under the "New or Increased Storage" supply-side strategy for surface water. While ASR is a way to develop surface water supplies by storing it underground, it also replenishes groundwater supplies in the process. In this context, ASR is a supply-side strategy for groundwater as well as surface water. See Section 6.1.2 for more detail on ASR and an example of where it has been used in the Pee Dee River basin.

6.3.3 Technical Evaluation of Strategies

Groundwater management strategies for the Pee Dee River basin were developed and evaluated using observed groundwater data, including SC Groundwater Monitoring Network well hydrographs, potentiometric surface maps, and groundwater use data. This approach was used in lieu of the USGS Atlantic Coastal Plain Groundwater Model, which is still in development for the Pee Dee River basin and may be incorporated into future iterations of the plan upon completion. Please refer to Section 3.4.1 for more information regarding the groundwater model.

SC Groundwater Monitoring Network Hydrographs

Hydrographs produced from wells in the Pee Dee River basin offer continuous data on groundwater levels, helping to identify trends such as increasing, declining, or stabilization of water levels in response to withdrawals and management strategies both long-term and at specific points in time.

Potentiometric Surface Maps

Potentiometric maps provide insight into groundwater levels and flow paths, and how they have changed over time. By comparing historical and recent potentiometric surface maps, it is possible to assess the impacts of groundwater withdrawals and the effectiveness of management strategies.

Reported Groundwater Withdrawal Data

Groundwater withdrawal data is critical for evaluating how changes in usage have affected the Coastal Plain aquifer system. This data allows for the quantification of groundwater usage trends and their correlation with observed aquifer conditions.

This combined approach allows for a clearer understanding of the direct relationship between groundwater pumping and aquifer stress, helping to identify where management strategies may need to be modified.

It is important to note that groundwater withdrawal data is self-reported to SCDES by permitted and registered groundwater users and the data is manually entered into the database by the user or program staff, which may result in inconsistencies. Water use data from private domestic wells, facilities that do not meet the reporting threshold, and data from facilities failing to report their annual water use are not included.

Conjunctive Water Use: Effective Groundwater Management in Florence County

A notable example of effective groundwater management in the Pee Dee River basin is the recovery and stabilization of the pumping cone that formed in the McQueen Branch aquifer below Florence, SC during the 1980s and 1990s.

Following the implementation of a conjunctive water use strategy in the late-1990s during which the City of Florence supplemented its groundwater supplies with surface water to meet the increasing water needs of a growing population. Figure 6-2 shows the relative amounts of surface and groundwater use in Florence County since the mid-1990s. Groundwater monitoring well FLO-0128 has exhibited a multidecadal recovery and recent stabilization of the pumping cone in Florence County (Figure 6-3).

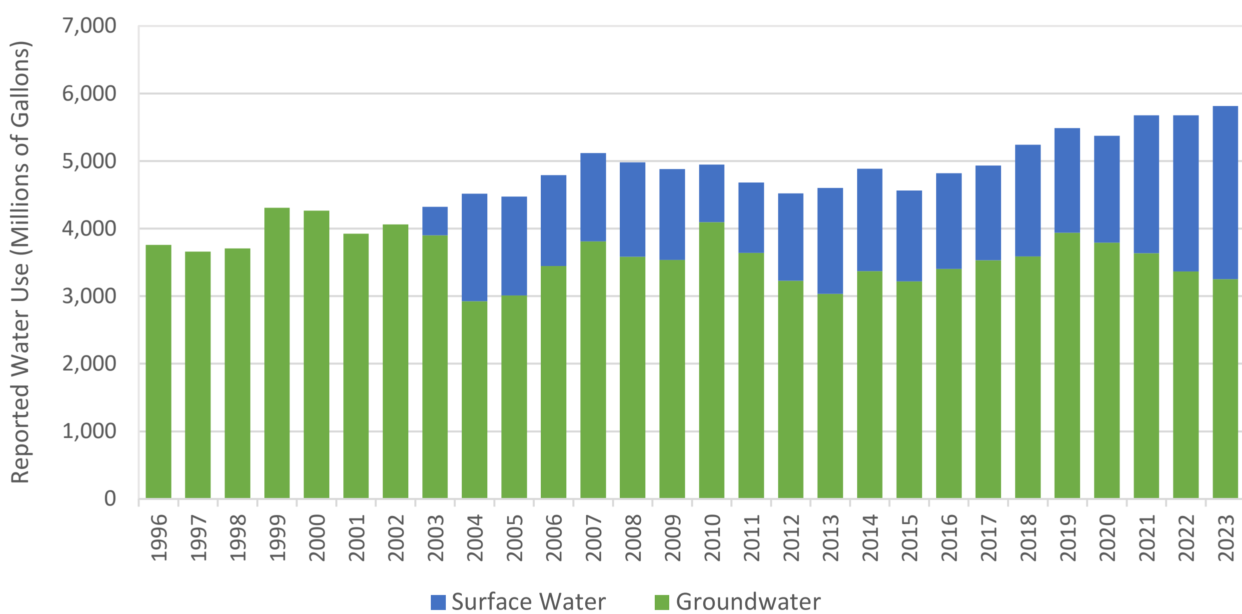


Figure 6-2. Total water use by type of supply in Florence County.

As of 2024, the cone of depression centered in northern Florence County has recovered by approximately 60 feet since reaching a record low of 92.07 feet relative to NAVD88 in the late 1990s (Czwartacki & Wachob, 2022). Observations from monitoring well FLO-0128 show the initial drawdown period throughout the 1980s and 1990s, subsequent recovery at a rate of approximately 2.4 feet per year through 2019, and recent stabilization of water levels (Figure 6-3).

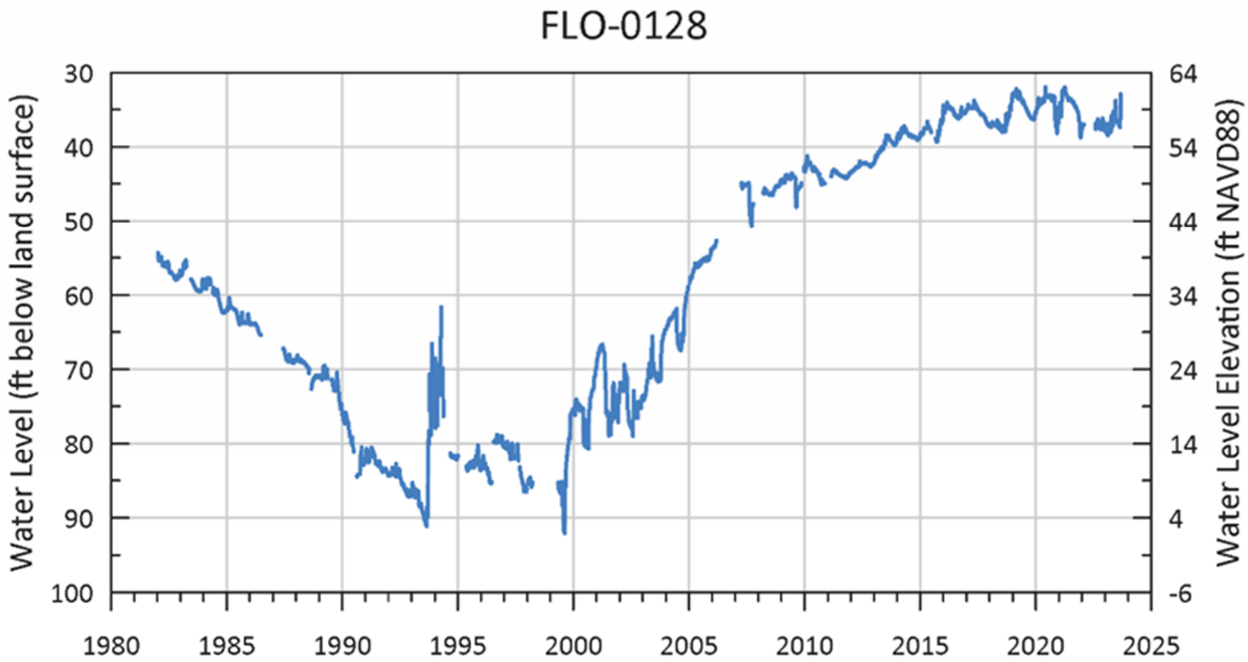


Figure 6-3. Groundwater levels in the McQueen Branch aquifer in northern Florence County.

Potentiometric surface maps, overlain with groundwater withdrawal data, further illustrate the continued effectiveness of the conjunctive water use strategy implemented by the City of Florence (see Figure 6-4). The cone of depression centered in northern Florence County marks the historical area of significant groundwater drawdown from the 1980s and 1990s. The steepness of the contours surrounding the Florence cone indicates that the effects of the persisting drawdown remain localized rather than regional, as seen in the cone of depression in Georgetown County. Furthermore, the 2022 groundwater use data illustrated in Figure 6-4 shows a lesser degree of pumping intensity at the center of the Florence cone, aligning with the observed recovery in monitoring well FLO-0128.

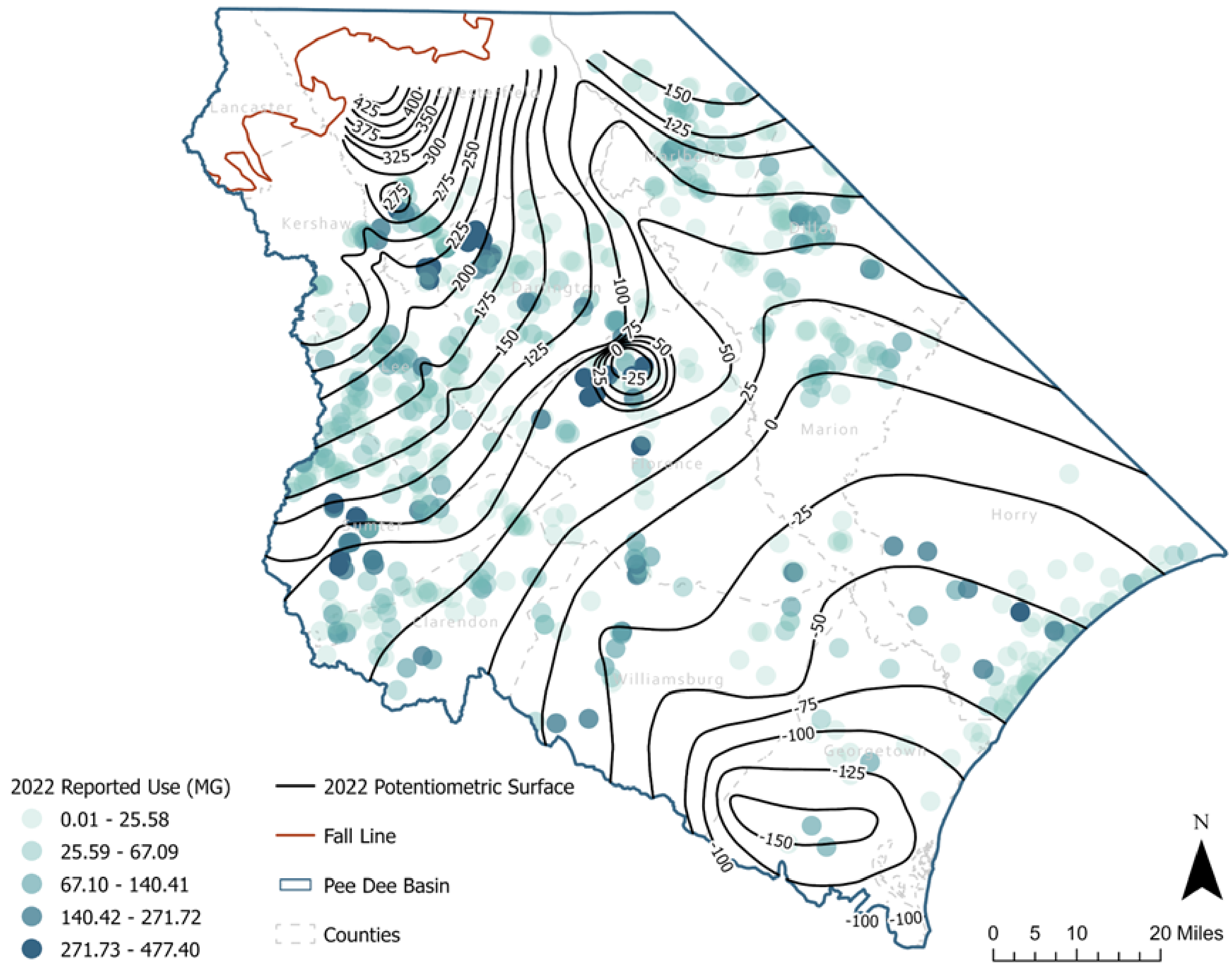


Figure 6-4. 2022 potentiometric surface of the McQueen Branch and Charleston aquifers (Czwartacki & Wachob, 2022) overlain with 2022 reported groundwater use (MG) from the McQueen Branch and Charleston aquifers in the Pee Dee River basin.
Contour lines are shown in feet relative to NAVD88.

The conjunctive use strategy was implemented by the City of Florence in the late 1990s, where increased reliance on surface water helped stabilize the demand on groundwater resources. The potentiometric surface maps and groundwater level hydrographs provide confirmation of the recovery trends and stabilization achieved through this conjunctive water management approach in the Pee Dee River basin. The recovery holds significant implications for groundwater management efforts across the state, underscoring the importance of continued monitoring and taking proactive measures to ensure the sustainable use of the state's groundwater resources.

6.3.4 Feasibility of Groundwater Management Strategies

The Pee Dee RBC assessed the feasibility of the water management strategies and practices described above with regard to consistency with regulations, reliability of water source, environmental impacts, socioeconomic impacts, and water quality impacts. This assessment is presented in Table 6-12 for supply-side groundwater strategies. Many of the supply-side strategies in Table 6-12 were assessed in the context of surface water in Table 6-11, but they are evaluated from a groundwater perspective in Table 6-12. Note that demand-side strategies for groundwater were the same as those for surface water, and the feasibility of demand-side strategies are assessed in Table 6-10.

Color coding is used to identify an expected effect of the strategy, ranging from moderate to high adverse effects to moderate to high positive effects. The selection of effects, whether it be adverse, neutral, or positive, was largely subjective and based on professional judgement and feedback from the RBC. The color coding is shown below for convenience, and it is the same coding used in Tables 6-10 and 6-11.

Color Coding for Assigning Expected Effects in Tables 6-12

Potential Moderate/High Adverse Effect	Potential Low Adverse Effect	Likely Neutral Effect (either no effect, or offsetting effects)	Potential Low Positive Effect	Potential Moderate/High Positive Effect

Table 6-12. Supply-side water management strategy feasibility assessment.

Water Management Strategy	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Drilling Wells into Lesser-used Aquifer Formations	Consistent – Wells that withdraw more than 3 MGD on average are required to apply for a permit under CUA requirements	Lesser-used aquifers should be reliable, though well yields may be lower depending on local conditions and reliability may lessen if strategy is over-used.	**Impacts:** None anticipated **Benefits**: Moderate environmental impacts – Transferring pumping to an aquifer with greater availability will reduce negative impacts in over-allocated aquifers, such as land subsidence, loss of storage capacity, and reduced well yields.	Moderate to high impacts – The cost of drilling to deeper aquifers will present a financial burden to withdrawers and may be infeasible for others	No anticipated effects	Water quality in the McQueen Branch aquifer would need to be evaluated. There is the potential for elevated hardness that could reduce the lifespan of irrigation equipment.
Desalination	Consistent	Source reliability (seawater) is considered high	**Impacts:** Moderate to high anticipated impacts due to discharge of brine, which can be toxic, and alteration of seabed during pipeline construction. **Benefits:** Reduces demand on (fresh) surface and groundwater sources	Moderate to high – The cost of desalination can be a factor of 10 higher than treatment of freshwater sources.	No anticipated effects	Brine effluent will impact quality of the receiving seawater
Conjunctive Use	Consistent – Wells that withdraw more than 3 MGD on average are required to apply for a permit under CUA requirements	Moderate to high reliability - depends on surface water supply which varies by location and can diminish during drought. The Pee Dee River basin is not projected to have significant surface water shortages.	**Impacts:** Low anticipated impacts – Surface water diversions will lessen flows, and construction of intake and treatment facilities can temporarily impact the environment. **Benefits:** Aquifer levels may recover	Moderate to high – The cost of new intake structures, treatment, and conveyance for surface water supplies and blending/switching supplies can be substantial depending on capacity.	No anticipated effects	Low to moderate anticipated impacts – Extent of impact depends on quality of local surface water, which can vary based on flow conditions.

Table 6-12 (continued). Supply-side water management strategy feasibility assessment.

Water Management Strategy	Consistency with Regulations	Reliability of Water Source	Environmental Impacts and Benefits[1]	Socioeconomic Effects	Potential Interstate or Interbasin Effects	Other Water Quality Considerations
Aquifer Storage and Recovery	Consistent	Moderate to high reliability – Reliability depends on availability of supplies for storage, and degree to which stored groundwater supplies are recoverable	**Impacts:** Low to moderate anticipated impacts: Groundwater quality impacts should be considered. **Benefits:** Depending on the extent of reclaim demand, reduced discharge from wastewater treatment facilities may result in improved receiving water quality. Can reduce risks of saltwater intrusion.	Moderate anticipated effects – Costs of well design, construction, permitting, treatment, operations, and maintenance can be significant based on the size of the system.	No anticipated effects	Moderate anticipated impacts – The geochemical impacts of mixing surface water with groundwater should be considered.
Reclaimed Water Programs/ Water Reuse and Recycling (a demand- and supply-side strategy)	SCDES regulates reclaimed wastewater systems for irrigation use with public contact; there are no laws or regulations pertaining to indirect potable reuse or direct potable reuse	Strategy reduces demand and extends supply, increasing water source reliability for other demands	**Impacts:** Low to moderate anticipated impacts: Depending on the extent of reclaim demand, reduced discharge from wastewater treatment facilities may reduce low flow levels **Benefits:** Depending on the extent of reclaim demand, reduced discharge from wastewater treatment facilities may result in improved receiving water quality	Moderate anticipated effects – Higher initial water bills to finance a reclaimed water program may be offset by long-term savings from postponing the need for new supplies and raw water treatment facilities. The need to hire operations staff could contribute to rate increase	No anticipated effects	See Environmental Benefits - Need to match end use with quality of reclaimed water. Consider emerging contaminants of concern (e.g., PFAS and microplastics)

6.3.5 Cost-Benefit Analysis of Groundwater Management Strategies

Available information related to costs and benefits in terms of potential savings of water or dollars for each supply-side groundwater strategy are summarized below. These are generalized values from literature or other locations and should be considered for planning-level assessment only, to help screen and understand the alternatives. Implementation planning would require more specific analysis. The information is presented for relative comparison purposes, so that the potential benefits, risks, and impacts of the alternatives can be understood more completely, and decision-makers can make more informed decisions about priorities. Note that the demand-side strategies for groundwater are the same as for surface water, and Section 6.2.2 describes the cost-benefit analysis for those strategies.

Drilling Wells into Lesser-Used Aquifer Formations

The 2021 Panhandle Regional Water Plan – Volume II estimated the cost of a 300-foot-deep, 350 gpm irrigation well and pump at just over $250,000 (Freese and Nichols, Inc 2020). Similar costs have been observed for production wells and their associated pumps and appurtenances in South Carolina (Walther, pers. comm, 2021). The cost-benefit of drilling a well and installing water conveyance will depend on the depth of the well, cost of obtaining water from other sources, such as a distant surface water source, or purchase of water from a nearby utility.

Desalination

The costs and benefits of desalination are described in Section 6.2.2.4.

Conjunctive Use

The costs and benefits for conjunctive water use strategies, from a groundwater management perspective, are very dependent on the scale and needed components of surface water development projects implemented to supplement or offset groundwater use. The conjunctive use approach pursued by the City of Florence provides an example of a 10 MGD surface water supply and treatment project that has been very beneficial in reversing long term declines in groundwater levels and reducing water supply risk for the city (see Chapter 5 for more information on the benefits of the project). Costs for the City of Florence's surface water supply and treatment project were unavailable.

Costs for a new intake structure and pumping facilities to deliver water to the Cherokee County Board of Public Works were estimated for the Broad River Basin Plan using the Colorado Statewide Water Supply Initiative Update, Water Project Cost Estimating Tool (CDM Smith, 2019). The new intake and pumping facilities were sized for 15 MGD capacity using a 30-inch, 2.2-mile pipeline to convey flows to an existing water treatment plant. Costs for engineering, surveying, permitting, and construction were estimated at $12 million (in 2022 dollars), which equates to $0.80 per gallon. Annual costs for debt service, operations and maintenance, and power costs total approximately $1.3 million (or $0.09 per gallon). Note that these costs do not include new surface water treatment facilities. Capital costs in the Water Project Cost Estimating Tool (2017 dollars) for various types of water treatment range from $40 million to $70 million depending on the type of treatment (assuming a 15 MGD plant). Annual operation and maintenance costs could range from $1.3 million to $2 million (again, depending on the type of treatment associated with a 15 MGD plant)

Water Reclamation

The costs and benefits of various water reclamation programs are described in Section 6.2.2.3.

Aquifer Storage and Recovery

Aquifer storage and recovery projects result in a wide variety of benefits. They provide a means for storing available supplies that is not subject to evaporative losses and has minimal impacts on the environment. They can lessen risks of saltwater intrusion into coastal aquifers. They can also help lessen the need to invest in expansion of surface water treatment facilities.

A cost/benefit evaluation of Grand Strand Water and Sewer Authority's (GSWSA) ASR project in Horry County for the City of Myrtle Beach was conducted in 1997 by Joffre Castro (Castro 1997). The ASR project implemented by GSWSA used available treatment capacity during off-peak periods to treat and then inject supplies into the aquifer. During peak use periods, the injected water was recovered and distributed to meet demands. The strategy allowed GSWSA to postpone expansion of their treatment plant and distribution lines. The evaluation conducted by Castro compared the costs of constructing and operating an ASR well to expanding the water treatment plant. The study found that the costs for expanding the treatment plant were more than twice the cost of the ASR well. Note that the unit costs are relatively dated. Since initiation, GSWSA has expanded the ASR program, and it includes 17 ASR wells either in operation or under development. Costs and benefits for ASR projects should be evaluated on a case-by-case basis, but in this instance, the ASR approach was a cost-effective alternative.

Chapter 7
Water Management Strategy Recommendations

The Pee Dee RBC considered a wide variety of demand-side and supply-side water management strategies (described in Chapter 6) that could be recommended for implementation in the Pee Dee River basin. As water management strategies were discussed, the Pee Dee RBC was cognizant of several core considerations with respect to future water supplies that were identified in the surface water modeling and groundwater data assessment conducted for this Plan. The challenges are briefly summarized below:

- **Surface water:** Significant surface water shortages or ecological risk due to low surface water flows are not projected to occur in the foreseeable future. While surface water management strategies are not needed to reduce projected shortages, they are beneficial in reducing water costs for municipal, industrial, and agricultural water users; mitigating potential localized shortages that are difficult to capture in the modeling; and sustaining surface water supplies if unforeseen future conditions occur (e.g., changed hydrology or unanticipated population growth).
- **Groundwater:** Groundwater levels near recharge zones away from the coast have remained relatively stable over time. However, cones of depression have developed due to groundwater pumping in Florence County and along the coast in Georgetown and Horry counties. Conjunctive water management strategies (i.e. using surface water supplies to supplement groundwater) in these areas have been beneficial in reducing demands and water supply risks to groundwater. Efficient use of groundwater supplies and conjunctive water management strategies will help sustain groundwater supplies into the future. The Coastal Plain Aquifer groundwater model, which is currently being updated, should be used to further evaluate potential groundwater supply risks and water management strategies to minimize risk.

The recommended water management strategies described in this chapter reflect the Pee Dee RBC's collaborative prioritization process as well as the overall River Basin Plan vision developed by the RBC at the beginning of this planning process. The vision of the Pee Dee RBC is "To make sure water is available for all in the Pee Dee River basin." Implementing the recommended water management strategies will help foster the realization of this vision.

7.1 Selection, Prioritization, and Justification for Recommended Water Management Strategies

The RBC used a multi-step scoring process to select and prioritize the water management strategies in this Plan. The process, described in detail herein, follows these steps:

(1) First, the technical team scored the strategies from Chapter 6 using a series of criteria to identify the most impactful strategies and provide guidance on focus areas for the RBC.

(2) Second, the RBC participated in a multi-voting prioritization process and ranked the strategies according to their preference.

(3) The results of the RBC ranking were evaluated using a Forced Ranking approach, which combines multiple analytical techniques to compare the strategy rankings.

7.1.1 Preliminary Strategy Scoring

The strategies were first preliminarily scored by the consultant team (JD Solomon and Brown and Caldwell) based on their benefits, costs, implementability, and timeframe for implementation. Table 7-1 describes the scoring criteria for these four categories.

Table 7-1. Preliminary scoring rubric.

Score	Description
Benefits	
1	Localized or marginal
2	Tens of millions of gallons per day
3	Hundreds of thousands or millions of gallons per day
Costs	
1	Limited capital costs ($1M or less) (for municipalities, industry and thermoelectric); least expensive for agriculture and golf courses
2	$10M order-of-magnitude (for municipalities, industry, and thermoelectric); significant expense for agriculture and golf courses
3	$100M order-of-magnitude (for municipalities, industry, and thermoelectric); most expensive for agriculture and golf courses
Implementability	
1	Easy, common, minimal new concepts and practices
2	May have been done locally but not at statewide scale; will take formal planning and permitting time
3	Not common or does not have a precedent in South Carolina; new regulatory or permitting considerations
Time	
1	Short timeframe; common practice; could be implemented within a couple of years
2	Medium timeframe; 10-year planning and implementation order-of-magnitude
3	Long timeframe; more than 10 years

The scoring process identified the strategies with the highest impact, which tended to be those scored with high benefits and low cost. The preliminary scoring results are summarized in Table 7-2 through

Table 7-4. Water management strategies in these tables are categorized into demand side strategies for both surface water and groundwater, supply side strategies for surface water, and supply side strategies for groundwater. Note that the number of symbols (i.e. water drops, dollar signs, check marks, and hour glasses) correspond to the scoring described in Table 7-1. The strategies in Table 7-12 are first sorted by benefit and then by cost.

Table 7-2. Demand-side strategies for both surface water and groundwater.

Sector	Strategy	Benefit	Cost	Implement-ability	Time
Municipal	Update of Drought Management Plans	💧💧💧	$	✓	⌛
Municipal	Public education on water conservation	💧💧💧	$	✓	⌛
Municipal	Water efficiency standards for new construction	💧💧💧	$	✓	⌛
Municipal	Pricing structures (ex. increasing block rates)	💧💧💧	$	✓	⌛
Municipal	Leak detection and water loss control programs	💧💧💧	$$	✓	⌛
Golf Courses	Water loss control and regular maintenance	💧💧💧	$$	✓	⌛
Industrial	Water loss control and routine maintenance	💧💧💧	$$	✓	⌛
Thermoelectric	Reclaimed water	💧💧💧	$$	✓	⌛⌛
Municipal	Incentives for low flow indoor fixtures	💧💧	$	✓	⌛
Municipal	Landscape irrigation programs and codes	💧💧	$	✓✓	⌛
Municipal	Time-of-day watering limits	💧💧	$	✓	⌛
Ag/Irrigation	Water audits and center pivot sprinkler retrofits	💧💧	$	✓	⌛
Golf Courses	Time-of-day watering practices	💧💧	$	✓	⌛
Ag/Irrigation	Cover cropping, conservation tillage, mulch	💧💧	$$	✓	⌛⌛
Ag/Irrigation	Irrigation scheduling	💧💧	$$	✓✓	⌛⌛
Ag/Irrigation	Drip/Trickle irrigation (for select crops)	💧💧	$$	✓✓	⌛⌛⌛
Golf Courses	Soil moisture monitoring	💧💧	$$	✓✓	⌛
Industrial	Water reuse and recycling	💧💧	$$	✓	⌛
Industrial	Water efficient processes	💧💧	$$	✓✓	⌛⌛
Industrial	Drought management best practice collaboration	💧💧	$$	✓	⌛

Sector	Strategy	Benefit	Cost	Implement-ability	Time
Municipal	Reclaimed water programs	💧💧	$$$	✓✓✓	⌛⌛
Golf Courses	Low-water use landscaping	💧💧	$$$	✓✓	⌛
Thermoelectric	Switch to combined-cycle natural gas	💧💧	$$$	✓✓✓	⌛⌛⌛
***Demand-side strategies not ranked by the RBC**					
Municipal	Residential water audits	💧	$	✓✓	⌛⌛
Municipal	Car wash recycling programs	💧	$	✓	⌛
Ag/Irrigation	Soil moisture sensors/smart irrigation	💧	$	✓✓	⌛⌛
Industrial	Low flow fixtures, toilets, and appliances	💧	$	✓	⌛
Thermoelectric	Energy saving appliances*	💧	$	✓✓	⌛⌛
Municipal	Xeriscaping	💧	$$	✓✓✓	⌛⌛
Ag/Irrigation	Grass buffers to prevent runoff	💧	$$	✓✓	⌛
Golf Courses	Wetting agents to reduce water use	💧	$$	✓	⌛⌛
Ag/Irrigation	Crop selection	💧	$$$	✓✓✓	⌛⌛⌛

**Due to the large number of demand side strategies, only those that received a benefit score of two or three were considered by the RBC in the ranking process described in Section 7.1.2. However, these strategies are often beneficial in other contexts and should not be dismissed or ignored.*

Table 7-3. Supply-side strategies for surface water.

Sector	Strategy	Benefit	Cost	Implement-ability	Time
New or Increased Storage	New impoundments, ponds, reservoirs, tanks	💧💧💧	$$$	✓✓	⌛⌛⌛
New or Increased Storage	Dredging (pond deepening)	💧💧	$$	✓	⌛⌛
New or Increased Storage	Reservoir expansion (raising dam height)	💧💧💧	$$$	✓	⌛⌛⌛
New or Increased Storage	Aquifer storage and recovery	💧💧	$	✓✓	⌛⌛
Water Reclamation	Water reuse systems (non-potable)	💧💧	$$$	✓✓	⌛⌛
Water Reclamation	Direct potable reuse	💧💧	$$$	✓✓	⌛⌛⌛
Water Reclamation	Stormwater capture and treatment	💧💧	$$	✓	⌛⌛
Conjunctive Use	Using groundwater to augment surface water	💧💧💧	$$$	✓✓	⌛⌛⌛

Table 7-4. Supply-side strategies for groundwater.

Sector	Strategy	Benefit	Cost	Implement-ability	Time
New Supply	Drill new or supplemental wells into lesser-used aquifer formations	💧💧💧	$$	✓✓	⌛⌛
New Supply	Desalination	💧💧	$$$	✓✓✓	⌛⌛⌛
Water Reclamation	Water reuse systems (non-potable)	💧💧	$$$	✓✓	⌛⌛
Water Reclamation	Direct potable reuse	💧💧	$$$	✓✓	⌛⌛⌛
Water Reclamation	Reuse for aquifer storage and recovery	💧💧	$$$	✓✓✓	⌛⌛⌛
Conjunctive Use	Use surface water to supplement groundwater	💧💧	$$	✓✓	⌛⌛⌛
Conjunctive Use	Aquifer storage and recovery	💧💧	$$	✓✓	⌛⌛
Conjunctive Use	Stormwater capture and use - potable	💧	$$	✓✓✓	⌛⌛⌛
Conjunctive Use	Stormwater capture and use - non-potable	💧	$$	✓✓	⌛⌛⌛

The initial scoring shown in Table 7-2 through Table 7-4 was used by the RBC to focus on high-impact strategies. Specifically, strategies that had the highest benefits (i.e., received a benefits score greater than or equal to two) and low costs were prioritized by the RBC using a Forced Ranking approach.

7.1.2 Preference Polling Using Forced Ranking

Forced ranking approaches can take various forms. The approach used for prioritization by the Pee Dee RBC is based on preferential voting methods by ballots (a ballot is simply a record of how a voter, in this case a workshop participant, voted). A preference ballot is utilized to provide a complete ranking of the river basin strategies, from most important to least important. The preference ballots are then converted into a preference schedule, which summarizes the results of all individual preferences.

A group of analytical methods are used to analyze and rank the data summarized in the preference schedule. Plurality, Borda Count and Pairwise Comparison are the three consensus methodologies used in the strategies prioritization. These methods are summarized below.

7.1.2.1 Plurality

Plurality involves prioritization based on the number of first-place rankings. The strategy with the most first-place votes is the highest priority. Plurality is the most intuitive but overly simplistic of the preferential voting methodologies. However, it is a useful starting point for developing consensus.

7.1.2.2 Borda Count

The Borda Count method provides points based on where strategies appear in a ranking. Each strategy gets one point for each last-place vote received, two points for each next-to-last-point vote, etc., up to N points for each first-place vote (where N is the number of strategies). The strategy with the largest point total wins the election, or in this case, is considered the highest priority.

In the Plurality method, only the information related to first place is used (which contrasts with the Borda Count method, which uses all the information from the ballots). The Borda Count approach gives greater importance to the voter's lower preferences and favors strategies with broad consensus. The tradeoff, however, is that the highest-ranked strategy may not be any single voter's highest priority.

7.1.2.3 Pairwise Comparison

In the method of Pairwise Comparisons, each strategy is matched one-on-one with each of the other strategies. Each strategy gets one point for a one-on-one win and half a point for a tie. The results of the one-on-one competitions are transferred to a preference table, and the strategy with the most total points is the highest priority.

The method of Pairwise Comparisons was explicitly designed to satisfy the "fairness criterion" in preference voting. Any strategy that wins all possible head-to-head matchups always has a higher point total than any other strategy and thus is declared the winner. Copeland's Method is utilized for the method of Pairwise Comparison performed in this prioritization effort.

7.1.3 Aggregation of Rankings

The results of the three preferential voting methods were summarized as shown in Figure 7-1 through Figure 7-3. The results for Borda Count and Pairwise Comparison are described as a "ranking," with a rank of "1" most preferred and higher rank numbers less preferred. Conversely, the Plurality process counts the number of top votes, so a higher value is seen as more preferred. The figures below illustrate general consistency among the most preferred strategies across all three methods.

> Figures 7-1, 7-2, and 7-3 focus on the highest priority water management strategies identified by the Pee Dee RBC. While some strategies were not highly prioritized, they are still viable and valuable in meeting local challenges or in specific situations.

Surface water and groundwater demand-side strategy rankings are shown in Figure 7-1. Below are observations on the data shown in Figure 7-1:

General

- Figure 7-1 focuses on the top eleven priority strategies.
- Leak detection and water loss control programs were ranked by the RBC as the highest priority demand-side water management strategies.
    - Other highly ranked strategies included updating water provider Drought Management Plans, establishing water efficiency standards for new construction, and developing landscape irrigation efficiency programs and codes.
- Public education on water conservation received several first-place rankings but it was not the highest priority strategy (though it is an important strategy and has a high priority relative to the full list of potential strategies).

Municipal

- Eight of the eleven highest priority demand-side water management strategies are in the municipal water sector.
- Many of the municipal water management strategies focus on the efficient use of water supplies. For example, water loss control, water efficiency standards, and time-of-day watering limits strive to minimize the amount of water sent to customers that does not meet its intended purpose.
- Reducing water use is another theme in the prioritized municipal water management strategies. Landscape codes and drought management strategies strive to reduce water uses that are not as beneficial as others.
- While public education on water conservation is a priority strategy and is generally focused on municipal water uses, it applies to other water sectors as well.

Industrial

- Three of the eleven highest priority demand-side water management strategies focus on industrial water uses.
- Like the municipal sector, industrial water management strategies focus on efficient use of water and reducing water demands during drought conditions.

Agricultural

- While agricultural water management strategies did not rank in the top eleven, they are important.
- The overall results of the prioritization process showed that conservation tillage/cover cropping, water audits and center pivot sprinkler retrofits, and irrigation scheduling programs were the top three agricultural water management strategies identified by the RBC. The prioritized agricultural strategies are beneficial regardless of water supply challenges (i.e., periodic low stream flows for surface water users, declining aquifer levels for groundwater users) because they can increase crop yields while reducing water use and cost.

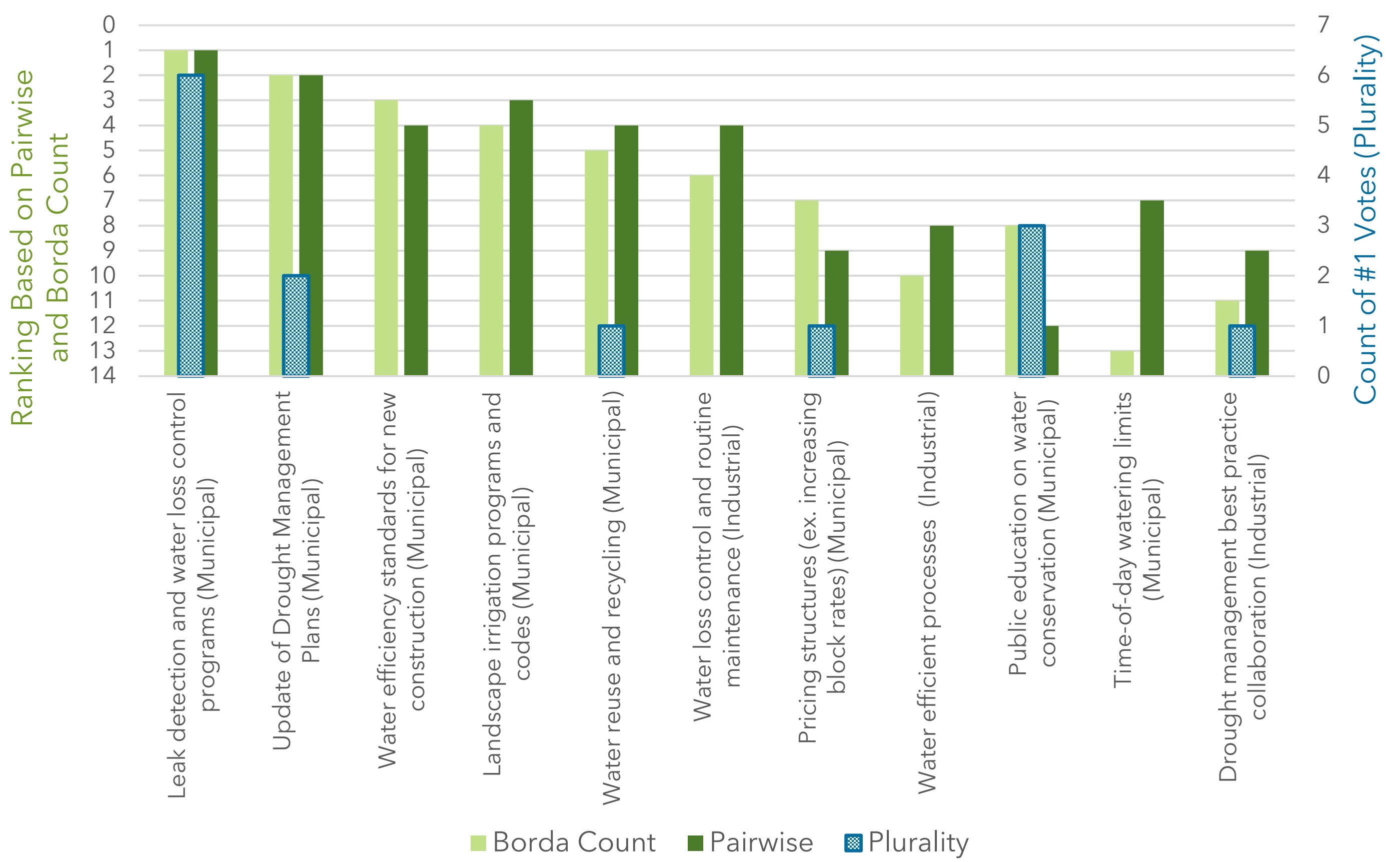


Figure 7-1. Demand-side surface water and groundwater strategy ranking comparison.

Surface water supply-side strategies and their prioritization by the RBC are shown in Figure 7-2. Below are observations on the results of the prioritization conducted by the RBC:

- Six of the eight supply-side surface water strategies were prioritized in a significant way through the RBC process.
- Using groundwater to supplement surface water supplies was the RBC's highest ranked

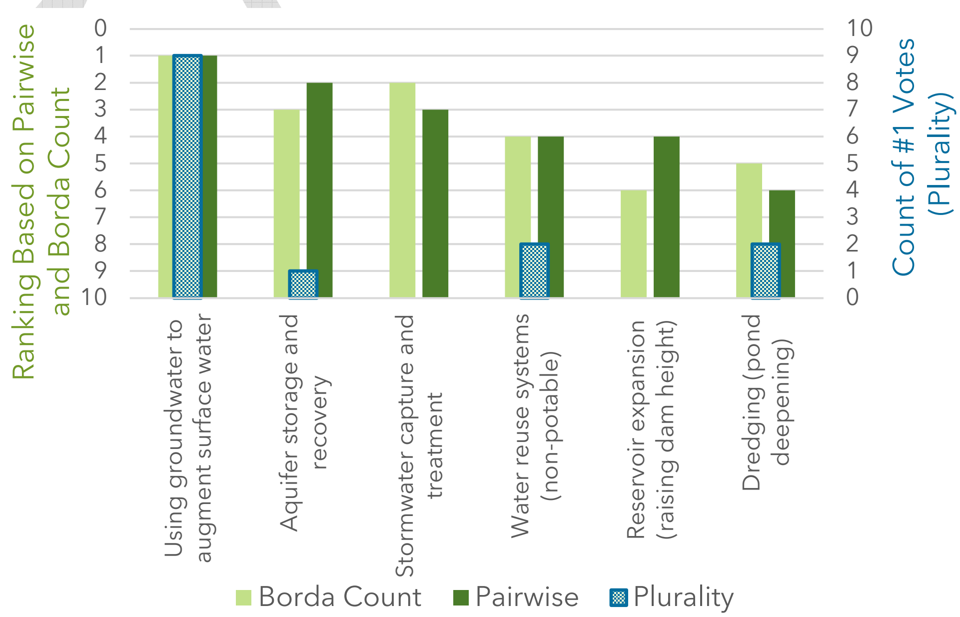


Figure 7-2. Supply-side surface water strategy ranking comparison.

priority followed by aquifer storage and recovery as well as stormwater capture and treatment.

- The three lower priority strategies in Figure 7-2 (which include water reuse, reservoir expansion, and pond deepening) were well-supported by the RBC.
- The priorities reflected a combination of strategies focused on conjunctive use of surface water and groundwater supplies, utilizing supplies that have historically not been beneficially used (i.e. wastewater and storm water), and increasing storage.
- The RBC noted that some strategies may not be useful or appropriate in certain geographic areas. For example, developing groundwater supplies to supplement surface water may not be allowed depending on CUA regulations.
- The priorities suggest a willingness to consider innovative approaches to supply-side challenges. Conjunctive water management, utilizing stormwater, managed storage in aquifers, and reusing wastewater are strategies that have been developed and implemented in more recent time periods and offer opportunities to think in new ways about using all of the water supplies in a "one water" approach.

Groundwater supply-side strategies and their prioritization by the RBC are shown in Figure 7-3. Below are observations on the results of the prioritization conducted by the RBC:

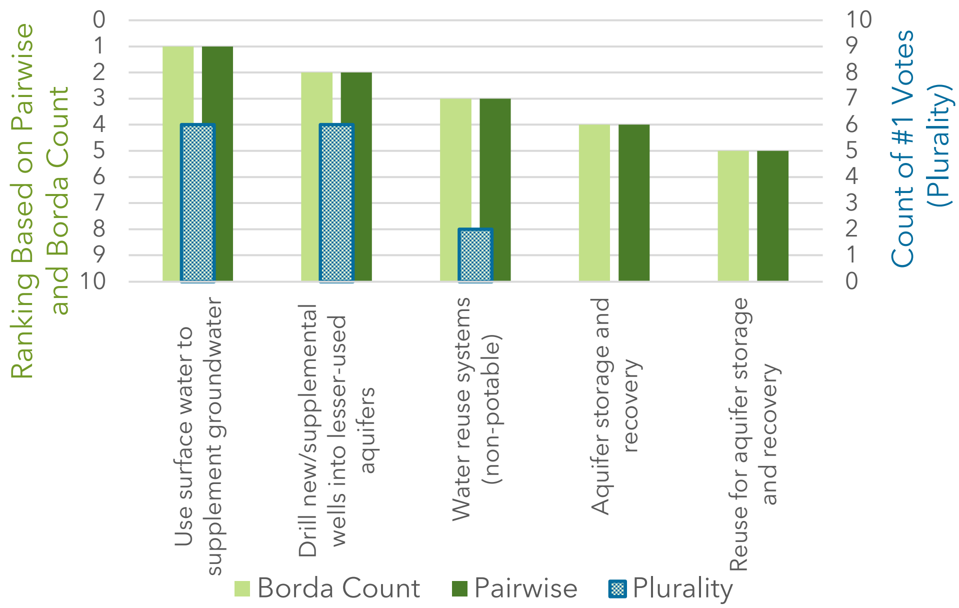


Figure 7-3. Supply-side groundwater strategy ranking comparison.

- Five of the nine supply-side groundwater strategies were prioritized in a significant way through the RBC process.
- Three supply-side groundwater strategies – using surface water to supplement groundwater supplies, drilling new wells, and reusing supplies to meet non-potable needs - were clearly prioritized by the RBC.
- Two prioritized strategies are focused on aquifer storage and recovery and are closely related. One of the strategies contemplates surface water supplies as the source of water for treatment and injection into groundwater aquifers and the other is focused on injecting treated reusable supplies (i.e. wastewater discharge) into aquifers.
- Water providers in the Pee Dee River basin have successfully implemented supply-side strategies focused on using surface water supplies to supplement groundwater and aquifer storage and recovery. The Pee Dee RBC anticipates that these strategies will be beneficial into the future but should be approached thoughtfully to prevent overuse of surface water supplies.
- The RBC noted that some strategies may not be useful or appropriate in certain geographic areas. For example, drilling new wells may not be allowed depending on Capacity Use Area regulations.

7.2 Remaining Shortages

The surface water analyses described in Chapter 5 did not indicate any significant shortages that will need to be addressed using demand-side or supply-side surface water management strategies. The Current Use, Moderate, and High Demand planning scenarios all demonstrated no significant shortages and no ecological risk driven by future stream flow reductions. Additional details on the technical evaluation of the strategies and impacts on shortages are described in Chapter 6 in Section 6.2.

7.3 Remaining Issues Regarding Designated Reaches of Interest or Groundwater Areas of Concern

The Planning Framework defines Reaches of Interest as "specific stream reaches that may have no identified Surface Water Shortage but experience undesired impacts, environmental or otherwise, determined from current or future water-demand scenarios or proposed water management strategies" (SCDNR 2019). The Pee Dee RBC did not identify any Reaches of Interest.

The Planning Framework defines a Groundwater Area of Concern as "an area in the Coastal Plain, designated by a River Basin Council, where groundwater withdrawals from a specified aquifer are causing or are expected to cause unacceptable impacts to the resource or to the public health and well-being" (SCDNR 2019). The Pee Dee RBC identified areas around Florence County and along the coast in Georgetown and Horry counties as preliminary areas of concern due to observed cones of depression and potential groundwater risk. The Pee Dee RBC also recognizes that water providers in these areas have implemented water management strategies that have reduced groundwater supply risks. The Pee Dee RBC anticipated using the Coastal Plain Aquifer groundwater model to evaluate Groundwater Areas of Concern and explore potential water management strategies that could reduce future groundwater supply risks in these areas. Due to delays in updating the groundwater model, these analyses will be postponed until the model update is complete.

Clemson Pee Dee Research and Education Center
(Photo credit: Matt Lindburg)

Chapter 8
Drought Response

8.1 Existing Drought Management Plans and Drought Management Advisory Groups

8.1.1 State Drought Response

Utilities in South Carolina are required to respond to drought conditions based on the requirements in the South Carolina Drought Response Act (Code of Laws of South Carolina, 1976, Section 49-23-10, et seq., as amended) (SCDNR 2009). The Act provided the state with a mechanism to respond to drought and stated that SCDNR will "formulate, coordinate, and execute a statewide drought mitigation plan." The Act also created the South Carolina Drought Response Committee (DRC), which is the committee "to be convened to address drought related problems and responses."

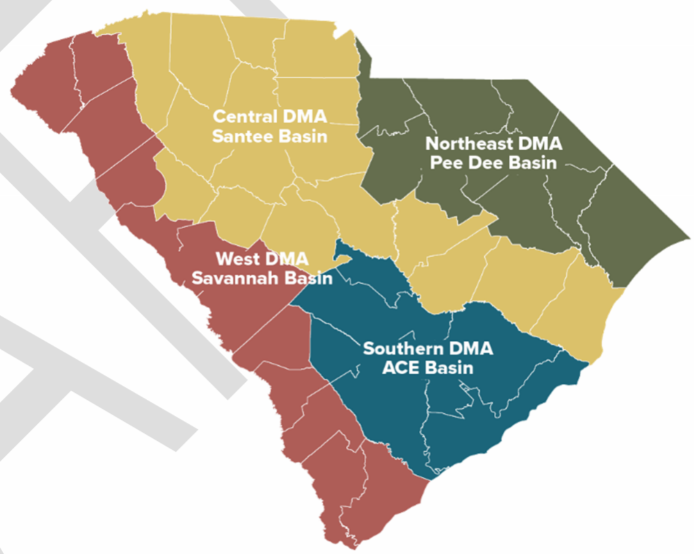


Figure 8-1. South Carolina Drought Management Areas.

SCDNR developed four drought management areas (DMAs) within the state to both enable geographically specific drought mitigation measures and to prevent overly broad drought responses that ignore local conditions and challenges. The four DMAs are illustrated in Figure 8-1. The Pee Dee River basin spans the Northeast DMA and extends into part of the Central DMA.

The Governor appoints members from various sectors to represent each DMA within the DRC. The organizational entities involved in drought response in South Carolina are illustrated in Figure 8-2.

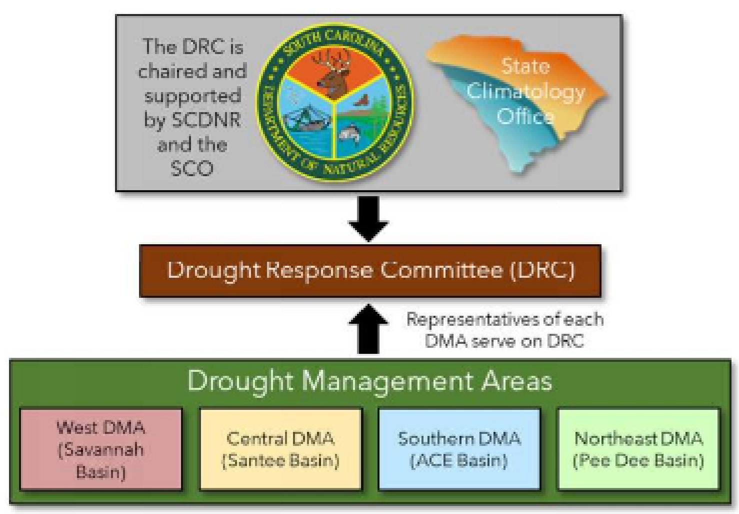


Figure 8-2. Drought Act organizational chart.

South Carolina has four drought alert phases: incipient, moderate, severe, and extreme. SCDNR and the DRC monitor a variety of drought indicators to determine when drought phases are beginning or ending. Examples of drought indicators include stream flows, groundwater levels, the Palmer Drought Severity Index, the Crop Moisture Index, the Standardized Precipitation Index, and the United States Drought Monitor. The South Carolina Drought Regulations establish thresholds for these drought indicators corresponding to the four drought alert phases. Declaration of a drought alert phase is typically not made based only on one indicator, rather a convergence of evidence approach is used. The need for the declaration of a drought alert phase is also informed by additional information including water supply and demand, rainfall records, agricultural and forestry conditions, and climatological data. SCDNR and the DRC coordinate the appropriate response with the affected DMAs or counties. Local drought response is discussed in more detail in the following section.

Details on South Carolina's drought management program are available at:

http://www.scdrought.com/

8.1.2 Local Drought Response by Public Water Utilities

Water utilities in South Carolina are required to have Drought Management Plans that meet the requirements of South Carolina drought regulations. The regulations require that drought response ordinances and plans include a minimum of the following information:

South Carolina drought regulations are available at:

http://www.scdrought.com/pdf/SCDroughtRegulations.pdf

1. A description of alternate supply sources, including time, costs, and problems associated with putting alternate sources on-line
2. A water use reduction plan and schedule for moderate, severe, and extreme drought for each category, as appropriate
3. An implementation plan and ordinance, as appropriate

The South Carolina Department of Natural Resources, per the requirements of the South Carolina Drought Management Act of 2000, developed a model Drought Management Plan and Response Ordinance to assist utilities in developing their own plans. The plans and ordinances reviewed in the Pee Dee River basin are consistent with the model plan and ordinance.

The elements of Drought Management Plans include the following:

- **Water system overview:** The water system layout and sources, system capacities, connections, and yields are described as well as the responsible representative for implementing the drought management plan.

- **Drought indicators for various phases:** Drought indicators are described for each of major drought phases – incipient, moderate, severe, and extreme drought phases. Note that most plans only cover the moderate, severe, and extreme phases, which are drought levels that result in mitigation measures.

- **Drought mitigation measures for each phase:** Plans summarize methods for mitigating drought impacts at each phase. Cooperative agreements and alternative water supply sources are described, along with pre-drought planning efforts, capital planning, and demand forecasting.

- **Drought Response Ordinance:** The actions that can be taken in each drought phase are included in the Drought Response Ordinance at the end of the Plan.

While each of the plans follow this same structure, the definitions for each drought phase and response actions can vary among the different plans.

A variety of plans in the Pee Dee River basin were reviewed to provide perspectives on the scope, triggers, and actions in the plans. Table 8-1 provides a list of the plans reviewed. Three water providers in the Pee Dee River basin use surface water, are in the SWAM model, and have drought management plans. These plans were reviewed along with a broad variety of other plans for water providers that do not use surface water. Detailed notes on the plans that were reviewed are provided in Appendix B.

Table 8-1. Water utility Drought Management Plans reviewed.

Entities Included in the Pee Dee SWAM Model	
City of Bennettsville	City of Florence
Town of Cheraw	
Sampling of Entities Not Included in the Pee Dee SWAM Model	
Marco Rural Water Company (Marion)	Marlboro Water Company
Cassatt Water Company	Town of Patrick
Chesterfield County Rural Water Company – Wolf Pond	Rural Community Water District of Georgetown County (RCWDGC)
City of Darlington	Georgetown County Water and Sewer District
City of Georgetown	Grand Strand Water and Sewer Authority
Lancaster County Water and Sewer District	City of Myrtle Beach
City of Sumter	Town of Kershaw
Trico Water Company	

Several additional water providers in the Pee Dee River basin have drought management plans, but they were not included in the sample of plans reviewed. Table 8-2 lists the water providers with plans that were not reviewed.

In total, 42 drought management plans were identified for water providers in the Pee Dee River basin. Table 8-1 identifies 18 plans that were summarized and are included in Appendix B, and Table 8-2 identifies an additional 24 plans that were not summarized.

Table 8-2. Additional Pee Dee River basin water providers with drought management plans.

Utility Names	
City of Bishopville	Town of Lamar
Town of Andrews	City of Lake City
Bethune Rural Water Company	Coward Water System
City of Conway	City of Manning
Bucksport Water System	Barrineau Public Utilities
High Hills Rural Water Company	City of North Myrtle Beach
City of Hartsville	Town of Olanta
Town of Heath Springs	Town of Pageland
Town of Hemingway	Town of Pamplico
Town of Jefferson	Darlington County Water and Sewer District
City of Johnsonville	Town of Turbeville
Town of Kingstree	Wallace Water Company

Additional information on drought management plans can be found at the link below:

http://www.scdrought.com/planning.html

While a total of 42 drought management plans are identified between Table 8-1 and Table 8-2, there are multiple communities that historically had drought management plans and have since transitioned to be served by other water providers. These communities include the Town of Timmonsville (which is now supplied by the City of Florence) as well as Latta, Mullins, Marion, and Little River Water and Sewage (which are now all supplied by GSWSA). Drought plans for these communities are now captured under the City of Florence and GSWSA.

8.1.2.1 Drought Phase Triggers

As stated above, the three commonly identified drought phases are moderate, severe, and extreme. The triggers for the three phases vary across the drought management plans reviewed and were determined by individual utilities based on their specific circumstances and water sources. Typical triggers are summarized below.

- **Committee based:** Droughts and drought phases are determined by the Drought Response Committee or the South Carolina Department of Natural Resources.
- **Demand based:** Phases are determined by specific increases in demand or specific water use levels for a specific period of time.
- **Streamflow based:** Phases are determined when streamflow falls below specific thresholds for specific periods of time. This method typically identifies prescriptive of flow rates for different months. Utilities serving coastal communities may include water quality criteria (i.e., conductivity).

- **Water level based:** Phases are determined when water in storage facilities or aquifers drop to specific levels for a specific period of time.
- **Storage index based:** Phases are determined based on the ratio of the Storage Index to the Target Storage Index.

8.1.2.2 Drought Phase Responses

Demand reduction strategies at various drought phases are largely consistent among utilities across the Pee Dee River basin. Most utilities implement a tiered, voluntary use reduction framework for moderate and severe droughts with a mandatory use reduction at the extreme drought phase. The most frequently used demand reduction strategy is summarized in Table 8-3.

Table 8-3. Typical demand reduction responses.

Drought Phase	Response
Incipient	None specified.
Moderate	Voluntary 20% reduction in residential use and 15% reduction in all other uses.
Severe	Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses.
Extreme	Mandatory reduction of 30% for residential and 25% for all other uses.

Of the plans listed in Table 8-1 that were reviewed, only two in the Pee Dee River basin have a different reduction strategy (Lancaster County Water and Sewer District and the City of Myrtle Beach). While they use a tiered structure for water use reductions like other utilities, these two have different approaches to what is mandatory and voluntary and different reduction percentages.

8.1.2.3 Alternative Water Supply Agreements

Of the 18 Drought Management Plans reviewed, 12 utilities have alternative water supply agreements with other entities. The agreements identify other providers from which the utility may receive water, and in what scenarios and what quantities. This, in addition to the demand reduction strategies, represents another method of drought planning and resilience for the utilities in the Pee Dee River basin.

8.1.3 Local Drought Response in Other Sectors

Responding to droughts is important for public water supply utilities but also water uses in other sectors. Agriculture, industry, and energy producers pursue different response strategies when droughts occur, as described in this section.

8.1.3.1 Agricultural Response

Drought impacts agriculture in a variety of ways. For agricultural producers that do not irrigate, drought can cause lower crop yields, decreases in pasture productivity, and challenges to feeding livestock. Where feasible and affordable, irrigation provides a buffer for drought conditions and allows agricultural producers to maintain productivity during dry conditions, but if a drought is severe enough, water supplies for irrigation may be threatened.

Agricultural producers may respond to drought in several ways. Producers that lack irrigation systems may invest in them. As described in Chapter 2, during the severe 2002 drought, agricultural producers dug new wells to access groundwater supplies for irrigation. In some cases, producers may grow crops that require less water (if markets for those crops exist). For producers with irrigation systems, drought response oftentimes requires a greater use of irrigation supplies to maintain crop production and economic stability for farmers. If water supplies for irrigation become scarce, for example due to declining groundwater levels, irrigators may invest in higher efficiency systems, such as center pivots with low pressure nozzles or drip irrigation. Higher efficiency systems help minimize losses and provide water to crops when and where it is needed.

8.1.3.2 Industry Response

Industries use water for a variety of different purposes, and drought response may vary across industries based on production processes and available water supplies. In general, industry responds to drought in a way that helps minimize the financial impacts of decreased supply or increased costs of water. Also, while the Drought Management Act does not apply to industrial water users, SCDES regulates both water supply and discharge from industrial sources and requires best management practices (including drought management plans as necessary) to minimize impacts during droughts. Some industries may invest in water reuse technologies to reduce their water needs and long-term water costs while decreasing their vulnerability to drought conditions. In severe cases, some industries may need to cut production due to lack of supply needed for manufacturing processes or to maintain minimum supplies for critical needs like fire protection. Industries that produce their own energy to support their processes may need to reduce energy production and/or purchase energy from other providers. Finally, industries are regularly investing in water efficiency and conservation technologies as a way to reduce costs and risks, and these investments help them build resilience to the impacts of drought.

8.1.3.3 Energy Response

Hydropower production is an important industry that has a significant influence on flows in the Pee Dee River. As described in Chapter 3, Duke Energy Progress and Cube Yadkin Generation underwent FERC hydro relicensing processes culminating in issuance of new licenses in 2015 and 2016, respectively, that involved a wide variety of stakeholders and resource interests. An important outcome of those processes was the development of a Low Inflow Protocol (LIP). The LIP is a unified drought response mechanism for the hydropower facilities that takes staged actions and reductions in water use during periods of low inflow to avoid a condition in which usable water storage in the reservoirs is fully depleted. The LIP alone is not a cure for drought; however, it seeks to maintain downstream flows and provide time for drought conditions to subside and for precipitation to restore inflows and water levels in reservoirs.

The LIP has five stages of drought, and specific water management actions are implemented at each stage. Drought stages are determined using three indicators: the amount of water in the largest of the six involved lakes, High Rock Lake (in North Carolina); the water flowing into the river basin; and information from the U.S. Drought Monitor. Evaluations of these indicators are conducted monthly by North Carolina Department of Water Resources to determine drought conditions and if those conditions would trigger the LIP.

> Monthly LIP Updates can be obtained at the following website:
>
> https://www.duke-energy.com/community/lakes/drought-management-advisory/yadkin-pee-dee-dmag

The Yadkin-Pee Dee Drought Management Advisory Group (YPD-DMAG) assists in the implementation of the LIP. The YPD-DMAG consists of representatives from Duke Energy, Cube Yadkin Generation (formerly Alcoa Power Generating Inc.), several State agencies in South Carolina and North Carolina, the USFWS, homeowners' associations on the lakes, environmental advocacy groups, and public water supply systems.

Lake Robinson, located on Black Creek, is a 2,250-acre cooling reservoir for Duke Energy's Robinson Nuclear Plant, a 710-MW base-loaded facility. The plant has a drought management operating plan to manage lake levels during drought conditions while protecting the generating capabilities of the nuclear plant in compliance with the operating license issued by the Nuclear Regulatory Commission. The management plan outlines in a stepwise fashion, certain actions that are taken by the plant to manage lake levels depending upon drought severity and the resultant lake levels.

8.2 RBC Drought Response

8.2.1 Roles and Responsibilities

Under the Planning Framework, the RBC will support drought response, collect drought information, and coordinate drought response activities. With support of SCDNR and SCDES, the RBC will:

- Collect and evaluate local hydrologic information for drought assessment
- Provide local drought information and recommendations to the DRC regarding drought declarations
- Communicate drought conditions and declarations to the rest of the RBC, stakeholders, and the public
- Advocate for a coordinated, basin wide response by entities with drought management responsibilities (e.g., water utilities, reservoir operators, large water users)
- Coordinate with other drought management groups in the basin as needed

8.2.2 Communication Plan

The Pee Dee RBC will communicate drought conditions and responses within the basin through the RBC's elected Chair (or Vice Chair, if the need arises). If any part of the basin is in a declared drought as determined by the DRC, the RBC Chair will solicit input from RBC members and other water managers and users regarding drought conditions and responses in their respective locations or interests. The Chair is then responsible for communicating updates on drought conditions and responses within the basin to the Northeast or Central DMA representatives (as applicable) on the DRC or the State Climatology Office (SCO). The DRC has existing mechanisms to communicate and coordinate drought response with stakeholders and the public. Under Section 49-23-70 of the Drought Response Act, SCDNR is responsible for disseminating public information concerning all aspects of the drought.

Further communication channels may exist if a member of the Pee Dee RBC also serves on the DRC as a Northeast or Central DMA representative. This member may work with the RBC Chair (or Vice Chair) to directly communicate between the Pee Dee RBC and the DRC. At the time of this Plan's development, Lindsay Privette of the Pee Dee Regional Council of Governments serves as a Northeast DMA representative on the DRC.

The Pee Dee RBC will communicate and/or coordinate with water management groups that include a focus on the North Carolina portion of basin (i.e., the YPD-DMAG and the Yadkin-Pee Dee Water Management Group). In particular, communication and/or coordination could occur with the electric utilities (i.e. Duke Energy and Cube Hydro Carolinas) and with the LIP coordinated drought response by the Yadkin-Pee Dee DMAG, which includes SCDNR and SCDES in implementing the LIP.

8.2.3 Recommendations

Through consideration and discussion, the Pee Dee RBC developed the following five recommendations related to drought planning and response. Some of these recommendations are more policy-focused and some describe actions that the Pee Dee RBC can directly implement before and during droughts. The steps to implement these recommendations are detailed in the five-year and long-range implementation plans in Chapter 10.

8.2.3.1 Policy-level Recommendations:

1. The RBC recommends that water utilities review and update their drought management plan and response ordinance every 5 years, or more frequently if conditions change. Once updated, the plans should be submitted to the SCO for review. Changing conditions that could merit an update include:

- A change in the source(s) of water
- A significant increase in water demand (such as the addition of a new, large wholesale customer)
- A significant change in the proportion of water used by one sector compared to another (e.g., residential versus commercial use)
- The addition (or loss) of another user relying on the same source of water
- A new water supply agreement with a neighboring utility

2. When droughts occur, the RBC encourages water users and those with water interests to submit their drought impact observations through the Condition Monitoring Observer Reports (CMOR). The CMOR system, maintained by the National Drought Mitigation Center (NDMC), provides supporting evidence in the form of on-the-ground information to help the authors of the U.S. Drought Monitor better understand local conditions. The U.S. Department of Agriculture (USDA) uses the Drought Monitor to trigger disaster declarations and determine eligibility for low-interest loans and some assistance programs. The SCO also reviews and uses CMOR reports in a variety of ways.

CMOR reports can be submitted by clicking the "Submit a Report" button at the NDMC's Drought Impacts Toolkit website:

https://droughtimpacts.unl.edu/Tools/ConditionMonitoringObservations.aspx

3. The RBC recommends that industries continue and enhance information sharing on best practices for drought management. Industries tend to use water efficiently, because they strive to minimize costs associated with obtaining and utilizing water supplies. The RBC encourages industries to consider the best practices they use during droughts to save water and share that information with other industries. The intent of this collaboration is for industries to learn from one another and potentially implement additional or improve existing water saving practices.

8.2.3.2 RBC-level Recommendations:

4. The RBC recommends that a Drought Management Advisory function be created within the RBC. The RBC can directly participate in drought management, coordination, and mitigation by creating a subcommittee or other functional group or process to implement the recommendations listed in this subsection. The committee or group could also serve as an information source for communicating with industry during drought conditions and for connecting smaller communities with resources and information to help them update or develop drought management plans.

5. The RBC recommends that water utilities, when updating their drought management plan and response ordinance, look for opportunities to develop response actions that are consistent with those of neighboring utilities and improve resilience. While triggers are likely to be unique to each water utility based on their source(s) of water, coordination of response actions identified in their ordinance, to the extent practical, supports consistent messaging through the basin, and helps avoid confusion between customers. Also, utilities should reflect on the effectiveness of existing response actions and consider ways to improve responses (if needed) and increase drought resilience.

6. The RBC recommends that water utilities coordinate, to the extent practical, their drought response messaging. Drought messaging refers to both the content and the method or mechanism to deliver the message. Since that time, more targeted means to reach water customers have emerged, including e-mails, text messages, automated phone calls and social media. While the RBC recommends that coordinated messaging continue, the need to coordinate how the message is delivered has largely been eliminated because of the more effective outreach mechanisms. Coordination on the content of the messaging should continue through the standing, monthly meetings, and other means as appropriate.

7. The RBC recommends that value-added collaboration be conducted among members and stakeholders to investigate additional ways to mitigate drought-related risks. The RBC can conduct additional investigations and collaborative discussions with stakeholders to identify new strategies that could be implemented in the near term or be recommended during the next update to the River Basin Plan. Examples of value-added collaboration are described below:

- **Drought surcharges:** The RBC encourages water utilities in the basin to consider drought surcharges on water use during severe and/or extreme drought phases. Drought surcharges, when used, are typically only implemented if voluntary reductions are not successful in achieving the desired reduction in water use. In the Pee Dee River basin, several water utilities have already built into their response ordinance, the ability to implement drought surcharges during the severe and/or extreme drought phases. An example is described below:

The City of Bennetsville encourages all residential water customers to voluntarily reduce overall monthly water usage to 70 percent of the customer's monthly average. If voluntary reduction of usage is not successful, the City of Bennettsville may, at its option, implement the following excessive use rate schedule for water:

- Tier I 0 – 7,500 gallons/household/month regular rate
- Tier II 7,500 – 13,000 gallons/household/month 2 times regular rate
- Tier III Over 13,000 gallons/household/month 3 times regular rate

The City of Bennetsville may impose a drought surcharge per thousand gallons of water that increases with higher usage. The general principle behind the drought surcharge is that the fee is imposed on water use in excess of 7,500 gallon of normal monthly use. The drought surcharge is a temporary fee imposed during the current water supply shortage and is not a cost-based rate. The drought surcharge is temporary and will be terminated at such time as the City of Bennettsville determines the water supply is above the trigger levels.

- **Drought plan commonalities and vulnerabilities:** The RBC could initiate a review of drought management plans in the Pee Dee River basin to identify common drought mitigation strategies or vulnerabilities. Plans could be evaluated by the size of their water system or source(s) of supply to further categorize and evaluate vulnerabilities among similar systems. Observations on commonalities and vulnerabilities could be shared with water utilities and discussions could be initiated to explore ways to mitigate similar vulnerabilities using coordinated approaches.

Chapter 9
Policy, Legislative, Regulatory, Technical, and Planning Process Recommendations

During the fourth and final phase of the planning process, the Pee Dee RBC identified and discussed recommendations related to the river basin planning process, technical, and program considerations as well as policy, legislative, or regulatory considerations. Various recommendations were proposed by RBC members and discussed over the span of several meetings. The RBC considered the recommendations and prioritized them as described later in this chapter. The prioritization process and assessment of RBC input on water management strategies described in Chapter 7 was used to recommend policy, regulatory, technical, and planning process recommendations in this chapter.

The planning process recommendations are summarized in Section 9.1, technical and program recommendations are summarized in Section 9.2, and policy, legislative, and regulatory recommendations are summarized in Section 9.3. While all the recommendations in Chapter 9 are important, Section 9.4 highlights the technical and policy recommendations prioritized by the RBC.

9.1 River Basin Planning Process Recommendations

The following planning process recommendations should be taken into consideration for future planning process phases.

- The RBC (in conjunction with SCDES) should develop guidance and guidelines for processes to replace RBC members if current members resign, and to adjust member terms if necessary. They should develop best practices for recruiting new members.
- SCDES should organize an annual state-wide meeting of RBCs and State agencies.
- Public relations and communication strategies should be developed to educate the public on who the RBC is, what it does, and the benefits of participation. Strategies should focus on both the role of the RBC in planning and in implementation.
- Diversify meeting locations and include more field trips, if possible.
- The South Carolina Legislature should continue to fund state water planning activities, including river basin planning. Currently, nearly all the funding for the river basin planning process has come from the legislature.
- The RBC should establish a social media presence and use this to describe the river basin planning process to customers and/or the public during ongoing outreach, education, or training programs.

- RBC members should be encouraged to present observations and outcomes of the river basin planning process at conferences that focus on water resources, sustainability, environmental stewardship, smart growth, and other related topics.

9.2 Technical and Program Recommendations

Technical and program recommendations aim to address information or data gaps identified during the planning process. The following technical recommendations were identified by the Pee Dee RBC. To implement these recommendations, the Pee Dee RBC will need support from SCDNR, SCDES, and technical experts.

Members of the RBC proposed the following recommendations related to model improvements:

- **Surface water modeling should extend to coastal areas**: Current surface water models are limited to areas that are upstream of reaches influenced by tidal impacts. The RBC would like modeling and analysis tools that include these areas to provide information on potential water supply and water quality risks. This is especially important due to high projected population growth along the coast, the need for additional supplies to meet future demands in these communities, and declining local groundwater levels.
- **Improved calibration efforts**: Additional surface water gaging stations should be installed in headwater areas to better understand flow conditions and improve future model calibration. Similarly, additional groundwater monitoring should be installed in areas that may see development pressure in the future.
- **Groundwater modeling should be completed**: A groundwater model for the Pee Dee River basin was being developed by the USGS during creation of the River Basin Plan, but it was not completed by the time the Plan was published. The groundwater model will be a valuable tool for evaluating current and potential future groundwater supply risks.

Members of the RBC developed the following recommendations related to technical studies to improve knowledge of specific issues:

- **Data improvement**: RBC members discussed the need for more and/or higher quality data to inform better decision making. Potential areas for new or improved data include more rainfall and meteorological monitoring throughout the basin, more metering data to better understand per capita water use and water losses, more stream flow and groundwater monitoring locations. The RBC recommends conducting an assessment of data types, sources, and quality needed for better decision making, identifying data gaps, developing a strategy for implementing and funding data collection efforts, and distributing data to stakeholders.
- **Land protection**: Improve the understanding of land use and land protection by studying and developing a strategy for additional land protection. The RBC recommends studying the water quantity and quality impacts of land use changes.
- **Climate change and variability**: Climate variability may impact future water demands, water supplies, and hydrology and create water resource conditions that are unprecedented in historical

observations. The RBC recommends incorporating potential climate variability impacts to demand projections and hydrologic conditions in scenario planning.

- **Storm prediction**: More Doppler radar capabilities should be created to help with storm prediction and data collection.
- **Drivers of groundwater issues**: The drivers of unsustainable groundwater withdrawals (i.e. cones of depression), such as water demands, local aquifer conditions, and groundwater well spacing and pumping rates should be more thoroughly understood to better inform groundwater management strategies.
- **Reuse potential**: Water reuse and recycling is a recommended water management strategy in the Pee Dee River Basin Plan. To assess the potential for water reuse and recycling, the quantity of effluent from basin dischargers (both municipal and industrial) should be evaluated.
- **Water quality**: Surface water and groundwater quality is an existing and growing concern in the Pee Dee River basin. Future Pee Dee RBC planning efforts should consider water quality. Water quality in the Pee Dee River basin has been studied and modeled in the past, and future considerations of water quality in planning efforts should leverage prior work as appropriate. Also, existing water quality monitoring data (and data gaps) should be evaluated as water quality considerations are incorporated.
- **Flooding**: RBC members observed that flooding poses an important water-related risk that not only threatens life and property, but it also can impact the ability to provide reliable water supplies when and after a flood occurs. Future Pee Dee RBC planning efforts should consider flooding. The Pee Dee RBC should also consider communication with the Yadkin-Pee Dee Water Management Group to share information on flooding risk and management of upstream dams.

9.3 Policy, Legislative, or Regulatory Recommendations

The Pee Dee RBC engaged in discussion about issues and concerns with the existing policies, laws, and regulations governing water withdrawals and water use. Current regulations regarding surface water and groundwater withdrawals are summarized in Table 9-1 located at the end of this section. The Pee Dee RBC developed the following recommendations for modifications to existing state or local laws, regulations, or ordinances:

- The South Carolina Surface Water Withdrawal, Permitting, Use, and Reporting Act should allow for reasonable use criteria to be applied to all surface water withdrawals, like those that currently exist for groundwater withdrawal. For surface water withdrawals, reasonable use criteria vary depending on the water use category and the time of permit application (pre- or post-2011, when SCDES's regulation, 61-119 Surface Water Withdrawal, Permitting, Use and Reporting, came into effect).
- Surface water withdrawal registrations should be limited to actual need.
    - Existing (pre-2011) non-agricultural surface water withdrawers do not need to meet reasonable use criteria. The permitted withdrawal is based on the largest volume as determined by previously documented use, current treatment capacity, or designed capacity of the intake structure.

- New (post-2011) or expanding non-agricultural surface water withdrawers must demonstrate that the requested water withdrawal amount meets the criteria for reasonable use.
- Agricultural surface water withdrawals, all of which do not require a permit where there is remaining safe yield in a basin, do not need to satisfy reasonableness criteria for the requested withdrawal amount.

Comparatively, under SCDES's regulation 61-113 Groundwater Use and Reporting, permittees of any use category seeking to withdraw greater than 3 million gallons in any month from groundwater must demonstrate to SCDES's satisfaction that groundwater withdrawal is reasonable and necessary and there are no unreasonable adverse effects on other water users.

- A cost share program should be developed to drill deeper wells into aquifer units with less development pressure.
- A joint compact or water management group should be established and funded that would focus on segments of the Yadkin-Pee Dee River basin that span North Carolina and South Carolina.
- Coastal community and tidal issues should be analyzed and considered in river basin planning.
- Policies should require water utilities to review and update their drought management plan and response ordinance every five years, or more frequently if conditions change. Policies should also require that updated plans be submitted to the State Climatology Office. When droughts occur, drought impact observations should be submitted through the CMOR.
- The South Carolina legislature should provide ongoing funding for plan implementation, including administration, technical evaluations, data collection and research, and providing grants to stakeholders for water projects. Funds should accommodate adequate State staff to provide dedicated, ongoing support for plan implementation.
  - A separate bureau or group within SCDES (or other department) that has staff dedicated to River Basin Plan implementation and updates should be established.
- The State should support and fund RBC-led and statewide water education programs that include all sectors of water use and promote the types of water management strategies recommended in River Basin Plans.
- SCDES should provide guidance on how RBCs should interface with other organizations.
- The State should fund an implementation organization in the future. Ideally, the implementation organization would be the RBC, but it could also be a watershed or issue-focused organization (e.g. focused on interstate water management, water conservation, or stakeholder assistance for funding acquisition and management).
- Water supply information should be considered when evaluating the feasibility of new industries.
- Larger private water utilities should create drought management plans and coordinate with public utilities that currently have a drought plan.
- Support the protection in perpetuity of habitat, particularly in the riparian corridors of the Pee Dee River basin. Priority sites contributing significantly to water quantity, quality, and or potential for enhancement of water quality should be identified and, where possible, protected by voluntary or purchased Conservation Easements or fee-title acquisition.

Table 9-1. Summary of regulations related to surface water and groundwater withdrawal.

Water Source	Use Type	User Type	Process	Applicability	Withdrawal Volume	Use Criteria	Low Flow Period Requirements	Review Period	Reporting
Surface Water	Agricultural	Existing (pre Jan 1, 2011)	Registration	Users withdrawing more than 3 MG in a month	Highest previous water usage	No criteria	No MIF obligations	No review, in perpetuity	Annual
		New (post Jan 1, 2011) or Expanding	Registration	Users withdrawing more than 3 MG in a month	Amount of water requested by the proposed withdrawer and availability of water at the point of withdrawal based on Safe Yield Calculations	Subject to safe yield assessment	No MIF obligations	No review, in perpetuity	Annual
	Hydropower	All	Exempt (non-consumptive use)						Annual
	All Other Use Types	Existing (pre Jan 1, 2011)	Permit	Users withdrawing more than 3 MG in a month	Largest volume as determined by previously documented use, current treatment capacity, or designed capacity of the intake structure	No criteria	Must address "appropriate industry standards for water conservation." Not subject to enforcement for MIF.	30 to 50 years[1]	Annual
		New (post Jan 1, 2011) or Expanding	Permit	Users withdrawing more than 3 MG in a month	Based on reasonableness, availability of water at point of withdrawal based on Safe Yield calculations.	Reasonable use criteria	Development of Contingency Plan for low flow periods, enforceable. Public water suppliers not subject to MIF[2]	20 to 50 years[1]	Annual

Water Source	Use Type	User Type	Process	Applicability	Withdrawal Volume	Use Criteria	Low Flow Period Requirements	Review Period	Reporting
Ground-water	All Other Use Types	Withdrawals in Capacity Use Areas	Permit	Users withdrawing more than 3 MG in a month	Permit withdrawals based on reasonable use guidelines, which vary by water use sector.	Reasonable use criteria	Requires development of Best Management Plan that identifies water conservation measures, alternate sources of water, justification of water use, and description of beneficial use	Every 5 years	Annual
	All Other Use Types	Withdrawals Outside of Capacity Use Areas	Registration	Users withdrawing more than 3 MG in a month	Registrations do not have limits but require reporting.	No criteria	No MIF obligations	No review, in perpetuity	Annual

[1] New surface water permitees may receive permits of 20 years or up to 40 years as determined by department review
Existing surface water permittees may receive permits of 30 years or up to 40 years as determined by department review
Municipal or governmental bodies may receive permits of up to 50 years to retire a bond it issues to finance the construction of waterworks (SECTION 49-4-100)
[2] Public water suppliers not subject to MIF but are required to implement their contingency plan in accordance with drought declarations 49-4-150 6

9.4 Selection, Prioritization, and Justification for Technical and Policy Recommendations

The RBC used a multi-step scoring process to select and prioritize the technical and policy recommendations described in Sections 9.2 and 9.3 above. The scoring and prioritization process used by the RBC was the same as that used for water management strategies and described in Section 7.1 (see that section for more detail on the process and scoring). The RBC scored and prioritized technical and policy recommendations separately.

9.4.1 Prioritization of Technical Recommendations

Like the process for water management strategies, a preliminary scoring process was used to identify the technical recommendations with the highest impact, which tended to be those scored with high benefits and low cost. A set of preliminary scores was developed by the consulting team and was considered by the RBC during the scoring process. The preliminary scoring results are summarized in Table 9-2. Note that the number of symbols (i.e. water drops, dollar signs, check marks, and hour glasses) correspond to the scoring rubric described in Table 7-1 (See Chapter 7).

Table 9-2. Preliminary scoring of technical recommendations.

Strategy	Benefit	Cost	Implement-ability	Time
Future Pee Dee RBC planning efforts should consider water quality	💧💧	$$	✓✓	⌛⌛
Extend surface water modeling to coastal areas	💧💧💧	$	✓	⌛⌛
Install additional surface water gaging stations in headwater areas	💧	$$$	✓	⌛⌛
Install additional groundwater monitoring in future growth areas	💧	$$$	✓	⌛⌛
Study the water quantity and quality impacts of land use changes	💧💧	$$	✓	⌛⌛
Incorporate future climate change projections or hydrologic conditions in future scenarios	💧💧💧	$$	✓	⌛⌛⌛
Create more Doppler radar capabilities to help with storm prediction and data collection	💧💧	$$$	✓	⌛⌛
Future Pee Dee RBC planning efforts should consider flooding	💧💧💧	$$	✓✓	⌛⌛
Better understand the drivers of unsustainable groundwater withdrawals	💧	$	✓	⌛
Evaluate the quantity of effluent from dischargers to assess reuse potential	💧	$	✓✓	⌛⌛⌛

After the preliminary scoring process, the RBC further prioritized these recommendations using a forced ranking approach. More details on this approach are provided in Section 7.1.2.

Figure 9-1 focuses on the highest priority technical recommendations identified by the Pee Dee RBC. While some recommendations were not highly prioritized, they are still viable and valuable for consideration by the State and stakeholders in the basin.

The results of three preferential voting methods derived from the forced ranking were summarized for the top five of the ten technical recommendations as shown in Figure 9-1. The results for Borda Count and Pairwise Comparison are described as a "ranking," with a rank of "1" most preferred and higher rank numbers less preferred. Conversely, the Plurality process counts the number of top votes, so a higher value is seen as more preferred. Figure 9-1 illustrates general consistency among the preferred strategies across all three methods.

Below are observations on the voting results shown in Figure 9-1:

- Additional studies and extending technical analysis tools to consider coastal areas are highly supported by the RBC.
- Evaluating the water quantity and quality impacts of land use changes is another high priority for the Pee Dee RBC.
- The Pee Dee RBC strongly favored considering water quality and flooding impacts in future updates to the River Basin Plan.

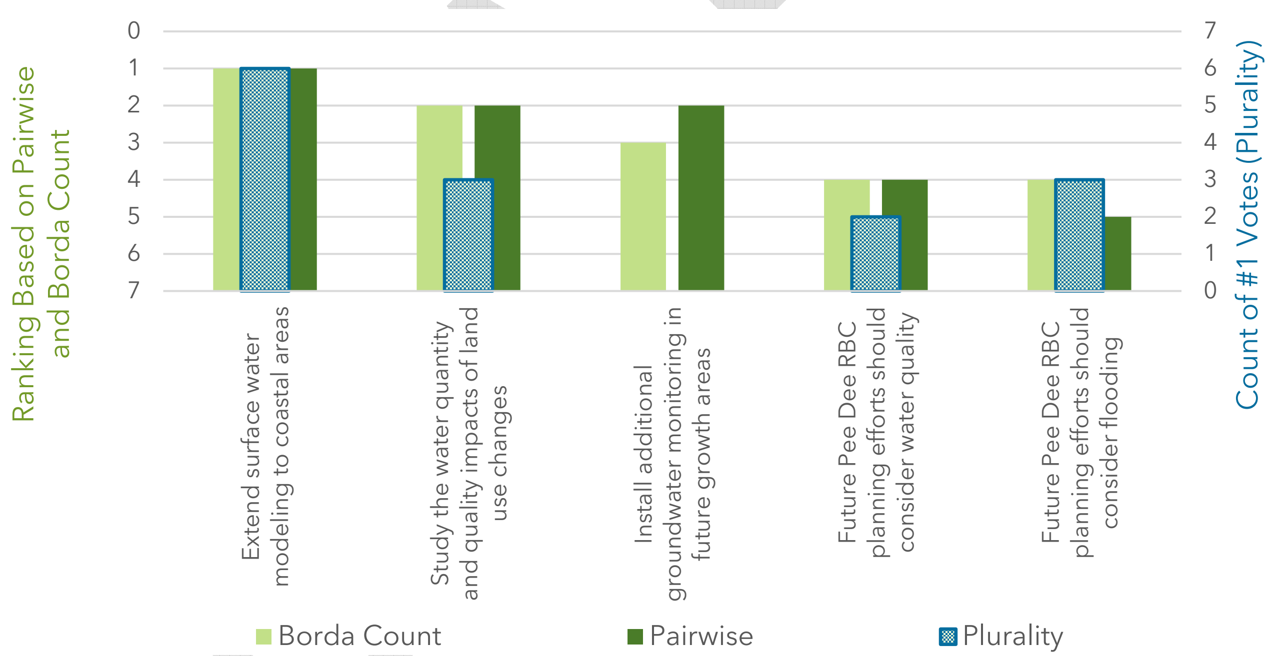


Figure 9-1. Technical recommendation ranking comparison.

Additional discussions by the Pee Dee RBC, which occurred after the prioritization process, centered on the need for good data and the importance of good data for making sound water management decisions. Several of the technical recommendations identified by the Pee Dee RBC focus on enhancing the amount and quality of data in the basin, and they include:

- Install additional surface water gaging stations in headwater areas.
- Install additional groundwater monitoring in future growth areas.
- Create more Doppler radar capabilities to help with storm prediction and data collection.
- While not a technical recommendation that was originally considered by the Pee Dee RBC, establishing a mesonet of weather stations was discussed and viewed favorably by the RBC. Specifically, the RBC discussed establishing at least one mesonet weather station in each county in the state to measure climate variables on a more consistent, comprehensive, and localized basis as a means for better drought monitoring and management as well as overall water resources management across sectors.

The Pee Dee RBC also discussed the importance of completing the groundwater model to help inform their understanding of current and potential future groundwater related risks and water management strategies to reduce risks.

9.4.2 Prioritization of Policy Recommendations

The same scoring process for technical recommendations was used for policy recommendations. The preliminary scoring process identified recommendations with the highest impact, which tended to be those scored with high benefits and low cost. A set of preliminary scores was developed by the consulting team and was considered by the RBC during the scoring process. The preliminary scoring results are summarized in Table 9-3. Note that the number of symbols (i.e. water drops, dollar signs, check marks, and hour glasses) correspond to the scoring rubric described in Table 7-1 (See Chapter 7).

Table 9-3. Preliminary scoring of policy recommendations.

Strategy	Benefit	Cost	Implement-ability	Time
Surface water withdrawal registrations should be limited to actual need	💧💧💧	$	✓✓✓	⌛⌛
Develop a cost share program to drill deeper wells into aquifer units that have less development pressure	💧	$$	✓✓	⌛⌛⌛
Fund a joint compact between SC and NC for the Yadkin-Pee Dee Basin	💧💧💧	$$$	✓✓✓	⌛⌛⌛
The State should fund an implementation organization in the future	💧💧💧	$$	✓✓	⌛⌛⌛
RBCs (where applicable) should consider coastal community (tidal) issues	💧💧💧	$	✓	⌛⌛
Water utilities should update their drought management plan and response ordinance every 5 years	💧💧	$	✓	⌛
Drought impact observations should be submitted through the Condition Monitoring Observer Reports (CMOR)	💧	$	✓	⌛
Provide ongoing funding for plan implementation (admin, tech, projects)	💧💧💧	$$$	✓✓	⌛⌛
Support and fund water education programs	💧💧	$$	✓✓	⌛⌛
Provide guidance on how RBCs should interface with other organizations	💧	$	✓	⌛
Use water supply information to evaluate the viability of new industries	💧	$	✓✓	⌛

After the preliminary scoring process, the RBC prioritized these recommendations using a forced ranking approach. More details on this approach are provided in Section 7.1.2.

The results of the three preferential voting methods derived from the forced ranking were summarized for policy recommendations as shown in Figure 9-2. The results for Borda Count and Pairwise Comparison are described as a "ranking," with a rank of "1" most preferred and higher rank numbers less preferred. Conversely, the Plurality process counts the number of top votes, so a higher value is seen as more preferred. Figure 9-2 illustrates general consistency among the most preferred strategies across all three methods.

Figure 9-2 focuses on the highest priority policy recommendations identified by the Pee Dee RBC. While some recommendations were not highly prioritized, they are still viable and valuable for consideration by the State and stakeholders in the basin.

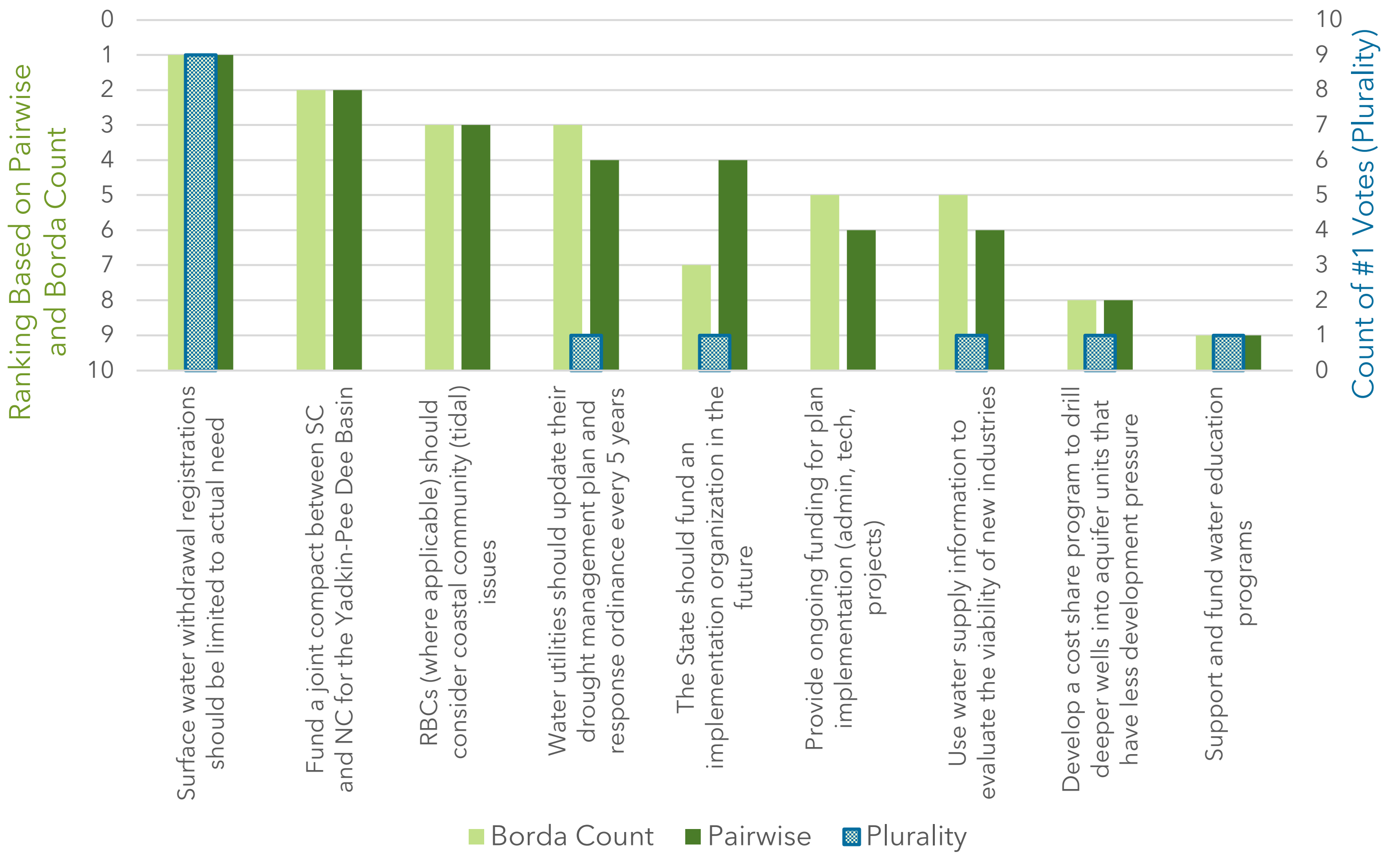


Figure 9-2. Policy recommendation ranking comparison.

Below are observations on the policy recommendations shown in Figure 9-2:

- The policy recommendation with the highest priority was that surface water withdrawal registrations should be limited to actual need. The high priority of this recommendation was very clear from the voting conducted by the RBC.
- While funding a joint compact between South Carolina / North Carolina and consideration of coastal community issues did not receive any #1 votes, they were well-supported by the RBC.

- Several policy recommendations were generally supported by the RBC and also received a #1 vote by five of the RBC members. These recommendations focus on updating drought management plans, state funding of an implementation organization, using water supply information to evaluate viability of new industry, funding for drilling wells into aquifers with less water use, and funding water education programs.
- The Pee Dee RBC prioritized and highly-supported several recommendations that focus on the continuation and implementation of the basin planning process (including funding an implementation organization, providing ongoing funding for implementation, and education programs). These recommendations will be critical for obtaining basin stakeholder buy-in and participation in the vision and implementation of the Pee Dee River Basin Plan.

Chapter 10
River Basin Plan Implementation

10.1 Recommended Five-Year Implementation Plan

10.1.1 Implementation Objectives

The Pee Dee RBC identified five overall implementation objectives for the Pee Dee River Basin Plan, and they are listed in Table 10-1. The objectives were developed based on RBC input throughout the river basin planning process and the themes that emerged from the recommendations made in previous chapters. Objective 1, improve water use efficiency to conserve and sustain water supplies, was derived from prioritized demand-side water management strategies described in Chapter 6 and recommended in Chapter 7. Objective 2, implement one-water approaches to optimize sources of supply, recognizes the need to consider all sources of available water supply to meet current and future needs as described in Chapter 6 and recommended in Chapter 7. Objective 3, improve drought management, corresponds to drought-related recommendations in Chapter 8. Objective 4, broaden technical understanding of water resource issues, comes from recommendations in Chapter 9. Objective 5, effectively communicate RBC findings and recommendations, encompasses a variety of recommendations from Chapters 7, 8, and 9. The Planning Framework states that the RBC should prioritize the objectives. The Pee Dee RBC ranked three objectives as high priority and two objectives as medium priority. The justifications for each priority ranking are summarized in Table 10-1.

Table 10-1. Implementation objectives and prioritization.

Objective	Priority	Prioritization Justification
Objective 1: Improve water use efficiency to conserve and sustain water supplies	High	While significant shortages were not projected in the Pee Dee Basin, efficient water use helps create resilience for unforeseen challenges. Many efficiency improvements can lower costs to homeowners, industry, and agriculture; can sustain supplies; and can be pursued immediately.
Objective 2: Implement one-water approaches to optimize sources of supply	High	Where water supplies are stressed, conjunctive use of surface and groundwater can help meet demands more reliably and sustainably. Actions should be implemented proactively in areas of water stress.
Objective 3: Improve drought management	Medium	Maintaining up-to-date drought plans and effective communication are important for public water supplier response and to coordinate actions at a basin- and state-level.
Objective 4: Broaden technical understanding of water resource issues	Medium	The RBC identified a wide variety of technical issues that need additional investigation to better understand current or potential future issues and to inform strategies to mitigate water supply risks.
Objective 5: Effectively communicate RBC findings and recommendations	High	Support and participation from basin stakeholders is critical to achieve the vision of the Pee Dee River Basin Plan.

The strategies and corresponding actions to achieve each objective are presented in Table 10-2. Under each objective where applicable, strategies are listed by its priority for implementation. Table 10-2 also includes an outline of 5-year actions, responsible parties, budget, and potential funding sources to achieve each objective. The funding sources are further described in Section 10.1.2.

Implementation of strategies and actions will require funding for RBC meetings, consulting assistance, etc. The Pee Dee RBC will continually evaluate the priority of actions, specific steps for implementing actions, and timelines for implementation as funding becomes available in the future.

The Pee Dee River Basin Plan was developed collaboratively using the best available science
(Photo credit: JD Solomon)

Table 10-2. Implementation plan.

Strategy	Sector	Strategy Priority	5-Year Actions	Responsible Parties	Budget	Funding Sources
Objective 1: Improve water use efficiency to conserve and sustain water supplies						
A. Leak detection and water loss control	Muni. Ind.	1 (Muni.) 5 (Ind.)	1. Identify funding opportunities (yrs 1-5) 2. To the extent practicable, establish a baseline of residential per capita water use (recognizing that water meter and other data may not be complete) and identify ways that data could be improved (yr 1). 3. Implement an outreach and education program about recommended water management practices and funding opportunities (yrs 1-5) 4. Individual water users to implement conservation practices (yrs 2-5) 5. Develop survey of practices implemented for municipal and industrial users, funding issues, and funding sources utilized (beginning in yr 5 as part of 5-year Plan update) 6. Review and analyze per capita water usage to improve understanding of water savings of strategies (beginning in yr 5 as part of 5-year Plan update)	*RBC with support of SCDES, SCDNR, and contractors* - Identify funding opportunities and develop information to distribute. Conduct per capita water use investigation and surveys and analyze results. *Municipal and Industrial Withdrawers* – Implement appropriate strategies and seek funding as necessary.	Costs of implementation will vary by municipality according to current program capabilities and financial means. See Section 6.1.6 for discussion of cost and benefit of individual strategies. Cost of RBC support activities are included in on-going RBC meeting budgets.	Individual strategies to be funded using outside funding opportunities or by evaluating existing rate structures. Possible outside funding sources include: Fed-1, 2, 4, 5, 8, 9 and USDA-8 and 9.
B. Water efficiency standards for new construction	Muni.	2				
C. Landscape irrigation programs and codes	Muni.	3				
D. Water reuse and recycling	Muni.	4				
E. Pricing structures	Muni.	6				
F. Water efficient processes	Ind.	7				
G. Time-of-day watering limits	Muni.	8				

Note: The above strategies focus on RBC priorities as described in Chapter 7. The strategies are anticipated to have the greatest impact for the most people across the basin and center on the municipal and industrial water use sectors. The RBC also recognizes that improving water use efficiency is important across all water use sectors (including agriculture, golf courses, thermoelectric generation, etc.) both for reducing water costs and sustaining water supplies. The RBC encourages all water use sectors to implement water saving measures.

Table 10-2 (continued). Implementation plan.

Strategy	Strategy Priority	5-Year Actions	Responsible Parties	Budget	Funding Sources
Objective 2: Implement one-water approaches to optimize sources of supply					
A. Conjunctive use of surface and groundwater supplies	1	1. Identify funding opportunities (yrs 1-5) 2. Implement outreach and education program about recommended water management practices and funding opportunities (yrs 1-5) 3. Individual water users to implement new water supply practices as appropriate (yrs 3-5) 4. Develop survey of practices implemented, funding issues, and funding sources utilized (beginning in yr 5 as part of 5-year Plan update)	*RBC with support of SCDES, SCDNR, and contractors -* Identify funding opportunities and develop information to distribute. Conduct surveys and analyze results. *Water providers -* implement appropriate strategies and seek funding as necessary.	Implementation costs for individual water providers or users can vary significantly based on infrastructure needed for implementation. See Section 6.1.3 for discussion of cost/benefit. Cost of RBC support activities are included in ongoing RBC meeting budgets.	Fed-1, 2, 3, 4, 5, 8 and 9 Possible outside funding sources for agricultural water withdrawers include USDA-7
B. Drill new or supplemental well into lesser-used aquifers	2				
C. Water reuse systems (non potable)	3				
D. Aquifer storage and recovery	4				
E. Stormwater capture and treatment	5				
F. Dredging or pond deepening	6				

Table 10-2 (continued). Implementation plan.

Strategy	Strategy Priority	5-Year Actions	Responsible Parties	Budget	Funding Sources
Objective 3: Improve drought management					
A. Public water providers on RBC to update drought management plans	1	1. Public suppliers on the RBC to review, update, and improve their drought management plans, including their supporting water shortage response ordinances and send them to the SCO (yrs 1-5) 2. Public suppliers on the RBC to consider ways to incorporate RBC drought management recommendations into their drought plans and ordinances (yrs 1-5) 3. Updates to drought management plans and ordinances should be shared with the SCO (e-mailed to drought@dnr.sc.gov)	Public water suppliers in the RBC	Drought planning activities to occur within public suppliers' annual budgets.	Fed-6
B. Industry to collaborate on drought management best practices	2	1. With SCO and industry representatives on RBC, identify best practices for drought management by industries (yr 1) 2. Develop materials on best practices for drought management by industry (yr 2) 3. Develop outreach strategy to communicate with industry and distribute materials (yr 3) 4. Execute outreach strategy and update materials as necessary (yrs 3-5) 5. Develop a survey to identify practices implemented and benefits gained from outreach (yrs 3-5)	RBC with support of industry, SCO, SCDES, and contractors	No direct cost, other than ongoing contractor support, if needed. Cost of RBC activities are included in on-going RBC meeting budgets. Cost for industries may vary by organization, but are anticipated to occur within existing industry operating budgets	
C. Foster drought communications among stakeholders	3	1. Create Drought Management Advisory committee (yr 1) 2. Communicate with Yadkin-Pee Dee Water Management Group on drought issues before and when droughts occur (yrs 1-5) 3. Develop materials on benefits and implementation of RBC drought management recommendations (yr 2) 4. Develop outreach strategy to communicate with stakeholders and distribute materials (yr 3) 5. Execute outreach strategy and update materials as necessary (yrs 3-5) 6. Develop approach to track progress (yrs 3-5)	RBC with support of SCO, SCDES, and contractors	No direct cost, other than ongoing contractor support, if needed. Cost of RBC activities are included in on-going RBC meeting budgets.	Fed-6

Table 10-2 (continued). Implementation plan.

Strategy	Strategy Priority	5-Year Actions	Responsible Parties	Budget	Funding Sources
Objective 4: Broaden technical understanding of water resource issues					
A. Complete groundwater model	--	1. USGS to complete the Coastal Plain Groundwater Model, and RBC to develop a subcommittee that meets quarterly to monitor and inform the model completion process (yrs 1 and 2) 2. Use the model to identify current and potential future groundwater supply risks and water management strategies to mitigate risks (yrs 1 and 2)	USGS to complete model and conduct RBC-informed simulations	SCDES existing budget. Contractor work to support simulations may range from $15,000 to $30,000.	Funded by SCDES budget as available
B. Evaluate data gaps and needs	--	1. Research topics and geographic areas in which more data are needed make better water management decisions across all sectors of water use (yrs 1 and 2) 2. Create a data gap summary and identify strategies to fund the acquisition and distribution of new and better data (yr 2)	RBC with support of SCDES and contractors	SCDES existing budget. Contractor work on feasibility analysis may range from $25,000 to $50,000.	Funded by SCDES budget as available
C. Extend surface water modeling to coastal areas	1	1. Research potential analysis tools (yr 1) 2. Depending on the findings of the research, RBC to consider incorporating coastal analyses into future modeling as appropriate (beginning in yr 5 as part of 5-year plan update)			
D. Study the water quantity and quality impacts of land use changes	2	1. Invite RTI to educate the RBC on Catawba Wateree Water Management Group (CWWMG) land conservation modeling. (yrs 1-2) 2. Consider performing similar land conservation modeling to identify how land use changes may impact water resources (yr 3) 3. Conduct modeling (yrs 3-5)	RBC with support from SCDES, SCDNR, and contractors	SCDES existing budget. Modeling could range from $50,000 to $100,000.	Funded by SCDES budget as available

Table 10-2 (continued). Implementation plan.

Strategy	Strategy Priority	5-Year Actions	Responsible Parties	Budget	Funding Sources
Objective 4: Broaden technical understanding of water resource issues (continued)					
E. Install additional groundwater monitoring in future growth areas	3	1. Continue to monitor water levels in existing wells throughout Pee Dee River basin (yrs 1–5) 2. Identify, seek access to, and monitor water levels in existing production wells in groundwater areas of concern to confirm actual groundwater conditions (yrs 1–5) 3. Seek funding and drill new monitoring wells in current or preliminary groundwater areas of concern, as needed (yrs 1–5) 4. Conduct data analysis (analyze collected water level data) (yrs 1–5)	SCDES with potential support from USGS	Costs of monitoring existing wells are within SCDES budget. New monitoring wells and monitoring equipment may range from $10,000 to $50,000 depending on depth.	SCDES and potential USGS budgets as available
F. Consider water quality and flooding in future planning efforts	4, 5	1. RBC to first identify specific water quality and flooding issues and concerns in the basin (yrs 2-3) 2. RBC to develop approach to further address water quality and flooding issues and concerns (possibly using contractor assistance on technical aspects of approach). Water quality approach could include the need to develop a watershed plan under SCDES's Watershed Program. RBC to consider collaboration with Yadkin-Pee Dee Water Management Group regarding flood risk (yrs 4-5)	RBC with support from SCDES, SCDNR, and contractors	RBC costs are included in on-going meeting and support budgets. Contractor work could be $10,000 to $30,000 Development of watershed plans would come from SCDES's existing Watershed Program budget.	Fed-6 and 8

Note: Strategies under Objective 4 that do not have a priority were discussed by the RBC and added after the prioritization exercise described in Chapter 9.

Table 10-2 (continued). Implementation plan.

Strategy	Strategy Priority	5-Year Actions	Responsible Parties	Budget	Funding Sources
Objective 5: Effectively communicate RBC findings and recommendations					
A. Conduct Pee Dee RBC meetings to review, initiate, and support implementation actions	1	1. Pee Dee RBC to meet quarterly as needed following publication of Pee Dee River Basin Plan. Meetings will focus on implementation plan actions and identifying funding (yr 1) 2. Future RBC meetings on less frequent basis, as deemed necessary (minimum 1 per year) (yrs 2-5) 3. SCDES and/or contractors to provide new member orientation (yrs 1-5, on-going) 4. Convene existing or form new ad-hoc subcommittees to address time-sensitive matters (yrs 1-5 as needed)	RBC members to attend. SCDES and contractors to organize.	No direct cost, other than ongoing contractor support, if needed. Cost of RBC activities are included in on-going RBC meeting budgets. If contractor led, RBC meetings may range between $5,000 and $15,000 per meeting, depending on effort needed to prepare for, conduct, and document each meeting.	Funded by SC Legislature and Fed-8
B. Develop a communication plan early in the implementation process and conduct education and outreach	2	1. SCDES to provide guidance on how RBC should interface with other organizations (yr 1) 2. Develop a social media policy (yr 1) 3. Develop social media accounts for the Pee Dee RBC (yr 1) 4. Develop talking points/script to provide consistent message from RBC. Talking points will vary depending on media and whether communication is with public or elected officials/decision makers. Engage communication specialists to help with messaging (yrs 1-5) 5. Track which representatives have been spoken to and by whom from the RBC. Note any outcomes of conversation (yrs 1-5)	SCDES provides guidance on interfacing with other organizations. RBC with the support of contractors to develop talking points and track interactions. RBC to engage public via social media and meetings	No direct cost, other than ongoing contractor support, if needed. Cost of RBC activities are included in on-going RBC meeting budgets.	No direct cost

10.1.2 Funding Opportunities

Existing external funding sources may be leveraged to promote implementation of the objectives described in Section 10.1.1. For example, EPA's Water Infrastructure Finance and Information Act (WIFIA) program offers funding to support eligible water and wastewater infrastructure projects including those related to drought prevention, reduction, and mitigation. Other funding to support drought mitigation efforts may be available through the Federal Emergency Management Agency's Hazard Mitigation Grant Program (HMGP) or Building Resilient Infrastructure and Communities (BRIC) programs. Table 10-3 describes a wide variety of federal and state funding sources that could be used to implement River Basin Plan objectives. The USDA offers numerous programs for farmers and ranchers to reduce risk from drought or to restore land impacted by drought. Table 10-4 summarizes existing USDA funding sources.

In 2022 Congress passed the Inflation Reduction Act (IRA), which may provide additional funding to programs related to agricultural conservation. For example, of the $20 billion allotted to the USDA, Section 21001 of the IRA assigned $8.5 billion in addition to amounts otherwise available to an existing USDA program, the Environmental Quality Incentives Program (EQIP). EQIP pays for ecosystem restoration and emissions reduction projects on farmland and may be used for activities such as the purchase of seed for cover crops (one of the agricultural conservation strategies discussed in this plan). Annual obligations from the EQIP program through the Farm Bill have been approximately $1.1 to $1.5 billion from 2018 through 2023, with between $28 to $32 million allotted for projects in South Carolina in these years. Additionally, through the IRA, $8.45 billion was allotted to EQIP, $3.25 billon to the federal Conservation Stewardship Program, $1.4 million to the Agricultural Conservation Easement Program, and $4.95 billion to the Regional Conservation Partnership Program. The IRA indicates that activities funded by these programs must "directly improve soil carbon, reduce nitrogen losses, or reduce, capture, avoid, or sequester carbon dioxide, methane, or nitrous oxide emissions, associated with agricultural production" (Inflation Reduction Act 2022). Projects that provide water efficiency benefits in addition to these climate benefits may be eligible for funding under these programs. Section 30002 of the IRA also designated $837.5 million in funding to the Secretary of Housing and Urban Affairs for projects that improve energy or water efficiency for affordable housing (Inflation Reduction Act 2022).

In September 2022, $70 million in USDA "Partnerships for Climate-Smart Commodities" funding was invested in South Carolina's two land-grant universities, Clemson University and South Carolina State University, to promote "climate-smart" agricultural practices in South Carolina. The project will utilize a coalition of 27 entities to promote the program to farmers, with a focus on peanuts, leafy greens, beef cattle, and forestry. Most of the funding will go directly to growers to offset the costs of implementing conservation practices. There may be opportunities to leverage this new funding source to implement the agricultural conservation strategies recommended in this plan.

Table 10-3. Federal funding sources.

Funding Source Index	Program	Agency	Grant/Loan Funds Available	Description
Fed-1	U.S. Economic Development Administration (EDA) Grants	EDA	No limit (subject to federal appropriation)	EDA's Public Works Program and Economic Adjustment Assistance Program aids distressed communities by providing funding for existing physical infrastructure improvements and expansions.
Fed-2	Water Infrastructure Finance and Information Act	U.S. Environmental Protection Agency (EPA)	Up to 49 percent of eligible project costs (minimum project size is $20 million for large communities and $5 million for small communities)	A federal credit program administered by EPA for eligible water and wastewater infrastructure projects, including drought prevention, reduction, and mitigation.
Fed-3	Section 502 Direct Loan Program	USDA Rural Development	Loans based on individual county mortgage limits	Loans are available for wells and water connections in rural communities. Availability is based on community income.
Fed-4	National Rural Water Association Revolving Loan Fund	USDA Rural Utilities Service	$100,000 or 75% of the total project cost	Provides loans for predevelopment costs associated with water and wastewater projects and for existing systems in need of small-scale capital improvements.
Fed-5	Emergency Community Water Assistance Grants	UDA Rural Development	Up to $100,000 or $1,000,000 depending on the type of project	Offers grants to rural areas and towns with populations of 10,000 or less to construct waterline extensions; repair breaks or leaks; address maintenance necessary to replenish the water supply or construct a water source, intake, or treatment facility.
Fed-6	HMGP	Federal Emergency Management Agency (FEMA)	Variable	Provides funds to states, territories, tribal governments, and communities for hazard mitigation planning and implementation of mitigation projects following a presidentially declared disaster event.
Fed-7	Building Resilient Infrastructure and Communities	FEMA	Variable	Building Resilient Infrastructure and Communities will support states, local communities, tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards.

Table 10-3 (continued). Federal funding sources.

Funding Source Index	Program	Agency	Grant/Loan Funds Available	Description
Fed-8	Planning Assistance to States	USACE	Variable – funding is 50% federal and 50% nonfederal	USACE can provide states, local governments, and other nonfederal entities assistance in the development of comprehensive plans for the development, use, and conservation of water resources.
Fed-9	Drinking Water State Revolving Fund	SCDES and SC Rural Infrastructure Authority	Congress appropriates funding for the Drinking Water State Revolving Fund that is then awarded to states by EPA based on results of the most recent Drinking Water Infrastructure Needs Survey and Assessment.	This program is a federal-state partnership aimed at ensuring that communities have safe drinking water by providing low-interest loans and grants to eligible recipients for drinking water infrastructure projects.

Table 10-4. USDA disaster assistance programs.

Funding Source Index	Program	Agency	Description
USDA-1	Crop Insurance	Risk Management Agency	Provides indemnity payments to growers who purchased crop insurance for production and quality losses related to drought, including losses from an inability to plant caused by an insured cause of loss.
USDA-2	Conservation Reserve Program Haying and Grazing	Farm Service Agency (FSA)	Provides for emergency haying and grazing on certain Conservation Reserve Program practices in a county designated as D2 or higher on the United States Drought Monitor, or in a county where there is at least 40% loss in forage production.
USDA-3	Emergency Assistance for Livestock, Honeybees, and Farm-Raised Fish Program	FSA	Provides assistance to eligible owners of livestock and producers of honeybees and farm-raised fish for losses.
USDA-4	Emergency Conservation Program	FSA	Provides funding and technical assistance for farmers and ranchers to restore farmland damaged by natural disasters and for emergency water conservation measures in severe droughts.
USDA-5	Emergency Forest Restoration Program	FSA	Provides funding to restore privately owned forests damaged by natural disasters. Assistance helps landowners carry out emergency measures to restore forest health on land damaged by drought disasters.
USDA-6	Farm Loans	FSA	Provides emergency and operating loss loans to help producers recover from production and physical losses due to natural disasters and can pay for farm operating and family living expenses.
USDA-7	Environmental Quality Incentives Program	FSA	Provides agricultural producers with financial resources and assistance to plan and implement improvements on the land in support of disaster recovery and repair and can help mitigate loss from future natural disasters. Assistance may also be available for emergency animal morality disposal from natural disasters.
USDA-8	Emergency Watershed Program (Recover)	Natural Resources Conservation Service	Offers vital recovery options for local communities to help people reduce hazards to life and property caused by droughts.
USDA-9	Emergency Community Water Assistance Grants	Rural Development	Offers grants to rural areas and towns with populations of 10,000 or less to construct waterline extensions; repair breaks or leaks; address maintenance necessary to replenish the water supply; or construct a water source, intake, or treatment facility.

10.1.3 Implementation Considerations

The Pee Dee RBC may encounter challenges with respect to implementation of the identified strategies. Potential challenges are listed and described below:

- **Funding**: Procuring sufficient and stable funding sources to implement strategies was identified by the RBC as a significant challenge. Water withdrawers may not have the financial capacity to pursue recommended strategies to achieve implementation of Objectives 1 and 2, either due to limited ability to increase water rates or limitations in external funding source availability. Agricultural and industrial water withdrawers similarly may have limited financial resources to implement expensive conservation or augmentation strategies. Identifying and pursuing new funding opportunities are time consuming endeavors that may lead to delays in implementation. Therefore, it is critical to identify immediately available funding opportunities, support funding applications, and investigate new funding sources to facilitate the implementation of strategies recommended under Objectives 1 and 2. Identifying stable funding sources is also important so that stakeholders are assured that funding will be available at predictable amounts into the future.
- **Stakeholder Acceptance**: The RBC has no authority to enforce recommendations in the basin, and implementation of many of the recommended strategies therefore require cooperation and acceptance from stakeholders. To address this, the RBC will develop and execute an outreach plan, including data to justify recommendations and strategies. The RBC will develop content relevant to various water sectors in the basin, including municipal, agricultural, industrial, energy, and golf course water users.
- **Support for the River Basin Planning Process:** Success of the River Basin Plan is dependent upon continued support for the South Carolina river basin planning process. Knowing this, the RBC developed and prioritized policy recommendations (see Chapter 9) that focus on the need for the State to fund an implementation organization in the future and to fund implementation of the River Basin Plan. The implementation organization would ideally be the Pee Dee RBC, though it could also take on other forms, such as a watershed stakeholder group or interstate water management advisory council.
- **Staff and Resource Capacity:** Implementation will need to be supported by South Carolina, but the Pee Dee RBC anticipates that the State will need additional staff capacity and resources focused and dedicated to implementation of River Basin Plans across the basins.
- **External Communications**: Guidance is needed to help direct how communications with outside groups should be conducted, what should be said, and who should be involved. Also, social media has been identified as an effective tool for communicating with the public; however, there is uncertainty surrounding who would be responsible for maintaining accounts. Running a social media account involves developing and vetting content, posting, engaging with other accounts, and providing oversite on account engagement. If a member of the RBC were to run the accounts, procedures would be required to vet and ensure content represents a broad perspective, and not only that of the account manager.
- **Continued RBC Meetings:** The Plan's success hinges on continued activity from the RBC to foster implementation of the strategies developed in this Plan. Rather than seeing the RBC as a stagnant planning body, the Planning Framework describes it as "actively engaged in promoting the implementation of the recommendations proposed" and "will continue to meet on a periodic basis

to pursue River Basin Plan implementation activities as needed" (SCDNR 2019, p. 90). The Pee Dee RBC has identified quarterly meetings as desirable in the first year after publication of the River Basin Plan to pursue funding and implementation. After the first year, meetings may be held less frequently as needed.

- **Consensus Framework:** As the RBC makes decisions related to implementation, the RBC should build consensus where possible and document alternative points of view when consensus is not possible. Full consensus on every issue is an unrealistic goal, but the RBC should have a process to discuss, revisit, and document issues from this and later planning phases that are marked by alternative or opposing points of view.
- **Clarity of Responsibilities:** The implementation plan identifies responsible entities for each short-term action, but as implementation is carried out, clear responsibilities should be established and communicated to minimize confusion and foster efficient work.

10.2 Long-Term Planning Objectives

The Pee Dee RBC's objectives described in Section 10.1 represent both short-term and long-term objectives. For each objective, short-term strategies are discussed in Section 10.1 and long-term strategies are presented below in Table 10-5.

Table 10-5. Long-term planning objectives.

Objective and Strategy	Long-Term Strategy
Objective 1: Improve water use efficiency to conserve and sustain water supplies	
All strategies	Continue short term goals. Adjust recommended actions based on water savings realized. Seek additional funding sources. Explore new technologies and incorporate into recommendations as appropriate. Continue to monitor and assess drivers of future water demand (e.g., climate change, population increases, new industries) and identify potential disruptors that could create supply shortages and the need for more aggressive water management.
Objective 2: Implement one-water approaches to optimize sources of supply	
A. Conjunctive use of surface and groundwater supplies	Continue short term goals. Continue to monitor sources of supply to assess potential for overuse. Understand the upper limit of demands that could be met with supplies in various regions of the basin.
B. Drill new or supplemental well into lesser-used aquifers	
C. Water reuse systems (non potable)	Continue short term goals.
D. Aquifer storage and recovery	Continue short term goals. Monitor implementation of strategies and incorporate lessons learned into recommendations as appropriate.
E. Stormwater capture and treatment	
F. Dredging or pond deepening	Continue short term goals.

Table 10-5 (continued). Long-term planning objectives.

Objective and Strategy	Long-Term Strategy
Objective 3: Improve drought management	
A. Public water providers on RBC to update drought management plans	Continue short-term goals. Monitor progress towards increasing the number of up-to-date or new (within last 5 years) drought management plans and implemented best practices in the basin.
B. Industry to collaborate on drought management best practices	
C. Foster drought communications among stakeholders	Continue short-term goals.
Objective 4: Broaden technical understanding of water resource issues	
A. Complete groundwater model	Update groundwater model as needed and use it to identify potential groundwater issues and inform management strategies
B. Evaluate data gaps and needs	Use new/improved data to make more informed water management decisions across all water use sectors
C. Extend surface water modeling to coastal areas	Incorporate modeling and findings into next 5-yr Plan update
D. Study the water quantity and quality impacts of land use changes	Incorporate land use projections and recharge impacts into future modeling efforts. Revise future strategy recommendations based on study results and modeling.
E. Install additional groundwater monitoring in future growth areas	Continue short-term goals. Monitor number of active monitoring locations in the basin and the results of monitoring.
F. Consider water quality in future planning efforts	Adopt approach recommended through short-term activities into the next 5-yr Plan update.
G. Consider flooding in future planning efforts	
Objective 5: Effectively communicate RBC findings and recommendations	
A. Conduct Pee Dee RBC meetings to review, initiate, and support implementation actions	Maintain regular meeting schedule to encourage continuity between various iterations of RBC membership.
B. Develop a communication plan early in the implementation process and conduct education and outreach	Continue regular communication to emphasize the ongoing work and impacts of the RBC.

10.3 Progress of River Basin Plan Implementation

The Framework proposes the development of progress metrics to assess the degree to which River Basin Plan recommendations and strategies are successfully being adopted and implemented across the Pee Dee River basin. A progress metric is a "benchmark used to monitor the success or failure of an action taken by an RBC" (SCDNR 2009). Noting that the ultimate value and impact of the river basin planning process is the dissemination of its findings and implementation of its recommendations, the Pee Dee RBC developed progress metrics around each of the five implementation objectives defined at the beginning of this chapter. The progress metrics are:

1. Improve water use efficiency to conserve water resources

   Metric 1a: Municipal and agricultural water conservation and efficiency strategies are considered, evaluated, and implemented. On the municipal side, a 5-year reduction in residential per capita demand is realized and water utility financial strength is maintained.

   Metric 1b: Funding opportunities are identified and used to implement strategies.

2. Implement one-water approaches to optimize sources of supply

   Metric 2a: Supply-side, one-water approaches are considered in long-range planning by water users and are proactively implemented (as opposed to reactive implementation in response to a crisis).

   Metric 2b: Funding opportunities are identified and successfully used to implement supply-side strategies.

3. Improve drought management

   Metric 3a: One hundred percent of public water suppliers' drought management plans are updated within the last 5 years and submitted to the SCO for review.

   Metric 3b: Drought-related best practices for industry are identified and shared with industry.

4. Broaden technical understanding of water resource management issues

   Metric 5a: A process is developed for extending surface water modeling and/or analyses to consider coastal areas.

   Metric 5b: The RBC has become familiar with the study in the Catawba River basin that assessed the relative impacts of climate and land use change on water supply resiliency and considered the value of a similar study in the Pee Dee River basin.

   Metric 5c: Water quality issues and concerns in the basin are identified and a strategy to study approaches to address them is developed.

   Metric 5c: Flood-related issues and concerns in the basin are identified and a strategy to study approaches to address them is developed.

5. Effectively communicate RBC findings and recommendations

   Metric 4a: Within 2 years, the RBC has presented the Pee Dee River Basin Plan to all County Councils that are within the basin and requested their feedback and ideas for future study.

   Metric 4b: Within 2 years, the RBC has communicated with all of the basin's legislative representatives at the state level regarding basin challenges and relevant policy recommendations.

This 2025 plan is the first for the Pee Dee River basin. Future 5-year updates will evaluate the Pee Dee RBC's performance relative to the progress metrics.

As noted throughout this plan, communication and the development of stakeholder buy-in is key to successful plan implementation. To develop stakeholder acceptance, RBC members, who are the ambassadors of the River Basin Plan, must have confidence in the planning process and outcomes. A key responsibility of RBC members, as defined in the Framework, is to regularly communicate with stakeholders to maintain a current understanding of RBC activities, the River Basin Plan, and emerging issues.

To assess each RBC member's confidence in the plan, the plan approval process dictates that there will first be a test for consensus on the Draft Pee Dee River Basin Plan. For the test of consensus, each member rates their concurrence with the plan using a five-point scale, as shown below:

1. Full Endorsement (i.e., member likes it).
2. Endorsement but with minor points of contention (i.e., basically member likes it).
3. Endorsement but with major points of contention (i.e., member can live with it).
4. Stand aside with major reservations (i.e., member cannot live with it in its current state and can only support it if changes are made).
5. Withdraw – Member will not support the draft river basin plan. The Planning Framework indicates that if a member votes 5 they will not continue working within the RBC's process and will leave the RBC. In practice, if a member votes 5 but wishes to remain engaged in future work of the RBC, the RBC has the discretion to vote on whether the member may remain on the RBC.

For the Final River Basin Plan, each RBC member votes simply to support or not support the plan. By indicating support, the member would be acknowledging his/her concurrence with the Final River Basin Plan and their commitment to support implementation of the plan. The results of the test for consensus of the Draft River Basin Plan and the RBC's votes on the Final River Basin Plan are shown in Table 10-6. The full results are included in Appendix C.

Table 10-6. Test of consensus results.

Test of Consensus Result	Number of RBC Members
Draft River Basin Plan	
1. Full Endorsement (i.e., member likes it).	11
2. Endorsement but with minor points of contention (i.e., basically member likes it).	8
3. Endorsement but with major points of contention (i.e., member can live with it).	0
4. Stand aside with major reservations (i.e., member cannot live with it in its current state and can only support it if changes are made).	0
5. Withdraw – Member will not support the draft river basin plan.	0
Final River Basin Plan	
Support	X
Does Not Support	X

Chapter 11
References

AECOM. 2019. Lake Whelchel Water Supply Evaluation Draft.

Ahlberg, Liz. 2016. "Reclaimed water could help power plants run more efficiently, study finds." University of Illinois Urbana-Champaign News Bureau. Published May 12, 2016, https://news.illinois.edu/view/6367/361171.

Amosson et al. 2011. Economics of Irrigation Systems.

Bower, L.M., Peoples, B.K., Eddy, M.C., and Scot, M.C. (2022). Quantifying flow–ecology relationships across flow regime class and ecoregions in South Carolina Science of the Total Environment 802 (2022) 149721. https://doi.org/10.1016/j.scitotenv.2021.149721.

Bower, L.M., Peoples, B.K., Eddy, M.C., and Scot, M.C. (2022). Quantifying flow–ecology relationships across flow regime class and ecoregions in South Carolina. Science of the Total Environment 802 (2022) 149721. https://doi.org/10.1016/j.scitotenv.2021.149721.

Caayao, Janine, 2024. How Much Does Xeriscaping Cost in 2024? Lawn Love website. Accessed May 10, 2024. https://lawnlove.com/blog/xeriscaping-cost/.

Castro, J.E. 1997. Aquifer Storage and Recovery: A Water Resources Management Alternative for Horry County, South Carolina. Journal of Contemporary Water Research and Education, Volume 106, Issue 1. https://opensiuc.lib.siu.edu/jcwre/vol106/iss1/14/.

Catawba-Wateree Water Management Group (CWWMG). n.d. "2018/2019 Annual Report." Accessed October 26, 2023. https://www.catawbawatereewmg.org/ar19/.

CDM Smith, 2019. Colorado Water Project Cost Estimating Tool Documentation. Accessed November 5, 2024. https://dnrftp.state.co.us/#/CWCB/Technical%20Update%20to%20Water%20Plan/1.%20Technical%20Update%20Documentation/

CDM Smith. 2017. South Carolina Surface Water Quantity Models: Pee Dee Basin Model. Prepared for SCDNR and SCDHEC.

City of Commerce, CA. 2021. Chapter 19.24 – Water-Efficient Landscaping Regulations. Code of Ordinances. Accessed March 10, 2022, https://library.municode.com/ca/commerce/codes/code_of_ordinances?nodeId=TIT19ZO_CH19.24WAFILARE_19.24.010TI.

Clemson College of Agriculture, Forestry and Life Sciences. 2021. "Clemson intelligent irrigation system: Increase profits, protect environment." Accessed April 12, 2022. https://news.clemson.edu/clemson-intelligent-irrigation-system-increase-profits-protect-environment/.

Clemson Cooperative Extension. 2022a. "Center Pivot Irrigation Test Program." Accessed March 3, 2022. https://www.clemson.edu/extension/water/programs/center-pivot-irrigation-test.html.

Conservation Technology Information Center (CTIC). 1999. "What's Conservation Tillage?"

DeOreo, William B., Peter Mayer, Benedykt Dziegielewski, and Jack Kiefer. 2016. "Residential End Uses of Water, Version 2". Water Research Foundation.

Duke Energy, 2022. Yadkin-Pee Dee Hydroelectric Project No. 2206, FERC License Flow Requirements and Reservoir Operations. Presented at September 2022 Pee Dee RBC meeting. https://www.des.sc.gov/sites/des/files/DNR/Hydrology/pdfs/basin-planning/peedee/PDRBC_4_Item4_Duke%20Energy%20Yadkin-Pee%20Dee%20Hydro%20Project%20FERC%20Presentation_09-27-2022.pdf.

Eddy, M. C., Lord, B., Perrot, D., Bower, L. M., and Peoples, B. K. (2022). Predictability of flow metrics calculated using a distributed hydrologic model across ecoregions and stream classes: Implications for developing flow–ecology relationships. Ecohydrology, 15(2), e2387. https://doi.org/10.1002/eco.238.

Freese and Nichols, Inc. 2020. 2021 Panhandle Water Plan. Prepared for Panhandle Water Planning Group. Accessed March 3, 2022. https://www.twdb.texas.gov/waterplanning/rwp/plans/2021/A/RegionA_2021RWP_V1.pdf.

Gellici, J.A., Lautier, J. 2010. Groundwater Availability in the Atlantic Coastal Plan of North and South Carolina. Chapter B Hydrogeologic Framework of the Atlantic Coastal Plain, North and South Carolina.

Grand Strand Water & Sewer Authority (GSWSA). 2023. "Aquifer Storage and Recovery Wells." Accessed October 25, 2023. https://www.gswsa.com/products_and_services.cfm?page=19.

Herber, Gunnar. 2024. The actual price of desalinated water: What Is the Price of Desalinated Water and How Does It Compare to Other Sources of Clean Water? Accessed May 10, 2024. https://medium.com/@desalter/what-is-the-price-of-desalinated-water-and-how-does-it-compare-to-other-sources-of-clean-water-02f20a7b64fb.

Janssen and Hill. 1994. "What is Conservation Tillage?" Accessed April 12, 2022. https://www.extension.purdue.edu/extmedia/ct/ct-1.html.

Marsik, Jason. "Aquatic Resources of the Pee Dee Basin." SCDNR, https://www.des.sc.gov/sites/des/files/DNR/Hydrology/pdfs/basin-planning/peedee/Aquatic%20Resources%20of%20the%20Pee%20Dee%20Basin_Marsik_SCDNR.pdf

Mullen, T. n.d. "Water Efficiency Standards for New Construction." Sustainable Development Code. Accessed March 10, 2022. https://sustainablecitycode.org/brief/water-efficiency-standards-for-new-construction-3/.

Multi-Resolution Land Characteristics Consortium (MRLC). 2019. "National Land Cover Database (NCLD)

2019". Accessed June 15, 2023. https://www.mrlc.gov/data.

NC State University. 2007. Irrigation Cost Spreadsheet. Accessed July 7, 2024. https://cals.ncsu.edu/are-extension/business-planning-and-operations/enterprise-budgets/irrigation-budgets/.

NOAA National Centers for Environmental Information. US Climate Normals. 2020. Accessed June 15, 2023. https://www.ncei.noaa.gov/access/us-climate-normals/#dataset=normals-monthly&timeframe=30&location=SC.

Oklahoma DEQ. 2021. The Economic Impact of Oklahoma's Water Loss Auditing and Control Program. Accessed July 7, 2024. https://www.okcommerce.gov/wp-content/uploads/DEQ-Full-Report-Final.pdf

Payne, Heather. 2017. "A Fix for a Thirsty World – Making Direct and Indirect Reuse Legally Possible." William & Mary Environmental Law and Policy Review, 42(1), p. 201-283. https://scholarship.law.wm.edu/cgi/viewcontent.cgi?article=1694&context=wmelpr.

Pelletier, A.M. 1985, Ground-water conditions and water-supply alternatives in the Waccamaw Capacity Use Area: South Carolina Water Resources Commission Report 144, 32 p.

Recalibrating the South Carolina Atlantic Coastal Plan Groundwater Availability Model for the Simulation of Groundwater Flow and Water Budgets in the Pee Dee River Basin Pee Dee RBC Public Meeting. South Atlantic Water Center (SAWSC) in collaboration with USGS.

Rodriguez, J.A., Newcome, Roy, Jr., and Wachob, Andrew. 1994, Ground-water resources of Darlington, Dillon, Florence, Marion and Marlboro Counties, South Carolina: South Carolina Department of Natural Resources Water Resources Report 1, 119 p.

SCDES. 2019b. Potentiometric Surface Maps of the Upper and Middle Floridan and Gordon Aquifers in South Carolina, November-December 2018. https://www.des.sc.gov/sites/des/files/DNR/Hydrology/pdfs/reports/Report_61_Floridan_Gordon_2018.pdf.

SCDES. 2024. Pee Dee Capacity Use Area Evaluation Groundwater Evaluation Report, Permitting Year 2025, South Carolina Department of Environmental Services, Technical Report Number: 005-2024, 42 p.

SCDES. Groundwater Management Planning. https://des.sc.gov/index.php/programs/bureau-water/groundwater-management-planning.

SCDES. How SCDES Measures Surface Water Quality. https://des.sc.gov/programs/bureau-water/aquatic-science/how-scdes-measures-surface-water-quality.

SCDHEC. 2019. Archived Watershed Water Quality Assessments. https://scdhec.gov/environment/your-water-coast/watersheds-program/archived-watershed-water-quality-assessments.

SCDHEC. 2022. The State of South Carolina's 2022 Integrated Report (IR). https://des.sc.gov/sites/des/files/Documents/BOW/WaterQuality/303dList2020-2022pdf.pdf

SCDHEC. 2022c. "Ambient Surface Water Monitoring" Accessed August 28, 2022c. https://des.sc.gov/programs/bureau-water/aquatic-science/how-scdes-measures-surface-water-quality.

SCDHEC. 2023. Waccamaw Capacity Use Area Groundwater Evaluation Report, Permitting Year 2024, South Carolina Department of Health and Environmental Control, Technical Report Number: 006-2023. 34 p.

SCDNR Geological Survey. Geology of South Carolina. https://scdnr.maps.arcgis.com/apps/Viewer/index.html?appid=735411a2f5714f28a424422296f77bb1.

SCDNR Scenic Rivers. Great Pee Dee River. Accessed June 15, 2023, https://www.dnr.sc.gov/water/river/scenic/greatpeedee.html#:~:text=Those%20who%20fish%20the%20Great,bowfin%2C%20carp%2C%20and%20gar.

SCDNR State Climatology Office. 2021. 1991-2022 South Carolina Climate Normals Contour Maps. https://www.dnr.sc.gov/climate/sco/ClimateData/cli_sc_climate.php.

SCDNR State Climatology Office. 2022b. Products derived from Drought Risk Atlas. https://droughtatlas.unl.edu/.

SCDNR. 2009. South Carolina State Water Assessment, Second Edition. https://www.dnr.sc.gov/water/hydro/HydroPubs/assessment/SC_Water_Assessment_2.pdf.

SCDNR. 2017. Potentiometric Surface Maps of the South Carolina Coastal Plain Aquifers November-December 2016. https://www.des.sc.gov/sites/des/files/DNR/Hydrology/pdfs/reports/Report_60_Potentiometric_maps_2016.pdf.

SCDNR. 2019c. "Mobile Irrigation Lab Pilot." Accessed April 12, 2022. South Carolina Mobile Energy/Irrigation Service. https://www.nascanet.org/nasca/wp-content/uploads/2019/11/8-SC-NASCA-Presentation-Myres.pdf.

SCDNR. 2020b. "Statewide Mobile Irrigation Laboratory pilot project announced at Florence expo." Accessed April 12, 2022. https://www.dnr.sc.gov/news/2020/jan/j15_irrigation.php.

SCDNR. 2022. "Surface Water Resources of the Pee Dee Basin". Accessed May 9, 2024. https://www.des.sc.gov/sites/des/files/DNR/Hydrology/pdfs/basin-planning/peedee/SCDNR_PeeDee-SWResources_09_27_22_Item3.pdf.

SCDNR. 2022c. "Groundwater Level Monitoring Network." Accessed April 1, 2022. https://www.des.sc.gov/programs/bureau-water/hydrology/groundwater-program/groundwater-level-monitoring-network.

SCDNR. Fish Species. Accessed June 15, 2023, https://www.dnr.sc.gov/wildlife/fishspecies.html.

Seacord, Thomas F. 2015. "Brackish Groundwater Desalination Experience on Hilton Head Island, SC." Presentation dated 2015.

Serena, M., Morris, K., Petrovsky, J. 2023. Measuring and Comparing the Water Requirements of Warm Season Grasses. Accessed November 19, 2024. https://www.usga.org/content/usga/home-page/course-care/green-section-record/61/issue-15/measuring-and-comparing-the-water-requirements-of-warm-season-gr.html.

SHDEC. 2019. SC Watershed Atlas. https://des.sc.gov/programs/bureau-water/watersheds-program/sc-watershed-atlas.

SHDEC. SC Active Mines Viewer. Accessed June 15, 2023, https://gis.dhec.sc.gov/activeminesviewer/.

Simonne, Eric, Robert Hochmuth, Jacque Breman, William Lamont, Danielle Treadwell, and Aparna Gazula. 2024. Drip-irrigation systems for Small Conventional Vegetable Farms and Organic Vegetable Farms. University of Florida. Accessed May 10, 2024. https://edis.ifas.ufl.edu/publication/HS388.

Smart Irrigation. 2019. Irrigation Scheduling. Accessed May 10, 2024. https://www.smartirrigationgeorgia.com/farmers.

South Carolina State Climate Office. 2019. South Carolina's Tornado Climatology 1950-2019. https://www.dnr.sc.gov/climate/sco/ClimateData/SC_Tornado_Climo_2019.pdf.

Texas Water Development Board. 2020. "Water Management Strategy Projects – 2021 Regional Water Plans (last updated 11/05/2020)." Accessed March 13, 2023. https://www.twdb.texas.gov/waterplanning/rwp/plans/2021/2021RWP_WMS_Project_List.xlsx.

Texas Water Development Board. 2021. Water for Texas. Accessed April 1, 2022, https://www.twdb.texas.gov/waterplanning/swp/2022/index.asp.

The Nature Conservancy, U.S. Geological Survey South Carolina Cooperative Fish & Wildlife Research Unit, and Clemson University, 2023. Flow-Ecology Relationships in the Pee Dee River basin, with Applications for Flow Performance Measures in SWAM.

Toro. 2007. Grower Solutions: Drip Irrigation Works… and Pays!. Accessed July 7, 2024. https://media.toro.com/Documents/Agriculture/ALT144_Grower_Solutions_Cox_WEB.pdf

Toro. 2010. Crop Solutions: Drip Irrigation on Cotton. Accessed July 7, 2024. https://media.toro.com/Documents/Agriculture/ALT186_Drip_on_Cotton_WEB.pdf.

U.S. Environmental Protection Agency (EPA). 2013. Water Audits and Water Loss Control For Public Water Systems. Accessed March 10, 2022, https://www.epa.gov/sites/default/files/2015-04/documents/epa816f13002.pdf.

University of Minnesota Extension, 2024. Soil moisture sensors for irrigation scheduling. Accessed May 10, 2024. https://extension.umn.edu/irrigation/soil-moisture-sensors-irrigation-scheduling.

US Census Bureau. 2010. "TIGER/Line Shapefiles." Accessed June 15, 2023. https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.2010.html#list-tab-790442341.

US Census Bureau. 2020. "TIGER/Line Shapefiles." Accessed June 15, 2023. https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.2020.html#list-tab-790442341.

USDA National Agricultural Statistics Service. "Census of Agriculture 2017 Census Volume 1, Chapter 2: County Level Data." Accessed June 15, 2023.

https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/South_Carolina/.

USDA National Agricultural Statistics Service. "Cropland Data Layer - National Download." Accessed June 15, 2023. https://www.nass.usda.gov/Research_and_Science/Cropland/Release/.

USDA. 2000. "Agricultural Chemicals and Production Technology: Glossary." Accessed March 3, 2022, https://wayback.archive-it.org/5923/20120620132042/http://www.ers.usda.gov/Briefing/AgChemicals/glossary.htm.

USFWS. 2023. National Wetlands Inventory. Wetlands Mapper. https://www.fws.gov/program/national-wetlands-inventory/wetlands-mapper.

USGA. 2024. Using Wetting Agents To Save Water And Improve Turf Conditions. Accessed May 10, 2024. https://www.usga.org/content/usga/home-page/course-care/water-resource-center/bmp-case-studies/2017/using-wetting-agents-to-save-water-and-improve-turf-conditions.html.

Wachob, A., Gellici, J.A., Czwartacki, B., 2017, Potentiometric surface maps of the South Carolina Coastal Plain, November–December 2016: South Carolina Department of Natural Resources Water Resources Report 60, 35 p.

WateReuse. 2023. "Types of Reuse." Accessed October 26, 2023, https://watereuse.org/educate/types-of-reuse/.

Appendix A: Demand Projections

Table A-1. Current Water Demands, Consumptive Use, and Returns

Source	User	Use Category	Withdrawl (MGD)	Consumptive Use (%)	Consumptive Use (MGD)	Return (MGD)
Coastal Surface Water	Combined User Data	Agriculture	0.47	100.0%	0.47	0.00
Coastal Surface Water	Combined User Data	Golf	3.94	100.0%	3.94	0.00
Coastal Surface Water	Combined User Data	Industry	7.68	100.0%	7.68	0.00
Coastal Surface Water	Combined User Data	Water Supply	58.70	100.0%	58.70	0.00
Groundwater	Combined User Data	Agriculture	34.30	100.0%	34.30	0.00
Groundwater	Combined User Data	Aquaculture	0.00	100.0%	0.00	0.00
Groundwater	Combined User Data	Golf	1.50	100.0%	1.50	0.00
Groundwater	Combined User Data	Industry	9.40	100.0%	9.40	0.00
Groundwater	Combined User Data	Nuclear Power	1.00	100.0%	1.00	0.00
Groundwater	Combined User Data	Water Supply	65.70	100.0%	65.70	0.00
Groundwater (SWAM)	Bishopville	Water Supply	1.30	19.2%	0.25	1.05
Groundwater (SWAM)	Hartsville	Water Supply	1.23	5.1%	0.06	1.17
Groundwater (SWAM)	Lynchburg	Water Supply	1.38	94.8%	1.31	0.07
Groundwater (SWAM)	Manning	Water Supply	1.04	9.5%	0.10	0.95
Groundwater (SWAM)	Martek	Industry	1.07	73.1%	0.78	0.29
Groundwater (SWAM)	McCall Farms	Industry	0.65	5.8%	0.04	0.61
Groundwater (SWAM)	McColl	Water Supply	0.29	41.8%	0.12	0.17
Groundwater (SWAM)	Pilgrims Pride	Industry	0.50	43.9%	0.22	0.28
Groundwater (SWAM)	Sumter	Water Supply	11.25	19.4%	2.19	9.07
Surface Water (SWAM)	Atkinson	Agriculture	0.01	100.0%	0.01	0.00
Surface Water (SWAM)	Belger	Agriculture	0.00	0.0%	0.00	0.00
Surface Water (SWAM)	Bennettsville	Water Supply	2.17	19.9%	0.43	1.74
Surface Water (SWAM)	Black Crest	Agriculture	0.59	100.0%	0.59	0.00
Surface Water (SWAM)	Carolina Plantation	Agriculture	0.27	100.0%	0.27	0.00
Surface Water (SWAM)	Chapman	Agriculture	0.02	100.0%	0.02	0.00
Surface Water (SWAM)	Cheraw	Golf	0.13	100.0%	0.13	0.00
Surface Water (SWAM)	Cheraw	Water Supply	2.47	14.1%	0.35	2.13
Surface Water (SWAM)	Dargan	Agriculture	0.07	100.0%	0.07	0.00
Surface Water (SWAM)	Domtar	Industry	16.36	2.5%	0.41	15.95
Surface Water (SWAM)	Florence	Golf	0.06	100.0%	0.06	0.00
Surface Water (SWAM)	Florence	Water Supply	14.20	21.5%	3.06	11.14
Surface Water (SWAM)	Hanson (Brewer)	Mining	0.11	100.0%	0.11	0.00
Surface Water (SWAM)	Hanson (Jefferson)	Mining	0.04	85.0%	0.03	0.01
Surface Water (SWAM)	Hanson (Marlboro)	Mining	0.03	100.0%	0.03	0.00
Surface Water (SWAM)	HB Robinson	Nuclear Power	745.28	0.3%	2.02	743.26
Surface Water (SWAM)	Hinson	Agriculture	0.00	100.0%	0.00	0.00
Surface Water (SWAM)	Hinson2	Agriculture	0.00	0.0%	0.00	0.00
Surface Water (SWAM)	Hinson3	Agriculture	0.00	0.0%	0.00	0.00
Surface Water (SWAM)	Hinson4	Agriculture	0.00	0.0%	0.00	0.00
Surface Water (SWAM)	Hinson5	Agriculture	0.00	0.0%	0.00	0.00
Surface Water (SWAM)	IP (Georgetown)	Industry	30.77	30.9%	9.51	21.27
Surface Water (SWAM)	Irwin	Agriculture	0.02	100.0%	0.02	0.00
Surface Water (SWAM)	Lawson Turf	Agriculture	0.22	100.0%	0.22	0.00
Surface Water (SWAM)	Martin Marietta	Mining	0.04	85.0%	0.03	0.01
Surface Water (SWAM)	McDonald	Agriculture	0.01	100.0%	0.01	0.00
Surface Water (SWAM)	Nucor	Industry	3.21	92.2%	2.96	0.25
Surface Water (SWAM)	Oaklyn Plantation	Agriculture	0.00	0.0%	0.00	0.00
Surface Water (SWAM)	O'Tuel	Agriculture	0.22	100.0%	0.22	0.00
Surface Water (SWAM)	Richard Rogers	Agriculture	0.22	100.0%	0.22	0.00
Surface Water (SWAM)	Rogers	Agriculture	0.23	100.0%	0.23	0.00
Surface Water (SWAM)	Sonoco	Industry	12.63	34.0%	4.30	8.34
Surface Water (SWAM)	Sugar Hill	Agriculture	0.01	100.0%	0.01	0.00
Surface Water (SWAM)	Tolson	Agriculture	0.05	100.0%	0.05	0.00
Surface Water (SWAM)	Turf Connections	Agriculture	0.13	100.0%	0.13	0.00
Surface Water (SWAM)	WestRock	Industry	16.51	22.7%	3.74	12.77
Surface Water (SWAM)	White Plains	Golf	0.06	100.0%	0.06	0.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.77	23.42	281.00
Groundwater	527	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.58	17.63	211.50
Groundwater	1001	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.11	3.33	40.00
Groundwater	#1 200 Pump Station	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.63	19.17	230.00
Groundwater	#1 WELL PUMP STATION	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	2.52	76.58	919.00
Groundwater	#1WELL151TOP OF HILL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	2.52	76.58	919.00
Groundwater	#2 200 Pump Station	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.63	19.17	230.00
Groundwater	#2 WELL BY WOODS	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	2.52	76.58	919.00
Groundwater	#3 BY TANK	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	2.52	76.58	919.00
Groundwater	#4WELL BY JEFFERSONS	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	2.52	76.58	919.00
Groundwater	#5 WELL 145 BY TRANS	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	2.52	76.58	919.00
Groundwater	10 Mile Bay Farm Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.87	26.54	318.50
Groundwater	10 Mile Bay Farm Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.87	26.54	318.50
Groundwater	10 Mile Bay Farm Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.87	26.54	318.50
Groundwater	10 Mile Bay Farm Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.87	26.54	318.50
Groundwater	2012 Cypress Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.42	43.33	520.00
Groundwater	2052 Billie Dr/Wise Farm	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.70	21.42	257.00
Groundwater	30/29TH AV NORTH	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.27	8.33	100.00
Groundwater	301 Firestation	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.91	490.90
Groundwater	31-113635 Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.77	23.42	281.00
Groundwater	31-113699 Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.77	23.42	281.00
Groundwater	313 Field	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.63	19.17	230.00
Groundwater	3892 Black River Rd		Agriculture	Crouch Branch	0.00	0.00	0.00
Groundwater	4"" Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.45	13.74	164.90
Groundwater	4"" Well 3HP	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.15	4.67	56.00
Groundwater	4""WELL 2HP	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.15	4.67	56.00
Groundwater	4""WELL 5HP	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.15	4.67	56.00
Groundwater	4009 Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.08	2.42	29.00
Groundwater	527 Big House	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.91	490.90
Groundwater	6 Inch Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.06	1.88	22.60
Groundwater	6""WELL 3HP	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.15	4.67	56.00
Groundwater	6""WELL 5HP	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.15	4.67	56.00
Groundwater	79 Cypress Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.42	43.33	520.00
Groundwater	95 Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.45	13.74	164.90
Groundwater	Airport		Agriculture	McQueen Branch	0.00	0.00	0.00
Groundwater	Akins Farm Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.29	8.83	106.00
Groundwater	Ald 7th Cut	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.11	64.08	769.00
Groundwater	Alex's Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.13	4.08	49.00
Groundwater	Allen Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.10	3.00	36.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Aluminum Gate #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.45	13.58	163.00
Groundwater	Aluminum Gate #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.45	13.58	163.00
Groundwater	Ammons #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.46	44.38	532.50
Groundwater	Ammons #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.46	44.38	532.50
Groundwater	Ammons #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.46	44.38	532.50
Groundwater	Arcadian Shores	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.02	0.71	8.50
Groundwater	Ashland Cross Roads Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.14	4.17	50.00
Groundwater	Ashwood 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.46	13.98	167.79
Groundwater	Ashwood/Green Lane	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.19	5.78	69.40
Groundwater	Ashwood/Lake Ashwood Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.19	5.78	69.40
Groundwater	Atlantic Center	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.10	3.00	36.00
Groundwater	Austin Farm	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.19	5.92	71.00
Groundwater	Avery Lane	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.11	3.33	40.00
Groundwater	Bacon Hill Rd Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.32	9.75	117.00
Groundwater	Bad bump	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	3.70	112.67	1,352.00
Groundwater	Baker Farm #1 Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.28	8.44	101.30
Groundwater	Baker Farm #2 Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.28	8.44	101.30
Groundwater	Barn Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.91	490.90
Groundwater	Barnett Tract - 310	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.63	19.17	230.00
Groundwater	Batson Farm #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Surficial	0.75	22.92	275.00
Groundwater	Batson Farm #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00
Groundwater	Bay Road Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.68	20.58	247.00
Groundwater	Bear Branch	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.07	2.17	26.00
Groundwater	Beatson Farm-Old Georgetown Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.70	21.42	257.00
Groundwater	BELK #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.83	490.00
Groundwater	BELK #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.83	490.00
Groundwater	Bell	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.41	42.92	515.00
Groundwater	Berry 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.28	39.00	468.00
Groundwater	Berry 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.28	39.00	468.00
Groundwater	Beverly Creek Well No. 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.18	5.34	64.12
Groundwater	Beverly Creek Well No. 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.18	5.34	64.12
Groundwater	Biddle	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	3.70	112.67	1,352.00
Groundwater	Big Stuckey	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.20	36.58	439.00
Groundwater	Big Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.68	20.58	247.00
Groundwater	Bill Dingle	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.04	62.15	745.80
Groundwater	Billys	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.41	42.92	515.00
Groundwater	Blackswamp Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.31	9.46	113.50
Groundwater	BLENHEIM WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.38	11.68	140.16

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	BLENHEIM WELL #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.38	11.68	140.16
Groundwater	BLENHEIM WELL #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.38	11.68	140.16
Groundwater	Bob Flemming	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.12	3.80	45.60
Groundwater	Bobo Newsome Rd Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.14	4.17	50.00
Groundwater	Bonanza Crossing @ Bloomville Rd		Agriculture	Crouch Branch	0.00	0.00	0.00
Groundwater	Boos House Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.68	20.58	247.00
Groundwater	Boots Branch Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.16	35.42	425.00
Groundwater	Boston Wells Road Well		Agriculture	McQueen Branch	0.00	0.00	0.00
Groundwater	Bottom Farm #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.07	2.00	24.00
Groundwater	Bottom Farm #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.07	2.00	24.00
Groundwater	Boxwood well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.25	7.50	90.00
Groundwater	Bradbury	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.36	10.83	130.00
Groundwater	Brick Church Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.33	10.17	122.00
Groundwater	Brick Church Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.33	10.17	122.00
Groundwater	Brick Church Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.33	10.17	122.00
Groundwater	Bristow	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.04	1.29	15.48
Groundwater	Broadway Farm	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00
Groundwater	Brunson	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.04	62.15	745.80
Groundwater	BULK'S BARN		Agriculture		0.00	0.00	0.00
Groundwater	Bunker Hill Road Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.14	4.14	49.70
Groundwater	Burgess Crossing Rd. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.04	1.25	15.00
Groundwater	Burndown Well (JD Heriot Rd)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	3.70	112.67	1,352.00
Groundwater	Butler Scurry Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.38	11.70	140.40
Groundwater	Canal Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.63	19.17	230.00
Groundwater	Cane Branch Circle	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.11	3.33	40.00
Groundwater	CARTER WELL #1 (Carter Melon)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.96	29.17	350.00
Groundwater	CARTER WELL #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.96	29.17	350.00
Groundwater	Carterville Highway-Chandler Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.16	5.00	60.00
Groundwater	CC #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.48	14.48	173.78
Groundwater	CC #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.48	14.48	173.78
Groundwater	CC Rd. Well		Agriculture	McQueen Branch	0.00	0.00	0.00
Groundwater	Cemetery Rd Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.91	490.90
Groundwater	Center Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.16	5.00	60.00
Groundwater	Center Road Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.11	3.33	40.00
Groundwater	CF #2 WELL PUMPSTAT	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.52	76.58	919.00
Groundwater	Chapman Home Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.26	7.83	94.00
Groundwater	Chavis Place	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch - Mcqueen Branch	0.06	1.78	21.36
Groundwater	Church Field	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.75	22.92	275.00
Groundwater	Clarendon Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.24	7.33	88.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Clubhouse Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.91	490.90
Groundwater	Clyde Black Well-Keels Road Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.20	6.17	74.00
Groundwater	Cooper	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.28	39.00	468.00
Groundwater	Cousar well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.45	13.58	163.00
Groundwater	Covington Field	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.15	4.67	56.00
Groundwater	Cow Pond Tract	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.82	25.00	300.00
Groundwater	Cribb #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.52	15.83	190.00
Groundwater	Cribb #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.52	15.83	190.00
Groundwater	Cribbs Well #2		Agriculture		0.00	0.00	0.00
Groundwater	Crosland #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.15	4.67	56.00
Groundwater	Curtis Mill Pond Rd. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.19	36.33	436.00
Groundwater	D #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.83	490.00
Groundwater	D #3 well 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.83	490.00
Groundwater	DABBS WELL		Agriculture		0.00	0.00	0.00
Groundwater	Dairy Pivot	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.52	15.88	190.50
Groundwater	Dalzell Cel	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	1.40	42.67	512.00
Groundwater	Dalzell Center	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.40	42.67	512.00
Groundwater	Deep Gravel Well 8""	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.03	1.00	12.00
Groundwater	Dells	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.11	64.08	769.00
Groundwater	Deschamps	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.58	17.63	211.50
Groundwater	Donaldson Rd Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.08	2.40	28.80
Groundwater	Donna	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	3.70	112.67	1,352.00
Groundwater	DRIVEWAY		Agriculture		0.00	0.00	0.00
Groundwater	Dubose Field	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.17	5.25	63.00
Groundwater	Duck Pond	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.70	21.42	257.00
Groundwater	Eastern School Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.28	8.42	101.00
Groundwater	Eastern School Rd/Hwy 527	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.40	12.16	145.88
Groundwater	Eckley & Dickenson	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.95	28.83	346.00
Groundwater	Edwards	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.91	27.60	331.20
Groundwater	Egg & I Farm		Agriculture	McQueen Branch	0.15	4.56	54.70
Groundwater	Egg Plant		Agriculture	McQueen Branch	0.00	0.00	0.00
Groundwater	Eliason Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.20	6.17	74.00
Groundwater	Elliot/Hwy 527	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.52	46.08	553.00
Groundwater	Elmore 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.49	15.03	180.30
Groundwater	Elmore 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.49	15.03	180.30
Groundwater	Elmore 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.49	15.03	180.30
Groundwater	Farm 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.11	64.08	769.00
Groundwater	Farm 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.11	64.08	769.00
Groundwater	Fats Well (Heriot Rd)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	3.70	112.67	1,352.00
Groundwater	Field 20 Pivot	WTR-Groundwater Withdrawal Registration	Agriculture	Mcqueen Branch	0.33	9.93	119.20
Groundwater	Fields Bridge Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.52	46.08	553.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Flinns Rd Pivot	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.52	15.88	190.50
Groundwater	Forrest 6 Tower	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.85	25.83	310.00
Groundwater	Forrest Pond	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.85	25.83	310.00
Groundwater	Fox Mill	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.41	42.92	515.00
Groundwater	Frank Evans	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.11	64.08	769.00
Groundwater	FreeStates Road Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.14	4.30	51.60
Groundwater	Gamble New	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.04	62.15	745.80
Groundwater	Garland Dirt Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.91	490.90
Groundwater	Gass	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	3.70	112.67	1,352.00
Groundwater	Goodland Farms	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.54	16.43	197.20
Groundwater	Goodson	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	3.70	112.67	1,352.00
Groundwater	Grain Bins	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.41	42.92	515.00
Groundwater	Grain Bins Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.29	8.83	106.00
Groundwater	Green Barn Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.11	3.20	38.40
Groundwater	Grice Buster Field	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.21	6.25	75.00
Groundwater	Hamer Farm Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.07	2.26	27.15
Groundwater	Hay Field	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.63	19.17	230.00
Groundwater	Hebron Church Farm Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.07	2.26	27.15
Groundwater	Herbert Lee Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.54	16.33	196.00
Groundwater	Herndon 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.25	7.48	89.70
Groundwater	Hickory Grove Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.07	2.15	25.80
Groundwater	Hickory Grove Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.07	2.15	25.80
Groundwater	HIGHWAY 151 CF#4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.52	76.58	919.00
Groundwater	HL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.82	25.00	300.00
Groundwater	Hodge	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.45	13.74	164.90
Groundwater	Hodge Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.18	5.58	67.00
Groundwater	Hodges Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.36	10.83	130.00
Groundwater	Hog Barn	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	3.70	112.67	1,352.00
Groundwater	Home Farm Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.12	3.75	45.00
Groundwater	Home Place Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.66	20.00	240.00
Groundwater	Howzer	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	2.03	61.73	740.80
Groundwater	HP #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.29	8.75	105.00
Groundwater	HP #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.29	8.75	105.00
Groundwater	Hudson Back	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.91	27.60	331.20
Groundwater	Hudson Front	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.91	27.60	331.20
Groundwater	Huggins Place	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.17	5.20	62.40
Groundwater	Hunter Farm Well No. 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.07	2.10	25.25
Groundwater	HWY 145 #8 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.52	76.58	919.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Hwy 15	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.03	61.73	740.80
Groundwater	HWY 151 CF #3 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.52	76.58	919.00
Groundwater	HWY 151 Market well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.52	76.58	919.00
Groundwater	Hwy 38 #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.34	10.42	125.00
Groundwater	Hwy 38 #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.34	10.42	125.00
Groundwater	Hwy 401 & Nancy Branch	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.14	4.17	50.00
Groundwater	Hwy 401/Swimming Pen	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.52	46.08	553.00
Groundwater	HWY 441	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.22	6.61	79.30
Groundwater	HWY 527	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.24	37.67	452.00
Groundwater	HWY 527	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.77	23.42	281.00
Groundwater	Hwy 527 Sardinia	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.20	6.17	74.00
Groundwater	Hwy 9 Field Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.38	11.67	140.00
Groundwater	HWY145 #7 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.52	76.58	919.00
Groundwater	Indian Branch	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.39	11.92	143.00
Groundwater	Indian Branch Rd Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.14	4.20	50.40
Groundwater	IP-STN #3 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.32	9.58	115.00
Groundwater	IRR #1	WTR-Groundwater Withdrawal Registration	Agriculture		0.00	0.00	0.00
Groundwater	IRR #2	WTR-Groundwater Withdrawal Registration	Agriculture		0.00	0.00	0.00
Groundwater	IRR #3	WTR-Groundwater Withdrawal Registration	Agriculture		0.00	0.00	0.00
Groundwater	Irrigation #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Surficial	0.14	4.17	50.00
Groundwater	IRRIGATION #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Surficial	0.14	4.17	50.00
Groundwater	IRRIGATION #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Surficial	0.14	4.17	50.00
Groundwater	IRRIGATION #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Surficial	0.14	4.17	50.00
Groundwater	Irrigation Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.10	3.00	36.00
Groundwater	Irrigation Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.07	2.00	24.00
Groundwater	J Ben Rodgers Rd Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.16	4.77	57.30
Groundwater	J W Rhames Rd Left	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.27	8.33	100.00
Groundwater	Jack's Irrigation		Agriculture	Crouch Branch	0.00	0.00	0.00
Groundwater	Jackson Farm	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.73	22.15	265.80
Groundwater	James Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.18	5.58	67.00
Groundwater	Jefferies Creek Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.08	2.50	30.00
Groundwater	Jerry's	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.04	62.15	745.80
Groundwater	Jessamyn	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.41	42.92	515.00
Groundwater	Jessamyn Rd Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.15	4.55	54.60
Groundwater	Jimmys	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.03	61.73	740.80
Groundwater	Jimmys #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	2.03	61.73	740.80
Groundwater	Joe Johnson Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.09	2.67	32.00
Groundwater	John's House #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.05	1.42	17.00
Groundwater	Josey Farm	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.73	22.15	265.80

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Keel's Pivot	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.54	16.33	196.00
Groundwater	Kelly Farm	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.29	8.75	105.00
Groundwater	Kilgo	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.28	39.00	468.00
Groundwater	Kirby Field	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.17	5.25	63.00
Groundwater	Kirven	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.28	39.00	468.00
Groundwater	Kissiah	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.25	7.50	90.00
Groundwater	Lamar	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.12	3.67	44.00
Groundwater	Lamar Cantey & Bradham	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.27	8.33	100.00
Groundwater	Latitude Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.40	42.67	512.00
Groundwater	Lee Field Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.22	6.61	79.30
Groundwater	Les Tindal Rd #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.24	7.42	89.00
Groundwater	Levi	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.04	62.15	745.80
Groundwater	Levy Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture		0.53	16.17	194.00
Groundwater	Lewis Field Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.35	10.50	126.00
Groundwater	LFW1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.09	2.81	33.70
Groundwater	LFW2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.09	2.81	33.70
Groundwater	Lins	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.03	61.73	740.80
Groundwater	Linwood Farms - Willard	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.66	20.00	240.00
Groundwater	Little Sister P1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.68	272.10
Groundwater	Little Sister P2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.68	272.10
Groundwater	Little Stuckey	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	1.20	36.58	439.00
Groundwater	Long Field Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.70	21.42	257.00
Groundwater	Lottie	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.85	25.83	310.00
Groundwater	Luckey Road 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.12	3.67	44.00
Groundwater	Lynchburg Hwy Well (Cribbs Well #3)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.51	15.63	187.60
Groundwater	Maidendown Bay Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.34	10.42	125.00
Groundwater	Maidendown Bay Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.34	10.42	125.00
Groundwater	Maidendown Bay Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.34	10.42	125.00
Groundwater	Mason Lane Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.08	2.50	30.00
Groundwater	Mayes Well #2		Agriculture		0.00	0.00	0.00
Groundwater	Mayesville Farm Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.29	8.83	106.00
Groundwater	Mayesville Swamp	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.52	46.08	553.00
Groundwater	Maysville Flats	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.52	46.08	553.00
Groundwater	Mcabe	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.04	62.15	745.80
Groundwater	McCall Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.52	15.83	190.00
Groundwater	McCoy Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.51	15.63	187.60
Groundwater	McElveen Rd. #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.20	6.17	74.00
Groundwater	Mcgee Town	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.09	2.67	32.00
Groundwater	McIntosh Pond Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.82	25.00	300.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	McKnight Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	1.24	37.67	452.00
Groundwater	McPhaul Field Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.38	11.67	140.00
Groundwater	McQueen Lane Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.07	2.00	24.00
Groundwater	MILK BARN	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.27	8.33	100.00
Groundwater	Mims	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.85	25.83	310.00
Groundwater	Mims Tract Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.89	27.15	325.80
Groundwater	Mims Tract Well #1		Agriculture	McQueen Branch	0.00	0.00	0.00
Groundwater	Mims Tract Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.89	27.15	325.80
Groundwater	Mims Tract Well #2		Agriculture	McQueen Branch	0.00	0.00	0.00
Groundwater	Minturn School Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.12	3.75	45.00
Groundwater	Moccasin & Sandy Grove	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.42	43.33	520.00
Groundwater	Moore Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.51	15.63	187.60
Groundwater	Mother's House Pivot	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.52	15.88	190.50
Groundwater	Motor Pool Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch-Charleston	0.02	0.71	8.50
Groundwater	Mt Sinai/St. Charles Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.52	46.08	553.00
Groundwater	Mulberry Church #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.16	35.42	425.00
Groundwater	Nebo	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.11	64.08	769.00
Groundwater	NEW D #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.83	490.00
Groundwater	Nitrogen Tank	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.04	62.15	745.80
Groundwater	No # Puddin Swamp Rd		Agriculture	Crouch Branch	0.00	0.00	0.00
Groundwater	Norwood Pivot #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.14	4.27	51.30
Groundwater	Old Camden #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.26	7.83	94.00
Groundwater	Old Camden #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.26	7.83	94.00
Groundwater	Old Creek Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.13	4.08	49.00
Groundwater	Old Manning Road		Agriculture		0.00	0.00	0.00
Groundwater	OLD SHED	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	2.11	64.08	769.00
Groundwater	OLD SHED		Agriculture		0.00	0.00	0.00
Groundwater	Park Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.38	11.70	140.40
Groundwater	Parnell Farm		Agriculture	McQueen Branch	0.15	4.56	54.70
Groundwater	Pate Well-Queen Chapel Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.96	29.17	350.00
Groundwater	Pauls Shop	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.73	22.15	265.80
Groundwater	Paxville Bay Valley	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.17	5.07	60.90
Groundwater	Paxville Big Pivot	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.17	5.07	60.90
Groundwater	Paxville Hwy Well (HWY 261 Well)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.27	8.33	100.00
Groundwater	Philadelphia #1 (Little)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.48	14.50	174.00
Groundwater	Philadelphia #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.48	14.50	174.00
Groundwater	Phillips Farm Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.54	16.33	196.00
Groundwater	Phillips Well-Queen Chapel Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.96	29.17	350.00
Groundwater	Pigeon Barn	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.22	6.58	79.00
Groundwater	Pigeon Barn 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.22	6.58	79.00
Groundwater	Pinchum Sly	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.28	39.00	468.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Pinewood Dr.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.37	11.17	134.00
Groundwater	Pond Well		Agriculture		0.00	0.00	0.00
Groundwater	Pondville	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.34	10.42	125.00
Groundwater	Pork Chops	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	2.03	61.73	740.80
Groundwater	Pork Chops #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.73	22.15	265.80
Groundwater	POULTRY		Agriculture		0.00	0.00	0.00
Groundwater	Pump Station 1	WTR-Groundwater Withdrawal Registration	Agriculture	Mcqueen Branch	0.33	9.93	119.20
Groundwater	Pump Station 2	WTR-Groundwater Withdrawal Registration	Agriculture	Mcqueen Branch	0.33	9.93	119.20
Groundwater	Queen Chapel Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.03	61.73	740.80
Groundwater	Quiet Brook Pivot Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.52	15.88	190.50
Groundwater	Rabb #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.32	9.67	116.00
Groundwater	Raccoon Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.19	5.93	71.16
Groundwater	Raccoon Rd		Agriculture		0.00	0.00	0.00
Groundwater	Ralph Jackson	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.70	21.42	257.00
Groundwater	Ray Williams (Jamestown Rd)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.08	2.58	31.00
Groundwater	Reames Back	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.28	39.00	468.00
Groundwater	Reames Front	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.28	39.00	468.00
Groundwater	Red Hill Rd Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.16	4.77	57.30
Groundwater	Reg 1827	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.04	1.08	13.00
Groundwater	Reynolds Farm	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.73	22.15	265.80
Groundwater	River Pump Station	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.63	19.17	230.00
Groundwater	Rivers	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	3.70	112.67	1,352.00
Groundwater	Roberts	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.46	13.98	167.79
Groundwater	Rodgers Farm Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.16	4.92	59.00
Groundwater	Rogers Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.11	64.08	769.00
Groundwater	ROOSTER COOP #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.27	8.33	100.00
Groundwater	ROOSTER COOP #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.27	8.33	100.00
Groundwater	Roper Woods	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch-Charleston	0.12	3.50	42.00
Groundwater	Ross	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	3.70	112.67	1,352.00
Groundwater	S Curve Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.60	18.17	218.10
Groundwater	Sandy Grove & State Park	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.42	43.33	520.00
Groundwater	Sandy Grove Chapel Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.42	43.33	520.00
Groundwater	Sandy Grove Church Rd @ Hwy 15	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.36	10.83	130.00
Groundwater	Savanah 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.24	7.38	88.60
Groundwater	Savanah 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.24	7.38	88.60
Groundwater	Scarborough Rd		Agriculture	McQueen Branch	0.00	0.00	0.00
Groundwater	SEGARS #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.83	490.00
Groundwater	SEGARS #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.83	490.00
Groundwater	SEGARS #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.83	490.00
Groundwater	Segars (Rembert Church Rd)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	3.70	112.67	1,352.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Selby	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.29	8.75	105.00
Groundwater	Severance Farm		Agriculture	McQueen Branch	0.15	4.56	54.70
Groundwater	Shaw 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.28	39.00	468.00
Groundwater	Shaw 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.28	39.00	468.00
Groundwater	Sherwood Well No. 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.14	4.17	50.00
Groundwater	Shop	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	2.03	61.73	740.80
Groundwater	Shop	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.04	62.15	745.80
Groundwater	Shop Big	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.20	36.58	439.00
Groundwater	Shop Little	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.20	36.58	439.00
Groundwater	Shop Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.91	490.90
Groundwater	Siding	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	3.70	112.67	1,352.00
Groundwater	Silo #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.52	15.83	190.00
Groundwater	Silo #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.52	15.83	190.00
Groundwater	Silo #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.52	15.83	190.00
Groundwater	Sinclair Farm	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.36	10.86	130.30
Groundwater	Smith	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.04	62.15	745.80
Groundwater	Snead Field	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.73	22.15	265.80
Groundwater	St. Charles #1, HWY 401	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.28	8.67	104.00
Groundwater	St. Charles #2, HWY 401	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.28	8.67	104.00
Groundwater	St. Charles FC	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.28	8.67	104.00
Groundwater	Stafford	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.91	27.60	331.20
Groundwater	State Park #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.42	43.33	520.00
Groundwater	State Park #7Q	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.42	43.33	520.00
Groundwater	Stateline Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.25	7.57	90.80
Groundwater	Stateline Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.25	7.57	90.80
Groundwater	Stokes	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.20	36.58	439.00
Groundwater	Store	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.29	8.75	105.00
Groundwater	Suggs Field	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.14	4.17	50.00
Groundwater	Sumter County Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.10	2.92	35.00
Groundwater	Swimming Pen Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.19	5.93	71.16
Groundwater	SYSTEM A	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.12	3.53	42.40
Groundwater	SYSTEM B	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.12	3.53	42.40
Groundwater	SYSTEM C	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.12	3.53	42.40
Groundwater	T Barn	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	2.11	64.08	769.00
Groundwater	Tailback South	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.16	35.42	425.00
Groundwater	Tarleton Rd Well #1.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.19	36.33	436.00
Groundwater	Tarleton Rd. Well #2.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.19	36.33	436.00
Groundwater	Tarleton Rd. Well #3.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.19	36.33	436.00
Groundwater	Taylor	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.25	7.50	90.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Tees	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	3.70	112.67	1,352.00
Groundwater	Tims	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.05	1.67	20.00
Groundwater	Tindal Tract		Agriculture		0.00	0.00	0.00
Groundwater	Tindal, Swimming Pen Rd		Agriculture	Crouch Branch	0.00	0.00	0.00
Groundwater	Toby Well (Woodrow Rd)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.11	3.33	40.00
Groundwater	Toeys	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	2.04	62.15	745.80
Groundwater	Toh Barn	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	2.04	62.15	745.80
Groundwater	Toms Creek	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.82	25.00	300.00
Groundwater	Tower	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.82	25.00	300.00
Groundwater	TRCT 3350 Field 7	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.03	0.77	9.20
Groundwater	Turf well	WTR-Groundwater Withdrawal Registration	Agriculture	Crouch Branch	0.33	9.93	119.20
Groundwater	Turkey House	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	2.03	61.73	740.80
Groundwater	Turkey House Well (Levy Rd)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.08	2.58	31.00
Groundwater	UNA Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.01	0.42	5.00
Groundwater	Unruh #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.22	6.67	80.00
Groundwater	Warners Bay #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.16	4.82	57.80
Groundwater	Warr Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.16	5.00	60.00
Groundwater	Welch Place Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.89	27.15	325.80
Groundwater	WELL #1	WTR-Groundwater Withdrawal Registration	Agriculture		0.00	0.00	0.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.19	5.83	70.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.15	4.71	56.50
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.24	7.20	86.40
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.26	38.29	459.50
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.69	21.00	252.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Charleston	0.46	14.04	168.50
Groundwater	WELL #1	WTR-Groundwater Withdrawal Registration	Agriculture		0.00	0.00	0.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.03	1.00	12.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.12	3.67	44.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.08	2.34	28.08
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.38	11.45	137.40
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.95	29.00	348.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.45	13.74	164.90
Groundwater	Well #1		Agriculture	McQueen Branch	0.00	0.00	0.00
Groundwater	WELL #1 - Stoney Run	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.45	13.70	164.40
Groundwater	Well #1 (Half Circle Pivot)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.98	29.67	356.00
Groundwater	WELL #1 (Old Manning Rd)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.42	12.67	152.00
Groundwater	Well #1 Bethel Church Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.49	15.00	180.00
Groundwater	WELL #1 DUBOSE SIDE	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.88	26.81	321.70

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	WELL #1 Waters	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.72	22.00	264.00
Groundwater	Well #1, Eden Rd. Turkey House	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.81	24.67	296.00
Groundwater	WELL #1/BAY	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.55	16.75	201.00
Groundwater	Well #10	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.34	40.83	490.00
Groundwater	Well #10		Agriculture		0.00	0.00	0.00
Groundwater	Well #11	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	1.34	40.83	490.00
Groundwater	Well #11		Agriculture		0.00	0.00	0.00
Groundwater	Well #12		Agriculture		0.00	0.00	0.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Registration	Agriculture		0.00	0.00	0.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.26	38.29	459.50
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.69	21.00	252.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Charleston	0.46	14.04	168.50
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.66	20.00	240.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.49	15.00	180.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.95	29.00	348.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.45	13.74	164.90
Groundwater	Well #2		Agriculture		0.00	0.00	0.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.19	5.83	70.00
Groundwater	WELL #2 Holy Lane		Agriculture		0.00	0.00	0.00
Groundwater	Well #2 - Grain Bins	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.45	13.70	164.40
Groundwater	Well #2 (Big Full Circle)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.98	29.67	356.00
Groundwater	WELL #2 Stokes	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.72	22.00	264.00
Groundwater	Well #2, EDENS WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.81	24.67	296.00
Groundwater	WELL #2/HOG HOUSE	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.55	16.75	201.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.26	38.29	459.50
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.69	21.00	252.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Charleston	0.46	14.04	168.50
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.49	15.00	180.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.45	13.74	164.90
Groundwater	Well #3		Agriculture		0.00	0.00	0.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.19	5.83	70.00
Groundwater	Well #3 - Hebron	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.00	0.00	0.00
Groundwater	Well #3 - Jack's	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.45	13.70	164.40
Groundwater	WELL #3 Scott		Agriculture		0.00	0.00	0.00
Groundwater	Well #3 (Small Field Circle)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.98	29.67	356.00
Groundwater	WELL #3 Heriot	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.72	22.00	264.00
Groundwater	WELL #3 R MCDANIEL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.88	26.81	321.70
Groundwater	Well #3, Black River Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.81	24.67	296.00
Groundwater	WELL #3/SHOP	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.55	16.75	201.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.69	21.00	252.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Charleston	0.46	14.04	168.50
Groundwater	Well #4		Agriculture	McQueen Branch	0.00	0.00	0.00
Groundwater	WELL #4 COLOUGH	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.88	26.81	321.70
Groundwater	Well #4 Rabon	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.72	22.00	264.00
Groundwater	Well #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00
Groundwater	Well #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.69	21.00	252.00
Groundwater	Well #5		Agriculture		0.00	0.00	0.00
Groundwater	WELL #5 DR BRADFORD	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.88	26.81	321.70
Groundwater	Well #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00
Groundwater	Well #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.69	21.00	252.00
Groundwater	Well #6		Agriculture		0.00	0.00	0.00
Groundwater	Well #6 Green	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.72	22.00	264.00
Groundwater	WELL #6 HANNAH	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.88	26.81	321.70
Groundwater	Well #7	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00
Groundwater	Well #7	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.69	21.00	252.00
Groundwater	Well #7		Agriculture		0.00	0.00	0.00
Groundwater	Well #8		Agriculture		0.00	0.00	0.00
Groundwater	Well #9		Agriculture		0.00	0.00	0.00
Groundwater	Well 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.95	28.83	346.00
Groundwater	Well 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.49	14.93	179.19
Groundwater	Well 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.22	6.67	80.00
Groundwater	Well 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	1.96	59.60	715.20
Groundwater	Well 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.09	2.67	32.00
Groundwater	Well 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00
Groundwater	WELL 10	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.58	17.57	210.80
Groundwater	Well 11	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	1.96	59.60	715.20
Groundwater	Well 12	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	1.96	59.60	715.20
Groundwater	Well 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.95	28.83	346.00
Groundwater	Well 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.49	14.93	179.19
Groundwater	Well 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.22	6.67	80.00
Groundwater	Well 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	1.96	59.60	715.20
Groundwater	Well 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00
Groundwater	Well 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.95	28.83	346.00
Groundwater	Well 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.49	14.93	179.19
Groundwater	Well 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.22	6.67	80.00
Groundwater	Well 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	1.96	59.60	715.20
Groundwater	Beverly Creek Well No. 2		Agriculture	McQueen Branch	0.00	0.00	0
Groundwater	Northbridge Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	1.40	42.67	512
Groundwater	Well 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.75	22.92	275.00
Groundwater	Well 4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.49	14.93	179.19

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Well 4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	1.96	59.60	715.20
Groundwater	Well 5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	1.96	59.60	715.20
Groundwater	Well 6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	1.96	59.60	715.20
Groundwater	Well 7	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	1.96	59.60	715.20
Groundwater	Well 8	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	1.96	59.60	715.20
Groundwater	Well 9	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch-Mcqueen Branch	0.58	17.57	210.80
Groundwater	Well Field 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.31	9.40	112.80
Groundwater	Well Field 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.31	9.40	112.80
Groundwater	WELL#1 Windham		Agriculture		0.00	0.00	0.00
Groundwater	Well#5 Segars	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.72	22.00	264.00
Groundwater	Westly Chapel	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.39	11.92	143.00
Groundwater	Wilkes #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.08	2.33	28.00
Groundwater	William's Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.13	4.08	49.00
Groundwater	Willie (Chaney Grove)		Agriculture	McQueen Branch	0.00	0.00	0.00
Groundwater	Winters Hill Road Left	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.27	8.33	100.00
Groundwater	Witt	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Crouch Branch	0.14	4.20	50.40
Groundwater	Woodham Farm Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.14	4.17	50.00
Groundwater	Zeigler	WTR-Groundwater Withdrawal Capacity Use Area Permit	Agriculture	Mcqueen Branch	0.29	8.75	105.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Aquaculture	Crouch Branch	0.08	2.58	31.00
Groundwater	Deep Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Mcqueen Branch	0.20	6.00	72.00
Groundwater	G1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.01	0.22	2.60
Groundwater	International Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch-Mcqueen Branch	0.15	4.54	54.50
Groundwater	IRR. WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.19	5.83	70.00
Groundwater	IRR. WELL 1		Golf	Surficial	0.07	2.08	25.00
Groundwater	IRR. WELL 2		Golf	Surficial	0.07	2.08	25.00
Groundwater	IRR. WELL 3		Golf	Surficial	0.07	2.08	25.00
Groundwater	IRR. WELL 4		Golf	Surficial	0.07	2.08	25.00
Groundwater	IRRIGATION WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.18	5.42	65.00
Groundwater	IRRIGATION WELL #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.18	5.42	65.00
Groundwater	Irrigation Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.18	5.42	65.00
Groundwater	IRRIGATION WELL 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.05	1.67	20.00
Groundwater	LOST CREEK AQUIFER	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Mcqueen Branch	0.09	2.82	33.90
Groundwater	MAIN IRRIGATION WELL		Golf	Crouch Branch	0.07	2.08	25.00
Groundwater	Main Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch-Mcqueen Branch	0.11	3.33	40.00
Groundwater	Main Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch-Mcqueen Branch	0.15	4.54	54.50
Groundwater	Maintenance	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.18	5.42	65.00
Groundwater	MBN-WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Mcqueen Branch	0.15	4.58	55.00
Groundwater	Restroom Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.18	5.42	65.00
Groundwater	RESTROOMWELL		Golf	Crouch Branch	0.07	2.08	25.00
Groundwater	South Beach Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch-Mcqueen Branch	0.07	2.08	25.00
Groundwater	Well	WTR-Groundwater Withdrawal Registration	Golf		0.00	0.00	0.00
Groundwater	WELL ""G2""	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.01	0.22	2.60

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	WELL ""G3""	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.01	0.22	2.60
Groundwater	WELL ""G4""	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.01	0.22	2.60
Groundwater	WELL ""G5""	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.01	0.22	2.60
Groundwater	WELL # 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.21	6.25	75.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.10	3.00	36.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.07	2.08	25.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.04	1.30	15.60
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.10	3.00	36.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.27	8.25	99.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.14	4.17	50.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.08	2.50	30.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.19	5.83	70.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.13	4.04	48.50
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch-Mcqueen Branch	0.09	2.67	32.00
Groundwater	Well #10	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #11	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #12	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	WELL #13	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #14	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #15	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #16	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #17	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #18	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #19	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	WELL #1A	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.21	6.25	75.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.10	3.00	36.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.04	1.30	15.60
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.10	3.00	36.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.27	8.25	99.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.08	2.50	30.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.19	5.83	70.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.13	4.04	48.50
Groundwater	Well #20	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	WELL #21	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #22	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #23	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.10	3.00	36.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.07	2.08	25.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.04	1.30	15.60
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.27	8.25	99.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.19	5.83	70.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.13	4.04	48.50
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.07	2.08	25.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.04	1.30	15.60
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.19	5.83	70.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.14	4.13	49.50
Groundwater	Well #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.07	2.08	25.00
Groundwater	Well #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.19	5.83	70.00
Groundwater	Well #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.14	4.13	49.50
Groundwater	Well #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.19	5.83	70.00
Groundwater	Well #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.14	4.13	49.50
Groundwater	Well #7	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.19	5.83	70.00
Groundwater	Well #7	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.14	4.13	49.50
Groundwater	Well #8	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #8	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.19	5.83	70.00
Groundwater	Well #9	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.15	4.58	55.00
Groundwater	Well #9	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch-Mcqueen Branch	0.19	5.83	70.00
Groundwater	WELL @ 11TH	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.07	2.07	24.84
Groundwater	WELL @ 13TH	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.07	2.07	24.84
Groundwater	WELL @ 16TH	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Surficial	0.07	2.07	24.84
Groundwater	WELL A	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.07	2.00	24.00
Groundwater	Well at Hole 14	WTR-Groundwater Withdrawal Capacity Use Area Permit	Golf	Crouch Branch	0.22	6.58	79.00
Groundwater	#3 Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	0.48	14.58	175.00
Groundwater	#4 Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	0.48	14.58	175.00
Groundwater	#5 Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	0.48	14.58	175.00
Groundwater	001 (HWY. 15)		Industry		0.00	0.00	0.00
Groundwater	002 (LEWIS RD.)		Industry		0.00	0.00	0.00
Groundwater	East Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	0.86	26.25	315.00
Groundwater	Facility Water Supply Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Charleston	0.21	6.33	76.00
Groundwater	NO. 11 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	4.82	146.50	1,758.00
Groundwater	NO. 9 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	4.82	146.50	1,758.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	NO.1 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	4.82	146.50	1,758.00
Groundwater	NO.2 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	4.82	146.50	1,758.00
Groundwater	NO.5 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	4.82	146.50	1,758.00
Groundwater	NO.6 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	4.82	146.50	1,758.00
Groundwater	NO.7 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	4.82	146.50	1,758.00
Groundwater	North Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	0.86	26.25	315.00
Groundwater	PW #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	1.37	41.67	500.00
Groundwater	PW #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	1.37	41.67	500.00
Groundwater	PW #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	1.37	41.67	500.00
Groundwater	PW #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Crouch Branch-Mcqueen Branch	1.78	54.17	650.00
Groundwater	PW #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	1.37	41.67	500.00
Groundwater	PW #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Crouch Branch	1.78	54.17	650.00
Groundwater	PW #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Charleston	1.78	54.17	650.00
Groundwater	PW #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Charleston	1.78	54.17	650.00
Groundwater	PW #7	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Charleston	1.78	54.17	650.00
Groundwater	RW-1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-10	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-11	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-12	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-13	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-14	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-15	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-7	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-8	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	RW-9	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Surficial	0.38	11.50	138.00
Groundwater	SOUTH WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Crouch Branch	0.01	0.42	5.00
Groundwater	Tower Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	0.86	26.25	315.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	0.01	0.42	5.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	2.35	71.33	856.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Crouch Branch	0.10	3.00	36.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Gordon	0.16	5.00	60.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Crouch Branch	1.64	50.00	600.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	1.64	50.00	600.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	0.35	10.50	126.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	1.75	53.25	639.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Crouch Branch	0.10	3.00	36.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Gordon	0.16	5.00	60.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Crouch Branch	1.64	50.00	600.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	1.64	50.00	600.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	2.35	71.33	856.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Gordon	0.16	5.00	60.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Crouch Branch-Mcqueen Branch	1.64	50.00	600.00
Groundwater	Well #3R	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	1.64	50.00	600.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	2.35	71.33	856.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Charleston	1.75	53.25	639.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Gordon	0.16	5.00	60.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	1.64	50.00	600.00
Groundwater	Well #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Charleston	1.75	53.25	639.00
Groundwater	Well #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Crouch Branch	1.64	50.00	600.00
Groundwater	Well #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	2.35	71.33	856.00
Groundwater	Well #7	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	2.35	71.33	856.00
Groundwater	Well #8	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	2.35	71.33	856.00
Groundwater	Well #9	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Mcqueen Branch	2.35	71.33	856.00
Groundwater	Williamsburg Co. Dev.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Industry	Crouch Branch-Mcqueen Branch	0.12	3.60	43.20
Groundwater	AB-1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Mcqueen Branch	1.82	55.30	663.60
Groundwater	AB-2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Mcqueen Branch	1.82	55.30	663.60
Groundwater	Well # 10	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Mcqueen Branch	1.82	55.30	663.60
Groundwater	Well # 9	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Mcqueen Branch	1.82	55.30	663.60
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Mcqueen Branch	1.82	55.30	663.60
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Mcqueen Branch	1.82	55.30	663.60
Groundwater	Well #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Crouch Branch	1.82	55.30	663.60
Groundwater	Well #8	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Crouch Branch	1.82	55.30	663.60
Groundwater	Well #A	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Mcqueen Branch	1.82	55.30	663.60
Groundwater	Well #B	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Mcqueen Branch	1.82	55.30	663.60
Groundwater	Well #C	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Mcqueen Branch	1.82	55.30	663.60
Groundwater	Well #D	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Mcqueen Branch	1.82	55.30	663.60
Groundwater	Well E	WTR-Groundwater Withdrawal Capacity Use Area Permit	Nuclear Power	Mcqueen Branch	1.82	55.30	663.60
Groundwater	#1 Ruby Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00
Groundwater	#10 Center Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00
Groundwater	#11 Center Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00
Groundwater	#12 Clyde School	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	#2 Airport Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00
Groundwater	#3 Camden Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00
Groundwater	#4 Ruby Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00
Groundwater	#5 Ashland Plant	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00
Groundwater	#6 Stucky Bottom	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00
Groundwater	#7 McKenzie Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00
Groundwater	#8 Ruby Rd,	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00
Groundwater	111 Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.33	10.00	120.00
Groundwater	12th and Madison	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.26	38.42	461.00
Groundwater	1st and Jackson	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.26	38.42	461.00
Groundwater	20th and Hudson	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.26	38.42	461.00
Groundwater	21ST AVENUE NORTH	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	0.02	0.71	8.50
Groundwater	341 Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Bedrock	0.33	10.00	120.00
Groundwater	38TH AVE NORTH	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.02	0.71	8.50
Groundwater	3RD AVENUE SOUTH	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	0.02	0.71	8.50
Groundwater	79TH AVENUE NORTH	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.02	0.71	8.50
Groundwater	903 Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Bedrock	0.33	10.00	120.00
Groundwater	Abrams Well (#43)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	AIRPORT	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	1.81	55.08	661.00
Groundwater	ARCADIA WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	Aynor Park Well (#2 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	Aynor Tank Well (#1)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	Baker lot Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.47	105.67	1,268.00
Groundwater	Bay Road Well (#21)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Beauty Spot Rd/Wallace St	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.96	59.75	717.00
Groundwater	Beauty Spot/International	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.96	59.75	717.00
Groundwater	Best Rd Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.33	10.00	120.00
Groundwater	BH-1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.49	14.85	178.16
Groundwater	BH-2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.49	14.85	178.16
Groundwater	BH-3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.49	14.85	178.16
Groundwater	BH-4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.49	14.85	178.16
Groundwater	BH-5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.49	14.85	178.16
Groundwater	BILLY MAC WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.82	25.00	300.00
Groundwater	Black River WTP Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	Bluff Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.50	45.67	548.00
Groundwater	Braves Village (#103 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch-Charleston	5.12	155.68	1,868.20
Groundwater	Brockington Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.80	24.31	291.75
Groundwater	Bucksport WWTP	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Burning Ridge Well (#28 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	5.12	155.68	1,868.20
Groundwater	BURT BEATSON WELL #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	By-Pass	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.93	28.25	339.00
Groundwater	Carolina Forest Well (#71 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Carolina Pines (ASR # 105)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch-Charleston	5.12	155.68	1,868.20
Groundwater	Caropines Well (#36 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Caropines Well (#39)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	Cedar Creek Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.47	105.67	1,268.00
Groundwater	Cemetery Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.81	54.92	659.00
Groundwater	CENTER WELL 9	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	4.93	150.00	1,800.00
Groundwater	Central WWTP	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	Checkerboard	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	1.81	55.08	661.00
Groundwater	Chestnut Cross Road Well (#23 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	CLA 24	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.03	0.92	11.00
Groundwater	CLA 28	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.03	0.92	11.00
Groundwater	CLA-146	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.47	44.68	536.20
Groundwater	CLA-27	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.47	44.68	536.20
Groundwater	CLA-29	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.47	44.68	536.20
Groundwater	CLA-64	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.47	44.68	536.20
Groundwater	Clemson Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.50	45.67	548.00
Groundwater	Cleveland Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	1.02	31.08	373.00
Groundwater	Conway Reservoir Well (#91)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Council Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.73	52.75	633.00
Groundwater	County Camp	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	0.80	24.31	291.75
Groundwater	Coxe Rd (Well #11)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.96	59.75	717.00
Groundwater	Cox's Ferry Well (#18)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	CRESENT BEACH	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.30	70.02	840.30
Groundwater	Crystal Lakes Well (#24 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Daisy Well (#9 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Deep Creek Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.26	68.61	823.30
Groundwater	Deerfield Well (#104 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Charleston	5.12	155.68	1,868.20
Groundwater	Deerfield Well (#32)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Dingle Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.71	21.50	258.00
Groundwater	DRINKING WATER	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	2.35	71.33	856.00
Groundwater	E. Main St. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.96	59.75	717.00
Groundwater	ECA Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Charleston	0.52	15.92	191.00
Groundwater	ECA Well - New	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.52	15.92	191.00
Groundwater	EMERGENCY WELL #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.05	1.67	20.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Eutaw St. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	1.50	45.67	548.00
Groundwater	EVERGREEN WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.47	44.86	538.34
Groundwater	Fennel Field	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.80	24.31	291.75
Groundwater	Fire Pond Well # 03	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.19	5.75	69.00
Groundwater	Forestbrook Well (#41)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Francis Marion Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.24	7.25	87.00
Groundwater	Front Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.02	31.08	373.00
Groundwater	Garden City Well (#27)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Gibson Ave.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.33	10.00	120.00
Groundwater	Gibson Hwy #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.96	59.75	717.00
Groundwater	Gibson Hwy #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.96	59.75	717.00
Groundwater	Greenwood Park	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.50	45.67	548.00
Groundwater	GSF High School Well (#15)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	Guest House Well # 05	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.19	5.75	69.00
Groundwater	HAGLEY WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.26	68.61	823.30
Groundwater	Hampton	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.93	28.25	339.00
Groundwater	Hanes Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.81	54.92	659.00
Groundwater	Hettie Ricket Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.47	105.67	1,268.00
Groundwater	HIGHTANK MURRELLS IN	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.26	68.61	823.30
Groundwater	Highway #34	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.26	38.42	461.00
Groundwater	Highway #9	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.26	38.42	461.00
Groundwater	Highway 377	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.80	24.31	291.75
Groundwater	Highway Department Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.73	52.75	633.00
Groundwater	HORSEPEN WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.82	25.00	300.00
Groundwater	HWY 179 WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Charleston	0.21	6.39	76.70
Groundwater	HWY 260	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.30	9.00	108.00
Groundwater	HWY 341 Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.14	4.17	50.00
Groundwater	Hwy 403 WTP	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	HWY 458	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Charleston	0.21	6.39	76.70
Groundwater	Hwy 501 Well (#22 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Hydropillar Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	1.18	36.00	432.00
Groundwater	Hyman Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.24	7.25	87.00
Groundwater	I-20 Industrial Park	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.73	52.75	633.00
Groundwater	Industrial Park	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	1.02	31.08	373.00
Groundwater	Industrial Park Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Charleston	0.52	15.92	191.00
Groundwater	INLET OAKS WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	INTERCHANGE WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.30	70.02	840.30
Groundwater	Irrigation Well # 04	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.19	5.75	69.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	James Industrial Park	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.73	52.75	633.00
Groundwater	Jamestown Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.47	105.67	1,268.00
Groundwater	Jamestown Well (#11 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Jamestown Well (#38)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	JORDANVILLE/WELL #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	1.47	44.86	538.34
Groundwater	Joyner Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	3.47	105.67	1,268.00
Groundwater	Keeler Rd Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	0.29	8.92	107.00
Groundwater	KING WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.54	16.33	195.95
Groundwater	Kingsburg Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Charleston	0.63	19.08	229.00
Groundwater	KRISPY KREME WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.30	70.02	840.30
Groundwater	Lee Well		Water Supply	McQueen Branch	0.00	0.00	0.00
Groundwater	LITCHFIELD HIGH TANK	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.26	68.61	823.30
Groundwater	Long Bay Well (#14)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	Longs Well (#29)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	Longs WWTP	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	Lucknow Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.47	105.67	1,268.00
Groundwater	Main Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.14	4.17	50.00
Groundwater	Main Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.05	1.67	20.00
Groundwater	MAIN WELL RED HILL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Charleston	2.26	68.61	823.30
Groundwater	MAINWELL PLANTERSV 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.26	68.61	823.30
Groundwater	MARYVILLE #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.54	16.33	195.95
Groundwater	Matthews Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	1.81	55.08	661.00
Groundwater	McColl Apt.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.33	10.00	120.00
Groundwater	McQueen Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.32	40.00	480.00
Groundwater	McQueen Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.32	40.00	480.00
Groundwater	McQueen Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.32	40.00	480.00
Groundwater	Morris Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	1.81	55.08	661.00
Groundwater	Mouzon Water System		Water Supply	Gramling	0.00	0.00	0.00
Groundwater	Myrtle Beach WTP Well #1 (#89)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Myrtle Beach WTP Well #2 (#95)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch-Charleston	5.12	155.68	1,868.20
Groundwater	Near R/R-West Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.18	5.42	65.00
Groundwater	Near Water Plt/East	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.18	5.42	65.00
Groundwater	Nesmith Rd Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	0.29	8.92	107.00
Groundwater	New Hope Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.21	6.33	76.00
Groundwater	New Hwy 38	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.32	40.00	480.00
Groundwater	New Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.48	14.58	175.00
Groundwater	New Well #1 Avondale	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.14	4.17	50.00
Groundwater	New Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.48	14.58	175.00
Groundwater	New Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.18	5.42	65.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	North 5th St. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.81	54.92	659.00
Groundwater	North ASR Well (#63 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	North Booster Well (#97 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	North Main	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.93	28.25	339.00
Groundwater	North Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.35	10.67	128.00
Groundwater	North Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.21	6.33	76.00
Groundwater	Oak Hill Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.63	19.08	229.00
Groundwater	OCEAN DRIVE	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	2.30	70.02	840.30
Groundwater	OCR-BH_2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.35	10.60	127.20
Groundwater	OCR-BH_2		Water Supply	Crouch Branch	0.00	0.00	0.00
Groundwater	OCR-BH-1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.35	10.60	127.20
Groundwater	OCR-BH-1		Water Supply	Crouch Branch	0.00	0.00	0.00
Groundwater	Odom Rd (Well #10)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.96	59.75	717.00
Groundwater	Old Beauty Spot #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.96	59.75	717.00
Groundwater	Old Beauty Spot #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.96	59.75	717.00
Groundwater	Old Hwy 403 Timmonsville (former G21423)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Old Stagecoach Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.47	105.67	1,268.00
Groundwater	PAWLEYS PLANTATION	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	PAWLEYS SHOP WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	Pawly's Swamp	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	1.47	44.86	538.34
Groundwater	Pender Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.71	21.50	258.00
Groundwater	PENNY ROYAL #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	PENNY ROYAL WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	Perry Road Well (#84)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch-Charleston	5.12	155.68	1,868.20
Groundwater	Piedmont Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.73	52.75	633.00
Groundwater	Pine Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.93	28.25	339.00
Groundwater	Pirate Cove Well (#13)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Pirateland Well (#17 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Plantersville Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	Prestwick Well (#45 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Prevatte Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	1.02	31.08	373.00
Groundwater	Process Well # 01A	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.19	5.75	69.00
Groundwater	Prosses Well # 01B	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.19	5.75	69.00
Groundwater	Racetrack Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	1.18	36.00	432.00
Groundwater	Rae Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	1.81	55.08	661.00
Groundwater	Railroad Ave. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.50	45.67	548.00
Groundwater	Replacement Well #11	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	River Rd. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.24	7.25	87.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	ROGER SHERRILL WELL #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	Rogers Rd. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	1.50	45.67	548.00
Groundwater	ROSE HILL WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	2.26	68.61	823.30
Groundwater	RV BRIARCLIFF	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.02	0.71	8.50
Groundwater	SAMPIT WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.26	68.61	823.30
Groundwater	Sandy Grove Ch Rd	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.96	59.75	717.00
Groundwater	Seaside Elementary (#34 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Shed Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.63	19.08	229.00
Groundwater	Shop Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.35	10.67	128.00
Groundwater	Sloan Rd. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	1.50	45.67	548.00
Groundwater	Smith St. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	1.50	45.67	548.00
Groundwater	Smith St. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.81	54.92	659.00
Groundwater	Sollie Circle	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.26	68.61	823.30
Groundwater	South 5th St. Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.81	54.92	659.00
Groundwater	SOUTH WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.35	10.67	128.00
Groundwater	South Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.21	6.33	76.00
Groundwater	Springs Mill	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.02	31.08	373.00
Groundwater	St. Anne Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	1.02	31.08	373.00
Groundwater	Studio City Well (#16 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Surfside 10th Ave Well (#10)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Surfside 3rd Ave Well (#3 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	SYDNOR#1 DEBORDIEU 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	SYDNOR#2 DEBORDIEU 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	Tamarack Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.82	25.00	300.00
Groundwater	Tatum Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.32	40.00	480.00
Groundwater	Tatum Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.32	40.00	480.00
Groundwater	Tern Hall Well (#25)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	test Well #2/Cypress St Replacement	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.41	12.34	148.12
Groundwater	Tilly Swamp Well (#19 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	TPI Tank Well (#69 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Charleston	5.12	155.68	1,868.20
Groundwater	Trade St. & First Ave.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.24	7.25	87.00
Groundwater	Tupperware Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Charleston	0.52	15.92	191.00
Groundwater	Tyson Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.71	21.50	258.00
Groundwater	Vereen WWTP	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	Vox Hwy Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.63	19.08	229.00
Groundwater	WACCHESAW PLANTATION	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.26	68.61	823.30
Groundwater	Wallace Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.81	55.08	661.00
Groundwater	WALT BEARD WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Wampee Well (#46)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	5.12	155.68	1,868.20
Groundwater	Water Supply # 02	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.19	5.75	69.00
Groundwater	Water Well #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	1.03	31.25	375.00
Groundwater	Watson's Riverside Well (#44 ASR)	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	5.12	155.68	1,868.20
Groundwater	Wedgefield Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	WELDON DRIVE	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL # 10 HWY 151	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.21	6.25	75.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.08	2.33	28.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.47	75.00	900.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.15	4.67	56.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.85	56.25	675.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.43	13.00	156.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.27	8.33	100.00
Groundwater	WELL #1	WTR-Groundwater Withdrawal Registration	Water Supply	Mcqueen Branch	0.11	3.33	40.00
Groundwater	WELL #1 - Road 92	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	Well #1 Cassatt Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.47	105.67	1,268.00
Groundwater	WELL #1 E TRTMNT PLT	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.28	8.42	101.00
Groundwater	Well #1 Hwy 52	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.14	4.17	50.00
Groundwater	Well #1 Main	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.04	1.10	13.20
Groundwater	Well #1 Old Stage Coach Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.47	105.67	1,268.00
Groundwater	WELL #1 PLANT 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #1 PLANT 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #1 PLANT 4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #1 PLANT 5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #1 TRMNT PLANT	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.15	4.50	54.00
Groundwater	Well #1/Fire Dept.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.41	12.34	148.12
Groundwater	Well #10	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	1.85	56.25	675.00
Groundwater	Well #10	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #11 - Old Creek Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	Well #12	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	Well #12	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #14	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #15	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #16	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #16 Pine Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #17	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #17 Dexter Drive	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Well #18	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #18 Gully Br. Deep	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #19	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #19 Edisto Shallow	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	13.46	409.42	4,913.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.21	6.25	75.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	2.35	71.33	856.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.47	75.00	900.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.15	4.67	56.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.85	56.25	675.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.15	4.50	54.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.43	13.00	156.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.15	4.50	54.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.27	8.33	100.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.28	8.42	101.00
Groundwater	WELL #2		Water Supply	Crouch Branch	0.00	0.00	0.00
Groundwater	Well #2	WTR-Groundwater Withdrawal Registration	Water Supply	Crouch Branch	0.11	3.33	40.00
Groundwater	WELL #2 - Road 346	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	Well #2 Church St.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.14	4.17	50.00
Groundwater	Well #2 Main St	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.14	4.17	50.00
Groundwater	Well #2 New	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.15	4.52	54.20
Groundwater	Well #2 New	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.04	1.10	13.20
Groundwater	Well #2 Old Stage Coach Rd.	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.47	105.67	1,268.00
Groundwater	WELL #2 PLANT 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #2 PLANT 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #2 PLANT 4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #2 PLANT 5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #2 TRTMNT PLNT	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.07	2.25	27.00
Groundwater	WELL #2 W TRTMNT PLT	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.28	8.42	101.00
Groundwater	WELL #2/Cypress St	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.41	12.34	148.12
Groundwater	Well #20	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #21 Darlington Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #22	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #22 McCown Shallow	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #23	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #24 Lucas Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #25		Water Supply	McQueen Branch	0.00	0.00	0.00
Groundwater	Well #25 Oakdale	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #26 G.E. Deep	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #27 Harmony Street	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Well #28 Santiago Drive	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	WELL #2R	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.13	3.92	47.04
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.19	5.83	70.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.47	75.00	900.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.13	3.92	47.04
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.85	56.25	675.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.43	13.00	156.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.27	8.33	100.00
Groundwater	Well #3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.28	8.42	101.00
Groundwater	WELL #3 BHND TRTMNT	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.07	2.25	27.00
Groundwater	WELL #3 BLD 2233	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	1.03	31.25	375.00
Groundwater	WELL #3 PLANT 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #3 PLANT 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #3 PLANT 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #3 PLANT 4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #3 PLANT 5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #3/Prison	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.41	12.34	148.12
Groundwater	Well #30 Wallace-Gregg	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #31 Mt. Zion	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #32 Ebenezer Deep	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #33 South Park	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #34 South Florence	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #35 Roberta Drive	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #36 Green Acres Deep	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #37 Ebenezer Shallow	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	13.46	409.42	4,913.00
Groundwater	Well #38 McCown Shallow	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	13.46	409.42	4,913.00
Groundwater	Well #39 Gully Br. Shallow	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	13.46	409.42	4,913.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.19	5.83	70.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	2.47	75.00	900.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	1.85	56.25	675.00
Groundwater	Well #4	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.27	8.33	100.00
Groundwater	WELL #4 - Sowell Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	WELL #4 BLD 2004	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	1.03	31.25	375.00
Groundwater	WELL #4 PLANT 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #4 PLANT 2	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	Well #40 Green Acres Shallow	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	13.46	409.42	4,913.00

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	Well #41 Eureka Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #42 Range Way	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #43 McCurdy Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #45 Alligator Deep	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #46 Alligator Shallow	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	13.46	409.42	4,913.00
Groundwater	Well #47 Twin Church	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #48 River Road	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	13.46	409.42	4,913.00
Groundwater	Well #4A	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	Well #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.47	44.86	538.34
Groundwater	Well #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	2.47	75.00	900.00
Groundwater	Well #5	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	1.85	56.25	675.00
Groundwater	WELL #5 - Hwy 1 South	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	WELL #5 BLD 1415	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	1.03	31.25	375.00
Groundwater	WELL #5 PLANT 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #5 Treatment Plant	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.15	4.50	54.00
Groundwater	Well #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	1.85	56.25	675.00
Groundwater	Well #6	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	WELL #6 - Hwy 145	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	WELL #6 BLD 3656	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.03	31.25	375.00
Groundwater	WELL #6 PLANT 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	WELL #6 PLANT 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	Well #7	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	1.85	56.25	675.00
Groundwater	Well #7	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	WELL #7 - Hwy 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	WELL #7 BLD 5640	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.03	31.25	375.00
Groundwater	WELL #7 PLANT 1	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	Well #7 Water Plant 3	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	15.22	462.80	5,553.60
Groundwater	Well #8	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	1.85	56.25	675.00
Groundwater	Well #8	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	WELL #8 - Hwy 151 South	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	Well #9	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.76	114.30	1,371.60
Groundwater	Well #9	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.85	56.25	675.00
Groundwater	Well #9	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	WELL 1-A	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Charleston	0.21	6.39	76.70
Groundwater	Well 24	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	3.88	117.92	1,415.00
Groundwater	WELL ONE-A	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	0.13	3.92	47.04
Groundwater	West Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.63	19.08	229.00
Groundwater	WHITE POINT WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.30	70.02	840.30

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Groundwater	WINDY HILL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.30	70.02	840.30
Groundwater	LAKE ARROWHEAD	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	0.02	0.71	8.5
Groundwater	AVX	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	0.02	0.71	8.5
Groundwater	WIRE MILL WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	0.82	25.00	300.00
Groundwater	WITHALACOOCHE	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	1.50	45.67	548.00
Groundwater	WWTP Deep	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch-Mcqueen Branch	2.26	68.61	823.30
Groundwater	WWTP Shallow	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Surficial	2.26	68.61	823.30
Groundwater	X-ROADS WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch	1.47	44.86	538.34
Groundwater	YAUHANNAH WELL	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Crouch Branch	2.26	68.61	823.30
Groundwater	Zion Well	WTR-Groundwater Withdrawal Capacity Use Area Permit	Water Supply	Mcqueen Branch-Charleston	1.50	45.67	548.00
Surface Water	Pond	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.00	0.00	0
Surface Water	Pond 2	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.00	0.00	0
Surface Water	Griggs Farm	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.05	1.63	19.548
Surface Water	Tolson Pond	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.00	0.00	0
Surface Water	#6 Newton	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.38	11.48	137.81
Surface Water	Atkinson Farm	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.27	8.00	96.00
Surface Water	Back Swamp Creek	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.18	5.50	66.00
Surface Water	Black Creek (S01)	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		180.00	5,400.00	64,800.00
Surface Water	Black River intake	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		1.00	30.00	360.00
Surface Water	Chappell Creek	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.39	11.57	138.78
Surface Water	Frank's Creek	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.32	9.72	116.64
Surface Water	Griggs Stream	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.11	3.26	39.10
Surface Water	Griggs Stream	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.08	2.40	28.80
Surface Water	Hawkins Canal #3	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.27	8.00	96.00
Surface Water	Louthers Lake	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.17	5.00	60.00
Surface Water	McCalls Mill Pond	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		1.90	57.02	684.28
Surface Water	McDonald Canal	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.31	9.22	110.59
Surface Water	Mcintosh pond	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.19	5.81	69.72
Surface Water	McLeod #2, Field 3	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		1.13	33.94	407.30
Surface Water	McLeod #3, Field 5	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		1.17	35.10	421.20
Surface Water	McLeod Pond #1	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		1.12	33.67	404.04
Surface Water	Naked Creek Intake	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		3.43	103.00	1,236.00
Surface Water	PEE DEE RIVER	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.55	16.52	198.24
Surface Water	Pump #1	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.86	25.80	309.60
Surface Water	Pump #2	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.32	9.52	114.24
Surface Water	Pump #3	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.25	7.62	91.44
Surface Water	Pump #4	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.09	2.77	33.24
Surface Water	Pump for John's and Bess	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		3.01	90.40	1,084.80

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Surface Water	Red Oak Camp Creek	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		3.04	91.30	1,095.60
Surface Water	River Intake Holy Lane	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.23	7.00	84.00
Surface Water	River Intake Mills Rd	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		1.00	30.00	360.00
Surface Water	T.C Coxe	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		2.00	60.00	720.00
Surface Water	Tom's Creek Pond	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.10	3.00	36.00
Surface Water	Westfield Creek	WTR-Surface Water Withdrawal Agricultural Registration	Agriculture		0.20	6.00	72.00
Surface Water	#1 Intake	WTR-Surface Water Withdrawal Existing Permit	Golf		0.89	26.78	321.36
Surface Water	Irrigation Lake	WTR-Surface Water Withdrawal Permit	Golf		0.60	18.00	216
Surface Water	Waterway Pump	WTR-Surface Water Withdrawal Existing Permit	Golf		0.83	25.00	300
Surface Water	Arcadian Shores GC - 26GC017S01	WTR-Surface Water Withdrawal Existing Permit	Golf		0.74	22.30	267.60
Surface Water	Buck Creek Intake	WTR-Surface Water Withdrawal Existing Permit	Golf		0.26	7.75	93.00
Surface Water	Golf Course Intake	WTR-Surface Water Withdrawal Permit	Golf		0.13	4.00	48.00
Surface Water	Golf Course Irrigation Pump House	WTR-Surface Water Withdrawal Existing Permit	Golf		1.56	46.80	561.64
Surface Water	Grande Dunes Transfer Station South	WTR-Surface Water Withdrawal Existing Permit	Golf		2.83	84.82	1,017.84
Surface Water	ICW Intake		Golf		0.60	18.00	216.00
Surface Water	ICW Intake	WTR-Surface Water Withdrawal Existing Permit	Golf		1.12	33.48	401.76
Surface Water	ICWW Intake	WTR-Surface Water Withdrawal Existing Permit	Golf		4.76	142.85	1,714.20
Surface Water	ICWW Under Bridge - North Pump	WTR-Surface Water Withdrawal Existing Permit	Golf		2.83	84.82	1,017.84
Surface Water	Intracoastal Waterway	WTR-Surface Water Withdrawal Existing Permit	Golf		0.36	10.80	129.60
Surface Water	Intracoastal Waterway	WTR-Surface Water Withdrawal Existing Permit	Golf		1.19	35.71	428.52
Surface Water	Irrigation Lake	WTR-Surface Water Withdrawal Existing Permit	Golf		1.63	49.00	588.00
Surface Water	Irrigation Lake #12	WTR-Surface Water Withdrawal Existing Permit	Golf		2.38	71.42	857.04
Surface Water	Main Pump House	WTR-Surface Water Withdrawal Existing Permit	Golf		2.31	69.19	830.28
Surface Water	Marina Basin	WTR-Surface Water Withdrawal Existing Permit	Golf		0.97	29.02	348.24
Surface Water	Oatland Lake Intake	WTR-Surface Water Withdrawal Existing Permit	Golf		3.33	100.00	1,200.00
Surface Water	Palmetto Transfer Pump	WTR-Surface Water Withdrawal Existing Permit	Golf		1.49	44.60	535.20
Surface Water	Pinehills transfer pump	WTR-Surface Water Withdrawal Existing Permit	Golf		1.49	44.60	535.20
Surface Water	Prince Creek Intake	WTR-Surface Water Withdrawal Existing Permit	Golf		0.74	22.32	267.84
Surface Water	Pump house	WTR-Surface Water Withdrawal Existing Permit	Golf		2.01	60.26	723.12
Surface Water	Pump House - Midway Lake	WTR-Surface Water Withdrawal Existing Permit	Golf		0.24	7.10	85.20
Surface Water	Pump House (Lake)	WTR-Surface Water Withdrawal Existing Permit	Golf		1.49	44.64	535.68
Surface Water	Pump House-Cane Patch Lake	WTR-Surface Water Withdrawal Existing Permit	Golf		0.20	5.99	71.88
Surface Water	Pump Station	WTR-Surface Water Withdrawal Existing Permit	Golf		0.67	20.00	240.00
Surface Water	Pumphouse	WTR-Surface Water Withdrawal Existing Permit	Golf		1.51	45.30	543.60
Surface Water	Pumphouse Intake	WTR-Surface Water Withdrawal Existing Permit	Golf		1.64	49.10	589.20
Surface Water	Reserve Pump House - 22GC018S01	WTR-Surface Water Withdrawal Existing Permit	Golf		2.23	66.96	803.52
Surface Water	River Hills Golf & CC Pumphouse	WTR-Surface Water Withdrawal Existing Permit	Golf		1.22	36.60	439.20
Surface Water	Singleton Lake Intake	WTR-Surface Water Withdrawal Existing Permit	Golf		4.32	129.58	1,554.96
Surface Water	TB Main Intake	WTR-Surface Water Withdrawal Existing Permit	Golf		2.38	71.42	857.04

Table A-2. Permitted and Registered Amounts for Current Water Users

Source	Owner	Permit or Registration	Use Category	Aquifer	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Surface Water	Tradition Maintenance Facility Intake	WTR-Surface Water Withdrawal Existing Permit	Golf		1.34	40.20	482.40
Surface Water	Transfer Pump	WTR-Surface Water Withdrawal Existing Permit	Golf		0.54	16.07	192.84
Surface Water	Unnamed Trib To Waverly Creek	WTR-Surface Water Withdrawal Existing Permit	Golf		1.57	47.00	564.00
Surface Water	Waccamaw River Intake-26GC032S01	WTR-Surface Water Withdrawal Existing Permit	Golf		0.35	10.36	124.32
Surface Water	Black Creek	WTR-Surface Water Withdrawal Existing Permit	Industry		1.03	31.00	372.00
Surface Water	Mill Supply	WTR-Surface Water Withdrawal - Special Authorization	Industry		0.00	0.00	0.00
Surface Water	North Pond-North PH - 22IN008S01	WTR-Surface Water Withdrawal Existing Permit	Industry		4.23	127.00	1,524.00
Surface Water	North Pond-South PH - 22IN008S02	WTR-Surface Water Withdrawal Existing Permit	Industry		3.97	119.00	1,428.00
Surface Water	Pee Dee River - 34IN005S01	WTR-Surface Water Withdrawal Existing Permit	Industry		31.23	937.00	11,244.00
Surface Water	Pond House (NO1)	WTR-Surface Water Withdrawal Existing Permit	Industry		11.16	334.80	4,017.60
Surface Water	Power Intake	WTR-Surface Water Withdrawal Existing Permit	Industry		29.13	873.89	10,486.68
Surface Water	River Fresh Water Intake	WTR-Surface Water Withdrawal Existing Permit	Industry		41.66	1,249.90	14,998.80
Surface Water	Sampit Intake 1	WTR-Surface Water Withdrawal Existing Permit	Industry		3.12	93.70	1,124.40
Surface Water	Sampit Intake 2	WTR-Surface Water Withdrawal Existing Permit	Industry		3.12	93.70	1,124.40
Surface Water	Brewer Intake	WTR-Surface Water Withdrawal Existing Permit	Mining		6.84	205.30	2,463.60
Surface Water	Jefferson Intake	WTR-Surface Water Withdrawal Existing Permit	Mining		0.89	26.80	321.60
Surface Water	Marlboro Intake	WTR-Surface Water Withdrawal Existing Permit	Mining		4.46	133.90	1,606.80
Surface Water	Raley Millpond	WTR-Surface Water Withdrawal Existing Permit	Mining		3.27	98.21	1,178.52
Surface Water	Robinson Fossil Plant Intake	WTR-Surface Water Withdrawal Existing Permit	Nuclear Power		129.47	3,884.00	46,608.00
Surface Water	Robinson Nuclear Plant Intake	WTR-Surface Water Withdrawal Existing Permit	Nuclear Power		746.20	22,386.00	268,632.00
Surface Water	22WS001S01	WTR-Surface Water Withdrawal Existing Permit	Water Supply		12.40	372.00	4,464.00
Surface Water	22WS002S01	WTR-Surface Water Withdrawal Existing Permit	Water Supply		12.20	366.00	4,392.00
Surface Water	Bull Creek	WTR-Surface Water Withdrawal Existing Permit	Water Supply		62.00	1,860.00	22,320.00
Surface Water	Lake Wallace	WTR-Surface Water Withdrawal Existing Permit	Water Supply		4.00	120.00	1,440.00
Surface Water	Myrtle Beach SWTP - 26WS009S01	WTR-Surface Water Withdrawal Existing Permit	Water Supply		62.00	1,860.00	22,320.00
Surface Water	Pee Dee Intake	WTR-Surface Water Withdrawal Existing Permit	Water Supply		31.00	930.00	11,160.00
Surface Water	Pee Dee River - 13WS001S01	WTR-Surface Water Withdrawal Existing Permit	Water Supply		11.90	357.00	4,284.00

Table A-3. Projected Water Demands

Source	User	Use Category	Year	Moderate Demand (MGD)	High Demand (MGD)
Coastal Surface Water	Combined User Data	Agriculture	2025	0.00	0.53
Coastal Surface Water	Combined User Data	Agriculture	2030	0.00	0.53
Coastal Surface Water	Combined User Data	Agriculture	2035	0.00	0.53
Coastal Surface Water	Combined User Data	Agriculture	2040	0.00	0.53
Coastal Surface Water	Combined User Data	Agriculture	2050	0.00	0.53
Coastal Surface Water	Combined User Data	Agriculture	2060	0.00	0.53
Coastal Surface Water	Combined User Data	Agriculture	2070	0.00	0.53
Coastal Surface Water	Combined User Data	Golf	2025	3.78	9.23
Coastal Surface Water	Combined User Data	Golf	2030	3.79	9.26
Coastal Surface Water	Combined User Data	Golf	2035	3.81	9.29
Coastal Surface Water	Combined User Data	Golf	2040	3.82	9.32
Coastal Surface Water	Combined User Data	Golf	2050	3.85	9.41
Coastal Surface Water	Combined User Data	Golf	2060	3.87	9.52
Coastal Surface Water	Combined User Data	Golf	2070	3.90	9.66
Coastal Surface Water	Combined User Data	Industry	2025	6.56	11.55
Coastal Surface Water	Combined User Data	Industry	2030	7.09	12.82
Coastal Surface Water	Combined User Data	Industry	2035	7.59	14.22
Coastal Surface Water	Combined User Data	Industry	2040	8.04	15.78
Coastal Surface Water	Combined User Data	Industry	2050	8.98	19.43
Coastal Surface Water	Combined User Data	Industry	2060	9.83	23.91
Coastal Surface Water	Combined User Data	Industry	2070	10.77	29.44
Coastal Surface Water	Combined User Data	Water Supply	2025	61.49	67.96
Coastal Surface Water	Combined User Data	Water Supply	2030	68.41	76.33
Coastal Surface Water	Combined User Data	Water Supply	2035	75.35	85.80
Coastal Surface Water	Combined User Data	Water Supply	2040	82.32	96.73
Coastal Surface Water	Combined User Data	Water Supply	2050	95.76	122.38
Coastal Surface Water	Combined User Data	Water Supply	2060	109.66	155.92
Coastal Surface Water	Combined User Data	Water Supply	2070	123.04	198.20
Groundwater	Combined User Data	Agriculture	2025	27.30	70.90
Groundwater	Combined User Data	Agriculture	2030	28.20	73.50
Groundwater	Combined User Data	Agriculture	2035	29.10	76.30
Groundwater	Combined User Data	Agriculture	2040	30.00	79.10
Groundwater	Combined User Data	Agriculture	2050	32.00	85.00
Groundwater	Combined User Data	Agriculture	2060	34.20	91.40
Groundwater	Combined User Data	Agriculture	2070	36.50	98.30
Groundwater	Combined User Data	Golf	2025	1.20	4.20
Groundwater	Combined User Data	Golf	2030	1.20	4.20
Groundwater	Combined User Data	Golf	2035	1.20	4.20
Groundwater	Combined User Data	Golf	2040	1.20	4.20
Groundwater	Combined User Data	Golf	2050	1.20	4.20
Groundwater	Combined User Data	Golf	2060	1.20	4.20
Groundwater	Combined User Data	Golf	2070	1.20	4.20
Groundwater	Combined User Data	Industry	2025	11.30	18.50
Groundwater	Combined User Data	Industry	2030	12.30	20.50
Groundwater	Combined User Data	Industry	2035	13.40	22.80
Groundwater	Combined User Data	Industry	2040	14.30	25.20
Groundwater	Combined User Data	Industry	2050	16.50	31.10
Groundwater	Combined User Data	Industry	2060	18.90	38.30
Groundwater	Combined User Data	Industry	2070	21.60	47.10
Groundwater	Combined User Data	Nuclear Power	2025	1.10	1.30
Groundwater	Combined User Data	Nuclear Power	2030	1.10	1.30
Groundwater	Combined User Data	Nuclear Power	2035	1.10	1.30
Groundwater	Combined User Data	Nuclear Power	2040	1.10	1.30
Groundwater	Combined User Data	Nuclear Power	2050	1.10	1.30
Groundwater	Combined User Data	Nuclear Power	2060	1.10	1.30
Groundwater	Combined User Data	Nuclear Power	2070	1.10	1.30
Groundwater	Combined User Data	Water Supply	2025	61.20	82.60
Groundwater	Combined User Data	Water Supply	2030	60.40	87.60
Groundwater	Combined User Data	Water Supply	2035	59.60	92.90
Groundwater	Combined User Data	Water Supply	2040	59.70	98.90
Groundwater	Combined User Data	Water Supply	2050	62.40	111.50
Groundwater	Combined User Data	Water Supply	2060	65.50	127.00
Groundwater	Combined User Data	Water Supply	2070	68.20	144.50
Groundwater	Combined User Data	Aquaculture	2025	0.00	0.10
Groundwater	Combined User Data	Aquaculture	2030	0.00	0.10
Groundwater	Combined User Data	Aquaculture	2035	0.00	0.10
Groundwater	Combined User Data	Aquaculture	2040	0.00	0.10
Groundwater	Combined User Data	Aquaculture	2050	0.00	0.10
Groundwater	Combined User Data	Aquaculture	2060	0.00	0.10
Groundwater	Combined User Data	Aquaculture	2070	0.00	0.10
Groundwater (SWAM)	Bishopville	Water Supply	2025	1.21	1.47
Groundwater (SWAM)	Bishopville	Water Supply	2030	1.11	1.54
Groundwater (SWAM)	Bishopville	Water Supply	2035	1.01	1.61
Groundwater (SWAM)	Bishopville	Water Supply	2040	0.95	1.68
Groundwater (SWAM)	Bishopville	Water Supply	2050	0.95	1.84

Table A-3. Projected Water Demands

Source	User	Use Category	Year	Moderate Demand (MGD)	High Demand (MGD)
Groundwater (SWAM)	Bishopville	Water Supply	2060	0.95	2.02
Groundwater (SWAM)	Bishopville	Water Supply	2070	0.95	2.21
Groundwater (SWAM)	Hartsville	Water Supply	2025	1.18	1.93
Groundwater (SWAM)	Hartsville	Water Supply	2030	1.08	2.02
Groundwater (SWAM)	Hartsville	Water Supply	2035	0.99	2.12
Groundwater (SWAM)	Hartsville	Water Supply	2040	0.94	2.21
Groundwater (SWAM)	Hartsville	Water Supply	2050	0.94	2.43
Groundwater (SWAM)	Hartsville	Water Supply	2060	0.94	2.66
Groundwater (SWAM)	Hartsville	Water Supply	2070	0.94	2.91
Groundwater (SWAM)	Hinson	Agriculture	2025	0.00	0.00
Groundwater (SWAM)	Hinson	Agriculture	2030	0.00	0.00
Groundwater (SWAM)	Hinson	Agriculture	2035	0.00	0.00
Groundwater (SWAM)	Hinson	Agriculture	2040	0.00	0.00
Groundwater (SWAM)	Hinson	Agriculture	2050	0.00	0.00
Groundwater (SWAM)	Hinson	Agriculture	2060	0.00	0.00
Groundwater (SWAM)	Hinson	Agriculture	2070	0.00	0.00
Groundwater (SWAM)	Lynchburg	Water Supply	2025	0.07	0.29
Groundwater (SWAM)	Lynchburg	Water Supply	2030	0.06	0.30
Groundwater (SWAM)	Lynchburg	Water Supply	2035	0.05	0.32
Groundwater (SWAM)	Lynchburg	Water Supply	2040	0.05	0.33
Groundwater (SWAM)	Lynchburg	Water Supply	2050	0.05	0.36
Groundwater (SWAM)	Lynchburg	Water Supply	2060	0.05	0.40
Groundwater (SWAM)	Lynchburg	Water Supply	2070	0.05	0.44
Groundwater (SWAM)	Manning	Water Supply	2025	0.96	1.40
Groundwater (SWAM)	Manning	Water Supply	2030	0.86	1.47
Groundwater (SWAM)	Manning	Water Supply	2035	0.76	1.54
Groundwater (SWAM)	Manning	Water Supply	2040	0.70	1.61
Groundwater (SWAM)	Manning	Water Supply	2050	0.70	1.76
Groundwater (SWAM)	Manning	Water Supply	2060	0.70	1.93
Groundwater (SWAM)	Manning	Water Supply	2070	0.70	2.12
Groundwater (SWAM)	WS: McColl	Water Supply	2025	0.29	0.45
Groundwater (SWAM)	WS: McColl	Water Supply	2030	0.28	0.48
Groundwater (SWAM)	WS: McColl	Water Supply	2035	0.27	0.50
Groundwater (SWAM)	WS: McColl	Water Supply	2040	0.26	0.52
Groundwater (SWAM)	WS: McColl	Water Supply	2050	0.26	0.57
Groundwater (SWAM)	WS: McColl	Water Supply	2060	0.26	0.62
Groundwater (SWAM)	WS: McColl	Water Supply	2070	0.26	0.68
Groundwater (SWAM)	WS: Sumter	Water Supply	2025	11.32	13.32
Groundwater (SWAM)	WS: Sumter	Water Supply	2030	11.01	13.94
Groundwater (SWAM)	WS: Sumter	Water Supply	2035	10.67	14.59
Groundwater (SWAM)	WS: Sumter	Water Supply	2040	10.45	15.27
Groundwater (SWAM)	WS: Sumter	Water Supply	2050	10.45	16.73
Groundwater (SWAM)	WS: Sumter	Water Supply	2060	10.45	18.33
Groundwater (SWAM)	WS: Sumter	Water Supply	2070	10.45	20.07
Surface Water (SWAM)	Hanson (Brewer)	Mining	2025	0.08	0.58
Surface Water (SWAM)	Hanson (Brewer)	Mining	2030	0.08	0.58
Surface Water (SWAM)	Hanson (Brewer)	Mining	2035	0.08	0.58
Surface Water (SWAM)	Hanson (Brewer)	Mining	2040	0.08	0.57
Surface Water (SWAM)	Hanson (Brewer)	Mining	2050	0.08	0.58
Surface Water (SWAM)	Hanson (Brewer)	Mining	2060	0.08	0.57
Surface Water (SWAM)	Hanson (Brewer)	Mining	2070	0.08	0.58
Surface Water (SWAM)	0304020105-Reedys Branch-Great Pee Dee River	Agriculture	2025	0.01	0.02
Surface Water (SWAM)	0304020105-Reedys Branch-Great Pee Dee River	Agriculture	2030	0.01	0.04
Surface Water (SWAM)	0304020105-Reedys Branch-Great Pee Dee River	Agriculture	2035	0.02	0.06
Surface Water (SWAM)	0304020105-Reedys Branch-Great Pee Dee River	Agriculture	2040	0.03	0.08
Surface Water (SWAM)	0304020105-Reedys Branch-Great Pee Dee River	Agriculture	2050	0.04	0.13
Surface Water (SWAM)	0304020105-Reedys Branch-Great Pee Dee River	Agriculture	2060	0.06	0.18
Surface Water (SWAM)	0304020105-Reedys Branch-Great Pee Dee River	Agriculture	2070	0.07	0.24
Surface Water (SWAM)	0304020107-Lower Black Creek	Agriculture	2025	0.01	0.03
Surface Water (SWAM)	0304020107-Lower Black Creek	Agriculture	2030	0.03	0.07
Surface Water (SWAM)	0304020107-Lower Black Creek	Agriculture	2035	0.04	0.12
Surface Water (SWAM)	0304020107-Lower Black Creek	Agriculture	2040	0.06	0.16
Surface Water (SWAM)	0304020107-Lower Black Creek	Agriculture	2050	0.10	0.26
Surface Water (SWAM)	0304020107-Lower Black Creek	Agriculture	2060	0.13	0.36
Surface Water (SWAM)	0304020107-Lower Black Creek	Agriculture	2070	0.17	0.47
Surface Water (SWAM)	0304020108-Three Creeks-Great Pee Dee River	Agriculture	2025	0.01	0.02
Surface Water (SWAM)	0304020108-Three Creeks-Great Pee Dee River	Agriculture	2030	0.02	0.05
Surface Water (SWAM)	0304020108-Three Creeks-Great Pee Dee River	Agriculture	2035	0.03	0.08
Surface Water (SWAM)	0304020108-Three Creeks-Great Pee Dee River	Agriculture	2040	0.05	0.11
Surface Water (SWAM)	0304020108-Three Creeks-Great Pee Dee River	Agriculture	2050	0.07	0.18
Surface Water (SWAM)	0304020108-Three Creeks-Great Pee Dee River	Agriculture	2060	0.10	0.25
Surface Water (SWAM)	0304020108-Three Creeks-Great Pee Dee River	Agriculture	2070	0.13	0.32
Surface Water (SWAM)	0304020203-Upper Lynches River	Agriculture	2025	0.00	0.00
Surface Water (SWAM)	0304020203-Upper Lynches River	Agriculture	2030	0.00	0.00
Surface Water (SWAM)	0304020203-Upper Lynches River	Agriculture	2035	0.00	0.00

Table A-3. Projected Water Demands

Source	User	Use Category	Year	Moderate Demand (MGD)	High Demand (MGD)
Surface Water (SWAM)	0304020203-Upper Lynches River	Agriculture	2040	0.00	0.00
Surface Water (SWAM)	0304020203-Upper Lynches River	Agriculture	2050	0.00	0.00
Surface Water (SWAM)	0304020203-Upper Lynches River	Agriculture	2060	0.00	0.00
Surface Water (SWAM)	0304020203-Upper Lynches River	Agriculture	2070	0.00	0.00
Surface Water (SWAM)	0304020205-Middle Lynches River	Agriculture	2025	0.00	0.01
Surface Water (SWAM)	0304020205-Middle Lynches River	Agriculture	2030	0.01	0.03
Surface Water (SWAM)	0304020205-Middle Lynches River	Agriculture	2035	0.01	0.04
Surface Water (SWAM)	0304020205-Middle Lynches River	Agriculture	2040	0.02	0.06
Surface Water (SWAM)	0304020205-Middle Lynches River	Agriculture	2050	0.03	0.09
Surface Water (SWAM)	0304020205-Middle Lynches River	Agriculture	2060	0.04	0.13
Surface Water (SWAM)	0304020205-Middle Lynches River	Agriculture	2070	0.05	0.17
Surface Water (SWAM)	0304020401-Upper Little Pee Dee River	Agriculture	2025	0.00	0.00
Surface Water (SWAM)	0304020401-Upper Little Pee Dee River	Agriculture	2030	0.00	0.00
Surface Water (SWAM)	0304020401-Upper Little Pee Dee River	Agriculture	2035	0.00	0.00
Surface Water (SWAM)	0304020401-Upper Little Pee Dee River	Agriculture	2040	0.00	0.00
Surface Water (SWAM)	0304020401-Upper Little Pee Dee River	Agriculture	2050	0.00	0.00
Surface Water (SWAM)	0304020401-Upper Little Pee Dee River	Agriculture	2060	0.00	0.00
Surface Water (SWAM)	0304020401-Upper Little Pee Dee River	Agriculture	2070	0.00	0.00
Surface Water (SWAM)	0304020408-Lower Little Pee Dee River	Agriculture	2025	0.00	0.00
Surface Water (SWAM)	0304020408-Lower Little Pee Dee River	Agriculture	2030	0.00	0.00
Surface Water (SWAM)	0304020408-Lower Little Pee Dee River	Agriculture	2035	0.00	0.01
Surface Water (SWAM)	0304020408-Lower Little Pee Dee River	Agriculture	2040	0.00	0.01
Surface Water (SWAM)	0304020408-Lower Little Pee Dee River	Agriculture	2050	0.00	0.01
Surface Water (SWAM)	0304020408-Lower Little Pee Dee River	Agriculture	2060	0.00	0.02
Surface Water (SWAM)	0304020408-Lower Little Pee Dee River	Agriculture	2070	0.00	0.02
Surface Water (SWAM)	0304020504-Pocotaligo River	Agriculture	2025	0.02	0.02
Surface Water (SWAM)	0304020504-Pocotaligo River	Agriculture	2030	0.03	0.06
Surface Water (SWAM)	0304020504-Pocotaligo River	Agriculture	2035	0.06	0.09
Surface Water (SWAM)	0304020504-Pocotaligo River	Agriculture	2040	0.08	0.12
Surface Water (SWAM)	0304020504-Pocotaligo River	Agriculture	2050	0.12	0.19
Surface Water (SWAM)	0304020504-Pocotaligo River	Agriculture	2060	0.17	0.27
Surface Water (SWAM)	0304020504-Pocotaligo River	Agriculture	2070	0.22	0.35
Surface Water (SWAM)	0304020505-Pudding Swamp	Agriculture	2025	0.00	0.00
Surface Water (SWAM)	0304020505-Pudding Swamp	Agriculture	2030	0.00	0.00
Surface Water (SWAM)	0304020505-Pudding Swamp	Agriculture	2035	0.00	0.01
Surface Water (SWAM)	0304020505-Pudding Swamp	Agriculture	2040	0.00	0.01
Surface Water (SWAM)	0304020505-Pudding Swamp	Agriculture	2050	0.01	0.02
Surface Water (SWAM)	0304020505-Pudding Swamp	Agriculture	2060	0.01	0.02
Surface Water (SWAM)	0304020505-Pudding Swamp	Agriculture	2070	0.01	0.03
Surface Water (SWAM)	Atkinson	Agriculture	2025	0.00	0.05
Surface Water (SWAM)	Atkinson	Agriculture	2030	0.00	0.05
Surface Water (SWAM)	Atkinson	Agriculture	2035	0.00	0.05
Surface Water (SWAM)	Atkinson	Agriculture	2040	0.00	0.05
Surface Water (SWAM)	Atkinson	Agriculture	2050	0.00	0.05
Surface Water (SWAM)	Atkinson	Agriculture	2060	0.00	0.05
Surface Water (SWAM)	Atkinson	Agriculture	2070	0.00	0.05
Surface Water (SWAM)	Belger	Agriculture	2025	0.00	0.00
Surface Water (SWAM)	Belger	Agriculture	2030	0.00	0.00
Surface Water (SWAM)	Belger	Agriculture	2035	0.00	0.00
Surface Water (SWAM)	Belger	Agriculture	2040	0.00	0.00
Surface Water (SWAM)	Belger	Agriculture	2050	0.00	0.00
Surface Water (SWAM)	Belger	Agriculture	2060	0.00	0.00
Surface Water (SWAM)	Belger	Agriculture	2070	0.00	0.00
Surface Water (SWAM)	Bennettsville	Water Supply	2025	2.22	2.62
Surface Water (SWAM)	Bennettsville	Water Supply	2030	2.12	2.75
Surface Water (SWAM)	Bennettsville	Water Supply	2035	2.01	2.87
Surface Water (SWAM)	Bennettsville	Water Supply	2040	1.95	3.01
Surface Water (SWAM)	Bennettsville	Water Supply	2050	1.95	3.30
Surface Water (SWAM)	Bennettsville	Water Supply	2060	1.95	3.61
Surface Water (SWAM)	Bennettsville	Water Supply	2070	1.95	3.95
Surface Water (SWAM)	Black Crest	Agriculture	2025	0.58	0.82
Surface Water (SWAM)	Black Crest	Agriculture	2030	0.58	0.82
Surface Water (SWAM)	Black Crest	Agriculture	2035	0.58	0.82
Surface Water (SWAM)	Black Crest	Agriculture	2040	0.58	0.82
Surface Water (SWAM)	Black Crest	Agriculture	2050	0.58	0.82
Surface Water (SWAM)	Black Crest	Agriculture	2060	0.58	0.82
Surface Water (SWAM)	Black Crest	Agriculture	2070	0.58	0.82
Surface Water (SWAM)	Carolina Plantation	Agriculture	2025	0.27	0.45
Surface Water (SWAM)	Carolina Plantation	Agriculture	2030	0.27	0.45
Surface Water (SWAM)	Carolina Plantation	Agriculture	2035	0.27	0.45
Surface Water (SWAM)	Carolina Plantation	Agriculture	2040	0.27	0.45
Surface Water (SWAM)	Carolina Plantation	Agriculture	2050	0.27	0.45
Surface Water (SWAM)	Carolina Plantation	Agriculture	2060	0.27	0.45
Surface Water (SWAM)	Carolina Plantation	Agriculture	2070	0.27	0.45
Surface Water (SWAM)	Chapman	Agriculture	2025	0.02	0.04

Table A-3. Projected Water Demands

Source	User	Use Category	Year	Moderate Demand (MGD)	High Demand (MGD)
Surface Water (SWAM)	Chapman	Agriculture	2030	0.02	0.04
Surface Water (SWAM)	Chapman	Agriculture	2035	0.02	0.04
Surface Water (SWAM)	Chapman	Agriculture	2040	0.02	0.04
Surface Water (SWAM)	Chapman	Agriculture	2050	0.02	0.04
Surface Water (SWAM)	Chapman	Agriculture	2060	0.02	0.04
Surface Water (SWAM)	Chapman	Agriculture	2070	0.02	0.04
Surface Water (SWAM)	Cheraw	Golf Course	2025	0.12	0.25
Surface Water (SWAM)	Cheraw	Water Supply	2025	2.29	2.83
Surface Water (SWAM)	Cheraw	Golf Course	2030	0.12	0.25
Surface Water (SWAM)	Cheraw	Water Supply	2030	2.12	2.96
Surface Water (SWAM)	Cheraw	Golf Course	2035	0.12	0.25
Surface Water (SWAM)	Cheraw	Water Supply	2035	1.95	3.10
Surface Water (SWAM)	Cheraw	Golf Course	2040	0.12	0.25
Surface Water (SWAM)	Cheraw	Water Supply	2040	1.84	3.24
Surface Water (SWAM)	Cheraw	Golf Course	2050	0.12	0.25
Surface Water (SWAM)	Cheraw	Water Supply	2050	1.84	3.55
Surface Water (SWAM)	Cheraw	Golf Course	2060	0.12	0.25
Surface Water (SWAM)	Cheraw	Water Supply	2060	1.84	3.89
Surface Water (SWAM)	Cheraw	Golf Course	2070	0.12	0.25
Surface Water (SWAM)	Cheraw	Water Supply	2070	1.84	4.26
Surface Water (SWAM)	Dargan	Agriculture	2025	0.09	0.31
Surface Water (SWAM)	Dargan	Agriculture	2030	0.09	0.31
Surface Water (SWAM)	Dargan	Agriculture	2035	0.09	0.31
Surface Water (SWAM)	Dargan	Agriculture	2040	0.09	0.31
Surface Water (SWAM)	Dargan	Agriculture	2050	0.09	0.31
Surface Water (SWAM)	Dargan	Agriculture	2060	0.09	0.31
Surface Water (SWAM)	Dargan	Agriculture	2070	0.09	0.31
Surface Water (SWAM)	Domtar	Industry	2025	17.25	19.50
Surface Water (SWAM)	Domtar	Industry	2030	17.62	21.64
Surface Water (SWAM)	Domtar	Industry	2035	17.90	24.01
Surface Water (SWAM)	Domtar	Industry	2040	18.17	26.56
Surface Water (SWAM)	Domtar	Industry	2050	19.13	32.79
Surface Water (SWAM)	Domtar	Industry	2060	20.05	40.25
Surface Water (SWAM)	Domtar	Industry	2070	21.13	49.69
Surface Water (SWAM)	Florence	Golf Course	2025	0.04	0.10
Surface Water (SWAM)	Florence	Water Supply	2025	13.54	16.54
Surface Water (SWAM)	Florence	Golf Course	2030	0.04	0.10
Surface Water (SWAM)	Florence	Water Supply	2030	13.21	17.31
Surface Water (SWAM)	Florence	Golf Course	2035	0.04	0.10
Surface Water (SWAM)	Florence	Water Supply	2035	12.81	18.12
Surface Water (SWAM)	Florence	Golf Course	2040	0.04	0.10
Surface Water (SWAM)	Florence	Water Supply	2040	12.55	18.97
Surface Water (SWAM)	Florence	Golf Course	2050	0.04	0.10
Surface Water (SWAM)	Florence	Water Supply	2050	12.55	20.77
Surface Water (SWAM)	Florence	Golf Course	2060	0.04	0.10
Surface Water (SWAM)	Florence	Water Supply	2060	12.55	22.75
Surface Water (SWAM)	Florence	Golf Course	2070	0.04	0.10
Surface Water (SWAM)	Florence	Water Supply	2070	12.55	24.92
Surface Water (SWAM)	Hanson (Jefferson)	Mining	2025	0.03	0.04
Surface Water (SWAM)	Hanson (Jefferson)	Mining	2030	0.03	0.04
Surface Water (SWAM)	Hanson (Jefferson)	Mining	2035	0.03	0.04
Surface Water (SWAM)	Hanson (Jefferson)	Mining	2040	0.03	0.04
Surface Water (SWAM)	Hanson (Jefferson)	Mining	2050	0.03	0.04
Surface Water (SWAM)	Hanson (Jefferson)	Mining	2060	0.03	0.04
Surface Water (SWAM)	Hanson (Jefferson)	Mining	2070	0.03	0.04
Surface Water (SWAM)	Hanson (Marlboro)	Mining	2025	0.00	0.00
Surface Water (SWAM)	Hanson (Marlboro)	Mining	2030	0.00	0.00
Surface Water (SWAM)	Hanson (Marlboro)	Mining	2035	0.00	0.00
Surface Water (SWAM)	Hanson (Marlboro)	Mining	2040	0.00	0.00
Surface Water (SWAM)	Hanson (Marlboro)	Mining	2050	0.00	0.00
Surface Water (SWAM)	Hanson (Marlboro)	Mining	2060	0.00	0.00
Surface Water (SWAM)	Hanson (Marlboro)	Mining	2070	0.00	0.00
Surface Water (SWAM)	HB Robinson	Nuclear Power	2025	722.54	825.44
Surface Water (SWAM)	HB Robinson	Nuclear Power	2030	722.54	825.44
Surface Water (SWAM)	HB Robinson	Nuclear Power	2035	722.54	825.44
Surface Water (SWAM)	HB Robinson	Nuclear Power	2040	720.53	823.22
Surface Water (SWAM)	HB Robinson	Nuclear Power	2050	722.54	825.44
Surface Water (SWAM)	HB Robinson	Nuclear Power	2060	720.53	823.22
Surface Water (SWAM)	HB Robinson	Nuclear Power	2070	722.54	825.44
Surface Water (SWAM)	IP (Georgetown)	Industry	2025	32.88	37.21
Surface Water (SWAM)	IP (Georgetown)	Industry	2030	33.58	41.28
Surface Water (SWAM)	IP (Georgetown)	Industry	2035	34.12	45.80
Surface Water (SWAM)	IP (Georgetown)	Industry	2040	34.63	50.67
Surface Water (SWAM)	IP (Georgetown)	Industry	2050	36.45	62.56
Surface Water (SWAM)	IP (Georgetown)	Industry	2060	38.21	76.78

Table A-3. Projected Water Demands

Source	User	Use Category	Year	Moderate Demand (MGD)	High Demand (MGD)
Surface Water (SWAM)	IP (Georgetown)	Industry	2070	40.28	94.80
Surface Water (SWAM)	Irwin	Agriculture	2025	0.03	0.07
Surface Water (SWAM)	Irwin	Agriculture	2030	0.03	0.07
Surface Water (SWAM)	Irwin	Agriculture	2035	0.03	0.07
Surface Water (SWAM)	Irwin	Agriculture	2040	0.03	0.07
Surface Water (SWAM)	Irwin	Agriculture	2050	0.03	0.07
Surface Water (SWAM)	Irwin	Agriculture	2060	0.03	0.07
Surface Water (SWAM)	Irwin	Agriculture	2070	0.03	0.07
Surface Water (SWAM)	Lawson Turf	Agriculture	2025	0.23	0.39
Surface Water (SWAM)	Lawson Turf	Agriculture	2030	0.23	0.39
Surface Water (SWAM)	Lawson Turf	Agriculture	2035	0.23	0.39
Surface Water (SWAM)	Lawson Turf	Agriculture	2040	0.23	0.39
Surface Water (SWAM)	Lawson Turf	Agriculture	2050	0.23	0.39
Surface Water (SWAM)	Lawson Turf	Agriculture	2060	0.23	0.39
Surface Water (SWAM)	Lawson Turf	Agriculture	2070	0.23	0.39
Surface Water (SWAM)	Martin Marietta	Mining	2025	1.18	1.38
Surface Water (SWAM)	Martin Marietta	Mining	2030	1.18	1.38
Surface Water (SWAM)	Martin Marietta	Mining	2035	1.18	1.38
Surface Water (SWAM)	Martin Marietta	Mining	2040	1.17	1.37
Surface Water (SWAM)	Martin Marietta	Mining	2050	1.18	1.38
Surface Water (SWAM)	Martin Marietta	Mining	2060	1.17	1.37
Surface Water (SWAM)	Martin Marietta	Mining	2070	1.18	1.38
Surface Water (SWAM)	McDonald	Agriculture	2025	0.00	0.00
Surface Water (SWAM)	McDonald	Agriculture	2030	0.00	0.00
Surface Water (SWAM)	McDonald	Agriculture	2035	0.00	0.00
Surface Water (SWAM)	McDonald	Agriculture	2040	0.00	0.00
Surface Water (SWAM)	McDonald	Agriculture	2050	0.00	0.00
Surface Water (SWAM)	McDonald	Agriculture	2060	0.00	0.00
Surface Water (SWAM)	McDonald	Agriculture	2070	0.00	0.00
Surface Water (SWAM)	Nucor	Industry	2025	0.50	0.62
Surface Water (SWAM)	Nucor	Industry	2030	0.50	0.69
Surface Water (SWAM)	Nucor	Industry	2035	0.50	0.76
Surface Water (SWAM)	Nucor	Industry	2040	0.51	0.84
Surface Water (SWAM)	Nucor	Industry	2050	0.50	1.04
Surface Water (SWAM)	Nucor	Industry	2060	0.50	1.27
Surface Water (SWAM)	Nucor	Industry	2070	0.51	1.57
Surface Water (SWAM)	O'Tuel	Agriculture	2025	0.14	0.64
Surface Water (SWAM)	O'Tuel	Agriculture	2030	0.14	0.64
Surface Water (SWAM)	O'Tuel	Agriculture	2035	0.14	0.64
Surface Water (SWAM)	O'Tuel	Agriculture	2040	0.14	0.64
Surface Water (SWAM)	O'Tuel	Agriculture	2050	0.14	0.64
Surface Water (SWAM)	O'Tuel	Agriculture	2060	0.14	0.64
Surface Water (SWAM)	O'Tuel	Agriculture	2070	0.14	0.64
Surface Water (SWAM)	Richard Rogers	Agriculture	2025	0.20	0.55
Surface Water (SWAM)	Richard Rogers	Agriculture	2030	0.20	0.55
Surface Water (SWAM)	Richard Rogers	Agriculture	2035	0.20	0.55
Surface Water (SWAM)	Richard Rogers	Agriculture	2040	0.20	0.55
Surface Water (SWAM)	Richard Rogers	Agriculture	2050	0.20	0.55
Surface Water (SWAM)	Richard Rogers	Agriculture	2060	0.20	0.55
Surface Water (SWAM)	Richard Rogers	Agriculture	2070	0.20	0.55
Surface Water (SWAM)	Rogers	Agriculture	2025	0.20	0.63
Surface Water (SWAM)	Rogers	Agriculture	2030	0.20	0.63
Surface Water (SWAM)	Rogers	Agriculture	2035	0.20	0.63
Surface Water (SWAM)	Rogers	Agriculture	2040	0.20	0.63
Surface Water (SWAM)	Rogers	Agriculture	2050	0.20	0.63
Surface Water (SWAM)	Rogers	Agriculture	2060	0.20	0.63
Surface Water (SWAM)	Rogers	Agriculture	2070	0.20	0.63
Surface Water (SWAM)	Sugar Hill	Agriculture	2025	0.01	0.04
Surface Water (SWAM)	Sugar Hill	Agriculture	2030	0.01	0.04
Surface Water (SWAM)	Sugar Hill	Agriculture	2035	0.01	0.04
Surface Water (SWAM)	Sugar Hill	Agriculture	2040	0.01	0.04
Surface Water (SWAM)	Sugar Hill	Agriculture	2050	0.01	0.04
Surface Water (SWAM)	Sugar Hill	Agriculture	2060	0.01	0.04
Surface Water (SWAM)	Sugar Hill	Agriculture	2070	0.01	0.04
Surface Water (SWAM)	Sunoco	Industry	2025	9.73	11.70
Surface Water (SWAM)	Sunoco	Industry	2030	10.57	12.98
Surface Water (SWAM)	Sunoco	Industry	2035	11.42	14.40
Surface Water (SWAM)	Sunoco	Industry	2040	12.40	15.93
Surface Water (SWAM)	Sunoco	Industry	2050	15.00	19.67
Surface Water (SWAM)	Sunoco	Industry	2060	17.71	24.14
Surface Water (SWAM)	Sunoco	Industry	2070	21.02	29.80
Surface Water (SWAM)	Tolson	Agriculture	2025	0.14	0.40
Surface Water (SWAM)	Tolson	Agriculture	2030	0.14	0.40
Surface Water (SWAM)	Tolson	Agriculture	2035	0.14	0.40
Surface Water (SWAM)	Tolson	Agriculture	2040	0.14	0.40

Table A-3. Projected Water Demands

Source	User	Use Category	Year	Moderate Demand (MGD)	High Demand (MGD)
Surface Water (SWAM)	Tolson	Agriculture	2050	0.14	0.40
Surface Water (SWAM)	Tolson	Agriculture	2060	0.14	0.40
Surface Water (SWAM)	Tolson	Agriculture	2070	0.14	0.40
Surface Water (SWAM)	Turf Connections	Agriculture	2025	0.00	0.00
Surface Water (SWAM)	Turf Connections	Agriculture	2030	0.00	0.00
Surface Water (SWAM)	Turf Connections	Agriculture	2035	0.00	0.00
Surface Water (SWAM)	Turf Connections	Agriculture	2040	0.00	0.00
Surface Water (SWAM)	Turf Connections	Agriculture	2050	0.00	0.00
Surface Water (SWAM)	Turf Connections	Agriculture	2060	0.00	0.00
Surface Water (SWAM)	Turf Connections	Agriculture	2070	0.00	0.00
Surface Water (SWAM)	WestRock	Industry	2025	16.60	20.17
Surface Water (SWAM)	WestRock	Industry	2030	16.96	22.38
Surface Water (SWAM)	WestRock	Industry	2035	17.23	24.83
Surface Water (SWAM)	WestRock	Industry	2040	17.49	27.47
Surface Water (SWAM)	WestRock	Industry	2050	18.41	33.92
Surface Water (SWAM)	WestRock	Industry	2060	19.30	41.63
Surface Water (SWAM)	WestRock	Industry	2070	20.34	51.40
Surface Water (SWAM)	White Plans	Golf Course	2025	0.04	0.06
Surface Water (SWAM)	White Plans	Golf Course	2030	0.04	0.06
Surface Water (SWAM)	White Plans	Golf Course	2035	0.04	0.06
Surface Water (SWAM)	White Plans	Golf Course	2040	0.04	0.06
Surface Water (SWAM)	White Plans	Golf Course	2050	0.04	0.06
Surface Water (SWAM)	White Plans	Golf Course	2060	0.04	0.06
Surface Water (SWAM)	White Plans	Golf Course	2070	0.04	0.06

Appendix B: Drought Management Plans

Summary of Drought Management Plans in the Pee Dee River Basin

Entity	Drought Management Area	Plan Last Updated	Customers	Water Source	Drought Indicator / Trigger Types	Demand Reduction Strategies	Alternative Water Supply Agreements
Entities Included in Pee Dee SWAM Model							
City of Bennettsville	Northeast (Pee Dee)	2003	12,000 customers	Surface and groundwater sources: Surface: Crooked Creek (Lake Wallace) Groundwater: 4 groundwater wells	**Moderate**: reservoir level reaches 141.5 ft-msl **Severe**: reservoir level reaches 140.5 ft-msl **Extreme**: reservoir level reaches 139.5 ft-msl	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	Agreements with the Marlboro Water Company and Wallace Water Company are in place to facilitate implementation of the plan. Water purchase contracts cover drought and water shortage conditions. Additional detail on agreements is not provided.
Town of Cheraw	Northeast (Pee Dee)	2003	6,500 customers through 2,600 taps	Pee Dee River	**Moderate**: river level is 18" at the intake for 3 consecutive days **Severe**: river level is less than 12" at the intake for 3 consecutive days **Extreme**: river level is less than 8" at the intake for 3 consecutive days	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	The Town of Cheraw has an agreement with Chesterfield County Rural Water. There will be two locations where they can receive water or provide to the rural water. An agreement with the Town of Chesterfield for emergency supply is being considered or negotiated.
City of Florence	Northeast (Pee Dee)	2004 (City of Florence Drought Management Plan was adopted and incorporated in their municipal code of ordinances in 2004)	26,735 customers	Groundwater supply from 24 wells in Middendorf aquifer and 5 wells in Black Creek aquifer. Surface water supply from Pee Dee River	**Moderate**: Pumping levels from the city's groundwater system reach an average depth of 280 feet below the ground surface elevation in combination with a stream flow of the Pee Dee River at the Pee Dee gauging station of 800 cfs; or the surface water plant is disabled and the groundwater system is not disabled and pumping levels from the city's groundwater system reach an average depth of 280 feet below the ground surface elevation; or the surface water plant is not disabled and the groundwater system is partially disabled and the 2 systems in combination with each other cannot meet the SCDHEC requirement of peak system demands at 16 hours per day of treatment capacity. **Severe**: Pumping levels from the city's groundwater system reach an average depth of 300 feet below the ground surface elevation in combination with a stream flow of the Pee Dee River at the Pee Dee gauging station of 600 cubic feet per second; or the surface water plant is disabled and the groundwater system is not disabled and pumping levels from the city's groundwater system reach an average depth of 290 feet below the ground surface elevation; or the surface water plant is not disabled and the groundwater system is partially disabled and the 2 systems in combination with each other cannot meet the SCDHEC requirement of peak system demands at 18 hours per day of treatment capacity. **Extreme**: Pumping levels from the city's groundwater system reach an average depth of 320 feet below the ground surface elevation in combination with a stream flow of the Pee Dee River at the Pee Dee gauging station of 500 cubic feet per second; or the surface water plant is disabled and the groundwater system is not disabled and pumping levels from the city's groundwater system reach an average depth of 300 feet below the ground surface elevation; or the surface water plant is not disabled and the groundwater system is partially disabled and the 2 systems in combination with each other cannot meet the SCDHEC requirement of peak system demands at 20 hours per day of treatment capacity.	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	Cooperative water supply agreement with Darlington County Water and Sewer Authority
Sampling of Entities Not Included in Pee Dee SWAM Model							
Cassatt Water Company	Northeast (Pee Dee)	2003	9,200 taps	16 groundwater wells	Drought phases determined by the Drought Response Committee	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	None
Chesterfield County Rural Water Company - Wolf Pond	Northeast (Pee Dee)	2003	The service area includes the entire County with the exception of the Towns of Cheraw, Chesterfield, Patrick, McBee and Pageland.	Groundwater wells: Alligator Rural Water, Anson County Water, Lancaster County Water, Town of Chesterfield, Town of Pageland, and Union County Water.	Moderate, severe, and extreme drought phases are declared by SC Department of Natural Resources and the Drought Response Committee.	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	None
City of Darlington	Northeast (Pee Dee)	2003	3,200 taps	4 groundwater wells	**Moderate**: when average demand increases by 15% **Severe**: when average demand increases by 25% **Extreme**: when average demand increases by 35% ***for all - OR when the DNR declares moderate/severe/extreme drought for this area***	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	None

Summary of Drought Management Plans in the Pee Dee River Basin

Entity	Drought Management Area	Plan Last Updated	Customers	Water Source	Drought Indicator / Trigger Types	Demand Reduction Strategies	Alternative Water Supply Agreements
City of Georgetown	Central	2003	City of Georgetown and limited areas south of the Sampit River	surface and groundwater sources	**Moderate**: Pee Dee River water level at intake of IP canal falls below -3 feet level **Severe**: Pee Dee River water level at intake of IP canal falls below -5 ft level or supplemental pumping for over 7 consecutive days or additional pumping incurred at mouth of canal **Extreme**: Pee Dee River flow les than 900 cfs for 10 consecutive days or IP implements supplemental pumping at mouth of canal for over 14 consecutive days	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	None
City of Marion	Northeast (Pee Dee)	2003	2,787 residential service connections	9 groundwater wells	**Moderate**: average daily use greater than 3.6 MGD for 30 consecutive days **Severe**: average daily use greater than 3.2 MGD for 60 consecutive days **Extreme**: average daily use greater than 3.65 MGD for 60 consecutive days	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	None
City of Sumter	Central	2003	Sumter, Oswego, Mayesville, and Rembert	18 groundwater wells	**Moderate**: elevated tank level drops to 7 ft below top of tanks for 5 days **Severe**: elevated tank level drops to 8 feet below top of tank for 5 days **Extreme**: elevated tank level drops to 9 feet below top of tank for 2 days	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	None
Lancaster County Water and Sewer District	Northeast (Pee Dee)	2011	16,560 active customers	Catawba River	**Watch**: On the first day of the month, Storage index is below the Target Storage Index, but greater than 90% of Target Storage Index; The U.S. Drought Monitor 3 Month Numeric Average has a value greater than or equal to 0; The sum of the actual rolling six-month average streamflows at the Monitored USGS Streamflow Gages is equal to or less than 85% of the sum of the period of record rolling average streamflows for the same six-month period. **Incipient**: On the first day of the month, the Storage Index is at or below 90% of Target Storage Index, but greater than 75% of the Target Storage Index and either of the following conditions exists; The U.S. Drought Monitor 3 Month Numeric Average has a value > 1 or the sum of the actual rolling six-month average streamflows at the Monitored USGS Streamflow Gages is equal to or less than 78% of the sum of the period of record rolling average streamflows for the same six-month period. **Moderate**: on the first day of the month, the Storage Index is at or below 75% of Target Storage Index, but greater than 57% of the Target Storage Index and either of the following conditions exists; The U.S. Drought Monitor 3 Month Numeric Average has a value > 2 or the sum of the actual rolling six-month average streamflows at the Monitored USGS Streamflow Gages is equal to or less than 65% of the sum of the period of record rolling average streamflows for the same six-month period. **Severe**: on the first day of the month, the Storage Index is at or below 57% of Target Storage Index, but greater than 42% of the Target Storage Index and either of the following conditions exists; The U.S. Drought Monitor 3 Month Numeric Average has a value > 3 or the sum of the actual rolling six-month average streamflows at the Monitored USGS Streamflow Gages is equal to or less than 55% of the sum of the period of record rolling average streamflows for the same six-month period. **Extreme**: on the first day of the month, the Storage Index is at or below 42% of Target Storage Index and either of the following conditions exists; The U.S. Drought Monitor 3 Month Numeric Average has a value > 4 or the sum of the actual rolling six-month average streamflows at the Monitored USGS Streamflow Gages is equal to or less than 40% of the sum of the period of record rolling average streamflows for the same six-month period.	Voluntary usage reductions for Incipient drought phase and Mandatory reduction for Moderate, Severe, and Extreme. Different reduction targets for different water uses. **Incipient**: Voluntary 3-5% reduction in residential use and 5% reduction in all other uses **Moderate**: Mandatory 5-10% reduction in residential use and 10% reduction in all other uses **Severe**: Mandatory 10-20% reduction in residential use and 20% reduction in all other uses **Extreme**: Mandatory 30% reduction in residential use and 25% reduction in all other uses	Springs Industries via City of Lancaster can supply a maximum of 1 million gallons per day during moderate drought conditions and 0.5 million gallons per day during severe drought conditions. Emergency connections with Charlotte Mecklenburg Utilities Department along Hwy 521 at the state line, along Harrisburg Road at Bridgehampton Subdivision, and along Harrisburg Road at the state line for approximately 1 million gallon per day during emergencies. Emergency connection with Union County, North Carolina along Shinnecock Lane at the state line for an amount as is necessary to handle any shortfall of the surrounding area as the hydraulics will permit during emergency situations
Marco Rural Water Company (Marion)	Northeast (Pee Dee)	2003	5,100 customers	7 groundwater wells	**Moderate**: storage below 75% capacity; average daily use greater than 1.6 MGD for 15 consecutive days **Severe**: storage below 50% capacity; average daily use greater than 1.8 MGD for 10 consecutive days **Extreme**: storage below 25% capacity; average daily use greater than 20 MGD for 5 consecutive days	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	Water Users Agreement signed by each water user stating Marco has the right to restrict water use if necessary.
Marlboro Water Company	Northeast (Pee Dee)	2003	1,752 residential and commercial taps	3 groundwater wells	**Moderate**: storage falls below 60% of capacity; average daily use greater than 0.8 mgd for 30 consecutive days **Severe**: storage falls below 50% of capacity; average daily use greater than 1.0 mgd for 14 consecutive days **Extreme**: storage falls below 40% of capacity; average daily use greater than 1.5 mgd for 7 consecutive days	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	Agreements with Trico Water Company, City of Bennettsville, Ton of Clio, and Wallace Water Company
Town of Patrick	Northeast (Pee Dee)	2003	313 active customers	Two groundwater wells	**Moderate** drought: aquifer levels less than 65% **Severe** drought: aquifer levels less than 75% **Extreme** drought: aquifer levels less than 85%	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	None
Rural Community Water District of Georgetown County (RCWDGC)	Central	2003	2,110 Taps	3 groundwater wells	**Moderate**: average daily use greater than .938 MGD for 10 consecutive days, Static water level drops 10' below average, pumping level drops 10' below average. **Severe**: average daily use greater than 1.050 MGD for 10 consecutive days, static water level drops 20' below average, pumping level drops 20' below average. **Extreme**: average daily use greater than 1.200 MGD for 10 consecutive days, static water level drops 25' below average, pumping level drops 25' below average. ***for all, or determination by RCWDGC leadership***	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	Browns Ferry Water - interconnect on SC Route 51 with manual valves Georgetown County Water and Sewer - interconnect at Black River on Hwy. 701 with manual valves and on Wedgefield Road with pressure sensing valves City of Georgetown - interconnect on North Frasier Street at area boundary with manual valves

Summary of Drought Management Plans in the Pee Dee River Basin

Entity	Drought Management Area	Plan Last Updated	Customers	Water Source	Drought Indicator / Trigger Types	Demand Reduction Strategies	Alternative Water Supply Agreements
Georgetown County Water and Sewer District	Northeast (Pee Dee)	2003	Unincorporated area of Georgetown County and the Town of Pawleys Island	11 deep aquifer wells	**Moderate**: The Pee Dee River flow as measured at Pee Dee, S.C. is less than 2,500 cubic feet per second over a twenty-four hour period, the average daily demand for the Waccamaw Neck service area is equal to 80% of the Waccamaw Neck Water Treatment Plant production capacity, the Waccamaw River conductivity measured at the Waccamaw Water Treatment Plant intake is 800 micro seimans for 12 continuous hours and rising, the available well capacity in any given subsystem is greater than 20% of the average day demand. **Severe**: The Pee Dee River flow as measured at Pee Dee, S.C. is less than 1,500 cubic feet per second, the average daily demand for the Waccamaw Neck service area is equal to 90% of the Waccamaw Neck Water Treatment Plant production capacity, the Waccamaw River conductivity measured at the Waccamaw Water Treatment Plant intake is 1,000 micro seimans for 12 continuous hours, The available well capacity in any given subsystem is greater than 10% of the average day demand. **Extreme**: The Pee Dee River flow as measured at Pee Dee, S.C. is less than 900 cubic feet per second, the average daily demand is equal to or greater than the total Waccamaw Neck available emergency and backup supplies, the Waccamaw River conductivity measured at the Waccamaw Water Treatment Plant intake is 1,200 micro seimans or greater for 6 continuous hours, the available well capacity in any given subsystem is equal to or less than the average day demand.	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	Water purchase agreement with the Grand Strand Water and sewer Authority, the City of Georgetown, the Rural Community Water district, the Town of Andrews, and the Browns Ferry Water Company. Grand Strand Water and Sewer Authority Agreement provides 1.15 mgd guaranteed available capacity and 0.85 mgd emergency reserve.
Grand Strand Water and Sewer Authority	Northeast (Pee Dee)	2003	over 35,000 retail customers	Bull Creek, arm of the combined Great Pee Dee and Little Pee Dee Rivers, and 25 wells in the Black Creek Aquifer	**Moderate**: Stream-flow less than 2,000 cubic feet per second and/or Waccamaw River measured at Georgetown County Water and Sewer District intake - conductivity greater than 800 microsiemens (24 Hours). **Severe**: Stream-flow less than 1,200 cubic feet per second and/or Waccamaw River measured at Georgetown County Water and Sewer District intake – conductivity greater than 1,000 microsiemens (12 Hours). **Extreme**: Stream-flow less than 900 cubic feet per second and/or Waccamaw River measured at Georgetown County Water and Sewer District intake – conductivity greater than 1,200 microsiemens (6 Hours).	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	Agreements with City of Conway, City of North Myrtle Beach, City of Loris, Georgetown County Water and Sewer District, City of Myrtle Beach, Little River Water and Sewerage Company
City of Myrtle Beach	Northeast (Pee Dee)	2003	46,175 customers	Atlantic Intra-Coastal Waterway and Bull Creek, 10 deep wells	**Moderate**: Saltwater/Freshwater interface in the Atlantic IntraCoastal Waterway located in vicinity of North Myrtle Beach Airport **Severe**: Saltwater/Freshwater interface in the Atlantic IntraCoastal Waterway located in vicinity of Briarcliffe Forest **Extreme**: Saltwater/Freshwater interface in the Atlantic IntraCoastal Waterway located in vicinity of Grande Dunes Bridge	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 10% reduction in all uses **Severe**: Voluntary 20% reduction in all uses **Extreme**: Mandatory reduction of 30% for all uses	Two inter-connects with Grand Strand Water and Sewer Authority. Approximately 5 Million Gallons a Day of water can be provided to either party (Bi-directional option).
Town of Kershaw	Northeast (Pee Dee)	2003	1,200 active customers	Catawba River	**Moderate**: streamflow less than 2258 cfs jan-apr, 1707 cfs may, June, dec, or 1269 cfs july-nov for 5 consecutive days, or avg daily use grater than 30 mgd for 12 consecutive days **Severe**: streamflow less than 2252 cfs jan-apr, 1701 cfs may, jun, dec, and 1263 cfs jul-nov for 5 consecutive days, or avg daily use greater than 34.5 mgd for 12 consecutive days **Extreme**: streamflow less than 2245 cfs jan-apr, 1695 may, jun, dec, and 1257 cfs jul-nov for 5 consecutive days, or avg daily use greater than 35.6 mgd for 12 consecutive days	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	Lancaster County Water and Sewer District via emergency connection adjacent to intersection of Fork Hill Road and US Highway 521 (about 100,000 gpd) Agreements under negotiation include: Union County North Carolina and Charlotte Mecklenburg Utilities Dept.
Trico Water Company	Northeast (Pee Dee)	2003	5,406 customers	13 groundwater wells drawing from Black Creek and Middendorf Aquifers	**Moderate**: when average daily use is greater than 2.5 MGD for 7 consecutive days **Severe**: when average daily use is greater than 3 MGD for 14 consecutive days **Extreme**: when average daily use is greater than 3.5 MGD for 7 consecutive days	Voluntary usage reductions for Moderate and Severe drought phases and Mandatory reduction for Extreme. Different reduction targets for different water uses. **Moderate**: Voluntary 20% reduction in residential use and 15% reduction in all other uses **Severe**: Voluntary 25% reduction in residential use and 20% reduction in all other uses. Note also mandatory restrictions for non-essential uses **Extreme**: Mandatory reduction of 30% for residential and 25% for all other uses	Tie in with Marlboro Water Company (should have been complete in 2003)

Appendix C: Draft and Final Consensus Survey Results

To assess each RBC member's confidence in the plan, the plan approval process dictates that there will be a test for consensus on the Draft River Basin Plan and a vote of support or disagreement on the Final River Basin Plan. For the test of consensus on the Draft Plan, each member rates their concurrence with the plan using a five-point scale, as shown below:

1. Full Endorsement (i.e., member likes it).
2. Endorsement but with minor points of contention (i.e., basically member likes it).
3. Endorsement but with major points of contention (i.e., member can live with it).
4. Stand aside with major reservations (i.e., member cannot live with it in its current state and can only support it if changes are made).
5. Withdraw – Member will not support the draft river basin plan, will not continue working within the RBC's process, and will leave the RBC.

For the Final River Basin Plan, each RBC member votes simply to support or not support the plan. By indicating support, the member would be acknowledging his/her concurrence with the Final River Basin Plan and their commitment to support implementation of the plan. The results of the test for consensus of the Draft River Basin Plan and the RBC's votes on the Final River Basin Plan are shown in Table C-1.

Table C-1. Level of consensus for the Draft and Final River Basin Plans

Name	Draft Plan Level of Endorsement	Final Plan Support or Disagree
Everett Allen	2	
Michael Bankert	1	
Tim Brown	1	
Cliff Chamblee	2	
John Crutchfield	1	
Jason Gamble	2	
Michael Hemingway	1	
Megan Hyman	1	
Eric Krueger	1	
Frances McClary	1	
Douglas Newton	2	
Hughes Page	1	
Bob Perry	2	
Lindsay Privette (Vice Chair)	1	
Buddy Richardson II (Chair)	1	
John Rivers	2	
Debra Buffkin	2	
Dr. Jeff Steinmetz	2	
Cynthia Walters	1	

Appendix D: Public Response and Comments


Brown AND Caldwell