SALUDA RIVER BASIN PLAN 2025 DRAFT

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Name and Organization

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Brandon Grooms, Colonial Pipeline Company
Robert Hanley, Greenville County Soil & Water Conservation District
Rick Huffman, Earth Design
Patrick Jackson, Laurens County Soil & Water Conservation District/Farmer
Paul Lewis, Holly Tree Country Club
Kevin Miller, Foothills Paddling Club
Larry Nates, Lexington County Soil & Water Conservation District
Josie Newton, Friends of the Reedy River
Jay Nicholson, (Lexington) Joint Municipal Water & Sewer Commission
Devin Orr, SC Rural Water Association
Eddie Owen, Dominion Energy SC
K.C. Price, Laurens County Water and Sewer Commission (LCWSC)
Melanie Ruhlman, Save Our Saluda
Kaleigh Sims, Renewable Water Resources (ReWa)
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Rett Templeton, Greenwood County
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Michael Waddell, SC Trout Unlimited
Rebecca Wade, Upstate Forever

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The Saluda RBC

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Acronyms

ACE	Ashepoo-Combahee-Edisto
AMI	Advanced metering infrastructure
AMR	Automated meter reading
AWWA	American Water Works Association
BEA	Bureau of Economic Analysis
BMP	Best Management Practice
BRIC	Building Resilient Infrastructure and Communities
cfs	cubic feet per second
CMOR	Condition Monitoring Observer Reports
COG	Council of Government
CPW	Commission of Public Works
CUA	Capacity Use Area
CWWMG	Catawba-Wateree Water Management Group
DMA	Drought Management Area
DRC	Drought Response Committee
ECU	Easley Combined Utilities
EDA	Economic Development Administration
EF	Enhanced Fujita Scale
EIA	Energy Information Agency
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
F	Fujita Scale
°F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FSA	Farm Service Agency
ft	feet
GC	golf course water user
GDP	gross domestic product
gpm	gallons per minute
HMGP	Hazard Mitigation Grant Program
HUC	Hydrologic Unit Code
in.	inches
IR	agricultural (irrigation) water user
IRA	Inflation Reduction Act

IRC	Interbasin River Council
IWNP	Intelligent Water and Nutrient Placement
JMWSC	Joint Municipal Water & Sewer Commission
LCWSC	Laurens County Water and Sewer Commission
LEPA	low elevation precision application
LESA	low elevation spray application
LIP	low inflow protocol
MADF	mean annual daily flow
MBWRA	Mountain Bridge Wilderness and Recreation Area
MESA	mid-elevation spray application
MGD	million gallons per day
MGM	million gallons per month
mi	miles
MIF	minimum instream flow
mph	miles per hour
MRLC	Multi-Resolution Land Characteristics Consortium
NA	not applicable
NASS	National Agricultural Statistics Service
NCW&SA	Newberry County Water and Sewer Authority
NDMC	National Drought Mitigation Center
NLCD	National Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
O&M	operations and maintenances
PFAS	Per- and polyfluoroalkyl substances
PPAC	Planning Process Advisory Committee
PT	thermoelectric power water user
P&R	Permitted and Registered
RBC	River Basin Council
ReWa	Renewable Water Resources
RMA	Risk Management Agency
SC ORFA	South Carolina Office of Revenue and Fiscal Affairs
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
SCE&G	South Carolina Electric & Gas Company
SCFC	South Carolina Forestry Commission

SCO	State Climatology Office
SCOR	South Carolina Office of Resilience
SCRF	South Carolina Rivers Forever
SCWSA	Saluda County Water and Sewer Authority
SEPA	Southeastern Power Administration
SMS	soil moisture sensor
SPI	Standard Precipitation Index
sq mi	square miles
SWAM	Simplified Water Allocation Model
SY	safe yield
TMDL	Total maximum daily load
UIF	unimpaired flows
USACE	United States Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
WBIC	Weather-based irrigation controller
WRRF	Water Resources Reclamation Facility
WS	water supply water user
WTF	Water Treatment Facility
WWQA	Watershed Water Quality Assessment

Chapter 1 Introduction

1.1 Background

The South Carolina Water Resources Planning and Coordination Act (§ 49-3-10, *et seq.*, Code of Laws of South Carolina, 1976) 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 (SCDNR 1998). In 2004, the plan was updated 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: Ashepoo-Combahee-Edisto (ACE), Pee Dee, Santee, and Savannah (SCDNR 2004). 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) decided to further subdivide the basins based on SCDHEC's delineations used for the Water Quality Assessments. The eight planning basins were the Broad, Catawba, Edisto, Pee Dee, Salkehatchie, Saluda, Santee, and Savannah. In 2022, SCDNR made two adjustments to the planning basins. In the Saluda basin, the drainage area just below the confluence of the Broad and Saluda Rivers, which is generally below the Fall Line, was added to the Santee basin. The Savannah basin was subdivided into two planning basins and the portion below Lake Thurmond was combined with the Salkehatchie basin to form the Lower Savannah-Salkehatchie basin, as shown in Figure 1-1.

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 2019a; 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 intent of the Planning Framework is to have the next update to the State Water Plan 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, analyses, and water management strategies to guide water resource development in the basin for a 50-year planning horizon. Specifically, a River Basin Plan answers four questions:

1. What are the basin's current available water supply and demand?
2. What are the current permitted and registered water uses within the basin?
3. What is the projected 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 may be employed in the basin to ensure the available supply meets or exceeds the projected demand throughout the planning horizon?

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. The Saluda RBC is the fourth of the eight RBCs to complete the process that culminated in developing this plan. River basin planning is expected to be an ongoing, long-term process, and this plan is recommended to be updated every 5 years.

1.2 Planning Process

The river basin planning process in South Carolina formally began with the development of eight river basin-specific 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 in the bullets that follow. More complete descriptions of the duties of each entity are provided in Chapter 3 of the Planning Framework.

- RBC: A group of approximately 25 members representing diverse stakeholder interests in the basin. Each RBC includes at least one representative from each of the eight broadly defined stakeholder interest categories shown in Figure 1-2. The RBC was responsible for developing and is responsible for implementing the River Basin Plan, communicating with stakeholders, and identifying recommendations for policy, legislative, regulatory, or process changes. Selection and responsibilities of RBC members are discussed later in this chapter.

- PPAC and WaterSC: At the time that the RBC Planning Framework was developed, the PPAC was a diverse group of water resource experts established by SCDNR to develop and help implement the Planning Framework for state and river basin water planning. The PPAC was dissolved in 2024 due to the creation of

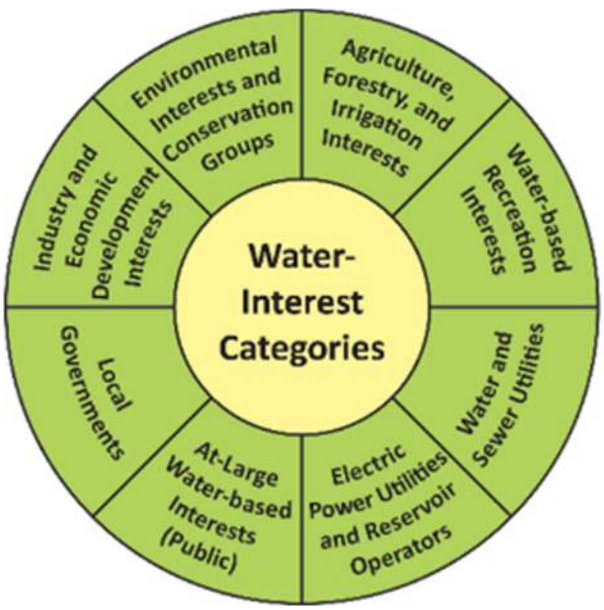


Figure 1-2. RBC water-interest categories.

the WaterSC Water Resources Working Group (WaterSC), which was established by Executive Order 2024-22 to advise the South Carolina Department of Environmental Services (SCDES) on developing the new State Water Plan and facilitating additional collaboration with ongoing water planning efforts and existing initiatives.

- State and Federal Agencies:
  - SCDNR was the primary oversight agency for the river basin planning processes until July 1, 2024 when the Water Division of SCDNR moved to the newly formed SCDES. Key duties of SCDNR, which now fall to SCDES, include appointing members to the 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 (formerly SCDHEC) is the regulatory agency that administers laws regarding water quality and use within the state and now oversees water planning activities. On July 1, 2024 and in accordance with South Carolina law, SCDHEC was divided into two agencies, placing environmental programs administered by SCDHEC into the newly-formed SCDES. Key duties of SCDES include ensuring recommendations are consistent with existing laws and regulations, serving as an advisor for recommended changes to existing laws and regulations, directing the river basin planning effort, and developing the State Water Plan.
  - Other State Agencies: Representatives from other state agencies including the South Carolina Office of Resilience (SCOR) and State Climatology Office (SCO) were asked to attend meetings in an advisory role and to present information to the RBC. Other state agencies, such as the Department of Agriculture, Department of Commerce, Forestry Commission, Rural Infrastructure Authority, and the Energy Office may be asked to attend future RBC meetings in an advisory role.
  - Federal Agencies: Representatives from the U.S. Geological Survey (USGS) were asked to attend RBC meetings to present information on streamflow monitoring and low flows. Other federal agencies, such as the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), U.S. Army Corps of Engineers (USACE), and Southeastern Power Administration (SEPA), may be asked to attend future RBC meetings as formal advisors.
- Contractors: SCDES hired contractors to perform administrative, facilitative, technical, authorship, and public outreach functions. Specific roles included:
  - Coordinator: Performed administrative functions. Coordination of Saluda RBC meetings and other activities was shared by representatives from CDM Smith and Clemson University, with assistance from SCDES along with the Chair and Vice-chair of the RBC (collectively, the Planning Team). The Planning Team met at least monthly in between RBC meetings.
  - Facilitator and Author: Guided RBC meetings in a neutral manner to encourage participation and provide River Basin Plan authorship services. CDM Smith served in these roles for the Saluda RBC.
  - Public Outreach Coordinator: Engaged stakeholders and the public in the planning process. Clemson University served in this role for the Saluda 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 Saluda RBC formed a subcommittee to help advise SCDNR staff (now part of SCDES) on water utility demands, projections, interconnections, and wholesale agreements during the initial, 2-year process of developing this plan.

- 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 Chapter 1.4.

The creation of the Saluda RBC began with two public meetings organized by SCDNR in 2022, which were held on November 1 (in Columbia) and November 3 (in Greenville). The goal of these meetings was to describe to stakeholders the need and process for river basin planning and solicit applications to join the Saluda RBC. SCDNR accepted applications through December 2022 and selected RBC appointees in February 2023, 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 basin). The diverse membership of the RBC is intended to allow for a variety of perspectives during development of the River Basin Plan. Table 1-1 lists the Saluda RBC members (at the time the Final River Basin Plan was issued) and their affiliations, appointment dates, and term lengths. Term lengths are staggered to ensure continuity in the planning process.

Table 1-1. Saluda RBC members and affiliations.

Name	Organization	Position	Interest Category	Appointment Date and Term Length (Years)
Katherine Amidon (Vice Chair)	Bolton & Menk Inc.	Water Resources Senior Planner	At-Large	March 2023 (4)
Jeff Boss	Greenville Water	Chief Operating Officer	Water and Sewer Utilities	March 2023 (3)
David Coggins	Laurens County Soil & Water Conservation District/Farmer	Chairman	Agriculture, Forestry, and Irrigation	March 2023 (4)
Jason Davis	Saluda Valley Farms, LLC	Operations Manager	Agriculture, Forestry, and Irrigation	March 2023 (2)
Tate Davis	Easley Combined Utilities	General Manager	Water and Sewer Utilities	March 2023 (2)
Phil Fragapane	Duke Energy	Lead Engineer	Electric Power Utilities	March 2023 (2)
Brandon Grooms	Colonial Pipeline Company	Senior Pipeline Operator	Industry and Economic Development	March 2023 (4)
Robert Hanley	Greenville County Soil & Water Conservation District	Commissioner	Agriculture, Forestry, and Irrigation	March 2023 (2)
Rick Huffman	Earth Design	Owner, Environmental Designer	At-Large	March 2023 (4)
Patrick Jackson	Laurens County Soil & Water Conservation District/Farmer	Vice-Chair	Local Governments	March 2023 (2)
Paul Lewis	Holly Tree Country Club	Grounds Superintendent	Agriculture, Forestry, and Irrigation	March 2023 (3)
Kevin Miller	Foothills Paddling Club	Conservation/Access Committee Chair	Water-Based Recreational	March 2023 (4)

Table 1-1. Saluda RBC members and affiliations. (Continued)

Name	Organization	Position	Interest Category	Appointment Date and Term Length (Years)
Larry Nates	Lexington County Soil & Water Conservation District	Commissioner	Local Governments	March 2023 (3)
Josie Newton	Friends of the Reedy River	Watershed Scientist	Environmental Interests	March 2023 (3)
Jay Nicholson	(Lexington) Joint Municipal Water & Sewer Commission	General Manager/CEO	Water and Sewer Utilities	March 2023 (3)
Devin Orr	SC Rural Water Association	Natural Resources Protection Specialist	At-Large	March 2023 (2)
Eddie Owen	Dominion Energy SC	Dam Safety Engineer	Electric Power Utilities	March 2023 (3)
K.C. Price (Chair)	Laurens County Water and Sewer Commission (LCWSC)	Engineering Manager	Water and Sewer Utilities	March 2023 (4)
Melanie Ruhlman	Save Our Saluda	President/Watershed Manager	Environmental Interests	March 2023 (2)
Kaleigh Sims	Renewable Water Resources (ReWa)	Regulatory Services Manager	Water and Sewer Utilities	March 2023 (4)
Thompson Smith	SC Farm Bureau and Twin Oaks Farm	District Director/Owner	Agriculture, Forestry, and Irrigation	March 2023 (3)
Rett Templeton	Greenwood County	City/County Engineer	Local Governments	March 2023 (2)
Charlie Timmons	Timmons Commercial	CEO	At-Large	March 2023 (3)
Michael Waddell	SC Trout Unlimited	State Council Chair	Water-Based Recreational	March 2023 (3)
Rebecca Wade	Upstate Forever	Clean Water Associate	Environmental Interests	March 2023 (4)

Jim Moore (Local Government), Sharon Appell (Water and Sewer Utilities), Joel Ledbetter (Water and Sewer Utilities), Mark Farris (Industry and Economic Development), Ed Bruce (Electric-Power Utilities), David Lawrence (Industry and Economic Development), and Justin McGrady (Water-based Recreational) also participated on the RBC during some of the planning process but were not active members when the River Basin Plan was finalized due to various reasons, such as retirement and relocation.

The Saluda RBC began meeting in March 2023, and continued meeting monthly using a hybrid format that allowed for virtual participation when needed. Meetings were held at different locations in the basin near or in Greenville, Lexington, and Laurens.

The planning process was completed in four phases, as specified in the Planning Framework. During the mostly informational phase (Phase 1), RBC members heard presentations from subject matter experts representing SCDNR, SCDHEC (now SCDES), USGS, Clemson University, SCOR, and CDM Smith. Presentation topics included water legislation and permitting; hydrology, monitoring, and low-flow characteristics; climatology; the South Carolina Drought Response Act; freshwater aquatic resources; State Scenic Rivers; Federal Energy Regulatory Commission (FERC) licensing; and the relationships between streamflow and ecologic health.

Phase 2 of the planning process focused on assessing past, current, and future surface water availability. The RBC reviewed historical and current water use, and 50-year planning scenario results from the surface water quantity model (referred to as the Simplified Water Allocation Model or SWAM). Potential water shortages and issues were identified and discussed.

During Phase 3, water management strategies to address water availability concerns 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.

Legislative, policy, technical, and planning process recommendations were considered during Phase 4 of the planning process, which culminated in developing this River Basin Plan. RBC recommendations are presented in Chapter 9.

Saluda RBC members participated in four field trips in fall 2023 and spring 2024. The goal of these field trips was to increase understanding of the water resources of the basin, how water is withdrawn and used to support public water supply needs, its importance in energy production, and impacts of and efforts to mitigate streambank erosion. In August 2023, the RBC toured the LCWSC Lake Greenwood Water Treatment Facility (WTF) (Figure 1-3). The following month, the RBC toured the Lake Murray Dam and Saluda Hydro Facility. The third field trip included tours of Greenville's Unity Park along the Reedy River and ReWa's laboratory and Mauldin Road Water Resources Reclamation Facility (WRRF). In April 2024, the RBC visited several sites where stream stabilization projects had recently been completed, as well as a stretch of the North Saluda River where a stream stabilization project is needed and may get underway in the coming year or two, pending available funding (Figure 1-4). In September 2024, several members of the RBC paddled a stretch of the Saluda River following their monthly RBC meeting.

1.3 Vision and Goals

During Phase 1 of the planning process, the Saluda RBC developed a vision statement establishing the desired outcome of the planning process, and actionable goals supporting their vision for the Saluda River basin. The vision statement and goals are presented in Table 1-2.

Table 1-2. Saluda RBC Vision Statement and Goals.

Vision Statement	
A resilient and sustainably managed Saluda River Basin that balances human and ecological needs.	
Goals	
1	**To perform a review and update of the plan every 5 years at a minimum or sooner should a significant event occur requiring plan update.**
2	**Develop and implement an education and communication plan to promote the strategies, policies, and recommendations developed for the Saluda River Basin.**
3	**Apply science-based resource management and conservation strategies that consider resource availability and allocation.**

Figure 1-3. Fall 2023 field trips. Clockwise from top left: Greenville's Unity Park, the Lake Murray Dam and Hydro Facility, ReWa's Mauldin Road WRRF, and LCWSC's Lake Greenwood WTF.

Figure 1-4. April 2024 field trip. Stream stabilization sites on tributaries to the North Saluda River.

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 (SCDES 2025) 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 24 RBC meetings, dedicated public meetings were also held to distribute information and/or solicit feedback.

- The first two public meetings were held on November 1 and 3, 2022, in Columbia and Greenville, respectively. At these meetings, the public was informed of the basin planning process and the plan for public participation. Saluda RBC membership applications were solicited at this meeting.

- The third public meeting will be held on May 29, 2025, in Greenville. A summary of the plan will be provided to attendees and a public comment period will open, which includes a verbal comment period at the meeting followed by a 30-day written comment period. Written comments received from the public and the RBC's responses to those comments will be included in Appendix F. ***[THIS WILL BE UPDATED FOLLOWING THE THIRD PUBLIC MEETING]***

1.5 Previous and Ongoing Water Planning Efforts

Several water planning efforts have already been completed or are ongoing in the Saluda River basin. While the focus of these plans has not been on water availability and the ability to meet current and projected demands, they explore water-related topics that help inform and guide recommendations and water management strategies made as part of this River Basin Plan. The planning efforts discussed below focus on a wide range of topics including water access and facilities, historic and archaeological sites, law enforcement, litter, resource protection, tourism, public safety, groundwater management, drought, and water quality. As the Saluda River Basin Plan is updated and implemented, other completed and ongoing water-related plans in the basin should continue to be reviewed to identify commonalities and to support and promote development of holistic recommendations and water management strategies.

1.5.1 Middle Saluda River Protected Corridor and Lower Saluda River Corridor Plan

The South Carolina Scenic Rivers Act of 1989 enabled and directed SCDNR to inventory and study rivers with unique and outstanding values. The Act was intended to protect the unique and outstanding resource values of South Carolina rivers based on their scenic, recreational, geological, botanical, aquatic and terrestrial wildlife, historic, and cultural characteristics. Statewide, 10 river reaches were formally designated as Scenic Rivers, including a 10-mile stretch of the Saluda River from one mile (mi) below Lake Murray Dam to its confluence with the Broad River. Even prior to the South Carolina Scenic Rivers Act of 1989, the Middle Saluda River became the first river protected under the Scenic Rivers Program in South Carolina. In 1978, a 600-foot wide scenic corridor of the Middle Saluda River was established through an agreement with the South Carolina Department of Parks, Recreation and Tourism. The corridor in northern Greenville County and completely within Jones Gap State Park, covers about five miles of the Middle Saluda and its major tributary, Coldspring Branch.

The South Carolina Water Resources Commission (now SCDNR), South Carolina Department of Parks, Recreation, and Tourism, and the Lower Saluda River Task Force produced the Lower Saluda River Corridor Plan in 1990. The Plan included river management issues and recommendations related to topics such as access and facilities, historic and archaeological sites, law enforcement, litter, resource protection, tourism, and public safety, as well as conceptual plans for parks and public access points along the river. Ten months later after the Plan's publication, the South

Carolina General Assembly designated the Lower Saluda as a State Scenic River.

In 2000, the Lower Saluda Scenic River Corridor Plan was prepared by the South Carolina Design Arts Partnership for SCDNR. This updated plan incorporated a range of additional issues, including protection of wildlife habitat, water quality, aesthetic values of the river, private property rights, and addressed issues at existing public access sites. The 2000 Plan also presented information related to creating a greenway trail system along the north bank of the river.

1.5.2 Groundwater Management Plans

The Groundwater Use and Reporting Act (SC Code of Laws §49-5-10 *et seq.*) establishes conditions for the designation of capacity use areas (CUAs). These are areas 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 mitigate these concerns and study the area's groundwater availability and demand and offer strategies to promote the sustainability of the resource. The plan must balance the competing needs and interests of the area, including those of future generations. Additionally, all users within the CUA withdrawing more than 3 million gallons of groundwater in any month must obtain a groundwater withdrawal permit. The southern end of the Saluda River basin contains a small portion (172,400 acres) of the Western CUA, which includes Lexington County, and an even smaller portion (13,100 acres) of the Santee-Lynches CUA, which includes Richland County. South Carolina CUAs are shown in Figure 1-5.

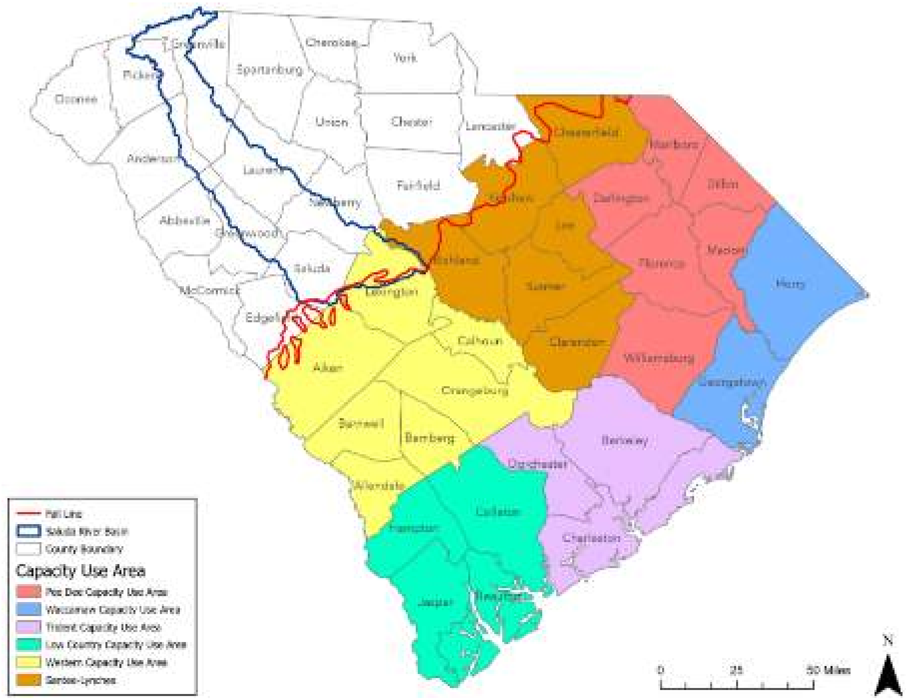


Figure 1-5. Capacity Use Areas.

The Western CUA was designated in 2018 and the Groundwater Management Plan was completed in November 2019. The Santee-Lynches CUA was designated in 2021 and the Groundwater Management Plan was completed in August 2022. In preparing the initial plans, SCDHEC convened stakeholder workgroups and solicited public comments. The plans outline 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. Although only a small portion of Saluda River Basin falls within the Western CUA, the best practices identified in its Groundwater Management Plan are relevant to the river basin planning effort, and have been considered by the Saluda RBC.

1.5.3 Drought Planning

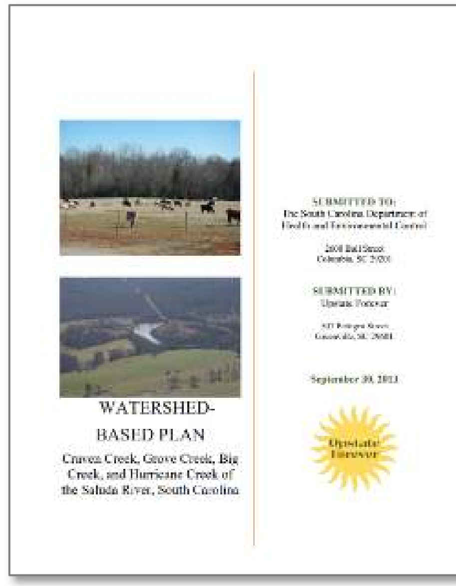
The South Carolina State Climatology Office is responsible for drought planning in the state. The South Carolina Drought Response Act and supporting regulations establish the South Carolina Drought Response Committee (DRC) as the drought decision-making entity in the state. The DRC is composed of state agencies and local members representing various stakeholder interests. To help prevent overly broad response to drought, SCDNR split the state into four drought management areas (DMAs) (see Figure 8-1). The Saluda River basin is within the Central DMA. 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 Saluda River basin are further discussed in Chapter 8 Drought Response, and the Saluda RBC's recommendations related to drought response and management are presented.

1.5.4 Watershed-Based Plans

In 1992, SCDHEC 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 Saluda River basin, Watershed Water Quality Assessments (WWQAs) were completed in 1995, 1998, 2004, and 2011. The WWQAs of the Saluda River basin describe, at the watershed level, water-quality-related activities that may potentially have an adverse impact on water quality. As of 2016, the WWQAs have been replaced by the SC Watershed Atlas (SCDHEC 2025), which allows users to view watershed information and even add data, create layers from selected features, and export data for use outside of the application. Chapter 3 presents more information on current water quality impairments in the basin.

In 2012 SCDES began funding Watershed-base plans. Watershed-based plans have been developed for various watersheds throughout South Carolina to document sources of pollution and present a course of action to protect and improve water quality within a watershed. While this first iteration of the Saluda River Basin Plan focuses on water quantity issues, previous planning efforts within the Saluda River basin that addressed water quality are worth noting. Water quality considerations may be more fully developed in future updates to the Saluda River Basin Plan. Acknowledging these existing plans is important for future Saluda River Basin Plan development.

Watershed-Based Plan for Craven Creek, Grove Creek, Big Creek, and Hurricane Creek of the Saluda River, South Carolina


WATERSHED-BASED PLAN
Craven Creek, Grove Creek, Big Creek, and Hurricane Creek of the Saluda River, South Carolina
SUBMITTED TO:
The South Carolina Department of Health and Environmental Control
SUBMITTED BY:
Upstate Forever
September 30, 2013

In 2013, a watershed-based plan was developed for the 74,000-acre watershed which includes Craven Creek, Grove Creek, Hurricane Creek, and Big Creek (Upstate Forever 2013). These subwatersheds are impaired for recreation due to elevated fecal bacterial concentrations. The plan identified agricultural pollution and on-site wastewater systems as the primary nonpoint sources of bacteria. A fecal coliform bacteria total maximum daily load (TMDL) for the Upper Saluda Basin was approved in 2004. The watershed plan encourages general public education related to proper pet waste disposal, urban stormwater, and wildlife. The plan also identifies agricultural best management practices (BMPs) and septic repairs as implementation plan steps for reducing bacteria pollution. Since 2015, 9 septic repairs have been completed, 4 agricultural BMP projects have been constructed, and 8 pet waste stations have been installed in the Craven Creek, Grove Creek, and Big Creek watersheds.

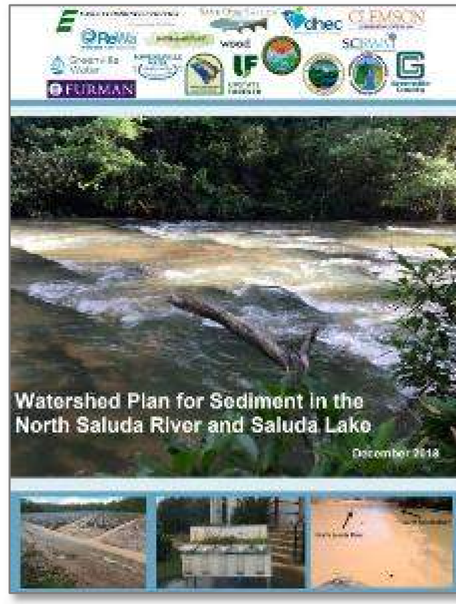
Watershed Plans for Sediment in the North Saluda River and Saluda Lake and Sediment in the South Saluda River

Sediment is a significant problem in Saluda Lake, the drinking water source for Easley and surrounding communities, and in contributing streams and rivers of the Upper Saluda Watershed. Reservoir capacity is compromised, water quality is impaired, aquatic habitat is degraded, and recreation is diminished due to excess sedimentation. Between 2011 and 2012, approximately 366,600 cubic yards of sediment were dredged from Saluda Lake at a cost of over $8 million. The dredged area has since filled in again and additional dredging is cost prohibitive.

In 2016, Easley Combined Utilities and Save Our Saluda began building a partnership of over twenty stakeholder organizations that share common goals for watershed and water quality protection and identified the need to reduce sediment runoff upstream in the watershed.

Partnering organizations form the Upper Saluda Technical Advisory Stakeholder Committee (TASC) for the Upper Saluda Watershed Program for Sediment, and include federal and state agencies, water and wastewater utilities, county stormwater programs, agricultural agencies, universities, and nonprofit conservation organizations. Partners developed two watershed plans for land areas that drain to Saluda Lake and began implementation of project work in 2019. Focus meetings were held with agricultural, urban, and forestry stakeholders to discuss practices and landowner issues related to sediment runoff in watershed planning areas. Multiple workshops on cover crops, soil health, and streambank stabilization were held in the watershed and online surveys were conducted to gather public input.

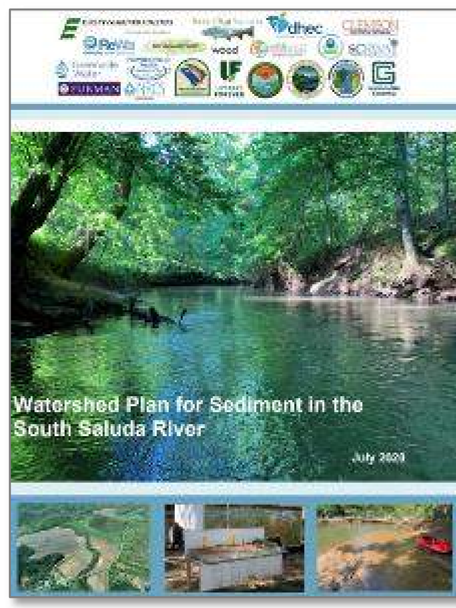
Data collection and modeling efforts for both plans indicated that sediment runoff from land uses originates largely from a small portion of the watershed and that intensively managed crop areas in floodplains are large contributors to sediment loads downstream. However, most of the sediment loading to Saluda Lake is likely coming from in-stream channel erosion, which is widespread throughout the watershed. Modeling did not capture channel erosion. Eroded streambanks are common in areas lacking sufficient riparian buffers, particularly floodplain croplands. The plans presented agricultural BMPs for soil conservation and streambank stabilization, as well as programmatic measures for sediment control for urban source areas. The plans also identified technical and financial assistance needs to implement the proposed solutions.



Implementation projects completed in the Upper Saluda Watershed to date include cover crops, floodplain and riparian restoration, farm road stabilization, streambank stabilization, sediment basin construction, and drainage improvement and stabilization. Farm equipment was also purchased for lease to area farmers to help facilitate soil conservation practices.

Watershed Plan for Sediment in the North Saluda River and Saluda Lake

The North Saluda River and Saluda Lake watershed-based plan was developed in 2018 (Save Our Saluda 2018). This area spans an approximately 125-square mile area in Greenville and Pickens Counties. Model results suggest that 74 percent of the sediment load from surface runoff originates from the Lower North Saluda River subwatershed and that 67 percent of the sediment load from land uses comes from croplands.



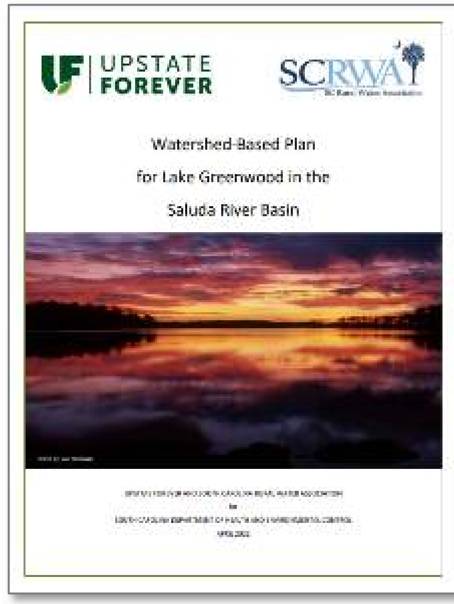
Watershed Plan for Sediment in the South Saluda River

The South Saluda River watershed-based plan was developed in 2020 (Save Our Saluda 2020). This area spans an approximately 171-square mile area in in Greenville and Pickens Counties. Model results suggest that 40 percent of the sediment load from surface runoff originates from the Oolenoy River subwatershed and that 57 percent of the load from land uses comes from croplands.

In addition to BMP implementation, partners have worked together since 2018 to help secure permanent protection of over 250 acres of riparian areas and floodplains for water quality protection, including nearly 30,000 feet of frontage on the North, Middle and South Saluda Rivers. This includes high quality mature forested systems on steep slopes and degraded floodplain farmlands that are currently in transition to stable ecosystems. Collaboration among these partners is ongoing to facilitate land conservation for source water protection in the Upper Saluda Watershed.

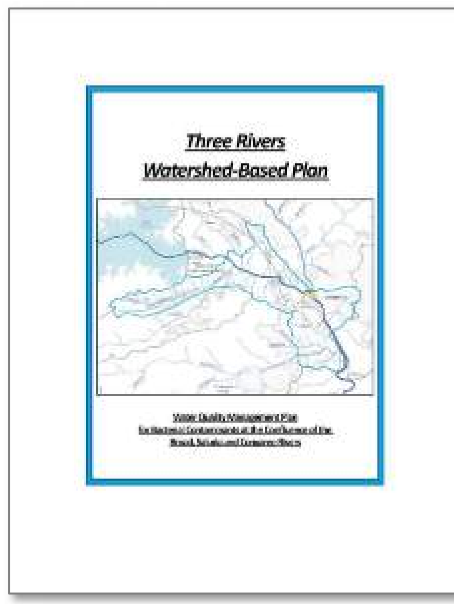
Watershed-Based Plan for Lake Greenwood in the Saluda River Basin

In 2022, a watershed-based plan was developed for the more than 126,000-acre watershed in Greenwood and Laurens Counties, including the 10,000-acre Lake Greenwood (Upstate Forever and South Carolina Rural Water Association 2022). The plan addressed bacteria, sediment, and nutrient pollution (nitrogen and phosphorus) concerns and outlined strategies to reduce nonpoint source pollution in waterways and drinking water sources. The focus area includes Rabon Creek, where failing septic systems, agricultural runoff, pet waste, wildlife, and stormwater runoff contribute to an impairment and TMDL for fecal coliform bacteria. Sediment and nutrients have similar sources. BMPs outlined in the plan include septic repair/restoration, agricultural methods, pet waste stations, land protection, and riparian buffer restoration. The plan also identified financial assistance needs to implement the proposed solutions.



Three Rivers Watershed-Based Plan

In 2022, a watershed-based plan was developed for the 55.6-sq mi watershed which drains to the confluence of the Lower Saluda, Broad, and Congaree Rivers (McCormick Taylor Inc., KCI, and Three Oaks Engineering 2022), *i.e.*, the Three Rivers Watershed. This area includes the Columbia metropolitan area and extends across Richland and Lexington Counties. This watershed faces problems typically associated with increased urbanization, such as stream erosion, water quality degradation, and loss of natural resources. The plan incorporated climate change and drinking water source protection considerations, as the intakes for the City of Columbia and the City of West Columbia are located within the focus area. Pollutant loads and sources were assessed and quantified in the plan. Non-structural load reduction methods were assessed, as well as structural methods such as stormwater BMP retrofits, riparian buffer restoration, and urban redevelopment with improved stormwater management. Riparian buffer enhancement and stormwater retrofits were determined in the plan analysis to be responsible for the largest potential bacteria reduction, as well as providing water quality benefits by reducing runoff volume which in turn helps reduces nutrient and sediment loadings in the watershed.



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 Saluda River Basin Plan is divided into 10 chapters, described as follows:

- **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 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. This 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 availability analysis. This chapter presents planning scenarios that were developed, and the performance measures used to evaluate them. Any water shortages or reaches of interest identified through this analysis are described. The projected water shortages identified in this chapter serve as the basis for the water management strategies presented in Chapter 6.

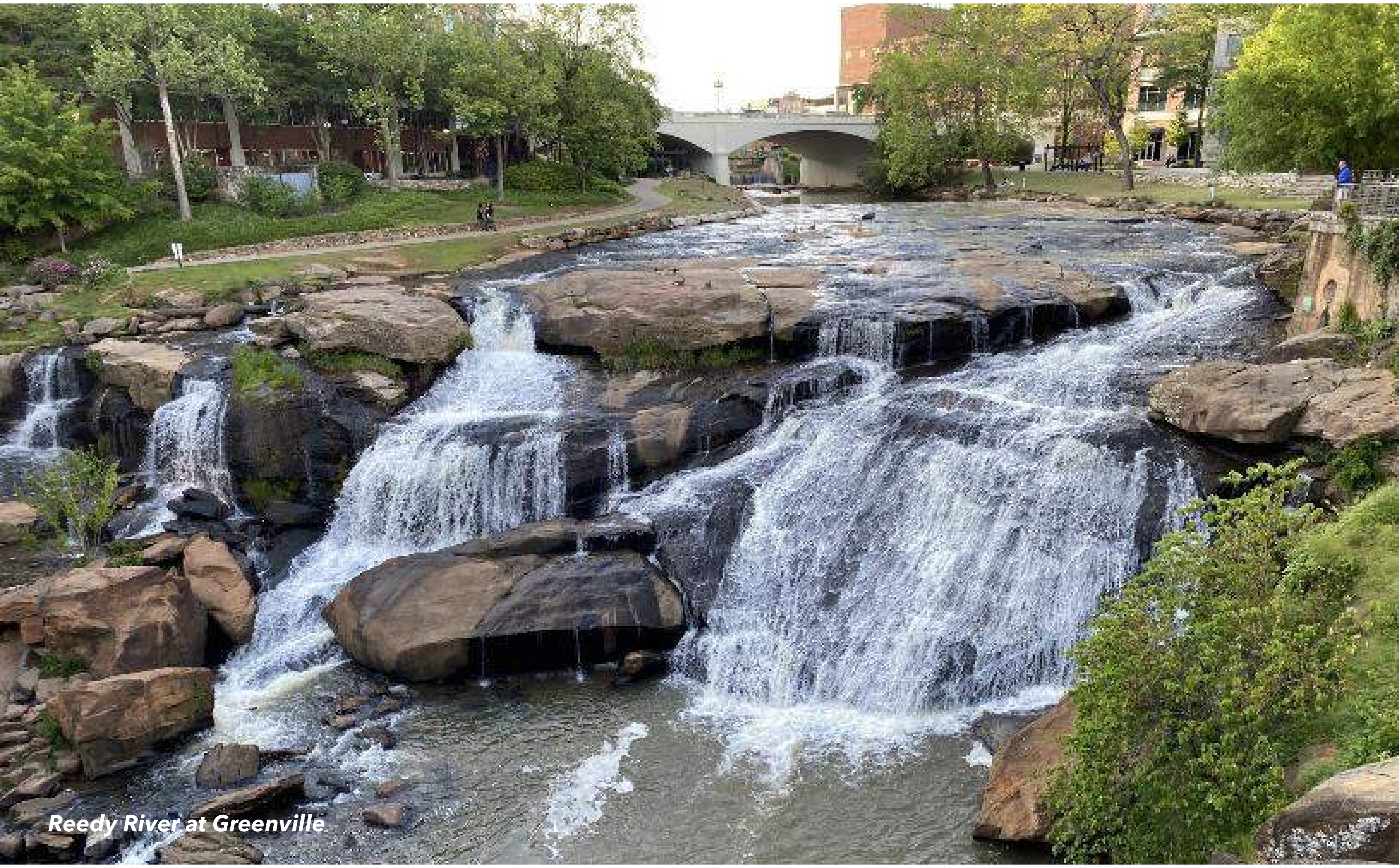
- **Chapter 6: Water Management Strategies** – Chapter 6 presents the water management strategies developed as potential solutions to the water shortages presented in Chapter 5. For each water management strategy considered, Chapter 6 includes a description of the measure, results from a technical evaluation (as simulated in the surface water quantity 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 analyses 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** – This chapter 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. There will be a chapter in future iterations of this plan that details progress made on planning objectives outlined in previous plan iterations.



Reedy River at Greenville

Chapter 2
Description of the Basin

2.1 Physical Environment

2.1.1 Geography

The Saluda River basin covers approximately 2,523 sq mi and is wholly contained within South Carolina, making up 8 percent of the state's total area (U.S. Census Bureau 2010). It is the fourth largest of the state's eight water planning basins, extending over 180 mi from the Blue Ridge Mountains to the confluence of the Broad and Saluda Rivers near the City of Columbia and spanning almost 40 mi at its widest point (USACE 1977) (Figure 2-1). Significant portions of Greenville, Greenwood, Laurens, Lexington, Newberry, and Saluda Counties all lie within the basin boundary. Smaller portions of Anderson and Pickens Counties, and even smaller portions of Abbeville, Aiken, Edgefield, and Richland Counties, also lie within the basin (Table 2-1).

The Saluda River is the major watercourse within the basin. Other major tributaries within the basin include the Reedy, Little, Bush, and Little Saluda Rivers. The headwaters include the North, Middle and South Saluda Rivers which originate in the Blue Ridge Mountains. The North Saluda River drains to the approximately 1,049-acre Poinsett (North Saluda) Reservoir and the South Saluda River drains to the approximately 476-acre Table Rock Reservoir. Both reservoirs serve as a source of water for much of Greenville County. Following the junction of the South, Middle, and North Saluda Rivers, the Saluda River flows south into Saluda Lake, which supplies water to Easley, and also produces energy. It continues to Lake Greenwood, an 11,400-acre body that is also fed by the Reedy River and Rabon Creek. Lake Greenwood supplies water, energy, and recreation to the surrounding region (Davis 2023). After Lake Greenwood, the Saluda

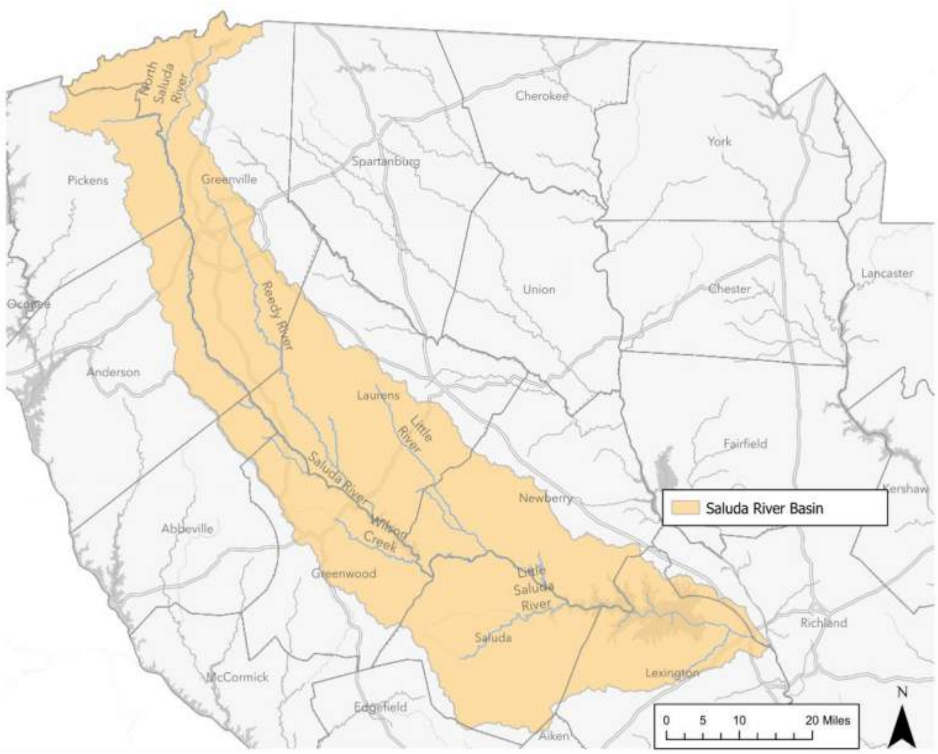


Figure 2-1. The Saluda River basin and surrounding counties.

River bends east, where it is joined by the Little River along the border of Saluda and Newberry Counties. At the confluence of the Saluda and Little Saluda Rivers, Lake Murray is formed, a nearly 51,000-acre reservoir that supplies water, energy, and recreation for the City of Columbia and its surrounding counties (McCartha 2023). A few miles beyond this reservoir, the Saluda River basin ends at the confluence of the Broad and Saluda Rivers, where the Congaree River is formed.

The character of the Saluda River changes as it flows the length of the basin. In its upper reaches, it is primarily a mountain river characterized by periodic rapids and high-velocity flows. In its lower reaches, the river possesses a predominantly uniform channel with well-defined banks and floodplains (USACE 1977). It experiences a change in elevation of 2,270 feet (ft) along its course. Much of the river is highly regulated and dammed, most notably in the development of the North Saluda Reservoir, Table Rock Reservoir, Lake Greenwood, and Lake Murray. In the basin reaches upstream of Lake Greenwood, there are over 150 smaller state- or federally-regulated dams and hundreds of unregulated dams (SCDNR 2013), and there are additional regulated and unregulated dams in the lower reaches of the basin. Regulated dams are those which meet one of the following criteria: more than 25 ft in height, impounds 50 acre-feet or more, and dams whose potential failure may cause loss of human life.

The Saluda River basin is known for its recreational fishing, wildlife habitat, and historical-cultural significance. A 5-mi portion of the Middle Saluda River that lies within Jones Gap State Park became the first South Carolina river protected under the South Carolina Scenic River Program in 1978 (SCDNR 2009). A 10-mi stretch of the Saluda River, from below the Lake Murray Dam to the confluence with the Broad River, was also designated a State Scenic River in 1991.

Table 2-1. Counties of the Saluda River basin.

County	Percentage of Saluda River Basin in County *	Percentage of County in Saluda River Basin
Greenville	19.1%	60.7%
Laurens	17.9%	62.4%
Saluda	16.3%	89.1%
Newberry	12.5%	49.3%
Lexington	10.6%	35.5%
Greenwood	9.7%	52.9%
Pickens	6.3%	30.7%
Anderson	5.2%	17.3%
Abbeville	1.5%	7.5%
Richland	0.8%	2.7%
Edgefield	0.1%	0.1%
Aiken	0.1%	0.1%

* Column does not add to 100% due to rounding.

2.1.2 Land Cover

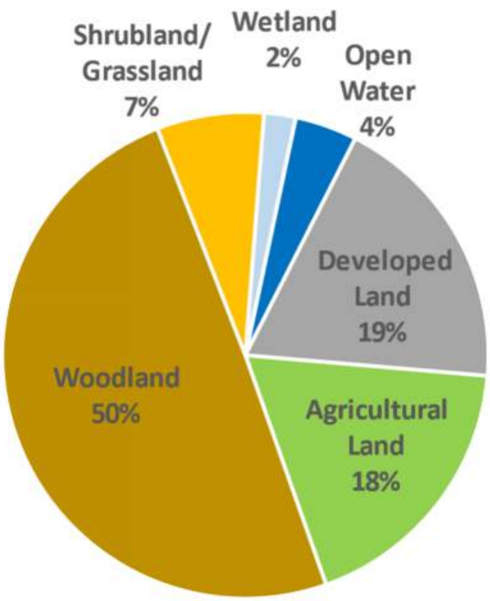


Figure 2-2. 2023 Saluda River basin land cover (MRLC 2024a).

Land cover in the Saluda River basin varies from rural farmland and forested areas to sprawling urban areas. Woodland is the dominant land cover in the basin, as shown in Figure 2-2 (Multi-Resolution Land Characteristics Consortium [MRLC] 2024a). The cities of Greenville, Greenwood, Laurens, and Newberry, and a significant portion of the Columbia suburbs are also within the basin. Agricultural lands are scattered throughout the basin but are mostly in the central and southern portions. Developed land and agricultural land are roughly equal in proportion in the basin.

Table 2-2, derived from MRLC's National Land Cover Database (NLCD), provides a more detailed summary of land cover types in the basin, and includes changes in land cover area from 2001 to 2023 (MRLC 2024a, 2024b). During that time, developed land increased by approximately 76 sq mi, while agricultural land (composed of hay/pasture and cultivated crops) collectively decreased by roughly 35 sq mi, predominantly represented by a 6 percent decrease in pastureland. Development pressure can substantially alter hydrology. Woodland areas (deciduous, evergreen, and mixed forests) also collectively decreased by approximately 81 sq mi, largely represented by a 16 percent decrease in mixed forested areas throughout the basin. A significant composition change can also be seen in shrubland (composed of shrub and herbaceous grassland), with a collective increase in shrubland cover of 39 sq mi.

Table 2-2. Saluda River basin land cover and trends (MRLC 2024a, 2024b).

NLCD Land Cover Class	2001 Area (sq mi)	2023 Area (sq mi)	Change from 2001 to 2023 (sq mi)	Percentage Change from 2001 to 2023	Percentage of Total Land (2023)
Open Water	102.8	104.7	1.8	1.8%	4.1%
Developed, Open Space	224.9	243.0	18.1	8.0%	9.6%
Developed, Low Intensity	121.2	155.7	34.5	28.4%	6.2%
Developed, Medium Intensity	36.4	54.6	18.2	49.9%	2.2%
Developed, High Intensity	13.7	18.8	5.1	37.0%	0.7%
Barren Land	3.2	4.3	1.0	32.1%	0.2%
Deciduous Forest	543.9	532.7	-11.2	-2.1%	21.1%
Evergreen Forest	528.6	498.8	-29.8	-5.6%	19.8%
Mixed Forest	258.1	217.8	-40.4	-15.6%	8.6%
Shrub/Scrub	62.6	76.0	13.5	21.5%	3.0%
Herbaceous	78.6	104.2	25.5	32.5%	4.1%
Hay/Pasture	463.5	434.8	-28.7	-6.2%	17.2%
Cultivated Crops	32.4	25.9	-6.6	-20.2%	1.0%
Woody Wetlands	53.3	51.8	-1.5	-2.9%	2.1%
Emergent Herbaceous Wetlands	0.5	1.0	0.5	94.4%	<0.1%
Total Land Area	**2,524.0**	**2,524.0**	**0.0**	**-**	**100.0%**

2.1.3 Geology

South Carolina is divided into three major physiographic provinces based on geologic characteristics: the Blue Ridge, the Piedmont, and the Coastal Plain. The Saluda River basin lies almost completely within the Piedmont province, although the headwaters originate within the Blue Ridge and the southeastern edge of the basin crosses the state Fall Line into the Coastal Plain. As the basin flows from its headwaters to its outlet, high hills in the north give way to rolling hills in the south. Figure 2-3 shows a generalized geologic map of the Saluda River basin.

The Piedmont province consists mostly of saprolite, weathered bedrock, and overlying crystalline rock. The saprolite layer can range from 10 to 150 ft in thickness and possesses a high porosity but low permeability. These characteristics mean saprolite typically absorbs and slowly releases rainwater into fractures within the underlying rock that can be accessed by wells. However, in the Piedmont province these fractures are small, and the underlying bedrock is therefore not able to form aquifers. Wells within this region typically yield less than 20 gallons per minute (gpm) (SCDNR 2009). Because of these relatively low well yields, registered groundwater withdrawals are not abundant in the Saluda River basin. Total reported groundwater withdrawals account for just 0.1 percent of the basin’s entire water usage (SCDHEC 2022a; SCDNR 2023a). While the reported level of groundwater use is small, the overall use from private wells is not a trivial amount in areas where public water supply is not available. Groundwater provides a larger contribution to surface water streamflow in the upper reaches of the basin where rainfall is higher (SCDNR 2023b).

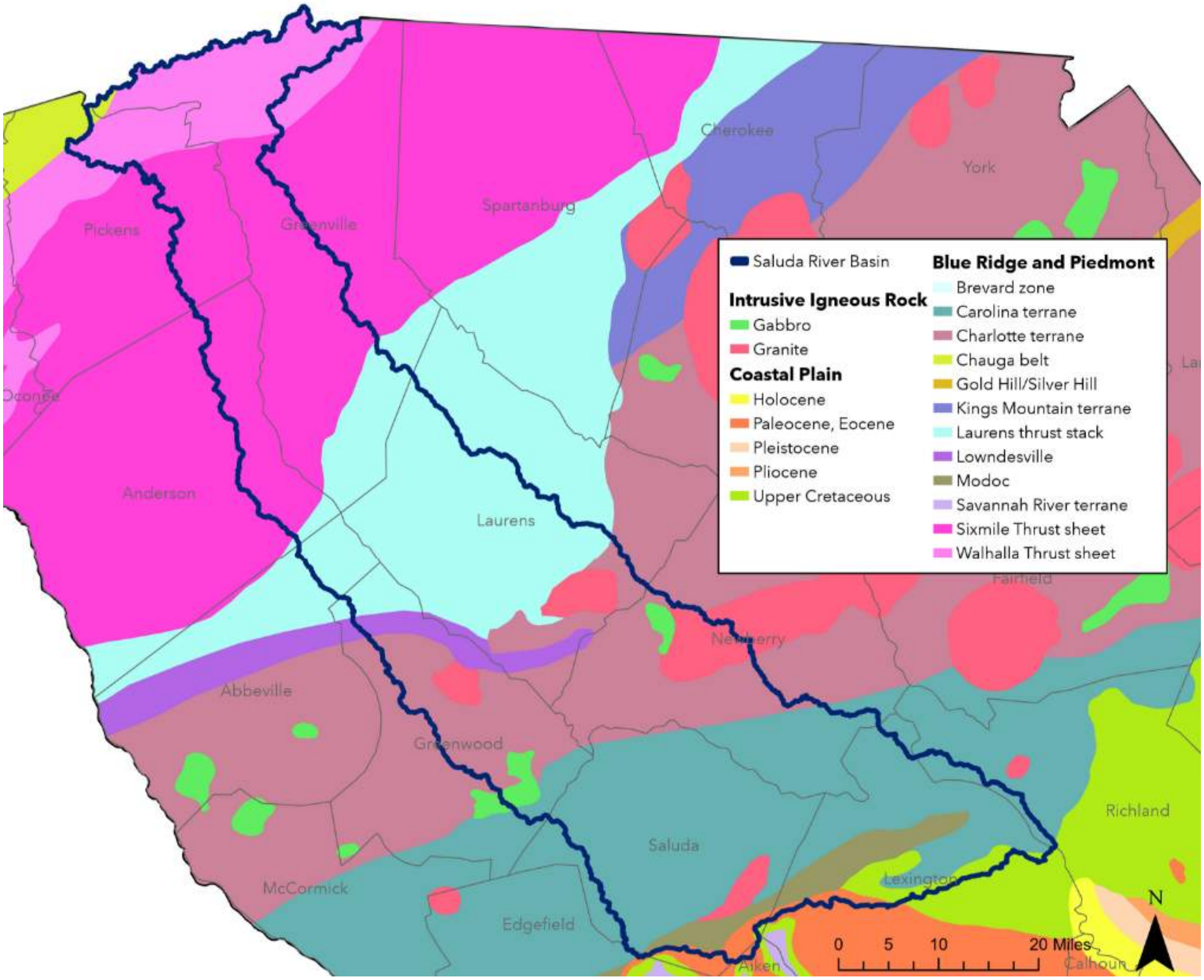


Figure 2-3. Generalized geological map of the Saluda River basin (SCDNR 2021).

2.2 Climate

2.2.1 General Climate

Much like the rest of the Carolinas, the climate of the Saluda River basin is described as humid subtropical, with hot summers and mild winters. Figure 2-4 shows the average annual temperature and annual average precipitation for the Saluda River basin, based on climate normals from 1991 to 2020. Additional temperature and precipitation maps based on these climate normals can be accessed from the South Carolina State Climatology Office (SCO) "Climate" webpage (SCDNR SCO 2021).

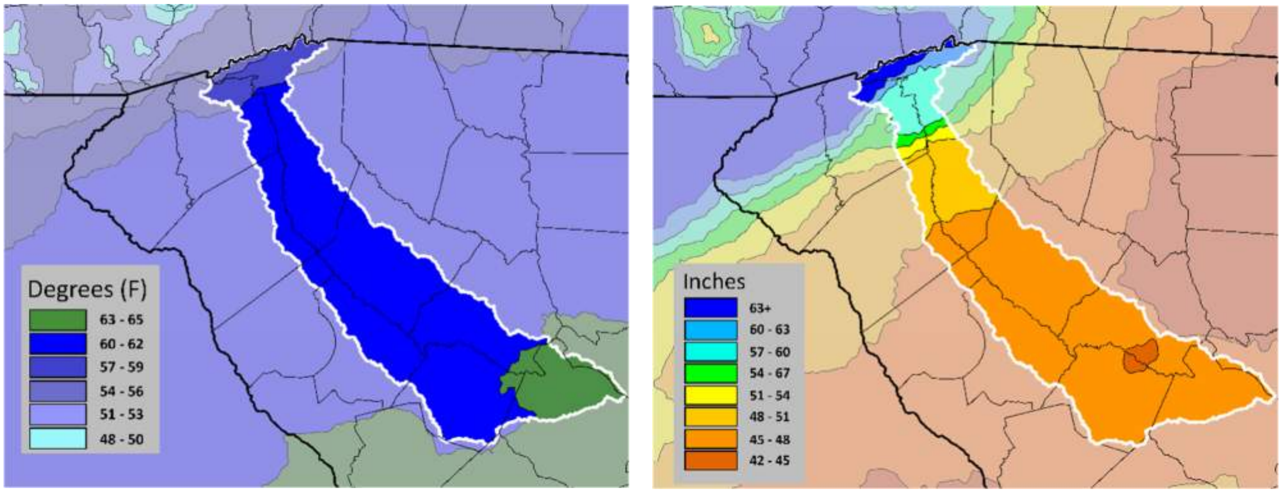


Figure 2-4. Normal annual average temperature and precipitation (1991 to 2020) for the Saluda River basin.

The average annual temperature throughout the basin ranges from 54 to 65 degrees Fahrenheit (°F), with temperature increasing from the upper basin to the lower basin. Annual average precipitation ranges from 42 to over 63 inches (in.) throughout the basin, with rainfall decreasing from the upper basin to the lower basin. The upper basin receives greater rainfall because of the topography. Higher elevations of the mountains cause air to rise, cool, and then condense, allowing for increased precipitation. This is known as orographic lifting. Smaller streams in the lower part of the basin may be more susceptible to droughts.

Temperature and precipitation values are not constant throughout the basin, nor are they consistent for a given location throughout the year. Figures 2-5 and 2-6 show the monthly variation in temperature and precipitation at the meteorological stations "Caesars Head" in Greenville County and "Saluda" in Saluda County. These two stations were selected because of their long-term records (data have been collected at Caesars since 1925 and at Saluda since 1902) and because they well represent climatological differences in the upper and lower portions of the basin (Caesars Head is near the top of the basin; Saluda is in the lower-middle part of the basin). The period of record for the analysis was designated from 1968 to 2022 because the Caesars Head station was moved in 1967, and 1968 was the first full year of data at the new location (SCDNR SCO 2023a). Both stations have gaps in data in the time series. Caesars Head lacks temperature data for 1974 to 1975, 1985, 1987, and 2010 to 2011, and lacks precipitation data for 1985 to 1987 and 2010. Saluda lacks temperature data for 1974 and 1979, and lacks precipitation data for 1974.

Both these stations show that temperature oscillates throughout the year, with July generally being the warmest month (with an average monthly temperature of 71.3°F at Caesars Head and 80.7°F at Saluda) and January being the coldest month (with an average monthly temperature of 35.7°F at Caesars Head and 41.9°F at Saluda). When comparing the climographs for Caesars Head and Saluda (Figures 2-5 and 2-6, respectively), average monthly temperatures at Caesars Head are about 5.5 to 9.5°F cooler than Saluda, with the differences being larger in the summer and smaller in the winter.

At both stations, precipitation varies throughout the year. The climatologically wettest month at Caesars Head is May (6.90 in.) and the driest month is February (5.41 in.). The climatologically wettest month at

Saluda is March (4.19 in.) and the driest month is November (3.19 in.) (SCDNR SCO 2023a). When comparing the climographs for the two stations (Figures 2-5 and 2-6, respectively), Caesars Head receives more rain each month than Saluda, with monthly average precipitation at Caesars Head being 1.5 to 3 in. more than Saluda.

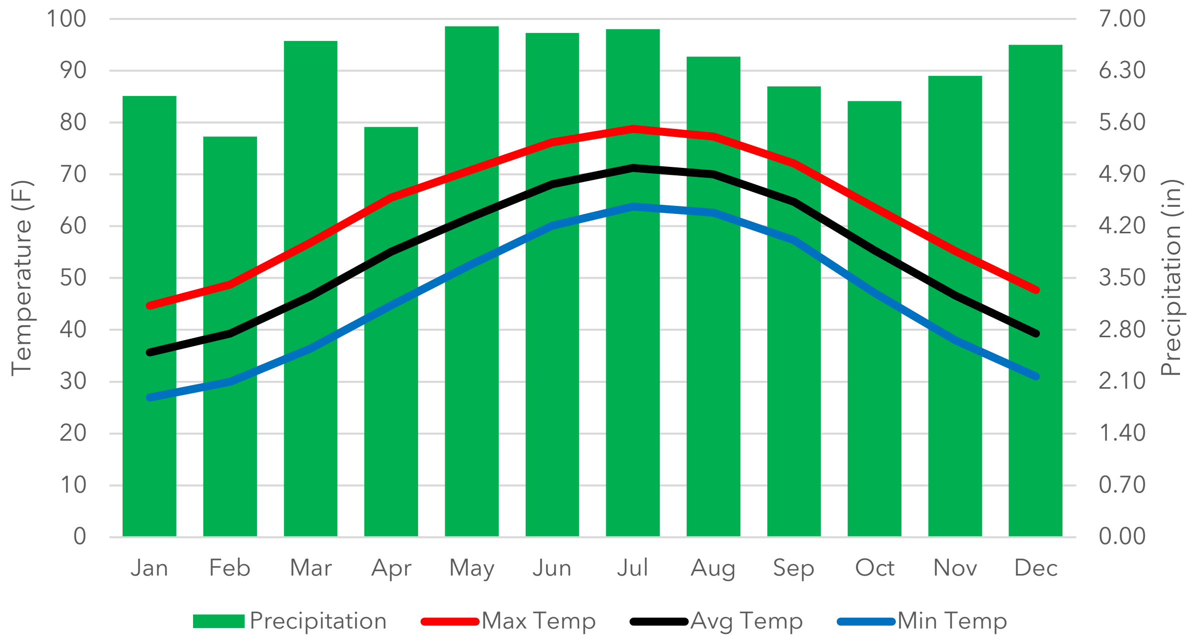


Figure 2-5. Caesars Head monthly climate averages from 1968 to 2022 (SCDNR SCO 2023a).

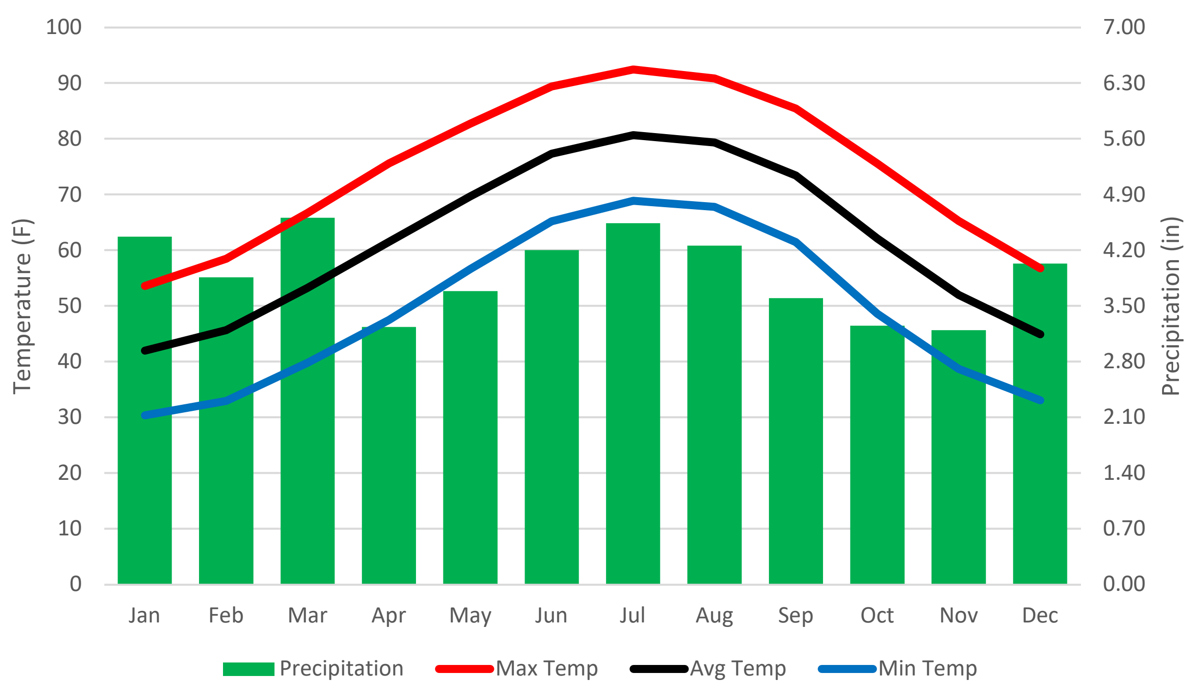


Figure 2-6. Saluda monthly climate averages from 1968 to 2022 (SCDNR SCO 2023a).

Over time, the annual average temperature and precipitation for the Carolinas and the Saluda River basin have varied (National Oceanic and Atmospheric Administration [NOAA] 2023a; SCNDR SCO 2023a). Figure 2-7 shows the 1968 to 2022 temperature time series for the Caesars Head and Saluda stations, with years of above- and below-average annual temperature. For this period, annual average temperatures were 54.0°F at the Caesars Head station and 61.8°F at the Saluda station. Table 2-3 shows the stations' warmest and coldest five years, with three of the warmest years in common (1998, 2016, and 2019) and 1998 being the warmest at both stations. The top five warmest years at both stations have occurred since 1990. There are no similarities in the coldest 5 years between the two stations; 1988 and 2009 were the coldest years at Caesars Head and 1976 was the coldest year at Saluda.

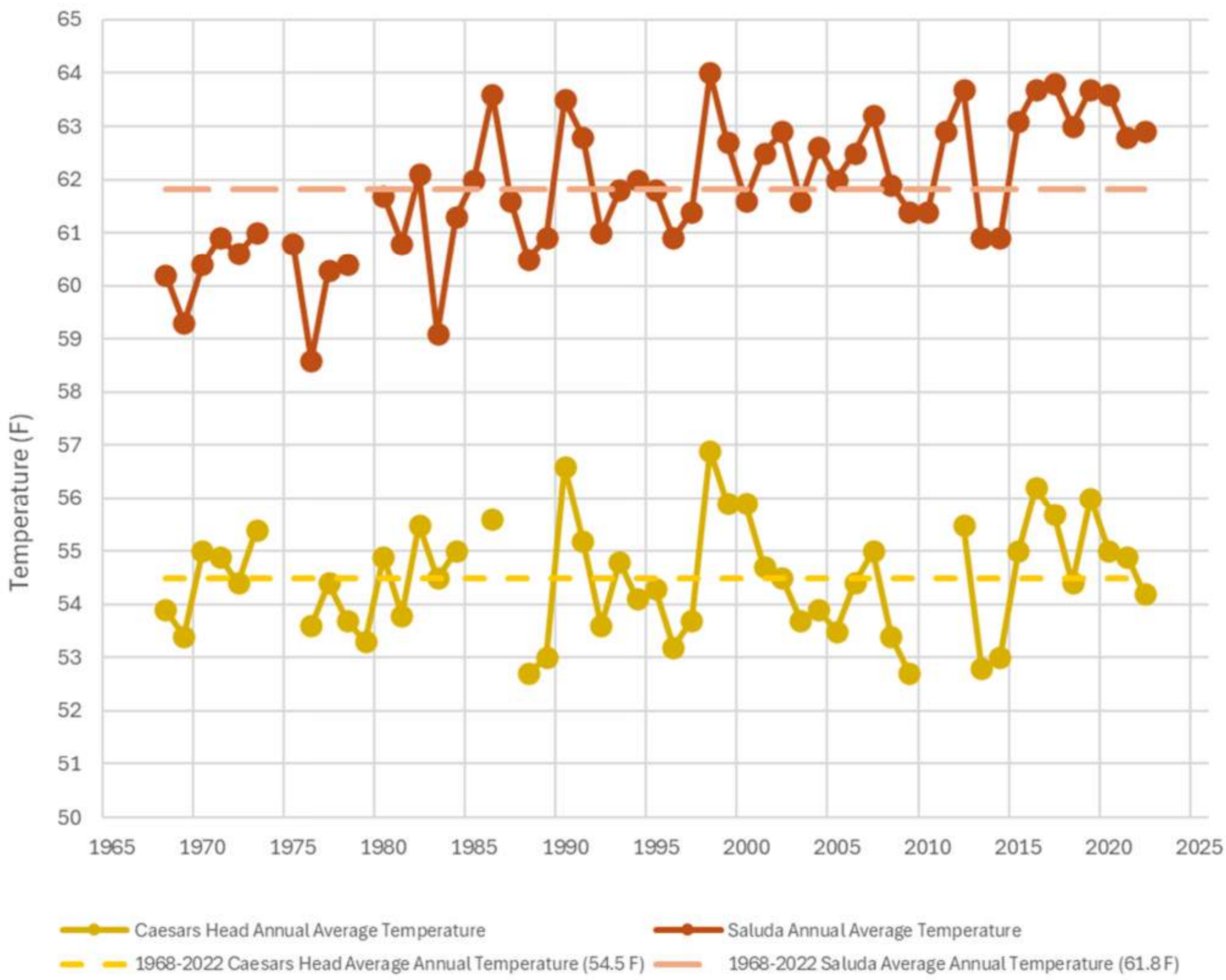


Figure 2-7. Annual average temperature for Caesars Head and Saluda Weather Stations, 1968 to 2022 (SCDNR SCO 2022).

Table 2-3. Comparison of the five warmest and coldest years for Caesars Head and Saluda stations from 1968 to 2022 (SCNDR SCO 2023a).

Rank	Warmest		Coldest	
	Caesars Head	Saluda	Caesars Head	Saluda
1	1998 (56.9°F)	1998 (64.0°F)	1988 (52.7°F)	1976 (58.6°F)
2	1990 (56.6°F)	2017 (63.8°F)	2009 (52.7°F)	1983 (59.1°F)
3	2016 (56.2°F)	2019 (63.7°F)	2013 (52.8°F)	1969 (59.3°F)
4	2019 (56.0°F)	2016 (63.7°F)	2014 (53.0°F)	1969 (60.2°F)
5	2000 (55.9°F)	2012 (63.7°F)	1989 (53.0°F)	1977 (60.3°F)

Figure 2-8 shows the 1968 to 2022 precipitation time series for the Caesars Head and Saluda stations, showing years of above- and below-average annual precipitation. For this period, annual average precipitation was 76.4 in. at the Caesars Head station and 47.0 in. at the Saluda. Table 2-4 shows the driest and wettest five years for each station. Because of the variability in precipitation and the differing climates at the two stations, there are no similarities between the stations for the five driest years. The driest year at Caesars Head was 1981, while the driest year at Saluda was 2001. The two stations share one of the five wettest years on record for the state (1975), which is the fifth wettest year on record for Caesars Head and the wettest on record for Saluda. The wettest year on record for Caesars Head is 2018.

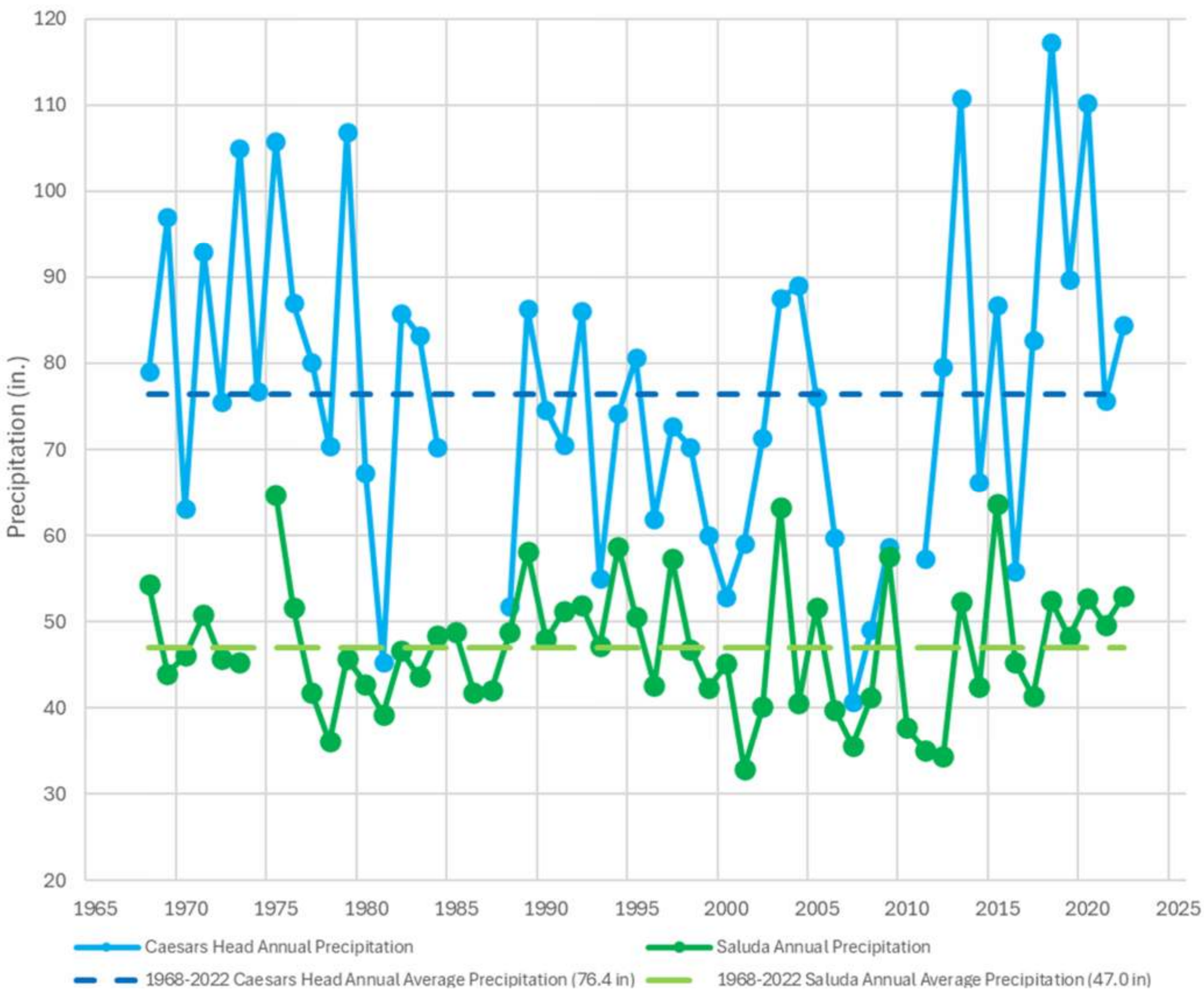


Figure 2-8. Annual average precipitation for Caesars Head and Saluda Weather Stations, 1968 to 2022 (SCDNR SCO 2023a).

Table 2-4. Comparison of five warmest and coldest years for Caesars Head and Saluda stations from 1968–2022 (SCNDR SCO 2023a).

Rank	Driest		Wettest	
	Caesars Head	Saluda	Caesars Head	Saluda
1	1981 (45.24 in.)	2001 (32.92 in.)	2018 (117.29 in.)	1975 (64.76 in.)
2	2008 (49.03 in.)	2012 (34.37 in.)	2013 (110.75 in.)	2015 (63.66 in.)
3	1988 (51.75 in.)	2011 (35.09 in.)	2020 (110.28 in.)	2003 (63. 29 in.)
4	2000 (52.86 in.)	2007 (35.60 in.)	1979 (106.93 in.)	1994 (50.70 in.)
5	1993 (55.07 in.)	1978 (36.08 in.)	1975 (105.83 in.)	1989 (58.12 in.)

Both stations have gaps in the precipitation and temperature time series. As monthly values were missing, accurate annual values could not be calculated; therefore, these years were not included in this dataset. Although Caesars Head lacks data for multiple years in the time series, the time series shows how elevation affects climatology in different parts of the basin. Annual average temperature and precipitation for each station (Figures 2-7 and 2-8) may not match the locations in the basin climatology images in Figure 2-4 because of differences in the periods of record. Long-term station data for Caesars Head and Saluda range from 1968 to 2022; Figure 2-4 is based on climate normals from 1991 to 2020.

2.2.2 Severe Weather

Severe weather, including thunderstorms, tornadoes, and tropical cyclones, may potentially impact some or all portions of the Saluda River basin.

2.2.2.1 Severe Thunderstorms and Tornadoes

There are between 45 and 63 thunderstorm days across the Saluda River basin annually, based on a NOAA analysis from 1993 to 2018 (NOAA 2023b). While thunderstorms occur throughout the year, severe thunderstorms are more common during climatological spring (March, April, and May) and summer (June, July, and August). For a thunderstorm to be considered severe, based on the National Weather Service (NWS) definition, it must produce wind gusts of at least 58 miles per hour (mph), hailstones of one inch in diameter or larger, or a tornado.

Most tornadoes in South Carolina are short-lived Enhanced Fujita (EF) Scale 0 and 1 tornadoes, the lowest strengths on the EF Scale, with winds between 65 and 110 mph. Yet tornadoes with the lowest intensity rating are still dangerous and pose a significant risk to lives and property. Table 2-5 shows the number of tornadoes confirmed within the Saluda River basin by intensity ranking between 1950 and 2022. (For reference, the EF Scale became operational in 2007, replacing the original Fujita [F] Scale used since 1971; historical data are referenced to the EF Scale for simplicity). The Saluda River basin experienced 124 tornadoes between 1950 and 2022, with 35 of them being of significant strength (EF 2 or higher). Lexington County reported the most tornadoes in the basin (20) followed by Greenville County (19) and Laurens County (19). Greenwood, Greenville, Newberry, Laurens, Lexington, Pickens, and Saluda have experienced four significant-strength tornadoes each. The only area within the Saluda River basin that has experienced an EF 4 tornado was Greenwood County. No part of South Carolina, including the Saluda River basin, has ever experienced an EF 5 tornado. SCDNR SCO collected tornado data from the NOAA National Center for Environmental Information Storm Events Database (NOAA 2023c), and from NWS, *Greenville-Spartanburg's Historic Tornadoes in the Carolinas*, and the Northeast Georgia Database (NWS 2023a).

Table 2-5. Count of Tornadoes in the Saluda River basin by intensity ranking, 1950 to 2022 (SCDNR SCO 2023a).

EF Scale	Wind Speed	Count
EF 0	65–85 mph	41
EF 1	86–110 mph	48
EF 2	111–135 mph	27
EF 3	136–165 mph	7
EF 4	166–200 mph	1
EF 5	200+ mph	0
Total Number of Tornadoes in Basin		124

2.2.2.2 Tropical Cyclones

South Carolina has an 80 percent chance each year of being affected by a tropical cyclone (including tropical depressions, tropical storms, or hurricanes). The chance of a major hurricane (a Category 3 storm with winds of 115 mph or higher) affecting the state is about 3 percent each year.

With an average size of approximately 300 mi in diameter, tropical cyclones can have far-reaching hazards, including storm surges, damaging wind, precipitation-induced flooding, and tornadoes, which are typically produced in the outer rainbands of tropical cyclones and can be hundreds of miles from the storm center. For example, Tropical Storm Beryl (1994) moved northeast through the Gulf of Mexico and tracked through Oconee County, South Carolina, as a tropical depression. Although the storm center did not travel through any portion of the Saluda Basin, Beryl produced 23 tornadoes in the state. The worst was an EF 3 tornado that impacted the Town of Lexington, injured 37 people, and caused over $18 million in damage (SCDNR SCO 2023b). Intense rainfall at the top of the Saluda River basin caused severe flooding in northern Greenville County and, at the time, was the worst flooding seen within the basin in 60 years (Figure 2-9).

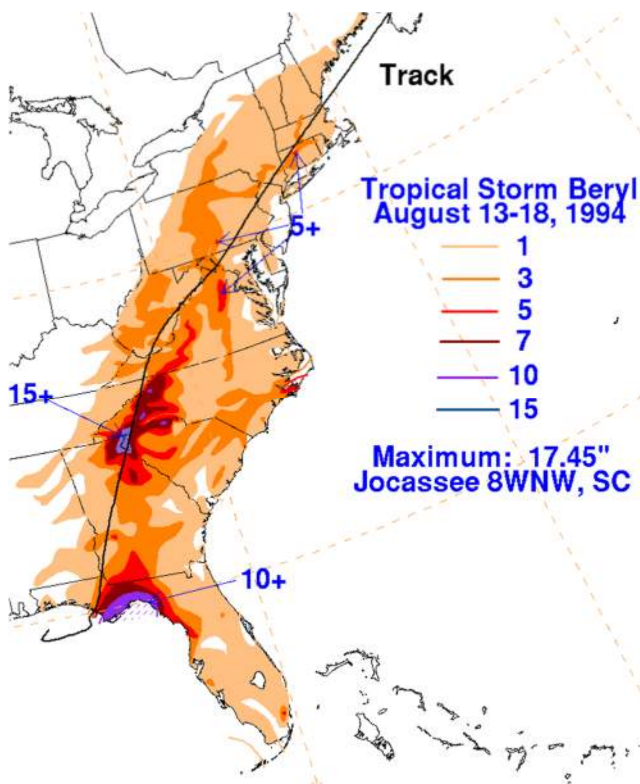


Figure 2-9. Track and precipitation from Tropical Storm Beryl 1994.

Courtesty of NOAA's Weather Prediction Center.

Since 1851, 27 tropical cyclones have tracked through the Saluda River basin. Of these, 15 were unnamed storms (pre-1951) and 12 were named. (The naming of tropical storms and hurricanes started in 1951). As of the publication of this document, the most recent named storm to hit the basin was Tropical Storm Claudette (2021), which affected the basin with the strength of a tropical depression. Because of the spatial extent of tropical cyclones, there have been multiple systems that have affected the Saluda River basin that did not track through the basin boundary.

For more information on tropical cyclones that have affected South Carolina, visit the SCDNR SCO Hurricane and Tropical Storms Database (SCDNR SCO 2023b).

2.2.2.3 Winter Storms

The Saluda River basin has been impacted by multiple winter weather events such as winter precipitation (snow, sleet, ice accumulation, and freezing rain accretion [accumulation]) and extreme cold. The basin has a 30 to 90 percent chance of a snow event each year, with average annual snow accumulations ranging from 1 to 8 in., dependent upon location within the basin. Annual snow probability and mean annual snowfall both decrease from the upper to the lower basin. The mountainous portions of the basin have the highest chance for snow each year and generally possess the highest snow accumulations compared to the rest of the basin. The largest snowfall total in the Saluda River basin was 28.9 in., recorded at Caesars Head February 15 to 17, 1969. This is also the state record for the largest snowfall total (SCDNR SCO 2023c). While other portions of the basin have not received snow accumulations that large, there have been other snow events affecting some or all the basin. Notable snow events, where at least a portion of the basin received 7 in. or more, occurred in February 1973, February 1979, January 2000, and February 2014.

Since 1958, 91 cold or freeze events have affected at least some part of the state; 62 of these affected the Saluda River basin. Multiple noteworthy cold events have occurred in the basin, including in January 1986, December 1989, January 2003, and December 2022. During these events, minimum temperatures in the basin ranged from subzero to the low teens, with minimum temperatures generally colder in the upper portion of the basin compared to the middle and lower portions. Caesars Head reported minimum temperatures of -5°F during the January 1985 event and -3°F during the December 2022 event. These temperatures only account for recorded temperatures and do not consider wind chill values (SCDNR SCO 2023d).

Because of their infrequent occurrence, winter weather events are usually high-impact situations in South Carolina. While winter precipitation mainly impacts travel and transportation, heavy snow accumulations and ice accretions have caused impacts to trees, power lines, and manmade structures. Since 1990, there have been seven freezing rain and ice events that have caused over $100,000 in property damage to South Carolina. These seven events also impacted the Saluda River basin. Impacts from these events were mainly from ice accretions of over half an inch, which damaged power lines, roofs, and trees. However, ice accretions on roads during some events led to car accidents and fatalities. Table 2-6 provides dates of notable winter storms and the estimated damage in dollars to the entire state (SCDNR SCO 2023d).

Table 2-6. Winter storms that have caused significant ice accretion and damage in South Carolina since 1990.

Event Date	Estimated Damage in Dollars*
December 27–28, 1992	$500,000 to $5 million & $500,000 to $5 million (agricultural)
March 13, 1993	$45 million & $38 million (agricultural)
January 2–3, 1999	$1.45 million
December 4–5, 2002	$100 million
January 25–27, 2004	$54 million
January 39–30, 2010	$180,000
January 9–11, 2011	$716,000

*Amounts refer to property damage unless otherwise stated.

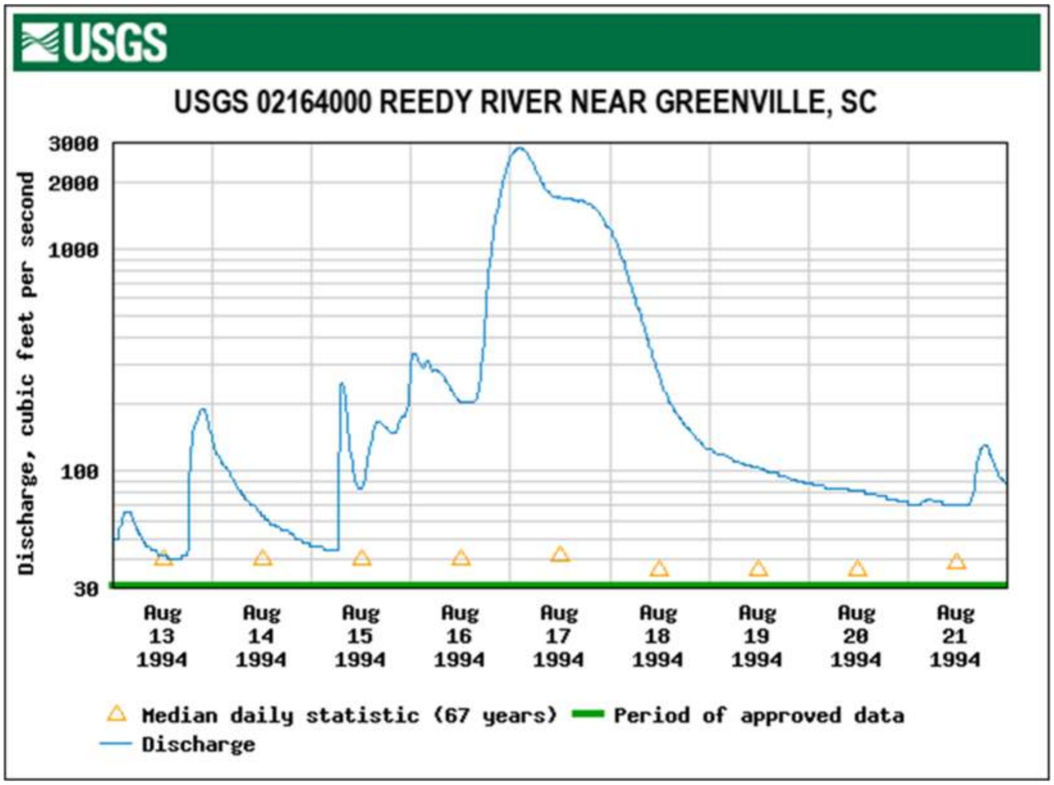
Extreme cold events also cause significant impacts and may freeze waterlines that are close to or above the ground. Waterlines that freeze typically burst, which can cause water loss and flooding inside structures. While these types of events have occurred on a more localized scale over time, large-scale freezing events in the Saluda River basin occurred when minimum temperatures across the basin dropped below 10°F in December 1985, January 1986, January 1994, January 2003, and December 2022. Beyond the water damage inflicted on homes and buildings from waterlines breaking, the large number of breaks caused some water systems to experience a significant drop in water supply. These extreme cold events highlight how natural hazards besides drought and severe weather can impact water supply, infrastructure, and delivery.

For more information about winter weather events that have affected South Carolina, visit the South Carolina State Climate Office Winter Weather Database (SCDNR SCO 2023d).

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. There are three common types of flooding: fluvial, pluvial, and coastal. Fluvial flooding, also known as riverine flooding, is the flooding of typically dry areas caused by the 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 fresh water from a severe or prolonged rain event. Pluvial flooding occurs when rainfall events cause flooding in an area independent of an overflowing body of water. This can occur when drainage systems are overwhelmed, or as flash floods caused by heavy rainfall or from a sudden release of water upstream or uphill. Coastal flooding occurs when seawater inundates land; this can be caused by wind-driven storm surge or tsunamis. The discussion below focuses on pluvial flooding.

Two examples of significant flooding in the basin are from Tropical Storm Beryl (1994) and Tropical Storm Jerry (1995). Both storms came through Florida and Georgia and caused significant flooding in the Saluda River basin and other parts of South Carolina. Beryl produced rainfall totals that ranged from 3.5 to over 6.5 in. across the basin between August 16 and 18, 1994 (Figure 2-9). This high precipitation caused high riverine volumetric flows on the Reedy River near Greenville and the Saluda River near Greenville. On the Reedy River near Greenville, maximum daily flow peaked at 2,830 cubic feet per second (cfs), about 75 times higher than the median daily flow of 40 cfs for that calendar day (Figure 2-10) (USGS 2023a). On the Saluda River near Greenville, maximum daily flow peaked at 6,750 cfs, about 20 times higher than the median daily flow of 350 cfs for that calendar day. While the maximum daily flow on the Reedy River near Greenville was not a top-ten flow event, the maximum daily streamflow on the Saluda River near Greenville on August 17th and 18th were the 5th and 6th highest flows at the time and are currently (as of 2024) the 9th and 10th highest flows (USGS 2023a). Due to Tropical Storm Beryl, the flows on the Reedy River did not reach flood stage. However, the Saluda River surpassed "moderate flood" stage and almost reached "major flood" stage (NWS 2023b).



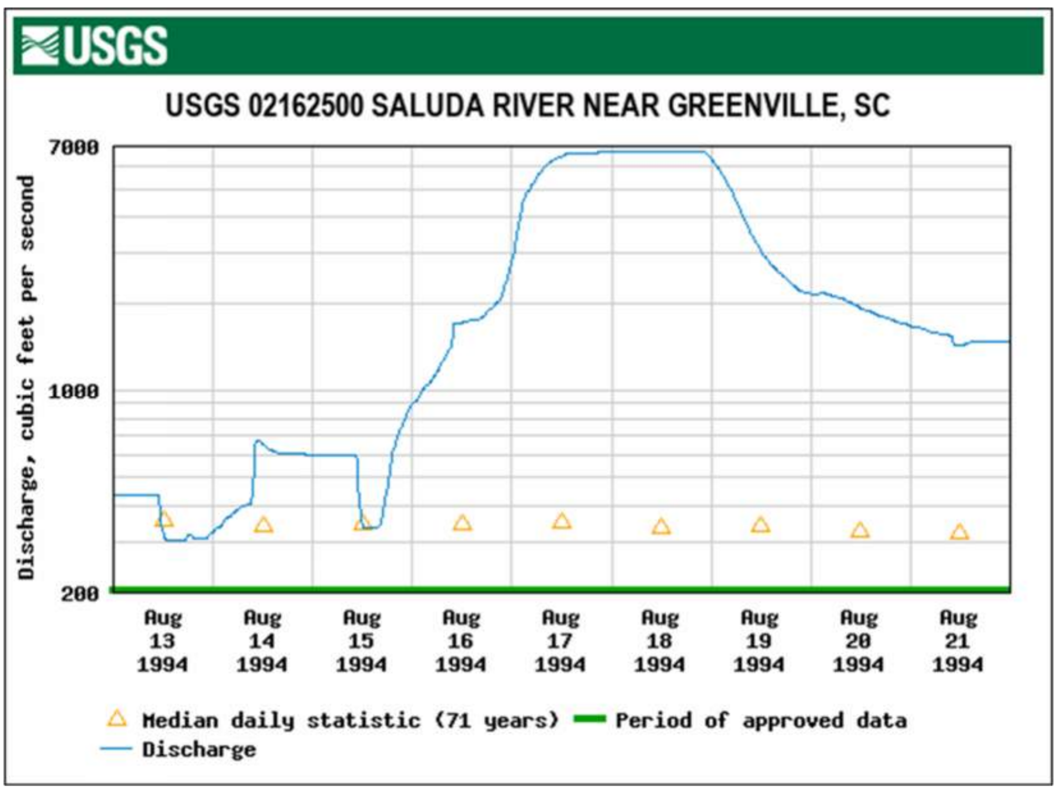


Figure 2-10. Increase in daily flows on the Reedy and Saluda Rivers near Greenville from Tropical Storm Beryl (1994) (USGS 2023a). Period of approved data indicates data that has been approved by the USGS quality control system.

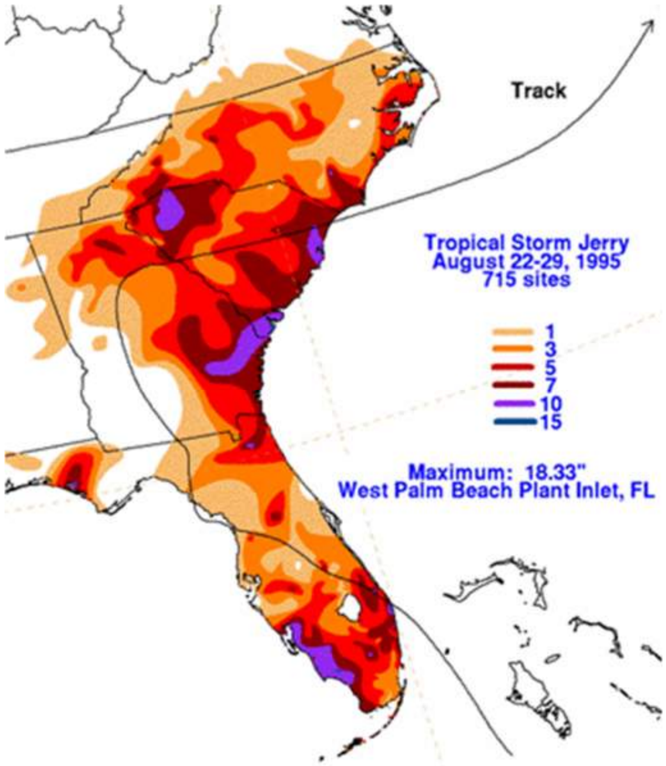


Figure 2-11. Track and precipitation from Tropical Storm Jerry 1995.

Courtesty of NOAA's Weather Prediction Center.

Tropical Storm Beryl (1994) caused the worst flooding in the Saluda River basin in a 60-year period, only to be surpassed a year later by Tropical Storm Jerry. The entire Saluda River basin received rain from Jerry, with basin totals exceeding that from Beryl. In the basin, rain totals ranged from 3.75 to over 14.00 in. (with the station at West Pelzer recording 14.57 in.) (Figure 2-11) between August 22 and 29, 1995. The high precipitation again caused high riverine volumetric flows on the Reedy River near Greenville and the Saluda River near Greenville. On the Reedy River near Greenville, maximum daily flow peaked at 5,400 cfs, about 150 times the median daily flow of 35 cfs for that calendar day (Figure 2-12) (USGS 2023a). On the Saluda River near Greenville, the maximum daily flow peaked at 8,550 cfs, about 28 times higher than the median daily flow of 300 cfs for that calendar day. For both gages, the flows were record high flows at the time. As of the end of September 2024, the record flow value for the Ready River near Greenville occurred on August 27, 1995, while this date holds the second highest flow value for the Saluda River near Greenville gage. Due to Tropical Storm Jerry, the flows on the Reedy River near Greenville reached "action" stage while the Saluda River near Greenville reached "major flood stage" (NWS 2023b).

Although Jerry caused significant flooding in the Saluda River basin, it also caused significant impacts to other portions of the state. To learn more about Jerry, and for more information on historical riverine flooding events across the state, refer to the SCO's *Keystone Riverine Flooding Events in South Carolina* publication (SCDNR SCO 2023e).

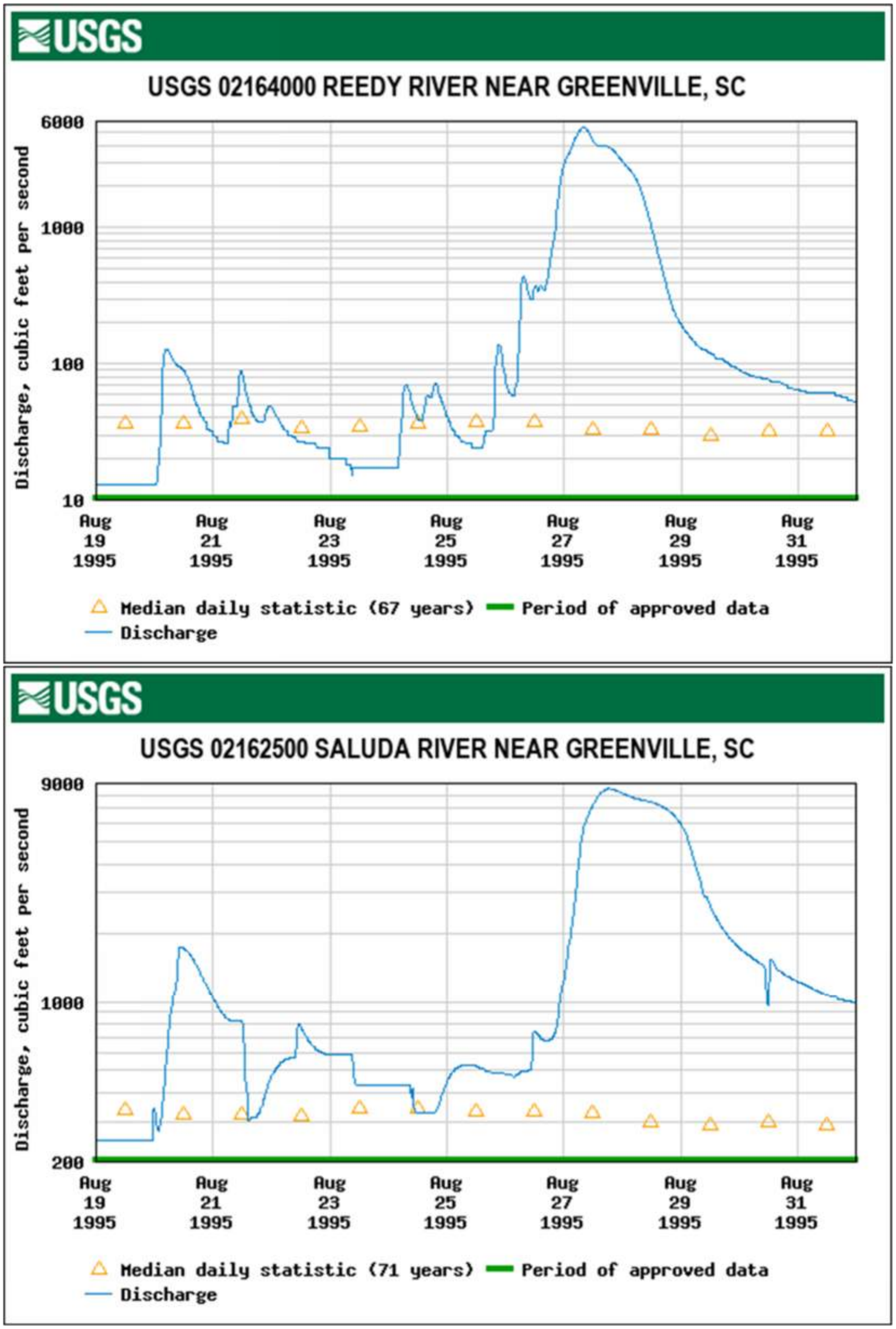


Figure 2-12. Increase in daily flows on the Reedy and Saluda Rivers near Greenville from Tropical Storm Jerry (1995) (USGS 2023a). Period of approved data indicates data that has been approved by the USGS quality control system.

2.2.3 Drought

Drought is a normal part of climate variability and occurs in every climate. Droughts result from a lack of precipitation over an extended period and often produce a water shortage for some activity or sector, or the environment. In contrast to other environmental hazards, droughts often develop slowly over weeks, months, or years. However, sometimes drought events can rapidly intensify due to lack of precipitation and increased evapotranspiration rates (from high temperatures, lower dew points, or increased wind). These events are more commonly known as "flash droughts." Three main categories physically define drought: meteorological, agricultural, and hydrological. These categories help determine the economic, ecological, and societal impacts of droughts in communities.

Figures 2-13 and 2-14 show the annual Standard Precipitation Index (SPI) value for the Caesars Head and Saluda stations, from 1968 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. Any index value equal to or less than -1.0 is considered a drought. The lesser the index value, the more severe the drought. The lowest SPI value was -2.09 for Caesars Head in 1981 and -1.94 for Saluda in 2001. These stations' smallest SPI values match their respective driest years on record. Over the previous decade (2012 to 2021), both stations had SPI values above-average wetness (greater than 1.0) and years of drought (less than -1.0) At the Caesars Head station, 2016 was the last year to have an annual SPI value in drought status (-1.0). At the Saluda station, 2012 was the last year to have an annual SPI value in drought status (-1.0). While 2016 was a drought year for Caesars Head, the annual SPI for Saluda was only -0.76, which does not meet the threshold of a drought. Similarly, 2012 was a drought year for Saluda but the annual SPI value for Caesars Head was 0.68, meaning it was a year of above-average wetness. The differences in the SPI values of these stations show that droughts can affect portions of the Saluda River basin differently.

Annual SPI values do not show short-term monthly or seasonal conditions. During a year with a negative annual SPI value, there can be months or seasons with positive SPI values within, and vice versa. While the annual SPI time series is provided here for reference, it is not the only method used to look 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.

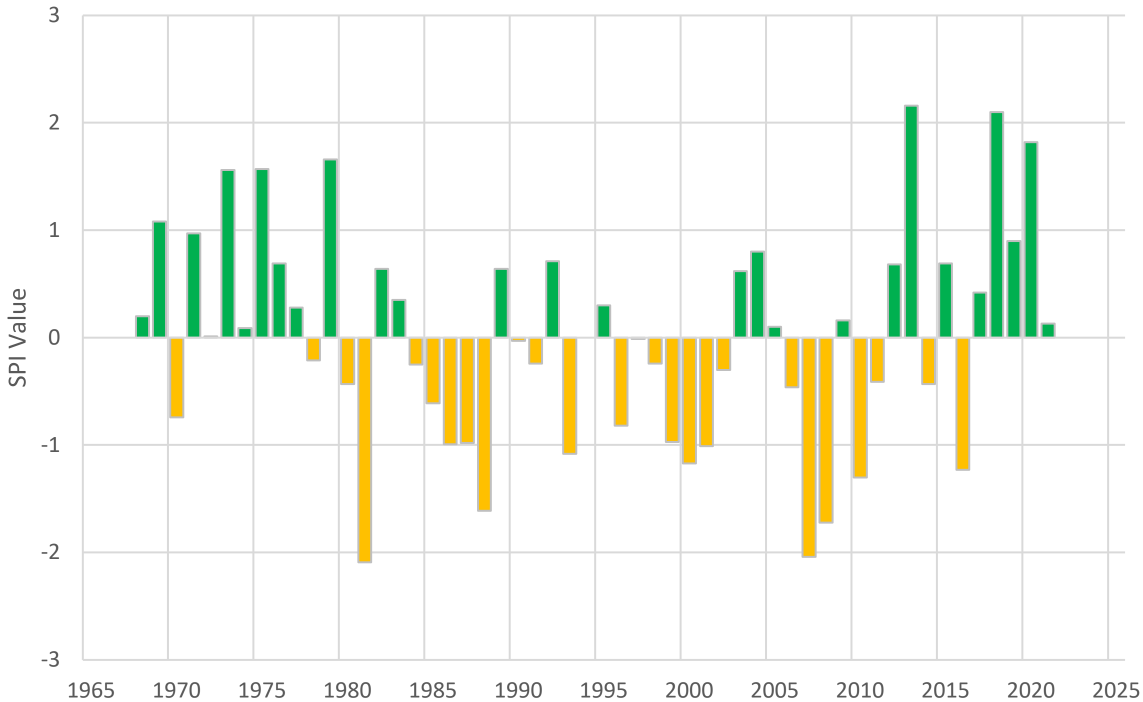


Figure 2-13. Annual SPI values for Caesars Head, 1968 through 2021 (SCDNR SCO 2023f).

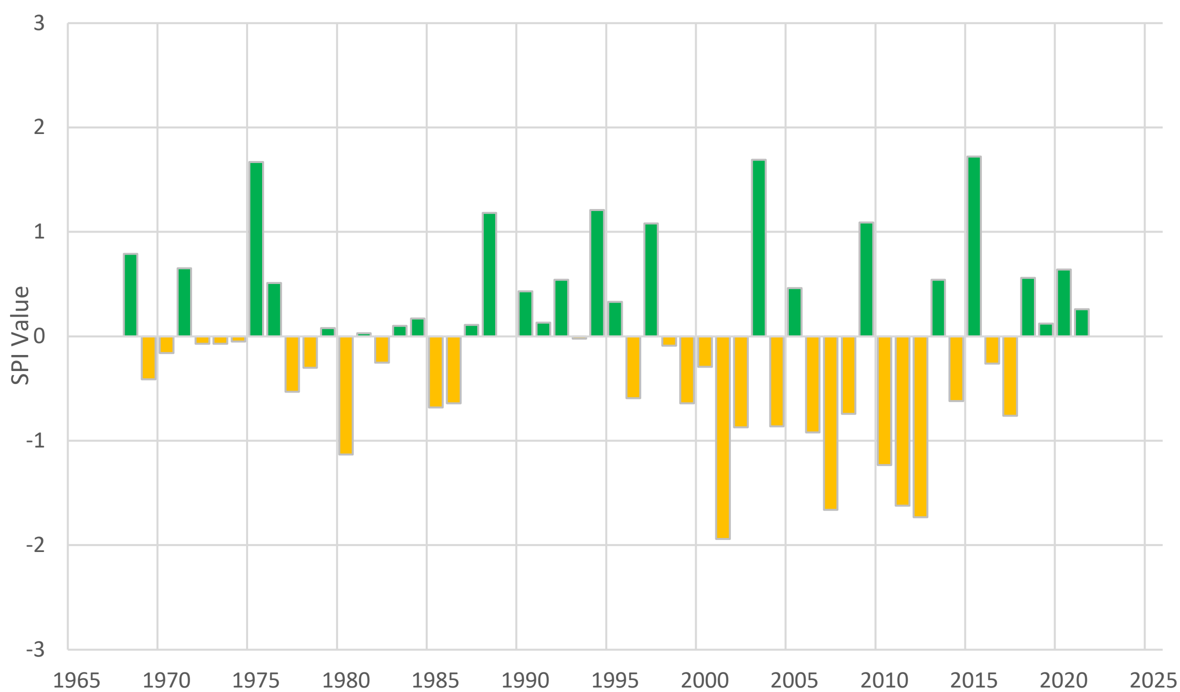


Figure 2-14. Annual SPI values for Saluda, 1968 through 2021 (SCDNR SCO 2023f).

The impact of drought on streamflow in the basin was analyzed using two USGS streamflow gaging stations at different locations. The gage at Saluda River near Chappells is in the middle of the basin, while the gage at Saluda River near Columbia is at the bottom of the basin; however, both are located downstream of dams with controlled releases. These two gages were selected for their long-term, continuous data records. Other stations upstream, such as the Reedy and Saluda Rivers near Greenville (discussed in the flooding subsection), possess multiple years of incomplete data. Table 2-7 shows the lowest monthly average flow and the year in which that low flow occurred for the Saluda River near Chappells and Saluda River near Columbia streamflow gages. Table 2-7 also shows the year with the lowest average annual flow and the long-term average annual flow for that calendar year. Although there are differences between the two gages for record lowest monthly flows, they both experienced their respective record lowest annual flows in 2008.

Table 2-7. Year of lowest monthly and annual average flow compared to the long-term average for the Saluda River at Chappells and Saluda River near Columbia, 1927 to 2022.

Saluda River at Chappells (USGS 02167000)													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Year of Minimum Flow	1956	2017	1988	1986	1940	1940	1940	2007	2008	1954	1953	2007	2008
Minimum Flow (cfs)	679	595	475	646	219	58	53	255	258	243	265	440	679
Saluda River near Columbia (USGS 02169000)													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Year of Minimum Flow	2008	1940	1938	1930	1930	1930	1930	1930	1930	1930	1930	1955	2008
Minimum Flow (cfs)	354	248	155	196	60	50	50	43	66	124	95	350	760

Figures 2-13 and 2-14 and Table 2-7 show that drought is a normal part of climate and hydrology in these areas of the Saluda River basin. While there have been multiple droughts that have affected the basin (1930 to 1935, 1950 to 1957, 1985 to 1986, and 1998 to 2002), the drought of 2007 to 2009 is recent and notable, and is a good benchmark for planning. For portions of the basin, 2007 was one of the climatologically driest years on record, with 2008 being the driest hydrological year on record. The 2007 to 2009 drought started in spring 2007 with drier-than-normal conditions, which elevated to drought conditions in early summer. In June 2007, the South Carolina DRC declared all 46 counties in moderate drought status. For reference, the DRC can classify counties in 5 different categories: normal status, incipient, moderate, severe, or extreme drought status. By September 2007, the DRC had placed 44 counties in severe drought status, with Jasper and Beaufort Counties staying in moderate drought status. The DRC retained the drought statuses throughout winter and early spring 2008. In April 2008, conditions had improved slightly and the DRC placed 20 counties in incipient, 14 counties in moderate, and 12 counties in severe status. Conditions deteriorated again in June 2008, but the peak of the drought occurred in August 2008, when 44 counties in the state were classified in some level of drought, with four in incipient, 21 in moderate, 5 in severe, and 14 in extreme status. Of the 10 counties in the

Saluda River basin, two counties were in moderate and eight counties were in extreme status. Although conditions improved after this point, parts of the state and the Saluda River basin remained in severe or extreme drought until February 2009. This was the last time the DRC classified any portion of the State in extreme drought status. It was not until June 2009 that the DRC changed the basin and the rest of the State back to normal status, 2 years after the entire State was classified as moderate drought status.

The 2007 to 2009 drought caused severe impacts across multiple sectors, including agriculture, recreation, forestry, and public water supplies. Agricultural impacts included a reduction in crop yields, yield loss, and decreases in the ability to adequately feed livestock. During this drought, 2007 was the worst year for corn production within the basin, with some counties reporting yields 40 percent below normal (Carolinas Precipitation Patterns & Probabilities 2023). For soybean production, 2008 was the worst year of the drought, with production decreasing to 40 percent of normal. Hay production was impacted more severely: 2007 yields were 20 to 40 percent below normal basin-wide, with many producers worrying about hay supplies not lasting through the winter into 2008. Hay production in the basin in 2008 was not much better than in 2007, with some yields as low as 30 percent below normal. Yields in the basin improved in 2009, with multiple counties reporting above-average yields of corn, soybeans, and hay.

During this same drought, the recreation industry experienced impacts from low flows that exposed hazards to boats and negatively affected businesses that relied on river recreation for income. Statewide, the forestry industry felt impacts because of increased fires from low soil moisture content and tree stress from reduced water availability. Early in the drought, in July and August 2007, wildfire numbers were above normal, with 518 fires and 2,730 acres burned. By April 2008, the number of wildfire numbers were above the annual average for the January through April period, with 2,800 fires and 17,000 acres burned (SCDNR SCO 2008a). By September 2008, the state had a 66 percent increase in the number of acres burned compared to the 5-year average (SCDNR SCO 2008b). It would not be until April 2009 that the risk of wildfires would start to wane because of an improvement in conditions.

The intensity and duration of the 2007 to 2009 drought also impacted public water supplies. By June 2007, six water systems across the state had implemented voluntary restrictions and two had implemented mandatory restrictions. By September, 10 water systems had voluntary restrictions and five had mandatory restrictions. In October 2007, the SCDNR sent a survey of water systems in the state to compile data on how they were responding to the current drought. Of the 263 systems that returned the survey, as of February 2008, 191 water systems across the state had some level of water conservation, with 146 systems implementing voluntary restrictions and 45 implementing mandatory restrictions (SCDNR SCO 2008c). Of the 14 water systems within the Saluda River basin, five reported voluntary restrictions. The other nine water systems did not report any type of restrictions.

In July 2008, the Governor, along with SCDNR, released a statement encouraging water conservation. Although this targeted counties in severe or extreme drought statuses, specifically in Upstate South Carolina, it was a message to all residents on how to conserve water inside and outside the home (SCDNR SCO 2008d). While this message only encouraged water conservation, the Governor has seldom used executive authority to encourage water conservation, indicating how severe the situation had become in the Upstate area.

The encouragement of water conservation across the State was because of reduced hydrologic conditions. Based on USGS basin average flows, monthly flows in the Saluda basin were below normal (less than the 25th percentile) for the 22-month period from May 2007 to February 2009. For 15 of the months within this period of time, the basin experienced monthly flows that were well below normal (less than the 10th percentile). Finally, In March 2009, monthly flows returned to the normal range (25th to 75th percentile) (USGS 2023b).

Although the 2007 to 2009 drought was historically not the most intense drought for South Carolina, it was a significant drought for the Saluda River basin. More information on historical drought events across the state, some of which have affected the Saluda River basin, can be found in the SCDNR SCO's *Keystone Drought Events in South Carolina* publication (SCDNR SCO 2023g).

Although South Carolina typically receives adequate precipitation, droughts can occur at any time of the year and last several months to several years. While precipitation is the main driver for water availability in the Saluda River basin, multiple factors, such as temperature, evapotranspiration, and water demands also need to be considered when evaluating how drought periods will impact stream and river flows in the basin. Because drought causes a lack of water across multiple sectors at different times, it is essential to plan for drought so that water demands can be adequately met and managed both before and during a severe drought.

2.3 Natural Resources

2.3.1 Soils, Minerals, and Vegetation

The USDA NRCS divides South Carolina into six land resource areas based on soil conditions, climate, and land use, as shown in Figure 2-15. These areas generally follow the boundaries of the state physiographic provinces (Section 2.1.3) but are defined based on soil characteristics and their supported land cover types. The Saluda River basin is primarily in the Southern Piedmont major land resource area, with small portions of the basin extending to the Blue Ridge Mountains and Carolina-Georgia Sandhills land resource areas. The land resource area descriptions below were originally presented in the South Carolina State Water Assessment (SCDNR 2009).

- The Blue Ridge Mountains land resource area consists of dissected, rugged mountains with narrow valleys. Most soils are moderately deep to deep and are located on sloping-to-steep ridges and side slopes. The underlying material consists mainly of weathered schist, gneiss, and phyllite. The area is predominantly forested with a mixture of oak, hickory, and pine. Small farms within the area produce truck crops, hay, and corn.

- The Southern Piedmont land resource area is a region of gentle to moderately steep slopes with broad-to-narrow ridge tops and narrow stream valleys. The area is covered with strongly acidic, firm clayey soils formed mainly from gneiss, schist, phyllite, and Carolina slate. The area is forested with mixed hardwoods and various pines. Cotton, corn, and soybeans are the major crops grown in the area.

- The Carolina-Georgia Sandhills land resource area consists of strongly sloping, sandy soils underlain by sandy and loamy sediments. Approximately two-thirds of the region is covered by forest types dominated by mixed pine and scrub oaks. With well-drained to excessively drained soils, the region supports cotton, corn, and soybean growth.

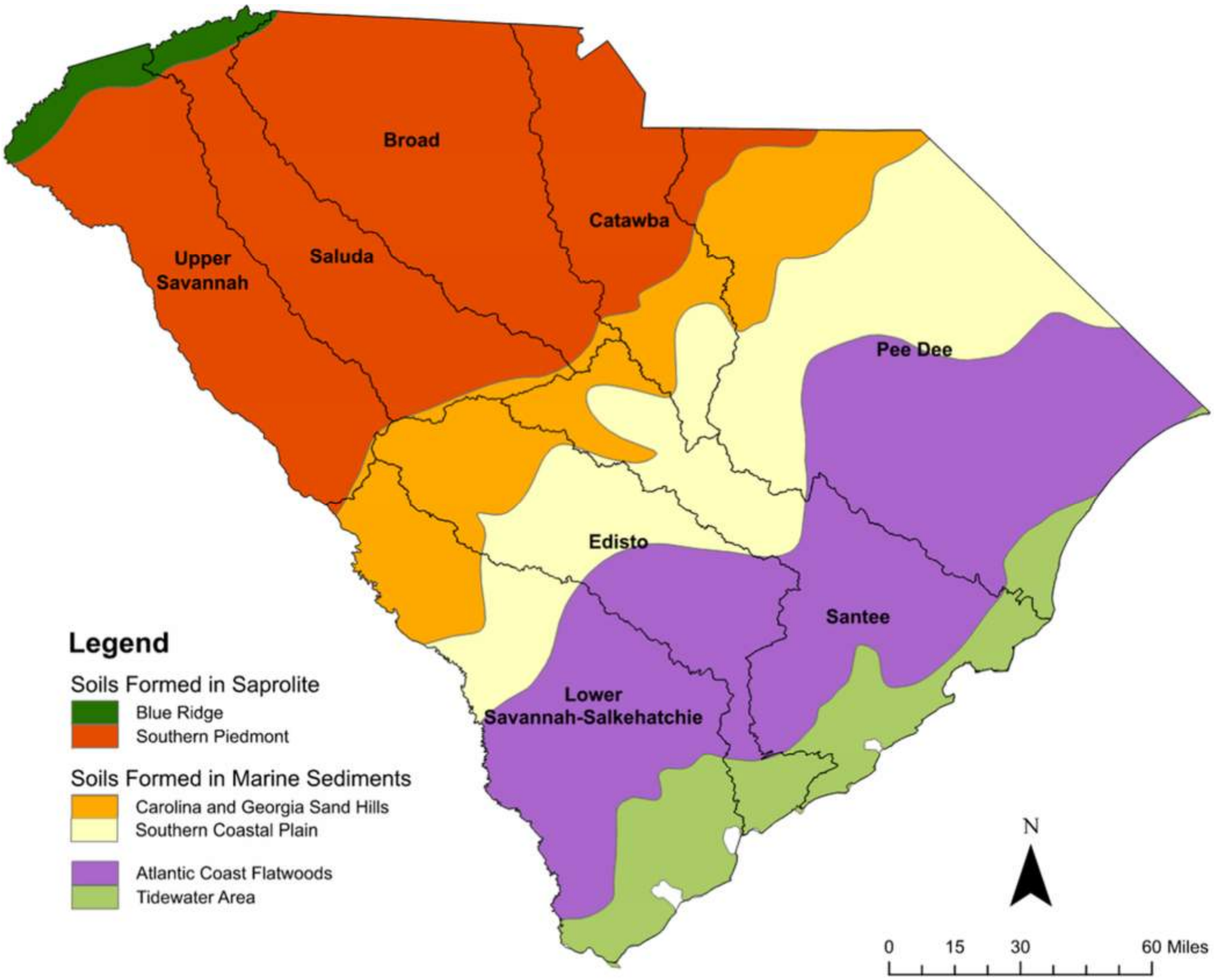


Figure 2-15. Generalized land resource and soils map of South Carolina.

Twenty-seven active mines exist within the Saluda River basin, most of which are in Greenville (9), Lexington (5), and Newberry (5) Counties. The most common mined materials are sand (16), granite (4), and vermiculite (4) (SCDHEC 2023a). According to the most recently published USGS Minerals Yearbook (USGS 2022a), in 2019 South Carolina produced $1.15 billion in nonfuel minerals, consisting primarily of cement, gold, sand and gravel, and crushed stone. These mines constitute 5.5% of the total number of mines in the state. Principal commodities in South Carolina include cement (masonry and Portland), clay (kaolin), sand and gravel (construction), and stone (crushed) (USGS 2022a).

2.3.2 Fish and Wildlife

The rivers and tributaries of the Saluda River basin are the most ecologically diverse for fish in South Carolina, with 84 species of freshwater fish present (SCDNR 2023c). Seventy-one of these species are native to the area. The basin accounts for 60 percent of South Carolina's native freshwater fish diversity in only 8 percent of the state's area. Eighteen Regional Fish Species of Greatest Conservation Need are present within basin waters, the most of any South Carolina basin. Fish commonly found in the basin include redbreast sunfish, greenfin shiners, and Piedmont darters. The North, Middle, and South Saluda tributaries, as well as several mountain lakes in the basin, are stocked with a mix of rainbow, brook, and brown trout, among other popular recreational fish such as striped bass (SCDNR 2023d). Populations of largemouth bass and black crappie are managed throughout the basin, and fish habitat enhancement projects remain ongoing in Lake Greenwood and Lake Murray.

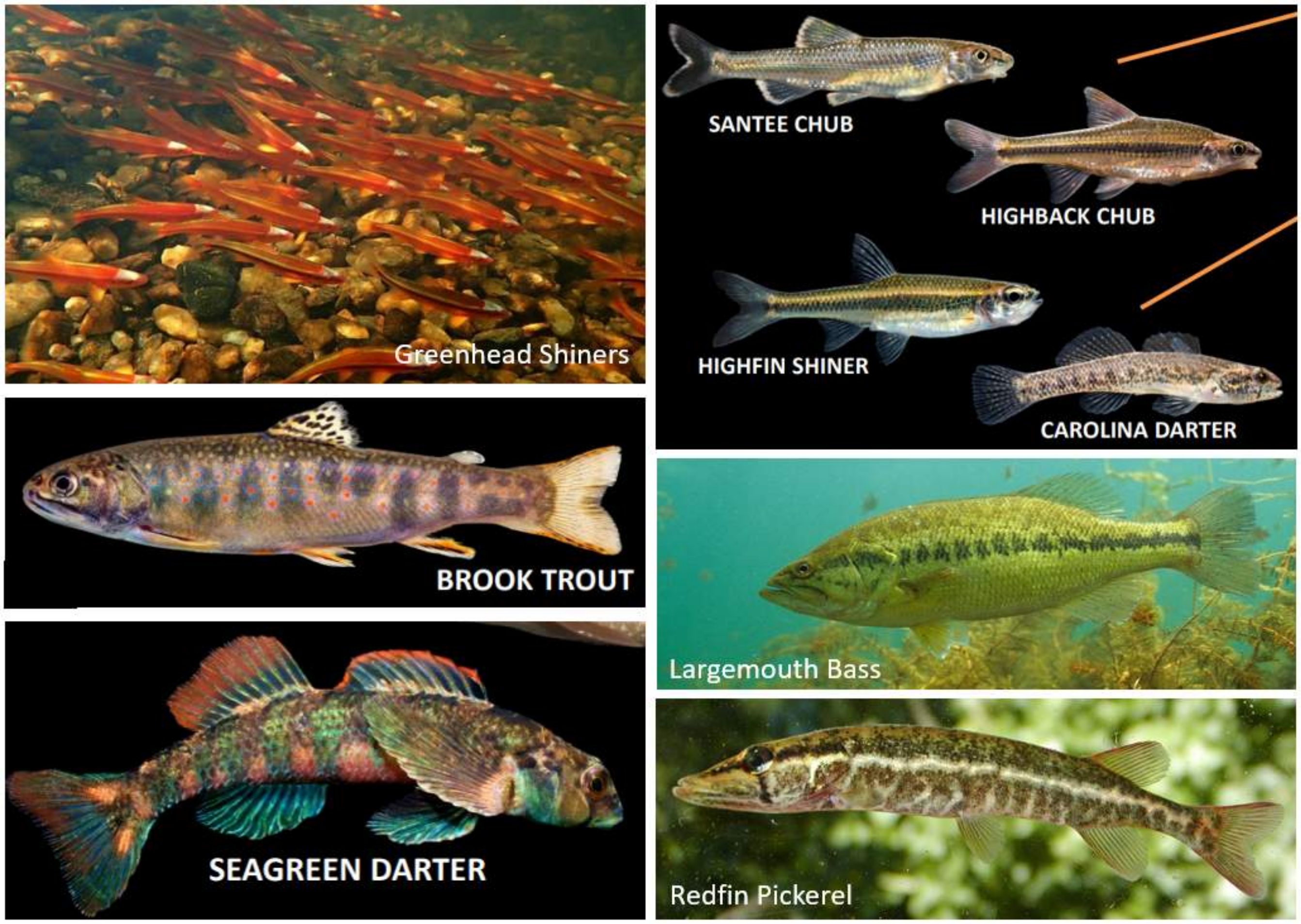


Figure 2-16. Representative species within the Saluda River basin.

The Saluda River basin provides habitat for numerous rare, threatened, and endangered species. In the 10 counties with more than 0.1 percent of their land area within the basin, there are 12 federally endangered species and eight federally threatened species. The basin is also home to seven state-listed endangered species and nine state-listed threatened species (SCDNR 2023e). The bald eagle, protected by the Bald and Golden Eagle Protection Act, has been noted in all 10 of these counties. The tricolored bat, which has been placed on the proposed federally endangered list, has been noted in all counties except Saluda. A list of the threatened and endangered species within the 10 counties examined is provided in Table 2-8.

Table 2-8. Federal- and state-listed endangered and threatened species in Saluda River basin counties (SCDNR 2023e).

Federal Endangered	Federal Threatened	State Endangered	State Threatened
Red-cockaded woodpecker	Pool sprite, snorkelwort*	Red-cockaded woodpecker	Bald eagle
Harperella	Swamp pink	Webster's salamander	Southern hog-nosed snake
Carolina heelsplitter*	Dwarf-flower heartleaf	Rafinesque's big-eared bat	American peregrine falcon
Rusty-patched bumble bee	Small whorled pogonia, little five-Leaves	Bewick's wren	Bog turtle*
Rock gnome lichen	Monkey-face orchid, white fringeless orchid	Wood stork	Eastern small-footed bat
Northern long-eared bat	Wood stork	Shortnose sturgeon*	Spotted turtle*
Bunched arrowhead*	Smooth purple coneflower	Carolina gopher frog*	Coal skink
Mountain sweet pitcherplant	Black rail	-	Pine barrens tree frog
White irisette, isothermal irisette	-	-	Carolina pygmy sunfish*
Shortnose sturgeon*	-	-	-
Pocosin loosestrife, roughleaf loosestrife	-	-	-
Canby's cowbane	-	-	-

** Aquatic or semi-aquatic species*

2.3.3 Natural and Cultural Preserves

The Saluda River basin is well known for its natural and cultural resources. The South Carolina Heritage Trust program was founded in 1974 to protect significant cultural sites, as well as critical natural habitats that tracked species of concern depend upon. There are three natural preserves designated by the South Carolina Heritage Trust program within the Saluda River basin (SCDNR 2019b). All are located in its upper reaches across the Blue Ridge Mountains and part of the Mountain Bridge Wilderness and Recreation Area (MBWRA) owned and managed by SCDNR:

- Watson-Cooper Heritage Preserve/Wildlife Management Area – The over 1,700-acre Watson-Cooper Heritage Preserve helps link the watersheds of the Table Rock and North Saluda Reservoirs with an unbroken chain of undeveloped mountain land. This preserve/wildlife management area protects the only montane bog habitat (distinguished from other bottomland forests by the presence of mossy open areas) in South Carolina and the only population of swamp pink (*Helonias bullata*), a federally threatened species, in the state. Many other rare flora and fauna are found here, including painted trillium (*Trillium undulatum*) and Appalachian cottontail (*Sylvilagus obscurus*).

- Bald Rock Heritage Preserve – The 165-acre preserve adjoins Caesars Head State Park. The rock of its namesake is a popular tourist destination that provides scenic and panoramic views of the mountains and foothills of the Blue Ridge. The preserve protects two headwater streams vital to the growth of many rare and nationally threatened plant species, including Piedmont ragwort (*Packera millefolium*) and grass-of-Parnassus *(Parnassia palustris*).

- Ashmore Heritage Preserve/Wildlife Management Area – The 1,125-acre preserve is near Caesars Head State Park. It protects many rare plants and animals, including Piedmont ragwort (*P. millefolium*) and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). Recreation trails extend throughout the preserve for visitors to enjoy.

There are five additional state parks within the Saluda River basin: Dreher Island, Lake Greenwood, Table Rock, Caesars Head, and Jones Gap (South Carolina State Parks 2023).

Two segments of the Saluda River (within Jones Gap State Park and in the river's lowest reaches near the confluence with the Broad River) are designated as State Scenic Rivers. Like other stretches of the river, these sections are noted for their diverse plant and animal life. In Jones Gap State Park, the river is adjacent to largely undeveloped and pristine natural areas. In its lower reaches, it is proximate to with historic manmade structures, many placed on the National Register of Historic Places. Major environments in the scenic river areas include levee and bottomland forests, upland pine forests, needle-leaved evergreen forests, hardwood forests, and pine-mixed hardwood forests (SCDNR 2000).

Approximately 6 percent, or approximately 150 sq mi, of the Saluda River basin is conserved land (The Nature Conservancy 2024). Land within the basin is primarily conserved through private organizations and state government entities, as shown in Figure 2-17.

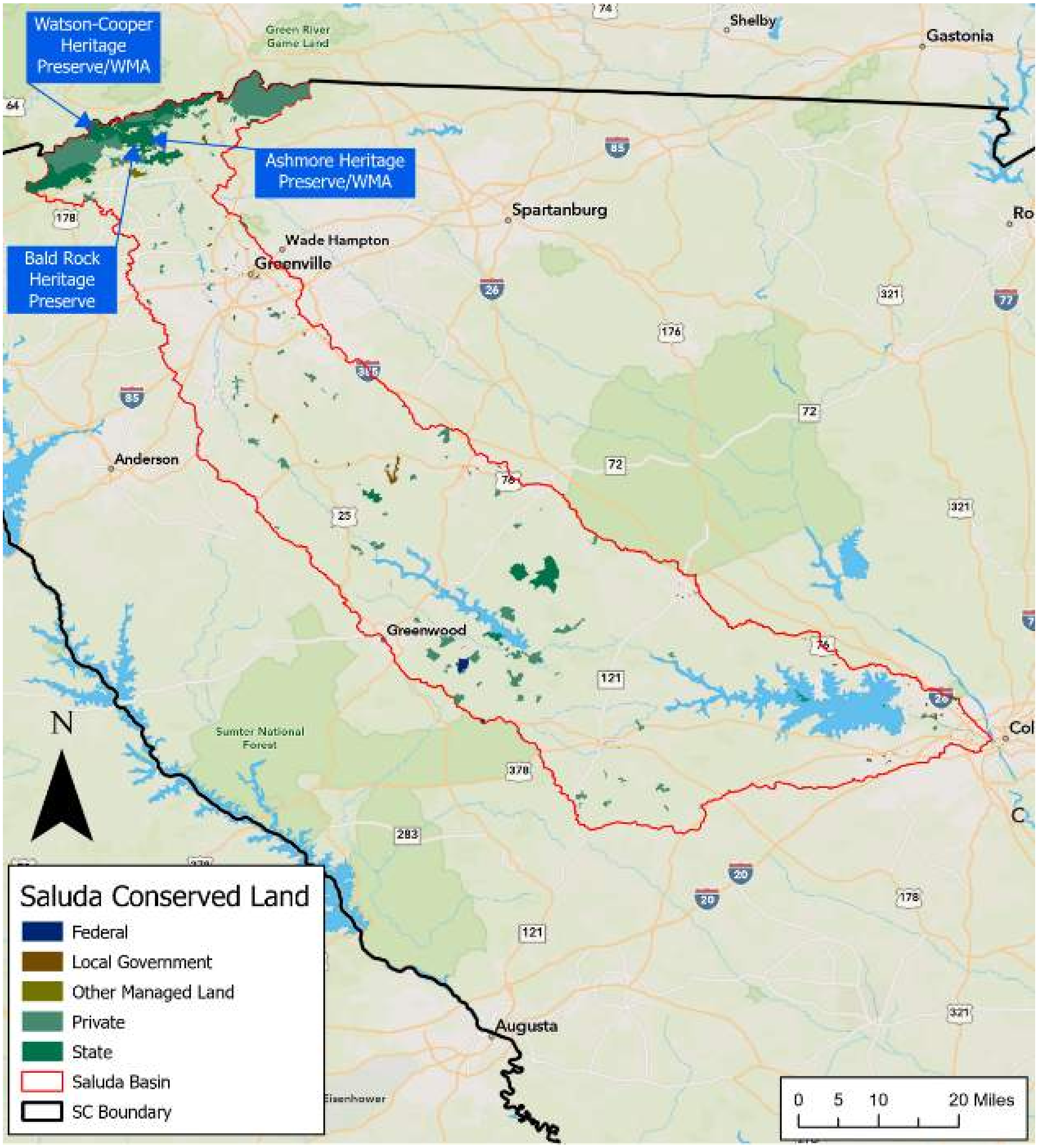


Figure 2-17. Conserved land within the Saluda River basin.

2.4 Agricultural Resources

2.4.1 Agriculture and Livestock

Farming, including the production of both crops and livestock, has historically been a central feature of the Saluda River basin. While agricultural land has been gradually replaced with urban development near major metropolitan areas such as Greenville and Columbia, a significant agricultural economy is present elsewhere in the basin.

Total crop and livestock sales for 9 of the counties (Abbeville County excluded) with greater than 0.1 percent of their land area within the basin totaled just over $1.0 billion in 2017 (Smith and Buckelew 2023). Top agricultural products include poultry and beef, as well as corn, cotton, hay, peanuts, soybeans, and wheat. A strong peach-growing presence also exists within the basin, with over 4,000 acres of peaches grown in Saluda County (Smith and Buckelew, 2023).

The NRCS, which inventories land that can be used to produce the nation's food supply, has categorized 35 percent of the basin as prime farmland and 23 percent as farmland of statewide importance, as shown in Table 2-9 and Figure 2-18 (USDA NRCS 2017). Prime farmland is defined as land containing the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, and a water supply that is dependable and of adequate quality. It is also 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 appropriate farming methods.

Table 2-9. Area of NRCS-categorized farmland in the Saluda River basin.

Farmland Type	Acres	Square Miles	Percent of Basin
Prime farmland	568,960	889	35.0%
Farmland of statewide importance	378,880	592	23.0%
Farmland of local importance	64	0.1	<0.1%
Not prime farmland	668,160	1,044	41.0%
Total	1,615,400	2,524	100.0%

Figure 2-18. Location of NRCS-categorized farmland in the Saluda River basin.

The total agricultural economic output of 10 major counties within the basin is shown in Figure 2-19. This figure confirms that most agricultural output occurs in the lower half of the basin, centered around counties such as Lexington, Saluda, and Newberry. Based on the locations of prime farmland within the basin depicted in Figure 2-18, these counties are among those with the greatest proportion of choice agricultural land. Counties in the north of the basin, such as Greenville and Pickens, are largely mountainous, steeply sloped, and, therefore, have less land amenable to farming.

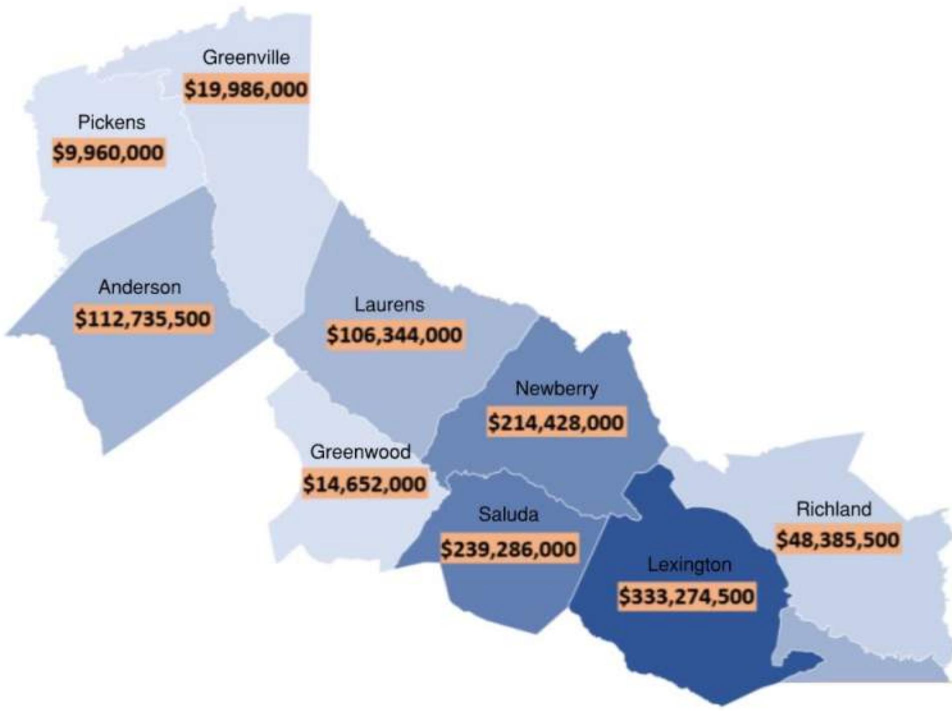


Figure 2-19. Agricultural economic output from major counties within the Saluda River basin.

As of March 2023, there were 1,777 active livestock operations in the Saluda River basin, shown in Figure 2-20 (SCDHEC 2023b). Raising poultry accounts for two-thirds of active operations and is followed by cattle, which makes up about a quarter of active operations. Livestock operations of all varieties are predominantly concentrated within the lower half of the basin, most significantly in Saluda, Laurens, and Newberry Counties. The dominant form of livestock operation varies by county. Livestock operations are virtually absent in the northern part of the basin.

Data from the Census of Agriculture suggests that the number of farm operations in South Carolina and irrigated acres of counties within the Saluda River basin each increased by roughly 13 percent between 2002 and 2017, as shown in Figure 2-21. However, while statewide irrigated acreage more than doubled in that timeframe, irrigated acreage within the Saluda River basin fluctuated between a 20 and 40 percent increase. This more modest increase, compared to the rest of the state, may reflect the low availability of groundwater in the basin because of its absence of large aquifers (Section 2.3.1). Historical trends in reported Saluda River basin irrigation reveal a sharper increase in irrigated land between 1992 and 2002. Within that period, the number of farms with irrigation and the amount of irrigated land each jumped by over 60 percent. In 2017, there were 564 reported farms within the basin possessing some form of irrigation, with a combined 22,987 irrigated acres. This is up from 498 farms and 16,785 acres in 2002, and 303 farms and 10,356 acres in 1992 (USDA National Agricultural Statistics Service [NASS] 2017).

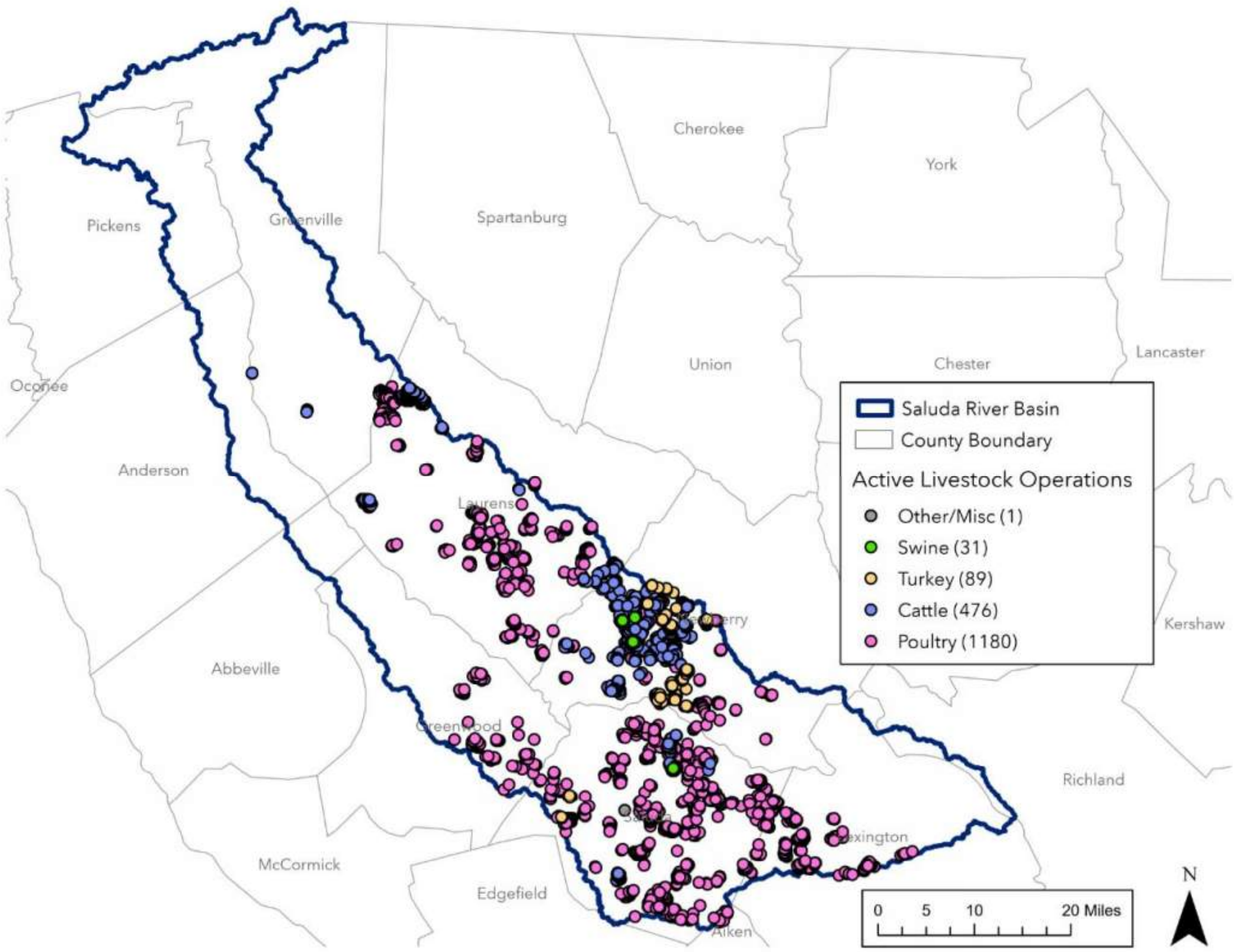


Figure 2-20. Active livestock operations in the Saluda River basin.

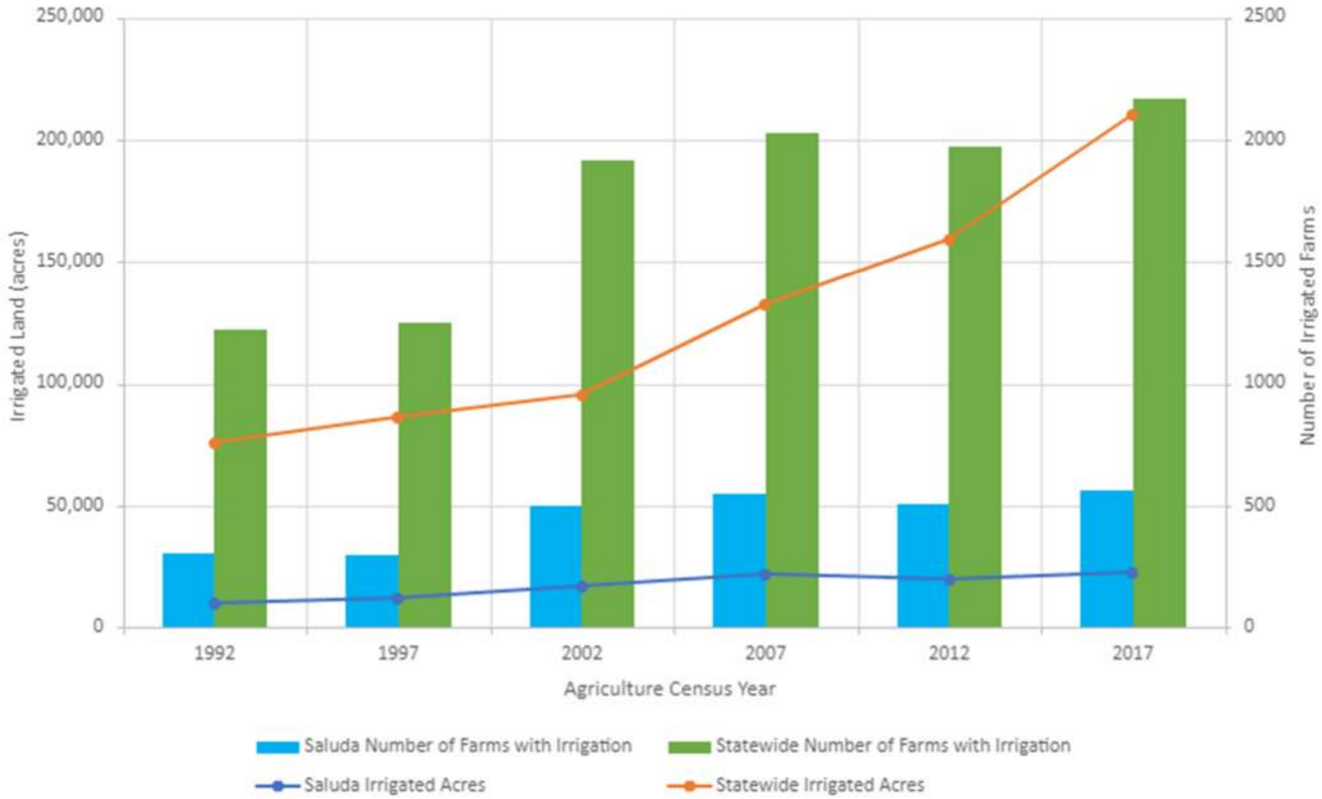


Figure 2-21. Number of farm operations and irrigated acreage for counties containing the Saluda River basin and statewide, 1992 to 2017 (USDA NASS 1997, 2007, 2017).

Additional 2017 Census of Agriculture data for Anderson, Lexington, Laurens, Newberry, and Saluda Counties, which represent the top five most productive counties in the Saluda River basin based on economic data, are shown in Table 2-10 (USDA NASS 2017). Top commodities within these counties include hay, soybeans, corn, and poultry. Basinwide totals are also included.

The amount of water needed annually by the major row crops grown within the Saluda River basin varies. Corn requires the most water per season on average, at roughly one million gallons per acre per year. This is followed by peanuts and soybeans, which use approximately 500,000 gallons per acre per year, and cotton, which uses around 430,000 gallons per acre per year. These average water uses may serve as an approximation of the total water demand these crops generate within the Saluda River basin, although their actual water usage may differ based on yield goal, genetic variety, and local environment (Smith and Buckelew 2023).

An agricultural water use survey conducted by Clemson University in 2018 found that surface drip irrigation is the most used irrigation technique in counties within the Saluda River basin, followed by subsurface drip irrigation (Sawyer et al. 2018). The water use survey represented a limited sample of statewide irrigation practices as it was based on responses from 167 participants representing practices used on 75,000 acres of irrigated land in the state. Statewide, most respondents noted groundwater as their main source of irrigation water (141), with other sources being lake/pond (29), river/stream (14), municipal (7), and recycled (2). Table 2-11 lists the irrigation techniques used by survey respondents who own farming operations in the Saluda River basin.

Table 2-10. Summary of 2017 Census of Agriculture for counties in the Saluda River basin (USDA NASS 2017).

	Anderson	Lexington	Laurens	Newberry	Saluda	Basin Total
Percentage of County Area in Saluda River Basin	17.3%	35.5%	62.4%	49.3%	89.1%	100%
Total Farm Operation (acres)	183,718	102,585	122,322	94,810	119,495	882,421
Total Cropland (acres)	69,888	47,761	40,898	31,591	33,307	286,599
Total Harvested Cropland (acres)	49,162	34,203	31,612	24,476	25,823	208,901
Total Irrigated Land (acres)	612	13,177	410	1,181	5,399	22,987
Total Hay and Haylage Harvested (acres)	37,860	13,350	28,840	13,111	13,727	144,817
Total Soybeans Harvested (acres)	7,228	2,898	(D)	3,089	594	14,787
Total Corn (Grain) Harvested (acres)	1,268	6,784	91	1,227	1,921	12,151
Total Cotton Harvested (acres)	(D)	1,595	–	(D)	–	1,595
Total Vegetables Harvested (acres)	346	8,397	143	54	(D)	9,311
Total Wheat Harvested (acres)	2,705	692	602	1,774	444	6,591
Total Corn (Silage) Harvest (acres)	(D)	(D)	1,079	2,869	1,429	5,377
Total Orchards Harvested (acres)	250	222	128	95	5,067	6,569
Total Peanut Harvested (acres)	–	1,284	–	–	–	1,284
Total Oats Harvested (acres)	326	111	50	218	242	985
Total Cattle Operations (number)	14	323	378	293	303	2,433
Total Cows/Beef Operations (number)	14	259	350	249	285	2,188
Total Cows/Milk Operations (number)	–	6	9	9	5	46
Total Hogs Operations (number)	2	52	17	26	29	252
Total Sheep Operations (number)	3	29	44	25	10	232
Total Chicken Layers (egg) Operations (number)	7	190	151	111	43	969
Total Chicken Broilers (meat) Operations (number)	–	74	16	14	43	180
Total Commodity Sales ($ million)	75	222	71	143	160	710
Total Crop Sales ($ million)	10	72	9	6	19	133
Total Animal Sales ($ million)	65	150	62	137	141	577

D – Not shown to avoid disclosure of confidential information; estimates are included in higher-level totals.

Table 2-11. Irrigation techniques used in the Saluda River basin (Sawyer et al. 2018)*.

General	High Efficiency	Precision
Center Pivot, Fixed Rate	Drip – Surface	Hand Watering
Traveling Gun	Drip – Subsurface	–
Solid Set	Micro-Irrigation	–
Portable Pipe	–	–
Other (not specified)	–	–

*Center pivot, fixed rate with best nozzle technology (a high-efficiency type) may also be used; however, this category was not included in the survey.

2.4.2 Silviculture

While not as prominent as other industries, silviculture is important in the Saluda River basin. South Carolina Forestry Commission (SCFC) timber production values for 2021 are summarized in Table 2-12 (SCFC 2022). Harvested timber values are categorized as both "stumpage," the value of standing trees on the stump, and "delivered," the value of logs when they are delivered to the mill. The latter considers all costs associated with cutting, preparing, and hauling timber to mills. Many of the mountainous counties in the north of the basin, such as Anderson, Greenville, and Pickens, rank low in delivered timber value. For instance, Pickens County is ranked last of the 46 counties. Counties in the middle and lower portion of the basin rank slightly higher, with Newberry County ranking first in the state for delivered timber value.

Table 2-12. Value of timber for counties in the Saluda River basin with state ranking.

County	Acres of Forestland	Percent Forest	Harvest Timber Value (in Millions)		Delivered Value Ranking (out of all 46 SC Counties)
			Stumpage	Delivered	
Abbeville	262,549	76%	7.0	14.9	32
Anderson	195,015	44%	2.4	5.4	43
Greenville	218,555	46%	2.3	5.0	44
Greenwood	212,656	70%	11.0	23.2	2
Laurens	335,129	74%	8.2	18.5	30
Lexington	256,920	52%	4.3	9.0	40
Newberry	341,564	80%	15.2	30.3	1
Pickens	227,860	68%	1.0	2.3	46
Richland	304,311	66%	8.3	18.8	29
Saluda	208,498	74%	10.0	20.6	2
Statewide	**12,849,182**	**66%**	**573.7**	**1,162.3**	**-**

Based on 2021 estimates from SCFC (2022).

2.4.3 Aquaculture

Limited data are available on aquaculture in the basin. However, the 2017 Census of Agriculture lists several farms with aquaculture sales within the basin, shown in Table 2-13. Richland County possesses the greatest diversity of aquaculture farms, while Pickens County possesses the greatest number these farms.

Table 2-13. Number of aquaculture farms in Saluda River basin counties.

	Saluda	Newberry	Lexington	Pickens	Anderson	Richland
Percentage of County Area in Saluda River Basin	89.1%	49.3%	35.5%	30.7%	17.3%	2.7%
Catfish	–	–	4	2	–	1
Other Food Fish	–	–	–	–	–	1
Crustaceans	–	–	–	–	2	-
Ornamental Fish	–	–	–	2	–	1
Sport or Game Fish	1	2	1	2	–	1

2.5 Socioeconomic Environment

2.5.1 Population and Demographics

Although the Saluda River basin covers 8 percent of the state's land area, it contains more than 17 percent of its population. The estimated Saluda River basin 2020 population of 886,793 has increased by approximately 13 percent since 2010. A population density map using data from the 2020 census is shown in Figure 2-22 (U.S. Census Bureau 2020).

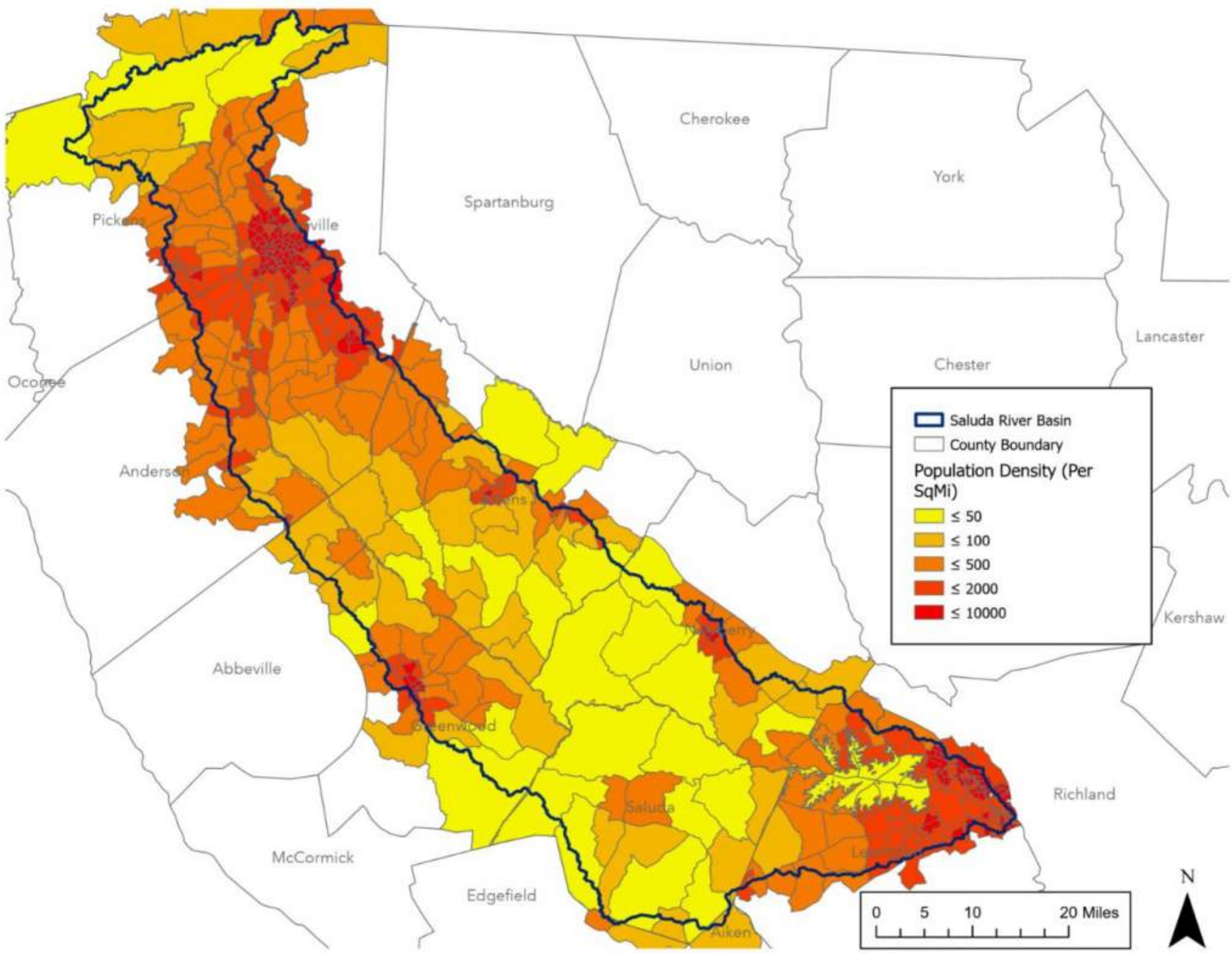


Figure 2-22. Population density of the Saluda River basin by census block group (U.S. Census Bureau 2020).

The Saluda River basin comprises a diverse mix of rural and urban areas. Most major urban areas are found along the Interstates 26 and 385 corridors, which combined, run the length of the basin. Greenville ranks as the fifth largest city in South Carolina, with approximately 70,000 residents, and its metropolitan population of over 900,000 is the highest medium-to-high population density in Upstate South Carolina. Greenville is also regularly ranked as one of the fastest growing cities in the United States. The City of Columbia and its surrounding suburbs throughout Richland and Lexington Counties comprise the predominant urban area in the lower third of the basin. Columbia, the capital of South Carolina, is the second largest city in the state with 139,698 residents. Its metropolitan area covers portions of six different counties, containing over 800,000 people. The middle reaches of the Saluda River basin are the most rural, with comparatively small urban areas centered around the cities of Greenwood (approximately 22,000 residents), Newberry (approximately 10,000 residents), and Laurens (approximately 9,000 residents) (U.S. Census Bureau 2020).

Population changes within the Saluda River basin from 2010 to 2020 are shown in Figure 2-23 (U.S. Census Bureau 2020). In general, the population is growing throughout the basin; more census blocks have increased in population than decreased. However, the most intensive population growth in the basin has occurred within areas of already existing high population density throughout the Greenville and Columbia metropolitan areas. Slower growth and, in some cases, population reduction, have occurred in the middle of the basin, with scattered pockets of greater population reduction. When the population projections of each major county within the basin are averaged, the Saluda River basin population is projected to grow 7.9 percent by 2035 (South Carolina Revenue and Fiscal Affairs Office 2019).

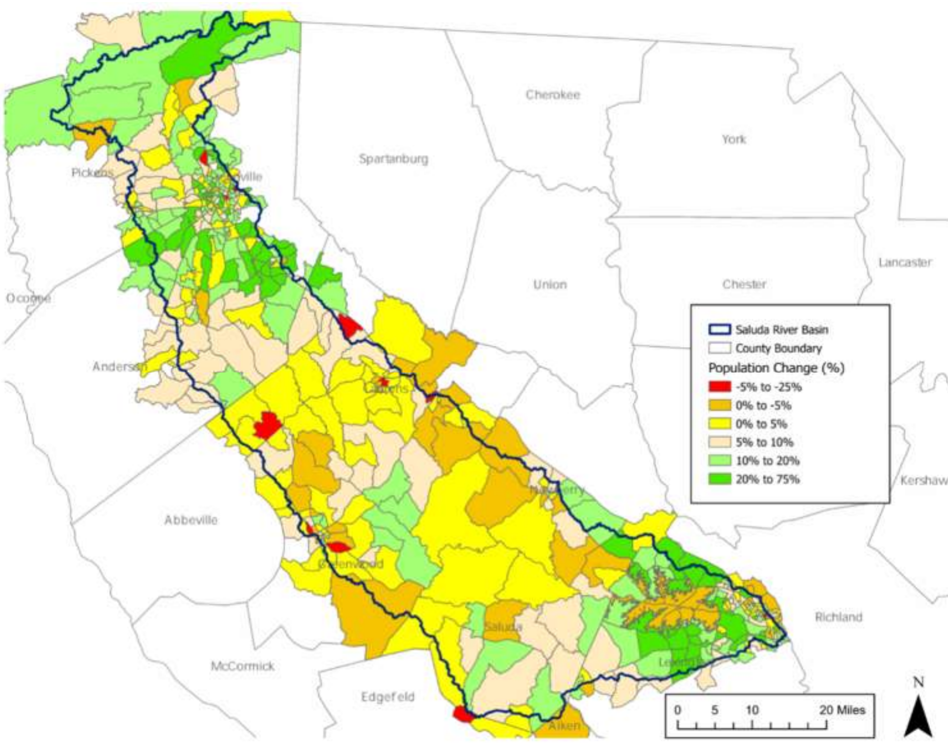


Figure 2-23. Change in Saluda River basin population from 2010–2020 (U.S. Census Bureau 2020).

The 2021 per capita income of counties that are partially or fully within the basin is provided from the U.S. Bureau of Labor Statistics and shown in Table 2-14. The 2021 per capita income for the 10 major counties within the basin ranges from $40,596 (Abbeville County) to $55,442 (Greenville County). The average income across the basin is $47,245, which is lower than the statewide average of $52,467.

Income rankings across the state for the Saluda River basin are mixed. Some counties, such as Abbeville and Laurens, fall within the bottom quartile, while others, such as Greenville, Lexington, and Richland, fall within the top 10. The percentage of the population below the poverty line for counties that intersect the basin ranges from 10.1 percent (Lexington County) to 18.5 percent (Laurens County). The average percentage of the population below the poverty line of these counties is 15.3 percent, which is higher than the state average of 14.5 percent (South Carolina Revenue and Fiscal Affairs Office 2021).

Table 2-14. 2021 per capita income for counties within the Saluda River basin.

County	2021 Per Capita Personal Income	Rank in State	Percent Change from 2020
Abbeville	$40,596	42	+6.6%
Anderson	$46,894	20	+6.7%
Greenville	$55,442	5	+5.9%
Greenwood	$44,723	25	+7.1%
Laurens	$41,245	38	+7.2%
Lexington	$55,304	6	+6.6%
Newberry	$46,917	19	+8.6%
Pickens	$43,842	28	+6.6%
Richland	$52,980	8	+6.4%
Saluda	$44,503	26	+10.1%
Saluda River Basin Average	**$47,245**	**-**	**+7.2%**
Statewide Average	**$52,467**	**-**	**+6.8%**

2.5.2 Economic Activity

The U.S. Bureau of Economic Analysis (BEA) tracks real gross domestic product (GDP) by county. The 2021 GDPs from the eight counties with more than 10 percent of their area within the Saluda River basin are shown in Table 2-15 (U.S. BEA 2021a). Data from select counties, including a mix of those with the greatest GDP and the greatest land area within the basin, are included. Several industries, including agriculture and manufacturing, rely heavily on the water resources of the Saluda River basin. The distribution of employment by industry sector for these counties is shown in Table 2-16 (U.S. BEA 2021b).

Table 2-15. 2021 GDP of select counties in the Saluda River basin (in thousands of dollars).

Industry Type	*Combined Counties	Greenville	Saluda	Lexington
All industry total	73,206,260	36,995,479	554,847	15,097,882
Private industries	64,056,037	33,826,012	476,319	12,792,294
Agriculture, forestry, fishing, and hunting	191,142	8,473	34,985	52,852
Mining, quarrying, and oil and gas extraction	116,142	15,203	0	45,968
Utilities	888,990	34,525	1,027	313,994
Construction	3,480,993	1,854,712	16,922	829,587
Manufacturing	13,682,182	5,505,737	195,311	2,008,272
Durable goods manufacturing	7,486,788	2,812,261	724	1,005,461
Nondurable goods manufacturing	6,195,393	2,693,476	194,587	1,002,810
Wholesale trade	7,010,725	4,678,074	9,744	1,413,073
Retail trade	5,340,390	2,358,677	20,345	1,462,653
Transportation and warehousing	1,728,518	758,287	(D)	624,074
Information	2,475,345	1,660,871	(D)	601,842
Finance, insurance, real estate, rental, and leasing	11,484,691	5,879,752	126,133	2,532,762
Finance and insurance	2,665,009	1,820,457	5,598	490,114
Real estate and rental and leasing	8,819,684	4,059,296	120,535	2,042,648
Professional and business services	7,795,352	5,861,192	(D)	1,155,664
Professional, scientific, and technical services	3,731,543	2,773,027	(D)	559,667
Management of companies and enterprises	934,277	747,591	(D)	130,502
Administrative and support and waste management and remediation services	3,270,829	2,340,574	(D)	465,494
Educational services, health care, and social assistance	5,288,947	3,183,438	(D)	834,600
Educational services	632,209	413,347	(D)	51,257
Health care and social assistance	4,656,738	2,770,091	(D)	783,344
Arts, entertainment, recreation, accommodation, and food services	2,600,635	1,319,416	8,392	510,677
Arts, entertainment, and recreation	344,631	193,483	2,042	50,672
Accommodation and food services	2,256,005	1,125,933	6,351	460,006
Other services (except government and government enterprises)	1,593,615	707,656	(D)	406,277
Government and government enterprises	9,150,223	3,169,466	78,528	2,305,588

*Includes only counties with >10% of their area within the Saluda River basin

D = Not shown to avoid disclosure of confidential information; estimates are included in higher-level totals

Table 2-16. Average percent employment by sector for all counties (12) in the Saluda River basin, 2021.

Industry Sector	Saluda River Basin Average Percent Employment
Farm employment	2.8%
Forestry, fishing, and related activities	1.0%
Mining, quarrying, and oil and gas extraction	<1.0%
Utilities	<1.0%
Construction	5.5%
Manufacturing	16.3%
Wholesale trade	2.6%
Retail trade	9.7%
Transportation and warehousing	3.5%
Information	<1.0%
Finance and insurance	3.6%
Real estate and rental and leasing	3.6%
Professional, scientific, and technical services	4.5%
Management of companies and enterprises	<1.0%
Administrative and support and waste management and remediation services	7.7%
Educational services	1.8%
Health care and social assistance	8.0%
Arts, entertainment, and recreation	1.6%
Accommodation and food services	7.0%
Other services (except government and government enterprises)	6.0%
Government and government enterprises	15.5%

< – less than

2.6 Conclusion

The Saluda River basin, the fourth largest water resource planning basin in South Carolina, is an important part of South Carolina's heritage. Within this basin, from the high Blue Ridge Mountains of the north to the rolling sandhills of the south, are many of South Carolina's great natural and manmade wonders. The basin boasts three heritage preserves, five state parks, and the greatest level of freshwater biodiversity anywhere in the state. It possesses major population centers, beautiful and productive rural areas, and a great assortment of industry and economic outputs. With over 16 percent of the basin used for agriculture and over 35 percent classified as prime farmland, the Saluda River basin also constitutes a major agricultural center within South Carolina. This wealth of land and resources has attracted thousands to reside within the basin's borders. The population of the Saluda River basin has grown rapidly in previous decades and is projected to continue growing. With an average basinwide projected population growth of 7.9 percent, proper management of the water resources within the Saluda River basin has never been more critical.

Chapter 3
Water Resources of the Saluda Basin

3.1 Surface Water Resources

3.1.1 Major Rivers and Lakes

The Saluda River is the main watercourse of the Saluda River basin in South Carolina. The river's headwaters originate in the Blue Ridge physiographic province of South Carolina, and the river flows across the Piedmont before joining with the Broad River near Columbia and forming the Congaree River. Major tributaries of the Saluda River are the Reedy River, Rabon Creek, Little River, Bush River, and Little Saluda River. No other river basins flow into the Saluda River basin, which shares a common northern boundary with North Carolina. The Saluda basin has a 2,505-sq mi drainage area (SCDNR 2009). Two river segments in the basin are designated as State Scenic Rivers: a 5-mi stretch of the Middle Saluda River was the first river designated in 1978, and a 10-mi stretch of the Saluda River was designated in 1991 (SCDNR 2009).

The largest reservoirs in the basin are Lake Murray and Lake Greenwood, both on the Saluda River. In the upper part of the Saluda River basin, streamflow has been affected by two water supply reservoirs: Table Rock Reservoir on the South Saluda River and North Saluda (Poinsett) Reservoir on the North Saluda River (SCDNR 2009). Similarly, streamflows in the lower part of the river have been impacted by controlled releases from Lake Murray and Lake Greenwood since the 1930s. Surface water development in the subbasin is discussed in more detail in Section 3.1.3.

Figure 3-1 shows the location of the Saluda River basin and the major riverine wetland types present.

3.1.2 Surface Water Monitoring

At the end of the 2023 water year (September 30, 2023), there were 36 active gaging stations operated by the USGS in the Saluda River basin in South Carolina, which report daily data. Twenty-five of the active stations report daily mean discharge (flow), seven report only daily mean stage, and the remaining four report daily precipitation or water quality data.

An additional 11 gaging stations are no longer active but provide historical streamflow data. Table 3-1 lists the gaging stations in the basin and provides the first and last years of their periods of record, their drainage areas, and select daily streamflow statistics through September 30, 2023 (where available and with USGS provisional data included). Gaging stations that do not record daily mean discharge data are included but streamflow statistics are excluded (cannot be tabulated). The locations of both active and inactive gaging stations are shown in Figure 3-2. The highest recorded streamflow on the Saluda River was 75,000 cfs near Silverstreet in 1929.

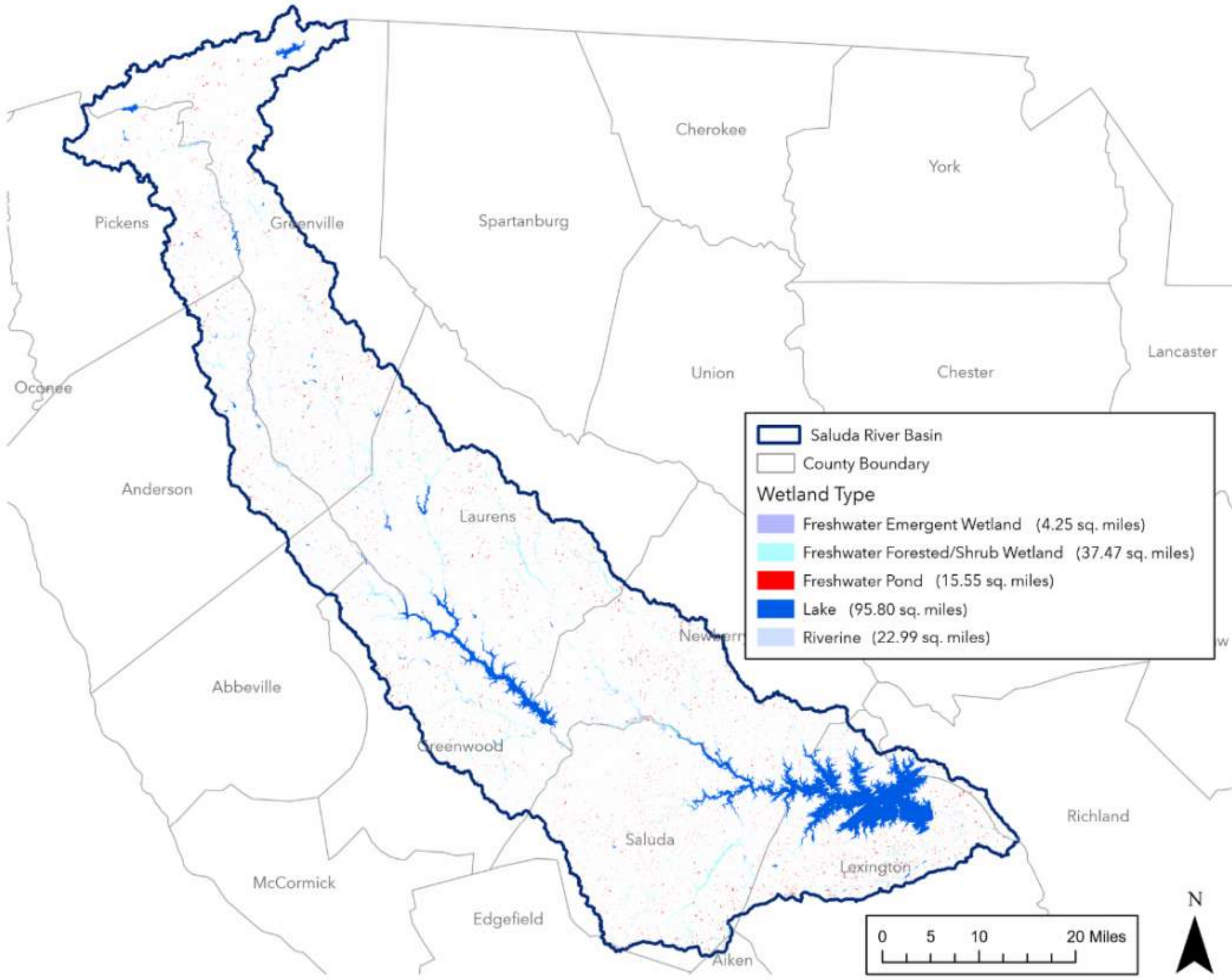


Figure 3-1. Wetland types of the Saluda River basin (U.S. Fish and Wildlife Service [USFWS] 2023).

Table 3-1. Streamflow characteristics at USGS gaging stations in the Saluda River basin.

Map Identifier	Gaging Station Name	Station Number	Period of Record[1]	Drainage (mi^2)	Average Daily Flow (cfs)	90% Exceeds Flow[2] (cfs)	Minimum Daily Flow (cfs) and Year	Maximum Daily Flow (cfs) and Year
1	South Saluda River near Rocky Bottom	021622845	2017-present	8.5	41	16	8.1 (2019)	472 (2018)
2	Slicking Creek near Rocky Bottom	021622847	2017-present	3.0	15	4.7	2.2 (2023)	205 (2017)
3	Table Rock Reservoir Tailrace near Cleveland[8]	02162287	2017-present	15	41	2.3	1.3 (2019)	594 (2018)
4	South Saluda River near Cleveland	02162290	2000-present	18	39	4.6	1.3 (2000)	2,730 (2004)
5	Middle Saluda River near Cleveland	02162350	1980-present	21	61	19	6.6 (2002)	1,160 (1994)
6	North Saluda River near Highland	021623950	2017-present	5.8	16	6.1	4.0 (2019)	263 (2020)
7	Big Falls Creek near Tigerville	021623957	2016-present	5.9	18	6.9	4.2 (2023)	177 (2020)
8	North Saluda River above Slater	021623975	2011-present	44	69	16	6.0 (2011)	1,040 (2020)
9	Saluda River near Greenville	02162500	1942-present	298	617	218	27 (2017)	10,200 (2020)
10	Hamilton Creek (RD 135) near Easley	02162525	1981-1986	1.6	2.9	0.80	0.09 (1986)	77 (1985)
11	Saluda River above I-85 near Golden	02162550	2022-present	341	583	267	119 (2022)	2,740 (2023)

Table 3-1. Streamflow characteristics at USGS gaging stations in the Saluda River basin (Continued).

Map Identifier	Gaging Station Name	Station Number	Period of Record[1]	Drainage (mi^2)	Average Daily Flow (cfs)	90% Exceeds Flow[2] (cfs)	Minimum Daily Flow (cfs) and Year	Maximum Daily Flow (cfs) and Year
12	Middle Branch near Easley	02162700	1998-2000	6.5	6.3	1.5	0.77 (2000)	140 (1999)
13	Saluda River near Pelzer	02163000	1929-1971	405	783	294	57 (1954)	12,100 (1936)
14	Saluda River below Pelzer	021630005	2022-present	45	NA	NA	NA	NA
15	Saluda River near Williamston	02163001	1995-present	414	728	213	6.3 (2000)	12,000 (1995)
16	Grove Creek near Piedmont	021630967	1994-2008	19	22	4.4	0.02 (2008)	1,000 (1995)
17	Saluda River near Ware Shoals	02163500	1939-present	580	961	295	11 (1941)	20,400 (2020)
18	Reedy River near Greenville	02164000	1941-present	49	80	23	5.0 (2008)	4,120 (1995)
19	Reedy River above Fork Shoals	02164110	1993-present	110	203	72	32 (2008)	7,780 (2020)
20	Reedy River near Ware Shoals	02165000	1939-2004	236	352	94	4.8 (1973)	8,800 (1963)
21	Reedy River near Waterloo	021650905	2004-present	251	309	71	13 (2011)	7,720 (2020)
22	South Rabon Creek near Gray Court	02165200	1966-present	30	33	7.1	0.06 (2011)	2,520 (1973)
23	North Rabon Creek near Hickory Tavern	021652801	2008-present	37	34	5.6	0 (2011)	1,670 (2015)
24	Dirty Creek Trib. Near Laurens[3]	02165350	1967-1972	0.90	NA	NA	NA	NA
25	Lake Greenwood Tailrace near Chappells	02166501	1993-present	1,170	1,455	408	1.7 (2019)	18,800 (2020)
26	Wilson Creek at Ninety-Six[8]	021668000	2020-present	56	NA	NA	NA	NA

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Table 3-1. Streamflow characteristics at USGS gaging stations in the Saluda River basin (Continued).

Map Identifier	Gaging Station Name	Station Number	Period of Record[1]	Drainage (mi^2)	Average Daily Flow (cfs)	90% Exceeds Flow[2] (cfs)	Minimum Daily Flow (cfs) and Year	Maximum Daily Flow (cfs) and Year
27	Ninety-Six Creek near Ninety-Six	02166970	1980–2001	18	16	0.36	0 (2000)	810 (1982)
28	Sample Branch at Greenwood	02166975	2021–present	1.2	NA	NA	NA	NA
29	Saluda River at Chappells	02167000	1926–present	1,360	1,800	472	7.8 (2019)	56,700 (1929)
30	Little River at Laurens	021671101	2021–present	24	NA	NA	NA	NA
31	Little River near Silverstreet	02167450	1990–present	224	158	17	0.02 (2011, 2015)	12,300 (2015)
32	Saluda River near Silverstreet	02167500	1927-1965	1,627	2,234	668	49 (1940)	75,000 (1929)
33	Bush River at Joanna	02167557	1995-2005	16	14	0.79	0 (2001, 2002, 2004)	730 (2003)
34	Bush River at Newberry	02167563	1999-2009	62	43	3.7	0 (2002)	1,880 (2003)
35	Bush River near Prosperity	02167582	1990–present	115	91	11	1.7 (2012)	7,140 (2015)
36	Saluda River near Prosperity[4,8]	02167600	1996-present	1,820	NA	NA	NA	NA
37	Little Saluda River at Saluda	021677037	1991–2007	90	80	0.53	0 (2001)	5,260 (2007)
38	Little Saluda River near Saluda[5]	02167705	1990–present	110	118	0	0 (1990, 2008-2020, 2022)	9,160 (2015)
39	Big Creek at Big Creek Rd near Saluda	021677090	2022–present	48	NA	NA	NA	NA
40	Moores Creek near Batesburg[8]	021677129	2022-present	7.5	NA	NA	NA	NA
41	Little Saluda River near Prosperity[6,8]	02167716	1993–present	335	NA	NA	NA	NA
42	Camping Creek Trib. near Prosperity[7]	02167750	1966–1972	0.52	NA	NA	NA	NA

Table 3-1. Streamflow characteristics at USGS gaging stations in the Saluda River basin (Continued).

Map Identifier	Gaging Station Name	Station Number	Period of Record[1]	Drainage (mi^2)	Average Daily Flow (cfs)	90% Exceeds Flow[2] (cfs)	Minimum Daily Flow (cfs) and Year	Maximum Daily Flow (cfs) and Year
43	Lake Murray Tailrace near Columbia	02168501	1986–present	2,420	NA	NA	NA	NA
44	Saluda River below Lake Murray Dam near Columbia	02168504	1984–present	2,420	2,213	472	155 (1989)	28,300 (2016)
45	Twelve Mile Creek at Lexington	02168810	2019–present	33	35	11	3.9 (2023)	435 (2023)
46	Saluda River at I-20, near Columbia	02168900	2017–2021	2,510	2,638	724	569 (2018)	18,800 (2020)
47	Saluda River near Columbia	02169000	1925–present	2,520	2,667	444	12 (1930)	62,300 (1929)

[1] "Present" indicates that the gage was active at the end of water year 2023 (September 30, 2023).
[2] "90%" exceeds flow" is the flow for which 90% of daily flows are higher and 10% are lower.
[3] The Dirty Creek Trib. near Laurens gage reports daily precipitation and annual peak streamflow.
[4] The Saluda River near Prosperity gage reports temperature and dissolved oxygen.
[5] The Little Saluda River near Saluda gage at times experiences small flow reversals because of wind effects and backwater from Lake Murray. Periods when negative flows were reported were treated as zero flow for the purposes of these statistics.
[6] The Little Saluda River near Prosperity gage reports temperature and dissolved oxygen.
[7] The Camping Creek Trib. near Prosperity gage reports daily precipitation and annual peak streamflow.
[8] The drainage area for this gage was not reported by USGS, and the value in the table is estimated.

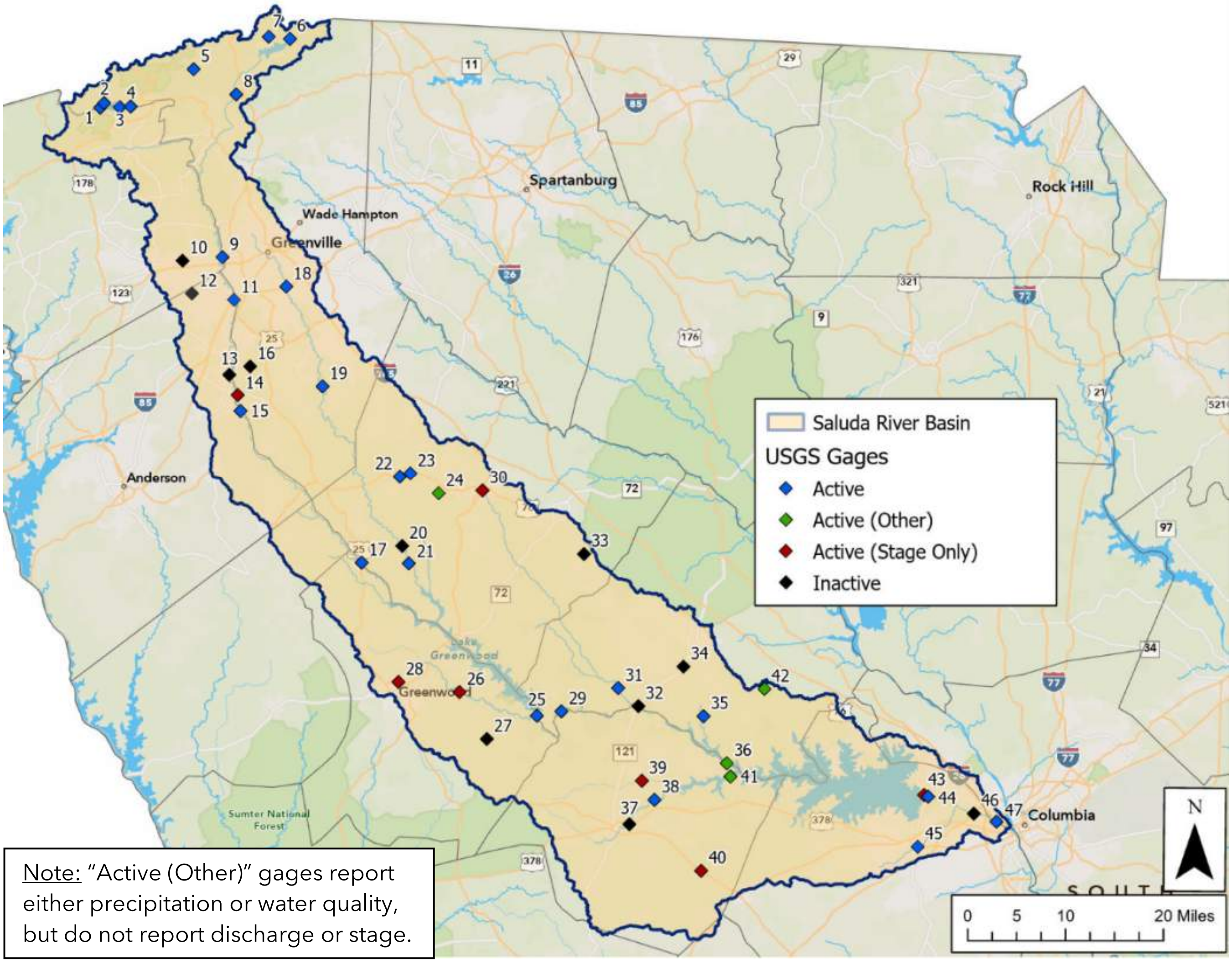


Figure 3-2. USGS streamflow gaging stations.

Duration hydrographs showing average daily streamflow throughout the year at select gaging stations on the Saluda and Reedy Rivers are shown in Figure 3-3. These hydrographs are based on daily streamflow data collected through water year 2023. Mean daily flows at five of the selected gages exhibit similar seasonal patterns and are at their greatest in March and April and least from August to October. Mean daily flows at the Saluda River near Columbia gage are not seasonal and are more variable than the upstream gages because of highly fluctuating discharges from hydroelectric facilities. The low and high extreme flow bands widen with distance downstream into the Piedmont region because of fluctuating hydropower releases and lower annual precipitation and groundwater recharge with increased distance from the mountains (SCDNR 2009). This phenomenon is demonstrated on both the Saluda and Reedy Rivers. At all stations selected, mean flows are higher than median flows owing to the influence of occasional short-duration flood events. For reference, the lowest recorded daily mean streamflow on the Saluda River during the period of record was 6.3 cfs, observed in 2000 near Williamston.

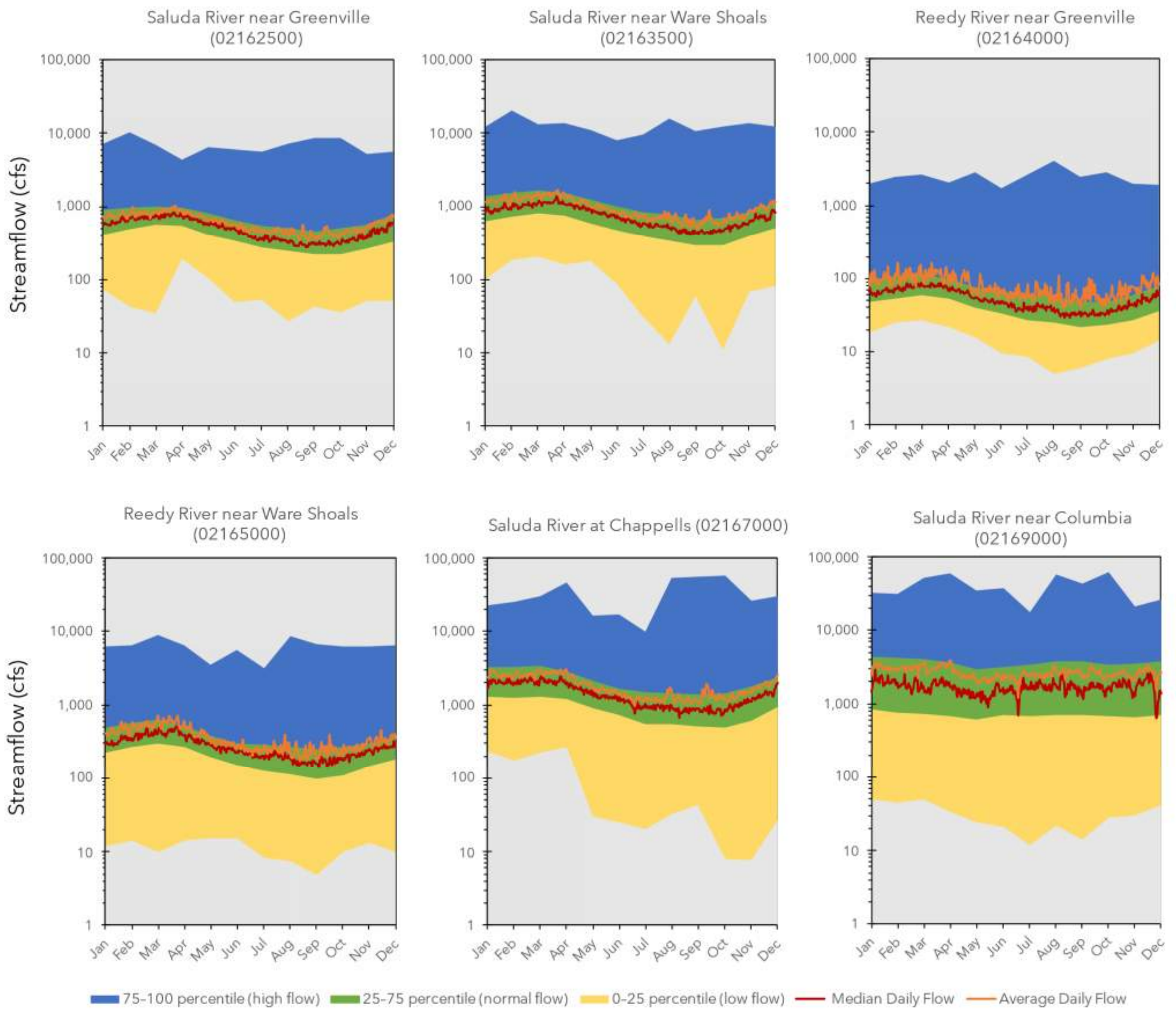


Figure 3-3. Duration hydrographs for select gaging stations on the Saluda and Reedy Rivers.

Mean monthly flows at the Saluda and Reedy Rivers gaging stations near Greenville over the previous 30 years (March 1993 to February 2023) are shown in Figure 3-4. The fifth percentile of the mean monthly flows over the 82-year period beginning in 1942 (indicative of potential drought conditions) is 189 cfs at the Saluda River near Greenville station. The fifth percentile of the mean monthly flows over the 83-year period beginning in 1941 is 26 cfs at the Reedy River near Greenville station. The ratio of the fifth percentile flows at these two stations is similar to the ratio of the acreage of their respective contributing drainage basins. Mean monthly flows at both stations exhibit similar patterns, with greater flows at the Saluda River station. The fifth percentile flows at the Reedy River station are used in the graph to distinguish the periods of drought, most of which occurred from 1999 to 2002 and from 2007 to 2011.

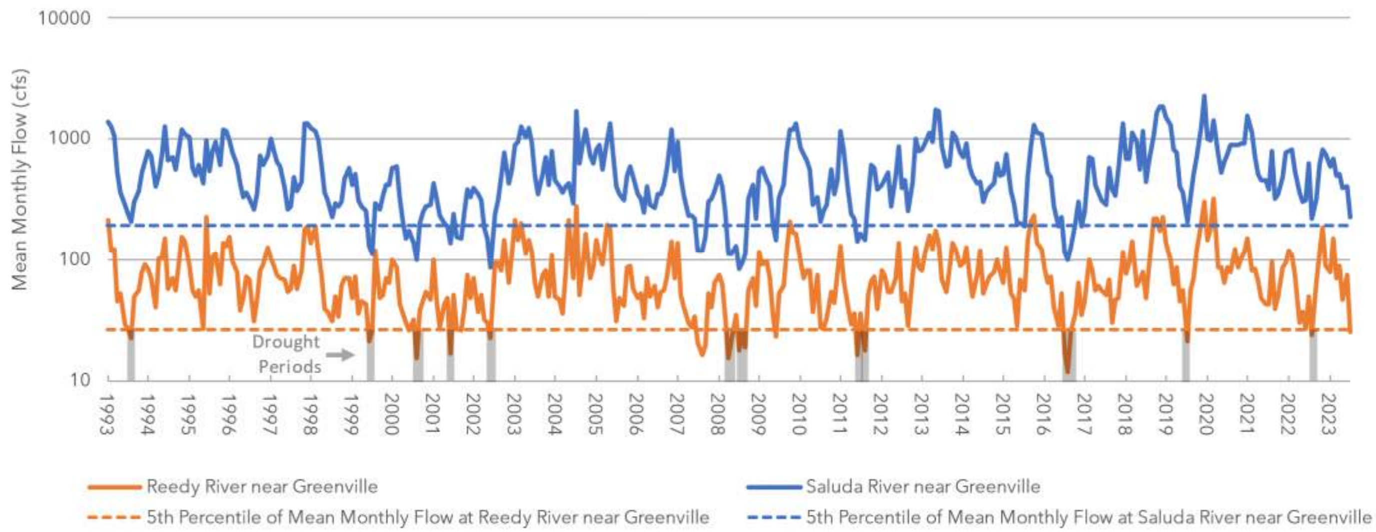


Figure 3-4. Mean monthly flows at gaging stations on the Saluda and Reedy Rivers near Greenville.

Figure 3-5 shows the mean monthly flow at the Saluda River gaging stations near Greenville and Columbia for the same 30-year period, plotted on a normal vertical axis to better visualize the difference between the two stations. The upstream station near Greenville has experienced less variable flows, whereas the downstream station near Columbia exhibits large flow fluctuations. The fifth percentile of the mean monthly flows recorded since 1925 is 589 cfs at the Columbia station; the lowest flows at this station were recorded during the 1930s.

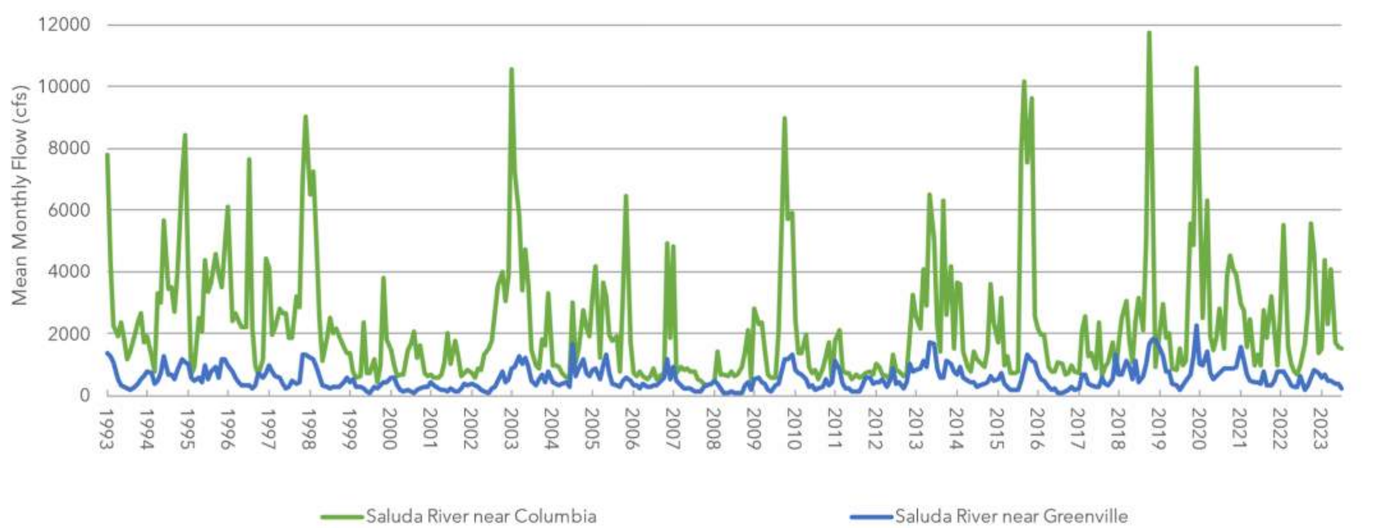


Figure 3-5. Mean monthly flows on the Saluda River near Greenville and Columbia.

Apart from the USGS gaging stations, which measure stage and flow, there are numerous sites throughout the basin where the SCDES collects water quality data as part of their ongoing Ambient Surface Water Physical and Chemical Monitoring program to assess the water's suitability for its designated 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 to provide consistent baseline water quality data. The statistical survey sites are sampled once per month for one year and change from year to year (SCDHEC 2022b).

3.1.3 Surface Water Development

The Saluda River basin has experienced surface water development primarily for hydroelectric power production, municipal water supply provision, and recreation. Lakes in the Saluda River basin larger than 200 acres are described in Table 3-2.

Lake Murray is the largest lake in the basin and ranks fifth in surface area and third in volume statewide (SCDNR 2009). Lake Murray is west of Columbia and was initially constructed in 1930 for hydroelectric power production. The lake now also serves recreation and water supply purposes. Located east of Greenwood, Lake Greenwood was constructed in 1940 for hydroelectric power production and to provide recreational opportunities and municipal water supply. North Saluda (Poinsett) and Table Rock Reservoirs are owned by the Commission of Public Works for the City of Greenville (Greenville Water) and are used for municipal water supply.

Table 3-2. Characteristics of lakes 200 acres or larger in the Saluda River basin.

Name	Stream	Surface area (acres)	Storage capacity (acre-feet)	Purpose
Lake Murray	Saluda River	51,000	2,114,000	Power, recreation, and water supply
Lake Greenwood	Saluda River	11,400	270,000	Power, recreation, and water supply
North Saluda (Poinsett) Reservoir	North Saluda River	1,034	33,000	Water supply
Lake Rabon	Rabon Creek	562	6,832	Water supply, recreation, and flood control
Table Rock Reservoir	South Saluda River	485	15,000	Water supply
Saluda Lake	Saluda River	305	7,228	Power, industry, and water supply
Boyd Mill Pond	Reedy River	203	3,000	Power and recreation

Source: Adapted from Table 6-9 in SCDNR (2009).

Additionally, numerous regulated and unregulated small dams create small impoundments on many of the Saluda River tributaries. These are largely privately owned (SCDNR 2009). Dams that are 25 ft or more in height, impound 50 acre-feet or more, or whose potential failure may cause loss of life are regulated under the South Carolina Dams and Reservoirs Safety Act, which is administered by SCDES. There are 285 SCDES-regulated dams in the Saluda River basin, most of which are classified as Low Hazard, Class 3 dams, as shown in Table 3-3. Most regulated dams, including those designated as high hazard dams, are on the upper reaches of the basin, as shown in Figure 3-6.

Table 3-3. Regulated dams in the Saluda River basin.

Dam Type	Number of Dams	Description
High Hazard, Class 1	91	Structure where failure will likely cause loss of life and/or serious damage to infrastructure
Significant Hazard, Class 2	30	Structure where failure will not likely cause loss of life but infrastructure may be damaged
Low Hazard, Class 3	164	Structure where failure may cause limited property damage
Total	**285**	

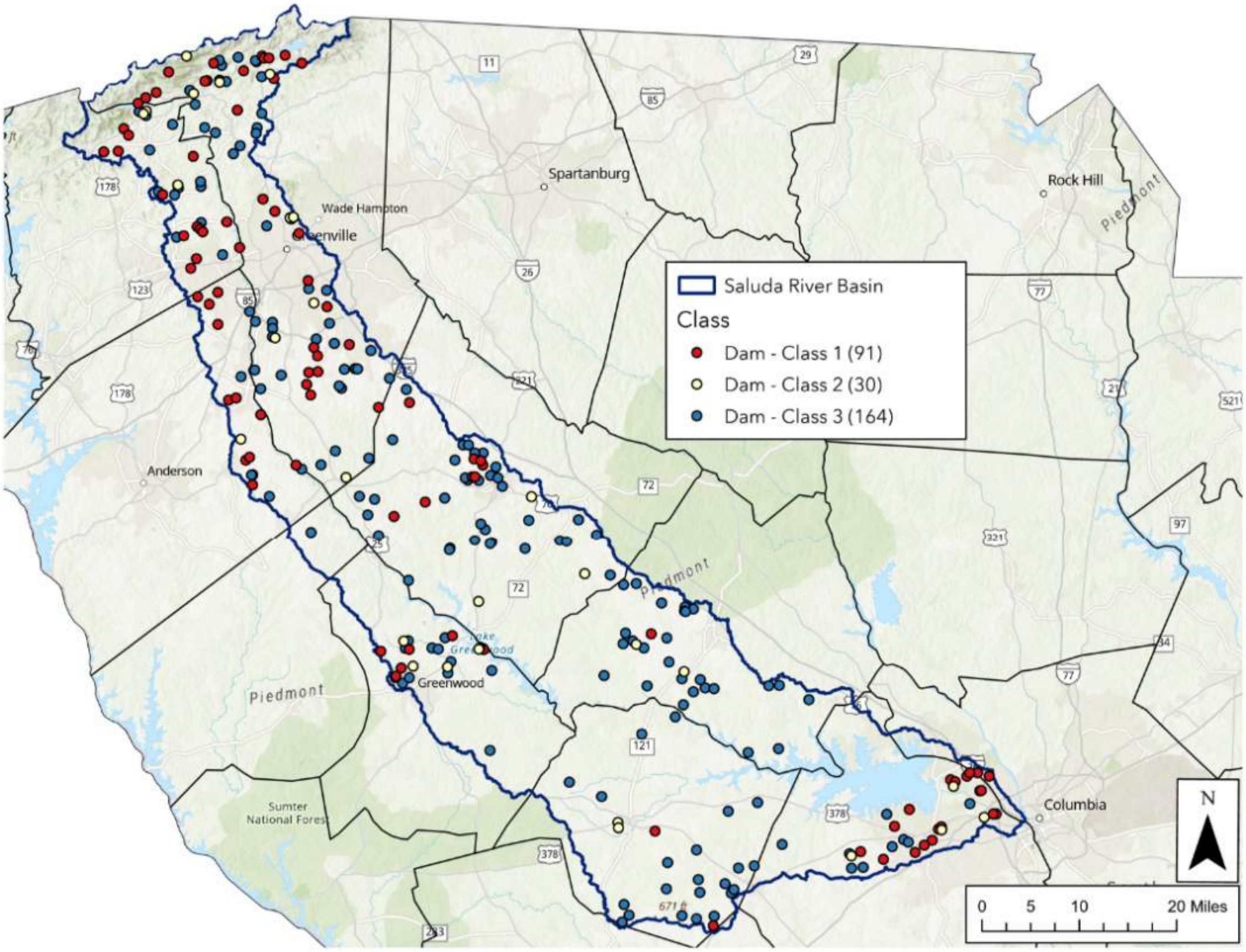


Figure 3-6. Regulated dams in the Saluda River basin.

The three largest hydroelectric-power-generating facilities in the Saluda River basin are described in Table 3-4. In addition to those listed, several smaller hydroelectric power plants with capacities of less than 5 megawatts are also located on the Saluda River (SCDNR 2009).

Table 3-4. Largest hydroelectric power generating facilities in the Saluda River subbasin.

Facility name and owner	Impounded stream	Reservoir	Generating capacity (megawatts)	Water use in year 2006 (million gallons)
Ware Shoals Aquenergy Systems Inc.	Saluda River	–	6.2	0
Buzzard's Roost Greenwood County	Saluda River	Lake Greenwood	15.0	93,433
Saluda Dominion Energy South Carolina (previously South Carolina Electric & Gas Company [SCE&G]) *	Saluda River	Lake Murray	202.6	149,244

Source: Adapted from Table 6-10 in SCDNR (2009). Ownership information is provided by the National Hydropower Association (2023).

*SCE&G was acquired by Dominion Energy in 2019 and now operates under the name Dominion Energy South Carolina (Columbia Business Monthly 2023). The generating capacity was provided by Bresnahan (2025).

The Ware Shoals facility was constructed in 1906 to provide power for textile manufacturing and now powers the town of Ware Shoals (Harris 2021). The facility is operated as a modified run of river and has seasonal downstream flow requirements of 200 cfs in December through February, 800 cfs in March through May, and 250 cfs in June through November.

Buzzard's Roost Dam was constructed between 1935 and 1940 and receives water from the Saluda and Reedy Rivers (Upstate Forever and South Carolina Rural Water Association 2022). Buzzard's Roost is operated as a peaking facility, which stores water to be released during peak energy use times when demand and prices are greatest. Required downstream releases vary based on season and upstream inflow.

Lastly, the dam that supports the Saluda hydroelectric facility was constructed between 1927 and 1930 (Bresnahan 2025), and at its completion was the largest earthen dam in the world at 1.6 mi long (SCDNR 2023f). The Saluda facility historically has operated as a baseload, peaking, load following, and reserve capacity facility. Currently, Saluda Hydro operates primarily as a reserve generation facility, for lake level management, and to provide downstream flow in the Lower Saluda River. While there are no current downstream flow requirements, there is a written agreement with SCDHEC (now SCDES) to provide 180 cfs as a minimum flow.

As of 2009, eighteen flood and erosion control projects have been federally authorized in the Saluda River basin (SCDNR 2009). Over the past 15 years, there have been several others, especially in the northern part of the basin which have focused on streambank stabilization. Between 1957 and 2009, eight projects involving more than 30 mi of channel improvement and 20 flood -retarding structures were completed. No navigation projects exist in the basin.

More than 99 percent of the total water withdrawals in the Saluda River basin in 2021 were surface water withdrawals (SCDNR 2023b). The greatest user of surface water that year was the thermoelectric power industry, which reported withdrawals totaling 47 percent of surface water withdrawals that year. Public water suppliers accounted for 42 percent of surface water withdrawals and industrial users accounted for

10 percent. Agricultural irrigation and golf courses each accounted for less than 1 percent of surface water withdrawals. Additional water use information and water demand projections are provided in Chapter 4, Current and Projected Water Demand.

3.1.4 Surface Water Conditions and Concerns

The Saluda River basin is completely contained within the borders of the state. Consequently, the basin does not experience some of the surface water concerns common to other river basins of the state such as out-of-state withdrawals and out-of-state flow regulation from major reservoirs or impacts from out-of-state FERC-licensed hydroelectric projects.

Streamflow in the Blue Ridge portion of the Saluda River basin is generally steady, with a well-sustained base flow supported by groundwater in addition to heavy rainfall and runoff (SCDNR 2009). This results in well-sustained flows in the upper reach of the Saluda River. Flows become increasingly variable with distance downstream, as the river travels through the Piedmont region, due to a combination of hydropower facility release patterns and less precipitation and groundwater discharge than occurs upstream. Streamflow is most variable downstream of the major hydroelectric facilities in the basin. These fluctuations lead to periods of extremely reduced flow, which can limit navigation, fish migration, and suitable fish habitat (SCDNR 2009).

Most lakes and streams in the Saluda River basin are designated by SCDES as Freshwater (Class FW) water bodies, meaning they are suitable for aquatic life, primary- and secondary-contact recreation, drinking water supply, fishing, and both industrial and agricultural uses. Several water bodies in the basin are designated as Outstanding Resource Waters (Class ORW), which indicates an outstanding recreational or ecological resource that is suitable as a drinking water source with minimal treatment (SCDNR 2009). These include parts of the North Saluda, Middle Saluda, and South Saluda Rivers, including Poinsett Reservoir, Table Rock Reservoir, and several creeks. The Saluda River basin also includes streams on tributaries in the Blue Ridge physiographic province designated as Trout Natural Waters (Class TN), which are suitable for supporting reproducing-trout populations and a cold-water-balanced indigenous aquatic community of fauna and flora. Part of the South Saluda River as well as Saluda River tributaries from the Lake Murray dam to the confluence with the Broad River are classified as Trout Put, Grow and Take Water (Class TPGT), which are freshwater bodies that specifically support the growth of stocked-trout populations.

Water quality concerns have been associated with stream and river reaches in the basin that do not meet water quality standards and do not support designated uses. Water quality monitoring conducted by SCDHEC from 2002 to 2006 demonstrated that aquatic life uses were fully supported at 67 percent (111 of 165) of sites sampled and evaluated for aquatic life support in the Saluda River basin (SCDHEC 2011). Approximately 61 percent (33 of the remaining 54) of sites not fully supportive of aquatic life uses were biologically impaired due to the types or lack of diversity of macroinvertebrate communities present. Recreational use was fully supported at 51 percent (66 of 129) of sampled sites. Sites not supportive of recreational use were all impaired by high levels of fecal coliform bacteria. More recently, the 2022 Section §303(d) Clean Water Act list of impaired waters documented impairments at 112 sampling stations impacting 56 different streams and lakes in the basin, including portions of the Saluda, Reedy, and Bush Rivers and Lake Murray, Lake Greenwood, and Lake Rabon (SCDHEC 2022c). Table 3-5 summarizes the causes of impairments and the associated non-supported designated uses. While recreational use impairments were previously assessed based on fecal coliform, the 2022 303(d) list assessed recreational use impairment based on *Escherichia coli*.

Table 3-5. 2022 303(d) Saluda River basin impairment summary.

Designated Use	Number of Stations with Impairments	Causes of Impairments (Number of Impairments)
Aquatic Life	84	Macroinvertebrate (48) Cadmium (1) Chlorophyll a (3) Chromium (2) Dissolved Oxygen (12) Lead (2) pH (11) Total Nitrogen (3) Total Phosphorus (3) Turbidity (12) Zinc (2)
Fish Consumption	4	Mercury (4)
Recreational Use	38	*Escherichia coli* (38)

In 2017, SCDHEC received a petition from South Carolina Rivers Forever (SCRF) to designate the 14-mi section of the Saluda River downstream of the Saluda Lake Dam to the headwaters of Piedmont Lake as a hydrologically impaired waterbody under Category 4C of the South Carolina 2018 Integrated Report. Saluda Lake Dam is used for hydropower on a modified peaking operation schedule. In RBC meeting discussions, the RBC agreed that the designation should be reassessed because it is dated 2018, and because several RBC members' personal experience support the need for reassessment.

In response to the petition, SCDHEC agreed that aquatic life and recreational uses in this stretch of the Saluda River have been impaired due to hydrologic alterations caused by the operation of the Saluda Lake Dam, and listed this segment under IR Category 4C, as of the 2018 Integrated Report. Category 4C of the Integrated Report is reserved for those waterbodies that are impaired due to pollution that is not caused by a pollutant load, so a Total Maximum Daily Load is not needed.

In RBC meeting discussions, several RBC members have noted that hydrologic alterations to the Reedy River in Greenville have also occurred, including larger peak flows and smaller base flows, leading to erosion. This could be due to urbanization, but, the Reedy River has not been designated by SCDES as hydrologically impaired, even though it was included in the 2017 petition.

Other surface water-related concerns have been raised by the RBC members during the planning process. Some of the concerns regarding surface water resources identified by one or more RBC members at the first, and subsequent meetings, included:

- Rapid population and demand growth, land development, and current land use regulations are a concern for the sustainability of surface water supplies to support both human and ecosystem needs.
- Releases from non-FERC licensed hydropower facilities may not always support recreation and other downstream uses.
- Droughts of increasing severity may make it difficult or impossible to continue to balance the needs of all users. Preserving adequate flows during drought will be important as more water is used to support the growing population.

- The loss of riparian buffers and increasing development will continue to impact water quality, erode streams, and increase sedimentation resulting in loss of reservoir storage. Sedimentation may also impact water quality and lead to increased water treatment cost.
- Changing climate conditions may impact water availability. Higher temperatures may cause increased evaporation from surface water. The frequency and severity of both droughts and heavy rain events causing flooding may increase.
- Risks associated with overallocation of water.

3.2 Surface Water Assessment Tools

3.2.1 Simplified Water Allocation Model

The SWAM platform was used to assess current and future surface water availability and 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 Saluda River basin model. The Saluda River basin SWAM model was updated in 2021 and 2023. Updates included extending the period of record to 2019, adding new permits and registrations, removing inactive users, and adding minimum reservoir releases.

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 also includes large lakes and reservoirs that serve communities and industries, but does not include smaller off-channel storage ponds used to help irrigate individual golf courses or farms. The model simulates basin hydrology at a daily or monthly timestep.

Inputs to SWAM include:

- Calculated and estimated "unimpaired flows" for the headwaters of the mainstem and major tributaries within 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 discussed later as user-adjusted variables).
- Reservoir characteristics, such as capacity, bathymetry, constraints, and flexible operating rules.
- USGS daily flow records, which are embedded in the model for comparative purposes – simulation results can be compared with historical records.

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

- Withdrawal targets (municipal, industrial, thermoelectric, agricultural, golf courses, and 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, SWAM 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 Saluda River basin SWAM framework.

SWAM 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 Saluda River basin are discussed further in

Chapter 4, Current and Projected Water Demand, and Chapter 5, Comparison of Water Resource Availability and Water Demand.

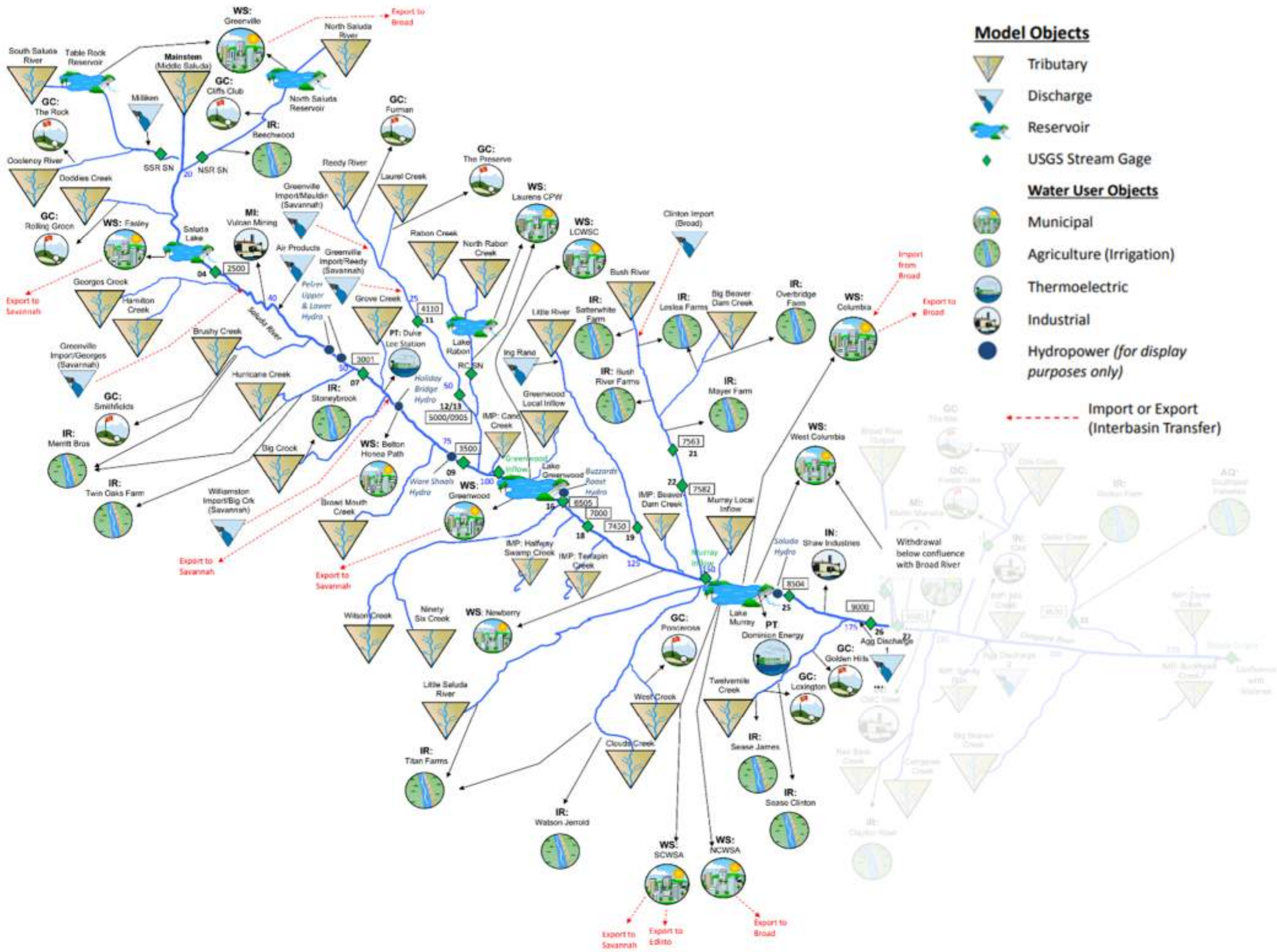


Figure 3-7. SWAM Model interface for the Saluda River basin.

The Saluda River basin 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: Saluda Basin Model Report* (CDM Smith 2017).

While SWAM can quantify water balance calculations for free-flowing streams and reservoirs based on several inputs, it has limitations. The model cannot perform 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 SWAM; 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 and/or net reservoir evaporation rates. Additionally, smaller-scale features such as third or fourth order tributaries and small off-channel storage ponds that are often used to help irrigate individual golf courses or farms are not included in the SWAM model.

The model, model users guide, and full report on developing and calibrating the Saluda River basin model are publicly available for download at SCDES's website. The models and associated documentation can be found at: https://des.sc.gov/programs/bureau-water/hydrology/surface-water-program/surface-water-models.

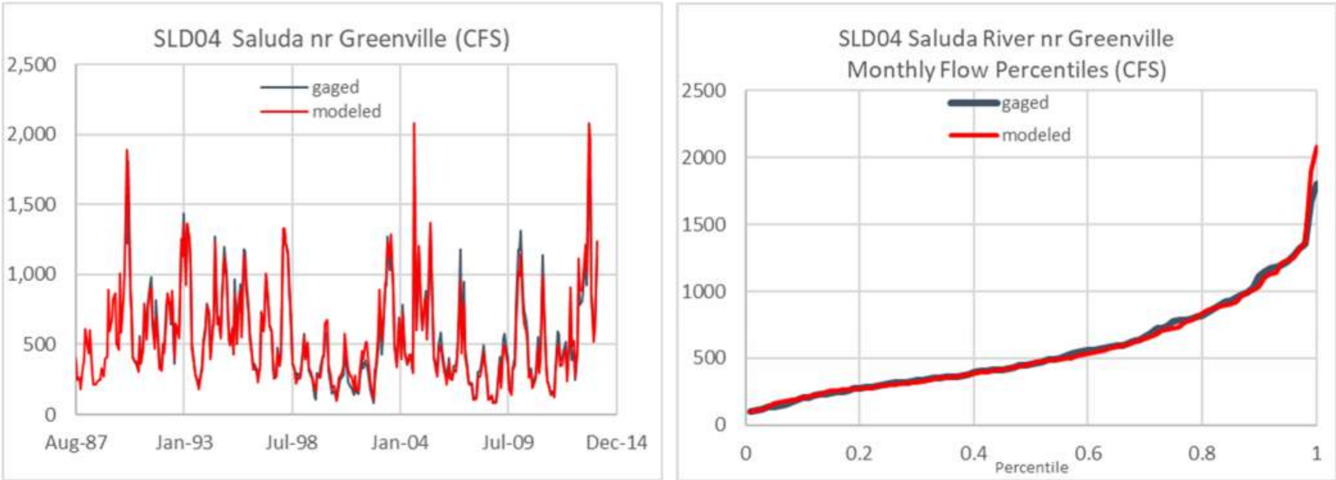


Figure 3-8. Representative Saluda River basin SWAM verification graphs (CDM Smith 2017).

3.2.2 Other Surface Water Analyses

While the models developed in SWAM focus on the hydrology of larger mainstem rivers and primary tributaries in the Saluda 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. To formulate relationships between hydrologic metrics (flow patterns, statistics, and variability in these streams for both pulses and long-term averages) and ecological suitability metrics, daily rainfall-runoff modeling of small headwater streams throughout the state was accomplished using WaterFALL (Watershed Flow ALLocation), as described in Eddy et al. (2022) and Bower et al. (2022). Bower et al. (2022) discusses the biological response metrics that 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 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, WaterFALL results augment SWAM results by providing similar hydrologic understanding of the smaller headwater streams not simulated explicitly or individually in SWAM. The use of the ecological flow metrics as performance measures in the Saluda RBC planning process is further discussed in Chapter 5, Comparison of Water Resources Availability and Water Demand.

3.3 Groundwater Resources

3.3.1 Groundwater Aquifers

Groundwater in the Saluda River basin is primarily stored in crystalline bedrock fractures and in saprolite rock, which underlie the Piedmont physiographic province (SCDNR 2009). The exception to this is the presence of Coastal Plain sediments, which constitute a shallow, sandy aquifer at the extreme southern end of the basin. Within the Piedmont province, the following six geologic units exist, from north to south: Chauga belt, Walhalla thrust sheet, Sixmile thrust sheet, Laurens thrust sheet, Charlotte terrane, and Carolina terrane. The Modoc Shear zone separates the metamorphic and igneous rocks of the Piedmont from the Coastal Plain sediments to the south. The Lowndesville shear zone partially separates the Charlotte and Carolina terranes. Gabbro and granite rock intrusions are also present in the basin.

The northwestern part of the basin contains numerous wells, while the southeastern part of the basin has sparse well coverage (SCDNR, 2009). Most wells in the basin are less than 350 ft deep. Well yields are generally 20 gpm or less, but some yield as much as 400 gpm. Groundwater availability is limited to zones with substantial rock fracturing. One study determined that wells drilled into fracture zones yielded anywhere from 10 to 500 gpm, while wells drilled outside of fracture zones only yielded 1 gpm or less (SCDNR 2009). Wells drilled into metamorphic and igneous rock fracture zones and/or valleys with linear features also provided greater yields. Approximately 25 percent of wells within the Piedmont region of the basin are large-diameter bored wells, with depths ranging from 6 to 88 ft and averaging 50 ft (SCDNR 2009). Yields from these bored wells are typically only a few gallons per minute, with the shallowest wells becoming unreliable during drought.

3.3.2 Groundwater Monitoring

Groundwater monitoring is performed by USGS and SCDES. Groundwater monitoring wells are used to identify short- and long-term trends in groundwater levels and aquifer storage and to monitor drought conditions. Statewide, the groundwater monitoring network operated by SCDES has more than 180 wells (SCDES 2024). Most wells have hourly data automatically recorded while some are measured manually four to six times per year. Most wells have water level records dating to the 1990s, with the earliest well dating to 1955. Only 15 SCDES wells are in the Piedmont and Blue Ridge physiographic provinces, with most monitoring wells situated in the Coastal Plain province. Ten active SCDES monitoring wells are within the Saluda River basin (SCDES 2024). USGS maintains a groundwater-level monitoring network of an additional 21 wells in South Carolina (USGS 2023c). One active USGS well is in the Saluda basin (AND-326 in Anderson County). SCDES and USGS groundwater monitoring wells in the Saluda River basin are shown in Figure 3-9.

The SCDES monitoring well in Laurens County is centrally located in the basin, LRN-1706, and has limited influence from area pumping, making it suitable for use in examining the relationship between precipitation, recharge, and groundwater levels. Figure 3-10 shows groundwater levels in this well with precipitation trends recorded at the nearby Laurens, South Carolina weather station (NOAA 2023a). The bottom graph compares precipitation trends to average annual precipitation from 1999 to 2022. The figure illustrates how the lower-than-average precipitation from 2005 through 2009 correlates to declining water levels over this same period. Levels increased sharply in response to greater-than-average rainfall in both 2003 and 2009. Precipitation trends have been gradually increasing since 2013, with groundwater levels following the same general trend over this period.

Groundwater levels recorded at the SCDES monitoring well near Saluda in Saluda County (SAL-0069) exhibit seasonal variations, as shown in Figure 3-11. Seasonal groundwater drawdowns of approximately 5 to 15 ft were observed, with water levels typically peaking around April and at their least around November. This monitoring well is near the headwaters of Lake Murray. The lake is operated with a drawdown starting in the fall. Through the late winter and early spring, the lake is filled to higher pool levels, which are maintained through the summer.

Potentiometric maps illustrating the levels to which groundwater will rise in wells have not been drawn for areas northwest of the Fall Line, including the Saluda River basin. Unlike the Coastal Plain region where water levels slope toward the coast, groundwater levels in the Saluda River basin generally follow topographic patterns.

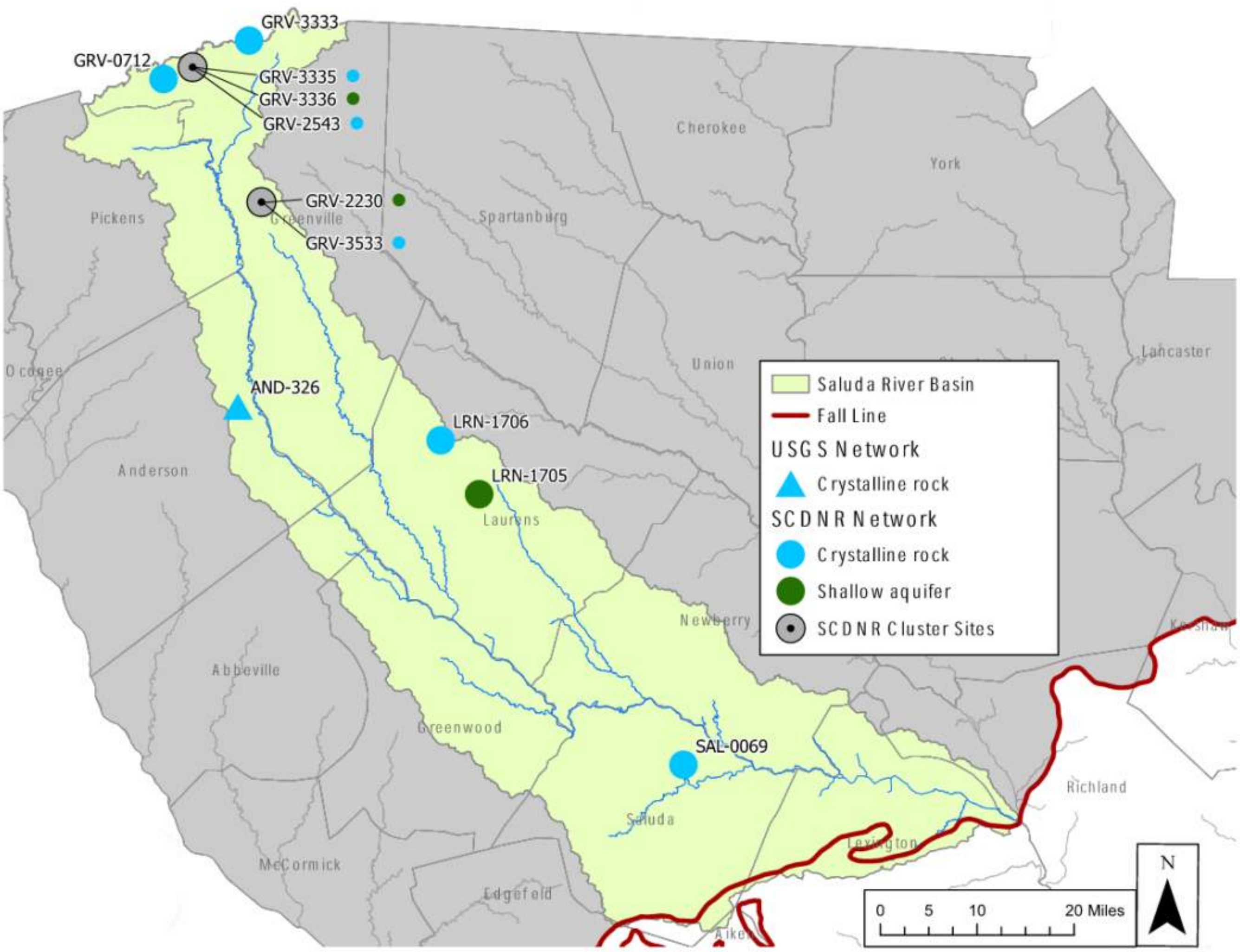


Figure 3-9. SCDES and USGS groundwater monitoring wells.

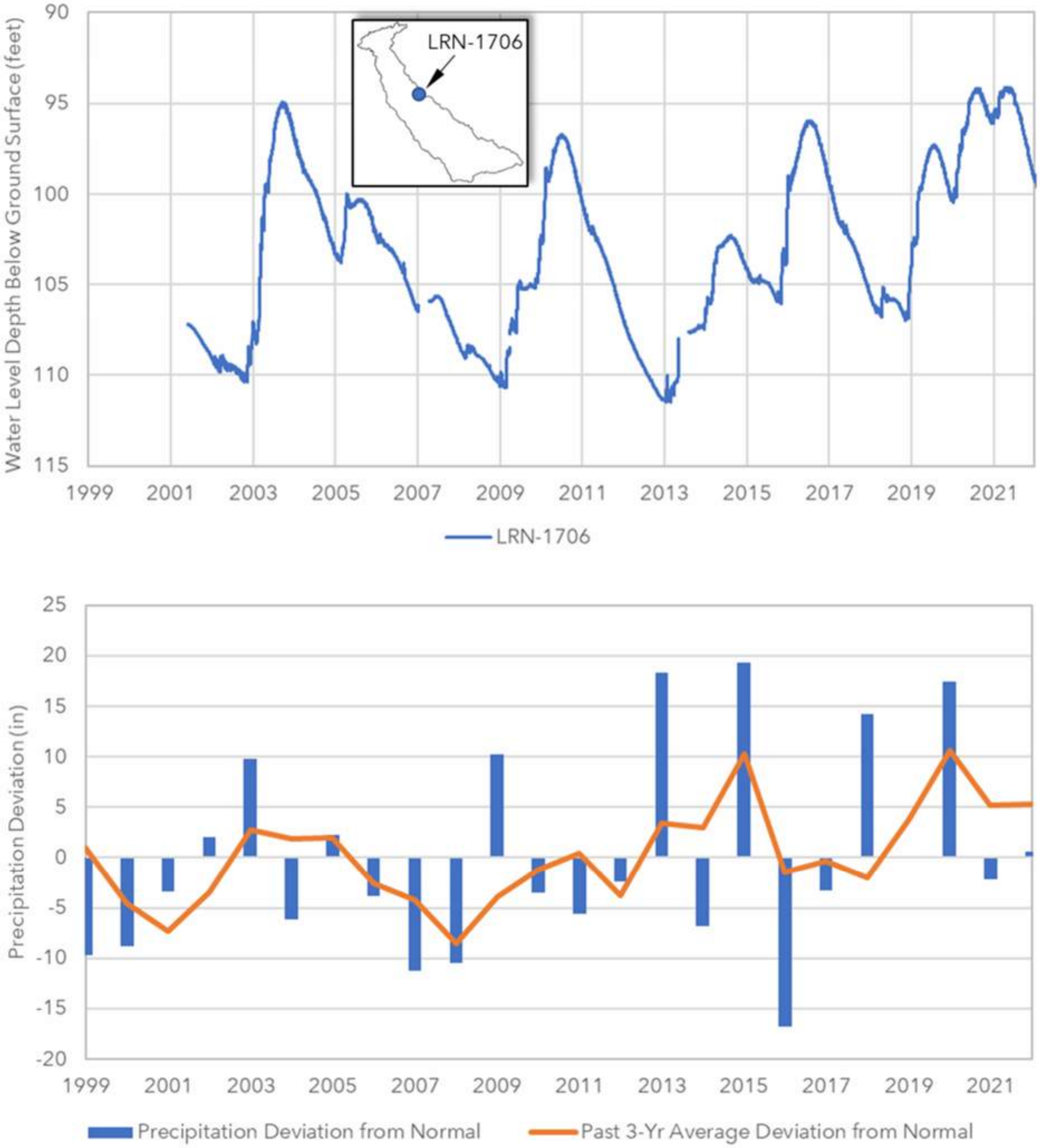


Figure 3-10. Groundwater levels in the crystalline rock aquifer (top graph) and the precipitation deviation from normal (bottom graph) in Laurens County.

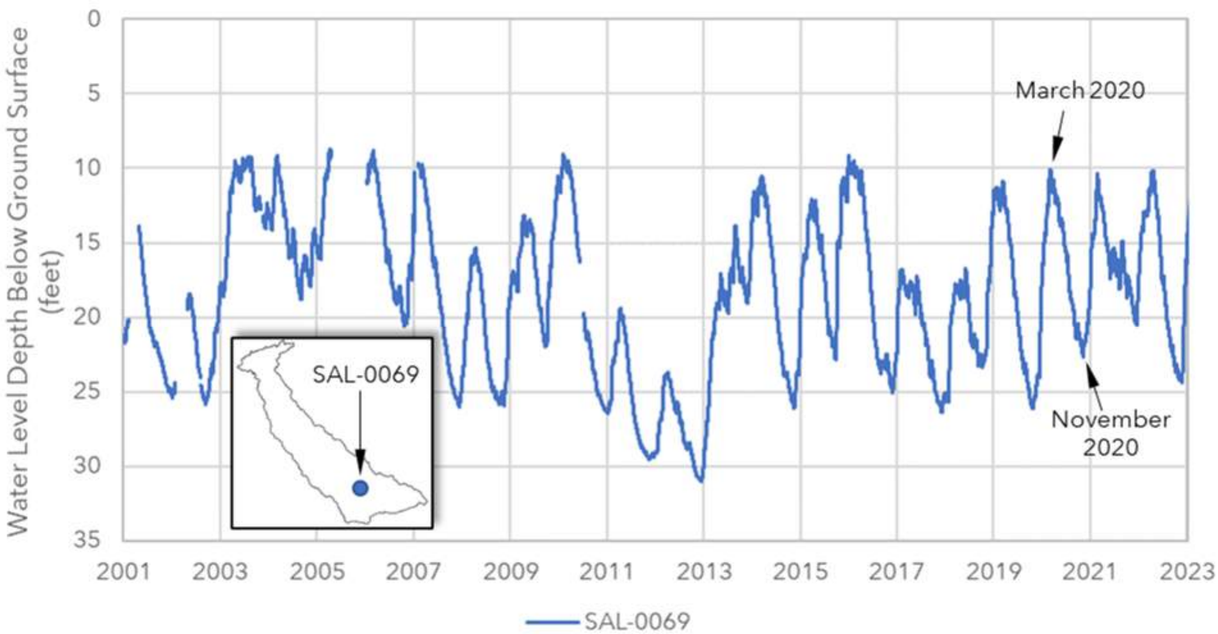


Figure 3-11. Groundwater levels in the crystalline rock aquifer in Saluda County.

3.3.3 Groundwater Development

The Saluda River basin had the least volume of groundwater withdrawals of the eight basins in the state in 2021 (SCDNR 2023b). Reported groundwater withdrawals in the Saluda River basin have been declining over the past 10 years, from 0.45 million gallons per day (MGD) in 2011 to 0.2 MGD in 2021 (SCDNR 2023b). In 2021, 58 percent of the reported withdrawals were for irrigation, 21 percent were for water supply, 20 percent were for industry, and less than 1 percent were for golf courses.

The greatest user of groundwater in the basin in 2021 was Walter P. Rawls and Sons, Inc., an irrigation user, which withdrew 0.0537 MGD from one well (SCDNR 2023b). The next greatest users were Gilber-Summit Rural Water District, a water supplier, and Mayer Farm, an agricultural irrigation user, who each withdrew approximately 0.035 MGD. All other permitted groundwater withdrawers in the basin reported uses of less than 0.02 MGD in 2021.

Groundwater is the principal source of residential water supply for rural homes in the basin (SCDNR 2023b). Well yields, although low, are adequate to support most domestic uses. Efforts have been made to increase well yields using dynamite, which was unsuccessful at a public supply well at Caesars Head State Park, and hydrofracturing, which increased yields from 1 to 5 gpm at a Greenville County domestic well.

3.3.4 Capacity Use Areas

Groundwater in South Carolina is regulated by SCDES in areas designated as CUAs. Under South Carolina's Groundwater Use and Reporting Act (Chapter 5, Section 49-5-60), a CUA is designated where excessive groundwater withdrawals present potential adverse effects to natural resources, public health, safety, or economic welfare. SCDES then coordinates with affected governing bodies and groundwater withdrawers to develop a groundwater management plan for the CUA.

The far southeastern corner of the basin lies within the Western CUA. This small portion is within Lexington County and includes Lake Murray. An even smaller portion of the basin lies within the Santee-Lynches CUA in Richland County. The CUAs are shown in Chapter 1, Figure 1-5. The Western CUA was designated in 2018 and the Santee-Lynches CUA was designated in 2021. Only a small portion of the Saluda River basin overlaps with this CUA. The limited number of permitted groundwater withdrawals in the Saluda basin are all within or near the Western CUA (SCDHEC 2025).

3.3.5 Groundwater Concerns

Groundwater use within the basin is limited; consequently, there are no areas experiencing significant water level declines as a result of overpumping (SCDNR 2009). Several wells with greater total dissolved solids levels are in the Carolina slate belt (SCDNR 2009). Groundwater from the Tertiary sand aquifer in Lexington County has been reported to have naturally high concentrations of gross-alpha particle activity and radium-226 activity, exceeding drinking water standards. High radium levels are concentrated to a narrow zone of granite rock adjoining the Fall Line. Some of this groundwater, therefore, may not be suitable for human consumption.

Also, during certain drought conditions, some private wells are vulnerable to lack of water, and some private well owners have contacted local public supply to inquire about connecting.

3.4 Chapter Summary

The Saluda River Basin covers over 2,500 sq mi in northwest South Carolina, beginning in the Blue Ridge and flowing across the Piedmont to join the Broad River near Columbia. The basin is completely contained within the state, meaning that it is not vulnerable to out-of-state management or other trans-boundary regulations. Hydrologic data are plentiful, with 25 active flow monitoring stations operated by the USGS. Surface water in the basin has been developed for hydroelectric power generation, municipal water supply, and recreation. Groundwater use is minimal, but small wells do support some irrigation, water supply, industry, and golf courses. Lake Murray, the basin's largest lake, is the third largest lake in the state by volume and supports hydroelectric power, municipal supply, and recreation. In 2018, a stretch of the mainstem from Saluda Lake Dam to the headwaters of Piedmont Lake was designated as hydrologically impaired, a classification that the RBC believes should be reassessed.

Other concerns in the basin, as expressed by RBC members, include rapid population and demand growth, coordination between non-FERC hydropower facilities and downstream recreational uses, droughts of increasing severity and uncertain future climate conditions, loss of riparian buffers, and issues associated with overallocation. To better understand these concerns and risks, SWAM was used to examine a broad array of surface water availability scenarios, from natural flow conditions to very conservative projections for future growth and water demand (Chapter 5). The model quantifies how reliably water in the Saluda Basin can meet all needs, including instream flow for ecosystem preservation. From these assessments, water management strategies were developed (Chapters 6 and 7).

Chapter 4
Current and Projected Water Demand

This chapter summarizes current water demands, permitted and registered water use, and projected water demands over the 50-year planning horizon from 2020 to 2070 in the Saluda River basin. Demand projections are based on historical demands and published projection datasets for driver variables, or variables that influence water demand including population, economic development, and irrigated acreage. SCDES developed a statistical model to project demands for each major water use category using the current demands and 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 in the surface water model to assess future water availability as described in Chapters 5 and 6.

4.1 Current Water Demand

Current surface water and groundwater demands are based on data available through 2019, when the SWAM model was last updates, and were developed to reflect average withdrawals from 2010 to 2019 (in most cases).

The withdrawals used for this demand characterization were reported to SCDES by permitted and registered water users in the Saluda River basin as required by Title 49 Chapter 4 South Carolina Surface Water Withdrawal, Permitting, Use, and Reporting Act. 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 Act. For groundwater withdrawals over the 3-million gallons threshold, users withdrawing within a CUA must permit their use, while those withdrawing outside of a CUA must only register their use. Lexington County is the only county that lies within the Western and Santee-Lynches CUAs and therefore, permit their use. Thus, most groundwater users in the Saluda River basin are outside of CUAs and therefore register their use.

Current permitted and registered water withdrawals in the Saluda River basin total approximately 312 MGD on average. Of this total withdrawal, 311 MGD is from surface water and less than 1 MGD is from groundwater. A portion of the water withdrawn from the basin is returned, called non-consumptive use, while the remaining portion, used consumptively, is called consumptive use. For example, for public supply withdrawals, the non-consumptive portion of withdrawal is returned to wastewater collection systems and treatment facilities, which discharge treated effluent back to surface water resources. The percentage of withdrawal deemed consumptive varies by water use category and individual user. About 53 MGD (17 percent) of the water is consumptively used and 259 MGD (83 percent) is returned to streams and rivers after use.

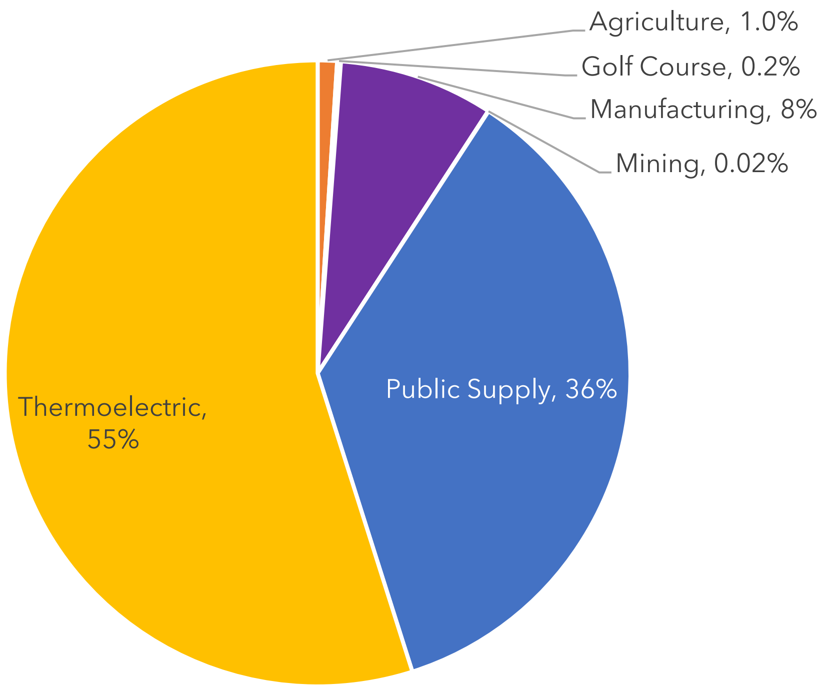
The thermoelectric and water supply sectors account for 55 and 36 percent of total withdrawals, respectively. Manufacturing sector withdrawals are about 8 percent of the total. Minimal water withdrawals are associated with agriculture (1 percent), golf course irrigation (0.2 percent), and mining (0.02 percent). Table 4-1 shows and Figure 4-1 summarizes distribution by sector. Although thermoelectric represents the largest withdrawal category in the basin, Dominion Energy, which makes up 97 percent of the total thermoelectric demand, uses a once-through cooling system in which approximately 98 percent of the water withdrawn is returned to the system and approximately 2 percent is consumed. Appendix A includes a table of all water users along with the user's source (surface water or groundwater), 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. It is assumed that all groundwater is used consumptively or returned to the groundwater system through septic tanks. Of the 311.9 MGD withdrawn from the Saluda River Basin, 53.2 MGD is used consumptively and 258.7 MGD is returned.

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

Water Use Category	Groundwater (MGD)	Surface Water (MGD)	Total (MGD)
Thermoelectric	-	171.2	171.2
Public Supply[1]	0.04	111.9	112.0
Manufacturing	0.02	24.9	24.9
Golf Course	0.02	0.6	0.6
Agriculture	0.4	2.7	3.1
Mining	-	0.1	0.1
Total	**0.5**	**311.4**	**311.9**

[1] The Public Supply Surface Water current water demand total does not include the demand satisfied by the transbasin import from the Broad River basin for the City of Columbia.

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



4.2 Permitted and Registered Water Use

As of July 2024, during the development of this River Basin Plan, a total of 1,098.6 MGD had been permitted or registered in the Saluda River basin, this value includes both surface water and groundwater. Of this total, 1,083.0 MGD had been permitted and 15.6 MGD had been registered. Only 28.4 percent (311 MGD) of the total permitted and registered surface water amount is withdrawn and only 4.8 percent (53 MGD) is used consumptively within the basin. The Joint Municipal Water & Sewer Commission (JMWSC), which serves communities throughout Lexington County, received approval from the FERC in 2021 for withdrawal of up to 50 MGD from Lake Murray. However, as of April 2025, JMWSC has not applied for nor received a surface water withdrawal permit from SCDES. Because of this, the 50 MGD withdrawal is not included in the total permitted and registered water use reported in this section. In addition, West Columbia received FERC approval to withdrawal 72 MGD from Lake Murray. Since West Columbia has not yet (as of April 2025) applied for nor received a surface water withdrawal permit from SCDES, it was also not included in the permitted and registered water use totals.

For groundwater, 1.2 MGD has been permitted and 0.4 MGD has been registered for use. Eighty percent of groundwater registrations included in this total are water users that are below the 3-million-gallon-per-month (MGM) permitting threshold but chose to be registered and report their groundwater use to SCDES.

Figure 4-2 shows the location of all permitted and registered surface water intakes and groundwater wells in the basin. Table 4-2 summarizes permitted and registered surface water and groundwater withdrawals by water use category. Appendix A includes a table of all permitted or registered withdrawals for each user.

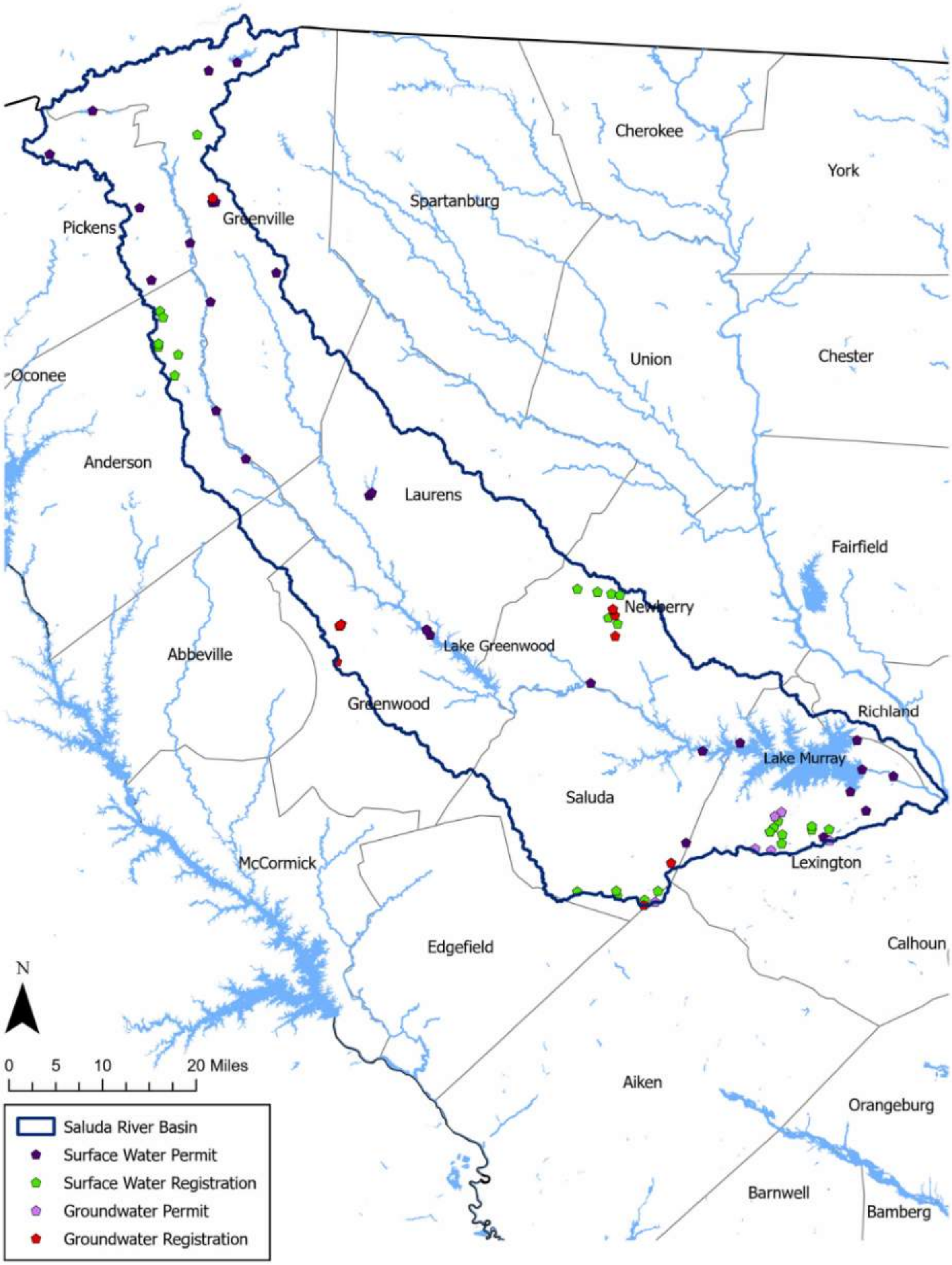


Figure 4-2. Locations of permitted and registered water intakes and groundwater wells with registrations in the Saluda River basin

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

Water Use Category	Surface Water (MGD)			Groundwater (MGD)			Total (MGD)		
	Permitted	Registered	Total	Permitted	Registered[1]	Total	Permitted	Registered	Total
Thermoelectric	501.6	-	501.6	-	-	-	501.6	-	501.6
Public Supply[2]	524.8	-	524.8	0.9	-	3.8	528.5	-	525.7
Manufacturing	44.9	-	44.9	0.1	0.01	0.3	45.2	0.01	45.0
Golf Course	10.1	-	10.1	-	0.02	0.02	10.1	0.02	10.1
Agriculture	-	15.3	15.3	0.1	0.3	0.4	0.1	15.6	15.7
Mining	0.5	-	0.5	-	-	-	0.5	-	0.5
Total	**1,081.8**	**15.3**	**1,097.0**	**1.2**	**0.4**	**1.6**	**1,083.0**	**15.6**	**1,098.6**

Water Use Category	Percentage of Total Permitted and Registered Surface Water Currently in Use	Percentage of Total Permitted and Registered Groundwater Currently in Use	Percentage of Total Permitted and Registered Water Currently in Use
Thermoelectric	34.1%	-	34.1%
Public Supply	21.3%	4.0%	21.3%
Manufacturing	55.5%	16.4%	55.4%
Golf Course	5.6%	100.0%	5.8%
Agriculture	17.7%	91.3%	19.8%
Mining	14.5%	-	14.5%
Total	**28.4%**	**31.3%**	**28.4%**

[1]Groundwater registrations do not include limits and were assumed to be equal to current use.
[2] Public Supply Surface Water Permits total does not include the transbasin import from the Broad River basin for the City of Columbia.

DRAFT

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 2019c). SCDNR developed this document over several years in collaboration with the South Carolina Water Resources Center at Clemson University and the USACE, with additional input from stakeholders including:

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

Following the guidance in the statewide projections report, SCDNR developed demands for the Saluda River basin with only minor deviations from the framework, as presented in this section. In the Saluda River basin, demands were projected to increase for the public water supply, manufacturing, and agriculture sectors. Nearly all (approximately 96 percent) water used for electric power generation is returned directly to the river and was projected to remain stable. Water use for mining and golf courses account for less than 1 percent of total withdrawals and were projected to remain stable over the planning horizon. All groundwater withdrawals, which also account for less than 1.0 percent of total withdrawals, were also assumed to remain at current levels over the planning horizon. Due to the low groundwater usage in the Piedmont, a groundwater model has not been developed.

For the three 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 4-3. Projections for these driver variables come from a variety of published sources and are listed in Table 4-3. Published values were extrapolated to 2070 to match the planning horizon of the River Basin Plan.

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 in recent reporting and moderate growth projections according to the driver variables, while the High Demand Scenario is based on the maximum monthly rates of water use in recent reporting and high-growth projections according to the driver variables. 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 Moderate and High Demand Scenarios have different starting points for the projections because, while they have the same users, the unit use rates for those users differ between the scenarios. The subchapters present additional details on the calculation of demand for each water use category.

Table 4-3. Driver variables for each water use category.

Water Use Category	Driver Variable	Driver Variable Data Source	Moderate Demand Scenario	High Demand Scenario
Public Supply	Population	South Carolina Office of Revenue and Fiscal Affairs (SC ORFA)	SC ORFA County projections to 2035; extend straight-line growth or assume constant population if the population projection is negative	Project using statewide or countywide growth rate, increased by 10%
Manufacturing	Economic production	Subsector growth rates from the U.S. Energy Information Agency (EIA)	Manufacturing subsector growth with the minimum adjusted to 0%	Manufacturing subsector growth with the minimum adjusted to 2.1%[1]
Agriculture	Irrigated acreage	National-scale studies: ▪ Brown et al. 2013 ▪ Crane-Droesch et al. 2019	Assume irrigated acreage increases with an annual growth rate of 0.65%	Assume irrigated acreage increases with an annual growth rate of 0.73%
Golf Course[2]	NA	NA	Assumed constant at median monthly use rate	Assumed constant at maximum monthly use rate
Thermoelectric[2]	NA	NA	Assumed constant at current use rate	Assumed constant at current use rate
Mining[2]	NA	NA	Assumed constant at current use rate	Assumed constant at current use rate

NA – not applicable

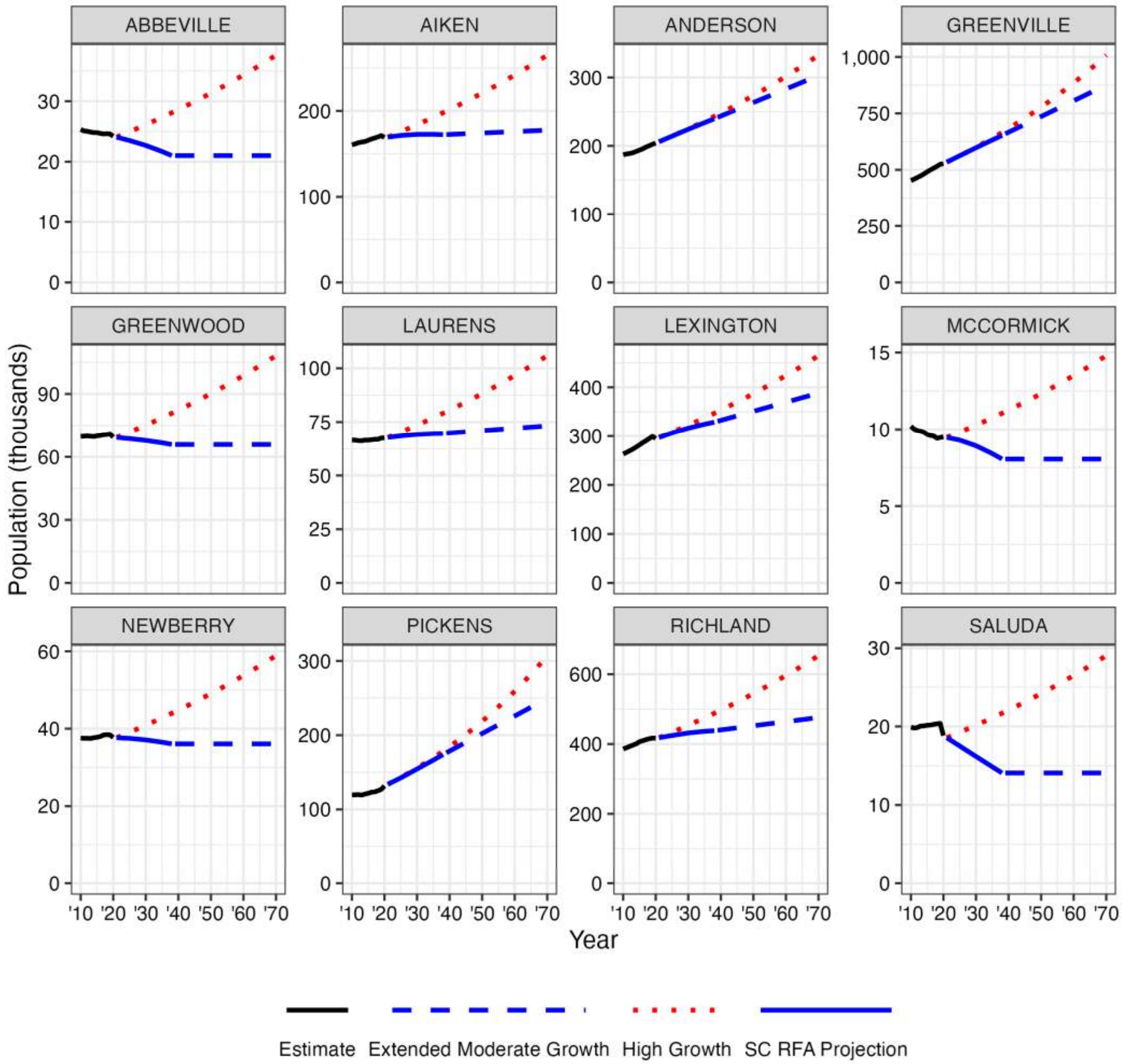
[1] 2.1% is the total overall EIA economic growth projection increased by 10% [1.9% +(10% x 1.9%) = 2.1%]

[2] While projections were developed for all use categories, only three use categories had projected increases in demands. The others (mining, golf course, thermoelectric) were projected to remain stable at either their current use rate for thermoelectric and mining (presented in Chapter 4.1) or their median or maximum monthly rates of recent historic use for golf course irrigation. This is described in Chapter 4.3.4.

4.3.1 Public Supply Demand Projections Methodology

Public supply is the second largest water use sector in the Saluda River basin. Greater than 99 percent of public supply withdrawals are met with surface water. Demand projections for public supply were developed based on county-level populations and water use projections. Population projections for the Moderate Demand Scenario were obtained from 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 is flatlined at 2035 levels. For the High Demand Scenario, populations are 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 state average, then the high-scenario population projection is set at the state average plus 10 percent. As shown in Figure 4-3, some counties are projected to experience population declines while others may experience substantial growth in both the Moderate and High Demand Scenarios. County populations are adjusted by the current population served by the public water system, such that the percentage of population on public supply or private wells remains constant. Populations are multiplied by a systemwide per capita usage to calculate demand. Nearly all public supply water use in the Saluda River basin is from surface water, with only the Gilbert-Summit Rural Water District withdrawing 0.04 MGD from groundwater. This minimal groundwater use for public supply was assumed to remain constant.

Figure 4-3. Population projections for counties withdrawing water from the Saluda River basin (SCDNR 2023a). Note: The Y-axis is scaled differently for each county.



4.3.2 Manufacturing Demand Projections Methodology

Water is used for manufacturing in the Saluda River basin to produce many products including flooring (Shaw Industries), tires (Michelin North America), and textiles (Greenwood Mills). Manufacturing demand projections were based on projected subsector growth rates from EIA, which ranged from 0.3 to 2.1

percent for the sectors present in the Saluda River basin (U.S. EIA 2020). The Moderate Demand Scenario used EIA projected growth rates, while the High Demand Scenario increased growth rates 10 percent over their projected values. Nearly all manufacturing water use in the Saluda River basin is from surface water; only 0.02 MGD is from groundwater. These minimal groundwater demands for manufacturing use were assumed to remain constant.

4.3.3 Agriculture Demand Projections Methodology

Water demand projections for agriculture were developed using existing unit use rates and irrigated acreage increase projections. Moderate Demand Scenario projections were based on regional projections of irrigated acers in the southeast growing 0.65 percent per year (Brown et al. 2013). For the High Demand Scenario, the growth rate was increased to 0.73 percent per year, based on projections of climate change impacts on agricultural irrigation in addition to the increase in acreage (Crane-Droesch et al. 2019).

For input to the SWAM model, projected growth of irrigation water use was assigned to Hydrologic Unit Code-10 (HUC-10) subbasin outlets in the model. This method represents a relatively robust assumption that irrigation will expand somewhere in each subbasin where irrigation currently occurs, but might underrepresent expansion of irrigation withdrawals on small tributaries within each subbasin.

4.3.4 Other Demand Projections Methodology

Other water withdrawals in the Saluda River basin support mining, thermoelectric energy production, and golf course irrigation. Mining withdrawals were assumed to remain constant at the current average use rates presented in Chapter 4.1. Thermoelectric demands were also held constant at the current average use rates presented in Chapter 4.1 based on consultation with representatives of Dominion Energy and Duke Lee Station. Golf course projections were developed where for the Moderate Demand Scenario, demands were held constant at the median monthly rate of recent historic use and for the High Demand Scenario, demands were held constant at maximum monthly rate of recent historic use.

4.4 Projected Water Demand

From 2025 to 2070, total withdrawals are projected to increase by 13 percent from 307.5 MGD to 347.8 MGD under the Moderate Demand Scenario and by 30 percent from 327.9 MGD to 426.8 MGD under the High Demand Scenario. Included in these projections is 0.5 MGD of groundwater withdrawals, which are projected to remain constant over the planning horizon. The Moderate and High Demand Scenarios have different starting points from one another and differ from the current use because the Moderate Demand Scenario is based on each user's median recent use, the High Demand Scenario is based on each user's maximum recent use, and the Current Use Scenario is based on each user's average recent use. Surface water demand is expected to reach 32 to 39 percent of currently permitted and registered surface water withdrawals by 2070 for the Moderate and High Demand Scenarios, respectively.

Table 4-4 shows and Figure 4-4 summarizes projected surface water and groundwater demands over the planning horizon. The figure includes stacked area graphs, with total demand shown as thick black lines and shaded areas showing which portion of total demand comes from groundwater or surface water. For example, in 2025, the Moderate Demand Scenario total demand is 308 MGD. Of that, 0.5 MGD is from groundwater and 307.5 MGD is from surface water. Figure 4-5 shows projected demands by water use category, which are further described in the subchapters that follow.

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

Year	Moderate Demand Scenario (MGD)			High Demand Scenario (MGD)		
	Surface Water	Groundwater	Total	Surface Water	Groundwater	Total
2025	307.5	0.5	308.0	327.4	0.5	327.9
2030	310.8	0.5	311.3	335.2	0.5	335.7
2035	313.8	0.5	314.3	343.7	0.5	344.2
2040	317.3	0.5	317.7	352.8	0.5	353.2
2050	326.7	0.5	327.2	373.5	0.5	374.0
2060	336.5	0.5	337.0	397.6	0.5	398.1
2070	347.8	0.5	348.3	426.3	0.5	426.8
Percent Increase 2025-2070	**13.1%**	**0%**	**13.1%**	**30.2%**	**0%**	**30.2%**

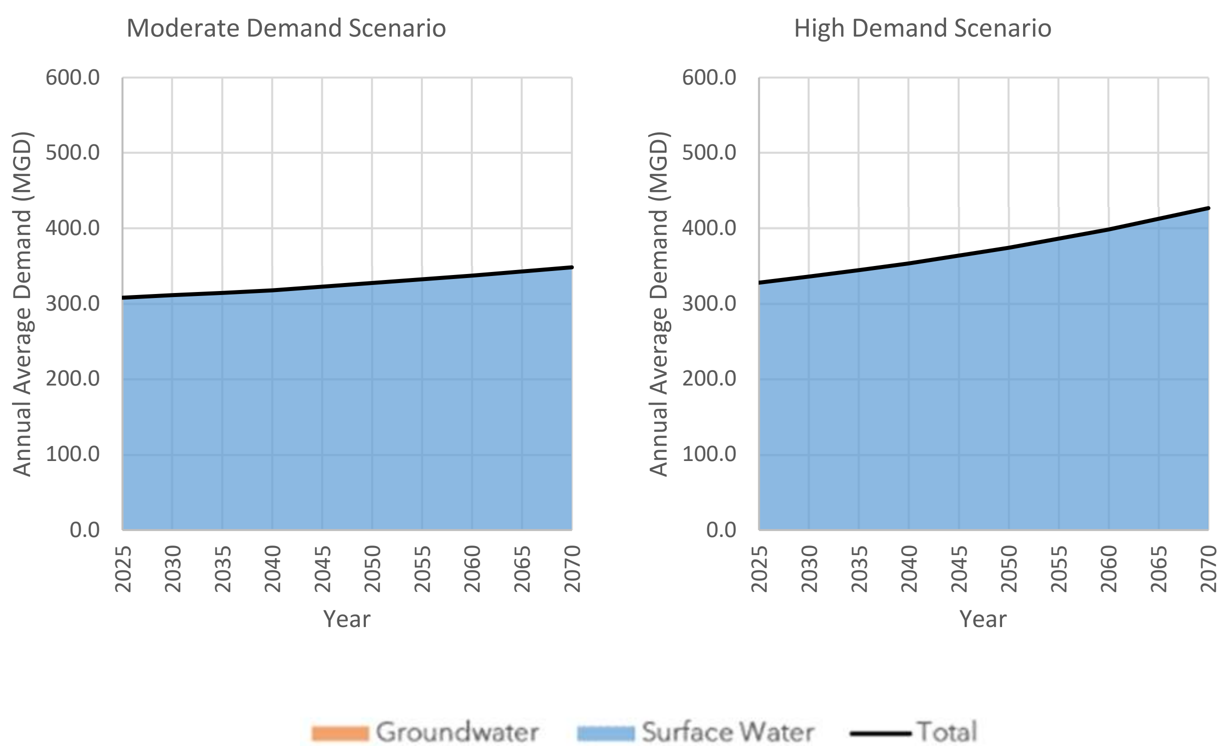


Figure 4-4. Demand projections by water source. (Groundwater demands projected at a constant average annual demand of 0.5 MGD are too small to be seen on this chart.)

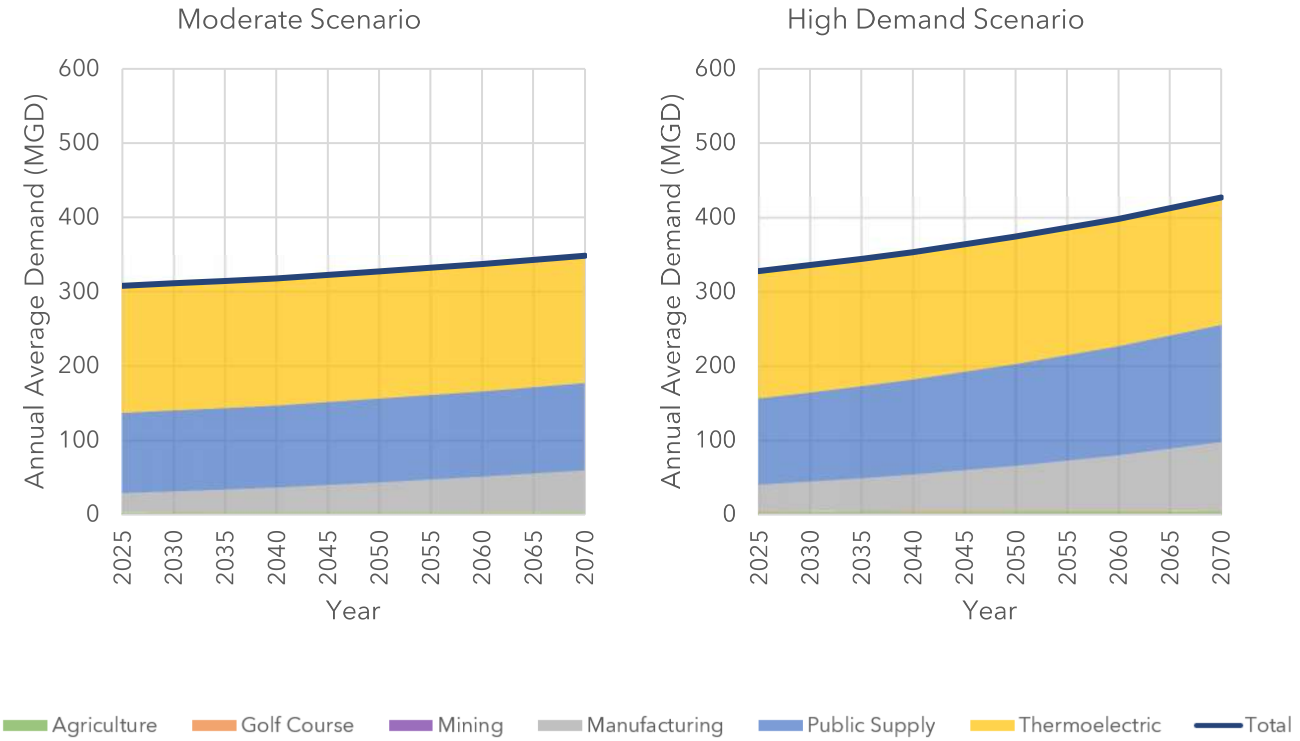


Figure 4-5. Demand projections by water use category. **(Agriculture, golf course, and mining demands make up less than 1 percent of the total 2070 demands and may be too small to be seen on this chart.)**

4.4.1 Public Supply Demand Projections

Most of the water demand growth in the Saluda River basin is expected to come from increasing demand for public water supply. Table 4-5 presents projected population increases. In the Moderate Demand Scenario, public supply demands are projected to increase 9 percent between 2025 and 2070 (107.8 to 116.2 MGD). In the High Demand Scenario, public supply demands are projected to increase by 36 percent (117.3 to 158.2 MGD). Most of the public supply demand increase will be met by surface water, which will serve over 99 percent of demand. The current permitted surface water withdrawal for public supply in the Saluda River Basin is 524.8 MGD, such that the projected 2070 withdrawals for the Moderate and High Demand Scenarios are approximately 22 and 30 percent, respectively, of the total permitted amount. Figure 4-6 shows and Table 4-6 summarizes public supply demand projections by water source.

After the public supply demand projections were developed and used to evaluate future conditions (as described in Chapter 5 – Comparison of Water Resource Availability and Water Demand), subsequent discussions with public water suppliers withdrawing from Lake Murray suggested that future water withdrawals from the lake may be larger than initially projected for this planning effort. West Columbia's demand projections may need to be revisited and potentially increased in subsequent phases of basin planning.

Table 4-5. Projected population increases (in thousands) (based on SC OFRA data through 2035, extended to 2070 by SCDES).

	County	2025	2030	2035	2040	2050	2060	2070
Moderate Demand Scenario	Abbeville	23.5	22.7	21.7	21.0	21.0	21.0	21.0
	Aiken	171.5	172.7	172.8	172.6	174.3	175.9	177.6
	Anderson	214.2	224.3	234	243.6	263.4	283.1	302.9
	Greenville	562.5	597.8	632.2	666.5	736.2	805.9	875.6
	Greenwood	68.7	67.8	66.7	65.9	65.9	65.9	65.9
	Laurens	68.5	69.2	69.6	69.8	70.9	72.1	73.2
	Lexington	306.6	316.5	324.6	332.4	351	369.5	388.1
	McCormick	9.3	8.9	8.4	8.1	8.1	8.1	8.1
	Newberry	37.5	37.1	36.5	36.1	36.1	36.1	36.1
	Pickens	142.5	154.4	166.4	178.6	202.2	225.9	249.5
	Richland	424.3	431.6	436.4	440.5	452.3	464	475.8
	Saluda	17.5	16.2	14.9	14.1	14.1	14.1	14.1
High Demand Scenario	Abbeville	25.0	26.1	27.3	28.6	31.3	34.3	37.6
	Aiken	175.8	184	192.6	201.5	220.8	241.8	264.9
	Anderson	214.3	225	236.3	248.1	273.5	301.6	332.6
	Greenville	562.5	600.1	640.3	683.2	777.7	885.3	1,007.7
	Greenwood	71.8	75.2	78.7	82.3	90.2	98.8	108.2
	Laurens	70.2	73.5	76.9	80.5	88.2	96.6	105.8
	Lexington	308.3	322.6	337.6	353.4	387.1	424	464.4
	McCormick	9.8	10.3	10.8	11.3	12.3	13.5	14.8
	Newberry	39.1	40.9	42.8	44.8	49.1	53.7	58.9
	Pickens	143.2	155.8	169.6	184.7	218.8	259.3	307.2
	Richland	433.6	453.8	474.9	497.1	544.5	596.4	653.2
	Saluda	19.3	20.2	21.1	22.1	24.2	26.5	29.0

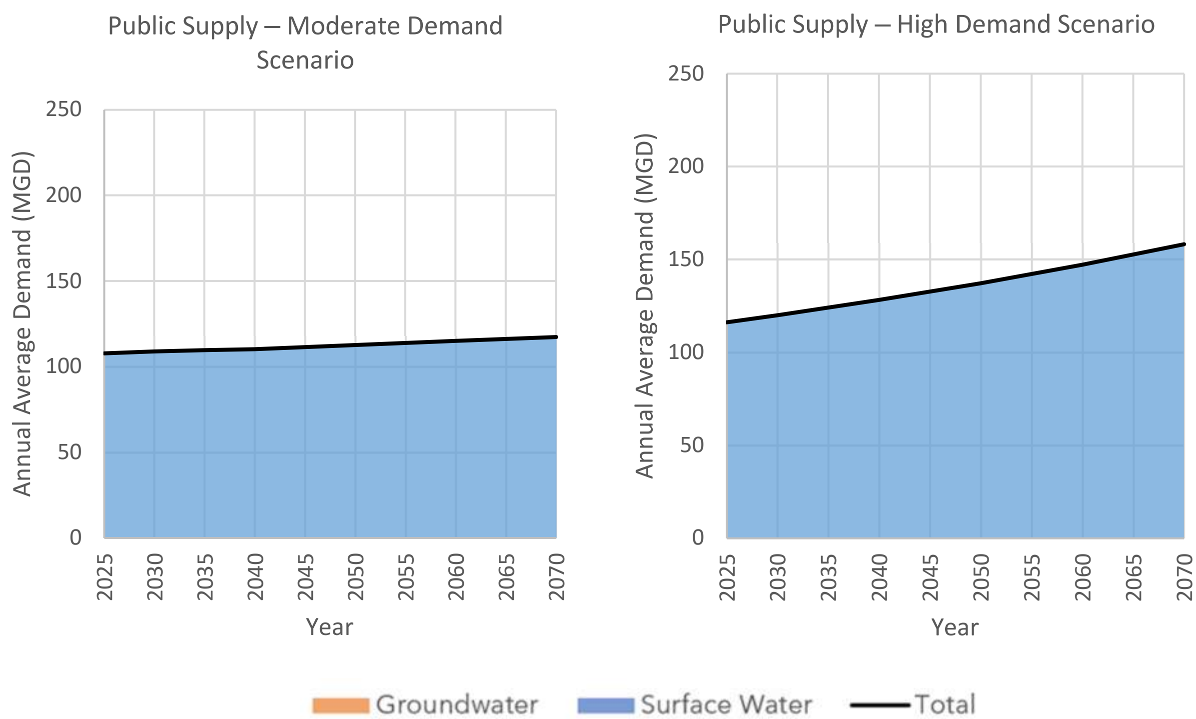


Figure 4-6. Projected public supply water demands. (Groundwater demands projected at a constant average annual demand of less than 1 MGD are too small to be seen on this chart.)

Table 4-6. Projected public supply water demands.

Year	Moderate Demand Scenario (MGD)			High Demand Scenario (MGD)		
	Surface Water	Groundwater	Total	Surface Water	Groundwater	Total
2025	107.7	0.04	107.8	116.1	0.04	116.2
2030	108.7	0.04	108.8	119.9	0.04	120.0
2035	109.4	0.04	109.5	123.9	0.04	124.0
2040	110.1	0.04	110.2	128.1	0.04	128.1
2050	112.5	0.04	112.6	137.1	0.04	137.2
2060	114.9	0.04	114.9	147.1	0.04	147.2
2070	117.2	0.04	117.2	158.2	0.04	158.2
Percent Increase 2025-2070	**8.8%**	**-**	**8.8%**	**36.2%**	**-**	**36.2%**

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4.4.2 Manufacturing Demand Projections

Manufacturing demands are projected to increase 116 percent between 2025 and 2070 (26.0 to 36.0 MGD) in the Moderate Demand Scenario. In the High Demand Scenario, manufacturing demands are projected to increase 155 percent between 2025 and 2070 (56.1 to 91.7 MGD). Less than 0.1 MGD manufacturing demand is from groundwater. Projected 2070 manufacturing surface water withdrawals for the Moderate and High Demand Scenarios are approximately 125 and 204 percent of currently permitted manufacturing surface water withdrawals, respectively. Figure 4-7 shows and Table 4-7 summarizes manufacturing demand projections.

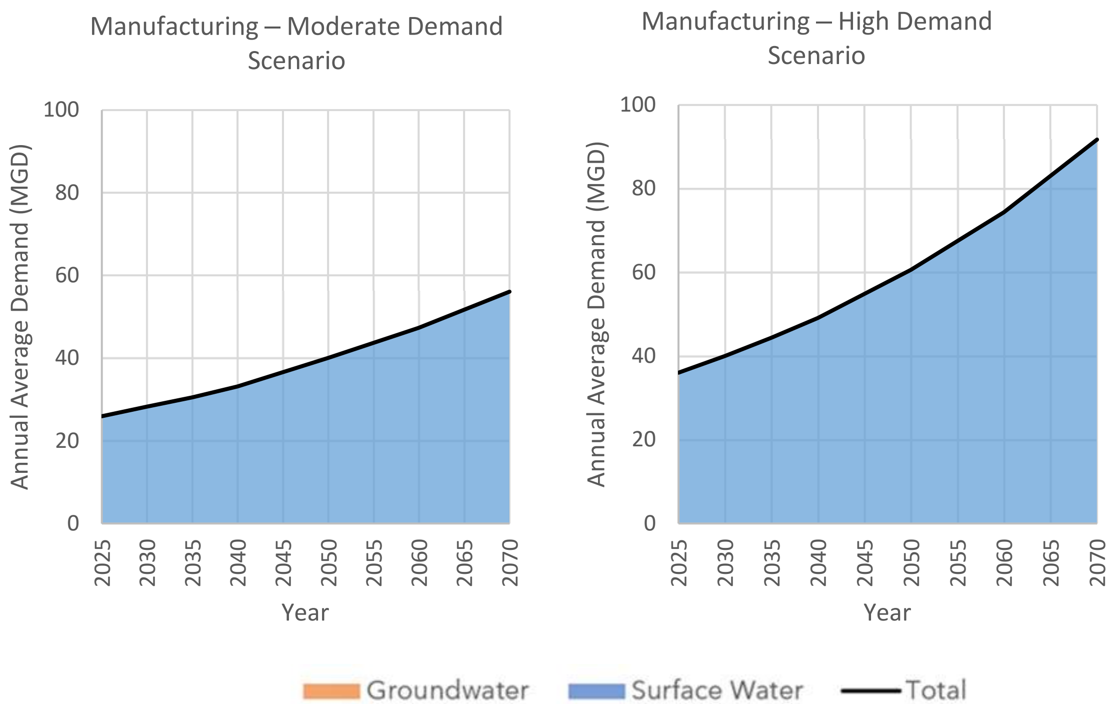


Figure 4-7. Projected manufacturing water demands. (Groundwater demands projected at a constant average annual demand of less than 1 MGD are too small to be seen on this chart.)

Table 4-7. Projected manufacturing water demands.

Year	Moderate Demand Scenario (MGD)			High Demand Scenario (MGD)		
	Surface Water	Groundwater	Total	Surface Water	Groundwater	Total
2025	25.9	0.02	26.0	36.0	0.02	36.0
2030	28.2	0.02	28.2	39.9	0.02	40.0
2035	30.5	0.02	30.5	44.3	0.02	44.3
2040	33.1	0.02	33.1	49.0	0.02	49.1
2050	40.0	0.02	40.0	60.5	0.02	60.5
2060	47.3	0.02	47.3	74.3	0.02	74.3
2070	56.1	0.02	56.1	91.7	0.02	91.7
Percent Increase 2025-2070	**116.1%**	-	**116.0%**	**154.8%**	-	**154.7%**

4.4.3 Agriculture Demand Projections

Agriculture demands are projected to increase 28 percent between 2025 and 2070 (2.5 to 3.2 MGD) in the Moderate Demand Scenario. In the High Demand Scenario, agriculture demands are projected to increase 34 percent (3.2 to 4.5 MGD). About 0.4 MGD of agriculture demand is from groundwater. Projected 2070 agriculture surface water withdrawals for the Moderate and High Demand Scenarios are approximately 18 and 27 percent of currently registered agriculture surface water withdrawals, respectively. Figure 4-8 shows and Table 4-8 summarizes agriculture demand projections.

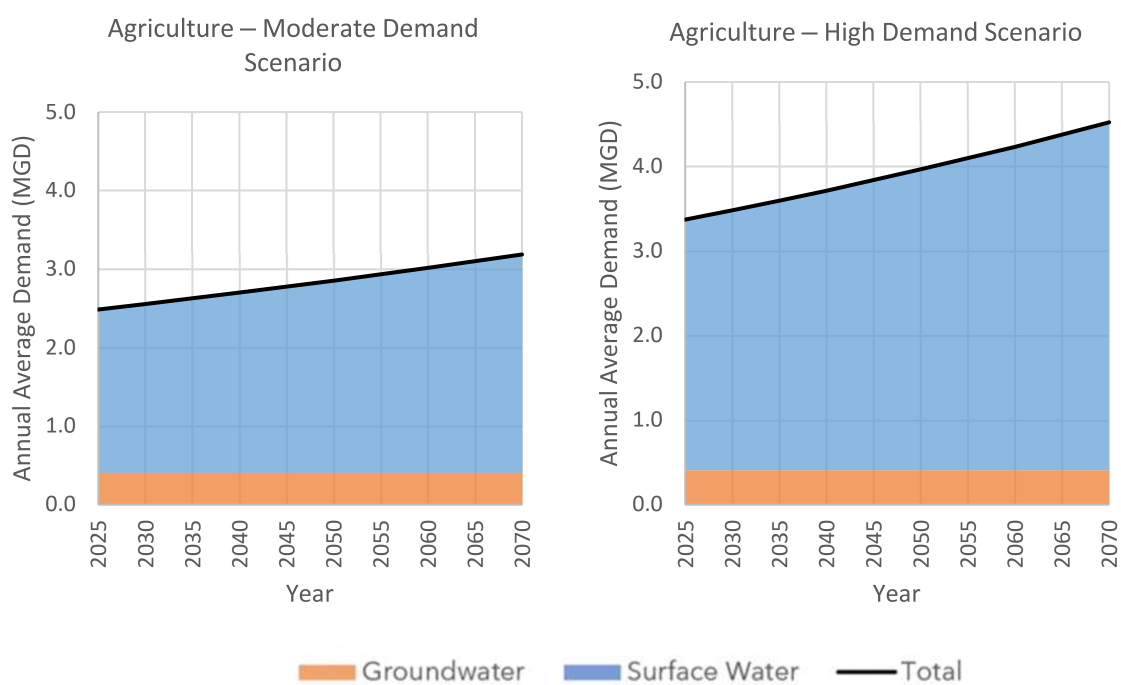


Figure 4-8. Projected agriculture water demands.

Table 4-8. Projected agriculture water demands.

Year	Moderate Demand Scenario (MGD)			High Demand Scenario (MGD)		
	Surface Water	Groundwater	Total	Surface Water	Groundwater	Total
2025	2.1	0.4	2.5	3.0	0.4	3.4
2030	2.1	0.4	2.5	3.1	0.4	3.5
2035	2.2	0.4	2.6	3.2	0.4	3.6
2040	2.3	0.4	2.7	3.3	0.4	3.7
2050	2.4	0.4	2.9	3.6	0.4	4.0
2060	2.6	0.4	3.0	3.8	0.4	4.2
2070	2.8	0.4	3.2	4.1	0.4	4.5
Percent Increase 2025-2070	**33.8%**	**-**	**28.3%**	**38.7%**	**-**	**34.0%**

4.4.4 Other Demand Projections

Mining demands were assumed to remain constant at the current average rate of 0.08 MGD from surface water in both the Moderate and High Demand Scenarios. Thermoelectric demands were also held constant at the current average use rate of 171.2 MGD in the Moderate and High Demand Scenarios based on consultation with representatives of Dominion Energy and Duke Lee Station. Golf course projections were developed where for the Moderate Demand Scenario, demands were held constant at 0.5 MGD based on median rates of recent historic use and for the High Demand Scenario, demands were held constant based on high rates of recent historic use at 1.1 MGD. Of this golf course demand, 0.02 MGD is from groundwater.

4.5 Chapter Summary

Total current water withdrawals in the Saluda River basin are approximately 312 MGD. Nearly all of this withdrawal comes from surface water, with only about 0.5 MGD withdrawn from groundwater. Thermoelectric withdrawals account for 55 percent of current total withdrawals, although only 4 percent of thermoelectric withdrawals are consumed with the remaining 96 percent being returned to the system. After thermoelectric use, public supply is the next largest use category (36 percent of basin withdrawals), then manufacturing (8 percent), then minimal withdrawals associated with agriculture (1 percent), golf course irrigation (0.2 percent), and mining (0.02 percent). These withdrawals represent 28 percent of the total permitted and registered amount for the basin.

For this planning effort, two future demand scenarios were developed: the Moderate Demand Scenario, which is based on median rates of water use in recent reporting and moderate growth projections, and the High Demand Scenario, which is based on the maximum monthly rates of water use in recent reporting and high growth projections. From 2025 to 2070, total water demand in the Saluda River basin is projected to increase by 13 percent from 308 MGD to 348 MGD for the Moderate Demand Scenario and by 30 percent from 328 MGD to 427 MGD for the High Demand Scenario. The Moderate and

High Demand Scenarios have different starting points from one another and differ from the current use because the Moderate Demand Scenario is based on each user's median recent use, the High Demand Scenario is based on each user's maximum recent use, and the Current Use Scenario is based on each user's average recent use. Included in these projections is 0.5 MGD of groundwater withdrawals, which are projected to remain constant over the planning horizon. Most of the water demand growth in the Saluda River basin is expected to come from increasing demand for public water supply, which is expected to increase 9 percent in the Moderate Demand Scenario and 36 percent in the High Demand Scenario.

Total projected water demands in 2070 are well below the total permitted and registered surface water amount of 1,097 MGD in the basin. 2070 demand projections reach 32 percent of currently permitted and registered withdrawals for the Moderate Demand Scenario and 39 percent for the High Demand Scenario. Permitted and registered withdrawals are not, however, proxies for water availability in the basin, because sufficient flows to satisfy such withdrawals rates cannot be guaranteed into the future.

Chapter 5
Comparison of Water Resource Availability and Water Demand

This chapter describes the methods used to assess surface water availability in the Saluda River basin. A surface water quantity 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. The results of these assessments are presented and compared, and potential water shortages and concerns are identified.

5.1 Methodology

5.1.1 Surface Water

Following are several key terms of the surface water modeling, introduced in the Planning Framework, used throughout this chapter.

- **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 that 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 Saluda RBC identified the 14-mi stretch of the Saluda River downstream of Saluda Lake, which is classified as being hydrologically impaired (SCDHEC 2022c), as a Reach of Interest.

- **Reservoir Safe Yield** – The Surface Water Supply for a reservoir or system of reservoirs over the simulated hydrologic period of record.

- **Strategic Node** – A location on a surface water body or aquifer designated to evaluate the cumulative impacts of water management strategies for a given model scenario. Strategic nodes serve as primary points of interest from which to evaluate a model scenario's performance measures. The RBC selected 11 Strategic Nodes.

- **Surface Water Condition** – A limitation, defined by the RBC, on the amount of water that can be withdrawn from a surface water source and that can be applied to evaluate Surface Water Supply for planning purposes. The Saluda RBC did not establish a Surface Water Condition for any location in the Saluda River basin in limitations. Therefore, all model results shown here assume no minimum instream flow requirements, or zero flow as the boundary for water availability for withdrawal. This assumption does not consider water supply needs at surface withdrawal points in order to maintain biological, chemical, and physical integrity of the stream or take into account the needs of downstream users.

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

- **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.

Surface water planning scenarios were constructed and simulated using the previously developed Saluda River basin surface water quantity model (CDM Smith 2017). This model was developed with CDM Smith's SWAM software. This Microsoft Excel-based model simulates river basin hydrology, water availability, and water use across a network over an extended timeseries.

SWAM provides efficient planning-level analyses of surface water supply systems. Simulations begin with naturally occurring headwater flow into the river reaches, estimated based on available records. The model then calculates physically available and permitted or allowable (not limited for use by a regulatory constraint) water flow, 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 in SWAM to allow for easy development of a range of systems. As an example, SWAM's reservoir object can include basic hydrology-dependent calculations including storage as a function of inflow, outflow, and evaporation. It can also include operational rules of varying complexity such as 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 Saluda River basin SWAM model simulates almost 95 years of historic hydrology (August 1925 through December 2019) 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 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 Saluda River basin model extends from the upstream headwaters to the confluence with the Wateree River (shown in Figure 1 as part of the Catawba Basin). For planning purposes in the Saluda River basin, only the portion above the confluence with the Broad River (where the Saluda and Broad Rivers combine to form the Congaree River) was considered. The area downstream of this will be included in the simulations presented in the Santee River Basin Plan. The Saluda portion of the model upstream of the Broad River includes 13 discrete agricultural (irrigation) users, 11 municipal systems, nine golf course, two thermoelectric plants, one industrial, and one mining water users. Hydroelectric projects, which are not operated as strictly run-of-river facilities but instead operate within permitted rules for water storage and passage, are generally represented through operating rules incorporated into reservoir objects. All water users with permitted withdrawals greater than 0.1 MGD are represented, either explicitly or implicitly. In the model version that represents current conditions, monthly water use is set equal to the average of a recent 10-year period (2010 through 2019) of reported use, with several exceptions. These exceptions include surface water users with recent demands that are significantly different from demands in the early part of the 10-year period or new surface water users who have not been withdrawing for 10 years. For example, withdrawals and returns for Duke Energy's W.S. Lee Station, Laurens County Commission of Public Works (CPW), LCWSC, and Dominion Energy's McMeekin Station on Lake Murray are based on more recent, reported data, since their water use patterns have recently changed. Model users also can adjust water use patterns to explore future water management scenarios, as discussed in this chapter.

A total of 54 "tributary objects" (rivers and streams) are represented discretely in the model, including the mainstem Saluda River. Boundary condition (headwater) flows for each tributary object are prescribed in the model based on external analyses (CDM Smith 2017), which estimated naturally occurring historical flows not influenced, or "unimpaired", by human use. Historic, current, and/or future uses can then be simulated against the same natural hydrology of the basin. Hydrologic flow gains (or losses) along each modeled 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. SWAM implicitly accounts for interaction between groundwater and surface water through the assignment of the gain/loss factors.

The Saluda River basin SWAM model was used to simulate current and potential future scenarios to evaluate surface water availability. Section 5.3 provides detailed descriptions of the surface water scenarios and their results.

5.1.2 Groundwater

The Saluda River basin is almost entirely in the Piedmont physiographic province where groundwater occurs in bedrock fractures and in the overlying saprolite. Groundwater use is limited in the basin, and as such, no modeling or other analysis was performed to assess groundwater availability.

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 flow change in a user-defined condition from an established baseline, which is used to assess the performance of a proposed water management strategy or combination of strategies. Performance measures establish an objective approach for comparing scenarios. Performance measures were selected in collaboration with the RBC as outlined below. Some of these quantitative flow indicators are also used to inform the semi-quantitative assessment of biological response metrics (Section 5.2.2).

5.2.1 Hydrologic-based Performance Measures

Table 5-1 presents the hydrologic surface water performance measures used to evaluate and compare simulation results. For each simulated scenario, performance measures were calculated as a post-processing step in the modeling. All measures, or metrics, were calculated for the entire simulation period. 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 are defined at eight of the USGS streamflow gaging stations in the basin, on the North and South Saluda Rivers above their confluences with the mainstem, and on Rabon Creek below Lake Rabon. Figure 5-1 shows all Strategic Node locations.

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)
Basinwide 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) - 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 (%) - 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)

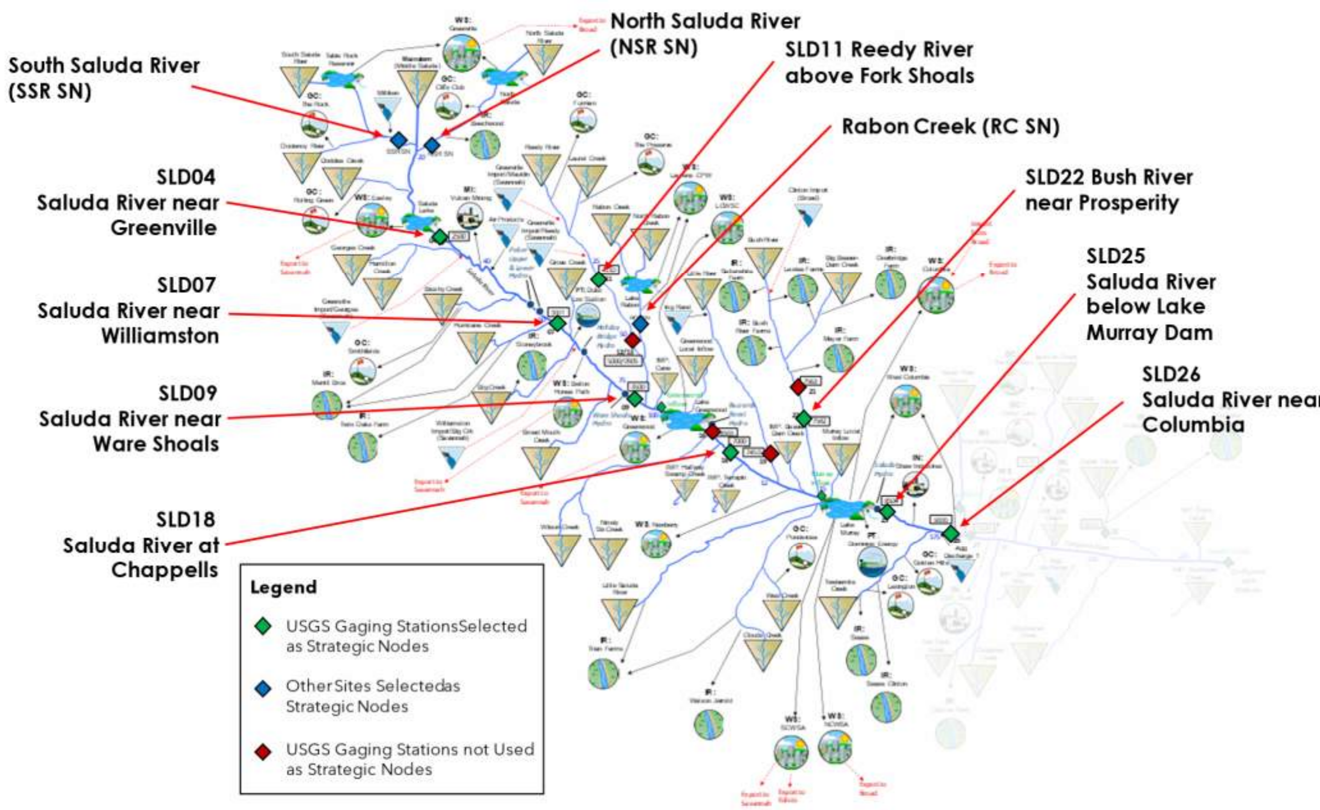


Figure 5-1. Strategic Node locations.

5.2.2 Biological Response Metrics

As referenced in Chapter 3.2.2 and discussed in Bower et al. (2022) and The Nature Conservancy et al. (2024), 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 as performance measures to help guide RBC discussions and recommendations for the Saluda 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 5.3.8 presents their values and interpretation in the context of the Saluda River basin.

The biological metrics were calculated at two of the Strategic Node locations shown in Figure 5-1 (Rabon Creek and Reedy River above Fork Shoals), as well as at a USGS gage location on the Bush River near Prosperity, and at a location on Twelvemile Creek near its confluence with the Saluda River. These represent a general, but limited, assessment of how aquatic life could 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. Biological metrics were based on flow-ecology relationships calculated using data from streams and small rivers with watershed areas less than or equal to 232 sq mi. Results are broadly applicable across the basin, because streams of this size comprise 87 percent of all surface water in South Carolina. However, the results should not be extrapolated to large rivers or reservoirs, nor should they be extrapolated to suggest resilience or vulnerability to other types of risks, such as water quality degradation.

Of the 14 biological response metrics identified in Bower et al. (2022), the following two biological response metrics were used in the Saluda River basin because of the relevance and strong connection to hydrologic statistics that could be readily extracted from the SWAM model (descriptions from The Nature Conservancy et al. 2024):

- **Species richness:** number of fish species found at a given site
- **Brood hiders:** proportional representation of fish individuals in the brood hiding breeding strategy, in which they hide their eggs but do not give parental care after.

Hydrologic statistics that correlated well to these biological metrics included two metrics that could be easily extracted from SWAM model results (The Nature Conservancy et al. 2024). 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 two flow metrics are:

- **Mean daily flow** is the mean (average) daily flow of the stream in cfs over the period of record
- **Timing of lowest observed flow** is the (Julian) date of the annual minimum flow, converted to a Julian date (a number from 1 to 365).

Mapped together, these hydrologic metrics were used to estimate changes in the biological response metrics, which characterizes the ecological integrity of the basin. Table 5-2 helps illustrate the flow-ecology relationships for the Piedmont Perennial Runoff (P1) stream type, which is the dominant stream type in the Saluda River basin (The Nature Conservancy et al. 2024); however, this table is not exhaustive. Chapter 5.3.8 presents and provides discussion of the application of the biological response metrics for the Saluda 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	Species Richness	Ecological Integrity
Timing of Low Flow	Brood Hiders	Ecological Integrity

5.3 Scenario Descriptions and Surface Water Simulation Results

Four scenarios were initially used to evaluate surface water availability and to identify any 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 Planning Framework. The RBC requested a fifth scenario, the Unimpaired Flow Scenario (UIF Scenario), and a model simulation was completed. The UIF Scenario removes all surface water withdrawals and discharges and simulates conditions before any surface water development. These five scenarios were simulated over the approximately 94-year period of variable climate and hydrology data based on availability spanning October 1925 to December 2019. All simulation results, except where noted, are based on model simulations using a monthly timestep. Summaries of the model results are presented in this Chapter, with more detailed results tables provided in Appendix B. Several scenarios were also prepared to evaluate the potential impacts from extended drought conditions. Those results are presented in Chapter 5.3.7.

5.3.1 Current Surface Water Use Scenario

The Current Scenario represents current operations, infrastructure, and water use in the Saluda River basin. Water demands were generally set based on reported water usage in the 10-year period spanning 2010 to 2019, 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.

Tables 5-3 through 5-5 summarize simulation results (using a monthly timestep) for the Current Scenario assuming zero minimum instream flow requirements. Table 5-3 lists the surface water users with one or more months of a simulated Surface Water Shortage (4 of 37 users). Figure 5-2 shows the locations of these water users on the SWAM model framework. Also shown are the average annual demand for each water user experiencing a shortage; the minimum physically available (monthly average) flow at the point of withdrawal; the maximum (monthly average) shortage; and the frequency of shortage. Four agricultural water users experience simulated shortages. These withdrawals are all located either on or adjacent to impoundments that are not included in the model. The impoundments may provide enough water to prevent the projected physical shortages at times when Big Beaverdam Creek and Clouds Creek are simulated to have very low flow.

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 basinwide performance metrics.

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: Leslea Farms	Big Beaverdam Creek	0.04	0.16	0.02	0.1%
IR: Overbridge Farm	Big Beaverdam Creek	0.02	0.01	0.03	0.2%
IR: Titan Farms	Clouds Creek	1.06	0.35	1.49	8.9%
IR: Watson Jerrold Farm	Clouds Creek	0.58	0.06	0.90	14.0%

IR = agricultural (irrigation) water user

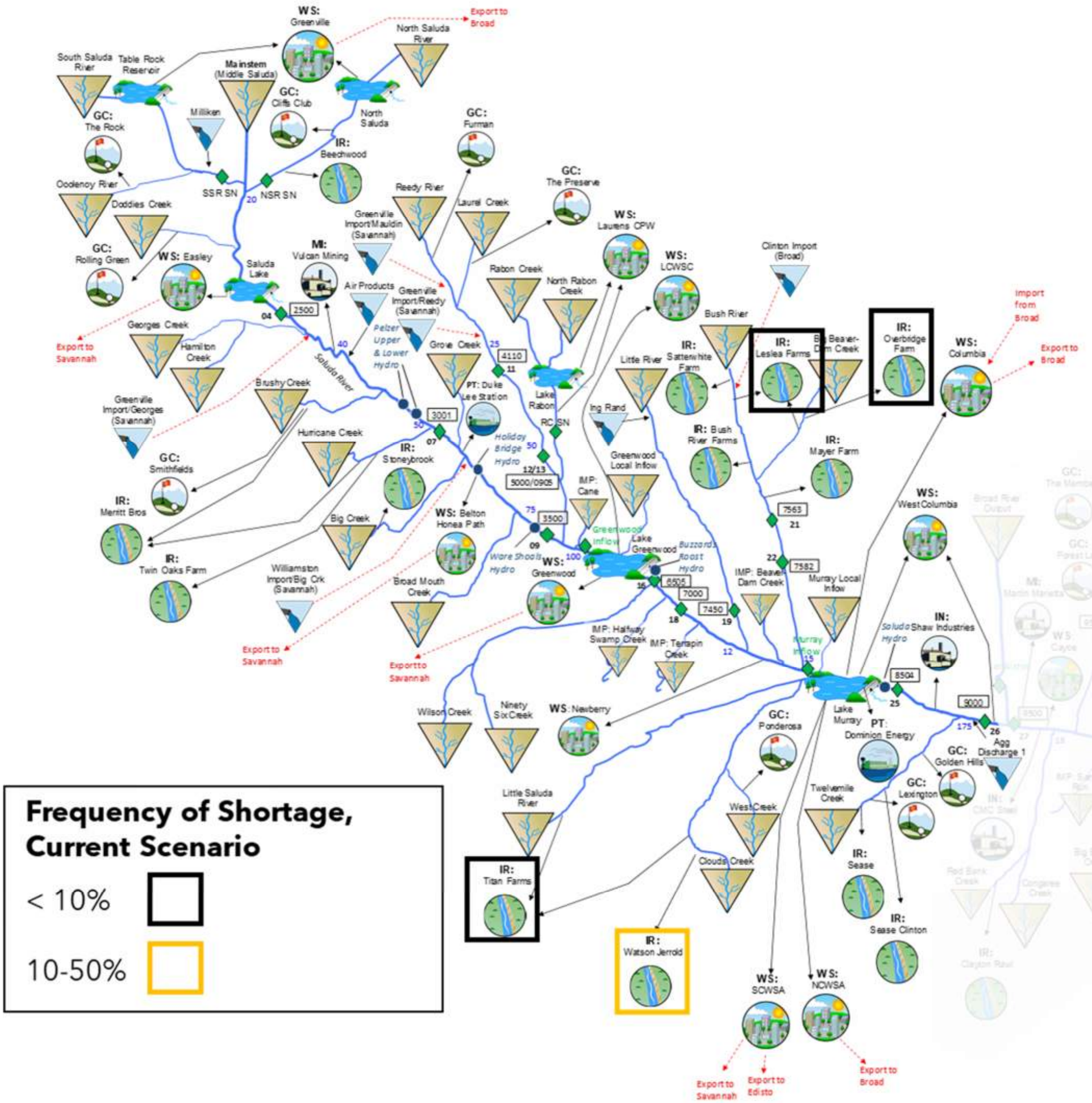


Figure 5-2. Water users with Surface Water Shortages and frequency of shortages, Current Scenario.

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
SLD04 Saluda River Near Greenville	595	491	78	314	226	176
SLD07 Saluda River Near Williamston	768	644	107	421	298	240
SLD09 Saluda River Near Ware Shoals	930	775	124	515	359	288
SLD18 Saluda River at Chappells	1,686	1,391	211	870	580	437
SLD25 Saluda River Below Lake Murray Dam Near Columbia	2,600	1,811	501	972	701	701
SLD26 Saluda River Near Columbia	2,686	1,876	516	1,020	745	733
South Saluda River Strategic Node	244	201	36	128	90	75
North Saluda River Strategic Node	141	112	20	72	53	45
Rabon Creek Strategic Node	100	74	7	38	20	15
SLD11 Reedy River Above Fork Shoals	224	184	58	125	93	77
SLD22 Bush River near Prosperity	120	72	6	46	26	16

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

Performance Measure	Result[1]
Total basin annual mean shortage (MGD)	0.09
Total basin annual mean demand (MGD)	342
Maximum water user shortage (MGD)	1.5
Total basin annual mean shortage (% of demand)	0.03%
Percentage of water users experiencing shortage	10.8%
Average frequency of shortage (%)	0.6%

1. Statistics only include water users above the Saluda River confluence with the Broad River. Total basin annual mean demand and total basin annual mean shortage (% of demand) include the approximately 32 MGD demand from water supply water user (WS): Columbia, which is satisfied by transbasin import from the Broad River basin.

5.3.2 Permitted and Registered Surface Water Use Scenario

In the P&R Scenario, modeled demands were 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?". This scenario provides information to determine whether surface water is currently over-allocated in the basin.

Tables 5-6 through 5-9 summarize the simulation results for the P&R Scenario (monthly timestep) assuming zero minimum instream flow requirements. In this scenario, river flows are predicted to decrease, compared to the Current Scenario, throughout the basin, resulting in Surface Water Shortages for several surface water users. These water users include the four agricultural users that have simulated shortages under the Current Scenario, plus an additional five golf courses, three agricultural water users, and two public water suppliers. Table 5-6 lists the surface water users with one or more months of a simulated Surface Water Shortage. Figure 5-3 shows locations of these water users on the SWAM model framework. Also shown are the average annual demand for each water user experiencing a shortage, the minimum physically available (monthly average) flow at the point of withdrawal, the maximum (monthly average) shortage, and the frequency of shortage.

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
GC: Furman	Reedy River	2.23	0.98	1.28	5.6%
GC: Lexington	Twelvemile Creek	0.73	0.69	0.03	0.1%
GC: Ponderosa	West Creek	1.47	0.87	0.56	0.2%
GC: Smithfields	Brushy Creek	1.47	0.09	1.35	5.9%
GC: The Preserve	Laurel Creek	1.91	0.58	1.29	8.1%
IR: Leslea Farms	Big Beaverdam Creek	0.52	0.06	0.46	9.0%
IR: Overbridge Farm	Big Beaverdam Creek	0.35	0.01	0.34	5.2%
IR: Satterwhite Farm	Bush River	0.13	0.07	0.06	0.1%
IR: Sease Clinton	Twelvemile Creek	0.98	0.23	0.73	0.9%
IR: Sease James	Twelvemile Creek	2.03	0.64	0.89	0.9%
IR: Titan Farms	Clouds Creek	3.29	0.35	2.98	40.2%
IR: Watson Jerrold Farm	Clouds Creek	5.92	0.06	5.94	76.3%
WS: Greenville	Table Rock/S. Saluda River and N. Saluda Res/N. Saluda River	129.51	0.00	120.89	82.0%
WS: Laurens CPW	Lake Rabon and Rabon Creek	66.37	0.06	66.15	68.7%

IR = agricultural (irrigation) water user; WS = water supply water user; GC = golf course water user

Note: Thermoelectric water user (PT) Duke Lee Station has a withdrawal permit limit of 10,081 MGM, based on previous operations during which a large percentage of the withdrawal was returned to the river (low consumptive use). The plant has transitioned from coal to natural gas and now has a higher consumptive use percentage. To account for this, the permit limit for Duke Lee Station was lowered to 156 MGM (or 5 MGD) for the P&R Scenario.

Table 5-7 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 5-8 shows the percentage decrease in P&R Scenario flow statistics compared to the Current Scenario. Modeled reductions are most pronounced during low-flow periods. Mean flows at the most downstream site on the mainstem (SLD26, Saluda River near Columbia) are predicted to decrease by approximately 13 percent, and median flows by approximately 22 percent, if all upstream users withdrew water from the system at their permitted or registered amount. The impact of full allocation withdrawals 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. As explained in Chapter 4, the fully permitted and registered withdrawal rates greatly exceed current use rates. Despite the low likelihood of the P&R Scenario, results demonstrate that the surface water resources of the basin are over-allocated based on existing permit and registration amounts. During implementation of the 2011 Surface Water Withdrawal, Permitting Use, and Reporting Act, permit amounts for pre-existing surface water users were based on intake capacities rather than safe yield calculations or minimum instream flows. The intake capacities allow for withdrawal of more water than may be available under certain drought conditions, as demonstrated by the results of the P&R Scenario.

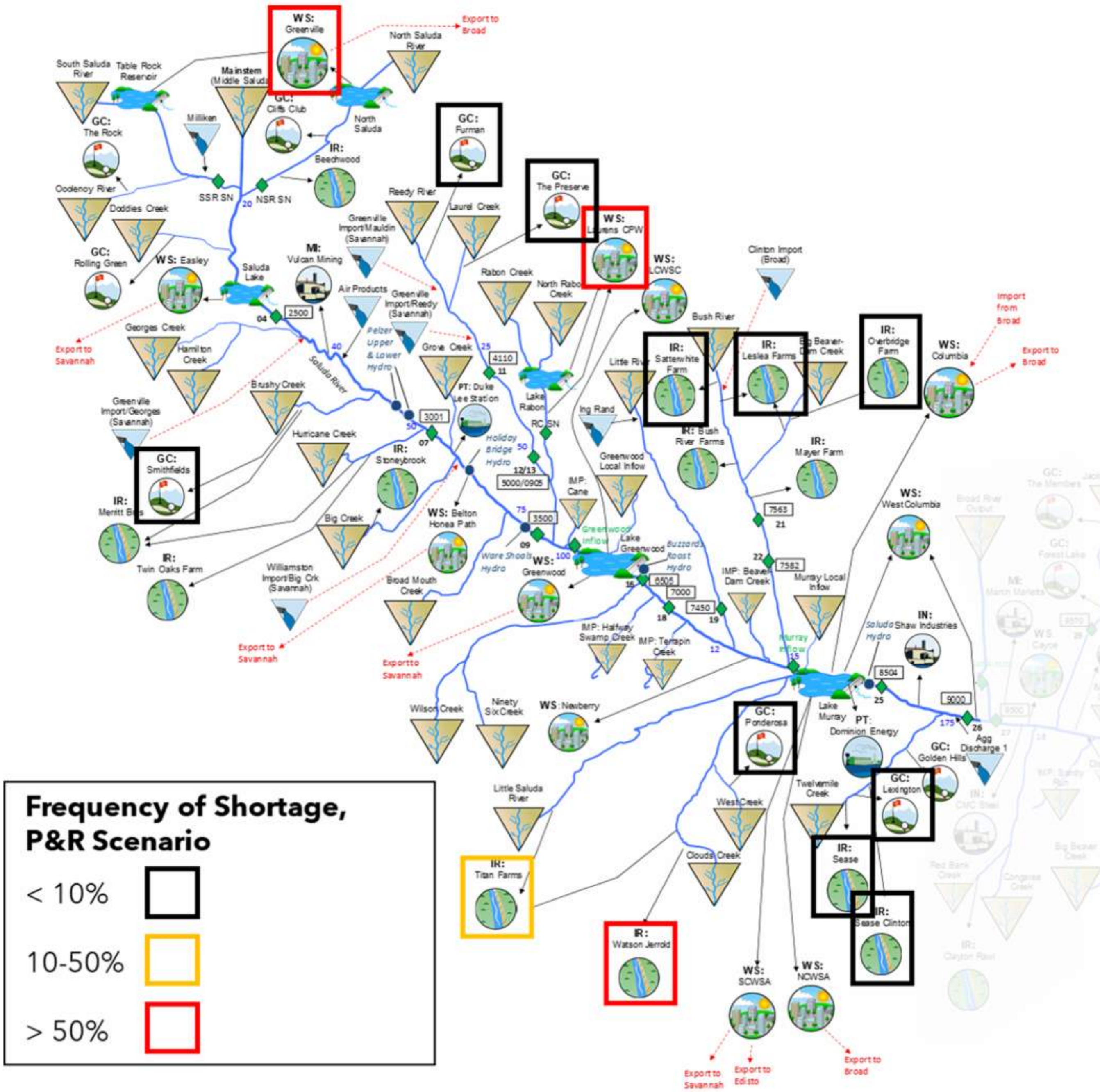


Figure 5-3. Water users with Surface Water Shortages and frequency of shortages, P&R Scenario.

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
SLD04 Saluda River Near Greenville	484	406	23	259	173	124
SLD07 Saluda River Near Williamston	670	569	58	373	256	195
SLD09 Saluda River Near Ware Shoals	838	700	80	472	322	248
SLD18 Saluda River at Chappells	1,488	1,203	64	721	476	355
SLD25 Saluda River Below Lake Murray Dam Near Columbia	2,267	1,389	501	701	701	501
SLD26 Saluda River Near Columbia	2,349	1,459	514	756	734	563
South Saluda River Strategic Node	203	172	31	119	85	70
North Saluda River Strategic Node	115	99	12	67	49	40
Rabon Creek Strategic Node	31	2	0	1	1	1
SLD11 Reedy River Above Fork Shoals	235	194	47	126	88	70
SLD22 Bush River near Prosperity	140	94	23	64	44	34

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

Strategic Node	Mean Flow	Median Flow	Surface Water Supply	Percentile Flows		
				25th	10th	5th
SLD04 Saluda River Near Greenville	-19%	-17%	-71%	-18%	-23%	-30%
SLD07 Saluda River Near Williamston	-13%	-12%	-46%	-11%	-14%	-19%
SLD09 Saluda River Near Ware Shoals	-10%	-10%	-35%	-8%	-10%	-14%
SLD18 Saluda River at Chappells	-12%	-14%	-70%	-17%	-18%	-19%
SLD25 Saluda River Below Lake Murray Dam Near Columbia	-13%	-23%	0%	-28%	0%	-29%
SLD26 Saluda River Near Columbia	-13%	-22%	0%	-26%	-2%	-23%
South Saluda River Strategic Node	-17%	-14%	-14%	-7%	-5%	-7%
North Saluda River Strategic Node	-18%	-11%	-38%	-7%	-9%	-12%
Rabon Creek Strategic Node	-69%	-97%	-100%	-96%	-96%	-96%
SLD11 Reedy River Above Fork Shoals	5%	6%	-19%	0%	-5%	-9%
SLD22 Bush River near Prosperity	17%	30%	268%	40%	68%	105%

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

Performance Measure	Result[1]
Total basin annual mean shortage (MGD)	71.3
Total basin annual mean demand (MGD)[2]	771
Maximum water user shortage (MGD)	120.9
Total basin annual mean shortage (% of demand)	9.2%
Percentage of water users experiencing shortage	38%
Average frequency of shortage (%)	8%

1. Statistics only include water users above the Saluda River confluence with the Broad River. Total basin annual mean demand and total basin annual mean shortage (percentage of demand) include the WS: Columbia demand that is satisfied by transbasin import from the Broad River basin. Thermoelectric power water user PT: Duke Lee Station has transitioned from coal to natural gas, increasing the consumptive use percentage; to better reflect this transition, the statistics here assume a permit limit of 156 MGM (lowered from 10,081 MGM).
2. The total basin annual mean demand under the Current Scenario is 342 MGD.

5.3.3 Moderate Water Demand Projection Scenario

For the Moderate Scenario, modeled demands were set to projected future levels based on an assumption of moderate population and economic growth, as described in Chapter 4.3. The year 2070 planning horizon was targeted using the demand projections developed by SCDES and presented in Chapter 4.4. As discussed in Chapter 4, future municipal water demands from Greenville were assumed to be met by Lake Keowee in the Upper Savannah River basin. The Moderate Scenario explores a plausible future where water demands increase with moderate population growth and climate change impacts are negligible, in both the short- and long-term. Additional future agricultural irrigation demands were represented in the SWAM model by both an increase in demands from existing agricultural water users and by adding new simulated water users located at the outlet of select watersheds where growth in agricultural irrigation was projected to occur.

Tables 5-10 through 5-13 summarize the Moderate Scenario (monthly timestep) simulation results for the 2070 planning horizon assuming zero minimum instream flow requirements. Calculated water shortages exist for three agricultural water users under the Moderate 2070 Scenario. Figure 5-4 shows the locations of these water users on the SWAM model framework. 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, recalling that agricultural uses are typically supplemented with small off-stream impoundments that can provide buffers against short-term low-streamflow conditions. However, there is no requirement that agricultural users use the water in their impoundments first before making additional withdrawals.

In the Moderate Scenario, flows are predicted to decrease slightly to moderately, depending on location, compared to the Current Scenario. Mean and median flows at the most downstream site on the mainstem (SLD26, Saluda River near Columbia) are predicted to decrease by 0.5 to 1.2 percent by 2070 if population and economic growth is moderate and climate change impacts are negligible.

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: Overbridge Farm	Big Beaverdam Creek	0.02	0.01	0.03	0.2%
IR: Titan Farms	Clouds Creek	1.12	0.35	1.90	9.5%
IR: Watson Jerrold Farm	Clouds Creek	0.31	0.06	0.59	7.2%

IR = agricultural (irrigation) water user

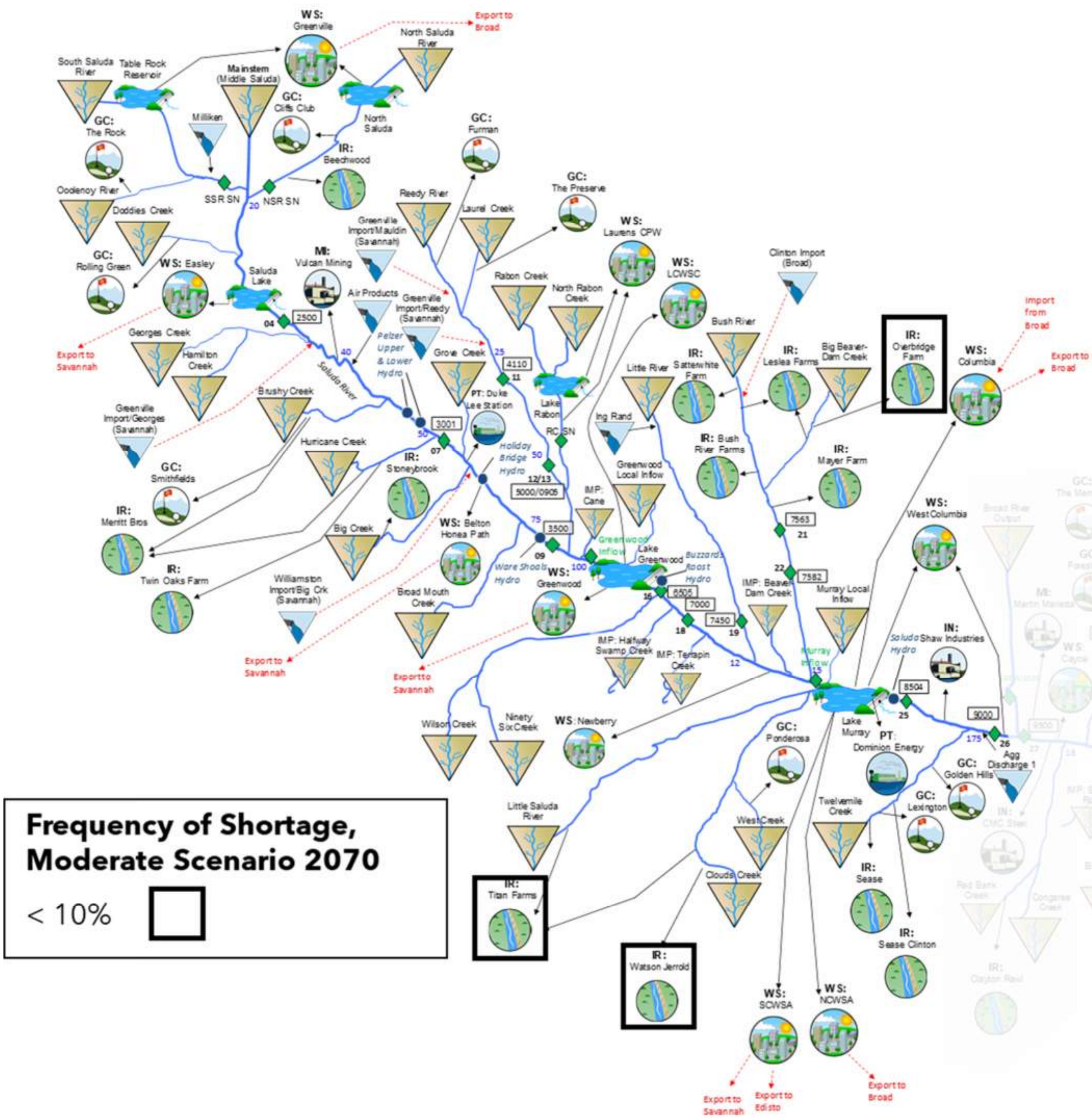


Figure 5-4. Water users with Surface Water Shortages and frequency of shortages, Moderate 2070 Scenario.

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
SLD04 Saluda River Near Greenville	595	490	76	313	224	174
SLD07 Saluda River Near Williamston	768	644	105	420	297	239
SLD09 Saluda River Near Ware Shoals	930	774	120	513	355	285
SLD18 Saluda River at Chappells	1,685	1,390	209	871	577	436
SLD25 Saluda River Below Lake Murray Dam Near Columbia	2,590	1,784	501	950	701	701
SLD26 Saluda River Near Columbia	2,673	1,854	514	992	742	730
South Saluda River Strategic Node	245	202	36	128	90	75
North Saluda River Strategic Node	142	111	20	72	53	45
Rabon Creek Strategic Node	100	74	6	37	20	15
SLD11 Reedy River Above Fork Shoals	223	184	58	125	94	78
SLD22 Bush River near Prosperity	118	70	5	44	25	15

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

Strategic Node	Mean Flow	Median Flow	Surface Water Supply	Percentile Flows		
				25th	10th	5th
SLD04 Saluda River Near Greenville	-0.02%	-0.2%	-3.1%	-0.5%	-1.0%	-1.3%
SLD07 Saluda River Near Williamston	0.1%	-0.003%	-1.7%	-0.2%	-0.4%	-0.6%
SLD09 Saluda River Near Ware Shoals	-0.05%	-0.1%	-2.6%	-0.2%	-0.9%	-0.9%
SLD18 Saluda River at Chappells	-0.1%	-0.1%	-0.6%	0.2%	-0.5%	-0.2%
SLD25 Saluda River Below Lake Murray Dam Near Columbia	-0.4%	-1.5%	-0.0%	-2.2%	0.0%	0.0%
SLD26 Saluda River Near Columbia	-0.5%	-1.2%	-0.3%	-2.7%	-0.5%	-0.4%
South Saluda River Strategic Node	0.4%	0.8%	0.1%	-0.1%	-0.01%	-0.02%
North Saluda River Strategic Node	0.7%	-0.1%	1.4%	-0.1%	-0.2%	-0.2%
Rabon Creek Strategic Node	-0.2%	-0.3%	-13.4%	-0.5%	-0.9%	-1.5%
SLD11 Reedy River Above Fork Shoals	-0.2%	-0.03%	-0.3%	-0.1%	1.2%	1.0%
SLD22 Bush River near Prosperity	-1.4%	-2.3%	-25.0%	-3.5%	-6.1%	-9.7%

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

Performance Measure	Result[1]
Total basin annual mean shortage (MGD)	0.09
Total basin annual mean demand (MGD)[2]	390
Maximum water user shortage (MGD)	1.9
Total basin annual mean shortage (% of demand)	0.02%
Percentage of water users experiencing shortage	7.0%
Average frequency of shortage (%)	0.4%

1. Statistics only include water users above the Saluda River confluence with the Broad River. Total basin annual mean demand and total basin annual mean shortage (% of demand) include the WS: Columbia demand, which is satisfied by transbasin import from the Broad River basin.
2. The total basin annual mean demand under the Current Scenario is 342 MGD.

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. Like the Moderate Scenario, a year 2070 planning horizon was targeted using the demand projections developed by SCDES. 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.

Tables 5-14 through 5-17 summarize the High Demand Scenario (monthly timestep) simulation results for the 2070 planning horizon assuming zero minimum instream flow requirements. Figure 5-5 shows the locations of these water users on the SWAM model framework. Two of the three agricultural water users with shortages in the Moderate 2070 Scenario exhibit slightly greater shortages under the High Demand 2070 Scenario. Two additional agricultural water users and one golf course also experience shortages under this scenario.

In the High Demand Scenario, river flows are predicted to decrease modestly to moderately compared to the Current Scenario, throughout the basin. Modeled reductions are most pronounced during low-flow periods. Flow changes at the most downstream site (SLD26, Saluda River near Columbia) is an exception to this; mean and median flows there are predicted to decrease by approximately 2 to 4 percent, and low flows by approximately 1 percent, based on 2070 high demands. Calculated water user shortages increase slightly, in terms of both duration and intensity, for the 2070 planning horizon, as compared to the Moderate Scenario results.

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
GC: Smithfields	Brushy Creek	0.08	0.09	0.03	0.1%
IR: Leslea Farms	Big Beaverdam Creek	0.06	0.14	0.09	0.3%
IR: Overbridge Farm	Big Beaverdam Creek	0.02	0.01	0.03	0.2%
IR: Satterwhite Farm	Bush River	0.07	0.07	0.04	0.1%
IR: Titan Farms	Clouds Creek	1.24	0.35	2.54	12.4%
IR: Watson Jerrold Farm	Clouds Creek	0.49	0.06	0.85	11.6%

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

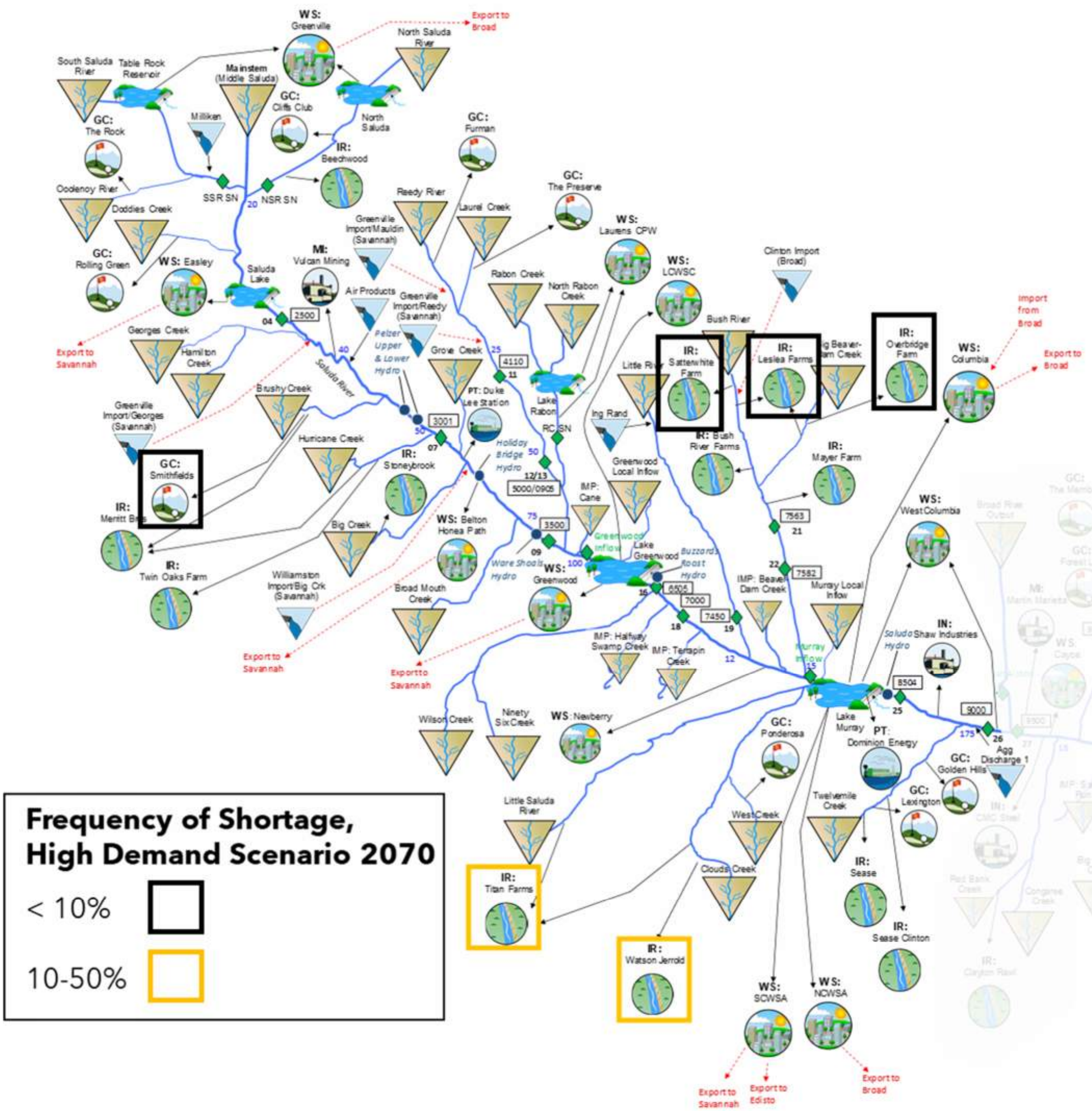


Figure 5-5. Water users with Surface Water Shortages and frequency of shortages, High Demand 2070 Scenario.

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
SLD04 Saluda River Near Greenville	590	484	69	308	218	168
SLD07 Saluda River Near Williamston	765	641	99	416	293	234
SLD09 Saluda River Near Ware Shoals	926	772	114	509	352	281
SLD18 Saluda River at Chappells	1,674	1,381	198	857	564	426
SLD25 Saluda River Below Lake Murray Dam Near Columbia	2,542	1,718	501	849	701	701
SLD26 Saluda River Near Columbia	2,622	1,796	510	896	736	725
South Saluda River Strategic Node	245	202	36	128	90	75
North Saluda River Strategic Node	142	111	20	72	53	45
Rabon Creek Strategic Node	98	73	2	36	19	14
SLD11 Reedy River Above Fork Shoals	223	183	57	125	94	77
SLD22 Bush River near Prosperity	121	73	7	47	28	17

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

Strategic Node	Mean Flow	Median Flow	Surface Water Supply	Percentile Flows		
				25th	10th	5th
SLD04 Saluda River Near Greenville	-0.9%	-1.4%	-12.5%	-2.1%	-3.5%	-4.7%
SLD07 Saluda River Near Williamston	-0.4%	-0.4%	-7.4%	-1.2%	-1.7%	-2.5%
SLD09 Saluda River Near Ware Shoals	-0.4%	-0.3%	-7.5%	-1.0%	-1.9%	-2.4%
SLD18 Saluda River at Chappells	-0.7%	-0.7%	-5.9%	-1.5%	-2.8%	-2.6%
SLD25 Saluda River Below Lake Murray Dam Near Columbia	-2.2%	-5.1%	-0.0%	-12.7%	0.0%	0.0%
SLD26 Saluda River Near Columbia	-2.4%	-4.3%	-1.2%	-12.1%	-1.2%	-1.0%
South Saluda River Strategic Node	0.4%	0.8%	-0.4%	-0.2%	-0.03%	-0.05%
North Saluda River Strategic Node	0.6%	-0.2%	0.6%	-0.5%	-0.3%	-0.8%
Rabon Creek Strategic Node	-1.3%	-1.9%	-75.5%	-4.0%	-8.0%	-6.7%
SLD11 Reedy River Above Fork Shoals	-0.4%	-0.2%	-1.3%	-0.5%	0.8%	0.4%
SLD22 Bush River near Prosperity	1.1%	1.9%	14.4%	2.7%	4.4%	5.2%

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

Performance Measure	Result [1]
Total basin annual mean shortage (MGD)	0.14
Total basin annual mean demand (MGD)[2]	491
Maximum water user shortage (MGD)	2.5
Total basin annual mean shortage (% of demand)	0.03%
Percentage of water users experiencing shortage	14.0%
Average frequency of shortage (%)	0.6%

1. Statistics only include water users above the Saluda River confluence with the Broad River. Total basin annual mean demand and total basin annual mean shortage (% of demand) include the WS: Columbia demand, which is satisfied by transbasin import from the Broad River basin.
2. The total basin annual mean demand under the Current Scenario is 342 MGD.

The High Demand Scenario for the 2070 planning horizon was also modeled using a daily timestep. Tables 5-18 through 5-20 summarize the results. Median modeled flows are lower for all Strategic Nodes for the daily simulation compared to the monthly timestep simulation, while mean modeled flows are higher for seven of the 11 Strategic Nodes. With the exception of the SLD22 Bush River Strategic Node, modeled extreme low flows (25th, 10th, and 5th percentiles) are lower for the daily timestep model compared to the monthly timestep. A greater range of flow variability is simulated with the higher resolution daily model, compared to the monthly model. Because of the higher temporal resolution, the daily model captures a basinwide maximum daily water user shortage that is higher than that quantified by the monthly timestep model (Table 5-20). This sensitivity can be useful to understand when using the model in the future to examine specific locations, changes in use, etc.

Table 5-18. Daily timestep 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
SLD04 Saluda River Near Greenville	655	439	2	215	151	127
SLD07 Saluda River Near Williamston	807	548	40	277	196	167
SLD09 Saluda River Near Ware Shoals	960	646	62	324	225	190
SLD18 Saluda River at Chappells	1,646	985	172	447	263	250
SLD25 Saluda River Below Lake Murray Dam Near Columbia	2,622	701	501	701	701	501
SLD26 Saluda River Near Columbia	2,694	776	502	723	709	516
South Saluda River Strategic Node	280	193	23	89	64	54
North Saluda River Strategic Node	161	100	20	54	40	36
Rabon Creek Strategic Node	92	38	9	15	13	10
SLD11 Reedy River Above Fork Shoals	208	137	46	82	66	58
SLD22 Bush River near Prosperity	210	58	10	34	24	18

Table 5-19. Percent change in High Demand 2070 Scenario daily flows at Strategic Nodes relative to Current Scenario daily flows.

Strategic Node	Mean Flow	Median Flow	Surface Water Supply	Percentile Flows		
				25th	10th	5th
SLD04 Saluda River Near Greenville	-1%	-0.4%	0%	-4%	-5%	-7%
SLD07 Saluda River Near Williamston	-1%	-0.1%	4%	-3%	-4%	-4%
SLD09 Saluda River Near Ware Shoals	-1%	-0.003%	1%	-2%	-3%	-4%
SLD18 Saluda River at Chappells	-1%	-1%	-0.1%	0.4%	-11%	2%
SLD25 Saluda River Below Lake Murray Dam Near Columbia	-2%	0%	0%	0%	0%	0%
SLD26 Saluda River Near Columbia	-2%	-2%	-2%	-1%	-1%	-1%
South Saluda River Strategic Node	-1%	1%	-0.3%	-0.004%	-0.1%	-0.2%
North Saluda River Strategic Node	1%	2%	-1%	0.2%	-0.2%	-0.4%
Rabon Creek Strategic Node	-1%	-5%	0%	-1%	-0.3%	0%
SLD11 Reedy River Above Fork Shoals	-0.4%	-1%	-2%	-1%	0.3%	5%
SLD22 Bush River near Prosperity	1%	3%	9%	4%	4%	8%

Table 5-20. Basinwide surface water model daily simulation results, High Demand 2070 Scenario.

Performance Measure	Result [1]
Total basin annual mean shortage (MGD)	0.23
Total basin annual mean demand (MGD)[2]	492
Maximum water user shortage (MGD)	3.2
Total basin annual mean shortage (% of demand)	0.05%
Percentage of water users experiencing shortage	25.6%
Average frequency of shortage (%)	0.9%

1. Statistics only include water users above the Saluda River confluence with the Broad River. Total basin annual mean demand and total basin annual mean shortage (% of demand) include the WS: Columbia demand, which is satisfied by transbasin import from the Broad River basin.
2. The total basin annual mean demand under the Current Use Daily Scenario is 342 MGD.

5.3.5 Unimpaired Flow Scenario

At the request of the RBC, the SWAM model was used to simulate the UIF Scenario throughout the Saluda 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 reservoirs, surface water users, dischargers, or water imports, as modeled. In other words, results represent "naturalized" surface water conditions in the basin.

Tables 5-21 and 5-22 summarize UIF Scenario monthly simulation results. Simulated UIFs are generally higher than simulated Current Scenario flows, as expected. This reflects the removal of consumptive water use for the UIF Scenario simulation. However, at Strategic Node locations on the Bush River (SLD22) and Reedy River (SLD11) the simulated UIFs are lower than Current Scenario flows. This reflects the removal of wastewater returns in the system for the UIF Scenario. The lack of wastewater returns more than offsets the lack of consumptive surface water use. At the most downstream site along the mainstem (SLD26), mean UIFs are approximately 14 percent higher than Current Scenario flows and median UIFs are approximately 19 percent higher. At this same location, UIF low flows (25th to 5th percentile) are approximately 2 to 39 percent higher than Current Scenario flows.

Table 5-21. 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
SLD04 Saluda River Near Greenville	666	569	101	392	285	229
SLD07 Saluda River Near Williamston	830	716	123	490	353	283
SLD09 Saluda River Near Ware Shoals	998	848	146	586	418	336
SLD18 Saluda River at Chappells	1,774	1,439	245	943	652	505
SLD25 Saluda River Below Lake Murray Dam Near Columbia	2,978	2,167	303	1,372	946	724
SLD26 Saluda River Near Columbia	3,061	2,232	315	1,417	987	751
South Saluda River Strategic Node	271	232	40	159	113	93
North Saluda River Strategic Node	169	146	20	101	72	61
Rabon Creek Strategic Node	104	78	3	43	25	21
SLD11 Reedy River Above Fork Shoals	180	140	18	84	51	36
SLD22 Bush River near Prosperity	113	65	1	39	20	11

Table 5-22. Percent change in UIF Scenario flows at Strategic Nodes relative to Current Scenario flows.

Strategic Node	Mean Flow	Median Flow	Surface Water Supply	Percentile Flows		
				25th	10th	5th
SLD04 Saluda River Near Greenville	12%	16%	30%	25%	26%	30%
SLD07 Saluda River Near Williamston	8%	11%	15%	16%	18%	18%
SLD09 Saluda River Near Ware Shoals	7%	9%	18%	14%	17%	17%
SLD18 Saluda River at Chappells	5%	3%	16%	8%	12%	16%
SLD25 Saluda River Below Lake Murray Dam Near Columbia	15%	20%	-39%	41%	35%	3%
SLD26 Saluda River Near Columbia	14%	19%	-39%	39%	32%	2%
South Saluda River Strategic Node	11%	15%	10%	25%	27%	23%
North Saluda River Strategic Node	20%	31%	2%	40%	36%	33%
Rabon Creek Strategic Node	4%	6%	-55%	14%	25%	39%
SLD11 Reedy River Above Fork Shoals	-19%	-24%	-69%	-33%	-45%	-54%
SLD22 Bush River near Prosperity	-6%	-9%	-87%	-14%	-25%	-36%

5.3.6 Comparison to Minimum Instream Flows

At the request of the RBC, model-simulated flows for the UIF, Current Use, 2070 Moderate, 2070 High Demand, and P&R Scenarios were compared to the calculated MIF at a subset of the Strategic Nodes. As defined in R.61-119, Surface Water Withdrawal, Permitting, Use and Reporting regulations, the MIF is the "*flow that provides an adequate supply of water at the surface water withdrawal point to maintain the biological, chemical, and physical integrity of the stream taking into account the needs of downstream users, recreation, and navigation*" (SCDHEC 2012). Under SCDNR's 2009 Minimum Instream Flow Policy, the MIF for the Piedmont region is set at 40 percent of the mean annual daily flow for the months of January, February, March, and April; 30 percent of the mean annual daily flow for the months of May, June, and December; and 20 percent of the mean annual daily flow for the months of July through November for surface water withdrawers. Table 5-23 shows the calculated MIFs at a subset of Strategic Nodes. The MIF regulation applies to new surface water permits only. In the Saluda River basin, nearly all permitted surface water users are "grandfathered" and are not subject to the MIFs. Grandfathered water users are those that had surface water withdrawals before January 1, 2011.

For these comparisons, modeled flows from daily timestep simulations were used. Table 5-24 presents and compares the percentage of days for all scenarios when flows are simulated to drop below the calculated MIF at the selected Strategic Nodes. The gages were selected primarily because of their longer periods of record. The entire simulation period of record covered 94.25 years or 34,473 days. The calculated MIF, which comes from measured flow at each USGS gaging station, is based on a shorter period that coincides with the gaging station's period of record (Table 5-23).

Table 5-23. Calculated MIF at select Strategic Nodes.

Gage Name	Gage ID	Period of Record	Mean Annual Daily Flow[1] (cfs)	MIF (cfs)		
				Jan-Apr	May, Jun, and Dec	Jul-Nov
Saluda River near Greenville	02162500	1942–1978; 1990–present	617	247	185	123
Saluda River near Williamston	02163001	1995–present	728	291	218	146
Saluda River near Ware Shoals	02163500	1939–present	961	384	288	192
Reedy River above Fork Shoals	02164110	1993–present	203	81	61	41
Saluda River at Chappells	02167000	1926–present	1,800	720	540	360
Bush River near Prosperity	02167582	1990–present	91	36	27	18
Percent of mean annual daily flow for calculating MIF ->				**40%**	**30%**	**20%**

[1] Mean annual daily flow was calculated using streamflow data through the end of water year 2023 (September 30, 2023).

Table 5-24. Percent of days below MIF at select Strategic Nodes.

Strategic Node	Scenario	Percentage of days below MIF[1]											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Saluda River near Greenville	UIF	2.6	2.0	0.5	0	0.1	1.8	0.5	1.6	4.6	4.5	1.9	2.0
	Current Use	5.0	3.4	0.7	0.1	0.7	5.0	1.5	4.4	8.7	7.3	3.1	4.5
	2070 Moderate	5.1	3.5	0.7	0.2	0.8	5.4	1.5	4.7	9.0	7.4	3.1	4.7
	2070 High Demand	5.6	3.7	0.8	0.3	0.9	6.5	2.0	5.4	9.8	8.5	3.7	4.8
	P&R	14.5	9.0	4.2	4.0	4.5	15.0	8.9	16.9	19.9	20.8	10.9	11.7
Saluda River near Williamston	UIF	1.9	1.4	0.4	0	0.1	1.6	0.5	1.5	3.4	3.7	1.3	1.2
	Current Use	3.0	2.0	0.6	0	0.3	2.9	0.7	2.5	5.9	5.3	2.0	1.8
	2070 Moderate	3.0	2.0	0.6	0	0.3	3.0	0.8	2.8	6.2	5.3	2.0	1.9
	2070 High Demand	3.0	2.1	0.6	0	0.3	3.4	1.0	3.0	7.2	5.5	2.3	2.1
	P&R	5.6	4.1	0.8	0.6	1.6	7.7	3.6	8.6	12.2	11.6	5.0	5.3
Saluda River near Ware Shoals	UIF	2.8	1.9	0.6	0	0.2	2.4	0.8	2.2	5.6	5.1	2.3	1.8
	Current Use	4.3	2.7	0.7	0.1	0.8	4.8	1.4	4.0	8.3	6.9	3.0	3.3
	2070 Moderate	4.3	2.7	0.7	0.0	0.8	4.9	1.5	4.4	8.5	7.2	3.0	3.4
	2070 High Demand	4.4	2.8	0.7	0.1	0.9	5.2	1.8	4.8	9.2	7.6	3.2	3.5
	P&R	6.8	4.5	0.9	0.8	2.2	8.4	4.1	9.2	13.2	12.6	5.2	6.0

Table 5-24. Percent of days below MIF at select Strategic Nodes. (Continued)

Strategic Node	Scenario	Percentage of days below MIF[1]											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Reedy River above Fork Shoals	UIF	14.8	9.3	3.0	6.0	11.5	19.9	16.3	23.1	31.7	34.2	19.0	16.8
	Current Use	1.4	0.2	0.2	0.3	0.5	2.2	0.0	0.0	0.0	0.0	0.0	0.2
	2070 Moderate	1.8	0.2	0.2	0.4	0.4	2.4	0.0	0.0	0.0	0.0	0.0	0.3
	2070 High Demand	1.8	0.2	0.2	0.4	0.6	2.5	0.0	0.0	0.0	0.0	0.0	0.3
	P&R	1.9	0.4	0.2	0.3	0.9	4.1	0.2	0.3	1.8	0.3	0.0	0.4
Saluda River at Chappells	UIF	5.8	3.4	0.8	0.5	2.0	7.2	2.8	6.5	10.3	10.1	4.2	5.5
	Current Use	3.9	13.8	8.2	5.5	5.2	13.4	7.5	12.2	16.0	13.0	0.9	0
	2070 Moderate	4.0	13.9	8.3	5.5	5.3	13.6	7.9	12.7	16.2	13.1	0.9	0
	2070 High Demand	4.1	14.3	8.6	5.8	5.7	14.5	8.6	13.6	17.4	13.8	1.1	0
	P&R	7.5	22.1	15.5	12.6	12.3	22.8	14.4	19.3	27.3	20.7	4.3	1.5
Bush River near Prosperity	UIF	13.5	9.9	5.5	11.3	19.2	26.0	22.7	23.5	25.0	22.8	14.3	14.5
	Current Use	9.3	6.5	3.9	8.2	15.4	22.1	18.6	19.4	20.6	17.2	11.5	10.7
	2070 Moderate	10.5	7.2	4.2	8.8	16.5	22.8	20.0	20.6	21.7	18.1	12.1	11.4
	2070 High Demand	8.8	6.0	3.6	7.5	14.8	21.4	17.9	19.0	20.1	16.5	10.5	9.6
	P&R	0.4	0.1	0	0	0.9	6.8	0	0	0	0	0	0

[1] There were 34,473 days in the simulation period.

From Table 5-24, results of the comparison to MIFs suggests the following:

- Under UIF conditions, flows drop below MIFs at all selected sites. This suggests that low-flow conditions below MIFs at these locations occur naturally. On the Saluda River mainstem, this happens most often at the Saluda River at Chappells Strategic Node downstream of Lake Greenwood, where UIFs drop below MIFs more than 10 percent of the time in September and October. On the Reedy River and Bush River tributaries, UIFs drop below MIFs at a greater frequency than on the mainstem.
- At most of the selected sites, there is a modest increase in the percentage of days when flows are below MIFs moving from the Current Use to the 2070 Moderate, 2070 High Demand, and P&R Scenarios. This is because of the higher surface water withdrawals simulated in those scenarios. The exception to this is the Bush River site, where there is a decrease in the percentage of days when flows are below MIFs for the 2070 High Demand and P&R Scenarios. This is because of the increased wastewater returns to the Bush River from the City of Newberry and LCWSC, upstream of the Bush River gage. The percentage of days below the MIF threshold at this location is lowest under the P&R Scenario.
- At three of the selected sites on the Saluda River, the percentage of days when flows of the 2070 Moderate and 2070 High Demand Scenarios drop below the MIF ranges from approximately 0 to 10 percent. On the Saluda River at Chappells, flows drop below the MIF in the 2070 High Demand Scenario between 13 and 18 percent of the days in February, June, and August through October.

- At the selected sites on the Saluda River, there is a relatively large increase in the percentage of days when P&R Scenario flows are below MIFs, compared to the other scenarios (1.5 – 11.3% compared with current use and moderate and high growth scenarios for the Saluda River at Chappells, for example). On the Reedy River tributary, the difference between the P&R Scenario and other scenarios is much less pronounced (0-2% difference compared with current use and future demand scenarios) On the Bush River tributary, the opposite trend is observed, with P&R Scenario flows less frequently below the MIFs because of upstream wastewater discharges.
- Flows are maintained above the MIFs the greatest percentage of the time at the Reedy River location, where flows are above MIFs during July through November for the Current Use, 2070 Moderate Demand, and 2070 High Demand Scenarios.

A similar analysis was performed at two locations in the uppermost region of the basin, at Strategic Nodes on the North Saluda and South Saluda Rivers. The USGS does not have stream gages installed at these locations; therefore, the MIFs for each month were calculated using the historical daily discharge records from upstream gages, and then scaled to account for the difference in drainage basin size. Tables 5-25 and 5-26 summarize the MIF comparison results at these two locations. Flows at these strategic nodes are influenced by releases from Table Rock Reservoir and North Saluda Reservoir. Greenville Water has stated a goal of maintaining a minimum release of 3 MGD (or 4.65 cfs) from each reservoir. The minimum releases are included in the reservoir operating rules for all scenarios. At both strategic nodes, flows are maintained above MIFs at approximately the same frequency across the Current Use, 2070 Moderate Demand, and 2070 High Demand Scenarios because demands assigned to Greenville Water are generally the same across all three Scenarios. Greenville Water intends to meet additional future demand from their Lake Keowee water supply.

Table 5-25. Calculated MIF at South Saluda River and North Saluda River Strategic Nodes.

Strategic Node	USGS Gage ID for Historical Flows	USGS Gage Period of Record	Mean Annual Daily Flow[1] (cfs)	MIF (cfs)		
				Jan-Apr	May, Jun, and Dec	Jul-Nov
South Saluda River Strategic Node	02162290	2000-2005; 2012-present	222	89	66	44
North Saluda River Strategic Node	021623975	2011-2013; 2015-present	115	46	35	23
Percent of mean annual daily flow for calculating MIF ->				**40%**	**30%**	**20%**

[1] Mean annual daily flow was calculated using streamflow data through the end of water year 2023 (September 30, 2023). Note that these gages have shorter periods of record than the gages used to develop mean annual daily flows in Table 5-23.

Table 5-26. Percent of days below MIF at South Saluda River and North Saluda River Strategic Nodes.

Strategic Node	Scenario	Percentage of days below MIF[1]											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
South Saluda River Strategic Node	UIF	1.7	1.2	0.4	0	0.0	1.3	0.5	1.5	3.7	3.5	1.3	1.4
	Current Use	3.8	2.6	0.6	0.1	0.3	3.0	1.0	2.3	6.4	5.6	2.4	3.5
	2070 Moderate	3.7	2.6	0.6	0.1	0.3	3.0	1.0	2.3	6.4	5.6	2.4	3.5
	2070 High Demand	3.7	2.6	0.6	0.1	0.3	3.0	1.0	2.3	6.5	5.6	2.4	3.5
	P&R	5.1	3.4	0.6	0.2	0.4	4.3	1.7	3.6	8.5	7.5	3.1	4.6
North Saluda River Strategic Node	UIF	1.7	0.7	0.6	0	0.0	0.6	0.2	1.3	1.2	1.6	0.6	0.9
	Current Use	2.4	1.0	0.6	0	0.0	0.7	0.2	1.1	1.3	1.4	0.5	1.0
	2070 Moderate	2.4	1.2	0.6	0	0.0	0.8	0.2	1.0	1.1	1.3	0.5	1.0
	2070 High Demand	2.4	1.2	0.6	0	0.0	0.9	0.2	1.1	1.2	1.4	0.5	1.1
	P&R	4.6	3.5	0.7	0.1	0.4	4.0	1.7	3.6	7.2	6.2	2.9	4.1

[1] There were 34,473 days in the simulation period.

5.3.7 Extended Drought Scenario Analysis

One of the uncertainties in the planning process identified by the RBC is future climate conditions. The RBC recognizes that climate conditions may be different in the future than the modeled historical (1925 through 2019) period. To further test water supply resiliency in the basin, the developed SWAM model was used to test additional, hypothetical hydrologic conditions within the basin under the 2070 High Demand Scenario water demands. For these simulations, headwater flows were adjusted in the model to represent more extended drought conditions, using the "Index Sequential" alternate hydrology option in the SWAM Scenario Planner. The 24-month period covering the drought of record (2007 through 2008) was repeated. A second 24-month low-flow period covering 2011 through 2012 was also tested.

Reservoir storage amounts were impacted in both repeating drought scenarios, as shown in Figure 5-6. Under the repeating 2007 through 2008 drought, water levels in the North Saluda reservoir consistently drop; however, under the 2011 through 2012 drought, North Saluda water levels are maintained at levels similar to the historical hydrology. Impacts are similar for Table Rock reservoir, with water levels approaching the dead pool during fall months after approximately 8 years of continuous drought in the 2007 through 2008 extended drought scenario. Lake Rabon experiences the lowest water levels in the 2011 through 2012 drought scenario because of the reduced inflows in 2011. Seasonal guide curves largely control water levels in Lake Greenwood and Lake Murray. Lake Greenwood has minimal impacts from both extended drought scenarios. Lake Murray water levels are overall similar to the historical hydrology conditions for the 2011 through 2012 extended drought scenario and are approximately 1 foot lower in the 2007 through 2008 extended drought scenario.

For the 2011 through 2012 repeating drought scenario, no additional water users in the basin experienced shortages through the end of the simulation period (2030); however, two agricultural water users on Clouds Creek (Watson Jerrold Farm and Titan Farms) experienced more frequent shortages than under the historical hydrology. For the 2007 through 2008 repeating drought scenario, in addition to more frequent shortages for Watson Jerrold Farm and Titan Farms, two more agricultural water users (Overbridge Farm and Leslea Farms) and one golf course (Smithfields) experience shortages. These water users all withdraw from tributary streams. Additionally, under this scenario, Greenville Water is projected to experience shortages after approximately 18 years of repeating drought. The projected shortage of 24 MGD is simulated to occur for 1 month out of every 24 months as the repeating 2007 through 2008 drought continues (Figure 5-7). This occurs when both Table Rock and North Saluda reservoirs are drained to their dead pool elevations. The repeating 2007 through 2008 drought was also simulated in the Savannah River basin, the results of which indicate that this brief Greenville Water shortage in the Saluda basin could be offset by water available in Lake Keowee, in the very unlikely case that a drought similar to the 2007 through 2008 drought of record would continue for a 20-plus-year duration.

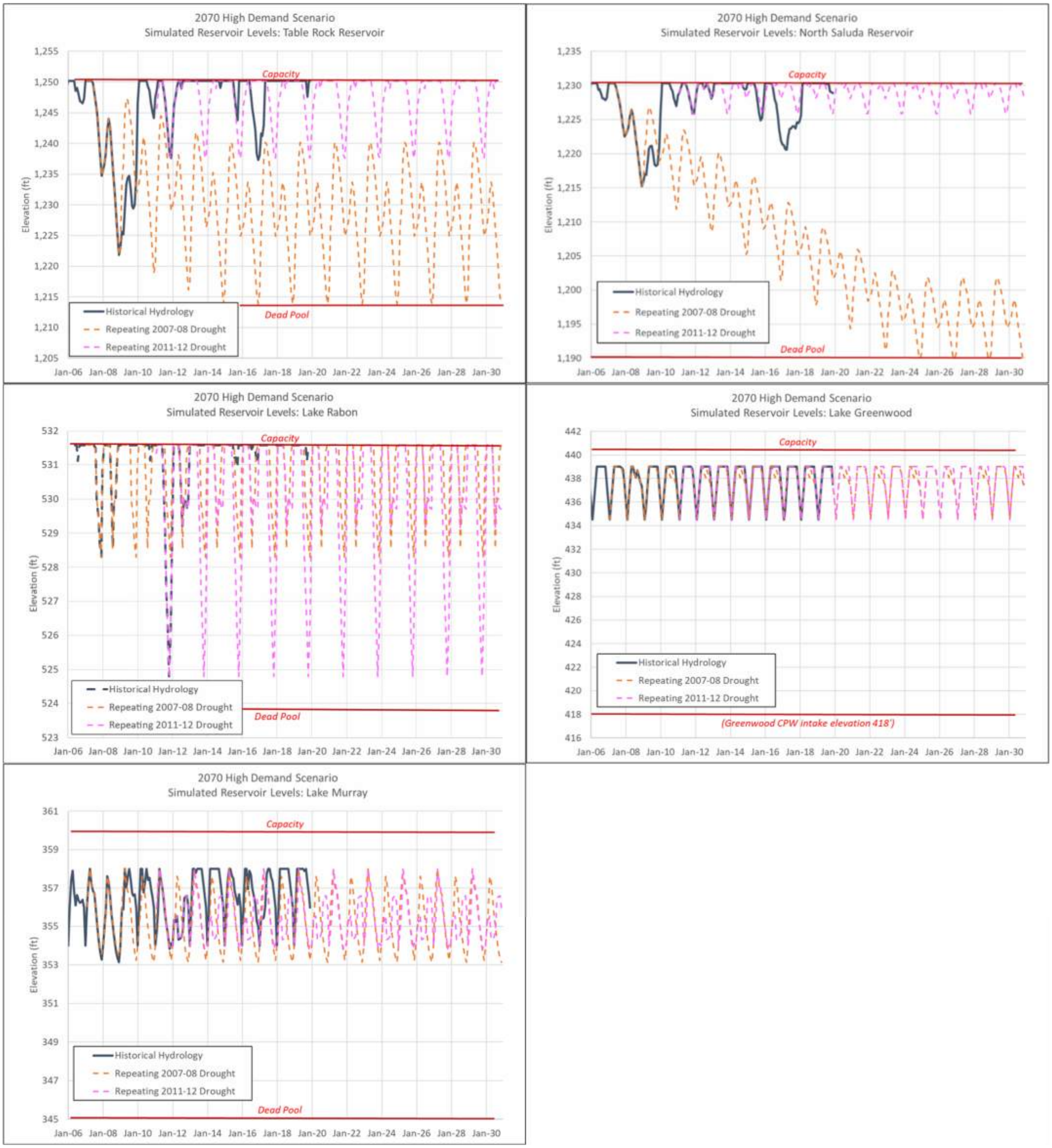


Figure 5-6. Extended drought scenario results for Saluda River basin reservoirs.

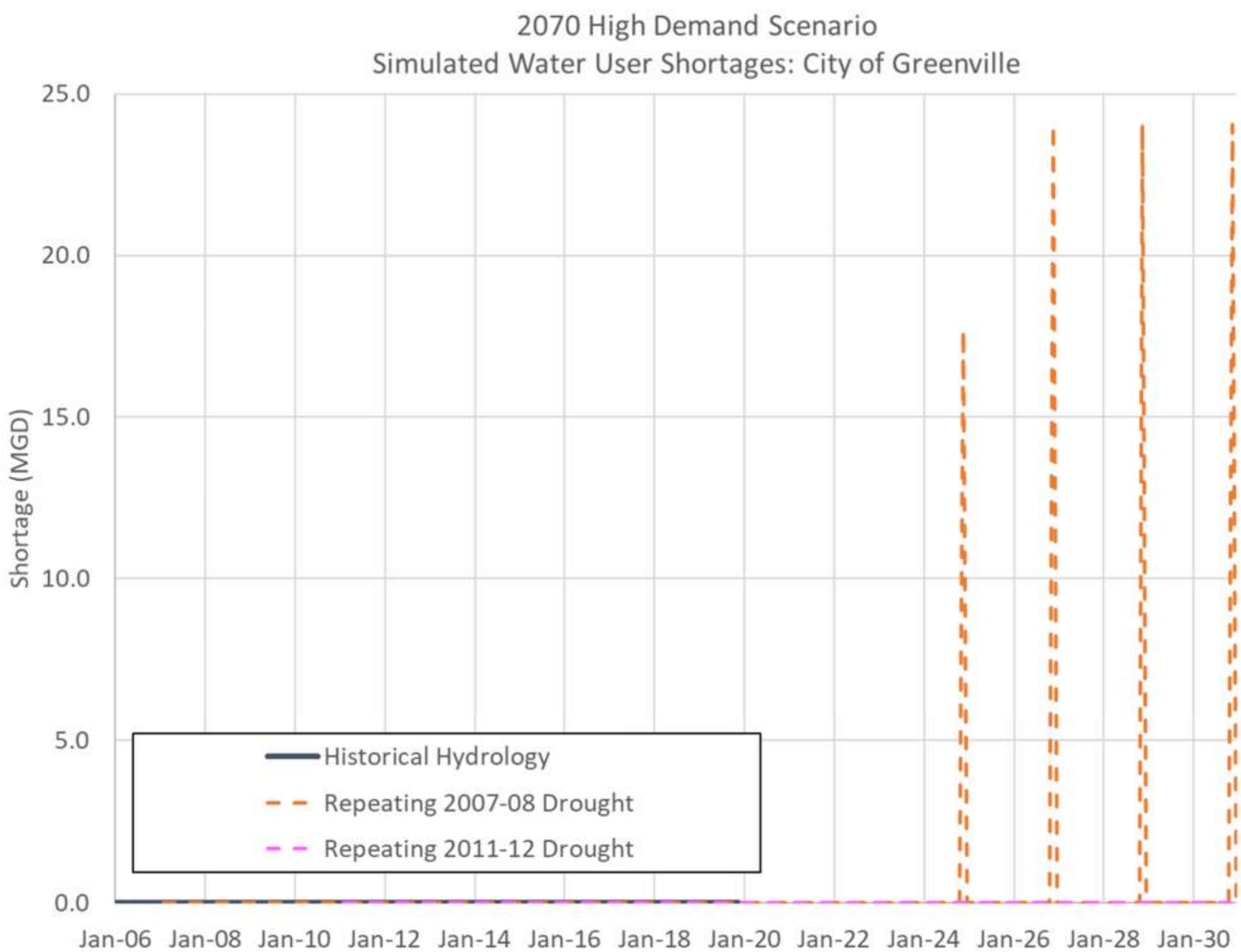


Figure 5-7. Extended drought scenario results for Greenville Water shortages.

5.3.8 Application of Biological Response Metrics

The biological response metrics developed by Bower et al. (2022) were correlated to model-simulated flows from the various planning scenarios to assess the potential for ecological risk, as described in The Nature Conservancy et al. (2024) report provided in Appendix C. Results of this assessment are not presented in their entirety, but rather illustrated by example for the various biological response metrics considered (as discussed in Chapter 5.2.2).

The consistent methodology used is discussed in Bower et al. (2022) and summarized in this plan in Chapter 5.2.2. Fundamentally, the two selected hydrologic metrics (mean daily 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. It should be noted that correlation does not imply causation. Table 5-25 and Figure 5-8 illustrate how the process works.

Table 5-27. Example of calculating changes in the biological metrics at the Rabon Creek Strategic Node[1]

Demand Scenario	Current Scenario Flow (cfs)	Projected Demand Scenario Flow (cfs)	Percentage Change in Flow Metric	Biometric	Percentage Change in Biometric	95% Confidence Interval[2]
UIF	99.83	104.24	-4%	Richness	-4%	-17.9% to 9.9%
Moderate 2070		99.64	0%	Richness	0%	-13.9% to 13.9%
High Demand 2070		98.48	-1%	Richness	-1%	-14.9% to 12.9%
P&R		35.56	-64%	Richness	-53%	-66.9% to -39.1%

[1]This table is one example, extracted from the analysis at the Rabon Creek 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.
[2] Ninety-five percent confidence interval for the percentage change in biometric estimates.

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 5-8.

Biological response metrics were applied at three Strategic Nodes (Rabon Creek, Reedy River above Fork Shoals, and Bush River near Prosperity) and at a location on Twelvemile Creek near its confluence with the Saluda River. Figure 5-9 presents representative results for many of the combinations of hydrologic metrics and biological response metrics at these locations.

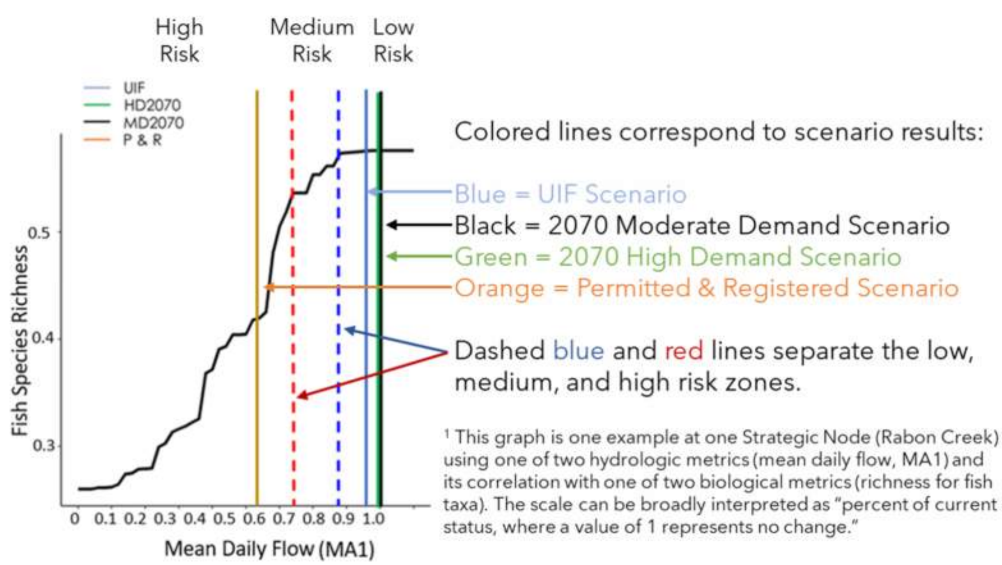
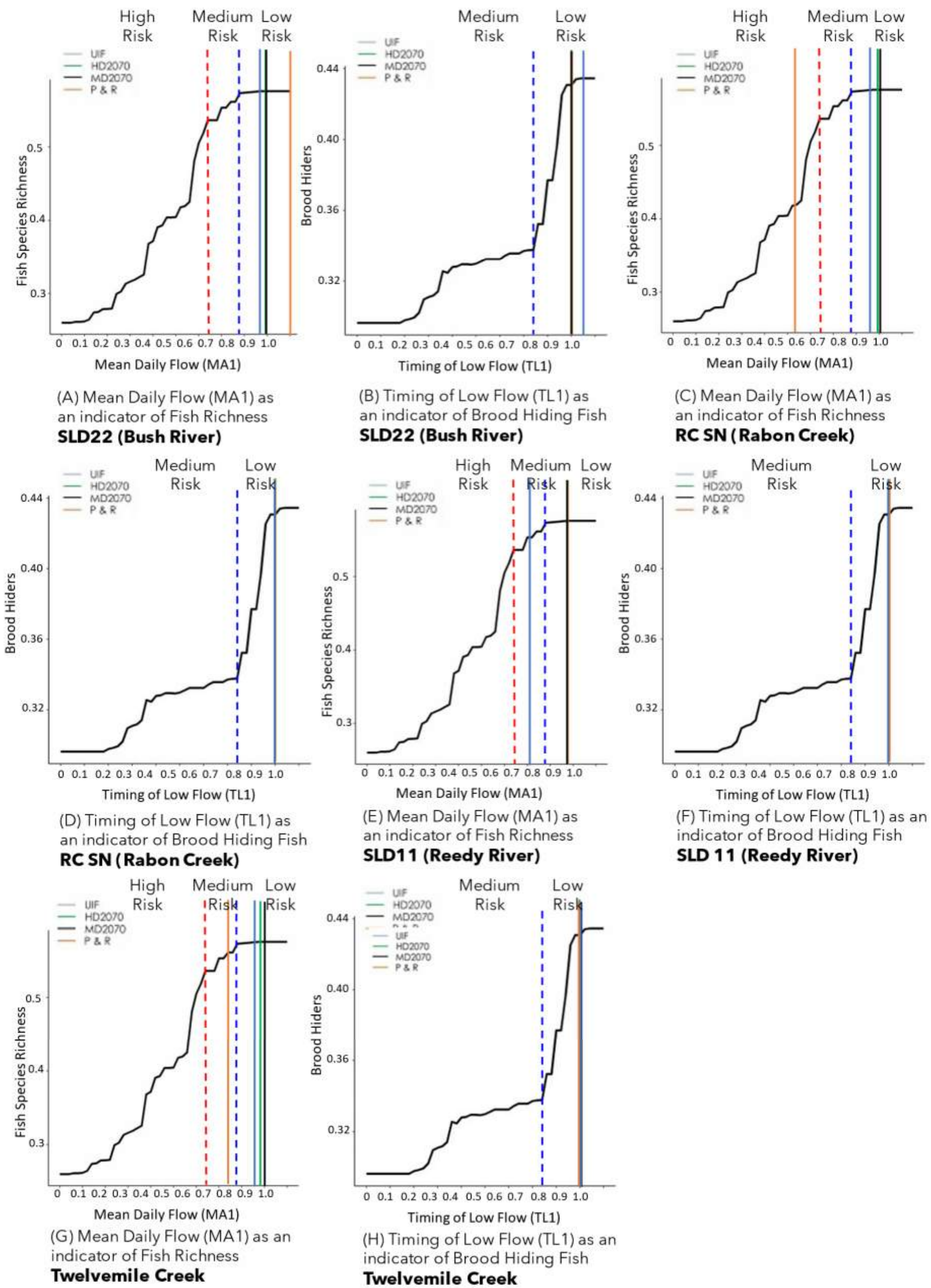


Figure 5-8. Example of the conversion of changes in biological metrics into risk (The Nature Conservancy et al. 2024).



(A) Mean Daily Flow (MA1) as an indicator of Fish Richness
SLD22 (Bush River)

(B) Timing of Low Flow (TL1) as an indicator of Brood Hiding Fish
SLD22 (Bush River)

(C) Mean Daily Flow (MA1) as an indicator of Fish Richness
RC SN (Rabon Creek)

(D) Timing of Low Flow (TL1) as an indicator of Brood Hiding Fish
RC SN (Rabon Creek)

(E) Mean Daily Flow (MA1) as an indicator of Fish Richness
SLD11 (Reedy River)

(F) Timing of Low Flow (TL1) as an indicator of Brood Hiding Fish
SLD 11 (Reedy River)

(G) Mean Daily Flow (MA1) as an indicator of Fish Richness
Twelvemile Creek

(H) Timing of Low Flow (TL1) as an indicator of Brood Hiding Fish
Twelvemile Creek

Figure 5-9. Selected biological risk level results for various biological metrics and Strategic Node locations (The Nature Conservancy et al. 2024).

As illustrated in Figure 5-9, SWAM model–simulated flow metrics for the UIF, Moderate Demand 2070, and High Demand 2070 Scenarios generally result in low risk for ecological integrity and tolerance (The Nature Conservancy et al. 2024). Large changes in mean daily flow for the P&R Scenario and the High Demand 2070 Scenario are predicted to substantially reduce the number of fish species at one Strategic Node, Rabon Creek. The 63 percent change in mean daily flow was predicted to substantially reduce the number of fish species by 53 percent. Two other Strategic Nodes showed a greater than 10 percent reduction in mean daily flow for the P&R model: Bush River and Twelvemile Creek. The linear relationships predicted losses in the number of species to be between less than 1 percent and 53 percent for the P&R Scenario and between less than 1 percent and 3 percent for the High Demand 2070 Scenario.

The unimpaired SWAM scenario predicted a 19 percent decrease in mean daily flow at the Reedy River Strategic Node because of the removal of wastewater discharge flows originally sourced from other water bodies or outside of the basin. This results in a 16 percent predicted decrease in the number of fish species at the Reedy River Strategic Node under the UIF Scenario. All other SWAM scenarios predicted low changes in mean daily flow and low losses in the number of fish species at this node. The standard error associated with these estimates is important to consider because it provides a range associated with each prediction. For example, the linear relationships predicted a 16 percent reduction in fish species with a standard error of 14 percent at Reedy River for the unimpaired SWAM scenario, suggesting reduction in fish species could be as low as 2 percent or as high as 30 percent.

The performance measures based on mean daily flow and species richness showed the P&R Scenario at the Rabon Creek Strategic Node high risk, and medium risk at the Twelvemile Creek Strategic Node (Figure 5-9). At the Reedy River Strategic Node, the SWAM unimpaired scenario would fall within a medium risk category.

SWAM generally did not predict large changes in timing of low flow, with all scenarios predicting less than a 2 percent change. Accordingly, all SWAM scenarios remained in the low-risk range for timing of low flow.

In general, the P&R future management scenario in this study suggests a moderate to high ecological risk to fish species on the wadable tributaries of the Saluda River basin. 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 on primary tributaries and at the downstream end of certain secondary tributaries. There may be other locations in the river network that are more susceptible to flow changes, or where flow changes may be higher percentages when compared against current conditions. This could lead to more significant impacts to associated ecological integrity and tolerance in these unexamined locations.

- It should be noted that macroinvertebrates are considered better indicators of water quality than fish because they are more sensitive to changes in environmental conditions, have shorter life cycles, and are often more readily affected by pollution, making them a more reliable gauge of a water body's overall health compared to fish populations. Moreover, macroinvertebrates are used in SCDES ambient monitoring to determine support of aquatic life and water quality impairment. Finally, fish data were limited and significantly limited the number of sites available for analysis.

- Non-wadable streams were not assessed for biological response sensitivities to flow changes caused by the various demand scenarios.
- Processing biological samples from wadeable sampling locations and hydrologic records throughout the Saluda 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 six hydrologic metrics and two 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.
- No assessment was performed for wadeable streams of the Saluda River basin in the Blue Ridge ecoregion. The lack of fish community data in the Blue Ridge ecoregion prevents the application of the flow-ecology relationships.
- 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 ecological integrity 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 Safe Yield of Reservoirs

An important factor in estimating the reliability of current water supply systems against future demand forecasts is the ability of reservoir systems to provide anticipated levels of supply without interruption. The safe yield of a reservoir, or system of reservoirs, is a measure of its long-term reliability. The Planning Framework defines Reservoir Safe Yield as “the Surface Water Supply for a reservoir or system of reservoirs over the simulated hydrologic period of record.” Since the Surface Water Supply is the maximum amount of water available for withdrawal 100 percent of the time, the safe yield of a reservoir or system of reservoirs can be thought of as the maximum annual average demand that can be sustained through the period of record without depleting available storage.

For the Saluda River basin, safe yield was computed for each reservoir and system of reservoirs that provide water to multiple municipal water users [Greenville Water, Laurens CPW, LCWSC, Greenwood CPW, City of Columbia, West Columbia, Newberry County Water and Sewer Authority (NCW&SA), and Saluda County Water and Sewer Authority (SCWSA)], as well as Dominion Energy's McMeekin Plant. Standard methods were used, in which the SWAM model was used to gradually increase hypothetical water demand over the entire period of record until a reservoir could no longer satisfy that demand with 100 percent reliability.

Several important factors in the analysis include:

- Future demand assumptions at the point of withdrawal are not relevant to safe yield calculations, since the question is simply, "How much can be supplied reliably?". However, if there are upstream withdrawals, the demand scenarios used for RBC planning purposes are important, since more upstream demand may reduce available flow into reservoirs downstream. For any demands upstream of the reservoirs being evaluated, the conservative 2070 High Demand assumptions were applied.
- Reservoir safe yield results presented are based on the essential water user in a reservoir with the shallowest intake opportunity (highest critical public water supply intake, for example).
- For each analysis, all water user demands for the reservoir being assessed were consolidated into a single water user object in the model.
- Lake Greenwood and Lake Murray operate on seasonal guide curves. The guide curve rules in the model were suspended when performing the safe yield analysis for each lake.
- Minimum downstream releases were maintained for all reservoirs.

Table 5-26 provides results of the safe yield analysis. In most cases, the simulated safe yield exceeds the anticipated level of demand in the 2070 High Demand Scenario, but not in all cases. These projections are based solely on historical hydrology, which may or may not exhibit similar dry-period trends in the future. The analysis was also conducted at a monthly timestep, which does not necessarily account for all operational flexibility of reservoirs.

Table 5-28. Safe yield results for Saluda River basin water supply reservoirs.

Water System with Shallowest Access Intake	Reservoir (Total System)	Safe Yield with SWAM Model (MGD)			Comparative Results from Other Studies (MGD)	Sufficiency for 2070 High Demand Scenarios
		Baseline	2070 High Demand	Permitted and Registered		
Greenville Water	Table Rock	19	See Note 1.		Table Rock: 21.5 MGD or 22.4 MGD North Saluda: 28.3 MGD (Brown and Caldwell 2022)[2]	Sufficient to satisfy 2070 High Demand of 34 MGD (average annual)
	North Saluda	24				
	Total System	43				
Laurens CPW	Lake Rabon	1.6	See Note 1.		N/A	Insufficient to satisfy 2070 High Demand of 2.4 MGD (average annual)
LCWSC	Lake Greenwood[3,5]	203	197	170	N/A	Sufficient to satisfy 2070 High Demand of 20 MGD (average annual)
SCWSA	Lake Murray[4,5]	367	359	334	N/A	Sufficient to satisfy 2070 High Demand of 311 MGD (average annual)

[1] No water users or dischargers are upstream of Table Rock Reservoir, North Saluda Reservoir, or Lake Rabon; therefore, there is no difference in safe yield for 2070 High Demand or P&R Scenarios from the baseline.
[2] Brown and Caldwell (2022) reported safe yield estimates of 22.4 MGD (reported previously) and 21.5 MGD (calculated) for Table Rock Reservoir, and 28.2 MGD (reported previously and calculated) for North Saluda Reservoir. These estimates were based on the 2002 drought condition, whereas the values in this table computed using SWAM are based on the 2008 drought condition. Simulated reservoir conditions leading up to and during the 2002 drought are uncertain, because reservoir release records were not available prior to August 2001.
[3] Lake Greenwood is the water source for Greenwood CPW and LCWSC (shallowest intake).
[4] Lake Murray is the water source for the City of Columbia, West Columbia, Dominion Energy's McMeekin Plant, NCW&SA, and SCWSA (shallowest intake).
[5] The Duke Lee Station thermoelectric plant (upstream of Lake Greenwood and Lake Murray) has recently transitioned from coal to natural gas and, as such, has a higher consumptive use percentage (approximately 92 percent) than reported previously. To account for this, the Duke Lee Station permit limit of 10,081 MGM was lowered in the model to 156 MGM to provide more realistic results for the P&R Scenario.

5.5 Summary of Water Availability Assessments

Application of the surface water model using current and projected rates of water withdrawals resulted in the identification of several key observations and conclusions regarding the availability of water resources in the Saluda River basin. The following are specific observations and conclusions relative to each planning scenario.

- Surface water availability modeling suggests a low risk of water supply shortages under the Current Scenario assuming no minimum instream flow requirements. Water supply shortages were identified using current, monthly average demands when considering the almost 95-year period of record covering hydrologic conditions observed from 1925 to 2019. Shortages are projected for four agricultural water users on tributary streams, and all these users withdraw water from or are adjacent to storage ponds that are not accounted for in the SWAM model, and which can likely buffer short-term reductions in water availability from their supply streams.

- The P&R Scenario explored the question of, "What if all water users used the full volume of water allocated through permits and registrations?". The results, which include projected shortages for seven agricultural operations, five golf courses, and two public water suppliers, demonstrate that the surface water resources of the basin are over-allocated based on existing permit and registration amounts without considering any requirements for minimum instream flows. Both public water suppliers with shortages (City of Greenville and Laurens CPW) have a projected frequency of shortage greater than 60 percent. Projected mean, median, and low flows at Strategic Nodes suggest that flows are significantly lower for the P&R Scenario than for the same performance measures for the Current Scenario. At the most downstream Strategic Node (SLD26, Saluda River near Columbia), mean flow is predicted to decrease by approximately 13 percent and median flow is predicted to decrease by approximately 22 percent.
- For the Moderate Demand Scenario, modeled demands were set to projected future levels based on an assumption of moderate population and economic growth. 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, without considering any requirements for minimum instream flows. Shortages are projected for three agricultural water users, all of which are able to withdraw water from adjacent storage ponds that are not accounted for in the SWAM model. River flows are predicted to decrease slightly to moderately, depending on location, compared to the Current Scenario. At the most downstream Strategic Node (SLD26, Saluda River near Columbia), mean and median flows are predicted to decrease by 0.5 to 1.2 percent, and low flows by about 0.4 percent, based on 2070 demands.
- 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 assumptions. This scenario represents an unlikely maximum for total water demand because it is very unlikely these demands would occur month after month and year after year for all water users; however, this scenario provides the RBC with information on which to base conservative management strategies. The three water users with shortages in the Moderate Demand 2070 Scenario exhibit slightly greater shortages under the High Demand 2070 Scenario. Two additional agricultural water users and one golf course experience shortages. River flows are predicted to decrease modestly to moderately, compared to the Current Scenario, throughout the basin. Modeled reductions are most pronounced during low-flow periods at most Strategic Nodes. Mean and median flows at the most downstream site of the mainstem (SLD26, Saluda River near Columbia) are predicted to decrease by approximately 2 to 4 percent, and low flows by approximately 1 percent, based on 2070 demands. Results do not consider requirements for maintaining minimum instream flows.
- The SWAM model was also used to simulate hydrologic conditions without the impact of surface water users, discharges, or water imports. Predicted river flows for the UIF Scenario are generally higher than simulated Current Scenario flows, as expected. However, at Strategic Nodes on the Bush River and Reedy River, the simulated UIFs are lower than Current Scenario flows. Both rivers receive wastewater discharges associated with water withdrawals that are sourced elsewhere.

Lower simulated UIFs reflect the removal of these wastewater returns in the system for the UIF Scenario. The lack of wastewater returns more than offsets the lack of consumptive surface water use. At the most downstream site along the mainstem (SLD26), mean UIFs are approximately 14 percent higher than Current Scenario flows and median UIFs are approximately 19 percent higher. At this same location, UIF low flows (25th to 5th percentile) are approximately 2 to 39 percent greater than Current Scenario flows.

- SWAM model–simulated flow metrics for the Moderate Demand 2070 and High Demand 2070 Scenarios result in low risk for ecological integrity and tolerance (The Nature Conservancy et al. 2024), without considering the negative impacts that increased development would have on flow regimes and the ecological integrity of streams and rivers in the basin. As such, the estimates of potential biodiversity loss are likely underestimated. On the Reedy River, the mean daily flow metric for the UIF Scenario results in a moderate risk in terms of fish species richness; this is because of streamflow reductions from the absence of upstream wastewater discharges. Changes in mean daily flow for the P&R Scenario are predicted to substantially reduce the number of fish species, with the Rabon Creek Strategic Node predicted to lose more than 50 percent of fish species. Low-risk outcomes in terms of timing of low flow were identified for all scenarios and locations assessed.

Results and conclusions are based on modeling that assumed historical climate patterns. In subsequent phases of river basin planning, the RBC may decide to evaluate potential impacts to Surface Water Supply availability resulting from changing climate conditions such as increasing temperatures and more variable precipitation. Modeling results led to the RBC identifying and evaluating a suite of water management strategies to address projected Surface Water Shortages, and to identify strategies to protect Surface Water Supply and maintain adequate river flows. Chapter 6, Water Management Strategies, presents the evaluation and selection of water management strategies.

Chapter 6
Water Management Strategies

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

6.1 Surface Water Management Strategies

Under the Planning 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.

6.1.1 Overview of Strategies

The Saluda RBC identified for consideration a portfolio of various demand-side strategies consisting of municipal water conservation and efficiency practices as well as agricultural water efficiency practices as listed in Tables 6-1 and 6-2. While these demand-side strategies were identified for surface water withdrawers, they also apply to the basin’s limited number of groundwater withdrawers. The RBC did not identify any strategies that increase the amount of surface water available for withdrawal (supply-side strategies) because modeling results of the High Demand Scenario did not indicate any significant Surface Water Shortages. However, the P&R Scenario did identify significant Surface Water Shortages, as detailed in Chapter 5. The few shortages that were identified were restricted to agriculture users and a golf course and their withdrawals are all located either on or adjacent to impoundments that are not included in the model. The impoundments may provide enough water to prevent the projected physical shortages at times when their source rivers and steams are simulated to have very low flow.

Table 6-1. Municipal water conservation and efficiency practices.

Municipal Practices	
Develop, Update, and Implement Drought Management Plans	Leak Detection and Water Loss Control Programs
Public Education of Water Conservation	Time-of-Day Watering Limits
Conservation Pricing Structures / Drought Surcharges	Reclaimed Water Programs
Residential Water Audits	Landscape Irrigation Program and Codes

Table 6-2. Agricultural water efficiency practices.

Agricultural Practices	
Water Audits and Nozzle Retrofits	Crop Variety, Crop Type, and Crop Conversions
Irrigation Scheduling and Smart Irrigation	Irrigation Equipment Upgrades
Soil Management	Future Technologies

The RBC additionally outlined water conservation approaches for manufacturing (industrial) and energy water users. In the Saluda River basin, these water users include Vulcan Mining, Duke Lee Station, Dominion Energy, and Shaw Industries. The identified approaches are water audits, rebates on energy-efficient appliances, water recycling and reuse, water-saving equipment and efficient water systems, water-saving fixtures and toilets, and educating employees. Several of these approaches overlap those listed for municipal users, described in Section 6.1.2 (Municipal Water Efficiency and Conservation Demand-Side Strategies).

These strategies do not represent an exhaustive list of possible strategies that water users in the Saluda River basin could implement. Similarly, not all 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 details on the surface water management strategies identified for consideration by the RBC, a technical evaluation of their potential effectiveness, and an assessment of their feasibility.

6.1.2 Municipal Water Efficiency and Conservation Demand-Side Strategies

This subchapter further describes municipal water efficiency practices considered as part of the toolbox of strategies. These demand-side strategies also apply to groundwater users.

Develop, Update, and Implement 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 a detailed description of the drought management plans in the Saluda 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. Presently, many of the existing drought management plans in the basin need to be updated, and may have contradictions or lack coordination amongst entities.

Public Education of Water Conservation

This strategy would involve expanding existing or developing new public education programs. Water conservation education could occur through public schools, civic associations, or other community groups. Water utilities and local governments could create informational handouts and/or include additional water conservation information on water utility bills. For this strategy to remain effective, public outreach would need to continue on a regular basis to maintain public engagement and motivation. The RBC discussed the possibility of larger water utilities sharing staffing or other conservation resources with smaller utilities. The RBC acknowledged that Greenville Water and ReWa already excel at this, and that the challenge often for in-person engagement can be funding for transportation.

For RBC Consideration: For an example of coordinated outreach, the Saluda RBC could look to the 2014 Water Use Efficiency Plan developed by the Catawba-Wateree Water Management Group (CWWMG) for an example of a basinwide outreach program. The Plan includes a public information campaign, education and outreach, and landscape water management techniques such as demonstration gardens. The Saluda RBC may request that members of the CWWMG provide an update on actions and results since the 2014 Plan, to guide the Saluda RBC's actions.

Conservation Pricing Structures / Drought Surcharges

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 price 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.

In the Saluda River basin, several utilities including Greenville Water and the City of Columbia have drought surcharges that may be implemented during severe and/or extreme drought phases. These surcharges are like conservation pricing structures, because the intent is to encourage customers to use less water. At the time of this report, if implemented during an extreme drought, Greenville Water charges the regular water rate for the first 5,000 gallons used in a month, three times the regular water rate for up to 7,500 gallons used, four times the regular water rate for up to 10,000 gallons used, and five times the regular rate for all water used above 10,000 gallons.

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, such as toilets, faucets, and showerheads, and outdoor uses, such as 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.

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 conserve water. Water-efficient landscapes begin with good designs that group plants based on water needs, use native plants that generally require less water, and emphasize reducing lawn size, using drip irrigation for trees and shrubs, and installing effective mulching (Huffman 2024). Native plants can reduce runoff by slowing water movement, allowing more groundwater recharge while filtering out nutrients and oil-based pollutants. To avoid evaporation, irrigation should be scheduled during early morning hours, use rain sensors to avoid overwatering, and sprinkler heads should be orientated to avoid watering hardscapes like sidewalks and driveways.

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 Rebates – Utilities may offer rebates to homeowners who replace their existing irrigation controllers with smart irrigation controllers that adjust irrigation according to soil moisture levels [using soil-moisture-based sensors, also known as soil moisture sensors (SMSs)] and precipitation and/or evapotranspiration rates [using weather-based irrigation controllers (WBICs)]. Controllers can be WaterSense-certified by meeting U.S. Environmental Protection Agency (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 micro-irrigation 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:

  - Verification of the best irrigation schedule for the climate and soil conditions
  - Verification of the recommended nozzle pressure in sprinklers
  - Adjustments to sprinkler locations to ensure water falls on lawn or garden (not on sidewalk or other impervious surfaces)
  - Use of a water meter to measure water used in landscape irrigation

Leak Detection and Water Loss Control Programs

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.

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 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 basinwide water audit and water loss control program is that of the 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 nonrevenue water that could be managed to increase utility revenue by $16.8 million (CWWMG 2023). 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 Saluda 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, which include:

- Completion of an annual water loss audit using American Water Works Association (AWWA) M36 Methodology
- Development and implementation of a water loss control program
- Development of individual goals to set measures of water supply efficiency
- Demonstration of progress toward improving water supply efficiency

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.

Time-of-Day Watering Limits

A time-of-day watering limit prohibits outdoor watering during the hottest part of the day, usually 10:00 a.m. to 6:00 p.m. This practice reduces water loss from evaporation.

6.1.3 Agriculture Water Efficiency Demand-Side Strategies

Following is a more detailed description of the agricultural water efficiency practices considered as part of the toolbox of strategies. 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 over-irrigation 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 under-watering, 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 over-irrigation 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 under-watering, suggested energy savings opportunities, and recommended upgrades or operational changes (SCDNR 2019d). The project provided no-cost water and energy audits on 24 agricultural center pivot irrigation systems throughout South Carolina over 3 years (SCDNR 2020).

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 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 Saluda 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 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 (Conservation Technology Information Center 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.

- Cover Crops – This practice involves planting cover crops, such as 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 because of the 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 Saluda River basin. Conversion programs that offer growers incentives may be necessary.

Irrigation Equipment Upgrades

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).

Future Technologies

There are several emerging technologies to improve irrigation efficiency and water conservation, which are under development or in the early stages of being adopted on a larger scale. Some examples of future technologies have already been discussed above, including smart irrigation systems that rely on soil moisture levels, weather conditions, and crop water needs in real time. High-efficiency irrigation control systems use weather data to adjust irrigation schedules automatically (HydroPoint 2012). Precision agriculture methods use GPS and satellite imagery to apply water, fertilizers, and pesticides more accurately. As new technologies are developed and commercialized, agricultural water users in the basin should consider how they might apply these technologies to aid in water conservation.

6.1.4 Supply-Side Strategies

The RBC did not identify any strategies that increase the amount of surface water available for withdrawal (supply-side strategies) because modeling results of the High Demand Scenario did not indicate any significant Surface Water Shortages. In future planning efforts, changing conditions and further consideration of uncertainty may suggest the identification of supply-side strategies.

6.1.5 Technical Evaluation of Strategies

None of the surface water management strategies in the Saluda River basin were evaluated using the SWAM surface water model. This was largely because the strategies could not be related to triggers that can be integrated into the model (i.e., streamflows or reservoir water levels). While some of the municipal drought management plans in the basin do have reservoir water level triggers, these were not tested using the model because of (1) the lack of water shortages related to reservoir storage throughout the basin in the 2070 High Demand Scenario and (2) the triggers would not become activated very often during the simulation and, therefore, would have a minimal impact on supply.

6.1.6 Feasibility of Surface Water Management Strategies

The Saluda RBC assessed the feasibility of the strategies described above considering consistency with regulations, reliability of water source, environmental impacts, socioeconomic impacts, potential interstate or interbasin impacts, and water quality impacts. Table 6-3 presents this assessment. Agricultural/irrigation and golf course practices are presented first, followed by municipal, industrial, and thermoelectric practices that 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 judgment and feedback from the RBC.

Color Coding for Assigning Expected Effects in Table 6-3.

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 6-3. 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 positive 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 overfertilization and prevention of overwatering may limit runoff, erosion, and sedimentation.	Low to moderate adverse effects – Initial costs of advanced technology may be partially offset by savings from reduced water and nutrient use.	No anticipated effects	See Environmental Benefits.
Soil Management	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 operations and maintenance (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.
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.

[1]For this comparison, "impacts" can be understood as potentially adverse consequences, while "benefits" are potential advantageous consequences.

Table 6-3. Water management strategy feasibility assessment (Continued).

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							
Irrigation Equipment Upgrades, 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.
Future Technologies	Demand-side – Agriculture	Consistent	Strategy reduces demand and extends supply, increasing water source reliability for other demands.	**Impacts:** None anticipated. **Benefits**: May reduce overfertilization and 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.
Demand-Side Municipal Practices							
Develop, Update, and Implement Drought Management Plans	Demand-side – Municipal	Consistent	Strategy reduces demand and extends supply, increasing water source reliability during droughts.	**Impacts:** None anticipated.	Low 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.

[1]For this comparison, "impacts" can be understood as potentially adverse consequences, while "benefits" are potential advantageous consequences.

Table 6-3. Water management strategy feasibility assessment (Continued).

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 Practices							
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 effects to residential users from reduced water bills (if billed at unit rate).	No anticipated effects	No anticipated impacts.
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 who 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.
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.

[1]For this comparison, "impacts" can be understood as potentially adverse consequences, while "benefits" are potential advantageous consequences

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Table 6-3. Water management strategy feasibility assessment (Continued).

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 Practices							
Leak Detection and Water Loss Control	Demand-side – Municipal	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.	No anticipated effects	No anticipated impacts.
Time-of-Day Watering Limits	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.
Reclaimed Water Programs/ Water Reuse and Recycling (a demand- and supply-side strategy)	Demand-side – Municipal	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).

[1]For this comparison, "impacts" can be understood as potentially adverse consequences, while "benefits" are potential advantageous consequences

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Table 6-3. Water management strategy feasibility assessment (Continued).

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 Practices							
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.

[1]For this comparison, "impacts" can be understood as potentially adverse consequences, while "benefits" are potential advantageous consequences

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6.1.7 Cost-Benefit Analysis

Available information related to costs and benefits in terms of potential savings of water or dollars for each strategy follows. 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 provided in this chapter is not intended to decide if any of the alternatives will be recommendations in the River Basin plan for the Saluda River basin. Rather, the information is 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.

Demand-Side Municipal Strategies

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 (Freese and Nichols, Inc. 2020). 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).

Conservation Pricing Structures / Drought Surcharges

The implementation of conservation pricing rate structures, which discourage the inefficient use or waste of water, is a cost-effective option for utilities because 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).

Residential Water Audits

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

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. The cost to the utility or municipality would be dependent on the rebate rate and percent uptake by customers.

Leak Detection and Water Loss Control Programs

The 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 (U.S. 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 generally have 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).

AMI and AMR technologies greatly reduce the labor required for water meter reading. Davie County Public Utilities, a water system in North Carolina, required 50 days (with frequent misreads) to manually read all 11,000 service connections in their network. After using AMR technology, they reduced their meter reading rate to 3,000 meters in two days, with nearly 100 percent accuracy (Atkinson 2016). In Michigan, the Oakland County Water Resources Commission achieved a 99 percent read success rate and reduced their meter reading staff by half after implementing an AMR system (Atkinson 2016).

A cost-benefit analysis for Washington Suburban Sanitary Commission Water concluded that an AMI system would pay for itself in 11 years, and project savings would exceed $286 million over a 20-year period (Arcadis 2020). The project cost was estimated to total $208 million dollars, with the primary driver of cost being the replacement of 492,000 meters. The analysis estimated that 29 of the existing 37 meter reader employee positions would be eliminated, and that the utility would have a revenue gain of more than $580 million over 20 years because of the improved meter accuracy. The improved domestic leak detection would save customers approximately $56 million over 20 years. Intangible benefits include safer working environments for utility employees because of the reduction in meter reading field activities, water and energy conservation by customers, identification of meter tampering and potential water theft, and benefits from more frequent billing cycles.

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 Department of Environmental Quality 2021).

Reclaimed Water Programs

Benefits 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.

Time-of-Day Watering Limits

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 these costs 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.

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 over-irrigation, the estimated suboptimal irrigation cost is $4.39/acre. With an irrigated area of 37.4 acres, this is 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 (North Carolina 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.

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 in. 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 in. per season would be expected to lower the seasonal irrigation need from 9.9 in. to 6.9 in., assuming average seasonal precipitation of 16 in., and an average seasonal corn crop watering need of 25.9 in. The reduction of 3 in. 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 seed, pumping, fertilizer, harvest, and water-use costs.

Irrigation Equipment Upgrades

Irrigation equipment upgrades may focus on lowering the elevation of nozzles on center pivot systems. Total replacement of a system (assumed 125-acre, 30-in. spacing) with a new 60-in. 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 in. of drip system water, compared to only 2.25 bales of cotton per acre using 16 in. 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 Groundwater Management Strategies

In the Saluda River basin, less than 1 percent of current demands are met by groundwater, and these demands are not projected to significantly increase over the planning horizon (SCDNR 2023a). The Saluda RBC, therefore, focused the evaluation and selection of water management strategies on surface water management strategies. The demand-side strategies described in the previous section for surface water withdrawers also apply to the basin's limited groundwater withdrawers. Should utilities begin to rely more on groundwater as a water source or for developing redundancy, additional analysis may be needed.

Chapter 7 Water Management Strategy Recommendations

The Saluda RBC considered a wide variety of water management strategies for implementation in the Saluda River basin. As water management strategies were identified and discussed, the RBC recognized that significant surface water shortages or ecological risk due to low surface water flows are not projected to occur over the approximately 50-year planning horizon based on the information presented and the modeling performed. Existing supply-side strategies are recognized as effective. The major reservoirs in the Saluda basin are effective water supply strategies and meet other needs such as recreation. Away from the major reservoirs, small impoundments (e.g., farm or golf course ponds) maintain access to needed supply during low flow conditions for irrigation.

Because no significant water shortages were projected, the RBC focused their efforts on the demand-side strategies. Demand-side strategies are beneficial for reducing the cost of water production and use, building resilience, mitigating potential localized shortages that are difficult to capture in the modeling, and sustaining and extending surface water supplies if unforeseen conditions occur such as changes in climate patterns, higher than expected growth, or higher than expected water use.

The water management strategy recommendations presented in this chapter align with the RBC vision and goal statements for the basin. By assessing a portfolio of demand-side strategies, the stakeholders comprising the RBC are recommending actions that help achieve the RBC's vision statement: "***A resilient and sustainably managed Saluda River Basin that balances human and ecological needs.***" The selection and recommendation of the demand-side strategies also support the RBC-identified goal to "***Apply science-based resource management and conservation strategies that consider resource availability and allocation.***"

7.1 Selection, Prioritization, and Justification for each Recommended Water Management Strategy

Demand and supply-side strategies recommended by the Saluda RBC to reduce or eliminate projected water shortages, enhance instream flows, and increase water supply availability are identified and discussed below.

Municipal Demand-side Strategies: The municipal water management strategies recommended by the Saluda RBC are summarized in Table 7-1. The RBC did not prioritize these strategies because of the significance of individual utility circumstances (e.g., current operations and programs, utility size, financial means) in determining which is the most desirable strategy to pursue. The strategies instead represent a "toolbox" of potential approaches to reduce water demands. Utility managers may find the descriptions and feasibility assessment presented in Chapter 6 helpful for determining which strategies to pursue.

Table 7-1. Municipal demand-side water management strategies.

Water Management Strategy	Prioritization
Public Education of Water Conservation	Toolbox of strategies. Priority varies by utility.
Conservation Pricing Structures	
Residential Water Audits	
Landscape Irrigation Program and Codes	
Leak Detection and Water Loss Control Program	
Reclaimed Water Programs	
Time-of-Day Watering Limit	

Agricultural Demand-side Strategies: Agricultural water use accounts for about one percent of current water use in the Saluda River basin and is not projected to increase over the planning horizon. Although this use category is small, the RBC considered and has recommended several agricultural demand-side water management strategies. Many of these practices recommended in Table 7-2 are already used in the basin.. The RBC chose not to prioritize strategies, recognizing that the most appropriate strategy for a given agricultural operation will depend on the size of the operation, crops grown, current irrigation practices, and financial resources of the owner/farmer. The descriptions and feasibility assessment presented in Chapter 6 may be helpful to owners/farmers for determining which strategy to pursue.

Table 7-2. Agricultural water management strategy prioritization.

Water Management Strategy	Prioritization
Water Audits and Nozzle Retrofits	Toolbox of strategies. Priority varies by operation.
Irrigation Scheduling	
Soil Management and Cover Cropping	
Crop Variety, Crop Type, and Crop Conversion	
Irrigation Equipment Changes	
Future Technologies (that improve water use efficiency)	

During their discussion of both supply and demand-side strategies, the RBC identified several additional considerations:

- There is a growing importance on maintaining existing water infrastructure, including conveyance, reservoirs, and storage facilities. Aging infrastructure will result in increased water loss.
- It has become more difficult to permit and build impoundments. Impoundments serve as critical storage opportunities for water users located far away from major sources. Relying on small streams, especially near headwaters, is difficult, unless impoundments are used to store water during dry periods, when lower order stream flows are reduced or zero.

- Watershed protections such as riparian buffers can be expanded to both improve water quality and reduce sediment loading to streams and reservoirs. Sediment loading to reservoirs results in loss of storage. Recovering lost storage through dredging is expensive and does not address the root cause of sedimentation.
- In the Saluda River basin, much of the water that is withdrawn for public water supply purposes is treated, returned to the system, and used further downstream in the basin. This is a form of indirect potable reuse.

7.2 Remaining Shortages

The surface water modeling described in Chapter 5 did not indicate any significant projected shortages that may need to be addressed using surface water management strategies. The Current Use, Moderate, and High Demand planning scenarios all demonstrated no significant shortages and limited ecological risk driven by future stream flow reductions. The recommended demand-side management strategies presented in this chapter will provide basin-wide benefit by increasing water supply and helping to maintain instream flows that support a healthy and diverse aquatic ecosystem. Implementation of these strategies also serves to protect against future climate conditions such as more frequent or severe droughts and water demands that exceed current projections.

7.3 Remaining Concerns Regarding Designated Reaches of Interest or Groundwater Areas of Concern

The evaluation presented in Chapter 6 allowed for the Saluda RBC to identify any Reaches of Interest or Groundwater Areas of Concern. Reaches of Interest are defined in the Framework 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 2019a). The Saluda RBC determined that the 14-mi stretch of the Saluda River below Saluda Lake is considered a Reach of Interest because of its classification as a hydrologically impaired stream segment, as discussed in Chapter 3.

A Groundwater Area of Concern is defined in the Framework 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 2019a). The Coastal Plain only intersects the Saluda River basin at its extreme southern end. The Saluda RBC did not identify any Groundwater Areas of Concern.

7.4 Adaptive Management

Adaptive management is a flexible framework used to implement options in a structured way as the future unfolds in to avoid the pitfalls of either underperformance or overinvestment. This allows for management adjustments based on real-time data and evolving conditions. Adaptive management can provide a means to more effective decisions and enhanced benefits while helping meet environmental, social, and economic goals; increasing scientific knowledge; and reducing tensions among stakeholders (National Research Council 2004).

Several pitfalls may occur because of uncertainties identified during river basin planning. The Saluda RBC identified and discussed the following potential uncertainties, which an adaptive management approach may help to address (Bing 2024a, 2024b) as the planning process continues:

- **Climate change** – Adaptive management involves monitoring climate data, updating hydrologic models, and adjusting water management strategies accordingly. If a region experiences more frequent droughts than anticipated, water conservation measures can be implemented or intensified, and alternative water sources can be explored.

- **Population growth** – Population projections can be incorporated into water resource models and updated periodically. This allows planners to anticipate future water needs and develop infrastructure accordingly. If a municipality is expected to grow rapidly, adaptive management might involve expanding water treatment facilities or developing new water sources to meet an increasing demand.

- **Infrastructure maintenance** – Regular inspections and maintenance of water resources infrastructure allow for data-driven decision-making. Planners can prioritize maintenance activities based on the condition and criticality of infrastructure components. This approach helps in extending the lifespan of infrastructure and reducing the likelihood of unexpected failures.

- **Industrial growth and types of industry in the basin** – Adaptive management considers the types of industries present and their water usage patterns and may include monitoring industrial growth and adjusting water allocation and treatment processes to ensure that industrial water needs are met without compromising the overall water supply. An approach to monitor industrial growth may be to study and map changes in industrial parks and associated properties. LocateSC and the SC PowerTeam have statewide industrial property databases that can be used and ReWa may have information to help characterize industrial growth.

- **Cyberwarfare** – Adaptive management involves the integration of cybersecurity measures into water resources planning. This may include regular updates to security protocols, continuous monitoring for potential threats, and developing contingency plans to ensure the resilience of water management systems against cyberattacks.

- **Emerging contaminants including PFAS** – Adaptive management allows for incorporating new scientific findings and regulatory changes into water quality management practices. By continuously updating treatment processes and monitoring programs, planners and engineers can better address the technical, financial, and human health risks posed by emerging contaminants and ensure the safety of water supplies.

- **Future land use patterns** – Land use changes (and related impacts on water supplies) should be continuously assessed. This could be accomplished through studying the counties' land use plans. The RBC has developed recommendations (discussed in Chapter 9) and implementation actions (discussed in Chapter 10) that are intended to provide information on the potential impact to water quantity and quality from land use changes.

- **Extreme flood events** – Adaptive management could involve using hydrological models and real-time data to predict and respond to flood risks. This approach enables planners and engineers to implement adaptive flood management strategies, such as dynamic reservoir operations and floodplain management, to mitigate the impacts of floods.

- **Modeling and data gaps** – Adaptive management addresses modeling and data gaps by continuously updating models with new data and refining them based on observed outcomes. This iterative process helps improve the accuracy of water resource models and ensures they remain relevant and reliable.

- **Energy uncertainty and loss of power** – Adaptive management plans for power outages by incorporating backup power systems and alternative energy sources into water management infrastructure. This ensures that water supply and treatment processes can continue uninterrupted during power outages.

As part of future Plan updates, the RBC will review these uncertainties, determine if and to what degree they have impacted current and projected water demand, water availability, or other factors, and identify or update strategies and develop recommendations to address them as needed.

Chapter 8
Drought Response

8.1 Existing Drought Management Plans and Drought Management Advisory Groups

8.1.1 Statewide Drought Response

The South Carolina Drought Response Act of 2000 (Code of Laws of South Carolina, 1976, Section 49-23-10, *et seq*., as amended) (The Act) was enacted to provide the state with a mechanism to respond to drought conditions (SCDNR 2009). The Act stated that SCDNR (now named SCDES) will formulate, coordinate, and execute a statewide drought mitigation plan. The Act also created the South Carolina DRC to be the major drought decision-making entity in the state. The DRC is a statewide committee, chaired and supported by SCDNR's SCO with representatives from local interests.

To help prevent an overly broad response to drought, the Act assigned SCDNR the responsibility of developing smaller DMAs within the state. SCDNR split the state into four DMAs that generally follow the boundaries of the four major river basins but are delineated along geopolitical county boundaries rather than basin boundaries. The Saluda River basin is primarily within the Central DMA but includes parts of the West DMA as shown in Figure 8-1. The Governor appoints members from various sectors to represent each DMA within the DRC. The organizational relationship of the DRC, DMAs, SCDNR, and SCO is shown in Figure 8-2.

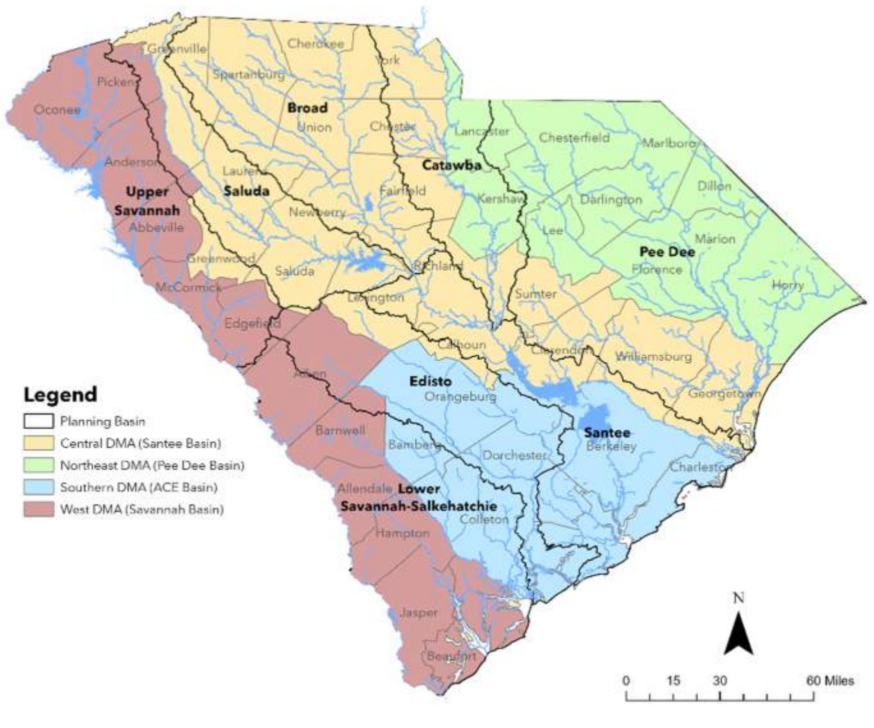

Figure 8-1. The four Drought Management Areas.

In accordance with the Drought Response Act, SCDNR developed the South Carolina Drought Response Plan, which is included as Appendix 10 of the South Carolina Emergency Operations Plan. South Carolina has four drought alert phases: incipient, moderate, severe, and extreme. The SCO and the DRC, with input from SCDES and others, monitor a variety of drought indicators to determine when drought phases are beginning or ending. Examples of drought indicators include streamflows,

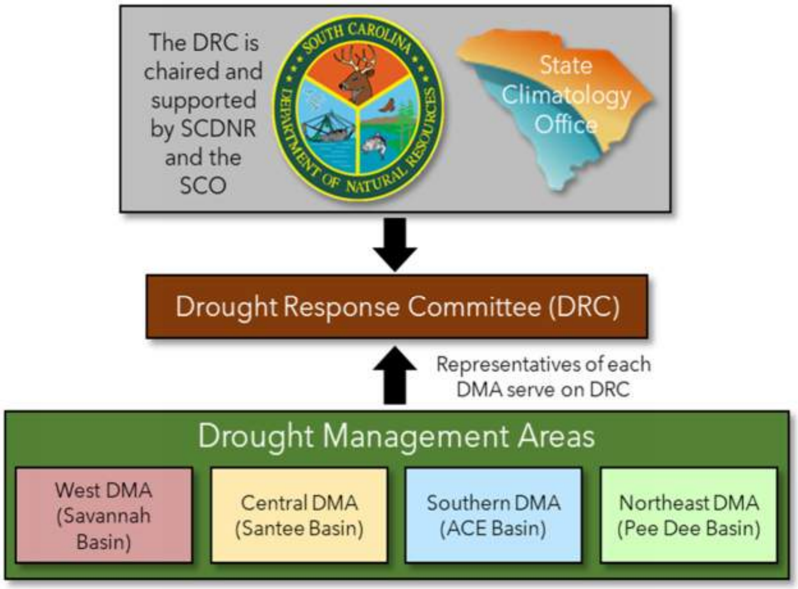

Figure 8-2. Drought Act organizational chart.

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 (R121-11) 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.

Based on their assessment of drought conditions, the SCO 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. Under Section 49-23-80 of the Drought Response Act, if the SCO and the DRC determine that drought has reached a level of severity such that the safety and health of citizens are threatened, the DRC shall report such conditions to the Governor. The Governor is then authorized to declare a drought emergency and may require curtailment of water withdrawals.

8.1.2 Local Drought Response

At a local level, Section 49-23-90 of the Drought Response Act states that municipalities, counties, public services districts, and commissions of public works shall develop and implement drought response plans or ordinances. These local plans must be consistent with the State Drought Response Plan. The SCO developed a sample drought management plan and response ordinance for local governments and water systems to use as templates. In a drought management plan, each phase of drought has a set of responses that are put in motion to reduce demand, bolster supply, or both. The drought plans and ordinances include system-specific drought indicators, trigger levels, and responses. Responses include a variety of actions that would be taken to reduce water demand at the levels indicated in Table 8-1. When drought conditions have reached a level of severity beyond the scope of the DRC and local communities, the State Drought Response Plan, Emergency Management Division, and State Emergency Response Team are activated.

The drought management plans and response ordinances on file for the public water systems in the Saluda River basin are listed in Table 8-2. Public water suppliers located in the Saluda River basin or who withdraw water from the basin largely follow the templates prepared by the SCO when developing their drought management plans. Many of the plans were submitted to the SCO in 2003, shortly after the Drought Response Act went into effect. As such, they may contain information that is outdated. The Act did not explicitly require drought plans to be updated at a specific interval; however, the SCO is actively encouraging public water suppliers to update their plans. In 2024, the SCO created a Drought Planning Guidebook. This guidebook is a sister document to the model drought plan and helps provide context for building a robust local drought plan for water systems. This guidebook uses case studies and best practices taken from water systems within South Carolina.

Table 8-1. Demand reduction goals of drought response plans in South Carolina.

Drought Phase	Response
Incipient	None specified
Moderate	Seek voluntary reductions with the goal of: ▪ 20% reduction in residential use ▪ 15% reduction in other uses ▪ 15% overall reduction
Severe	Mandatory restrictions for nonessential use and voluntary reductions of all use with the goal of: ▪ 25% reduction in residential use ▪ 20% reduction in other uses ▪ 20% overall reduction
Extreme	Mandatory restrictions of water use for all purposes with the goal of: ▪ 30% reduction in residential use ▪ 25% reduction in other uses ▪ 25% overall reduction

Table 8-2. Drought Management Plans and Response Ordinances for water suppliers withdrawing water from the Saluda River basin.

Water Supplier	Year	Water Source	Drought Indicator/Trigger Types[1]	Alternative Water Supply Agreements
Belton-Honea Path Water Authority	2003	**Surface Water** - Saluda River	- Stream impoundment level at Holidays Dam 2 ft, 3 ft, or 4 ft below flashboards on the dam. - DRC declares Moderate, Severe, or Extreme Drought accordingly.	None
City of Columbia	2003	**Surface Water** - Broad River Canal, Lake Murray	- Average daily use greater than 85 MGD for 7-10 consecutive days, 90 MGD for 7 consecutive days, or 95 MGD for 2-3 consecutive days.	None
Easley-Central Water District	2003	**Surface Water** - Twelve-Mile River (in Savannah basin)	- Storage falls below 80%, 70%, or 60% of capacity. - Average daily use greater than 1.8 MGD, 1.9 MGD, or 2.0 MGD for 30 consecutive days.	Verbal agreement with the City of Liberty to purchase up to 0.3 MGD as needed based on system demand.
Easley-Central Water District #2	2003	**Purchased Surface Water** - Easley Combined Utilities (ECU)	- Storage falls below 80%, 70%, or 60% of capacity.	Verbal agreement with the City of Liberty to purchase water as needed in emergency situations.

Table 8-2. Drought Management Plans and Response Ordinances for water suppliers withdrawing water from the Saluda River basin (Continued).

Water Supplier	Year	Water Source	Drought Indicator/Trigger Types[1]	Alternative Water Supply Agreements
Easley Combined Utilities (ECU)	2007	**Surface Water** - Saluda Lake	- Average discharge in Saluda Lake is 99.5, 91.9 or 80.0 cfs or - Average daily use is greater than 16.5 MGD for 5 consecutive days, 17.0 MGD for 5 consecutive days, or 17.5 MGD for 3 consecutive days.	ECU currently has a contract to purchase 3 MGD of water from the Greenville Water System
Greenville Water	2024	**Surface Water** - Table Rock Reservoir, Pointsett (North Saluda) Reservoir, and Lake Keowee (in Savannah basin)	- When the Low Inflow Protocol (LIP) for the Keowee-Toxaway River Basin is in Stage 2 and both the Table Rock Reservoir is below 1,245 ft and the North Saluda Reservoir is below 1,225 ft. - When the LIP for the Keowee-Toxaway River Basin is in Stage 3 and both the Table Rock Reservoir is below 1,240 ft and the North Saluda Reservoir is below 1,220 ft. - When the LIP for the Keowee-Toxaway River Basin is in Stage 4 and both the Table Rock Reservoir is below 1,235 ft and the North Saluda Reservoir is below 1,215 ft.	Due to its size, the Greenville Water System cannot look to other neighboring systems for emergency supplies in the event of drought. The Greenville Water System has, however, developed the ability to draw water from its' three water supplies to provide alternative sources of water within its system should the need arise.
Greenwood Commissio-ners of Public Works	2003	**Surface Water** - Lake Greenwood	- Lake Greenwood falls to elevation 433 ft (50% full), 431 ft (40% full), or 430 ft (30% full). - System storage falls below 25%, 50%, or 75% of capacity and is unable to recover. - Daily use greater than 24 MGD, 26 MGD, or 28 MGD for 5 consecutive days.	Wholesale water agreements with the town of Ware Shoals and the town of Ninety-six.
Laurens Commission of Public Works	2003	**Surface Water** - Lake Rabon, Rabon Creek, and Reedy Fork Creek	- The elevation of Lake Rabon falls to 528 ft, 527 ft, or 526 ft.	None
Laurens County Water and Sewer Commission (LCWSC)	2023	**Surface Water -** Lake Greenwood **Purchased Surface Water -** Greenville Water and City of Clinton	For Lake Greenwood source: - Announcement by the State DRC - Production levels at 80% (severe) and 90% (extreme) - Lake Greenwood levels dropping to 430 ft. For Greenville Water and City of Clinton sources: - Water use restrictions issued by each utility. Lake Rabon is also a trigger: - Lake Rabon levels dropping to 528, 527, or 526 ft.	LCWSA has water purchase agreements with Greenville Water (which provides approximately one-third of the average daily demand, and the City of Clinton for a small portion of the LCWSC service area along Hwy 56).
Newberry County Water & Sewer Authority (NCW&SA)	2003	**Groundwater** - 4 water supply wells **Purchased Surface Water** - City of Newberry Water Treatment Plant from the Saluda River	- Storage falls below 70%, 60%, or 50% of capacity. - Average daily use greater than 1.2 MGD, 1.4 MGD, or 1.6 MGD for 90 consecutive days. - All booster pumps running more than 16 hours/day, 20 hours/day, or for 24 hours/day. - City of Newberry seeks voluntary reductions for all water usage; seeks voluntary reductions for all water usage and mandatory restrictions for all non-essential water use; or issues mandatory restrictions for all water usage.	NCW&SA has a water purchase agreement with the City of Newberry. Purchased water from the City of Newberry and treated water from the new Lake Murray Water Treatment Plant will provide NCW&SA the capacity to meet current and future demands.

Table 8-2. Drought Management Plans and Response Ordinances for water suppliers withdrawing water from the Saluda River basin (Continued).

Water Supplier	Year	Water Source	Drought Indicator/Trigger Types[1]	Alternative Water Supply Agreements
City of Newberry	2008	**Surface Water** - Saluda River	- Aquifer levels less than 348 ft, 345 ft, or 341 ft. - Average daily use greater than 92% of plant rating for 2 consecutive days., 100% for 2 consecutive days, or 100% for 3 consecutive days. - The sum of ground and elevated storage tanks have less than 30%, 20%, or 15% of total capacity and plant production is not able to meet usage. - Water line failure is depleting elevated tank(s) to less than 30%, 20%, or 15% of total capacity. - Water transmission line(s) is out of service and elevated tank(s) levels are less than 30%, 20%, or 15% of total capacity.	None
Saluda County Water and Sewer Authority (SCWSA)	2004	**Purchased Surface Water** - City of Newberry Water Treatment Plant from the Saluda River	- City of Newberry Aquifer levels less than 348 ft, 345 ft, or 341 ft. - Average daily use at the City of Newberry's plant greater than 92% of plant rating for 2 consecutive days, 100% for 2 consecutive days, or 100% for 3 consecutive days. - The sum of the City of Newberry's ground and elevated storage tanks have less than 30%, 20%, or 15% of total capacity and plant production is not able to meet usage. - Water line failure is depleting elevated tank(s) to less than 30%, 20%, or 15% of total capacity. - City of Newberry seeks voluntary reductions for all water usage; seeks voluntary reductions for all water usage and mandatory restrictions for all non-essential water use; and issues mandatory restrictions for all water usage. - Water transmission line is out of service and elevated tank are less than 20% (severe) or 15% (extreme) of total capacity.	None
City of West Columbia	2003	**Surface Water** - Lake Murray and the Saluda River	- Average daily usage is greater than 14 MGD for 30 consecutive days, 16 MGD for 14-21 consecutive days, or 18 MGD for 7-10 consecutive days.	Water agreement between the City of West Columbia and the Town of Lexington. Water agreement between the City of West Columbia and the Lexington County Joint Municipal Water and Sewer Authority.

[1] When three trigger points are listed, those reflect trigger points for the moderate, severe, and extreme drought phases, in ascending order.

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 from the SCO 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 Saluda RBC will communicate drought conditions and responses within the basin through a designated RBC Liaison. The RBC Liaison may be the Chair, Vice Chair, or other RBC member. If any part of the basin is in a declared drought as determined by the DRC, the Liaison will solicit input from RBC members and other water managers and users regarding drought conditions and responses in their respective locations or interests. The Liaison is then responsible for communicating updates on drought conditions and responses within the basin to the Central and West DMA representatives on the DRC or the 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 Saluda RBC also serves on the DRC as a Central or West DMA representative. This member may work with the Liaison to directly communicate between the Saluda RBC and the DRC. At the time of this Plan's development, no Saluda RBC members serve as a representative for the Central or West DMAs.

8.2.3 Recommendations

Through consideration and discussion, the Saluda RBC developed the following five recommendations related to drought planning and response. The steps to implement these recommendations are detailed in the 5-year and long-range implementation plans in Chapter 10.

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 might include:

- Change in the source(s) of water
- Significant increase in water demand (such as the addition of a new, large wholesale customer)
- Significant change in the proportion of water used by one sector compared to another (e.g., residential versus commercial use)
- Addition (or loss) of another user relying on the same source of water
- New water supply agreement with a neighboring utility

2. The RBC recommends that water utilities consider use of the SWAM model to evaluate the potential effectiveness of drought triggers when updating their drought management plans. The SWAM model can simulate reductions in water demands when associated trigger levels are met and can provide information that helps water managers evaluate the effectiveness of demand reductions in extending their supply. The SWAM model is capable of simulating drought triggers that are based on streamflow and reservoir levels. If a utility uses streamflow or reservoir levels as drought triggers, they can utilize the model to inform the development of trigger levels based on their desired drought plan outcomes. The Saluda River Basin SWAM model is available for download through SCDES Water Planning webpage.

3. The RBC recommends that water utilities coordinate, to the extent practical, their drought response messaging. Consistent and coordinated drought response messaging can be important, especially when there are drought conditions impacting the entire basin and possibly neighboring basins. Consistent and coordinated messaging can help to avoid confusion and provide efficiency. However, the RBC recognizes that coordinated and consistent messaging may not be possible when drought conditions are appreciably different across the basin, when utilities are in different stages of drought response, or when utilities' response strategies are different.

4. 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 Saluda 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.

5. The RBC encourages water users and those with water interests to submit 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 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 the CMOR system in a variety of ways. CMORs can be submitted by clicking the "Submit a Report" button at the NDMC's Drought Impacts Toolkit website. The RBC also recommends that:

a. The SCO conduct outreach to make more stakeholders aware of the CMOR system and encourage its use to report drought conditions.
b. The NRCS promote the use of the CMOR system.
c. The South Carolina Adopt-a-Stream program promote use of the CMOR by its participants so that hydrologic conditions prior to and during drought may be documented.

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

During the fourth and final phase of the planning process, the Saluda RBC identified and discussed recommendations related to the river basin planning process; technical and program considerations; and policy, legislative, or regulatory considerations. Various recommendations were proposed by RBC members and discussed over the span of several meetings. Most recommendations received broad RBC support and are to be taken as having consensus as defined by the River Basin Council Bylaws (SCDNR 2019a). Under these bylaws, consensus is achieved when all members can "live with" a decision, although some members may strongly endorse a solution while others may only accept it as a workable agreement.

In some instances, during RBC discussion, it was determined that consensus could not be achieved on certain recommendations, especially those related to policy, regulation, and legislation. Although consensus was not reached, the RBC decided to include these recommendations when there was a majority in favor. The Planning Framework defines a majority as "more than half of the Members present and voting in favor." In most of these cases, the level of support for the recommendation is provided. In some instances, the reasons that RBC members and/or the interest categories they represent did not support recommendation, are presented.

The planning process recommendations are summarized in Chapter 9.1; the technical and program recommendations are summarized in Chapter 9.2; and the policy, legislative, and regulatory recommendations are summarized in Chapter 9.3.

9.1 River Basin Planning Process Recommendations

The following planning process recommendations should be taken as considerations for future phases of the river basin planning process. To implement these recommendations, the Saluda RBC will need support from SCDES, technical experts, and the South Carolina Legislature.

The Saluda RBC recommends the following to improve communication among RBCs, stakeholders, and state agencies/workgroups:

- **SCDES, the RBC Planning Teams, and the RBCs should conduct regular (every 6 months) reviews of the RBC membership to make sure all interest categories are adequately represented and attendance across all interest categories meets the requirements of the RBC Bylaws.** Adequate representation of all water use groups may require intentional, targeted outreach to encourage potential members to apply to the RBC. Manufacturing is an interest category that is not well represented in many RBCs but is important. Membership should also be reviewed when any member resigns from the council to ensure there is still sufficient representation of that member's water interest category. Recognizing that RBC members invest significant time over the planning process in understanding the water resources of the river basin and the variety of issues, any appointments of RBC members after the river basin planning process is underway would need to be considered on a case-by-case basis. Appointments would be at the discretion of SCDES and would consider feedback from the RBC. In such instances, orientation would be necessary to bring new members up to speed.

- **RBCs should hold additional public meetings to enhance public engagement.** Following guidance in the Planning Framework, SCDES has held two public meetings in different parts of each river basin, prior to the formation of each RBC. Following the formation of each RBC, public meetings have not been held until near the end of the two-year planning period, when the draft and final river basin plans are presented. One or more additional public forums at key points during the planning process may help to further engage stakeholders and raise awareness of the planning effort. The Saluda RBC also noted the opportunity to conduct public meetings during the 5-year update of the plan.

- **SCDES should organize an annual coordination meeting of all RBCs**. This meeting should be scheduled before the start of the legislative session to allow for coordination of shared legislative priorities. This meeting should have a clear agenda with action items summarized. RBCs should also be present at the Legislature's Water Day, occurring on the first Monday of March. Coordinated concerns or suggestions resulting from these meetings should be shared with the Legislative Surface Water Study Committee and with WaterSC for as long as WaterSC continues to convene to guide development of the State Water Plan.

- **SCDES should form an upstate Interbasin River Council** (IRC) consisting of representatives from the Broad, Saluda, and Upper Savannah RBCs to coordinate on shared interests and goals as headwater basins.

- **The Saluda RBC will support and promote outreach and education to increase awareness with the general public around watershed-based planning.** The Saluda RBC should coordinate with groups that have existing education and outreach efforts focused on water conservation such as the Clemson University and South Carolina State Extension Services. Existing groups have the experience and resources to help promote the water conservation ethic and strategies recommended in this River Basin Plan.

Members of the Saluda RBC proposed the following recommendations for funding needs and sources of funding:

- **To continue positive progress at the state level for river basin planning, state agencies should assess the current funding to SCDES to support river basin planning.** A proposal to the legislature from SCDES should be prepared explaining the funding needed to implement the RBC recommendations in their plans and to continue to support consistent RBC-driven water planning.

9.2 Technical and Program Recommendations

The Saluda RBC offers the following technical and program recommendations to address any data gaps or information needs identified during the river basin planning process. The following recommendations should be taken as considerations for future phases of the river basin planning process. To implement these recommendations, the Saluda RBC will need support from SCDES and other technical experts.

The Saluda RBC recommends the following SWAM model improvements and applications:

- **Future SWAM modeling should incorporate flow monitoring data collected at the county level to validate flows.** Additional county streamflow data are available in parts of the Upstate region and could be used to further refine and validate the simulation of previously ungaged reaches in the SWAM Model (this is a relatively small technical effort). Additionally, some sites may offer data on nutrients and sediment, which should be reviewed by the RBC and considered for future planning purposes to address water quality and quantity.

- **Future SWAM modeling should incorporate scenarios that further examine future uncertainties, such as changes in rainfall and hydrology, alternative population growth scenarios, and potential impacts of future development on runoff.** This can be accomplished by changing input data to the existing SWAM models, and with certain automated scenario development features within the models. Note that increases in runoff potential due to changes in land use would need to be estimated outside of the model and incorporated by adjusting the built-in hydrologic data.

The Saluda RBC recommends expanding focus in future phases of planning:

- **Future planning efforts should include evaluation of surface water quality and trends, including nutrient loading and sedimentation.**

Members of the Saluda RBC identified the following needs and actions for more data:

- **SCDES should explore expansion of the ambient water quality monitoring network.** The Saluda RBC recommends increasing the number of fixed monitoring sites, particularly in the upper portion of the Saluda River basin.

- **State agencies and partners should collect and organize existing water quality data:** To expand future phases of study to include water quality, existing data on sediment loading, sedimentation in reservoirs, and nutrient loading should be gathered, gaps identified, and a strategy formulated for filling those gaps to support future River Basin Plan updates.
- **The Saluda RBC will support continued efforts to maintain and expand streamflow gages.** The RBC recognizes that comprehensive, reliable, and long-term hydrologic data are critical to water planning and management. Additional partners and sponsors should be identified to help fund and maintain streamflow gages. The RBC also recommends that local governments that collect streamflow data make it publicly accessible. Priority consideration to the following water bodies is recommended:
    - South Saluda River at SC 186 and Middle Saluda at SC 288

- Oolenoy River
- Saluda River below Holiday Dam
- Tributaries in Lower Saluda basin

- **SCDES should create and maintain an online library of, or a catalog of links to, technical information that will enhance the RBC's technical understanding of water resources concepts and issues.** Historic data, and new data when developed, need to be publicly accessible and in a consistent, standardized, format that supports public comprehension. The SC Watershed Atlas could be part of this solution.

- **The Saluda RBC should coordinate with SCDES to identify and define data gaps and possible avenues for filling gaps in future phases (or in preparation for future planning phases).**

- **South Carolina legislature should fund, and state agencies and partners should establish a mesoscale network of weather and climate monitoring stations in South Carolina.** Establishing a mesoscale network of weather and climate monitoring stations, known as a Mesonet, provides near real-time data at the local level to improve situational awareness and preparedness and support decision-makers and stakeholders, such as emergency management agencies, water resources managers, agricultural interests, transportation officials, and energy providers. Currently, South Carolina is one of only 12 states without a Mesonet. A Mesonet consisting of a network of 46 weather stations (one per county) would provide an essential public service to the citizens of South Carolina.

- **State agencies and partners should expand analysis and understanding of flow-ecology relationships.**

  - **Encourage more fish and macroinvertebrate data collection in Blue Ridge province to support development of flow-ecology relationships.** During the development of this plan, insufficient data were available to assess flow needs in the Blue Ridge Province. The RBC recommends consulting with USGS and Clemson University about the need for additional data in the Blue Ridge. The application of ecological flow standards is a relatively new process in South Carolina which will continue to be modified and improved throughout the water planning process.

  - In lieu of, or during the development of additional fish and macroinvertebrate collection per the above recommendation, **encourage researchers assessing flow-ecology relationships to make use of the limited data that is available.** The Saluda RBC recognizes that there may be more uncertainty in results based on this limited dataset but encourages its use with appropriate caveats.

- **The Saluda RBC should explore the potential impacts of private and community/commercial wells, and how they may affect surface water (especially during droughts) and/or better characterize growth potential in future planning phases.** In the crystalline fractured rock aquifer system of the Piedmont, groundwater withdrawals may reduce baseflow in streams and lower surface water availability for both in-stream and off-stream uses. *The RBC did not reach consensus on this recommendation, but it received a majority approval.*

The Saluda RBC identified the following opportunities to align with other water-related planning efforts in the basin and region:

- **For river basins with state or federal specially designated streams (e.g., National Wild and Scenic Rivers or State Scenic Rivers), watershed-based plans, and any other similar plans, the RBCs should assess alignment between the River Basin Plan and the management plan associated with the special designation.**

- **As part of the comprehensive planning process, each local government should consult the Resilience Plan developed by the South Carolina Office of Resilience, local Hazard Mitigation Plans, and the associated River Basin Plan(s) developed by the RBCs for inclusion within the resilience element as required by the South Carolina Local Government Comprehensive Planning Enabling Act as amended in 2020.** The RBC encourages land use regulations and ordinances be adjusted to support the resilience element.

- **The Saluda RBC encourages the use of the Saluda River Basin Plan as a tool for local comprehensive plans and economic development.** For example, Chapter 5 illustrates where water resources are relatively abundant and areas where, during drought conditions, there is a higher frequency of flows below the calculated minimum instream flow. Recognizing that streamflow alone does not guarantee water availability and sufficient infrastructure at a given location in the basin, the Saluda RBC also recommends that **developers work with water utilities to ensure the availability of adequate water and infrastructure**.

While not recommendations for additional data, the Saluda RBC developed the following recommendations for actions to take to protect the water resources of the basin.

- **The Saluda RBC supports the reduction of sediment loading to reservoirs and waterways through:**
    - **Streambank restoration, riparian buffers, and other practices that reduce sediment load to streams and reservoirs.**
    - **Sustainable development that implements green infrastructure and BMPs to reduce downstream runoff.**
    - **Encouraging local governmental ordinances with incentives for green infrastructure.**
    - **More enforcement, monitoring, and maintenance of stormwater controls and sediment and erosion control measures. Strengthen penalties for non-compliance with stormwater and erosion/sediment control permits, plans, and ordinances.**
    - **Strengthened stormwater design standards to capture larger storm events.**
    - **Incentives to landowners to not sell their land to development and, rather, place them in permanent protected status, such as through conservation easements.**
    - **Incentives that encourage farming practices that minimize soil disturbance, reduce soil loss, and improve soil health.**

  - **Use of USDA Environmental Quality Incentives Program (EQIP) program for regenerative farming practices that minimize soil disturbance, reduce soil loss, and improve soil health.**
  - **Studies to better identify sediment loading sources and the financial costs associated with mitigating those sources to our reservoirs and waterways.**
- **The Saluda RBC should work to remove the Saluda River hydrologic impairment (4C) below the Saluda Lake hydro project**. Aquatic life and recreational uses in the 14-mile stretch of the Saluda River have been impaired due to hydrologic alterations caused by the operation of the Saluda Lake Dam, and this segment has been designated under IR Category 4C, as of the 2018 Integrated Report and has not been delisted.

9.3 Policy, Legislative, or Regulatory Recommendations

The Saluda RBC engaged in discussion about issues and concerns with the existing policies, laws, and regulations governing water withdrawals and water use. For each issue, a proposed recommendation was developed by one or more RBC members and the members were asked to indicate whether they supported or did not support the proposed recommendation. The proposed recommendations and voting results are summarized below.

- **The Legislature should fund and SCDES should establish and manage a grant program to support the implementation of the actions and strategies identified in each RBC's River Basin Plan. One example is Georgia's Regional Water Plan Seed Grant Program which supports and incentivizes local governments and other water users as they undertake their Regional Water Plan implementation responsibilities.**

  This recommendation passed by consensus.

- **Utilities should identify alternative sources including interconnections to build resilience and ensure adequate quantity of water.**

  This recommendation passed by consensus.

- **Water utilities within watersheds should consider partnership and collaboration opportunities. Partnership is one tool to better manage the availability of water resources and build resilience**.

  This recommendation passed by consensus.

- **The South Carolina Surface Water Withdrawal, Permitting, Use, and Reporting Act should allow for reasonable use criteria to be applied to all new surface water withdrawals, like those that currently exist for groundwater withdrawals.** Groundwater withdrawal regulations require that an applicant "provide reasonable and appropriate documentation that the proposed water use is necessary to the anticipated needs of the applicant". The documentation required varies by water use sector. For public water supply, reasonable use is demonstrated by providing information describing the water system, population served, anticipated growth, annual water use statistics (e.g., monthly average, peak summer/winter consumption). For agriculture, reasonable use is demonstrated by providing information on irrigated acreage, major crops, water use by crop (per acre), calculated irrigation requirement, critical period growth requirements, growing season, and nutrient and pest management strategy. Other information is required for industrial, golf course, and aquaculture uses.

This recommendation passed by a majority vote. Seventeen RBC members participated in voting. Twelve voted in favor of this proposed recommendation and five voted against. Three RBC members abstained from voting. Although a formal vote was not taken, some of those five that voted against this recommendation cited the need for reasonable use criteria to be applied to all (both existing and new) surface withdrawals. Additional discussion determined that a majority of the RBC was in favor of recommending that reasonable use criteria only be applied new surface water withdrawals.

- **The current laws that allow for regulation of water use should be improved so that they are enforceable and effective.** The current water law, which grandfathers most water users, needs to be improved to support effective management of the state's water resources.

  This recommendation passed by a majority vote. Sixteen RBC members participated in voting. Eleven voted in favor of this proposed recommendation and five voted against. Five RBC members abstained from voting.

- **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.** The RBC can provide guidance on topics that are important.

  This recommendation passed by consensus.

- **State and local governments should develop/review/update/adopt and enforce laws, regulations, policies, and/or ordinances that improve the management of stormwater runoff, encourage infiltration, minimize streambank erosion, reduce sedimentation, and protect water resources. The following are RBC-recommended best management practices:**
  - **Riparian buffer protection**
  - **Open space protection**
  - **Strengthening stormwater regulations to minimize stormwater runoff volume from construction sites**
  - **Incentivizing green infrastructure in development designs**
  - **Allocating local funding sources for land conservation**

  The Saluda RBC noted the need to clarify what is meant by open space and referred to the United States Forest Service definition, which states that open space includes all unbuilt areas, whether publicly or privately owned, protected or unprotected. Open space lands include forests and grasslands, farms and ranches, streams and rivers, and parks. The BMPs included in this recommendation represent a subset of BMPs discussed by the RBC that received the broadest support. As the RBC begins implementation of the River Basin Plan following its publication, the

RBC will further explore how BMPs could be encouraged such as by state-wide laws, local ordinances, permit revisions, or other incentives.

This recommendation passed by consensus.

- **The Saluda RBC strongly recommends counties and municipalities prioritize and incentivize native tree canopy protection and permanent vegetative cover within headwater streams and along riparian areas.** Trees and tree canopies provide ecosystem services for watersheds by protecting headwater streams, slowing evapotranspiration, cooling waters, slowing runoff, and directly affecting surface drinking water supply. Trees are the cornerstone of ecosystem services for watersheds.

  This recommendation passed by a majority vote. Twenty RBC members participated in voting. Fifteen voted in favor of this recommendation and five voted against. One RBC member abstained from voting.

- **SCDNR/SCDES should review the science behind MIF standards to ensure they are based on best available science to adequately protect designated uses and recognize regional differences.** During discussion, members of the Saluda RBC noted that SCDNR/SCDES should routinely review its MIF methodology because best practices for determining MIF may change in the future. The South Carolina Surface Water Withdrawal, Permitting Use, and Reporting Act currently defines MIF as:

  > *The flow that provides an adequate supply of water at the surface water withdrawal point to maintain the biological, chemical, and physical integrity of the stream taking into account the needs of downstream users, recreation, and navigation and that flow is set at forty percent of the mean annual daily flow for the months of January, February, March, and April; thirty percent of the mean annual daily flow for the months of May, June, and December; and twenty percent of the mean annual daily flow for the months of July through November for surface water withdrawers as described in Section 49-4-150(A)(1).*

  This recommendation passed by consensus.

- **Regulation 61-119 Surface Water Withdrawal, Permitting, Use and Reporting should be reviewed to ensure consistency with the South Carolina Surface Water Withdrawal, Permitting Use, and Reporting Act, including a review of the existing definition of "safe yield" (SY) in the implementing regulations. SY should be redefined to be consistent with the law and protective of minimum instream flow requirements that safeguard the integrity and designated uses of state waters.** For example, Regulation 61-119 states that for stream segments not impacted by impoundment, SY is calculated at the point of withdrawal as 80 percent of the mean annual daily flow (MADF). Since MIF is calculated as 20, 30, or 40 percent of the MADF, depending on the month, by definition, in months where MIF is 30 or 40 percent of MADF, MIF will not be achieved if the full safe yield is withdrawn.

  This recommendation passed by consensus.

Two additional recommendations were considered by the Saluda RBC, but did not have consensus and the attempt to identify whether there was a majority in favor ended in a tie vote. The first proposed recommendation ending in a tie vote was: **State water law and implementing regulations should not distinguish between registrations and permits.** Current law allows for agricultural surface water users and all groundwater users withdrawing water outside of CUAs to register their water use rather than apply for permits. Nineteen RBC members participated in voting. Eight voted in favor of this proposed recommendation, eight voted against, and three abstained. Because there was no consensus or a majority in favor, this is not considered to be an adopted recommendation.

A second proposed recommendation ending in a tie vote had a similar intent to the proposed recommendation above, adding additional specificity as to what would be required if there was no distinction between registrations and permits, and all users had permits. This recommendation was: **Require permits statewide for all existing and new water withdrawals over 3 MGM, including those before 2011 and all registered users. All users must be evaluated for reasonableness and must meet MIF requirements.** Twenty RBC members participated in voting. Nine voted in favor of this proposed recommendation, nine voted against, and two abstained. Because there was no consensus or majority in favor, this is not considered to be an adopted recommendation.

Chapter 10
River Basin Plan Implementation

10.1 Recommended Five-Year Implementation Plan

10.1.1 Implementation Objectives

The Saluda RBC identified six implementation objectives for the Saluda River Basin Plan. These six objectives were developed based on themes that emerged from the recommendations made and presented in previous chapters. The Planning Framework provides the RBC the opportunity to prioritize these objectives. The Saluda RBC's objectives are summarized and prioritized in Table 10-1.

Table 10-1. Implementation objectives and prioritization.

Objective	Source of Related Recommendations	Prioritization*	Prioritization Justification
Objective 1. Improve water use efficiency to conserve water resources	Chapters 6 and 7	4	The efficient use of water helps to maintain adequate streamflow for instream uses and should be implemented even if water shortages are not an immediate concern.
Objective 2. Communicate, coordinate, and promote findings and recommendations from the River Basin Plan	Chapter 9	1	Communication is essential to promoting RBC recommendations and ensuring implementation objectives are pursued by stakeholders. Communication should be on-going.
Objective 3. Improve technical data and understanding of water resource management issues	Chapter 9	3	Additional technical information is necessary to inform and continually update the RBC's understanding of basin issues and best practices to manage concerns.
Objective 4. Protect water resources	Chapter 9	5	Protection of water resources from sedimentation and hydrologic impairment are on-going objectives to be sustained while pursuing higher priority objectives.
Objective 5. Improve drought management	Chapter 8	6	Maintaining up-to-date drought plans is critical for public water supplier response and to coordinate actions at a basin- and state-level.
Objective 6. Promote engagement in the water planning process	Chapter 9	2	Engagement is essential for stakeholder buy-in on recommendations and continued support for river basin planning.

** 1 is the highest priority and 6 is the lowest priority.*

The strategies and corresponding actions to achieve each objective are presented in Table 10-2. Of these strategies, the Saluda RBC prioritized those it deemed imperative to pursue. Table 10-2 also includes an outline of 5-year actions, responsible parties, budget, and potential funding sources to achieve each strategy. Potential funding sources are further described in Chapter 10.1.2. Unless stated otherwise, RBC refers to the Saluda RBC.

Table 10-2. Implementation plan.

<table>
<tr><th colspan="2">Strategy</th><th>Prioritized Strategies</th><th>5-Year Actions</th><th>Responsible Parties</th><th>Budget</th><th>Funding Sources[1]</th></tr>
<tr><td colspan="7">Objective 1. Reduce demand to conserve water resources</td></tr>
<tr><td rowspan="7">A. Promote municipal conservation.</td><td>Public Education of Water Conservation</td><td rowspan="7">Toolbox of strategies

Applicability and priority varies by utility</td><td rowspan="7">1. RBC identifies funding opportunities (yrs 1-5).
2. RBC surveys utilities to understand the extent of AMI/AMR use (yrs 1-2).
3. RBC encourages water utilities to conduct a water loss/leak detection audit using a water system appropriate method, such as AWWA M36 Water Audits and Water Loss Control method, establish a baseline, and continue to measure every 2-3 years (yrs 1-2).
4. RBC works with water utilities to determine how water is being used and understand where conservation measures may have the most impact (yrs 2-3).
5. RBC develops and implements outreach and education program about recommended water management practices and funding opportunities (yrs 1-5).
6. Individual water users implement conservation practices (yrs 3-5).
7. RBC develops survey of practices implemented, change in per capita use, funding issues, and funding sources utilized (beginning in yr 5 as part of 5-year Plan update).</td><td rowspan="7">RBC with support of SCDES and contractors: Identify funding opportunities and develop information to distribute. Conduct surveys and analyze results.

Public water system withdrawers: Implement appropriate strategies and seek funding from recommended sources as necessary.</td><td rowspan="7">Costs of implementation will vary by public water system according to current program capabilities and financial means. See Chapter 6.1.6 for discussion of cost-benefit of individual strategies.
The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved)</td><td rowspan="7">Individual strategies may be funded using outside funding opportunities or by evaluating existing rate structure. Possible outside funding sources include: Fed-1, 2, 5, 6, 7 and 9 and USDA-8 and 9.</td></tr>
<tr><td>Conservation Pricing Structures</td></tr>
<tr><td>Leak Detection and Water Loss Control Program</td></tr>
<tr><td>Reclaimed Water Programs</td></tr>
<tr><td>Residential Water Audits</td></tr>
<tr><td>Landscape Irrigation Program and Codes</td></tr>
<tr><td>Time-of-Day Watering Limit</td></tr>
</table>

[1] See Tables 10-3 and 10-4 for funding source references.

Table 10-2. Implementation plan. (Continued)

Strategy		Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 1. Reduce demand to conserve water resources						
B. Promote agricultural conservation.	Water Audits and Nozzle Retrofits Irrigation Equipment Changes Soil Management Crop Variety, Crop Type, and Crop Conversion Irrigation Scheduling	Toolbox of strategies Priority varies by operation	1. RBC identifies funding opportunities (yrs 1-5). 2. RBC develops and implements outreach and education program about recommended water management practices and funding opportunities (yrs 1-5). 3. Individual water users implement conservation practices (yrs 3-5). 4. RBC develops survey of practices implemented, funding issues, and funding sources utilized (beginning in yr 5 as part of 5-year Plan update). 5. RBC reviews and analyzes 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 and contractors: Identify funding opportunities and develop information to distribute. Conduct surveys and analyze results. Farmers: Implement appropriate strategies and seek funding from recommended sources as necessary. The Farm Bureau may be able to assist with funding applications.	Costs of implementation will vary by agricultural operation according to size of operation, crops grown, current irrigation practices, and financial means. See Chapter 6.1.6 for discussion of cost-benefit of individual strategies. The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved)	Possible funding sources include: USDA-7
C. Promote industrial and energy conservation.	Water Audits Rebates on Energy Efficiency Appliances Water Recycling and Reuse Water Saving Equipment and Efficient Water Systems Installing Water Saving Fixtures and Toilets Educating Employees	Toolbox of strategies Priority varies by operation	1. RBC develops and implements outreach and education programs about recommended water management practices (yrs 1-5). 2. Individual water users implement conservation practices (yrs 3-5). 3. RBC develops survey of practices implemented, funding issues, and funding sources utilized (beginning in yr 5 as part of 5-year Plan update). 4. RBC reviews and analyzes 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 and contractors: Identify funding opportunities and develop and implement outreach program. Conduct surveys and analyze results. Industrial operators: Implement appropriate strategies and seek funding from recommended sources as necessary.	Costs of implementation will vary by industrial operation. See Chapter 6.1.6 for discussion of cost-benefit of individual strategies. The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved)	Industry funded

[1] See Tables 10-3 and 10-4 for funding source references.

Table 10-2. Implementation plan. (Continued)

Strategy	Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 2. Communicate, coordinate, and promote findings and recommendations from the River Basin Plan					
A. Conduct additional public meetings to enhance public engagement.		1. SCDES and contractors inform future RBCs of this recommendation to consider in their planning processes (yrs 1-5). 2. RBC plans and conducts public meetings during 5-yr update of Plan (yrs 1-5).	The RBC conducts meetings with the support of contractors and SCDES.	Public meetings have no direct cost, other than ongoing contractor support, if needed and possible facility rental.	Limited to no direct cost
B. Hold annual coordination meeting of all RBCs.	Yes	1. SCDES gages interest from all active RBCs (yr 1). 2. If other RBCs concur with the recommendation, SCDES plans the first annual meeting location, agenda, and invitees. SCDES will also identify cost and assess availability of funding, if needed (yr 1). 3. SCDES executes annual meeting (yrs 1-5).	SCDES leads the effort. RBC members attend meetings.	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.	SCDES water planning budget via SC Legislature and Fed-7
C. Form an upstate Interbasin River Council consisting of representatives from the Broad, Saluda, and Upper Savannah RBCs to coordinate on shared interests and goals as headwater basins.	Yes	1. SCDES gages interest from chairs of the Broad, Saluda and Upper Savanah RBCs and determines meeting frequency (yr 1). 2. SCDES plans the first meeting location, agenda, and invitees and identify costs and funding source (yr 1). 3. SCDES executes meetings (yrs 1-5).	SCDES leads the effort. RBC members attend meetings.	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.	SCDES water planning budget via SC Legislature and Fed-7
D. To continue positive progress at the state level for river basin planning, conduct a state led assessment of the current funding to SCDES to support river basin planning.	Yes	1. RBC works with SCDES to identify scope (yr 1). 2. SCDES identifies funding needs for continued water planning at the river basin scale and for implementation activities, and communicates the needs with the Legislature (yr 2-5).	SCDES identifies the scope. Legislature approves the funding	Existing SCDES budget can be used to develop the scope. The budget for planning is to be determined.	Existing SCDES budget can be used to develop scope. Water planning budget to be determined with SCDES and Legislature approval.

[1] See Tables 10-3 and 10-4 for funding source references.

Table 10-2. Implementation plan. (Continued)

Strategy	Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 2. Communicate, coordinate, and promote findings and recommendations from the River Basin Plan					
E. Local governments consult the Resilience Plan developed by the South Carolina Office of Resilience, local Hazard Mitigation Plans, and the associated River Basin Plan(s) developed by the RBCs for inclusion within the resilience element as required by the South Carolina Local Government Comprehensive Planning Enabling Act as amended in 2020. The RBC encourages adjustment of land use regulations and corresponding ordinances to support the resilience element.		1. RBC develops outreach documents to municipalities with information about the Resilience Plan and associated River Basin Plans (yr 1). 2. RBC conducts outreach to planning entities within the local governments of the Saluda River Basin (yr 2).	RBC conducts outreach with support from SCDES and contractors.	The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved).	No direct cost
F. For river basins with state or federal specially designated streams (e.g., National Wild and Scenic Rivers or State Scenic Rivers), watershed-based plans, and any other similar plans, assess alignment between the River Basin Plan and the management plan associated with the special designation.		1. RBC further reviews recommendations and identified strategies of the management plans summarized in Chapter 1 of the Saluda River Basin Plan (yrs 1-4). 2. RBC shares River Basin Plan with developers of any on-going planning efforts (yrs 1-5). 3. RBC considers and incorporates recommendations and strategies from other plans in 5-year Plan update, where appropriate and supported by the RBC (yrs 4-5).	RBC coordinates with support from SCDES and contractors.	Cost of RBC support activities would be included in the budget for on-going RBC planning (if approved)	No direct cost
G. Consider use of the River Basin Plan as a tool for local comprehensive plans and economic development. Encourage that developers work with water utilities to ensure adequate water availability and infrastructure.		1. RBC reviews and distills information in the River Basin Plan to identify areas with ample water resources, now and through the 2070 planning period, that can best support growth and economic development (yr 1). 2. RBC develops a 1-2 page "fact sheet" summarizing the current and projected availability of water resources in the basin, for use as a guide to support decision making by local governments and economic development organizations (yr 2-5).	RBC identifies water resources and conducts outreach with support from SCDES and contractors.	The cost of RBC activities are included in on-going RBC meeting and support budgets.	No direct cost

[1] See Tables 10-3 and 10-4 for funding source references.

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Table 10-2. Implementation plan. (Continued)

Strategy	Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 2. Communicate, coordinate, and promote findings and recommendations from the River Basin Plan					
H. The Legislature funds and SCDES establishes and manages a grant program to help support the implementation of the actions and strategies identified each RBC's River Basin Plan.	Yes	1. SCDES identifies funding needs, with input from the RBCs, and communicates with Legislature (yr 1-5).	SCDES identifies the scope. The legislature approves the funding	Existing SCDES budget can be used to develop scope. The budget for implementation is to be determined.	Existing SCDES budget to develop scope. Water planning budget to be determined with SCDES and Legislature approval
I. The State supports and funds 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.		1. RBC determines education topics of importance and target audiences for education programs (yr 1). 2. RBC meets with organizations (e.g., Clemson University Extension, Soil & Water Conservation Districts, and non-profits) that already conduct water-related education and outreach, to discuss opportunities for collaboration (yr 1). 3. RBC identifies what education programs exist to meet these needs and promote them (yrs 2-5). 4. With support of SCDES and/or contractors, RBC presents funding recommendations to legislature (yrs 3-5). 5. With support of SCDES and/or contractors, RBC develops new education and outreach program to fill gaps (yrs 3-5).	RBC provides guidance on education. The legislature approves the funding.	The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved). The budget for education programs is to be determined based on recommendations.	No direct cost for RBC meetings. Legislature approval required for additional state funding of education programs

[1] See Tables 10-3 and 10-4 for funding source references.

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Table 10-2. Implementation plan. (Continued)

Strategy	Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 3. Improve technical data and understanding of water resource management issues					
A. Assess the potential impacts of private and community/commercial wells, and how they may affect surface water (especially during droughts) and/or better characterize growth potential in future planning phases.		1. RBC works with SCDES and/or contractors to identify the location and number of likely private/public/commercial wells in the basin and prepares a groundwater budget to help assess potential impact to surface water (yrs 1-3). 2. RBC assesses results of analysis and incorporate findings into the next 5-year update (yrs 4-5).	RBC conducts analysis with support from SCDES and contractors.	Development of a groundwater budget could range from $25,000 to $75,000, depending on data availability and level of detail.	SCDES water planning budget via SC Legislature and Fed-7
B. Update models to consider future uncertainties (changing weather patterns, population growth, water use scenarios, etc.).		1. RBC identifies and assesses any uncertainties for potential model scenario development and analysis (yrs 3-5). 2. Contractor performs analysis and presents results to RBC (yrs 3-5). 3. RBC assesses results of analysis and incorporates findings into the next 5-year update (yrs 4-5).	RBC guides with support from SCDES and contractors.	The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved). Modeling could range from $25,000 to $50,000 depending on the number of scenarios.	SCDES water planning budget via SC Legislature and Fed-7
C. Include evaluation of surface water quality and trends, including nutrient loading and sedimentation, in future planning efforts.	Yes	1. RBC identifies specific water quality issues and concerns in the basin with consideration to approved SCDES Watershed-based plans (yr 1). 2. RBC determines if there are data gaps and recommends data collection to fill gaps (yr 1). 3. RBC develops approach to further address identified water quality issues and concerns, including the need for development of a watershed plan under SCDES Watershed Program (yrs 2-5).	RBC coordinates with support from SCDES and contractors.	The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved). The development of watershed plans would come from SCDES's existing Watershed Program budget.	SCDES water planning budget via SC Legislature and Fed-7

[1] See Tables 10-3 and 10-4 for funding source references.

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Table 10-2. Implementation plan. (Continued)

Strategy	Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 3. Improve technical data and understanding of water resource management issues					
D. Support continued efforts to maintain and expand streamflow gages. Public entities that collect streamflow data make it publicly accessible. Priority consideration to the following water bodies is recommended: a. South Saluda River at SC 186 and Middle Saluda at SC 288 b. Oolenoy River c. Saluda River below Holiday Dam d. Tributaries in the Lower Saluda basin.	Yes	1. RBC further considers specific locations (yr 1). 2. RBC develops communication strategy for speaking with USGS and other entities funding stream gages (yr 1-2). 3. RBC conducts outreach to USGS and current funding entities on the importance of streamflow data to the river basin planning process. RBC supports search for additional funding sources as needed (yr 3-5).	RBC coordinates with support from SCDES and contractors.	The costs of monitoring and processing data for existing streamflow gages are included in USGS existing budget. Some gages are maintained by other entities. A stream gauge suitable for inclusion in the USGS system costs between $20,000 and $35,000 to install, depending on the site, and $16,000 a year to operate (Gardner-Smith 2021).	USGS, SCDES, and co-sponsors
E. SCDES creates and maintains an online library of, or a catalog of links to, technical information that will enhance the RBC's technical understanding of water resources concepts and issues.		1. SCDES, with support from Contractor, creates an online library/catalog of technical information to support RBC (yrs 1-5). 2. SCDES, with support from Facilitator, adds resources based on new topics discussed in RBC meetings and at request of RBC members (yrs 1-5). 3. SCDES assesses how often RBC members access and use the resources to determine if the effort should continue (yr 5).	Contractors create resource through contract with SCDES.	There is no direct cost, other than ongoing contractor support, if needed and potential cost of maintaining a web page. The cost of RBC activities are included in on-going RBC meeting and support budgets.	SCDES water planning budget and Fed-7
F. Coordinate with SCDES to identify and define data gaps and possible avenues for filling gaps in future phases.	Yes	1. RBC identifies data gaps encountered during publication of first River Basin Plan (yr 1). 2. RBC works with SCDES to identify an approach to fill data gaps (yrs 2-5). 3. RBC, SCDES, and partners seek funding and pursue additional data collection efforts (yrs 3-5).	RBC coordinates with SCDES to identify data gaps. SCDES seeks funding to pursue what is recommended.	Budget is to be determined in consultation with SCDES and partners.	SCDES water planning budget and Fed-7

[1] See Tables 10-3 and 10-4 for funding source references.

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Table 10-2. Implementation plan. (Continued)

Strategy	Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 3. Improve technical data and understanding of water resource management issues					
G. SCDES explores the expansion of the ambient water quality monitoring network.		1. RBC identifies opportunities for expansion (sites, parameters, etc.) (yr 1). 2. RBC coordinates with SCDES on recommendations, potentially through an RBC meeting (yr 2). 3. SCDES pursues funding and implementation (yrs 3-5).	RBC guides exploration of expansion. SCDES and contractors implement the expansion.	The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved)The budget for expanding the monitoring network is to be determined by SCDES.	No direct cost for actions 1 and 2
H. Explore incorporating county-collected data (e.g. flow data) to augment existing models (e.g. SWAM model).		1. Contractors identify data and determine applicability for SWAM modeling (yr 3). 2. Contractors incorporate county-data into SWAM models, validating ungaged reaches and confirming accuracy of SWAM model (yr 4). 3. RBC utilizes results from updated SWAM model for 5-yr Plan update (yrs 4-5)	Contractors explore augmentation of model through contract with SCDES.	A contract to support data collection and model validation could range from $5,000 to $15,000.	SCDES water planning budget via SC Legislature and Fed-7
I. State agencies and partners expand analysis and understanding of flow-ecology relationships.		1. RBC coordinates with USGS, SCDNR and Clemson University on how to best determine and assess ecological flow requirements in the Blue Ridge region (yrs 1-2).	RBC coordinates with USGS, Clemson University, The Nature Conservancy, SCDES, and contractors.	Aquatic data collection is funded through on-going SCDES programs. Additional funding may be needed to continue developing ecological flow relationships.	Existing SCDES budgets with The Nature Conservancy, USGS, Clemson University contributions.

[1] See Tables 10-3 and 10-4 for funding source references.

Table 10-2. Implementation plan. (Continued)

Strategy	Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 3. Improve technical data and understanding of water resource management issues					
J. Conduct studies to better identify sediment loading sources and the financial costs associated with mitigating those sources to our reservoirs and waterways.		1. RBC works with utilities and other impacted parties to identify funding that could be used to estimate the financial impact of sedimentation on reservoirs and water resources (yr 1). 2. RBC performs a study to identify the financial impact of sedimentation resulting from loss of storage, increased treatment costs, loss of property values, and loss of recreation (yrs 2-5).	RBC conducts analysis with support from SCDES and contractors.	Studies may be funded under existing SCDES budget.	SCDES water planning budget via SC Legislature and Fed-7
K. South Carolina legislature funds and state agencies and partners establish a mesoscale network of weather and climate monitoring stations in South Carolina.		1. RBC coordinates with SCO and other RBCs on how to best support appropriation of funding and establishment of network (yrs 1-2).	The legislature funds the effort. SCO oversees development of the monitoring network.	The budget is to be determined with SCO.	To be determined

[1] See Tables 10-3 and 10-4 for funding source references.

Table 10-2. Implementation plan. (Continued)

Strategy	Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 4. Protect water resources					
A. The Saluda RBC supports reducing sediment loading to reservoirs and waterways through: 1. Streambank restoration, riparian buffers, and other practices that reduce sediment load to streams and reservoirs. 2. Sustainable development that implements green infrastructure and best management practices (BMPs) to reduce downstream runoff. Encourage local governmental ordinances with incentives for green infrastructure 3. More enforcement, monitoring, and maintenance of stormwater controls and sediment and erosion control measures. 4. Strengthening design standards to capture larger storm events. 5. Providing more incentives to landowners to not sell their land to development and, rather, place it in permanent protected status, such as through conservation easements. 6. Providing incentives to encourage farming practices that minimize soil disturbance and soil loss and improve soil health. 7. Leveraging of USDA EQIP programs for regenerative farming practices that minimize soil disturbance and soil loss and improve soil health 8. Strengthening penalties for non-compliance of erosion/sediment control and stormwater permits and ordinances.		1. RBC works with local governments and Councils of Government (COGs) to incorporate strategies into land use, planning, zoning, permitting processes (yrs 1-5).	RBC performs outreach with support of SCDES. Local governments and COGs enact amendments.	The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved).	No direct cost

[1] See Tables 10-3 and 10-4 for funding source references.

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Table 10-2. Implementation plan. (Continued)

Strategy	Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 4. Protect water resources					
B. Work to remove the Saluda River hydrologic impairment (4C) below the Saluda Lake.		1. RBC characterizes current conditions and alternative conditions with contractor and potentially modeling support (yrs 1-2). 2. RBC invites Saluda Hydro operator to RBC meetings to review alternatives and opportunity for collaboration (yrs 3-5).	RBC coordinates with support from SCDES and contractors.	The cost of RBC activities is included in on-going RBC meeting and support budgets. Modeling, if needed could require $10k in Contractor support.	SCDES water planning budget via SC Legislature
Objective 5. Improve drought management					
A. 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 are submitted to the SCO for review.	Yes	1. Public suppliers on the RBC review and update their drought management plans and send them to the SCO (yrs 1-5). 2. Public suppliers on the RBC consider ways to incorporate RBC drought management recommendations into their drought plans (yrs 1-5). 3. Public suppliers share updates to drought management plans with the SCO (e-mailed to drought@dnr.sc.gov) (yrs 1-5).	Public suppliers in the RBC update drought plans.	Drought planning activities would occur within public suppliers' annual budgets.	Fed-6

[1] See Tables 10-3 and 10-4 for funding source references.

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Table 10-2. Implementation plan. (Continued)

Strategy		Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 5. Improve drought management						
B. Develop materials and outreach strategy to public suppliers in the basin to implement the RBC's drought management recommendations (see Chapter 8.2.3).	1. 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.	Yes	1. RBC develops materials on the benefits and implementation of RBC drought management recommendations (yr 1). 2. RBC develops outreach strategy to communicate with public suppliers and distribute materials (yr 2). 3. RBC executes outreach strategy and updates materials as necessary (yrs 3-5). 4. RBC develops approach to track updates to drought management plans in the basin (yrs 3-5).	RBC conducts outreach with support of SCDES and contractors.	There is no direct cost, other than ongoing contractor support, if needed. The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved).	Fed-6
	2. The RBC recommends that water utilities coordinate, to the extent practical, their drought response messaging.					
	3. The RBC encourages water utilities in the basin to consider drought surcharges on water use during severe and/or extreme drought phases.					
	4. The RBC encourages water users and those with water interests to submit drought impact observations through CMORs.					

[1] See Tables 10-3 and 10-4 for funding source references.

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Table 10-2. Implementation plan. (Continued)

Strategy	Prioritized Strategies	5-Year Actions	Responsible Parties	Budget	Funding Sources[1]
Objective 6. Promote engagement in the water planning process					
A. SCDES, the RBC Planning Teams, and the RBCs conduct regular (every 6 months) reviews of the RBC membership to make sure all interest categories are adequately represented and attendance across all interest categories meets the requirements of the RBC Bylaws.	Yes	1. SCDES, RBC Planning Team, and RBC conduct review of membership every 6 months (yrs 1-5). 2. SCDES and RBC conduct outreach to promote membership for under-represented groups as necessary (yrs 1-5).	SCDES, RBC Planning Team, and RBC and conduct reviews.	The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved).	No direct cost
B. Support and promote outreach and education to increase awareness with the general public around watershed-based planning.	Yes	1. RBC develops outreach sub-committee (yr 1). 2. RBC partners with SCDES and SCDNR to develop a statewide educational strategy and budget needs (yr 1-2). 3. RBC identifies opportunities to support education programs such as a) providing education or materials on the river basin planning process and b) promoting existing citizen science tools such as CoCoRaHS, CMOR and Adopt-A-Stream (yrs 2-5). 4. RBC members present at local and state conferences or to local organizations regarding the river basin plan and process (yrs 2-5).	RBC conducts outreach with support of SCDES and contractors.	The cost of RBC support activities would be included in the budget for on-going RBC planning (if approved).	No direct cost

[1] See Tables 10-3 and 10-4 for funding source references.

10.1.2 Funding Opportunities

Existing external funding sources may be leveraged to promote implementation of the objectives outlined in Chapter 10.1.1. For example, EPA's Water Infrastructure Finance and Information Act 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 (FEMA's) Hazard Mitigation Grant Program (HMGP). Table 10-3 summarizes existing federal funding sources for public water suppliers.

Although agricultural water use in the Saluda River basin is limited and many growers have already implemented strategies to use water more efficiently, funding opportunities related to agricultural programs are also included in this section for reference. The USDA offers numerous programs for farmers and ranchers to reduce risk from natural disasters or to restore land impacted by natural disasters, such as drought or flooding. The Farm Bill has authorized several programs to provide relief to farms and ranches experiencing drought, including the Federal Crop Insurance Program; the Emergency Conservation Program; the Pasture, Rangeland, and Forage Program; and the Livestock Forage Disaster Program. In addition, EQIP provides assistance to farm operations for implementation of conservation measures. Some EQIP assistance is targeted toward water-conserving efforts in drought-prone regions through the WaterSMART Initiative, a collaboration between the USDA and the U.S. Department of the Interior's Bureau of Reclamation. Table 10-4 summarizes these and other 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 fiscal years 2023 through 2026. 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, EQIP. EQIP pays for ecosystem restoration and emissions reduction projects on farmland and may be used for activities such as the purchase of cover crops (one of the agricultural conservation strategies discussed in this plan). Annual obligations from the EQIP program have been approximately $1.8 to $1.9 billion from 2018 through 2021, with between $36 to $45 million allotted for projects in South Carolina in these years. Additionally, $3.25 billion was allotted 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" (IRA 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 (IRA 2022). On January 20, 2025, an Executive Order was issued requiring all agencies to immediately pause the disbursement of funds appropriated through the IRA and for agency heads to review the IRA to enhance their alignment with the administration's new policies. On February 20, 2025, $20 million in contracts for the EQIP, Conservation Stewardship Program, and Agricultural Conservation Easement Programs were released. At the time this Plan was prepared in May 2025, it is unknown if any funding for the Regional Conservation Partnership Program will be released and if the remaining IRA funding for all programs noted above will be continued or eliminated.

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. Although enrollment is currently closed as of the drafting of this plan, interested parties are encouraged to sign up to learn about future opportunities. At the time this Plan was prepared in March 2025, funding disbursements for the program were frozen and it is unknown if funding will be continued or eliminated.

Table 10-3. Federal funding sources.

Funding Source Index[1]	Program	Agency	Grant/Loan Funds Available	Description
Fed-1	U.S. Economic Development Administration (EDA) Grants	U.S. 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. 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	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	USDA 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	FEMA	Variable	Provides funds to states, territories, tribal governments, and communities for hazard mitigation planning and the implementation of mitigation projects following a presidentially declared disaster event.

[1] As referenced in the "Funding Sources" column of Table 10-2.

Table 10-3. Federal funding sources. (Continued)

Funding Source Index[1]	Program	Agency	Grant/Loan Funds Available	Description
Fed-7	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-8	Drinking Water State Revolving Fund	SCDES, 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.
Fed-9	Clean Water State Revolving Fund	SCDES, SC Rural Infrastructure Authority	Congress appropriates funding for the Clean Water State Revolving Fund that is then awarded to states by EPA	This program is a federal-state partnership that provides funding for water quality infrastructure projects including wastewater treatment facilities, nonpoint source pollution control, stormwater runoff mitigation, and water reuse.

[1] As referenced in the "Funding Sources" column of Table 10-2.

Table 10-4. USDA disaster assistance programs.

Funding Source Index[1]	Program	Agency	Description
USDA-1	Crop Insurance	Risk Management Agency (RMA)	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 (severe drought) or higher on the United States Drought Monitor, or in a county where there is at least a 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 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	NRCS	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 mortality disposal from natural disasters.
USDA-8	Emergency Watershed Program (Recovery)	NRCS	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.
USDA-10	Pasture, Rangeland, and Forage Program	RMA	Offers farmers and ranchers financial support to replace lost income due to forage losses caused by lower than average rainfall.
USDA-11	Livestock Forage Disaster Program	FSA	Offers financial support to livestock producers who experience grazing losses due to qualifying drought conditions or fire on federally managed lands. Payments compensate for lost grazing opportunities and additional feed costs incurred due to the disaster.

[1] As referenced in the "Funding Sources" column of Table 10-2.

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10.1.3 Implementation Considerations

To effectively implement the recommended strategies of the River Basin Plan, the RBC must continue to meet as a planning body. The Planning Framework states that the River Basin Plan should not be perceived as a static document and the RBC should not be a stagnant planning body between successive updates. Rather, the RBC is to be "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 2019a, p. 90). The RBC included a recommendation to continue funding of the river basin planning process under Objective 2 and recommendations to sustain the RBC and promote coordination with other RBCs and groups under Objective 6. Under Objective 2, the Saluda RBC also included the creation of an upstate IRC including representatives of the Broad, Upper Savannah, and Saluda RBCs and an annual coordination meeting of all the RBCs. Additional RBCs, including the Broad RBC and Upper Savannah RBC, have recommended joint meetings of multiple RBCs, suggesting there is broad support for this recommendation.

The Saluda RBC may encounter challenges in the implementation of the identified strategies. One such challenge is the identification of sufficient funding. As noted in the previous section, there is growing uncertainty as to the availability of certain federal funding programs. For the implementation of Objective 1, *improve water use efficiency to conserve water resources*, water withdrawers may have limited financial capacity to pursue the recommended water management strategies. A municipal water utility's budget is limited by its customer base and rate structure. The increases to water rates necessary to fund implementation of the actions associated with the RBC's objectives may not be feasible for some communities. Agricultural water withdrawers may have limited financial resources to invest in new and potentially expensive water conservation or augmentation strategies. Industries will likely need to self-fund any conservation strategies. Although some outside funding sources exist for municipal and agricultural withdrawers, applications for such programs may present a technical or resource barrier to many water withdrawers. Any new funding sources pursued by the RBC with SCDES support may take time to develop, leading to delays in implementation. Identifying immediately available funding opportunities, supporting funding applications, and investigating new funding sources are vital to implementation of the Objective 1 recommended strategies. The River Basin Plan and the recommendations within should be leveraged to strengthen grant applications and funding requests where possible, as the recommendations stem from a 2-year, stakeholder-based planning process. Objective 3, *improve technical data and understanding of water resource management issues*, includes strategies involving additional monitoring, modeling, or analysis that would require funding to implement. The Saluda RBC included a recommendation to establish a grant program to support implementation of River Basin Plan recommendations. This strategy is included under Objective 2, *communicate, coordinate, and promote findings and recommendations from the River Basin Plan*.

Another challenge to implementing the River Basin Plan is stakeholder acceptance. The RBC itself has no authority to enforce recommendations in the basin. Therefore, implementation of these strategies is dependent upon effective communication of RBC findings and recommendations to stakeholders. For example, stakeholder acceptance is vital for achieving Objective 1, *improve water use efficiency to conserve water resources,* and Objective 5, *improve drought management,* as these strategies rely on individual water withdrawers to reduce their demands or modify their drought management plans. To gain acceptance, water withdrawers must understand the need for and goals of the recommended strategies as well as have assurance that they are viable and effective in improving equitable access to the basin's water resources. Stakeholder acceptance is also vital to achieving Objective 4, *protect water resources*, which requires other entities to take action to reduce sediment loading or address hydrologic impairment. Strategies that require coordination with another entity or require another entity to act include outreach components as part of the 5-year actions in the implementation table. Outreach may include the development of print or online materials to describe potential water management strategies, benefits and funding sources, and to describe how these strategies relate to findings from the planning process. Recognizing the importance of stakeholder acceptance, the RBC included Objective 6, *promote engagement in the water planning process,* and developed a strategy for increasing the number of public meetings held under Objective 2.

As the RBC makes decisions related to implementation, the RBC should aim to build consensus where possible and consider documenting alternative points of view when consensus is not possible. Documenting alternative points of view can be equally valuable to officials who have a role implementing water management strategies and/or recommendations made by a portion of the RBC. Full consensus on every issue may not be achievable, but the RBC should continue to discuss, revisit, and document issues from this and later planning phases that are marked by alternative or opposing points of view.

10.2 Long-term Planning Objectives

The Saluda RBC's objectives described in Chapter 10.1 represent both short-term, 5-year actions and long-term objectives. For each objective, the 5-year actions are discussed in Chapter 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 water resources	
A. Promote municipal conservation.	Continue 5-year actions. Adjust recommended actions based on water savings realized. Seek additional funding sources.
B. Promote agricultural conservation.	Continue 5-year actions. Adjust recommended actions based on water savings realized. Seek additional funding sources. Explore new technologies and incorporate into recommendations as appropriate.
C. Promote industrial and energy conservation.	Continue 5-year actions. Adjust recommended actions based on water savings realized. Seek additional funding sources. Explore new technologies and incorporate into recommendations as appropriate.
Objective 2. Communicate, coordinate, and promote findings and recommendations from the River Basin Plan	
A. Conduct additional public meetings to enhance public engagement such as announcing the formation of the RBCs and presenting the Draft and Final River Basin Plans.	Seek opportunities to increase public engagement through public meetings.
B. Hold annual coordination meeting of all RBCs.	Coordinate efforts and recommendations among RBCs.

Table 10-5. Long-term planning objectives. (Continued)

Objective and Strategy	Long-Term Strategy
Objective 2. Communicate, coordinate, and promote findings and recommendations from the River Basin Plan	
C. Form an upstate Interbasin River Council consisting of representatives from the Broad, Saluda, and Upper Savannah RBCs to coordinate on shared interests and goals as headwater basins.	Coordinate efforts and recommendations among RBCs.
D. To continue positive progress at the state level for river basin planning, conduct a state led assessment of the current funding to SCDES to support river basin planning.	Continue funding of river basin and state water planning activities.
E. Local governments consult the Resilience Plan developed by the South Carolina Office of Resilience, local Hazard Mitigation Plans, and the associated River Basin Plan(s) developed by the RBCs for inclusion within the resilience element as required by the South Carolina Local Government Comprehensive Planning Enabling Act as amended in 2020. Encourage land use regulations and corresponding ordinances be adjusted to support the resilience element.	Continue outreach with each 5-year update of the Plan and with development of State Water Plan.
F. For river basins with state or federal specially designated streams (e.g., National Wild and Scenic Rivers or State Scenic Rivers), watershed-based plans, and any other similar plans, assess alignment between the River Basin Plan and the management plan associated with the special designation.	Consider relevant findings from other plans in next 5-yr Plan update. Share River Basin Plan with other planning entities in the basin.
G. Consider use of the River Basin Plan as a tool for local comprehensive plans and economic development. Encourage that developers work with water utilities to ensure adequate water availability and infrastructure.	Consider findings of the River Basin Plan to identify water resources that can be used for growth.
H. The Legislature funds and SCDES establishes and manages a grant program to help support the implementation of the actions and strategies identified each RBC's River Basin Plan.	Continue funding of river basin and state water planning activities.
I. The State supports and funds 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.	Continue support of statewide water education programs.
Objective 3. Improve technical understanding of water resource management issues	
A. Assess the potential impacts of private and community/commercial wells, and how they may affect surface water (especially during droughts) and/or better characterize growth potential in future planning phases.	Consider findings of analysis and include recommendations in next 5-yr Plan update.
B. Update models to consider future uncertainties (changing weather patterns, population growth, water use scenarios, etc.).	Consider findings of analysis and include recommendations in next 5-yr Plan update.

Table 10-5. Long-term planning objectives. (Continued)

Objective and Strategy	Long-Term Strategy
Objective 3. Improve technical understanding of water resource management issues	
C. Include evaluation of surface water quality and trends, including nutrient loading and sedimentation, in future planning efforts.	Consider findings of analysis and include recommendations in next 5-yr Plan update.
D. Support continued efforts to maintain and expand streamflow gages. Public entities that collect streamflow data make it publicly accessible. Priority consideration to the following water bodies is recommended: a. S. Saluda at SC 186 and Middle Saluda at SC 288 b. Oolenoy River c. Saluda below Holiday Dam d. Tributaries in the Lower Saluda basin.	Continue 5-year actions. Monitor number of active gages in the basin.
E. SCDES creates and maintains an online library of, or a catalog of links to, technical information that will enhance the RBC's technical understanding of water resources concepts and issues.	Continue 5-year actions.
F. Coordinate with SCDES to identify and define data gaps and possible avenues for filling gaps in future phases.	Continue to identify and fill data gaps to provide planning bodies with needed information.
G. SCDES explores the expansion of the ambient water quality monitoring network.	Expand the ambient water quality monitoring network.
H. Explore incorporating county-collected data (e.g. flow data) to augment existing models (e.g. SWAM model).	Utilize all relevant, available data for water planning.
I. State agencies and partners expand analysis and understanding of flow-ecology relationships.	Consider findings of analysis in next 5-yr Plan update. Support continued collection of fish and invertebrate data.
J. Conduct studies to better identify sediment loading sources and the financial costs associated with mitigating those sources to our reservoirs and waterways.	Demonstrate the financial benefits of erosion and sedimentation control measures.
K. South Carolina legislature funds, and state agencies and partners establish a mesoscale network of weather and climate monitoring stations in South Carolina.	Develop and maintain a mesoscale network. Incorporate data to improve drought management.

Table 10-5. Long-term planning objectives. (Continued)

Objective and Strategy	Long-Term Strategy
Objective 4. Protect water resources	
A. The RBC supports reducing sediment loading to reservoirs and waterways through: 1. Streambank restoration, riparian buffers, and other practices that reduce sediment load to streams and reservoirs. 2. Sustainable development that implements green infrastructure and best management practices (BMPs) to reduce downstream runoff. Encourage local governmental ordinances with incentives for green infrastructure 3. More enforcement, monitoring, and maintenance of stormwater controls and sediment and erosion control measures. 4. Strengthening design standards to capture larger storm events. 5. More incentives to landowners to not sell their land to development and, rather, place them in permanent conservation easements. 6. Incentives that encourage farming practices that minimize soil disturbance and soil loss and improve soil health. 7. Leveraging of USDA EQIP programs for regenerative farming practices that minimize soil disturbance and soil loss and improve soil health 8. Strengthening penalties for non-compliance of erosion/sediment control and stormwater permits and ordinances.	Encourage best practices to reduce sediment loading to water bodies.
B. Work to remove the Saluda River hydrologic impairment (4C) below the Saluda Lake.	Remove hydrologic impairments or minimize impacts
Objective 5. Improve drought management	
A. 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 are submitted to the SCO for review.	Utilize all relevant, available data for water planning

Table 10-5. Long-term planning objectives. (Continued)

<table>
<tr><th colspan="2">Objective and Strategy</th><th>Long-Term Strategy</th></tr>
<tr><td colspan="3">Objective 5. Improve drought management</td></tr>
<tr><td rowspan="4">B. Develop materials and outreach strategy to public suppliers in the basin to implement the RBC's drought management recommendations (see Chapter 8.2.3).</td><td>1. 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.</td><td rowspan="4">Continue 5-year actions. Monitor progress towards increasing the number of up-to-date (within last 5 years) drought management plans in the basin.</td></tr>
<tr><td>2. The RBC recommends that water utilities coordinate, to the extent practical, their drought response messaging.</td></tr>
<tr><td>3. The RBC encourages water utilities in the basin to consider drought surcharges on water use during severe and/or extreme drought phases.</td></tr>
<tr><td>4. The RBC encourages water users and those with water interests to submit drought impact observations through CMORs.</td></tr>
<tr><td colspan="3">Objective 6. Promote engagement in the water planning process</td></tr>
<tr><td colspan="2">A. SCDES, the RBC Planning Teams, and the RBCs conduct regular (every 6 months) reviews of the RBC membership to make sure all interest categories are adequately represented and attendance across all interest categories meets the requirements of the RBC Bylaws.</td><td>Continually assess representation of interest categories in the planning process.</td></tr>
<tr><td colspan="2">B. Support and promote outreach and education to increase awareness with the general public around watershed-based planning.</td><td>Continue 5-year actions.</td></tr>
</table>

10.3 Progress on River Basin Plan Implementation

To assess the performance of and quality of actions taken by the RBC, the Framework proposes the development of progress metrics. A progress metric is a "*benchmark used to monitor the success or failure of an action taken by an RBC*" (SCDNR 2019a). 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 Saluda RBC developed progress metrics around each of the six implementation objectives defined at the beginning of this chapter. The progress metrics are:

1. Improve water use efficiency to conserve water resources

    Metric 1a: Utilities meet industry standards for water loss/leak detection.

    Metric 1b: Funding opportunities are identified and used to implement conservation strategies.

2. Communicate, coordinate, and promote fundings and recommendations from the River Basin Plan

    Metric 2a: The Saluda RBC continues to meet regularly including regular coordination meetings with other RBCs.

    Metric 2b: The State continues funding for river basin planning activities.

    Metric 2c: The River Basin Plan is referenced during complementary planning processes such as resilience planning, watershed-based planning, economic development planning, and education program planning.

    Metric 2d: The Saluda RBC coordinates with other planning bodies in the state during their planning processes.

    Metric 2e: The Saluda RBC participates in the WaterSC process.

    Metric 2f: The South Carolina State Water Plan incorporates the Saluda River Basin Plan.

    Metric 2g: The Saluda River Basin Plan is available, accessible, and easy to find, supporting its use by the public, utilities, agencies, etc.

3. Improve technical data and understanding of water resources management issues

    Metric 3a: Future planning phases assess the impacts of groundwater use.

    Metric 3b: Future modeling efforts consider county-collected flow data.

    Metric 3c: Future modeling and analysis consider future uncertainties (changing weather patterns, population growth, land use, water use scenarios, etc.).

    Metric 3d: Water quality issues and concerns in the basin are identified and a strategy to study approaches to address them is developed.

    Metric 3e: USGS streamflow gages in the basin are maintained and increased. The Saluda RBC tracks additions, removals, and operability of gage data.

    Metric 3f: All data necessary to support implementation actions and future areas of study is accessible and made available to the RBC and public.

Metric 3g: The financial impacts of sedimentation on reservoirs and water resources are identified. Results are communicated to local governments.

Metric 3h: The Saluda RBC has advocated for the development of a mesoscale network of climate monitoring stations, and actions toward implementation are occurring.

4. Protect water resources

    Metric 4a: The primary sources of sediment loading to reservoirs are identified.

    Metric 4b: Measures are put in place by responsible authorities to mitigate and minimize sediment loading to reservoirs.

    Metric 4c: The hydrologic impairment (4C) below Saluda Lake has been removed.

5. Improve drought management

    Metric 5a: One hundred percent of public water supplier's drought management plans are updated within the last 5 years and submitted to the SCO for review.

6. Promote engagement in the water planning process

    Metric 6a: The RBCs continue beyond 2025 with a diverse, active and representative membership with balanced representation from all eight interest categories.

    Metric 6b: Coordination occurs with groups that have existing education and outreach efforts focused on water planning.

    Metric 6c: The Saluda RBC is actively engaging the public.

This 2025 publication is the first Saluda River Basin Plan. Future 5-year updates will evaluate the Saluda 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 Saluda 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 on 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 D.

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 fully accepts the plan).	**10**
2. Endorsement but with Minor Points of Contention (i.e., Member mostly accepts the plan).	**14**
3. Endorsement but with Major Points of Contention (i.e., Member can live with the plan).	**1**
4. Stand aside with Major Reservations (i.e., Member cannot live with the plan in its current state and can only support it if changes are made).	**0**
5. Withdraw – Member will not support the plan and will not continue working within the RBC's process. Member has decided to leave the RBC.	**0**
Final River Basin Plan	
Support	
Does Not Support	

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Appendix A
Demand Projections for Individual Water Users

Table A-1. Current Water Demands, Consumptive Use, and Returns.

User	Use Category	Source	Withdrawal (MGD)	Consumptive Use (%)	Consumptive Use (MGD)	Return (MGD)
Beechwood	Agriculture	Surface Water	0.12	100%	0.12	0.00
Bush River Farms	Agriculture	Surface Water	0.27	100%	0.27	0.00
Leslea Farms	Agriculture	Surface Water	0.04	100%	0.04	0.00
Mayer Farm	Agriculture	Surface Water	0.01	100%	0.01	0.00
Merritt Bros	Agriculture	Surface Water	0.02	100%	0.02	0.00
Overbridge Farm	Agriculture	Surface Water	0.02	100%	0.02	0.00
Satterwhite Farm	Agriculture	Surface Water	0.03	100%	0.03	0.00
Sease Clinton	Agriculture	Surface Water	0.08	100%	0.08	0.00
Sease James	Agriculture	Surface Water	0.45	100%	0.45	0.00
Stoneybrook	Agriculture	Surface Water	0.02	100%	0.02	0.00
Titan Farms	Agriculture	Surface Water	1.07	100%	1.07	0.00
Twin Oaks Farm	Agriculture	Surface Water	0.01	100%	0.01	0.00
Watson Jerrold Farm	Agriculture	Surface Water	0.58	100%	0.58	0.00
BUSH RIVER FARMS	Agriculture	Groundwater	0.044	100%	0.04	0.00
J & P Park Aquisitions, Inc.	Agriculture	Groundwater	0.004	100%	0.00	0.00
James R. Sease Farms, Inc.	Agriculture	Groundwater	0.001	100%	0.00	0.00
MAYER FARM	Agriculture	Groundwater	0.286	100%	0.29	0.00
Walter P. Rawl and Sons, Inc.	Agriculture	Groundwater	0.074	100%	0.07	0.00
Cliffs Club	Golf Course	Surface Water	0.07	100%	0.07	0.00
Furman	Golf Course	Surface Water	0.08	100%	0.08	0.00
Golden Hills	Golf Course	Surface Water	0.05	100%	0.05	0.00
Lexington	Golf Course	Surface Water	0.09	100%	0.09	0.00
Ponderosa	Golf Course	Surface Water	0.05	100%	0.05	0.00
Rolling Green	Golf Course	Surface Water	0.10	100%	0.10	0.00
Smithfields	Golf Course	Surface Water	0.04	100%	0.04	0.00

User	Use Category	Source	Withdrawal (MGD)	Consumptive Use (%)	Consumptive Use (MGD)	Return (MGD)
The Preserve	Golf Course	Surface Water	0.08	100%	0.08	0.00
The Rock	Golf Course	Surface Water	0.02	100%	0.02	0.00
FURMAN GOLF CLUB	Golf Course	Groundwater	0.018	100%	0.02	0.00
Shaw Industries	Manufacturing	Surface Water	24.91	9%	2.30	22.62
GREENWOOD MILLS INC HARRIS PLANT	Manufacturing	Groundwater	0.014	100%	0.01	0.00
Michelin North America	Manufacturing	Groundwater	0.011	100%	0.01	0.00
Vulcan Mining	Mining	Surface Water	0.08	90%	0.07	0.01
Belton Honea Path	Public Supply	Surface Water	1.82	39%	0.73	1.09
Columbia	Public Supply	Surface Water	30.71	21%	6.79	23.92
Easley	Public Supply	Surface Water	8.65	68%	5.97	2.68
Greenville	Public Supply	Surface Water	35.19	40%	14.86	20.32
Greenwood	Public Supply	Surface Water	9.68	9%	0.88	8.80
Laurens CPW	Public Supply	Surface Water	1.55	36%	0.56	0.99
LCWSC	Public Supply	Surface Water	2.26	64%	1.46	0.80
NCWSA	Public Supply	Surface Water	0.88	67%	0.60	0.29
Newberry	Public Supply	Surface Water	5.11	29%	1.49	3.62
SCWSA	Public Supply	Surface Water	2.50	0%	0.00	2.50
West Columbia	Public Supply	Surface Water	13.60	43%	6.19	7.41
Gilbert-Summit Rural Water District	Public Supply	Groundwater	0.037	100%	0.04	0.00
Dominion Energy	Thermoelectric	Surface Water	166.90	2%	3.59	163.31
Duke Lee Station	Thermoelectric	Surface Water	4.29	91%	3.96	0.33

Table A-2. Permit and Registration Amounts for Current Water Users.

User	Use Category	Water Source	Permit or Registration	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Beechwood	Agriculture	Surface Water	Registration	0.4	12.2	146
Belton Honea Path	Public Supply	Surface Water	Permit	4.1	124.7	1496.5
Bush River Farms	Agriculture	Surface Water	Registration	0.6	18.3	219
Cliffs Club	Golf Course	Surface Water	Permit	0.4	12.2	146
Columbia	Public Supply	Surface Water	Permit	127.4	3875.1	46501
Dominion Energy	Thermoelectric	Surface Water	Permit	170.1	5173.9	62086.5
Duke Lee Station	Thermoelectric	Surface Water	Permit	331.4	10080.1	120961
Easley	Public Supply	Surface Water	Permit	36.7	1116.3	13395.5
Furman	Golf Course	Surface Water	Permit	2.2	66.9	803
Golden Hills	Golf Course	Surface Water	Permit	1.1	33.5	401.5
Greenville	Public Supply	Surface Water	Permit	129.4	3935.9	47231
Greenwood	Public Supply	Surface Water	Permit	56.1	1706.4	20476.5
Laurens CPW	Public Supply	Surface Water	Permit	66.3	2016.6	24199.5
LCWSC	Public Supply	Surface Water	Permit	17.8	541.4	6497
Leslea Farms	Agriculture	Surface Water	Registration	0.5	15.2	182.5
Lexington	Golf Course	Surface Water	Permit	0.7	21.3	255.5
Mayer Farm	Agriculture	Surface Water	Registration	0.2	6.1	73
Merritt Bros	Agriculture	Surface Water	Registration	0.6	18.3	219
NCWSA	Public Supply	Surface Water	Permit	6.1	185.5	2226.5
Newberry	Public Supply	Surface Water	Permit	22.4	681.3	8176
Overbridge Farm	Agriculture	Surface Water	Registration	0.3	9.1	109.5
Ponderosa	Golf Course	Surface Water	Permit	1.5	45.6	547.5
Rolling Green	Golf Course	Surface Water	Permit	0.5	15.2	182.5
Satterwhite Farm	Agriculture	Surface Water	Registration	0.1	3.0	36.5
SCWSA	Public Supply	Surface Water	Permit	15.3	465.4	5584.5
Sease Clinton	Agriculture	Surface Water	Registration	1	30.4	365

User	Use Category	Water Source	Permit or Registration	Permit or Registration Amount (MGD)	Permit or Registration Amount (MGM)	Permit or Registration Amount (MGY)
Sease James	Agriculture	Surface Water	Registration	2	60.8	730
Shaw Industries	Manufacturing	Surface Water	Permit	44.9	1365.7	16388.5
Smithfields	Golf Course	Surface Water	Permit	1.5	45.6	547.5
Stoneybrook	Agriculture	Surface Water	Registration	0.1	3.0	36.5
The Preserve	Golf Course	Surface Water	Permit	1.9	57.8	693.5
The Rock	Golf Course	Surface Water	Permit	0.2	6.1	73
Titan Farms	Agriculture	Surface Water	Registration	3.3	100.4	1204.5
Twin Oaks Farm	Agriculture	Surface Water	Registration	0.1	3.0	36.5
Walker Farm	Agriculture	Surface Water	Registration	0.1	3.0	36.5
Watson Jerrold Farm	Agriculture	Surface Water	Registration	5.9	179.5	2153.5
West Columbia	Public Supply	Surface Water	Permit	43.2	1314.0	15768

Table A-3. Projected Water Demands by Water User.

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Cliffs Club	Surface Water	GC	Moderate	2025	0.05
Cliffs Club	Surface Water	GC	Moderate	2030	0.05
Cliffs Club	Surface Water	GC	Moderate	2035	0.05
Cliffs Club	Surface Water	GC	Moderate	2040	0.05
Cliffs Club	Surface Water	GC	Moderate	2050	0.05
Cliffs Club	Surface Water	GC	Moderate	2060	0.05
Cliffs Club	Surface Water	GC	Moderate	2070	0.05
Furman	Surface Water	GC	Moderate	2025	0.09
Furman	Surface Water	GC	Moderate	2030	0.09
Furman	Surface Water	GC	Moderate	2035	0.09
Furman	Surface Water	GC	Moderate	2040	0.09
Furman	Surface Water	GC	Moderate	2050	0.09
Furman	Surface Water	GC	Moderate	2060	0.09
Furman	Surface Water	GC	Moderate	2070	0.09
Furman	Groundwater	GC	Moderate	2025	0.02
Furman	Groundwater	GC	Moderate	2030	0.02
Furman	Groundwater	GC	Moderate	2035	0.02
Furman	Groundwater	GC	Moderate	2040	0.02
Furman	Groundwater	GC	Moderate	2050	0.02
Furman	Groundwater	GC	Moderate	2060	0.02
Furman	Groundwater	GC	Moderate	2070	0.02
Golden Hills	Surface Water	GC	Moderate	2025	0.04
Golden Hills	Surface Water	GC	Moderate	2030	0.04
Golden Hills	Surface Water	GC	Moderate	2035	0.04
Golden Hills	Surface Water	GC	Moderate	2040	0.04
Golden Hills	Surface Water	GC	Moderate	2050	0.04
Golden Hills	Surface Water	GC	Moderate	2060	0.04
Golden Hills	Surface Water	GC	Moderate	2070	0.04
Lexington	Surface Water	GC	Moderate	2025	0.08
Lexington	Surface Water	GC	Moderate	2030	0.08
Lexington	Surface Water	GC	Moderate	2035	0.08
Lexington	Surface Water	GC	Moderate	2040	0.08
Lexington	Surface Water	GC	Moderate	2050	0.08

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Lexington	Surface Water	GC	Moderate	2060	0.08
Lexington	Surface Water	GC	Moderate	2070	0.08
Ponderosa	Surface Water	GC	Moderate	2025	0.03
Ponderosa	Surface Water	GC	Moderate	2030	0.03
Ponderosa	Surface Water	GC	Moderate	2035	0.03
Ponderosa	Surface Water	GC	Moderate	2040	0.03
Ponderosa	Surface Water	GC	Moderate	2050	0.03
Ponderosa	Surface Water	GC	Moderate	2060	0.03
Ponderosa	Surface Water	GC	Moderate	2070	0.03
Rolling Green	Surface Water	GC	Moderate	2025	0.10
Rolling Green	Surface Water	GC	Moderate	2030	0.10
Rolling Green	Surface Water	GC	Moderate	2035	0.10
Rolling Green	Surface Water	GC	Moderate	2040	0.10
Rolling Green	Surface Water	GC	Moderate	2050	0.10
Rolling Green	Surface Water	GC	Moderate	2060	0.10
Rolling Green	Surface Water	GC	Moderate	2070	0.10
Smithfields	Surface Water	GC	Moderate	2025	0.03
Smithfields	Surface Water	GC	Moderate	2030	0.03
Smithfields	Surface Water	GC	Moderate	2035	0.03
Smithfields	Surface Water	GC	Moderate	2040	0.03
Smithfields	Surface Water	GC	Moderate	2050	0.03
Smithfields	Surface Water	GC	Moderate	2060	0.03
Smithfields	Surface Water	GC	Moderate	2070	0.03
The Preserve	Surface Water	GC	Moderate	2025	0.07
The Preserve	Surface Water	GC	Moderate	2030	0.07
The Preserve	Surface Water	GC	Moderate	2035	0.07
The Preserve	Surface Water	GC	Moderate	2040	0.07
The Preserve	Surface Water	GC	Moderate	2050	0.07
The Preserve	Surface Water	GC	Moderate	2060	0.07
The Preserve	Surface Water	GC	Moderate	2070	0.07
The Rock	Surface Water	GC	Moderate	2025	0.01
The Rock	Surface Water	GC	Moderate	2030	0.01
The Rock	Surface Water	GC	Moderate	2035	0.01
The Rock	Surface Water	GC	Moderate	2040	0.01

User	Water Source	Use Category	Projection	Year	Demand (MGD)
The Rock	Surface Water	GC	Moderate	2050	0.01
The Rock	Surface Water	GC	Moderate	2060	0.01
The Rock	Surface Water	GC	Moderate	2070	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	Moderate	2025	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	Moderate	2030	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	Moderate	2035	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	Moderate	2040	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	Moderate	2050	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	Moderate	2060	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	Moderate	2070	0.01
Michelin North America	Groundwater	IN	Moderate	2025	0.01
Michelin North America	Groundwater	IN	Moderate	2030	0.01
Michelin North America	Groundwater	IN	Moderate	2035	0.01
Michelin North America	Groundwater	IN	Moderate	2040	0.01
Michelin North America	Groundwater	IN	Moderate	2050	0.01
Michelin North America	Groundwater	IN	Moderate	2060	0.01
Michelin North America	Groundwater	IN	Moderate	2070	0.01
Shaw Industries	Surface Water	IN	Moderate	2025	25.94
Shaw Industries	Surface Water	IN	Moderate	2030	28.20
Shaw Industries	Surface Water	IN	Moderate	2035	30.47
Shaw Industries	Surface Water	IN	Moderate	2040	33.08
Shaw Industries	Surface Water	IN	Moderate	2050	40.02
Shaw Industries	Surface Water	IN	Moderate	2060	47.26
Shaw Industries	Surface Water	IN	Moderate	2070	56.07
305010901	Surface Water	IR	Moderate	2025	0.00
305010901	Surface Water	IR	Moderate	2030	0.01
305010901	Surface Water	IR	Moderate	2035	0.01
305010901	Surface Water	IR	Moderate	2040	0.02
305010901	Surface Water	IR	Moderate	2050	0.02
305010901	Surface Water	IR	Moderate	2060	0.03

User	Water Source	Use Category	Projection	Year	Demand (MGD)
305010901	Surface Water	IR	Moderate	2070	0.04
305010903	Surface Water	IR	Moderate	2025	0.00
305010903	Surface Water	IR	Moderate	2030	0.00
305010903	Surface Water	IR	Moderate	2035	0.00
305010903	Surface Water	IR	Moderate	2040	0.00
305010903	Surface Water	IR	Moderate	2050	0.00
305010903	Surface Water	IR	Moderate	2060	0.00
305010903	Surface Water	IR	Moderate	2070	0.00
305010910	Surface Water	IR	Moderate	2025	0.03
305010910	Surface Water	IR	Moderate	2030	0.07
305010910	Surface Water	IR	Moderate	2035	0.11
305010910	Surface Water	IR	Moderate	2040	0.15
305010910	Surface Water	IR	Moderate	2050	0.24
305010910	Surface Water	IR	Moderate	2060	0.34
305010910	Surface Water	IR	Moderate	2070	0.44
305010911	Surface Water	IR	Moderate	2025	0.01
305010911	Surface Water	IR	Moderate	2030	0.02
305010911	Surface Water	IR	Moderate	2035	0.03
305010911	Surface Water	IR	Moderate	2040	0.04
305010911	Surface Water	IR	Moderate	2050	0.06
305010911	Surface Water	IR	Moderate	2060	0.08
305010911	Surface Water	IR	Moderate	2070	0.10
305010912	Surface Water	IR	Moderate	2025	0.00
305010912	Surface Water	IR	Moderate	2030	0.00
305010912	Surface Water	IR	Moderate	2035	0.01
305010912	Surface Water	IR	Moderate	2040	0.01
305010912	Surface Water	IR	Moderate	2050	0.02
305010912	Surface Water	IR	Moderate	2060	0.02
305010912	Surface Water	IR	Moderate	2070	0.03
305010914	Surface Water	IR	Moderate	2025	0.01
305010914	Surface Water	IR	Moderate	2030	0.02
305010914	Surface Water	IR	Moderate	2035	0.03
305010914	Surface Water	IR	Moderate	2040	0.05
305010914	Surface Water	IR	Moderate	2050	0.08

User	Water Source	Use Category	Projection	Year	Demand (MGD)
305010914	Surface Water	IR	Moderate	2060	0.11
305010914	Surface Water	IR	Moderate	2070	0.14
Beechwood	Surface Water	IR	Moderate	2025	0.12
Beechwood	Surface Water	IR	Moderate	2030	0.12
Beechwood	Surface Water	IR	Moderate	2035	0.12
Beechwood	Surface Water	IR	Moderate	2040	0.12
Beechwood	Surface Water	IR	Moderate	2050	0.12
Beechwood	Surface Water	IR	Moderate	2060	0.12
Beechwood	Surface Water	IR	Moderate	2070	0.12
Bush River Farms	Groundwater	IR	Moderate	2025	0.04
Bush River Farms	Groundwater	IR	Moderate	2030	0.04
Bush River Farms	Groundwater	IR	Moderate	2035	0.04
Bush River Farms	Groundwater	IR	Moderate	2040	0.04
Bush River Farms	Groundwater	IR	Moderate	2050	0.04
Bush River Farms	Groundwater	IR	Moderate	2060	0.04
Bush River Farms	Groundwater	IR	Moderate	2070	0.04
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2025	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2030	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2035	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2040	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2050	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2060	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2070	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2025	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2030	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2035	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2040	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2050	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2060	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2070	0.00
Leslea Farms	Surface Water	IR	Moderate	2025	0.03
Leslea Farms	Surface Water	IR	Moderate	2030	0.03
Leslea Farms	Surface Water	IR	Moderate	2035	0.03
Leslea Farms	Surface Water	IR	Moderate	2040	0.03

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Leslea Farms	Surface Water	IR	Moderate	2050	0.03
Leslea Farms	Surface Water	IR	Moderate	2060	0.03
Leslea Farms	Surface Water	IR	Moderate	2070	0.03
Mayer Farm	Surface Water	IR	Moderate	2025	0.00
Mayer Farm	Surface Water	IR	Moderate	2030	0.00
Mayer Farm	Surface Water	IR	Moderate	2035	0.00
Mayer Farm	Surface Water	IR	Moderate	2040	0.00
Mayer Farm	Surface Water	IR	Moderate	2050	0.00
Mayer Farm	Surface Water	IR	Moderate	2060	0.00
Mayer Farm	Surface Water	IR	Moderate	2070	0.00
Mayer Farm	Groundwater	IR	Moderate	2025	0.29
Mayer Farm	Groundwater	IR	Moderate	2030	0.29
Mayer Farm	Groundwater	IR	Moderate	2035	0.29
Mayer Farm	Groundwater	IR	Moderate	2040	0.29
Mayer Farm	Groundwater	IR	Moderate	2050	0.29
Mayer Farm	Groundwater	IR	Moderate	2060	0.29
Mayer Farm	Groundwater	IR	Moderate	2070	0.29
Merritt Bros	Surface Water	IR	Moderate	2025	0.00
Merritt Bros	Surface Water	IR	Moderate	2030	0.00
Merritt Bros	Surface Water	IR	Moderate	2035	0.00
Merritt Bros	Surface Water	IR	Moderate	2040	0.00
Merritt Bros	Surface Water	IR	Moderate	2050	0.00
Merritt Bros	Surface Water	IR	Moderate	2060	0.00
Merritt Bros	Surface Water	IR	Moderate	2070	0.00
Satterwhite Farm	Surface Water	IR	Moderate	2025	0.05
Satterwhite Farm	Surface Water	IR	Moderate	2030	0.05
Satterwhite Farm	Surface Water	IR	Moderate	2035	0.05
Satterwhite Farm	Surface Water	IR	Moderate	2040	0.05
Satterwhite Farm	Surface Water	IR	Moderate	2050	0.05
Satterwhite Farm	Surface Water	IR	Moderate	2060	0.05
Satterwhite Farm	Surface Water	IR	Moderate	2070	0.05
Sease Clinton	Surface Water	IR	Moderate	2025	0.07
Sease Clinton	Surface Water	IR	Moderate	2030	0.07
Sease Clinton	Surface Water	IR	Moderate	2035	0.07

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Sease Clinton	Surface Water	IR	Moderate	2040	0.07
Sease Clinton	Surface Water	IR	Moderate	2050	0.07
Sease Clinton	Surface Water	IR	Moderate	2060	0.07
Sease Clinton	Surface Water	IR	Moderate	2070	0.07
Sease James	Surface Water	IR	Moderate	2025	0.30
Sease James	Surface Water	IR	Moderate	2030	0.30
Sease James	Surface Water	IR	Moderate	2035	0.30
Sease James	Surface Water	IR	Moderate	2040	0.30
Sease James	Surface Water	IR	Moderate	2050	0.30
Sease James	Surface Water	IR	Moderate	2060	0.30
Sease James	Surface Water	IR	Moderate	2070	0.30
Stoneybrook	Surface Water	IR	Moderate	2025	0.01
Stoneybrook	Surface Water	IR	Moderate	2030	0.01
Stoneybrook	Surface Water	IR	Moderate	2035	0.01
Stoneybrook	Surface Water	IR	Moderate	2040	0.01
Stoneybrook	Surface Water	IR	Moderate	2050	0.01
Stoneybrook	Surface Water	IR	Moderate	2060	0.01
Stoneybrook	Surface Water	IR	Moderate	2070	0.01
Titan Farms	Surface Water	IR	Moderate	2025	1.13
Titan Farms	Surface Water	IR	Moderate	2030	1.13
Titan Farms	Surface Water	IR	Moderate	2035	1.13
Titan Farms	Surface Water	IR	Moderate	2040	1.13
Titan Farms	Surface Water	IR	Moderate	2050	1.13
Titan Farms	Surface Water	IR	Moderate	2060	1.13
Titan Farms	Surface Water	IR	Moderate	2070	1.13
Twin Oaks Farm	Surface Water	IR	Moderate	2025	0.00
Twin Oaks Farm	Surface Water	IR	Moderate	2030	0.00
Twin Oaks Farm	Surface Water	IR	Moderate	2035	0.00
Twin Oaks Farm	Surface Water	IR	Moderate	2040	0.00
Twin Oaks Farm	Surface Water	IR	Moderate	2050	0.00
Twin Oaks Farm	Surface Water	IR	Moderate	2060	0.00
Twin Oaks Farm	Surface Water	IR	Moderate	2070	0.00
Walter P. Rawl and Sons, Inc.	Groundwater	IR	Moderate	2025	0.07
Walter P. Rawl and Sons, Inc.	Groundwater	IR	Moderate	2030	0.07

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Walter P. Rawl and Sons, Inc.	Groundwater	IR	Moderate	2035	0.07
Walter P. Rawl and Sons, Inc.	Groundwater	IR	Moderate	2040	0.07
Walter P. Rawl and Sons, Inc.	Groundwater	IR	Moderate	2050	0.07
Walter P. Rawl and Sons, Inc.	Groundwater	IR	Moderate	2060	0.07
Walter P. Rawl and Sons, Inc.	Groundwater	IR	Moderate	2070	0.07
Watson Jerrold Farm	Surface Water	IR	Moderate	2025	0.32
Watson Jerrold Farm	Surface Water	IR	Moderate	2030	0.32
Watson Jerrold Farm	Surface Water	IR	Moderate	2035	0.32
Watson Jerrold Farm	Surface Water	IR	Moderate	2040	0.32
Watson Jerrold Farm	Surface Water	IR	Moderate	2050	0.32
Watson Jerrold Farm	Surface Water	IR	Moderate	2060	0.32
Watson Jerrold Farm	Surface Water	IR	Moderate	2070	0.32
Vulcan Mining	Surface Water	MI	Moderate	2025	0.08
Vulcan Mining	Surface Water	MI	Moderate	2030	0.08
Vulcan Mining	Surface Water	MI	Moderate	2035	0.08
Vulcan Mining	Surface Water	MI	Moderate	2040	0.08
Vulcan Mining	Surface Water	MI	Moderate	2050	0.08
Vulcan Mining	Surface Water	MI	Moderate	2060	0.08
Vulcan Mining	Surface Water	MI	Moderate	2070	0.08
Dominion Energy	Surface Water	PT	Moderate	2025	166.90
Dominion Energy	Surface Water	PT	Moderate	2030	166.90
Dominion Energy	Surface Water	PT	Moderate	2035	166.90
Dominion Energy	Surface Water	PT	Moderate	2040	166.90
Dominion Energy	Surface Water	PT	Moderate	2050	166.90
Dominion Energy	Surface Water	PT	Moderate	2060	166.90
Dominion Energy	Surface Water	PT	Moderate	2070	166.90
Duke Lee Station	Surface Water	PT	Moderate	2025	4.29
Duke Lee Station	Surface Water	PT	Moderate	2030	4.29
Duke Lee Station	Surface Water	PT	Moderate	2035	4.29
Duke Lee Station	Surface Water	PT	Moderate	2040	4.29
Duke Lee Station	Surface Water	PT	Moderate	2050	4.29
Duke Lee Station	Surface Water	PT	Moderate	2060	4.29
Duke Lee Station	Surface Water	PT	Moderate	2070	4.29
Belton Honea Path	Surface Water	WS	Moderate	2025	1.95

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Belton Honea Path	Surface Water	WS	Moderate	2030	2.06
Belton Honea Path	Surface Water	WS	Moderate	2035	2.16
Belton Honea Path	Surface Water	WS	Moderate	2040	2.27
Belton Honea Path	Surface Water	WS	Moderate	2050	2.49
Belton Honea Path	Surface Water	WS	Moderate	2060	2.71
Belton Honea Path	Surface Water	WS	Moderate	2070	2.93
Columbia	Surface Water	WS	Moderate	2025	31.95
Columbia	Surface Water	WS	Moderate	2030	32.50
Columbia	Surface Water	WS	Moderate	2035	32.87
Columbia	Surface Water	WS	Moderate	2040	33.19
Columbia	Surface Water	WS	Moderate	2050	34.09
Columbia	Surface Water	WS	Moderate	2060	35.00
Columbia	Surface Water	WS	Moderate	2070	35.90
Easley	Surface Water	WS	Moderate	2025	6.60
Easley	Surface Water	WS	Moderate	2030	6.97
Easley	Surface Water	WS	Moderate	2035	7.33
Easley	Surface Water	WS	Moderate	2040	7.69
Easley	Surface Water	WS	Moderate	2050	8.43
Easley	Surface Water	WS	Moderate	2060	9.17
Easley	Surface Water	WS	Moderate	2070	9.91
Gilbert-Summit Rural Water District	Groundwater	WS	Moderate	2025	0.04
Gilbert-Summit Rural Water District	Groundwater	WS	Moderate	2030	0.04
Gilbert-Summit Rural Water District	Groundwater	WS	Moderate	2035	0.04
Gilbert-Summit Rural Water District	Groundwater	WS	Moderate	2040	0.04
Gilbert-Summit Rural Water District	Groundwater	WS	Moderate	2050	0.04
Gilbert-Summit Rural Water District	Groundwater	WS	Moderate	2060	0.04
Gilbert-Summit Rural Water District	Groundwater	WS	Moderate	2070	0.04
Greenville	Surface Water	WS	Moderate	2025	35.19
Greenville	Surface Water	WS	Moderate	2030	35.03
Greenville	Surface Water	WS	Moderate	2035	34.88

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Greenville	Surface Water	WS	Moderate	2040	34.72
Greenville	Surface Water	WS	Moderate	2050	34.41
Greenville	Surface Water	WS	Moderate	2060	34.10
Greenville	Surface Water	WS	Moderate	2070	33.79
Greenwood	Surface Water	WS	Moderate	2025	9.57
Greenwood	Surface Water	WS	Moderate	2030	9.45
Greenwood	Surface Water	WS	Moderate	2035	9.29
Greenwood	Surface Water	WS	Moderate	2040	9.18
Greenwood	Surface Water	WS	Moderate	2050	9.18
Greenwood	Surface Water	WS	Moderate	2060	9.18
Greenwood	Surface Water	WS	Moderate	2070	9.18
Laurens CPW	Surface Water	WS	Moderate	2025	1.57
Laurens CPW	Surface Water	WS	Moderate	2030	1.58
Laurens CPW	Surface Water	WS	Moderate	2035	1.59
Laurens CPW	Surface Water	WS	Moderate	2040	1.60
Laurens CPW	Surface Water	WS	Moderate	2050	1.62
Laurens CPW	Surface Water	WS	Moderate	2060	1.65
Laurens CPW	Surface Water	WS	Moderate	2070	1.67
LCWSC	Surface Water	WS	Moderate	2025	2.28
LCWSC	Surface Water	WS	Moderate	2030	2.30
LCWSC	Surface Water	WS	Moderate	2035	2.32
LCWSC	Surface Water	WS	Moderate	2040	2.33
LCWSC	Surface Water	WS	Moderate	2050	2.36
LCWSC	Surface Water	WS	Moderate	2060	2.40
LCWSC	Surface Water	WS	Moderate	2070	2.44
NCWSA	Surface Water	WS	Moderate	2025	0.88
NCWSA	Surface Water	WS	Moderate	2030	0.85
NCWSA	Surface Water	WS	Moderate	2035	0.82
NCWSA	Surface Water	WS	Moderate	2040	0.81
NCWSA	Surface Water	WS	Moderate	2050	0.81
NCWSA	Surface Water	WS	Moderate	2060	0.81
NCWSA	Surface Water	WS	Moderate	2070	0.81
Newberry	Surface Water	WS	Moderate	2025	3.20
Newberry	Surface Water	WS	Moderate	2030	3.12

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Newberry	Surface Water	WS	Moderate	2035	3.02
Newberry	Surface Water	WS	Moderate	2040	2.95
Newberry	Surface Water	WS	Moderate	2050	2.95
Newberry	Surface Water	WS	Moderate	2060	2.95
Newberry	Surface Water	WS	Moderate	2070	2.95
SCWSA	Surface Water	WS	Moderate	2025	2.18
SCWSA	Surface Water	WS	Moderate	2030	2.13
SCWSA	Surface Water	WS	Moderate	2035	2.06
SCWSA	Surface Water	WS	Moderate	2040	2.01
SCWSA	Surface Water	WS	Moderate	2050	2.01
SCWSA	Surface Water	WS	Moderate	2060	2.01
SCWSA	Surface Water	WS	Moderate	2070	2.01
West Columbia	Surface Water	WS	Moderate	2025	12.34
West Columbia	Surface Water	WS	Moderate	2030	12.74
West Columbia	Surface Water	WS	Moderate	2035	13.06
West Columbia	Surface Water	WS	Moderate	2040	13.38
West Columbia	Surface Water	WS	Moderate	2050	14.13
West Columbia	Surface Water	WS	Moderate	2060	14.87
West Columbia	Surface Water	WS	Moderate	2070	15.62
Cliffs Club	Surface Water	GC	High Demand	2025	0.12
Cliffs Club	Surface Water	GC	High Demand	2030	0.12
Cliffs Club	Surface Water	GC	High Demand	2035	0.12
Cliffs Club	Surface Water	GC	High Demand	2040	0.12
Cliffs Club	Surface Water	GC	High Demand	2050	0.12
Cliffs Club	Surface Water	GC	High Demand	2060	0.12
Cliffs Club	Surface Water	GC	High Demand	2070	0.12
Furman	Surface Water	GC	High Demand	2025	0.20
Furman	Surface Water	GC	High Demand	2030	0.20
Furman	Surface Water	GC	High Demand	2035	0.20
Furman	Surface Water	GC	High Demand	2040	0.20
Furman	Surface Water	GC	High Demand	2050	0.20
Furman	Surface Water	GC	High Demand	2060	0.20
Furman	Surface Water	GC	High Demand	2070	0.20
Furman	Groundwater	GC	High Demand	2025	0.02

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Furman	Groundwater	GC	High Demand	2030	0.02
Furman	Groundwater	GC	High Demand	2035	0.02
Furman	Groundwater	GC	High Demand	2040	0.02
Furman	Groundwater	GC	High Demand	2050	0.02
Furman	Groundwater	GC	High Demand	2060	0.02
Furman	Groundwater	GC	High Demand	2070	0.02
Golden Hills	Surface Water	GC	High Demand	2025	0.09
Golden Hills	Surface Water	GC	High Demand	2030	0.09
Golden Hills	Surface Water	GC	High Demand	2035	0.09
Golden Hills	Surface Water	GC	High Demand	2040	0.09
Golden Hills	Surface Water	GC	High Demand	2050	0.09
Golden Hills	Surface Water	GC	High Demand	2060	0.09
Golden Hills	Surface Water	GC	High Demand	2070	0.09
Lexington	Surface Water	GC	High Demand	2025	0.14
Lexington	Surface Water	GC	High Demand	2030	0.14
Lexington	Surface Water	GC	High Demand	2035	0.14
Lexington	Surface Water	GC	High Demand	2040	0.14
Lexington	Surface Water	GC	High Demand	2050	0.14
Lexington	Surface Water	GC	High Demand	2060	0.14
Lexington	Surface Water	GC	High Demand	2070	0.14
Ponderosa	Surface Water	GC	High Demand	2025	0.06
Ponderosa	Surface Water	GC	High Demand	2030	0.06
Ponderosa	Surface Water	GC	High Demand	2035	0.06
Ponderosa	Surface Water	GC	High Demand	2040	0.06
Ponderosa	Surface Water	GC	High Demand	2050	0.06
Ponderosa	Surface Water	GC	High Demand	2060	0.06
Ponderosa	Surface Water	GC	High Demand	2070	0.06
Rolling Green	Surface Water	GC	High Demand	2025	0.19
Rolling Green	Surface Water	GC	High Demand	2030	0.19
Rolling Green	Surface Water	GC	High Demand	2035	0.19
Rolling Green	Surface Water	GC	High Demand	2040	0.19
Rolling Green	Surface Water	GC	High Demand	2050	0.19
Rolling Green	Surface Water	GC	High Demand	2060	0.19
Rolling Green	Surface Water	GC	High Demand	2070	0.19

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Smithfields	Surface Water	GC	High Demand	2025	0.08
Smithfields	Surface Water	GC	High Demand	2030	0.08
Smithfields	Surface Water	GC	High Demand	2035	0.08
Smithfields	Surface Water	GC	High Demand	2040	0.08
Smithfields	Surface Water	GC	High Demand	2050	0.08
Smithfields	Surface Water	GC	High Demand	2060	0.08
Smithfields	Surface Water	GC	High Demand	2070	0.08
The Preserve	Surface Water	GC	High Demand	2025	0.14
The Preserve	Surface Water	GC	High Demand	2030	0.14
The Preserve	Surface Water	GC	High Demand	2035	0.14
The Preserve	Surface Water	GC	High Demand	2040	0.14
The Preserve	Surface Water	GC	High Demand	2050	0.14
The Preserve	Surface Water	GC	High Demand	2060	0.14
The Preserve	Surface Water	GC	High Demand	2070	0.14
The Rock	Surface Water	GC	High Demand	2025	0.05
The Rock	Surface Water	GC	High Demand	2030	0.05
The Rock	Surface Water	GC	High Demand	2035	0.05
The Rock	Surface Water	GC	High Demand	2040	0.05
The Rock	Surface Water	GC	High Demand	2050	0.05
The Rock	Surface Water	GC	High Demand	2060	0.05
The Rock	Surface Water	GC	High Demand	2070	0.05
Greenwood Mills INC Harris Plant	Groundwater	IN	High Demand	2025	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	High Demand	2030	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	High Demand	2035	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	High Demand	2040	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	High Demand	2050	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	High Demand	2060	0.01
Greenwood Mills INC Harris Plant	Groundwater	IN	High Demand	2070	0.01
Shaw Industries	Surface Water	IN	High Demand	2025	35.99
Shaw Industries	Surface Water	IN	High Demand	2030	39.93

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Shaw Industries	Surface Water	IN	High Demand	2035	44.30
Shaw Industries	Surface Water	IN	High Demand	2040	49.05
Shaw Industries	Surface Water	IN	High Demand	2050	60.51
Shaw Industries	Surface Water	IN	High Demand	2060	74.32
Shaw Industries	Surface Water	IN	High Demand	2070	91.69
305010901	Surface Water	IR	High Demand	2025	0.00
305010901	Surface Water	IR	High Demand	2030	0.01
305010901	Surface Water	IR	High Demand	2035	0.02
305010901	Surface Water	IR	High Demand	2040	0.02
305010901	Surface Water	IR	High Demand	2050	0.03
305010901	Surface Water	IR	High Demand	2060	0.05
305010901	Surface Water	IR	High Demand	2070	0.06
305010903	Surface Water	IR	High Demand	2025	0.00
305010903	Surface Water	IR	High Demand	2030	0.01
305010903	Surface Water	IR	High Demand	2035	0.01
305010903	Surface Water	IR	High Demand	2040	0.01
305010903	Surface Water	IR	High Demand	2050	0.02
305010903	Surface Water	IR	High Demand	2060	0.03
305010903	Surface Water	IR	High Demand	2070	0.04
305010910	Surface Water	IR	High Demand	2025	0.04
305010910	Surface Water	IR	High Demand	2030	0.10
305010910	Surface Water	IR	High Demand	2035	0.15
305010910	Surface Water	IR	High Demand	2040	0.21
305010910	Surface Water	IR	High Demand	2050	0.34
305010910	Surface Water	IR	High Demand	2060	0.47
305010910	Surface Water	IR	High Demand	2070	0.61
305010911	Surface Water	IR	High Demand	2025	0.01
305010911	Surface Water	IR	High Demand	2030	0.02
305010911	Surface Water	IR	High Demand	2035	0.03
305010911	Surface Water	IR	High Demand	2040	0.04
305010911	Surface Water	IR	High Demand	2050	0.07
305010911	Surface Water	IR	High Demand	2060	0.10
305010911	Surface Water	IR	High Demand	2070	0.13
305010912	Surface Water	IR	High Demand	2025	0.00

User	Water Source	Use Category	Projection	Year	Demand (MGD)
305010912	Surface Water	IR	High Demand	2030	0.01
305010912	Surface Water	IR	High Demand	2035	0.01
305010912	Surface Water	IR	High Demand	2040	0.02
305010912	Surface Water	IR	High Demand	2050	0.03
305010912	Surface Water	IR	High Demand	2060	0.04
305010912	Surface Water	IR	High Demand	2070	0.06
305010914	Surface Water	IR	High Demand	2025	0.02
305010914	Surface Water	IR	High Demand	2030	0.05
305010914	Surface Water	IR	High Demand	2035	0.08
305010914	Surface Water	IR	High Demand	2040	0.12
305010914	Surface Water	IR	High Demand	2050	0.18
305010914	Surface Water	IR	High Demand	2060	0.26
305010914	Surface Water	IR	High Demand	2070	0.34
Beechwood	Surface Water	IR	High Demand	2025	0.14
Beechwood	Surface Water	IR	High Demand	2030	0.14
Beechwood	Surface Water	IR	High Demand	2035	0.14
Beechwood	Surface Water	IR	High Demand	2040	0.14
Beechwood	Surface Water	IR	High Demand	2050	0.14
Beechwood	Surface Water	IR	High Demand	2060	0.14
Beechwood	Surface Water	IR	High Demand	2070	0.14
Bush River Farms	Groundwater	IR	High Demand	2025	0.04
Bush River Farms	Groundwater	IR	High Demand	2030	0.04
Bush River Farms	Groundwater	IR	High Demand	2035	0.04
Bush River Farms	Groundwater	IR	High Demand	2040	0.04
Bush River Farms	Groundwater	IR	High Demand	2050	0.04
Bush River Farms	Groundwater	IR	High Demand	2060	0.04
Bush River Farms	Groundwater	IR	High Demand	2070	0.04
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2025	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2030	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2035	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2040	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2050	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2060	0.00
James R. Sease Farms, Inc.	Groundwater	IR	Moderate	2070	0.00

User	Water Source	Use Category	Projection	Year	Demand (MGD)
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2025	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2030	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2035	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2040	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2050	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2060	0.00
J & P Park Aquisitions, Inc.	Groundwater	IR	Moderate	2070	0.00
Leslea Farms	Surface Water	IR	High Demand	2025	0.06
Leslea Farms	Surface Water	IR	High Demand	2030	0.06
Leslea Farms	Surface Water	IR	High Demand	2035	0.06
Leslea Farms	Surface Water	IR	High Demand	2040	0.06
Leslea Farms	Surface Water	IR	High Demand	2050	0.06
Leslea Farms	Surface Water	IR	High Demand	2060	0.06
Leslea Farms	Surface Water	IR	High Demand	2070	0.06
Mayer Farm	Surface Water	IR	High Demand	2025	0.00
Mayer Farm	Surface Water	IR	High Demand	2030	0.00
Mayer Farm	Surface Water	IR	High Demand	2035	0.00
Mayer Farm	Surface Water	IR	High Demand	2040	0.00
Mayer Farm	Surface Water	IR	High Demand	2050	0.00
Mayer Farm	Surface Water	IR	High Demand	2060	0.00
Mayer Farm	Surface Water	IR	High Demand	2070	0.00
Mayer Farm	Groundwater	IR	High Demand	2025	0.29
Mayer Farm	Groundwater	IR	High Demand	2030	0.29
Mayer Farm	Groundwater	IR	High Demand	2035	0.29
Mayer Farm	Groundwater	IR	High Demand	2040	0.29
Mayer Farm	Groundwater	IR	High Demand	2050	0.29
Mayer Farm	Groundwater	IR	High Demand	2060	0.29
Mayer Farm	Groundwater	IR	High Demand	2070	0.29
Merritt Bros	Surface Water	IR	High Demand	2025	0.03
Merritt Bros	Surface Water	IR	High Demand	2030	0.03
Merritt Bros	Surface Water	IR	High Demand	2035	0.03
Merritt Bros	Surface Water	IR	High Demand	2040	0.03
Merritt Bros	Surface Water	IR	High Demand	2050	0.03
Merritt Bros	Surface Water	IR	High Demand	2060	0.03

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Merritt Bros	Surface Water	IR	High Demand	2070	0.03
Satterwhite Farm	Surface Water	IR	High Demand	2025	0.07
Satterwhite Farm	Surface Water	IR	High Demand	2030	0.07
Satterwhite Farm	Surface Water	IR	High Demand	2035	0.07
Satterwhite Farm	Surface Water	IR	High Demand	2040	0.07
Satterwhite Farm	Surface Water	IR	High Demand	2050	0.07
Satterwhite Farm	Surface Water	IR	High Demand	2060	0.07
Satterwhite Farm	Surface Water	IR	High Demand	2070	0.07
Sease Clinton	Surface Water	IR	High Demand	2025	0.14
Sease Clinton	Surface Water	IR	High Demand	2030	0.14
Sease Clinton	Surface Water	IR	High Demand	2035	0.14
Sease Clinton	Surface Water	IR	High Demand	2040	0.14
Sease Clinton	Surface Water	IR	High Demand	2050	0.14
Sease Clinton	Surface Water	IR	High Demand	2060	0.14
Sease Clinton	Surface Water	IR	High Demand	2070	0.14
Sease James	Surface Water	IR	High Demand	2025	0.64
Sease James	Surface Water	IR	High Demand	2030	0.64
Sease James	Surface Water	IR	High Demand	2035	0.64
Sease James	Surface Water	IR	High Demand	2040	0.64
Sease James	Surface Water	IR	High Demand	2050	0.64
Sease James	Surface Water	IR	High Demand	2060	0.64
Sease James	Surface Water	IR	High Demand	2070	0.64
Stoneybrook	Surface Water	IR	High Demand	2025	0.03
Stoneybrook	Surface Water	IR	High Demand	2030	0.03
Stoneybrook	Surface Water	IR	High Demand	2035	0.03
Stoneybrook	Surface Water	IR	High Demand	2040	0.03
Stoneybrook	Surface Water	IR	High Demand	2050	0.03
Stoneybrook	Surface Water	IR	High Demand	2060	0.03
Stoneybrook	Surface Water	IR	High Demand	2070	0.03
Titan Farms	Surface Water	IR	High Demand	2025	1.24
Titan Farms	Surface Water	IR	High Demand	2030	1.24
Titan Farms	Surface Water	IR	High Demand	2035	1.24
Titan Farms	Surface Water	IR	High Demand	2040	1.24
Titan Farms	Surface Water	IR	High Demand	2050	1.24

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Titan Farms	Surface Water	IR	High Demand	2060	1.24
Titan Farms	Surface Water	IR	High Demand	2070	1.24
Twin Oaks Farm	Surface Water	IR	High Demand	2025	0.02
Twin Oaks Farm	Surface Water	IR	High Demand	2030	0.02
Twin Oaks Farm	Surface Water	IR	High Demand	2035	0.02
Twin Oaks Farm	Surface Water	IR	High Demand	2040	0.02
Twin Oaks Farm	Surface Water	IR	High Demand	2050	0.02
Twin Oaks Farm	Surface Water	IR	High Demand	2060	0.02
Twin Oaks Farm	Surface Water	IR	High Demand	2070	0.02
Walter P. Rawl and Sons, Inc.	Groundwater	IR	High Demand	2025	0.07
Walter P. Rawl and Sons, Inc.	Groundwater	IR	High Demand	2030	0.07
Walter P. Rawl and Sons, Inc.	Groundwater	IR	High Demand	2035	0.07
Walter P. Rawl and Sons, Inc.	Groundwater	IR	High Demand	2040	0.07
Walter P. Rawl and Sons, Inc.	Groundwater	IR	High Demand	2050	0.07
Walter P. Rawl and Sons, Inc.	Groundwater	IR	High Demand	2060	0.07
Walter P. Rawl and Sons, Inc.	Groundwater	IR	High Demand	2070	0.07
Watson Jerrold Farm	Surface Water	IR	High Demand	2025	0.49
Watson Jerrold Farm	Surface Water	IR	High Demand	2030	0.49
Watson Jerrold Farm	Surface Water	IR	High Demand	2035	0.49
Watson Jerrold Farm	Surface Water	IR	High Demand	2040	0.49
Watson Jerrold Farm	Surface Water	IR	High Demand	2050	0.49
Watson Jerrold Farm	Surface Water	IR	High Demand	2060	0.49
Watson Jerrold Farm	Surface Water	IR	High Demand	2070	0.49
Vulcan Mining	Surface Water	MI	High Demand	2025	0.08
Vulcan Mining	Surface Water	MI	High Demand	2030	0.08
Vulcan Mining	Surface Water	MI	High Demand	2035	0.08
Vulcan Mining	Surface Water	MI	High Demand	2040	0.08
Vulcan Mining	Surface Water	MI	High Demand	2050	0.08
Vulcan Mining	Surface Water	MI	High Demand	2060	0.08
Vulcan Mining	Surface Water	MI	High Demand	2070	0.08
Dominion Energy	Surface Water	PT	High Demand	2025	166.90
Dominion Energy	Surface Water	PT	High Demand	2030	166.90
Dominion Energy	Surface Water	PT	High Demand	2035	166.90
Dominion Energy	Surface Water	PT	High Demand	2040	166.90

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Dominion Energy	Surface Water	PT	High Demand	2050	166.90
Dominion Energy	Surface Water	PT	High Demand	2060	166.90
Dominion Energy	Surface Water	PT	High Demand	2070	166.90
Duke Lee Station	Surface Water	PT	High Demand	2025	4.29
Duke Lee Station	Surface Water	PT	High Demand	2030	4.29
Duke Lee Station	Surface Water	PT	High Demand	2035	4.29
Duke Lee Station	Surface Water	PT	High Demand	2040	4.29
Duke Lee Station	Surface Water	PT	High Demand	2050	4.29
Duke Lee Station	Surface Water	PT	High Demand	2060	4.29
Duke Lee Station	Surface Water	PT	High Demand	2070	4.29
Belton Honea Path	Surface Water	WS	High Demand	2025	2.17
Belton Honea Path	Surface Water	WS	High Demand	2030	2.31
Belton Honea Path	Surface Water	WS	High Demand	2035	2.46
Belton Honea Path	Surface Water	WS	High Demand	2040	2.62
Belton Honea Path	Surface Water	WS	High Demand	2050	2.97
Belton Honea Path	Surface Water	WS	High Demand	2060	3.37
Belton Honea Path	Surface Water	WS	High Demand	2070	3.83
Columbia	Surface Water	WS	High Demand	2025	35.32
Columbia	Surface Water	WS	High Demand	2030	36.97
Columbia	Surface Water	WS	High Demand	2035	38.69
Columbia	Surface Water	WS	High Demand	2040	40.49
Columbia	Surface Water	WS	High Demand	2050	44.35
Columbia	Surface Water	WS	High Demand	2060	48.58
Columbia	Surface Water	WS	High Demand	2070	53.21
Easley	Surface Water	WS	High Demand	2025	7.35
Easley	Surface Water	WS	High Demand	2030	7.83
Easley	Surface Water	WS	High Demand	2035	8.33
Easley	Surface Water	WS	High Demand	2040	8.87
Easley	Surface Water	WS	High Demand	2050	10.06
Easley	Surface Water	WS	High Demand	2060	11.42
Easley	Surface Water	WS	High Demand	2070	12.97
Gilbert-Summit Rural Water District	Groundwater	WS	High Demand	2025	0.04

User	Water Source	Use Category	Projection	Year	Demand (MGD)
Gilbert-Summit Rural Water District	Groundwater	WS	High Demand	2030	0.04
Gilbert-Summit Rural Water District	Groundwater	WS	High Demand	2035	0.04
Gilbert-Summit Rural Water District	Groundwater	WS	High Demand	2040	0.04
Gilbert-Summit Rural Water District	Groundwater	WS	High Demand	2050	0.04
Gilbert-Summit Rural Water District	Groundwater	WS	High Demand	2060	0.04
Gilbert-Summit Rural Water District	Groundwater	WS	High Demand	2070	0.04
Greenville	Surface Water	WS	High Demand	2025	35.19
Greenville	Surface Water	WS	High Demand	2030	35.03
Greenville	Surface Water	WS	High Demand	2035	34.88
Greenville	Surface Water	WS	High Demand	2040	34.72
Greenville	Surface Water	WS	High Demand	2050	34.41
Greenville	Surface Water	WS	High Demand	2060	34.10
Greenville	Surface Water	WS	High Demand	2070	33.79
Greenwood	Surface Water	WS	High Demand	2025	10.75
Greenwood	Surface Water	WS	High Demand	2030	11.25
Greenwood	Surface Water	WS	High Demand	2035	11.77
Greenwood	Surface Water	WS	High Demand	2040	12.32
Greenwood	Surface Water	WS	High Demand	2050	13.49
Greenwood	Surface Water	WS	High Demand	2060	14.78
Greenwood	Surface Water	WS	High Demand	2070	16.19
Laurens CPW	Surface Water	WS	High Demand	2025	1.61
Laurens CPW	Surface Water	WS	High Demand	2030	1.68
Laurens CPW	Surface Water	WS	High Demand	2035	1.76
Laurens CPW	Surface Water	WS	High Demand	2040	1.84
Laurens CPW	Surface Water	WS	High Demand	2050	2.02
Laurens CPW	Surface Water	WS	High Demand	2060	2.21
Laurens CPW	Surface Water	WS	High Demand	2070	2.42
LCWSC	Surface Water	WS	High Demand	2025	2.34
LCWSC	Surface Water	WS	High Demand	2030	2.45
LCWSC	Surface Water	WS	High Demand	2035	2.56

User	Water Source	Use Category	Projection	Year	Demand (MGD)
LCWSC	Surface Water	WS	High Demand	2040	2.68
LCWSC	Surface Water	WS	High Demand	2050	2.94
LCWSC	Surface Water	WS	High Demand	2060	3.22
LCWSC	Surface Water	WS	High Demand	2070	3.53
NCWSA	Surface Water	WS	High Demand	2025	1.07
NCWSA	Surface Water	WS	High Demand	2030	1.12
NCWSA	Surface Water	WS	High Demand	2035	1.18
NCWSA	Surface Water	WS	High Demand	2040	1.23
NCWSA	Surface Water	WS	High Demand	2050	1.35
NCWSA	Surface Water	WS	High Demand	2060	1.48
NCWSA	Surface Water	WS	High Demand	2070	1.62
Newberry	Surface Water	WS	High Demand	2025	3.93
Newberry	Surface Water	WS	High Demand	2030	4.11
Newberry	Surface Water	WS	High Demand	2035	4.30
Newberry	Surface Water	WS	High Demand	2040	4.50
Newberry	Surface Water	WS	High Demand	2050	4.93
Newberry	Surface Water	WS	High Demand	2060	5.41
Newberry	Surface Water	WS	High Demand	2070	5.92
SCWSA	Surface Water	WS	High Demand	2025	2.68
SCWSA	Surface Water	WS	High Demand	2030	2.81
SCWSA	Surface Water	WS	High Demand	2035	2.94
SCWSA	Surface Water	WS	High Demand	2040	3.07
SCWSA	Surface Water	WS	High Demand	2050	3.37
SCWSA	Surface Water	WS	High Demand	2060	3.69
SCWSA	Surface Water	WS	High Demand	2070	4.04
West Columbia	Surface Water	WS	High Demand	2025	13.70
West Columbia	Surface Water	WS	High Demand	2030	14.34
West Columbia	Surface Water	WS	High Demand	2035	15.01
West Columbia	Surface Water	WS	High Demand	2040	15.71
West Columbia	Surface Water	WS	High Demand	2050	17.21
West Columbia	Surface Water	WS	High Demand	2060	18.85
West Columbia	Surface Water	WS	High Demand	2070	20.65

Appendix B
Surface Water Supply Model Results Tables

Table B-1. Current Use Scenario Summary of Water Supply Shortages.

Water User Name	Source Water	Location (mi)	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Average Shortage (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
WS: Easley	Mainstem/Saluda Lake	30	8.6	NA	0.0	0.0	0%
MI: Vulcan Mining	Mainstem	40	0.08	60	0.0	0.0	0%
PT: Duke Lee Station	Mainstem	58	4.3	72	0.0	0.0	0%
WS: Belton Honea Path	Mainstem	65	1.8	71	0.0	0.0	0%
WS: LCWSC	Mainstem/Greenwood Lake	101	2.3	NA	0.0	0.0	0%
WS: Greenwood	Mainstem/Greenwood Lake	101	9.7	NA	0.0	0.0	0%
WS: Newberry	Mainstem	129	5.1	145	0.0	0.0	0%
WS: Columbia	Mainstem/Lake Murray	169	61.4	1,147	0.0	0.0	0%
WS: SCWSA	Mainstem/Lake Murray	169	2.5	NA	0.0	0.0	0%
WS: NCWSA	Mainstem/Lake Murray	169	0.9	NA	0.0	0.0	0%
PT: Dominion Energy	Mainstem/Lake Murray	169	166.9	NA	0.0	0.0	0%
WS: West Columbia	Mainstem and Lake Murray	169	13.6	768	0.0	0.0	0%
IN: Shaw Industries	Mainstem	171	24.9	323	0.0	0.0	0%
GC: The Rock	Oolenoy River	1	0.02	2.0	0.0	0.0	0%
WS: Greenville	Table Rock/S. Saluda River and N. Saluda Res/N. Saluda River	2	35.2	NA	0.0	0.0	0%
GC: Cliffs Club	North Saluda River	7	0.07	5.3	0.0	0.0	0%
IR: Beechwood	North Saluda River	15	0.12	9.2	0.0	0.0	0%
GC: Rolling Green	Doddies Creek	1	0.10	1.0	0.0	0.0	0%
GC: Smithfields	Brushy Creek	1	0.03	0.1	0.0	0.0	0%
IR: Merritt Bros	Hurricane Creek	1	0.02	3.3	0.0	0.0	0%
IR: Twin Oaks Farm	Hurricane Creek	3	0.01	1.4	0.0	0.0	0%
IR: Stoneybrook	Big Creek	1	0.02	0.4	0.0	0.0	0%
WS: Laurens CPW	Lake Rabon and Rabon Creek	4	1.5	4.4	0.0	0.0	0%
GC: The Preserve	Laurel Creek	1	0.08	0.6	0.0	0.0	0%
GC: Furman	Reedy River	1	0.08	1.0	0.0	0.0	0%
IR: Overbridge Farm	Big Beaverdam Creek	1	0.02	0.01	0.0	0.03	0.2%

Water User Name	Source Water	Location (mi)	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Average Shortage (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
IR: Leslea Farms	Big Beaverdam Creek	2	0.04	0.2	0.0	0.02	0.1%
IR: Satterwhite Farm	Bush River	8	0.03	0.1	0.0	0.0	0%
IR: Bush River Farms	Bush River	14	0.27	1.6	0.0	0.0	0%
IR: Mayer Farm	Bush River	16	0.005	1.2	0.0	0.0	0%
GC: Ponderosa	West Creek	3	0.05	0.9	0.0	0.0	0%
IR: Watson Jerrold Farm	Clouds Creek	1	0.58	0.1	0.1	0.9	14%
IR: Titan Farms	Clouds Creek	4	1.1	0.4	0.04	1.5	9%
IR: Sease James	Twelvemile Creek	1	0.45	0.9	0.0	0.0	0%
GC: Lexington	Twelvemile Creek	6	0.09	1.1	0.0	0.0	0%
IR: Sease Clinton	Twelvemile Creek	7	0.08	1.2	0.0	0.0	0%
GC: Golden Hills	Twelvemile Creek	12	0.05	2.1	0.0	0.0	0%

IR = Agriculture (irrigator); GC = Golf Course (irrigator); MI = Mining Operation; WS = Public Water Supplier; PT = Power Thermal; IN = Industry

NA - Not applicable (reservoir withdrawal)

Table B-2. Moderate Demand 2070 Scenario Summary of Water Supply Shortages.

Water User Name	Source Water	Location (mi)	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Average Shortage (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
WS: Easley	Mainstem/Saluda Lake	30	9.9	NA	0.0	0.0	0%
MI: Vulcan Mining	Mainstem	40	0.08	58	0.0	0.0	0%
PT: Duke Lee Station	Mainstem	58	4.3	70	0.0	0.0	0%
HUC903 Future IR	Mainstem	59	0.004	66	0.0	0.0	0%
WS: Belton Honea Path	Mainstem	65	2.9	70	0.0	0.0	0%
WS: LCWSC	Mainstem/Greenwood Lake	101	2.4	NA	0.0	0.0	0%
WS: Greenwood	Mainstem/Greenwood Lake	101	9.2	NA	0.0	0.0	0%
WS: Newberry	Mainstem	129	3.0	144	0.0	0.0	0%
HUC912 Future IR	Mainstem	143	0.03	159	0.0	0.0	0%
WS: Columbia	Mainstem/Lake Murray	169	78.1	1,156	0.0	0.0	0%
WS: SCWSA	Mainstem/Lake Murray	169	2.0	NA	0.0	0.0	0%
WS: NCWSA	Mainstem/Lake Murray	169	0.8	NA	0.0	0.0	0%
PT: Dominion Energy	Mainstem/Lake Murray	169	166.9	NA	0.0	0.0	0%
WS: West Columbia	Mainstem and Lake Murray	169	15.6	766	0.0	0.0	0%
IN: Shaw Industries	Mainstem	171	56.0	323	0.0	0.0	0%
HUC914 Future IR	Mainstem	175	0.1	333	0.0	0.0	0%
GC: The Rock	Oolenoy River	1	0.01	2.0	0.0	0.0	0%
WS: Greenville	Table Rock/S. Saluda River and N. Saluda Res/N. Saluda River	2	33.8	NA	0.0	0.0	0%
GC: Cliffs Club	North Saluda River	7	0.05	5.3	0.0	0.0	0%
IR: Beechwood	North Saluda River	15	0.12	9.2	0.0	0.0	0%
HUC901 Future IR	North Saluda River	22	0.04	13.9	0.0	0.0	0%
GC: Rolling Green	Doddies Creek	1	0.10	1.0	0.0	0.0	0%
GC: Smithfields	Brushy Creek	1	0.03	0.1	0.0	0.0	0%
IR: Merritt Bros	Hurricane Creek	1	0.0001	3.5	0.0	0.0	0%
IR: Twin Oaks Farm	Hurricane Creek	3	0.003	1.4	0.0	0.0	0%
IR: Stoneybrook	Big Creek	1	0.01	0.4	0.0	0.0	0%

Water User Name	Source Water	Location (mi)	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Average Shortage (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
WS: Laurens CPW	Lake Rabon and Rabon Creek	4	1.7	3.8	0.0	0.0	0%
GC: The Preserve	Laurel Creek	1	0.07	0.6	0.0	0.0	0%
GC: Furman	Reedy River	1	0.09	1.0	0.0	0.0	0%
IR: Overbridge Farm	Big Beaverdam Creek	1	0.02	0.01	0.00003	0.03	0.2%
IR: Leslea Farms	Big Beaverdam Creek	2	0.03	0.2	0.0	0.0	0%
IR: Satterwhite Farm	Bush River	8	0.05	0.1	0.0	0.0	0%
IR: Bush River Farms	Bush River	14	0.3	1.6	0.0	0.0	0%
IR: Mayer Farm	Bush River	16	0.0	1.3	0.0	0.0	0%
HUC911 Future IR	Little Saluda River	26	0.1	1.9	0.0	0.0	0%
GC: Ponderosa	West Creek	3	0.03	0.9	0.0	0.0	0%
IR: Watson Jerrold Farm	Clouds Creek	1	0.3	0.1	0.02	0.6	7%
IR: Titan Farms	Clouds Creek	4	1.1	0.4	0.07	1.9	10%
HUC910 Future IR	Clouds Creek	27	0.4	2.4	0.0	0.0	0%
IR: Sease James	Twelvemile Creek	1	0.3	0.9	0.0	0.0	0%
GC: Lexington	Twelvemile Creek	6	0.08	1.3	0.0	0.0	0%
IR: Sease Clinton	Twelvemile Creek	7	0.07	1.3	0.0	0.0	0%
GC: Golden Hills	Twelvemile Creek	12	0.03	2.3	0.0	0.0	0%

IR = Agriculture (irrigator); GC = Golf Course (irrigator); MI = Mining Operation; WS = Public Water Supplier; PT = Power Thermal; IN = Industry

NA - Not applicable (reservoir withdrawal)

Table B-3. High Demand 2070 Scenario Summary of Water Supply Shortages.

Water User Name	Source Water	Location (mi)	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Average Shortage (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
WS: Easley	Mainstem/Saluda Lake	30	13.0	NA	0.0	0.0	0%
MI: Vulcan Mining	Mainstem	40	0.1	53	0.0	0.0	0%
PT: Duke Lee Station	Mainstem	58	4.3	66	0.0	0.0	0%
HUC903 Future IR	Mainstem	59	0.04	62	0.0	0.0	0%
WS: Belton Honea Path	Mainstem	65	3.8	66.4	0.0	0.0	0%
WS: LCWSC	Mainstem/Greenwood Lake	101	3.5	NA	0.0	0.0	0%
WS: Greenwood	Mainstem/Greenwood Lake	101	16.2	NA	0.0	0.0	0%
WS: Newberry	Mainstem	129	5.9	137	0.0	0.0	0%
HUC912 Future IR	Mainstem	143	0.1	151	0.0	0.0	0%
WS: Columbia	Mainstem/Lake Murray	169	118.2	1,180	0.0	0.0	0%
WS: SCWSA	Mainstem/Lake Murray	169	4.0	NA	0.0	0.0	0%
WS: NCWSA	Mainstem/Lake Murray	169	1.6	NA	0.0	0.0	0%
PT: Dominion Energy	Mainstem/Lake Murray	169	166.9	NA	0.0	0.0	0%
WS: West Columbia	Mainstem and Lake Murray	169	20.6	676	0.0	0.0	0%
IN: Shaw Industries	Mainstem	171	91.6	323	0.0	0.0	0%
HUC914 Future IR	Mainstem	175	0.3	330	0.0	0.0	0%
GC: The Rock	Oolenoy River	1	0.05	2.0	0.0	0.0	0%
WS: Greenville	Table Rock/S. Saluda River and N. Saluda Res/N. Saluda River	2	33.8	NA	0.0	0.0	0%
GC: Cliffs Club	North Saluda River	7	0.1	5.3	0.0	0.0	0%
IR: Beechwood	North Saluda River	15	0.1	9.2	0.0	0.0	0%
HUC901 Future IR	North Saluda River	22	0.1	13.8	0.0	0.0	0%
GC: Rolling Green	Doddies Creek	1	0.2	1.0	0.0	0.0	0%
GC: Smithfields	Brushy Creek	1	0.1	0.1	0.00003	0.03	0.1%
IR: Merritt Bros	Hurricane Creek	1	0.03	4.4	0.0	0.0	0%
IR: Twin Oaks Farm	Hurricane Creek	3	0.02	1.4	0.0	0.0	0%
IR: Stoneybrook	Big Creek	1	0.03	0.4	0.0	0.0	0%

Water User Name	Source Water	Location (mi)	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Average Shortage (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
WS: Laurens CPW	Lake Rabon and Rabon Creek	4	2.4	0.8	0.0	0.0	0%
GC: The Preserve	Laurel Creek	1	0.1	0.6	0.0	0.0	0%
GC: Furman	Reedy River	1	0.2	1.0	0.0	0.0	0%
IR: Overbridge Farm	Big Beaverdam Creek	1	0.02	0.01	0.00003	0.03	0.2%
IR: Leslea Farms	Big Beaverdam Creek	2	0.06	0.1	0.0002	0.1	0.3%
IR: Satterwhite Farm	Bush River	8	0.07	0.1	0.00004	0.04	0.1%
IR: Bush River Farms	Bush River	14	0.3	1.9	0.0	0.0	0%
IR: Mayer Farm	Bush River	16	0.0	1.5	0.0	0.0	0%
HUC911 Future IR	Little Saluda River	26	0.1	2.2	0.0	0.0	0%
GC: Ponderosa	West Creek	3	0.1	0.9	0.0	0.0	0%
IR: Watson Jerrold Farm	Clouds Creek	1	0.5	0.1	0.04	0.8	12%
IR: Titan Farms	Clouds Creek	4	1.2	0.4	0.1	2.5	12%
HUC910 Future IR	Clouds Creek	27	0.6	2.4	0.0	0.0	0%
IR: Sease James	Twelvemile Creek	1	0.6	0.9	0.0	0.0	0%
GC: Lexington	Twelvemile Creek	6	0.1	0.8	0.0	0.0	0%
IR: Sease Clinton	Twelvemile Creek	7	0.1	0.9	0.0	0.0	0%
GC: Golden Hills	Twelvemile Creek	12	0.1	1.7	0.0	0.0	0%

IR = Agriculture (irrigator); GC = Golf Course (irrigator); MI = Mining Operation; WS = Public Water Supplier; PT = Power Thermal; IN = Industry

NA - Not applicable (reservoir withdrawal)

Table B-4. Permitted and Registered Scenario Summary of Water Supply Shortages.

Water User Name	Source Water	Location (mi)	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Average Shortage (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
WS: Easley	Mainstem/Saluda Lake	30	36.7	NA	0.0	0.0	0%
MI: Vulcan Mining	Mainstem	40	0.53	25	0.0	0.0	0%
PT: Duke Lee Station	Mainstem	58	5.1	40	0.0	0.0	0%
WS: Belton Honea Path	Mainstem	65	4.1	40	0.0	0.0	0%
WS: LCWSC	Mainstem/Greenwood Lake	101	17.8	NA	0.0	0.0	0%
WS: Greenwood	Mainstem/Greenwood Lake	101	56.1	NA	0.0	0.0	0%
WS: Newberry	Mainstem	129	22.4	54	0.0	0.0	0%
WS: Columbia	Mainstem/Lake Murray	169	127.5	1,095	0.0	0.0	0%
WS: SCWSA	Mainstem/Lake Murray	169	15.3	NA	0.0	0.0	0%
WS: NCWSA	Mainstem/Lake Murray	169	6.1	NA	0.0	0.0	0%
PT: Dominion Energy	Mainstem/Lake Murray	169	170.3	NA	0.0	0.0	0%
WS: West Columbia	Mainstem and Lake Murray	169	43.2	636	0.0	0.0	0%
IN: Shaw Industries	Mainstem	171	44.9	323	0.0	0.0	0%
GC: The Rock	Oolenoy River	1	0.23	2.0	0.0	0.0	0%
WS: Greenville	Table Rock/S. Saluda River and N. Saluda Res/N. Saluda River	2	129.5	NA	47.6	120.9	82%
GC: Cliffs Club	North Saluda River	7	0.44	2.2	0.0	0.0	0%
IR: Beechwood	North Saluda River	15	0.39	5.9	0.0	0.0	0%
GC: Rolling Green	Doddies Creek	1	0.52	1.0	0.0	0.0	0%
GC: Smithfields	Brushy Creek	1	1.47	0.1	0.02	1.4	6%
IR: Merritt Bros	Hurricane Creek	1	0.58	8.5	0.0	0.0	0%
IR: Twin Oaks Farm	Hurricane Creek	3	0.11	1.2	0.0	0.0	0%
IR: Stoneybrook	Big Creek	1	0.10	0.4	0.0	0.0	0%
WS: Laurens CPW	Lake Rabon and Rabon Creek	4	66.4	0.1	20.2	66.1	69%
GC: The Preserve	Laurel Creek	1	1.91	0.6	0.04	1.3	8%
GC: Furman	Reedy River	1	2.23	1.0	0.03	1.3	6%
IR: Overbridge Farm	Big Beaverdam Creek	1	0.35	0.01	0.01	0.34	5.2%

Water User Name	Source Water	Location (mi)	Average Annual Demand (MGD)	Minimum Physically Available Flow (MGD)	Average Shortage (MGD)	Maximum Shortage (MGD)	Frequency of Shortage (%)
IR: Leslea Farms	Big Beaverdam Creek	2	0.52	0.1	0.02	0.46	9.0%
IR: Satterwhite Farm	Bush River	8	0.13	0.1	0.0001	0.1	0.1%
IR: Bush River Farms	Bush River	14	0.56	4.8	0.0	0.0	0%
IR: Mayer Farm	Bush River	16	0.214	4.2	0.0	0.0	0%
GC: Ponderosa	West Creek	3	1.47	0.9	0.001	0.6	0.2%
IR: Watson Jerrold Farm	Clouds Creek	1	5.92	0.1	2.9	5.9	76%
IR: Titan Farms	Clouds Creek	4	3.3	0.4	0.46	3.0	40%
IR: Sease James	Twelvemile Creek	1	2.03	0.6	0.004	0.9	1%
GC: Lexington	Twelvemile Creek	6	0.73	0.7	0.00003	0.03	0.1%
IR: Sease Clinton	Twelvemile Creek	7	0.98	0.2	0.003	0.7	1%
GC: Golden Hills	Twelvemile Creek	12	1.07	1.1	0.0	0.0	0%

IR = Agriculture (irrigator); GC = Golf Course (irrigator); MI = Mining Operation; WS = Public Water Supplier; PT = Power Thermal; IN = Industry

NA - Not applicable (reservoir withdrawal)

Table B-5. Summary of Water Supply Shortages.

Supply Shortage Metric	Current Use	Moderate Demand 2070	High Demand 2070	Permitted and Registered
Total basin annual mean shortage (MGD)	0.09	0.09	0.14	71.3
Maximum water user shortage (MGD)	1.5	1.9	2.5	120.9
Total basin annual mean shortage as a percentage of total water demand	0.03%	0.02%	0.03%	9.2%
Percentage of surface water users experiencing a shortage	10.8%	7.0%	14.0%	37.8%
Average frequency of shortage (%)	0.6%	0.4%	0.6%	8.2%

Table B-6. Hydrologic Performance Measures at Strategic Nodes.

Performance Measure	SLD04 Saluda River Near Greenville	SLD07 Saluda River Near Williamston	SLD09 Saluda River Near Ware Shoals	SLD18 Saluda River at Chappells	SLD25 Saluda River Below Lake Murray Dam Near Columbia	SLD26 Saluda River Near Columbia	South Saluda River Strategic Node	North Saluda River Strategic Node	Rabon Creek Strategic Node	SLD11 Reedy River Above Fork Shoals	SLD22 Bush River near Prosperity
	All values in CFS										
Current Use Scenario											
minimum flow	78	107	124	211	501	516	36	20	7.4	58	6
mean flow	595	768	930	1,686	2,600	2,686	244	141	100	224	120
median flow	491	644	775	1,391	1,811	1,876	201	112	74	184	72
25th percentile flow	314	421	515	870	972	1,020	128	72	38	125	46
10th percentile flow	226	298	359	580	701	745	90	53	20	93	26
5th percentile flow	176	240	288	437	701	733	75	45	15	77	16
Moderate Demand 2070 Scenario											
minimum flow	76	105	120	209	501	515	36	20	6	58	5
mean flow	595	768	930	1,685	2,603	2,685	245	142	100	223	118
median flow	490	644	774	1,390	1,807	1,876	202	111	74	184	70
25th percentile flow	313	420	513	871	971	1,020	128	72	37	125	44
10th percentile flow	224	297	355	577	701	742	90	53	20	94	25
5th percentile flow	174	239	285	436	701	730	75	45	15	78	15
High Demand 2070 Scenario											
minimum flow	69	99	114	198	501	510	36	20	1.81	57	7
mean flow	590	765	926	1,674	2,562	2,642	245	142	98	223	121
median flow	484	641	772	1,381	1,751	1,814	202	111	72.8	183	73
25th percentile flow	308	416	509	857	885	950	128	72	36.0	125	47
10th percentile flow	218	293	352	564	701	737	90	53	18.7	94	28
5th percentile flow	168	234	281	426	701	726	75	45	14.4	77	17

Performance Measure	SLD04 Saluda River Near Greenville	SLD07 Saluda River Near Williamston	SLD09 Saluda River Near Ware Shoals	SLD18 Saluda River at Chappells	SLD25 Saluda River Below Lake Murray Dam Near Columbia	SLD26 Saluda River Near Columbia	South Saluda River Strategic Node	North Saluda River Strategic Node	Rabon Creek Strategic Node	SLD11 Reedy River Above Fork Shoals	SLD22 Bush River near Prosperity
	All values in CFS										
Permitted and Registered Scenario											
minimum flow	23	58	80	64	501	514	31	12	0.04	47	23
mean flow	484	670	838	1,488	2,267	2,349	203	115	31	235	140
median flow	406	569	700	1,203	1,389	1,459	172	99	2.5	194	94
25th percentile flow	259	373	472	721	701	756	119	67	1.5	126	64
10th percentile flow	173	256	322	476	701	734	85	49	0.9	88	44
5th percentile flow	124	195	248	355	501	563	70	40	0.6	70	34
Unimpaired Flow Scenario											
minimum flow	101	123	146	245	303	315	40	20	3.35	18	1
mean flow	666	830	998	1,774	2,978	3,061	271	169	104	180	113
median flow	569	716	848	1,439	2,167	2,232	232	146	78.5	140	65
25th percentile flow	392	490	586	943	1,372	1,417	159	101	42.9	84	39
10th percentile flow	285	353	418	652	946	987	113	72	25.4	51	20
5th percentile flow	229	283	336	505	724	751	93	61	21.4	36	11

Table B-7. Difference in Performance Measures at Strategic Nodes from UIF Scenario.

Performance Measure	SLD04 Saluda River Near Greenville	SLD07 Saluda River Near Williamston	SLD09 Saluda River Near Ware Shoals	SLD18 Saluda River at Chappells	SLD25 Saluda River Below Lake Murray Dam Near Columbia	SLD26 Saluda River Near Columbia	South Saluda River Strategic Node	North Saluda River Strategic Node	Rabon Creek Strategic Node	SLD11 Reedy River Above Fork Shoals	SLD22 Bush River near Prosperity
Current Use Scenario											
minimum flow	78	107	124	211	501	516	36	20	7	58	6
mean flow	595	768	930	1,686	2,600	2,686	244	141	100	224	120
median flow	491	644	775	1,391	1,811	1,876	201	112	74	184	72
25th percentile flow	314	421	515	870	972	1,020	128	72	38	125	46
10th percentile flow	226	298	359	580	701	745	90	53	20	93	26
5th percentile flow	176	240	288	437	701	733	75	45	15	77	16
Moderate Demand 2070 Scenario minus Current Use Scenario flow (cfs)											
minimum flow	-2	-2	-3	-1	0	-1	0	0	-1	0	-2
mean flow	0	0	0	-1	3	0	1	1	0	-1	-2
median flow	-1	0	-1	-1	-4	0	2	0	0	0	-2
25th percentile flow	-2	-1	-1	1	-1	0	0	0	0	0	-2
10th percentile flow	-2	-1	-3	-3	0	-3	0	0	0	1	-2
5th percentile flow	-2	-1	-3	-1	0	-3	0	0	0	1	-2

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Performance Measure	SLD04 Saluda River Near Greenville	SLD07 Saluda River Near Williamston	SLD09 Saluda River Near Ware Shoals	SLD18 Saluda River at Chappells	SLD25 Saluda River Below Lake Murray Dam Near Columbia	SLD26 Saluda River Near Columbia	South Saluda River Strategic Node	North Saluda River Strategic Node	Rabon Creek Strategic Node	SLD11 Reedy River Above Fork Shoals	SLD22 Bush River near Prosperity
Percent Difference between Moderate Demand 2070 Scenario flow and Current Use Scenario flow											
minimum flow	-3.1%	-1.7%	-2.6%	-0.6%	0.0%	-0.3%	0.1%	1.4%	-13.4%	-0.3%	-25.0%
mean flow	0.0%	0.1%	0.0%	-0.1%	0.1%	0.0%	0.4%	0.7%	-0.2%	-0.2%	-1.4%
median flow	-0.2%	0.0%	-0.1%	-0.1%	-0.2%	0.0%	0.8%	-0.1%	-0.3%	0.0%	-2.3%
25th percentile flow	-0.5%	-0.2%	-0.2%	0.2%	-0.1%	0.0%	-0.1%	-0.1%	-0.5%	-0.1%	-3.5%
10th percentile flow	-1.0%	-0.4%	-0.9%	-0.5%	0.0%	-0.4%	0.0%	-0.2%	-0.9%	1.2%	-6.1%
5th percentile flow	-1.3%	-0.6%	-0.9%	-0.2%	0.0%	-0.4%	0.0%	-0.2%	-1.5%	1.0%	-9.7%
High Demand 2070 Scenario minus Current Use Scenario flow (cfs)											
minimum flow	-10	-8	-9	-12	0	-6	0	0	-6	-1	1
mean flow	-5	-3	-4	-11	-37	-44	1	1	-1	-1	1
median flow	-7	-3	-2	-10	-60	-61	2	0	-1	0	1
25th percentile flow	-7	-5	-5	-13	-87	-70	0	0	-1	-1	1
10th percentile flow	-8	-5	-7	-16	0	-8	0	0	-2	1	1
5th percentile flow	-8	-6	-7	-11	0	-7	0	0	-1	0	1
Percent Difference between High Demand 2070 Scenario flow and Current Use Scenario flow											
minimum flow	-12.5%	-7.4%	-7.5%	-5.9%	0.0%	-1.2%	-0.4%	0.6%	-75.5%	-1.3%	14.4%
mean flow	-0.9%	-0.4%	-0.4%	-0.7%	-1.4%	-1.6%	0.4%	0.6%	-1.3%	-0.4%	1.1%
median flow	-1.4%	-0.4%	-0.3%	-0.7%	-3.3%	-3.3%	0.8%	-0.2%	-1.9%	-0.2%	1.9%
25th percentile flow	-2.1%	-1.2%	-1.0%	-1.5%	-9.0%	-6.8%	-0.2%	-0.5%	-4.0%	-0.5%	2.7%
10th percentile flow	-3.5%	-1.7%	-1.9%	-2.8%	0.0%	-1.1%	0.0%	-0.3%	-8.0%	0.8%	4.4%
5th percentile flow	-4.7%	-2.5%	-2.4%	-2.6%	0.0%	-1.0%	0.0%	-0.8%	-6.7%	0.4%	5.2%

Performance Measure	SLD04 Saluda River Near Greenville	SLD07 Saluda River Near Williamston	SLD09 Saluda River Near Ware Shoals	SLD18 Saluda River at Chappells	SLD25 Saluda River Below Lake Murray Dam Near Columbia	SLD26 Saluda River Near Columbia	South Saluda River Strategic Node	North Saluda River Strategic Node	Rabon Creek Strategic Node	SLD11 Reedy River Above Fork Shoals	SLD22 Bush River near Prosperity
Permitted and Registered Scenario minus Current Use Scenario flow (cfs)											
minimum flow	-56	-49	-43	-147	0	-2	-5	-8	-7	-11	17
mean flow	-111	-98	-92	-198	-333	-337	-41	-26	-69	11	21
median flow	-85	-75	-75	-188	-422	-417	-29	-13	-72	11	22
25th percentile flow	-56	-47	-43	-149	-271	-263	-8	-5	-36	1	18
10th percentile flow	-53	-42	-36	-104	0	-12	-4	-5	-19	-5	18
5th percentile flow	-52	-45	-40	-83	-200	-170	-5	-6	-15	-7	17
Percent Difference between Permitted and Registered Scenario flow and Current Use Scenario flow											
minimum flow	-71.0%	-45.9%	-35.2%	-69.7%	0.0%	-0.4%	-13.7%	-38.1%	-99.5%	-18.6%	267.5%
mean flow	-18.6%	-12.8%	-9.9%	-11.7%	-12.8%	-12.5%	-16.8%	-18.4%	-69.0%	5.0%	17.4%
median flow	-17.4%	-11.6%	-9.6%	-13.5%	-23.3%	-22.2%	-14.3%	-11.4%	-96.7%	5.7%	30.3%
25th percentile flow	-17.7%	-11.2%	-8.3%	-17.1%	-27.9%	-25.8%	-6.6%	-6.5%	-96.1%	0.5%	39.7%
10th percentile flow	-23.5%	-14.0%	-10.1%	-17.9%	0.0%	-1.6%	-4.6%	-8.6%	-95.6%	-5.2%	67.7%
5th percentile flow	-29.7%	-18.9%	-14.0%	-18.9%	-28.5%	-23.2%	-6.6%	-12.3%	-95.9%	-8.8%	105.0%
Unimpaired Flow Scenario minus Current Use Scenario flow (cfs)											
minimum flow	23	16	23	34	-198	-201	4	0	-4	-40	-6
mean flow	70	62	67	89	378	376	28	28	4	-43	-7
median flow	78	72	73	48	357	356	31	34	4	-44	-7
25th percentile flow	77	69	71	73	401	397	31	29	5	-42	-6
10th percentile flow	59	55	60	72	246	242	24	19	5	-42	-7
5th percentile flow	52	43	48	68	24	18	18	15	6	-41	-6

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Performance Measure	SLD04 Saluda River Near Greenville	SLD07 Saluda River Near Williamston	SLD09 Saluda River Near Ware Shoals	SLD18 Saluda River at Chappells	SLD25 Saluda River Below Lake Murray Dam Near Columbia	SLD26 Saluda River Near Columbia	South Saluda River Strategic Node	North Saluda River Strategic Node	Rabon Creek Strategic Node	SLD11 Reedy River Above Fork Shoals	SLD22 Bush River near Prosperity
Percent Difference between Unimpaired Flow Scenario flow and Current Use Scenario flow											
minimum flow	29.5%	15.0%	18.4%	16.3%	-39.5%	-38.9%	10.4%	1.9%	-54.7%	-69.3%	-87.4%
mean flow	11.8%	8.1%	7.2%	5.3%	14.5%	14.0%	11.3%	20.0%	4.4%	-19.4%	-5.7%
median flow	15.8%	11.2%	9.4%	3.4%	19.7%	19.0%	15.4%	30.6%	5.8%	-23.8%	-9.3%
25th percentile flow	24.5%	16.4%	13.8%	8.3%	41.2%	38.9%	24.5%	40.0%	14.2%	-33.2%	-13.8%
10th percentile flow	26.2%	18.4%	16.6%	12.4%	35.1%	32.4%	26.5%	35.6%	25.4%	-45.2%	-24.9%
5th percentile flow	29.7%	17.8%	16.6%	15.5%	3.4%	2.5%	23.4%	33.3%	38.5%	-53.6%	-36.2%

Negative percent differences indicate lower flow in the Scenario, compared to the Current Use Scenario

DRAFT

Appendix C
Flow-Ecology Relationships in the Saluda River Basin

08/30/2024

Flow-Ecology Relationships in the Saluda River Basin

With Applications for Flow Performance Measures in SWAM

DISCLAIMER

The following peer-reviewed scientific publications contain detailed information on data sources, flow metric calculations, statistical analyses relating flow to aquatic organisms, etc.:

- Bower, L. M., Peoples, B. K., Eddy, M. C., & Scott, M. C. (2022). Quantifying flow–ecology relationships across flow regime class and ecoregions in South Carolina. Science of the Total Environment, 802, 149721. URL: https://www.sciencedirect.com/science/article/pii/S0048969721047963
- Eddy, M. C., Lord, B., Perrot, D., Bower, L. M., & 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. URL: https://onlinelibrary.wiley.com/doi/full/10.1002/eco.2387

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Michele Eddy

Benjamin Lord

The Nature Conservancy

Eric Krueger

CDM Smith

John Boyer

US Forest Service

James Keith Whalen

Weyerhaeuser Corporation

Daniel Hanks

EXECUTIVE SUMMARY

Responses of organisms to stream flow change have long been recognized in scientific literature. The evolution of methods, large data sets, and statistical improvements over the last 20 years have advanced our ability to characterize these responses. If the necessary data is available, it is now possible to understand these responses to a specificity, making them useful for water resource management.

We identified a wide variety of flow–biological relationships to derive a set of recommended performance measures and predict changes in biological metrics in response to changes in flow for the Saluda River basin. These relationships:

1) are highly relevant to drought management and water withdrawal,

2) are the strongest relationships between flow and river health, and

3) capture the greatest number of flow regime components of the streams and rivers of the Saluda Basin.

We found statistically significant effects of flow on fish and invertebrates for all attributes of the natural flow regime, including magnitude, duration, frequency, timing, or rate of change. For this recommendation, only measures that are relevant to the Saluda River, can be calculated in SWAM, and meet the three principles cited above were used.

<u>*Priority Flow Characteristics*</u>

Four flow metrics emerged as having the greatest impact on instream health in the Basin. They are:

1. *Mean Daily Flow*: The mean daily flow is the mean of daily flows over the period of record.
2. *Duration of High Flow*: Duration of high flow is defined by the annual average number of days of flow above the 75th percentile of all daily values over the period of record.
3. *Frequency of High Flow*: Frequency of high flow is defined by the annual average of the number of flow events above the 75th percentile of all daily values over the period of record.
4. *Calendar day of lowest observed flow*: This is simply the day of the year when the lowest flow is observed, converted to Julian date (a number from 1-365).

<u>*Results Summary*</u>:

Mean daily flow is expected to be impacted more by water use than the timing of low flow based on the SWAM scenarios. The changes in mean daily flow predicted by the full allocation a are expected to substantially reduce the number of fish species and pose a high-medium risk to fish species at two strategic nodes with reductions in the number of fish species up 53% ± 14%. The linear relationships and performance measures suggest that Rabon Creek and Twelvemile Creek may be at the highest risk of fish species loss based on the full allocation SWAM water use scenarios. All other SWAM scenarios generally indicated little change in mean daily flow and timing of low flow suggesting a low risk to the fish and macroinvertebrates.

INTRODUCTION

South Carolina is home to a rich diversity of freshwater organisms, including a variety of fishes and invertebrates. These organisms have unique traits that make them especially adapted for life in rivers. Many species have traits that make them *sensitive* to environmental change. Some of these traits include spawning or living in gravel habitats, or specialized body shapes for living in high-flow conditions. Likewise, other species have traits that make them *tolerant* to environmental change, such as the ability to spawn in a variety of habitats or tolerate a wide range of temperatures.

Over 50 years of research supports the fact that aquatic organisms respond readily to changes in their environment. It is well known that key *biological metrics* such as the total number of species in a location and the representation of species with similar traits are directly indicative of *aquatic ecosystem health*. As ecosystems become less healthy, sensitive species are removed and replaced by tolerant species. Scientists use these biological metrics to assess aquatic ecosystem health to (a) identify high quality ecosystems to maintain and (b) identify ecosystems in poor health for remediation.

Aquatic ecosystem health is influenced strongly by instream flow. Sensitive species are especially adapted to the *natural flow regime*. The natural flow regime is described by five aspects of flow events that culminate to describe the overall flow conditions in a stream or river. These include:

-*Magnitude*: The size of high- and low-flow events

-*Frequency*: How often high- and low-flow events occur

-*Duration*: How long high- and low-flow events last when they do occur

-*Timing:* The time of year in which high- and low-flow events occur

-*Rate of change*: How often flows change from increasing to decreasing, or vice versa

Historically, instream flow management recommendations have focused only on maintaining minimum daily flows. However, it is becoming increasingly recognized that management for all five components of the natural flow regime is necessary for maintaining aquatic ecosystem health.

The natural flow regime is different across regions, and changes based on geology, natural vegetation, and precipitation patterns (see **Saluda River Stream Types** below). Humans can alter the natural flow regime by withdrawing water directly from surface water or indirectly through groundwater withdrawal. Humans can also affect flow by changing land cover. Converting natural forests, grasslands, and wetlands to intensive agriculture or urban/suburban land cover types changes natural patterns of surface runoff and groundwater recharge. These changes have direct effects on aquatic ecosystem health and are indicated by aquatic organisms.

South Carolina is a state that is rich in water resources. However, the state is experiencing a period of rapid economic growth and population expansion. As such, identifying relationships between key instream flow metrics and biological metrics (hereafter, *flow-ecology relationships*) will provide guidance for developing recommendations for instream flow management that allows for smart development while maintaining the natural flow regime for aquatic ecosystem health.

THIS STUDY

The goal of this study was to estimate flow-ecology relationships for fishes and macroinvertebrates for streams and small rivers in the Saluda River basin, South Carolina to provide recommendations for guiding instream flow management in the basin. The best available data sources and statistical modeling tools were used to accomplish this goal. The approach is summarized as follows:

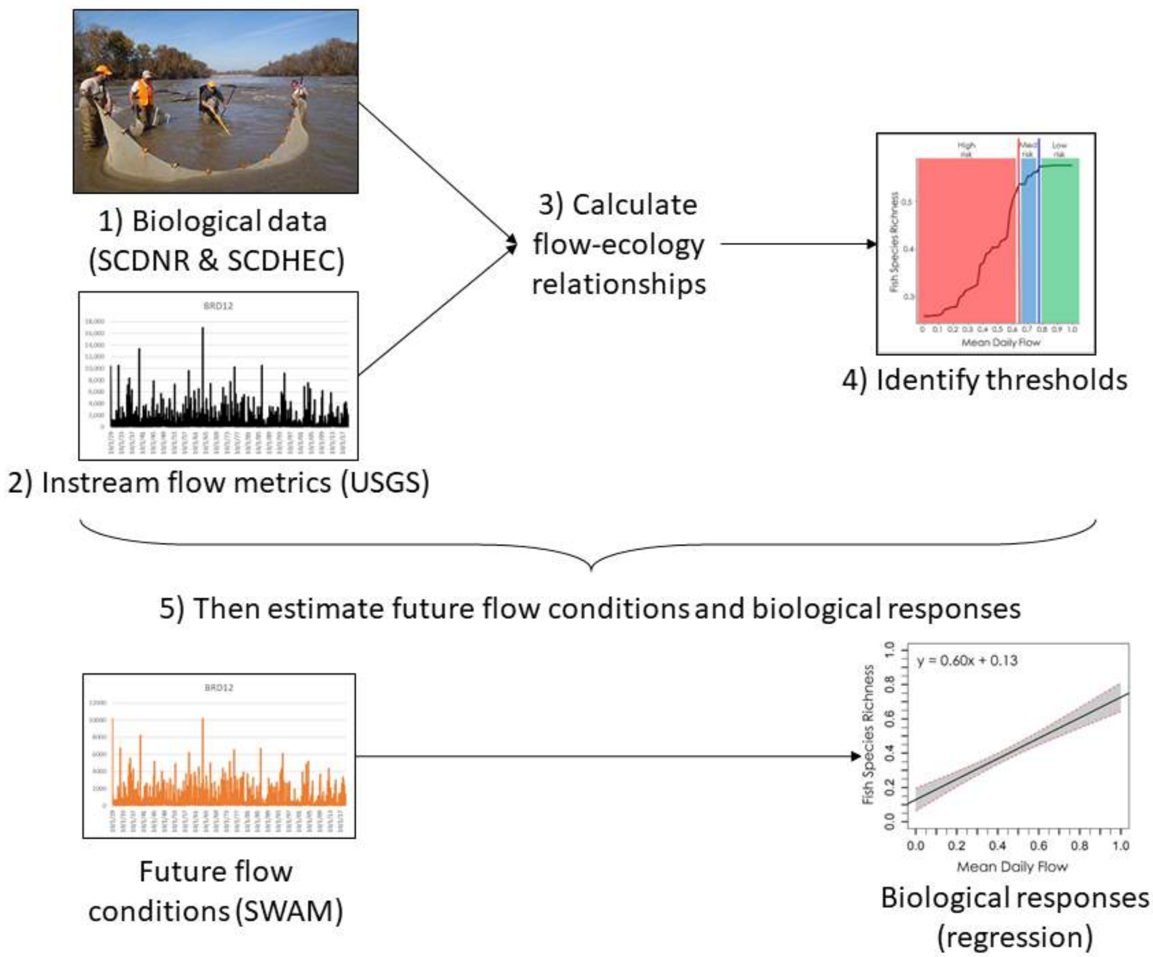


Figure 1: Flow chart of the described methods.

1. *Obtain biological data*: Fish community data is collected by the South Carolina Department of Natural Resources (SCDNR). Aquatic invertebrate community data is collected by the South Carolina Department of Environmental Services (SCDES). In total, these include 1,022 sampling locations across the state, and 59 in the Saluda River basin (Figure 2). All data are collected using standardized protocols designed to fully characterize the aquatic community for the purpose of quantifying aquatic ecosystem health. Sampling protocols can be found in Scott et al. (2009) and SCDHEC (2017). Raw fish and invertebrate community data were summarized into numerous biological metrics for each sampling site based on the number of species and proportional representation of species with similar traits. These metrics have been shown in previous studies to be directly indicative of aquatic ecosystem health. The full list of biological metrics included in this study is presented in Appendix Table 1.

2. *Estimate instream flow metrics*. The US Geological Survey maintains 26 flow gauges in the Saluda River Basin. However, biological sampling does not always occur at those locations, and the

number of gauged sites does not present sufficient sample sites for estimating flow ecology relationships. Accordingly, flow metrics were estimated for every stream/river in the Saluda River basin using the WaterFALL(™) flow allocation model. This work was accomplished by researchers from RTI International and is reported in full detail in Eddy et al. (2022). The full list of candidate flow metrics used in this study is presented in Appendix Table 2.

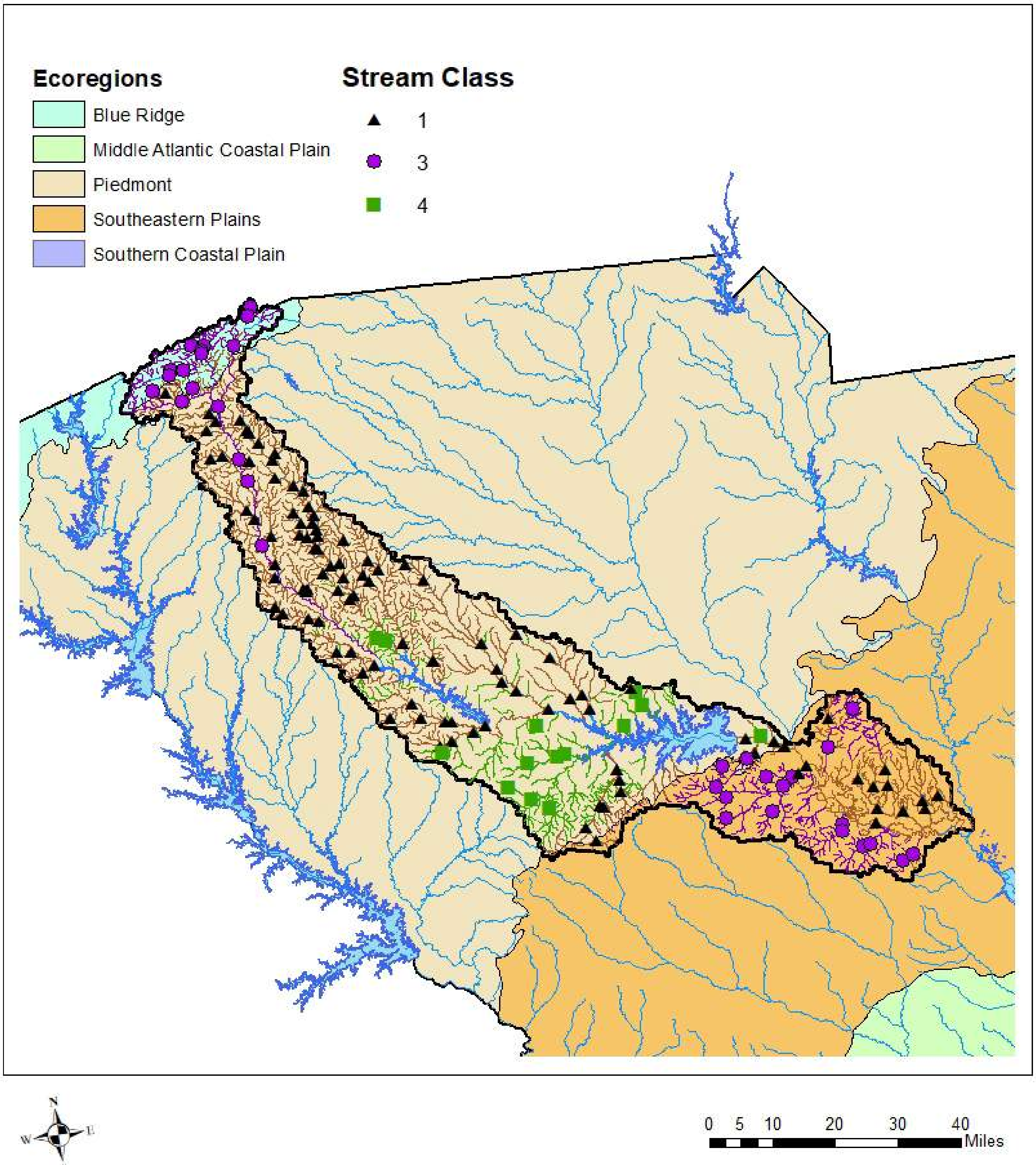


Figure 2: *Map of the Saluda River Basin overlain with ecoregion boundaries and stream classifications. Each point is also a biological sampling point for either fish, or aquatic invertebrates, or both. Stream classes are labeled as follows:1 (perennial runoff),* 3 (stable base flow), and 4 (perennial flashy).

3. *Identify critical flow-ecology relationships*. The modeling approach started with 24 flow metrics and 14 biological metrics, yielding an untenable number of potential relationships. To reduce this complexity, we only analyzed flow metrics that were (a) shown to be biologically relevant (b) captured all components of the flow regime, and (c) were non-redundant (Appendix Table 2). Because many biological metrics will be weakly correlated with some flow metrics, it was critical to identify the strongest and most informative flow-ecology relationships to develop recommendations. This was accomplished using *random forests*—a type of machine learning statistical model that is ideal for identifying complex ecological relationships.

4. *Use flow-ecology relationships to identify potentially harmful/protective levels of flow change*. The most important relationships can be identified by random forest in two ways: 1) as a performance measure to determine the potential biological impact of water withdrawal, and 2) to estimate predicted change in a biological metric based on estimated change in flow due to water withdrawal. To create the performance measures, the random forest model plots were used as seen below (Figure 2). These plots are scaled to represent the estimated proportional change in the biotic metric that would result from a proportional change in the flow metric. These plots were used to identify potential flow thresholds – a point along a flow metric that corresponds to large shifts in biological health. The thresholds define the best points to set performance measures. Two distinct thresholds were identified in each relationship to produce 3 zones corresponding to high, medium, and low levels of risk to the chosen biotic metric.

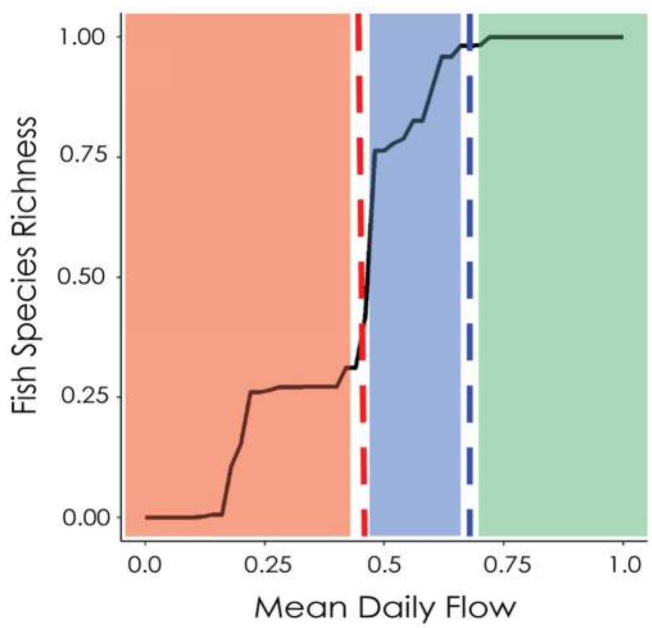


Figure 3*: Model-estimated risk ranges for the selected biota and flow metrics. in Piedmont Flashy Streams. Areas of high risk are shaded red, medium risk in blue, and low risk in green. Changes in the overall flow regime cause mean daily flow to fall between 71 and 49% of current values in Piedmont flashy perennial streams correspond to low and high risk for fish species loss, respectively. Reducing mean daily flow into the zone of 49-71% constitutes medium risk for fish species loss.*

5. *Estimate potential future flow conditions and biological response*. Researchers from CDM Smith used the Surface Water Allocation Model (SWAM) to estimate future flow conditions at *strategic nodes*–key locations in tributaries to the Saluda River (Figure 4). Estimates were provided for four potential future water withdrawal scenarios: (1) unimpaired flow (no water withdrawals occur in the system), (2) moderate development by 2070, (3) high development by 2070, and (4) full allocation (all permitted water withdrawals are realized) for each strategic node. Finally, potential future changes in biological metrics were estimated in each of the four future water withdrawal scenarios based on (a) model-predicted responses of biological metrics to instream flow, and (b) SWAM-based predicted flow metrics. To do this, linear relationships between each flow metric and biological metric were used for the important relationships identified by random forest models. This method provides a more precise estimate of the biological change in response to flow alteration and the error associated with this estimate (Figure 5). This process was conducted for each of three main categories of streams and rivers in the Saluda River Basin (see below).

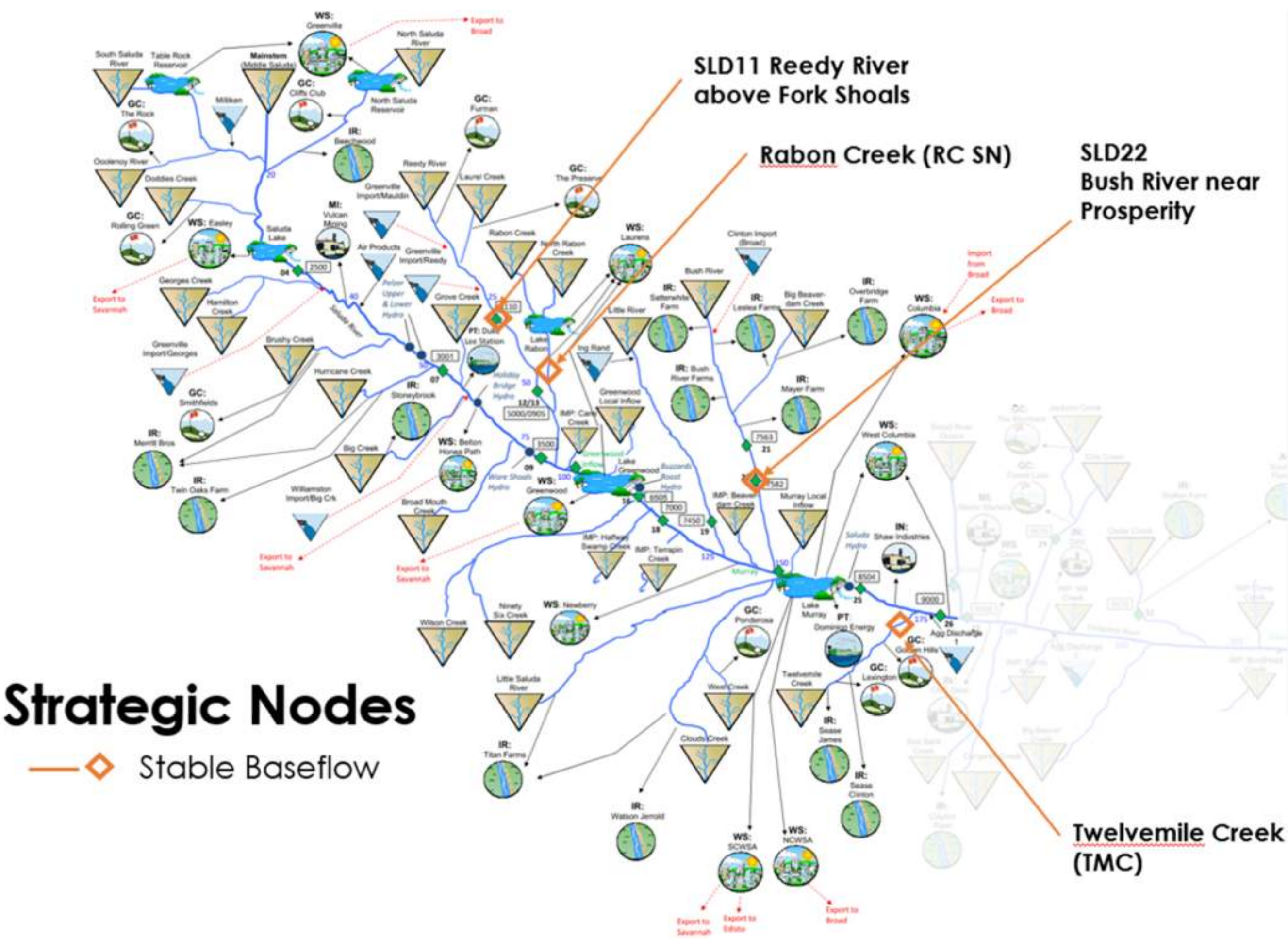


Figure 4: *Location of example strategic nodes from the Saluda River Basin*

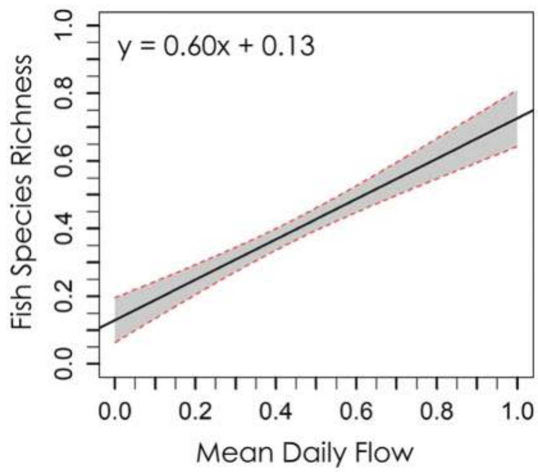


***Figure 5**. Example of the linear relationship established between mean daily flow and fish species richness in Piedmont Flashy Streams. The formula,* Y = 0.60x + 0.13*, allows us to apply this relationship to the flow projection scenarios by replacing* x *with the predicted mean daily flow to derive the predicted change in fish richness, represented by* Y.

SALUDA RIVER STREAM TYPES

There are 5 stream types in the Saluda River Basin (**Figure 2**), determined by ecoregion and water source / behavior (~3,500 segments):

1. Piedmont Perennial Runoff (P1): Streams and rivers in the Piedmont ecoregion characterized by moderately stable flow and distinct seasonal extremes.
2. Piedmont Perennial Flashy (P4): Streams in the Piedmont ecoregion with moderately stable flow with high variability.
3. Southeastern Plains Perennial Runoff (SE1): Streams and rivers in the Southeastern Plains ecoregion characterized by moderately stable flow and distinct seasonal extremes.
4. Southeastern Plains Stable Base Flow (SE3): Streams and rivers in the Southeastern Plains ecoregion whose flow is composed of both high stable base flow and rainfall runoff.
5. Blue Ridge Plains Stable Base Flow (SE3): Streams and rivers in the Blue Ridge ecoregion whose flow is composed of both high stable base flow and rainfall runoff.

However, no strategic nodes were selected in the Southeastern Plains or Blue Ridge ecoregions, restricting the results to a single stream class: Piedmont Perennial Runoff.

ASSUMPTIONS OF THE APPROACH

Like all model-based studies, the approach relies on a few assumptions that should be considered when interpreting the results.

First, the flow-ecology relationship analyses assume that flow metrics were estimated perfectly. This is not the case, and indeed is impossible, as described in detail in Eddy et al. (2022). However, this study relied on the most precisely estimated flow metrics estimated by Eddy et al. (2022), and omitted flow metrics with high levels of uncertainty.

Second, models are only as good as the data on which they are based. The most up-to-date sources to estimate flow metrics and their relationships with biological metrics were used. However, data are continuously being collected by USGS, SCDES, and SCDNR. As such, the inclusion of new data into potential future approaches could yield different results. However, the inclusion of new data would be expected to only increase the precision of the estimates.

A third assumption is that future flow-ecology relationships will exist in the same shape and magnitude as they currently do. The future flow scenarios are based solely on changes to instream flow metrics due to known surface water withdrawal demands. These scenarios assume that land cover, temperature, and precipitation, and thus instream flow, will remain the same in the future. While this may not be a reasonable assumption, incorporating these factors into more detailed estimates of future instream flow conditions is beyond the scope of the present work, but will be an important contribution to ongoing flow management efforts.

Finally, this work was developed on streams in rivers with watershed areas of 3 to 600 km^2. Streams of this size represent 87% of the surface water in South Carolina. This work did not include data from reservoirs or large rivers, and as such is not informative for making recommendations regarding flow management of any waterbody with a watershed greater than 600 km^2.

RESULTS: IDENTIFYING FLOW-ECOLOGY RELATIONSHIPS

Biotic metrics: Random Forest models allowed us to identify clear flow-ecology relationships. A single biotic metric was found to be informative of changes in instream flow in the one stream class. A list of at-risk species in the Saluda Basin is provided in Appendix Table 3. This included:

- Species Richness: the number of species found at a given site

Flow metrics: Statistically significant effects of flow on fish and invertebrates were found for all attributes of the natural flow regime, including magnitude, duration, frequency, timing, or rate of change. However, for this recommendation, we are only bringing forward measures that are relevant to the one stream class within Saluda River basin, can be calculated in SWAM, and meet the three principles cited above. Two flow metrics emerged as having the greatest impact on aquatic ecosystem health in the Saluda River Basin:

1. <u>*Mean Daily Flow*</u>: The mean of all daily flows over the period of record.
2. <u>*Calendar day of lowest observed flow*</u>: This is simply the day of the year when the lowest flow is observed, converted to Julian date (a number from 1-365).

RECOMMENDED PERFORMANCE MEASURES

Based on the flow-ecology relationships identified above, we suggest the following performance measures (Table 1). The recommended measures reflect the variability of biological response in different ecoregions and stream types while producing a manageable set of responses to consider.

Table 1: The risk ranges for the most informative flow and biological metric for each stream class in the Saluda River basin. The biological metric is given in brackets. The risk ranges are colored as green (low risk), yellow (medium risk), and red (high risk).

	Instream Flow Performance Recommendations and Risk Ranges		
Stream Type:	**Piedmont Perennial Runoff**		
	Risk Ranges		
	Low	**Med**	**High**
Flow Metric			
Mean Daily Flow (FR)	>0.78	0.64-0.78	<0.64
Calendar Day of Lowest Flow (BHF)	>327		

FR=Fish Species Richness: The number of fish species found in a stream or river reach
BHF=Brood hiding fishes. Brood hiders bury of place their eggs in a concealed location, but do not guard or provide any parental care.

APPLICATION: EVALUATING WATER USE SCENARIOS IN SWAM

SWAM was used to create four flow scenarios based on water withdrawals:

1. Unimpaired flow (no water withdrawals occur in the system)
2. Moderate development by 2070
3. High development by 2070
4. Full allocation (all permitted water withdrawals are realized) for each strategic node.

We used the flow–biological relationships in conjunction with SWAM results to estimate the responses of the organisms to these various water withdrawal scenarios at each strategic node. The performance measures can be used in an intuitive graphic approach to quickly compare the scenario performance and identify patterns. The performance measures can be used to

1) analyze the impacts or benefits of flow changes within a SWAM scenario
2) to compare impacts or benefits across multiple SWAM scenarios
3) to compare the benefits of water management strategies to a SWAM scenario(s)

Performance measure plots provide a visual way to compare the water withdrawal scenarios with respect to aquatic ecosystem health. This feature can also be informative when water management strategies are applied to the scenarios, revealing which strategies best protect stream health while still meeting essential water needs. Figure 6 shows an example of the performance measure plots.

Linear relationships were used to estimate the change in a biological metric from current flows for each SWAM scenario, producing color-coded output with the specific percentage change of the biological metric and its associated estimate error. Figure 7 shows an example of the linear relationship output.

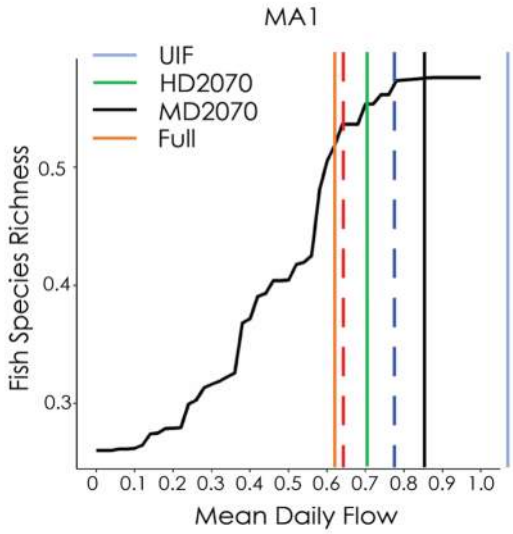


Figure 6: In this example (Mean daily flow at Middle Tyger River in the Broad River Basin), the predicted change in mean daily flow was plotted for the four SWAM scenarios along the X axis, allowing for quick determination of risk to the biologic metric. In this example, the full allocation model (orange) had a 37.3% reduction in flow, meaning only 62.7% of current flows remain, which is considered 'high risk' to the biotic metric, fish species richness. Alternatively, the medium development scenario (vertical black line), predicted only a 14% reduction in flow, which was considered 'low risk'.

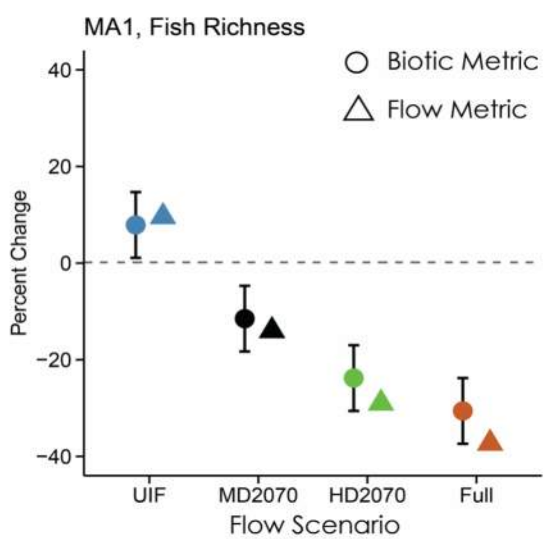


Figure 7: In this figure, the four SWAM scenarios are plotted along the X axis, and percent change for each scenario is plotted along the Y axis. The horizontal dashed line indicates the current conditions. Predicted flow metrics (triangles) were derived from the SWAM model, whereas predicted biotic metrics (circles) were derived from linear regression (Figure 5). Error bars on the biotic metrics represent the standard error or the uncertainty in the predictions.

SWAM results summary.

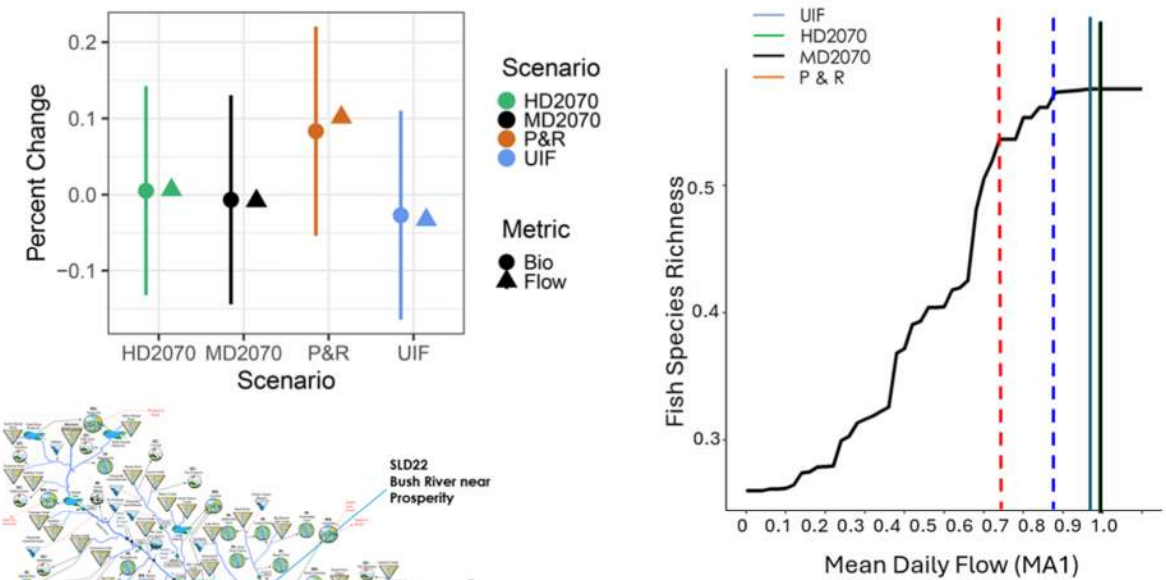
Overall, SWAM estimated large changes in mean daily flow (MA1) only for the full allocation model (P&R) at one strategic node, Rabon Creek (Figure 10). This 63% change in mean daily flow was predicted to substantially reduce the number of fish species by 53%. Two other strategic nodes showed a >10% reduction in mean daily flow for the full allocation model: Bush River and Twelvemile Creek (Figures 8 and 14). The linear relationships predicted losses in the number of species to be between <1% and 53% for the full allocation water use scenario and between <1% and 3% for the high development scenario (Figure 8-14). The unimpaired SWAM scenario predicted a 19% decrease in mean daily flow at the Reedy River strategic node, resulting in a 16% predicted decrease in the number fish species (Figure 12). All other SWAM scenarios predicted low changes in mean daily flow between <1% to 4% and low losses in the number of fish species ranging between <1% and 4%. The standard error associated with these estimates is important to consider because it provides a range associated with each prediction. For example, the linear relationships predicted a 16% reduction in fish species with a standard error of 14% at Reedy River for the unimpaired SWAM scenario, suggesting reduction in fish species could be as low as 2% or as high as 30%.

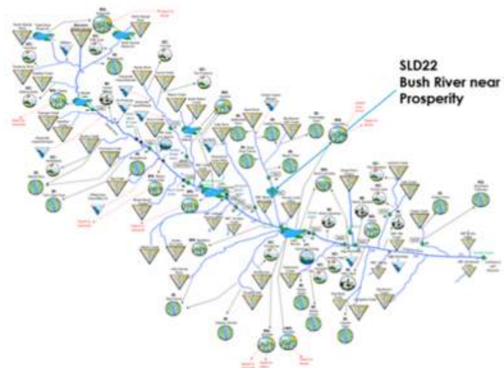
The performance measures based on mean daily flow and species richness showed the full allocation scenario at the Rabon Creek strategic node high risk (Figures 10) and medium risk at the Twelvemile Creek strategic node (Figure 14). At the Reedy River strategic node, the SWAM unimpaired scenario would fall within a medium risk category.

SWAM generally did not predict large changes in timing of low flow with all scenarios predicting less than a 2% change. Accordingly, all SWAM scenarios remained in the low-risk range for timing of low flow, high flow duration, and high flow frequency (Figures 8-31).

CONCLUSIONS

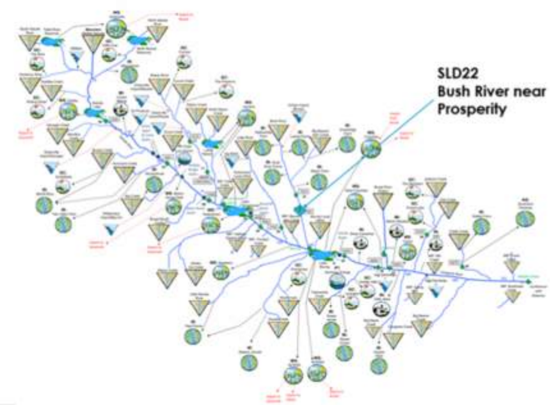
Mean daily flow is expected to be impacted more by water use than the timing of low flow based on the SWAM scenarios. The changes in mean daily flow predicted by the full allocation are expected to substantially reduce the number of fish species and pose a high-medium risk to fish species at two strategic nodes. The linear relationships and performance measures suggest that the strategic nodes at Rabon Creek and Twelvemile Creek may be at the highest risk of fish species loss due to water use. These results suggest high water withdrawals, mainly the full allocation water use scenarios, would pose a medium to high risk to fish species and result in large losses in the number of fish species. However, these findings do not rule out all potential risks to ecological integrity or aquatic biodiversity related to other metrics or flow alterations.





Scenario	Current	Predicted	% Flow	Bio Metric	% Bio	SE	95%
UIF	205.89	199.12	-3%	Richness	-3%	7	13.9
MD 2070	205.894	204.21	-1%	Richness	-1%	7	13.9
HD 2070	205.894	207.17	1%	Richness	1%	7	13.9
P&R	205.894	226.79	10%	Richness	8%	7	13.9

Figure 8: Mean daily flow (MA1) projections for Bush River near Prosperity (SLD22). The triangles indicate the percent change in mean daily flow for the four scenarios predicted by the SWAM model. The circles indicate the percent change in fish species richness based on the SWAM predictions, with the uncertainty of that prediction described by standard error (error bars). The percent change in mean daily flow for each SWAM scenario is shown on performance measure plots to quickly assess risk, finding all scenarios were in the low-risk zone. The table shows the SWAM scenario, the current conditions, predicted flow metric value by SWAM, precent change in flow metric, the biological metric of interest, percent change in biological metric for given SWAM scenario, the standard error, and 95% confidence interval.



Scenario	Current	Predicted	% change	Bio Metric	Risk
UIF	227	242	6%	Brood	Low
MD 2070	227	227	0%	Brood	Low
HD 2070	227	225	<-1%	Brood	Low
P&R	227	224	-1%	Brood	Low

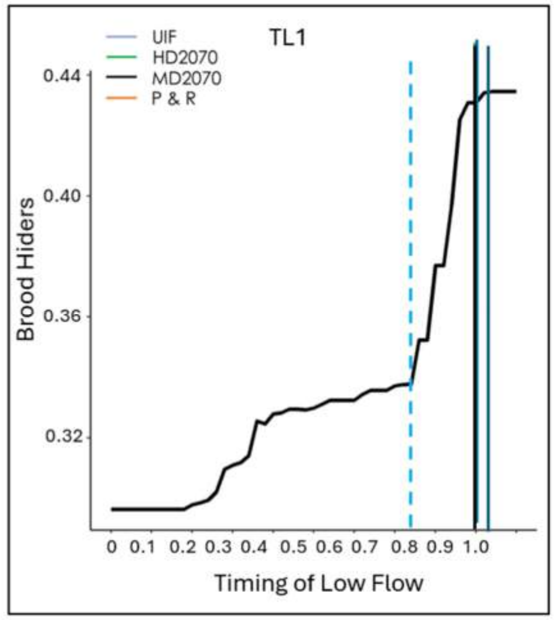
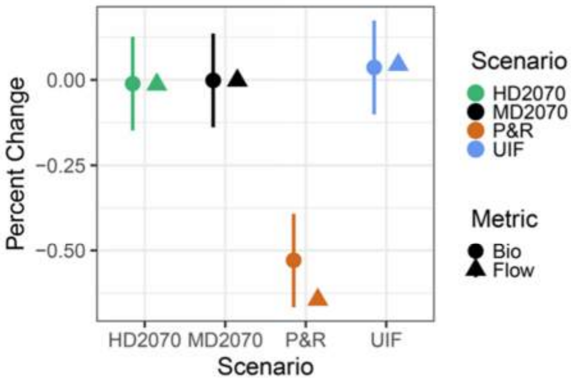
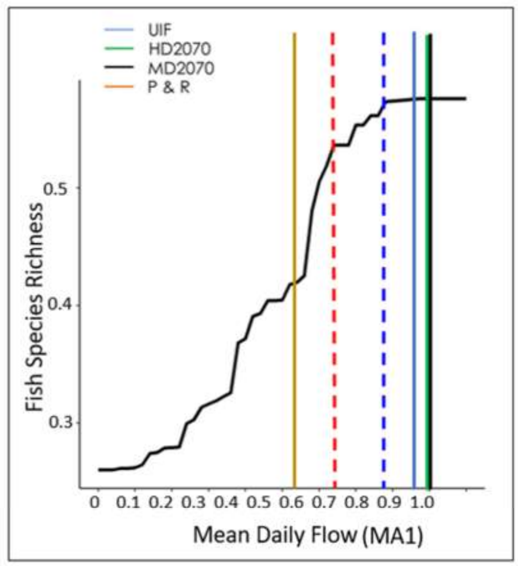
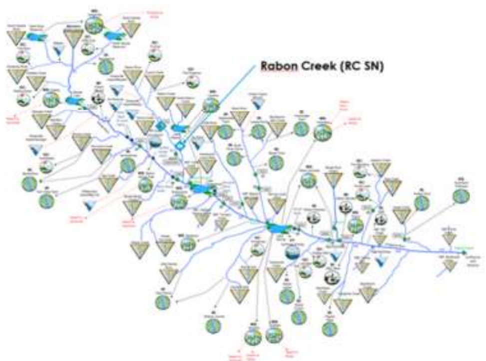


Figure 9: Timing of low flow (TL1) projections for the for Bush River near Prosperity (SLD22). The percent change in timing of low flow for each SWAM scenario is shown on performance measure plots to quickly assess risk, finding only that while the unimpaired flows projected a 6% change in the proportion of brood hiding fish. All other scenarios were in the low-risk zone. The table shows the SWAM scenario, the current conditions, predicted flow metric value by SWAM, precent change in flow metric for given SWAM scenario, and the biological metric of interest.

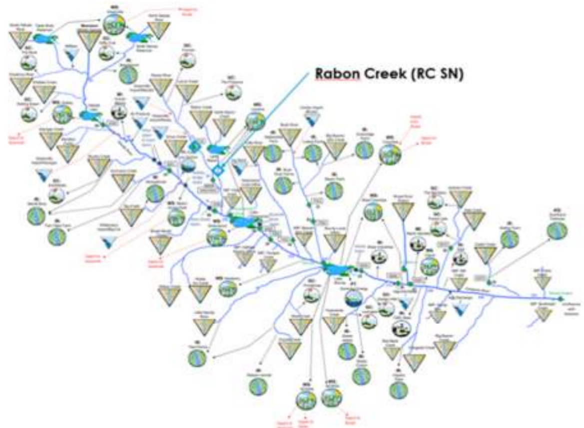






Scenario	Current	Predicted	% Flow	Bio Metric	% Bio	SE	95%
UIF	99.83	104.24	-4%	Richness	-4%	7	13.9
MD 2070	99.83	99.64	0%	Richness	0%	7	13.9
HD 2070	99.83	98.48	-1%	Richness	-1%	7	13.9
P&R	99.83	35.562	-64%	Richness	-53%	7	13.9

Figure 10: Mean daily flow (MA1) projections for Rabon Creek (RC SN). The triangles indicate the percent change in mean daily flow for the four scenarios predicted by the SWAM model. The circles indicate the percent change in fish species richness based on the SWAM predictions, with the uncertainty of that prediction described by standard error (error bars). The percent change in mean daily flow for each SWAM scenario is shown on performance measure plots to quickly assess risk, finding only that the full allocation scenario (P&R) to be 'high risk' due to a projected loss of 53% of fish richness. All other scenarios were in the low-risk zone. The table shows the SWAM scenario, the current conditions, predicted flow metric value by SWAM, precent change in flow metric, the biological metric of interest, percent change in biological metric for given SWAM scenario, the standard error, and 95% confidence interval.



Scenario	Current	Predicted	% change	Bio Metric	Risk
UIF	256	256	0%	Brood	Low
MD 2070	256	256	0%	Brood	Low
HD 2070	256	257	<-1%	Brood	Low
P&R	256	255	0%	Brood	Low

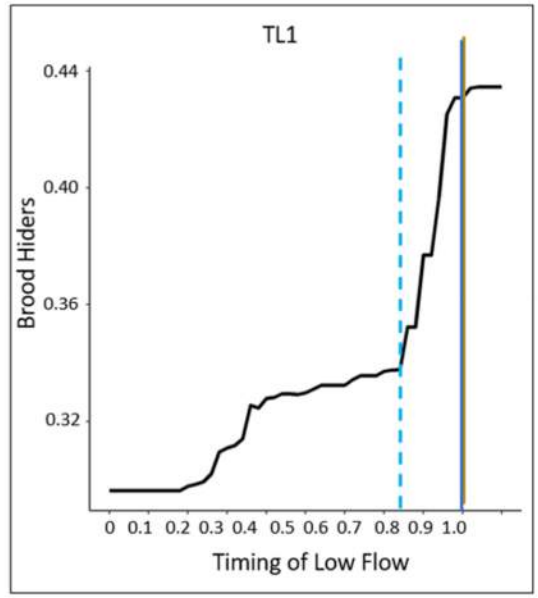
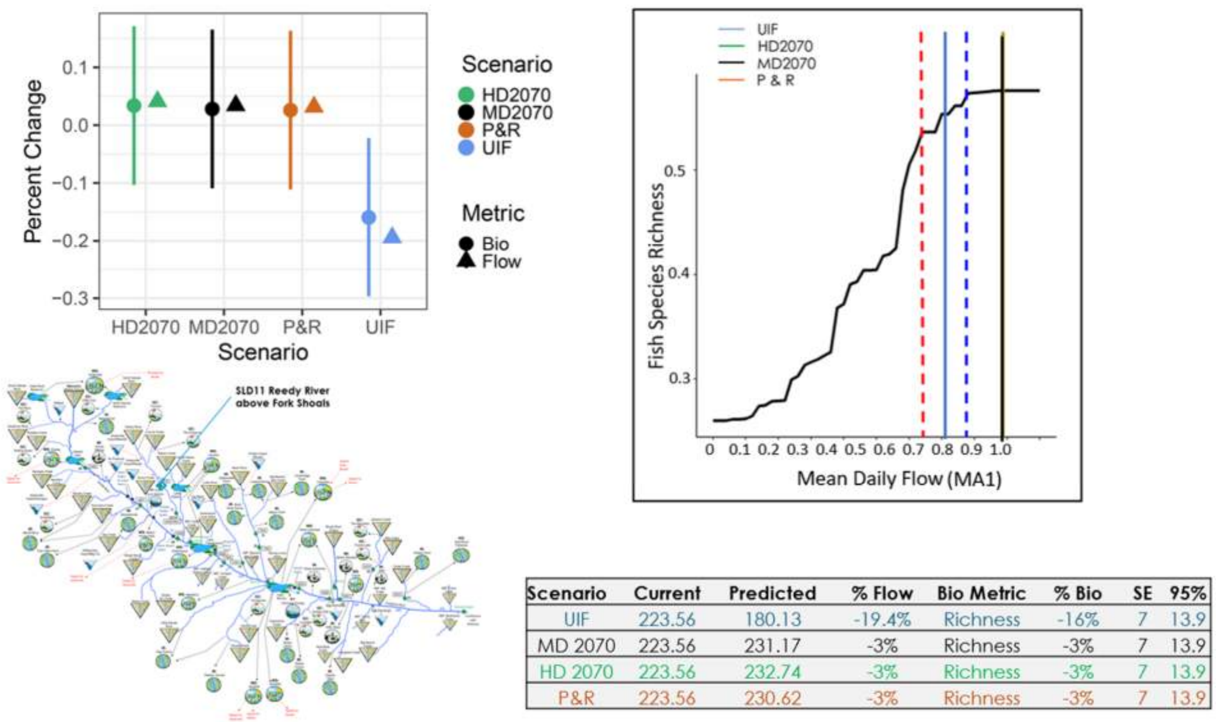
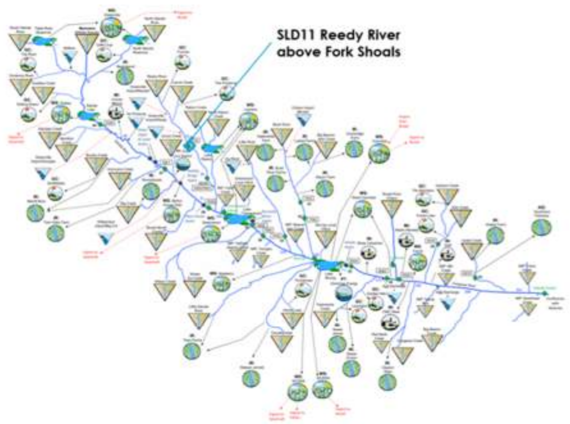


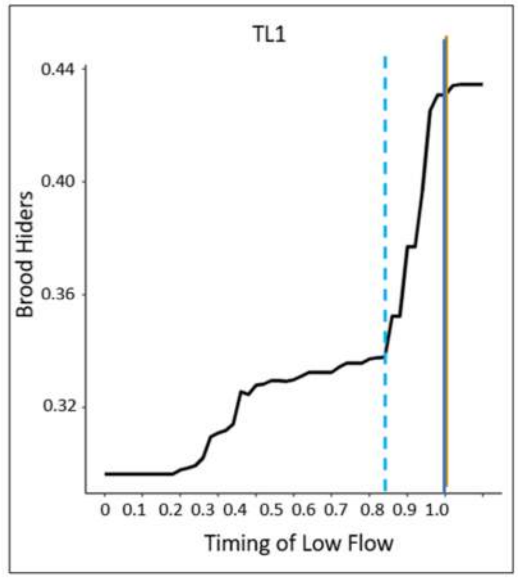
Figure 11: Timing of low flow (TL1) projections for Rabon Creek (RC SN). The triangles indicate the percent change in timing of low flow for the four scenarios predicted by the SWAM model. The circles indicate the percent change in fish species richness based on the SWAM predictions, with the uncertainty of that prediction described by standard error (error bars). The percent change in timing of low flow for each SWAM scenario is shown on performance measure plots to quickly assess risk, finding that all scenarios were in the low-risk zone. The table shows the SWAM scenario, the current conditions, predicted flow metric value by SWAM, precent change in flow metric for given SWAM scenario, and the biological metric of interest.



Scenario	Current	Predicted	% Flow	Bio Metric	% Bio	SE	95%
UIF	223.56	180.13	-19.4%	Richness	-16%	7	13.9
MD 2070	223.56	231.17	-3%	Richness	-3%	7	13.9
HD 2070	223.56	232.74	-3%	Richness	-3%	7	13.9
P&R	223.56	230.62	-3%	Richness	-3%	7	13.9

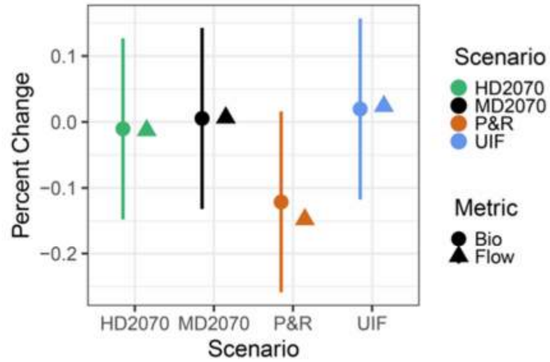
Figure 12: Mean daily flow (MA1) projections for the Reedy River above Fork Shoals (SLD111). The triangles indicate the percent change in mean daily flow for the four scenarios predicted by the SWAM model. The circles indicate the percent change in fish species richness based on the SWAM predictions, with the uncertainty of that prediction described by standard error (error bars). The percent change in mean daily flow for each SWAM scenario is shown on performance measure plots to quickly assess risk, finding only that the full allocation scenario to be 'medium risk' due to a projected loss of 16% of fish richness. All other scenarios were in the low-risk zone. The table shows the SWAM scenario, the current conditions, predicted flow metric value by SWAM, precent change in flow metric, the biological metric of interest, percent change in biological metric for given SWAM scenario, the standard error, and 95% confidence interval.

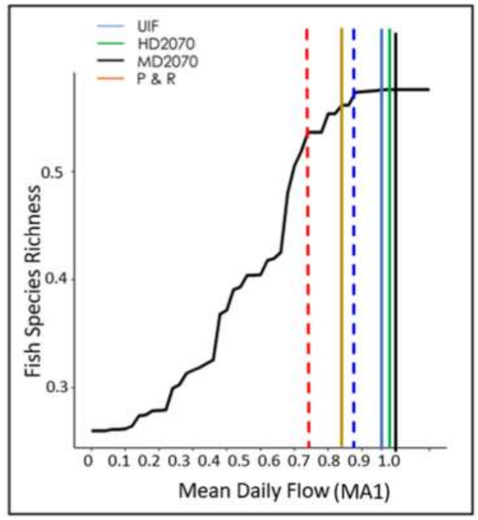


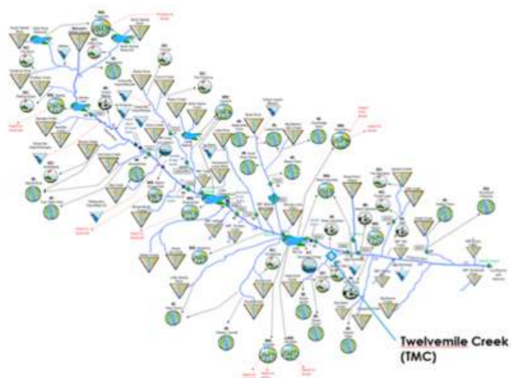


Scenario	Current	Predicted	% change	Bio Metric	Risk
UIF	260	260	0%	Brood	Low
MD 2070	260	259	<-1%	Brood	Low
HD 2070	260	258	<-1%	Brood	Low
P&R	260	259	<-1%	Brood	Low

Figure 13: Timing of low flow projections for Reedy River above Fork Shoals (SLD11). The triangles indicate the percent change in timing of low flow for the four scenarios predicted by the SWAM model. The circles indicate the percent change in fish species richness based on the SWAM predictions, with the uncertainty of that prediction described by standard error (error bars). The percent change in timing of low flow for each SWAM scenario is shown on performance measure plots to quickly assess risk, finding that all other scenarios were in the low-risk zone. The table shows the SWAM scenario, the current conditions, predicted flow metric value by SWAM, precent change in flow metric for given SWAM scenario, and the biological metric of interest.

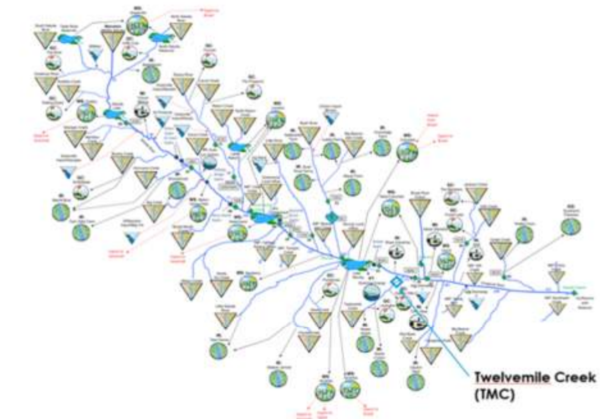






Scenario	Current	Predicted	% Flow	Bio Metric	% Bio	SE	95%
UIF	27.78	28.44	2.4%	Richness	2%	7	13.9
MD 2070	27.78	27.96	<1%	Richness	<1%	7	13.9
HD 2070	27.78	27.43	-1%	Richness	-1%	7	13.9
P&R	27.78	23.68	-15%	Richness	-12%	7	13.9

Figure 14: Mean daily flow (MA1) projections for Twelvemile Creek (TMC). The triangles indicate the percent change in mean daily flow for the four scenarios predicted by the SWAM model. The circles indicate the percent change in fish species richness based on the SWAM predictions, with the uncertainty of that prediction described by standard error (error bars). The percent change in mean daily flow for each SWAM scenario is shown on performance measure plots to quickly assess risk, finding the full allocation scenario to be 'medium risk' due to a projected loss of 12% of fish richness. All other scenarios were in the low-risk zone. The table shows the SWAM scenario, the current conditions, predicted flow metric value by SWAM, precent change in flow metric, the biological metric of interest, percent change in biological metric for given SWAM scenario, the standard error, and 95% confidence interval.



Scenario	Current	Predicted	% change	Bio Metric	Risk
UIF	257	259	<1%	Brood	Low
MD 2070	257	260	1%	Brood	Low
HD 2070	257	255	<-1%	Brood	Low
P&R	257	256	<-1%	Brood	Low

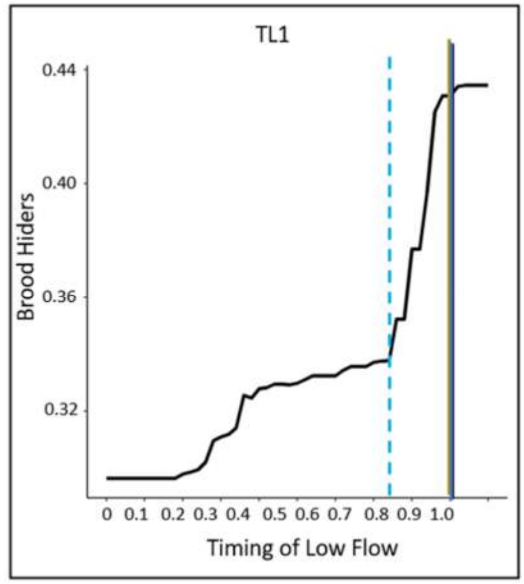


Figure 15: Timing of low flow (TL1) projections for Twelvemile Creek (TMC). The triangles indicate the percent change in timing of low flow for the four scenarios predicted by the SWAM model. The circles indicate the percent change in fish species richness based on the SWAM predictions, with the uncertainty of that prediction described by standard error (error bars). The percent change in timing of low flow for each SWAM scenario is shown on performance measure plots to quickly assess risk, finding that all scenarios were in the low-risk zone. The table shows the SWAM scenario, the current conditions, predicted flow metric value by SWAM, precent change in flow metric for given SWAM scenario, and the biological metric of interest.

Appendix Table 1: *Abbreviation, description, and association with type of biological metrics*

Fish metrics	
Abbreviation	***Description***
Richness	*Taxa richness*
Shannon	*Shannon's diversity index*
Lepomis	*proportional representation of individuals in the genus Lepomis*
Brood Hider	*proportional representation of individuals in the brood hiding breeding strategy (Balon, 1975).*
Nest Spawner	*proportional representation of individuals in the nest spawning breeding strategy (Balon, 1975).*
Open substrate	*proportional representation of individuals an open substrate spawning breeding strategy (Balon, 1975).*
Lotic	*proportional representation of individuals that prefer lotic environments*
Tolerance	*proportional representation of tolerant individuals*
Benthic Macroinvertebrate metrics	

Abbreviation	***Description***
Richness	*Taxa richness*
Shannon	*Shannon's diversity index*
EPT	*proportional representation of individuals in*
Chronomidae	*proportional representation of individuals in Chrionomidae family*
M-O index	*Average of an index indicative of Odonata and Megaloptera taxa preference for lotic or lentic conditions*
Tolerance	*Average tolerance index for macroinvertebrate taxa*

Appendix Table 2: List of hydrologic metrics, their associated flow regime component, and description.

Code	**Flow regime**	**Description**
DL16	Duration	Low flow pulse duration. The average pulse for flow events below a threshold equal to the 25th percentile value for the entire flow record.
DL17	Duration	Coefficient of vitiation in DL16
DL18	Duration	Number of zero-flow days
DH15	Duration	High flow pulse duration. The average duration for flow events with flows above a threshold equal to the 75th percentile value for each year in the flow record.
DH16	Duration	Coefficient of vitiation in DH15
FL1	Frequency	Low flow pulse count. Average number of flow events with flows below a threshold equal to the 25th percentile value for the entire flow record
FL2	Frequency	Coefficient of vitiation in FL1
FH1	Frequency	High flow pulse count. Average pulse duration for each year for flow events below a threshold equal to the 25th percentile value for the entire flow record.
FH2	Frequency	Coefficient of vitiation in FH1
MA1	Magnitude	Mean daily flow (cfs)
MA3	Magnitude	Mean of the coefficient of vitiation (standard deviation/mean) for each year of daily flows
MA41	Magnitude	Annual runoff computed as the mean of the annual means divided by the

MA42	Magnitude	Coefficient of vitiation of MA41
ML17	Magnitude	Base flow index. The minimum of a 7-day moving average flow divided by the mean annual flow for each year.
ML18	Magnitude	Coefficient of vitiation in ML17
ML22	Magnitude	Specific mean annual minimum flow. Annual minimum flows divided by the drainage area
MH14	Magnitude	Median of annual maximum flows. The ratio of annual maximum flow to median annual flow for each year
MH20	Magnitude	Specific mean annual maximum flow. The annual maximum flows divided by the drainage area
RA8	Rate	Number of reversals. Number of days in each year when the change in flow from one day to the next changes direction
TA1	Timing	Constancy or stability of flow regime computed via the formulation of Colwell (see example in Colwell, 1974).
TL1	Timing	Julian date of annual minimum
TL2	Timing	Coefficient of vitiation in TL1
TH1	Timing	Julian date of annual maximum starting at day 100
TH2	Timing	Coefficient of vitiation in TH1

Appendix Table 3: A list of species of greatest conservation concern based on SCDNR's State Wildlife Action Plan (https://www.dnr.sc.gov/swap/index.html).

Carolina Quillback	*Carpiodes cyprinus*
Atlantic Highfin Carpsucker	*Carpiodes velifer*
Notchlip Redhorse	*Moxostoma collapsum*
V-Lip Redhorse	*Moxostoma pappillosum*
Snail Bullhead	*Ameiurus brunneus*
White Catfish	*Ameiurus catus*
Flat Bullhead	*Ameiurus platycephalus*
Stoneroller	*Campostoma anomalum*
Rosyside Dace	*Clinostomus funduloides*
Greenfin Shiner	*Cyprinella chloristia*
Thicklip Chub	*Cyprinella labrosa*
Fieryblack Shiner	*Cyprinella pyrrhomelas*
Santee Chub	*Cyprinella zanema*
Highback Chub	*Hybopsis hypsinotus*
Rosyface Chub	*Hybopsis rubrifrons*
Highfin Shiner	*Notropis altipinnis*
Swallowtail Shiner	*Notropis procne*
Sandbar Shiner	*Notropis scepticus*
Lowland Shiner	*Pteronotropis stonei*
Western Blacknose Dace	*Rhinichthys obtusus*
Striped Bass	*Morone saxatilis*
Carolina Fantail Darter	*Etheostoma brevispinum*
Carolina Darter	*Etheostoma collis*
Seagreen Darter	*Etheostoma thalassinum*
Piedmont Darter	*Percina crassa*
Southern Brook Trout	*Salvelinus fontinalis*

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Eddy, M. C., Lord, B., Perrot, D., Bower, L. M., & 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.

Scott, M. C., L. Rose, K. Kubach, C. Marion, C. Thomason, and J. Price. 2009. The South Carolina stream assessment standard operating procedures. South Carolina Dept. of Natural Resources, Columbia, SC.

South Carolina Department of Health and Environmental Control (SCDHEC). 2017. Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling. Bureau of Water, Columbia, South Carolina, USA.

Appendix D
Draft and Final Plan Survey Consensus 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 and will not continue working within the RBC's process. Member has decided to leave the RBC.

For the Final River Basin Plan, each RBC member votes simply to support or disagree with 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 RBC member's votes on the Draft and Final River Basin Plans are listed below.

Table D-1. Level of consensus for the Draft and Final River Basin Plan.

RBC Member	Draft Plan Level of Endorsement	Final Plan Support or Disagree
Katherine Amidon	2	
Jeff Boss	2	
David Coggins	2	
Jason Davis	2	
Tate Davis	1	
Phil Fragapane	1	
Brandon Grooms	2	
Robert Hanley	1	
Rick Huffman	2	
Patrick Jackson	1	
Paul Lewis	1	
Kevin Miller	1	
Larry Nates	1	
Josie Newton	2	
Jay Nicholson	2	
Devin Orr	1	
Eddie Owen	2	
K.C. Price	2	
Melanie Ruhlman	2	
Kaleigh Sims	1	
Thompson Smith	2	
Rett Templeton	2	
Charlie Timmons	1	
Michael Waddell	3	
Rebecca Wade	2	

Appendix E
Public Comments and Responses