Watershed-Based Plan

for Lake Greenwood in the

Saluda River Basin

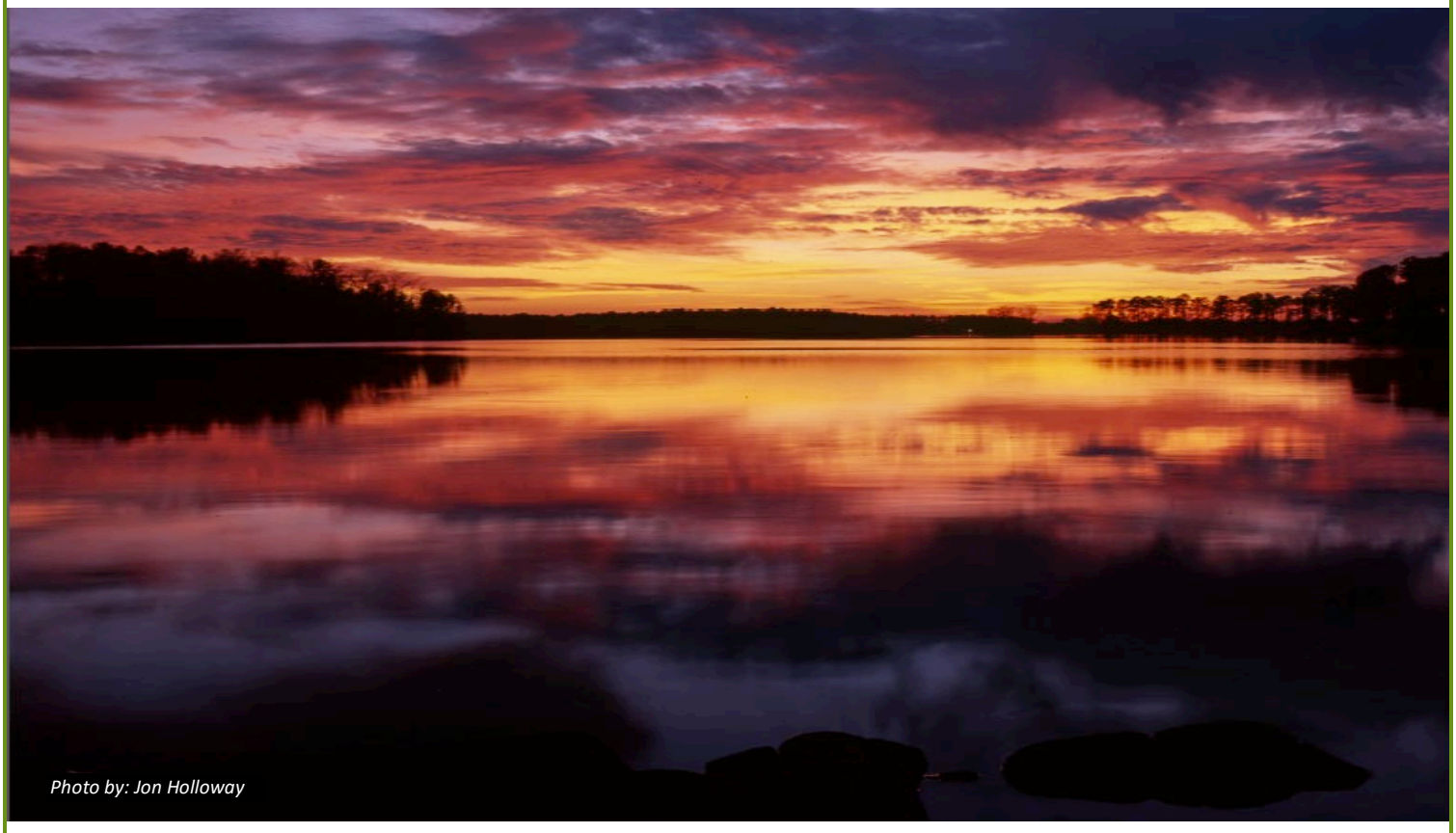

Photo by: Jon Holloway

UPSTATE FOREVER AND SOUTH CAROLINA RURAL WATER ASSOCIATION

for

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

APRIL 2022

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Project Stakeholders:

Waterloo Water Wizards

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ACEP	Agricultural Conservation Easement Program
AL	Aquatic Life
AWEP	Agricultural Water Enhancement Program
BMP	Best Management Practice(s)
CAFO	Concentrated Animal Feeding Operation
CE	Conservation Easement
CFU	Colony Forming Unit
CLM	Upstate Forever's Critical Lands Map
CPW	Commission of Public Works
CRP	Conservation Reserve Program
CSP	Conservation Stewardship Program
CU	Clemson University
CU Ext.	Clemson University Cooperative Extension
CWA	Upstate Forever's Critical Watershed Area
ECHO	EPA's Enforcement and Compliance History Online
E.coli	*Escherichia coli*
EPA	United States Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FC	Fecal Coliform
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FSA	Farm Service Agency
FW	Fresh Water
GIS	Geographic Information System
gSSURGO	Gridded Soil Survey Geographic Database
HFRP	Healthy Forests Reserve Program
HUC	Hydrologic Unit Code
INDNR	Indiana Department of Natural Resources
InVEST	Integrated Valuation of Ecosystem Services and Trade-Offs (model)
LA	Load Allocation
lbs	Pounds

LCWSC	Laurens County Water and Sewer Commission
mg/L	Milligrams per Liter
ml	Milliliter
MOS	Margin of Safety
MPN	Most Probable Number
MRLC	Multi-Resolution Land Characteristics
MS4	Municipal Separate Storm Sewer System
MSL	Mean Sea Level
MST	Microbial Source Tracking
NAWCA	North American Wetlands Conservation Act
ND	No Discharge
NHD	National Hydrography Dataset
NLCD	National Land Cover Dataset
NLT	Naturaland Trust
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NTU	Nephelometric Turbidity Units (NTU)
ONRW	Outstanding Natural Resource Waters
PCBs	Polychlorinated biphenyls
RCPP	Regional Conservation Partnership Program
RRWQG	Reedy River Water Quality Group
(R)USLE	(Revised) Universal Soil Loss Equation
SC	South Carolina
SC AAS	South Carolina Adopt-A-Stream
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCFC	South Carolina Forestry Commission
SCRWA	South Carolina Rural Water Association
SMP	Shoreline Management Plan
SMZ	Streamside Management Zones
SSO	Sanitary Sewer Overflow
STEPL	Spreadsheet Tool for Estimating Pollutant Loads

STORET	EPA's Water Quality Storage and Retrieval Data Warehouse
SWCD	Soil and Water Conservation District
SWPA	Source Water Protection Area
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TNC	The Nature Conservancy
TP	Total Phosphorus
TPL	Trust for Public Land
TPGT	Trout, Put, Grow, Take
TSS	Total Suspended Solids
UF	Upstate Forever
US	United States
USDA	United States Department of Agriculture
USLE	Universal Soil Loss Equation
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WBP	Watershed-Based Plan
WLA	Waste Load Allocation
WOTUS	Waters of the United States
WQMS	Water Quality Monitoring Station
WQX	EPA's Water Quality Data
WWTP	Wastewater Treatment Plant

1) EXECUTIVE SUMMARY

This watershed-based plan (WBP) focuses on six HUC-12 watersheds totaling more than 126,600 acres, which includes more than 10,000 acres of Lake Greenwood in Greenwood and Laurens counties. Lake Greenwood was formed through the construction of the Buzzards Roost Dam between 1935-1940, with water inflows from the Saluda and Reedy rivers. The primary uses of Lake Greenwood are power generation, drinking water supply, and recreation. The land surrounding Lake Greenwood is comprised primarily of privately-owned forested land, nearly 63% of the focus area's total land cover. The focus area is home to over 10,000 people and supplies drinking water to over 100,000 residents in the Greenwood and Laurens counties. This WBP addresses bacteria, sediment, and nutrient pollution concerns through strategies that efficiently reduce and/or prevent nonpoint source pollutant runoff from contaminating waterways and drinking water resources. These proposed methods serve to improve water quality and reduce the potential burden of increased drinking water treatment costs on local drinking water utilities.

Pollutants and Sources – There is one Total Maximum Daily Load (TMDL) for Rabon Creek in the focus area, addressing Fecal Coliform (FC) bacteria. This TMDL was approved by the South Carolina Department of Health and Environmental Control (SCDHEC) in 2004 and calls for an annual bacterial reduction of 2.17E+14 counts (see Section 5) to meet state standards. Stations included in this TMDL are S-096 and S-307. Load reduction calculations are based solely on S-096; according to the TMDL, "the load allocated at S-307 is addressed through the TMDL at S-096 and expected reductions presented for S-096" [1]. Additionally, stations RS-09116 and S-021 are listed as impaired for *E.coli* on the SCDHEC 2018 List of Impaired Waters [2]. Identified sources of bacterial pollution include failing septic systems, agricultural runoff, pet waste, wildlife, and stormwater runoff. It is estimated that nearly 27% of homes within the focus area are likely experiencing failing or malfunctioning septic systems, which would mean the focus area is seeing 1.73E+13 bacterial loading annually from septic systems alone. Sedimentation is another major pollutant of concern in the focus area. SCDHEC Water Quality Monitoring Station RL-13077 is listed as impaired for turbidity on the 2018 303(d) List of Impaired Waters, which can be an indicator of sedimentation. According to loading estimates (detailed in Section 6), agricultural lands contribute the highest amount of sediment loading to the focus area, followed by forestry and urban lands. Stormwater runoff is also associated with sedimentation, especially in areas experiencing significant residential and commercial development. The impacts of upstream development are particularly evident in the upper reaches of Lake Greenwood and associated tributaries which have experienced substantial sedimentation. Lastly, this plan focuses on nutrient pollution, specifically nitrogen and phosphorus. SCDHEC Water Quality Monitoring Station S-308 is listed as impaired for nitrogen on the 2018 303(d) List of Impaired Waters. Comparable to bacteria and sediment pollution, sources of nutrient pollution can be attributed to stormwater runoff, agricultural practices, and wastewater discharges. Since all three major pollutants of concern have similar sources, the suite of recommended Best Management Practices (BMPs) in this WBP addresses reduction of all three simultaneously.

Pollutant Load Reductions – To address the three pollutants of concern, Upstate Forever (UF) and SCRWA (South Carolina Rural Water Association) analyzed the existing TMDL document and utilized the Spreadsheet Tool for Estimating Pollutant Loads (STEPL) to determine the necessary load reductions required to meet state standards for each pollutant of concern.

TABLE 1. POLLUTANT LOAD REDUCTIONS NEEDED IN THE LAKE GREENWOOD WATERSHEDS

Pollutant of Concern	Load Reduction Needed
Bacteria	2.17E+14 counts/year
Sediment	6,535 tons/year
Nutrients	356,281 pounds (lbs)/year

Recommendations to Reduce Pollutant Loads – This WBP presents specific BMPs to address bacteria, sediment, and nutrient pollution within the focus area. Additionally, pollution prevention strategies are included, such as permanent land protection. Though total restoration of the focus area would be ideal, this plan takes a more financially realistic approach and focuses on incremental reductions in bacteria levels. While sediment loading can be attributed to upstream sources, this WBP addresses methods to reduce sedimentation within the focus area. Although nine BMP categories of protection and restoration strategies are analyzed, Table 2 details the five BMP categories that will most efficiently and successfully meet the necessary pollutant reduction goals based on load reduction data and cost estimates. The remaining four BMP categories are supplemental to the five recommended strategies. Although the supplemental BMP categories do not have associated load reduction calculations, they provide important management strategies pertinent to the Lake Greenwood watersheds. The five recommended BMP strategies are: land protection, septic repair/replacement, agricultural BMPs, riparian buffer BMPs, and pet waste management; the four supplemental BMP categories are: forestry management, shoreline management, stormwater management, and wetland BMPs.

Prioritizing BMP Installation Locations – UF/SCRWA conducted an in-depth Geographic Information Systems (GIS) land prioritization analysis (Section 9) at the parcel level for nine BMP categories of protection and restoration (discussed above). The major goal of the analyses was to identify lands that, if protected or restored, would provide the biggest benefit or improvement to water quality. For each category, weighted criterion (*e.g.*, land cover, proximity to water quality impairments, percent of existing riparian buffer coverage) based on importance to water quality protection or restoration were assigned to each individual parcel, resulting in detailed maps that categorize parcels for high, medium, and low priority implementation. These maps will help to facilitate the targeted and strategic implementation of improvement projects in the focus area by identifying areas that will have the greatest impact on protecting and restoring water quality.

Implementation and Cost Estimates – Utilizing the results of the land prioritization analyses, UF/SCRWA developed a targeted public education and outreach strategy, project implementation timeline, and estimated costs for BMP installations to meet pollutant load reduction requirements. The five main BMPs listed in Table 2 are recommended to achieve necessary load reductions; however, supplemental BMPs should be considered as funding and resources allow. Taking advantage of a network of engaged partners and stakeholders will increase the potential for the successful implementation of the recommendations proposed in this WBP.

TABLE 2. RECOMMENDED BMPS AND ANNUAL LOAD REDUCTIONS IN THE LAKE GREENWOOD WATERSHEDS

BMP	# Of Projects	Bacteria Load Reduction/ Prevention (counts/year)	Sediment Load Reduction/ Prevention (tons/year)	Nutrient Load Reduction/ Prevention (lbs/year)
Septic Repair/ Restoration	25	6.05E+11	--	1,135.02
Agricultural BMP Bundle	2	2.89E+12	13.0	24.40
Pet Waste Stations	1	2.14E+12	--	18.36
Land Protection*	1 (55+ acres)*	2.27E+09*	2.59*	167.70*
Riparian Buffer Restoration	2	1.36E+11	2.0	49.60
Total		**8.66E+12**	**17.59**	**1,345.48**

**Pollutant load prevented*

This WBP recommends incremental water quality improvements over 36-month implementation phases. This recommendation follows the typical cycle for SCDHEC 319 Grant for Implementation Projects and cost estimates are based upon the SCDHEC cost-share rate of 60%. As detailed in Table 3, the federal request to complete one phase, aimed at achieving incremental bacterial pollutant reduction, is estimated to be $207,807.84 for BMP costs; to achieve all necessary load reductions, the cost is estimated to be over $3.1 million over the course of 25 phases (100 years). These estimates are subject to landowner participation and funding availability.

TABLE 3. LAKE GREENWOOD WATERSHEDS PROJECT IMPLEMENTATION COST ESTIMATES (PER PHASE)

BMP	Average Cost	Recommended Projects	Estimated Cost Per Phase	SCDHEC Cost Share Per Phase
Septic Repair/ Restoration	$4,500	25	$112,500	$67,500
Agricultural BMP Bundle	$22,539.15	2	$45,078.30	$27,046.98
Pet Waste Stations	$300	1	$300	$180
Land Protection (CEs*)	$23,250	1 (55+ acres)	$23,250	$13,950
Riparian Buffer Restoration	$13,339.77	2	$26,679.54	$16,007.72
Total (per phase)			**$207,807.84**	**$124,684.71**

**CE = Conservation Easement*

2) GENERAL WATERSHED INFORMATION

2.1) WATERSHED SUMMARY

This WBP includes six Hydrologic Unit Code (HUC)-12s encompassing Lake Greenwood, which is a part of the greater Saluda River Basin (HUC 03050109). This document refers to this area as the "focus area" (or "watersheds"), as shown in Figure 1. The Saluda River Basin encompasses a total of 2,055,866 acres and is subdivided into 18 HUC-10 watersheds that flow from the Blue Ridge ecoregion, through the Piedmont, and into the Sandhills and Upper Coastal Plains ecoregions [2]. Within the 126,637-acre focus area, there are approximately 427 stream miles, situated in Greenwood, Laurens, and Newberry counties (Table 4). All streams and lakes within the focus area are classified as Fresh Waters (FW) [3]. Lake Greenwood was created by the construction of the Buzzards Roost Dam between the years 1935-1940. Lake Greenwood is currently managed by the Greenwood County Lake Management Department and leased for hydropower to Lockhart Power. Although the primary uses of Lake Greenwood are power generation and drinking water supply, recreation on the lake is a major contributor to the local economy.

TABLE 4. LAKE GREENWOOD CHARACTERISTICS

Watershed	HUC-12 Code	Total Acreage	All Streams (miles)	Lake (acres)
Rabon Creek	030501090503	25,398	83.46	174.76
Long Lick Branch-Reedy River	030501090603	5,636	21.95	80.68
Outlet Reedy River	030501090604	27,433	105.76	929.91
Cane Creek-Saluda River	030501090806	20,766	75.75	541.10
Upper Lake Greenwood-Saluda River	030501090807	20,792	60.97	2,895.05
Lower Lake Greenwood-Saluda River	030501090808	26,612	79.55	5,433.65
Total		**126,637**	**427.44**	**10,055.15**

2.2) LOCATION AND HYDROLOGY

The focus area is situated primarily in Greenwood and Laurens counties, with a portion of the watersheds extending into Newberry County at the southern end near Chappells, SC. The watersheds are located between Highway 252 to the north, Highway 39 to the east, Highway 34 to the south, and Highway 246 and Riverfork Road to the west. The focus area is intersected by US Highway 221 through the middle portion of the watersheds. Nearby cities/towns include Laurens, Ware Shoals, Greenwood, Ninety-Six, and Chappells. The focus area is located within the Southern Outer Piedmont Ecoregion (EPA Level IV), part of the greater Piedmont Ecoregion (EPA Level III) [4]. Tracts of land in this ecoregion are generally lower in elevation, classified as irregular plains, and are dominated by forested areas [5]. Elevation in the focus area ranges from 355-760 feet, with most of the higher elevations located near the northern portion of the watersheds. The two major tributaries of Lake Greenwood are the Saluda and Reedy rivers, both with headwaters in Greenville County, SC. The focus area encompasses nearly 12

miles of the Reedy River in the northern portion of the watersheds at Highway 252, beginning just below Boyd's Mill Pond. The Saluda River meets Lake Greenwood at the western middle corner of the focus area, forming the Saluda arm of Lake Greenwood, about 3.75 miles northwest of where Old Laurens Road crosses the lake. Major creeks and streams flowing into Lake Greenwood include Rabon Creek, Walnut Creek, Long Lick Branch, Quarter Creek, and Cane Creek (see Figure 1). The maximum depth of Lake Greenwood is 68.9 feet, and the average depth is 23 feet [6].

2.3) POPULATION

According to the 2018 5-Year Estimates by the United States Census Bureau, there are an estimated 3,962 households within the Lake Greenwood watersheds, an average household size of 2.5 people, and a total population of approximately 10,225 people. The focus area is predominantly rural, with roughly 67% residing in Laurens County, and most of the population living directly around the Lake Greenwood reservoir [7].

2.4) GEOLOGY AND SOILS

The northern portion of the watersheds are defined by the Laurens thrust sheet, which cuts off near the confluence of the Reedy and Saluda rivers. Directly below, the Lowndesville Shear Zone dissects the middle portion of the watersheds, and the Charlotte thrust sheet defines the southern quarter of the focus area. Multiple fault lines of the Ductile Shear Zone are within the southern half of the watersheds. Lithology is primarily defined by granite and gneiss rocks and most soils are classified as sandy loams. Principal soils include Appling, Cataula, Cecil, Enon, Helena, Hiwassee, Pacolet, and Wilkes. The soil erodibility factor, or K-factor, for the soils in the focus area ranges from 0.10 to 0.37 [8]. K-factor values closer to 1.0 indicate higher soil erodibility, which implies a greater need for protection measures. Taken as a whole, the soils found in the focus area are well-drained, moderately permeable soils.

2.5) LAND COVER

Sourced from the 2016 National Land Cover Dataset (NLCD), land cover in the focus area has been divided into nine categories, as shown in Table 5 and Figure 2. Because the NLCD is only updated every five years, Table 5 shows land cover in 2016, which is the most recent data available. Forested land makes up the largest land classification in the focus area, totaling nearly 63% [9].

TABLE 5. LAND COVER IN THE LAKE GREENWOOD WATERSHEDS

Land Cover Type	**Land Cover in 2016 (acres)**	**Percent Coverage**
Cultivated Crops	7.56	0.01%
Barren	331.19	0.26%
Wetlands	1,450.34	1.15%
Shrub/Scrubland	4,064.87	3.21%
Herbaceous	5,527.85	4.37%
Water	10,384.00	8.20%
Developed	11,589.33	9.15%
Pasture/Hay	13,702.28	10.82%
Forest	79,580.17	62.84%
Total	**126,637.59**	

Figure 1: Lake Greenwood Watersheds

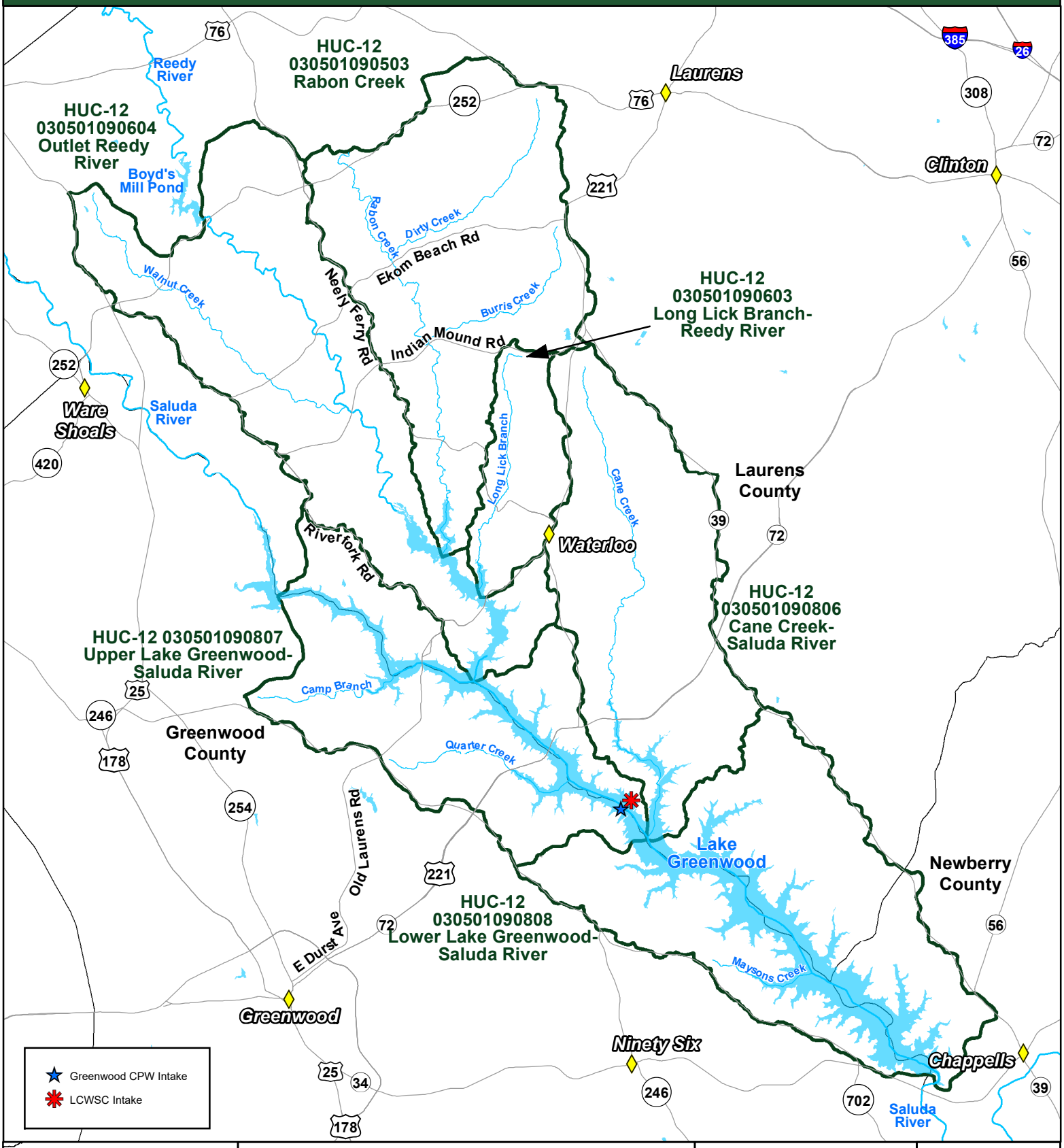
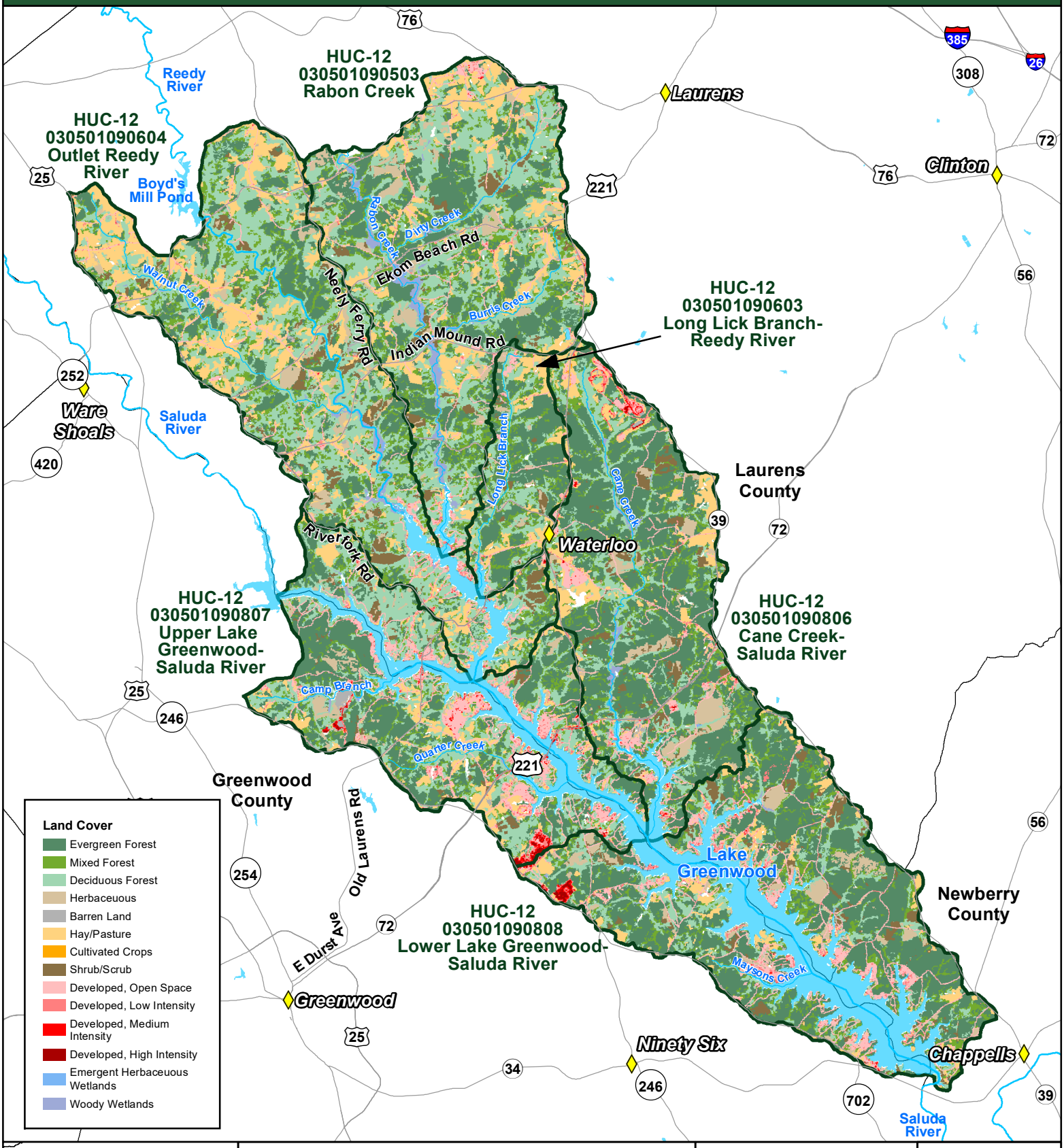


Figure 2: Land Cover



DISCLAIMER:
This map is not a land survey and is for general reference purposes only. Upstate Forever and SC Rural Water Association make no warranty or representation as to the accuracy of this map and disclaim all responsibility for any costs or damages that may arise from its use.

Map by: KPH - 11/10/2020

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2.6) BENEFITS OF WATERSHED-BASED PLANS

WBPs enhance source water protection planning efforts by evaluating all potential nonpoint source impacts to source waters throughout an entire watershed. Through a variety of strategies (*e.g.*, land protection, agricultural BMPs, septic system repairs, and improved riparian buffers) it is possible to efficiently reduce and/or prevent nonpoint source pollutants from running off land and contaminating waterways and drinking water resources. These actions improve water quality and prevent increases in treatment costs for utilities and ultimately, their customers. WBPs outline specific actions and strategies for water quality protections and improvements that will help ensure sustainable and safe drinking water supplies for local communities. Additionally, approved WBPs are eligible for funding through the Section 319 Nonpoint Source Program for land improvement projects.

2.7) PREVIOUS WORK IN THE LAKE GREENWOOD WATERSHEDS

The Saluda-Reedy Watershed is a well-studied watershed in the Southeast, with numerous surveys and significant research efforts conducted over the past several decades. The research focused on contaminants such as heavy metals, polychlorinated biphenyls (PCBs), nutrient loading, and sedimentation. For this plan, reports published from 2004-2020 were reviewed. In 2009, UF and the Saluda-Reedy Watershed Consortium published an action plan for water quality protection and restoration: *Saving Lake Greenwood* [10]. The plan outlines nutrient loading (particularly phosphorus pollution) and sedimentation from nonpoint sources as the chief causes for future water quality concerns, with a high percentage (80%) of phosphorus storage in suspended sediment remaining in the lake, likely exacerbating water quality problems. As a part of this effort, more than 50 reports and analyses were conducted from 2003-2009 and detailed in the Summary of Major Reports and Studies [11]. Included were two by the SC Department of Natural Resources (SCDNR) in 2008 examining oxygen depletion, water flow and temperature, phosphorus loading, and algal development in Lake Greenwood. Both studies focused on the development of a water quality model for the lake [12]. A peer-reviewed paper published in *the Journal of Water, Air, & Soil Pollution* in December 2020 examined the presence of heavy metals in sediment deposits in Lake Greenwood and tributary streams. The research found that levels have significantly decreased since 2012, likely resulting from the flood of 2015 [13]. Another article from *Ecological Engineering*, published in 2014, analyzed costs associated with mitigating impacts from future development in the Greenville area on the Reedy River Watershed and Lake Greenwood [14]. Following the publication of *Saving Lake Greenwood*, the Preserving Lake Greenwood (PLG) group was formed with the mission of conserving, caring, and protecting Lake Greenwood. This group has been involved in the Lake Greenwood community, sponsoring activities such as volunteer water quality monitoring, public outreach, and engagement/involvement with various community projects. The Lake Greenwood community has a history of active resident and citizen engagement opportunities, with other groups such as Connect Lake Greenwood and the Waterloo Water Wizards taking the lead to ensure Lake Greenwood is a healthy, safe, and fun place to enjoy.

2.8) WATERSHED ASSESSMENT

UF/SCRWA conducted in-depth watershed assessments both, on-the-ground and virtually, to gather information on land use, potential sources of pollution, and verification of areas of concern.

2.8.1) WINDSHIELD AND DESKTOP SURVEYS

Desktop Survey: Utilizing aerial photography, Google search engine, and GIS data, UF/SCRWA were able to identify potential sources of pollution including livestock/farms, sedimentation from upstream rivers, and lakeside development. Because much of the watershed is private property, aerial photography assisted in the identification of areas of concern (Sections 9-21).

Windshield Surveys: Based on the results of the desktop survey, UF/SCRWA conducted five windshield surveys, both by car and by boat, to visit agricultural sites, impaired streambanks, forestry sites, and other potential sources of pollution. The windshield surveys revealed that agriculture is not a predominant land use activity within the focus area. Proper shoreline management will be a primary focus, and it will be important to partner with groups such as the South Carolina Forestry Commission (SCFC) to identify problem areas on forestry tracts as most forested properties are privately owned and operated. SCRWA contacted the SCFC to review courtesy site visits that have been conducted in the focus area between 2018-2021 to identify forested lands that could benefit from utilizing the suite of BMPs mentioned in Section 14.

2.8.2) PUBLIC OUTREACH AND ENGAGEMENT

UF/SCRWA provided multiple opportunities for public engagement during the development of this plan. An online survey was developed and distributed to landowners and residents through project partners to gauge current water quality awareness and areas or topics of concern in the region. The survey collected 103 responses and included questions about fertilizer use, septic system maintenance, forested land utilization, and invited respondents to submit questions or concerns they have about threats to water quality. The survey also asked respondents what water-related features in the focus area they valued most and used frequently. Based on the survey results, participants listed water-based recreation and clean drinking water as the top values of Lake Greenwood and greater watershed with sedimentation and failing septic systems as the leading threats to water quality in the region. A copy of the public survey can be found in Appendix F. Additionally, UF/SCRWA recorded a webinar in July of 2020 that gave an overview of the WBP development and the public input process which has been viewed over 100 times.

2.8.3) STAKEHOLDER ENGAGEMENT

UF/SCRWA communicated regularly with project stakeholders throughout the development of this plan. In September of 2020, a virtual stakeholder meeting was held to update stakeholders on the WBP progress and solicit input regarding potential sources of pollution, BMP recommendations, and data collection. In October of 2020, SCRWA presented on the progress of the WBP to the Laurens Rotary Club and distributed the public survey (Appendix F). Throughout the planning process, stakeholders were involved in data collection and interpretation as well as BMP recommendations. This culminated at the final stakeholder meeting held virtually in October of 2021, where final comments were collected and then incorporated into the document. Additionally, UF/SCRWA attended PLG meetings throughout the planning process to provide updates on the WBP to the community.

3) WATER QUALITY MONITORING AND ASSESSMENT

3.1) INTRODUCTION TO WATER QUALITY MONITORING AND IMPAIRMENTS

SCDHEC is entrusted with the responsibility of enforcing state water quality standards. These standards, R. 61-68 Water Classification & Standards, have been established to protect the surface and groundwater resources of South Carolina. The purpose of this regulation is to create general rules, specific numeric and narrative criteria, and anti-degradation rules for the protection of classified and existing water uses and to establish procedures to classify waters of the state [15]. Waters that are listed as impaired, or not meeting specific numeric and narrative criteria or designated uses, are placed on the biannual South Carolina 303(d) List of Impaired Waters [16]. Once a site is placed on the 303(d) List, it can only be removed if:

1. The site meets water quality standards (Standard Attained); or
2. The site was listed in error; or

3. A TMDL is developed and approved. In the case of a TMDL, it does not mean that the site meets water quality standards, but that the potential pollutant source(s) and amount of pollutant reduction needed to meet water quality standards have been identified.

3.2) AVAILABLE WATER QUALITY DATA

Water quality monitoring within the focus area includes both regulatory and drinking water utility monitoring stations, as well as citizen-science monitoring sites. Citizen groups from the SC Adopt-A-Stream program (SC AAS) have expanded the range of water quality monitoring within the focus area through their citizen driven monitoring efforts. While data collected by SC AAS is not permitted to be used for regulatory purposes, citizen monitoring is helpful in identifying sources of pollution and providing baseline information on streams not currently monitored by SCDHEC. There are currently nine established SC AAS sites within the focus area. Additionally, Woolpert, sponsored by Greenwood County, ReWa, and the Reedy River Water Quality Group (RRWQG), operates a sampling station on the Reedy River arm of the lake.

3.2.1) SCDHEC WATER QUALITY MONITORING STATIONS

Within the focus area, there are seven active SCDHEC water quality monitoring stations (WQMS), (Table 6), five inactive WQMS, and an additional 15 random lake and stream water quality sampling stations, both active and inactive. These sites are sampled for a combination of water quality parameters including pollutants and macroinvertebrate populations. Special study sites determine if, and to what extent, nonpoint source runoff is impacting these waterways [3]. See Sections 3.3-3.6 for details on current water quality impairments.

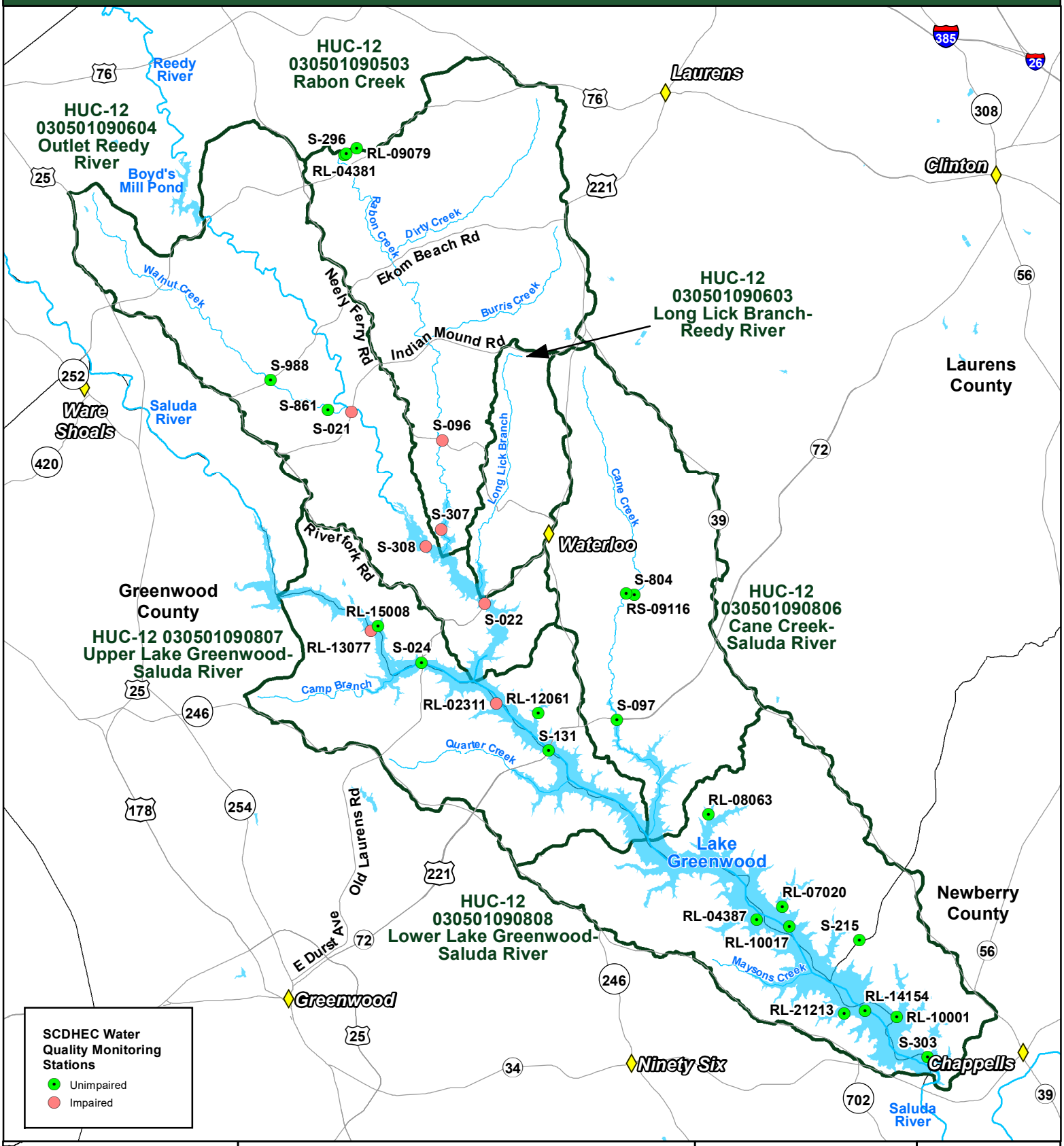
TABLE 6. SCDHEC WATER QUALITY MONITORING STATION (WQMS) LOCATIONS AND STATUS

	WQMS	WQMS Location	Type	Years Sampled	2018 303(d) List Status
Lake Monitoring Stations	RL-02311	LAKE GREENWOOD 1.0 MI NW OF SEABOARD RR CROSSING	Random Lake	Inactive: 2002	--
	RL-04381	LAKE RABON 300 FT US OF DAM - USE S-296	Random Lake	Inactive: 2004	--
	RL-04387	LAKE GREENWOOD, 2.2 MI NW OF LAKE GREENWOOD STATE PARK	Random Lake	Inactive: 2004	--
	RL-07020	LAKE GREENWOOD MOUTH OF COVE NEAR END OF S-30-87 - ANGLERS HAVEN	Random Lake	Inactive: 2007	--
	RL-08063	LAKE GREENWOOD NEXT SMALL ARM EAST OF CANE CREEK ARM IN SMALL EMBAYMENT	Random Lake	Inactive: 2008	--
	RL-09079	LAKE RABON ABOUT 0.3 MILES NORTHEAST OF S-296	Random Lake	Inactive: 2009	--
	RL-10001	LAKE GREENWOOD 1.9MI WSW OF JCT OF SC-39 AND SC-56	Random Lake	Inactive: 2010	--
	RL-10017	LAKE GREENWOOD 2.95MI WSW OF LAURENS/ NEWBERRY COUNTY LINE ON SC-39	Random Lake	Inactive: 2010	--
	RL-12061	LAKE GREENWOOD IN LARGE ARM TO NORTH BETWEEN US 221 AND RAILROAD TRESTLE	Random Lake	Inactive: 2012	--

Table 6 continued

	WQMS	WQMS Location	Type	Years Sampled	2018 303(d) List Status
Lake Monitoring Stations	RL-13077	LAKE GREENWOOD JUST OFF SHORELINE FROM LARGE OPEN YARD PROPERTY OFF EAGLE HARBOR DR; APPROX 1.4 MI N	Random Lake	Inactive: 2013	Impairment: Turbidity
	RL-14154	LAKE GREENWOOD APPROX 940 YDS ENE OF GREENWOOD SHORES BOAT RAMP	Random Lake	Inactive: 2014	--
	RL-15008	LAKE GREENWOOD 0.15 MILES WEST OF THE INTERSECTION OF CANNON RD AND STILL WATER RD	Random Lake	Inactive: 2015	--
	RL-18084	REEDY FORK OF LK GREENWOOD AT S-30-29	Random Lake	Inactive: 2018	--
	RL-21213	LAKE GREENWOOD LOCATED 0.6 MILES SE FROM GREENWOOD STATE PARK BOAT RAMP	Random Lake	Active: 2021	--
	S-024	LAKE GREENWOOD HEADWATERS, JUST UPSTREAM OF S-30-33	Ambient, Base	Active: 2001-present	--
	S-097	LAKE GREENWOOD, CANE CK ARM AT SC 72, 3.1 MILES SW OF CROSS HILL	Ambient, Historic	Inactive: 1999-2006	--
	S-131	LAKE GREENWOOD AT US 221, 7.6 MILES NNW OF NINETY-SIX	Ambient, Base	Active: 1999-present	--
	S-303	LAKE GREENWOOD 200 FEET UPSTREAM OF DAM	Ambient, Historic	Inactive: 2001-2016	--
	S-307	LAKE GREENWOOD, RABON CK ARM, .8 KM N RD S-30-307	Ambient, Historic	Inactive: 2001-2006	TMDL Fully Supported: Fecal Coliform
	S-308	LAKE GREENWOOD; REEDY RVR ARM; 150 YDS US RABON CK	Ambient, Base	Active: 1999-present	Impairment: Nitrogen
	S-988	@ EKOM BEACH RD (SR 36)	Special Study Site	Inactive: 2005, 2008	--
Stream Monitoring Stations	RS-09116	UNNAMED TRIB TO CANE CK AT BRIDGE ON S-30-19	Random Stream	Inactive: 2009	Impairment: *E.coli*
	S-021	REEDY RVR AT S-30-06 E WARE SHOALS	Ambient, Base	Active: 1999-present	Impairment: *E.coli*
	S-022	REEDY FORK OF LK GREENWOOD AT S-30-29	Ambient, Random	Active: 2001-present	--
	S-096	RABON CK AT S-30-54 8.8 MI NW CROSS HILL	Ambient, Base	Active: 1999-present	TMDL Not Supported: Fecal Coliform
	S-804	CANE CREEK. @ SEC.RD. 19	Macroinvertebrate, Historic	Inactive: 1992-93, 1997, 2001	--
	S-861	WALNUT CREEK AT SR 64	Macroinvertebrate, Historic	Inactive: 1996-97, 2001, 2004, 2006	--

Figure 3: SCDHEC Water Quality Monitoring Stations



DISCLAIMER:
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Map by: KPH - 11/18/2020

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3.2.2) GREENWOOD CPW

Greenwood Commissioners of Public Works (CPW) began a formal Source Water Monitoring Plan in February 2017, with revisions made in February 2021 [17]. A summary of the source water monitoring plan is as follows:

1. Collection and analyses of water samples are taken quarterly from Lake Greenwood at eight locations upstream of the Greenwood CPW drinking water intakes for the identification and quantification of taste and odor-causing cyanobacteria, or blue-green algae.
2. Samples will be collected during the second or third week of each month.
3. Included with the above sample collection are the analyses of total nitrogen, total phosphorus, pH, temperature, turbidity, and Chlorophyll A.
4. Once determined if taste & odor-causing cyanobacteria are present and in high enough densities to cause taste and odor and/or cyanotoxins, recommendations for the treatment of the source water with state approved algaecides may be drafted to control the taste and odor-causing algae and/or cyanotoxins that could potentially become detectable in the drinking water from Greenwood CPW.
5. All sample analyses shall follow approved methods for source water monitoring.

Greenwood CPW is coordinating with the Greenwood County Lake Management group to collect water quality samples from the lake for this effort. Lake Management is allowing Greenwood CPW to assist their staff in collecting samples from the eight sampling locations. Lake Management is also monitoring the sampling results in the context of their water quality goals. Together, Lake Management and Greenwood CPW are assessing this monitoring plan from both its historical context and current implications of algal activity and nutrient loading in Lake Greenwood to determine if future remediation and treatment will be required. The following table is a summary of these monitoring activities.

TABLE 7. GREENWOOD CPW WATER QUALITY MONITORING ON LAKE GREENWOOD

Map ID	Sample Site Description	Analyses Performed
1	Intake No. 1	• Algae Level 2 speciation & density (cells/ml) • Chlorophyll A • pH, Temp • Nutrients (TN, TP*) • Turbidity
2	Mouth of cove across from intake #1	
3	Mouth of cove Camp Fellowship	
4	Quarter Creek at Shrine Club Rd. (Greenwood Side)	
5	Mouth of cove Ridgewood Air	
6	Mouth of cove at Stoney Point	
7	Mouth of Reedy	
8	Saluda River at confluence with Reedy River	

*TN = Total Nitrogen, TP = Total Phosphorus

3.2.3) SOUTH CAROLINA ADOPT-A-STREAM

South Carolina Adopt-A-Stream (SC AAS) is a joint program managed by SCDHEC and the Clemson University Center for Watershed Excellence. The program provides opportunities for South Carolinians to be involved in the protection and management of state waterways through water quality monitoring and reporting activities. These volunteers provide important data that compliments water quality data provided by local and state governments. Volunteers are trained not only to take water quality samples but are also given the skills and tools to effectively increase awareness regarding the relationships between pollution, watershed management, land use changes, and

personal responsibilities needed for overall better environmental stewardship [18]. The project area contains nine individual inactive SC AAS sponsored monitoring sites, which are presented in Table 8. Currently, the SC AAS program is providing incentives for local groups to take over established but inactive sites throughout the state. SC AAS is an ideal program for local citizens interested in monitoring water quality such as schools and community groups. The SC AAS program offers trainings and monitoring resources under four protocols - Stream Habitat Assessment, Physical/Chemical Monitoring, Bacteria Monitoring, and Macroinvertebrate Monitoring. The information obtained through voluntary monitoring programs is valuable because it increases our understanding of water quality in areas that SCDHEC is unable to monitor.

SC Adopt-A-Stream volunteers collecting a water sample (left) and analyzing samples (right).

TABLE 8. SC ADOPT-A-STREAM SITES IN THE LAKE GREENWOOD WATERSHEDS

Site Name	**Waterbody**	**Monitoring Group**	**Years Sampled**	**Parameters**
BC-0078	Burris Creek	Waterloo Water Wizards	2014-2015	*E.coli*, Dissolved Oxygen, pH, Macroinvertebrates
CCAR7B-0074	Cane Creek at Rt 72 bridge		2015-2017	*E.coli*, Dissolved Oxygen, pH
DC-0080	Dirty Creek		2014-2015	*E.coli*, Dissolved Oxygen, pH, Macroinvertebrates
HLCBA-0072	Hidden Lake, Crystal Bay area		2016	*E.coli*, Dissolved Oxygen, pH
LC-0026	Lick Creek		2017-2018	*E.coli,* pH, Conductivity, Dissolved Oxygen
LG-0025	Lake Greenwood		2015-2018	*E.coli,* pH, Conductivity, Dissolved Oxygen
RCABC-0077	Rabon Creek at Burris Creek		2015-2016	*E.coli,* pH, Conductivity, Dissolved Oxygen, Macroinvertebrates
RCANFB-0024	Rabon Creek at Neely Ferry Bridge		2017-2018	*E.coli,* pH, Conductivity, Temperature, Dissolved Oxygen
RRAEB-0079	Reedy River at Ekom Beach		2015-2016	*E.coli,* pH, Conductivity, Dissolved Oxygen, Macroinvertebrates

3.2.4) LAKE GREENWOOD

Within the project area, there is one real-time buoy in Lake Greenwood funded by Laurens County Water and Sewer Commission (LCWSC), Greenwood County, ReWa, and the City of Greenville. This buoy is operated by Woolpert under subcontract to WQR, Inc. and collects data every 15 minutes on pH, temperature, conductivity, dissolved oxygen, turbidity, and Chlorophyll A. Woolpert also operates one continuous rain gauge on the Reedy River upstream from the lake. North of the project area, they operate between 15 and 20 real-time water quality monitoring stations upstream from Boyd's Mill Pond, on behalf of Greenville County and the City of Greenville.

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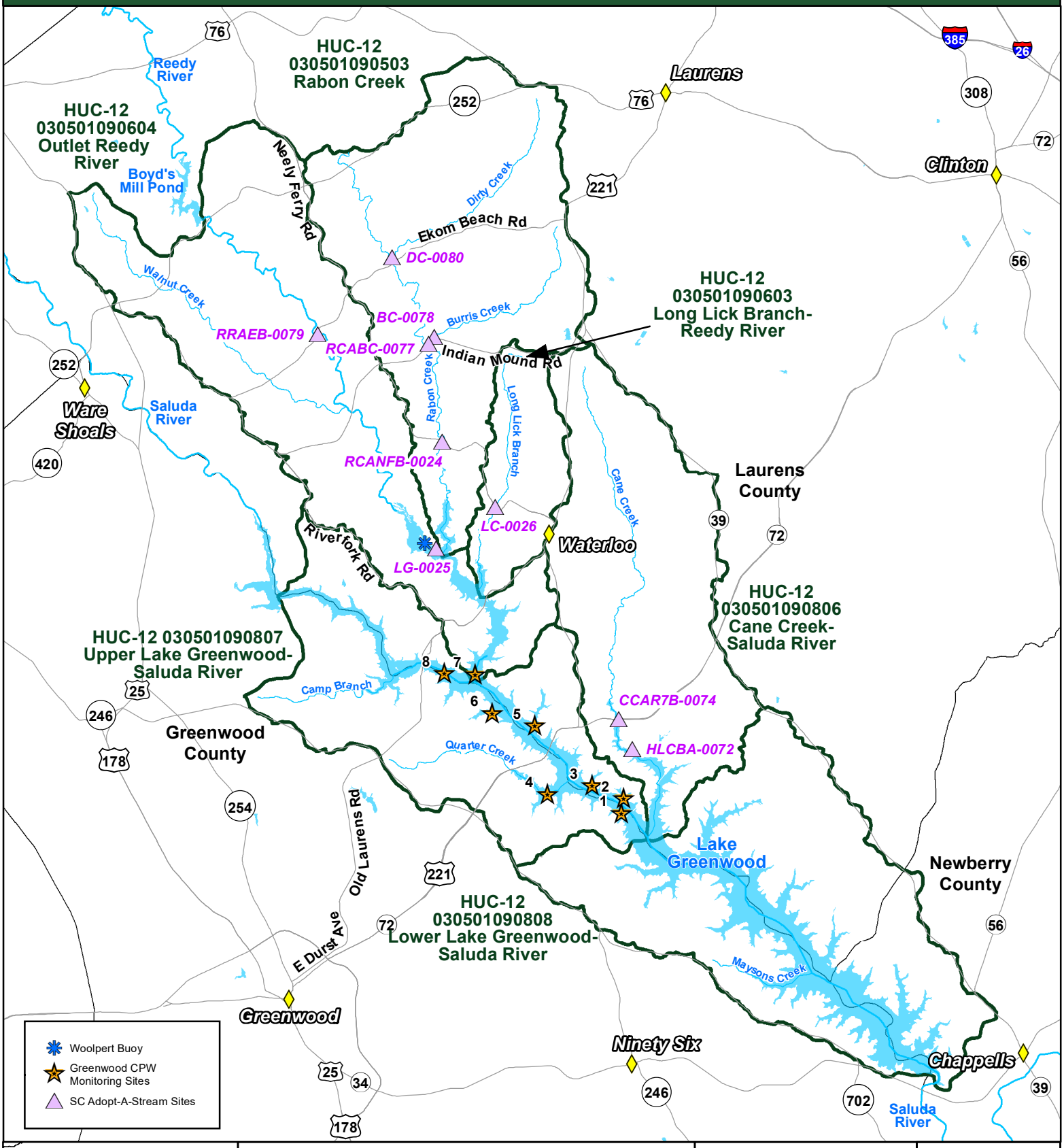
Figure 4: Additional Water Quality Monitoring Efforts



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Map by: KPH - 5/27/2021

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3.3) BACTERIAL DATA

Prior to 2013, South Carolina used Fecal Coliform (FC) as the bacterial indicator to evaluate the safety of freshwaters for recreational purposes. The standard for FC was a maximum daily concentration of 400 Colony Forming Units (CFU) per 100 milliliters (ml) of water and a 30-day geometric mean of 200 CFU per 100 ml. Water samples that exceeded this standard more than 10% of the time were considered impaired and unsafe for recreational use. Sites considered impaired for FC were then placed on the SCDHEC biennial 303(d) list of Impaired Waters. In 2013 SCDHEC switched to *Escherichia coli* (*E.coli*) as the bacterial indicator for freshwaters. The current SC standard for *E.coli* is a daily concentration not to exceed 349 Most Probable Number (MPN)/100 ml and a 30-day geometric mean of 126 MPN/100 ml. FC and *E.coli* are typically not a threat to human health; however, their presence in fresh waters is indicative of fecal pollution in surface waters. Fecal contamination is considered a human health risk because it may contain disease-causing organisms such as pathogenic bacteria, viruses, protozoa, or parasites [19]. Due to this transition in bacteria standards, most of the available water quality data for the water quality monitoring sites in the focus area are recorded as FC. Consequently, in this WBP the bacteria load reductions were calculated using FC data and are referred to generically as "bacteria". Although Table 9 details both FC and *E.coli* monitoring data, the monitoring recommendations detailed in Section 3.7.2 are designed specifically to address *E.coli* bacteria.

3.3.1) BACTERIA DATA FROM SCDHEC MONITORING SITES

Of the SCDHEC water quality monitoring stations in the focus area, 19 have FC data recorded from the years 1999-2013 and 11 have *E.coli* data recorded from the years 2013-2021. This data was pulled from the EPA Water Quality Portal (WQX) and summarized in Table 9. Because the bacterial indicator changed from FC to *E.coli* in 2013, this plan focuses on bacterial improvements of *E.coli*.

Although station RS-09116 is listed as impaired for *E.coli* on the 2018 303(d) List of Impaired Waters, there is not *E.coli* data available at this location. According to the 2018 303(d) document: "For development of 2018 303(d) list, any site determined to be impaired due to freshwater recreational use will be listed for *E.coli.* This includes sites where no pathogen indicator data are being assessed from the 2012-2016 timeframe but are being carried over as impaired from the 2016 303(d) listing cycle." This indicates that station RS-09116 is considered impaired due to freshwater recreational use, carried over from the 2016 303(d) cycle based on the collected FC data.

According to the 2018 SCDHEC 303(d) list, the study area contains two sampling stations showing *E.coli* levels exceeding the state standard (Table 9). The stations with the two highest percentages of *E.coli* exceedances are S-096 (Rabon Creek) and S-021 (Reedy River). Several stations saw highest recorded *E.coli* samples of 2,419.6 MPN/100ml; S-021 on 4/9/2014, S-096 on 1/23/2017, S-131 on 12/11/2018, S-308 on 1/16/2013 and 2/17/2021. Based on the data, bacterial reduction efforts should target the areas surrounding the Reedy River and Rabon Creek as they flow into Lake Greenwood.

TABLE 9. SCDHEC BACTERIA MONITORING RESULTS FROM 1999-2021

Station	Indicator	Sample Years	Total Samples	Average Sample	Percent Exceedances	Highest Sample	2018 303(d) List Status
RL-02311	FC*	2002	12	17.50	0.00%	86.00	--
RL-04387	FC	2004	12	17.50	0.00%	39.00	--
RL-07020	FC	2007	12	15.33	0.00%	120.00	--
RL-08063	FC	2008	12	34.25	0.00%	240.00	--
RL-09079	FC	2009	9	3.56	0.00%	9.00	--
RL-10001	FC	2010	11	8.18	0.00%	37.00	--
RL-10017	FC	2010	11	6.82	0.00%	30.00	--
RL-12061	FC	2012	12	54.17	0.00%	190.00	--
RL-13077	*E.coli***	2013	12	107.52	8.33%	365.40	--
RL-14154	*E.coli*	2014	12	11.19	0.00%	79.40	--
RL-15008	*E.coli*	2015	12	79.32	0.00%	214.20	--
RL-21213	*E.coli*	2021	2	16.65	0.00%	18.70	--
RS-09116	FC	2009	10	256.60	20.00%	740.00	Impairment: *E.coli*
S-021	*E.coli*	2013-2021	75	235.07	14.67%	2,419.60	Impairment: *E.coli*
	FC	1999-2012	146	195.60	6.85%	4,400.00	
S-022	*E.coli*	2013-2021	75	103.21	8.00%	1,553.10	--
	FC	2001-2012	41	11.78	0.00%	120.00	
S-024	*E.coli*	2013-2021	75	98.48	6.67%	1,553.10	--
	FC	2001-2012	121	71.08	1.65%	3,500.00	
S-096	*E.coli*	2013-2021	74	289.65	20.27%	2,419.60	Impairment: FC
	FC	1999-2012	135	219.37	10.37%	2,200.00	
S-097	FC	1999-2006	36	162.31	8.33%	1,900.00	--
S-131	*E.coli*	2013-2021	73	75.22	5.48%	2,419.60	--
	FC	1999-2012	64	21.27	3.13%	420.00	
S-296	FC	1999-2009	89	5.79	0.00%	84.00	--
S-303	*E.coli*	2016	6	2.60	0.00%	14.60	--
	FC	2001-2010	110	6.15	0.00%	160.00	
S-307	FC	2001-2006	23	50.96	0.00%	220.00	--
S-308	*E.coli*	2013-2021	97	149.91	8.25%	2,419.60	--
	FC	1999-2012	81	30.70	0.00%	380.00	

**FC data units: CFU/100 ml*
***E.coli data units: MPN/100 ml*

3.3.2) *E.COLI* DATA FROM SC ADOPT-A-STREAM SITES

All nine SC AAS sites have *E.coli* data, with samples taken between 2014-2018 by the Waterloo Water Wizards. This data is summarized in Table 10. The highest recorded sample was taken at CCAR7B-0074 (Cane Creek) on 09/28/2016. The average sample for each station is under the *E.coli* standard of 349 MPN/100ml, except for LC-0026 (Lick Creek) which has an average of 573.33 MPN/100ml. Nearly all the *E.coli* samples that are recorded as exceedances were taken on waters flowing into Lake Greenwood from the Reedy River tributary.

TABLE 10. SC ADOPT-A-STREAM *E.COLI* MONITORING RESULTS FROM 2014-2018

Station	Total Samples	Average Sample (MPN/100ml)	Highest Sample
BC-0078	11	121.21	466.67
CCAR7B-0074	13	228.21	1900.00
DC-0080	9	214.81	800.00
HLCBA-0072	1	300.00	300.00
LC-0026	5	573.33	733.33
LG-0025	24	31.94	200.00
RCACB-0077	10	173.33	666.67
RCANFB-0024	4	291.67	400.00
RRAEB-0079	17	115.69	433.33

3.4) NUTRIENT DATA

According to the SCDHEC R. 61-68 Water Classifications and Standards the term “nutrients” to refer to nitrogen and phosphorus [16]. The standards set in this document indicate that in the Piedmont ecoregion, total phosphorus shall not exceed 0.06 mg/L and total nitrogen shall not exceed 1.5 mg/L. These standards apply to lakes greater than or equal to 40 acres, such as Lake Greenwood, however, in-stream nutrient criteria do not yet exist for South Carolina. Because of this, streams are not eligible to be placed under an impairment for nutrient pollution as they do not have narrative criteria assigned for monitoring. Nutrient data collected from streams are still included in this review, however, the nutrient standards do not apply.

3.4.1) NUTRIENT DATA FROM SCDHEC MONITORING SITES

Tables 11 and 12 summarize nutrient monitoring on Lake Greenwood from the years of 1999-2021. Overall, sampling efforts revealed more phosphorus sample exceedances than nitrogen. Of the 19 lake monitoring stations, nine had results exceeding the phosphorus standard and three had results exceeding the nitrogen standard. While phosphorus exceedances were seen throughout the focus area, there are not any stations listed on the SCDHEC 303(d) List as impaired for phosphorus. SCDHEC listed Station S-308 (Reedy River tributary of Lake Greenwood) as impaired for nitrogen in the SCDHEC 2018 303(d) List of Impaired Waters.

TABLE 11. SCDHEC PHOSPHORUS MONITORING RESULTS FROM 2002-2021

	Station	Years	# Samples	Average Sample (mg/L)	Percent Exceedances	Highest Samples (mg/L)
Lake Monitoring Stations	RL-02311	2002	12	0.030	0.00%	0.06
	RL-04387	2004	12	≤0.020	0.00%	0.03
	RL-07020	2007	12	0.022	8.33%	0.15
	RL-08063	2008	12	0.022	8.33%	0.077
	RL-09079	2009	9	0.013	0.00%	0.054
	RL-10001	2010	12	0.034	0.00%	0.06
	RL-10017	2010	12	0.026	0.00%	0.055
	RL-12061	2012	12	≤0.020	8.33%	0.061
	RL-13077	2013	12	0.027	0.00%	0.056
	RL-14154	2014	12	≤0.020	0.00%	0.024
	RL-15008	2015	12	0.028	0.00%	0.058
	RL-21213	2021	2	≤0.020	0.00%	≤0.020
	S-024	2002-2021	186	0.035	6.99%	0.62
	S-097	2006-2006	12	0.030	16.67%	0.073
	S-131	2006-2021	104	≤0.020	0.96%	0.14
	S-296	2002-2009	60	≤0.020	1.67%	0.069
	S-303	2002-2016	106	≤0.020	2.83%	0.37
	S-307	2006-2006	12	≤0.020	0.00%	0.042
	S-308	2002-2021	159	0.041	13.21%	0.33
Stream Monitoring Stations*	RS-09116	2009	10	0.064	n/a	0.16
	S-021	2002-2021	186	0.050	n/a	0.63
	S-022	2006-2021	105	0.028	n/a	0.081
	S-096	2002-2021	184	0.026	n/a	0.75
	S-804	2008-2010	3	0.030	n/a	0.037
	S-861	2008-2017	58	0.025	n/a	0.095

**Phosphorus standards do not apply to in-stream collected data*

TABLE 12. SCDHEC NITROGEN MONITORING RESULTS FROM 1999-2021

	Station	Years	# Samples	Average Sample (mg/L)	Percent Exceedances	Highest Sample (mg/L)	2018 SCDHEC 303(d) List Status
Lake Monitoring Stations	RL-02311	2002	5	0.38	0.00%	0.89	--
	RL-04387	2004	10	0.41	0.00%	0.78	--
	RL-07020	2007	7	0.20	0.00%	0.65	--
	RL-08063	2008	11	0.25	0.00%	0.87	--
	RL-09079	2009	9	≤0.12	0.00%	0.55	--
	RL-10001	2010	12	0.30	0.00%	1.2	--
	RL-10017	2010	12	0.30	0.00%	0.663	--
	RL-12061	2012	11	0.33	0.00%	0.85	--
	RL-13077	2013	12	0.62	0.00%	1.18	--
	RL-14154	2014	12	0.41	0.00%	1	--
	RL-15008	2015	11	0.63	0.00%	1.25	--
	RL-21213	2021	2	0.26	0.00%	0.52	--
	S-024	2001-2021	169	0.42	0.00%	1.2	--
	S-097	2001-2006	15	≤0.12	0.00%	0.53	--
	S-131	1999-2021	107	0.42	0.93%	1.6	--
	S-296	1999-2009	55	0.14	0.00%	1.05	--
	S-303	2001-2016	87	0.36	1.15%	3.94	--
	S-307	2001-2006	16	0.24	0.00%	0.7	--
	S-308	2001-2021	151	0.99	14.57%	2.82	Impaired: Nitrogen
	S-861	2009-2017	57	0.35	0.00%	1.03	--
Stream Monitoring Stations*	RS-09116	2009	10	≤0.12	n/a	0.318	--
	S-021	2001-2021	169	1.31	n/a	2.41	--
	S-022	2001-2021	105	0.73	n/a	5.48	--
	S-096	2001-2021	166	0.41	n/a	1.08	--
	S-804	2009-2010	2	0.31	n/a	0.358	--

**Nitrogen standards do not apply to in-stream collected data*

3.4.2) NUTRIENT DATA FROM GREENWOOD CPW MONITORING SITES

Greenwood CPW monitors each of its eight sampling sites within Lake Greenwood on a quarterly basis for parameters including phosphorus and nitrogen. As shown in Figures 5 and 6, the quarterly averages of phosphorus levels have exceeded the SC state standards since June of 2017, with the highest readings occurring in 2018. Phosphorus exceedances ranged from 80-100% of all samples taken. Average nitrogen samples collected were well below the SC state standards for all samples taken, and no exceedances were recorded in the data provided.

FIGURE 5. QUARTERLY AVERAGE OF PHOSPHORUS AT GREENWOOD CPW MONITORING SITES

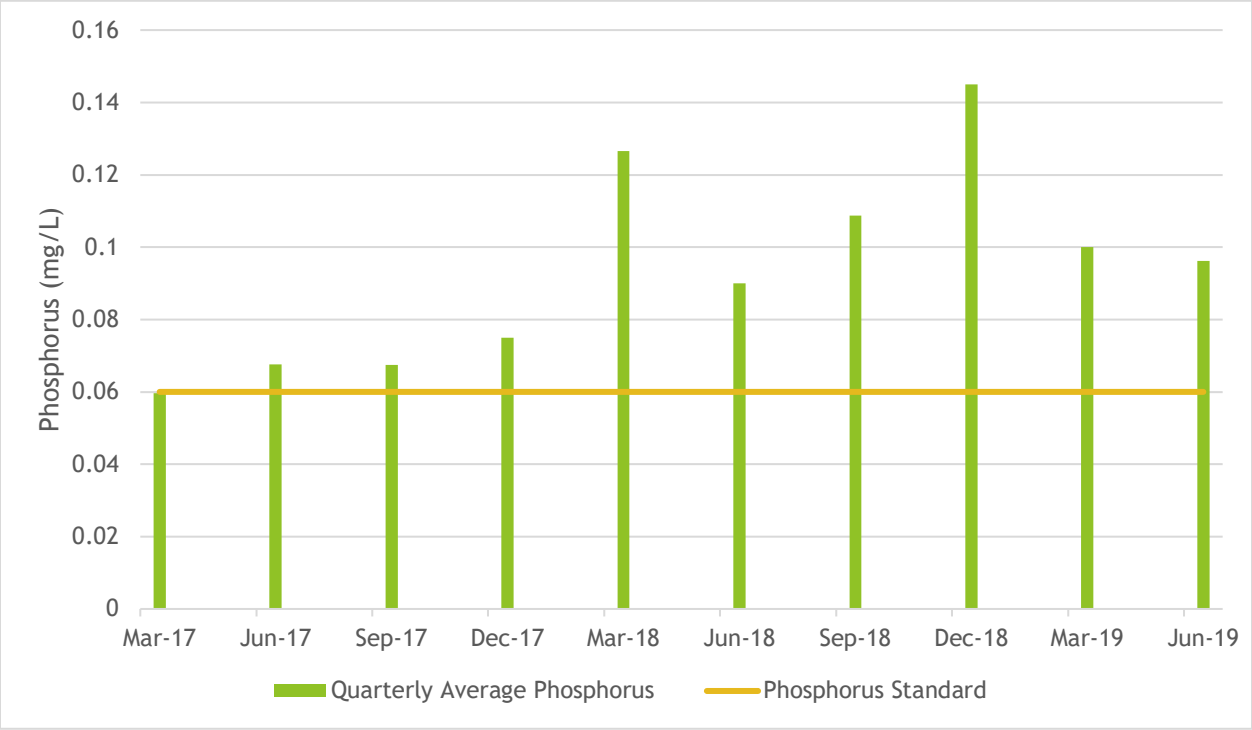
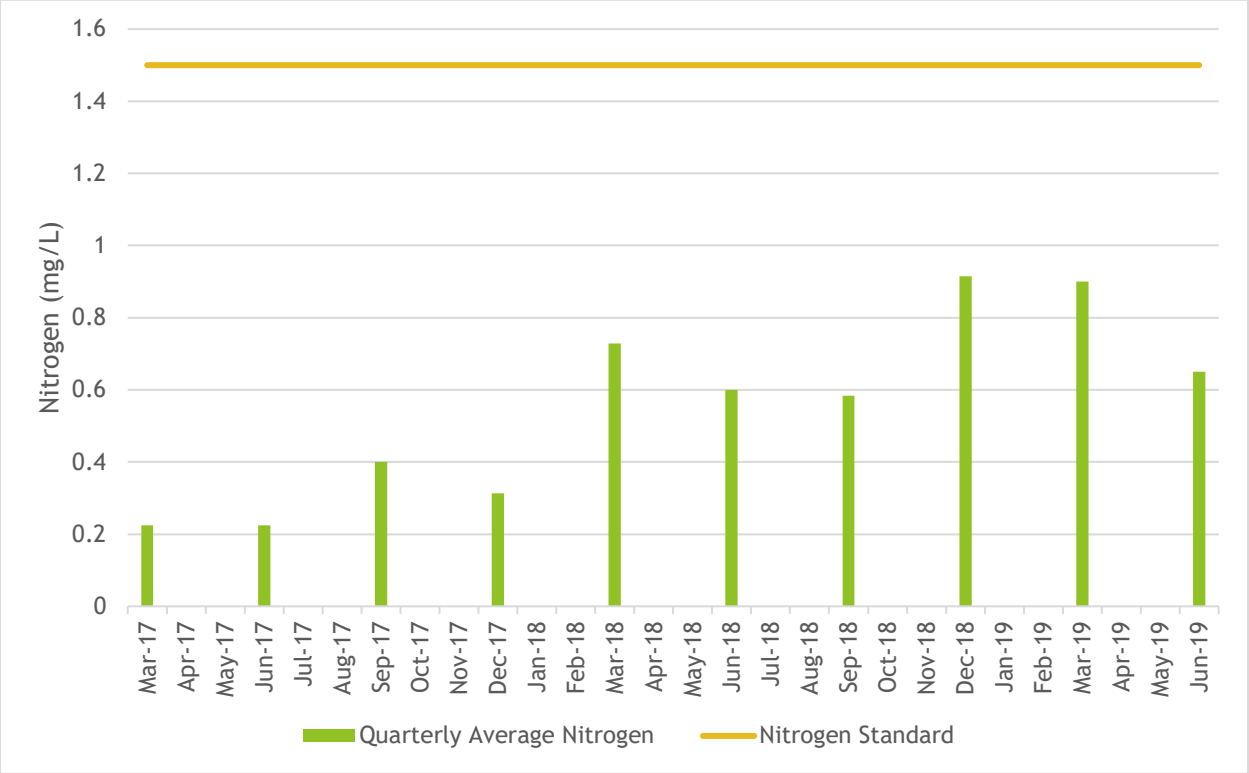


FIGURE 6. QUARTERLY AVERAGE OF NITROGEN AT GREENWOOD CPW MONITORING SITES



3.5) SEDIMENT DATA

Based on SCDHEC water quality data, increased turbidity levels were closely correlated with water bodies experiencing sediment impairments. According to R. 61-68 Water Classifications and Standards, published by SCDHEC, measurements for turbidity are not to exceed 25 Nephelometric Turbidity Units (NTU) in lakes and 50 NTU in freshwaters. Turbidity data was obtained from SCDHEC water quality monitoring sites within the focus area. Station RL-13077 is listed as impaired for turbidity on the 2018 303(d) list and shows the highest level of percent exceedances (Table 13).

TABLE 13. SCDHEC TURBIDITY MONITORING RESULTS FROM 1999-2021

	Station	Sample Years	# Samples	Average Sample (NTU)	Percent Exceedances	Highest Sample (NTU)	2018 SCDHEC 303(d) List Status
Lake Monitoring Stations	RL-02311	2002	11	13.10	18.18%	55	--
	RL-04387	2004	12	6.43	8.33%	26	--
	RL-07020	2007	12	7.56	0.00%	17	--
	RL-08063	2008	12	6.11	0.00%	19	--
	RL-09079	2009	10	7.96	0.00%	18	--
	RL-10001	2010	12	7.71	8.33%	32	--
	RL-10017	2010	12	10.29	16.67%	58	--
	RL-12061	2012	12	6.66	0.00%	24	--
	RL-13077	2013	11	19.66	27.27%	40	Impaired: Turbidity
	RL-14154	2014	12	6.35	8.33%	32	--
	RL-15008	2015	11	14.40	18.18%	31	--
	RL-21213	2021	2	6.25	0.00%	7.2	--
	S-024	2001-2021	192	16.05	11.46%	170	--
	S-097	1999-2006	34	31.89	26.47%	400	--
	S-131	1999-2021	138	8.58	5.07%	65	--
	S-296	1999-2009	88	4.33	1.14%	29	--
	S-303	2001-2016	115	5.28	1.74%	80	--
	S-307	2001-2006	23	9.52	0.00%	18	--
	S-308	1999-2021	177	15.67	11.30%	100	--
	S-861	2008-2010	3	7.63	0.00%	10	--
Stream Monitoring Stations	RS-09116	2009	10	16.31	10.00%	60	--
	S-021	1999-2021	218	17.11	6.88%	240	--
	S-022	2001-2021	114	12.31	2.63%	100	--
	S-096	1999-2021	204	12.28	2.94%	190	--
	S-804	2008-2010	3	5.53	0.00%	8.3	--

3.6) WATER QUALITY MONITORING TECHNIQUES

It is highly recommended that existing monitoring data and targeted sampling data should be utilized to establish baseline conditions in areas that are near the proposed BMP implementation locations. Available monitoring data can be sourced from SCDHEC, SC AAS, Greenwood CPW, Greenwood County Lake Management, LCWSC, and certified laboratory personnel that specialize in water quality sampling.

3.6.1) MICROBIAL SOURCE DETECTION TECHNIQUES

There are a variety of methods for analyzing bacteria in source waters. Currently, no Microbial Source Tracking (MST) is being conducted in the focus area. The two most common methods are: Most Probable Number (MPN) method and MST.

Most Probable Number (MPN) Method

Water samples using this method are processed for *E.coli* using the EPA approved standard for detection of total coliforms and *E.coli*, such as the IDEXX Colilert method for Coliform/*E.coli* [20].

Microbial Source Tracking

Microbial Source Tracking (MST), also known as Bacterial Source Tracking, is a method used to discern sources of fecal contamination in surface waters. This method can determine if the source of fecal contamination is human, wildlife, domestic livestock, pets, or a combination of sources. MST could prove to be a useful tool for bacterial source detection in the focus area if funding and resources are available. Currently, Clemson University is using qPCR, quantitative polymerase chain reaction, to quantify bacteria loading from warm-blooded mammals (*e.g.*, swine, bovine, human, and dog) in surface waters. The cost per sample is $350. Tests are being conducted in partnership with the Clemson University Molecular Plant Pathogen Detection Lab and will provide valuable information to SC water resource managers [21].

3.7) PROPOSED WATER QUALITY MONITORING

The goal of a WBP is to attain water quality standards using a variety of management strategies. Accordingly, it is critical to develop a robust water quality monitoring approach to measure progress towards such goals as management strategies are implemented. Currently, water quality monitoring in the project area is intermittent in both location and frequency, creating gaps in available data. The monitoring strategy for this plan will address these data gaps and include suggested sampling locations, parameters to be monitored, sample collection protocol, recommended microbial detection techniques, and potential individuals and/or organizations qualified to conduct water sampling in the project area.

3.7.1) GAPS IN CURRENT WATER QUALITY MONITORING

Water quality monitoring efforts are widely distributed throughout the northern half of the lake. There are 48 monitoring locations in both deep water and tributary locations, 17 of which are currently active (2020-present). Of these 48 locations, nine are operated by the Greenwood CPW and Greenwood County Lake Management group, one is operated by the LCWSC and Woolpert, 10 are SC AAS volunteer sites, and 28 are operated by SCDHEC as fixed surface water monitoring stations. In addition, it is important to note several feeder streams/rivers in the project area are impaired and do not have any water quality monitoring stations upstream, making it difficult to discern potential sources of contamination. The most prominent data gap is located along the Saluda River, north of the impaired SCDHEC station RL-13077.

It is advised that for impaired streams, additional water quality samples be taken upstream of areas where land use activities have the potential to contribute bacteria to waterways (*e.g.*, agricultural land near streams, urban areas, and residential properties). If samples indicate high bacteria or turbidity levels, additional samples should be collected further upstream until the source(s) locations are identified. Prior to BMP installations, it is suggested that sampling occur at the nearest feasible publicly accessible downstream location so that changes in water quality can be documented over time, subject to funding and volunteer monitoring availability.

3.7.2) WATER QUALITY MONITORING RECOMMENDATIONS

1. Encourage the expansion of SC AAS certified volunteers and monitoring through SC AAS trainings. New SC AAS volunteers could assist with gathering baseline data in areas above and below BMP projects in the focus area. This will ensure that data is publicly available for use and analysis, help facilitate the expansion of the monitoring network, and provide consistency across all forms of data collection.
2. Encourage certified SC AAS volunteers/organizations to engage in routine sampling with a focus on locations associated with BMP sites, particularly before and after BMP projects are implemented.
3. Support the continued monitoring by the Greenwood CPW and Greenwood County Lake Management group for their Greenwood Source Water Monitoring Plan. This includes continued monthly monitoring for total phosphorus, total nitrogen, and Chlorophyll A at all selected sites.
4. Recommend the addition of monitoring station(s) at the north end of the project area where the Saluda River feeds into Lake Greenwood. Sampling stations can include SC AAS monitoring sites or SCDHEC monitoring stations. Presently, SCDHEC site RL-13077 is located on this portion of the lake and is impaired for aquatic life, with the listed cause as turbidity. This site was only sampled in 2013. It is recommended that monthly sampling is resumed here by SCDHEC or SC AAS, or a new site is added nearby to help determine water quality conditions.
5. Advocate for statewide in-stream nutrient water quality standards, which would help provide baseline conditions for analyzing streams with nutrient impairments.

3.8) SUMMARY OF WATER QUALITY DATA

There are 48 water quality sampling sites in the focus area, 30 of which are located on Lake Greenwood. These monitoring locations are made up from a combination of SCDHEC water quality monitoring stations, monitoring conducted by utilities, private businesses on behalf of municipalities/counties, and volunteer monitoring efforts. While only SCDHEC data can be utilized for regulatory purposes, additional water quality monitoring efforts help to provide a general picture of the overall water quality conditions of the watersheds.

There are currently three stations listed as impaired for bacteria on the 2018 303(d) List of Impaired Waters or under an existing unsupported TMDL [16]. Data analyzed from SCDHEC and SC AAS both indicated that bacterial impairments are mostly seen on the Rabon Creek/Reedy River tributary of Lake Greenwood. Based on this data, it is recommended to concentrate bacterial reduction efforts in these portions of the focus area first. Nutrient sampling data from SCDHEC and Greenwood CPW both indicated higher phosphorus levels than nitrogen, and only one SCDHEC monitoring station is listed as impaired for nitrogen (S-308). Although SCDHEC data for turbidity does not indicate widespread sedimentation, site visits and aerial imagery indicate it is an issue in the upper portion of Lake Greenwood along the Saluda and Reedy River arms of the lake. One SCDHEC station is listed as impaired for turbidity (RL-13077), located on the Saluda River arm of Lake Greenwood.

To ensure comprehensive review of water quality throughout the focus area, volunteer water quality monitoring through SC AAS should be encouraged to the best extent possible. Analysis of data collected through SCDHEC, water utilities, and volunteer monitoring efforts will help to assess the improvement of watershed conditions as

implementation of this plan begins. Gaps in monitoring are noted in the northern portion of the focus area, particularly where the Saluda River flows into Lake Greenwood. More importantly, in-stream nutrient water quality standards are needed to help gauge water quality conditions and guide local governments in their efforts to mitigate the impacts of nonpoint source pollution in their communities.

4) BACTERIAL POLLUTION SOURCES

Bacterial pollution can be attributed to both point and nonpoint sources within the Lake Greenwood watersheds, including wastewater effluent, agricultural land uses, urban runoff, and wildlife (Table 14).

TABLE 14. POTENTIAL POINT AND NONPOINT SOURCES OF BACTERIAL POLLUTION IN THE FOCUS AREA

Wastewater	Agriculture	Urban	Wildlife
• Septic Tanks • Private Wastewater Treatment Plants	• Cattle • Horses • Sheep & Goats • Poultry • Swine • Cropland	• Stormwater Runoff • Domestic Pets	• Waterfowl • Wild Hogs • Deer • Beavers

4.1) POINT SOURCES OF BACTERIAL POLLUTION

As defined in Section 502(14) of the Clean Water Act, a point source pollutant is any discrete and confined conveyance (*e.g.*, pipe, ditch, channel, tunnel, well, confined animal feeding operation) from which pollutants are discharged [22].

National Pollution Discharge and Elimination System (NPDES) Sites – The National Pollution Discharge and Elimination System (NPDES) controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Major municipal dischargers include all facilities with design flows greater than one million gallons per day, while minor dischargers are less than one million gallons per day [23]. According to the SCDHEC Watershed Atlas, there are three NPDES permit holders within the focus area that have bacterial limits, all of which are covered under SC General Permits. These sites are listed in Table 15 and shown in Figure 7. No bacterial violations are recorded for these permits within the last five years (2016-2020). All NPDES information for these facilities was obtained from the following website https://echo.epa.gov/facilities/facility-search [24].

TABLE 15. ACTIVE NPDES PERMITS WITHIN THE LAKE GREENWOOD WATERSHEDS

Map Id	NPDES Permit #	Facility Name	Facility Type	Bacterial Compliance Violations (Years 2016-2020)
1	SCG730051	Vulcan Construction Materials	Industrial	None
2	SCG646008	W.R. Wise Water Treatment Facility	Municipal	None
3	SCG730035	Specialty Vermiculite/Madden-Kernells Mine	Industrial	None

No-Discharge (ND) Class B Sludge Application Sites – There are three permitted ND sites within the watersheds where Wastewater Treatment Plants (WWTPs) are permitted to land-apply wastewater treatment effluent, non-hazardous sludge, and septage (Table 16 and Figure 7). These permits are considered ND because there is no direct discharge to surface waters [25]. However, these sites have been included in this WBP because they have the potential to contribute bacteria and nutrients to surface waters if improperly managed (*e.g.*, applications taking place during or preceding rain events).

TABLE 16. ACTIVE NO-DISCHARGE PERMITS IN THE LAKE GREENWOOD WATERSHEDS

Map Id	Permit #	Generator	Facility Type
4	ND0086223	JACABB Utilities/The Lake Club WWTP	Wastewater
5	ND0085898	JACABB Utilities/ Cane Creek Motorcoach Resort WWTP	Wastewater/Lagoon
6	ND0080802	Campbell Septic Tank Co.	Wastewater/Irrigation
7	ND0089281	Garrett Broilers	Poultry Operation
8	ND0005193	Nixon Poultry Farm	Poultry Operation

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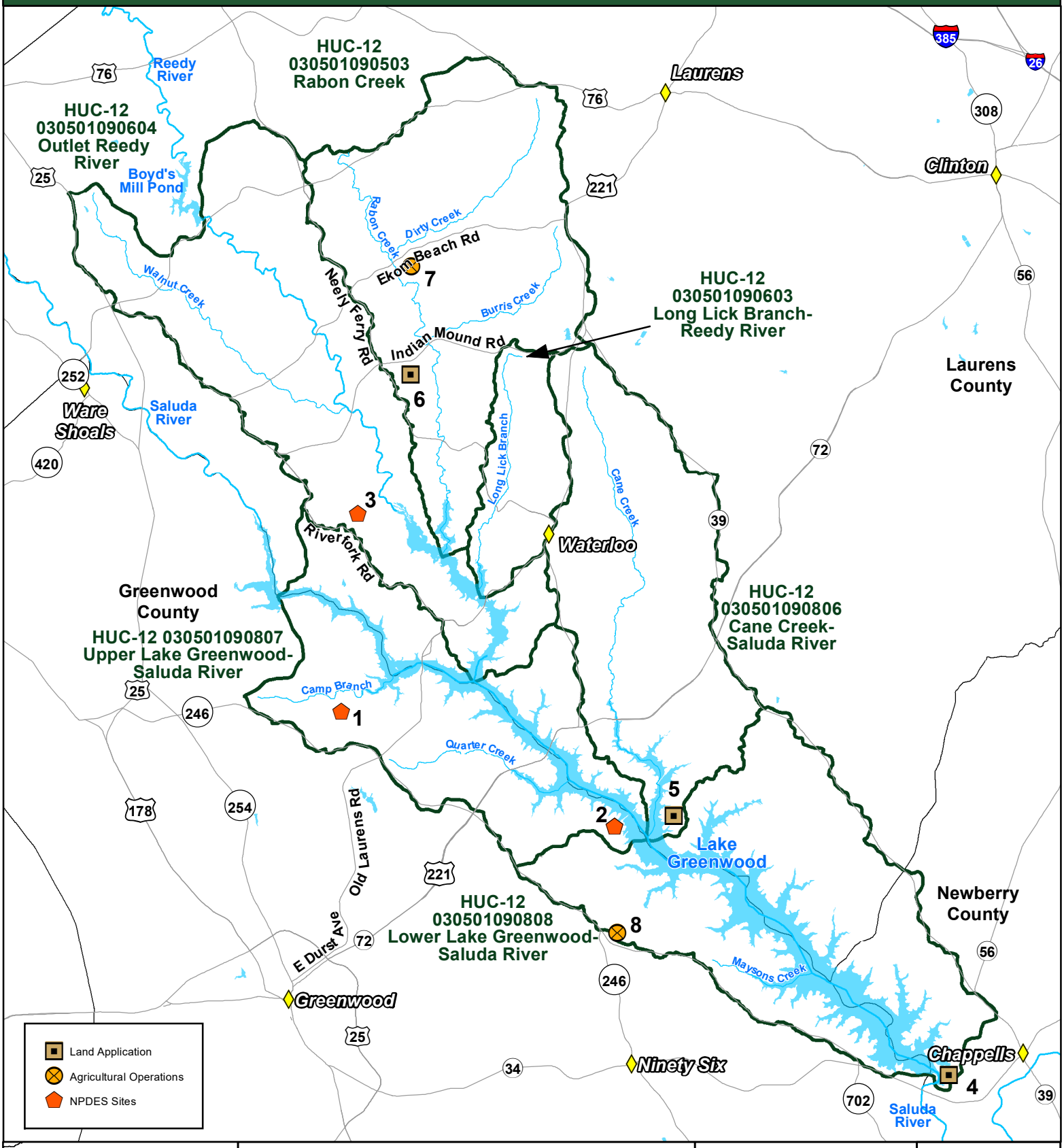
Figure 7: NPDES and ND Permit Sites



4.2) NONPOINT SOURCES OF BACTERIAL POLLUTION IN THE LAKE GREENWOOD WATERSHEDS

Nonpoint source pollution is the result of rainfall moving over and through the ground, transporting with it pollutants such as bacteria to waterways as it flows. Nonpoint source bacteria pollution can be associated with malfunctioning septic systems, agriculture (*e.g.*, livestock operations, cropland, and sediment), domestic pets, stormwater runoff, and wildlife. Approximately 90% of the land in the watersheds is rural. Accordingly, this WBP focuses bacterial load reductions on bacterial inputs from failing septic tanks, agriculture, and domestic pets (Section 5).

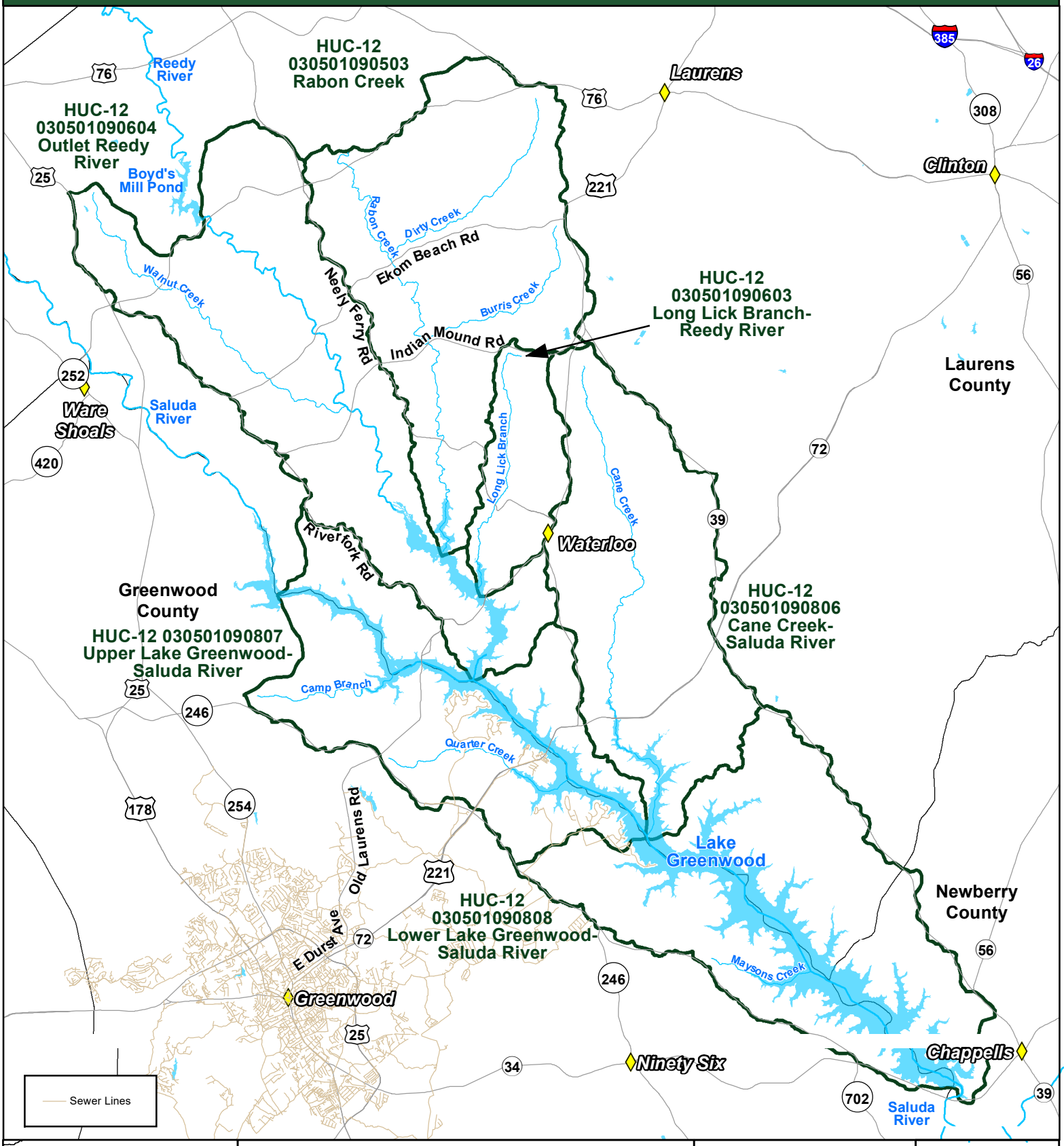
Septic Systems – Damaged or improperly maintained septic systems can be a significant source of bacteria to surface and groundwater resources. Septic systems typically have four main components: an exit pipe that transports the wastewater out of the home to the septic tank, a septic tank where waste material naturally breaks down, a drain field where the effluent is discharged, and a soil layer that filters and breaks down wastewater contaminants. Improper connections, clogs, heavy use, or unmaintained systems increase the chance that untreated wastewater will leak into surface and groundwater resources.

Failing septic drain fields in the 3&20 Creek (left) and Tyger River (center and right) watersheds.

Most of the land cover within the watersheds is rural, with only 9% of land cover classified as urban. As such, sewer infrastructure is not available in much of the focus area and private septic systems are the primary means for the treatment of wastewater. Consequently, it is reasonable to infer that failing septic systems within the focus area are likely the primary source of bacterial pollution.

According to the Spreadsheet Tool for Estimating Pollutant Load (STEPL) Input Data Server [26], there are an estimated 2,660 septic systems in the Lake Greenwood watersheds, which translates to approximately 6,783 users. While sewer infrastructure is available in the southern side of the lake in Greenwood County, septic systems serve as the primary method of wastewater treatment for 67% of households in the focus area (see Figure 8). The estimated failure rate for septic systems in this focus area is 27% (Appendix A)[26].

Figure 8: Existing Sewer Lines



Agriculture - Livestock (*e.g.*, cattle, horses, and goats) are the primary agricultural concern for increasing the concentration of bacteria in waterways in the focus area. Livestock with access to waterways can contribute bacteria directly into waterways through their fecal matter or indirectly by causing erosion by disturbing stream banks. Runoff from agricultural facilities (*e.g.*, barnyards, feeding areas, manure storage areas) can also lead to increases in bacteria levels as well as other contaminants (*e.g.*, fertilizers, pesticides, and sediment). Additionally, fertilizers such as manure and sludge, when applied to cultivated crops, can cause increased bacteria levels if applied in excess amounts or before rain events.

Cattle in a stream within the focus area (above).

The number of livestock animals in the watersheds was estimated by combining information from the 2017 United States Department of Agriculture (USDA) Census of Agriculture [27] with a GIS analysis of the acreage of farmland in the focus area. The acreage of farmland within the watershed is based on an analysis of the 2016 NLCD within ArcGIS. The USDA Census of Agriculture provides the total acreage of farmland and total animal counts for each county; based on this, a ratio of animals per acre in Laurens, Greenwood, and Newberry counties was calculated. This ratio was then applied to the acreage of farmland within the watershed to estimate the total number of farm animals living within the boundaries of the watershed area. An example formula is shown below.

FORMULA 1. CALCULATING THE TOTAL NUMBER OF ANIMALS IN THE LAKE GREENWOOD WATERSHEDS

$$\text{Number of (Cattle) in the Focus Area} = \left(\frac{\text{Total Number of (Cattle) within the County}}{\text{Total Acreage of Agricultural Lands within the County}} \right) \times \text{Acreage of Agricultural Lands within Focus Area}$$

Agricultural land, which for the purposes of this plan includes the Pasture/Hay NLCD land cover classifications, covers approximately 13,702 acres within the Lake Greenwood watersheds, nearly 11% of total land use [9]. Based on these calculations, an estimated 2,240 cattle live in these watersheds. Other farm animals that could impact surface water bacteria levels include horses, goats, sheep, swine, and poultry (Table 17).

TABLE 17. LIVESTOCK ESTIMATIONS IN THE LAKE GREENWOOD WATERSHEDS

Livestock Type	Number of Livestock
Cattle	2,240
Swine	18
Sheep & Lamb	66
Horses	131
Poultry*	236,760
Goats	133
Total	**239,349**

**Estimate of # of poultry in the focus area comes from the STEPL Input Data Server* [26]

Croplands are another potential source of bacteria levels in waterways. Manure applications, for fertilizer, contain bacteria that may wash into nearby waterways during rain events. Severely eroded soils can also contribute fertilizers, pesticides, and sediment to surface waters in the area. Based on the overall acreage of cropland, cultivated crops do not appear to be a primary source of bacterial loading in the focus area, as there are less than eight acres of cropland in the entire region (Table 5).

Domestic Pets - Domestic pet waste is a threat to human health and water quality when not disposed of properly. Pet waste left on the ground can runoff into nearby waterways during rain events and is a concern especially in developed areas containing higher densities of impervious surfaces. Developed land (commercial and residential) accounts for only nine percent of total land cover in the focus area and is mostly concentrated directly around the Lake Greenwood reservoir.

According to the USDA, a single dog can produce approximately 274 pounds of waste each year [28]. Pet waste can contain harmful organisms such as bacteria, viruses, and parasites. Using the total number of households within a watershed area and a formula prepared by the American Veterinary Medical Foundation shown below, it was determined that roughly 2,220 dogs live within the focus area.

FORMULA 2. ESTIMATED NUMBER OF DOG-OWNING HOUSEHOLDS

Number of Dog Owning Households	=	National % of Dog Owning Homes*	x	Total Number of Households
1,490 Homes with Dogs	=	0.376	x	3,962 Homes

**This number comes from the US Humane Society 2017-2018 American Pet Products Association Survey and is the average of dog-owning households with small, medium, and large dogs* [29]

FORMULA 3. ESTIMATED NUMBER OF DOGS WITHIN THE WATERSHED

Number of Dogs	=	National Average of Dogs in Homes*	x	Total Number of Dog-Owning Households
2,220	=	1.49	x	1,490 Dog-Owning Households

**This number comes from the US Humane Society 2017-2018 American Pet Products Association Survey*

According to the calculated number of dogs within the watershed and the EPA dog waste statistic (the average dog can produce 274 pounds/year), dogs living within the focus area produce approximately 608,280 pounds of waste annually to the Lake Greenwood watersheds.

Wildlife – Wildlife has the potential to impact bacteria levels in water and is a contributor to elevated levels of bacteria in this watershed. Examples of species contributing to bacterial loads include deer, geese, beavers, and feral hogs. In fact, a single Canada goose can produce an average of 82 grams (0.18 pounds) of waste per day, 29,930 grams per year (365 pounds/year). [30]. Feral hogs, which are present in the focus area, are also a threat to water quality because their rooting behavior contributes to soil erosion while their fecal matter contains viruses and pathogens that are harmful to human health [31].

Waterfowl congregating along Lake Greenwood shoreline (above).

Stormwater Runoff – Urbanized areas, particularly those built prior to stormwater management requirements, present an increased risk of negatively impacting nearby waterways from the high density of impervious surfaces. Impacts such as increased surface water runoff, decreased groundwater recharge, stream channelization, heightened erosion, and flooded areas can all contribute to impaired water quality. Bacteria runoff in urban settings is largely attributed to wildlife and pet waste but can also result from leaking sewer infrastructure. As was previously noted, sewer infrastructure is not a primary concern within the focus area.

Examples of shorelines on Lake Greenwood with high runoff potential. Exposed soil (left), paved boat ramp (right).

5) BACTERIAL LOAD REDUCTIONS

A TMDL is the calculation of the maximum amount of a pollutant allowed to enter a water body so that the water body will meet water quality standards for that pollutant [32]. Bacterial load reductions for this plan were based on the bacteria TMDL for Rabon Creek. Although there are multiple bacterial impairments within the focus area, only one approved TMDL exists. Stations included in this TMDL are S-096 and S-307. Load reduction calculations are based solely on S-096; according to the TMDL, "the load allocated at S-307 is addressed through the TMDL at S-096 and expected reductions presented for S-096" [1].

TMDL is expressed as "the sum of all Waste Load Allocations (WLAs: point source loads), Load Allocations (LAs: nonpoint source loads and background), and a Margin of Safety (MOS), which accounts for uncertainty concerning the relationship between effluent limitations and water quality" [32]. FC values have been converted to *E.coli* values by multiplying by 0.8725 [33]. The TMDLs are calculated using the following equation seen in Formula 4. Although Formula 4 outlines the standard TMDL equation, there are no point sources within the focus area, and as a result WLAs are not included in the calculations in this plan. Table 18 is a summary of the three TMDL documents, and the values were taken from the aforementioned documents.

FORMULA 4. TMDL CALCULATION

$$TMDL = \sum WLA + \sum LA + MOS$$

TABLE 18. TMDL SUMMARY OF BACTERIAL REDUCTIONS WITHIN THE LAKE GREENWOOD WATERSHEDS

WQMS	Existing Nonpoint LA (counts/day)*	MOS*	TMDL (counts/day)*	% Reduction	Reduction Needed (counts/day)*
			Existing LA + MOS		*TMDL x % Reduction (Formula 9)*
S-096 & S-307	9.16E+11	5.10E+10	9.68E+11	65%	6.30E+11

**The numbers in this row were converted to E.coli by multiplying the FC numbers by 0.8725*

5.1) BACTERIAL LOAD REDUCTION CALCULATIONS

The bacteria load reductions outlined in this plan are based on the TMDL documents referenced above. In this case, the TMDLs include only nonpoint sources in the bacteria load calculations because there are no contributing point sources within the focus area. This information was used to calculate specific nonpoint source bacteria load reductions for the focus area. Additionally, protecting land can prevent bacterial loads from entering waterways, which is outlined in Section 5.1.2.

5.1.1) BACTERIAL NONPOINT LOAD REDUCTIONS

Waste Load Allocations:

Waste Load Allocation (WLA) – WLA represents all point sources of bacteria to the water (*e.g.*, wastewater treatment facilities, combined feeding operations). No WLA values are included in these calculations because there are no point sources contributing to waste loads in these watersheds.

MS4 WLA (% Reduction) – This represents the waste load allocation associated with the municipal stormwater sources NPDES permits. The focus area does not include any Municipal Separate Storm Sewer System (MS4) areas, and therefore does not include MS4 Waste Load Allocations within the TMDL documents.

Load Allocations:

Existing Nonpoint Load Allocation (LA) - Existing Nonpoint LA represents the bacterial load from nonpoint sources and is calculated, as shown below, using the sum for all four WQMS under TMDLs. The nonpoint load reduction (counts/day) is calculated by subtracting the MOS from the TMDL Existing Load.

Margin of Safety (MOS) - A TMDL consists of WLA, LA, and a MOS. The MOS is a percentage of the TMDL that accounts for the uncertainty associated with the TMDL model assumptions and data limitations [34].

TMDL (Formula 4) – The TMDL consists of the WLA (point source load), LA (nonpoint source load), and the MOS in counts/day. In the case of the TMDLs in the Lake Greenwood watersheds, there are no WLAs, so the TMDL consists of the LA and the MOS.

Nonpoint Load Reduction Needed (Formulas 5 and 6) – This number was calculated using TMDL data for the four creeks within the focus area, and represents the bacteria reduction needed from nonpoint sources daily and per year in the watershed to meet water quality standards. Formula 5 shows the calculations for daily nonpoint load reductions needed. Formula 6 multiplies Formula 5 by 365 to calculate the annual nonpoint load reductions.

FORMULA 5. CALCULATING DAILY NONPOINT LOAD REDUCTIONS NEEDED

Nonpoint Load Reduction Needed (counts/day)	=	TMDL LA (counts/day)	x	TMDL Nonpoint % Reduction Needed

TABLE 19. DAILY NONPOINT LOAD REDUCTIONS NEEDED IN THE LAKE GREENWOOD WATERSHEDS

WQMS	**Nonpoint Load Reduction Needed (counts/day)**	**=**	**TMDL LA (counts/day)**	**x**	**TMDL Nonpoint % Reduction Needed**
S-096 & S-307	5.95E+11	=	9.16E+11	x	65%

FORMULA 6. CALCULATING ANNUAL NONPOINT LOAD REDUCTIONS NEEDED

Nonpoint Load Reduction Needed (counts/year)	=	Nonpoint Load Reduction Needed (counts/day)	x	365 days/year

TABLE 20. ANNUAL NONPOINT LOAD REDUCTIONS NEEDED IN THE LAKE GREENWOOD WATERSHEDS

WQMS	**Nonpoint Load Reduction Needed (counts/year)**	**=**	**Nonpoint Load Reduction Needed (counts/day)**	**x**	**365 days/year**
S-096 & S-307	2.17E+14	=	5.95E+11	x	365

5.1.2) PREVENTING BACTERIAL POLLUTION

Land Protection – Preventative bacterial load reductions from land protection represent the number of bacteria that are prevented from impacting waterways if the land is not developed. For example, it is the anticipated bacteria load associated with a developed land use state (*e.g.*, single family residential, commercial) that is prevented from impacting local waterways by keeping the land in its current state (*e.g.*, forest, agricultural). This number was derived using the estimated annual pollutant loads by land use for bacteria for the conversion of undeveloped land into single family low density residential [35]. In this calculation, current land use is represented as a combination of estimated bacterial loading from agricultural pasture lands and forest lands within the high priority land protection parcels. Refer to the calculation below for the total estimated bacterial prevention rates using land protection BMPs.

FORMULA 7. ESTIMATED TOTAL POSSIBLE BACTERIAL PREVENTION FROM LAND PROTECTION

Estimated Bacterial Prevention from Land Protection	=	Bacterial Load per Single Family Low Residential Land Use	-	Bacterial Load per Current Land Use (Agricultural + Forest)

TABLE 21. TOTAL POSSIBLE BACTERIAL LOAD PREVENTION FROM LAND PROTECTION

Estimated Bacterial Prevention from Land Protection	**=**	**Bacterial Load per Single Family Low Residential Land Use**	**-**	**Bacterial Load per Current Land Use (Forest + Agricultural)**
1.19E+12 counts/acre/year	=	4.59E+13 counts/acre/year	-	(3.76E+13 + 7.06E+12) counts/acre/year

Once the total possible bacterial load prevented from land protection was calculated, the expected amount of bacterial load prevented from one conservation easement (CE) of 55 acres was calculated using Formula 8.

FORMULA 8. ESTIMATED BACTERIAL PREVENTION FROM ONE CONSERVATION EASEMENT

Estimated Bacterial Prevention from 1 CE	=	(	Total Possible Bacterial Prevention	/	Acreage Identified as High Priority for Protection	)	* 55 acres

TABLE 22. ESTIMATED BACTERIAL LOAD PREVENTION FROM ONE CONSERVATION EASEMENT (CE)

Estimated Total Bacterial Prevention with Land Protection	**=**	**Total Possible Bacterial Prevention**	**/**	**Acreage Identified as High Priority for Protection**	*****	**Minimum Acreage of 1 CE**
4.13E+07 counts/acre/year	=	1.19E+12	/	28,929.78 acres	*	55 acres

5.2) BACTERIAL LOAD REDUCTIONS/PREVENTIONS PER BMP

Although total restoration of the focus area would be ideal, this plan focuses on incremental bacterial reductions (see Section 22). The implementation of WBPs in South Carolina most often utilize Section 319 Nonpoint Source Implementation Grants through SCDHEC and cannot exceed 36 months; recommendations are based on the feasible implementation of BMPs in a 36-month implementation phase. As shown in Table 20, a bacterial reduction/prevention of 2.17E+14 counts/year is needed per the TMDL. Table 23 outlines the approximate number of BMPs recommended to achieve incremental bacterial load reductions in a 36-month timeframe. To address bacterial loading reduction requirements detailed in Section 5.1, BMPs were used to target bacteria pollution sources (*i.e.*, septic, agricultural, riparian buffers, and pet waste) in the focus area as well as preventatively through land protection. The agricultural BMPs bundle mentioned in Table 23 includes exclusionary fencing, heavy use area protection, alternate water source availability, and riparian buffer improvements (*e.g.*, grass, vegetation, and other erosion control techniques). These BMPs will address bacterial loading from agricultural sources (see Appendix C). These estimations were derived using the standard annual bacteria removal/prevention rates for each BMP multiplied by the suggested number of BMPs in the watershed to attain the necessary reductions. The standard bacteria removal rates per BMP that were used to estimate pollutant loads from sources are found in Appendices B and C and shown in Table 23.

TABLE 23. RECOMMENDED BMPS TO REDUCE BACTERIAL LOADS

BMP	Standard Bacteria Removal/Prevention per BMP	# Of Projects	Total Bacteria Reduction/Prevention Per BMP (counts/year)
Septic Repair/Replacement	2.42E+10	25	6.05E+11
Agricultural BMPs Bundle	2.89E+12	2	5.78E+12
Pet Waste Station	2.14E+12	1	2.14E+12
Riparian Buffer Restoration	6.79E+10	2	1.36E+11
Land Protection*	4.13E+07*	1 (55+ acres) *	2.27E+09*
Total			**8.66E+12 counts/year**

**Bacterial load prevented*

6) SEDIMENT POLLUTION SOURCES AND LOAD REDUCTIONS

6.1) SEDIMENT POLLUTION

According to the EPA, sediment is the most common pollutant in rivers, streams, lakes, and reservoirs in the country [36]. Sediment can come from both natural sources (*e.g.*, erosion) and human-induced activities (*e.g.*, construction and agriculture). Excess sediment has the potential to degrade water quality and aquatic habitats. For example, too much sediment can increase the cost of drinking water treatment, lead to flooding issues, clog fish gills, and destroy aquatic habitats. Additionally, sedimentation can cause infilling of lakes, especially in areas where water levels are lower in warmer months. This can cause issues for lake access, recreation, and aquatic life. Although approximately 30% of sedimentation can be attributed to natural erosion, the remaining 70% is caused by accelerated erosion from human land use practices. Table 24 details the potential point and nonpoint sources of sediment pollution in the focus area [37].

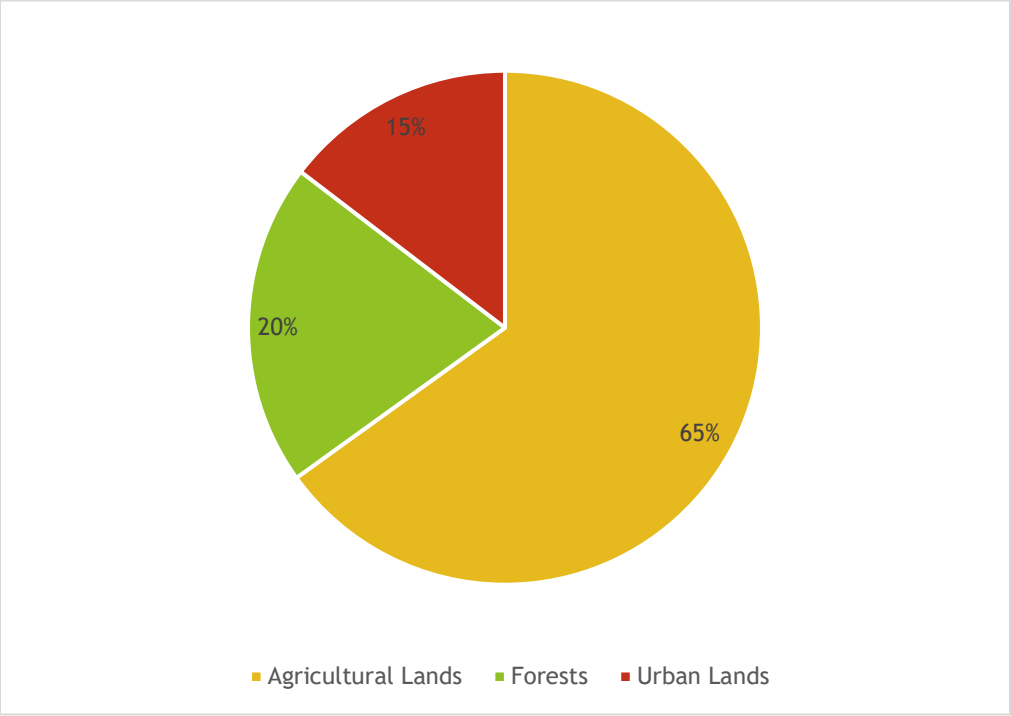
Example of sedimentation in Lake Greenwood (above). Source: UF.

TABLE 24. POTENTIAL SOURCES OF SEDIMENT POLLUTION IN THE LAKE GREENWOOD WATERSHEDS

Agriculture	Forestry	Urban
• Croplands • Livestock Operations	• Road Construction • Road Use • Clear Cutting • Silviculture	• Stormwater Runoff • Construction

Annual sediment loading for the watershed was calculated using STEPL. The STEPL model estimates annual sediment and nutrient loading based on the Universal Soil Loss Equation (USLE) and considers sediment loading from land uses (*e.g.*, urban, cropland, pastureland, and forest lands) as well as the number of animals within the focus area (Table 17) [38]. Data inputs for STEPL were derived from both UF/SCRWA collected data and the STEPL Input Data Server [26]. Using this tool, it is estimated that cumulatively, the focus area contributes 6,535 tons of sediment per year to the region, largely attributed to agricultural lands, forests, and urban development. Agricultural lands (*i.e.*, crop lands, pasture lands) are estimated to be the greatest contributor of sediment loading in the Lake Greenwood watersheds, accounting for 65%, or 4,252 tons/year, of total sediment loading. Although agricultural lands only comprise approximately 11% of the focus area, the impact on sediment loading from this land use practice is the greatest in comparison to other land uses. For example, it is estimated that forests contribute 20% of the total estimated sediment loading and urban lands contribute 14.6% to the watersheds. The breakdown of annual sediment loading (tons/year) per land use category is shown in Figure 9.

FIGURE 9. ANNUAL SEDIMENT LOADING PER LAND USE CATEGORY



6.1.1) POINT SOURCES OF SEDIMENT POLLUTION

As stated in Section 4.1, the NPDES permit system, operated by SCDHEC in South Carolina, protects water quality by regulating point sources of pollution from being discharged into Waters of the United States [39]. Sediment is regulated from stormwater point sources within an MS4 program area, stormwater from construction sites, and stormwater associated with industrial permits. Because there are no MS4 designations within the focus area, none of the NPDES permits within the focus area pertain to stormwater. See Table 15 for a complete list of NPDES permits in the focus area [40].

6.1.2) NONPOINT SOURCES OF SEDIMENT POLLUTION

The excess sedimentation of freshwaters from nonpoint source pollution is a prevalent problem in the focus area. Nonpoint sources of sediment pollution typically include construction sites, agriculture (*e.g.*, livestock operations, cropland), stormwater runoff, and forestry practices. Sediment is considered a nonpoint source pollutant both inside and outside of MS4 boundaries.

Agriculture - The most common source of pollution from agriculture is soil runoff from fields during rain events [41]. This sediment often transports chemicals including fertilizers, pesticides, and heavy metals into waterways as these contaminants attach themselves to sediment particles. Agricultural practices that exacerbate sediment erosion include overgrazing, misplaced and mismanaged feeding operations, over plowing, and poorly timed/excessive fertilizer, pesticide, or irrigation water applications. Additionally, livestock with access to streams can also contribute to sediment pollution by causing erosion along streambanks.

Agricultural sediment load reductions represent the projected amount of sediment removed annually through agricultural BMPs installed on high priority agricultural sites in the focus area.

Forestry – Large amounts of sediment can run off into water bodies from forestry practices, such as clear cutting and access road building, as these practices expose large amounts of bare soil to the elements. With the increased slope and topographical variation in the Upstate, higher erosion rates are expected as opposed to the Midlands and Coastal Plain areas of the state which might see lower rates of erosion based on flatter topography. This is particularly a concern with clear-cutting or any other practice that creates greater erosion potential. Therefore, for the Greenwood area, extra care should be taken to preserve forests and utilize forestry BMPs in the project area, particularly on parcels with steeper slopes, to maximize the soil retention and stabilization potential for forest lands.

Urban – In general, urbanized watersheds often have negative impacts on water quality. Activities most associated with urbanization are land disturbances; the channelization of streams, expansion of impervious surfaces, and increases in stormwater runoff [42]. Sediment pollution from urban areas is usually linked to mismanaged construction sites, but can also come from streets, yards, and streams.

6.1.3) PREVENTING SEDIMENT POLLUTION

Land Protection – Land protection can be used as a tool to prevent future sedimentation of waterways from land development activities. Sediment prevention from land protection represents the amount of sediment that is prevented from impacting waterways if land is protected (and significant land development is avoided). This number was derived using the estimated Annual Pollutant Loads by Land Use for Total Suspended Solids (TSS) for the conversion of undeveloped land into single family low density residential (see Appendix B). In this calculation, Current Land Use is represented as a combination of TSS loading from agricultural pasture lands and forest lands

within the High Priority Land Protection parcels. Refer to the calculation below for the total estimated sediment prevention rates using land protection BMPs. This number assumes that all lands identified as high priority for land protection (Section 10) are protected through strategies such as conservation easements.

FORMULA 9. ESTIMATED SEDIMENT PREVENTION WITH LAND PROTECTION

Estimated TSS Prevention with Land Protection	**=**	**TSS Load per Single Family Low Residential Land Use**	**-**	**TSS Load per Current Land Use (TSS Forest + TSS Agricultural)**
1,360.3 tons/year	=	2,571.3 tons/year	-	(1,020.1 + 190.9) tons/year

Once the total possible sediment load prevented from land protection was calculated, the expected amount of sediment load prevented from one conservation easement (CE) of 55 acres was calculated using Formula 10.

FORMULA 10. ESTIMATED SEDIMENT PREVENTION FROM ONE CONSERVATION EASEMENT

Estimated Sediment Prevention from 1 CE	=	(	Total Possible Sediment Prevention	/	Acreage Identified as High Priority for Protection	)	* 55 acres

TABLE 25. ESTIMATED SEDIMENT LOAD PREVENTION FROM ONE CONSERVATION EASEMENT

Estimated Total Sediment Prevention with Land Protection	**=**	**Total Possible Sediment Prevention**	**/**	**Acreage Identified as High Priority for Protection**	*****	**Minimum Acreage of 1 CE**
2.59 tons/CE/year	=	1,360.3 tons/year	/	28,929.78 acres	*	55 acres

Riparian Buffer Restoration – Properly functioning riparian buffers can reduce sediment reaching waterways by slowing stormwater runoff and preventing erosion. Sediment removal estimates for riparian buffers represent the amount of sediment that is prevented from impacting waterways if riparian buffers are protected, enhanced, and/or restored. Examples include, but are not limited to, riparian buffer protection ordinances, planting vegetation, implementing a variety of erosion control techniques, and/or stream enhancement/restoration activities. These removal estimates were determined using the STEPL streambank and gully tool, and urban land coverage on parcels considered high priority for riparian buffer BMPs (see Section 13). Based on this information, it was determined that the sediment removal per riparian buffer restoration project within the focus area is equal to 1.0 ton/year (see Appendix D).

6.2) SEDIMENT LOAD REDUCTIONS PER BMP

Sediment load reductions were estimated for three BMP categories: protected lands, agricultural lands, and riparian buffers. As mentioned in Section 6.1, the watershed contributes 6,535 tons of sediment per year to the region with most of the loading attributed to pasturelands and forests. Table 26 outlines the approximate number of BMPs recommended to achieve a reduction of this amount. These estimations were derived using the standard annual sediment removal rates for each BMP multiplied by the suggested number of BMPs in the watershed. The acreage of Land Protection is based on the minimum acreage requirement for a conservation easement (CE) (55 acres), under UF Land Trust policies and procedures, considering 1 easement per 36-month phase (Section 22). In

total, the combined installation of the BMP projects listed in Table 26 is estimated to prevent 17.59 tons of sediment from entering the water system annually.

TABLE 26. TOTAL SEDIMENT REDUCTIONS PER PHASE FROM RECOMMENDED BMPS

BMP	Standard Sediment Removal per BMP	# Of Projects	Total Sediment Reduction/ Prevention Per BMP
Agricultural BMP Bundle	6.5 tons/year	2	13.0
Land Protection**	2.59 tons/CE*/year	1 (55+ acres)	2.59
Riparian Buffer Restoration	1 ton/year	2	2.0
Total		**17.59 tons**	

**CE = Conservation Easement*

***Sediment load prevented*

7) NUTRIENT POLLUTION SOURCES AND LOAD REDUCTIONS

7.1) NUTRIENT POLLUTION

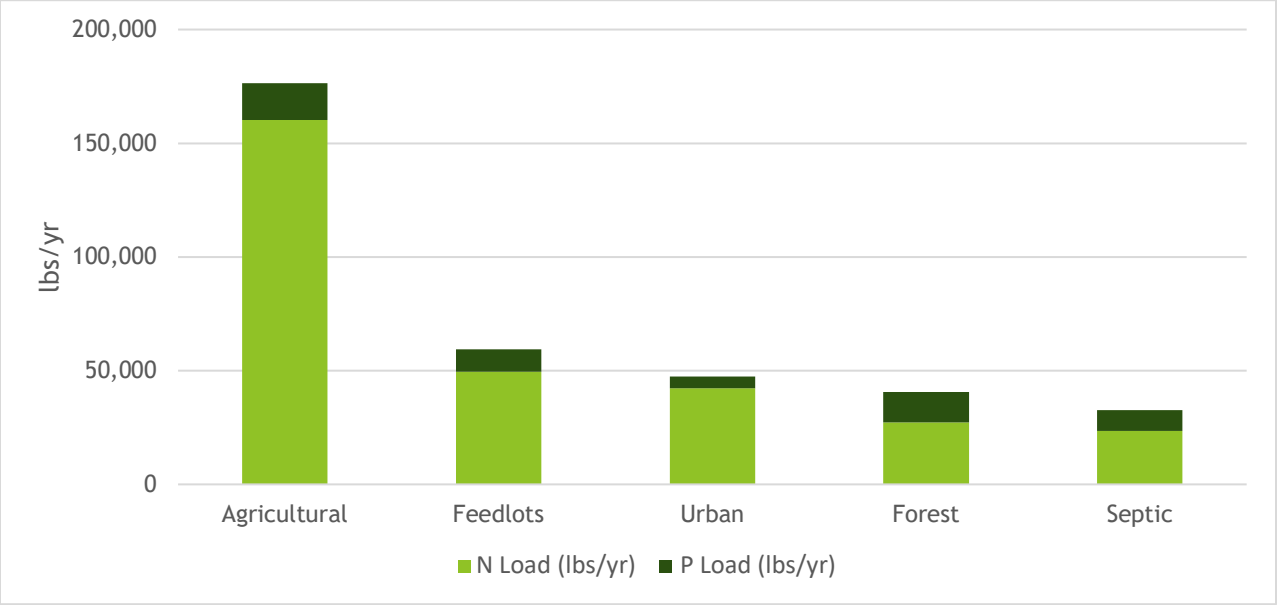
Nutrient pollution is considered one of the most widespread and difficult challenges for water quality in the US [40]. Excess levels of nitrogen and phosphorus can cause both economic and environmental impacts such as harmful algal blooms in surface waters, increased drinking water treatment costs, and aquatic habitat degradation [43]. Nutrient pollution is associated with both point and nonpoint sources and is most often attributed to anthropogenic influences (Table 27).

TABLE 27. POTENTIAL SOURCES OF NUTRIENT POLLUTION IN THE LAKE GREENWOOD WATERSHEDS

Agriculture	Urban	Wastewater	Industrial
• Livestock • Fertilizer applications • Soil erosion	• Stormwater Runoff • Yard Waste • Yard Fertilizers/Pesticides • Pet waste	• WWTPs • Septic Systems	• Factories

Annual nutrient loading for the watershed was calculated using the STEPL model. The model estimates that the focus area contributes 53,558.96 pounds of phosphorus per year and 302,722.06 pounds of nitrogen per year to the region with most of the loading attributed to agricultural practices, urban development, forestry, and septic systems. The breakdown of annual nutrient loading per land use is shown in Figure 10.

FIGURE 10. ANNUAL NUTRIENT LOADING PER LAND USE CATEGORY FOR THE LAKE GREENWOOD WATERSHEDS



7.1.1) POINT SOURCES OF NUTRIENTS

The primary point sources of nutrients include sewage treatment plants, industry, and factories. As stated in Section 4.1, the NPDES system controls water pollution by regulating point sources that discharge pollutants into Waters of the United States (WOTUS).

NPDES Discharges - There are three NPDES facilities permitted to discharge into surface waters in the Lake Greenwood watersheds (Table 15, Figure 7). These facilities are regulated by SCDHEC to ensure compliance with the Clean Water Act. None of the listed NPDES facilities (Table 15) have compliance violations for nutrients such as total phosphorus (TP) and total nitrogen (TN).

7.1.2) NONPOINT SOURCES OF NUTRIENTS

Nutrient pollution (*i.e.*, nitrogen and phosphorus) from nonpoint sources is common in the Lake Greenwood watersheds. Within the focus area, excess nitrogen and phosphorus loading to waterways is associated with agricultural, urban, and domestic wastewater sources.

Agriculture - Agriculture is considered one of the largest sources of nitrogen and phosphorus pollution to waterways in the country [40]. Fertilizers and animal manure, both rich with nitrogen and phosphorus, are the primary causes of nutrient pollution from agriculture when not managed properly. Restricting livestock access to streams and properly managing fertilizer applications protects water quality by reducing the amount of excess nutrients entering local waterways.

Agricultural nutrient load reductions reflect the amount of nutrients projected to be removed annually using the Agricultural BMPs (Section 12.3) installed on high priority agricultural sites within the focus area.

Urban - Nutrient pollution from urban areas is typically attributed to stormwater runoff. As impervious surfaces in a region increase (*e.g.*, roads, parking lots, roof tops), landscapes lose their ability to absorb precipitation during

rain events. As a result, stormwater runs off these surfaces at higher volumes and speeds, picking up debris and other pollutants, and then discharging them into nearby waterways. Nitrogen and phosphorous can be found in yard waste, fertilizers, and pet waste and is often washed into local rivers and streams during rain events.

Forestry – Managed forested land can serve as a buffer to nonpoint source runoff and absorb other nonpoint sources of water quality impairments. Unmanaged silviculture loses the ability to effectively buffer and absorb nonpoint source pollutants. Some examples that contribute to nonpoint source pollution on forested lands include removal of streamside vegetation, logging road construction and use, timber harvesting, and mechanical preparation for planting trees. In each of these examples, nutrient rich soils are not buffered or absorbed and instead reach the nearby waterbodies causing increased nutrient loading. Nutrients such as fertilizers, insecticides, and herbicides from silviculture may also reach nearby water bodies if not properly managed.

Wastewater - Domestic wastewater contains nutrients (*i.e.*, nitrogen and phosphorus) from human waste, food scraps, soaps, and detergents. Consequently, malfunctioning or mismanaged septic systems are a potential source of nutrient pollution in the Lake Greenwood watersheds. When not properly maintained, septic systems can potentially release nitrogen and phosphorus into local waterways or groundwater [40].

7.1.3) PREVENTING NUTRIENT POLLUTION

Land Protection – Nutrient load prevention (*i.e.*, TP, TN) with land protection represent the amount of nutrients that are prevented on undeveloped lands from impacting waterways if significant development of the land is avoided. This number was derived using the estimated annual pollutant loads by land use for TP and TN for the conversion of undeveloped land into single family low density residential [35]. In this calculation, current land use is represented as a combination of TP and TN loading from agricultural pasture lands and forest lands within the high priority land protection parcels (Formula 11). This number assumes that all lands identified as high priority for land protection (Section 10) are protected through strategies such as conservation easements.

FORMULA 11. ESTIMATED TOTAL POSSIBLE NUTRIENT PREVENTION WITH LAND PROTECTION

Estimated Total Nutrient Prevention with Land Protection	=	Nutrient Load per Single Family Low Residential Land Use	-	Nutrient Load per Current Land Use (Agricultural + Forest)

TABLE 28. TOTAL POSSIBLE NUTRIENT LOAD PREVENTION WITH LAND PROTECTION

Indicator	**Estimated Total Nutrient Prevention with Land Protection**	**=**	**Nutrient Load per Single Family Low Residential Land Use**	**-**	**Nutrient Load per Current Land Use (Forest + Agricultural)**
Phosphorus	11,387.89 lbs/year	=	14,142.03 lbs/year	-	(2,609.45 + 144.69) lbs/year
Nitrogen	50,731.9 lbs/year	=	102,851.1 lbs/year	-	(47,444.5 + 4,674.7) lbs/year

Once the total possible nutrient load prevented from land protection was calculated, the expected amount of nutrient load prevented from one conservation easement (CE) of 55 acres was calculated using Formula 12.

FORMULA 12. ESTIMATED NUTRIENT PREVENTION FROM ONE CONSERVATION EASEMENT

Estimated Nutrient Prevention from 1 CE	=	(	Total Possible Nutrient Prevention	/	Acreage Identified as High Priority for Protection	)	*	55 acres

TABLE 29. ESTIMATED NUTRIENT LOAD PREVENTION FROM ONE CONSERVATION EASEMENT

Indicator	**Estimated Total Nutrient Prevention with Land Protection**	**=**	**Total Possible Nutrient Prevention**	**/**	**Acreage Identified as High Priority for Protection**	*****	**Minimum Acreage of 1 CE**
Phosphorus	21.65 lbs/CE/year	=	11,387.89 lbs/year	/	28,929.78 acres	*	55 acres
Nitrogen	96.45 lbs/CE/year	=	50,731.9 lbs/year	/		*	
Total	**118.10 lbs/CE/yr**						

Riparian Buffer Restoration – Properly installed riparian buffers can reduce nutrients from reaching waterways by slowing stormwater, preventing erosion, and filtering out pollutants before entering waterways. Nutrient removal estimates for riparian buffers represent the nutrient loading prevented from impacting waterways if riparian buffers are protected, enhanced, and/or restored. Examples of actions include, but are not limited to, riparian buffer protection ordinances, planting vegetation, erosion control techniques, and/or stream enhancement/restoration activities. Using the EPA STEPL model, specifically the streambank and gully tool, it was determined that the nutrient removal per a typical riparian buffer restoration project within the focus area is equal to 2.6 pounds/year (phosphorus) and 22.2 pounds/year (nitrogen). In the Lake Greenwood watersheds, the average size of a high priority parcel for riparian buffer BMPs is 34.5 acres.

Pet Waste – When used properly, pet waste stations can effectively reduce nutrient loading within a watershed by reducing the amount of pet waste that could run off into nearby waterways. Nutrient removal estimates for pet waste represent the average amount of nutrients removed annually by one installed pet waste station. Utilizing pet waste station data from Greenville County in 2012 and the average nutrient load/day from dogs [44], it was determined that one pet waste station removes 3.19 pounds of phosphorus and 15.17 pounds of nitrogen annually (18.36 pounds/year total).

7.2) NUTRIENT LOAD REDUCTIONS PER BMP

As mentioned in Section 7.1, the focus area contributes 53,558.96 pounds of phosphorus annually and 302,722.06 pounds of nitrogen annually to the region (total of 356,281.02 pounds/year), with much of the loading attributed to agriculture, urban development, forestry, and septic systems. Table 23 outlines the approximate number of BMPs recommended to achieve a reduction equal to this amount. These estimations were derived using the standard annual nutrient removal rates for each BMP multiplied by the suggested number of BMPs in the watershed to attain the necessary reductions. The numbers for septic repairs/replacements and agricultural BMPs were taken from the recommended number of projects for bacterial load reduction (Table 23), while the number for riparian buffer BMPs was based on the recommended sediment reductions (Section 6.2).

TABLE 30. RECOMMENDED BMPS TO ADDRESS NUTRIENT REDUCTIONS

BMP	Standard TP Removal/ Prevention per BMP	Standard TN Removal/ Prevention per BMP	# Of Projects	Total Nutrient Reduction/ Prevention Per BMP (lbs/year)
Septic Repair/ Replacement	12.78 lbs/year	32.62 lbs/year	25	1,135.02
Agricultural BMP Bundle	3.4 lbs/year	8.8 lbs/year	2	24.40
Land Protection*	21.65 lbs/CE/year*	96.45 lbs/CE/year*	1 (55+ acres)*	118.10*
Riparian Buffer Restoration	2.6 lbs/acre/year	22.2 lbs/acre/year	2	49.60
Pet Waste Stations	3.19 lbs/station/year	15.17 lbs/station/year	1	18.36
Total				**1,345.48**

**Nutrient load prevented*

The completion of the projects in Table 30 would prevent/remove over 1,300 pounds of nutrients from entering the focus area annually. While these estimates do not fully address the combined annual nutrient load of 356,281.02 (pounds/year) for watersheds, the goal is to attain feasible incremental improvements over a phased approach.

8) LOAD REDUCTION SUMMARY AND COST ESTIMATES

As summarized in Table 31, the recommended load reductions for bacteria, sediment, and nutrients would be achieved with the implementation of the following septic, agricultural, land protection, and riparian buffer restoration projects over the course of each 36-month implementation phase.

TABLE 31. ANNUAL LOAD REDUCTIONS AND RECOMMENDED BMPS IN THE LAKE GREENWOOD WATERSHEDS

BMP	# Of Projects	Bacteria Load Reduction (counts/year)	Sediment Load Reduction (tons/year)	Nutrient Load Reduction (lbs/year)
Septic Repair/ Restoration	25	6.05E+11		1,135.02
Agricultural BMP Bundle	2	5.78E+12	13.0	24.40
Pet Waste Stations	1	2.14E+12		18.36
Land Protection	1 (55+ acres)	4.13E+07	2.59	118.10
Riparian Buffer Restoration	2	1.36E+11	2.0	49.60
Total		**8.66E+12**	**17.59**	**1,345.48**

8.1) COST ESTIMATES

- Septic Repair/Replacement: Septic repairs/replacement cost estimates were based on projects in the North, Middle, and South Tyger River watersheds and the 3&20 Creek Watershed completed between 2018-2021 with an average cost of $4,300 and $4,400, respectively. For the purposes of this WBP the averages were rounded up to $4,500.
- Agricultural BMP Bundle: As detailed in Appendix C, agricultural BMP project costs average around $22,540 per project. The 2021 Natural Resource Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) rates were used to determine agricultural and riparian buffer BMP project costs [45].
- Riparian Buffer Restoration: Site preparation and establishment for a forested buffer is $390/acre (Formula 10) and the average size of non-agricultural high priority parcels for riparian buffers in the Lake Greenwood watersheds is 34.5 acres. This resulted in an estimated average cost $13,340 per project (refer to Sections 12.4 and 13.4 for more details on funding options).
- Land Protection: While land protection costs can vary significantly, the UF Land Trust estimates a price of $23,250 to close a single conservation easement. Costs include staff time, due diligence (*e.g.*, title searches, appraisals, closing costs), and stewardship fees.

The total anticipated costs for implementing the recommended BMPs for the Lake Greenwood watersheds is $207,810 (Table 32) per 36-month phase. Based on the SCDHEC cost-share rate of 60%, the federal request to complete one phase is estimated to be $124,680 for BMP projects. While estimates are based upon the SCDHEC cost-share rate, federal funding is not guaranteed and subject to availability. Over 25 phases would be needed to achieve all bacterial reductions needed to satisfy the TMDL, costing over $3.1 million in total.

TABLE 32. LAKE GREENWOOD WATERSHEDS PROJECT IMPLEMENTATION COST ESTIMATES

BMP	Average Cost	Recommended Projects	Estimated Cost	SCDHEC Cost Share (60%)
Septic Repair/ Replacement	$4,500	25	$112,500	$67,500
Agricultural BMP Bundle	$22,540	2	$45,080	$27,048
Pet Waste Stations	$300	1	$300	$180
Land Protection (CEs)	$23,250	1 (55+ acres)	$23,250	$13,950
Riparian Buffer Restoration	$13,340	2	$26,680	$16,008
Total			**$207,810**	**$124,686**

9) PARCEL PRIORITIZATION METHODOLOGY

UF developed a GIS-based parcel prioritization analysis for eight categories of protection, restoration, and BMP implementation utilizing weighted criteria to analyze each parcel within the focus area. The forestry BMP land prioritization analysis was developed in partnership with SCRWA. Each criterion was assigned a total number of possible points based on its importance to water quality protection and/or restoration. Cumulative points for each parcel were used to identify the parcels most important for protecting or improving water quality. Parcels that are already protected/preserved through conservation easements, national, state, or city/county parks, or owned by conservation organizations were removed from the protection analysis. The results of the analyses identify lands that should be protected or improved to provide the most benefit to water quality. The criteria and associated point system were analyzed using the most current GIS and available data layers.

Prior to beginning the analyses, parcel layers for each county within the focus area were added and clipped to the watershed boundary. For each analysis, parcels were evaluated based on various factors that are key to protecting high quality waters and/or improving impaired waters. Once the results were compiled in ArcGIS, they were then exported to an Excel spreadsheet for further review and refinement. Refer to Appendix E for a detailed overview of the criteria and scoring for each category.

9.1) SCORING METHODOLOGY

Individual parcels were scored based on criteria weighted by importance to water quality in each category. Relevant criteria were evaluated, points assigned to each parcel as appropriate, and points were then summed for each parcel in each category. Some criteria were included in multiple categories (*e.g.*, adjacency to drinking water intakes, land cover type, upstream of current water quality impairments). For each category, parcels have a total score that placed them in a high, medium, or low priority category. A higher point value indicates increased importance to water quality within each category (Protection, Restoration/Enhancement, BMPs).

9.2) ANALYZING AND REFINING RESULTS

The results identify the high priority parcels for actions to protect and improve water quality. If the analysis identified many parcels as “high priority” the results were further refined to provide an actionable strategic plan for initial implementation. Specific refinement strategies varied and are explained in the individual results and recommendations sections. Implementing these cost-effective solutions will help protect and improve water quality. An overview of the practices analyzed is shown in Table 33. The results are presented in summary and map formats.

9.3) PARCEL PRIORITIZATION CATEGORIES

Parcels in the focus area were analyzed in ten categories utilizing the parcel prioritization methodology. While the Land Protection category focuses on high-quality existing lands that are recommended for protection in their current state, the remaining eight categories focus on lands most important for restoration practices specific to each category.

TABLE 33. SUMMARY OF PARCEL PRIORITIZATION CATEGORIES

Category	Main Goals
Land Protection	Protecting lands that remain in good condition or may be currently providing significant benefits to water quality and will help mitigate future impairments or loss of benefits. If developed, these lands would have the biggest negative impact on water quality.
Septic System Repair/ Replacement	Identifying locations most susceptible to septic system failure based on age of septic system and soil suitability.
Agricultural BMPs	Identifying agricultural parcels that may be contributing sources of bacteria or sediment pollution for the implementation of agricultural BMPs.
Riparian Buffer Restoration & Enhancement	Identifying parcels with highly sensitive riparian buffers that, if restored, would provide significant water quality benefits such as slowing and filtering stormwater runoff, reducing flooding, stabilizing streambanks, and minimizing erosion.
Forestry	Identifying strategies for proper forest management to manage/reduce loads of sediment and nutrients to nearby waterways.
Shoreline Management	Identifying parcels adjacent to drinking water reservoirs or surface water intakes that are high priority for shoreline management BMPs with the goal of reducing pollutants directly entering drinking water sources.
Stormwater BMPs	Identifying parcels within developed areas that may be appropriate for installation of stormwater retrofits, which would reduce stormwater runoff and pollutant loading into nearby waterways in an urbanized setting.
Pet Waste Stations	Identifying parcels that may be suited for the installation of pet waste stations to encourage proper disposal of pet waste and reduce bacteria loadings from pets, targeting high traffic pet locations such as parks or veterinary offices.
Wetland Restoration & Enhancement	Identifying parcels containing impacted, low quality, or inundated wetlands that could provide additional water quality benefits if restored or enhanced to a higher quality wetland.
Wildlife	Identifying strategies for reducing the impacts of wild animals, specifically wild boar and waterfowl, to minimize pollutant loads. Parcel prioritization was not utilized for this category.

10) LAND PROTECTION

The goal of this analysis is to identify parcels that, if developed, would have the biggest negative impact on water quality. Protecting lands that remain in good condition or may be currently providing significant benefits to water quality can help mitigate future impairments or loss of ecological benefits. Parcels that are already protected were removed from this analysis such as parks, heritage preserves, utility owned properties, and properties already protected by a conservation easement (Figure 11).

10.1) LAND PROTECTION CRITERIA

Table 34 is an overview of the specific criteria and possible points that were used to evaluate each parcel in the focus area. The total score for each parcel was used to determine those that are of high (21-31 points), medium (11-20 points), and low (1-10 points) priority for protection (Figure 9). For a detailed overview of the criteria and scoring, refer to Appendix E.

TABLE 34. CRITERIA AND RANKING SYSTEM FOR LAND PROTECTION PRIORITIZATION

Criteria	Ranking	Points	Possible Points per Category
Critical Watershed Area (CWA)	High Priority CWA	4	4
	Medium Priority CWA	3	
Stream Order	Headwater (1st and 2nd Order) Streams	4	4
Stream Classifications	ORW and TN Streams	4	4
	TGPT Streams	3	
	FW Streams with No Impairments	2	
	FW Streams with 1 or More Impairments	1	
Highly Sensitive Riparian Buffer Areas	43+ Acres of Riparian Buffers	4	4
	20-42.99 Acres of Riparian Buffers	3	
	8-19.99 Acres of Riparian Buffers	2	
	2-7.99 Acres of Riparian Buffers	1	
Forested Riparian Buffer Areas	Falls within the Highly Sensitive Riparian Buffer Area and has Forested Land Cover	1	1
Wetlands	FW Forested/Shrub, FW Emergent, Riverine Wetlands	3	3
	FW Pond and Lake Wetlands	2	
Hydric Soils	50+ Acres of Hydric Soils	3	3
	30-49.99 Acres of Hydric Soils	2	
	5-29.99 Acres of Hydric Soils	1	
100-Year Floodplain	100-Year Floodplain with no Urban/Developed Land	2	2
	100-Year Floodplain with Urban/Developed land	1	
Source Water Protection Areas	Source Water Protection Areas	2	2
Average Stream Length	Longer-than-Average Stream Length	2	2
Adjacency to Existing Protected Land	Adjacent to Existing Protected Land	1	1

Parcel Size	50 Acres or Larger	1	1
TOTAL POSSIBLE PROTECTION POINTS PER PARCEL			**31**

10.2) LAND PROTECTION RESULTS AND RECOMMENDATIONS

Out of 31 points possible in this category, the highest score a parcel received was 28. This analysis identified 84 parcels as high priority for protection to maintain the land in its current state (Figure 12). To further refine high priority results, parcels meeting the following qualifications were selected for more in-depth analysis:

1. 100 acres or greater; or
2. High priority for both Protection and Wetland Restoration; or
3. Parcels with 50 acres or greater non-urban land cover (50+ acres of agricultural, forested, or existing riparian buffer coverage); or
4. Parcels were REMOVED if use is a golf course or university

The refined results identified 74 parcels for initial protection efforts. These parcels are located throughout the focus area and over 85% of the refined high priority parcels are 100 acres or more (Figure 13). Only one refined parcel scored 28 points, which is located along Rabon Creek between Indian Mound Road and Ekom Beach Road. Most high priority parcels are located at or north of where the Reedy and Saluda arms of Lake Greenwood converge. Concentrations of high priority parcels occur along the creeks in the upper watersheds (Rabon Creek, Dirty Creek, Walnut Creek, Long Lick Creek, and Cane Creek) and at the upper portion of the Reedy River.

Based on these results, it is recommended to focus land protection efforts on the upper portion of the focus area, specifically along major feeder creeks/streams that drain into the Reedy River arm of Lake Greenwood. Additionally, larger tracts of land that are considered working forests or agricultural in nature should be prioritized for land protection.

10.3) LAND PROTECTION STRATEGIES

Land protection can be accomplished through a variety of mechanisms. The following are suggested land protection strategies that could be utilized in the focus area to protect high-quality lands in the region.

10.3.1) CONSERVATION EASEMENT

A conservation easement is a voluntary contract between a landowner and a qualified land trust, which allows the landowner to legally restrict certain land uses from occurring on their property [46]. These agreements are permanent and remain with the land even after it has been sold or willed to heirs. Conservation easements can be either donated or purchased and are typically stewarded by a land trust or governmental agency to ensure the conservation easement complies with the written agreement. Costs associated with a conservation easement, either donated or purchased, may include attorney fees, appraisals, surveys, and other due diligence items, as well as perpetual annual stewardship management of the property. The UF Land Trust has estimated that the total average cost estimated for an easement is roughly $23,250, typically paid by the landowner. This includes $6,250 for staff time, due diligence, and attorney fees and $9,500-17,000 to cover stewardship fees for the property.

10.3.2) FEE SIMPLE ACQUISITION (PURCHASED)

Entities (*e.g.*, water utilities, local governments, States, NGOs, public agencies, etc.) could purchase priority parcels and voluntarily restrict certain undesirable land uses from occurring on a property to protect water quality. Restrictions could be permanent or temporary, depending on continued management and ownership decisions.

10.3.3) LAND DONATION/FEE SIMPLE ACQUISITION (DONATED)

While this option would likely have limited availability, some current property owners may be interested in donating land, or a portion of their land, through a fee-simple donation, charitable contribution, donation with life estate, or bequest to an organization or business dedicated to stewarding the land for environmental benefits.

10.3.4) DEED RESTRICTION

While not the preferred land use protection option, property owners could place restrictions on the deed to limit the allowable uses or development of the property, which could protect priority parcels. Deed restrictions are subject to enforcement by a third party that may not have the resources to ensure land is protected.

10.4) LAND PROTECTION FUNDING SOURCES

Land protection can be accomplished through a variety of funding sources. The following are suggested funding sources that could be utilized in the focus area to protect high-quality lands in the region, employing the strategies mentioned in Section 10.3.

10.4.1) SECTION 319 FUNDING

The EPA provides annual funding to SCDHEC for projects that reduce or prevent nonpoint source water pollution by implementing an approved WBP. SCDHEC distributes these Section 319 funds through grants that will pay up to 60% of eligible project costs, with a 40% non-federal match generally provided by the landowner. For land protection, this grant funding could compensate landowners for a portion of their due diligence costs (*e.g.*, closing fees, land appraisal, earnest fee, title search fee).

10.4.2) SOUTH CAROLINA CONSERVATION BANK

Funded by the State of South Carolina, the SC Conservation Bank is the only State agency that provides funding to family farmers and farmlands for land protection through conservation easements and fee simple acquisitions. Projects are ranked based on the following criteria: public access, proximity to existing protected lands, acreage size, wildlife habitat, prime farmland soils, timberland, ecological value, and historic resources. Application cycles are biannual, January 31st and July 31st of each year.

10.4.3) WATER UTILITY FUNDED WATERSHED PROTECTION PROGRAMS

Water utility funded watershed protection programs are another alternative for protecting lands within source water protection areas. An example of such a program is the Savannah River Clean Water Fund. Using this model, water utilities work cooperatively with conservation efforts to protect land near drinking water sources. It is well documented that land conversion or other land disturbance impacts water quality; therefore, land acquisition and management can be an effective tool for the protection of drinking water sources. For example, preserving lands around source waters can help reduce loading and impacts of nonpoint source pollution on drinking water sources, recharge streams and groundwater sources, reduce risk of hazardous spills, and lower overall treatment costs for operators [47]. Using this WBP, drinking water utilities can identify high priority lands for protection and/or restoration and then work with local communities and landowners to develop strategies to purchase priority properties and/or create a management plan for parcels surrounding the source water.

10.4.4) USDA REGIONAL CONSERVATION PARTNERSHIP PROGRAM (RCPP)

RCPP is a standalone program with annual funding of $300 million. In partnership with eligible organizations, NRCS seeks to co-invest in conservation projects to address resource challenges at the local and regional levels, specifically to benefit both agricultural producers and the environment. This program operates through the USDA NRCS Farm Bill. Conservation activities that are supported include, but are not limited to, public works/watershed improvement projects, land rentals, land management/improvement/restoration, entity-held conservation easements, and US-held conservation easements. Projects completed through this program must demonstrate the challenges that are faced, provide measurable improvements, and report on environmental outcomes [48].

10.4.5) NORTH AMERICAN WETLANDS CONSERVATION ACT (NAWCA)

NAWCA grants aim to "increase bird populations and wetland habitats while supporting local economies and American traditions such as hunting, fishing, bird watching, family farming, and cattle ranching." The federally funded NAWCA program provides 1:1 ratio matching grants for wetlands conservation projects in the United States, Canada, and Mexico. Operating in two cycles annually, eligible proposals are ranked by the North American Wetlands Conservation Council [49].

10.4.6) FOREST LEGACY PROGRAM (FLP)

The Forest Legacy Program (FLP) is administered by the US Forest Service in partnership with state agencies. It is a conservation program that encourages the protection of environmentally important, privately owned forest lands through conservation easements or purchases. The FLP provides economic incentives for forest landowners to either sell their property outright or retain ownership and placing the land under a conservation easement [50].

10.4.7) AGRICULTURAL CONSERVATION EASEMENT PROGRAM (ACEP)

ACEP helps landowners, land trusts, and other entities to 1) protect, restore, and enhance wetlands; and 2) protect working farms and ranches through conservation easements. Under the Agricultural Land Easements component of the program, eligible landowners of privately held land can receive financial assistance to keep working farms in agriculture by restricting non-agricultural use through the terms of a conservation easement, with contributing funds between 50-75% of the fair market value of the agricultural land easement [51].

10.5) LAND TRUSTS

A land trust, by definition, is an organization that partners with landowners to conserve and permanently protect significant conservation resources, most often through a conservation easement [52]. Land trusts work in cooperation with landowners to place conservation easements on their property and work to ensure that land protected by conservation easements are properly managed/conserved as detailed in the conservation easement agreement. Once a conservation easement is recorded, the land trust that holds the easement will monitor that site annually to ensure its terms are upheld. Land trusts in the vicinity of the Lake Greenwood watersheds include:

- Upstate Forever
- Upper Savannah Land Trust
- Naturaland Trust
- The Nature Conservancy
- Ducks Unlimited
- Open Space Institute

Figure 11: Protected Lands

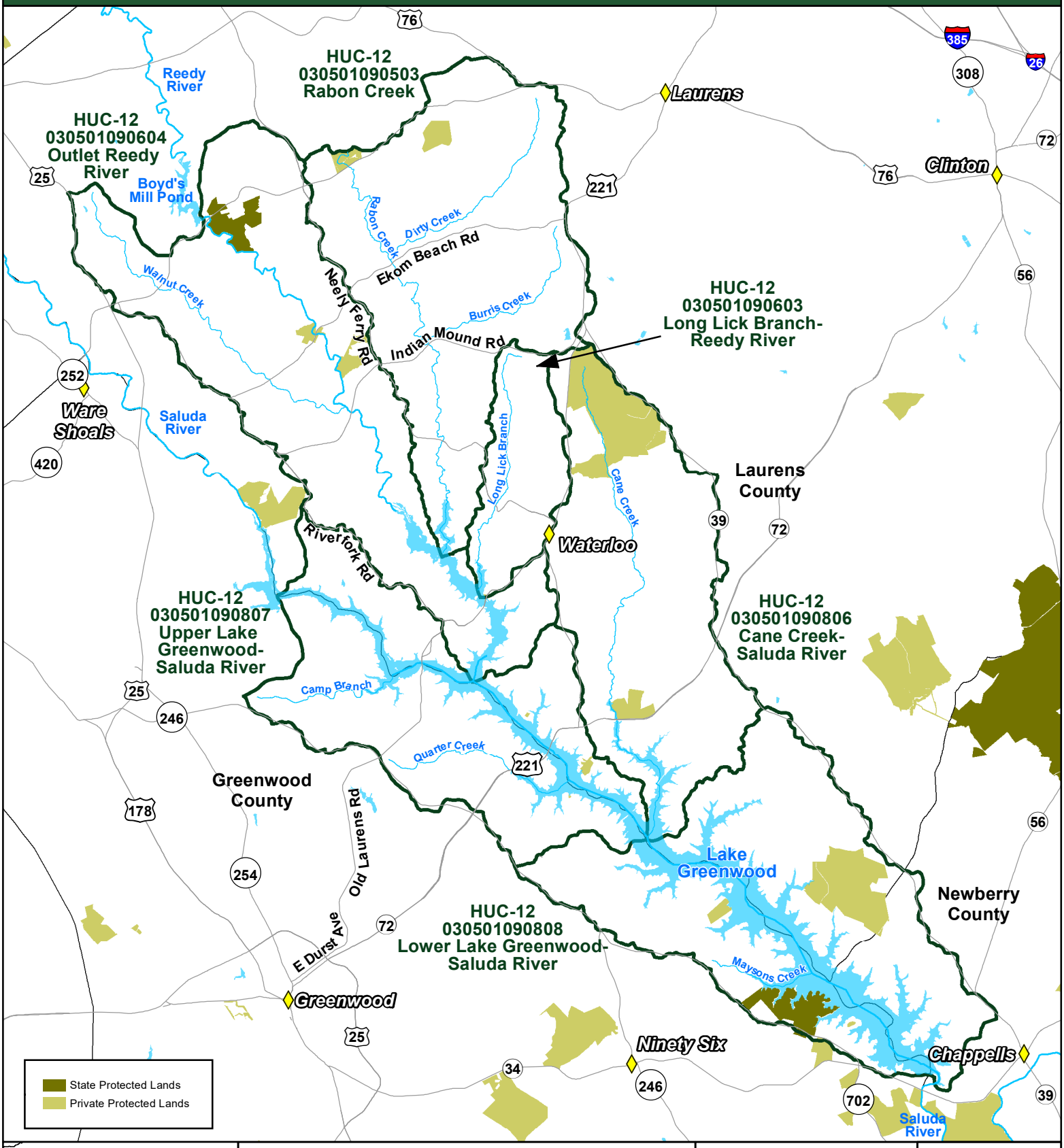


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Figure 12: Parcel Prioritization for Land Protection

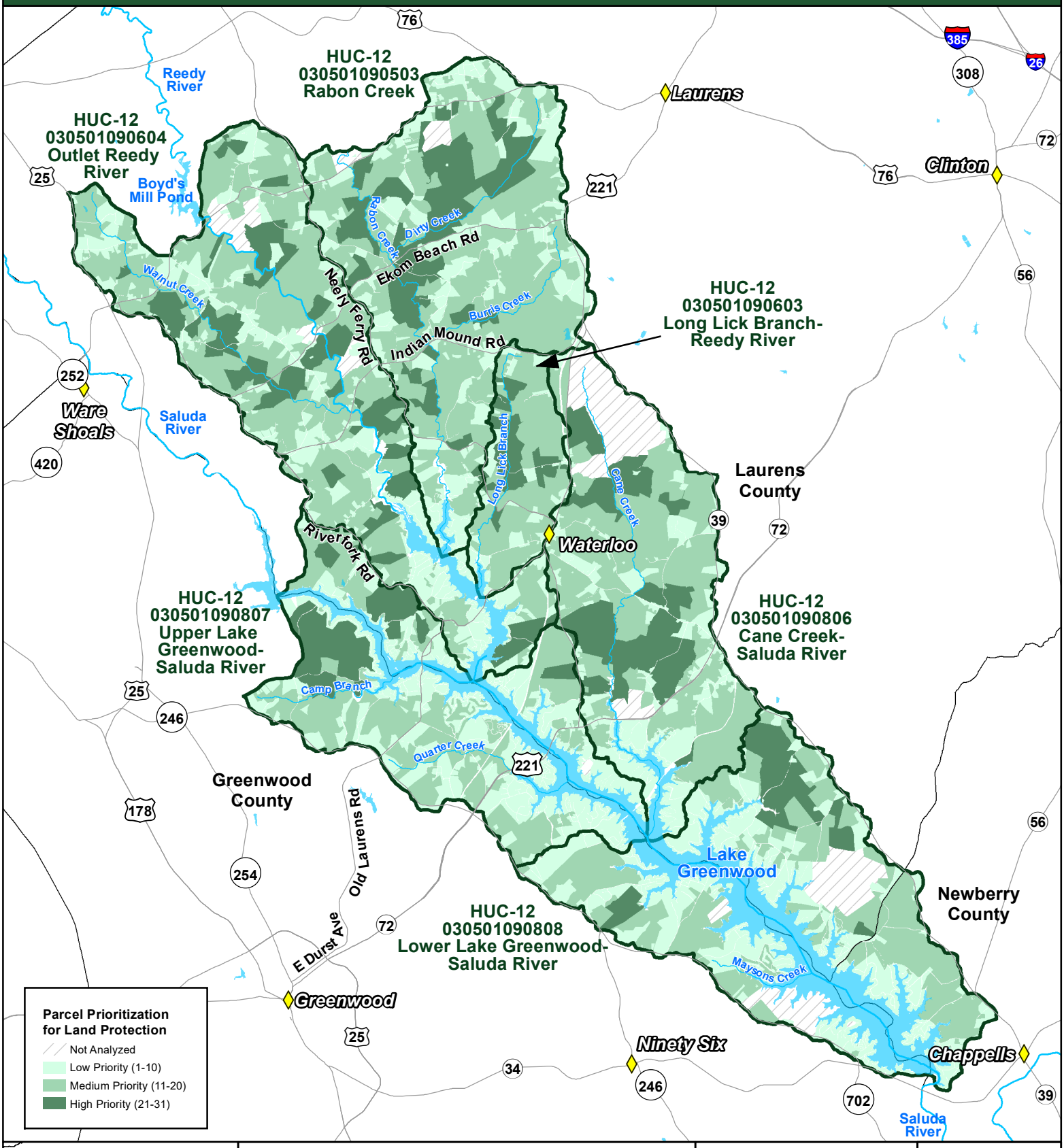

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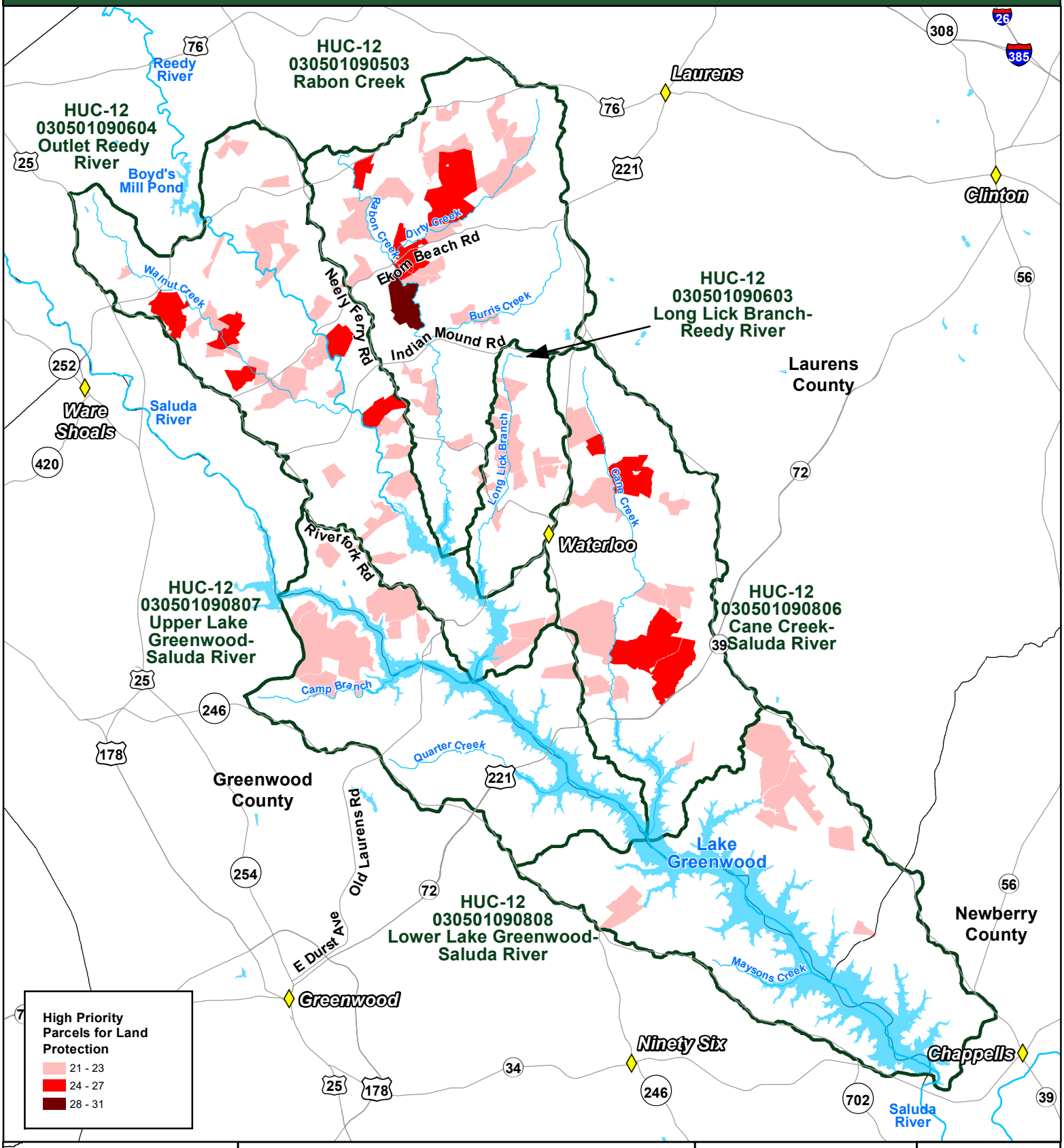
Figure 13: High Priority Parcels for Land Protection



11) ANALYZING PARCELS FOR SEPTIC REPAIRS/REPLACEMENTS

Damaged or improperly maintained septic systems can be a significant source of bacteria to surface and groundwater resources. Improper connections, clogs, heavy use, or unmaintained systems can increase the chance that untreated wastewater will leach into surface and groundwater, which can pose a threat to public health. Septic tanks should be pumped every 3-5 years to maintain efficiency [53]. Septic system repairs and replacements can reduce bacteria pollution in nearby streams by preventing bacteria leakage from faulty systems. The estimated failure rate for septic systems in this focus area is 27% (see Section 4.2) [26].

11.1) SEPTIC SYSTEM REPAIR/REPLACEMENT CRITERIA

Table 35 is an overview of the specific criteria and scoring used to evaluate each parcel. The total score for each parcel was used to determine those that are of high (9-13 points), medium (5-8 points), and low (1-4 points) priority for septic tank repair/replacement (see Figure 14). For a detailed overview of the criteria and scoring, please refer to Appendix E.

TABLE 35. CRITERIA AND RANKING SYSTEM FOR SEPTIC SYSTEM REPAIR AND REPLACEMENT

Criteria	Ranking	Points	Possible Points per Category
Sewer Service Availability (prerequisite for further analysis)	Parcels without Sanitary Sewer Lines	1	1
Soil Suitability for Septic Tank Absorption Fields (based on NRCS SSURGO database)	Very Limited – unfavorable for septic tanks; limitations cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance expected.	3	3
	Somewhat Limited – moderately favorable; limitations can be overcome or minimized; fair performance and moderate maintenance expected.	2	
	Not Limited – moderately favorable; limitations can be overcome or minimized; fair performance and moderate maintenance expected.	1	
Adjacency to Drinking Water Reservoirs/Intakes or Waterways	Adjacent to Drinking Water Reservoirs or Intakes	4	4
	Adjacent to other Waterways	2	
Current Water Quality Impairments	Include, Adjacent to, or Upstream of Existing Impairments	3	3
Land Cover	Urban/Developed Land	2	2
TOTAL POSSIBLE SEPTIC POINTS PER PARCEL			**13**

11.2) SEPTIC SYSTEM RESULTS AND RECOMMENDATIONS

This analysis identified 4,634 parcels as high priority for septic repair/replacement (Figure 15), which is about 32% of the total number of parcels in the focus area. High priority parcels are mainly located in the northern portion of the focus area and around Lake Greenwood, especially on the Laurens County side of the lake. Based on these results, UF/SCRWA recommends focusing septic tank repairs/replacements with the following priorities:

- Priority 1 – Properties immediately surrounding Lake Greenwood, especially on the Laurens County side of the Lake
- Priority 2 – Properties north of the confluence of the Saluda and Reedy rivers
- Priority 3 – Properties that drain to Lake Greenwood, especially north of Highway 221

11.3) SEPTIC SYSTEM REPAIR/REPLACEMENT STRATEGIES

According to the EPA STEPL Model, a typical septic system generates 2.42E+10 counts of bacteria annually (see Appendix B). The following BMPs are considered the most relevant and effective for residential areas in the watershed for bacterial pollution relating to onsite wastewater systems.

11.3.1) REPAIR/REPLACE SEPTIC SYSTEM

Replacing and/or repairing malfunctioning septic systems improves water quality and quality of life for residents dealing with failing septic systems because many of the failures will eventually cause sewage backup in homes and/or yards.

Examples of septic drain-line repairs in the 3&20 Creek Watershed. EZ-flow pipe (left), outlet pipe (right).

11.3.2) EXTENDING SEWER LINES

In regions with a high concentration of failing septic systems and near existing sewer lines, tying into municipal sewer systems may be the most cost-effective long-term solution. Careful consideration and analysis should be given to this option as it often requires a significant financial investment.

11.4) SEPTIC SYSTEM BMP UNIT COST ESTIMATES AND FUNDING OPTIONS

Many homes in the focus area are not within the service area of a municipal sewer system. The following table outlines the cost estimates and funding options for septic BMPs (Table 36).

TABLE 36. SEPTIC SYSTEM BMP UNIT COST AND POTENTIAL FUNDING SOURCES

Nonpoint Sources of Bacterial Pollution	**BMP**	**Estimated BMP Unit Cost**	**Potential Funding Sources**
Septic Tanks	Replace/repair onsite failing septic systems and leach fields	$4,500/system	SCDHEC 319(h) Funds Local Governments and Organizations USDA Rural Utilities Service State Revolving Funds USDA Rural Development US Department of Housing and Urban Development (HUD)
	Tie into Existing Sewer Infrastructure	$2,500/hookup*	

**Estimate from LCWSC*

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Figure 14: Parcel Prioritization for Septic Repairs/Replacements

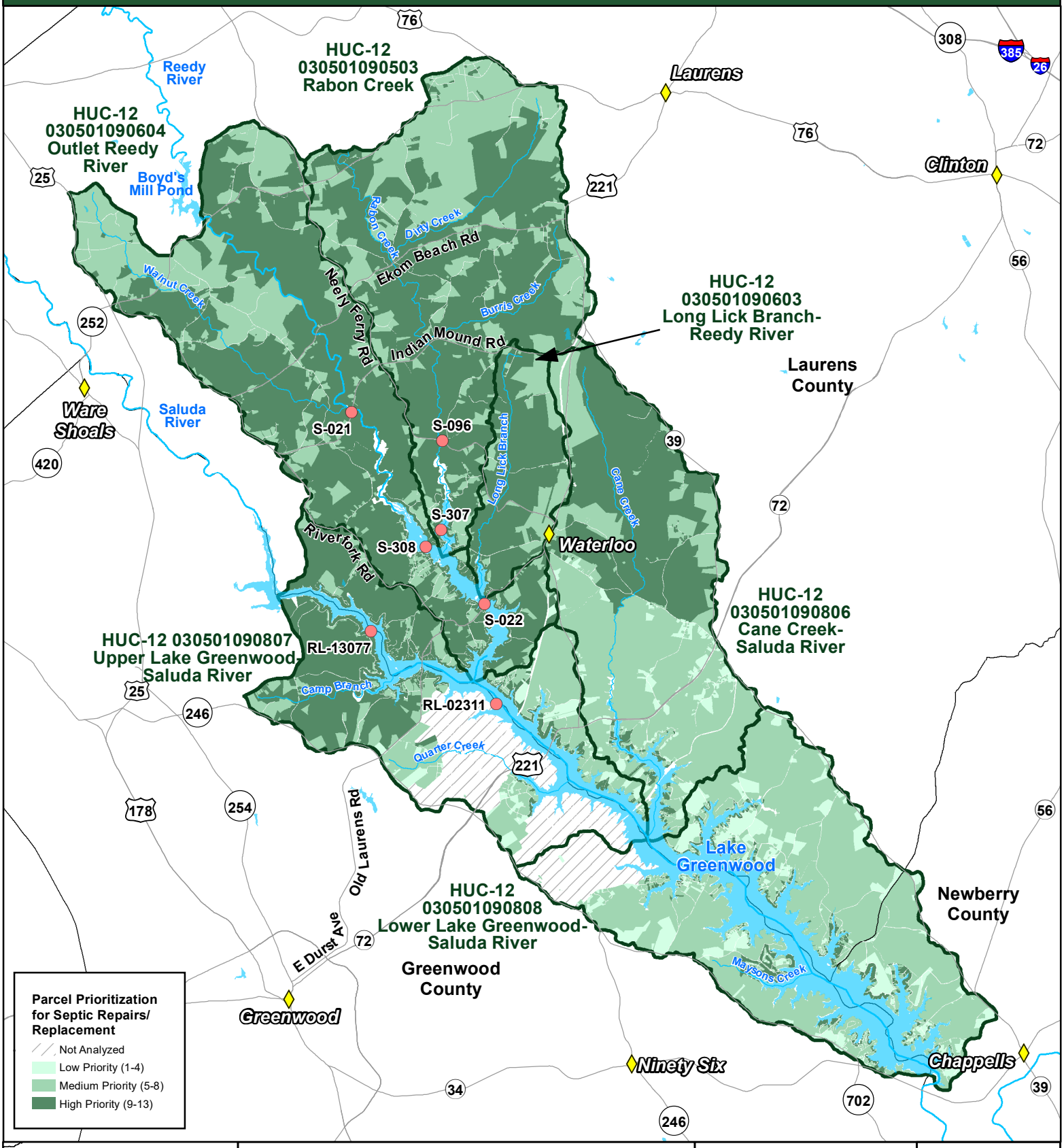

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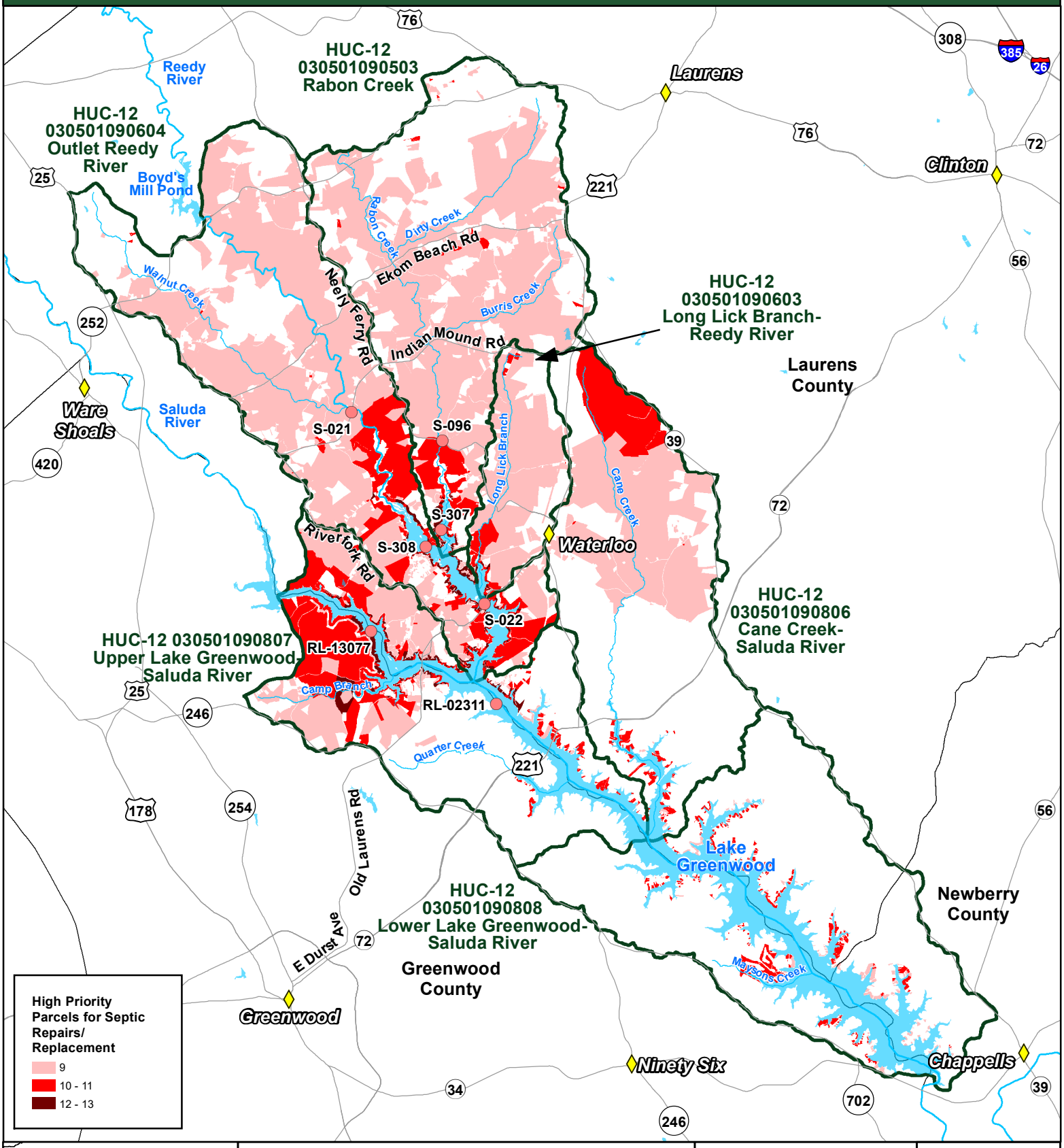
Figure 15: High Priority Parcels for Septic Repairs/Replacements



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12) ANALYZING PARCELS FOR AGRICULTURAL BMPS

The implementation of agricultural BMPs reduces bacteria, nutrient, and sediment pollution in nearby streams while maintaining, and often improving, conditions for livestock and overall land productivity. For the purposes of this plan, agricultural land includes pasture for livestock, grasslands, hay, and cultivated crops. Livestock are considered the primary agricultural source of bacterial pollution throughout the focus area and can also contribute to nutrient and sediment pollution. Therefore, to address bacteria inputs, agricultural BMPs will focus on restricting animal access to streams, providing alternative water sources, and reinforcing heavy use areas. Agricultural BMPs are often installed in combination with one another; for example, if exclusion fencing is installed to restrict livestock from a stream, an alternative watering source would also need to be installed to provide water to the livestock (Section 12.3).

12.1) AGRICULTURAL BMP CRITERIA FOR PARCEL PRIORITIZATION

Examples of agricultural BMPs include exclusionary fencing, improving heavy use areas, streambank stabilization, alternative watering sources, cover crops, drip irrigation, and riparian buffers. Table 37 is an overview of the specific criteria and points possible that were used to evaluate each parcel for potential BMPs. The total score for each parcel was used to determine those that are of high (12-17), medium (6-11), and low (1-5) priority for agricultural BMPs (Figure 16). Only parcels that were classified as agricultural were considered in this analysis. For a detailed overview of the criteria and scoring, refer to Appendix E.

TABLE 37. CRITERIA AND RANKING SYSTEM FOR AGRICULTURAL BMPS

Criteria	Ranking	Points	Total Possible Points per Category
Land Cover	50% or greater Agricultural Land Cover *(Prerequisite for further analysis)*	2	4
	Agricultural Land Adjacent to Streams	2	
Current Pollutant Export (for each Nitrogen, Phosphorus, and Sediment)	High Range of Export	3	9 (3-point maximum for each pollutant)
	Medium Range of Export	2	
Current Water Quality Impairments	Include, Adjacent to, or Upstream of Existing Impairments	3	3
Permitted and Unpermitted Point Source Pollutants	Unpermitted Point Sources (farms)	1	1
	Permitted Point Sources (CAFOs, biosolid application areas, Animal Management Areas)	1	
TOTAL POSSIBLE AGRICULTURAL POINTS PER PARCEL			**17**

12.2) AGRICULTURAL BMP ANALYSIS RESULTS AND RECOMMENDATIONS

This analysis identified 713 parcels as high priority for agricultural BMPs (roughly 5% of all parcels), with the highest score of 17 on one parcel (Figure 17). Only 13% of parcels within the focus area were analyzed for agricultural BMPs due to a low number of parcels meeting the requirement for analysis of 50% or more agricultural land use. Although agricultural land only accounts for 15% of total land coverage within the Lake Greenwood

watersheds, agriculture is a significant contributor of sediment and nutrient loads within the focus area and therefore, agricultural BMPs are an important consideration.

According to this analysis, high priority parcels are located mostly in the northern portion of the focus area, north of the confluence of the Saluda and Reedy rivers. Specifically, clusters of high priority parcels can be seen along Walnut Creek and at the headwaters of Long Lick Branch, Burris Creek, and Dirty Creek. UF/SCRWA recommends focusing outreach efforts within the northern portion of the focus area first, specifically targeting landowners along the previously mentioned creeks for agricultural BMP installations.

12.3) AGRICULTURAL BMP STRATEGIES

The following is a list of BMPs considered the most relevant and effective for agricultural areas in the watershed for bacteria, sediment, and nutrient pollution. While they are defined separately, they are most often installed in combination. Agricultural bacterial load reductions represent the bacteria load projected to be removed annually using agricultural BMPs installed on high priority agricultural sites within the focus area. In this plan, the typical agricultural BMP bundle includes exclusionary fencing, heavy use area protection, alternate water source availability, and riparian buffer improvements (*e.g.*, grass, vegetation, and other erosion control techniques). Further detailed in Appendix C, this plan assumes that for every one water well or watering facility, an average of 630 feet of waterline, 1,736 feet or fencing, 1,999 square feet of heavy use area protection, 1,649 feet of shoreline protection, and 0.19 acres of riparian buffer areas are installed.

Typical Agricultural BMP Bundle:

- 1 well with pump
- 1 watering facility
- 630 linear feet of waterline
- 1,736 feet of fencing
- 1,999 square feet of heavy use area protection
- 1,649 feet shoreline protection
- 0.19 acres of riparian buffer area

12.3.1) LIVESTOCK EXCLUSION FENCING

Installing fences along rivers, streams, and ponds limits livestock access to waterways. This practice ensures that manure is not deposited directly into waters, protects riparian vegetation, and reduces erosion along streambanks.

Example of livestock exclusion fencing in Tyger River area (above).

12.3.2) ARMORED STREAMBANK CROSSINGS /CULVERT CROSSING

In certain situations, stream crossings may be necessary to move livestock from one area to another. Armored streambank crossings and culvert crossings provide protection to reduce erosion within the crossing area. The type of stream crossing needed will depend upon specific site conditions such as stream size, flow, slope, number of livestock and streambed substrate.

Example of Armored Streambank Crossing (above).

12.3.3) ALTERNATIVE WATERING SOURCES/WELLS AND LINEAR PIPELINE

Streams and ponds in pastures are often used as the primary watering source for livestock. If fences restrict livestock access to water, an alternative watering source will be needed. Alternative watering sources prevent livestock from entering waterways, therefore reducing manure deposited directly into streams, protecting riparian vegetation, and reducing erosion along streambanks. Additionally, providing a clean reliable source of water improves livestock health and reduces risk of mortality from injury or disease. Linear pipelines may be necessary to transport water from the well to the alternative watering sources.

Examples of alternative watering source installed (left) and linear pipeline (right) in the Walnut Creek watershed.

12.3.4) ANIMAL HEAVY USE AREA PROTECTION

Animal heavy use area protection is used to stabilize ground surfaces in areas that experience high animal grazing and traffic which make it difficult to maintain vegetation leading to erosion. Installing durable materials (*e.g.*, crush and run gravel) reduces erosion and pollutant loading from stormwater runoff and can be an alternative to maintaining vegetation in these high use areas.

Examples of animal heavy use areas for cropland management (left) and watering facility (right). Source: Save Our Saluda (left); UF project in Walnut Creek watershed(right).

12.3.5) RIPARIAN BUFFERS

Riparian buffers are vegetated areas along waterways that stabilize soil, filter runoff, and provide wildlife habitat. The restoration of riparian buffers helps improve water quality by stabilizing streambanks and reducing manure, sediment, fertilizers, pesticides, and other pollutants entering nearby streams.

Example of riparian buffer restoration (above). Source: Save Our Saluda.

12.3.6) DRIP IRRIGATION

Drip irrigation systems, otherwise known as micro-irrigation, provide precise, uniform water application to plant roots either directly on the surface or sub-surface. Benefits of drip irrigation include reduced water usage, erosion prevention, soil loss preventions, and maintenance of soil moisture, which can encourage proper plant growth.

Example of drip irrigation system installed on muscadine vine fields in Tyger River watersheds. Primary irrigation pipe (left), surface emitters and piping (right).

12.3.7) COVER CROPS

Cover crops can be grasses, legumes, or other forbs that are planted to provide many benefits such as decreased soil erosion, nutrient content, and improving soil structure [54]. The use of cover crops reduces the need for fertilizer because they provide needed soil nutrient availability. Farmers often use cover crops to stabilize and renew soils in between cash crop planting seasons.

Examples of cover crop installations and practice. Crimper-roller (left), planted wheat, oat, and sorghum (right). Source: Save Our Saluda (left); Cover crop planting in South Tyger Watershed(right).

12.4) AGRICULTURAL BMP UNIT COSTS ESTIMATES AND FUNDING OPTIONS

Agricultural BMP unit cost estimates are based on information provided by the USDA (Table 38) [45]. There are numerous cost-share programs available to landowners at the federal, state, and local levels. 2021 NRCS rates are based on 75% for the cost of materials and installation. The USDA, including the NRCS and Farm Service Agency (FSA), implements many voluntary programs that help reduce bacteria loading by establishing riparian buffers, protecting wetlands, and conserving water resources.

TABLE 38. AGRICULTURAL BMP UNIT COSTS

BMP	**NRCS Code**	**Estimated Cost Per Unit (2021 NRCS Rates)**
Composting Facility	317	$7.49/square foot
Conservation Cover, Native Species	327	$155.10/acre
Cover Crop	340	$51.99/acre
Fencing	382	$2.02/foot
Riparian Buffer Restoration	390/391	$439.30/acre
Filter Strip, Native Species	393	$183.71/acre
Drip Irrigation-Surface PE with Emitters	441	$4,617.71/acre
Linear Pipeline	516	$3.98/Lb.
Access Road	560	$13.03/foot
Heavy Use Protection Area	561	$2.80/square foot
Stream Crossing	578	$6.67/square foot
Watering Facility	614	$856.87/each
Typical Water Well	642	$4,981.06/each

12.4.1) CONSERVATION STEWARDSHIP PROGRAM (CSP)

The CSP is a voluntary program funded through the NRCS program and provides financial and technical assistance to eligible producers to conserve and enhance soil, water, air, and related natural resources on their land. Eligible projects include cropland, grassland, prairie land, improved pastureland, rangeland, non-industrial private forest lands, agricultural land under the jurisdiction of a tribal government, and other private agricultural land (including cropped woodland, marshes, and agricultural land used to produce livestock) on which resource concerns related to agricultural production could be addressed [55].

12.4.2) CONSERVATION RESERVE PROGRAM (CRP)

The CRP is a land conservation program administered by the USDA Farm Service Agency (FSA). Farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality in exchange for an annual rental payment. Contracts for land

enrolled in CRP are 10-15 years in length. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat [48].

12.4.3) ENVIRONMENTAL QUALITY INCENTIVE PROGRAM (EQIP)

The NRCS EQIP program promotes agricultural production while maintaining or improving environmental quality. According to USDA NRCS, typically, up to a 75% cost-share assistance is offered to participating landowners for project costs and forgone income. Historically underserved farmers can receive up to a 90% cost-share. The specific priorities to be addressed on the property are:

- improvement of water quality in impaired waterways
- conservation of ground and surface water resources
- improvement of air quality
- reduction of soil erosion and sedimentation
- improvement or creation of wildlife habitat for at-risk species

12.4.4) AGRICULTURAL WATER ENHANCEMENT PROGRAM (AWEP)

Within EQIP, AWEP provides additional funding to NRCS offices to provide technical and financial assistance to agricultural producers to implement water enhancement activities on agricultural land to conserve surface and groundwater and overall improve water quality. Examples of previously funded projects include high efficiency irrigation systems, nutrient and pest management plans, and agricultural BMPs.

12.4.5) SECTION 319 FUNDING

The EPA provides annual funding to SCDHEC for projects that reduce or prevent nonpoint source water pollution by implementing an approved WBP. SCDHEC distributes these Section 319 funds through grants that will pay up to 60% of eligible project costs alongside a 40% non-federal match, generally provided by the landowner or other supporting organizations.

12.4.6) PARTNERS FOR FISH AND WILDLIFE PROGRAM

The US Fish and Wildlife Service (USFWS) sponsors the Partners for Fish and Wildlife Program, which provides technical and financial assistance to conserve or restore native ecosystems. Cost-share is determined by multiple factors including project location, type of habitat being restored, and species that will benefit. This voluntary program primarily involves streambank fencing, tree planting, and invasive species control. Projects on private lands must improve the habitat of Federal Trust species (*i.e.*, migratory birds, threatened and endangered species, inter-jurisdictional fish, and certain marine mammals) for the principal benefit of the Federal Government. These agreements are usually for a period of 10 years or more [56].

Figure 16: Parcel Prioritization for Agricultural BMPs

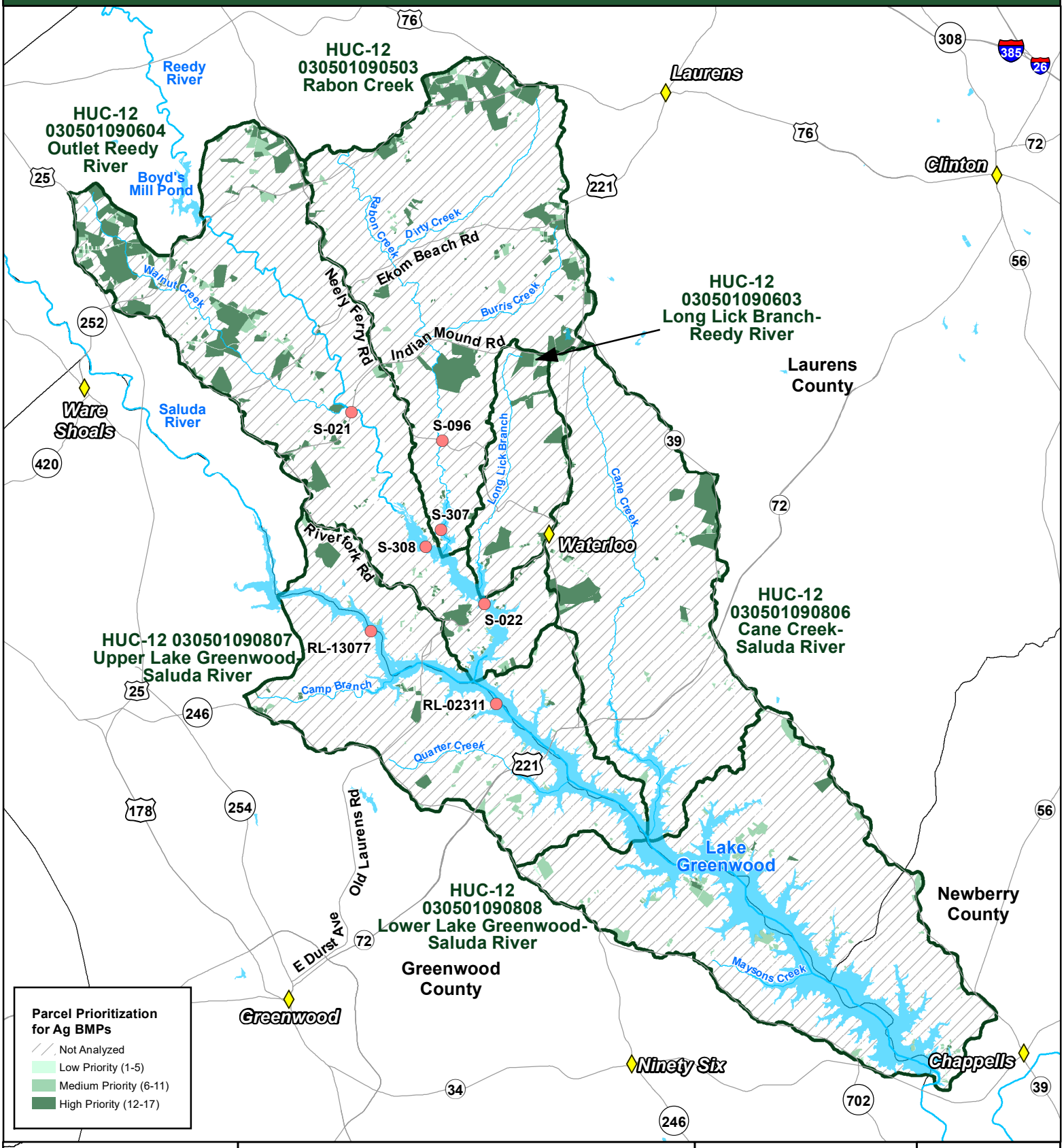

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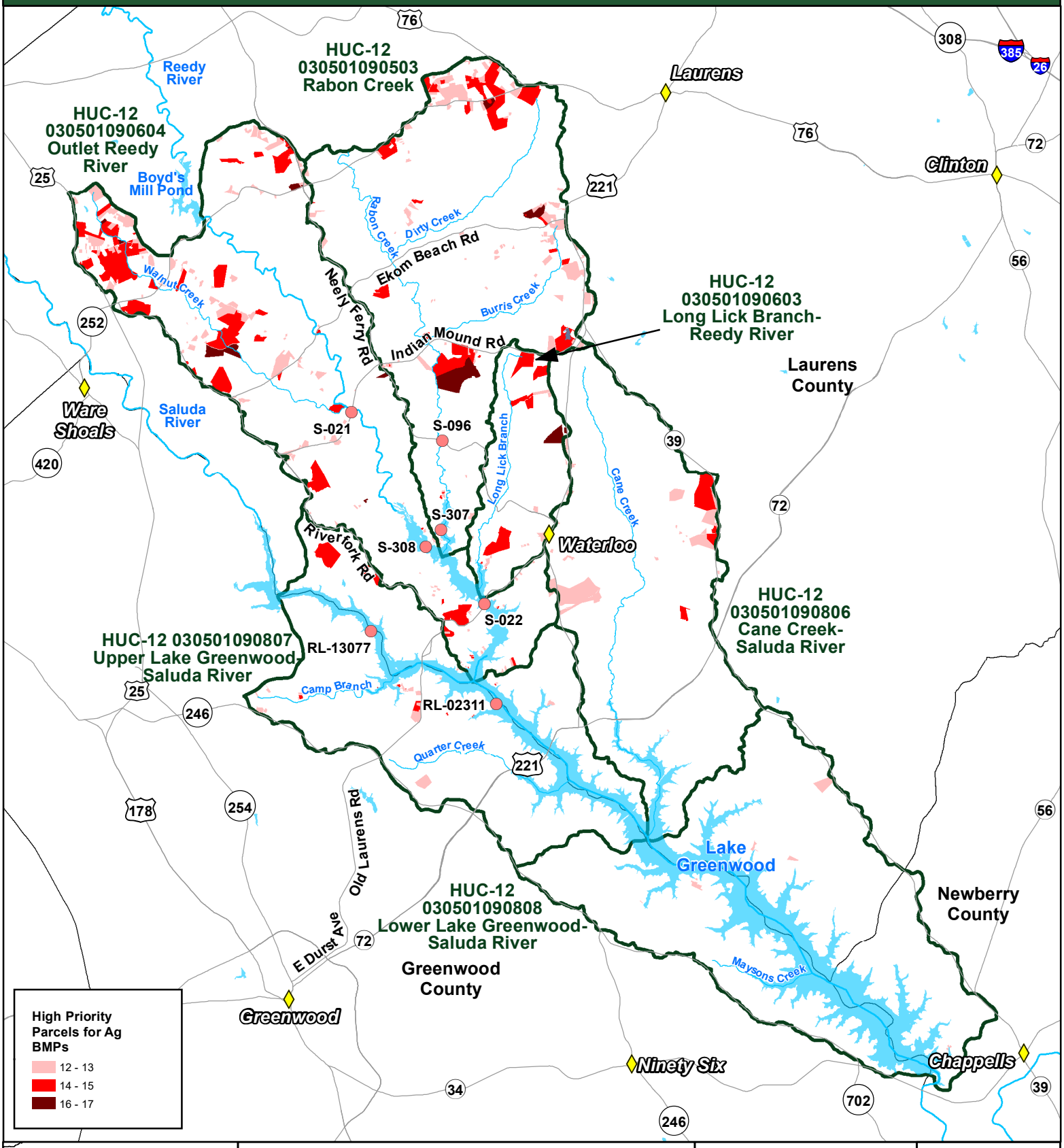
Figure 17: High Priority Parcels for Agricultural BMPs



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13) ANALYZING PARCELS FOR RIPARIAN BUFFER BMPS

This analysis identifies parcels that are high priority for riparian buffer BMPs with the purpose of improving current riparian buffer areas, increasing vegetation coverage, and adding riparian buffers to sensitive areas. The SCDNR recommends establishing and maintaining riparian buffers as the single most important BMP for the protection of stream and river resources [57]. Riparian buffers provide many ecological benefits such as erosion and nonpoint source pollution control and filtration, wildlife habitat, streambank stabilization, and groundwater recharge, with wider riparian buffers providing greater benefits [58]. Increasing the coverage of riparian buffers, especially along impaired or sensitive streams, can reduce water treatment costs, help mitigate future impairments, and assist with erosion and flood control. SCDNR states that "for the protection of water quality, a minimum buffer width of 40 to 80 feet (dependent on slope) on both sides of the stream is recommended" [57]. For the protection of wildlife habitat and scenic value, the SC Scenic Rivers Program, managed by SCDNR, strongly advocates for a minimum buffer of 100 feet bordering each side of water bodies [59].

13.1) RIPARIAN BUFFER BMPS ANALYSIS CRITERIA

Table 39 is an overview of the specific criteria and points possible that were used to evaluate each parcel. The total score of each parcel was used to determine those that are of high (18-26 points), medium (9-17 points), and low (0-8 points) priority for riparian buffer BMPs (Figure 18). For a detailed overview of the criteria and scoring, refer to Appendix E.

TABLE 39. CRITERIA AND RANKING SYSTEM FOR RIPARIAN BUFFER BMPS

Category	Criteria	Points	Total Possible Points per Category
Highly Sensitive Riparian Buffer Areas (prerequisite for further analysis)	Within/adjacent to the highly sensitive riparian buffer areas layer	4	4
Stream Order	First and Second Order Streams	4	4
Adjacency to Drinking Water Reservoirs or Intakes	Adjacent to Drinking Water Reservoirs or Intakes	4	4
	Adjacent to Waterways	2	
Current Water Quality Impairments	Include, Adjacent to, or Upstream of Existing Impairments	3	3
Current Pollutant Export (for each Nitrogen, Phosphorus, and Sediment)	High Range of Export	3	9 (3-point maximum for each pollutant)
	Medium Range of Export	2	
100-Year Floodplain	Within/adjacent to 100-year floodplain	2	2
TOTAL POSSIBLE BUFFER POINTS PER PARCEL			**26**

13.2) RIPARIAN BUFFER BMPS ANALYSIS RESULTS AND RECOMMENDATIONS

The riparian buffer parcel analysis identified 1,064 parcels as high priority for riparian buffer BMPs (Figure 18). To further refine high priority results, parcels within urban floodplain areas were removed since they are more likely to benefit from stormwater management solutions (Section 16). Of the remaining 719 high priority parcels, 6 parcels scored 25 points, the highest achieved score (Figure 19). High priority parcels are primarily located in the northern portion of the watersheds, with the highest scoring parcels along major creeks as well as the Saluda River arm of Lake Greenwood. UF/SCRWA recommends focusing the riparian buffer strategies (listed in Section 13.3) on high priority parcels, particularly north of the confluence of the Saluda and Reedy rivers.

13.3) RIPARIAN BUFFER BMP STRATEGIES

The following are recommendations for riparian buffer restoration and/or enhancement strategies for the Lake Greenwood and upstream watersheds.

13.3.1) ENSURE COMPLIANCE WITH LAKE GREENWOOD SHORELINE MANAGEMENT PLAN

As detailed in Article 403 of the Lake Greenwood Federal Energy Regulatory Commission (FERC) license, the Greenwood County Lake Management District is responsible for the operation and management of Lake Greenwood. This Shoreline Management Plan was approved in 2001 and outlines specific use requirements for all lands and waters within the approved 440-foot Mean Sea Level FERC project boundary. The Shoreline Management Plan includes a multi-pronged approach that includes an encroachment and permitting system for structures within the FERC boundary, site inspections, education, and enforcement. The Lake Greenwood Management Department recommends shoreline protection through natural means whenever possible using vegetated buffer zones, riprap, and natural stone [60]. Additionally, a Source Water Protection Area (SWPA) width of 1,500 buffer feet has been designated for all of Lake Greenwood to provide extra protection for this important drinking water source.

13.3.2) LOCAL GOVERNMENT RIPARIAN BUFFER ORDINANCES

In 2000, a statewide task force on riparian buffers convened at the University of South Carolina and agreed on a recommended minimum buffer width of 35 feet of native vegetation to protect water quality [61]. Based on this information, it is recommended that local communities develop buffer management plans to include the implementation of buffer widths that meet or exceed the minimum width of 35 feet. Other considerations for buffer management plans may include restoration programs, considerations for current and future land use, and public education programs.

The establishment of local municipal and county ordinances is an effective approach to addressing protections for waterways and riparian areas. Such ordinances could include provisions preventing clear-cutting vegetation down to the edge of waterways, protecting natural canopy, and improving stormwater management in highly urban areas. The EPA has provided technical guidance and examples of successful aquatic buffer ordinances throughout the US [62]. The guidance states that effective buffer ordinances provide guidelines for buffer creation and maintenance, and should require:

- buffer boundaries to be clearly marked on local planning maps
- language that restricts disturbance of vegetation and soils
- tables that illustrate buffer width adjustment by slope and type of waterway
- clear direction on allowable uses and public education.

In Greenville County, a coalition of organizations working together to reduce nutrient pollution in the Reedy River Watershed, known as the Reedy River Water Quality Group, completed a study recently that revealed the economic benefits associated with an expanded riparian buffer (50 feet for watersheds less than 50 acres, 100 feet for watersheds larger than 50 acres) exceeded the costs of implementation of the buffer ordinance. The economic impacts evaluated included water quality, home value, economic development, neighborhood development, tax revenue, flood protection, and recreational value [63]. This economic information, coupled with evidence from 2001-2011, indicates a significant loss in riparian buffers along the main stem of the Reedy River. This finding has prompted Greenville County staff to recommend increased buffer protections to a 50-foot total buffer zone for streams with drainage areas <50 acres, and a 100-foot total buffer zone for streams with drainage areas >50 acres [64]. With development pressures increasing in Laurens and Newberry counties it is strongly recommended that these local governments consider establishing post construction buffer ordinances to provide additional protection to waterbodies as they are considered economic assets for the region.

13.3.3) RESTORATION/ENHANCEMENT

Land adjacent to waterways and wetlands can be restored to their natural vegetative state by stabilizing banks, planting native vegetation, and ensuring proper maintenance. Potential partners for restoration projects may include local governments, developers in need of stream or wetland mitigation, and landowners interested in protecting or improving their property.

Example of a riparian buffer stream repair on Brushy Creek, Greer, SC.
Installed erosion control fabric with livestakes (left) and educational signage (right).

13.3.4) TREE GIVEAWAYS

Voluntary participation programs such as tree giveaways are an efficient public education and community involvement tool that can also benefit water quality. Programs like this can be targeted to specific areas and used to encourage landowners to plant trees near streams/shorelines, which will in turn provide water quality and riparian buffer benefits (*e.g.*, streambank stabilization, additional shade/vegetative cover, and erosion control). Trees Upstate is a local nonprofit organization based in Greenville, SC, that works in collaboration with Duke Energy to host tree giveaways throughout the year, promoting tree planting across the region.

Examples of tree giveaways. Event announcement (left) available trees (right). Source: Trees Upstate

13.4) RIPARIAN BUFFER BMPS COSTS ESTIMATES AND FUNDING OPTIONS

Riparian buffer BMP cost estimates are based on information provided by the USDA. There are numerous cost-share programs available to landowners at the federal, state, and local levels. The USDA NRCS and FSA programs administer many voluntary programs that help reduce bacteria loading by establishing riparian buffers, protecting wetlands, and conserving water resources. Based on 2021 NRCS rates, an estimated average cost for riparian buffer BMP project is $386.66/acre (Formula 13).

FORMULA 13. AVERAGE COST OF RIPARIAN BUFFER BMP PROJECT

Average Cost of Riparian Buffer BMP Project	**=**	**Tree/Shrub Site Preparation**	**+**	**Tree/Shrub Establishment**
$386.66/acre	=	$106.43/acre	+	$280.23/acre

TABLE 40. RIPARIAN BUFFER BMP UNIT COSTS [65]

Riparian Buffer BMP Unit	Estimated Cost Per Unit (2021 NRCS Rates)
Tree/Shrub Site Preparation (NRCS Code 490)	Average $106.43/acre
Chemical Ground Application	$50.42
Chemical Application	$87.35
Mechanical – Very Light	$34.34
Mechanical – Light	$66.73
Mechanical - Medium	$141.71
Mechanical – Very Heavy	$258.02
Tree/Shrub Establishment (NRCS Code 612)	Average $280.23/acre
Conifer – Bare Root	$230.02
Conifer-High density, containerized	$250.96
Conifer-Low density, containerized	$215.39
Hardwood Hand Planting - bare	$432.62
Hardwood Hand Planting – bare root protected	$319.48
High Density mech planting	$323.70
High Density- hand plant BR	$334.67
High Density-hand plant Conifer	$330.89
Medium Density – mech plant Conifer	$225.17
Shrub Planting	$139.35

13.4.1) RIPARIAN BUFFER BMP FUNDING OPTIONS

There are a variety of federal funding programs available for riparian buffer restoration/enhancement projects. More information about these programs can be found in the following sections:

- EQIP (Section 12.4.3)
- AWEP (Section 12.4.4)
- Section 319 Funding (Section 12.4.5)
- Partners for Fish and Wildlife Program (Section 12.4.6)

Figure 18: Parcel Prioritization for Riparian Buffer BMPs

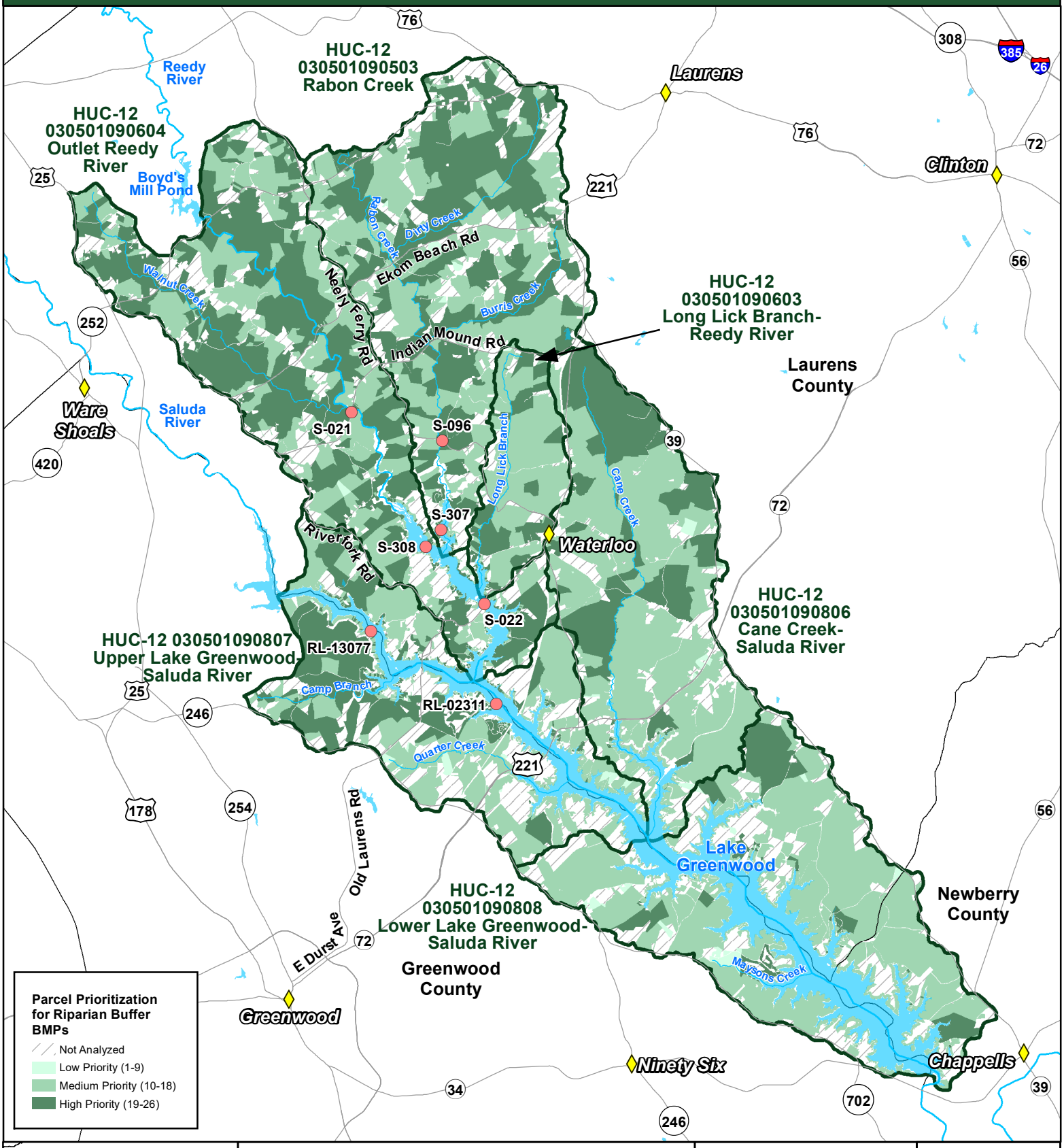

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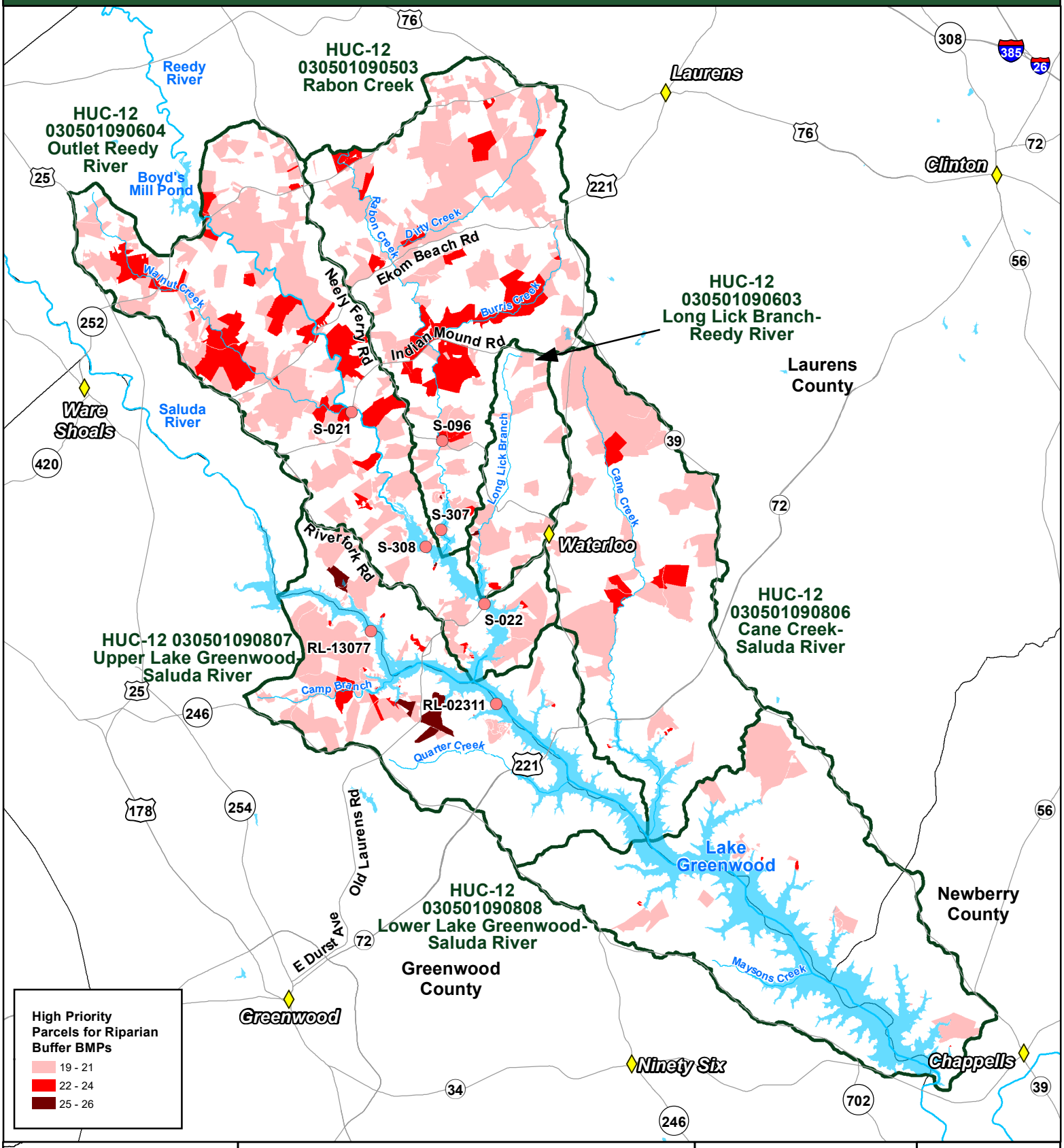
Figure 19: High Priority Parcels for Riparian Buffer BMPs



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14) FOREST MANAGEMENT

The purpose of this analysis is to identify forested parcels that would benefit from proper forest management strategies to manage/reduce loads of sediment and nutrients to nearby waterways. According to the SCFC, forests contribute over $21 billion annually to the economy of South Carolina and provide employment to over 84,000 South Carolinians [66]. With over 67% of the Lake Greenwood watersheds classified as forested, herbaceous, or grassland land cover, forest management is a major consideration for water quality protection. Almost 100% of forested lands in the watersheds are privately owned, with only 509 acres under public ownership (0.6% of all forested lands in the watershed). Healthy, well managed forests produce clean water while, improper forest management has the potential to add significant nutrient rich sediment to nearby waterways.

Timberlands in the Lake Greenwood area are often very fragile, as much of the land in the area was historically cotton fields prior to being converted to timberland in recent decades. In some cases, properties with hillsides that are managed by foresters are still terraced as a relic of cotton planting. Soil on former cotton land is depleted of nutrients and is highly erodible; poor land management throughout the last two centuries has resulted in severely eroded topsoil. Many areas in the Upstate are also heavily gullied, another remnant from overuse in the cotton farming era. Numerous streams that are classified as intermittent in South Carolina are frequently active during heavy storm events and are essential for carrying water to minimize impacts of flash flooding. Mitigation applied to these ephemeral streams in the form of buffers would therefore be beneficial in further decreasing the impact of flashy flows and large rainfall events on the landscape. This is particularly important to consider as flash flood events occur in the expanding impervious urban development areas in our state as well as otherwise heavily developed watersheds. In highly urbanized watersheds, buffer areas on intermittent streams could be incorporated into green infrastructure plans, such as parks and public access urban greenway trails.

SCRWA conducted phone interviews with forestry management companies and timber buyers. Of those interviewed, most foresters implement BMPs prescribed by the SCFC, such as minimum 40-foot buffers on all perennial streams, and most other subcontract loggers and/or other foresters follow similar practices. Loggers that are subcontracted by foresters in the focus area are South Carolina certified loggers, managing plot sizes ranging from 20 to 300 acres.

14.1) FOREST MANAGEMENT CRITERIA

Table 41 is an overview of specific criteria and possible points that were used to evaluate each parcel in the focus area. The total score of each parcel was used to determine those that are of high (17-25 points), medium (9-16 points), and low (1-8 points) priority for forestry management solutions (Figure 20). For a detailed overview of the criteria and scoring, refer to Appendix E.

TABLE 41. CRITERIA AND RANKING SYSTEM FOR FOREST MANAGEMENT PRIORITIZATION

Criteria	Ranking	Points	Total Possible Points per Category
Land Cover (prerequisite for further analysis)	>50% Forested, Grassland, and/or Herbaceous Land Cover	2	3
	10 Acres or Larger	1	
Land Use	Known Logging Operations	1	1
Proximity to Streams and Waterbodies	Within 0-0.3 miles of streams/waterbodies	3	3
	Within 0.31-0.66 miles of streams/waterbodies	2	
	Within 0.67-1 mile of streams/waterbodies	1	
Current Water Quality Impairments	Includes, Adjacent to, or Upstream of Existing Impairments	3	3
Soil Hydrologic Group (SSURGO Data)	Predominantly C/D (Low Infiltration) Soil Classification	3	3
	Predominantly B (Moderate Infiltration) Soil Classification	2	
	Predominantly A (High Infiltration) Soil Classification	1	
Soil Erodibility (K Factor)	Highest Soil Erodibility (0.29-0.37)	3	3
	Moderate Soil Erodibility (0.20-0.28)	2	
	Lowest Soil Erodibility (0.10-0.19)	1	
Maximum Slope on Property	>18% Slope	3	3
	8-17% Slope	2	
	<8% Slope	1	
TNC Forest Conservation Vision Areas (2018) **[67]**	Forest Cores	4	4
	Buffers and Restoration Areas	3	
	Corridors	2	
	Additional Resilient Areas	1	
100-Year Floodplain	Within/Adjacent to 100-Year Floodplain	2	2
TOTAL POSSIBLE FORESTRY MANAGEMENT POINTS PER PARCEL			**25**

14.2) FOREST MANAGEMENT RESULTS AND RECOMMENDATIONS

A total of 165 parcels scored as high priority for forest management, with 20 being the highest score received by one parcel (Figure 21). Most parcels considered high priority are in the northern portion of the focus area along the Reedy River, Walnut Creek, and Rabon Creek. UF/SCRWA recommends:

- Focusing outreach efforts primarily north of the confluence of the Saluda and Reedy rivers, targeting landowners in the northern portion of the focus area to help ensure that large loads of sediment are not contributing to current sedimentation issues at the mouths of Saluda and Reedy rivers.
- Working with SCFC to communicate with forest managers to encourage the utilization of the SCFC courtesy exams and suites of BMP strategies and design.
- Encouraging foresters/loggers to expand riparian buffer minimums to 50 feet on all perennial water bodies (*i.e.*, rivers, streams, etc.), particularly on steep slopes with a higher potential for erosion.
- Encouraging foresters/loggers to include at least a 15-foot riparian buffer on intermittent streams.

14.3) FOREST BMP STRATEGIES

Forested watersheds are some of the most important watersheds to protect because of the significant water quality benefits they provide. Ensuring they are not contributing to additional pollutant loading is essential. To reduce the impacts on water quality, all silvicultural activities should be conducted in accordance with SCFC BMPs. Additionally, compliance should be required in all written contracts. For complete BMP recommendations please refer to the South Carolina Best Management Practices for Forestry Manual [68]. The strategies listed below are forestry-based options that address sediment and nutrient concerns, ensure forest health and regeneration, and provide economic benefits to foresters.

14.3.1) PRESCRIBED BURNING

South Carolina legal statutes require that the SCFC must be notified prior to prescribed burning as a precaution to prevent a fire from escaping and provide smoke management. Prescribed burning is a useful silvicultural tool that can be utilized as a site preparation method to improve wildlife habitat and reduce wildfire hazards. According to the SCFC BMP Manual, a prescribed burn, conducted in compliance with all applicable BMPs, should not have an adverse effect on water quality.

Examples of a prescribed burn at Harbison State Forest (above). Source: SCFC.

14.3.2) STREAM CROSSINGS

Crossing streams is sometimes necessary to access different sections of a forested tract. All stream crossings should be constructed in compliance with SC Forestry BMPs to minimize disturbance and limit the amount of sediment and nutrients entering the stream. Applicable practices include using gradual slopes on crossing approaches, crossing the stream at a right angle, using drainage structures such as waterbars and turnouts to prevent road and ditch runoff from entering streams, adequately stabilizing exposed soil, using portable bridges, and ensuring culverts are sized correctly [68].

Examples of stabilized ford crossings: dirt road (left), crushed gravel (right). Source: SCFC.

14.3.3) FOREST ROAD CONSTRUCTION AND STABILIZATION

Temporary and permanent forest access roads are used for forest land management and recreational activities. Historically, forest access roads have been the largest contributor of sediment to streams during forestry operations. To protect water quality and minimize sediment from entering stream channels, roads should be designed and planned utilizing sediment control techniques (*e.g.,* filter strips, waterbars). Access roads need to be properly maintained during any silvicultural activity and stabilized when complete (*e.g.,* gravel, grass, compacted dirt). Foresters stabilize temporary roads with straw after land management activity is complete. This helps stabilize the exposed soil on temporary roads, prevent erosion, and improve water quality by allowing vegetation to establish sooner, speeding up landscape recovery and regeneration.

Stabilized dirt forest road (left) and un-stabilized dirt forest road (right). Source: SCFC.

Forested Wetland Road Construction

According to the SCFC Forestry BMP Manual, "road construction for silvicultural purposes in jurisdictional wetlands does not require a permit because of the silvicultural exemption under Section 404 of the Clean Water Act. However, to qualify for the silvicultural exemption, the road construction must comply with BMPs from the Clean Water Section 404 Program Definition and Permit Exemption, Part 232.3" [68]. Due to the regulatory nature of wetland roads, contacting local BMP Foresters for guidance on construction and maintenance is encouraged.

14.3.4) TIMBER HARVESTING

Landowners are encouraged to seek the advice of a licensed forester or the SCFC when planning and executing timber harvests to ensure they are both environmentally responsible and economically efficient. Timber harvests should be conducted in compliance with SC BMPs, and before logging begins, account for Streamside Management Zones (SMZs), road locations, stream crossings, and forest regeneration methods [68]. Proper planning and execution of timber harvests can prevent excess flooding and runoff, thus preventing sediment loads from entering the water system. In addition to construction sites, clearcutting is one of the more prevalent causes of erosion and sediment loading in the Lake Greenwood watersheds, according to the local forest management companies.

Examples of BMPs during timber harvests; grass and silt fence (left), debris stabilization (right). Source: SCFC.

14.3.5) FORESTRY EASEMENTS

Conservation easements on forested lands can be utilized as working forests while still being protected from future development. Working with existing land trusts such as UF, Naturaland Trust (NLT), and The Nature Conservancy (TNC) can help to identify priority lands for conservation.

When calculating the cost of an easement on forested land the land trust should ensure that the conservation easement is more profitable to the landowner than the combined foregone income from timber (currently estimated at $2000-2500/acre for pine) and subsequent tree thinning.

14.3.6) STREAMSIDE MANAGEMENT ZONES (SMZS)

Forested lands on or adjacent to perennial, intermittent, ephemeral streams, ponds, and lakes have the potential to contribute higher nutrient and sediment loads to the water systems and may require additional management during the forestry operations. Once water characteristics (*e.g.,* stream type, flow, behavior during storms) on a forested tract are identified by the landowner or licensed forest manager, the SMZ is broken into primary and secondary zones that range from 40-80 feet. However, according to foresters interviewed in the project area, this does not apply to intermittent streams where there is currently no requirement to keep a buffer in place when harvesting trees.

Specific BMPs within an SMZ are dependent on the specific characteristics of the forest tract (*i.e.,* slope and land cover) and types of streams on the land. BMP strategies within an SMZ can include minimal overstory basal area, keeping streams cleared of fallen trees, handling toxic/hazardous materials outside of the SMZ, and minimizing disturbances to the forest floor. An additional BMP recommendation by forestry companies during our conversations is leaving trees with root structures in the banks of intermittent streams and gullies. This is currently not required by the SCFC, but individual foresters implement this BMP voluntarily. Based on feedback from local forestry companies, it is suggested that BMP implementation for this WBP be adopted to ensure bank stabilization on intermittent stream slopes. Additionally, a 15-foot buffer is recommended on intermittent streams during and after timber harvesting.

Example of a buffered SMZ (above). Source: SCFC.

14.3.7) SITE PREPARATION

Before artificial or natural regeneration, site preparation is important to protect seedling survival and prevent onsite erosion. The three main methods of site preparation techniques are mechanical site preparation, chemical site preparation, and prescribed fire. Use of the site preparation techniques vary depending on the slope, natural conditions of land, tree species, and cost.

14.3.8) REFORESTATION

Reforestation can be accomplished either naturally or artificially and is best initiated soon after logging operations occur. This helps to prevent erosion and sediment loading in nearby streams. Methods of reforestation depend on factors such as slope of land, crop tree species, and cost.

14.3.9) FERTILIZATION AND PESTICIDES

Pesticide, herbicide, and insecticide use can help control unwanted vegetation and insects while protecting water quality, especially on erodible Piedmont and mountainous land. To safely use these products, operators are encouraged to delineate the treatment areas to avoid applying to riparian buffers and follow use specifications (*e.g.,* wind speeds, nearby sensitive areas, method of treatment).

Fertilization can help replace missing soil nutrients and enhance tree growth. According to the SCFC BMP Manual, the number of prescribed fertilizers that are properly applied pose no additional risk to water quality. Protecting open waters from fertilizer applications and proper use of riparian buffers prevents additional nutrient loads from reaching waterways [68].

14.3.10) MINOR DRAINAGE

Minor drainage installations can be used to remove excess surface water from forested tracts, which helps facilitate land access and forest regeneration. Proper site design and compliance with wetland regulations are required to mitigate impacts to water quality. Coordination with a SCFC BMP Forester is recommended prior to initiating any minor drainage project.

Examples of stabilized culverts (above). Source: SCFC.

14.3.11) SCFC COURTESY BMP EXAMS

The SCFC has BMP Foresters who conduct BMP Courtesy Exams that identify potential environmental impacts before, during, or after forestry operations. The SCFC BMP Foresters also suggest BMPs for pollutant mitigation and assist with site design. Utilizing this service ensures compliance with state and federal cost-share requirements, which can cover a portion of the landowner expenses.

Forestry companies interviewed also see a need for landowner education in the area and would appreciate increased outreach to landowners by both state agencies and nonprofit conservation organizations, who they feel might have a greater impact. They also indicated that additional BMP implementation and an increased number of conservation easements might be of interest to landowners if sufficient financial incentives and cost-share options were available.

14.4) FOREST BMP FUNDING OPTIONS

Funding for forestry BMPs is limited, however, cost-share assistance may be available through the NRCS EQIP and CSP programs. Foresters are encouraged to contact their local NRCS office and/or SCFC BMP Forester to learn more about possible funding sources. Some cost-share assistance for forested landowners is available through the SCFC, specifically the Forest Renewal Program and the Southern Pine Beetle Prevention Program.

14.4.1) FOREST RENEWAL PROGRAM

The Forest Renewal Program encourages tree planting on forested land and is funded jointly through the South Carolina State Legislature and wood-based product production companies. The program is designed to help landowners increase the productivity of their woodlands, stimulate the economy, and provide environmental benefits such as clean air, clean water, and enhanced wildlife habitat. The program is available to eligible landowners that are approved by the SCFC. Eligible landowners include private individuals, groups, partnerships, associations, trusts, or corporations not engaged in the manufacture of wood products, or any other legal entity owning non-industrial forestland capable of producing wood products.

14.4.2) NRCS HEALTHY FORESTS RESERVE PROGRAM (HFRP)

The HFRP "helps landowners restore, enhance, and protect forestland resources on private lands through easements and financial assistance. The HRFP provides landowners with 10-year restoration agreements and 30-year or permanent easements for specific conservation actions. HRFP applications must provide proof of land ownership for easement enrollments. An operator (tenant) must provide written concurrence from the landowner of tenancy for the period of the HFRP restoration agreement. Land enrolled in HFRP easements must be privately owned, or owned by tribal entities, and restore, enhance, or measurably increase the recovery of threatened or endangered species, improve biological diversity, or increase carbon sequestration" [69].

14.4.3) ADDITIONAL FOREST MANAGEMENT FUNDING OPTIONS

For additional funding options that are applicable to multiple restoration categories, refer to the sections listed below:

- EQIP (Section 12.4.3)
- CSP (Section 12.4.1)

Figure 20: Parcel Prioritization for Forestry Management

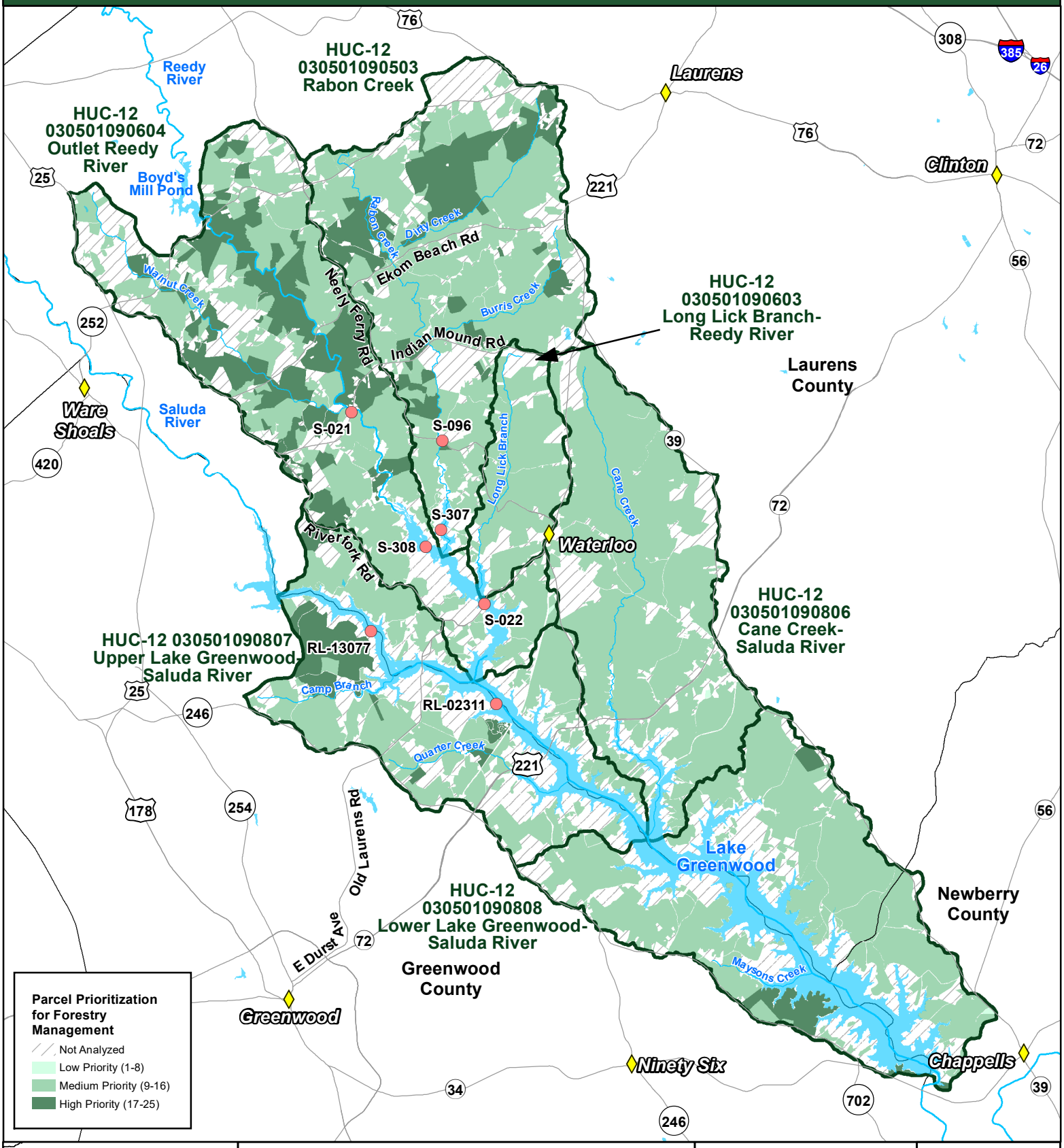

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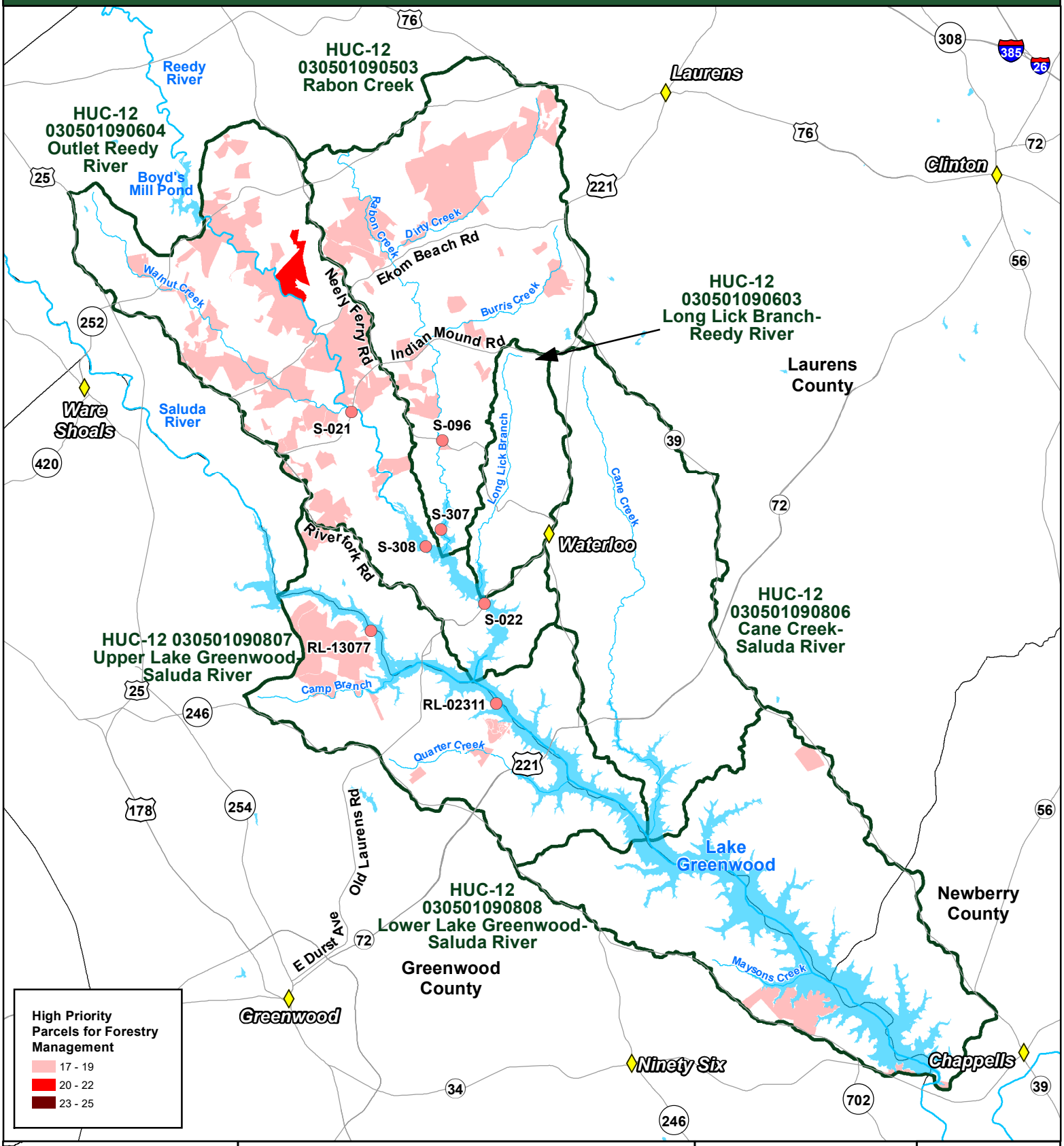
Figure 21: High Priority Parcels for Forestry Management



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15) ANALYZING PARCELS FOR SHORELINE MANAGEMENT

This analysis identifies parcels adjacent to drinking water reservoirs or intakes that are high priority for Shoreline Management BMPs. The goal for these BMPs is to reduce the pollutants that are directly entering drinking water sources. Properties bordering drinking water reservoirs and upstream of the source water intakes have the potential to degrade water quality because there is little opportunity for settling and filtration of sediment before water is received for treatment. If managed properly, shoreline parcels can slow stormwater runoff, protect against streambank erosion, filter pollutants, and help control flooding. Because many drinking water sources are used recreationally and are surrounded by private landowners, encouraging certain management strategies can help reduce the cost of water treatment and prevent pollutants from directly entering a drinking water reservoir upstream of an intake facility.

15.1) SHORELINE MANAGEMENT ANALYSIS CRITERIA

Table 42 is an overview of the specific criteria and possible points used to evaluate each parcel. The total score for each parcel was used to determine those that are of high (14-20 points), medium (7-13 points), and low (1-6 points) priority for Shoreline Management strategies (Figure 22). For a detailed overview of the criteria and scoring, refer to Appendix E.

TABLE 42. CRITERIA AND RANKING SYSTEM FOR SHORELINE MANAGEMENT

Category	Criteria	Points	Total Possible Points per Category
Adjacency to Drinking Water Reservoirs or Intakes (prerequisite for further analysis)	Adjacent to Drinking Water Reservoirs or Intakes	4	4
Current Pollutant Export (for each Nitrogen, Phosphorus, and Sediment)	High Range of Export	3	9 (3-point maximum for each pollutant)
	Medium Range of Export	2	
Highly Sensitive Riparian Buffer Areas	Within/adjacent to the highly sensitive riparian buffer areas layer	4	4
Critical Habitat Areas	Adjacent to Critical Habitat Areas	4	4
Private Boat Ramps or Docks	Private Boat Ramps	2	3
	Private Docks	1	
TOTAL POSSIBLE SHORELINE MANAGEMENT POINTS			**24**

15.2) SHORELINE MANAGEMENT ANALYSIS RESULTS AND RECOMMENDATIONS

The water level of Lake Greenwood is generally kept at the 439-contour line; the FERC project boundary is set at the 440-contour line, of which Greenwood County owns and has jurisdiction. There are approximately 7,100 parcels along the shoreline of Lake Greenwood and this analysis identified 1,769 parcels as high priority for shoreline management strategies, which is approximately 25% of all shoreline parcels (Figure 23 and 24). UF/SCRWA recommends lakefront property owners maintain natural riparian buffers at minimum to the 440-contour line, comply with the Lake Greenwood Shoreline Management Plan, and keep boat docks free from contaminants.

15.3) SHORELINE MANAGEMENT BMP STRATEGIES

15.3.1) RESTORE BUFFERS ALONG SHORELINES

For residential properties, UF/SCRWA recommends installing vegetative buffers that allow runoff from lawns and impervious surfaces to be filtered, which helps prevent additional shoreline erosion. This can be accomplished through planting native vegetation or installing a no-mow zone, particularly within the 440-contour line and below. Additional buffer above the 440-contour line is also recommended [70].

According to a statewide analysis of riparian forest buffers (RFB), a minimum width of 35 feet is recommended to protect water quality, however, a width of 100 feet or more is strongly encouraged to attain enhanced water quality protection [61]. This is particularly important if the slope to the shoreline is steep. The forested portion can be managed for underbrush, keeping the aesthetic quality for maintaining property value.

Example of lakefront property with vegetated buffer (left) vs. eroded shoreline along Lake Greenwood (right).

15.3.2) CRITICAL HABITAT AREAS

In 2002, the Critical Habitat Inventory was completed, which designated shoreline areas along Lake Greenwood into categories: Residential, Future Residential, Commercial/Non-residential, Future Commercial/Non-residential, Public Recreation, Future Public Recreation, Public Infrastructure, Project Operations, Impact Minimization Zones, Natural Areas, Vegetated-Stream Confluences, Woody Debris, Conservation, and Critical Habitat. Shorelines categorized as “red zones”, which are Conservation, Critical Habitat, and Natural Areas, have additional fineable restrictions in place such as no sediment or vegetative removal and limited new construction, enforced by Greenwood County Lake Management Department. While the Greenwood County Lake Management Department monitors and enforces these restrictions, education and outreach to landowners, particularly new buyers, would be beneficial to the maintenance of these areas. Multiple Listing Service (MLS) listings are not required to list critical habitat areas, so new buyers may not be aware that their property has building/vegetative limitations upon purchase. UF/SCRWA recommends working with area realtors to include these details in MLS listings and include educational materials to new buyers about maintaining their “red zone” shoreline properly. Additionally, educational materials should be sent to landowners in “red zones” to inform them of any restrictions on their properties.

Grassy buffer at edge of Lake Greenwood (above).

15.3.3) PRIVATE BOAT DOCK MAINTENANCE

Residents on Lake Greenwood are required to work with the Greenwood County Lake Management Department to ensure that private boat docks are well-maintained, free from contaminants, and follow the requirements outlined in the SMP (*e.g*., riparian buffer, encroachment, and shorelines requirements).

15.3.4) ENSURE COMPLIANCE WITH LAKE GREENWOOD SHORELINE MANAGEMENT PLAN (SMP)

This BMP strategy can be useful for multiple restoration categories and was previously detailed under the Riparian Buffer repair/restoration BMP strategies list; see Section 13.3.1 of this document for description.

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Figure 22: Parcel Prioritization for Shoreline Management

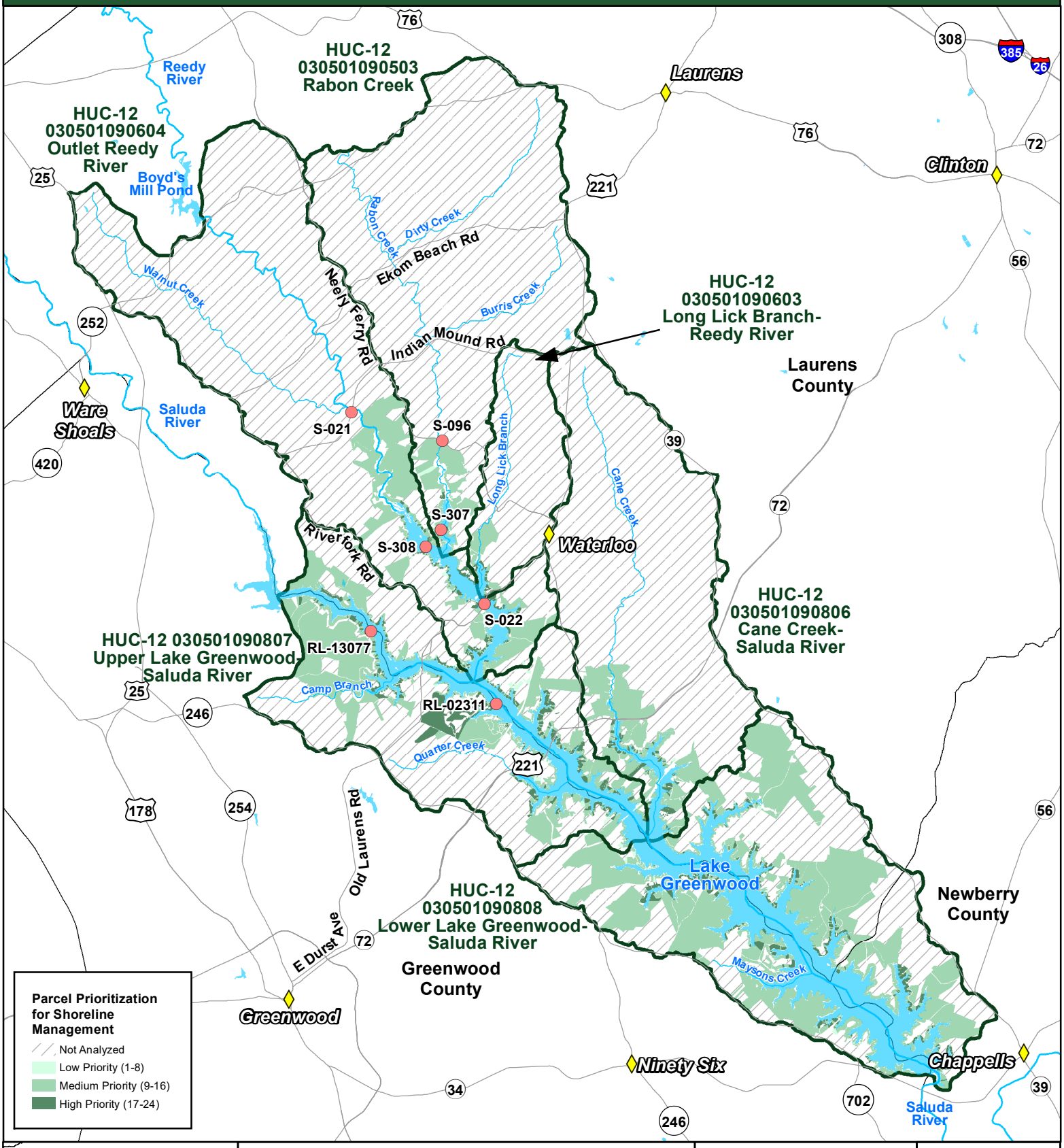

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Figure 23: High Priority Parcels for Shoreline Management

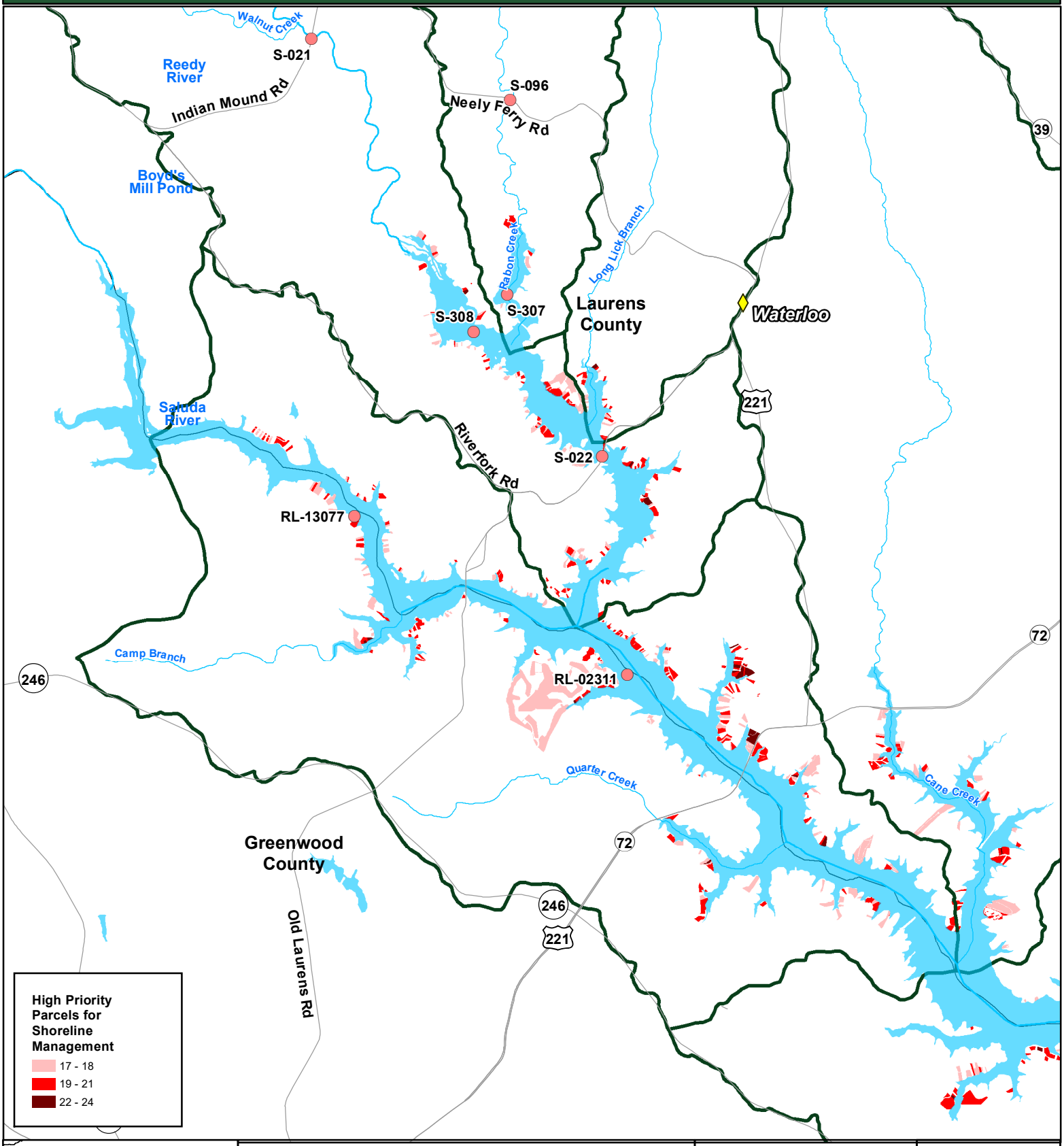

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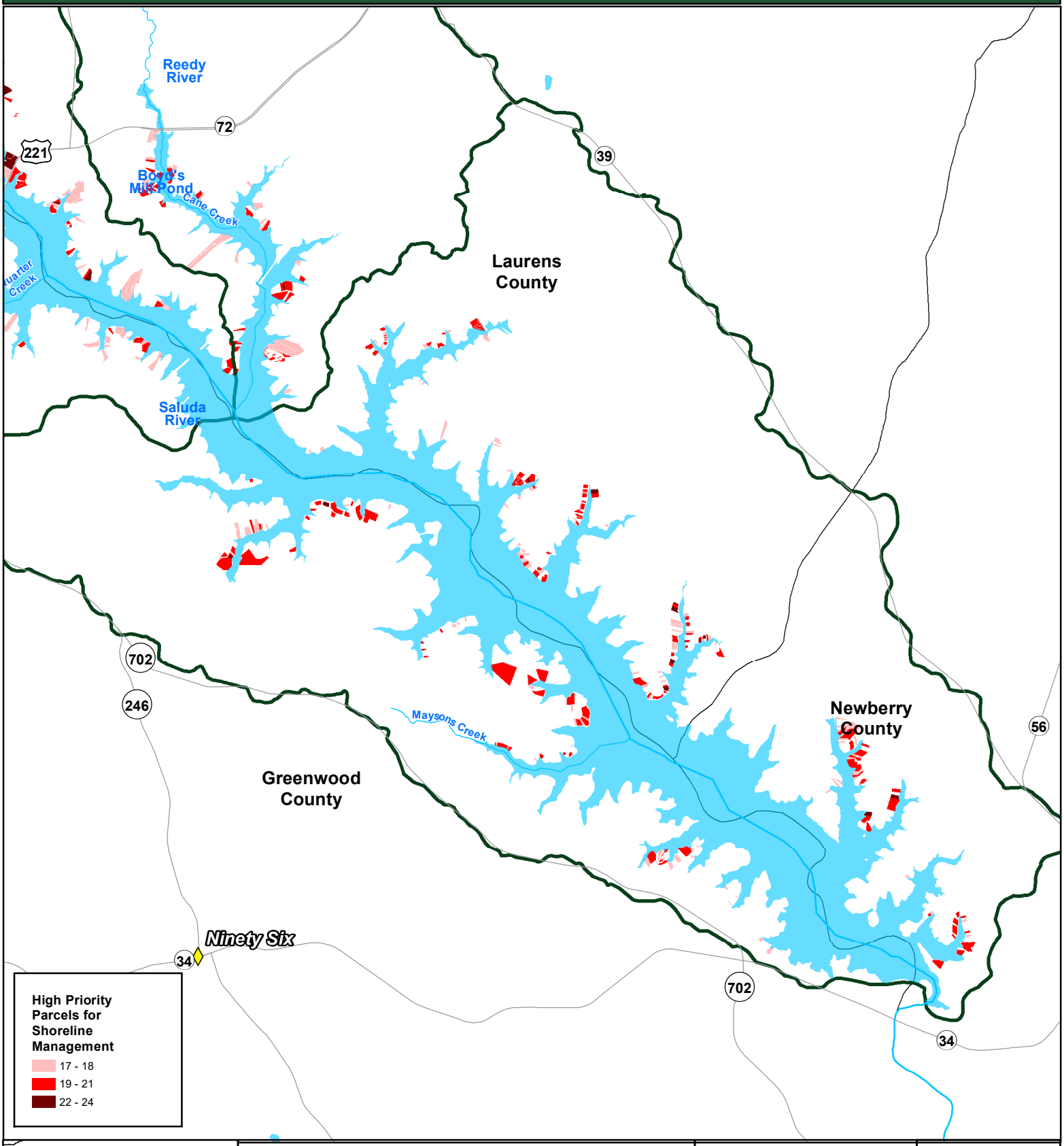
Figure 24: High Priority Parcels for Shoreline Management



LEGEND

- Impaired WQMS
- Cities/Towns
- Roads
- Rivers
- Major Creeks
- Impounded Water
- HUC-12's
- County Boundary

N

0 0.225 0.45 0.9 1.35 1.8 Miles

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16) ANALYZING PARCELS FOR STORMWATER BMPS

The Stormwater BMPs analysis identifies parcels within developed areas that may be appropriate for stormwater retrofits, which consist of a variety of practices that reduce stormwater runoff and pollutant loading from existing developed areas into nearby waterways. Urbanized areas, particularly those built prior to stormwater management requirements, are at an increased risk of negatively impacting nearby waterways due to the greater density of impervious surfaces. In the Lake Greenwood watersheds, developed land comprises approximately 9.15% of total land use. Most of this development occurs along the Lake Greenwood shoreline. As development continues, stormwater runoff will increase. This will lead to impacts that degrade water quality such as stream channelization, increased erosion, flooding, and decreased groundwater recharge [71]. Installing lot-scale stormwater BMPs in both residential and public settings will help mitigate the impacts from stormwater related impairments in the Lake Greenwood watersheds.

16.1) STORMWATER BMP ANALYSIS CRITERIA

Table 43 is an overview of the specific criteria and possible points that were used to evaluate individual parcels for stormwater improvements. The total score for each parcel was used to determine those that are of high (12-16 points), medium (6-11 points), and low (1-5 points) priority for Stormwater BMPs (Figure 25). For a detailed overview of the criteria and scoring, refer to Appendix E.

TABLE 43. CRITERIA AND RANKING SYSTEM FOR STORMWATER BMPS

Category	**Criteria**	**Points**	**Total Possible Points per Category**
Land Cover (prerequisite for further analysis)	Urban/Developed Land	2	2
	Known Logging Operations	1	
Current Pollutant Export (for each Nitrogen, Phosphorus, and Sediment)	High Range of Export	3	9 (3-point maximum for each pollutant)
	Medium Range of Export	2	
Current Water Quality Impairments	Includes, Adjacent to, or Upstream of Existing Impairments	3	3
Unpermitted Point Source Pollutants	Unpermitted Point Source Pollutants	1	1
Permitted Point Source Pollutants	Permitted Point Source Pollutants	1	1
TOTAL POSSIBLE STORMWATER BMP POINTS			**16**

16.2) STORMWATER BMP ANALYSIS RESULTS AND RECOMMENDATIONS

The analysis identified only one parcel as high priority for the installation of stormwater BMPs. The parcel received a score of 12 points and is located near the confluence of the Reedy and Saluda rivers. Urban land is not prominent in the focus area (a prerequisite for analysis) and only 44% of parcels were analyzed for Stormwater BMPs. Of the 6,268 parcels that were analyzed, 3,855 (61.5%) scored in the medium priority range (6-11 points). These medium priority parcels are located throughout the focus area, specifically along major creeks/rivers and directly surrounding Lake Greenwood. Agricultural parcels were removed from consideration because they are likely covered by the Agriculture BMP analysis. The resulting 3,508 medium and high priority parcels (those scoring 6 points or more in the analysis) are shown on Figure 26.

UF/SCRWA recommends the following:

- Partnering with local organizations to support stormwater education and outreach initiatives.
- Partnering with local organizations to host a rain barrel giveaway or sale.
- Consider the installation of a stormwater demonstration project at a highly visible public location (*e.g.*, public park, boat launch, community center, large neighborhood).

16.3) STORMWATER BMPS STRATEGIES

In more highly developed lakefront neighborhoods, existing HOAs should consider encouraging homeowners to employ some of the strategies listed below. As development in urban areas and interstate corridors upstream continues, urban and suburban BMPs will become increasingly important in mitigating the impacts of stormwater runoff. The ability to provide increased natural resource-based mitigation will depend on the ability of local governments, the development community, HOAs, and others to be more flexible and allow for the use of nature-based stormwater management techniques when considering their land management policies and design protocols.

16.3.1) RESIDENTIAL STORMWATER BMPS

In areas built prior to stormwater control requirements, the installation of stormwater BMPs (*e.g.*, pervious pavement, rain gardens, and rain barrels) could provide a significant reduction in stormwater runoff and pollutants. Homeowners can employ these techniques on their properties and help mitigate nonpoint source pollution in the watershed. For example, a rain barrel distribution program or event could provide residents with free or low-cost rain barrels to install at their homes. This program would be particularly relevant for residents living along the Lake Greenwood shoreline, or along rivers and streams that feed into Lake Greenwood. Additionally, lawn maintenance practices such as proper fertilizer/pesticide application and keeping grass length longer to reduce need for irrigation and chemical applications are recommended.

Examples of installed rain barrel (left) painted rain barrel (right).

16.3.2) STORMWATER BMP RETROFITS

In areas built prior to stormwater water quality requirements, or where existing stormwater infrastructure is not sufficient to capture and treat stormwater runoff, stormwater BMP retrofits could be installed to improve stormwater management and protect water quality. For example, on publicly owned parcels (*e.g.*, schools, libraries, and parks) there may be opportunities to install a variety of green infrastructure techniques such as pervious pavement, rain gardens, or rain barrels to slow and treat runoff. The installation of green infrastructure practices in public settings would provide excellent opportunities to teach residents about a variety of stormwater management techniques while also delivering important water quality benefits. Additionally, in older residential neighborhoods, disconnecting downspouts from impervious surfaces, rain harvesting, and rain gardens would help to slow down and capture stormwater runoff on site, thereby help reducing the potential for pollutant loading and stream channel incision.

Example of pervious pavement at the Upstate Forever office in Greenville, SC (above).

Examples of rain gardens in City of Greenville at Cleveland Park (left) and First Baptist Church (right). Source: Save Our Saluda.

16.4) STORMWATER BMP POTENTIAL FUNDING SOURCES

16.4.1) SECTION 319 FUNDING (SCDHEC)

This funding source is applicable to multiple restoration categories and was previously detailed under the Riparian Buffer repair/restoration funding sources list; see Section 12.4.5 of this document for description.

16.4.2) EPA FIVE STAR URBAN WATERS RESTORATION GRANTS

The Five Star Urban Waters Restoration Program seeks to restore local natural resources through community-based conservation activities. Projects must be focused on water quality and habitat improvements and can include wetland, forest, riparian and coastal habitat restoration, stormwater management, and educational outreach and stewardship. Grant awards range from $10,000 to $40,000, with $20,000 as the average grant awarded [72].

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Figure 25: Parcel Prioritization for Stormwater BMPs

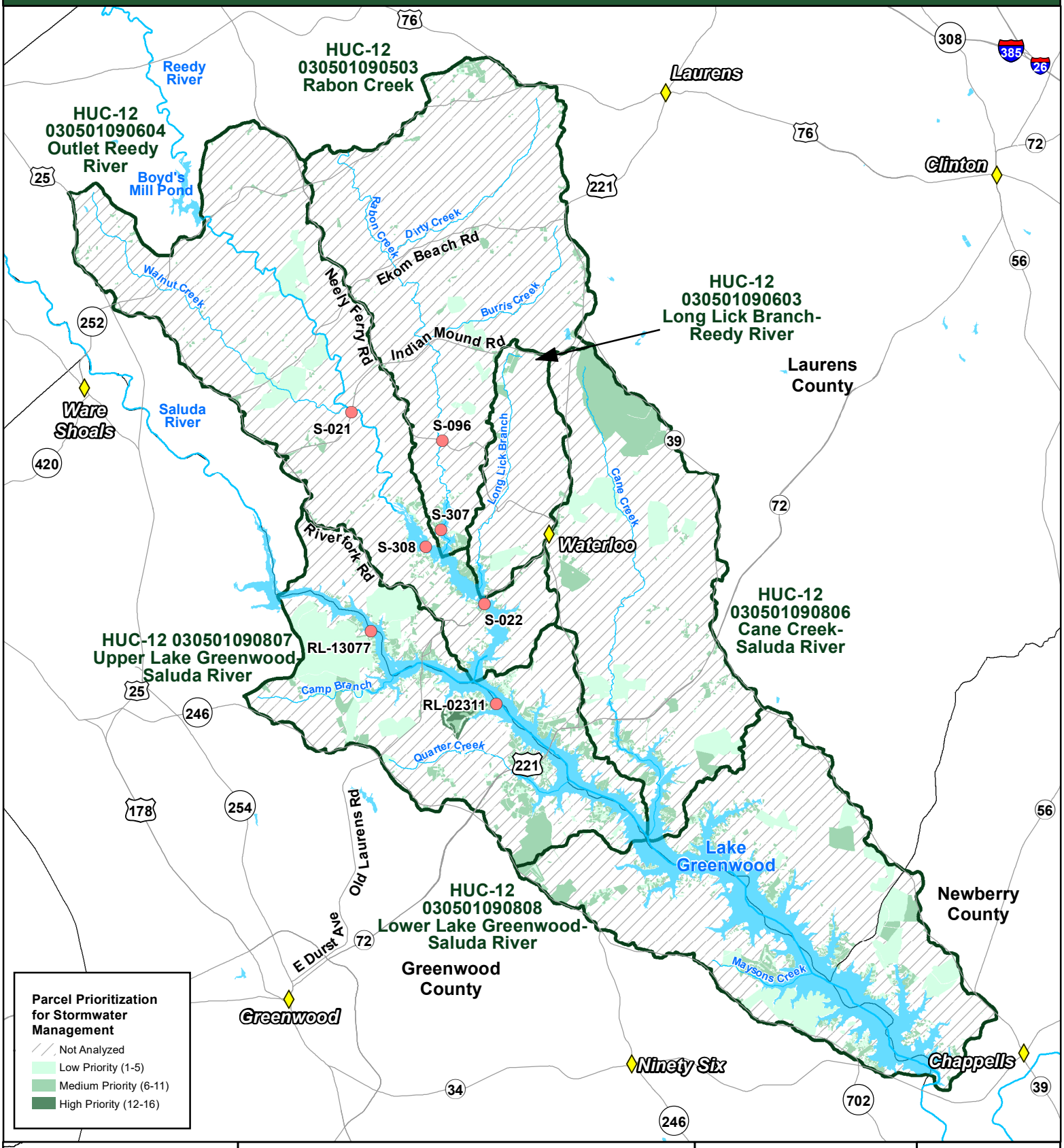

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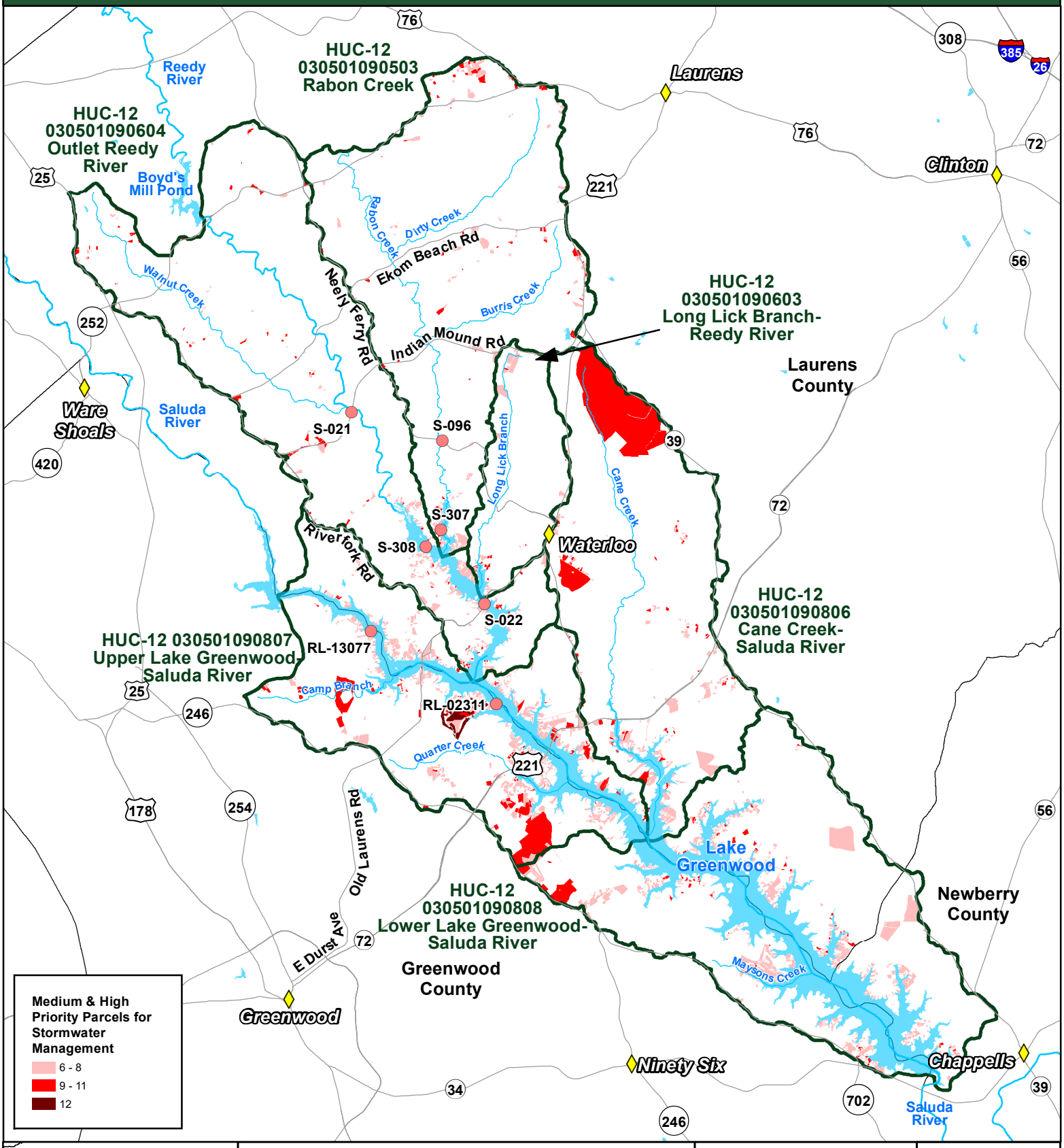
Figure 26: Medium and High Priority Parcels for Stormwater BMPs



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17) ANALYZING PARCELS FOR PET WASTE STATIONS

This analysis identifies parcels that may be suitable for the installation of a pet waste station to encourage proper disposal of pet waste and reduce bacteria loadings from pets. Domestic pet waste is a threat to human health and water quality when not properly disposed. Pet waste can contain harmful organisms such as bacteria, viruses, and parasites that are carried into nearby waterways during and after rain events. Based on the national averages for the number of dog-owning homes, number of dogs per dog-owning household, and the approximate amount of waste each dog can produce annually (274 pounds), there are an estimated 2,220 dogs in the focus area producing a total of 608,280 pounds of waste each year (Section 4.1).

17.1) PET WASTE STATION ANALYSIS CRITERIA

Table 44 is an overview of the specific criteria and possible points that were used to evaluate each parcel. The total score for each parcel was used to determine those of high (1-2 points) and low (0 points) priority for pet waste station installations (Figure 27). No medium priority range was included for this analysis as most parcels scoring in this category will receive 1 point at most. Refer to Appendix E for a detailed overview of the criteria and scoring.

TABLE 44. CRITERIA AND RANKING SYSTEM FOR PET WASTE STATIONS

Category	**Criteria**	**Points**	**Total Possible Points per Category**
High Traffic Commercial Pet Locations	Locations that are likely to have increased dog traffic	1	1
Parks	Existing Public Land	1	1
TOTAL POSSIBLE PET WASTE POINTS			**2**

17.2) PET WASTE STATION ANALYSIS RESULTS AND RECOMMENDATIONS

Pet waste stations are a cost-effective way to educate people about an important threat to water quality and encourage people to dispose of their pet waste properly. The visibility of this outreach message at popular public locations will educate the public about water quality and may lead to additional behavioral changes.

This analysis identified 24 parcels as high priority for pet waste station installation (Figure 27). These parcels include 22 parks/public access sites, one veterinary facility, and one pet groomer. Installing pet waste stations at public parks is the priority. Public outreach campaigns on proper pet waste disposal through pet related businesses and veterinary offices will also help to reduce bacterial loading in the focus area.

Example of a pet waste station and signage at parks in Greenwood, SC (above).

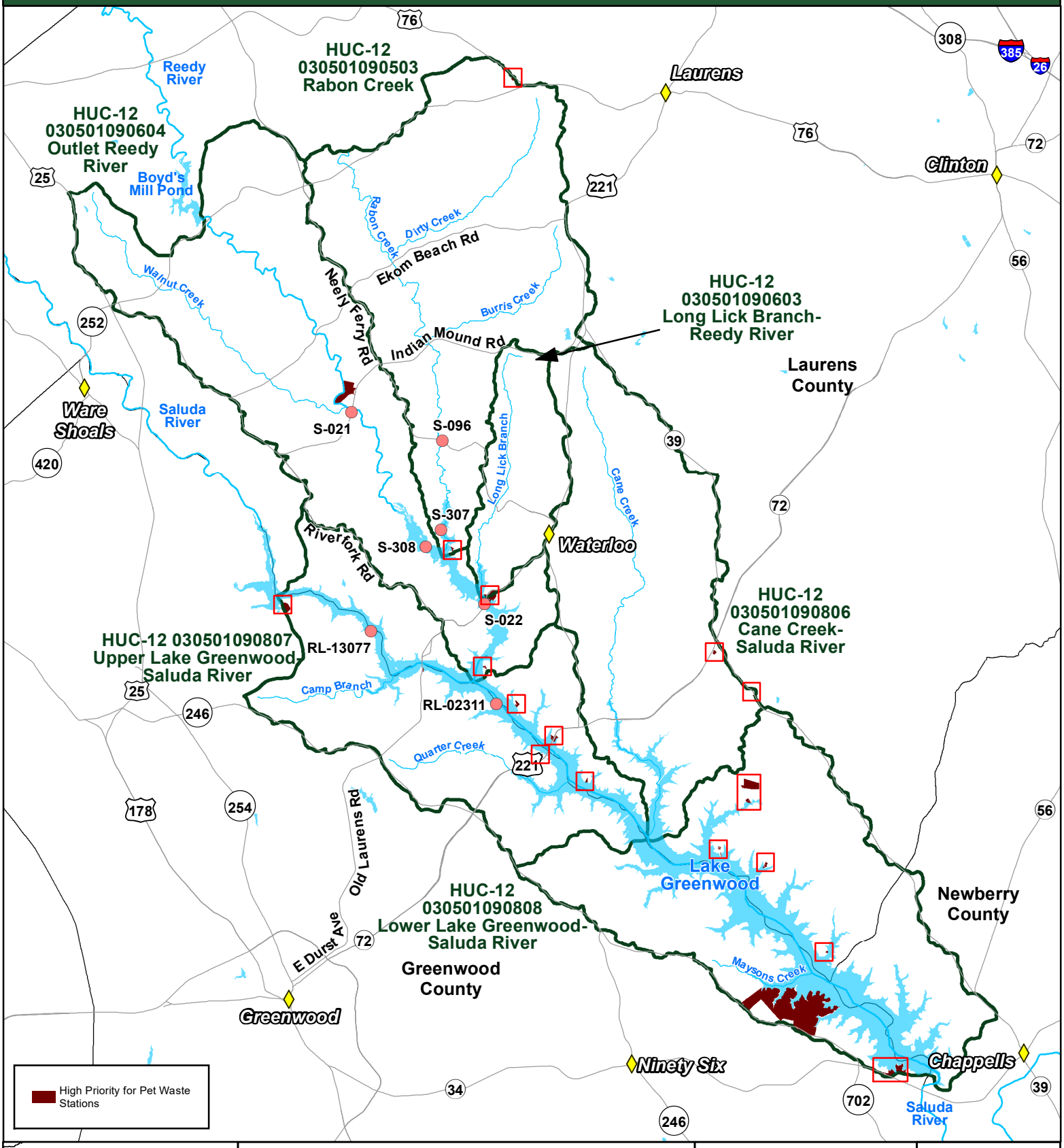
17.3) PET WASTE STATION UNIT COST ESTIMATES AND POTENTIAL FUNDING OPTIONS

Cost estimates for pet waste stations are based on information provided by Greenville County and Anderson Pickens County Stormwater Partners. Table 45 outlines funding options and cost estimates for pet waste BMPs.

TABLE 45. PET WASTE STATION UNIT COSTS AND POTENTIAL FUNDING SOURCES

Nonpoint Sources of Bacteria Pollution	**BMP**	**Estimated BMP Unit Cost**	**Potential Funding Sources**
Domestic Pets	Pet Waste Station	$225 each ($300 for installation with bags)	Greenwood County SWCD Laurens County SWCD Newberry County SWCD Clemson University Cooperative Extension (CU Ext.) Local Governments
	Pet Bags	$60/2,000	

Figure 27: High Priority Parcels for Pet Waste Stations



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18) ANALYZING PARCELS FOR WETLAND BMPS

This analysis identifies parcels containing impacted, low quality, or inundated wetlands that could provide additional water quality and quantity benefits if restored or enhanced to a higher quality wetland. Wetlands provide many natural ecosystem services such as water filtration, pollutant sinks, wildlife habitat, erosion control, and flood management [73]. Wetlands that have been impacted or inundated are likely no longer providing the myriad of important ecological and water quality benefits that are possible. Restoring impacted, low quality, and inundated wetlands is ecologically beneficial and can reduce the costs of water treatment, flood management, and pollution control by naturally providing those services.

18.1) WETLAND BMPS ANALYSIS CRITERIA

Table 46 is an overview of the specific criteria and possible points that were used to evaluate each parcel. The total score for each parcel was used to determine those that are of high (13-18 points), medium (7-12 points), and low (1-6 points) priority for wetland BMPs (Figure 28). These ranges were chosen based on the total available points and the highest scores parcels received. Refer to Appendix E for a detailed overview of the criteria and scoring.

TABLE 46. CRITERIA AND RANKING SYSTEM FOR WETLAND BMPS

Criteria	**Ranking**	**Points**	**Total Possible Points per Category**
Restorable Wetlands (prerequisite for further analysis)	Wetlands with special modifiers (excavated, spoil, artificial substrate, diked/impounded, managed, farmed, partially drained/ditched, beaver)	2	4
	Historic Wetlands	2	
Current Water Quality Impairments	Includes, Adjacent to, or Upstream of Existing Impairments	3	3
Current Pollutant Export (for each Nitrogen, Phosphorus, and Sediment)	High Range of Export	3	9 (3-point maximum for each pollutant)
	Medium Range of Export	2	
Water Impoundments and Dams	Low, Medium, and High Hazard Dams	2	2
TOTAL POSSIBLE WETLAND POINTS PER PARCEL			**18**

18.2) WETLAND BMP ANALYSIS RESULTS AND RECOMMENDATIONS

One hundred and fifty-four parcels scored within the high priority range for wetland BMPs. Five parcels received 15 points, which is the highest score received by all parcels analyzed (Figure 29). All high priority parcels are located at or north of Highway 221, with most high priority parcels located in the northern portion of the watersheds (north of the confluence of the Saluda and Reedy rivers). UF/SCRWA recommends focusing wetland restoration efforts in the northern portion of the watershed, specifically targeting wetlands that are immediately

adjacent to major creeks, streams, and rivers. Additionally, parcels with existing high-quality wetlands should be protected from degradation (Sections 10.2 and 10.3).

18.3) WETLAND BMP STRATEGIES AND FUNDING OPTIONS

While this analysis focuses on identifying wetlands that would benefit from restoration practices as detailed in below in Sections 18.3.1-18.3.4, the protection of high-quality existing wetlands (*e.g.,* conservation easements) is also recommended (Section 10).

18.3.1) WETLAND RESTORATION/ENHANCEMENT

Wetland restoration refers to the re-establishment or rehabilitation of the physical, chemical, or biological characteristics of a former or degraded wetland to improve natural function. Restoration can be regulatory or voluntary. Situations that may lead to regulatory wetland restoration or enhancement projects may be the result of federal, state, tribal or local laws that prohibit, condition, or compensate for permitted impacts to existing wetlands (wetland mitigation) [74].

18.3.2) WETLAND PROTECTION

Protecting high-quality existing wetlands helps to ensure that wetland degradation does not occur, and that natural ecosystem services (*e.g.,* erosion control, water treatment, flood management) are maintained. Land protection methods mentioned in Section 10.3, particularly conservation easements, are strategies to consider for parcels with high-quality wetlands.

18.3.3) WETLAND MITIGATION BANKING

Wetland mitigation banking is the enhancement, repair, or creation of wetlands for the purpose of compensating for unavoidable impacts at another location [75]. Typically, compensations for wetland impacts are from development, and although projects do not need to be in the same watershed, it is recommended to focus mitigation efforts upstream of the proposed impact.

18.3.4) PERMITEE-RESPONSIBLE MITIGATION

As defined by the Federal Mitigation Rule, permittee-responsible mitigation (PRM) refers to restoration, enhancement, and/or preservation of aquatic resource, which are completed by the permittee to satisfy compensatory mitigation requirements for which the permittee retains full responsibility. Identifying priority parcels with the potential for wetland restoration or enhancement allows for PRM projects, particularly when mitigation credits are not available from appropriate mitigation banks. In addition, because PRM projects can be located closer to the impacts and within the same subwatershed, they can provide more suitable benefits than mitigation banking or in-lieu fee programs.

Figure 28: Parcel Prioritization for Wetland Restoration/Enhancement

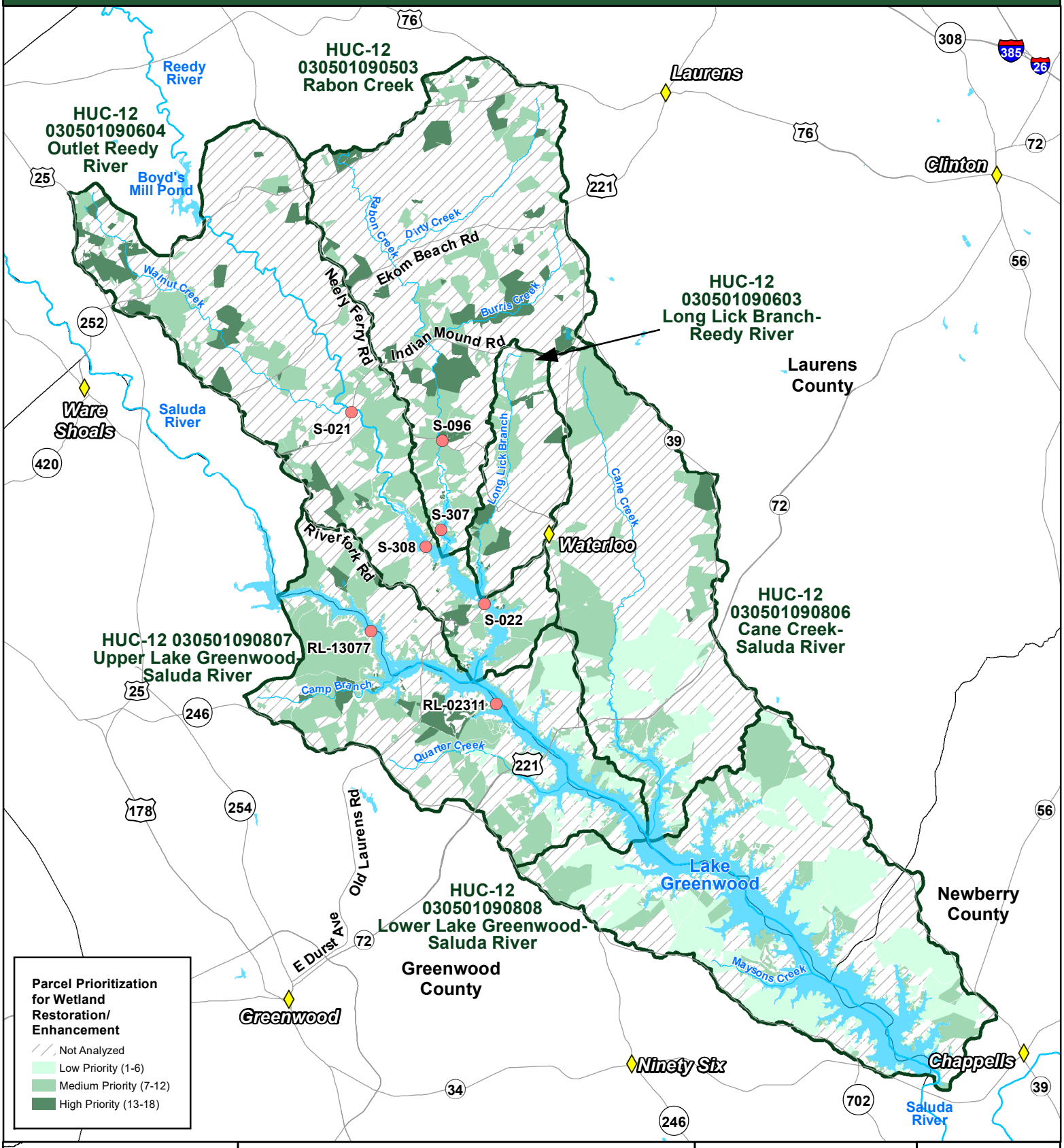

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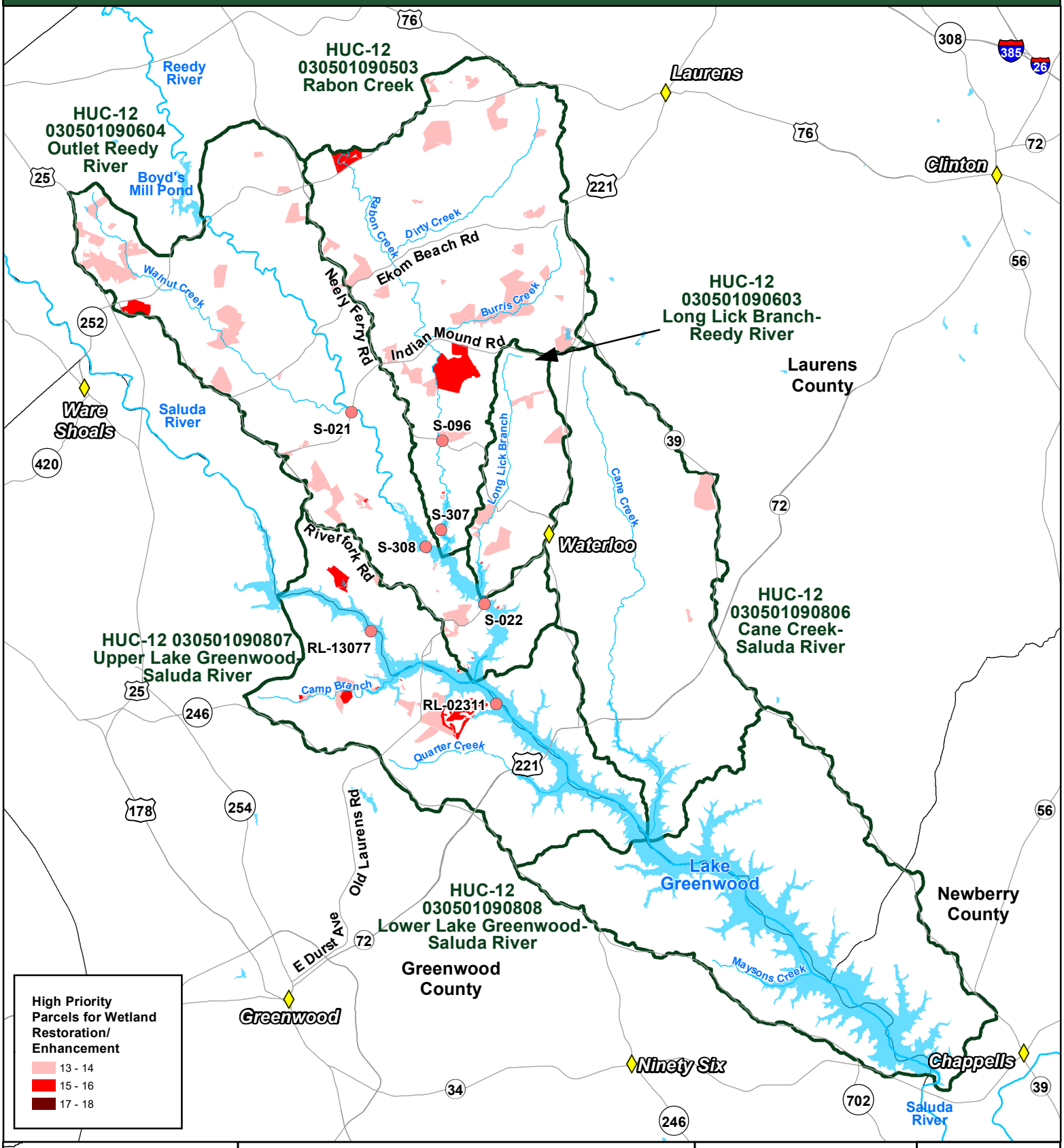
Figure 29: High Priority Parcels for Wetland Restoration/Enhancement



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19) WILDLIFE BMP STRATEGIES

Wildlife populations can contribute to elevated bacteria and sediment levels in the focus area. Tracking these pollutant levels and their corresponding wildlife sources can be difficult. Therefore, it is recommended the identification of wildlife populations that could be contributing to bacterial loads and target areas be included in this public outreach campaign. For example, educating landowners about the signs of wildlife activity, such as rooting damage by feral hogs, will help to identify where this activity is occurring. Once wildlife populations have been identified, the types and locations of BMPs can be prioritized accordingly. Based on SCDNR data, wildlife estimated to contribute to pollution within the focus area include waterfowl, wild hogs, deer, and beavers (Table 47) [76] [77].

19.1) WILDLIFE MANAGEMENT RECOMMENDATIONS

Many wildlife management strategies can help mitigate water quality pollutants from other sources, including promoting the establishment and maintenance of natural riparian buffers, especially at parks and along shorelines, as outlined in Sections 13 and 15. Working with local governments to advocate for more stringent riparian buffer requirements is a crucial step towards reducing pollutants from many sources, including wildlife. Also, it is recommended to conduct public outreach through local organizations (*e.g.*, Preserving Lake Greenwood, Connect Lake Greenwood) about how to discourage the congregation of wildlife populations near waterways. Waterfowl control along shorelines will be most relevant to the focus area.

19.2) WILDLIFE BMP STRATEGIES

There are a variety of BMPs that can be effective in reducing impacts from wildlife on water quality. In the case of the Lake Greenwood watersheds, it is recommended to utilize wildlife BMPs that focus on reducing erosion and the direct contribution of fecal matter into waterways (*e.g.*, riparian buffers, population management, and educational signage).

19.2.1) PUBLIC OUTREACH AND EDUCATION

Working with partners in the region to educate the public on the impacts of wildlife species on water quality through workshops, websites, social media, and print resources is an effective strategy for wildlife management. Print materials can be available for distribution in public locations (*e.g.*, library, local government offices). Topics include safe and proper methods to reduce or eliminate problem species, benefits of riparian buffers along waterways, discouraging wildlife congregation, and managing fecal contamination in waterways from wildlife.

19.2.2) RIPARIAN BUFFERS

Vegetated riparian barriers remove bacteria from runoff. Wild hogs tend to be attracted to heavily vegetated areas near streams, thus the effective management of riparian buffer areas are necessary to ensure that wildlife is not destructive to the buffers, thereby contributing to erosion. Buffers also discourage waterfowl (*e.g.*, Canada geese) from congregating. Creating a buffer strip with tall, thick vegetation will also deter waterfowl from congregating along shorelines as they typically prefer gently rolling slopes with short vegetation along the land/water interface [78]. Focusing on the high priority sites for riparian buffer repair/restoration and shoreline management identified in Section 13.2 and Section 15.2 is recommended.

Riparian buffer along the Reedy River in Cleveland Park, Greenville, SC (above).

19.2.3) TRAPPING

Trapping is a particularly effective management application in the control of wild hog populations. Trapped hogs must be tagged and permitted and then either eliminated or released. Box, swing, and corral traps are all effective tools used in trapping wild hogs. Traps can also be effective with beaver populations. Wildlife control operators perform wildlife control services on a contract-fee basis and can be hired by landowners who do not wish to directly handle wild animals. Relocating wild hogs is not permitted.

Examples of corral traps for wild hogs in Pickens County, SC (above).

19.2.4) HUNTING

Hunting is a common method used to control wildlife populations. Educating landowners and community members about hunting safety and training is a critical component. If wildlife populations become problematic SCDNR can issue out-of-season permits for species such as deer and wild hogs [31]. There is no closed season for hunting wild hogs on private land.

19.2.5) NO FEEDING WILDLIFE SIGNAGE

Feeding wildlife often contributes to increases in species congregating near waterways (*e.g.*, waterfowl) and can contribute to the increase of bacteria in waterways. One way to reduce wildlife populations in these areas is to discourage people from feeding wildlife, especially in public parks through signage and other outreach materials. The CU Ext. Carolina Clear program has information and signage residents can use to develop effective management strategies to deter Canada geese from settling along shorelines. Waterfowl can produce up to two pounds of waste per day. This waste contains 25 times the amount of fecal material as human waste [79]. As geese populations increase in watersheds so do bacteria levels in waterways, which can pose a threat to public health.

Example of Signage to Discourage Feeding Waterfowl Furman University (left) and Falls Park, Greenville, SC (right).

19.3) WILDLIFE BMP UNIT COST ESTIMATES AND FUNDING OPTIONS

Some wildlife BMPs are also mentioned as possible agricultural solutions and can be used to control both wildlife and livestock populations. Because of this, some of the funding sources for wildlife BMPs are also mentioned in the Agricultural BMP section (Section 12.3). BMP unit cost estimates are derived from Section 12.4 as well as estimates from NRCS. Table 47 provides an overview of wildlife BMP unit costs and possible funding sources.

TABLE 47. WILDLIFE BMP UNIT COSTS AND POTENTIAL FUNDING SOURCES

Nonpoint Sources of Bacteria Pollution	BMP	Estimated BMP Unit Cost	Potential Funding Sources
Waterfowl Wild Hogs Beavers Deer	Linear Streambank Fencing	$2.65/foot	EQIP AWEP CSP County Governments USFWS Section 319 Funds
	Filter Strips	$149.04/acre	
	Riparian Buffers	$404.71/acre	
	Box, Swing, and Corral Traps	$320-460 each	Private Landowners

19.3.1) USDA NRCS

There are several voluntary NRCS programs that help reduce bacteria loading by establishing riparian buffers, protecting wetlands, and conserving water resources. Examples include CSP and EQIP. See Section 12.4 for more information on each of these federal cost share programs.

19.3.2) ADDITIONAL WILDLIFE BMP FUNDING OPTIONS

For additional funding options that are applicable to multiple restoration categories refer to the sections listed below:

- EQIP (see Section 12.4.3)
- Section 319 Funding (see Section 12.4.5)
- CSP (see Section 12.4.1)

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20) SUMMARY OF BMP RECOMMENDATIONS

Table 48 presents a summary of the recommendations described in Sections 10-19 and provides a guide to where BMP implementation will best achieve pollutant load reductions and protection of high-quality lands.

TABLE 48. SUMMARY OF PARCEL PRIORITIZATION RECOMMENDATIONS

Parcel Prioritization Category	**Summary of Recommendations**
Land Protection	Target land protection efforts in the upper portion of the focus area, specifically along major feeder creeks/streams that drain into the Reedy River arm of Lake Greenwood. Additionally, larger tracts of land that are considered working forests or agricultural in nature should be prioritized for land protection.
Agricultural BMPs	Target outreach efforts in the northern portion of the focus area first, specifically targeting landowners along Walnut Creek and at the headwaters of Long Lick Branch, Burris Creek, and Dirty Creek for agricultural BMP installations.
Septic Repairs/Replacements	Priority 1 – Properties immediately surrounding Lake Greenwood, especially on the Laurens County side of the Lake Priority 2 – Properties north of the confluence of the Saluda and Reedy rivers Priority 3 – Properties that drain to Lake Greenwood, especially north of Highway 221
Riparian Buffer BMPs	Ensure compliance with the Lake Greenwood Shoreline Management Plan. Encourage riparian buffers/no-mow zones up to the 440-contour line. Work with local government on riparian buffer ordinances, which should include: • Buffer boundaries to be clearly marked on local planning maps; • Language that restricts disturbance of vegetation and soil; • Tables that illustrate buffer width adjustment by slope and type of waterway; and • Direction on allowable uses and public education.
Forest Management	Targeted outreach efforts primarily north of the confluence of the Saluda and Reedy rivers and working with SCFC to communicate with forest managers to encourage the utilization of SCFC courtesy exams and suite of BMPs strategies and design.
Shoreline Management	UF/SCRWA recommends lakefront property owners maintain natural riparian buffers at minimum to the 440-contour line, comply with the Lake Greenwood Shoreline Management Plan, and keep boat docks free from contaminants.
Stormwater BMPs	Partner with local organizations to support stormwater education and outreach initiatives such as a rain barrel giveaway or sale. Consider the installation of a stormwater demonstration project at a highly visible public location (*e.g.*, public park, boat launch, community center, large neighborhood)
Wetland Restoration/ Enhancement	All 5 of the high priority parcels are located at or north of Highway 221. Focus efforts in the northern portion of the watershed, specifically targeting wetlands that are immediately adjacent to major creeks/streams/rivers.
Pet Waste Stations	Install pet waste stations at identified public parks/areas. Consider a public outreach campaign on proper pet waste disposal through veterinary offices or pet-related businesses such as groomers or supply stores.
Wildlife BMPs	For the Lake Greenwood watersheds, it is recommended to utilize wildlife BMPs that focus on reducing erosion and the direct contribution of fecal matter into waterways (*e.g.*, riparian buffers, population management, and educational signage).

21) CLIMATE CHANGE ADAPTATIONS

As the threat of climate change continues to increase, it is of utmost importance to address the potential and actual impacts that it may have on water resources. This WBP accounts for climate change adaptations in each of the planned BMPs. Specifically, these BMPs will address more frequent and intense rain events and flooding, tropical storm events, higher stream flows, increased rates of erosion, more frequent and larger wildfires, as well as the potential increase in pathogens, nutrients, and dissolved oxygen that come from a rise in temperature and in-watershed disturbances.

21.1) RIPARIAN BUFFERS

Riparian buffers and wetlands serve a variety of purposes in restoration and conservation, including many advantages that combat against the effects that climate change has on water quality. Forested/vegetated riparian buffers and wetlands can help to prevent excess erosion, filter nutrients, and mitigate stormwater flow. The shoreline management analysis in this WBP outlines the importance of maintaining and creating riparian buffer areas throughout the focus area. Riparian buffer restorations in the Lake Greenwood watersheds are estimated to reduce nearly 50 pounds of nutrients from entering the watershed each year, partially accounting for the increased nutrient load due to climate change. Wetland restoration and prioritization of wetlands is vital not only for immediate environmental concerns, but also for climate change mitigation, as they are crucial for water retention, storm buffers, and carbon storage. Wetlands can store excess floodwater during a storm and then slowly release it back into the system while simultaneously purifying it, leading to less pollution and reduced impacts of stormwater runoff on the watershed.

21.2) LAND PROTECTION

Land protection is an effective natural solution that can be used to mitigate the impacts of climate change on local communities. Forests and undeveloped lands absorb greenhouse gases, preventing them from releasing into the atmosphere. In fact, it is estimated that forests, prairies, farmlands, and other natural areas absorb roughly 15% of carbon dioxide emissions generated from the US [80]. Land protection also has the potential to prevent the release of greenhouse gases by avoiding various land development activities such as deforestation and the conversion of natural and agricultural lands into sprawling residential/commercial areas. What is more, these protected lands can reduce the impacts of flooding in neighborhoods by serving as buffers in vulnerable areas (e.g., wetlands, floodplains, coastal areas). Per the criteria established in this WBP, a minimum of 55 acres of land is required to be considered eligible for a conservation easement. Land management strategies also play a key role in our efforts to mitigate climate change. For example, the preservation and proper management of forests in the watershed contributes to the capture and storage of carbon within the forest biomass. Forest management techniques, such as the ones outlined in this WBP, are crucial to climate change adaptation because they focus on the priority forested lands in the watershed and managing them according to SCFC BMPs.

21.3) AGRICULTURAL BMPS

Agricultural practices contribute to climate change through the release of excess nutrients into waterways. The agricultural BMP bundle outlined in this WBP will inadvertently address these issues using a variety of different techniques. Farmers can utilize riparian buffers, livestock exclusion fencing, and armored streambank crossings to reduce the inflow of nutrients into the watershed and decrease the rate of erosion in agricultural areas. These steps help reduce the impact of more intense weather events and flooding on the watershed. By addressing agricultural issues within the watershed, the presence of harmful algal blooms will decrease due to the reduction of excess nutrients being released into the watershed.

21.4) URBAN RETROFITS

This WBP focuses on installing urban retrofits that will work to combat the historical issues that affect water quality, as well as address climate change impacts resulting from an increase of stormwater flow and erosion due to more intense weather events in the Lake Greenwood watersheds. Much of the watershed lacks green infrastructure to address these issues, therefore this WBP outlines several BMPs that will work to mitigate the current water quality impairments and help limit the appearance of future impairments. These include rain barrels, pervious pavements, and rain gardens that store and treat runoff. These BMPs will provide additional educational benefits to the residents in the watershed, showing them the importance of green infrastructure for the improvement of local water quality. To address historical water quality issues, this WBP recommends disconnecting downspouts from impervious surfaces, rain harvesting, and rain gardens that will slow and capture stormwater runoff in the residential areas of the watershed. Combined, these BMPs will reduce increased pollutant loading, sedimentation, and erosion that results from climate change.

22) PROJECT IMPLEMENTATION AND MILESTONES

It is recommended to implement this WBP in 36-month phases. This approach will help achieve incremental improvements in water quality. Following the guidelines and process outlined in the SCDHEC Section 319 Nonpoint Source Implementation Grant process, each implementation phase should be 36 months (three years) in length. In Section 5.2, it was determined that an incremental bacterial reduction for each 36-month implementation phase is most achievable. In Section 8 (Table 32), the recommended BMPs for each 36-month phase would cost a little over $100,000 in federal cost-share funding. Section 22.1 specifies the recommended implementation timeline and milestones that will help to achieve the implementation goals detailed throughout this WBP.

22.1) IMPLEMENTATION MILESTONES

Implementing BMPs depends on landowner participation and available funding sources. Predicting landowner preferences and participation levels is difficult. Therefore, it is suggested to evaluate the WBP implementation successes throughout each phase and adjust goals and expectations accordingly to ensure reduction goals are being met. For example, adjustments to the Public Outreach and Education Strategy may be needed if participation is lower than expected. Regular BMP evaluation is important. Specifically, it is critical to note issues before, during, or after construction which will help streamline the process for future participants. Table 49 suggests milestones for the BMP implementation, public outreach, and ways to ensure each phase meets recommended reduction goals.

TABLE 49. BMP IMPLEMENTATION AND MILESTONES

Action Items for each 36-Month Phase			Year		
			1	2	3
Required BMPs to meet load reductions	Land Protection	Send out targeted mailings to priority landowners, targeting forested lands first	x	x	
		Protect (at minimum) 55+ acres of land through 1+ Conservation Easements or other land protection strategies		x	x
	Septic BMPs	Send out targeted mailings to priority landowners and septic contractors	x	x	
		Circulate information about available funding and program details through attending/conducting meetings, social media, public displays, etc.		x	
		Facilitate 25 septic system repairs/replacements and/or tie-ins to sewer infrastructure		x	x
	Agricultural BMPs	Send out targeted mailings to priority landowners	x	x	
		Circulate information about available funding and program details through attending/conducting meetings, social media, public displays, etc.		x	
		Facilitate 2 agricultural BMP projects		x	x
	Riparian Buffers	Work with local governments on strengthening riparian buffer ordinances	x	x	x
		Complete 2 riparian buffer enhancement projects, targeting lakeside landowners and forested lands		x	x
	Pet Waste Stations	Install 1 pet waste station at a park or frequently accessed location within the watershed			x
Supplemental BMPs (as funding and resources allow)	Forestry BMPs	Encourage foresters to coordinate with the South Carolina Forestry Commission to utilize the SCFC courtesy exams and suite of BMP strategies and design	x	x	x
	Shoreline Management	Work with Greenwood County Lake Management to send our targeted mailings educating landowners about the benefits of riparian buffers, recommended no-mow zones, and protection of critical habitat areas.	x	x	x
	Stormwater	Coordinate education and outreach efforts in partnership with local organizations about residential stormwater BMPs such as rain barrels and rain gardens.		x	x
		Assist in the coordination of a rain barrel sale or giveaway.			x
	Wetland	Encourage wetland mitigation efforts on high priority lands for wetland restoration/enhancement.		x	x
	Wildlife	Education and outreach to landowners regarding wildlife and ways to discourage congregation near waterbodies, specifically focusing on riparian buffers and educational signage.	x	x	x

22.2) TRACKING BMP SUCCESS

To ensure the longevity and success of BMP projects, tracking their success, and ensuring landowners have access to BMP maintenance materials will be important. In addition to water quality monitoring (Section 3.7), post-BMP materials could be distributed to landowners including a survey, fact sheets about BMP maintenance, and a thank you letter for participating in the program. Asking landowners to complete a survey would help determine how to improve the cost-share program. The distribution of BMP maintenance fact sheets to participating landowners will help to ensure the BMP is properly maintained. Materials to consider sending to landowners in a post-BMP packet include:

- SCDHEC Septic Maintenance Record Sheet
- Link to CU Ext. website "Be Septic Safe" and relevant materials
- Coordinating with local NRCS offices and Conservation Districts to provide information on maintenance of agricultural BMPs
- Coordinating with SCFC to provide information on forestry BMP maintenance

Examples of questions to include on the post-BMP participation survey include:

- How did you hear about this grant program?
- What types of projects did you install on your property?
- How would you rate the grant application process?
- What aspect, if any, of the grant process did you find most difficult?
- How long did the grant process take from start to finish?
- How likely would you be to recommend this grant program to others?
- Did this grant program increase your awareness of water quality issues in your community?
- Do you have any questions or comments to help us improve this grant program?
- Would you be willing to provide a testimonial about your experience?

23) PUBLIC OUTREACH AND EDUCATION STRATEGY

The goal of this WBP is to reach a diverse audience that includes residents, forestry companies, and landowners. It is recommended to use a multi-pronged approach to our education and outreach strategy.

23.1) OUTREACH TO LANDOWNERS AND GENERAL PUBLIC

It is recommended that education and outreach to the landowners in the focus area about water quality concerns takes place through a combination of distributed educational materials and direct contact and outreach. These strategies are further detailed for each BMP category in Section 23.2.

23.1.1) EDUCATIONAL MATERIALS

Recommended distribution methods for educational materials include direct mailings, social media postings, and regular communications with community partners (*i.e.*, drinking water and wastewater utilities). These efforts could include any or all the following: informational postcards/circulars distributed to homeowners and businesses via HOA volunteers, mail, etc.; educational posts on HOA and partner websites/social media platforms; and/or bill inserts by partner utilities.

23.1.2) TARGETED OUTREACH

Targeted outreach to landowners within the focus area could take the form of direct mailings, phone calls, online surveys targeted to specific community groups, and public informational meetings on BMP topics relevant to local landowners. In addition to working with committed community partners, collaborating with local and state resources to expand outreach capacity is highly recommended. For example, direct mailings to homeowners with older homes, especially adjacent to drinking water sources, distributing information about proper septic tank maintenance, could help homeowners identify septic tank failures or leaks.

23.1.3) OUTREACH TO FORESTRY COMPANIES AND LANDOWNERS

Comparable to the phone calls made to forestry and timber companies during data collection, an outreach strategy to foresters and landowners could include phone calls to local SCFC staff foresters and local timber management companies asking them to either connect us or to act as liaison on our behalf to landowners in the WBP area. This outreach has the potential to accomplish the following:

1. Distribute educational materials targeted to landowners (*e.g.,* fliers, informational documents on cost-share programs, success stories, etc.).
2. Distribute a landowner survey, as described below, to be conducted prior to BMP installation to gauge landowner interest and participation in the project.
3. Have landowners interested in participating contact UF to set up BMP implementation. Create a prioritized list of landowners to contact based on results from our GIS parcel prioritization, with highest priority parcels for each BMP to be contacted first, followed by lower priority parcels.

23.2) PUBLIC OUTREACH STRATEGY PER BMP

23.2.1) LAND PROTECTION

TARGET AUDIENCES

- Landowners/Homeowners
- SC Cattlemen's Association
- Carolina Farm Stewardship Association

MESSAGES

- Voluntary conservation easements can protect the land you love while you continue to own and manage it for traditional uses; you may also realize significant tax benefits.
- Conservation agreements typically prevent land uses such as residential subdivisions, commercial or industrial operations, and mining, while allowing for traditional rural land uses, such as farming, grazing, hunting, and timbering to continue.

METHODS OF OUTREACH

- Send letters to high priority landowners with information about conservation easements.
- Provide information on conservation easements for inclusion in local organization websites and newsletters.
- Host public outreach meetings with UF Land Conservation staff targeting landowners with large tracts of land, working farms, etc.

POTENTIAL PROJECT PARTNERS

- Clemson Extension (CU Ext.)
- Connect Lake Greenwood (CLG)
- Greenwood County Conservation District (GCCD)
- Laurens County Conservation District (LCCD)
- Save Our Saluda (SOS)
- SC Farm Bureau (SCFB)
- SC Forestry Commission (SCFC)
- South Carolina Forestry Association (SCFA)
- USDA Natural Resource Conservation Service (NRCS)
- SC Cattlemen's Association
- SC Department of Natural Resources (SCDNR)
- SC Rural Water Association (SCRWA)
- Upper Savannah Land Trust (USLT)
- Upstate Forever (UF)

23.2.2) SEPTIC SYSTEM REPAIR/REPLACEMENT

TARGET AUDIENCES

- Homeowners
- Homeowner Associations (HOAs)
- Certified Septic System Contractors
- Local Wastewater Providers
- Municipal Staff

MESSAGES

- Septic systems can pollute waterways and pose a threat to human health. Damaged or failing septic systems may expose residents to harmful bacteria and viruses by causing sewage backups into a home or contaminating drinking water sources.
- Faulty septic systems can cause untreated wastewater to rise to the surface of leach fields and drain into nearby waterways, polluting surface waters.
- Septic systems should be inspected and serviced every three - five years to ensure proper functioning.

METHODS OF OUTREACH

- Send targeted mailing to homeowners
- Information displays and/or brochures posted at public libraries, local government offices (town, city, county), conservation districts, CU Ext., utility offices, and public recreational facilities
- Utility bill stuffers
- Local newsletters
- Social media platforms and websites of local organizations

POTENTIAL PROJECT PARTNERS

- CLG
- CU Ext.
- Greenwood CPW
- FORR
- Greenwood County
- GCCD
- LCWSC
- LCCD
- Laurens County
- Newberry County
- PLG
- SCRWA
- SOS
- UF

23.2.3) AGRICULTURAL BMPS

TARGET AUDIENCES

- Landowners
- Agricultural Operators/Livestock Owners
- Farm Bureaus
- SC Cattlemen's Association
- Carolina Farm Stewardship Association

MESSAGES

- It is important to keep animals out of waterways because it improves herd health while also protecting water quality.
- Riparian buffers are effective at reducing the amount of soil, bacteria, sediments, and nutrients from entering streams and keeping animals out of waterways.
- Proper use of fertilizers and pesticides is important to protect water quality (in appropriate amounts and not before or during rain events).
- Livestock can contribute to the sedimentation of waterways by trampling streambanks with their hooves.

METHODS OF OUTREACH

- Mail letters to landowners
- Informational displays and/or brochures about proper agricultural practices at city and town halls, county government offices, utilities, NRCS and Conservation District offices.
- Provide information on BMP cost share programs for inclusion in local Conservation Districts and SC Cattlemen's Association webpages, and newsletters.

POTENTIAL PROJECT PARTNERS

- CU Ext.
- GCCD
- Greenwood County
- Laurens County
- LCCD
- Newberry County
- NRCS
- SOS
- UF
- USLT

23.2.4) RIPARIAN BUFFER AND WETLAND BMPS

TARGET AUDIENCES

- Homeowners
- HOAs
- Municipal/County Staff
- Mitigation Projects

MESSAGES

- Plant native vegetation along creeks/streams to prevent erosion.
- Buffers are one of the most cost-effective ways to protect water quality.
- Conserve existing forested riparian buffers.

METHODS OF OUTREACH

- Utility bill stuffers
- Informational brochures and posters at local public offices.
- Host public tree or native plant giveaways for homeowners.
- Establish support for county-wide post construction riparian buffer ordinances.
- Outreach to logging/timber companies to consider additional BMP practices.

POTENTIAL PROJECT PARTNERS

- CLG
- CU Ext.
- Greenwood CPW
- FORR
- GCCD
- Greenwood County
- Laurens County
- Newberry County
- LCWSC
- LCCD
- PLG
- SOS
- SCRWA
- Trees Upstate
- UF
- USLT

23.2.5) FOREST MANAGEMENT

TARGET AUDIENCES

- Landowners
- Foresters
- Loggers/Timber Buyers

MESSAGES

- Improper forestry practices degrade water quality.
- Avoid any forestry activities in streamside management zones.
- Harvesting operations should be planned and executed with the goal to protect the site.
- Roads should be constructed in a manner to prevent stream crossings and steep slopes to the best extent possible and stabilized after harvest activities are complete.
- Sites should be prepped and restored to prevent erosion.

METHODS OF OUTREACH

- Provide information to landowners with forestry operations.
- Put informational brochures at local public offices.
- Send letters to private and public forest landowners with information about SCFC classes and informational resources.

POTENTIAL PROJECT PARTNERS

- CU Ext.
- Greenwood County
- Laurens County
- Newberry County
- SCFC
- South Carolina Forestry Association (SCFA)
- SCRWA
- Trees Upstate
- UF
- USLT

23.2.6) SHORELINE MANAGEMENT

TARGET AUDIENCES

- Homeowners
- HOAs
- Water Utilities
- Reservoir Operators

MESSAGES

- Plant native plants along shorelines to prevent erosion.
- Avoid mowing lawns to the edge of waterways to reduce runoff.
- Promote the establishment of no fertilizer or pesticide zones along shorelines on rivers, streams, and lakes.
- Avoid removing or trimming vegetation along shorelines without seeking proper guidelines and permits.
- Obtain proper permits and abide by permit requirements when working within shoreline management area.

METHODS OF OUTREACH

- Utility bill stuffers
- Informational brochures and posters at local public offices
- Host trainings and workshops on shoreline management for homeowners
- Local newsletters
- Social media platforms and websites of local organizations

POTENTIAL PROJECT PARTNERS

- CLG
- FORR
- Greenwood CPW
- Greenwood County
- Laurens County
- LCWSC
- LCCD
- PLG
- SOS
- SCRWA
- UF

23.2.7) STORMWATER BMPS

TARGET AUDIENCES

- Homeowners
- HOAs
- Schools
- Local Community Groups (*e.g.*, YMCAs)
- Local Governments
- Home Builder Associations
- Engineers

MESSAGES

- Routinely sweep sidewalks and driveways.

- Use weed-free mulch when reseeding bare spots on lawns and erosion control blankets if restarting or tilling a lawn.
- Notify local government officials when seeing sediment entering streets or streams from construction sites.
- Riparian buffers protect streams by reducing erosion and prevent pollutants from entering streams.
- Set mowing height to remove only 1/3 of grass length to reduce need for irrigation and fertilizers.
- Get soils tested to help determine the proper amount of fertilizer needed for lawns.
- Create no mow zone of at least 10 feet from the edge of a stream or creek.
- Wash your car at a commercial car wash or on a surface that absorbs water, such as grass or gravel.
- Do not dump waste down storm drains because water flowing into storm sewers usually drains directly into local waterways without treatment.
- Contractors should install sediment control devices according to specifications.
- Contractors should abide by local and state stormwater regulations.
- Large tracts of cleared lands should be stabilized as soon as possible to prevent erosion.

METHODS OF OUTREACH

- Do PSAs about stormwater runoff and water quality on local radio and television stations.
- Maintain a presence at local festivals.
- Help promote watershed education in public school systems.
- Promote online educations resources related to water quality (CU Ext. Carolina Clear Program, city and county websites, and local Soil and Water Conservation Districts (SWCDs)
- Informational brochures and posters at local public offices (*e.g.*, CU Ext., NRCS, SWCDs)
- Local newsletters
- Social media platforms and websites of local organizations

POTENTIAL PROJECT PARTNERS

- CU Ext.
- CLG
- FORR
- Greenwood CPW
- Municipal and County Staff (Public Works, Parks, Stormwater Depts.)
- LCWSC
- LCCD
- PLG
- SOS
- SCRWA
- UF

23.2.8) PET WASTE

TARGET AUDIENCES

- Homeowners
- HOAs
- Apartment Complexes
- Veterinary Offices
- Animal Shelters
- Animal Groomers

MESSAGES

- It is important to dispose of pet waste properly! The incorrect disposal of pet waste is a major threat to water quality and human health because pet waste contains elevated levels of bacteria, parasites, and viruses.
- Pet waste also contains nutrients and can contribute to algae growth in waterways.

- Pet waste washed into lakes or streams can decrease dissolved oxygen and release ammonia, which can cause fish kills.

METHODS OF OUTREACH

- Pet waste station and signage installations
- Informational posters at veterinary offices, groomers, kennels, animal shelters, libraries, city halls, and local schools.
- Provide dog waste bag holders to veterinary offices, groomers, kennels, and animal shelters.
- Advocate for the adoption of pet waste ordinances in local municipalities and counties

POTENTIAL PROJECT PARTNERS

- CLG
- CU Ext.
- FORR
- Greenwood County Lake Management Dept.
- Greenwood/Laurens/Newberry County Parks Depts.
- PLG
- SOS
- UF

23.2.9) WILDLIFE BMPS

TARGET AUDIENCES

- Homeowners
- HOAs
- Apartment Complexes
- Landowners
- Municipal Staff
- Hunt Clubs
- Sporting Goods Stores

MESSAGES

- Animal waste from wildlife contributes to bacteria pollution in rivers, lakes, and streams.
- Discourage wildlife species from congregating in areas near impaired waters by planting riparian vegetation and posting not feeding signage.

METHODS OF OUTREACH

- Host workshops on methods for controlling Canada geese, beaver, deer, and feral hog populations.
- Promote signage in public areas with message “Don’t Feed the Geese”.
- Create informational flyers on wildlife for displays in public places.

POTENTIAL PROJECT PARTNERS

- CLG
- CU Ext.
- Greenwood/Laurens/Newberry County Parks Depts.
- LCCD
- NRCS
- PLG
- SCDNR
- USLT

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[92] United States Environmental Protection Agency (US EPA), "Wetland Functions and Values, Watershed Academy Web," 2020.

[93] Natural Capital Project, "InVEST," 2017.

APPENDIX A. STEPL INPUT DATA SERVER DOWNLOAD

The data in the following table was downloaded directly from the STEPL Input Data Server [26] for the six HUC-12 watersheds of the focus area.

	Watershed Name	*Outlet Reedy River*	*Long Lick Branch-Reedy River*	*Cane Creek-Saluda River*	*Upper Lake Greenwood-Saluda River*	*Lower Lake Greenwood-Saluda River*	*Rabon Creek*
	HUC12	*30501090604*	*30501090603*	*30501090806*	*30501090807*	*30501090808*	*30501090503*
Land Cover	**Urban**	1981.97	410.54	2124.09	3309.9	2964.74	1583
	Cropland	39.14	0.89	35.58	24.46	48.04	33.14
	Pastureland	7594.78	1142.89	3654.83	3423.76	3746.23	6118.96
	Forest	16685.14	3996.2	14252.6	10929.37	14350.23	17314.3
	Water	1008.56	82.51	618.26	2981.42	5456.23	309.8
Animals	**Beef Cattle**	874	132	421	213	393	704
	Dairy Cattle	40	6	19	6	48	32
	Swine	9	1	4	3	3	7
	Sheep	25	4	12	12	16	20
	Horse	91	14	44	54	49	73
	Chicken	2	0	1	1	3467	2
	Turkey	76416	11499	36773	11032	39473	61567
	Duck	10	2	5	3	3	8
Septic	**Septic Systems**	391	88	547	751	623	260
	Population per Septic System	2	2	2	2	2	2
	% Septic Failure Rate	0.27	0.27	0.27	0.27	0.27	0.27
Soil	**Hydrological Soil Group**	C	C	C	C	C	B

APPENDIX B. STANDARD NUMBERS FROM SCDHEC

The information in this Appendix is provided by SCDHEC (12/11/2015)

STANDARD NUMBERS FOR POLLUTANT LOADING FROM ANIMALS

ESTIMATED POLLUTANT LOADS FROM FAULTY SEPTIC SYSTEMS

- Bacteria: 2.76 x10E+6/hr*24*365=2.4176 E+10 per household
- Nitrogen: 31.1lb/yr *(load from one septic tank, per the StepL septic input page)*
- Phosphorus: 12.2 lb/yr

ESTIMATED POLLUTANT LOADS FROM CATTLE

These numbers assume direct input to stream(s) from cattle with stream access, and year-round spring deposition rate (*reference 5)*

- Bacteria 5.4 x E+8 bacteria/day/cow * 365=1.97 x E+11/yr/cow *(reference 5)*
- Phosphorus: 0.004lbs/day/cow * 365=0.73 lbs/yr/cow
- Nitrogen: 0.005lbs/day/cow * 365= 1.83 lbs/yr/cow *(reference 5)*

ESTIMATED POLLUTANT LOADS FROM DOGS

- 4.09 xE09 bacteria/day

ESTIMATED FECAL COLONIES

These numbers are in lbs/animal/day (*reference 4)*

- Chicken (layers): 1.36 x 10E+8
- Turkey: 9.3 x 10E+7
- Hogs: 1.08 x 10E+10
- Horse: 4.20 x 10E+8

LIVESTOCK EQUIVALENTS

These numbers compare mass of waste produced per day, in PBCE (pasture beef cow equivalents)

- Beef Cow: 1
- Dairy Cow: 2.6
- Horse: 1.1
- Hog: 0.24
- Sheep: 0.04
- Goat: 0.04
- Camel: 0.5
- Llama: 0.5
- Dog: 0.01

ANNUAL FC BACTERIAL LOADING FOR LIVESTOCK ANIMALS

The table below shows the amount of FC bacteria available for deposit on the watershed per individual animal per year (100 % does **not** wash off). (*Reference 10)*

Livestock	CFU/year	Reference
Cow	1.97×10^{12}	Metcalf and Eddy, 1991
Horse	1.53×10^{11}	ASAE, 1998
Hog	3.63×10^{12}	Metcalf and Eddy, 1991; ASAE 1998
Sheep	1.10×10^{13}	Metcalf and Eddy, 1991; ASAE 1998
Hen	4.61×10^{10}	Calculated from fecal waste of chicken (CFU/year) multiplied by hen: chicken mass ratio
Goat	1.10×10^{13}	(Assumed same as sheep)
Chicken	1.39×10^{11}	Metcalf and Eddy, 1991; ASAE 1998

STANDARD NUMBERS FOR POLLUTANT LOADING FROM LAND USE

ANNUAL POLLUTANT LOADS BY LAND USE

Annual pollutant loads by land use (kg/ha-yr) are listed in the table below *(reference 11).*

Land Use		TSS	TP	TN	Pb	In	Cu	FC
Road	Minimum	281	0.59	1.3	0.49	0.18	0.03	7.10 E+07
	Maximum	723	1.5	3.5	1.1	0.45	0.09	2.80 E+08
	Median	502	1.1	2.4	0.78	0.31	0.06	1.80 E+08
Commercial	Minimum	242	0.69	1.6	1.6	1.7	1.1	1.70 E+09
	Maximum	1,369	0.91	8.8	4.7	4.9	3.2	9.50 E+09
	Median	805	0.8	5.2	3.1	3.3	2.1	5.60 E+09
Single Fam Residential Low density	Minimum	60	0.46	3.3	0.03	0.07	0.09	2.80 E+09
	Maximum	340	0.64	4.7	0.09	0.2	0.27	1.60 E+10
	Median	200	0.55	4	0.06	0.13	0.18	9.30 E+09
Single Fam Residential High Density	Minimum	97	0.54	4	0.05	0.11	0.15	4.50 E+09
	Maximum	547	0.76	5.6	0.15	0.33.	0.45	2.60 E+10
	Median	322	0.65	5.8	0.1	0.22	0.3	1.50 E+10
Multi Fam Residential	Minimum	133	0.59	4.7	0.35	0.17	0.17	6.30 E+09
	Maximum	755	0.81	6.6	1.05	0.51	0.34	3.60 E+10
	Median	444	0.7	5.6	0.7	0.34	0.51	2.10 E+10
Forest	Minimum	26	0.1	1.1	0.01	0.01	0.02	1.20 E+09
	Maximum	146	0.13	2.8	0.03	0.03	0.03	6.80 E+09
	Median	86	0.11	2	0.02	0.02	0.03	4.00 E+09
Grass	Minimum	80	0.01	1.2	0.03	0.02	0.02	4.80 E+09
	Maximum	588	0.25	7.1	0.1	0.17	0.04	2.70 E+10
	Median	346	0.13	4.2	0.07	0.1	0.03	1.60 E+10
Pasture	Minimum	103	0.01	1.2	0.004	0.02	0.02	4.80 E+09
	Maximum	583	0.25	7.1	0.015	0.17	0.04	2.70 E+10
	Median	343	0.13	4.2	0.01	0.1	0.03	1.60 E+10

LAND USE POLLUTANT LOAD CONVERSIONS

- Conversion from kgs to lbs: multiply by 2.2
- Conversion from hectares to acres: multiply by 0.404
- To get lbs/ac/yr, multiply values in the above table by 0.45 then 0.404
- To get number of bacteria/acre-year, multiple values in the table above by 0.404

Appendix B References:

1. STEP_L model
2. Watershed Characterization System References Tab, Septics Tab per Horsley and Whitten 1999
3. USEPA July 2003 National Management Measures for the Control of Nonpoint Pollution from Agriculture
4. EPA-841-B-03-004 ASAE 1998 ASAE Standards 45 edition Standards Engineering Practices Data pp 646 (With EPA Region IV input)
5. University of California Extension Fact Sheet No 25. Manure Loading into Streams from Direct Fecal Deposits
6. http://dnrweb.dnr.state.md.us/watersheds/surf/bmp/swbmp.asp
7. http://rpitt.eng.ua.edu/Publications/4_Stormwater_Characteristics_Pollutant_Sources_and_Land_Development_Characteristics/Stormwater_characteristics_and_the_NSQD/NSQD%203.1%20summary%20for%20EPA%20Cadmus.pdf
8. Mednick A. C. “Development of a Tool for Predicting and Reducing Bacterial Contamination at Great Lakes Beaches.” Wisconsin DNR, Oct 2011.
9. Mishra A. et al. “Bacterial Transport from Agricultural Lands Fertilized with Animal Manure”. Water Air and Soil Pollution 189:127-134. (2008)
10. http://www.crwr.utexas.edu/gis/gishydro05/Modeling/WaterQualityModeling/BacteriaModel.htm
11. Shaver, Ed, et al "Fundamentals of Urban Runoff: Technical and institutional issues: 2nd edition, 2007

APPENDIX C. CALCULATING BACTERIAL REMOVAL FOR AGRICULTURAL BMPS

Agricultural BMPs are most often installed in packages, or combinations of multiple BMPs. The SCDHEC Nonpoint Source Management Program 2019 Annual Report outlines several current and past 319 projects for both agriculture and septic BMPs. Within the Upstate region of South Carolina, there have been numerous completed 319 projects that have focused predominantly on either septic or agricultural BMPs. The eight projects detailed below completed various combinations of agricultural and/or septic BMPs.

TMDL/ 319 Project	Total Fecal Coliform Removal (CFU)	Alternative water sources (units)	Watering Facilities (units)	Water Well (units)	Controlled Stream Access for Livestock Watering (ft)	Fence (ft)	Heavy Use Area Protection (sq. ft)	Pipeline (ft)	Vegetated Riparian Buffers (ac)	Streambank and Shoreline Protection (ft)	Onsite Wastewater Treatment Systems (Units)	Pet Waste Stations (Units)
Rabon Creek	3.87E+13	2	1		152	3,143	10,918		2		43	
Cane/ Little Cane Creek	6.22E+11									2,644	17	
Long Cane Creek	2.87E+12	5				3,735	23,491			41,916	9	
Twelve Mile Creek	1.34E+14	4	44	14		57,122	55,391	14,135	10	29,267		
Tyger River	3.14E+12	19		5		27,385	14,994	15,193		27,385	57	
NMS Tyger River	4.28E+12	8				4,786				1,000	32	
Saluda River	3.75E+12	1				1,430	441				9	8
Walnut Creek	4.26E+13		16	4		10,046	18,727	9,706			10	
Total	**2.30E+14**	**39**	**61**	**23**	**152**	**107,647**	**123,962**	**39,034**	**12**	**102,212**	**177**	**8**

Because the numbers above are calculated in CFU, it is necessary to convert to MPN to account for SCDHEC's change in standards from Fecal Coliform to *E.coli*. Multiplying the total number of 2.30E+14 by the *E.coli* conversion rate of 0.8725 gives us 2.01E+14 MPN/100ml.

Conversion from Fecal Coliform to *E.coli*:

2.30E+14 x 0.8725 = **2.01E+14 MPN/100ml**

Looking only at agricultural BMPs, which would include all but the onsite wastewater treatment system and pet waste station projects, there are only a few BMPs that are measured in units: alternative watering sources, watering facilities, and water wells. Water wells and alternative watering sources are very often installed in conjunction with one another. Based on the 23 water wells and 39 alternative watering sources installed across the eight projects (62 total), each of the other BMPs are divided by 62 to find the average BMPs installed for every 1 water well with pump. Based on this assumption, an "average" agricultural BMP bundle includes:

Average Agricultural BMP Bundle:

- 1 well with pump
- 1 watering facility
- 1,736 ft. of fencing
- 1,999 sq. ft. of heavy use area protection
- 630 linear feet of waterline
- 1,649 ft. shoreline protection
- 0.19 acres of riparian buffer area

Bacterial Removal Calculations

To determine the average fecal coliform bacteria one agricultural BMP bundle removes, it is necessary to separate fecal reductions from septic, pet waste, and agricultural BMPs. The standard bacterial removal rate for a septic tank repair/replacement is 2.42E+10 (see Appendix B) and the standard bacterial removal rate for a pet waste station is 2.14E+12. This indicates that 1.79E+14 is removed just from agricultural BMPs.

BMP	Standard Bacteria Removal per BMP	# Of Projects	Total Counts of Bacteria Reduction Per BMP
Septic Repair/Replacement	2.42E+10	177	4.28E+12
Pet Waste Station	2.14E+12	8	1.71E+13
Total bacteria removal from septic & pet waste			**2.14E+13**

Bacterial Removal from Agricultural BMPs:

2.01E+14 – 2.14E+13 = **1.79E+14 MPN/100ml**

The total number for all agricultural practices for 8 projects is 1.79E+14. Dividing this number by 62 to find the average bacterial removal for the Average Agricultural BMP Bundle gives us **2.89E+12 MPN/100ml**.

Final Assumption:

Average Agricultural BMP Bundle:

- 1 well with pump
- 1 watering facility
- 1,736 ft. of fencing
- 1,999 sq. ft. of Heavy Use Area protection
- 630 linear feet of waterline
- 1,649 ft. shoreline protection
- 0.19 acres of riparian buffer area

Average Agricultural BMP Bundle Bacteria Removal:

- 2.89E+12 MPN/100ml

APPENDIX D. CALCULATING SEDIMENT AND NUTRIENT LOAD REDUCTIONS USING STEPL

Calculating Estimated Total Watershed Sediment and Nutrient Load Reductions

- Open STEPL and choose the number of HUC-10 watersheds
- Once the spreadsheet opens, choose the following inputs:
    - DO NOT check "Treat all subwatersheds as parts of a single watershed"
    - Choose your weather station based on the county with most acreage in the watersheds
    - 1. Input all acreages
        - Urban – all developed lands
        - Cropland – Cultivated Crops
        - Pastureland – Pasture/Hay + Grasslands
        - Forest – all forested lands
        - User Defined – leave blank
        - Feedlots – leave blank
    - 2. Use the total number of estimated animals and divide evenly among the watersheds.
        - Using the cattle total, divide by 2 (half beef, half dairy) before dividing evenly among the watersheds. For example, if you have 2 watersheds, divide the cattle total by 4.
    - 3. Estimate the number of septic systems for each watershed; do not modify population per septic system (2.43 is the national average). Change the septic failure rate to 20%
    - 8. You can change the percentages of urban areas if needed, but not necessary
        - Commercial = medium and high intensity development
        - Single Fam = low intensity development
- Hit Export Data button at the top of the spreadsheet input page (input and output with graphs)
- Total Loads for TSS, TN, TP, and BOD will be calculated and found on the "Total Load" tab of the spreadsheet

Finding the Average Load Reductions for Typical Agricultural BMP "Packages"

- Open a new STEPL spreadsheet
    - The number of BMPs in your typical agricultural BMP "package" is the number you will enter in for "watersheds".
    - Choose your weather station based on the county with most acreage in the watersheds
        - In a typical BMP package, we used 4 BMPs
            - Livestock Exclusion Fencing
            - Alternative Water Sources
            - Heavy Use Area
            - 35 m Improved Buffer
    - Enter in "1" for impaired streambank to consider the need for an alternative watering source
- Once the spreadsheet opens, choose the following inputs:
    - DO NOT check "Treat all subwatersheds as parts of a single watershed"
    - Choose your weather station based on the county with most acreage in the watersheds
- Inputs
    - 1. Enter "1" for all watersheds under pastureland; leave everything else empty
    - Under the BMP tab:
        - 2. Choose one type of BMP (of your agricultural package) per "Watershed" and enter 100% Area BMP applied for each one
            - Alternative Water Supply
            - Heavy Use Area Protection
            - Grass Buffer (minimum 35 feet wide)
            - Livestock Exclusion Fencing
    - Unhide the Gully and Erosion Tab if needed
        - Choose the watershed with the Alternate Watering Source listed as the BMP

        - Length (ft) used is the average length of fencing in a typical agricultural BMP package (we used 1,686)
        - Height is 3 ft (recommended height from SCDHEC)
        - Lateral Recession – Moderate (recommended from SCDHEC)
        - Soil Texture Class – predominant soil type in the watersheds overall
    - Under the Total Load tab, use the total loads for Sediment, N and P for reduction estimated per agricultural BMP package

Finding the Average Load Reductions for Riparian Buffers

- Open STEPL and choose the number of HUC-10 watersheds
- Once the spreadsheet opens, choose the following inputs:
    - DO NOT check "Treat all subwatersheds as parts of a single watershed"
    - Choose your weather station based on the county with most acreage in the watersheds
    - 1. Under urban lands, enter the total amount of urban lands for each watershed that is on high priority buffer parcels
    - 8. Modify urban acreage percentages to reflect [for each watershed]:
        - Commercial = medium and high intensity development
        - Single Family = low intensity development
        - Open Space = open space
        - Every other urban land use should be zero, and the total % area should equal 100
- Under the BMPs tab, select the Urban BMP tool
    - For each watershed:
        - Click commercial and choose "LID/Filter/Buffer Strips"; the BMP drainage area will automatically populate based on the percentages you entered in. Click apply. Click OK on the confirmation window.
        - Repeat the same process for each of the urban land use types you have entered for each watershed; so, if you entered commercial, single family, and open space for two watersheds, you would do this a total of 6 times (3 for each type of urban land use for each watershed).
        - Exit when done
- Go to total load tab and get your loads for sediment and nutrients. This will give you the average amount of sediment and nutrients expected for each riparian buffer BMP project installed.

APPENDIX E. PARCEL PRIORITIZATION CRITERIA

Parcel Prioritization for Land Protection Criteria

1) Critical Watershed Area (CWA)

The Critical Watershed Area study was completed by Furman University using the InVEST model. The results of this analysis identified areas that, if developed, would have the biggest (negative) impact to water quality. Highest valued areas, if developed, would have significant negative impact to water quality, and are therefore the most important to protect.

Scoring: The Critical Watershed Area raster file created by Furman University was used to assign points to individual parcels based on higher potential water quality impacts. The average value per parcel was calculated; then the range of averaged values was separated into high, medium, and low priority categories. Because the results had a non-normal distribution, geometric intervals were used to divide them into three categories (high, medium, and low priority). Parcels designated high priority areas received "4" points; parcels designated medium priority areas were received "3" points; other parcels received "0" points

Critical Watershed Area Priority Ranges

Range	CWA Values
Low Priority Range	0 – 0.000066
Medium Priority Range	0.000067-0.000694
High Priority Range	0.000695-0.006641

GIS Layers Used: Parcel, Critical Watershed Area [80].

2) Stream Order

First order, or headwater, streams are the smallest stream channels in a river network and are of increased importance to river/watershed health due to their ability to retain floodwater, store nutrients, reduce sediment, maintain base flow of rivers, and provide critical habitat. Loss of headwater streams can have significant negative impacts to water quality and watershed health and are therefore very important to protect [81].

Scoring: Using the National Hydrology Dataset, parcels containing headwater (1st order) streams received "4" points. All other parcels received "0" points.

GIS Layers Used: Parcel, National Hydrology Dataset

3) Stream Classification

Streams that are in the most pristine condition are the most important to protect; once impacted they are difficult and expensive to restore. SCDHEC classifies streams throughout South Carolina; Outstanding Resource Waters are of "exceptional recreational or ecological importance or of unusual value" and Trout Waters Natural (TN) support natural populations and a "cold water balanced indigenous aquatic community of flora and fauna". Therefore, the ORW and TN waters are most important to protect from an ecological standpoint.

Scoring: Parcels that contained a stream, or portion thereof, were assigned points based on stream's classification. Parcels with streams classified as ORW or TN (*i.e.*, highest quality streams that are a priority for protection) received "4" points; parcels with streams classified as Trout Waters Grow Put Take (TGPT) received "3" points; parcels with streams classified as Freshwater (FW) and no stream impairments received "2" points. Parcels with streams classified as FW and at least one impairment received "1" point. Parcels without streams along/within their boundaries received "0" points.

GIS Layers Used: Parcel, Stream Classification

4) Highly Sensitive Riparian Buffer Areas

Riparian, or vegetated, stream buffers provide water quality benefits including slowing and filtering stormwater runoff, reducing flooding, preventing stream channelization, stabilizing streambanks, and minimizing erosion [58]. Protecting the most sensitive riparian buffers ensures that lands continue to provide valuable water quality

benefits. For water quality protection, riparian buffer zones should be a minimum of 100 feet wide on each side of the waterbody [82].

Scoring: UF identified highly sensitive riparian areas by combining the results from the USFS Riparian Buffer Delineation Model v.5.2 (www.riparian.solutions, run by UF) with a 100-foot buffer around all waterways [84]. Parcels were assigned points according to acreage of highly sensitive riparian buffer areas within each parcel, based on the "natural breaks" in the resulting acreage data (partitioning data into classes based on natural groups in the data distribution). Parcels with 74.4 acres or more of highly sensitive riparian buffer acreage received "4" points; parcels with 34.7-74.3 acres of highly sensitive riparian buffer acreage received "3" points; parcels with 14.5-34.6 acres of highly sensitive riparian buffer acreage received "2" points; parcels with 3.9-14.4 acres of highly sensitive riparian buffer acreage received "1" point; parcels with <3.8 acres of highly sensitive riparian buffer acreage received "0" points.

GIS Layers Used: Parcel, Variable Width Riparian Buffer Model Results Layer (Inputs: DEM Raster Files, NLCD Land Cover 2011, National Wetlands Inventory, State Soil Survey Geographical Database, National Hydrography Dataset), 100-foot Waterway Buffer Layer

5) Forested Riparian Buffer Areas

Forested riparian buffers provide increased benefits to water resources and provide habitat benefits to terrestrial and aquatic species. Protecting forested areas within highly sensitive riparian buffer areas will ensure that forest cover and water quality benefits are not lost.

Scoring: Parcels that have overlap with both forested land cover (mixed, evergreen, and deciduous) and the Highly Sensitive Riparian Buffer Areas layer received "1" point; all other parcels received "0" points.

GIS Layers Used: Parcel, Highly Sensitive Riparian Buffer Areas Layer, Forest Land Cover

6) Wetlands Classifications

A wetland is an area that is permanently or seasonally saturated with water, supports predominately hydric vegetation, and contains hydric soils. The ecological and environmental benefits of wetlands include flood control, water purification, shoreline stabilization, groundwater recharge, and streamflow maintenance. Freshwater (FW)-Forested/Shrub, FW-Emergent, and Riverine wetlands are the highest functioning types of wetlands, providing the most water quality benefits.

Scoring: Parcels containing wetlands were assigned points based on the type of wetland present. Parcels with FW Forested/Shrub, FW Emergent, and Riverine wetlands (*i.e.*, the classifications of higher value wetlands) received "3" points; parcels with FW pond and lake wetlands received "2" points; remaining parcels received "0" points.

GIS Layers Used: Parcel, National Wetlands Inventory

7) Hydric Soils

Hydric soils are defined by federal law as "soil that, in its undrained condition, is saturated, flooded, or ponded long enough during a growing season to develop an anaerobic condition that supports the growth and regeneration of hydrophytic vegetation" [84]. While wetlands must have hydric soils, presence of hydric soil does not necessarily indicate presence of wetlands. Hydric soils favor the formation of wetlands, support groundwater recharge, help identify the presence and boundary of wetlands, and support the growth of important vegetation that can help with pollution dissipation [85]. Presence of hydric soils within parcels indicates the current/potential for ecological services that are important to protecting water quality.

Scoring: Point values were assigned based on the acreage of the parcel that contains hydric soils. Parcels with 50 or more acres hydric soils received "3" points. Parcels with 30-49.99 acres of hydric soils received "2" points. Parcels with 5-29.99 acres of hydric soils received "1" point. Parcels with 4.99 acres or less of hydric soils received "0" points.

GIS Layers Used: Parcel, State Soil Survey Geographical Database

8) 100-Year Floodplain

Floodplains help protect people and infrastructure from flooding and benefit water quality by acting as natural filters as well as recharging aquifers [86]. By protecting existing undeveloped floodplains, the ecological benefits provided to the river system can continue. Flooding can be increased by land development, which may increase stormwater runoff and velocity.

Scoring: The National Flood Hazard Layer represents the current effective flood risk within an area, depicting which areas have a 1% probability of occurring in any given year. Parcels that fall within the 100-year floodplain approved by the Federal Emergency Management Agency (FEMA) without any urban/developed land received "2" points; parcels within the 100-year floodplain with urban/developed land received "1" point; all other parcels received "0" points.

GIS Layers Used: Parcel, National Flood Hazard (FEMA), NLCD Land Cover (2011)

9) Source Water Protection Areas

The Safe Drinking Water Act of 1996 was amended to provide a greater focus on pollution prevention to ensure surface water and groundwater are protected from pollution. These amendments require states to provide Source Water Assessment Reports (SWAR) that contain important information about drinking water sources and their susceptibility to contamination and identify the areas that contribute to a surface-water intake, or Source Water Protection Areas (SWPA). Protecting SWPAs is crucial to protecting drinking water sources.

Scoring: Parcels within source water protection areas received "2" points; parcels outside source water protection areas received "0" points.

GIS Layers Used: Parcel, Source Water Protection Areas

10) Stream Length

Parcels containing more linear feet of streams offer the opportunity to better protect water quality.

Scoring: Parcels with streams along/within their boundary were analyzed to determine the average length of streams within parcels throughout the watershed. In the Lake Greenwood watersheds, the average stream length within/adjacent to a parcel is 0.232 miles. Parcels with above average stream length received "2" points; other parcels received "0" points.

GIS Layers Used: Parcel, National Hydrography Dataset

11) Adjacent to Existing Protected Land

Protecting larger areas can enhance the environmental benefits provided by existing protected lands. Examples of existing protected lands include national and state parks, conservation easements, heritage preserves, and water utility-owned properties. Environmental benefits can include reduced flooding and soil erosion, streambank stabilization, improved water and air quality, and habitat protection [87]. Existing protected land can be seen in Figure 9.

Scoring: Parcels that were adjacent to existing protected land received "1" point; parcels not adjacent to existing protected land received "0" points.

GIS Layers Used: Parcel, NCED [88], UF Conservation Easements, County Parks, National Heritage Preserves

11) Parcel Size

Some land protection costs remain constant whether protecting a 200-acre or a 20-acre parcel. Since larger parcels generally provide increased environmental benefits, in many cases focusing on larger parcels will provide the most cost-effective option for protecting water quality.

Scoring: Parcels that meet the UF standard minimum acreage for conservation easements (50 acres) received "1" point; all other parcels received "0" points.

GIS Layers Used: Parcel, HUC-12 Watershed

Parcel Prioritization for Restoration BMPs

1) Current Water Quality Impairments

Parcels including, directly adjacent to, or upstream of an existing known bacterial impairment could be contributing to the problem.

Scoring: Parcels including, adjacent to, or upstream of streams with existing bacteria water quality impairments received "3" points. All other parcels received "0" points.

GIS Layers Used: Parcel, 303(d) List of Impaired Waters (2018), National Hydrography Dataset

Restoration Categories: Septic System Repair/Replacement, Wetland Restoration/ Enhancement, Riparian Buffer Restoration/Enhancement, Stormwater BMPs

2) Land Cover

Agricultural lands directly adjacent to waterways are more likely to contribute bacteria, nutrients, and sediment when stormwater runoff carries fertilizer and animal waste directly into streams. This criterion is a prerequisite to further analysis within the agricultural BMP category; parcels that do not have agricultural land cover are not eligible for agricultural BMPs and are excluded from further analysis. Parcels must either have 50% or greater agricultural land cover or have any percentage of agricultural land cover adjacent to streams; parcels must meet one or both criteria to be considered for further analysis.

Various land activities, such as logging and urban development, can negatively impact water quality through increased stormwater runoff, pollutant loads, stream channelization, and increased flooding [89]. This factor identifies parcels with urban lands or known logging operations that are likely contributing higher pollutant loads and where BMP implementation may provide water quality benefits.

Scoring:

Septic System Repair/Replacement: Parcels with 50% or more urban land cover received "2" points.

Agricultural BMPs: Parcels with 50% or more agricultural land cover (identified as pasture/hay and cultivated crops) received "2" points. Parcels with agricultural lands that are adjacent to streams or include a water impoundment received "2" points. Parcels with 50% or greater agricultural land that are adjacent to streams or include a water impoundment received "4" total points. All other parcels received "0" points.

Stormwater BMPs: Parcels within urban/developed land areas received "2" points. Parcels with known logging operations received "1" point; all other parcels received "0" points.

GIS Layers Used: Parcel, National Land Cover Dataset (2016) [9], Landowner Database

Restoration Categories: Agricultural BMPs, Stormwater BMPs

3) Current Pollutant Export

This criterion prioritizes parcels likely to have high levels of nitrogen, phosphorus, and sediment export by using the results from Furman University's InVEST Model results.

Scoring: For each pollutant (nitrogen, phosphorus, and sediment) the average value of exports within each parcel was calculated; the range of averaged values was then separated into high, medium, and low export categories. For each pollutant, parcels within the highest average range of export received "3" points; parcels within the medium range of export received "2" points; parcels within the low range/no export received "0" points.

Current Pollutant Export Priority Ranges

Pollutant	Units	Low Priority	Medium Priority	High Priority
Nitrogen	Kg/pixel/year	0.008273-0.019927	0.019928-0.073698	0.073699-0.321786
Phosphorus	Kg/pixel/year	0-0.000013	0.000014-0.003079	0.00308-0.743411
Sediment	tons/pixel/year	0	0.000001-0.000006	0.000007-0.000193

GIS Layers Used: Parcel, Furman University's Current Pollutant Export Layers for Nitrogen, Phosphorus, and Sediment (results from the InVEST Model) [80]

Restoration Categories: Agricultural BMPs, Wetland Restoration/Enhancement, Riparian Buffer Restoration/Enhancement, Shoreline Management, Stormwater BMPs

4) Unpermitted Point Source Pollutants

Although under the threshold for a permit, some point source activities may contribute to water quality pollution through stormwater runoff, such as existing agricultural operations (*i.e.*, use of fertilizers, chemicals, or land applications of manure or waste).

Scoring: Parcels identified as including agricultural operations (farms) below the NPDES permit threshold received "1" point; all other parcels received "0" points.

GIS Layers Used: Parcel, Google searches: Farms, Golf Courses, Car Lots/Washes, Gas Stations, and Dry Cleaners

Restoration Categories: Agricultural BMPs, Stormwater BMPs

5) Permitted Point Source Pollutants

Permitted agricultural point sources could be contributors to bacteria, nutrient, or sediment pollution and may benefit from installation of agricultural BMPs.
Scoring:

Agricultural BMPs: Parcels with agricultural points source permits (*e.g.*, CAFOs, Animal Management Areas, biosolid application areas, known farms) received "1" point. All other parcels received "0" points.

Stormwater BMPs: Parcels with NPDES (non-agricultural), mines/gravel pits, landfills, etc. received "1" point. All other parcels received "0" points.

GIS Layers Used: Parcel, Agricultural and Non-Agricultural NPDES, Land Applications, Animal Management Areas, Biosolid Application Areas, known farms (Google Search), Landfills, Mines/Gravel Pits

Restoration Categories: Agricultural BMPs, Stormwater BMPs, Forestry Management

6) Restorable Wetlands

A wetland is an area that is permanently or seasonally saturated with water, supports predominately hydric plants, and contains hydric soils. The ecological and environmental benefits of wetlands include flood control, water purification, shoreline stabilization, groundwater recharge, and streamflow maintenance [90]. Restoring inundated and modified wetlands to their natural states would provide significant environmental and water quality benefit [91].

Scoring: Parcels with wetlands with special modifiers (excavated, spoil, artificial substrate, diked/impounded, managed, farmed, partially drained/ditched, beaver) received "2" points. Additionally, parcels with historic wetlands received an additional "2" points.

GIS Layers Used: Parcel, National Wetland Inventory (Current and Historical)

Restoration Categories: Wetland Restoration/Enhancement

7) Water Impoundments and Dams

Dams physically alter the aquatic ecology and often convert natural wetlands into open water, reducing ecological benefits. Removal of obsolete dams can restore natural wetlands and stream flow, improve aquatic habitat, and

renew natural sedimentation levels. Removing dams is not always a viable, or preferred, option depending on the use of the dam, condition, and owner interests.

Scoring: Parcels with dams received "2" points; all other parcels received "0" points.

GIS Layers Used: Parcel, National Inventory of Dams

Restoration Categories: Wetland Restoration/Enhancement

8) Highly Sensitive Riparian Buffer Areas

Riparian, or vegetated, stream buffers provide water quality benefits including slowing and filtering stormwater runoff, reducing flooding, preventing stream channelization, stabilizing streambanks, shading streams, and minimizing erosion. This criterion places priority on parcels with highly sensitive riparian buffers that, if enhanced or restored, would provide significant water quality benefits.

Scoring: UF identified highly sensitive riparian areas by combining the results from the USFS Riparian Buffer Delineation Model v.5.2 (www.riparian.solutions, run by UF) with a 100-foot buffer around all waterways [84]. Parcels were assigned points according to acreage of highly sensitive riparian buffer areas within each parcel, based on the "natural breaks" in the resulting acreage data (partitioning data into classes based on natural groups in the data distribution). Parcels that fell fully or partially within this layer were assigned "4" points; all other parcels were assigned "0" points [82]. This criterion is a prerequisite for further analysis.

GIS Layers Used: Parcel, Variable Width Riparian Buffer Model Results Layer (Inputs: DEM Raster Files, NLCD Land Cover 2011, National Wetlands Inventory, State Soil Survey Geographical Database, National Hydrography Dataset), 100-foot Waterway Buffer Layer

Restoration Categories: Riparian Buffer Restoration/Enhancement, Shoreline Management

9) Stream Order

Priority was given to parcels along first and second order streams to account for the enhanced benefits riparian buffers provide on smaller, higher order streams.

Scoring: Using the National Hydrology Dataset, parcels containing headwater (first or second order) streams received "4" points. All other parcels received "0" points.

GIS Layers Used: Parcel, National Hydrology Dataset

Restoration Categories: Riparian Buffer Restoration/Enhancement

10) Adjacency to Drinking Water Reservoirs or Drinking Water Intakes

Parcels directly adjacent to waterways and drinking water sources are more likely to contribute to pollutant loading, as there is less opportunity for filtration or removal before reaching surface and groundwater.

Scoring: Parcels adjacent to drinking water intakes or reservoirs received "4" points. Parcels adjacent to any waterways (other than drinking water intakes or reservoirs) received "2" points; all other parcels received "0" points.

GIS Layers Used: Parcel, National Hydrography Dataset, Drinking Water Intakes

Restoration Categories: Septic System Repair/Replacement, Riparian Buffer Restoration/Enhancement, Shoreline Management

11) 100-Year Floodplain

Floodplains help protect people and infrastructure from flooding and benefit water quality by acting as natural filters and recharging aquifers [92]. Impacts from flooding events are exacerbated by land development, which increases stormwater runoff volume and velocity. Restoring existing undeveloped floodplains return ecological benefits to the river system and downstream communities.

Scoring: The National Flood Hazard Layer represents the current effective flood risk within an area, depicting which

areas have a 1% probability of flooding in any given year. Parcels that contain areas within the 100-year floodplain approved by the Federal Emergency Management Agency (FEMA) received "2" points; all other parcels received "0" points.

GIS Layers Used: Parcel, National Flood Hazard (FEMA), NLCD Land Cover (2016) [9]

Restoration Categories: Riparian Buffer Restoration/Enhancement

12) Private Boat Ramps and Docks

Existing private boat ramps and docks can cause increased stormwater runoff, increased pollutants from boat fuel, sedimentation, and more.

Scoring: Parcels with private boat ramps along drinking water reservoirs received "2" points; parcels with private docks along drinking water reservoirs received "1" point. All other parcels received "0" points. A parcel with both a private boat ramp and a private dock received "3" total points: "2" for a private boat ramp and "1" for a private dock.

GIS Layers Used: Parcel, Private Boat Ramps and Docks

Restoration Categories: Shoreline Management

13) High Traffic Commercial Pet Locations

Some locations are more likely to have more dog traffic; if pet waste is not properly disposed of these areas are at increased likelihood of contributing to water quality pollution through stormwater runoff that includes concentrated levels of pet waste.

Scoring: Parcels containing veterinary hospitals, pet stores, pet grooming or boarding facilities, or humane societies/animal shelters received "1" point; all other parcels received "0" points.

GIS Layers Used: Parcel, Google searches: Veterinary Hospitals, Pet Stores, Pet Grooming and/or Boarding Facilities, Animal Shelters.

Restoration Categories: Pet Waste Stations

14) Parks

Existing public land where people may take their dogs include parks and heritage preserves. If not properly disposed of, pet waste negatively impacts water quality by increasing bacteria levels.

Scoring: Parcels categorized as existing public land (National/State/County/City Parks, Heritage Preserves, other lands open to the public) received "1" point. All other parcels received "0" points.

GIS Layers Used: Parcel, National/State/County/City Parks, Heritage Preserves

Restoration Categories: Pet Waste Stations

15) TNC Forest Conservation Vision Areas (2018)

The Nature Conservancy (TNC) has published several reports that examine existing forests and their attributes as well as identifying key conservation corps and corridors [67].

Scoring: Parcels falling within the following categories were assigned up to 4 points:

- 4 points – Forest Cores – 5,000-acre patches of contiguous forests that are of highest priority for conservation and protection.
- 3 points – Buffers and Restoration Areas – 10,000-acre patches of contiguous forests that are of highest, high, and medium priority for conservation and protection.
- 2 points – Corridors – Connected lands that permit wildlife to move between core areas, not captured by Core or Buffer areas.
- 1 point – Additional Resilient Areas – Contiguous 5,000-acre patches of forests scoring >=1,000 on TNC's resilient lands that are not already captured in other classes.

GIS Layers Used: Parcel, TNC Forest Conservation Vision Areas

Restoration Categories: Forestry Management

16) Soil Hydrologic Group

Soils with high infiltration capabilities, such as sands and loams, are more susceptible to runoff.

Scoring: Parcels with predominantly A-type soils were assigned “1” point; parcels with predominantly B-type soils were assigned “2” points; parcels with predominantly C or D-type soils were assigned “3” points”.

GIS Layers Used: Parcel, gSSURGO Database

Restoration Categories: Forestry Management

17) Soil Erodibility (K Factor)

The K Factor refers to the susceptibility of an area to erosion by runoff and rainfall impact, with high values indicating a higher susceptibility to erosion.

Scoring: - Parcels with an average K-Factor of 0.10-0.19 received “1” point; Parcels with an average K-Factor of 0.20-0.28 received “2” points; Parcels with an average K-Factor of 0.29-0.37 received “3” points.

GIS Layers Used: Parcel, gSSURGO Database

Restoration Categories: Forestry Management

18) Maximum Slope on Property

Parcels with greater slopes are more susceptible to erosion by runoff and rainfall impact.

Scoring: Parcels with a maximum slope of >18% slope was assigned “3” points; parcels with a maximum slope of 8-17% were assigned “2” points; parcels with a maximum slope of <8% were assigned “1” point.

GIS Layers Used: Parcel, Statewide DEM

Restoration Categories: Forestry Management

19) Sewer Service Availability

Parcels without existing sewer lines on or within 100 feet are considered to utilize septic systems for wastewater management.

Scoring: Parcels without sanitary sewer lines on or within 100 feet were assigned “1” point. This is a prerequisite for further analysis within the Septic System Repair/Replacement analysis.

GIS Layers Used: Parcel, sanitary sewer line(s)

Restoration Categories: Septic System Repair/Replacement

20) Soil Suitability for Septic Tank Absorption Fields

The NRCS Soils Database (gSSURGO) provides information on soil suitability for septic tank absorption fields. Soils are rated based on their ability to provide suitable conditions for a properly working septic system. Parcels with soils unsuitable for septic systems have a higher likelihood of needing repairs/replacements because of improper function.

Scoring: Parcels with soils rated predominantly “very limited” were assigned “3” points; parcels with soils rated predominantly “somewhat limited” were assigned “2” points; parcels with soils predominantly rated “not limited” were assigned “1” point.

GIS Layers Used: Parcel, NRCS gSSURGO Database

Restoration Categories: Septic System Repair/Replacement

21) Critical Habitat Areas

Parcels adjacent to “red zone” areas (minimal impact zones).

Scoring: Parcels adjacent to Critical Habitat Areas, as defined by Lake Greenwood Lake Management Department, were assigned “4” points”.

GIS Layers Used: Parcel, Critical Habitat Areas

Restoration Categories: Shoreline Management

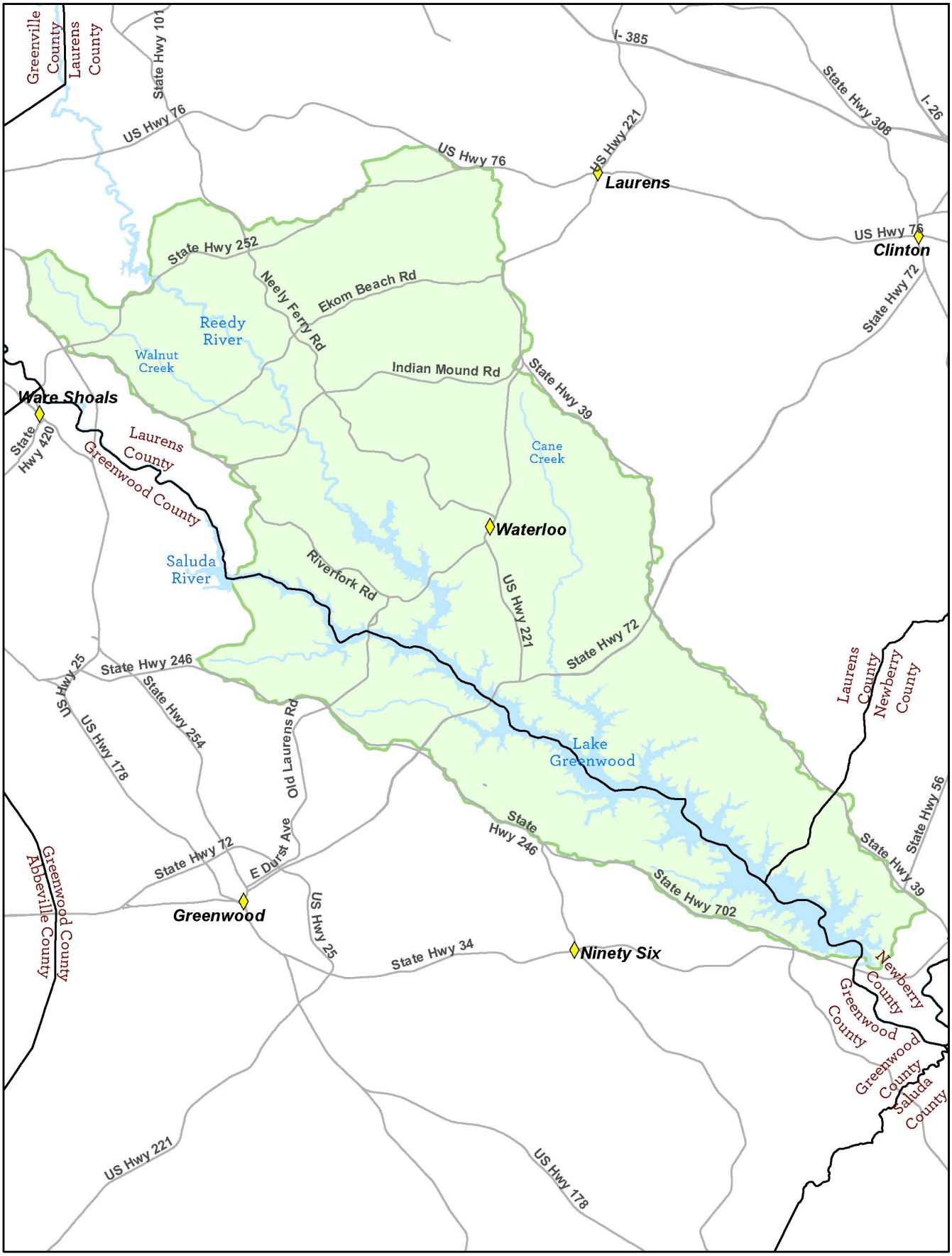
APPENDIX F. PUBLIC OUTREACH MATERIALS

Throughout the duration of this WBP, UF/SCRWA relied on input from local residents, businesses, and organizations. This input helped shape the final recommendations of both BMPs and implementation timelines and strategies. The following pages are examples of outreach materials utilized during the development of this WBP.

- Public Survey
- Stakeholder Information Submission Form
- Simple Map of Lake Greenwood Watersheds

Lake Greenwood Watersheds Water Quality Survey

Thank you for taking the time to fill out this survey. Upstate Forever and South Carolina Rural Water Association appreciates any information you can provide us, as it will help us improve our watershed-based planning efforts for protecting and restoring the unique characteristics of the Lake Greenwood Watersheds.


Greenville County
Laurens County
State Hwy 101
US Hwy 76
I- 385
State Hwy 308
I-26
US Hwy 221
Laurens
Clinton
State Hwy 252
Neely Ferry Rd
Ekom Beach Rd
Reedy River
Walnut Creek
Indian Mound Rd
State Hwy 39
State Hwy 72
Ware Shoals
State Hwy 420
Laurens County
Greenwood County
Cane Creek
Waterloo
Saluda River
Riverfork Rd
US Hwy 221
State Hwy 72
US Hwy 25
State Hwy 246
State Hwy 254
US Hwy 178
Old Laurens Rd
Lake Greenwood
Laurens County
Newberry County
State Hwy 56
State Hwy 246
State Hwy 39
State Hwy 702
State Hwy 72
E Durst Ave
Greenwood
Greenwood County
Abbeville County
US Hwy 25
State Hwy 34
Ninety Six
Newberry County
Greenwood County
Greenwood County
Saluda County
US Hwy 221
US Hwy 178

Do you live in, own land, or own/operate a business in the Lake Greenwood Watersheds (area shaded in green, pictured above)?

◯ Yes ◯ No

If you have a home or business within the watershed, do you get your drinking water from a public system or a private well?

◯ Public System
◯ Private System
◯ Private Well
◯ Other
◯ N/A
◯ Other

If you own more than 10 acres of forested land within the Lake Greenwood Watersheds, do you actively manage your forested land?

◯ Yes ◯ No

Do you access waters of the Lake Greenwood Watershed for fishing, paddling, swimming, boating, or other recreational purposes?

◯ Yes ◯ No

What of the following do you value about the Lake Greenwood Watersheds?

☐ Biking
☐ Clean Drinking Water
☐ Hiking
☐ Horseback Riding
☐ Local Parks
☐ Local Family Farms
☐ Rural Character
☐ Water Recreation (paddling, boating, swimming, fishing, etc.)
☐ Other

Check all that apply.

Which do you consider to be the top threat(s) to water quality in Lake Greenwood?

- [ ] Agricultural Runoff
- [ ] Chemical Spills
- [ ] Industrial Waste
- [ ] Invasive Species (plants and animals)
- [ ] Land Development
- [ ] Sedimentation
- [ ] Septic Tanks
- [ ] Street Runoff (Urban/Suburban Runoff)
- [ ] Timber Harvesting
- [ ] Trash
- [ ] Other

Check all that apply

Do you use fertilizer on your property?

◯ Yes ◯ No

Is your home or business on a septic system?

◯ Yes ◯ No

Rating Scale Questions

	Not Important	Somewhat Important	Neutral	Important	Very Important
How important is water quality of local streams, rivers, and lakes?	◯	◯	◯	◯	◯
How important is recreational use of local streams, rivers, and lakes?	◯	◯	◯	◯	◯

	Not Important	Somewhat Important	Neutral	Important	Very Important
How important are healthy fisheries and aquatic conditions of local waters?	◯	◯	◯	◯	◯
How important is land conservation for water quality and stream health?	◯	◯	◯	◯	◯

Do you think additional measures are needed to protect local streams, rivers, wetlands, and lakes as development of the watershed increases?

◯ Yes ◯ No

Do you support riparian buffer (vegetated area) requirements at new development sites for protection of streams, rivers, lakes, and wetlands?

◯ Yes ◯ No

Developers are required by SCDHEC under the Construction General Permit to buffer lakes and streams (30-45 feet) from development activities only during construction. Do you believe these buffers should remain permanent to protect water quality and habitat?

◯ Yes ◯ No

Do you support land conservation (e.g. conservation easements, parks, preserves) as a method to protect drinking water resources?

◯ Yes ◯ No

Do you have any concerns with water quality in the Lake Greenwood Watersheds? Are there any problem areas we should be aware of?

Thank you for your time!

Please press the submit button when your survey is complete.

Would you like to receive information about future public meetings/workshops about watershed planning, protection, and restoration in the Lake Greenwood Watersheds?

◯ Yes ◯ No

For more information about the development of the Lake Greenwood Watershed-Based Plan, please contact:

Katie Hottel, GIS Coordinator, Upstate Forever

khottel@upstateforever.org

This project was funded wholly or in part by the USEPA under a Capitalization Grant for Drinking Water State Revolving Funds through the SC Department of Health and Environmental Control (SCDHEC).

Funding provided by:

Submit

Areas of Concern in Lake Greenwood Watersheds Project Area

In addition to completing our stakeholder survey, which can be found at:
https://www.cognitoforms.com/UpstateForever1/LakeGreenwoodWatershedsWaterQualitySurvey

we are asking you to provide (if able) some supplemental information on any areas of concern for water quality that you may be aware of in the project area. *Please note: we are only able to address issues that are located within the project area; a map is provided below for reference.

Please use the form provided below to report to us, and email this document back; feel free to copy and paste as many times as needed for the number of areas of concern/problem spots you are familiar with. A couple of filled-out examples are included below. Feel free to attach any photos you may have of the issue of concern (if applicable) to your email, along with this document (please note: total file size(s) may not exceed 20 MB per email). Please put "Greenwood Watershed WQ Issue" in the subject line.

James Kilgo
Source Water Protection Specialist, South Carolina Rural Water Association
james@scrwa.org

Sarah Nyikos
Natural Resources Protection Specialist, South Carolina Rural Water Association
sarah@scrwa.org

Issue/Area of Concern Type:

Property Owner name (if known/applicable):

Property Owner Contact Information (if known):

Location/Address of Concern (approximate is acceptable):

Description of Issue:

EXAMPLES:

Issue/Area of Concern Type: Headwater tributary, cattle access.

Property Owner name (if known/applicable): Mr. X. Young

Property Owner Contact Information (if known): (###) ###-####, name@email.com

Location/Address of Concern (approximate is acceptable): 1234 Farm Rd, Ware Shoals, SC 12345

Description of Issue: The headwaters of a tributary of the Reedy River are located in a cattle pasture, with no fence around the water source. Cattle have free access and may be a source of bacteria. Nutrients may also be entering the stream from surrounding crop fields.

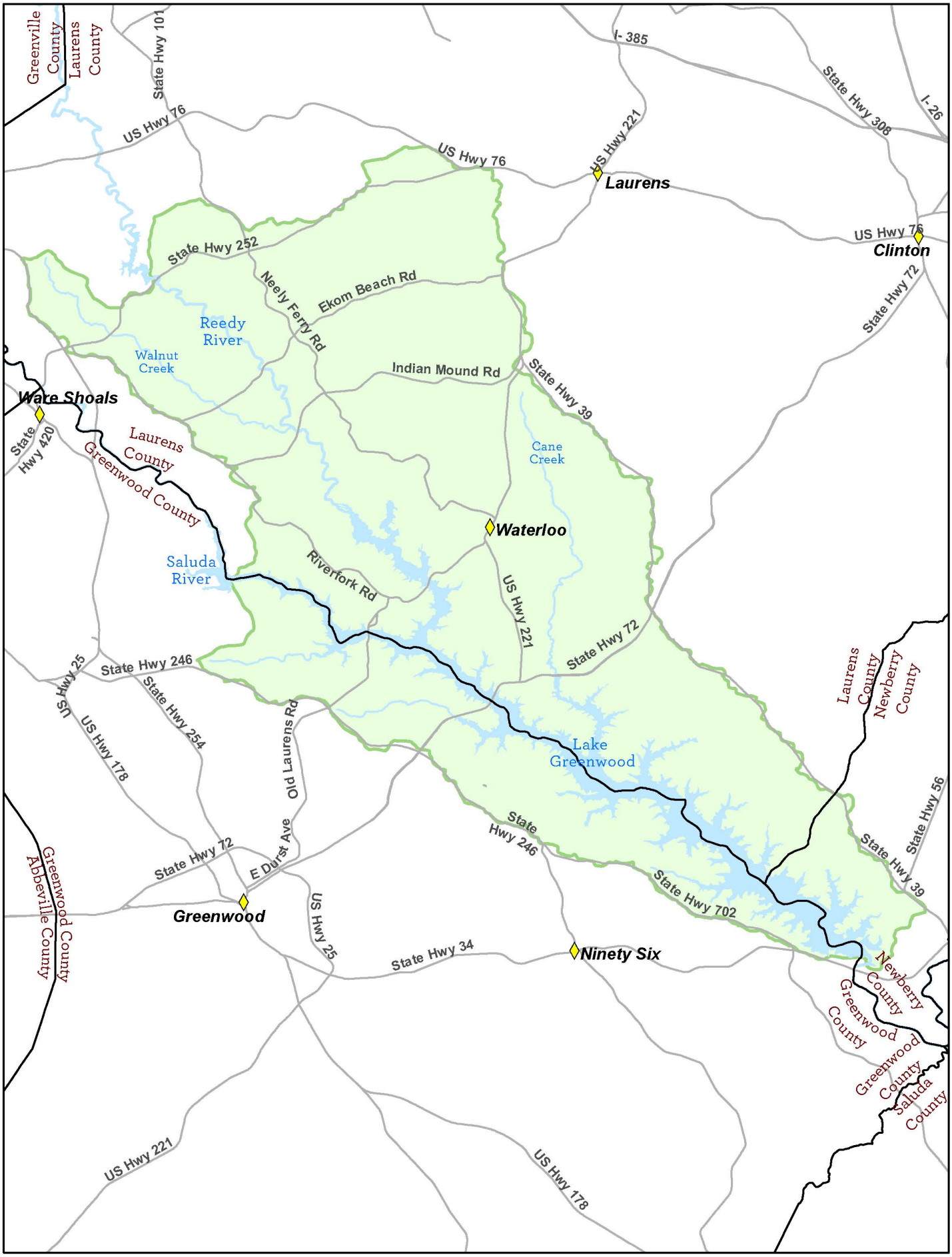
Issue/Area of Concern Type: forested land immediately adjacent to rivers, set to be cleared/developed

Property Owner name (if known/applicable): Corporation Z, Inc.

Property Owner Contact Information (if known): Contact person: Manager Mr. Smith, (###) ###-####, smith@email.com

Location/Address of Concern (approximate is acceptable): 1234 Town Rd, Laurens, SC 12345

Description of Issue: Corporation Z owns several forested parcels, each 200-500 acres in size, in the project area. They plan to develop Parcel A on the banks of Cane Creek to be a suburban housing development, expected to start June 2022. Unknown whether or not there are plans in place for environmental mitigation e.g. riparian buffers. Parcel B is set to be clear-cut for timber in May 2021 and may be a source of sediment from run-off due to intense logging.


Greenville County
Laurens County
State Hwy 101
US Hwy 76
I- 385
State Hwy 308
I- 26
US Hwy 221
Laurens
Clinton
State Hwy 252
Neely Ferry Rd
Ekom Beach Rd
Reedy River
Walnut Creek
Indian Mound Rd
State Hwy 39
State Hwy 72
Ware Shoals
State Hwy 420
Laurens County
Greenwood County
Cane Creek
Waterloo
Saluda River
Riverfork Rd
US Hwy 221
State Hwy 72
US Hwy 25
State Hwy 246
State Hwy 254
US Hwy 178
Old Laurens Rd
Lake Greenwood
Laurens County
Newberry County
State Hwy 56
State Hwy 246
State Hwy 39
State Hwy 702
State Hwy 72
E Durst Ave
Greenwood
US Hwy 25
State Hwy 34
Ninety Six
Greenwood County
Abbeville County
Newberry County
Greenwood County
Greenwood County
Saluda County
US Hwy 221
US Hwy 178