Warwoman Creek Watershed Management Plan

Warwoman Creek at Earl's Ford

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Contents

Introduction

Purpose

The purpose of the Warwoman Creek Watershed Management Plan (Warwoman WMP or WWMP) is to provide a context and a road map for how the watershed could be managed to restore and protect its water quality. This plan will provide an analysis of the sources of the Warwoman Creek watershed's water quality problems and their relative contributions, and then identify management, educational, and financing programs, along with stakeholder resources, that would be committed to remediate these problems.

In general, the purpose of watershed planning and implementation is to engage local governments, institutions, and decision-makers in the restoration and protection of watersheds through the following series of steps:

- Characterize existing conditions
- Identify and prioritize problems
- Define management objectives, including estimated quantitative values representing water quality restoration in impaired stream segments
- Develop protection or restoration measures
- Implement and adapt selected actions

The Warwoman Creek Watershed Management Plan is intended to help ensure that:

- ✓ Limited resources are directed to priority actions that will address significant water pollution sources in critical areas of the watershed
- ✓ The pace of restoration can be accelerated
- ✓ Information is provided to leverage related resources
- ✓ Feedback mechanisms are established to allow adjustments

The Warwoman WMP (or WWMP) project follows the U. S. Environmental Protection Agency's (EPA) steps for developing a *Nine Element Watershed Management Plan*. In addition, the corrective actions proposed herein will carry out portions of the pertinent Total Maximum Daily Load Implementation Plans (TMDLIP) for Warwoman Creek and its impaired tributaries as specified by the Georgia Department of Natural Resources, Environmental Protection Division (GADNR and/or GAEPD).

Goals to Attain

The goal of the Warwoman WMP is to facilitate the timely implementation of management strategies and corrective and protective actions to improve water quality

Warwoman Creek is a primary tributary to the National Wild & Scenic Chattooga River.

in the Warwoman Creek watershed. Measures will be spelled out to mitigate pollution sources that have contributed to the impairment of Warwoman Creek, one of its tributaries (Roach Mill Creek), and one tributary of the West Fork of the Chattooga River (Law Ground Creek) due to excessive levels of fecal coliform and/ or sediment (sediment impairment is also referenced as "macroinvertebrate biota" impairment). The focus will be on restoring these streams to "supporting" their designated use of fishing on the *State of Georgia's 2016 305(b)/ 303(d) List of Waters*.

It is important to note that consequential influences to achieving the goals and objectives of this WMP are:

- ✧ State and local stormwater management codes
- ✧ Sewer, water, and onsite wastewater treatment regulations
- ✧ Local enforcement of erosion, sedimentation, and flood plain protection laws
- ✧ Local comprehensive land use plans
- ✧ Intergovernmental cooperation

To move from existing conditions in the Warwoman watershed to include watershed-based perspectives, and protection and restoration of impaired waters will require a significant shift in local codes, policies, and enforcement, as well as considerable resources. Thus, the Warwoman WMP recognizes the success of its implementation will also depend on additional actions and alternatives that are complimentary to this WMP, or that are updates to this WMP, which may be dependent on political will and the availability of more resources.

Introduction

WATER QUALITY STANDARDS A *Total Maximum Daily Load* (TMDL) calculates the maximum amount of a pollutant allowed to enter a water body, so that the water body will meet and continue to meet water quality standards for the particular pollutant and the water body's designated uses. The TMDL allocates maximum allowable pollutant loads to point sources and nonpoint sources, which include both anthropogenic and natural pollutant sources. The TMDL includes three components, as follows:
TMDL = LA + WLA + MOS, where:

LA = Load Allocation for nonpoint sources
WLA = Waste Load Allocation for point sources
MOS = Margin of Safety
(Source: www.epa.gov/owow/tmdl)

♦ The Georgia State Water Quality Standards for *fecal coliform* are:

May-October (summer): a minimum of 4 water samples collected within a 30-day period resulting in a geometric mean of ≤ 200 colony forming units (cfu) per 100 mL.

November-April (winter): a minimum of 4 water samples collected within a 30-day period resulting in a geometric mean of ≤ 1,000 cfu per 100 mL, with no single sample exceeding 4,000 cfu per 100 mL.[1]

The Warwoman watershed is a conglomeration of four sub-basins with a combined total area of 45,226 acres within the State of Georgia.

♦ The Georgia State Water Quality Standards for *biota* (macroinvertebrates) due to sediment are included in an established narrative criteria for sediment that applies to all waters of the State of Georgia. The purpose of the narrative standard is to prevent objectionable conditions that interfere with legitimate water uses, as stated in Georgia Regulation 391-3-6-.03(5)(c), to wit:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses (GAEPD, 2004).

1. A qualifying condition is also allowed for certain waters on a case-by-case basis: "Should...fecal coliform levels from non-human sources exceed 200/100 mL (geometric mean) occasionally, then the allowable geometric mean fecal coliform shall not exceed... 500/100 mL in free flowing freshwater streams."

Scope

Geographic Range The Warwoman Creek watershed is an administratively drawn boundary including the primary streams of Warwoman Creek and the West Fork of the Chattooga River, the latter of which is included in the National Wild & Scenic Chattooga River corridor. Located in the headwaters of the Savannah River Basin in northeast Georgia at an elevation of approximately 2,600 feet and beginning about 2.3 miles East of Clayton, GA, the Warwoman watershed extends eastward all the way to Highway 28, northward to the North Carolina State line, and southward to the Chattooga River. Flowing East from Clayton, GA, Warwoman Creek runs through Rabun County and the Chattahoochee National Forest before emptying into the Chattooga Wild and Scenic River near Earl's Ford. Flowing south from the confluence of Overflow, Holcomb and Clear Creeks, the West Fork of the Chattooga River passes through Rabun County and the Chattahoochee National Forest before emptying into the Chattooga Wild and Scenic River near the Highway 28 Bridge in Mountain Rest, South Carolina.

The Warwoman Creek watershed (HUC-10: 0306010202) is a conglomeration of sub-basins within the greater Chattooga River watershed, and is approximately 45,226 acres in size. These sub-basins include the following: Headwaters of the West Fork of the Chattooga River (HUC-12: 030601020202); West Fork of the Chattooga River (HUC-12: 030601020203); Upper Warwoman (HUC-12: 030601020206); and Lower Warwoman (HUC-12: 030601020205). The Headwaters of the Chattooga River sub-basin extends into North Carolina, but this WMP only pertains to the Georgia portion of this sub-basin. In total, the Warwoman watershed is ~10.4% (4,728 acres) private land, which is located primarily along or near Warwoman Road and Highway 28, and ~89.6% (40,520 acres) public land on the Chattahoochee National Forest. This public land also includes the Warwoman Wildlife Management Area (WMA), a 15,800-acre property managed by the GADNR. The WMA is almost entirely within the Warwoman Creek watershed, extending from Bartram Trail to Hale Ridge Rd. It includes nearly all of the public land to the north of Warwoman Rd. in the Upper Warwoman subwatershed, a majority in the Lower Warwoman subwatershed, and small portions of the West Fork and Headwaters West Fork subwatersheds.

Introduction

The Warwoman watershed includes the reaches of the following primary tributaries: Finney Creek; Roach Mill Creek; Tuckaluge Creek; Hoods Creek; Walnut Fork; Sarah's Creek; Morsingsills Creek; West Fork of the Chattooga River (which is also included in a Wild and Scenic River corridor); Law Ground Creek; Reed Mill Creek; Big Creek; Holcomb Creek; and Overflow Creek. Law Ground Creek, Warwoman Creek, and Roach Mill Creek are listed by the GAEPD and the EPA as impaired waters due to sedimentation. The lower stretch of Warwoman Creek is also listed by the GAEPD and the EPA as impaired due to fecal coliform.

Temporal Range The Warwoman watershed has a long, yet somewhat undocumented history of polluting the National Wild and Scenic Chattooga River. In the early years of the 1900s, sediment was cited as a problem in the Chattooga watershed (Source: USDA, Message from the President of the United States, 1902). The Clean Water Act (CWA) of 1972 declared the nation's intent to restore and maintain the chemical, physical and biological integrity of our waters, while setting national water quality goals of fishable, swimmable waters by July 1st, 1983. While the initial emphasis of the CWA dealt with point-source pollution, a majority of pollutants in our nation's water comes in the form of non-point source pollution. As such, the CWA was amended in the 1990s to include more direction to control non-point sources. In Georgia, this new mandate required the Georgia EPD to implement TMDL implementation plans to regulate, monitor and enforce non-point source pollution loads in waterways. Yet, despite this instruction, Georgia EPD waited until 2002, amidst a turbulent environmental political theater, to establish a TMDL Implementation Program.

Jeep tracks erode an embankment adjacent to Warwoman Creek near the Chattooga River.

In 1996, a series of highly-publicized lawsuits brought by the Sierra Club resulted in rulings and settlements that required the Environmental Protection Agency and Georgia EPD to ensure implementation of the CWA and, specifically, its TMDL program. Thereafter, several efforts to make progress in improving water quality in the Warwoman watershed were engaged. Thus, the Warwoman Watershed Management Plan builds on these prior initiatives, which include the following:

✧ ***1993-1995 The USFS "Chattooga River Ecosystem Management Demonstration Project"*** involved researchers from the USFS, Clemson University, and graduate students from several academic institutions.
✧ Focus: The project encompassed the entire Chattooga River watershed. Portions of several studies addressed the Warwoman Creek watershed, such as a macroinvertebrate survey, and particularly a study of erosion and sedimentation sources impacting the Chattooga River, which specifically identified streams in the Warwoman watershed as problematic sources of erosion and sedimentation into the Chattooga River.

✧ ***1998 The USFS's "Chattooga River Watershed Water Resource Inventory"*** involved researchers and forest hydrologists from the Francis Marion and Sumter National Forests.
✧ Focus: An inventory employing the Water Resource Inventory (WRI) program in the Chattooga watershed resulting in qualitative and quantitative information relative to stream (channel, reach, valley segment), watershed, landscape, and ecosystem quality and stating that Big Creek, located in the Warwoman watershed, contributed 20% of the Chattooga River's total suspended solids load.

✧ ***1999 EPA's "Assessment of Water Quality Conditions in the Chattooga River Watershed"*** involved researchers and scientists from Region 4 of the Water Management Division of the U.S. EPA and the Georgia Forestry Commission.
✧ Focus: An assessment of water quality conditions of the Chattooga River watershed that was conducted in response to issues related to the settlement of the "Georgia TMDL lawsuit." Portions of several studies that were included in the assessment specifically identified streams in the Warwoman watershed as impaired due to fecal coliform and sedimentation.

Introduction

✧ ***2001 Total Daily Maximum Load (TMDL) for Sediment in the Chattooga River Watershed for Roach Mill Creek, Upper Warwoman Creek and Law Ground Creek*** Prepared by Region 4 of the Environmental Protection Agency (EPA).
✧ Focus: The EPA established a TMDL for sediment for the protection of aquatic life in Upper Warwoman Creek, Roach Mill Creek and Law Ground Creek. This TMDL identifies the allowable daily maximum, low to mean flow in-stream sediment concentration, and annual load of sediment that will result in attainment of the applicable narrative water quality standard.

✧ ***2002 Total Maximum Daily Load Implementation Plan (TMDLIP) for Bio M in Warwoman Creek (Sarah's Creek to Chattooga River); Law Ground Creek and Roach Mill Creek*** involved GA EPD issung the first Warwoman Creek TMDLIP as a platform for evaluating and tracking water quality protection and restoration.
✧ Focus: The plan addressed characteristics of the watershed and sources of pollution, and also involved stakeholders and educational/outreach activities. The TMDLIP describes regulatory and voluntary practices and control actions (known as best management practices, or "BMPs") to reduce pollutants, measurable milestone schedules for development of the BMPs, and a monitoring plan to determine BMP effectiveness.

Gravel Forest Service roads throughout the Warwoman Creek watershed produce ongoing erosion and sedimentation into streams.

✧ ***2005 Total Maximum Daily Load (TMDL) Evaluation for Fecal Coliform in Warwoman Creek (Sarah's Creek to Chattooga River)*** involved GA EPD issuing the first Warwoman Creek (Sarah's Creek to Chattooga River) TMDL and an initial TMDLIP for Fecal Coliform as a platform for evaluating and tracking water quality protection and restoration.
✧ Focus: The plan briefly addressed characteristics of the watershed and sources of pollution, and also involved stakeholders. This TMDLIP included a list of regulatory and voluntary practices and control actions (BMPs) to reduce pollutants, and provided for an initial implementation demonstration project for one of the major pollutants.

✧ ***2007 TIER 2 TMDL Implementation Plan, Revision #2, Warwoman Creek (Source to Black Diamond Road) & TIER 2 TMDL Implementation Plan, Revision #1, Warwoman Creek (Sarah's Creek to Chattooga River).*** Focus: Under the guidance of the GA EPD, the Warwoman watershed's original TMDLIP was updated, with the same objectives and by employing the same methodology as the first TMDLIP. The revision for Warwoman Creek (Source to Black Diamond Road) addresses impairment of Biota M (Sediment), and the revision for Warwoman Creek (Sarah's Creek to Chattooga River) addresses impairment due to Fecal Coliform.

✧ ***2008 US Forest Service Letter Seeking Comments on Proposed Forest Plans Goals 22, 24, and 49.*** Focus: The US Forest Service sought comments on proposed Forest Plan Goals aimed at improving watershed conditions in the Big Creek and Reed Creek drainages. Illegal off-road vehicle use was identified as the primary cause of negative impacts to water quality and ecological functions, and remediation treatments for two roads in the Big Creek drainage (Walking Stick Rd. and Horse Cove Rd.) were proposed.

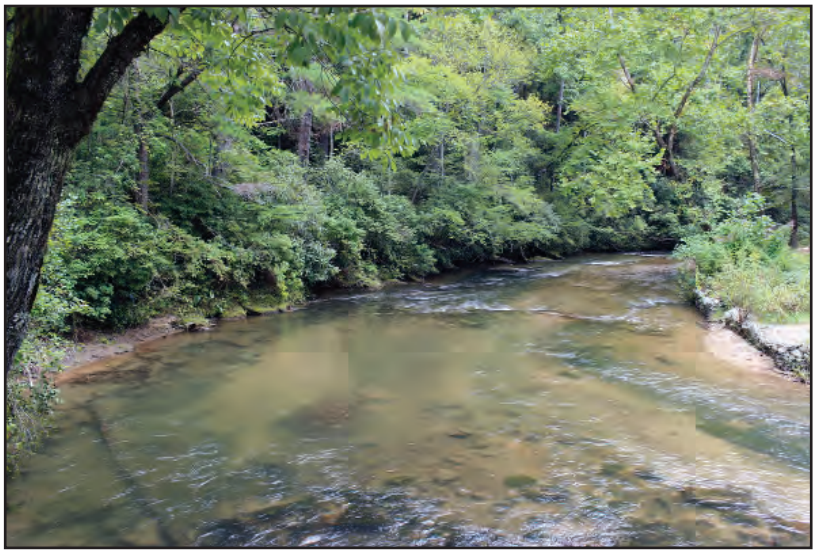
Issues of Concern & Characterization of the Issues' Impacts

♦ **Nonpoint Source Pollution in the National Wild & Scenic Chattooga River** Warwoman Creek and the West Fork of the Chattooga River are tributaries to the federally protected Wild and Scenic Chattooga River, and nonpoint source pollution in those tributary watersheds is widely acknowledged as a significant threat to the river's water quality.

♦ **Agriculture** Predominant agricultural practices in the Warwoman watershed allow livestock free access to streams, and often do not employ riparian buffer strips and additional BMPs for pastures, field crops, waste management, etc. This creates ongoing, chronic sources of fecal coliform, erosion, and sedimentation in the Warwoman watershed.

Introduction

♦ **Roads** The Warwoman watershed contains approximately 144.4 miles of roads. Impervious surfaces such as Highway 28 and Warwoman Road may contribute some stormwater pollution, but issues associated with routine county and Forest Service gravel road maintenance regimes contribute large volumes of pollution as well as ongoing erosion and sedimentation during rain events. In particular, we have identified Earl's Ford Rd. along lower Warwoman Creek, Tuckaluge Creek Rd./ FS153 along Tuckaluge Creek, FS155A along upper Walnut Fork, FS156 along Sarah's Creek, and Overflow Creek Rd. along the West Fork of the Chattooga River as major contributors of nonpoint source pollution into these creeks.



This section of Warwoman Creek beyond the Earl's Ford Rd. bridge is stocked regularly with trout.

♦ **Erosion and Sedimentation Laws** Field surveys during the preparation of this WMP revealed that erosion and sedimentation contributed by land-disturbing activities (LDA) is ongoing. In the Warwoman watershed, LDA includes development of forest to residential area, and continued development on existing residential or pasture land. Improvement in enforcement of erosion and sedimentation laws in the Warwoman watershed is necessary to restore water quality.

♦ **Primary Trout Waters** The streams and tributaries of the Warwoman watershed are classified by the GADNR as "primary trout waters," as are all tributaries of the Chattooga River. Aquatic impairment in the Warwoman watershed makes some streams largely dependent on the GADNR's stocking program to maintain trout populations. The agency stocks Warwoman Creek, the West Fork of the Chattooga River, and Sarah's Creek weekly from April to July, twice before Labor Day, and once in September or October. Holcomb Creek is also stocked twice per month from April to July.

♦ **Wildlife** The large wild pig population is an ongoing concern throughout the State of Georgia, including in the Warwoman watershed. Wild pigs cause damage to the environment and water quality by rooting, exposing roots and loosening soil, and by wallowing in streams and ponds to keep cool. In these ways, they can contribute to both sediment and fecal coliform pollution in the watershed, though the extent of this pollution is unknown. According to staff at the GADNR, an estimated 400-500 wild pigs presently inhabit the Warwoman WMA alone.

Planning Approach

Developing the scope of the Warwoman WMP involved using relatively simple conceptual models as suggested by the EPA's *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*. The conceptual models for the Warwoman WMP employed flow chart-based processes to define the water quality impairment, link the impairment with its environmental stressors and impacts, and identify the sources of the impairment. Utilizing a conceptual model is an accepted practice for identifying the relationship between: a) impairments of fecal coliform and sediment; b) sources of these water quality impairments; and c) their impacts in the Warwoman watershed.

The methodology for composing the Warwoman WMP followed the EPA's *Nine Elements of Watershed Planning* model, which is based on the nine elements presented in the Clean Water Act's section 319 guidelines. **Following these guidelines, the Warwoman WMP's priorities are to:**

✓ *Provide an analysis of the sources of the watershed's water quality problems*

✓ *Estimate the relative contributions from these sources and load reductions expected from applying appropriate best management practices (BMPs)*

✓ *Identify management, educational, and financing measures to remediate these problems along with critical target areas for BMP implementation*

✓ *Establish interim milestones to gauge progress on implementing BMPs*

✓ *Set up criteria to evaluate BMP effectiveness, how well WMP recommendations have addressed water quality issues, and the need for future updates and revisions.*

1. Stream Selection

The geographic and temporal ranges, issues of concern, and impacts of those issues on the watershed (see Scope above) were the main drivers for selecting the Warwoman watershed for nine-element planning (Figure 1).

Warwoman Creek, one of its tributaries, and one tributary of the West Fork of the Chattooga River were classified as impaired under Section 303(d) of the Clean Water Act for not meeting their designated use of fishing due to excessive sediment and/or fecal coliform levels (Figure 2). One additional tributary of the West Fork, Big Creek, was not classified as impaired, but is visibly impacted by a heavy sediment load and in need of assessment.

Total Maximum Daily Load Implementation Plans (TMDLIPs) for Biota M due to Sediment (2002) and Fecal Coliform (2005) aimed at restoring each impaired stream to its designated use as a primary trout stream. However, those TMDLIPs needed to be updated. Revised Tier 2 TMDLIPs were released in September 2007 for Biota M due to Sediment in Warwoman Creek (Source to Black Diamond Rd.) and Fecal Coliform in Warwoman Creek (Sarah's Creek to Chattooga River), which are now out-of-date. One impaired section of Warwoman Creek (Black Diamond Rd. to Sarah's Creek) has been excluded from TMDLIPs thus far. This stretch is part of the section of Warwoman Creek (Finney Creek to Sarah's Creek) that is included in the 2016 303(d) List of Waters as impaired due to excessive sediment.

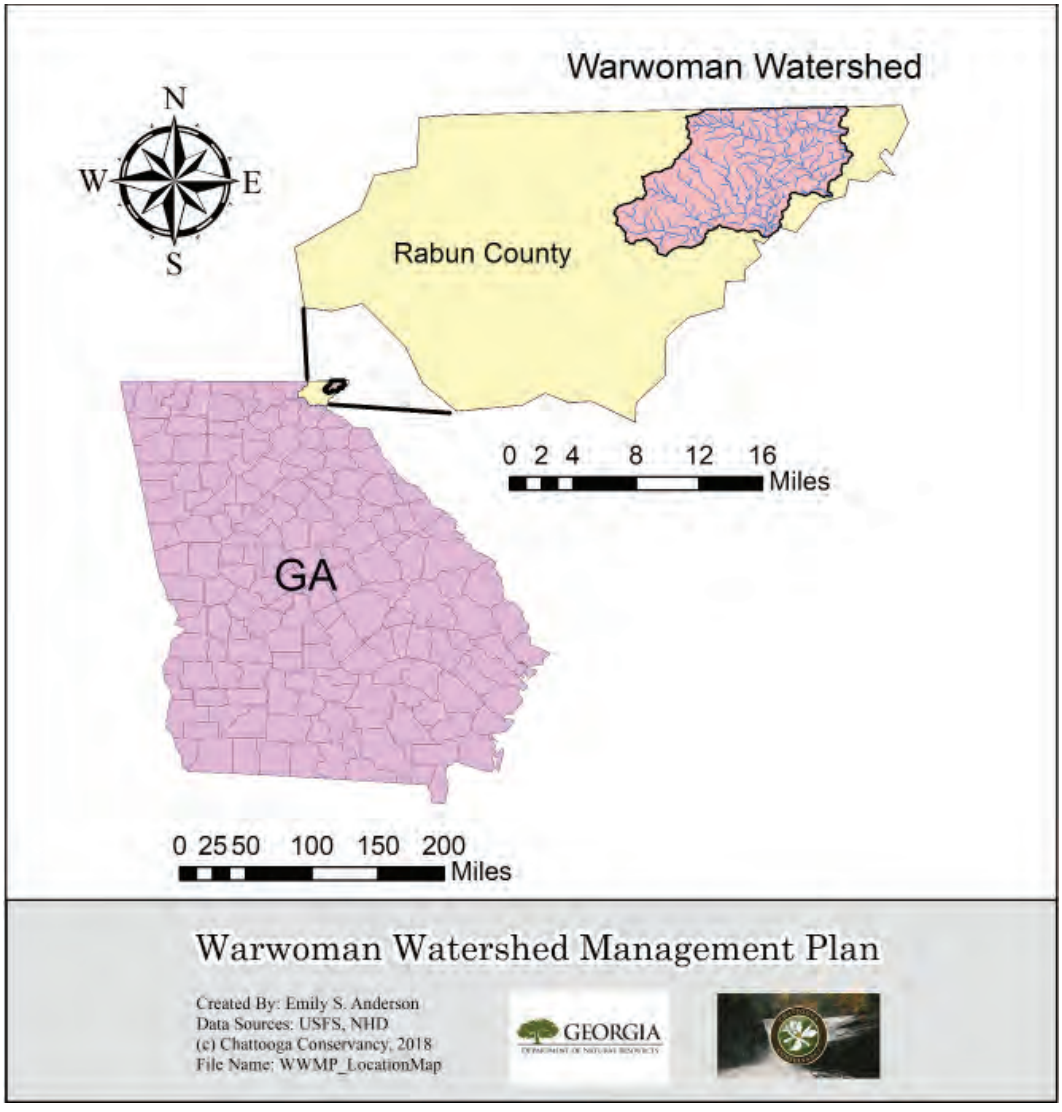


Figure 1: Warwoman Creek Watershed
Rabun County / State of Georgia

Stream Selection

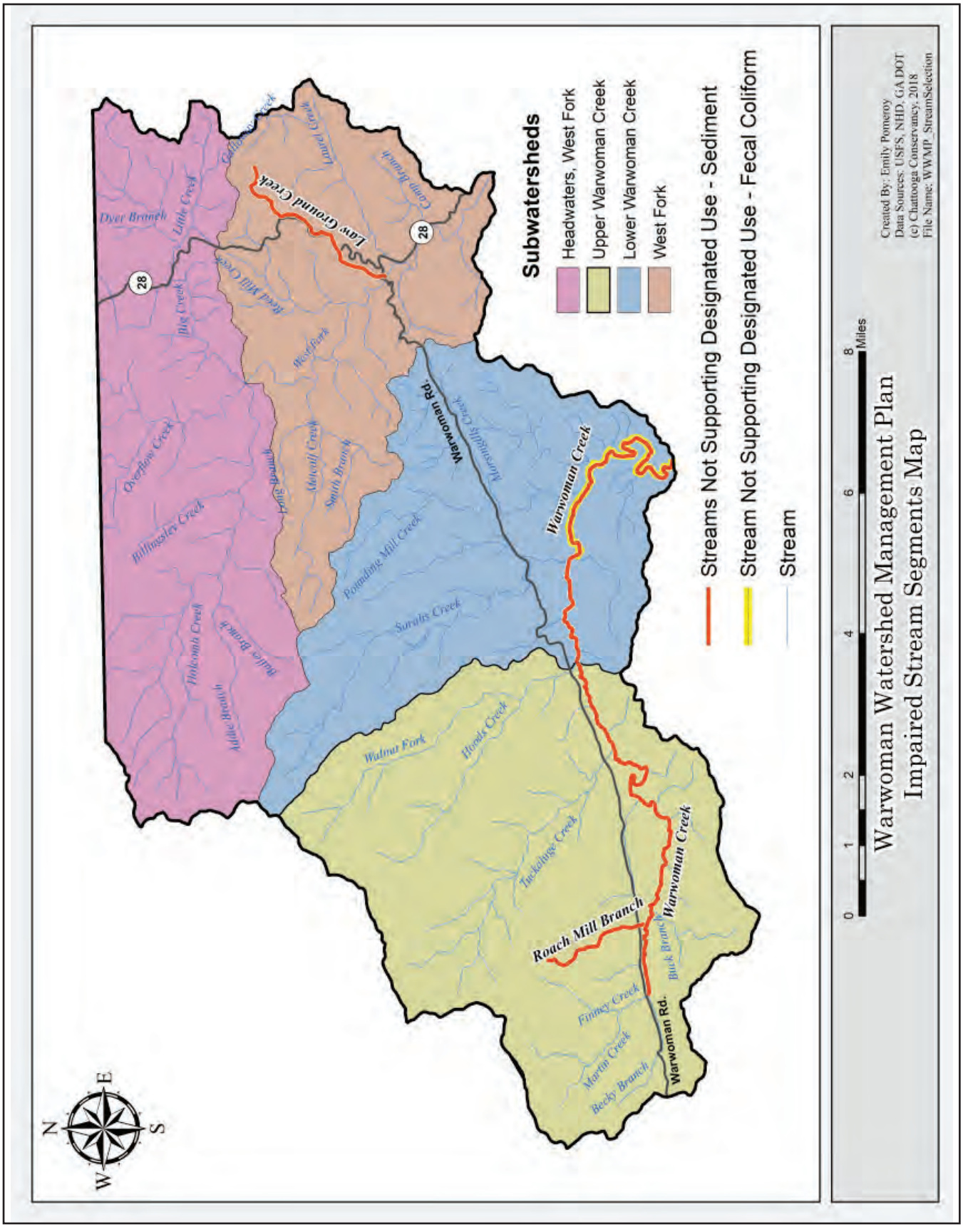


Figure 2: Warwoman Creek Watershed, Impaired Stream Segments

2. Formation of Watershed Advisory Committee

To assist in planning, developing and implementing the Warwoman WMP, a watershed advisory committee (WAC) was convened. Members were selected from the following categories:

- Local Government Representatives: Public Works; Water and Wastewater Departments; Marshals; Sewer and Water Authority
- Regional Governmental Representatives: Health Department; Resource Conservation and Development Council; Regional Commission
- State and Federal Representatives: GA Forestry Commission; US EPA; Natural Resources Conservation Service (NRCS); U. S. Forest Service
- Citizens' groups
- Environmental groups

WAC members were invited from the following specific entities:

- Rabun County Planning and Zoning, Marshal
- Rabun County Health Department; Environmental Health
- Chattahoochee-Oconee National Forest, Chattooga River Ranger District
- Georgia Department of Natural Resources
- IB Environmental
- Georgia Forestry Commission, Chief Ranger
- Rabun County Sewer & Water Authority
- University of Georgia, Agricultural Extension Agent
- Trout Unlimited, Rabun County Chapter

⇨ **See Appendix1 – List of WAC**

3. Source Assessment

The Warwoman watershed source assessment started with a process called "characterizing the watershed." This involved reviewing the watershed's history, problems, and pollution sources to provide the basis for developing effective management strategies specific to the goal of improving water quality in Warwoman Creek, Law Ground Creek, and Roach Mill Creek. While providing historical information and current baseline data for the purposes of this watershed management plan, the characterization and analysis process also helped prioritize the most critical needs, issues of concern, and the types of goals to strive to attain.

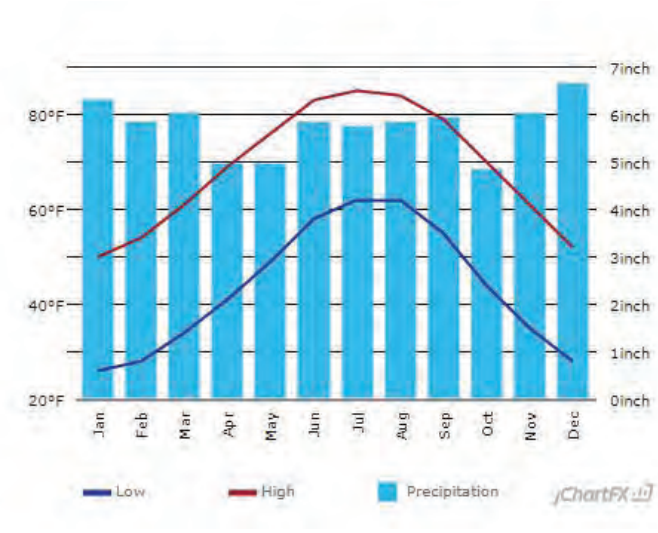
Characterize the Warwoman Watershed

Population Rabun County, Georgia, was established on December 21, 1819, by the Georgia Legislature, and was comprised of land formerly occupied by the Cherokee Indians. The county was named for William Rabun, Governor of Georgia at that time. Since then, Rabun County's population has grown steadily, with two instances of a negative population growth prior to 1910, and a small decline in 1950. According to the 2010 U.S. Census, the population of Rabun County was 16,276 and its population ranked 102nd out of Georgia's 159 counties. The population of Rabun County increased 55.5% between 1980 and 2010. The most significant growth rate in that time was 29.2% in the period between 1990 and 2000, which yielded a net increase of 3,402 residents. As of the 2010 census, more than 70% of the county's total population lived in unincorporated areas, which has been true since the 1980's. The county seat of Clayton has fluctuated between population growth and decline over the past 30 years. Clayton experienced a negative population growth of -12.2% between 1980 and 1990. Since then, Clayton has had periods of rapid growth, ~28.7% between 1990 and 2000, and slower growth, just ~3.4% between 2000 and 2010 (Source: Rabun Co. Comprehensive Plan, 2013 draft; U.S. Census Bureau; GeorgiaInfo, 2018).

Physiography Rabun County is located in two primary physiographic districts: the Blue Ridge Mountains District and the Gainesville Ridges District. The Blue Ridge Mountains District is part of the Blue Ridge physiographic province, which is part of the Appalachian Mountain range. Nearly the entire county is within the Blue Ridge Mountains District, with the exception of a small portion along the Chattooga River. The district is characterized by rugged mountains and ridges with elevations ranging from 3,500 to 4,700 feet, with stream valleys often 1,500 to 2,000 feet below surrounding mountaintops. The southeastern edge of the county is in the Gainesville Ridges District, which is part of the Piedmont Province. This district is characterized by a series of low, northeast-trending, parallel ridges, generally ranging from 1,500 to 1,600 feet in elevation, and narrow stream valleys. (Source: Clark and Zisa, 1976).

Climate Historically, Rabun County touts the area as a place "Where Spring Spends the Summer." During the winter, valleys are very cool with freezing temperatures and also occasional warming trends; upper slopes and mountain tops are generally quite cold. Precipitation in the winter is usually in the form of rain with some instances of snow, freezing rain and ice storms. Storms with frozen precipitation may be heavy; however, ice and snow cover generally does not persist. During the summer, valleys are very warm and frequently hot, and mountains that are hot during the day usually become pleasantly cool at night. Precipitation is heavy and usually distributed throughout the year, with an annual average rainfall of over 70 inches. In fact, the greater Chattooga River watershed receives the largest quantity of annual precipitation of any area east of the Mississippi. Summer precipitation falls chiefly during thunderstorms, and heavy rain events are common.

Figure 3: Precipitation & Temperature
Clayton, Georgia 1981-2010



Source: usclimatedata.com, 1981-2010 annual weather patterns

Groundwater Recharge Areas Recharge is the hydrologic process by which precipitation infiltrates soil and rock to enter an aquifer. Aquifers are underground layers of soils, unconsolidated material, permeable rocks, or rock fractures that hold groundwater. Aquifers yield water to wells, and major water resources may develop in locations where permeable aquifers underlie or are connected to significant recharge areas. Most of

Source Assessment

Table 1: Hydrology - Wetlands & Impoundments in the Warwoman Creek Watershed					
Watershed	Wetland forested, shrub	Wetland emergent	Wetland farmed, other	Wetland riverine	Impoundments
Upper Warwoman	5.73 ac	--	--	--	0.46 ac
Lower Warwoman	6.97 ac	3.48 ac	1.96 ac	0.94 ac	0.88 ac
Headwaters, West Fork	12.81 ac	0.58 ac	--	--	3.24 ac
West Fork	13.26 ac	--	--	35.01 ac	0.62 ac

Source: U. S. Fish & Wildlife Service, National Wetlands Inventory, 2015

northeast Georgia is underlain by crystalline rocks with little to no porosity; however, these rocks do contain joints and fractures that can act as conduits for groundwater movement. Weathered material called saprolite overlies much of the region, and is relatively porous. Precipitation infiltrates through this layer of saprolite and soil to reach fractures and joints in the rocks. Groundwater can be extracted from the saprolite or from rock fractures, where water is stored. These highly fractured zones are the most reliable groundwater sources in the region.

The primary recharge areas in the Piedmont and Blue Ridge Provinces are areas of thick soils/saprolite with low slopes. Due to relatively high elevations and steep slopes of the Blue Ridge Province, large groundwater recharge areas are not common. Only two small groundwater recharge areas are documented in Rabun County: one area is located northwest of the Warwoman watershed, and one area is due west of the Warwoman watershed (Source: GA DNR Hydrologic Atlas 18, 1989).

Hydrology - Wetlands & Impoundments The presence of wetlands and freshwater impoundments in the Warwoman Creek watershed was assessed using the U.S. Fish & Wildlife Service's National Wetlands Inventory (see Table 1, above).

land Use & Habitat Due to the mountainous topography, both agricultural and urban/residential intensive land uses are concentrated along the streams in Rabun County, which include the impaired waterways of Warwoman Creek, Law Ground Creek, and Roach Mill Creek. Warwoman Creek, in particular, bears the brunt of the negative impacts from its proximity to unpaved county roads including Earl's Ford Rd., Sandy Ford Rd., John Houck Rd., and Black Diamond Rd. A report sponsored by the Forest Service in 1995 concluded that open graveled and unsurfaced roads and unfenced pastures in riparian areas were also major sediment sources (Source: Van Lear et al., 1995) (See table 2, land use, & p. 14, Fig. 4, land Cover map.)

Soils Most of the soils in the Warwoman watershed are rich in micaceous schist and are typically very erosive, especially in the absence of vegetative cover and forest floor material. The entire Chattooga River watershed is located within the Blue Ridge Belt. The watershed overlies crystalline bedrock, including gneisses, mica-schists, quartzites, and granites. The region's cool climate and abundant rainfall have contributed to the formation of its loamy, erodible mountain soils. Shallow, sandy loam soils can be found at high elevations, formed by narrow ridges and steep slopes, while well-drained, fine sandy clay loam soils can be found on mid-slope locations and broad ridges. Colluvium at the base of slopes and in coves produces the deepest soils (Source: Van Lear et al., 1995.) (See p. 15, figure 5, soils map & key to soils map.)

Land Use in the Warwoman Creek Watershed				
Table 2	Urban low intensity	Urban high intensity	Clearcut / sparse	Deciduous forest
	3.39%	0.01%	0.04%	68.73%
Evergreen forest	Mixed forest	Row crop/ pasture	Forested wetland	Open water
23.50%	2.93%	1.22%	0.09%	0.02%

⦿ ***Land cover in the Warwoman Creek Watershed*** *is summarized in* ***Table 2****.* (Source: National Land Cover Dataset (NLCD), 2011)

Flood Plain Management – History The Georgia DNR Flood Map Program shows the 1% annual chance (100-year) flood zone around Warwoman Creek, the West Fork of the Chattooga River, and all associated tributaries. Warwoman Creek's flood zone is generally narrow, except in areas where it flows through low-lying fields and private land. It includes portions of Warwoman Road, Joe Speed Road, John Houck Road, Sandy Ford Road, and Earl's Ford Road. Roach Mill's flood zone is narrow within the Chattahoochee National Forest and private land north of Warwoman Road, but widens within farm land south of Warwoman Road at the confluence with Warwoman Creek. The flood zone surrounding the

Source Assessment

West Fork is generally narrow as it flows primarily through the Chattahoochee National Forest, but it does include portions of Overflow Creek Road, Warwoman Road, and Highway 28. No flood zone is shown for Law Ground Creek. Pounding Mill Creek runs in close proximity to Hale Ridge Rd. and crosses beneath it twice; however, no flood zone is recognized for Pounding Mill Creek.

Onsite Sewage Disposal Systems The majority of unincorporated Rabun County is served by septic systems. Septic systems may be appropriate for many areas; however, variables such as soil type, soil depth, slope angle and general maintenance of the system affect the absorption and filtration capability of septic tanks and drain fields. There is not an ordinance in Rabun County requiring septic systems to be pumped out on a regular basis, which is critical for the system's long-term viability to effectively treat sewage on site. Failing septic systems in the Warwoman watershed have been identified as a potentially significant contributor to degradation of water quality (Source: Tier 2 TMDLIP (Revision #1) for Warwoman Creek (Sarah's Creek to Chattooga River), 2007.)

Identifying Data Gaps

There are two significant administrative loopholes that were relevant to the preparation of this WMP. These are as follows:

Missing Stretch of Warwoman Creek in TIER 2 TMDLIPs. There are currently two Tier 2 TMDLIPs that address Warwoman Creek. The first of these plans concerns the section of Warwoman Creek from its source to Black Diamond Road, and is focused on Biota M (sediment) impairment. The second Tier 2 TMDLIP concerns the section of Warwoman Creek from Sarah's Creek to its confluence with the Chattooga River, and is focused on fecal coliform impairment. Missing from these TMDLIPs is the stretch of Warwoman Creek that flows between Black Diamond Road and Sarah's Creek, a segment totaling 3 stream miles. There is no Tier 2 TMDLIP for the stretch of Warwoman Creek that flows between Black Diamond Road and Sarah's Creek; however, this section is not listed as a separate reach on the 2016 303(d) impaired List of Waters. The List of Waters identifies the entire stretch of Warwoman Creek from Finney Creek to Sarah's Creek as impaired due to excessive sediment.

Big Creek, Tributary to West Fork of the Chattooga River. Each stream in Rabun County, and in the State of Georgia, is given a designated use by the GA EPD, in cooperation with the Georgia Wildlife Resources Division. According to multiple officials in each agency, the general intent concerning Rabun County is that all streams are classified as "primary trout streams," an assumption that is reflected in the current existing (and substantiated) designated uses/classifications. An important exception to this rule, however, is Big Creek, which has no recorded information concerning its disposition, classification, or designation. This is significant because Big Creek has been documented as contributing a substantial portion of the Chattooga River's total sedimentation load, via the West Fork of the Chattooga River, and is therefore a potentially significant source of impairment. Yet, surprisingly, it is not listed as "impaired."

Source Loads and Load Reductions Needed

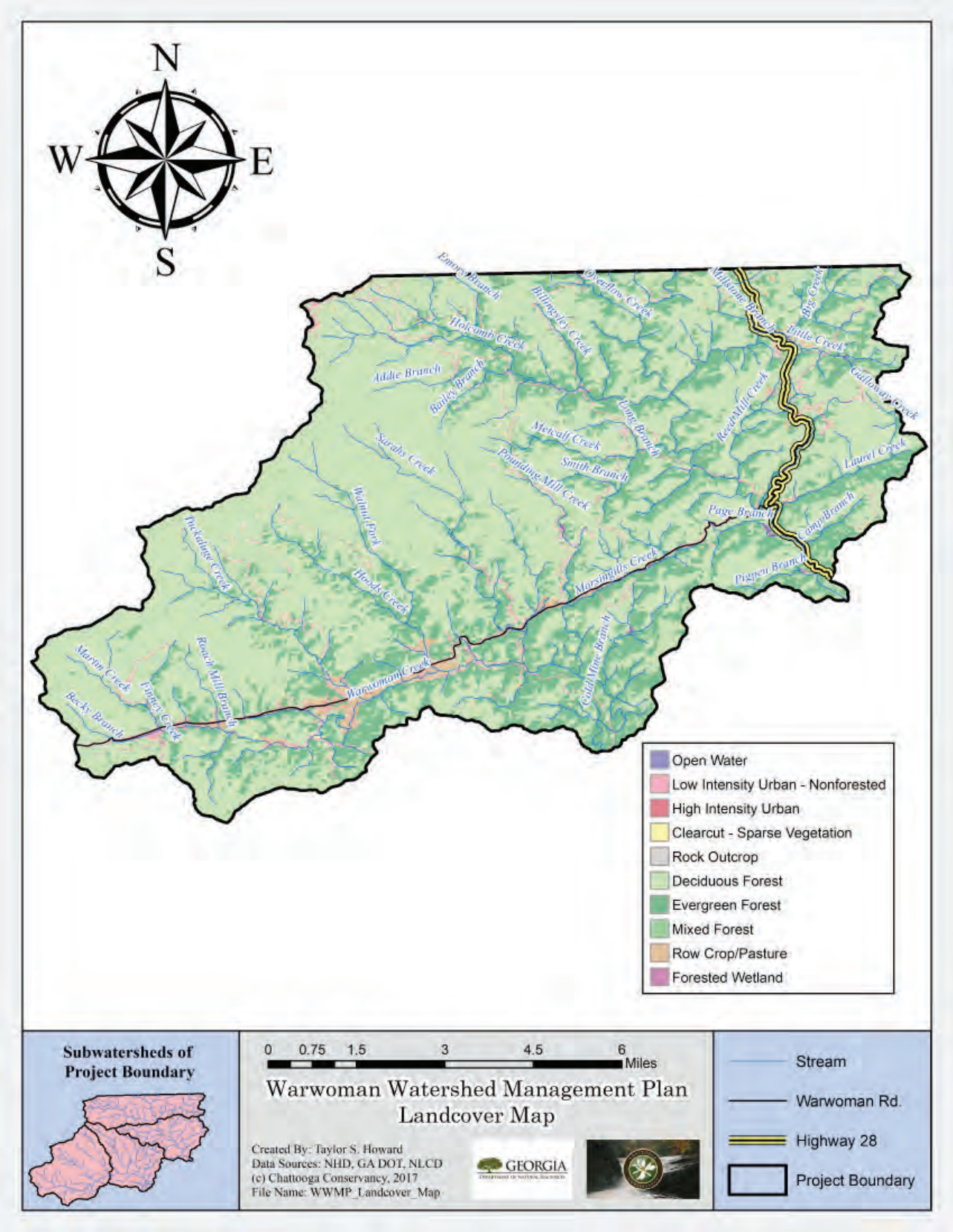
◈ *For summary of source loads and reductions needed, see p. 18, Table 4.*

**Note: The 2002 TMDLIP for Roach Mill and Law Ground Creek switched these creeks, misidentifying Roach Mill as a tributary of the West Fork of the Chattooga River and Law Ground Creek as a tributary of Warwoman Creek. Appropriate details and river lengths for both creeks have been corrected in Table 4 and in this report.*

Warwoman Creek at Earl's Ford after a heavy rain event.

Source Assessment

Figure 4: Land Cover in the Warwoman Creek Watershed



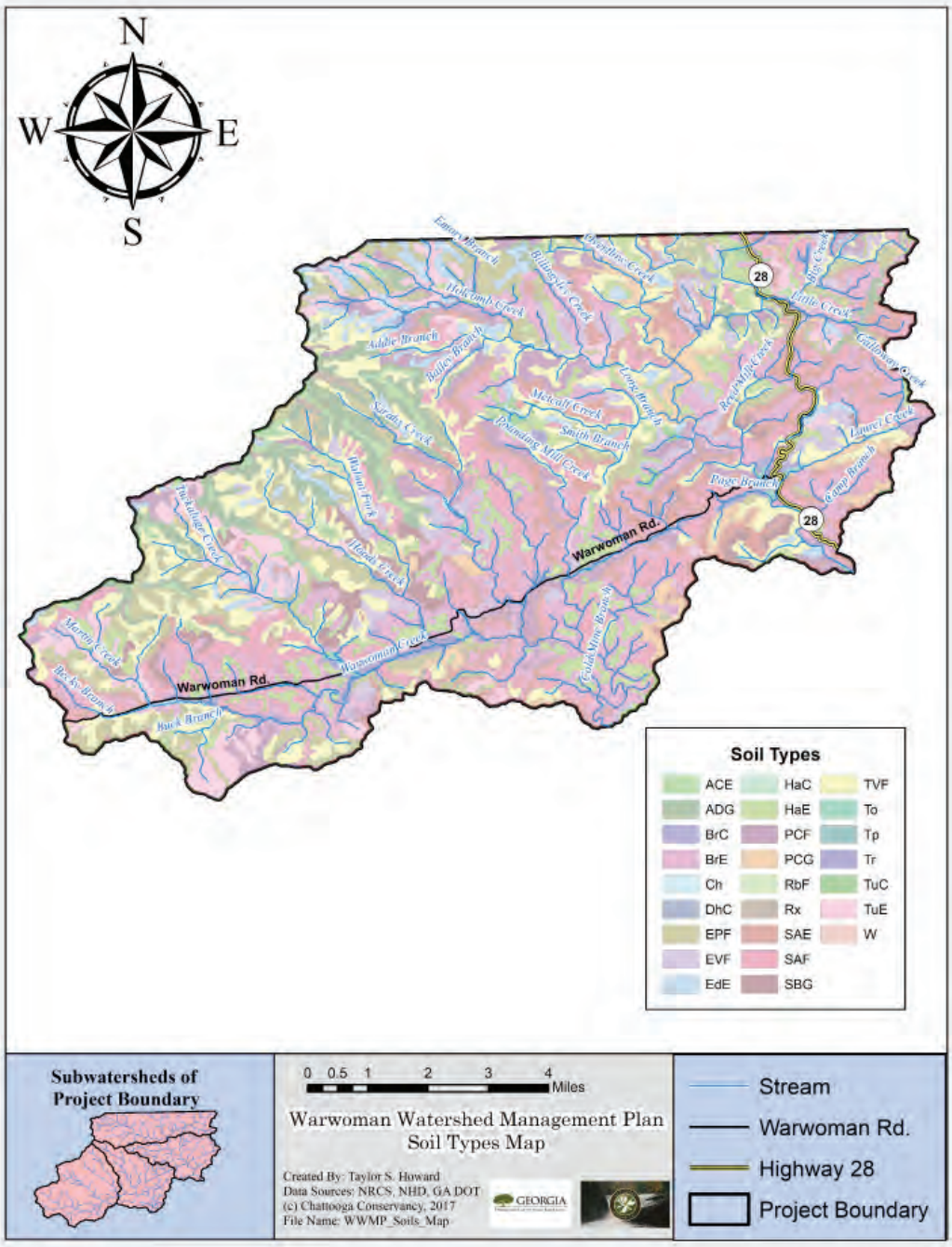
Source Assessment

Table 3 Key to Soil Types

⇨ *Key contains soil type, its brief description, and its corresponding acreage in the Warwoman watershed*

ACE Ashe-Porters association, moderately steep; *619.26 ac*
ADG Ashe association, stony, very steep; *2,021.96 ac*
BrC Bradson fine sandy loam, 2 to 10% slopes; *453.79 ac*
BrE Bradson fine sandy loam, 10 to 25% slopes; *5,978.75 ac*
Ch Chatuge loam; *153.79 ac*
DhC Dillard sandy loam, 2 to 6% slopes; *7.58 ac*
EPF Edneyville-Ashe association, stony, steep; *3,871.11 ac*
EVF Evard association, steep; *1,319.2 ac*
EdE Edneyville sandy loam, 10 to 25% slopes; *1,281.73 ac*
HaC Hayesville fine sandy loam, 2 to 10% slopes; *15.47 ac*
HaE Hayesville fine sandy loam, 10 to 25% slopes; *3,650.27 ac*
PCF Porters association, stony, steep; *2,422.28 ac*
PCG Porters association, stony, very steep; *1,649.82 ac*
RbF Rabun Stony Loam, 25-50% slopes; *34.04 ac*
Rx Rock outcrop; *153.84 ac*
SAE Saluda association, moderately steep; *3,463.76 ac*
SAF Saluda association, steep, *6,151.98 ac*
SBG Saluda and Ashe stony soils, very steep; *977.04 ac*

Figure 5: Soil Types in the Warwoman Creek Watershed



TVF Tusquitee-Haywood association, steep; *6,725.43 ac*
To Toccoa fine sandy loam; 154.*16 ac*
Tp *22.11 ac*
Tr Transylvania-Toxaway complex *459.06 ac*
TuC Tusquitee loam, 4 to 10 percent slopes; *307.34 ac*
TuE Tusquitee loam, 10 to 25% slopes; *2,677.89 ac*
W Water; *60.47 ac*

Source Assessment

◈ Warwoman Creek, Source to Black Diamond Road

The Tier 2 TMDL Implementation Plan (Revision 02) dated September 2007, states that 3.5 miles of Warwoman Creek, from its source to where it meets Black Diamond Rd., do not support a designated use of fishing due to excessive levels of sediment resulting in degraded biota macroinvertebrates. The source location in this case is considered to be the confluence of Finney Creek and Warwoman Creek, and the distance from this point to Black Diamond Rd. actually totals approximately 4 stream miles. The primary sources of sedimentation in this stretch of Warwoman Creek have been identified as originating from urban/residential areas, and associated impervious surfaces, within a close proximity of the creek; urban/residential areas, and associated land disturbances including unpaved roads, construction runoff, and denuded stream banks that are within a close proximity of the creek; agricultural activities, and associated land uses resulting in soil exposure; and, forestry/silvicuture and associated road and pathway construction. The Tier 2 TMDL Implementation Plan calls for a 64% reduction of the existing sediment load for this stretch of Warwoman Creek to meet its designated water quality standards for fishing, and as a primary trout stream.

◈ Warwoman Creek (Sarah's Creek to Chattooga River Confluence)

The Tier 2 TMDL Implementation Plan (Revision #01) for Warwoman Creek (Sarah's Creek to Chattooga River), states that 4.0 miles of Warwoman Creek, from Sarah's Creek to the Chattooga River, do not meet water quality standards due to excessive levels of fecal coliform. The primary sources of fecal coliform in this stretch of Warwoman Creek have been identified as originating from agricultural livestock; failing septic systems; and, to a lesser extent, wildlife, including waterfowl, raccoons, beavers, muskrats, river otters, minks, and white tailed deer. The Tier 2 TMDL Implementation Plan calls for a 69% reduction of existing fecal coliform loads for this stretch of Warwoman Creek to meet its designated water quality standards for fishing, and as a primary trout stream

Sediment turnout from the gravel road through Warwoman Dell is directed toward Warwoman Creek. Even in the furthest upstream sections of the creek, sedimentation coming from unpaved roads is an apparent issue.

Source Assessment

◈ Warwoman Creek (Sarah's Creek to Chattooga River Confluence)

The TMDL Implementation Plan for the Chattooga River watershed, dated 2002, states that 4.0 miles of Warwoman Creek, from Sarah's Creek to the Chattooga River, do not support a designated use of fishing due to excessive levels of sediment resulting in degraded biota macroinvertebrates. The primary sources of sediment in this stretch of Warwoman Creek have been identified as originating from unpaved or poorly maintained roads; construction runoff prior to the limitations established by the General Storm Water Permit; new construction runoff; silviculture; agriculture; and in-stream velocity. The TMDLIP calls for a 64% reduction of existing sediment loads for this stretch of Warwoman Creek to meet its designated water quality standards for fishing, and as a primary trout stream.

◈ Law Ground Creek

The TMDL Implementation Plan for the Chattooga River Watershed, dated 2002, states that 4,407 meters (2.74 miles) of Law Ground Creek, from its source to the West Fork of the Chattooga River, do not support a designated use of fishing due to excessive levels of sediment resulting in degraded biota macroinvertebrates. The primary sources of sediment in this stretch of Law Ground Creek have been identified as originating from unpaved or poorly maintained roads; construction runoff prior to the limitations established by the General Storm Water Permit; new construction runoff; silviculture; agriculture; and in-stream velocity. The TMDLIP calls for a 67% reduction of existing sediment loads for this stretch of Law Ground Creek to meet its designated water quality standards for fishing, and as a primary trout stream.

◈ Roach Mill Creek

The TMDL Implementation Plan for the Chattooga River Watershed, dated 2002, states that 2,689 meters (1.67 miles) of Roach Mill Creek, from its source to Warwoman Creek, do not support a designated use of fishing due to excessive levels of sediment resulting in degraded biota macroinvertebrates. The primary sources of sediment in this stretch of Roach Mill Creek have been identified as originating from unpaved or poorly maintained roads; construction runoff prior to the limitations established by the General Storm Water Permit; new construction runoff; silviculture; agriculture; and instream velocity. The TMDLIP calls for a 44% reduction of existing sediment loads for this stretch of Roach Mill Creek to meet its designated water quality standards for fishing, and as a primary trout stream.

◈ Big Creek

Big Creek is not classified as impaired, and is therefore not included in any existing TMDLs or TMDLIPs. Big Creek has, however, been recognized as a large sediment contributor to the Chattooga River, though its land base is only ~4% of the Chattooga River watershed area (Source: Van Lear et al., 1995 and Hansen, 1998). Water quality monitoring (Appendix 4) has shown that at least the segment of Big Creek from the Walking Stick Rd. bridge to the Highway 28 bridge, a distance totaling approximately 0.6 stream miles, is highly impacted by sediment. The primary sources of sediment in this stretch of Big Creek have been identified as originating from Lige Mill Rd., as well as private dirt trails and farmland along Walking Stick Rd.

Chattooga Conservancy staff collecting water samples from Law Ground Creek.

◈ Environmental Indicators of Water Pollution

Environmental indicators for measuring levels of water pollution in this WMP focus on fecal coliform as the primary indicator of bacteria, and turbidity as the primary indicator of sediment loads. These indicators, based on current TMDLIPs and the historical record of quantitative data assembled for evaluating water quality in the Warwoman watershed, allow for a consistent quantitative measurement of progress towards improving water quality in the watershed. To help measure progress in improving water quality, this WMP also considers stream temperature and the quality of riparian and in-stream habitat. Data collected following a GAEPD-approved QA/QC Water Quality Monitoring Plan are presented in Appendix 4.

Table 4

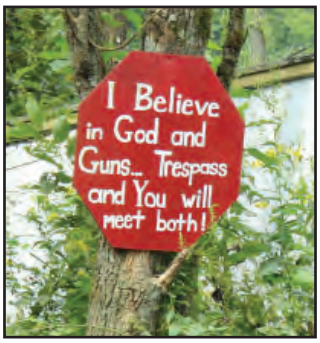
Stream Segments Not Supporting / Partially Supporting Designated Uses in the Warwoman Creek Watershed

Waterbody • ***Designated Use*** • ***Status***	• ***Reach*** • ***Extent***	• ***Criterion Violated*** • ***Percent Reduction Needed from TMDL***	***Potential Causes***	***Date Listed***
Warwoman Creek • Fishing • Impaired: sediment	• Finney Creek to Sarah's Creek • 7.2 miles	• Biota (sediment) 64% reduction	*Impervious surfaces* *Unpaved/poorly maintained roads* *Land disturbances* *New/old construction runoff* *Silviculture* *Agriculture* *In-stream velocity* *Forestry*	TMDLIP 2002 (Black Diamond Rd. to Chattooga); TMDLIP 2007 (Finney Creek to Black Diamond Rd.)
Warwoman Creek • Fishing • Impaired: fecal coliform, sediment	• Sarah's Creek to Chattooga River • 4.0 miles	• Fecal coliform 69% reduction • Biota (sediment) 64% reduction	*Wildlife* *Failing septic systems* *Livestock* *Agricultural* *Silviculture* *Unpaved/poorly maintained roads* *New/old construction runoff* *In-stream velocity*	TMDL 2001 (Sediment); TMDLIP 2007 (FC)
Law Ground Creek • Fishing • Impaired: sediment	• Source to West Fork of the Chattooga River • 1.67 miles	• Biota (sediment) 44% reduction	*Unpaved/poorly maintained roads* *Silviculture* *Agriculture* *Bad instream velocity* *Low intensity residential land disturbance* *New/old construction runoff*	TMDLIP 2002
Roach Mill Creek • Fishing • Impaired: sediment	• Source to Warwoman Creek • 2.74 miles	• Biota (sediment) 67% reduction	*Unpaved/poorly maintained roads* *Silviculture* *Agriculture* *Bad instream velocity* *Low intensity residential land disturbance* *New/old construction runoff*	TMDLIP 2002

4. Assessment and Characterization of Current Conditions

▶ Visual Stream Survey

The visual stream surveys of the Warwoman Creek watershed occurred from October 2017 to September 2018. These surveys covered portions of Warwoman Creek, Roach Mill Creek, Law Ground Creek, Big Creek, Reed Mill, Morsingills Creek, Sarah's Creek, Tuckaluge Creek, Walnut Fork, Clear Creek, and the West Fork of the Chattooga River. Google Earth aerial images were also used to survey areas with limited or no access.



Google Earth was used to survey areas with limited or no access.

♦ *Warwoman Creek Watershed*

Warwoman Creek Watershed - Overview

The Warwoman Creek watershed in Georgia is approximately 70.7 square miles, encompassing approximately 45,226 acres, and includes about 177.5 stream miles. It is comprised of four 12-digit sub-watersheds: the Headwaters of the West Fork of the Chattooga River (HUC-12: 030601020202); West Fork of the Chattooga River (HUC-12: 030601020203); Lower Warwoman (HUC12: 030601020206) and Upper Warwoman (HUC12: 030601020205). Approximately 89.6% of the total watershed is public land on the Chattahoochee National Forest, while the remaining ~10.4% is private land. There are approximately 51 miles of non-U.S. Forest Service roadways, and 93.4 miles of U.S. Forest Service roadways within the Warwoman Creek watershed. The Warwoman Creek watershed's land base (in Georgia) is ~25.3% of the Chattooga River watershed's total area.

Warwoman Creek - Overview

➢ Warwoman Creek is an order six (6) tributary to the Chattooga Wild and Scenic River that originates above the confluence of Martin Creek and Becky Branch, about 1.5 miles east of Clayton, GA, at an elevation of about 1,970 feet above sea level near the landform called Saddle Gap. The creek flows primarily east then south over the course of approximately 12.2 miles, from its headwaters down to its confluence with the Chattooga Wild and Scenic River, which is located near the terminus of Earl's Ford Rd. Warwoman Creek's gradient is mostly moderate throughout its course, with an average gradient of about 39.3 feet per mile.

Annual precipitation in the Upper and Lower Warwoman Creek subwatersheds ranges from around 80 inches near the north-central boundary at higher elevations to approximately 72 inches near Warwoman Creek's confluence with the Chattooga River (Source: USGS, 1990). This area is characterized by heavy storm events. Rainfall frequency and intensity exacerbates many of the issues associated with pollution of Warwoman Creek and its tributaries, as evidenced during visual surveys and water sampling.

➢ From its headwaters, Warwoman Creek initally parallels Warwoman Rd. for approximately 7.5 miles through a landscape that generally appears as farms, pasture lands, residences, and unpaved county roads. Warwoman Rd. is a somewhat busy east-west route that stretches from Clayton, Georgia, to Highway 28. Once the creek departs from Warwoman Rd., it flows an additional 4.7 miles southeast, roughly paralleling Earl's Ford Rd., to where it meets the Chattooga River.

➢ Warwoman Creek's final 4.2 miles are almost exclusively contained within the Chattooga River Ranger District of the Chattahoochee National Forest, where the stream is bordered by relatively undisturbed, mesic mixed oak and pine forests. Just prior to its confluence with the Chattooga River, Warwoman Creek is forded by Earl's Ford Rd.

♦ *Upper Warwoman Creek Subwatershed*

Upper Warwoman Creek Subwatershed - Overview

The Upper Warwoman Creek subwatershed (HUC12: 030601020205) encompasses a total of approximately 14,677 acres, or 22.9 square miles, to the east of the cities of Clayton, Mountain City, and Dillard. The western edge follows the Tennessee Valley Divide for much of its extent. It is the westernmost portion of the Warwoman watershed. In total, approximately 6.9 miles of Warwoman Creek are included in the Upper Warwoman Creek subwatershed. Several tributaries are within the subwatershed's extent, including Becky's Creek (Becky Branch), Martin Creek, Rock Mountain Creek, Roach Mill Branch, Buck Branch, Tuckaluge Creek, Hoods Creek, and Walnut Fork. The Upper and Lower Warwoman Creek subwatersheds are divided at the confluence of Walnut Fork and Warwoman Creek.

Approximately 89.9% (13,193 acres) of the subwatershed is public land located in the Chattahoochee National

Assessment and Characterization of Current Conditions

Forest, and the remaining 10.1% (1,484 acres) is private land, primarily consisting of rural single-family homes and agricultural/ farm land.

Table 5	Urban, low intensity	Urban, high intensity	Clearcut/ sparse vegetation	Deciduous forest
	3.14%	0.03%	0.06%	74.60%
Evergreen forest	Mixed forest	Row crop & pasture	Wetland, forested	Rock out-crop
17.67%	2.04%	2.38%	0.01%	0.04%

◉ ***Land cover in the Upper Warwoman Creek Subwatershed*** *is summarized in* ***Table 5***. (Source: National Land Cover Dataset (NLCD), 2011)

Upper Warwoman Creek- Current Conditions

The headwaters of Warwoman Creek flow from the east side of Saddle Gap, south of Warwoman Road, and from the north side of hills on the western edge of Warwoman Dell. Warwoman Dell is a small, wooded valley that contains a nature trail, historical sites, waterfalls, and the trailhead for Bartram Trail. The entrance to Warwoman Dell is a small gravel and dirt drive with two parking areas, and Warwoman Creek flows just south of the parking areas. A small wooden bridge crosses the stream from the eastern parking lot to a picnic area with a wooden pavilion. From the western parking lot, a trail leads further upstream to another bridged stream crossing (Sample Point (SP) #1). The trail continues following Warwoman Creek upstream to where it emerges from the hillside as a small waterfall.

The creek through Warwoman Dell is heavily shaded within the primarily deciduous forest, and surrounded by abundant rhododendron and other wildflowers. Warwoman Creek is narrow and shallow, the water appears clear, and the stream bed is not heavily sedimented. The gravel road that leads to Warwoman Dell, however, is a likely source of sediment influx into the stream downstream of the sampling point and foot bridge.

Upper Warwoman Creek flows through Warwoman Dell.

The headwaters of Warwoman Creek emerge from the hillside as a small waterfall in Warwoman Dell.

Becky Branch flows from the northwest to meet Warwoman Creek between the two parking areas, ~0.4 miles downstream from Warwoman Creek's start. The confluence is covered in dense vegetation. Warwoman Creek exits Warwoman Dell and continues alongside Warwoman Rd. towards the east-northeast. The creek passes through a horse farm beginning at mile ~0.7, bordered with vegetation and a fence. It then flows beneath a gravel driveway and through another field with horses, lined with little to no vegetation. It passes under Aviator Dr. and along the southern edge of a third field with horses, lined with trees. A house is located less than 100 ft. to the south of the creek on this property. Just before reaching Benny Mountain Rd. at mile 1.1, the creek flows just north of a barn or garage located approximately 15 ft. from its bank. Two other buildings are on this property as well, both within close vicinity of the creek.

Just beyond Benny Mountain Rd., Warwoman Creek meets Martin Creek, which crosses under the road from

Assessment and Characterization of Current Conditions

the northwest. The confluence is located within pasture land, ~35 feet south of Warwoman Road (SP #2). Warwoman Creek flows in a southeastward direction for roughly 350 feet away from the road before turning to flow east-northeast. At the bend, a structure is visible on aerial maps located approximately 20' south of the creek. Roughly 275' downstream, another structure sits within 20-25' of the north bank of the creek, and two additional structures sit ~35' from the south bank. Warwoman flows beneath Beck Ln. and to the south of a small field of row crops, then continues eastward, surrounded by a sparse to absent vegetated buffer as it cuts through agricultural and pasture land, past barns and sheds.

Warwoman Creek flows alongside John Houck Rd.

Roach Mill Creek enters Warwoman Creek from the north ~0.9 miles downstream from the confluence with Martin Creek (mile 2.0). Warwoman continues southeastward between a corn field and pasture for another ~0.15 mile before meeting Buck Branch, which flows from the southwest. The stream continues through fields and into forested land before emerging between two private properties at approximate mile 2.85. Both properties contain residences, and the southern property also contains two outbuildings and a plowed field adjacent to the creek. Warwoman flows southward alongside and then beneath a driveway, then turns eastward at approximately mile 3.0. Following John Houck Road, the creek weaves past homes as close as ~25 ft. and alongside or through several fields containing row crops or livestock, alongside or beneath driveways, and through a small wooded area. This stretch of John Houck Road is gravel and is a source of sediment loading into the creek, particularly during rain events.

Warwoman Creek continues to follow alongside John Houck Rd., often with virtually no vegetative buffer separating it from the gravel road. It crosses under Sandy Ford Rd. at stream mile 3.75 (SP #4). John Houck Rd. ends at this location as Sandy Ford turns north toward Warwoman Rd. Sandy Ford Rd. is gravel as it crosses over the creek, but is paved as it travels north. The creek often appears fairly clear and rocky at the bridge. A small waterfall can be seen upstream, adjacent to remnants of a historic water wheel. The creek is lined with some vegetation until this point.

From the intersection, Warwoman Creek flows northeastward toward Warwoman Rd. It follows Sandy Ford Rd. for approximately 500 ft., with little buffer between them. The east side of the river is heavily vegetated adjacent to a small farm. The creek curves around a private residence on the east side of the road, then again follows the road for ~800 ft. Within this stretch, a bridge crosses the creek constructed of a row of metal culverts topped with concrete and loose gravel. The stream then curves before curving around the east side of another residence located immediately adjacent to the creek, within only a few feet. Homes in this area have residential septic tanks and associated drain fields; in the case of this home, this on-site waste management must be located in close proximity to the creek.

From this point, Warwoman Creek crosses under a private driveway and flows between two houses, each only ~45-50 ft. from the stream. No vegetated buffer is present along the streambanks in this location. As with the house upstream, these houses must have residential septic tanks and drainage fields located near Warwoman Creek. Just beyond these houses, a small barnyard is located ~25 ft. from the creek on its eastern side. Warwoman Creek then turns to the east to flow through forested land,

Warwoman Creek is crossed by a bridge on Sandy Ford Rd.

Assessment and Characterization of Current Conditions

looping briefly back to the west, then south and southeast to agricultural land. A cleared path in the woods follows the stream's path on the river's east bank as it flows south and southeast, which connects to a larger field of row crops. Pasture land borders the right bank. Warwoman Creek turns north, between corn fields and more pasture to the east, which contains cows and at least one donkey. The creek is surrounded by a minimal or nearly absent vegetative buffer, but the livestock are prevented from reaching the stream by a fence.

Warwoman Creek then passes beneath the gravel Black Diamond Road (SP #4.5) and continues northward through additional fields that appear to hold horses (though none have been seen during visual surveys), past two permanent camper homes. The creek then turns northeastward along the south side of a horse camp, then meets Tuckaluge Creek at stream mile 5.6, flowing in from the northwest. The two meet at the southwest corner of a property containing four very large chicken houses. A chicken house is located as close as ~285 ft. to the east of Tuckaluge Creek, and ~440 ft. to the north of Warwoman Creek as it flows along the southeastern edge of the property, bounded to the south by forest land.

Warwoman Creek continues flowing northeast through fields and cropland for about a mile. A footbridge crosses the creek at roughly mile 6.4, and the banks nearby appear eroded and unprotected from the surrounding fields in aerial images. Warwoman Creek then crosses under Joe Speed Rd. at stream mile 6.6 (SP #7). The road is paved, and stormwater turnout from the road on the upstream side of the bridge could contribute to increased runoff velocity and volume, creating sedimentation from stream bank erosion. The stream is noticeably murkier and deeper in this location than the previous sampling location. The vegetated buffers surrounding it on either side of the road are sparse or nonexistant in some locations, but surrounding fields are fenced. Warwoman continues northeastward past several permanent campers, located immediately alongside the creek. The bank of the creek is stripped of vegetation in this location. Opposite the campers is a large hay field, which is presumably fertilized with chicken manure during the spring. Warwoman Creek then passes between properties with structures located ~35-40 ft. from either side of the creek, before meeting Walnut Fork flowing in from the north at stream mile 6.9.

Becky Branch - Overview & Current Conditions

Becky Branch is one of the westernmost tributaries in the Warwoman Creek watershed and a source of Warwoman

Warwoman Creek passes through farmland as it travels toward the first bridge on Joe Speed Rd.

Creek's headwaters, originating in the Chattahoochee National Forest at an elevation of approximately 2,600 ft. It flows to the southeast through deciduous forest and past several wildlife openings for ~0.9 miles before crossing Warwoman Road and dropping into Warwoman Dell as a small waterfall. The water appears clear and shallow as it tumbles over rocks in the creek bottom. The creek flows between two trails for roughly 320 ft. before meeting Warwoman Creek just south of the gravel road.

Martin/ Finney Creek- Overview & Current Conditions

Finney Creek is a 2nd order tributary to Warwoman Creek, formed at the confluence of Martin Creek and Rock Mountain Creek. Martin Creek originates in the mountains of the Chattahoochee National Forest at an elevation of approximately 2,590 ft., while Rock Mountain Creek to the east begins slightly higher at about 2,640 ft. Martin Creek originates in primarily deciduous forest, but enters evergreen forest as it nears the confluence with Rock Mountain Creek. Rock Mountain Creek flows through primarily deciduous forest to the northwest and evergreen/ mixed forest to the southeast. Several wildlife openings are located near and upgradient of these creeks.

Assessment and Characterization of Current Conditions

Finney Creek has a sandy streambed when it reaches Warwoman Road.

Finney Creek itself is approximately half a mile in length from the confluence of its two primary headwater creeks to Warwoman Creek. It is located entirely within the Chattahoochee National Forest until it reaches Warwoman Rd. Finney Creek Rd., a gravel Forest Service road, follows along the eastern side of Finney Creek, crosses Rock Mountain Creek, and continues along the northeastern side of Martin Creek before turning toward the east. The proximity of this gravel/dirt road to these streams makes it a likely source of sedimentation. Just before the intersection of Finney Creek/ Finney Creek Rd. with Warwoman Rd., a large pile of lime sits adjacent to the creek. The pile is separated from the creek by vegetation; however, the lime is not currently covered and reportedly does not have a known purpose at this location. Finney Creek meets Warwoman Creek just ~35 ft. south of Warwoman Rd. within agricultural land.

Roach Mill Branch - Overview

Roach Mill Branch is an impaired (sediment) 1st order tributary to Warwoman Creek. The headwaters of the tributary originate in the Chattahoochee National Forest north of Warwoman Road at an elevation of approximately 2,676 ft. Over the course of its 1.66-mile reach, it loses approximately 900 feet in elevation (~10.3% gradient). The stream flows south-southeast through national forest for most of its course until reaching privately-owned land just north of Warwoman Road. Roach Mill Branch meets Warwoman Creek just south of Warwoman Road within agricultural fields.

Roach Mill Branch - Current Conditions

At its source in the Chattahoochee National Forest, Roach Mill Branch is surrounded by dense vegetation in the largely deciduous forest. It flows through patches of evergreen and mixed forest, mostly appearing in its lower half. A 3.0-acre wildlife opening is located ~0.1 mile immediately west of the creek's source, ~125 ft. upgradient.

The stream enters private land ~1.2 miles from its source. The entrance to this property is gated and inaccessible. Based on information from the Rabun County Tax Assessor's website, the property consists of a single-family residence. Aerial maps show the stream flowing under a driveway and through a wooded portion of the property, passing ~65 feet to the west of a small (~0.25-acre) pond. It then flows along the eastern side of a cleared yard, within or adjacent to forested land, before passing immediately to the west of another single-family residence at ~mile 1.4. The stream crosses beneath a bridge containing a gravel driveway in front of the house and continues south to Warwoman Road, past a large garden, surrounded by a vegetated buffer. It reaches Warwoman Road ~1.55 miles from its source (SP #3). South of Warwoman Road, it continues for 0.12 miles

Roach Mill flows south from Warwoman Road through agricultural fields.

Assessment and Characterization of Current Conditions

within a small vegetated buffer through agricultural fields before reaching Warwoman Creek.

Tuckaluge Creek - Overview & Current Conditions

Tuckaluge Creek is a 3rd order tributary that drains ridges and valleys in the Chattahoochee National Forest north of Warwoman Rd., beginning in the northwestern portion of the subwatershed. It begins at an elevation of ~2,930 ft. and loses ~1,275 ft. in elevation by the time it reaches Warwoman Creek 4.5 miles downstream, giving it an average 5.9% grade. It is not classified as an impaired tributary, but could potentially be a source of heavy sedimentation in Warwoman Creek.

Forest Service road 153 crosses Tuckaluge Creek at stream mile 3.5.

Tuckaluge Creek begins within primarily deciduous forest, but increasing amounts of evergreen forest appear throughout its course to Warwoman Creek. The first ~3.6 miles of Tuckaluge Creek are entirely within public land in the Warwoman WMA. A 3.0-acre wildlife opening is present approximately 0.35 mile from the creek's source, located 0.13 miles to the east and 325' upgradient. A second ~2.85-acre wildlife opening is located 0.15 miles to the northeast and 170 ft. upgradient at mile 2.45. Tuckaluge Creek and its tributaries are frequently crossed or adjacent to a network of U.S. Forest Service roads, including FS 153, 153A, and 153B. These roads are gravel and dirt, making them easily erodible and likely to contribute sediment to these creeks. Erosion mitigation features such as ditches and berms are present throughout the road system, but several areas in need of improved stormwater control were identified. Where FS 153 crosses one tributary, evidence of stormwater draining directly into the tributary from the roadway can be seen. Berms are frequently in need of reconstruction or reconfiguration to properly direct stormwater, and culverts are often damaged and/or too small. A portion of FS 153 follows extremely closely along Tuckaluge Creek; at stream mile 2.5, a large portion of the road washed out and down the steep slope directly to the creek. This landslide reportedly occurred in the spring of 2016, and the area continues to be a source of sedimentation. This road is open seasonally (~8 days out of the year). Evidence of wild pigs was observed throughout the Tuckaluge Creek watershed traveling along FS 153. In several locations along the road and in tributaries to Tuckaluge Creek, soil is loose and turned, roots are exposed, and pools of standing water have been created. Wild pig behavior exacerbates or creates erosion and sedimentation issues from the roads and within streambeds, and likely contributes fecal coliform pollution as well.

Once Tuckaluge Creek enters private land, it immediately flows within ~20-30 ft. of three houses on its west bank. To the east, Tuckaluge is separated from agricultural fields by a vegetated buffer. Continuing to the southeast, it passes several more houses and outbuildings, within ~15-40 ft., on properties containing farms and pasture. Vegetation separates the stream from these properties in some locations.

Tuckaluge Creek reaches Warwoman Rd. at mile 4.2. It flows under the road through a culvert, then passes between pasture to the southwest and a farm containing four very large chicken houses to the northeast. The vegetated buffer surrounding the stream is inconsistent as it flows toward and meets Warwoman Creek at mile 4.5.

Wild hog activity, including rooting and wallowing, impacts water quality in the Warwoman watershed.

Assessment and Characterization of Current Conditions

Walnut Fork- Overview & Current Conditions

Walnut Fork is a 3rd order tributary to Warwoman Creek, and its last tributary on the eastern edge of the Upper Warwoman Creek subwatershed. Its total length is approximately 4.8 miles, and it has an average gradient of 6.8%. Walnut Fork flows through the Chattahoochee National Forest for 3.75 miles before meeting Hoods Creek, an unimpaired stream that flows from the northwest. Above the confluence, several Forest Service roads (FS 155, 155A, 155B, and 155D) run adjacent to or cross Walnut Fork, creating a potential heavy sediment load into the creek.

FS 155 crosses over the headwaters of Hoods Creek, then continues southeastward where it crosses Walnut Fork at approximately stream mile 2.0. FS 155B and 155D are smaller roads that both run between Hoods Creek and Walnut Fork. FS 155A, however, is the primary concern for heavy sedimentation into Walnut Fork. This road travels north from 155 just on the east side of Walnut Fork. At the beginning of 155A, a large campsite sits directly next to the creek. The campsite ground is stripped of vegetation and sedimentation washes directly into the adjacent creek. Just past the campsite, the road is gated. It is only open seasonally to vehicles for hunting, reportedly for less than 10 days out of the year. In numerous locations along this road, stormwater washes directly down the steep slope to the creek. In at least one location, a tributary that would flow under the road through a small culvert was dammed, causing pooling and flow across the road.

Just downstream of the FS 155/155A intersection, several campsites are located along the creek. These sites certainly produce sedimentation during storm events, as ditches and ruts can be seen through them. By one campsite, a makeshift impoundment to fashion a wading pool has been constructed in the creek.

At stream mile 4.05, roughly 0.3 miles below the Hoods Creek confluence, Walnut Fork enters private land. The east bank appears heavily vegetated as it passes pasture land, while the west bank is does not appear vegetated as it passes a horse camp and several structures within 150 ft. As Walnut Fork continues southward, it flows between agricultural land to the west and national forest to the east, separated from the stream by a dirt road. It then passes alongside another field before reaching Warwoman Rd. at mile 4.6 (SP #6). South of the road, Walnut Fork crosses between more agricultural/ pasture land and flows for another 0.2 miles before reaching Warwoman Creek.

A barren campsite in the headwaters of Walnut Fork produces heavy sedimentation into the adjacent creek.

Runoff from FS 155A flows directly to Walnut Fork and one of its tributaries.

FS 155A is a large sediment source to Walnut Fork due to lack of maintenance and the road's close proximity to the stream.

Assessment and Characterization of Current Conditions

♦ Lower Warwoman Creek Subwatershed

Lower Warwoman Creek Subwatershed - Overview

The Lower Warwoman Creek subwatershed (HUC12: 030601020206) encompasses a total of approximately 10,285 acres, or 16.1 square miles, to the east and northeast of the Upper Warwoman Creek subwatershed. Approximately 5.4 miles of Warwoman Creek are included in the Lower Warwoman Creek subwatershed, from its confluence with Walnut Fork to where it enters the Chattooga River. Several tributaries are within the subwatershed's extent, including Sarah's Creek, Pounding Mill Creek, Morsingills Creek, and Gold Mine Branch.

Approximately 90.1% (9,275 acres) of the subwatershed is public land located in the Chattahoochee National Forest, and the remaining 9.9% (1,010 acres) is private land, primarily consisting of rural single-family homes and agricultural/ farm land.

Table 6	*Urban, low intensity*	*Rock outcrop*	*Clearcut/ sparse vegetation*	*Deciduous forest*
	3.35%	*0.04%*	*0.05%*	*64.98%*
Evergreen forest	*Mixed forest*	*Row crop & pasture*	*Wetland forested*	*Open water*
27.25%	*3.35%*	*0.83%*	*0.14%*	*0.01%*

- ***Land cover in the Lower Warwoman Creek Subwatershed*** *is summarized in* ***Table 6.*** (Source: NLCD, 2011)

Lower Warwoman Creek - Current Conditions

Warwoman Creek flows roughly eastward from the confluence with Walnut Fork, surrounded by a vegetated buffer as it travels through agricultural fields and pasture land. At ~mile 7.05, a small structure sits directly on the south bank of the creek. Another home is located ~35 ft. from the bank on the next property downstream, and additional structures can be seen near the creek as it flows toward the northeast.

Warwoman Creek again flows under a bridge on Joe Speed Rd. at approximate stream mile 7.6 (SP #8). Joe Speed Rd. intersects with Earl's Ford Rd. across the bridge. The creek in this location is much wider and appears shallower than the previous crossing, and the water is notably clearer. The creekbed is filled with rocks that have little visible sedimentation. Just upstream of this location is the Hatch Camp and Art Farm, which includes

Warwoman Creek is typically relatively clear as it flows under the second bridge on Joe Speed Rd. The Hatch Camp stocks the creek upstream.

a campground, venue, and fishing destination. The Hatch Camp stocks the creek with trout at this location. The camp proprietor reported no concerns with the water quality in the creek, including visible issues or odors. Corn fields are located across the creek from the Hatch Camp before the bridge.

Downstream of this bridge, Warwoman flows past row crops, then between two or three homes <100 ft. from the river's south bank and a property containing stables (no horses have been seen during field surveys) on the stream's north bank. About a quarter of a mile from the bridge (mile 7.85), it flows beneath another bridge on Daisey Ln. Several homes are located along Daisey Ln., to the south of Warwoman Creek. At mile 8.0, Warwoman Creek flows beneath a bridge on Earl's Ford Rd. from the southwest (SP #9). The creek again appears shallower and wider than at the previous bridge crossing. A campsite

Several campsites on Earl's Ford Rd. are located immediately alongside Warwoman Creek.

Assessment and Characterization of Current Conditions

The Earl's Ford Rd. campsites are infrequently maintained and often filled with trash and waste.

Campsites along Earl's Ford Rd. exhibit chronic sources of sediment and bacterial pollution into Warwoman Creek.

A toilet seat used at a campsite on Earl's Ford Rd. sits just a few feet from Warwoman Creek.

on private property sits on the west side of the creek just before the bridge. This campsite contains a significant amount of garbage and waste, which could be a source of pollution into the creek.

Earl's Ford Road turns to gravel beyond the bridge. Just downstream of the bridge, Warwoman again turns toward the east. Beyond this point, the creek is located entirely within the Chattahoochee National Forest. Seven campsites have been established immediately adjacent to the creek along Earl's Ford Rd. over approximately 0.56 stream miles, and approximately four campsites sit on the opposite side of the road. These campsites are infrequently maintained and do not have any associated facilities, but they are often in use, sometimes for weeks at a time. Piles of trash and human waste have been found throughout these campsites, making them a likely source of fecal coliform and other pollution in the creek and posing a public health risk. The road closely follows the creek for this stretch, often within ~30 ft., and as little as ~15 ft. from the streambank in at least one area.

Sarah's Creek flows into Warwoman Creek from the north at stream mile 8.2. Beyond this point, Warwoman Creek is classified as impaired from both sediment and fecal coliform. Warwoman Creek turns to the south and meets an unnamed tributary ~320 yards downstream.

Earl's Ford Rd. veers south at stream mile 8.6 and follows a similar path toward the Chattooga River along the opposite side of a ridge. At stream mile 9.2, Morsingills Creek flows into Warwoman Creek from the north, followed by Gold Mine Branch ~0.5 mile further downstream. There is reportedly an old splash dam in this section of the creek.

At mile 11.1, Warwoman Creek turns back toward the west and crosses over Earl's Ford Rd. (SP #10). This is a passable ford for 4WD vehicles at low water, but during higher water events, the creek is very wide and swift in this location. Here, Earl's Ford Road can be observed as the source of a substantial amount of sediment flowing into Warwoman Creek. The road is both gravel and dirt, and becomes very muddy during rain. Chronic erosion and sedimentation from the road is visible at the mouth of the ford. Adjacent to the intersection of the creek and Earl's Ford Rd., vehicle tracks are present on a steep and muddy embankment; activities of this nature certainly contribute to erosion and sedimentation directly into the creek as well. Two large campsites are also located directly on the right bank, often littered with trash. Runoff from these campsites flows to the road and creek.

Beyond the ford, Warwoman Creek flows freely through undeveloped forest land for the remainder of its course until reaching the Chattooga River.

Assessment and Characterization of Current Conditions

Wooded campsites at Earl's Ford.

Sarah's Creek - Overview & Current Conditions

Sarah's Creek is an unimpaired tributary to Warwoman Creek. It originates from ridges of the Chattahoochee National Forest at an elevation of ~3,685 feet in the western portion of the watershed, and flows for a total length of approximately 6.2 miles to its confluence with Warwoman Creek. It has an average gradient of ~6.4%, losing ~2,085 feet in elevation from beginning to end.

Sarah's Creek begins in primarily deciduous forest, then flows southeastward through evergreen and mixed forest toward Warwoman Rd. Within the national forest, Sarah's Creek and its tributaries are frequently in close proximity to or crossed by Forest Service roads, including FS 156, 156A, 156B, 156C, 155, and 155C. FS 156C follows the top of a ridge to the southwest of upper Sarah's Creek; this road is only open seasonally, for approximately seven weeks out of the year. FS 156 is approximately 4.6 miles long, and follows the creek closely for at least half this distance, fording it at least once (approximate stream mile 2.4). This ford was blocked by a downed tree during the visual survey, so we were prevented from traveling further north. The road reportedly becomes very difficult to traverse.

At stream mile 2.8, Sarah's Creek is forded by a road leading to a few campsites and a vault toilet associated with Sarah's Creek Campground. Approximately 0.4 miles downstream, an unnamed road off FS 156 fords Sarah's Creek, leading to a series of dirt roads on the opposite side. These roads are not identified on USFS maps. The main portion of Sarah's Creek Campground is located between approximate stream miles 3.3 and 3.6. At the beginning of this stretch, the creek flows beneath a bridge on FS 156. In total, the campground contains 26 campsites and two chemical vault restroom facilities. These named roads and the campground are the only development along Sarah's Creek until it reaches Warwoman Rd. at stream mile 5.4.

As Sarah's Creek flows south from Warwoman Road, it meets an unnamed tributary flowing from the northeast at the south end of private property. The tributary flows along the edge of the property before meeting Sarah's Creek. The property is labeled Godfrey Farms and contains several old farm buildings, but does not appear to currently house any livestock or chickens (Source: David Vinson, USFS). From this confluence, Sarah's Creek flows south through a large wildlife opening managed by the US Forest Service. According to David Vinson of the USFS, the wildlife opening is frequented by bears, deer, beavers, and some small species including rabbits, squirrels, etc. In the past, corn was planted in the opening. Beavers have routinely dammed Sarah's Creek and diverted its flow into the field, but storms break up these dams.

Sarah's Creek is forded several times by Forest Service system roads and unnamed trails.

Morsingills Creek - Overview & Current Conditions

Morsingills Creek is a 3rd order tributary to Warwoman Creek that flows from the northeast. Its length totals approximately 3.7 miles, over half of which is located immediately adjacent to the south side of Warwoman Rd. It begins just above a 3.0-acre pond located on private property. Just below the pond, it flows through Chattahoochee National Forest, crosses beneath a gravel Forest Service road, and crosses beneath Warwoman Rd. twice before again reaching private land. Morsingills Creek

Assessment and Characterization of Current Conditions

then flows for about 0.75 miles through horse pastures and below driveways. The creek flows through a culvert beneath an earthen bridge on one property, which is presumably for horses or other livestock, but no vegetative buffer surrounds the creek as it flows through these properties (Source: Google Earth).

Morsingills Creek downstream of the confluence with Pounding Mill Creek.

Morsingills Creek reenters forested land at the confluence with Pounding Mill Creek at mile 2.2, from which point it turns to flow to the south toward Warwoman Creek. Just below the confluence and before turning toward the south, Morsingills is a shallow stream within an evergreen forested area (SP #11). The water appears somewhat murky, but the cobbles in the creekbed are not heavily sedimented. Beyond this point, the creek passes alongside a plowed field, then flows near a dirt road and private property for ~0.35 miles before turning toward the east. It continues through Chattahoochee National Forest land until reaching Warwoman Creek downstream of the Sarah's Creek confluence.

Pounding Mill Creek - Overview & Current Conditions

Pounding Mill Creek is a 4.9-mile tributary that flows roughly north-south in the central portion of the Lower Warwoman sub-basin. From its headwaters north of Warwoman Rd. to the confluence with Morsingills Creek, it loses approximately 885 feet in elevation (~3.4% gradient). A private residence is located near the headwaters of Pounding Mill Creek. It passes three additional homes or structures on private property, each within ~50' of the creek, around mile 1.4-1.5. The creek flows in close proximity to Hale Ridge Rd. for nearly its entire reach within Chattahoochee National Forest. Hale Ridge Rd. is a gravel road that follows along the eastern side of Pounding Mill in its headwaters, then crosses to follow closely along the western side of the creek. The road is typically within ~200-600 feet away from the creek at any time, upgradient. Pounding Mill passes a couple of houses, as well as a small farm and a private residence, as it crosses beneath Warwoman Rd. at mile 4.85. Just downstream of crossing Warwoman Rd. is where Pounding Mill meets Morsingills Creek on private property.

♦ West Fork Chattooga River Subwatershed

West Fork Chattooga River Subwatershed - Overview

The West Fork Chattooga River subwatershed is comprised of HUC-12 #030601020203, and encompasses a total of approximately 8,624 acres/ 13.5 square miles to the north and northeast of the Lower Warwoman subwatershed, and to the south of the Headwaters West Fork Chattooga River subwatershed. The boundary between the West Fork and Headwaters West Fork subwatersheds is a roughly East-West divide that extends through the scenic "Three Forks" area, where Overflow Creek, Holcomb Creek, and Big Creek meet to form the West Fork. The entire ~6 miles of the West Fork are located in the West Fork Chattooga River subwatershed. Several tributaries are also within the subwatershed's extent, including Long Branch, Metcalf Creek, Smith Branch, Reed Mill Creek, Law Ground Creek (impaired, biota/sediment), Laurel Creek, Page Branch, Camp Branch, and Pigpen Branch.

Approximately 91.4% (7,880 acres) of the subwatershed is public land located in the Chattahoochee National Forest, and the remaining 8.6% (744 acres) is private land, primarily consisting of rural single-family homes and agricultural/ farm land.

The West Fork of the Chattooga River is a 6th order tributary to the Chattooga Wild and Scenic River, and is included in the Wild and Scenic corridor for the duration of its length. It originates at an elevation of 1,829.6 feet above sea level. It flows in a southeasterly direction from

Assessment and Characterization of Current Conditions

its source to the Chattooga River, and has a very low gradient (<1%), losing only around 265 feet in elevation throughout its course.

Table 7	*Urban, low intensity*	*Urban, high intensity*	*Clearcut sparse*	*Deciduous forest*
	4.02%	*0.00%*	*0.03%*	*64.47%*
Evergreen forest	*Mixed forest*	*Row crop & pasture*	*Wetland forested*	*Rock out-crop*
27.62%	*3.11%*	*0.49%*	*0.17%*	*0.10%.*

⦿ ***Land cover in the West Fork Chattooga River Subwatershed*** *is summarized in* ***Table 7****.* (Source: NLCD, 2011)

West Fork Chattooga River - Current Conditions

The West Fork of the Chattooga River begins at the confluence of Big Creek, Holcomb Creek, and Overflow Creek in the north-central portion of the subwatershed. It winds through undisturbed forest land for the first 2 miles before reaching the Overflow Creek Road bridge (SP #14.5). The river in this location is wide and shallow at normal flow levels, and appears relatively clear. Prior to this point, three unnamed tributaries flow into the West Fork from the southwest and northeast.

Beyond the Overflow Creek Rd. bridge, Overflow Creek Rd. closely follows the northern side of the river for about half a mile before diverging around the opposite side of a hill, then returns to a point within 200 feet of the river as it winds toward the intersection with Warwoman Rd. Approximately 0.4 miles downstream from the bridge is the West Fork Campground on the east side of the river. The campground consists of a gravel parking lot, five primitive campsites that are only accessible on foot, and a chemical vault toilet next to the parking lot.

About 500 feet downstream of the lowest campsite, Reed Mill Creek flows into the West Fork from the north through a large culvert. Another 0.8 miles downstream (mile 3.35) is SP #12, where Warwoman Rd. crosses over the West Fork. The river's appearance is similar to upstream at the Overflow Creek Rd. bridge, but it is typically somewhat deeper. At lower levels, sand is visible coating the river bed. Warwoman Rd. and Overflow Creek Rd. intersect on the north side of the river. A gravel parking lot is located in this intersection, which is most commonly used by fishers

The West Fork of the Chattooga River from the Warwoman Rd. bridge.

Assessment and Characterization of Current Conditions

or boaters. The parking lot does not contain any restroom facilities or trash collection, and the ground is littered with garbage and waste. This parking lot's location ~110 ft. away and upgradient of the West Fork of the Chattooga River is concerning, as this is clearly a potential source of fecal coliform pollution during heavy-use seasons and rain events.

Law Ground Creek meets the West Fork from the northeast just below the bridge (mile 3.4). Approximately 0.14 miles downstream of the confluence, the West Fork passes two plowed openings on the west bank, as Highway 28 runs ~50 ft. from the river along its east bank. Page Branch flows into the West Fork from the west at river mile 3.8. Highway 28 continues to follow closely alongside the river at distances ranging from ~50 ft. to 0.2 miles to the Chattooga River. The West Fork passes another wildlife opening at mile 4.7, then meets Pigpen Branch at approximately mile 5.0. From this point, it continues through undisturbed forest land for the remainder of its course to the Chattooga River.

Law Ground Creek - Overview

Law Ground Creek is an impaired 3rd order tributary to the West Fork of the Chattooga River. The headwaters of the tributary originate in the Chattahoochee National Forest east of Highway 28 at an elevation of approximately 2,600 ft. It flows down a steep gradient over the course of its 2.74-mile reach, losing approximately 1,000 feet in elevation by the time it reaches the West Fork (~6.9% gradient). The stream flows in a southwest direction through national forest and areas of private land before meeting the West Fork just southeast of Warwoman Road.

Law Ground Creek flows through a culvert beneath Warwoman Rd.

Law Ground Creek - Current Conditions

Law Ground Creek begins along the south side of Glade Rd., less than 100 ft. from the pavement. It closely follows the road for just over half a mile before entering private property, where it passes to the east of a house and immediately adjacent to two small ponds. It crosses beneath the gravel driveway and flows southwest beneath Timberlane Rd. From here, it flows through private forest land and turns toward the south, where it continues onto public forest land. It closely follows Highway 28, generally within 100 ft. or less, for nearly a mile, then crosses beneath Highway 28 approximately 1.8 miles downstream from its source (SP #15).

To the southwest, Law Ground again flows onto private property at mile ~2.3. The property contains several houses or outbuildings, a gravel driveway, and a small pond. The property is named Overflow Creek Farm, but currently only has a garden and a small number of chickens. The creek flows through forested land along the eastern side of the cleared property for 0.2 miles. It passes through private forested land until reaching Warwoman Rd. at mile 2.67 (SP #13), where it emerges as a relatively clear mountain stream surrounded by thick vegetation. Approximately 370 ft downstream, Law Ground Creek flows into the West Fork of the Chattooga River.

Reed Mill Creek - Overview & Current Conditions

Reed Mill Creek is a 2nd order tributary to the West Fork of the Chattooga River. It is approximately 2.0 miles long and has an average gradient of 6.5%. Reed Mill is not listed on the 303(d) List of Waters. It does, however, appear to be a significant source of sedimentation to the West Fork based on sampling results (Figure 8, p. 38).

Reed Mill's headwaters originate in forested hillslopes on private land to the west of Highway 28. Within its first ~0.45 mile, it flows through plowed fields and yards, near several houses, and alongside or beneath multiple dirt/gravel roads and driveways with little or no vegetative buffer along its banks. Once exiting private land, it continues through national forest for most of its course.

Assessment and Characterization of Current Conditions

It meets a primary tributary at mile 0.65, which has passed through more farm land to the east of Hwy. 28. These private properties are likely primary sources of sedimentation into Reed Mill Creek. FS road 86D, or Reed Mill Creek Rd., follows along this tributary as it exits private land for ~0.3 miles, and continues alongside Reed Mill Creek for roughly half a mile. This portion of the road has reportedly been closed for approximately 15 years.

Reed Mill meets Overflow Creek Rd. approximately 70 ft. from its confluence with the West Fork of the Chattooga River. It flows through a very large culvert under the road into the West Fork.

Reed Mill Creek flows through a large culvert into the West Fork of the Chattooga River.

♦ *Headwaters of the West Fork Chattooga River Subwatershed*

Headwaters of the West Fork Chattooga River Subwatershed - Overview

The Georgia portion of the Headwaters West Fork Chattooga River subwatershed is included in HUC-12 #030601020202, and encompasses a total of approximately 11,640 acres/ 18.2 square miles, making up the northernmost portion of the Warwoman watershed, extending to the Georgia-North Carolina border. The Headwaters West Fork Chattooga River subwatershed extends into North Carolina for an additional ~16,365 acres; however, this WMP is limited to the portion of the subwatershed located within the State of Georgia. Overflow, Holcomb, and Big Creeks, which join to become the West Fork of the Chattooga River, are all located within the Headwaters West Fork Chattooga River subwatershed. Several other tributaries are also within the subwatershed's extent, including Bailey Branch, Addie Branch, Emory Branch, Billingsley Creek, Clear Creek, Millstone Branch, Talley Mill Creek, Pin Mill Branch, and Little Creek.

Approximately 87.4% (10,172 acres) of the subwatershed is public land located in the Chattahoochee National Forest, and the remaining 12.6% (1,468 acres) is private land, primarily consisting of rural single-family homes and agricultural/ farm land. These areas of private land are primarily located in the western portion of the watershed near the headwaters of an unnamed tributary to Holcomb Creek, and in the eastern portion of the watershed around Big Creek and its tributaries. Clear Creek also flows through private land in North Carolina.

Table 8	*Urban, low intensity*	*Rock outcrop*	*Clearcut/ sparse vegetation*	*Deciduous forest*
	3.27%	*0.13%*	*0.01%*	*67.79%*
Evergreen forest	*Mixed forest*	*Row crop & pasture*	*Wetland forested*	*Open water*
24.48%	*3.55%*	*0.62%*	*0.10%*	*0.05%*

⦿ ***Land cover in the Headwaters West Fork Chattooga River Subwatershed*** *is summarized in* ***Table 8****. (Source: NLCD, 2011)*

Holcomb Creek - Overview & Current Conditions

Holcomb Creek is an unimpaired 5th order stream and one of three primary headwater tributaries that form the West Fork of the Chattooga River. It originates on the northern slope of Rabun Bald in Georgia at an elevation of ~3,555 ft. Over its 6.4 miles, it averages a steep 5.1% gradient, losing roughly 1,725 ft. in elevation by the time it converges with Overflow and Big Creeks at Three Forks. Holcomb Creek flows entirely through Chattahoochee National Forest land, but the creek and its tributaries are crossed numerous times by Forest Service roads FS 86, 86B, 7, and 696, Overflow Creek Rd., and Hale Ridge Rd.

Assessment and Characterization of Current Conditions

Overflow Creek - Overview & Current Conditions

Overflow Creek is an unimpaired 5th order stream and also one of the three primary headwater tributaries that form the West Fork. It begins to the northeast of Scaly Mountain, NC, and flows towards the southeast, crossing into Georgia in its lower half. It enters Georgia at an elevation of ~2,278 ft. and flows for an additional 3.8 miles to the Three Forks confluence. In this stretch, Overflow Creek loses roughly 448 ft. in elevation and has an average 2.2% gradient.

Approximately 0.2 miles into north Georgia, Overflow is crossed by Billingsley Creek Rd./ FS 86B. The creek follows this road for a short distance (~0.3 miles), then continues toward the southeast through undeveloped public forest land for the remainder of its course to Three Forks.

Sediment washes across and down Walking Stick Rd. toward Big Creek from farmland and dirt trails.

Big Creek - Overview & Current Conditions

Big Creek is the third primary headwater tributary that forms the West Fork. It is not identified as an impaired tributary on the GA EPD 305(b)/303(d) list, but it is a known contributor of a significant amount of sediment to the West Fork (Source: Van Lear et al., 1995). It is a 4th order tributary.

Big Creek begins in North Carolina and flows to the southwest, crossing into Georgia to the east of Highlands, NC. Its total length within Georgia is approximately 4.4 miles and it has an average gradient of ~2%. From the border, it flows just over one mile through undisturbed national forest before reaching private property, where a single home sits immediately adjacent to the creek, within ~25 feet. Lige Mill Road begins at this house and parallels the northwest side of the creek for 0.3 miles. Several other buildings are visible in aerial photos, sitting along or near the road, upgradient from the creek. Several dirt trails are cut throughout the hillside.

Big Creek flows beneath Hwy 28 and alongside a gravel driveway.

Big Creek flows beneath Walking Stick Rd. just southeast of the intersection of Lige Mill Rd. and Walking Stick Rd. (SP #17), at approximate stream mile 1.7. At this location, Big Creek has a visibly high sediment and sand load. The creek shallows on the downstream side of the bridge. A pipe enters the stream on the upstream east side of the bridge, to be used for pumping. The creek is bordered by a vegetated buffer as it continues downstream. In two separate locations along Walking Stick Road, just to the northwest and upgradient of the creek, large swaths of sediment cover the road. The sediment appears to wash out of the field on the south side of the road and a dirt road on the north side of Walking Stick Rd.

Continuing downstream, Big Creek winds past a field with crops and a pasture. A house or barn is located only ~25 ft. from the creek on the south bank. Little Creek meets Big Creek from the southeast at stream mile 1.8. As Big Creek continues past a field of wildflowers and agricultural land, it passes two small structures, each located roughly 50' from the left bank, and a house located ~70 ft. from the right bank. Big Creek reaches Hwy. 28 at stream mile 2.2 (SP #16), where it is

Assessment and Characterization of Current Conditions

crossed by a paved bridge. The creek has widened and appears slightly deeper at this location, and the water is often noticeably more turbid. From here, Big Creek flows in a general southwestern direction through the Chattahoochee National Forest with a ~3.4% gradient until reaching Three Forks.

⇨ *See* **Figure 6: Map of Warwoman Creek Watershed Bacterial Sampling Locations** (SEE P. 36)

⇨ *See* **Figure 7: Map of Warwoman Creek Watershed, Bacterial Sampling Locations_ Level of Impairment** (SEE P. 37)

⇨ *See* **Figure 8: Map of Warwoman Creek Watershed, Turbidity Sampling Locations_ Level of Impairment** (SEE P. 38)

⇨ *See* **Appendix 5: Warwoman Creek Watershed Fecal Coliform Bacteria Sampling Data 5-18_9-18 Final**

⇨ *See* **Appendix 6: Warwoman Creek Watershed Data Table_comprehensive**

▶ Review of Existing Data

Data records documenting water quality in the Warwoman Creek watershed have been reviewed. These records include several years of targeted water sampling results as well as studies of sediment sources, U.S. Forest Service management objectives, ecological units, major forest communities, successional stage habitats, rare species, management indicator species, fisheries, and non-native invasive species of the public lands contained within the watershed. This data has been assembled by a wide variety of individuals and organizations including the GA DNR, U.S. Forest Service, U.S. EPA, Western North Carolina Alliance, academic institutions, students, community groups, and non-governmental organizations. To reference this information, please see:

⇨ **Appendix 2 – Bibliography and Literature Review**

⇨ **Appendix 3 – List of Historical Data**

▶ Monitoring

Historical water quality data were useful in identifying consistent hot spots of bacteria and sediment pollution in the Warwoman Creek watershed. Review of existing data showed the need to update water quality information and to establish some new sampling sites to focus on suspected sources of pollution. It was determined that a targeted water quality monitoring plan would be implemented to produce a contemporary record of data, as well as a characterization of the causes and sources of bacteria and sediment pollution in the Warwoman Creek watershed.

▶ Water Quality Monitoring Plan

The *Warwoman Creek Watershed Targeted Water Quality Monitoring Plan* was approved by the GA EPD prior to conducting any water sampling and analysis. Water quality samples and in-stream measurements were collected from May 2018 through September 2018 at targeted locations using GA EPD-approved techniques based on Georgia Adopt-A-Stream sampling protocols.

The purpose of the Warwoman Creek Targeted Water Quality Monitoring Plan was to provide a current record of water quality conditions within the watershed by: a) identifying pollution hotspots of sediment and fecal coliform bacteria; b) recording indications of malfunctioning septic systems; c) establishing pre-Best Management Practice baseline data; and d) verifying stream segments in need of corrective action and protection. The data collected are not to be used for water quality listing purposes by the GA EPD.

⇨ **See Appendix 4 – *Targeted Water Quality Monitoring Plan for the Warwoman Creek Watershed in Rabun County, Georgia***

Implementing the *Warwoman Creek Watershed Targeted Water Quality Monitoring Plan* accomplished the following metrics:

- Water quality data were initially collected at 17 total sites in the Warwoman Creek watershed: seven (7) in the Upper Warwoman Creek subwatershed, four (4) in the Lower Warwoman Creek subwatershed, four (4) in the West Fork Chattooga River subwatershed, and two (2) in the Headwaters West Fork Chattooga River subwatershed. Throughout the sampling period, sites were added and/or removed to attempt to pinpoint hotspots. In total, samples were collected from seven (7) additional locations, three (3) of which were sampled once.
- Eight (8) water sampling events were completed over the course of four months (5/2018- 9/2018).
- The measurements collected were: water and

Assessment and Characterization of Current Conditions

ambient air temperature; fecal coliform bacteria levels (CFUs/100mL); and turbidity (NTU).

- Geographical Information Systems (GIS) maps were produced to depict the results of the data collected according to the *Warwoman Creek Watershed Targeted Water Quality Monitoring Plan*.

- The complete data record of water sampling results for fecal coliform, tubidity, and stream/air temperature is included in this report as Appendix 5.

- The source assessment for the Warwoman WMP focused on fecal coliform and turbidity monitoring, and the apparent causes of the stream's failure to meet water quality standards—i.e. probable bacteria and sediment pollution sources based on observed land use practices and activities, as well on-site waste disposal systems (septic tanks).

The source assessment's results indicated that the primary sources of fecal coliform bacteria and sediment loadings in the Warwoman Creek watershed can be attributed to:

- ***Livestock and agricultural practices, absent BMPs***
- ***Septic system failures***
- ***Land disturbing activities, absent BMPs***
- ***Gravel/dirt roads***
- ***Stormwater discharge***
- ***Urban runoff (humans and animals)***
- ***Stream bank erosion***
- ***Wildlife (wild pigs)***

Consistent with the TMDL implementation plans for the subject streams in the Warwoman Creek watershed, recommended management measures will be targeted towards reducing pollution inputs from agricultural, forestry, and urban/residential sources. Urban/residential pollution inputs include stormwater; septic systems; highways and bridges; and gravel and dirt roads.

A weighted sampling yoke was used to collect samples from bridges and roadways.

Grab samples were collected from streams when possible.

Assessment and Characterization of Current Conditions

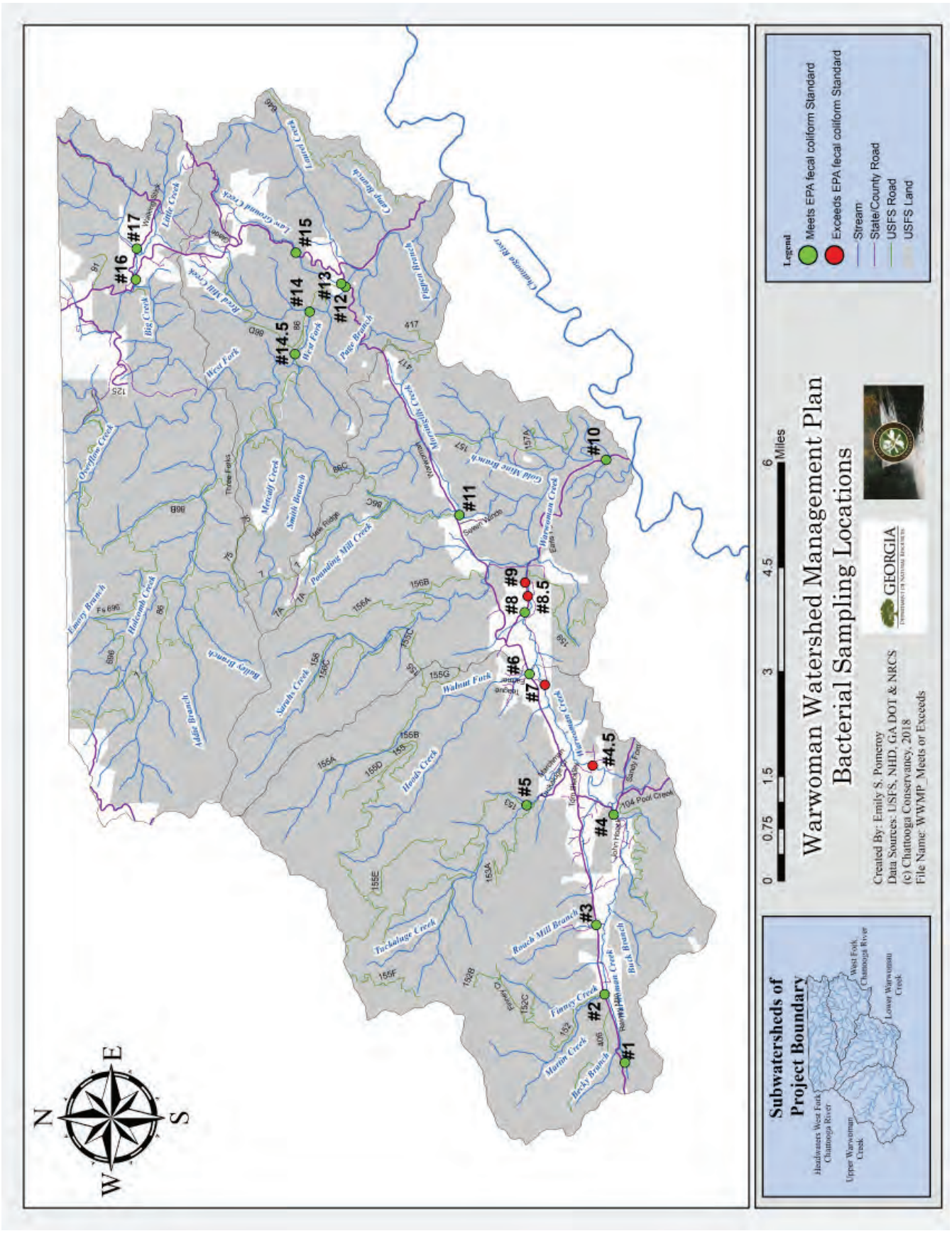


Figure 6: Warwoman Watershed Bacterial Sampling Locations

Assessment and Characterization of Current Conditions

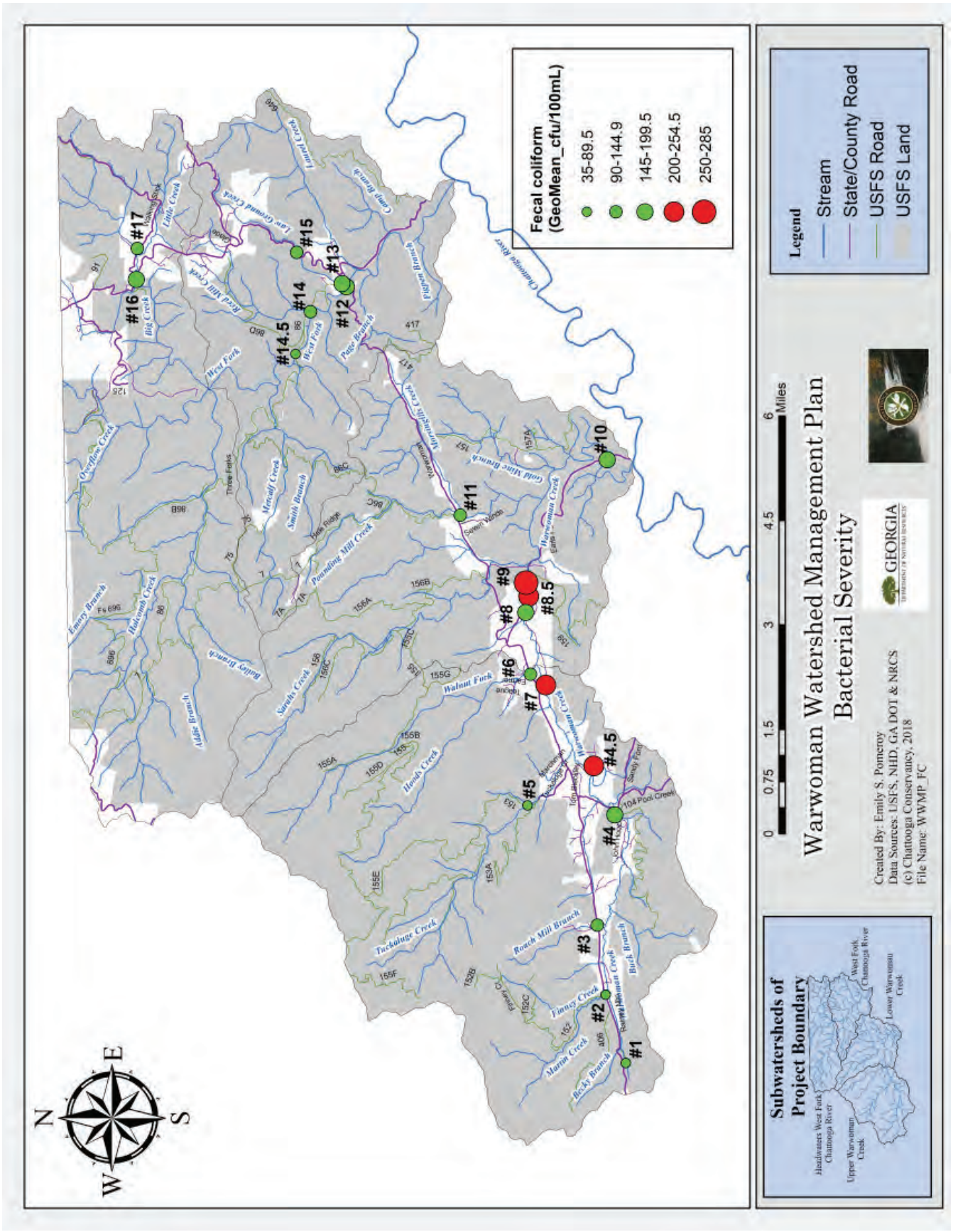


Figure 7: Warwoman Watershed Bacterial Severity

Assessment and Characterization of Current Conditions

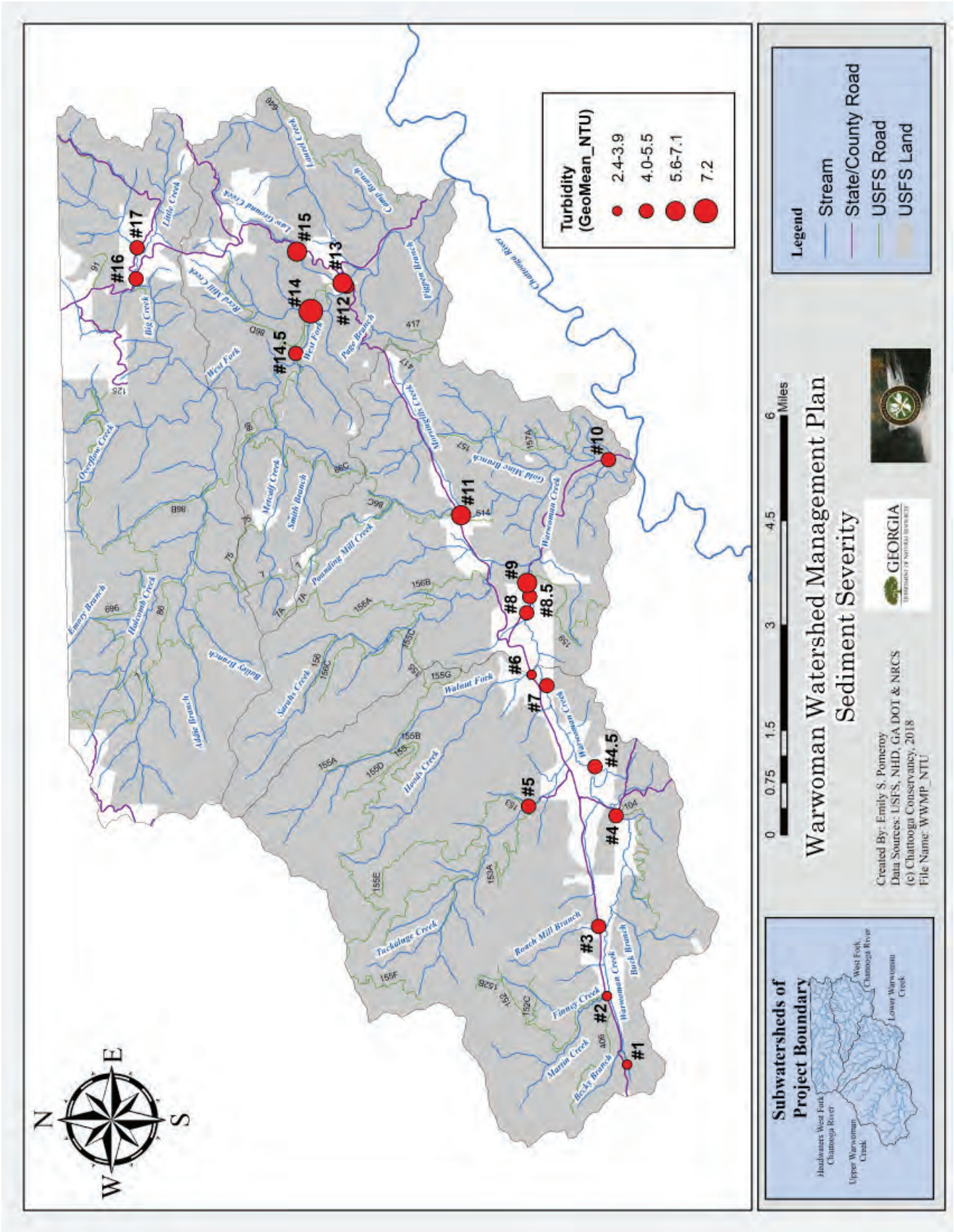


Figure 8: Warwoman Watershed Sediment Severity

5. Recommended Management Measures

Overview

The results from visual stream surveys, targeted water sampling, inquiry, and analysis indicate that water quality could be significantly improved through the application of site-specific Best Management Practices (BMPs) and targeted management measures. In the following pages, the Warwoman Creek watershed Management Plan cites BMPs and actions that implement them where polluted runoff from the source has been identified as a concern. The best management practices are generally those to be implemented immediately adjacent to or upland of a water body to address the targeted pollution sources.

It is important to determine which specific management practices can be implemented in the critical areas identified. A number of factors must be considered to determine the most promising and acceptable options for management, including pollutant reduction efficiencies, legal requirements, cost, and physical constraints. It is also critical to note that many of the management practices are voluntary. Once management practices are identified and screened, the final selected practices should be prioritized in order of the most effective in achieving the load reductions needed to improve water quality, to meet the standards for bacteria and sediment, or to meet acceptable ratings for macroinvertebrate biota.

Thick vegetative buffers alongside farms and pastures help prevent sediment, fecal coliform, and other pollutants from reaching streams.

- ⇨ See **page 40, Figure 9: Upper Warwoman Creek Watershed, Priority Sites for Corrective Action**
- ⇨ See **page 41, Figure 10: Lower Warwoman Creek Watershed, Priority Sites for Corrective Action**
- ⇨ See **page 42, Figure 11: West Fork Chattooga River Watershed, Priority Sites for Corrective Action**
- ⇨ See **page 43, Figure 12: Headwaters West Fork Chattooga River Watershed, Priority Sites for Corrective Action**

Method

Management practices may include structural controls, nonstructural controls, or both. Structural controls are built facilities that typically capture runoff, treat it through chemical, physical, or biological means, and discharge the treated effluent to receiving waters, groundwater, or conveyance systems. Nonstructural controls typically involve changes in activities or behavior and focus on controlling pollutants at their source. Controlling or preventing pollution at its source is much more effective from a cost perspective, as well as for reducing pollutant loads, than implementation of structural controls.

Goals

Achieving the estimated fecal coliform and sediment load reductions needed to attain water quality standards will require numerous concurrent management and resource protection strategies. The management measures included in this WMP describe many BMPs that would result in effective load reductions for one or both of these pollutants. In addition, BMPs are included for urban/ residential areas to control and mitigate stormwater runoff. A reduction in stormwater runoff is expected to reduce the concentration of fecal coliform, sediment, and other pollutants delivered to streams. These BMPs are proposed to address the Warwoman Creek watershed's hot spots of pollution as identified during the watershed assessment. The goal is to implement measures to significantly reduce or eliminate these pollutants in the Warwoman Creek watershed in order to make progress towards or attain the desired water quality standards.

Initial Steps to Prioritize BMPs in Critical Loading Areas

1. Define a set of available watershed improvement tools based on current technology and accepted watershed management practices.

2. Match the most appropriate, likely-to-succeed solutions to the dominant land uses in the Warwoman Creek watershed, i.e., agriculture, urban/residential, and forested landscapes.

Recommended Management Measures

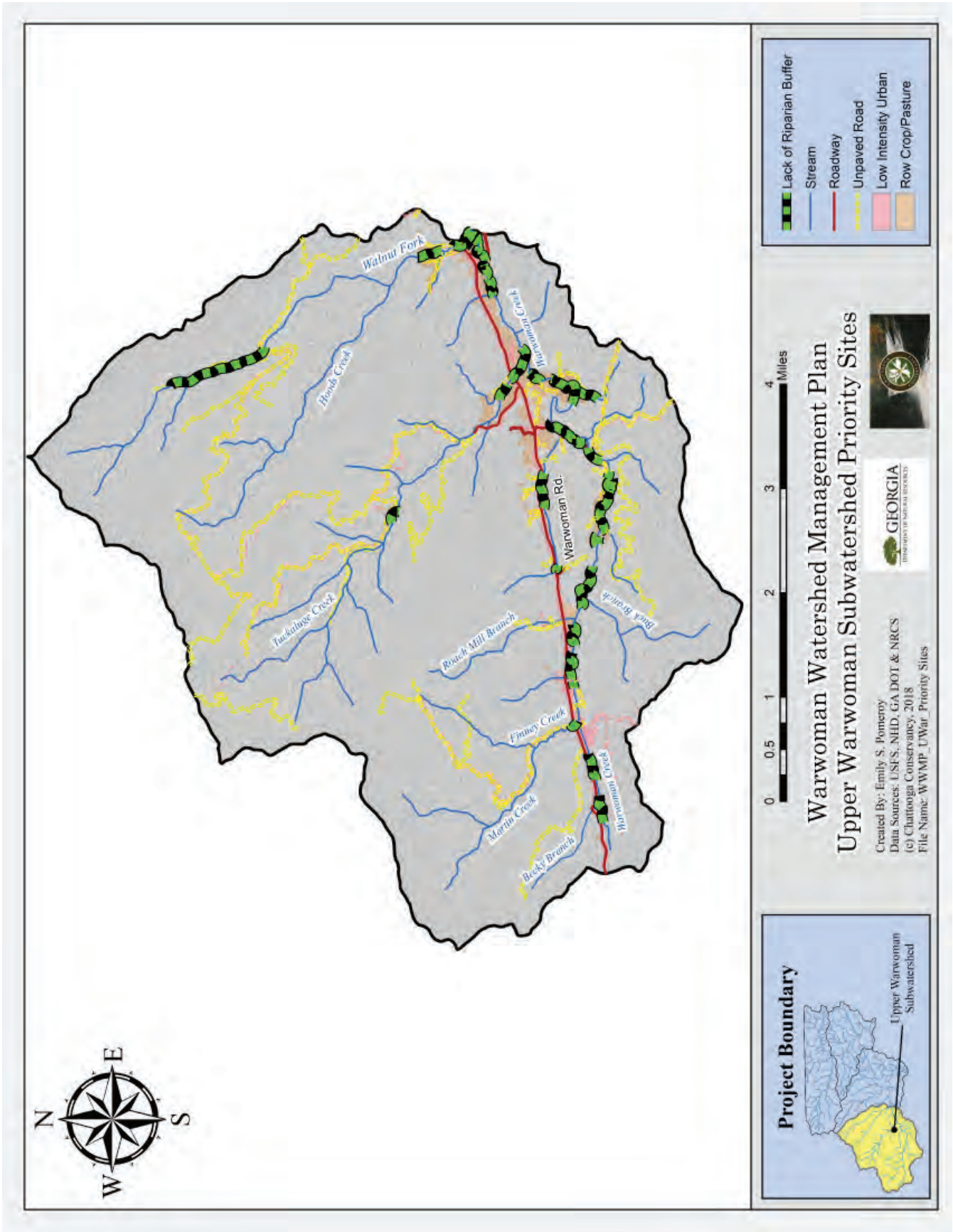


Figure 9: Upper Warwoman Subwatershed Priority Sites for Corrective Action

Recommended Management Measures

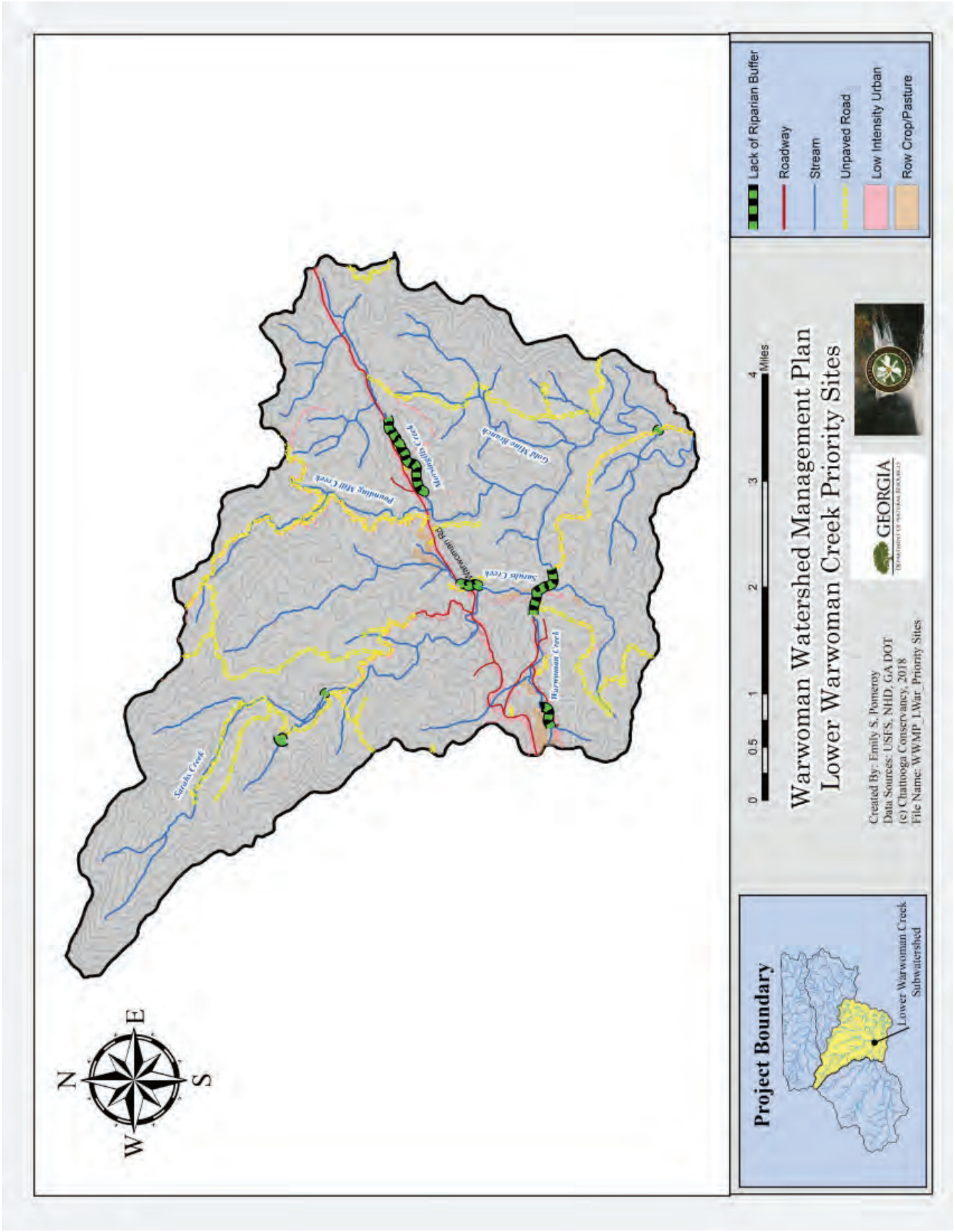


Figure 10: Lower Warwoman Subwatershed Priority Sites for Corrective Action

Recommended Management Measures

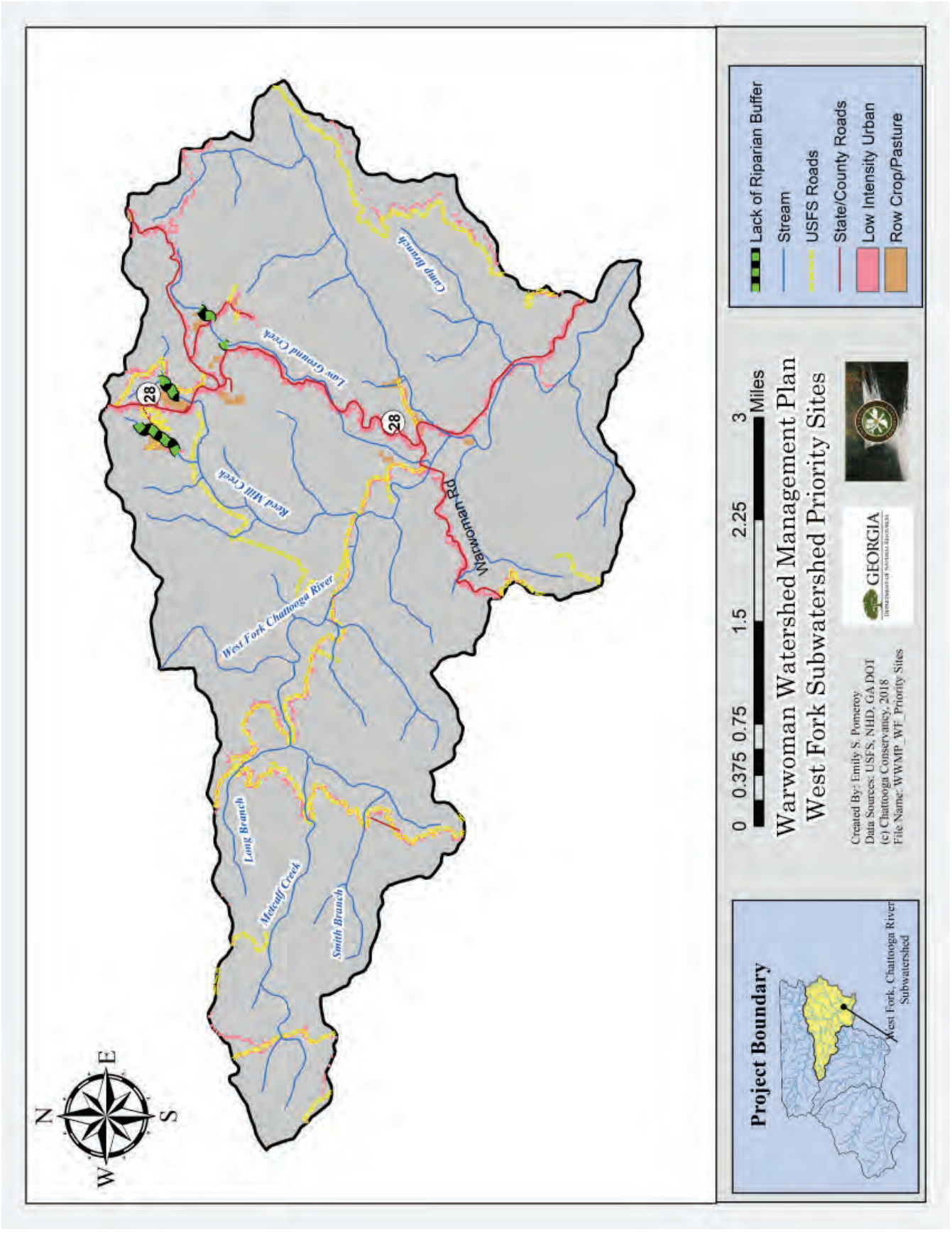


Figure 11: West Fork Chattooga Subwatershed Priority Sites for Corrective Action

Recommended Management Measures

Figure 12: Headwaters West Fork Chattooga Subwatershed Priority Sites for Corrective Action

Recommended Management Measures

3. Identify critical sites in the watershed where these practices could possibly be applied. This process involved the use of GIS and field reconnaissance. Potential sites were identified based on several observable site characteristics including size, location, land use, and physical constraints. The process specifically looked for ways to achieve project goals and objectives through a variety of improvement sites, and was conservative in terms of omitting or failing to identify potential sites. This strategy was used to ensure that as many opportunities as possible were included that might provide potential benefits to water quality in the Warwoman Creek watershed.

The management measures and BMPs presented in the following tables have been identified as potential candidates for mitigating erosion, sedimentation, stormwater, and bacterial pollution from a variety of sources. The implementation of management measures and BMPs would involve technical experts from the Natural Resources Conservation Service (NRCS), EPA, and others to design each site-specific installation to be the most effective and sustainable for each particular situation. Specific projects should be considered on a case-by-case basis among Warwoman Creek and its sub-watersheds, to address the "hot spots" identified during the watershed assessment.

Four large chicken houses located at the confluence of Tuckaluge Creek and Warwoman Creek.

Expected Load Reductions From Implementing BMPs in Critical Loading Areas

Expected load reductions for each BMP activity are a function of the specific size, extent, soil texture, and other variables at the site. The EPA has developed two spreadsheet models for calculating expected load reductions for specific BMP activities, which are available online at: http://it.tetratech-ffx.com/steplweb/. BMP manuals produced by the Natural Resources Conservation Service and the American Society of Civil Engineers can also be used to reference more general load reduction information for certain BMPs. In addition, the Georgia Stormwater Management Manual- 2016 Edition provides comprehensive guidance of post-construction BMPs for stormwater runoff and associated pollutants. Table 7 includes expected load reductions for certain BMPs.

Management Measures for Agricultural Sources

The 2012 Census of Agriculture developed by the USDA reported the area used as farmland in Rabun County to be 8,064 acres, or 3% of the county's land area (Source: Rabun County Profile, 2012 USDA Census of Agriculture). Although it's a relatively small percentage of the total land use, these agricultural operations arguably have a disproportionate effect on water quality, because they can be found in floodplain, riparian, and lowland areas along Warwoman Creek, several of its major tributaries, and tributaries of the West Fork of the Chattooga River. The primary agricultural nonpoint source pollutants are nutrients (particularly nitrogen and phosphorus), erosion and sediment, animal wastes, pesticides, and salts.

Agricultural nonpoint sources enter surface water through direct surface runoff, or through seepage to groundwater that, in turn, recharges a surface water outlet. Various farming activities result in soil erosion. Sediment produced by erosion can damage fish habitat and wetlands, and often transports excess agricultural chemicals resulting in contaminated runoff. This runoff, in turn, affects changes to aquatic habitat such as increased temperature and decreased oxygen. The most common sources of excess nutrients in surface water from agricultural nonpoint sources are chemical fertilizers and manure from animal facilities, which cause eutrophication in surface water. Pesticides used for pest control in agricultural operations can also contaminate surface as well as groundwater resources. Runoff and leachate from irrigated lands may transport sediment, nutrients, salts, and other materials. Lastly, certain grazing practices in riparian and upland areas can deplete grass or herbaceous cover from pastures, causing sediment

Recommended Management Measures

TABLE 9 - *Management Measures for Agriculture*

Source: Best Management Practices for Georgia Agriculture, Georgia Soil & Water Conservation Commission, 9/2013.

FECAL COLIFORM BMPs

Alternative Water Sources – includes using troughs and tanks to provide livestock with watering sources away from streams to reduce direct fecal coliform contribution and associated erosion. This measure is often used in conjunction with exclusion fencing.

Exclusion Fencing – provides barriers to prohibit livestock from freely entering streams. Allows for periodic "turning out" of animals to graze in the vegetated buffer for short periods of time, thus controlling areas where fecal loadings are present. This practice can reduce fecal coliform loads in streams by 50-99%.

Critical Area Planting – establishes permanent vegetation (preferably native plant material) in highly erodible areas to reduce sediment and filter bacteria. Critical area plantings may reduce fecal coliform and sediment runoff by as much as 75%.

Riparian Herbaceous Cover – uses grasses, forbs, and trees directly on stream banks to protect wildlife habitat, provide wildlife habitat, and to stabilize stream banks and channels. This practice can reduce fecal coliform and sediment loads by 50-75%.

Riparian Forest Buffers – uses trees, shrubs, and grasses to filter surface runoff prior to entering streams. This practice can reduce fecal coliform and sediment loads in surface runoff by 50-75%.

Filter Strips – are vegetated areas between cropland, grazing land, or disturbed areas and surface waters to protect water quality. Filter strips may remove as much as 50-80% of nutrients and sediment from surface runoff.

Stream Crossings – provide a stable stream bed and reduce erosion where livestock must cross streams, which can significantly reduce both fecal coliform and sediment loads.

Nutrient Management – assists growers and producers in improving farm management and litter or manure application strategies. Nutrient management can reduce phosphorus loads by 35% and nitrogen loads by 15%.

Animal Waste Storage – includes composters and stack houses for manure and litter storage. Proper composting reduces viable bacteria and nutrient concentrations, reducing fecal coliform loads by 70-80%.

SEDIMENT BMPs

Heavy Use Area Protection – reduces sediment and bacterial runoff up to 80% by protecting areas with heavy livestock traffic such as troughs and feeding areas.

Pasture and Forage Planting – prevents soil erosion by establishing native vegetation (preferable) or introduced forages in fields or pastures.

Grassed Waterways – are natural channels to slow the flow of water, remove excessive sediment and nutrients, and prevent gully erosion. Grasses waterways can reduce sediment loads by 60-80%.

Field Borders – are permanently vegetated buffers around pastures to reduce soil erosion, that can reduce sediment loads by 50-80%.

Conservation Cover – is the establishment of permanent vegetative cover to prevent erosion and protect water quality on retired agricultural land, which can reduce sediment loads by 90%.

Prescribed Grazing – manages grazing animals for long term benefits; promotes vegetative quality and quantity and reduces erosion, reducing sediment loads by 75%.

Streambank and Shoreline Protection – stabilizes and protects streambanks to significantly reduce erosion and prevent water quality degradation.

Stream Channel Stabilization – strengthens or stabilizes the bed or bottom of the channel in very specific instances when normal protection and riparian buffers are inadequate to protect water quality.

Tree/Shrub Establishment – slows runoff and allows for increased infiltration of runoff, thus reducing pollutant concentrations by up to 50%.

Recommended Management Measures

and animal waste to enter surface waters, thus degrading water quality.

⦿ **Table 9** presents a prioritized summary of management measures to reduce sources of fecal coliform and sediment from agricultural sources. Note that in many instances, management and protection strategies can address both bacteria and sediment.

Management Measures for Forestry

Rabun County contains an abundance of prime forest land, most of which is managed by the United States Forest Service and contained within the boundaries of the Chattooga River Ranger District of the Chattahoochee National Forest. The 1998 USDA Forest Statistics for North Georgia identified 207,300 acres of total forestland in Rabun County, or 87% of the total area in the county. Privately owned forest land in Rabun County accounts for 57,900 acres or 24% of the total area in the county (Source: 1998 USDA Forest Statistics for North Georgia and Rabun Co. Comprehensive Plan, 2013 draft). The Warwoman WMP project area is 89.6% national forest land and 10.4% private land.

Sediment, nutrients, pesticides and temperature are the pollutants commonly associated with forestry activities. Sediment concentrations can increase because of the accelerated erosion during timber harvesting activities; water temperatures can increase through removal of riparian area shade; slash and other organic debris can accumulate in water bodies, depleting dissolved oxygen; and organic and inorganic chemical concentrations can increase as a result of harvesting and applications of fertilizers and pesticides. These potential increases in water quality contaminants are usually proportional to the severity of site disturbance, and the impacts of silvicultural nonpoint source pollution depend on site characteristics, climatic conditions and the forestry practices employed.

⦿ **Table 10** presents a prioritized summary of management measures to address sources of sediment from forest harvesting activities.

Management Measures for Urban / Residential Areas

During urbanization, pervious surfaces such as vegetated and forested lands are converted to uses that typically involve increased areas of impervious surfaces such as roads, sidewalks, parking lots and roofs. In response to site clearing, grading and the addition of impervious surfaces and maintained landscapes, hydrologic and hydraulic changes occur. Most problematic are the greatly increased stormwater runoff volumes and velocities, and the ensuing pollutant loadings to surface waters that accompany these changes to the landscape. The pollutants contained in stormwater runoff could include oil, grease and toxic chemicals from motor vehicles; pesticides and nutrients from lawns and gardens; road salts; heavy metals from roof shingles, motor vehicles and other sources; thermal pollution from dark impervious surfaces such as streets and rooftops; and, viruses, bacteria and nutrients from pet waste, failing septic systems, and leaking sewage collection infrastructure.

Table 10 - *Management Measures for Forestry*

Source: Georgia's Best Management Practices for Forestry Manual Georgia Forestry Commission, May 2009.

SEDIMENT BMPs

Pre-harvest Planning — designed to ensure that silvicultural activities, including timber harvesting, site preparation, and associated road construction, are conducted in a way that takes into account potential nonpoint source pollutant delivery to surface waters.

Streamside Management Zones (SMZ) — establishes areas along surface waters that are managed to protect the water quality of the adjacent waterbody. SMZs protect against soil disturbance and reduce the delivery of sediment and nutrients from upslope activities to waterbodies.

Road Construction/Reconstruction and Management — should reduce generation and delivery of sediment from road construction or reconstruction, and prevent sedimentation and pollution from runoff-transported materials on existing roads.

Timber Harvesting Prescriptions — intended to reduce NPS pollution resulting from timber harvesting operations, including the location of roads, skid trails and log landings, the operation of ground-skidding and cable yarding equipment, and the prevention of pollution from petroleum products.

Site Preparation and Forest Regeneration — components of this measure address keeping slash materials out of drainages, operating machinery on the contour, and protecting the ground cover in ephemeral drainages and SMAs.

Fire Management — intended to reduce the potential nonpoint source pollution and erosion resulting from prescribed fire for site preparation and from methods for suppression of wildfire.

Recommended Management Measures

As population density increases with urbanization, there is a corresponding increase in pollutant loadings.

▶ There are six major categories of urban/residential nonpoint pollution sources that affect surface waters: 1) runoff from developing areas; 2) runoff from construction sites; 3) runoff from existing development; 4) on-site sewage disposal systems; 5) general sources (households, commercial, and landscaping); and, 6) roads, highways, and bridges. (Source: *National Management Measures to Control Nonpoint Source Pollution from Urban Areas* EPA-841-B-05-004 November 2005).

Campsites on Earl's Ford Rd. are infrequently monitored and maintained. Trash and human waste left behind from campers produces pollution in Warwoman Creek.

Urbanization in the Warwoman Creek watershed has included installing bridges over Warwoman Creek and its tributaries and channeling the waterways into culverts beneath access roads and the highway; construction of impervious roadways next to Warwoman Creek; and building residential areas with associated septic systems, all of which are located within or immediately next to riparian buffer zones along Warwoman Creek , Big Creek, Law Ground Creek, Roach Mill Creek, Morsingills Creek, Walnut Fork, and Tuckaluge Creek.

▶ The management practices to address the categories of urban/residential nonpoint source pollution can be grouped into two basic categories: *non-structural practices* and *structural practices*.

Non-Structural Practices prevent or reduce urban runoff problems in receiving waters by reducing potential pollutants or managing runoff at the source, and take the form of regulatory controls such as codes, ordinances, regulations, standards, and rules, or the establishment of voluntary, community-wide pollution prevention programs. Non-structural controls can be further subdivided into land use practices and source control practices. Land use practices are aimed at reducing impacts on receiving waters by minimizing, controlling, or preventing development in sensitive areas of the watershed, and/or by including green space, greenways, parks, rain gardens, and other green infrastructure in local development standards while also accommodating growth. Source control practices are aimed at preventing or reducing potential pollutants at their source before they come into contact with runoff or aquifers. Some source controls are associated with new development, and others are implemented after development occurs and include pollution prevention activities that attempt to modify aspects of human behavior, such as educating citizens about the proper disposal of used motor oil, human waste, and pet waste, and the application/disposal of lawn fertilizers and pesticides.

Studies demonstrate that the range of non-structural practices known as "pollution prevention" dramatically and cost-effectively reduce the frequency and concentration of pollutants winding up in stormwater. Management, planning, development design, or material substitution or reduction that incorporates stormwater pollution prevention before an activity takes place, are almost always the most effective as well as cost-effective means to reducing stormwater pollution. In already-developed zones of the Warwoman Creek watershed, some pollution prevention measures may have limited opportunities for application; however, should new development become imminent in the watershed, such measures would be appropriate.

Structural Practices To reduce stormwater runoff problems in established developments, treatment with structural measures can be an effective alternative. Structural practices are engineered to manage or alter the flow, velocity, duration, and other characteristics of stormwater runoff by physical means. In doing so, they can control stormwater volume and peak discharge rates, and in some cases, improve water quality. Structural practices can also have ancillary benefits such as reducing downstream erosion, providing flood control, and promoting ground water recharge.

Recommended Management Measures

Sediment washes across a road near Big Creek. Without stormwater management, paved roads can contribute to increased runoff velocity and volume.

There is a large and comprehensive library of educational publications and resources available on stormwater BMP selection, installation and maintenance, and the specific management measures that could minimize and treat stormwater runoff. Many of these practices are broadly known as green infrastructure, which at the local scale includes an approach to managing stormwater by infiltrating it into the ground during rainfall using vegetation or porous surfaces, or by capturing the stormwater for later re-use. Elevated stormwater flows also necessitate the construction of runoff conveyances, or the modification and retrofitting of existing drainage systems with green infrastructure to avoid or mitigate erosion of streambanks and steep slopes. Retrofitting such practices in the Warwoman watershed has broad opportunities and much fertile ground for their application, as follows.

Green infrastructure is an approach to water management that protects the natural drainage patterns while restoring the hydrologic cycle. By improving stormwater management and flood mitigation, it has shown to be effective in enhancing community safety and quality of life. Utilizing both natural and engineered systems, a comprehensive green infrastructure program can cleanse stormwater, conserve ecosystem functions, and provide a wide array of benefits to people and wildlife. Green infrastructure solutions can be implemented on differing scales ranging from site-level installations to broader, watershed-level efforts. On the local scale, green infrastructure practices include rain gardens, permeable pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting systems. At the largest scale, the preservation and restoration of natural landscapes (such as forests, floodplains, and wetlands) provide additional benefits to the larger green infrastructure program. To date, investments in green infrastructure have been driven by a variety of motivations. Communities may invest in green infrastructure to limit the cost of managing peak stormwater flows and/or combined sewer overflow control. Private property owners may choose to invest in green infrastructure to limit their stormwater discharge fees and/or limit the cost of water for irrigation. Foundations and/or non-governmental organizations (NGOs) may invest in green infrastructure for the above-named reasons, which ultimately improve the quality of life in an area.

The measures discussed in *National Management Measures to Control Nonpoint Source Pollution from Urban Areas* (EPA-841-B-05-004, 11/2005) are exhaustive, and are hereby incorporated by reference into this watershed management plan as potentially appropriate for application in the Warwoman Creek watershed.

⦿ A prioritized selection of management measures for urban stormwater pollution sources is presented in **Table 11**.

New construction on Warwoman Rd. with minimal stormwater management could create increased sedimentation into Warwoman Creek.

Recommended Management Measures

TABLE 11 - *Management Measures for Urban Stormwater Runoff*

Source: National Management Measures to Control Nonpoint Source Pollution from Urban Areas EPA-841-B-05-004 November 2005.

STORMWATER RUNOFF PREVENTION BMPs

Impervious Surface Reductions – through street and parking lot design and the use of technologies such as permeable pavement and green roofs.

Construction Practices – to ensure that grading and clearing are done appropriately and that a system of BMPs is considered prior to development. This includes measures for mass grading, sequencing development, and maintaining the proper site-specific BMPs.

Soil Erosion Control on Exposed Soils – using mulches, blankets and mats, vegetative measures, structural methods, inlet protection, silt fences, check dams and temporary sedimentation basins or traps.

STORMWATER TREATMENT BMPs

Infiltration Basins - are impoundments in which incoming urban runoff is temporarily stored until it gradually infiltrates into the soil surrounding the basin.

Infiltration Trenches - are shallow excavated ditches that have been backfilled with stone to form an underground reservoir. Urban runoff diverted into the trench gradually infiltrates from the bottom of the trench into the subsoil and eventually into the ground water.

Vegetated Filter Strips - are areas of land with vegetative cover that are designed to accept runoff as overland sheet flow from development.

Grassed Swales - are an infiltration/filtration method that is usually used to provide pretreatment before runoff is discharged to treatment systems, and are typically shallow, vegetated ditches designed so that the bottom elevation is above the water table to allow runoff to infiltrate into ground water.

Porous Pavement and Permeable Surfaces - reduces much of the need for urban runoff drainage conveyance and treatment off-site. Instead, runoff is diverted through a porous asphalt layer into an underground stone reservoir.

Concrete Grid Pavement - consists of concrete blocks with regularly dispersed void areas that are filled with pervious materials, such as gravel, sand or grass, allowing infiltration of surface water into the underlying soil.

Water Quality Inlets - are underground retention systems designed to remove settle-able solids.

Extended Detention Ponds - temporarily detain a portion of urban runoff for up to 24 hours after a storm, using a fixed orifice to regulate outflow at a specified rate, allowing solids and associated pollutants the required time to settle out.

Wet Ponds - are basins designed to maintain a permanent pool of water and temporarily store urban runoff until it is released at a controlled rate.

Constructed Wetlands - are engineered systems designed to simulate the water quality improvement functions of natural wetlands to treat and contain surface water runoff pollutants and decrease loadings to surface waters.

Filtration Basins - are impoundments lined with filter media, such as sand or gravel. Urban runoff drains through the filter media and perforated pipes into the subsoil.

Sand Filters - are a self-contained bed of sand to which the first flush of runoff water is diverted. The runoff percolates through the sand, where colloidal and particulate materials are strained out by the surface of the filter media.

Retention and Detention Systems – including bioretention cells and rain gardens, which detain pollutants and detain storm water for release more slowly, over time. These measures can help reduce storm water volume and pollutant concentration, and help prevent harmful effects of storm water on aquatic life.

Recommended Management Measures

Gravel roads lacking stormwater BMPs and structural controls are a primary source of sedimentation into the Warwoman watershed.

On-site Waste Disposal Systems Pollutant loads in the Warwoman Creek watershed are potentially linked to failing septic systems. For the purpose of this report, this category also includes human waste from dispersed camping and other recreational activities.

⦿ **Table 12** presents a prioritized list of management measures for septic systems to remediate non-point sources of fecal coliform.

Roads (Paved) & Bridges The upper portion of Warwoman Creek and several of its tributaries are greatly impacted by Warwoman Road and a multitude of access roads and bridges. The West Fork of the Chattooga River and several of its tributaries are also impacted by State Hwy. 28 and numerous access roads and bridges. Implementing management measures and runoff controls for highways and bridges is of high priority in this watershed management plan.

⦿ **Table 13** presents a list of recommended basic management guidelines for paved roads.

In addition, a specific management practice strategy for bridges involves the use of “scupper drains,” which can be implemented to mitigate the bridges’ sources of stormwater pollution.

o The most prevalent mitigation practice to direct the drainage from the bridge to an on-shore treatment system is via a scupper drain system. A scupper drain is an opening in the floor of a bridge that provides a means for rain or other water accumulated on the roadway surface to drain into the space beneath the structure. In this instance, rather than draining directly to the water below, the runoff can be conveyed from scupper drains through a pipe to adjacent land, where it could be sent to a retention pond or other runoff treatment practice (Source: *EPA National Management Measures to Control Nonpoint Source Pollution from Urban Areas*, November 2005, EPA-841-B-05-004.)

Dirt & Gravel Roads In 1995, Dr. David Van Lear, Professor of Forestry at Clemson University, conducted extensive field research as a component of the USFS’s “Chattooga River Ecosystem Management Demonstration Project,” and published a report entitled *Sedimentation in the Chattooga River Watershed*. The report concluded that “unpaved multipurpose roads" were the biggest sedimentation sources in the watershed, and that the “frequency of sediment sources associated with roads was highest in Georgia,” (Source: *Sedimentation in the Chattooga River Watershed*). Although the Van Lear report is over 20 years old, surveys performed as a component of the preceding Source Assessment confirm that dirt and gravel roads in the Warwoman watershed persist and are major sources of erosion and sedimentation in the watershed. Portions of Warwoman Creek, the West Fork of the Chattooga River, and several of their tributaries are highly impacted by unpaved county, private, and Forest Service roads. Implementing management measures and runoff controls for dirt and gravel roads is a top priority in this watershed management plan.

⦿ **Table 14** summarizes environmentally sensitive maintenance and mitigation practices for protecting and restoring water quality from the impacts of unpaved roads located in close proximity to streams.

Unmaintained campsites with no facilities lead to fecal coliform pollution into Warwoman Creek and its tributaries.

TABLE 12 - *Management Measures for Septic Systems*

Source: National Management Measures to Control Nonpoint Source Pollution from Urban Areas EPA-841-B-05-004 November 2005

Development of Septic System Inventories and Assessment of Maintenance Needs - including system location, type, age, design capacity, maintenance schedule, and potentially affected water resources.

Septic System Repair & Maintenance – to include pumping septic tanks at least once every 5 years, and inspections to determine where on-site sewage disposal systems are not properly designed, installed, or maintained.

Development of Local Ordinances for Septic System Maintenance – adoption of local ordinances by Clayton City Council and Rabun County Board of Commissioners to require pumping septic tanks at least once every 5 years..

Constructed Wetlands - have traditionally been used for polishing effluent that has already had some degree of treatment. Vegetated submerged beds, also known as submerged constructed wetlands, subsurface flow constructed wetlands, or plant rock filters are designed primarily to reduce concentrations of biochemical oxygen demand and suspended solids in wastewater effluent from the septic tank.

Public Septic Facility Installation - to include installation and maintenance of vault toilets or portable toilets at heavy-use camping and recreation sites in the watershed.

TABLE 13 - *Management Measures for Paved Roads*

Source: EPA National Management Measures to Control Nonpoint Source Pollution from Urban Areas, November 2005, EPA-841-B-05-004, Ch. 7.

Live Stakes - involve inserting and tamping live, root-able vegetative cuttings into the ground to create a living root mat that stabilizes the soil by reinforcing and binding soil particles together and extracting excess soil moisture.

Fascines - are long bundles of branch cuttings bound together into sausage-like structures, and installed in contoured trenches to reduce surface erosion and rilling.

Brush Layers – are branches placed perpendicular to the slope contour to break up the slope length and prevent surface erosion.

Branch-Packing - involves reinforcing a slope with alternating layers of live branch cuttings and compacted backfill to repair small, localized slumps and holes in earthen embankments.

Live Gully Repair - is similar to branch-packing and is used to repair rills and gullies.

Live Crib Walls - are hollow, boxlike structures of interlocking untreated timber members installed with backfill material and layers of live branch cuttings, and are appropriate for stabilizing the toe of a slope and reducing its steepness.

Vegetated Rock Walls - consist of a combination of rocks and live branch cuttings used to stabilize the toe of steep slopes.

Joint Planting - stabilizes slope faces by planting live cuttings in spaces between stones or riprap.

Table 14 - *Management Measures for Erosion, Sedimentation & Stormwater Runoff from Gravel/Dirt Roads*

Sources: Georgia Better Back Roads Field Manual, Georgia Resource Conservation & Development Council, May 2009; Environmentally Sensitive Maintenance for Dirt & Gravel Roads, Report Number USEPA-PA-2005, Oct. 2007 Reissue

In-sloping - is applied to a road constructed along a steep bank, with a steep uphill bank on one side and a steep downhill bank on the other side, ending at the edge of a stream. In-sloping means the entire surface of the road slopes toward the uphill embankment side to eliminate drainage over the downhill embankment, into the stream.

Out-sloping - is applied when the road crosses a gentle sloping terrain, and means the entire surface of the road slopes toward the downhill side allowing the natural sheet flow conditions to prevail.

Ditch Turnouts & Vegetative Filter Strips - should automatically go together. The ditch turnout carries the flow from the ditch, away from the road and into a vegetative filter strip, which filters out the sediment-laden ditch water, increases water infiltration into the ground and permits only clean runoff into a nearby stream.

Broad Based Dips - are shallow gradual dips across the road in the direction of water flow, directing water to an outlet or turnout to a vegetative filter strip.

Grade Breaks - are long gradual breaks in the longitudinal grade of a road on a downhill slope, breaking the road into shorter lengths for more efficient drainage.

Culvert End Structures - are built at either the entrance or outlet end of a culvert opening, to reduce erosion.

Aprons - installed at culvert outlets to spread the water flow and dissipate the erosive energy.

Through-Drains - are cross culverts that are placed to handle natural springs or spring seeps flowing perpendicular to the road, and carry them under the road to the other side to continue in the original channel.

Stream-Saver Systems - raise the road profile over the low-point stream crossing, and the road surface remains level for an extended area away from the stream on both sides, and use broad-based dips and turnouts to vegetative filter strips for road and ditch flows on each approach.

Raising Entrenched Roads - involves major filling of the road cross-section between high banks, bringing the road surface back up to the original road surface elevation. When the road is immediately next to a stream, the road is raised up-slope away from the stream, allowing for sheet flow across a vegetated filter strip.

Slope Geometry, Benching, & Diversion Swales - are all related to bank stability. Diversion swales divert upslope surface water before it washes over the top of the road bank and into the road's drainage ditch. Benching is commonly used on long, steep slopes, with the benefits of holding soil, water, seed and mulch for enhanced vegetation growth.

Roadside Trees - provide shade, control dust and invasive species, and offer the benefit of being beautiful.

Road Separation Fabrics - geosynthetic fabrics that separate subsoil from the road aggregate, providing improved road stability, reinforcement, drainage, prevention of subgrade pumping of fines, and thereby dust reduction.

6. Working with the Public

The Warwoman Creek Watershed Management Plan's educational component includes several proposed outreach efforts, including activities at local schools, homeowner seminars, watershed festivals, public service announcements, and electronic and print media. The goal of these outreach activities is to provide the general public and community officials with information on:

- Nonpoint source pollution
- Local watersheds
- Water quality problems
- Solutions to water quality problems
- Biological, physical, and chemical water quality information for the watershed
- Watershed Management Plan implementation, revisions & updates

Public Education Resources Prior to implementing a targeted education and outreach program, the specific audience will be identified and analyzed. Based on the characteristics of each audience, a specific communication medium will be chosen and the message will be crafted and packaged for optimum effect. An excellent resource for creating awareness, educating specific audiences, and motivating positive behavior change to improve water quality is *Getting In Step - A Guide for Conducting Watershed Outreach Campaigns* (3rd edition, November 2010 EPA 841-B-10-002 https://cfpub.epa.gov/npstbx/files/getnstepguide.pdf). This publication is exhaustive, and can be used in alliance with other resources to guide outreach efforts, such as guidance from the National Environmental Services Center (http://www.nesc.wvu.edu/) and the EPA's "Surf Your Watershed" program (http://www.epa.gov/waterdata/surf-your-watershed). The Leave No Trace organization (https://lnt.org/) offers both online courses and in-person training to teach responsible outdoor recreation practices and behaviors.

Education and outreach can include sampling streams for macroinvertebrates and learning why they are important indicators of water quality.

Public Education Options & Activities Standard examples of public education strategies include: a school program that could involve educating students pre-K through high school about water quality issues and getting them involved in bacteriological, biological, and chemical monitoring of surface waters near their school districts. Classroom and outdoor sessions with younger students could feature hands-on lessons in macroinvertebrate sampling, including equipment demonstration, examination of preserved or live macroinvertebrate samples, and the installation of in-stream leaf packs (https://www.leafpacknetwork.org) for future macroinvertebrate sampling. Young children love seeing and touching bugs, and would receive an explanation as to why they are important to water quality. Sessions with older students could include both in-class and field activities, with the class lessons covering such topics as water quality, nonpoint source and point source pollution, and the impacts of everyday activities on water quality including priority topics such as erosion, stormwater discharge, and hydromodification. The field exercises could involve students in visual assessments of streams and macroinvertebrate sampling. Teachers could organize a watershed festival event highlighting the natural resources housed in their local watershed, threats to water quality, and solutions to the water quality issues.

Adult community outreach efforts could include evening seminars, stream clean-ups, instructions on how to install a rain garden, and informational sessions on responsible hunting and camping practices. For example, the local health department could sponsor an evening seminar describing septic system maintenance, followed by the distribution of an informational packet that explains the symptoms and effects of failing septic systems. The local agricultural extension outreach agent could develop presentations and informational packets that describe the benefits of implementing agricultural best management practices, and funding opportunities for installing agricultural BMPs. The local marshal could present information about the benefits of installing

Working with the Public

stormwater management practices, and their benefits to water quality and the community. DNR Wildlife Technicians could present information about issues with wild pigs in the watershed and responsible hunting practices, including current laws regarding this issue. Forest Service Rangers could organize events to teach the public about Leave No Trace/ Pack it In, Pack it Out practices and the importance of responsible forest use.

Educational outreach materials for the general public would be designed to emphasize practices that individuals or neighborhoods could implement to assist their communities in preventing pollution and water quality impairments caused by everyday activities, such as the proper disposal of household chemicals and pet waste, as well as recreational activities involving the use of public land and waterways. In addition, a comprehensive public information and education program could explain the basis, purpose, and details of installing green infrastructure, stormwater management facilities, and agricultural BMPs, and the vital role this could play in improving water resources and the quality of life in their communities. This information can be presented through flyers, brochures, public service announcements, social media outlets, posters, and other educational aids. Community-wide watershed festival events could also be hosted by local businesses, utilities, forestry, or wildlife agencies.

Presentations by green infrastructure and storm water management experts to public works/utilities directors/ operators, planning boards, municipal councils and committees can also be of great assistance. The presentations could be augmented by developing training, educational programs and materials for public officials, contractors, and others involved with the design, funding, installation, operation, inspection, and maintenance of stormwater remediation structures. Training programs and educational materials for public officials, public employees, contractors, and the general public are crucial to implementing effective stormwater management programs. Contractor certification, inspector training, and competent design review staff are also important for program implementation and continuing effectiveness of stormwater remediation strategies.

Pollution Prevention Activities That Result in Behavioral Changes These management measures have been included in the Warwoman WMP to ensure that the community is well-informed of pollution prevention activities that could result in behavioral changes to reduce nonpoint source pollutant loading. Some of the major pollution sources addressed by these management measures include: storage, use, and disposal of household hazardous chemicals, including automobile fluids, pesticides, paints, solvents, etc.; lawn and garden activities, including the application and disposal of lawn and garden care products, leaves, and yard trimmings; turf management on golf courses, parks, and recreational areas; operation and maintenance of onsite disposal systems; discharge of pollutants into storm drains, including floatables, waste oil, and litter; and disposal of human and pet/domestic animal excrement.

◉ **Table 15** presents a prioritized list of management measures for pollution prevention. Flexibility is the key in specific activities for this management measure, to align with local needs and priorities, community acceptance, and availability of funding, and to determine acceptance of administrative mechanisms that could be practical or effective solutions.

Table 15 - *Management Measures for Pollution Prevention*

Source: EPA, National Management Measures to Control Nonpoint Source Pollution from Urban Areas, November 2005, EPA-841-B-05-004, Ch.9

Public Education – outreach activities utilizing resources such as *Getting In Step - A Guide for Conducting Watershed Outreach Campaigns* (see also additional resources in Section 6, Working With the Public).

Conservation Easements and Greenways – to control or prevent land use in sensitive areas of the watershed, and/or minimize the total land used for development while also accommodating growth.

Trash Control – including periodic stream clean-ups, and for roadside and parking lot trash.

Septic System Inspection and Maintenance – see Table 12 (p. 51).

Pollution Prevention, Training, and Urban Runoff Control Plans - for local governments and/or commercial establishments, which could include measures such as ordinances, certification and training requirements.

Proper Management of Maintained Landscapes – including lawns and parks, to eliminate sources of stormwater runoff, nutrient, bacterial, and/or chemical pollution from entering streams.

Promotion and Installation of Green Infrastructure – see pp. 48 and Table 11 (p. 49).

7. Implementing Recommended Best Management Practices

The Warwoman Creek Watershed Management Plan's Implementation Schedule aims to:

♦ Promote the application of agricultural, forestry, and urban/residential best management practices to improve water quality by systematically reducing sources of fecal coliform and sedimentation pollution in the Warwoman Creek watershed, so that Warwoman Creek, Roach Mill Creek, and Law Ground Creek can attain water quality standards for their designated use of fishing.

♦ Attain measureable improvements in Warwoman Creek's water quality by the application of agricultural, forestry, and urban/residential best management practices, so that the stream will cease to be a public health hazard and polluted tributary to the National Wild & Scenic Chattooga River.

⊙ **Table 16** (See p. 56-59) presents the **Warwoman Creek Watershed Management Plan BMP Implementation Schedule.**

The BMPs entered in Table 16 were selected based on the following criteria: most effective for critical areas; most feasible given existing community support and potential funding sources; and, most likely to reduce/control pollutant loadings.

Implementation of this plan will begin when funding is secured for any of the management measures described in the preceding pages. In lieu of designated and secured funding, the milestone timetable in the chart below is depicted with a generalized timeline of short, mid, and long term implementation. The success of implementing the Warwoman WMP will depend on the leadership of a project manager, which could be established within the city or county government and/or with a local non-profit by securing the commitment and funding to create this position. Success, of course, is also dependent on the support of the City of Clayton and Rabun County to cooperatively pursue and apply the management measures named in this WMP.

Criteria To Measure Success Quantitative measurements of the various watershed management plan implementation projects delineated in the preceding implementation schedule will be of the most importance in gauging how these actions have contributed to accomplishing the goal of attaining state water quality standards for impaired streams in the Warwoman Creek watershed. Tracking water quality improvements through a Targeted Water Quality Monitoring Plan and other **environmental indicators** will measure progress toward reducing levels of fecal coliform and sediment. Tracking **programmatic and social indicators** will show that the implementation program is gaining momentum and accomplishing goals. For example, participation rates of students and community members in education and outreach opportunities, and of agricultural producers, private property owners, local governments and local/state agencies can help measure progress and determine the successes of WMP implementation.

Success is dependent on the support of the City of Clayton, Rabun County, and local citizens to cooperatively pursue and apply the management measures named in this watershed management plan.

⊙ **Table 17** (See p. 60) presents a number of **environmental, programmatic and social indicators useful in measuring success**.

Financial and Technical Resources The Warwoman Creek WMP will require significant financial and technical resources for its implementation. The total dollar amount needed for executing the recommended implementation projects to the extent necessary to meet water quality goals is unknown at this time. However, Table 19 presents known expenses as well as the anticipated cost of implementing a variety of management measures named in this WMP, incorporating some financial information gained from the 319(h) Clayton-Rabun County Watershed Project (EPD grant #751-100052) and GA NRCS Practice Payment figures. Please note that this list is not exhaustive; the initial years of implementing the Warwoman Creek WMP will provide valuable insight as to the total amount of money that will be necessary to meet water quality standards.

There are a variety of financing mechanisms that can be applied to watershed improvement efforts, and some mechanisms offer planners more reliability and predictability than others. For example, when relying on grant funding, effective long-term planning is difficult because grant funding decisions are usually unpredictable. Thus, in addition to grant opportunities, proponents of implementing the Warwoman WMP should also be focused on more sustainable and predictable sources of financing. (*Financial and Technical Resources* *continues on p. 60.*)

Implementing Recommended Best Management Practices

TABLE 16

Warwoman Creek Watershed Management Plan BMP Implementation Schedule

Management Strategies	*Who Should Be Involved*	Milestone Benchmarks		
		Years 1-2	Years 3-5	Years 5+
Objective: ***Public education and outreach about water quality issues, and the benefits of implementing pollution prevention measures as well as best management practices to reduce fecal coliform and sediment pollution from agricultural, forestry and urban/residential sources.*** *(See Table 15, p. 54, and pp. 53-54, Working With the Public)*				
Task: Create educational media about agricultural, forestry and urban/ residential BMPs	Project manager (lead), & : Rabun County Health Department, NRCS, UGA AG Extension Agent, GA Forestry Commission, Clayton marshal, Rabun County marshal	√	√	
Task: Identify landowners for AG BMP opportunities	Project manager (lead), &: NRCS, UGA AG Extension Agent	√	√	
Task: Identify landowners for forestry BMPs	Project manager (lead), &: GA Forestry Commission	√	√	
Task: Identify landowners for urban/ residential BMPs	Project manager (lead), &: Rabun County Health Department, Clayton marshal, Rabun County marshal	√	√	
Task: Distribute educational media about agricultural, forestry, urban/ residential BMPs to the appropriate demographic group	Project manager (lead), &: Rabun County Health Department, NRCS, UGA AG Extension Agent, GA Forestry Commission, Clayton marshal, Rabun County marshal, *Clayton Tribune*, *Rabun Laurel*, SKY 104, local homeowner's and Lake Burton/Lake Rabun civic associations, cooperating businesses	√	√	
Task: Develop and publish quarterly educational media articles about pollution prevention measures, green infrastructure strategies, and BMPs for agriculture, forestry and urban/ residential areas	Project manager, *Clayton Tribune*, *Rabun Laurel*, SKY 104, local homeowners, Lake Burton and Lake Rabun civic associations, cooperating businesses	√	√	
Task: Assemble and distribute educational resources for students	Project manager, Rabun County schools	√	√	
Task: Host water quality monitoring workshops for student groups	Project manager, GA Adopt-A-Stream, Rabun County schools	√	√	√
Task: Develop, publish, and distribute a booklet detailing Warwoman Creek watershed facts and protection measures	Project manager	√	√	
Task: Assemble and distribute specific pollution prevention information and mitigation resources for the community	Project manager, Rabun County Health Department	√	√	√

Implementing Recommended Best Management Practices

TABLE 16

Warwoman Creek Watershed Management Plan BMP Implementation Schedule

Management Strategies	*Who Should Be Involved*	Milestone Benchmarks		
		Years 1-2	Years 3-5	Years 5+
Task: Host one or more annual clean-up of Warwoman Creek, the West Fork of the Chattooga River, and their impaired tributaries	Project manager, City of Clayton, Rabun County, civic organizations, Chattooga River Ranger District, U.S. Forest Service	√	√	√
Task: Create and distribute educational materials or install kiosks at public recreation sites regarding forest use rules and Leave No Trace principles	Project Manager, Chattooga River Ranger District, U. S. Forest Service, civic organizations	√	√	√
Task: Host one or more public events to educate citizens about responsible camping and recreation practices	Project Manager, Chattooga River Ranger District, U. S. Forest Service, civic organizations	√	√	√
Objective: ***Implement best management practices to reduce fecal coliform and sedimentation pollution from agricultural, wildlife, and human sources.*** *(See Table 9, p. 45)*				
Task: Contact agricultural landowners about participating in programs	Project manager, NRCS, UGA AG Extension Agent	√	√	
Task: Design and monitor the installation of appropriate AG BMPs	NRCS	√	√	√
Task: Develop, publish, and distribute educational materials about wild pig issues and management	Project Manager, GADNR	√	√	
Task: The Chattooga River Ranger District designs and implements a plan to manage dispersed campsites along Warwoman Creek	Chattooga River Ranger District, U. S. Forest Service	√	√	√
Objective: ***Implement best management practices to reduce sedimentation pollution from forestry sources.*** *(See Table 10, p. 46)*				
Task: Contact forest landowners about participating in programs	Project manager, GA Forestry Commission	√		
Task: Design and monitor the installation of appropriate forestry BMPs	GA Forestry Commission	√	√	

Implementing Recommended Best Management Practices

TABLE 16

Warwoman Creek Watershed Management Plan BMP Implementation Schedule

Management Strategies	*Who Should Be Involved*	Milestone Benchmarks		
		Years 1-2	Years 3-5	Years 5+
Task: Contact the U. S. Forest Service to request remediation of certain system roads and closure of illegal ATV trails in the Warwoman watershed	Project manager	√		
Task: The Chattooga River Ranger District completes remediation of system roads and closures of illegal ATV trails	Chattooga River Ranger District, U. S. Forest Service	√	√	√
Objective*: Implement best management practices to reduce fecal coliform and sedimentation pollution from urban/residential sources*. (*See Table 11, p. 49; Tables 12 & 13, p. 51; Table 14, p. 52)*				
Task: Contact residents and businesses using septic systems to engage them in septic system maintenance, repair and rehabilitation programs	Project manager, Rabun County Health Department	√	√	√
Task: Identify and implement site-specific stormwater management practices and/or retrofits for impervious surfaces to improve water quality	Project manager, engineering consultant, residents and businesses, Clayton marshal, Rabun County marshal	√	√	√
Task: Identify and implement site-specific management measures to mitigate erosion and sedimentation into surface waters from dirt or gravel county roads	Project manager, engineering consultant, Rabun County	√	√	√
Objective*: Maintain and restore stream buffers to the greatest extent possible.* *(Components of this objective are in all of the management measures' tables)*				
Task: To the greatest extent possible, implement proactive measures to restore riparian areas and stream banks within the designated 50-foot buffer zones on Warwoman Creek, Roach Mill Creek, Tuckaluge Creek, Walnut Fork, Law Ground Creek, Big Creek, Morsingills Creek, and Sarah's Creek.	City of Clayton, Rabun County, GA DOT, US Forest Service	√	√	√
Task: Restore degraded stream banks and the riparian zone at bridges over Warwoman Creek and Big Creek.	GA DOT, City of Clayton, Rabun County	√	√	√

Implementing Recommended Best Management Practices

TABLE 16

Warwoman Creek Watershed Management Plan BMP Implementation Schedule

Management Strategies	*Who Should Be Involved*	Milestone Benchmarks		
		Years 1-2	Years 3-5	Years 5+
Objective*: Establish a long term water quality monitoring program to provide contemporary data to support decision-making*. (*See Section 6., Working with the Public, pp. 53-54; Section 8, Developing the Long Term Monitoring Plan, p. 65; and, Section 4, Assessment and Characterization of Current Conditions, Monitoring, p. 34.)*				
Task: Update EPD-approved Targeted Water Quality Monitoring Plan for fecal coliform and sediment to provide for continued and post BMP monitoring.	Project manager	√		
Task: Conduct ongoing short-term monitoring under GA EPD-approved Targeted Water Quality Monitoring Plan.	Project manager	√	√	
Task: Conduct long-term water quality monitoring by AAS-qualified personnel under EPD-approved Targeted Water Quality Monitoring Plan.	Project manager			√
Objective*: Secure funding to initiate progress on implementing the Warwoman Creek Watershed Management Plan* *(See Financial and Technical Resources, pp. 55, 60-64)*				
Task: Submit a proposed work plan, grant request, and associated documents to apply for various funding options.	City of Clayton, Rabun County, Rabun County Health Department, Georgia Mountains Regional Commission, Chattooga Conservancy, IB Environmental	√		√

Remediation of certain system roads and dispersed camping sites in the national forest is necessary to help reduce sediment and fecal coliform pollution in creeks throughout the watershed.

Implementing Recommended Best Management Practices

TABLE 17

Criteria to Measure Success - useful examples

Indicator Type	Indicator Measurement
Environmental	Water quality data for fecal coliform and turbidity (sediment) in Warwoman Creek, Roach Mill Creek, and Law Ground Creek
Environmental	Water quality data for stream temperature
Environmental	Monitoring data for quality of riparian habitat, quality of instream habitat, and benthic macroinvertebrate community structure
Social	Number of participants in education and outreach programs
Social	Number of inquiries and responses to "call to action" media
Programmatic	Number and size (acres, linear feet, etc.) of agricultural, urban/residential, and forestry BMPs implemented
Programmatic	Number of education and outreach programs held
Programmatic	Quantity of educational and outreach media presented
Programmatic	Acreage of riparian habitats conserved through conservation easements.
Programmatic	Number of creek clean-ups

The list below first presents technical resources, then sources of grant funding, and lastly suggests some longer-term financing mechanisms to strive towards.

⊙ **Table 18** (SEE P. 61) presents **cost range examples for selected management measures**.

▶ *Technical Resources*

Georgia Adopt-A-Stream: Provides manuals, training, and technical support to increase public awareness of the state's nonpoint source pollution and water quality issues, and encourage community participation in addressing these issues.

Natural Resources Conservation Service: Provides technical expertise and conservation planning for farmers, ranchers and forest landowners wanting to make conservation improvements to their land.

Chestatee-Chattahoochee RC&D: Assists individuals and communities in utilizing and protecting natural resources while improving the economy, environment and quality of life.

UGA Agricultural Extension Service: Provides technical assistance to landowners on agricultural practices, water, and soil testing.

Blue Ridge Mountain Soil and Water Conservation District: Provides soil and water conservation advice and technical assistance to landowners.

Georgia Mountains Regional Commission: Offers assistance to local governments for planning, economic development, grant preparation, administration, and job training.

Partners for Fish and Wildlife Program: May provide technical and financial assistance to private landowners to restore or improve native habitats for fish and wildlife.

Funding for Green Infrastructure: The EPA offers many resources on their website; for example, the following link discusses approaches to funding green infrastructure:

Implementing Recommended Best Management Practices

TABLE 18

Cost Range Examples for Selected Management Measures

Note: Agricultural practices may be eligible for a 75% subsidy through the USDA EQIP program

Stream bank restoration – bioengineered	*$21,000 / 100 feet / severely eroded streambank*
Riparian area restoration, includes removing invasive species and installing native plants	*$20,000 / 1.5 acres / severely impacted site*
Septic system, new – conventional (1)	*$4,000 - $6,000*
Septic system, new – advance treatment system (1)	*$12,000 - $15,000*
Urban filtration basin and stormwater delivery system	*$14,000 - $20,000*
Bio-swales	*$11 per square foot*
Porous concrete	*$2 – $6.50 per square foot*
Interlocking pavers	*$5 - $10 per square foot*
Composting facility (AG)	*$5 - $7 per square foot*
Conservation cover (AG)	*$200 - $500 per acre*
Cover crop (AG)	*$75 - $150 per acre*
Critical area planting (AG)	*$160 - $950 per acre*
Diversion (AG grading and shaping)	*$2.50 per linear foot*
Fence (AG)	*$1.50 - $3 per foot*
Filter strip (AG)	*$250 - $450 per acre*
Heavy use area protection (AG)	*$1.50 - $7 per square foot*
Nutrient management system (AG)	*$2 - $23 per acre*
Riparian forest buffer (AG)	*$260 per acre*
Stream crossing (AG)	*$4 - $7 per square foot*
Stream bank and shore line protection (AG)	*$19 - $160 per linear foot*
Water well	*$4,500 - $7,000*

Implementing Recommended Best Management Practices

https://www.epa.gov/green-infrastructure/green-infrastructure-funding-opportunities.

▶ ***Grants / Financial Resources***

USEPA Nonpoint Source Implementation Grant: Under Section 319(h) of the Clean Water Act, the EPA awards a Nonpoint Source Implementation Grant to the GA EPD. GA EPD then disburses these grant funds to projects that support the implementation of the Georgia Nonpoint Source Management Program. This grant program requires a substantial match. Once a watershed management plan has been developed for an area, future rounds of 319 funding may be possible, particularly for implementation of projects identified within the plan.

Aquatic Ecosystem Restoration Projects (Section 206): This program is through the Army Corps of Engineers and involves the design and building of projects to restore aquatic ecosystems for fish and wildlife.

Southeast Aquatic Resources Partnership: Provides funding for aquatic habitat restoration and species conservation.

USDA Environmental Quality Incentives Program: Provides financial and technical assistance to agricultural producers to address natural resource concerns and deliver environmental benefits such as BMPs for improved water and air quality, conserved ground and surface water, reduced soil erosion and sedimentation, and improved or created wildlife habitat.

USDA Conservation Stewardship Plan: Helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns. Participants earn payments for conservation performance—the higher the performance, the higher the payment.

Audubon Cooperative Sanctuary Program for Golf: Is an education and certification program that helps golf courses protect the environment on their property.

EPA Environmental Education Grants Program: Supports environmental education projects that promote environmental awareness and stewardship, and helps provide people with the skills to take responsible actions to protect the environment.

USDA Conservation Reserve Program: Assists agricultural producers to set aside environmentally sensitive land for conservation benefits.

USFWS Five Star Restoration Program: Provides challenge grants for environmental restoration projects involving partnerships to address wetland, riparian, forest and coastal habitat restoration, urban wildlife conservation, stormwater management, education and outreach.

North Georgia Community Foundation/Community Impact Program: Offers grant funding opportunities to 501(c)(3) organizations in north GA counties for projects addressing quality of life issues.

USFWS Partners for Fish and Wildlife Habitat Restoration Program: Provides technical and financial assistance to private landowners to restore or improve native habitats for fish and wildlife, and may be used to restore riparian buffers and degraded wetlands.

River Network Partner Grants: Can be applied for by conservation groups to help build a volunteer base to implement protection and management strategies.

NRCS Watershed Protection and Flood Prevention Program: Offers technical and financial assistance for watershed protection, water supply, water quality, erosion and sediment control, and fish and wildlife habitat enhancement.

Watershed Assistance Grants: Provides small grants to local watershed partnerships for organizational development.

EPA Pollution Prevention Grant Program: Funds grants/cooperative agreements that implement pollution prevention technical assistance services and/or training for businesses and support projects that utilize pollution prevention techniques to reduce and/or eliminate pollution from air, water and/or land.

USDA National Integrated Water Quality Program: For improving water quality through research, education, and extension activities.

USDA Wetlands Reserve Program: Pays agricultural operators to set aside environmentally sensitive lands from production.

Rabun County Chapter of Trout Unlimited: Provides volunteer labor for stream clean up projects, and helps fund stream habitat and restoration activities through Trout Unlimited's Embrace-A-Stream program.

Audubon/Toyota Together Green Grants: Offers grant funding for community-based projects that conserve or restore habitat and protect species, improve water quality

Implementing Recommended Best Management Practices

or quantity, and reduce the threat of climate change by reducing energy use and improving efficiency.

USDA Technical Assistance to Develop and Implement Conservation Programs: Assists landowners in planning, designing, implementing, monitoring, and evaluating fish and wildlife habitat development projects in Georgia.

Georgia Wetlands and Stream Trust Fund: Preserves wetlands or streams that need protection.

USDA Wildlife Habitat Incentives Programs: Are voluntary programs for landowners to implement applicable wildlife habitat practices.

NRCS Agricultural Conservation Easement Program: Provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits.

Duke Energy Water Resources Fund: To improve water quality mainly in the Carolinas; however, specific parts of Georgia may also be eligible.

National Fish and Wildlife Foundation: Provides funding to projects that sustain, restore and enhance the nation's fish, wildlife, and plants and their habitats. Warwoman Creek's designation as a major tributary to the National Wild & Scenic Chattooga River may help in this instance.

Tull Charitable Foundation: Provides grants for a variety of causes to nonprofit organizations in the State of Georgia.

GA Environmental Finance Authority: The State Revolving Fund (SRF) provides low-interest financing for publicly-owned water and wastewater projects; the Land Protection Program provides financing for local governments, state agencies and non-government organizations for permanent land conservation projects, including water quality protection for rivers, streams, and lakes.

▶ ***Financial Resources / Working with Local Government Entities***

Rabun County and the City of Clayton, which are irrevocably tied to the Warwoman Creek watershed, have a stake in its water quality as a prominent quality of life resource and as an economic asset or liability. Research shows that in many cases, local governments have provided funds for watershed protection and restoration. Some local financing options include:

General Fund Contributions: A local government may choose to dedicate a portion of its general fund to water quality improvement efforts.

A Portion of Water or Wastewater Fees Revenue: The local water utility may use its discretion to dedicate a portion of its operating budget to water quality protection projects.

Watershed Protection Utility Fee: The local water utility may add a mandatory fee to its water/wastewater bill that is restricted to watershed efforts.

Contributions from Individual Rate Payers: Some utilities have provided their customers the option of paying more than is due on their water bill. The voluntary contribution is dedicated to water quality efforts such as planting additional trees.

Stormwater Utility Revenue: Some local governments have created a separate utility that charges a fee that funds stormwater management in particular. These utilities have a mission that aligns well with watershed improvement efforts and can be a source of funding for partners involved in these types of projects.

Clean Water State Revolving Fund: The federal government provides money to each state for managing a loan program for clean water projects. These loans, offered by the GA Environmental Finance Authority, are relatively low interest ones, and in very specific cases, less than 100% of the loan needs to be repaid. A sister program, the *Drinking Water State Revolving Fund,* has also been used for financing projects related to water quality. In the State of Georgia, only local government entities are eligible for these loans. However, a watershed group may partner with the local government to implement the project. Approval for the loan is contingent on a clear and reliable revenue source for repayment.

▶ ***Financial Resources / Working with Private Entities***

Nationwide, there is considerable attention to the potential role of private entities in financing of water quality projects. Collectively known as public private partnerships (P3s), this concept can take a range of forms:

Public Private Partnerships (P3s): P3s are established to share the risk and reward of constructing and operating facilities (such as green infrastructure projects) for the benefit of the community. Municipalities may be attracted to P3s because they can defer up-front costs. This may be of particular interest to municipalities that are

Implementing Recommended Best Management Practices

approaching their bonding limit. Conversely, investors are attracted because of the high level of transparency, investment premiums, and secured repayment streams.
Donations From Local Businesses: Donating funds to a cause such as water quality protection can be beneficial to a business's image in the community. With proper recognition from the watershed project, such as signs with logos and ribbon cutting events, local businesses may be encouraged to provide financial contributions.

▶ *Financial Resources / Diversity of Funding & Partners*

The healthiest approach to financing watershed improvements may be a diverse funding base. As planners strive towards more sustainable funding sources, grants will probably continue to play a role in the overall budget. As part of diversifying the sources of funding, watershed improvement efforts should also aim to engage a diverse set of stakeholders and partners. Since watershed lines usually cross political boundaries, there is an opportunity to generate funds from different jurisdictions. For example, a typical watershed may intersect with multiple cities, a county, a soil and water conservation district, water planning region, and a regional commission. All of these partners have a stake in water quality. Another key role that partners can play is providing matching funds in a grant application. Many grant programs have a cost share or match requirement. Funders tend to look favorably on applications where the match comes from partners, demonstrating the support of these partners for the project.

An abundance of public forest land makes the Warwoman watershed a popular destination for outdoor recreation.

If the watershed projects involve wetland areas, a tool, the ***Financing Wetland and Water Quality Improvements Tool*** http://www.efc.sog.unc.edu/reslib/item/financing-wetland-and-water-quality-improvements-tool is also useful in modeling input from multiple partners. This revenue tool allows one to ten separate governments, non-profits, or other entities looking to partner together on water quality projects to estimate how much money they can raise from various sources. In particular, the tool allows these partners to look at the revenue potential from changes to property taxes, sales taxes, water and wastewater fees, stormwater fees, flood control zone fees, permit fees, grants, and other sources. The tool has options for partners looking to raise a specific level of revenue, or for partners to see how much revenue they could generate by entering multiple scenarios into the tool.

Financing from Septic Tank Companies: Recognizing that the cost of septic tank installation, repair and replacement is out of reach for many private homeowners, some septic tank companies provide their own payment plans

Crowd Source Payments/ Donations: There has been increased attention in methods of collecting funds from "crowds" through IT applications for specific initiatives. Crowd source platforms such as *Kickstarter* and *GoFundMe* have become very popular to raise funds for specific projects, either as low interest loans or direct contributions. The forested nature of this watershed and the popularity of North Georgia for outdoor recreation may make this a good candidate for crowdsourcing.

8. Developing the Long Term Monitoring Plan

Targeted Water Quality Monitoring Plan All future water quality monitoring would be in accordance with an EPD approved *Targeted Water Quality Monitoring Plan* for fecal coliform and turbidity. The monitoring plan would contain Standard Operating Procedures for field data collection and laboratory analyses to ensure the quality of the data. In addition to data collected during the watershed assessment, it is suggested that macroinvertebrate data be added to the information already available.

Routine monitoring for sediment and bacteria will continue as well as work to refine "hot spot" locations for corrective action. The goal is to ensure that BMPs are implemented in places where they will result in water quality improvements and progress towards attainment of water quality standards and supporting designated uses. In all cases where BMPs are installed or management measures implemented, both pre- and post- activity monitoring would occur upstream and downstream of the subject area. The monitoring will evaluate and assess physical, chemical, and biological variables as applicable, to monitor trends in stream habitat, water quality, and the biotic community. Parameters evaluated would include:

- *Turbidity*
- *Fecal coliform/ E. coli bacteria levels*
- *Macroinvertebrate community structure and function*
- *Dissolved oxygen*
- *Stream temperature*
- *pH*
- *Conductivity*

Routine monitoring for sediment and bacteria will help measure progress towards long-term water quality goals.

- *Quality of riparian habitat*
- *Quality of instream habitat*

Additionally, fecal coliform bacteria analysis by a certified water/wastewater treatment operator such as from the City of Clayton or Rabun County would occur to add to the record of data, with special attention paid to stream segments listed for fecal coliform impairment.

Monitoring can include visual assessments of the quality of riparian area habitat.

9. Watershed Management Plan Implementation, Evaluation, & Revision

⦿ **See Table 17, pp. 49-51** for the **Warwoman Creek Watershed Management Plan BMP Implementation Schedule.**

Keys to Success The keys to successful implementation of the Warwoman Creek Watershed Management Plan include:

- ★ *Measurable goals and objectives;*
- ★ *Dedicated staff to carry out administrative duties;*
- ★ *Consistent, long-term funding;*
- ★ *Dedicated individuals who are supported by local government agencies;*
- ★ *Local ownership of the watershed plan;*
- ★ *A method for monitoring and evaluating implementation strategies;*
- ★ *Involvement of stakeholders in planning the next phase of implementing the WMP;*
- ★ *Open communication between organization members; and,*
- ★ *Watershed Management Plan implementation, revisions, & updates.*

Careful attention to these key factors should be assured in the next phase of implementing the Warwoman WMP.

The Players To address agricultural, forestry, and urban/residential impacts, and future remediation of negative impacts on water quality in the Warwoman Creek watershed, it is important to note that the following entities are positioned to "make or break" the implementation of the proposed management measures:

➔ Within their respective jurisdictions, both the City of Clayton and Rabun County are the Local Issuing Authorities for Land Disturbing Activities under the Georgia Erosion & Sediment Pollution Control Act, and thus have lead responsibilities in the control of erosion and sedimentation during site development, and ensuring that proper site planning and storm water management occurs to protect wetlands, riparian areas and water quality.

➔ The Rabun County Health Department is responsible for permitting new septic systems and addressing failing septic systems.

➔ The U.S. Forest Service Chattooga River Ranger District is responsible for maintenance of all U.S. Forest Service roads in the Warwoman Creek watershed in the State of Georgia, as well as enforcement of laws pertaining to their use.

➔ Success is also dependent on the support of the City of Clayton and Rabun County to cooperatively pursue and apply the management measures named in this watershed management plan.

➔ Lastly, the State of Georgia has the overall authority and responsibility to protect the "waters of the State" throughout the project area.

Evaluation Timeline Evaluation of three major components of the Warwoman WMP should occur every five (5) years, and include the following:

◈ *Inputs* — the elements of the process used to implement a program i.e., resources of time and technical expertise, stakeholder participation.

◈ *Outputs* — the tasks conducted and the products developed i.e., implementation activities such as installing management practices.

◈ *Outcomes* — the results or outcomes realized from implementation efforts, i.e., environmental improvements like water quality.

The Watershed Advisory Committee should convene every five years to revise and adjust the Warwoman WMP implementation schedule in a methodical manner, and in accordance with these evaluation components.

Butterfly weed in the Warwoman watershed.

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Remnants of an abandoned railroad truss alongside Warwoman Creek.