TARGETED WATER QUALITY MONITORING PLAN

for

FOUR HUC-12 WATERSHEDS IN THE WARWOMAN CREEK DRAINAGE AREA OF THE CHATTOOGA RIVER WATERSHED

in Rabun County, Georgia

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Submitted to Georgia Department of Natural Resources

Environmental Protection Division

Watershed Protection Branch

by Chattooga Conservancy

June 2018

TABLE OF CONTENTS

INTRODUCTION

Under the Clean Water Act (33 U.S. Code §1256), Section 106 Water Pollution Control Grant from the Georgia Department of Natural Resources, Environmental Protection Division (GAEPD), the Chattooga Conservancy will develop a Nine-Element Watershed Management Plan (WMP) for the Warwoman Creek HUC-10 #0306010202 Watershed (which includes 4 separate sub-watersheds: Headwaters West Fork Chattooga River HUC-12 #030601020202, West Fork Chattooga River HUC-12 #030601020203, Upper Warwoman Creek HUC-12 #030601020205 and Lower Warwoman Creek HUC-12 #030601020206).

The Warwoman Creek Drainage Area WMP is being developed pursuant to GAEPD contract number 751-170143, and will utilize the US Environmental Protection Agency's (USEPA) Nine Elements of Watershed Planning to identify the various sources of impairment in the Warwoman Creek drainage area, and serve as a guide for restoring and protecting the watershed.

This project requires the targeted monitoring of water quality according to a Water Quality Monitoring Plan approved by GAEPD. Water quality samples and in-stream measurements will be collected from targeted locations using Georgia's Adopt-A-Stream (AAS) and other GAEPD approved techniques. This targeted monitoring will provide a picture of water quality conditions within the watershed to help identify potential sources of pollution, establish pre-Best Management Practice (BMP) baselines, and to develop strategies for water quality restoration and protection in critical sections of the drainage area. *The data will not be used for water quality listing purposes by GAEPD.*

The project coordinator for the Warwoman Creek Drainage Area Watershed Management Plan and the Water Quality Monitoring Plan is:

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Watershed Description & Reason for Monitoring The Warwoman Creek Drainage Area (Project Area) includes Warwoman Creek and the West Fork of the Chattooga River, two major tributaries of the National Wild and Scenic Chattooga River. The Project Area encompasses approximately 61,604 acres. The Warwoman Creek watershed is located entirely within Rabun County, Georgia, and the West Fork watershed includes portions of Rabun County, Georgia, and Macon County, North Carolina.

Warwoman Creek originates east of the City of Clayton near a landform called Saddle Gap, and flows eastward through largely agricultural areas along Warwoman Road, then south through more agricultural land and the Chattahoochee National Forest before emptying into the Chattooga River. The West Fork of the Chattooga River is fed by a multitude of headwater streams in the Chattooga watershed, and begins downstream of a confluence known as "Three Forks." The West Fork flows in a generally southeasterly direction before emptying into the Chattooga River.

Land uses in the Project Area are approximately 95% forested lands primarily in the Chattahoochee National Forest, and 5% agricultural lands that include livestock and poultry operations located within flood plain and riparian areas.

GAEPD has listed 2 miles of Law Ground Creek, from its headwaters to the West Fork of the Chattooga River, for biota macroinvertebrates impairment; 2 miles of Roach Mill Creek, from its headwaters to Warwoman Creek, for biota macroinvertebrates impairment; 6 miles of Warwoman Creek—Finney Creek to Sarah's Creek—for biota macroinvertebrates impairment; and, 4 miles of Warwoman Creek—Sarah's Creek to Chattooga River—for both biota macroinvertebrates and fecal coliform impairments.

These elevated bacteria and sediment levels in the four HUC-12 watersheds in the Warwoman Creek drainage area of the Chattooga River Watershed are attributed primarily to non-point sources of pollution. See Figure 1: Warwoman Creek Drainage Area and Impaired Waterways.

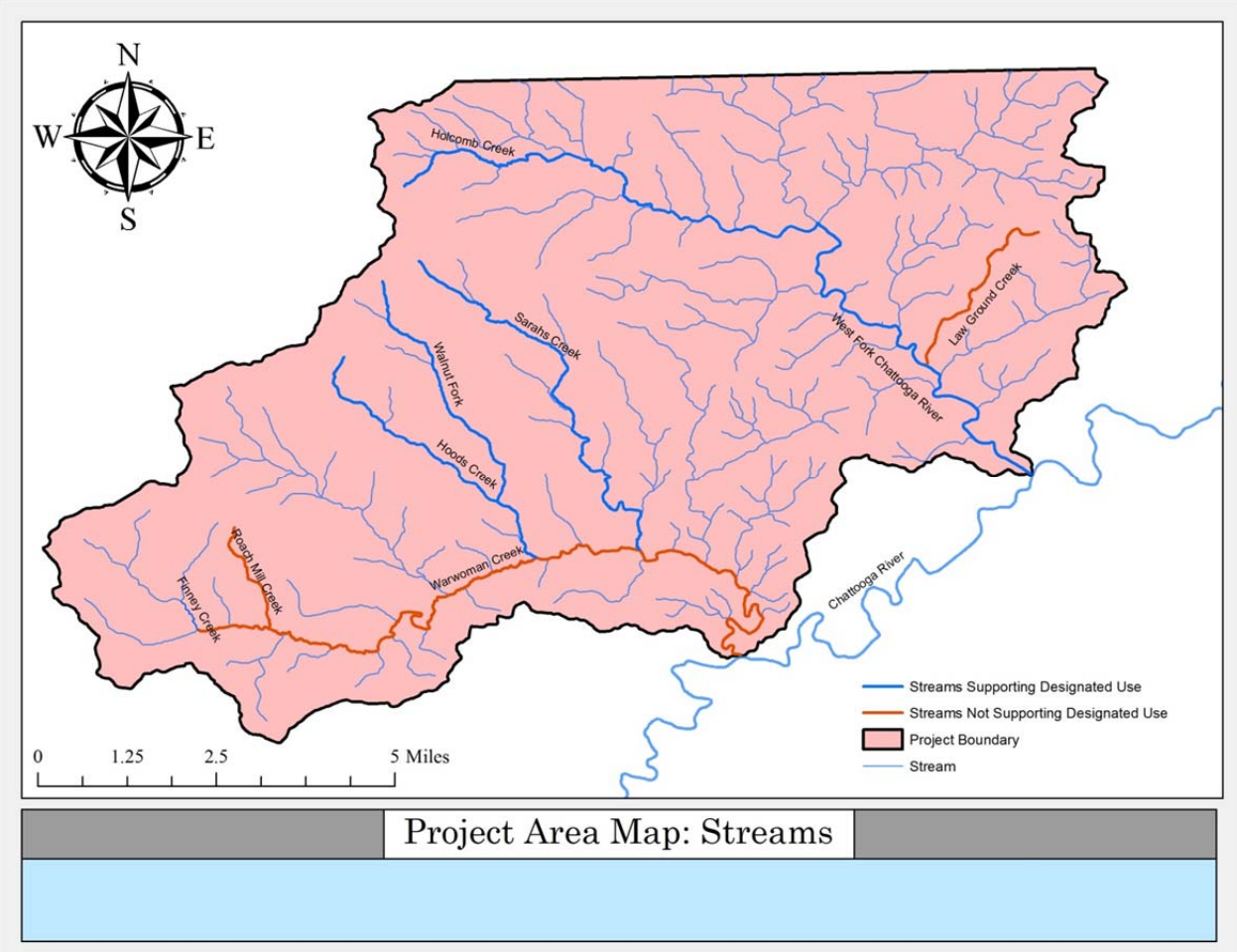

Figure 1: Warwoman Creek Drainage Area and Impaired Waterways

The USEPA and GAEPD Total Maximum Daily Load reports and implementation plans for the Project Area identify the biota macroinvertebrates and bacteria impairment in the drainage area as due primarily to unpaved or poorly maintained roads, construction runoff, agriculture, low intensity residential and silviculture (forestry) activities.

See:

- Total Daily Maximum Load (TMDL) for Bio M (biota macroinvertebrates), Law Ground Creek, Roach Mill Creek and both segments of Warwoman Creek, 2001.
- TMDL for fecal coliform, Warwoman Creek—Sarah's Creek to Chattooga River, 2005.
- TMDL Implementation Plans for Bio M, Warwoman Creek—Sarah's Creek to Chattooga River; Law Ground Creek and Roach Mill Creek, 2002.
- TMDL Implementation Plan for Bio M, Warwoman Creek—source to Black Diamond Road, that includes the listed segment of Finney Creek to Sarah's Creek, 2007.
- TMDL Implementation Plan for fecal coliform, Warwoman Creek—Sarah's Creek to Chattooga River, 2007.
- TMDL for Bio M in the Chattooga River Watershed, USEPA, 4/2001
- State of Georgia TMDL Implementation Plan Watershed Approach Savannah River Basin, 12/2002.

POLLUTANTS, INDICATORS, SCHEDULE & LOCATIONS

Pollutants and Indicators to be Monitored One (1) bacterial pollutant—fecal coliform— will be measured under this Water Quality Monitoring Plan, and if resources permit, *Escherichia coli (E. coli*), a second bacterial pollutant, will also be monitored. One (1) Bio M pollutant indicator—turbidity—will be measured under this Water Quality Monitoring Plan. In addition, water temperature and air temperature will be recorded at each sampling site.

Indicators

- Fecal coliform Fecal coliform bacteria commonly live in the intestinal tract of warm-blooded animals and originate from animal and human fecal matter. GAEPD uses fecal coliform as the water quality standard for bacterial contamination in surface waters because it indicates the potential presence of contamination by human feces, which can transmit disease-causing pathogens. The laboratory at the City of Clayton Water Pollution Control Plant will analyze water samples for fecal coliform.

- *E. coli* *E. coli* is a subgroup of fecal coliform bacteria. The USEPA recommends *E. coli* as an indicator for assessing potential health risks in recreational waters because *E. coli* are more closely related with swimming-related gastrointestinal illnesses than other fecal coliform bacteria. Like other fecal coliform bacteria, *E. coli* indicates the potential presence of disease-causing pathogens from human feces. In addition, *E. coli* can directly harm humans who come into contact with it during recreational activities, such as swimming or boating, where there is opportunity for ingestion of contaminated water. Symptoms of *E. coli* infection include diarrhea, stomach cramps, and fever. *E. coli* is a good indicator of pathogens because it generally lives longer than pathogens, is found in greater numbers than pathogens, and is less risky to culture and study in a laboratory than pathogens.

- Turbidity/Sediment Turbidity is a measure of water clarity and how much the passage of light through the water has been decreased by suspended sediment. Turbidity samples will be reported in Nephelometric Turbidity Units (NTUs). Sediment in streams causes significant

degradation of water and habitat quality by increasing water temperatures through the absorption of heat by the suspended particles. This reduces the concentration of dissolved oxygen available to aquatic life because warm water holds less oxygen than cold. In addition, sediment clogs fish and macroinvertebrate gills, which reduces resistance to disease, lowers growth rates, diminishes egg and larval development, and ultimately can suffocate or starve filter-feeding organisms. Sediment also causes macro habitat degradation through the accumulation of excessive sand or silt on the stream bottom that fills macroinvertebrate sheltering areas, and through suspended materials that scour streambanks, removing vegetation and woody debris that provides habitat for macroinvertebrates to feed, hide and breed. Suspended materials are in the size range of 0.004 mm (clay) to 1.0 mm (sand).

- Temperature Temperature is a critical water quality and environmental parameter because it governs the kinds and types of aquatic life, regulates the maximum dissolved oxygen concentration of the water, and influences the rate of chemical and biological reactions. The organisms within the ecosystem have preferred temperature regimes that change as a function of season, organism age or life stage, and other environmental factors. With respect to chemical and biological reactions, the higher the water temperature the higher the rate of chemical and metabolic reactions. Seasonal variations in stream temperature may be caused by changing air temperature, solar angle, meteorological events, and a number of physical aspects related to the stream and watershed. These physical features include stream origin, velocity, vegetation types and coverage, stream configuration, land-use, and percentage of impervious area. For example, a narrow, deep well-shaded shoreline reduces the impact of warming by the sun; whereas, a wide shallow stream would be more impacted by solar heating.

Table 1 includes the GAEPD and USEPA limits on bacteria in recreational waters. If any sampling site reveals equal to or more than 300 cfu/100 ml for fecal coliform or *E. coli*, or the presence of colonies too numerous to count, the project coordinators will immediately notify the Rabun County Health Department. All sampling data will be reported to GAEPD in the quarterly reports.

Table 1 Pollutants/Indicators & Schedule for Sampling

Pollutant or Indicator	**Recommended Water Quality Limits**	**Sampling Schedule**
Fecal Coliform	**Recreation** 200 cfu/100ml May-October 1,000 cfu/100ml November-April Action Warranted > 300 cfu/100 ml	Sample collection will occur in 2018 during the months of May, June, July and August, and will consist of at least 7 sampling events. Sample collection will be on Tuesdays and/or Thursdays, and include a minimum of 1 wet weather sample during a rain event in excess of 0.2 inches. Additional sample collection may also occur, to provide supplemental hotspot data as needed, and as indicated by data trends.

E. coli	**Swimming Categories** Designated: <235 cfu/100 ml Moderate: <298 cfu/100 ml Light: <410 cfu/100 ml Infrequent: <576 cfu/100 ml Action Warranted > 300 cfu/100 ml	Sample collection to provide additional hotspot data as needed and as resources permit.
Turbidity	All waters shall be free from turbidity that causes a substantial visual contrast in a water body.	Sample collection will occur in 2018 during the months of May, June, July, August and September and will consist of at least 7 complete sampling events. Sample collection will be on Mondays, Tuesdays and/or Thursdays, and include a minimum of 1 wet weather sample during a rain event in excess of 0.2 inches. Additional sample collection may also occur to provide supplemental hotspot data as needed, and as indicated by data trends.
Temperature	Air temperature and stream water temperature will be recorded in the field, at each sample site every time samples are collected.	

Monitoring Locations The initial targeted sampling points (SP) have been selected from: 1) the GAEPD-USEPA official site or sites used to establish the Total Maximum Daily Load reports for the watershed; 2) sites in impaired streams upstream of confluences with Warwoman Creek and the West Fork of the Chattooga River; and 3) known or suspected hotspots determined through visual stream surveys and prior water quality monitoring. Each sampling site will be assigned an Adopt-A-Stream number. See Table 2.

Table 2 Warwoman Drainage Area, Initial Monitoring Locations

SP	AAS Number	Latitude/Longitude	Physical Location	Stream Segment
1		34.88229 -83.3503	Warwoman Creek – Baseline data. Near Saddle Gap at Warwoman Dell.	Warwoman Creek
2		34.88551 -83.3395	Finney Creek, just above Finney/Warwoman confluence	Finney Creek
3		34.88727 -83.3251	Roach Mill Creek, just above confluence with Warwoman Creek. **GAEPD listing site*	Roach Mill Creek
4		34.88364 -83.3022	Warwoman @ Sandy Ford Rd., 1st bridge	Warwoman Creek
5		34.90171 -83.3002	Tuckaluge Creek, above confluence with Warwoman, 1st bridge on Tuckaluge Rd.	Tuckaluge Creek
6		34.90112 -83.273	Walnut Fork (tributary to Warwoman)	Walnut Fork
7		34.89793 -83.2752	Warwoman Creek, bridge at intersection of Sandy Ford Rd. and John Houck Rd.	Warwoman Creek
8		34.9021 -83.2602	Joe Speed Rd. Bridge @ Hatch Camp	Warwoman Creek
9		34.90202	Earl's Ford Rd., bridge **GAEPD listing site*	Warwoman

		-83.254		Creek
10		34.88521 -83.2285	Warwoman Creek ford to Earl's Ford, GA	Warwoman Creek
11		34.91553 -83.24	Morsingills Creek, upstream of Warwoman confluence	Morsingills Creek
12		34.93932 -83.1926	West Fork of Chattooga River	West Fork
13		34.94022 -83.1919	Law Ground Creek * *GAEPD listing site*	Law Ground Creek
14		34.9468 -83.1977	Reed Mill	Reed Mill Creek
15		34.94964 -83.1854	Law Ground Creek near Hwy. 28	Law Ground Creek
16		34.98291 -83.191	Big Creek @ Hwy. 28 bridge	Big Creek
17		34.98272 -83.1846	Big Creek @ Walking Stick Rd.	Big Creek

During the course of the project, data trends will be used to target additional monitoring sites to further refine the locations of sources of pollution. Monitoring sites with a record of consistently low numbers, particularly those sites located at or near the headwaters of tributaries to Warwoman Creek and the West Fork of the Chattooga River, will be noted and may be omitted from further sample collection. Sites such noted may be revisited as necessary to obtain data to address potential seasonal variations. Ultimately, the data will be used to determine pollution hotspots, and the potential location of Best Management Practices (BMPs) and other corrective actions for future implementation and evaluation.

Generally, sampling sites will be as near as possible to road crossings, on public right-of-ways, or along utility easements to make access easier, decrease private property concerns, and ensure safe operations. In addition, the sites have been assessed to confirm latitude and longitude coordinates, directions, mileage and travel time. See Figure 2: Warwoman Creek Drainage Area Map of Initial Sampling Points.

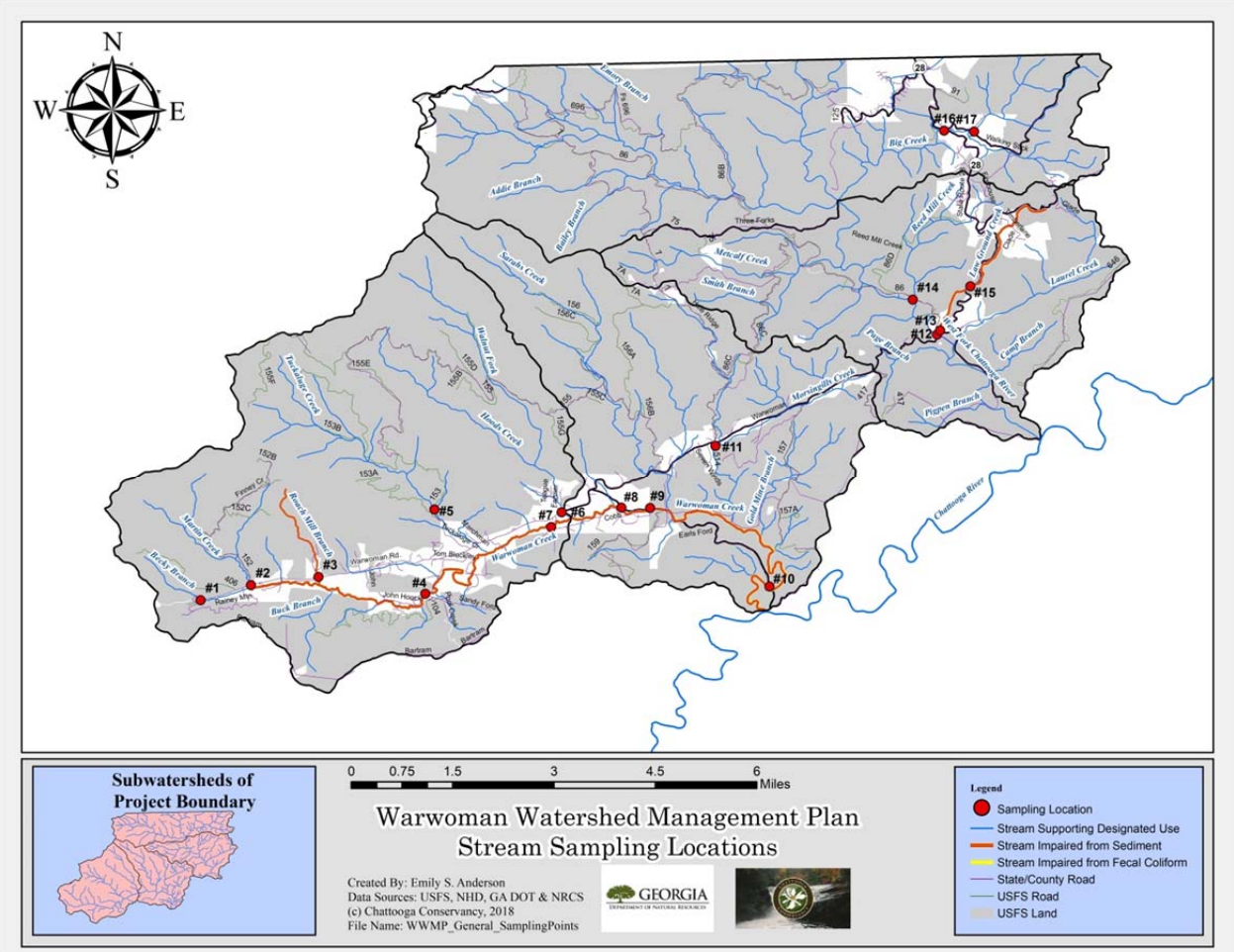

Figure 2: Warwoman Creek Drainage Area Map of Initial Sampling Points

TRAINING

Chattooga Conservancy staff members and volunteers will conduct the field work, including sample collection, temperature measurement, and initial data recording. Chattooga Conservancy project staff will be trained and supervised by Nicole Hayler. Hayler has received certifications from the Georgia EPD Adopt-A-Stream (AAS) program in bacterial, macroinvertebrate and chemical monitoring, and has also been trained by GA EPD in visual stream assessment protocols. . Additional project participants will work under the supervision of Hayler, or hold current AAS certifications.

QUALITY ASSURANCE & CONTROL

Water sampling protocols will adhere to AAS field techniques. All sample collection protocols and laboratory analysis will be conducted in accordance with the GAEPD Adopt A Stream (AAS) Quality Assurance Project Plan (QAPP) and Quality Monitoring Plan (QMP) developed and maintained by GAEPD. Copies of the QAPP and QMP will be provided by GAEPD and electronic files of the documents will be kept on site as reference and guidance on water quality monitoring procedures. Any additional agencies, organizations, or subcontractors that participate in the water quality monitoring activities shall also adhere to GAEPD AAS procedures and this guidance.

Methodology & Materials The methodologies used to collect and analyze water samples have been derived from the most current Georgia AAS Macroinvertebrate & Chemical Stream Monitoring and Bacterial Monitoring manuals, or developed by the entities employing the techniques and/or the manufacturers providing the equipment to yield comparably competent data.

The Chattooga Conservancy has an agreement with the laboratory at the City of Clayton's Waste Water Treatment Plant to conduct the sample analyses for fecal coliform and turbidity. These entities will conduct their analyses to produce data that meets the standards of the field. See Appendix A: Standard Operating Procedures.

Analytical results of collected water samples for fecal coliform and *E. coli* will be reported in colony forming units per 100 ml of water (cfu/100ml). Turbidity samples will be reported in Nephelometric Turbidity Units (NTUs), which is the amount of light scattered by suspended particles. The laboratory at the City of Clayton Water Pollution Control Plant will assist in reporting and analyzing fecal coliform and turbidity samples (and *E. coli* if resources permit).

Samples for measuring fecal coliform, *E. coli* and turbidity will be collected by a grab sample or via a weighted sampling yoke from the side of a bridge or culvert.

- Prior to collecting the water sample, a 100ml sterile bottle will be marked with indelible ink to record time, name of stream, date and sample site number. Sterile bottles will be used to collect the water samples for fecal coliform and *E. coli*. A small, numbered Nalgene bottle will be used to collect water for turbidity tests.

- Grab samples will be collected by hand, mid-stream and mid-depth, and the 100 ml sampling bottle closed immediately after collection.

- From a bridge or culvert, the water sample collection will be taken on the upstream side of the bridge/culvert. A weighted sampling yoke secured to a rope will be used. The sampling yoke will contain one 100 ml sterile bottle or Nalgene bottle. The bottle will be opened after it is placed in the yoke. The yoke will be lowered midstream and mid-depth into flowing water for about three seconds. After the sample is collected, the sampling yoke will be raised and the sample bottle closed and sealed before removal from the yoke.

- Water temperature and air temperature will be recorded at each sample site. The measurement will be recorded in Celsius. For water temperature, the thermometer will be placed a few inches below the water surface for approximately two minutes, at a location that is shaded. A second thermometer will record air temperature.

- Chattooga Conservancy staff will obtain water samples for measuring bacteria, turbidity and temperature using the sampling yoke or wading into the stream as described above.

- One sterile container labeled "blank" will be prepared in advance with organic-free, distilled water and placed on ice before the start of each sampling trip. The presence of fecal coliform

and/or *E. coli* in the field blank specimen will be considered an anomaly and will require re-sampling.

- Duplicate samples will be collected and placed on ice for every ten samples or during each sampling trip to provide quality assurance and quality control. Bottles used for quality control will be marked with a duplicate # that corresponds to the identification for the appropriate sample site. Variations of more than ten percent between the collected sample and the duplicate sample will be considered an anomaly and will require re-sampling. Data for field blanks and duplicates will be reported in the monitoring reports along with sample site data.

Materials used for water sampling will be purchased from Thermo Fischer Scientific to collect and analyze samples for fecal coliform, *E. coli.* and turbidity. These will be:

- ❖ 120 ml sterile vessels with sodium thiosulfate
- ❖ 250 ml vessels

In addition, equipment purchased from Forestry Suppliers will be used to measure air and water temperature and to record field data. These include:

- ❖ LaMotte armored thermometer
- ❖ Rite in the Rain all-weather environmental field book no. 550

All data collected in the field will be recorded in the field logbook, on an approved chain-of-custody form if being delivered to a laboratory, and in the monitoring reports submitted as part of the project. See Appendix B – Chain of Custody Form.

Storage, Transport, Cleaning & Disposal After collection, sample bottles will be immediately placed on ice in a cooler, and delivered with the chain of custody form to the appropriate laboratory within 6 hours of sampling. Commercial disinfectants, such as Lysol, or ten percent bleach solutions will be used to de-contaminate sample bottles for disposal.

DATA VALIDATION & SUBMISSION

The project coordinators will be responsible for the integrity of data submitted. Prior to data collection, materials will be assembled and collection processes followed as outlined above. Any data collected outside prescribed parameters and ranges will be investigated thoroughly for equipment and/or collector error. Anomalies in data will be reviewed and described in the monitoring reports; and sites will be re-sampled, if necessary, as soon as possible after discovery of the anomaly. Significant physical changes at data collection sites will also be reported.

Laboratory personnel will complete the results section of the chain of custody sheet and transmit the finished form to the Chattooga Conservancy electronically. Electronic and hard copy files of the monitoring results will be on file at the Chattooga Conservancy's office. The project coordinators will

submit data on Georgia's online database at www.GeorgiaAdopt-A-Stream.org, and on quarterly Monitoring Reports to GAEPD, which will include:

1. Sampling site name, AAS number, and USEPA/GAEPD site numbers.
2. Latitude/longitude coordinates for each sample.
3. Description of each collection site with identity of landowner and directions to each site.
4. A map with stream name, site identification, latitude/longitude coordinates, and road crossings.
5. Names of individuals conducting sampling and of individuals and entities receiving data.
6. Completed chain of custody form for each sampling site.
7. Location and duration of data storage.

At the close of the 4-month monitoring period, Chattooga Conservancy staff will summarize the data and draft conclusions regarding trends, causation, corrective action and, if appropriate, the need for ongoing sampling, data collection, and analysis. Data will be analyzed to identify pollution hotspots, and critical areas in the watershed that would benefit from BMPs. The summary and conclusions will be submitted to GAEPD and the project stakeholders. After review and editing; the summary and conclusions will be integrated into the Watershed Management Plan.

APPENDIX A: Protocols for Sample Analysis

Fecal Coliform
Clayton, GA Water Pollution Control Plant - Fecal Coliform Filter Procedure

Turbidity
Clayton Water Pollution Control Plant - Turbidity Measurement Procedure

E. coli
Testing procedure will be added if resources permit testing for *E. coli*, and included in a revised water sampling plan

Temperature
Chattooga Conservancy Field Methods

APPENDIX B: Chain of Custody Form