TARGETED WATER QUALITY MONITORING PLAN

FOR

THE STEKOA CREEK WATERSHED

IN

RABUN COUNTY, GEORGIA

Submitted to Georgia Department of Natural Resources
Environmental Protection Division
Watershed Protection Branch

by

THE CITY OF CLAYTON, GEORGIA

and

THE CHATTOOGA CONSERVANCY

September 2013
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INTRODUCTION

Through a Clean Water Act Section 319(h) grant from the Georgia Department of Natural Resources Environmental Protection Division (GAEPD), the City of Clayton, Georgia in partnership with the Chattooga Conservancy, Inc. will produce a Stekoa Creek Watershed Management Plan (WMP) pursuant to EPD Contract number 751-130127. The WMP will utilize the US Environmental Protection Agency's (USEPA) *Nine Elements of Watershed Planning* to identify the various sources of impairment in the Stekoa Creek watershed 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 restoration and protection of the watershed. The data will not be used for water quality listing purposes by GAEPD.

The project coordinators for the Stekoa Creek Watershed Management Plan and the Water Quality Monitoring Plan are:

City of Clayton, Georgia
Cissy Henry, City Manager
837 Highway 76 West, Suite 101
Clayton, GA 30525
706-782-4512
cishenry@windstream.net

Chattooga Conservancy, Inc.
Nicole Hayler, Executive Director
8 Sequoia Hills Lane
Clayton, GA 30525
706-782-6097
info@chattoogariver.org.

Watershed Description and Reason for Monitoring - Stekoa Creek is a major tributary of the National Wild and Scenic Chattooga River. Stekoa Creek's watershed encompasses approximately 26,000 acres and is located entirely within Rabun County, Georgia. The creek originates near Mountain City and flows southward along US Highway 441, through the City of Clayton, then south and east through largely agricultural areas and the Chattahoochee National Forest before emptying into the Chattooga River. Land uses in the Stekoa Creek watershed are approximately 20% urban-residential; 40% agricultural, including a multitude of intensive livestock operations located within flood plains; and 40% forested lands, primarily in the Chattahoochee National Forest.

GAEPD has listed fourteen miles of Stekoa Creek from Clayton, Georgia to its confluence with the Chattooga, four miles of Scott Creek, one mile of Saddle Gap Creek, three miles of Chechero Creek, and three miles of She Creek, all within the Stekoa Creek watershed, as being impaired by both fecal coliform and sediment. Three miles of Stekoa Creek from Cox Lake in Mountain City to Stekoa Creek's confluence with Scott Creek and two miles of Pool Creek are listed as impaired by excessive sediment. See *Figure 1 – Stekoa Creek Watershed and Impaired Waterways.* These elevated bacteria and sediment levels in the Stekoa Creek watershed are attributed to both point and non-point sources of pollution.

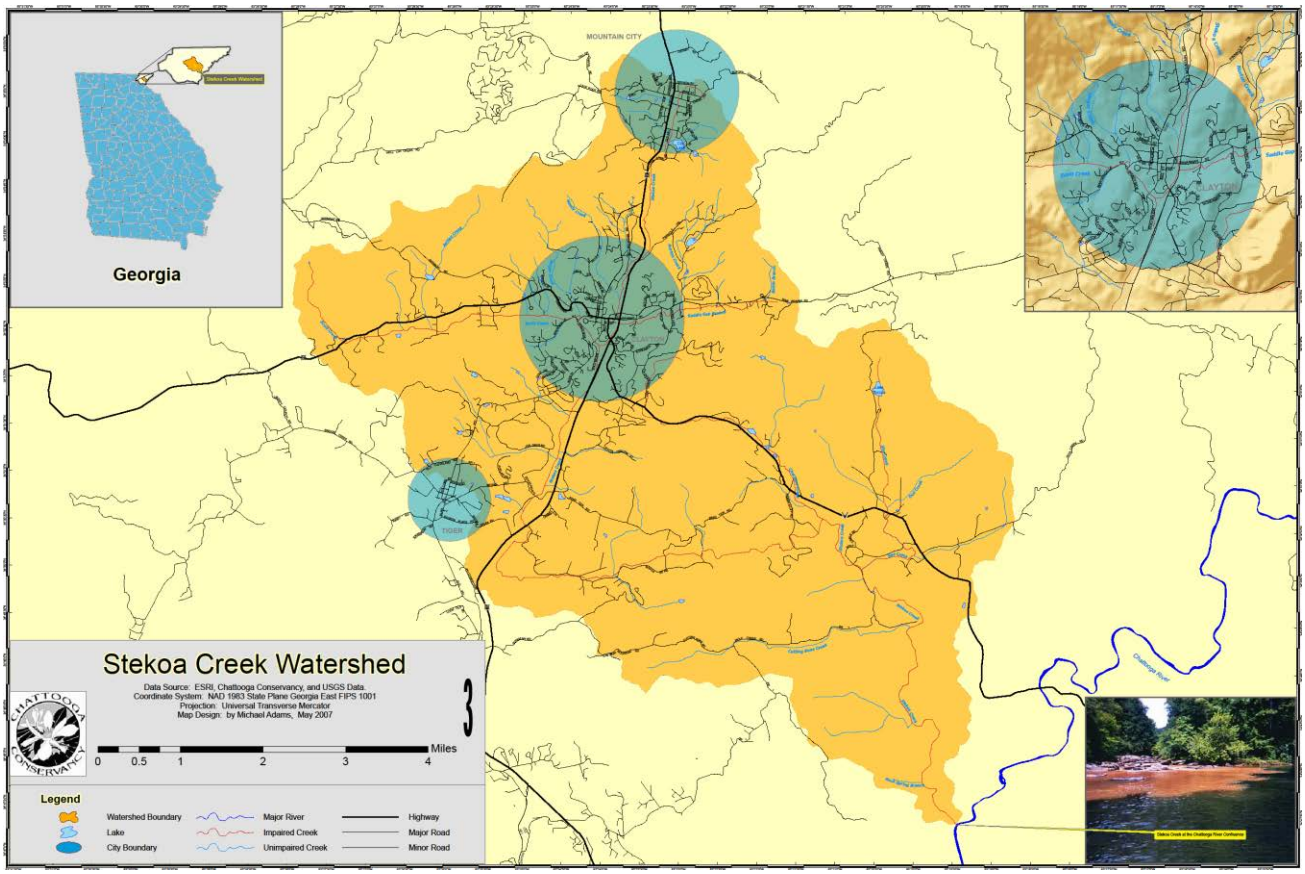

Figure 1 – Stekoa Creek Watershed and Impaired Waterways

The USEPA and GAEPD Total Maximum Daily Load reports and implementation plan identify impairment by bacteria in the watershed as due primarily to livestock management and domestic wastewater treatment operations in the floodplains of Stekoa Creek and its tributaries and sediment impairment to nonpoint sources such as agriculture, construction, unpaved or poorly maintained roads, urban development, and residential development. See - Final Total Maximum Daily Load (TMDL) for Fecal Coliform and Sediment (Biota Impacted) in She Creek, Savannah River Basin, Rabun County, Georgia prepared by the USEPA in February 2005; Total Maximum Daily Load (TMDL) Development for Fecal Coliform in the Stekoa Creek Watershed, Rabun County, Stekoa Creek, Georgia prepared by the USEPA on March 7, 2000; Total Maximum Daily Load (TMDL) for Sediment in the Chattooga River Watershed for Segments Stekoa Creek Watershed – Stekoa Creek, Scott Creek, Pool Creek, Chechero Creek, Saddle Gap Creek,, Warwoman Creek Watershed – Upper Warwoman Creek, Roach Mill Creek, West Fork Creek Watershed – Law Ground Creek prepared by the USEPA on April 30. 2001; and State of Georgia TMDL Implementation Plan Watershed Approach Savannah River Basin, dated December 1, 2002. These operations include dysfunctional septic systems, sewage spills and leaks from the City of Clayton's Water Pollution Control Plant and collection infrastructure, and providing livestock with access to streams.

Readily observable sources of sedimentation include stream bank erosion by livestock, unbuffered crop cultivation along streams, and unpaved, unbermed roads adjacent to streams. For example, within one half mile of the Conservancy office staff can observe, on a daily basis, cows and pigs wading in Stekoa Creek and/or in tributaries to it. In addition, along US Highway 76 Conservancy

staff can observe, each day, cornfields plowed and planted close to She Creek; and on August 20, 2013, while driving the sampling route for this project, Conservancy staff observed portions of Claude Smith Road, Wolf Creek Road, and File Road along Stekoa Creek where streamside berms could lessen or prevent the washing of sediments into the creek.

POLLUTANTS, INDICATORS, SCHEDULE, AND LOCATIONS

Pollutants and Indicators to be Monitored – Two bacterial pollutants - fecal coliform and *Escherichia coli (E. coli*) - and two pollution indicators – turbidity and optical brighteners - will be measured under this Water Quality Monitoring Plan. The methodologies used to collect and analyze samples have been derived from the most current Georgia AAS' Biological and 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 agreements with laboratories at the City of Clayton's Water Pollution Control Plant, North Georgia Technical College in Clarkesville, Georgia, and Texidyne Inc. in Clemson, South Carolina (if needed) to conduct the sample analyses for fecal coliform, *E. coli,* and turbidity. These entities will conduct their analyses to produce data that meets the standards of the field. See *Appendix A - Standard Operating Procedures.*

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; Texidyne Inc. will be available to analyze water samples for the presence of 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. 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.

Analytical results of collected water samples for fecal coliform and *E. coli* will be reported in colony forming units per 100 ml (cfu/100ml). The laboratory at the North Georgia Technical College will assist in analyzing *E. coli* samples. In addition, the adult Scout Masters and Scouts of Boy Scout Troop 6 of Clayton who were AAS certified on June 20, 2013, will conduct *E. coli* sampling at selected sites, and the laboratories at the City of Clayton Water Pollution Control Plant and Texidyne Inc. will be available.

Table 1 includes the GAEPD and USEPA limits on bacteria in recreational waters. If any sampling site reveals equal to or more than 1,000 cfu/100 ml for *E. coli* or the presence of colonies too numerous to count, the project coordinators will immediately notify the wastewater and health

departments of Rabun County and the City of Clayton. Such data will be reported to GAEPD in the quarterly reports.

Table 1 – Pollutants/Indicators and Schedule for Sampling

Pollutant or Indicator	Recommended Water Quality Limits	Sampling Schedule
Fecal Coliform	**Recreation** 200 cfu/100ml	Sample collection to provide additional hotspot data as needed.
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** > 1,000 cfu/100 ml	Sample collection on Monday, Tuesday, or Wednesday of every other week (initial round); on every third Monday, Tuesday, or Wednesday (secondary round); and on the 1st Monday, Tuesday, or Wednesday of each month (final round). During the final round, additional sample collection may also occur to provide supplemental hotspot data as needed.
Optical Brighteners	**N/A**	Sample collection on Monday, Tuesday, or Wednesday of every other week (initial round); on every third Monday, Tuesday, or Wednesday (secondary round); and on the 1st Monday, Tuesday, or Wednesday of each month (final round). During the final round, additional sample collection may also occur to provide supplemental hotspot data as needed.
Turbidity	All waters shall be free from turbidity that causes a substantial visual contrast in a water body.	Sample collection on Monday, Tuesday, or Wednesday of every other week (initial round); on every third Monday, Tuesday, or Wednesday (secondary round); and on the 1st Monday, Tuesday, or Wednesday of each month (final round). During the final round, additional sample collection may also occur to provide supplemental hotspot data as needed. Plus 3 wet weather samples per season (May-October & November-April) during a rain event in excess of 0.2 inches for 6 wet weather samples for each sampling site.

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), which is the amount of light scattered by suspended particles. 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 because warm water holds less oxygen than cold. In addition, sediment clogs fish gills, which reduces resistance to disease in fish, lowers their growth rates and diminishes egg and larval development. Suspended materials are in the size range of 0.004 mm (clay) to 1.0 mm (sand).

Trained staff at the Chattooga Conservancy will use a Turner Designs *Aqua*Fluor handheld turbidimeter and fluorometer to measure turbidity directly at the sampling sites. In addition, the laboratories at the City of Clayton Water Pollution Control Plant and Texidyne Inc. will be available to analyze turbidity samples.

Optical brighteners – Optical brighteners are components added to laundry soaps to brighten clothes. Generally, effluent from septic systems and wastewater treatment plants is the only source of optical brighteners in rivers and streams. The presence of optical brighteners will significantly increase the accuracy in pinpointing sources of wastewater discharges into the watershed. Trained staff at the Chattooga Conservancy will use a Turner Designs *Aqua*Fluor hand held fluorometer and

turbidimeter to detect the presence of optical brighteners in the Stekoa Creek watershed. The laboratory at Texidyne Inc. will be available to analyze for optical brighteners.

Temperature - Water and air temperature will be recorded in the field each time samples are taken.

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 Stekoa Creek; and 3) known or suspected hotspots determined through observation and prior water quality monitoring. Each sampling site will be assigned an Adopt-A-Stream number.

Table 2 – Stekoa Creek Watershed - Initial Monitoring Locations

SP	AAS Number	Latitude/Longitude	Physical Location	Stream Segment
1		34.8365N 83.3319W	She Creek Road	Pool Creek
2		34.8393N 83.3369W	Woods Road off US Highway 76E, upstream of confluence with Pool Creek	She Creek
3		34.8352N 83.3463W	Wolf Creek Road Bridge near Woods Road – GAEPD Site No. 01002001	Stekoa Creek
4		34.8502N 83.3597W	Levee Road Ford near New Hope Church, Clayton	Chechero Creek
5		34.8380N 83.3596W	Claude Smith Road Bridge	Stekoa Creek
6		34.8692N 83.3975W	Behind Dairy Queen at US Highway 441, Clayton	Stekoa Creek
7		34.8793N 83.3880W	Polly Gap Road Bridge, Clayton	Saddle Gap Creek
8		34.8811N 83.3839W	Warwoman Road Bridge near Pinnacle Road, Clayton	Norton Creek
9		34.9091N 83.3875W	File Street Bridge at Cox Lake Road, Mountain City	Stekoa Creek
10		34.8884N 83.3937W	Stekoa Creek Park, Clayburn Street, Clayton	Stekoa Creek
11		34.8889N 83.3954W	Smith Road Bridge, Clayton	Coffee Branch
12		34.8825N 34.4080W	Meadow Stream Lane Bridge, Clayton	Ginger Creek
13		34.8742N 83.4561W	Dan Crane Road (County Road 194) Bridge near US Highway 76	Scott Creek
14		34.8783N 83.4237W	Kastner Drive Bridge	Scott Creek
15		34.8781N 83.4056W	Marsengill Street Bridge, Clayton	Scott Creek
16		34.8751N 83.4034W	Shadyside Apts. Clayton Housing Authority, Clayton	Scott Creek
17		34.8726N 83.4016W	Duvall Motors Footbridge, Clayton	Stekoa Creek
18		34.8677N 83.4027W	Stove Mill Drive Bridge at Checkers, Clayton	Stekoa Creek
19		34.8468N 83.4141W	Bethel Church Road Bridge, Clayton	Stekoa Creek
20		34.8374N 83.3789W	Rickman Airfield Road Bridge near Roland R.	Stekoa Creek
21		34.8324N 83.4042W	Rickman Airfield Road Bridge near Chota	Stekoa Creek
22		34.7962N 83.3316W	Wolf Creek Church Road - just upstream of confluence with the Chattooga River	Stekoa 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 Stekoa Creek, will be noted and may be omitted from 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 the location of BMP's 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.

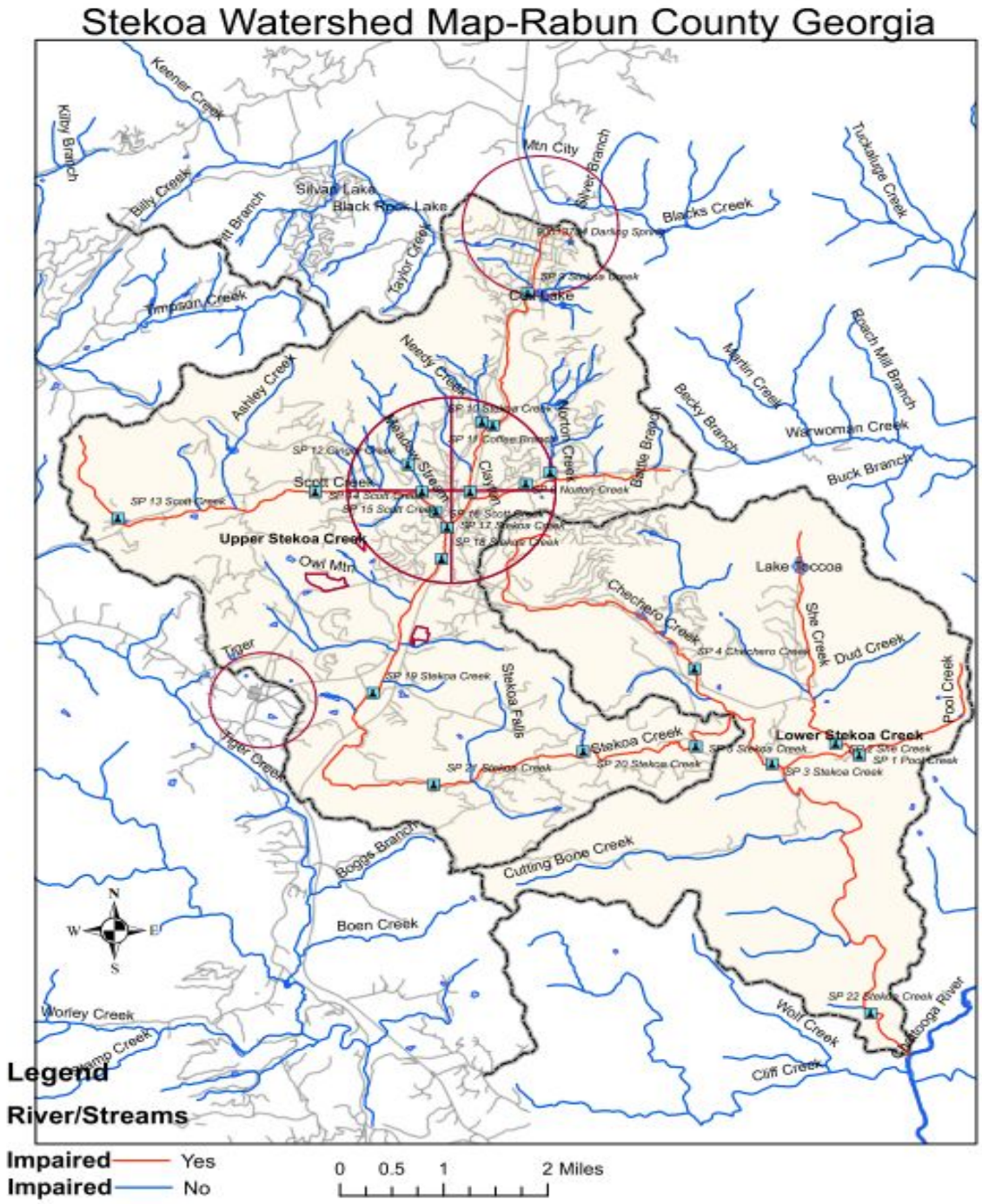

Figure 2 – Map of Initial Sampling Sites

Sampling Schedule - Initial Round - During the first two months of sampling, September and October 2013, the initial sites will be monitored every other week for a total of four sampling days. This data will be used to detect initial trends in water quality and to target additional, secondary sites in the watershed.

Second Round – During the third and fourth months of sampling, November and December 2013, initial and secondary sites will be sampled every third week for a total of three sampling days. Data trends will be used to establish additional, tertiary sites further upstream and downstream in the watershed.

Final Round - Starting in the second full quarter of sampling, January 2014, and continuing through August 2014, each initial, secondary, and tertiary site will be sampled once a month for a total of eight sampling days. Again, data trends may be used to establish additional sites further upstream and downstream in the Stekoa Creek watershed to help isolate hotspots and sources of water pollution.

In addition, turbidity samples will be drawn in the midst of long rain events (in excess of 0.2 inches), in the warm season of May-October and in the cold season of November-April for a total of at least 6 wet weather samples for each site.

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, Nicole Hayler, Andy Smith, and Reid Smith are certified per Georgia AAS quality assurance and quality control protocols; certificates are on file at the Chattooga Conservancy. Additional project participants will work under the supervision of Hayler, Smith, and Smith or hold current AAS certification.

QUALITY ASSURANCE AND CONTROL

All sample collection protocols and laboratory analysis will be conducted in accordance with the GAEPD 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 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 and Materials - Samples for measuring fecal coliform, *E. coli,* and sediment will be collected by a grab sample or via a weighted sampling yoke from the upstream side of a bridge or culvert.

- Grab samples will be collected by hand, mid-stream and mid-depth, and the 100 ml sampling bottle or Whirl-Pak closed immediately after collection. Rubber gloves should be used to protect the sample from contaminants.

- From a bridge or culvert, the 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.

Prior to collecting the water sample, a 100ml sterile bottle or Whirl-Pak will be marked with indelible ink to record time, name of stream, date, and sample site number. Sterile bottles or Whirl-Pak bags 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 sediment tests.

One field 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 drawn 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.

Chattooga Conservancy staff will obtain water samples for measuring turbidity and detecting the presence of optical brighteners using the sampling yoke or wading into the stream as described above. Samples will then be analyzed per the Turner Design User's Manual.

The Chattooga Conservancy will use materials purchased from IDEXX Laboratories, 3M, and Cole Parmer to collect and analyze samples for *E. coli*. These include:

IDEXX:	Colilert 18 Reagent – Gamma Irradiated Colilert Quanti-Tray/2000 120 ml Vessels with Sodium Thiosulfate
3M:	3M Petrifilm Enterobacteriaceae Count Plates
Cole Parmer:	Fixed Volume Pipette 1000L with Disposable Tips.

The Chattooga Conservancy will use equipment purchased from and pre-calibrated by Turner Designs to detect the presence of optical brighteners and measure turbidity, including:

*Aqua*Fluor (8000-450) Fluorometer
Cuvettes – Methacrylate (Optical Brighteners)
Cuvettes – 10mmSQ, 4.5 ml (Turbidity).

The *Aqua*Flor User Manual, describing the standard operating procedures for taking samples to measure optical brighteners and turbidity is included in Appendix A.

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

Enviro-Safe Field 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 forms 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, and 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.

Regarding the *AquaFluor* fluorometer and turbidimeter - if a sample is accidentally spilled inside the sample compartment of the *Aqua*Fluor, it will be inverted to drain out the excess liquid, and the inside area dried with a clean soft towel or tissue. If extra cleaning is needed, a mild detergent on a damp towel will be used. Cuvettes will be cleaned with distilled water, no detergent, and air dried on paper towels. Cuvettes that have visible surface scratchers will be discarded.

DATA VALIDATION AND SUBMISSION

The project coordinators will be responsible for the integrity of data submitted. Prior to data collection, instruments will be calibrated 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 housed at the Chattooga Conservancy. 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 twelve month monitoring period, Chattooga Conservancy staff will summarize the data and draft conclusions regarding trends, causation, and, if appropriate, the need for ongoing sampling, data collection, and analysis. 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

E. coli

Chattooga Conservancy - Bacterial Monitoring Method with 3M Petrifilm
Clayton, Georgia Water Pollution Control Plant - *E. coli* Screening Method
North Georgia Technical College - *E. coli* Analysis Method
Texidyne Inc. - *E. coli* Test Method

Fecal Coliform

Clayton, GA Water Pollution Control Plant - Fecal Coliform Filter Procedure
Texidyne Inc. - Fecal Coliform Analysis Method

Optical Brighteners

Chattooga Conservancy – Turner Designs AquaFluor Handheld Fluorometer and Turbidimeter User's Manual

Turbidity

Chattooga Conservancy – Turner Designs AquaFluor Handheld Fluorometer and Turbidimeter User's Manual
Clayton Water Pollution Control Plant - Turbidity Measurement Procedure
Texidyne Inc. - Turbidity Analytical Method

Temperature

Chattooga Conservancy

APPENDIX B – Chain of Custody Form