GEORGIA

Adopt-A-Stream

Department of Natural Resources
Environmental Protection Division
Spring 2014

Bacterial Monitoring

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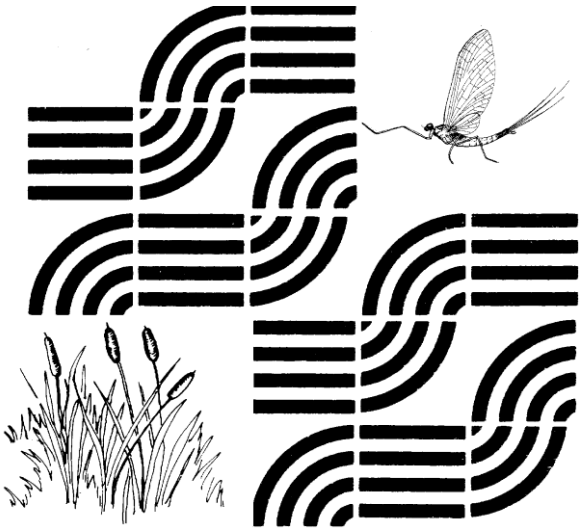

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Acknowledgements

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Georgia's Adopt-A-Stream program wishes to express our gratitude to the authors of *Citizens Monitoring Bacteria: A Training Manual for Monitoring*. The Adopt-A-Stream Bacterial Manual was adapted from the Citizens Monitoring Bacteria manual, a product of the CSREES Great Lakes Regional Partnership.

Getting Started with Georgia Adopt-A-Stream

Georgia Adopt-A-Stream (AAS) is a statewide volunteer water quality monitoring program. AAS is housed in the NonPoint Source Program, Watershed Protection Branch of the Georgia Environmental Protection Division (EPD) and is funded by a United States Environmental Protection Agency (U.S. EPA) Section 319(h) Grant. Georgia Adopt-A-Stream encourages individuals and communities to monitor and/or improve sections of streams, wetlands, lakes or estuaries. Manuals, training and technical support are provided through Georgia EPD and more than 60 established Community organizers. Community programs organize monitoring groups in their watershed, county or city. These local programs are funded by counties, cities and nonprofit organizations and use the Georgia Adopt-A-Stream model, manuals and workshops to promote nonpoint source pollution education and data collection in their area.

The goals of Georgia Adopt-A-Stream are easy to remember by using the acronym "**ADOPT**".

Awareness: Increase public awareness of the State's nonpoint source pollution and water quality issues

Data: Collect baseline water quality data

Observations: Encourage volunteers to take observations of their adopted site and surrounding environment

Partnerships: Encourage partnerships between citizens and their local government

Tools and Training: Provide citizens with the tools and training to evaluate and protect their local waterways

Awareness

Georgia Adopt-A-Stream has been tasked with the goal of increasing public awareness of the State's nonpoint source pollution and water quality issues. We accomplish this through workshops, outreach materials such as newsletters, manuals and brochures, as well as our annual volunteer conference and by presenting at community events. We encourage our volunteers to also foster this goal by building awareness within their own communities.

Data

Georgia Adopt-A-Stream houses an online clearinghouse for volunteer water quality data for the State of Georgia. This data is publicly accessible on our website at www.GeorgiaAdoptAStream.org and can be viewed at the city, county and watershed level to help citizens better understand the health of their local waterways. Volunteer monitoring data is used to educate the public and help local, state and federal agencies make informed decisions and to identify water quality impairments.

Observations
Careful observations of our waterways can lead to success in protecting and improving its conditions. In addition to the data found on the datasheets, you may notice other details that are important to record when visiting your adopted site. Stay aware of baseline conditions so if anything changes in future visits, you will be able to tell and can act accordingly.

Partnerships
Adopt-A-Stream encourages new groups to inform their local government about their activities and to create partnerships with local schools, businesses, watershed organizations and government agencies. These partnerships can enhance your program by providing support for your group through data interpretation, advice on restoration techniques, remediation, sponsorships and volunteer recruitment. If you need help establishing partnerships, we encourage you to contact your local coordinator/trainer or the AAS state office.

Tools and Training
The Adopt-A-Stream program offers many levels of involvement including training, certification and monitoring. Some of our monitoring programs require the volunteer to obtain Quality Assurance/Quality Control certification (QA/QC), which is accomplished by attending a workshop and passing the QA/QC test. This certification allows the volunteer to enter data into the database. Our non-QA/QC programs offer a training workshop and manuals, but certification is not required. Manuals and support materials are provided for each monitoring type to guide volunteers through the monitoring process. To find out more about different levels of involvement, visit our website: http://georgiaadoptastream.org/db/aas_levels.asp

Adopt-A-Stream Certifications and Monitoring Programs For Freshwater and Coastal Waterways

Watershed Assessments (Y)	Visual Monitoring (Q)
Macroinvertebrate Monitoring (Q)*	Amphibian Monitoring (bi-monthly)
Chemical Monitoring (M)*	Bacterial Monitoring (M)*
Freshwater Wetland Monitoring (Q)	Coastal Monitoring (M)*
Lake Monitoring (M)	Rivers Alive (year round)
Trainer Certification*	

*=QA/QC programs M=Monthly Sampling Q=Quarterly Sampling Y=Yearly Sampling

Currently, Adopt-A-Stream has over 3,300 active volunteers who monitor 520 sites and our bi-monthly newsletter has over 8,000 subscribers. We invite you to join us to help protect Georgia's water resources.

Water Quality Monitoring

Many water quality parameters can be monitored to help assess the condition of a river, lake or coastal area. These can include physical, chemical and biological monitoring. Each of these tells us part of the story about the health of a waterway. Physical monitoring evaluates aspects of the stream including the stability of the streambed and channel as well as the adjacent riparian zone. Chemical monitoring provides a snapshot of the chemical properties at a specific time while macroinvertebrate monitoring shows more long term information about the health of the stream. Bacterial monitoring can help citizens determine if the water is 'safe' for human contact. This manual will guide you through bacterial monitoring and why it so important in determining water quality of your adopted site. Please refer to the Chemical and Macroinvertebrate Monitoring manual for more information on those methods.

Water quality data collected by volunteers for a particular waterway has many uses and benefits along with determining if a particular waterway is safe for recreational purposes. These benefits include:

- **Establishing Baseline Data** – Georgia has more than 70,000 miles of rivers, 400,000 acres of lakes, and 100 miles of coastline - of which, about 20% are monitored on a regular basis. Long-term data collection enables volunteers to take a more active role in protecting their waterways.

- **Assessing Watersheds** – Data generated by volunteers may be used to describe current water quality conditions within a watershed and provide valuable information to water utilities and local decision makers.

- **Educating Citizens** – Volunteers can educate themselves about water quality problems within their watershed. Often this education leads to a sense of "connectedness" to their stream, river, lake or coast and a willingness to promote good stewardship.

- **Targeted Sampling** – Water quality monitoring can help identify sources (hot spots) of pollution caused by stormwater runoff, ruptured or overflowing sewer lines, leaking septic tanks, certain landuse operations, industries and other sources of pollution.

- **Total Maximum Daily Load (TMDL) Development and Implementation** – Volunteers can provide data to state agencies developing TMDLs and Watershed Management Plans (also known as TMDL Implementation Plans and Watershed Improvement Plans). The information gathered by volunteers can help with TMDL modeling and help identify effective best management practices (structural and non-structural activities that improve water quality) for improving waterway conditions.

Setting Goals and Designing a Sampling Program

Before starting, first determine your goals. These will guide the level of your participation and help to develop your monitoring program. Where, when, and how often you sample will depend on these goals.

Georgia Adopt-A-Stream offers many opportunities to engage and protect waterways. Follow the below steps to get started, it's simple!

1. **Determine your level of participation and goals.** There are many levels to adopting a waterway. Take your time and think about why you want to monitor, what type of data you want to collect and who may be interested in using your data. Call us anytime if you need advice or guidance, and we can help you through this process:
    A. Basic level: Conduct one outreach event (i.e. river cleanup) and walk your watershed.
    B. Monitoring: In addition to 'A,' select a monitoring program(s) that interests your group (visual survey, macroinvertebrate, bacterial, chemical, and/or amphibian monitoring).
2. **Attend a workshop.** Depending on your interest in participating in collecting baseline data, you and your group should attend our monitoring workshops. These workshops are fun and informative!

    To learn more about these workshops and to view our workshop calendar, visit www.GeorgiaAdoptAStream.org. If there is not a workshop scheduled for your area, please contact your local coordinator or the State Office and we'll organize one in your area.

3. **Select a site to adopt.** Look around and find a stream, wetland or coastal area that is important to you. Georgia Adopt-A-Stream does not assign monitoring sites, but can provide guidance and support in your decision. We suggest you find a waterbody that is easy, safe and legal to access.
4. **Create a group.** You will need help when adopting a site to monitor, restore and protect. It's always better to have two sets of eyes collecting data, to help with equipment and costs, and for safety reasons.
5. **Register your group and site(s).** Registration forms are on our website under 'Forms & Reports.' Register your group first, then your site(s). To register your site you will need the latitude/longitude location (this can also be generated from our site's google maps application; you can also call us or your local coordinator for help with obtaining this information).
6. **Get informed, read your manuals!** Get a copy of the manual 'Getting to Know Your Watershed.' To obtain a copy, contact the Georgia Adopt-A-Stream office or download a copy at www.GeorgiaAdoptAStream.org. **Chapter 1** of this manual will give you some basic background on watersheds, landuse issues and effects of development. **Chapter 2** provides background on nonpoint source pollution

and some of the laws that are used to protect water quality. In **Chapter 3**, follow the directions on how to register your stream, wetland or lake.

7. **Take it slow, be safe and have fun!** Start slowly, ask a lot of questions, tell your neighbors what you are learning, make sure you are being safe when you sample, and most importantly, enjoy yourself!

Quality Assurance Certification

Georgia Adopt-A-Stream's monitoring program is aligned with the protocols set forth in our Quality Assurance Project Plan (QAPP) that has been submitted to and approved by the United States Environmental Protection Agency (US EPA). This plan is the core of our monitoring program and it is essential that volunteer monitors follow these protocols to ensure the collection of credible data. Volunteers who wish to ensure that their data is of the highest quality, can become quality assurance quality control (QA/QC) certified. Quality assurance quality control certification is part of every bacterial training workshop. Data collected under a QA/QC plan can be entered into the Adopt-A-Stream database and is often used by local and state agencies to assess water quality conditions. To become a bacterial monitoring QA/QC volunteer, the following conditions must be met.

Volunteers must:

1. Attend a QA/QC bacterial workshop.
2. Demonstrate the ability to collect a bacterial sample.
3. Identify, with 90% accuracy, the *E.* coli counts and correctly calculate the *E. coli* levels of sample plates on written test.
4. Pass the written test with a score of at least 80%.
5. Re-certify annually in order to submit QA/QC data.

Bacterial volunteers are encouraged to sample once a month for one year and send their results to Georgia Adopt-A-Stream.

Trainer Certification

Georgia Adopt-A-Stream has a trainer program for our chemical, macroinvertebrate, and bacterial monitoring programs.

Criteria for new trainers:

- Attend a macroinvertebrate (6-hours), chemical (5-hours), or bacterial (4-hours) Train-The-Trainer workshop and pass field and written tests. To attend a TTT workshop, one must have current QA/QC certification in the training of interest, have working knowledge of biology, chemistry, microbiology or a related field, and commit to conducting two workshops within a year. Train-The-Trainer workshops cover what it means to be a trainer, how to conduct a workshop, and how to work with volunteers.

- After attending the TTT workshop, a new trainer must do two co-trainings with another trainer who has been approved by the State Office. These co-trainings count towards the two workshops that a trainer commits to do within a year.

Safety and Health Checklist

Your safety and health are of number-one importance to Georgia Adopt-A-Stream. There are several important things to remember when you are monitoring your adopted stream, river, lake or wetland. If you follow these "rules of monitoring" you will have a fun, enjoyable and accident-free experience.

Before visiting your site:

- Develop a site emergency plan: (i.e. site location, nearest medical center, nearest phone, medical conditions of team members and their emergency contact, etc).
- Check weather reports. Stop monitoring if a storm occurs while you are monitoring.
- Determine if you have safe, legal access to your site.

Rules to monitor by:

- Your adopted site should be wadeable or accessible by a bridge. Do not monitor waters that are deeper.
- If at any time you feel uncomfortable about the condition of the waterbody or your surroundings, stop monitoring and leave the site.
- Monitor during base flow conditions. Do not monitor if the waterbody is at flood stage. Fast moving water is very dangerous. Never wade in swift or high water.
- Never cross private property without the permission of the landowner.
- Always bring your 'Who to Call List' on page 56 of this manual and your emergency plan.
- If you are sampling from a bridge, be wary of passing traffic. Never lean over bridge rails unless you are firmly anchored to the ground or the bridge with good hand/foot holds. If walking under a bridge, watch for objects knocked off the road from overhead.
- Look out for broken glass, poison ivy, snakes and biting/stinging insects.
- Never drink the water. Always wash or sanitize hands after monitoring.
- Do not monitor if the water body is posted as unsafe for body contact.
- Carry a first aid kit with you.
- Adopt-A-Stream recommends that you monitor with another person.
- Wear gloves while monitoring.

If you observe any of the following at your sampling station STOP and refer to your 'Who to Call List' on page 56 for the course of action.

- STOP! If you observe closed or leaking drums near or in the water.
- STOP! If you observe a large quantity of dead fish or other organisms.
- STOP! If you observe a pipe discharging some odd looking/smelling substance into the water.

Monitoring in areas with high fecal coliform levels:

The following conditions warrant concern for high fecal coliform levels; occurrence of heavy rain in the past 24 hours, muddy water, a leaking sewer line and/or the presence of a large number of animals in the water. If monitoring in these conditions please take the following precautions:

- If you have open or incompletely healed wounds, avoid any contact with water.
- Avoid swimming or other high contact activities for at least 24 hours after heavy rains, or if water is obviously muddy.
- Avoid stirring or disturbing sediment. There are higher survival rates of bacteria and potentially other pathogens in sediment.
- Avoid swimming or other high contact activities areas where fecal droppings from wildlife are obvious, large numbers of wildlife are present (ducks, geese), or domestic or companion animals are observed in the waterway or on shore (cows, dogs, etc.).
- Anyone with a compromised immune system should avoid any primary contact activities in waters that have elevated levels of fecal bacteria.
- Avoid contact with water for at least a week if recovering from gastrointestinal illness, especially children.

Health Safety Contacts:

Division of Public Health
404-657-2700
http://health.state.ga.us/contact.asp

Center for Disease Control
1-800-232-4636
http://www.cdc.gov

Resources Available from Georgia Adopt-A-Stream

- Organization and technical support
- Website at www.GeorgiaAdoptAStream.org
- Online water quality data clearing house
- *Getting To Know Your Watershed* manual & workshop✳
- *Visual Stream Survey* manual & workshop ✳
- *Macroinvertebrate and Chemical Stream Monitoring* manual & workshop ✳
- *Bacterial Monitoring* manual & workshop
- *Amphibian Monitoring* manual & workshop
- *Adopt-A-Wetland* manual & workshop for freshwater wetlands
- *Coastal Georgia Adopt-A-Wetland* manual & workshop
- *Adopt-A-Lake* manual & workshop
- Rivers Alive *'Guide to Organizing and Conducting a Cleanup'*
- *'Life at The Water's Edge'* brochure on protecting, preserving and restoring local waterways
- *Georgia Adopt-A-Stream: It All Begins With You* DVD
- Train – The – Trainer workshops
- '*You Are The Solution To Water Pollution'* posters and brochures
- Six (6) bi-monthly newsletters (available also in e-newsletter format)
- Confluence, our annual volunteer conference and award ceremony

✳ **Available in Spanish**

Water Quality in Georgia

As outlined in Water Quality in Georgia, 2010-2011, Chapter 1, Executive Summary (Georgia Environmental Protection Division, Department of Natural Resources)

Georgia is one of the fastest growing states in the nation. Between 2000 and 2010, Georgia gained 1.5 million new residents, ranking 4th nationally. The increasing population places considerable demands on Georgia's ground and surface water resources in terms of water supply, water quality, and in the assimilative capacity of rivers to receive wastewaters from industrial and municipal discharges. To address these demands, the General Assembly and Governor Perdue in February 2008 approved the implementation of the Comprehensive State-wide Water Management Plan in Georgia. The regional water plans are not themselves an end. The plans present solutions identified by a cross-section of regional leaders, drawing on regional knowledge and priorities. The plans are based on consistent, statewide forecasts of needs and reflect the best available information on the capacities of Georgia's waters. More about these plans can be found at:
http://gaepd.com/Files_PDF/305b/Y2012_303d/Y2012_Coverpage-Chapter_2_305b.pdf

The pollution impact on Georgia streams has radically shifted over the last several decades. Streams are no longer dominated by untreated or partially treated sewage discharges which resulted in little or no oxygen and little or no aquatic life. The sewage is now treated, oxygen levels have returned and fish have followed. However, another source of pollution is now affecting Georgia streams. That source is referred to as nonpoint and consists of mud, litter, bacteria, pesticides, fertilizers, metals, oils, detergents and a variety of other pollutants being washed into rivers and lakes by stormwater. Even stormwater runoff itself, if rate and volume is unmitigated, can be extremely detrimental to aquatic habitat and hydrologic systems. Nonpoint source pollution, although somewhat less dramatic than raw sewage, must be reduced and controlled to fully protect Georgia's streams. Structural and nonstructural techniques such as green infrastructure, pollution prevention and best management practices must be significantly expanded to minimize nonpoint source pollution. These include both watershed protection through planning, zoning, buffer zones, and appropriate building densities as well as increased use of stormwater structural practices, low impact development, street cleaning and perhaps eventual limitations on pesticide and fertilizer usage.

Another issue of importance is the reduction of toxic substances in rivers, lakes, sediment and fish tissue. This is extremely important in protecting both human health and aquatic life. The sources are widespread. The most effective method to reduce releases of toxic substances into rivers is pollution prevention, which consists primarily of eliminating or reducing the use of toxic materials or at least reducing the exposure of toxic materials to drinking water, wastewater and stormwater. It is very expensive and difficult to reduce low concentrations of toxic substances in wastewaters by treatment technologies. It is virtually impossible to treat large quantities of stormwater and reduce toxic substances. Therefore, toxic substances must be controlled at the source.

Nutrients also serve a very important role in our environment. They provide the essential building blocks necessary for growth and development of healthy aquatic ecosystems. However, if not properly managed, nutrients in excessive amounts can have detrimental effects on human health and the environment, creating such water quality problems as excessive growth of macrophytes and phytoplankton, harmful algal blooms, dissolved oxygen depletion, and an imbalance of flora and fauna. In Georgia, site specific nutrient criteria have been adopted for several major lakes and their tributaries. Some of these lakes are currently listed for chlorophyll a, which is the primary biological indicator in lakes for nutrient over-enrichment. TMDLs, based on watershed modeling, have been completed or are in development to address the nutrient issues for these lakes. Currently, the Georgia EPD is in the process of collecting the necessary data and information for use in developing nutrient standards for rivers, streams and other waterbodies in Georgia. Determining the relationship of nutrient levels and biological response is necessary in order to develop appropriate nutrient criteria.

It is clear that local governments and industries, even with well-funded efforts, cannot fully address the challenges of toxic substances and nonpoint source pollution control.

Citizens must individually and collectively be part of the solution to these challenges. The main focus is to achieve full public acceptance of the fact that what we do on the land has a direct impact on water quality. Adding more pavement and other impervious surfaces, littering, driving cars which drip oils and antifreeze, applying fertilizers and other activities and behaviors all contribute to toxic and nonpoint source pollution. If streams and lakes are to be pollutant free, then some of the everyday human practices must be modified. The Georgia EPD will be emphasizing public involvement; not only in decision-making but also in direct programs of stream improvement. The first steps are education and adopt-a-stream programs.

Water Resources Atlas

State Population (2012 estimate)	9,383,941
State Surface Area	58,910 square miles
Number of Major River Basins	14
Number of Perennial River Miles	44,056 miles
Number of Intermittent River Miles	23,906 miles
Number of Ditches and Canals	603 miles
Total River Miles	70,150 miles
Number of Lakes Over 500 Acres	48
Acres of Lakes Over 500 Acres	265,365 acres
Number of Lakes Under 500 Acres	11,765
Acres of Lakes Under 500 Acres	160,017 acres
Total Number of Lakes & Reservoirs, Ponds	11,813
Total Acreage of Lakes, Reservoirs, Ponds	425,382 acres
Square Miles of Estuaries	854 square miles
Miles of Coastline	100
Acres of Freshwater Wetlands	4,500,000 acres
Acres of Tidal Wetlands	384,000 acres

Water Quality in Georgia, 2010-2011, Chapter 3, Water Quality Monitoring and Assessment **(Georgia Environmental Protection Division, Department of Natural Resources)**

Chapter 1

BACTERIA AND WATER QUALITY

- What are Bacteria?
- What are Indicator Bacteria?
- How Do Bacteria Get Into Streams and Rivers?
- What Risks Do Bacteria Pose To Human Health?
- Georgia Bacterial Standards
- Relationship Between Fecal Coliforms and *E. coli*
- Recommended E. coli Standards for Recreational Waters
- Weather and Seasonal Influences
- Important Water Quality Parameters

What are Bacteria?

Bacteria are microscopic, single-celled organisms. They are so small that that five million could be placed on the head of a pin. Under favorable conditions they can reproduce rapidly and can form colonies that are visible without magnification. Bacteria can utilize a large variety of habitats and can survive and adapt to almost all conditions present on planet earth. They have been so successful that they are the most numerous life forms on the planet. Most bacteria are beneficial and responsible for important environmental processes such as decomposition, nutrient cycling and the breakdown of environmental toxins. Some bacteria, however, are pathogenic (or disease causing) and result in human health problems.

Coliform bacteria are members of the Enterobacteriaceae family. While some coliform bacteria can be naturally found in soil, the type of coliform bacteria that lives in the intestinal tract of warm-blooded animals and originates from animal and human waste is called fecal coliform bacteria. *Escherichia coli* (*E. coli*) is one subgroup of fecal coliform bacteria. Even within this species, there are numerous different strains, some of which can be pathogenic. The mere presence of these naturally occurring organisms in the environment is generally not a cause for alarm unless they appear in numerical levels that exceed US EPA recommended limits.

What are Indicator Bacteria?

An indicator organism signals that certain conditions exist in the environment. The presence of fecal coliform bacteria indicates the possible presence of pathogens. Trying to detect disease-causing bacteria and other pathogens in water requires considerable training, time and expense. The US EPA recommends *E. coli* bacteria as good indicator organisms of fecal contamination because they are associated with warm-blooded animal wastes, generally live longer than pathogens, are found in greater numbers and are less risky to culture in a laboratory than pathogens. However, their presence does not necessarily mean that pathogens are present, but rather indicates a potential risk to human health. Monitoring for these indicator organisms is an easy and economical method for citizens or professionals to assess health risks due to bacterial contamination of surface waters. If bacterial contamination of surface water is found, other disease-causing organisms such as viruses and protozoans may also be present in these wastes and pose a health threat.

How do Bacteria Get into Streams and Rivers?

E.coli in waterways can originate from the intestinal tracts of both humans and other warm-blooded animals, such as dogs, cats, livestock and wildlife. Human sources include failing septic tanks, leaking sewer lines, wastewater treatment plants, sewer overflows, land application of biosolids, boat discharges and urban storm water runoff. In urban watersheds, fecal indicator bacteria are significantly correlated with human density (Frenzel and Couvillion, 2002). Possible animal sources of fecal coliform bacteria include cattle in streams, land application of animal waste, dairy operations, poultry operations, hobby horse farms, dog and cat waste from parks, lawns, streets and wildlife such as geese, pigeons, ducks, deer and raccoons.

Fecal material as well as other pollutants can be transported to waterways through runoff from rain events. How quickly pollutants are transported partially depends on the type of land use. Grasses and vegetated land tend to soak up rainfall, thereby increasing infiltration into the ground and reducing runoff to waterways. Developed lands such as streets, rooftops, sidewalks, parking lots and driveways create more impervious surfaces thereby increasing runoff. Lands that support animals such as cattle, hogs or horses can also be a source of bacteria, particularly if animals enter the water for drinking or if heavy rains wash manure from the land into receiving waters.

Another source of bacterial pollution to stream waters originates from point sources, such as the discharge of pollutants through a pipe. Bacteria can enter waterways from broken pipes, illicit connections and stormwater outfalls. Additionally, large rain events, power failures or maintenance problems can cause wastewater treatment plants to discharge partially treated sewage directly into rivers and streams due to the excessive volume of water entering the plant.

What Risks Do Bacteria Pose To Human Health?

People should be aware of the risk that high bacterial levels may pose to human health. The higher the bacterial levels, the greater the potential health risk for gastroenteritis, a condition indicated by vomiting, diarrhea, fever, nausea and stomachache; skin disease; and respiratory, eye, ear, nose, throat and skin infections. While *E. coli* by itself is not generally a cause for alarm, excessive levels of *E. coli* may indicate the presence of pathogens such as harmful bacteria *E. coli* 0157, *Salmonella* and *shigella* (which can cause gastrointestinal illnesses), *Psuedomonas aeruginosa* (which can cause swimmer's ear or dermatitis), protozoans such as *Cryptosporidium* and *Giardia* and viruses such as hepatitis A.

Georgia Bacterial Standards

The State of Georgia uses fecal coliform as the water quality standard for bacterial contamination. The chart below shows an outline of fecal coliform standards set by the state. The standards were established to support the requirement by the US EPA to protect all waters for use of primary contact recreation or swimming. Fecal coliform levels are determined by use classification for all bodies of water.

Georgia Fecal Coliform Standards

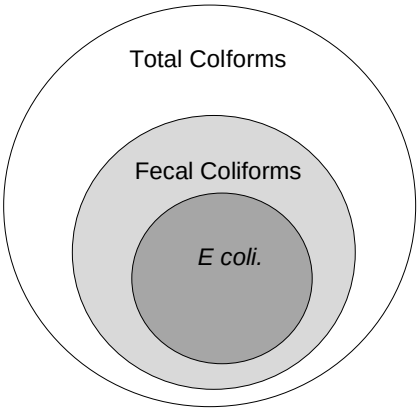
	Bacteria Levels (Fecal coliform)	
Use Classification	**30-Day Geometric Mean (cfu/100 ml)**	**Maximum (cfu/100ml)**
Drinking Water requiring treatment	1,000 (Nov-April) 200 (May-Oct)	4,000 (Nov-April)
Recreation	200 (Freshwater) 100 (Coastal)	--
Fishing Coastal Fishing	1,000 (Nov-April) 200 (May-Oct)	4,000 (Nov-April)
Scenic River	No alteration of natural water quality	
Wild River	No alteration of natural water quality	

Relationship between Fecal Coliforms and *E. coli*

Fecal Coliforms are a form of coliform bacteria, and as its name implies, it originates from fecal matter. *E. coli* is a species within the fecal coliform bacteria that originates from the waste of warm-blooded animals and is estimated to be about 60 – 80% of the fecal coliform value (See illustration).

The US EPA recommended conversion factor between fecal coliform and *E. coli* is 126/200, which results in an *E. coli/*Fecal Coliform (EC/FC) ratio of 0.63. However, a recent US Geological Survey paper showed the EC/FC ratio to be closer to 0.77.

Because *E. coli* is related more closely with swimming-related gastrointestinal illnesses compared to fecal coliforms, the US EPA has recommended *E. coli* as an appropriate indicator species for assessing potential health risks for recreational waters.



General organization of coliform bacteria

Recommended *E. coli* Standards for Recreational Waters

The US EPA recommended *E. coli* as the freshwater quality criterion for bacteria in the *Ambient Water Quality Criteria for Bacteria* document published in 1986 - a departure from earlier recommendations of total coliform and fecal coliform. The *E. coli* recommendation resulted from epidemiological studies that found that *E. coli* was statistically correlated with swimming-related gastrointestinal illnesses.
i

EPA's recommended limit of *E. coli* within recreational waters such as swimming and water skiing (full body contact) within recreational waters is equal to or less than 126 cfu/100 ml (colony forming units per 100 milliliters of water) based on a geometric mean or a one-time measurement equal to or less than 235 cfu/100 ml. EPA recommends a set of standards for *E. coli* in fresh water bodies as a single maximum allowable count. These rates correspond to an acceptable risk level of 8 people out of 1000 getting sick.

	Designated Swimming	**Moderate Swimming Area**	**Light Swimming Area**	**Infrequent Swimming Area**
***E. coli* (cfu/100 ml)**	<235	<298	<410	<576

(from US EPA 1986, 2002a)

Even with good watershed management measures, there will always be fecal bacteria in the environment. However, if you repeatedly find unusually high levels of *E. coli* on a long-term, regular basis in your river, lake or beach, you should alert and work with water agencies, health departments, local governments, watershed groups and community leaders to identify and correct the problem. To find more information on *E. coli* levels that warrant action according to Georgia Adopt-A-Stream, see Getting "High" Bacteria Counts in Chapter 2.

Weather and Seasonal Influences

Weather and seasonal effects influence the level of bacteria. This natural variability makes the bacterial concentrations in waterways difficult to predict at any one time. Bacteria numbers often increase following a heavy storm or other excessive runoff event. *E. coli* bacteria are often more prevalent in turbid waters because they live in soil and can attach to sediment particles. Bacteria can also remain in streambed sediments for long periods of time. If the streambed has been stirred up by increased flow or rainfall, your sample could have elevated bacteria levels. This is why you should avoid disturbing the streambed as you wade out into the stream and be sure to collect the water sample upstream from you. If you are collecting at several sites within the stream, collect the furthest downstream sample first and proceed upstream.

A number of other environmental factors will affect bacteria survival in waterbodies. *E.coli* counts are often higher during the summer months compared to lower counts during the winter months. Higher *E. coli* counts may be found in warmer waters because *E.coli* survive longer at its optimal growth temperatures (*E. coli* are adapted to living in the warm environment of the intestines of warm-blooded animals). However, ultraviolet light from the sun can kill bacteria in clear streams, rivers or lakes.

Additional Water Quality Parameters

A comprehensive assessment program of stream water quality should consider monitoring for other water quality indicators. A combination of biological, chemical and physical factors can indicate if a waterbody is degraded or polluted. How the water will be used (drinking, swimming, etc.) may influence which characteristics are used to determine water quality.

In addition to bacteria, Adopt-A-Stream recommends chemical testing for basic parameters including dissolved oxygen, temperature, conductivity and pH which are discussed in detail in the *Macroinvertebrate & Chemical Monitoring* manual. Other common water quality measurements include clarity and nutrients (particularly nitrogen and phosphorus) and macroinvertebrate biological communities. Recording visual observations of your monitoring site also provides vital information for assessing the waterbody. To provide volunteers with background in visual waterway assessment, Adopt-A-Stream offers a *Visual Stream Survey* manual and accompanying workshop.

Many of the potential land use activities that will impact your stream, lake or coastal area can be pinpointed by carefully analyzing human activity within your watershed. Determining land uses within your watershed can give you a better picture of the potential sources of pollution to your waterbody. The Watershed Survey and Map Assessment located in the *Getting to Know Your Watershed* manual provide guidance on what activities and land uses to note.

Typical Ranges for Recreational Water in Georgia

Dissolved Oxygen (mg/L)	Temperature (°C)	Conductivity (μS/cm)	pH
5-6, up to 14.6	Not to exceed 32°C	0 – 1500	6-8.5, can be as low as 3.5

Different water quality standards exist based on many of these parameters, however the standards may vary depending on the use of the water such as drinking water versus irrigation water.

For more information on our chemical, macroinvertebrate or visual stream monitoring programs, please contact Adopt-A-Stream. Georgia Adopt-A-Stream has developed several manuals to assist volunteers in their monitoring efforts. These manuals include *Getting to Know Your Watershed, Visual Stream Survey, Macroinvertebrate and Chemical Stream Monitoring, Educator's Guide* (for grades K-12), *Amphibian Monitoring, Wetland Monitoring*, and *Adopt-A-Lake*.

Chapter 2

BACTERIAL MONITORING

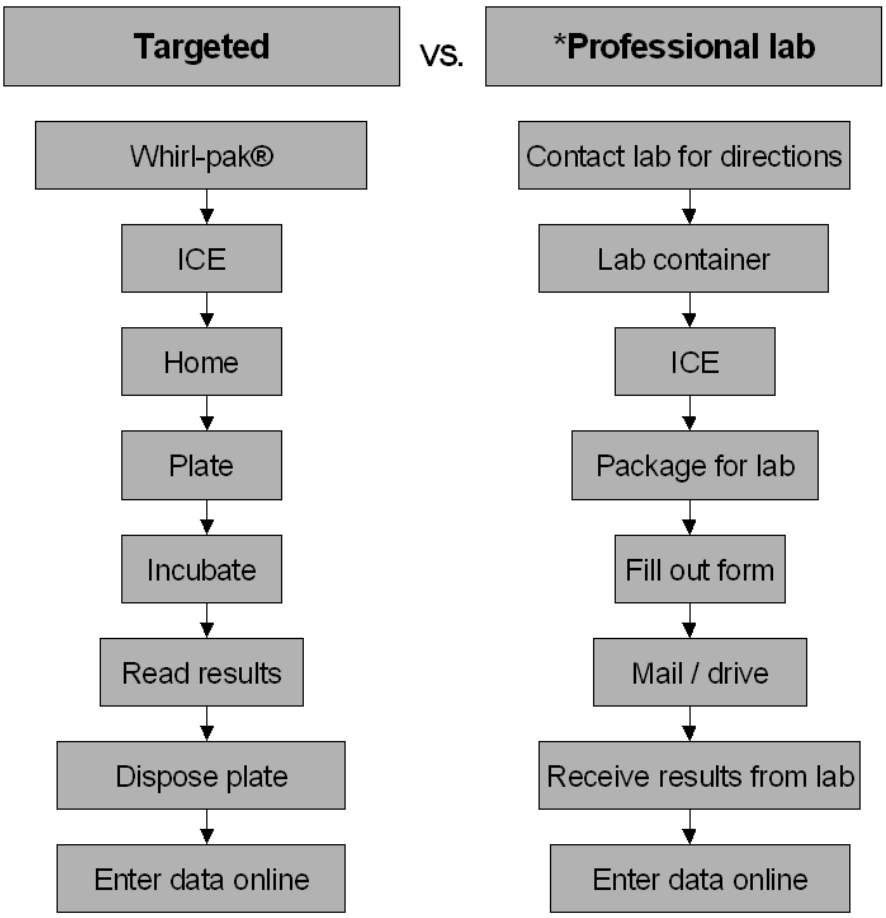
- When to Sample
- Choosing Your Sampling Method
- Equipment Needed for Bacterial Monitoring
- Directions for Bacteria Monitoring Using 3M Petrifilm™
- Reading the Results
- Getting “High” Bacteria Counts
- Source Tracking

When to Sample

Georgia Adopt-A-Stream recommends that sampling for *E. coli* should be done at least monthly during dry weather conditions. You should also be consistent with the time of day you sample. These factors help in the comparison of your data over time. The number of times that you’ll need to sample varies and depends on your goals. The more you sample, however, the better information you will have when interpreting your data.

Choosing Your Sampling Method

Volunteers have the option of processing their samples at home using 3M™ Petrifilm™ plates and an incubator or by packaging and shipping samples to a professional lab. Many studies have shown that the 3M™ Petrifilm™ method is as effective as the professional lab methods and is more practical and cost efficient for the volunteer monitor. If you need professional quality lab data, please refer to page 36 for more information about Adopt-A-Stream’s partnership with UGA Cooperative Extension Service’s water quality lab. Shown below is a flow chart that provides a general guide to process water samples taken from the field.



For more information comparing these methods, see The Volunteer Monitor's Bacteria Methods Comparison Study at http://water.epa.gov/type/rsl/monitoring/upload/2006_03_20_monitoring_volunteer_newsletter_volmon18no1.pdf.

Equipment Needed for Bacterial Monitoring

After a thorough review of the various testing methods, Adopt-A-Stream has developed a list of equipment that is required for *E. coli* monitoring using 3M Petrifilm™ plates. This method requires an incubator that has to be maintained at a specific temperature. For equipment specifications and ordering information, please see Appendix A.
To collect a sample in the field, you will need:

- Bacterial data form
- Rubber boots, waders or old tennis shoes
- Bucket with rope or grab sample pole (if sampling from a bridge)
- Whirl-pak® bags (labeled with site and collection information)
- Latex or vinyl gloves
- Permanant marker
- Disinfected cooler with ice

- First aid kit
- 'Who to Call List'
- Trash bag to pick up litter

To plate and incubate samples at home, you will need:

- Bacterial data form
- Cup to hold Whirl-pak® bags
- 3M™ Petrifilm™ *E.coli* plates
- 1ml fixed-volume pipettor & sterile tips
- Clean space for sample processing with good lighting
- Incubator
- Digital thermometer
- Permanent marker
- Latex or vinyl gloves
- Safety glasses
- 10% Bleach solution, OR Lysol spray/disinfectant, AND watertight bag for sample disposal

Directions for Bacteria Monitoring Using 3M Petrifilm™

Part 1: Preparing the blank/control sample

For each sampling event (i.e. a day of sampling up to 10 sites), the volunteer shall fill a Whirl-pak® bag with distilled water at the first sample site to serve as the blank/control. Having a field blank when you sample is necessary to serve as a control. A control will ensure that you are practicing a sterile technique that prevents contamination. If you are sampling at more than one site, prepare one blank for every 10 sites. The blank is then plated and analyzed with the stream samples in the lab. Lab analysis of the blank should result in a zero reading for bacteria. If it is contaminated, you will need to discard all samples; no data can be submitted for these samples. Prior to collecting the control sample, label the Whirl-pak® bag with the stream name, site number, date and time collected, and the sample collector.

1. While in the field, correctly label 1 Whirl-pak® bag with a permanent marker for the blank/control.
2. Put on latex gloves and remove the perforated seal from the top of the Whirl-pak® bag.
   IMPORTANT! Do not touch the inside of the Whirl-pak® as this will contaminate your sample and alter the results.
3. Use the two small white tabs to pull open the bag.
4. Fill the Whirl-pak® bag 2/3 full with distilled water.

5. Grab the ends of the twist ties and “whirl” or spin the bag tight. Cross the twist ties to close the bag.
6. Make sure the bag is closed securely by inverting the bag to test the seal (no water leaks out).
7. Immediately place the Whirl-pak® bag into a properly disinfected cooler with ice and store there throughout your sampling event.

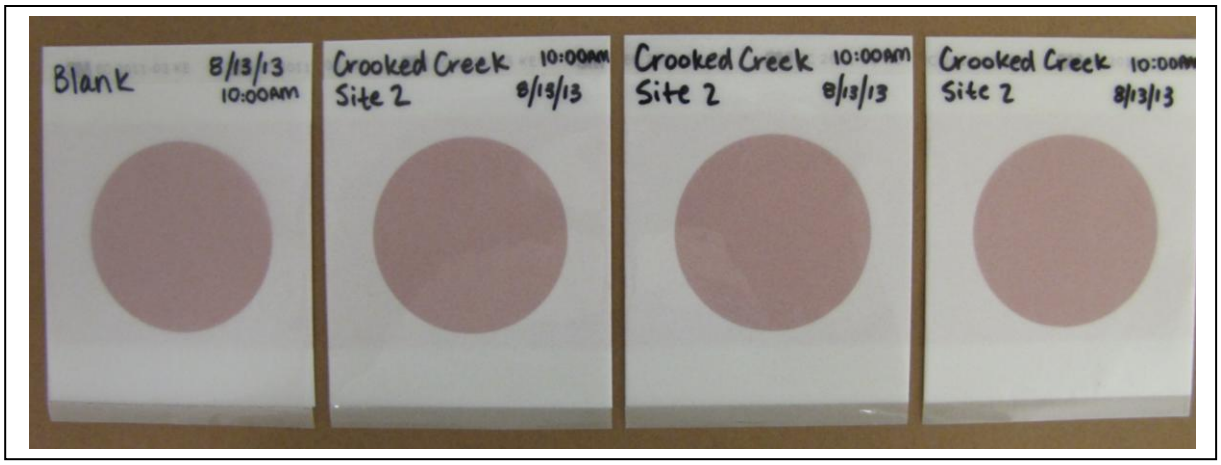
Part 2: Collecting site samples in the field

1. Correctly label new Whirl-pak® bag with a permanent marker for the sample/site information.
2. Put on latex gloves and remove the perforated seal from the top of the Whirl-pak® bag.
   IMPORTANT! Do not touch the inside of the Whirl-pak® as this will contaminate your sample and could alter the results.
3. Use the two small white tabs to open the bag.
4. While holding the yellow twist ties place the bag in the water at mid-stream, mid-depth or in a well-mixed area and allow the water to flow into the bag. Fill the bag with water up to 2/3 full.
   *Remember to collect the water sample (at least wrist deep) upstream of where you are standing. If sampling from a bridge, use a rope tied to a small disinfected bucket to grab the sample.
5. Grab the ends of the twist ties and “whirl” or spin the bag until tight. Cross the twist ties to close the bag.
6. Make sure the bag is closed securely by inverting the bag to test the seal (no water leaks out).
7. Immediately place the Whirl-pak® bag into a cooler with ice.
8. Optimal holding time for samples on ice or refrigeration is less than 6 hours but no more than 24 hours.
9. Properly dispose of gloves.

Part 3: Plating your samples

Note: Turn incubator on before plating to ensure it will reach the correct incubation temperature. Process the blank/control sample first (use 1 plate) and then follow with the stream sample (use 3 plates). Use 1 pipette tip per sample bag.

1. Clean working area with disinfectant spray and let dry.
2. Put on latex gloves. NOTE* You should always wear these when handling the plates (even when going to read them).
3. Correctly label plates (1 for the blank & 3 for the site sample), and lay them on a clean, flat surface. Plates should indicate stream name, site number and the incubation start time and date. See below figure for examples of how to label plates.



4. Gently shake Whirl-pak® bag to ensure an even mix of sample.
5. Place the Whirl-pak® bag in a cup to keep from spilling and open the bag using the white tabs.
   IMPORTANT! Do not touch the inside of the Whirl-pak® as this will contaminate your sample and could alter the results.
6. Carefully remove pipette tip from sterile container. Don't touch the pipette tip inside of the sterile container and practice caution to ensure that the tip is not contaminated thereafter.
6. Pipette 1 ml of the sample using the fixed-volume pipettor.
7. Lift the top film of the Petrifilm™ plate and dispense 1 ml of sample on the center of the circular plate.
8. Slowly roll the top film down onto the sample until the plate is completely covered to prevent trapping air bubbles. Do not touch the center of the petrifilm plate.
9. If necessary, distribute the sample evenly by using the 3M® spreader or slightly tilting the Petrifilm™ plate back and forth. Tilting too much will cause the sample to pour out of the plate.
10. Leave plate undisturbed for one minute to allow the gel to solidify and then place in the incubator.
11. Repeat: Plate two more samples for a total of three plates per sample site.

Part 4: Incubating

1. Plan to turn on the incubator prior to plating to ensure it will be ready. Place the incubator lid on top.
2. Insert the thermometer into the incubator.
3. Once the incubator is at 35°C ± 1°C, place the processed Petrifilm plates in the incubator and reset the thermometer.
4. Incubate plates in a horizontal position, with the top film side up, in stacks of up to 20 plates. **Incubate for 24 ± 1 hour at 35 ± 1 degrees Celsius.**

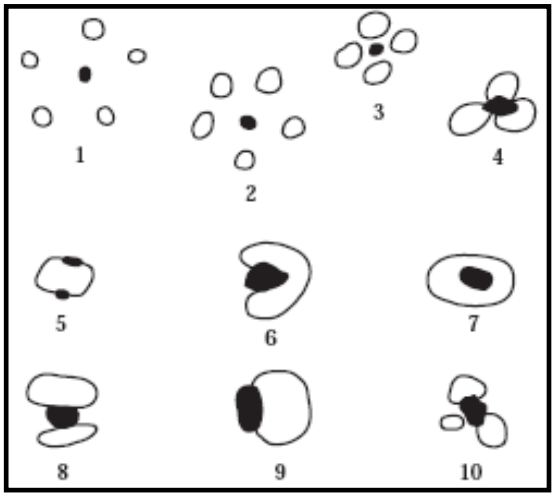
5. After 24 hours, remove plates (with gloves on) and count *E.coli* colonies.
6. Record the minimum and maximum temperatures that are displayed on the thermometer after incubating, as well as the time in/out of the incubator.
7. Record all data on the Bacterial Data Form.
8. Dispose of plates by spraying them with an appropriate disinfectant and placing in a sealed zip lock bag, discarding in the trash.

Part 5: Cleanup & Disinfect

Properly disinfect your lab space, incubator and cooler using 10% bleach disinfectant.

Reading the Results

When reading Petrifulm plates, ***E. coli*** colonies appear blue to red-blue and are closely associated with entrapped gas. **General coliform** colonies appear bright red and closely associated (approximately one colony diameter) with entrapped gas. Remember that we are only concerned with counting the *E. coli* colonies in the medium, and we do not count colonies that appear on the foam barrier of the plate. Gas bubble patterns associated with gas producing colonies are shown on the right. **Only count blue to red-blue colonies that have a gas bubble!**



Bacteria growths on plates are enumerated using a standard unit. The standard reporting unit is the number of **c**olony **f**orming **u**nits per 100 milliliters of water sample (cfu/100ml). Each Petrifilm plate holds 1mL of sample.

Exception: You might encounter a plate with colonies that are too numerous to count (TNTC) and that have one or more of the following characteristics: 150 *E. coli* colonies or more, many gas bubbles, and deepening of the gel color from red to purple-blue. High concentrations of *E. coli* will cause the entire growth area to turn a deep purple-blue color. The plate will be filled with colonies so much so that barely any empty space is present. If this happens, and the plate also contains blue to red-blue colonies, count them as presumptive *E. coli* whether or not gas bubbles are present.

To determine the number of colony forming units (cfu) per 100 ml of water sample, the following steps should be taken:

STEP I. Count the number of *E.coli* colonies on all three of your plates and add them together.	⇨	Let's assume you counted 6, 7, and 8 colonies = 21 colonies
STEP II. Find the average number of colonies. Take the total number of colonies and divide them by the number of plates used.	⇨	21 colonies / 3 plates = 7
STEP III. Now, multiply the average number of colonies by 100. You have now determined the number of colony forming units per 100 ml of sample.	⇨	7 x 100 = **FINAL COUNT** **700 cfu/100 ml**

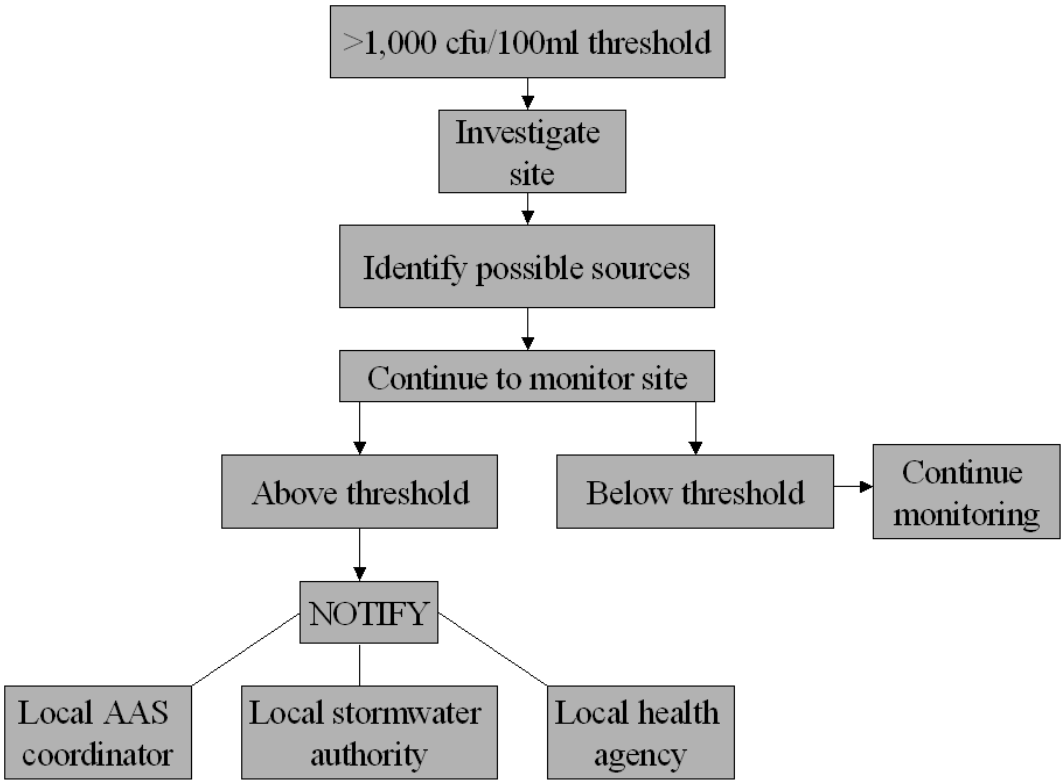
Getting "High" Bacteria Counts

Georgia Adopt-A-Stream recommends that *E. coli* sampling be done monthly during normal flow conditions. It is common to find high bacteria counts in urban areas. *E. coli* counts (cfu/100ml) that exceed 235 cfu/100 ml are considered "high" and should be closely monitored, but when counts exceed the 1000 cfu/100 ml threshold, they warrant special action. A count of 235 cfu/100 ml correlates to 8 incidents of 1000 people getting sick, but a count of 1000 cfu/100 ml correlates to about 14 incidents of 1000 people getting sick.

If you find a "high" bacterial count, it may be a one-time event or occurrence. This information is useful, but before taking further action, you should return to the site to take more samples. When you return, pay careful attention to anything out of the ordinary at the site. Look for the presence of animals and be alert for any unusual odors. Walk the banks again to look for obvious sources of pollution (see Chapter 2), and note past and current weather conditions. Continue to sample and contact your local health agency if numbers remain high. Be sure to wear gloves while sampling and wash your hands carefully afterwards.

If you continue to find counts above the 1000 cfu/100 ml threshold, work through your local Adopt-A-Stream coordinator to find the cause. You may also wish to alert your local watershed group or local agency about your monitoring efforts and the results so far. They may be able to work with you on determining the possible sources of *E. coli* pollution.

Detected High *E. coli* Counts: Follow These Steps



Using guidance provided by the US EPA, states have developed ambient standards for fecal coliform bacteria and/or *E. coli*. Compliance is often based on the average mean or the geometric mean of three or more samples taken during the same sampling event at representative locations within a defined sampling area. Detailed tables containing state fecal coliform standards and US EPA *E.coli* standards can be found in Chapter 1.

Source Tracking

One method for determining sources of *E. coli* is called Bacterial Source Tracking. Bacterial Source Tracking (BST) is a collective group of new methodologies being developed to determine sources of fecal pollution in environmental samples. Sources of fecal pollution include domestic pets, cows, deer, geese, hogs, other wild animals and humans.

If used successfully, BST methodologies have the potential to turn nonpoint (diffuse) sources into point sources. Current BST research is being driven by the recent implementation of the Total Maximum Daily Load (TMDL) concept by EPA. BST methods represent the best tools available for determining sources of fecal pollution in water and should be an integral part of any project that involves TMDL development for fecal coliforms. BST methods can also be used in the design and implementation of Best Management Practices (BMP) to reduce fecal loading in water.

Currently, both molecular (genotype) and biochemical (phenotype) BST methods are under development. DNA finger printing has received the greatest publicity, but numerous methods show potential. Most researchers believe that some combination of BST methods will be needed to provide the most accurate and reliable source identification answers. It is doubtful that any one BST method will emerge as the “best” method for all situations.

While this is not a procedure that the volunteers will be conducting, it is a procedure to be aware of, and a possible step that state agencies might take. At this point, it is still an emerging and costly technology, but is being incorporated more in government agencies.

Chapter 3

BACTERIAL FORMS

- Bacterial Data Form
- UGA Adopt-A-Stream Lab Submission Form

GEORGIA ADOPT-A-STREAM: Bacterial Form

To be conducted every month

SITE INFORMATION

Group Name:_____ Event Date: _____ (MMDDYYYY)

Group ID: G-_____ Site ID: S-_____ Time Sample Collected:_____ (HHMM am/pm)

Stream Name:_____ Time Spent Sampling: _____ (Min)

Monitor(s):_____ Total Time Spent Traveling *(optional)*: _____ (Min)

Number of Participants:_____ Furthest Distance Traveled *(optional)*: _____(Miles)

WEATHER

Present conditions (check all that apply)

☐ Heavy Rain ☐ Steady Rain ☐ Intermittent Rain

☐ Overcast ☐ Partly Cloudy ☐ Clear/Sunny

Amount of rain, if known?

Amount in Inches :_____

In Last Hours/Days:_____

*Refer to *wunderground.com* for rainfall data

OBSERVATIONS

Flow/Water Level: *(check all that apply)* ☐ Dry ☐ Stagnant/Still ☐ Low ☐ Normal ☐ High ☐ Flood (over banks)

Water Clarity: ☐ Clear/Transparent ☐ Cloudy/Somewhat Turbid ☐ Opaque/Turbid

Water Color: ☐ No Color ☐ Brown/Muddy ☐ Green ☐ Milky/White ☐ Tannic ☐ Other:_____

Water Surface: ☐ Clear ☐ Oily Sheen: does it break when disturbed? Yes/No (circle one) ☐ Algae

☐ Foam ◯ Greater than 3" high ◯ It is white

Water Odor: ☐ Natural/None ☐ Gasoline ☐ Sewage ☐ Rotten Egg

☐ Fishy ☐ Chlorine ☐ Other:_____

Photos: Please take images to document your observations and changes in water quality conditions. Photo point directions can be found in the manuals. Images can be submitted online with your other data.

Trash: ☐ None ☐ Yes, I did a cleanup ☐ This site needs an organized cleanup

BACTERIAL

3M Petrifilm Method: *Escherichia coli*

Run three (3) plates/tests for each site, plus one (1) blank plate. Process within 6-24hrs, incubate at 35°C ±1° and read at 24 ± 1 hr

Plate	Colonies	Find AVG of Number of Colonies (total # colonies/total # of plates (do not include blank))	cfu/100mL
Blank			
1		(/) x 100 =	
2			
3			
Total # Colonies			

Sample Holding Time (HH): _____

Date START(MMDDYYYY): _____ Date END (MMDDYYYY):_____

Time START (HHMM):_____ Time END (HHMM):_____

MIN Temp (^{0}C):_____ MAX Temp (^{0}C): _____

COMMENTS

Any changes since you last sampled at this site? If yes, please describe.

Please submit data to our online database at www.GeorgiaAdoptAStream.org

AGRICULTURAL AND ENVIRONMENTAL SERVICES LABORATORIES
2300-2400 College Station Road, Athens, GA 30602-9150
706-542-7690

The University of Georgia
College of Agricultural and Environmental Sciences
Cooperative Extension

LAB #:
Received by:
Date and Time:

UGA ADOPT-A-STREAM LAB SUBMISSION FORM

Samples accepted Monday – Thursday
You must call the lab to schedule advanced testing prior to shipping your sample.

AAS Group Name: _____ **Group ID Number:** _____

ADVANCED LAB TEST PACKAGE $50

- pH
- Total Alkalinity
- Specific Conductance
- Turbidity

(1 liter for all four parameters)

- Nitrate-Nitrogen
- Ammonia-Nitrogen

125 ml w/ sulfuric acid for both Nitrate and Ammonia

Total Reactive Phosphorus (125 ml glass bottle)

OTHER LAB TESTS

Fecal Coliform $30 (contact UGA lab for 125 ml sterile bottle)
Escherichia coli $30 (contact UGA lab for 125 ml sterile bottle)
Total Kjeldahl Nitrogen $20 (250 ml)
Total Phosphorus $22 (250 ml)
(Or 500 ml for both)
Total Suspended Solids $15 (1 liter or 500 ml for clean water)
Chlorophyll A $50 or $40 if submitted as frozen filters (1 liter)
Metal Scan – Ca, Mg, Na, K, Zn, Fe, Mn, Cu, B, Mo, Al, Cd, Cr $15 (125 ml)

AAS Site ID #	Field Data (MUST be provided)				Test Requested (See above)	
	pH	Water Temp	Date/Time Collected	Collected By	Advanced Lab Test Package	Other Lab Tests

Relinquished by: _____ Date/Time: _____
Received by: _____ Date/Time: _____
Relinquished by: _____ Date/Time: _____
Received by: _____ Date/Time: _____

Send samples, forms, and payment to:
Feed and Environmental Water Lab
2300 College Station Road
Athens, GA 30602 - 9105

Note: Make check payable to the **"Feed and Environmental Lab"**
**Prices may change without notice, please confirm prices with the lab prior to submitting samples.

Chapter 4

DIRECTIONS FOR COMPLETING FORMS

- General Monitoring Information
- Bacterial Data Form
- Example Form

General Monitoring Information

This chapter directs the volunteer step by step through the process of completing the Georgia Adopt-A-Stream Bacterial Data Form. Before you get started, pull your Bacterial Data Form out and photocopy it, or download it from www.GeorgiaAdoptAStream.org so that you have extra blank forms to work with in the future. The following is a description of how to complete this form. Example of a completed form is shown at the end of this chapter.

The Georgia Adopt-A-Stream Chemical/Bacterial Data Form can be used if you are combining both of these monitoring methods at the same site. The Bacterial section is filled out in the same way as the Bacterial Data Form. Please refer to the Chemical Monitoring manual for information on filling out the Chemical section of this form.

The UGA Adopt-A-Stream Submission Form is used if you are taking samples to be sent to their laboratory. It is necessary to contact UGA Cooperative Extension Service first to receive their specific bottles for sampling.

Bacterial Data Form

SITE INFORMATION

Group Name: Choosing a group name is covered in the Georgia Adopt-A-Stream's introductory manual, Getting to Know Your Watershed, and registration of this group should be completed online in the database. Each of your monitoring sites will be registered to your group name.

Group ID: This is the ID number provided to you by the Georgia Adopt-A-Stream online database after you register your group. It will be in the format AAS-G- ###.

Site ID: When you register each of your monitoring sites, the online database will send you your site number, in the format AAS-S- ####. This site number allows you and the State to identify the exact location of your monitoring site.

Stream Name: List the stream name that you registered with the online database.

Monitors: List all QA/QC volunteers who assisted with monitoring.

Number of Participants: List the number of people who joined you as you monitored (both certified and non-certified volunteers).

Event Date (MMDDYYYY): The time of year you conduct your survey is very important. List the date of your sampling event in the MMDDYYYY format.

Time Sample Collected (HHMM): Document the time of day you began sampling. Try to be consistent and go out at about the same time each time you monitor.

Time Spent Sampling (in minutes): Report the time spent monitoring. Include preparation time for sampling and processing of samples. This is required information. *Example:* 1 individual went sampling from noon-1pm, this would be 60 minutes of sampling time. Or if 4 individuals sampled from noon-1pm, this would still be 60 minutes of sampling time.

Total Time Spent Traveling (in minutes; optional): Report the time spent traveling to/from sampling site. *Example*: 1 individual traveled 10 minutes to and 10 minutes from the site, this would be 20 minutes of travel time reported. Or, if there is more than one individual traveling to and from the site, report the sum of each monitor's to/from travel time. So if Mary traveled 20 minutes, Larry 10 minutes, and Dan 30 minutes, the total time to report would be 60 minutes.

Furthest Distance Traveled (in miles; optional): Your mileage to and from your site. This can be reported a few different ways. *Example*: 1 individual traveled 10 miles to and 10 miles from the site; this would be 20 miles reported. Or, if there is more than one individual traveling to and from the site, report the longest distance traveled. So if Mary traveled 20 miles, Larry 10 miles, and Dan 30 miles, you would report Dan's mileage, since it was the furthest.

WEATHER

Present Conditions: Please select all that apply: Heavy Rain, Steady Rain, Intermittent Rain, Overcast (no blue sky between any of the clouds), Partly Cloudy (clouds present but also some blue sky), or Clear/Sunny (no clouds).

Amount of Rain, if Known: Please check your local weather station or go to wunderground.com to find out the most recent rain levels in the past 24-48 hours in inches. If you have a rain gauge at your site, you may also use this for your measurement.

OBSERVATIONS

Note: You will need a clear cup or bottle and a white background to determine water color, water clarity and water odor. To evaluate these three parameters, take a water sample from your monitoring site.

Flow/Water Level

Even if your waterway is flooded or completely dry, that is valuable information and data. Please still fill out the datasheet as completely as possible (weather, air temperature, flow, comments section) and submit your information to the Adopt-A-Stream database.

Select one of the following:

- **Dry:** The stream or lake is dry with no visible pools.
- **Stagnant/Still (streams only):** This occurs when the water body is not flowing downstream. You should also check this box if there are pools of water in the stream or river bed that are not connected by flowing water (the bed is dry in between pools).
- **Low:** This is when the water level is lower than normal. There are a few indicators that the level is low: some parts of the creek or lake bed are dry between the water surface and the shoreline plants, or aquatic plants/algae are now exposed and lying out of the water.
- **Normal:** Based off of your observations and opinion, this is what your water body's level normally looks like.
- **High:** This is when the water body is higher than normal. Look for partially submerged shoreline vegetation, which is usually out of the water.
- **Flood (over banks):** Please do not sample when it is flooding, but a record of this level is important to note.

***NOTE:** With major changes in weather patterns, our waterways may exhibit periods of time not conducive to base flow water quality testing, including periods of extreme drought or flooding. Georgia Adopt-A-Stream encourages citizens to remember safe monitoring practices when major storms appear and waterways rise to unsafe levels.

Water Clarity

Select one of the following that describes the relative cloudiness of the water:

- **Clear/Transparent:** Water can transmit light rays and one can see through the water.
- **Cloudy/Somewhat Turbid:** Water can transmit some light rays, but one cannot see through the water.
- **Opaque/Turbid:** Neither clear nor cloudy; water cannot allow light to pass through most likely due to stirred up sediment.
- **Other**

Water Color
Select one of the following that describes the relative color of the water:

- **No Color**
- **Brown/Muddy**
- **Green**
- **Milky/White**
- **Tannic**
- **Other**

Water Surface
Select any of the following that describes the appearance of the water surface which can be a physical indicator of water pollution:

- **Clear:** No appearance of anything on the water surface.
- **Oily Sheen:** This is a multicolored reflection that may indicate oil floating in the stream. Some sheens are natural (a byproduct of iron bacteria), and may break into geometric patterns when touched (you can use a stick). Test if the oily sheen breaks when disturbed and select “yes” or “no.”
- **Algae:** Note if any types of algae are present in your stream. Algae are simple plants which do not grow true roots, stems, or leaves and which live mainly in water. They can be brown, green, reddish and can grow on rocks, the streambed or float on the surface.
- **Foam:** The presence of foam can be natural or due to pollution (e.g. detergents or nutrients). Foam that is several inches high and does not brush apart easily is generally due to some sort of pollution.
    - **If Foam is Present:**
      Select if it is more than 3 inches tall and/or if it is pure white in color.
- **Other:** Explain what you see on the water surface.

Water Odor
Select one of the following:

- **Natural/None**
- **Gasoline**
- **Sewage**
- **Rotten Egg**
- **Fishy**
- **Chlorine**
- **Other**

***NOTE:** DO NOT SMELL if there is a strong chemical odor or there is an appearance of chemical spill.

Trash
Trash is a form of pollution and is not only unsightly, but can affect the health of our waterways including aquatic life. Removing trash from streams is a simple way to protect and improve your waterways and can be done individually or with a larger group such as Rivers Alive (RiversAlive.org) and Georgia Adopt-A-Stream. The information you collect will support the efforts of these programs to identify sites across the state needing a cleanup.

Select any of the following:

- **None:** What a luxury, you monitor at a trash free site!
- **Yes, I did a cleanup:** Great, you successfully cleaned your site!
- **This site needs an organized cleanup:** Help! There is more trash present than our group can handle, and a larger effort needs to be conducted.

COMMENTS
This section is open to your personal observations of your site. Please write down information not captured by the datasheets including alterations to your site that are new since you last monitored ("*ATV tracks were seen up and down the stream channel*" or "*site access has changed to the west side of the bank*") or biological observations ("*algal growth was tremendous"* or "*fishes were seen*") as well as any other significant changes.

PHOTOS
Please take images to document your observations and changes in water quality conditions. Photo point directions are located in the Visual Stream Survey manual which can be downloaded from www.GeorgiaAdoptAStream.org. Images of your site can be submitted online.

Bacterial Section

This section records all of the information from incubating the water sample to finding the final *E. coli* level of your sample.

Sample Holding Time (HH): This is the time from when you collected the sample from the waterway to the time you begin plating the sample. Ideally, this is less than six hours but can be up to 24 hours.

Date START (MMDDYYYY): The date you started incubating your blank and sample plates.

Time START (HHMM): This is the time you put your samples in the incubator. This is important so you know when the plates are ready to be counted.

Date END (MMDDYYYY): Record the date you take the samples out of the incubator.

Time END (HHMM): List the time you take the samples out of the incubator. It is important to know the length of time the samples have been incubated. This should be within 24 +/- 1 hour of when you placed the sample plates into the incubator.

MIN Temp (°C): This is the minimum temperature the incubator reached during the time the samples were inside. The digital thermometer will record both the minimum and the maximum temperatures.

MAX Temp (°C): Document the maximum temperature of the incubator while the samples were inside. The temperatures within the incubator should stay within +/- 1°C of 35°C.

Colonies: The number of blue colonies with entrapped air bubbles for each of your plates including the blank. The blank should show no trace of any bacteria, red or blue colonies.

Total Number of Colonies: The sum of your plates (do not include the blank).

Find AVG of number of colonies: Describe how you determined the average number of colonies for your sample by recording the total number of colonies divided by the total number of sample plates. The final *E. coli* level is found by multiplying this by 100.

cfu/100mL: Record the final *E. coli* level of your sample. If you get a high level, look back at Chapter 2 in the section "Getting High Bacteria Counts" to determine if you need to take further action.

Comments

This section is open to your personal observations of your site. Please write down information not captured by the datasheets including alterations to your site that are new since you last monitored ("*ATV tracks were seen up and down the stream channel*" or "*site access has changed to the west side of the bank*") or biological observations ("*algal growth was tremendous"* or "*fishes were seen*") as well as any other significant changes.

EXAMPLE FORM

GEORGIA ADOPT-A-STREAM: Bacterial Form

To be conducted every month

SITE INFORMATION

Group Name: Chattahoochee Hills Creek Keepers
Event Date: 07252013 (MMDDYYYY)
Group ID: G- 1214 Site ID: S- 1507
Time Sample Collected: 0900 (HHMM am/pm)
Stream Name: Little Bear Creek
Time Spent Sampling: 15 (Min)
Monitor(s): Mary and Matt Mayfly
Total Time Spent Traveling *(optional)*: 20 (Min)
Number of Participants: 2
Furthest Distance Traveled *(optional)*: 15 (Miles)

WEATHER

Present conditions (check all that apply)

☐ Heavy Rain ☐ Steady Rain ☑ Intermittent Rain
☐ Overcast ☐ Partly Cloudy ☐ Clear/Sunny

Amount of rain, if known?

Amount in Inches : 0.5
In Last Hours/Days: 3 days
*Refer to *wunderground.com* for rainfall data

OBSERVATIONS

Flow/Water Level: *(check all that apply)* ☐ Dry ☐ Stagnant/Still ☐ Low ☑ Normal ☐ High ☐ Flood (over banks)

Water Clarity: ☐ Clear/Transparent ☑ Cloudy/Somewhat Turbid ☐ Opaque/Turbid

Water Color: ☐ No Color ☑ Brown/Muddy ☐ Green ☐ Milky/White ☐ Tannic ☐ Other:_____

Water Surface: ☐ Clear ☑ Oily Sheen: does it break when disturbed? Yes/No (circle one) ☑ Algae
☐ Foam ◯ Greater than 3" high ◯ It is white

Water Odor: ☑ Natural/None ☐ Gasoline ☐ Sewage ☐ Rotten Egg
☐ Fishy ☐ Chlorine ☐ Other:_____

Photos: Please take images to document your observations and changes in water quality conditions.
Photo point directions can be found in the manuals. Images can be submitted online with your other data.

Trash: ☐ None ☑ Yes, I did a cleanup ☑ This site needs an organized cleanup

BACTERIAL

3M Petrifilm Method: *Escherichia coli*

Run three (3) plates/tests for each site, plus one (1) blank plate. Process within 6-24hrs, incubate at 35°C ±1° and read at 24 ± 1 hr

Plate	Colonies
Blank	0
1	2
2	1
3	3
Total # Colonies	6

Find AVG of Number of Colonies (total # colonies/total # of plates (do not include blank)): (6 / 3) x 100 = 200

cfu/100mL: 200

Sample Holding Time (HH): 02
Date START(MMDDYYYY): 07252013
Time START (HHMM): 1130
MIN Temp (°C): 34.6

Date END (MMDDYYYY): 07262013
Time END (HHMM): 1145
MAX Temp (°C): 35.2

COMMENTS

Any changes since you last sampled at this site? If yes, please describe.

Yes. There is new foot bridge being constructed 100 feet upstream of our monitoring site.

Please submit data to our online database at www.GeorgiaAdoptAStream.org

Appendix A

EQUIPMENT MAINTENANCE AND PURCHASING

- Equipment Maintenance
- Using A Fixed Volume Pipettor With Sterile Tips
- 3M Petrifilm™ Storage
- Disposal Technique
- Purchasing Information

Equipment Maintenance

It is important when working with bacteria to practice sterile techniques to avoid contamination of samples. Store pipette tips in a sterile container. Be sure to use a new sterile pipette tip when plating from different water samples. Make sure the cooler that holds ice is washed with a 10 % bleach solution before and after every use. Be sure to wash hands thoroughly with soap before and after plating, and always use latex or vinyl gloves when handling equipment.

Using a Fixed-Volume Pipettor with Sterile Tips

Keep tips in a sterile container before using.

Step 1: Add tip to pipettor.
Step 2: Depress the “plunger” to the first stage. Dip the tip in the water sample.
Step 3: Release the “plunger” slowly to reach the ready position. The water sample will be filled in the tip. Make sure there are no air bubbles.
Step 4: Depress the “plunger” gently to the first stage. Solution will be dispensed but a small amount of liquid will be left in the tip.
Step 5: After a pause, continue to depress the “plunger” to the second stage. The small amount of liquid left in the tip is also dispensed.
Step 6: Release the “plunger” to reach the ready position.

*Note: You should also remember to agitate your water sample before drawing a sample with a pipette.

3M™ Petrifilm™ Storage

Store un-opened Petrifilm™ plate pouches in the refrigerator. Once pouches have been opened, avoid any moisture that may come into contact with the plates. Store the opened Petrifilm™ plate pouches in a re-sealable plastic bag and place them in the FREEZER. Place a weight down on the top of the bag to keep the plates lying flat. Exposure of Petrifilm™ plates to temperatures greater than 25°C (77°F), and/or humidity greater or equal to 50% relative humidity can affect the performance of the plates. Opened pouches that have been stored properly this way will last until the EXPIRATION DATE located on the back of the pouch (shown in the image below). Discard any plates that have discoloration.

*NOTE: Before plating your sample, remember to remove the number of plates you will use from the freezer and allow to thaw. This will take about 10 to 15 minutes.

Expiration date (Sept. 2014)

Disposal Technique

After counting the bacterial colonies, plates need to be disinfected before disposal. Any of the following disinfectants may be used:

- A 10% bleach solution
- Lysol spray
- Rubbing Alcohol or ethanol

Put on gloves and add any of the mentioned disinfectants to each plate. When working with bleach, be sure not to get any of the solution onto skin or clothes. Place the plates in a re-sealable plastic bag. Allow the contents to mix for 5 minutes. Finally, dispose of the bag in the trash.

Purchasing Information

PETRIFILM™ PLATES

3M Food Safety
3M Center Bldg. 275-5W-05
St.Paul, MN USA 35022-5649
Phone: 1-800-328-1671
http://solutions.3m.com/wps/portal/3M/en_US/Microbiology/FoodSafety/

To view product online and to learn more about the product, please visit:
http://solutions.3m.com/wps/portal/3M/en_US/Microbiology/FoodSafety/product-information/product-catalog/

Product	Description	Catalog #	Price
3M™ Petrifilm™ E. coli/Coliform Count Plates 6404	50 plates/box, E. coli Count Plates (EC) for Escherichia coli and coliform enumeration.	6404	$82*
3M™ Petrifilm™ E. coli/Coliform Count Plates 6414	500 plates/case, E. coli Count Plates (EC) for Escherichia coli and coliform enumeration.	6414	$569

*Minimum order of $200. If you need assistance, please contact the State Office 404-657-5947.

Nelson-Jameson

2400 E. 5th St.
Marshfield, WI 5449
715-387-1151
Phone: 1-800-826-8302
SKU: 4603404

To view product online and to learn more about the product, please visit:
http://nelsonjameson.com/3M-Petrifilm-E-coli-Coliform-Count-Plates-p2028.html
*No minimum order

INCUBATOR

G.Q.F. Manufacturing Company
(912) 236-0651 www.gqfmfg.com
Genesis Hova-Bator: $134.95 (product # 1588)
Hova-Bator Circulated Air Picture Window: $102.90 (product #1583)
Thermal Air Hova-Bator: $55.98 (product # 1602N)

FIXED-VOLUME PIPETTES & STERILE TIPS

Cole-Parmer
1-800-323-4340 www.coleparmer.com
Fixed-volume Pipette 1000uL: $85.00 (model # EW21600-06)
Sterile tips: 1000/pk tips for $42.00 (product # EX25711-50)

VWR.com
1-800-932-5000 us.vwr.com
Lil'pet Mini-Pipettor, 1000µL: $22.40 (product # 470149-048)
Sterile tips: 1000/pk tips for $42.00 (product # EX25711-50)

WHIRL-PAK®

Cole-Parmer
1-800-323-4340 www.coleparmer.com
Whirl-pak® sterile sampling bag with white labeling area,
18 oz capacity: Box of 500 for $107.00 (product # EW-06499-80)

THERMOMETER

VWR.com
1-800-932-5000 us.vwr.com
VWR® Big-digit Thermometer with dual min/max: $42.37
(product # 61161-324)

*NOTE: Prices are as of August 2013.

Appendix B

OTHER SAMPLING METHODS

- UGA Cooperative Extension Service
- IDEXX Colisure
- IDEXX Colilert
- Packaging Your Water Samples for Shipping

For more information comparing different processing methods, see The Volunteer Monitor's Bacteria Methods Comparison Study at http://water.epa.gov/type/rsl/monitoring/upload/2006_03_20_monitoring_volunteer_newsletter_volmon18no1.pdf.

UGA Cooperative Extension Service

Adopt-A-Stream has a partnership with UGA Cooperative Extension Service to process E-coli samples. The UGA lab requires specific, pre-approved containers provided by their lab. Contact UGA Cooperative Extension Service for general recommendations on mailing samples. Contact information can be found on the UGA Adopt-A-Stream Submission Form found in Chapter 3. Volunteers have the option of using any state-certified lab to process samples.

IDEXX Colisure

Because of the equipment costs associated with the IDEXX Colisure, volunteers did not select it for use. However, its accuracy when compared with laboratory analyses was as good as the two methods selected.

Preparation and Setup

1. Turn on IDEXX Quanti-Tray® Sealer.
2. Label Quanti-Trays using a permanent marker. This label should include site ID, date and time of sample collection, and sample number.

Preparing the Sample
1. Water samples are collected in 100 ml plastic IDEXX bottles by filling the bottles up to the 100 ml graduation.
2. Add Colisure reagent and two drops of anti-foam solution into sample.
3. Mix thoroughly until reagent is dissolved.
4. Pour sample into Quanti-Tray.
5. Place Quanti-Tray on rubber insert, and seal with Quanti-Tray Sealer.
6. Remove from back of sealer as soon as sealing is completed.

Incubation and Interpretation
Incubate at 35 degrees Celsius for 24-48 hours. After incubation is complete, read results. Wells containing total coliforms will turn from yellow to magenta. Wells containing *E. coli* will turn from yellow to magenta and fluoresce under UV radiation. If wells appear pink or orange, return tray to incubator and reexamine in 4 hours.

After all positive wells are counted refer to the Most Probable Number (MPN) table to determine total coliform MPN and *E. coli* MPN.

Sample Disposal
Because Quanti-Trays need to be sterilized by autoclaving, used trays are stored in large Ziploc bags and returned for disposal during each subsequent sample transfer.

IDEXX Colilert

Because of the equipment costs associated with the IDEXX Colilert, it was not selected for use by volunteers. However, its accuracy when compared with laboratory analyses was as good as the two methods selected.

Preparation and Setup
1. Turn on IDEXX Quanti-Tray® Sealer.
2. Label Quanti-Trays using a permanent marker. This label should include site ID, date and time of sample collection, and sample number.

Preparing the Sample
1. Water samples are collected in 100 ml plastic IDEXX bottles by filling the bottles up to the 100 ml graduation.
2. Add Colilert reagent and two drops of anti-foam solution into sample.
3. Mix thoroughly until reagent is dissolved.
4. Pour sample into Quanti-Tray.
5. Place Quanti-Tray on rubber insert and seal with Quanti-Tray Sealer.
6. Remove from back of sealer as soon as sealing is completed.

Incubation and Interpretation
Incubate at 35 degrees Celsius for 24 hours. After incubation is complete, read results. Wells containing total coliforms will turn from clear to yellow. Wells containing *E. coli* will turn from clear to yellow and fluoresce under UV radiation. After all positive wells are counted refer to MPN table to determine total coliform MPN and *E. coli* MPN.

Sample Disposal
Because Quanti-Trays need to be sterilized by autoclaving, used trays are stored in large Ziploc bags and returned for disposal during each subsequent sample transfer.

Packaging Your Water Samples for Shipping

All samples taken should be analyzed within 24 hours. So, if you need to ship your water samples to an analytical lab, try to collect them in the early part of the week and no later than a Wednesday to allow time for the lab to process them prior to the weekend. Make arrangements with your mail carrier prior to sampling to make sure the samples will be collected promptly and delivered within 24 hours. On the day of sampling, you will need to sample early in the day so the samples can be shipped out the afternoon of the same day. When shipping, make sure the bottles are secure with no leaks, and are kept cold. You should consider the following:

- Using a plastic garbage bag to line the shipping container to prevent leaks of water.
- Sealing each sample in its own plastic bag to prevent any cross-contamination and to contain the sample in case of leaks or breakage
- Packing the samples with ice or ice packs.
- Using a sealed plastic cooler or specialized water sample shipping container. Be sure to fill out the sampling form completely, the chain of custody form, any other paperwork and place it inside of the container before sealing. You may want to seal the paperwork in a large zippered storage bag.
- Finally, attach the pre-addressed, pre-paid mailing label and ship overnight.

* Please note that UGA Cooperative Extension Service requires specific, pre-approved containers provided by the UGA lab. Contact UGA Cooperative Extension Service for general recommendations on mailing samples.

Appendix C

SUPPLEMENTAL INFORMATION

- References
- Glossary of Terms
- Who to Call List

References

- Beauchene, M., L. Wahle, S. Weiss, C. Sullivan (2002). Water quality testing manual for the project search student monitoring program. Science Center of Connecticut; Connecticut Department of Environmental Protection. Hartford, CT.

- Cassidy, M. (2003). Waterwatch Tasmania bacteriological monitoring guide for the Coliscan Easygel® method. Resource Management and Conservation Division, Department of Primary Industries Water and Environment. Tasmania, Australia. www.tas.waterwatch.org.au/pdf/Bacteriological_Monitoring_Guide.pdf

- Frenzel, S.A., C.S. Couvillion (2002) Fecal-indicator bacteria in streams along a gradient of residential development. Journal of the American Water Resources Association. 38:265-273.

- Merrell, K. (2003). Citizen's guide to bacteria monitoring in Vermont Waters. Water Quality Division, Department of Environmental Conservation. Waterbury, VT.

- Michaud, J. P. (1994). A citizen's guide to understanding and monitoring lakes and streams. Washington State Department of Ecology. Olympia, WA.

- Niemi, R.M., J.S. Niemi (1991) Bacterial pollution of waters in pristine and agricultural lands. Journal of Environmental Quality. 20:620-627.

- Overdevest, C., C. Huyck Orr, and K. Stepenuck. (2004) Volunteer stream monitoring and local participation in natural resource issues. Human Ecology Review. Vol. 11(2): 177-185.

- United States Department of Agriculture, Natural Resources Conservation Service photo gallery http://photogallery.nrcs.usda.gov

- United States Environmental Protection Agency (USEPA) (1986). Ambient WaterQuality Criteria for Bacteria EPA 440/5-84-002. Office of Water Regulations and Standards. Criteria and Standards Division. January 1986.
- United States Environmental Protection Agency (USEPA) (1996). The Volunteer Monitor's Guide To Quality Assurance Project Plans. www.epa.gov/owow/monitoring/volunteer/qappcovr.htm

- EPA 841-B-96-003. Office of Wetlands, Oceans and Watersheds. September 1996.

- United States Environmental Protection Agency (USEPA) (1997). Volunteer Stream Monitoring: A Methods Manual. (www.epa.gov/OWOW/monitoring/volunteer/stream) EPA 841-B-97-003. Office of Water. November 1997.

- USEPA (2002a). Implementation Guidance for Ambient Water Quality Criteria for Bacteria (Draft). May 2002 www.epa.gov/ost/standards/bacteria/bacteria.pdf

- USEPA (2002). Water Quality Conditions in the United States: 2000 National Water Quality Inventory. EPA-841-R-02-001. August 2002.

- United States Geological Survey (2004). National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9 http://water.usgs.gov/owq/FieldManual/index.html

Glossary of Terms

Agar – A gelatinous medium on which to grow bacteria.

Blank – Pure distilled water used to monitor for contamination by comparing against actual samples, and is often used as a control.

CFU – Colony Forming Units.

Colony – Visible growth of microorganisms.

Culture – Growing microorganisms (i.e., *E. coli*) in a nutrient medium that encourages. their growth

Delineate – To define or portray, often by drawing.

DNR – Department of Natural Resources.

E. coli – A species of fecal bacteria that lives in the intestinal tract of warm-blooded animals and is essential in digestion.

EPA – The U.S. Environmental Protection Agency, a government agency whose mission is "…to protect human health and the environment."

EPD – Georgia Environmental Protection Division.

Gastroenteritis – Irritation of the digestive tract, often resulting in abdominal pain, vomiting and/ or diarrhea.

Geometric mean – the average results of four samples collected within a 30-day period, with all samples collected at least 48 hours apart from one another.

GIS – Geographic Information Systems. A software program that combines different layers of information (streams, land use, cities, counties, elevation, etc.) for analyses.

GPS – Global Positioning System. Hand-held or larger devices that triangulate your position on earth from satellites in orbit. One can take reading(s) at a sampling site, and later download this data into a software program.

Holding time – The amount of time a sample can be stored before it is considered void.

Imperviousness – Impenetrable surfaces such as driveways, roads, etc.

Incubator – An apparatus in which environmental conditions can be set and controlled (i.e. temperature).

Medium – The nutrient substance used to grow microorganisms.

Pathogen – A disease-causing life form such as a virus, bacterium, or other microorganism.

Pipette – An instrument used in the lab to transfer measurable amounts of liquid.

Plate – A container with nutrient medium on which, microorganisms can be cultured.

Replicate – Samples collected in the field in duplicate, triplicate, or more. Or samples plated in the lab in duplicate, triplicate, or more. Replicates help identify any variability in the stream or lab procedures.

TMDL – Total Maximum Daily Load. A TMDL is a regulation that specifies the sum of the pollutant contributions from point source discharges, *non-point* (diffuse) sources, and natural background levels that a water body can process and still meet water quality standards.

TNTC – Too Numerous To Count or too many colonies were present, generally defined as greater than 150 colonies.

Tributary – Smaller streams that feed into a larger portion of the main stream or river.

Watershed – The area of land that drains to a common water body.

Georgia Adopt-A-Stream "Who to Call List"

Emergency Response 1-800-241-4113 or 404-656-4863

Use this number to report an emergency situation that is currently happening. Examples include fish kills, chemical, sewage or oil spills, illegal dumping in progress, poaching or anything that warrants immediate attention.

Non-Emergency Response 1-888-EPD-5947 or 404-657-5947

Use this number for non-emergency situations such as illegal dumping after the fact, buffer violations, sedimentation, or other impairments that warrant attention.

Georgia Adopt-A-Stream State Office 404-657-5947

Monday through Friday - 8:00 a.m. to 4:30 p.m.

Your phone call may be forwarded to a voicemail box, in this instance please review the notes below.

Your Local Contacts

Local Emergency Hotline_____ Local DNR Ranger _____
Local Health Department_____ Local EPD Office _____
Local Code Enforcement_____ Local AAS Coordinator _____
***** Remember to get after hour numbers as well.

Please call Georgia Adopt-A-Stream and your local coordinator if you have reported a situation to one of the numbers above so that we are aware of the situation and can follow-up within the Environmental Protection Division.

Please remember to take detailed notes on the following:

- Exact location: address or GPS coordinates (more specific than 'John Doe's Farm')
- Clear directions on how to get there
- Describe the nature of the issue
- Date and when the issue occurred or what time did it start
- Take a picture of the site
- If the conditions are safe, gather water quality data and a water sample in a sterile container

Important information to give to the operator:

- Your phone number first, so they can call you back if you are disconnected
- Request a call back if you wish to talk to an EPD officer, if you have not received a call within 1 hour, please call back and also report this to Adopt-A-Stream.
- Talk clearly and slowly

Other Useful Numbers

EPD Hazardous Waste Program (for illegal dumping)	404-656-7802
EPD Water Protection (responds to underground storage complaints)	404-362-2688
EPD Georgia Safe Dams Program (questions about dams)	404-362-2678
EPD Water Protection (modeling and monitoring or water quality)	404-675-6236
NonPoint Source Program (erosion, buffers, stormwater)	404-657-5947

EPD Regional Offices (for water quality questions, erosion & sedimentation problems)

Mountain District (Atlanta)	404-362-2671	Northeast District (Athens)	706-369-6376
Mountain District (Cartersville)	770-387-4900	Northeast District (Augusta)	706-792-7744
Middle GA District (Macon)	478-751-6612	Northwest District (Albany)	229-430-4144
Coastal District (Brunswick)	912-264-7284		

DNR Coastal Resource Division	912-264-7218
Georgia Wildlife Resources Division	770-918-6400
Endangered Species	912-994-1438
Georgia Cooperative Extension Service	706-542-3824
Georgia Forestry Commission	912-751-3500
Georgia Soil & Water Conservation Commission	706-542-3065

US NRCS	Regional	404-347-6105
	Clayton	770-473-5467
	Fulton	770-393-2849
	Gwinnett	770-963-9288
	Henry	770-957-5705
	Cobb	770-528-2218

EPA	Environmental Education	404-562-8327
	Lakes/Rivers/Streams	404-562-9355
	Wetlands Information	1-800-426-4791
	Wetlands/Oceans/Watersheds	404-562-9355

USGS Water Resources Division	770-409-7700
US Fish and Wildlife Service	404-679-7319
Army Corps of Engineers	678-422-2720
US Geological Survey	404-656-3214

For a complete list of EPD numbers look under “Contacts” at
http://www.gaepd.org/Documents/wpb_phonelist.pdf