

QUALITY ASSURANCE PROJECT PLAN
for
South Carolina Adopt-a-Stream



**Encouraging public awareness and protection
of South Carolina's Streams**

prepared by

*The South Carolina Department of Health and Environmental Control
Bureau of Water and Clemson University Center for Watershed Excellence*

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A2.

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A3. DISTRIBUTION LIST

These individuals and organizations will receive a copy of the approved Quality Assurance Project Plan (QAPP) and any subsequent revisions:

- U.S. EPA Region 4 SC Monitoring Coordinator
- South Carolina Department of Health and Environmental Control
 1. Director, Water Quality Division
 2. Director, Monitoring, Protection, and Assessment Division
 3. Manager, Surface Water Monitoring
- Clemson University
 1. Director, Center for Watershed Excellence
 2. Director, SC Water Resources Center
 3. VP of Research
- South Carolina Adopt-a-Stream Advisory Board Members
- South Carolina Adopt-a-Stream Certified Trainers

The South Carolina Adopt-a-Stream(SC AAS) program’s Quality Assurance Project Plan (QAPP) is available online for download at www.scadoptastream.org.

A4. PROJECT/TASK ORGANIZATION

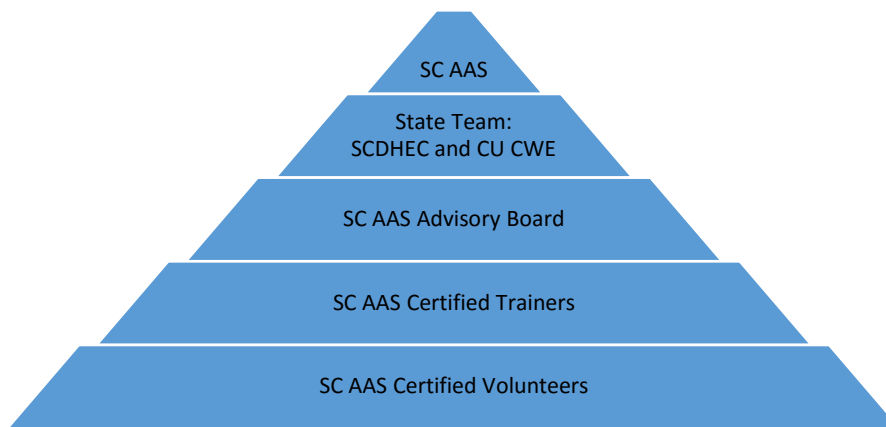
The South Carolina Department of Health and Environmental Control (SCDHEC) is partnering with the Clemson University Center for Watershed Excellence (CU CWE) to implement the stream sampling design of Georgia Adopt-A-Stream (GAAAS) in South Carolina. The GAAAS program, the CU CWE, and SCDHEC, have signed a Memorandum of Understanding in support of this SC effort.

SC AAS will:

- Adapt manuals and Standard Operating Procedures (SOP)
- Develop the training program and resources for SC
- Create a SC database
- Promote the SC AAS program throughout the state

SC AAS is led in a partnership between SCDHEC and the CU CWE, hereafter the SC AAS State Team. We are hosting this great effort to enhance watershed stewardship in SC, with thanks and appreciation to the GAAAS program for their examples and leadership, as well as to the original SC volunteer monitors and trainers. This is a program built for the volunteers and for the improved management and protection of our shared watersheds.

Figure 1. South Carolina Adopt-a-Stream Organizational Chart



The SC AAS State Team is responsible for the day-to-day coordination of the program, including development and consistency of programmatic materials, volunteer monitoring handbook, continued learning resources, data recording and safekeeping, program administration, communication, and program integrity.

The SC AAS State Team will:

- Provide resources and consistent materials about the SC AAS program.
- Provide training materials for volunteer monitoring workshops.
- Identify and target opportunities for expanding the SC AAS program.
- Coordinate a network of trainers from various community settings.
- Provide technical assistance to volunteer monitoring teams.

- Meet the training and continuing education needs through regular contact with volunteers (webinars, listserv, conference), and trainers (annual basin meetings, webinars, listserv, conference).
- Compile data from quality assured volunteer groups for reporting on the program at annual meetings, conferences, and on the website.

Appointed members of the SC AAS Advisory Board are responsible for providing advice on program initiatives and operations, making recommendations, supporting implementation of the annual work plan, promoting the program, and assisting with the identification of funding and support.

A5. PROBLEM DEFINITION/BACKGROUND

Human activities have a significant effect on South Carolina's water quality. Point and nonpoint source pollution contribute to water quality problems. Point sources, or regulated discharges, have been the focus of regulatory oversight for decades. Attention to point source problems has resulted in significant improvement in water quality. Nonpoint sources are now a substantial detriment to achieving designated uses for South Carolina's streams and rivers. SC AAS volunteers can play an important role in tracking and monitoring water quality and sharing information about local water resources with their communities. SC AAS empowers individuals, communities, and watershed groups to increase the amount of information known about a local waterway, collect data in a consistent way, and share it with interested parties. SC AAS focuses on what individuals and communities can do to improve water quality problems from nonpoint sources.

The goals of the SC AAS program are to: (1) increase public awareness of the State's nonpoint source pollution and water quality issues, (2) provide citizens with the tools and training to evaluate and protect their local waterways, (3) encourage partnerships between citizens and their local government to address watershed needs, (4) collect quality baseline water quality data and (5) make observations about the quality of the local waterways. To accomplish these goals, SC AAS encourages individuals, organizations, and communities to monitor and/or improve sections of streams and rivers. Volunteer monitoring occurs on a local level. SC AAS volunteers can provide baseline information about water and streambank conditions to help local communities, educators, and governmental agencies evaluate and correct water quality problems. All of the collected data can be found online, is accessible to the public worldwide, and will be available to download from the SC AAS database. None of the data collected will be used by SCDHEC for regulatory purposes.

Additionally, SC AAS seeks to create a network of watershed stewardship engagement and education through involvement. Beyond trainings and monitoring, the volunteer will be linked to watershed protection activities and groups offering such opportunities. These are anticipated to include shoreline plantings, rain garden installations, stream clean-ups, streambank restoration, and other such offerings made available by partners of the program and the project team.

A6. PROJECT/TASK DESCRIPTION

Volunteer monitors may engage in different levels of involvement. Techniques for physical, chemical, macroinvertebrate, and bacterial monitoring are presented at training workshops held throughout South Carolina by SCAAS certified trainers. Volunteer monitors select sampling sites based on safety, accessibility, and interest.

At the most basic level, volunteer monitors inform their local government of their activities and create partnerships with local schools, businesses, government agencies and/or non-governmental organizations. The volunteers are asked to register their site with the SC AAS State Team, notify their local government, find local partners and develop a “Who to Call” list, which is a list of appropriate authorities for incidents such as fish kills, sediment and erosion problems, or other water quality impairments. The next step is to learn about the monitoring history, water quality conditions, and permitted activities within the watershed around their selected stream by visiting SCDHEC’s S.C. Watershed Atlas at <https://gis.dhec.sc.gov/watersheds/>. Volunteers can then conduct a driving tour and walk the stream to gain first-hand knowledge of factors that affect their stream reach.

Volunteer monitors may also conduct physical, chemical, macroinvertebrate, and/or bacterial monitoring. The Stream Habitat Assessment, Macroinvertebrate, Physical/Chemical, and Bacterial Monitoring instructions are all part of the SC AAS Volunteer Freshwater Monitoring Handbook (Appendix A) which guides volunteers through preparation, sampling methods, analyses, safety, and data entry. Volunteers must attend a workshop led by a certified SC AAS Trainer and must pass a written test as well as demonstrate proper field procedures and identification of specimens in order to be considered certified data collectors under the SC AAS QAPP. Each certification requires a workshop in techniques, procedures, and program organization, with the visual stream survey being a component of each. In addition, when volunteers are monitoring for each of the above parameters, they will make and record observations on weather conditions, stream flow, water clarity, water color, and odor. The data collected by volunteers is submitted to SCAA through the mobile-friendly, on-line database.

Certified volunteer chemical monitors are trained to collect water samples and test five basic core parameters; dissolved oxygen, air temperature, water temperature, pH, and conductivity. Chemical monitoring samples are collected monthly. Details regarding sampling methods and analysis can be found in the SC AAS Volunteer Freshwater Monitoring Handbook (Appendix A).

Macroinvertebrate assessments of streams focus on aquatic communities. Organism diversity is used to assess the ecological condition of a stream. Certified volunteers are trained to determine stream type, identify habitats, collect a sample, and identify the macroinvertebrates that are found in the sample. The stream macroinvertebrate assessment is conducted quarterly. Details on conducting macroinvertebrate surveys can be found in the SC AAS Volunteer Freshwater Monitoring Handbook (Appendix A).

Bacterial monitoring focuses on monitoring *Escherichia coli* (*E. coli*), a subgroup of fecal coliform bacteria. Volunteers are trained to collect, plate, and count bacterial colonies. Bacterial monitoring samples are collected monthly. Details on sample collection and analysis can be found in the SC AAS Volunteer Freshwater Monitoring Handbook (Appendix A).

A7. OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Stream Habitat Assessment

The Stream Habitat Assessment reports any significant changes in the sampling site, which may include changes in profile depth measurement, and stream flow. Along with these measurements, field observations include stream bank conditions, and a visual, biological, and habitat assessment. This Assessment should be performed annually and during full leaf-out conditions.

Precision, Accuracy, and Measurement Range for Chemical and Bacterial Monitoring

The table below illustrates the precision, accuracy, and measurement ranges for the core parameters measured by SC AAS volunteers. The table also features methods used, sensitivity of the test instrument, and calibration requirements.

Table 1. Data Quality Objectives

PARAMETER	METHOD/ RANGE	UNITS	DUPLICATE PRECISION	ACCURACY ^(allowable range comparing monitor value to QA value)	SENSITIVITY	CALIBRATION
Temperature	Thermometer -5.0 - 50.0	Degrees Celsius (°C)	N/A	+/- 1.0 °C	0.5 °C	Ice bath
pH	Color Comparator 3.0 -10.5	Standard pH units (su)	+/- 0.25 su	+/- 0.25 su	0.5 su	Use of current and non- contaminated reagents
Dissolved Oxygen	Micro Winkler Titration	ppm or mg/L	+/- 0.6 ppm or mg/L	+/- 0.1 ppm or mg/L	0.1 ppm or mg/L	Winkler Titration Standard Methods
Conductivity	Meter 0-1999µS/cm	µS/cm	N/A	+/- 1% of Full Scale	10 µS	Standard of 1413µS
<i>E. coli</i>	3M Petrifilm	cfu/100 ml	NA	NA	33cfu/100ml	NA

Chemical Monitoring

To ensure precision in sampling, certified chemical monitoring volunteers must attain at least an 80% on the written test and demonstrate proper sample collection and testing for each parameter. Volunteers are taught to take duplicate samples for dissolved oxygen (DO) and pH. The precision

limit for DO is +/- 0.6 mg/L and +/- 0.25 standard units for pH. If this is not achieved, the volunteer must repeat the tests until they have two samples within the duplicate precision range.

Macroinvertebrate Monitoring

For macroinvertebrate monitoring the goal is to achieve greater than 80% on the written test, at least 90% accuracy in the identification of macroinvertebrate taxa and provide a correct calculation of the water quality rating index using the SC AAS macroinvertebrate monitoring protocols. SC AAS has developed the ‘Macroinvertebrate Field Guide for South Carolina’s Streams’ to help volunteers correctly identify and obtain accurate information for species found in South Carolina. Table 2 provides the quality assurance checklist to be used in certifying macroinvertebrate monitoring volunteers.

Table 2. Macroinvertebrate Monitoring QA/QC Check List

Observed	Task
	Monitor anchored kick seine to bottom and checked the net for gaps
	Monitor rubbed all rocks only within the 2x2 area
	Monitor rubbed all rocks directly in front of the net
	Monitor knew the appropriate number of samples to take from each habitat in the rocky bottom and muddy bottom methods
	Monitor could identify and properly sample from vegetative margin
	Monitor demonstrated proper use of the d-frame net
	Monitor could identify and properly sample from substrate
	Monitor could identify and properly sample from organic matter and leaf packs
	Monitor showed adequate macroinvertebrate identification skills
	Monitor correctly filled out Water Quality Index value sheet

Bacteria Monitoring

For bacteria monitoring, volunteers must achieve greater than 80% on the written exam and must correctly identify and count, with 90% precision, *E. coli* colonies using plate identification sheets. Volunteers are instructed to collect one water sample and to prepare one control (blank) for each sampling event. Three plates are prepared and incubated for each sample site. One control is prepared and incubated for 10% of the samples (1 blank per 10 sites). The water samples and controls are plated on 3M Petrifilm Plates™ and incubated for 24 hours +/- 1 hour at 35° C +/- 1° C. At the end of the incubation period, volunteers count and record the bacteria results as well as the maximum and minimum temperatures on their data sheet.

A8. SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

SC AAS offers QA/QC Volunteer and Train the Trainer workshops in physical/chemical, macroinvertebrate, and bacteria monitoring. The following are the requirements for certifying trainers and volunteers for physical/chemical, macroinvertebrate, and bacteria monitoring.

Physical/Chemical QA/QC Certification

The physical/chemical monitoring workshop highlights each of the core parameters and volunteers learn why these parameters are important to aquatic life, the significance of different levels, and how these levels can be affected. Trainers will lead the volunteers through field techniques and check techniques in collecting the sample and using the kits properly (detailed in the SC AAS Volunteer Freshwater Monitoring Handbook, Appendix A). Volunteer monitors will be trained to take duplicate samples for DO and pH, and to evaluate and check measurements, equipment, and reagents. Volunteers will be certified when they achieve results within the acceptable duplicate precision range of those obtained by the certified Trainers (refer to Table 1, Data Quality Objectives) and achieve 80% accuracy on a written test. To maintain QA/QC status volunteers shall replace reagents when they expire and must be recertified annually. The recertification workshop includes a field based test in addition to a written test. Volunteers are encouraged to sample monthly.

Macroinvertebrate QA/QC Certification

In the macroinvertebrate monitoring workshop, volunteers will learn to identify macroinvertebrates and will demonstrate the ability to collect a sample from a stream, which is detailed in the SCAAS Volunteer Monitoring Handbook (Appendix A). The in-class identification will include identifying a collection of macroinvertebrates. Sample collection methods and habitat types are reviewed, and the rocky bottom and sandy/muddy bottom methods for collection sampling are demonstrated. The workshop participants will process the collection, complete the SC AAS data form, and tally the macroinvertebrate water quality index value to assign the rating for the health of the stream.

Volunteers will be tested on their ability to identify macroinvertebrates and interpret the results. The trainer may use reference collections or live specimens to assess the volunteer's knowledge of macroinvertebrates. Those certified will achieve 90% accuracy in identifying at least twenty macroinvertebrates, correctly calculating the macroinvertebrate water quality index value and achieve 80% accuracy on a written test. Volunteers are encouraged to sample quarterly and must be recertified annually to maintain certification. The recertification workshop includes a field-based test in addition to a written test.

Bacteria QA/QC Certification

The SC AAS methods were designed to allow volunteers to quickly assess health risks due to bacterial contamination of surface waters. This workshop focuses on sample collection, plating samples onto 3M Petrifilm™ plates to culture *E. coli*, and counting the *E. coli* colonies. Bacterial protocols require collecting one (1) field blank and one (1) stream sample and preparing a control plate and three (3) sample plates from each site to ensure accurate results (detailed in the SC AAS Volunteer Freshwater Monitoring Handbook, Appendix A).

To become certified in bacterial monitoring, volunteers must achieve 80% or better on the written test, achieve 90% accuracy in colony counting, and demonstrate the ability to collect, plate, and read the 3M Petrifilm™ plates. To maintain certification, volunteers are encouraged

to sample monthly and must attend a recertification workshop annually. The recertification workshop includes a field based test in addition to a written test.

Train the Trainer Certification

The ‘Train the Trainer’ workshop encompasses the goals of the program, procedures for quality assurance, how to conduct a workshop, and an understanding of South Carolina’s regional variations in water quality data. After completing the trainer workshop, a new trainer conducts at least two co-training workshops with another experienced trainer, preferably in one year, unless scheduling does not provide that availability. These co-trainings count toward the two workshops that a trainer commits to do within the year. Following completion of these activities, trainers will then be eligible to certify volunteers, review submitted data and will have the responsibility of assessing volunteer proficiency and checking equipment. Trainers are recertified and tested annually by the SC AAS State Team.

A9. DOCUMENTATION AND RECORDS

Field data will be recorded on data sheets (Appendix D), or directly into the mobile-friendly database. Information from the data sheets will be entered into the online database. The SC AAS database includes error alerts when a value has been entered outside of normal range. In these cases, the database will prompt the enterer to re-enter a result within range or confirm that this is the actual result. Additionally, the SC AAS database will send automated alerts of certain stream conditions to local authorities and the SC AAS State Team. As the final quality control officers, SC AAS reserves the right to accept or disregard submitted data. Volunteers can load up to three photos of each site they monitor into the database.

B1. SAMPLING PROCESS DESIGN

Site selection for sampling includes determining safe access, identifying potential hazards, gaining legal access, and establishing a site-specific safety plan with the monitoring group. A detailed safety and health checklist is present in the SC AAS Volunteer Freshwater Monitoring Handbook (Appendix A) as well as in Appendix F. SC AAS volunteers can choose their own sampling site, or they can work with their local or state government to determine an appropriate site.

Volunteers will conduct a Stream Habitat Assessment of the selected site once per year in accordance with procedures described in the SC AAS Volunteer Freshwater Monitoring <https://gis.dhec.sc.gov/watersheds/>. The yearly watershed survey and map assessment identifies land use activities and tracks changes within the watershed.

Visual stream and waterway characteristics are collected each time the volunteer conducts sampling. The more comprehensive Stream Habitat Assessment reports any significant changes in the sampling site, which may include changes in profile, depth measurement, and stream flow.

This Assessment should be performed annually and during full leaf-out conditions. Along with these measurements, field observations include stream bank conditions, and a visual, biological, and habitat assessment. Complete Stream Habitat Assessment procedures are included with the each of the detailed monitoring instructions in the SC AAS Volunteer Freshwater Monitoring Handbook. (Appendix A).

Chemical data will be collected monthly. The five basic water quality parameters include air and water temperature, pH, dissolved oxygen, and conductivity. The basic parameters form a "common denominator" of measurements among all volunteer monitors statewide for establishing baseline conditions and water quality trends. Along with these basic parameters, the field observations noted will include: weather conditions, flow status, water clarity, color and odor, and comments about general appearance.(Detailed monitoring techniques can be found in the SC AAS Volunteer Freshwater Monitoring Handbook, Appendix A.)

Macroinvertebrate data will be collected quarterly. The macroinvertebrate assessment data consists of the macroinvertebrate community diversity. Volunteers will collect a macroinvertebrate sample based on the methods detailed in the SC AAS Volunteer Freshwater Monitoring Handbook, (Appendix A), to determine the water quality index score and water quality rating. These ratings are based on the diversity of the macroinvertebrate community.

Bacteria data will be collected monthly. Bacteria monitoring is used to quickly assess health risks due to *E. coli* bacteria contamination of surface waters. Volunteers collect a water sample and prepare one control and three samples for each monitoring site, plated using 3M Petrifilmpates and incubated for 24 hours. A complete listing of procedures for bacterial monitoring can be found in the SC AAS Volunteer Freshwater Monitoring Handbook(Appendix A).

All monitoring forms include visual field observations such as weather conditions, flow status, water clarity, color and odor, and comments about general appearance. Data forms can be found in Appendix D.

B2. SAMPLING METHODS REQUIREMENTS

Sample collection and measurement procedures are detailed in Appendix E. The following table describes a portion of this information.

Table 3. Sampling Methods Requirements

Matrix	Parameter	Sampling Equipment	Sample Holding Container	Sample Preserv. Method	Maximum Holding Time
Water Air	Temperature	LaMotte Thermometer (Code 1066)	None	NA	NA

Water	pH	LaMotte Color Comparator	Glass sample tube	None	Immediately
Water	Dissolved Oxygen	LaMotte DO Kit	Sampling Bottle	None	Immediately
Water	Conductivity	Chek-Mite 30 Oakton ECTester Oakton ECTester 11	None	NA	NA
Substrate	Macro-invertebrates	D-frame net	Sorting pans	NA	Immediately
Substrate	Macro-invertebrates	Kick seine	Sorting pans	NA	Immediately
Water	Bacteria	3M Petrifilm™	Whirlpak Bags	NA	optimum: 6 hours, max: 24 hours

B3. SAMPLE HANDLING AND CUSTODY REQUIREMENTS

For a majority of the time water quality parameters will be measured in the field by a certified volunteer monitor using certified test kits (detailed in the SC AAS Volunteer Freshwater Monitoring Handbook, Appendix A). If desired, and for a fee, volunteers can send samples to a state certified lab in South Carolina. These labs provide the volunteer with sample handling and custody requirements when they call. For a list of state certified labs, volunteers can email labcerthelp@dhec.sc.gov, or call (803) 896-0970.

B4. ANALYTICAL METHODS REQUIREMENTS

SC AAS Chemical monitoring protocols outlined in the SC AAS Volunteer Freshwater Monitoring Handbook (Appendix A) are based on the standard methods in the EPA Document, *Volunteer Stream Monitoring: A Methods Manual*. The SC AAS Stream Habitat Assessment is a combination of traits from the GAAAS Volunteer Monitoring Handbook, the USDA Stream Visual Assessment Protocol, and the Revised SVAP by Rutgers Cooperative Extension Water Resources Program. The SC AAS macroinvertebrate monitoring program is based on protocols developed by Izaak Walton League's "Save our Streams" program and modified for South Carolina with assistance by the GA EPD Ambient Monitoring Program and SCDHEC Bureau of Water Aquatic Biology Section. The macroinvertebrate monitoring protocols are outlined in the SC AAS Volunteer Freshwater Monitoring Handbook (Appendix A). Bacteria sample collection methods are based on Citizens Monitoring Bacteria: A training manual for monitoring *E. coli*, and are outlined in the SC AAS Volunteer Freshwater Monitoring Handbook (Appendix A).

B5. QUALITY CONTROL REQUIREMENTS

SC AAS's Quality Assurance/Quality Control workshops are designed to ensure that volunteers are taught the quality control requirements outlined in this QAPP. These quality control requirements can also be found in the SC AAS Volunteer Freshwater Monitoring Handbook (Appendix A). Specifically, the workshop includes the following:

Chemical QA/QC

- Duplicate measurements for dissolved oxygen and pH will be performed during volunteer monitoring. If the results disagree by more than 0.6 mg/L for dissolved oxygen and more than 0.25 standard units for pH, a third sample should be analyzed. This is repeated until the volunteer obtains two readings within the acceptable range.
- Volunteers shall achieve 80% or better on the written exam.
- Chemical reagents must be replaced when they expire or become contaminated. Volunteers will be asked to record expiration dates for each reagent on their data forms.

Macroinvertebrate QA/QC

- Volunteers shall identify a sample of twenty macroinvertebrates with 90% accuracy during the workshop and achieve 80% or better on the written exam.

Bacterial QA/QC

- The bacterial monitoring protocol requires the collection of a sample of stream water and one blank. Triplicate plates will be incubated for each site plus one blank for 10% of the sites (1 blank per 10 sites).
- Volunteers shall achieve 80% or better on the written exam and show their ability to correctly count, with 90% accuracy, the *E.coli* colonies on sample plates on the written test.

Overall QA/QC

- The volunteer monitors will be taught how to review their own data before sending it to the SC AAS Trainer or entering it online. The importance of carefully completing all sections of the data sheets, including the monitor's name, date, time, time spent monitoring, and sampling site locations, will be stressed.
- The data proofing system will be used as established in Sections B10 and C1.
- Volunteers are certified annually.

B6. INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE REQUIREMENTS

Because some volunteer monitoring groups supply their own equipment, maintenance is extremely important. Certified volunteer monitors will inspect chemical monitoring kits and reagents frequently. Proper storage of chemical test kits includes storage in a cool, dark, dry

place at 10-30⁰C, with no exposure to heat, light and humidity. Proper care of macroinvertebrate monitoring equipment will be stressed during workshops.

Reagents are to be replaced prior to the expiration date located on the side of the bottle. They are also to be replaced if contaminated. At the time of recertification, it is recommended that the certified trainer inspect the test kits and reagents to ensure compliance. Volunteers are required to record expiration dates for each reagent on their data forms.

The 3M Petrifilm™ plates used for bacterial monitoring shall be stored in a freezer and thawed before use. Opened pouches will be placed in a sealed bag and stored in the freezer.

B7. INSTRUMENT CALIBRATION AND FREQUENCY

SC AAS staff, trainers and volunteers shall replace the reagents in test kits according to the manufacturer’s expiration date of each reagent. SC AAS Trainers will have at least one complete and calibrated test kit to use in workshops. Volunteer kits will be examined to ensure completeness, condition of equipment and reagent supply and dates. If a test kit is found to be out of compliance, data from that test kit will not be incorporated into the SC AAS database until the reagents and/or faulty equipment are replaced.

Table 4. Adopt-a-Stream Calibration Methods

Parameter	Calibration Method	Frequency
Temperature	Ice Bath	Annually
Conductivity	Chek-Mite 30 – 84 μS/cm ECTester – 100 μS/cm ECTester 11 – 1413 μS/cm	Prior to each sampling event

B8. INSPECTION/ACCEPTANCE REQUIREMENTS

The equipment for monitoring activities, including visual, chemical, macroinvertebrate, and bacterial are described in the SC AAS Volunteer Freshwater Monitoring Handbook (Appendix A) and on the SC AAS website. Kits containing equipment for conducting SC AAS monitoring are currently assembled by the USC Upstate Watershed Ecology Center. Kits are loaned to volunteers through SC AAS Trainers. Broken or defective equipment or supplies are returned to the manufacturer. Volunteers shall list expired reagents on their data forms and equipment, and replace as necessary.

B9. DATA ACQUISITION REQUIREMENTS

The types of data and information collected as well as the format for our monitoring programs are found in the SC AAS Volunteer Freshwater Monitoring Handbook (Appendix A). The

Handbook describes assessment techniques and provides examples of data collection and monitoring equipment. Volunteers using advanced water-testing instruments must follow the approved EPA standard operating procedures for the instrument. The State reserves the right to accept or disregard data as final quality control officers.

B10. DATA MANAGEMENT

SC AAS manages and maintains the online volunteer water quality monitoring database housed at Clemson University and the CU CWE and accessed through the website scadoptastream.org. This database, created in 2017, houses all QA/QC volunteer water quality monitoring data collected in South Carolina and affiliated with SC AAS. In addition, the database provides program documentation and volunteer/group participation information and certification status.

Volunteers enter their data online using a unique login and password for their SC AAS account. Our program accepts visual, chemical, macroinvertebrate, and bacterial data from volunteers that are currently QA/QC certified. Checkpoints to ensure the data are being managed according to the QAPP include automatically requiring volunteers to confirm data that does not meet our duplicate precision rule as well as data that falls outside of the normal range set for each parameter. Volunteers call their SC AAS Trainer to discuss any data that fall outside the normal range. In addition, the SC AAS database helps to administer the integrity of the program through tracking of sampling events, certification calendars, recertification needs, and coordination of watershed volunteers.

The SC AAS database is hosted on a set of load-balanced Oracle Linux 6 servers running PHP 7. Data is stored on a set of MySQL 5.19 servers. All data are backed up nightly.

C1. ASSESSMENT AND RESPONSE ACTIONS

Precision and accuracy levels of the Trainer's test kits will be obtained as detailed in Table 1 and Sections A8 and B7. Comparing the volunteer's results to values taken from the trainer's calibrated test kit during workshops will assess the precision and accuracy levels of certified volunteer monitors.

The SC AAS program accepts visual, chemical, macroinvertebrate, and bacterial data from volunteers who are currently QA/QC certified. Abnormal readings may be questioned, but not disregarded, because they may be indicative of a pollution problem. The SC AAS database includes error alerts when a value has been entered outside of normal range. In these cases the database will prompt the enterer to re-enter a result within range or confirm that this is the actual result. Additionally, the SC AAS database will send automated alerts of certain stream conditions to local authorities and the SC AAS State Team. Consultation between the SC AAS State Team, the certified Trainer, and/or the volunteer monitor regarding questionable data is advised. These topics will be addressed in annual river basin Trainer meetings and more frequently on an as-needed basis.

C2. REPORTS

The reporting capabilities of the database are numerous. These reports are available to all trainers and volunteers who are QA/QC certified and have created an AAS database account. Each SC AAS group has an individual page in the database, which displays the adopted site(s) geographically on a map and lists the group leader and volunteers. Once the data is in the database, it is available in a number of formats, such as graphically by parameter, geographically on a map, and through a downloadable excel file.

SC AAS Trainers have access to more database capabilities and can create reports to determine the number of active sites and volunteers, the number of volunteer hours for a specific time period, and can compile a contact list for all of their volunteers. These data are often used in annual reports and to support grant applications.

SC AAS completes annual reports that are posted on the website, included in the newsletter, and presented at the biennial conference.

D1. DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

Performance audits will be conducted at the training workshops and will consist of the QA/QC activities described in Section A8. Each quality assured volunteer is required to attend an annual recertification workshop. Trainers will attend yearly river basin meetings to evaluate QA/QC field procedures and provide program updates.

D2. VALIDATION AND VERIFICATION METHODS

Comparing the monitor's results to values taken from the trainer's calibrated test kit during workshops will assess the precision and accuracy levels of certified volunteer monitors.

The data will be checked as follows: the data sheets will first be reviewed by a certified volunteer monitor to check for errors or problems such as missing data, dates, times, incorrect units, improper decimal placement or obvious outliers. The online data entry has embedded data sets for the parameter's acceptable ranges, outliers will be flagged and the volunteer will contact their trainer to discuss. Trainers will discuss with the SC AAS State Team any discrepancies in data and determine if the data are acceptable.

SC AAS Trainers will be aware of "typical" water quality ranges of the different physiographic regions in the State. Errors may be resolved by contacting the SC AAS Trainer or SC AAS State Team by phone or e-mail. If extreme readings are found that are not "typical" for the region or cannot be obviously explained, the SC AAS Trainer and/or State Team may contact local or state officials for further evaluation and consultation.

D3. RECONCILIATION OF DATA TO PROJECT OBJECTIVES

Data that does not meet quality objectives outlined in Section A7 “Objectives and Criteria for Measurement Data” of this document will be re-sampled. If the quality objectives are not met due to equipment failure (such as outdated or damaged equipment), the equipment shall be updated. If the quality objectives are not met due to volunteer error, the volunteer will be retrained before sampling reoccurs.

REFERENCES

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