WATER CHEMISTRY QUALITY ASSURANCE PLAN

(Revision of the Quality Assurance Plan Approved June, 1994)

For

Alabama Water Watch

A Program dedicated to developing
Citizen Volunteer Monitoring of
Alabama's Lakes, Streams and Coasts

Funded in part by a grant from the U.S. EPA, Region 4
Clean Water Act, Section 319
And the Alabama Department of Environmental Management

Prepared for
U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 4

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APPROVALS

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4 PROJECT/TASK ORGANIZATION

The **Alabama Water Watch (AWW)** program is funded in part by a grant from the U.S. Environmental Protection Agency (EPA), Region 4 and the Alabama Department of Environmental Management (ADEM). The Department of Fisheries and Allied Aquacultures at Auburn University (AU) is contracted by ADEM to implement, coordinate and provide technical support for the program. A flow chart of the project organization and responsibility charges is presented in Figure 1.

The Program Manager at AU is responsible for overall management (training and technical backstopping of citizen volunteers) and supervision of the technical support staff of the AWW Program. The AWW Program staff develops the AWW Manuals, reports and all information presented at the workshops. The Data Quality Coordinators are responsible for carrying out the quality control/quality assurance exercises and data management as detailed in the QAPP. Qualifications of key program participants (full-time and part-time) are presented below.

Alabama Water Watch Personnel at Auburn University

William Deutsch (Ph.D., Aquatic Ecology and Fisheries)
Program Manager (October 1992 - present)
He has been on the faculty of the AU Department of Fisheries and Allied Aquacultures since 1988. In addition to AWW responsibilities, he works through the International Center for Aquaculture and Aquatic Environments conducting environmental studies and training with international projects.

Wendi Hartup (B.S., Marine Biology)
Special Projects Coordinator (September 1997 - present)
Her work with AWW previously involved GIS mapping, coordination of monitor training, and managing the AWW Listserve. Presently, her work involves training and program document design and development.

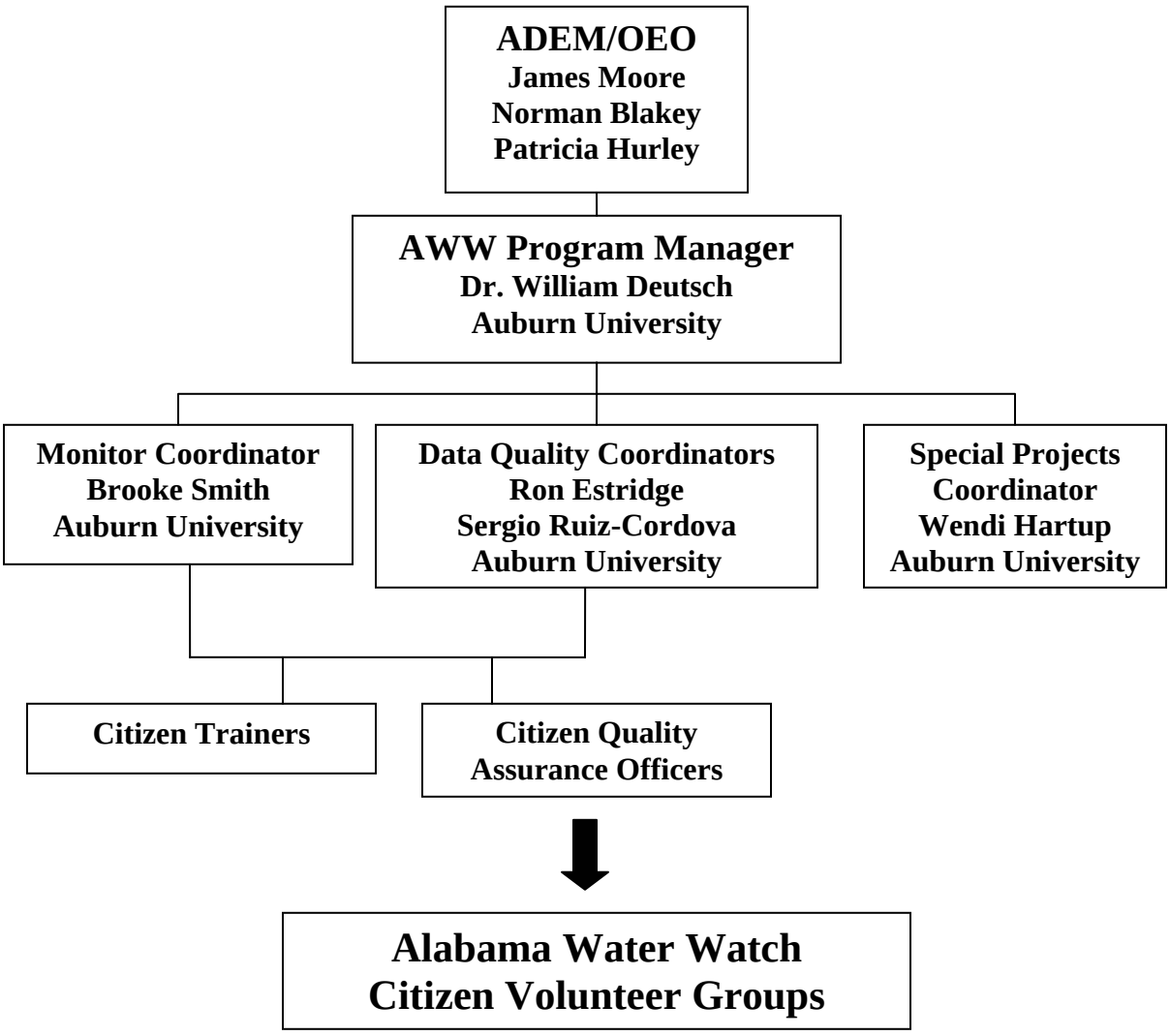
Ronald Estridge (M.S., Zoology)
Data Quality Coordinator (June 1998- present)
His work with AWW primarily involves data quality assurance, processing, and maintaining the statewide database.

Brooke Smith (B.S., International Business and Management Information Systems)
Monitor Coordinator (April 2002 - present)
Her work with the AWW program involves desktop publishing, coordination of monitor training, maintenance of reagent and monitor kit inventories, distribution of reagents and kit supplies, and AWW Listserve and website administration.

Sergio Ruiz-Cordova (B.S., Biology)
Data Quality Coordinator (April 2001- present)
His work with AWW primarily involves programming and maintaining the statewide database. He is also responsible for creating data reports and responding to data requests.

Eric Reutebuch (M.S., Fisheries)
Technical Advisor (January 1998 - present)
His work with AWW involves assisting with site mapping, data analyses, graphing and data interpretation sessions for citizen groups.

Figure 1. Alabama Water Watch Program Organizational Chart



5 PROBLEM DEFINITION/ BACKGROUND

Alabama Water Watch is a network of volunteers from various backgrounds who are committed to studying and protecting the lakes and streams of the State as well as in shared watersheds of neighboring states. AWW volunteers monitor for several parameters. Volunteer monitoring provides baseline information about water conditions to help evaluate and correct water quality problems. Becoming a certified water quality monitor is something people can do to protect and restore aquatic resources.

Monitors regularly submit their data to the program office at Auburn University, either by mail or via the Internet. The process of data submission involves steps to be taken by the monitors first. The Data Quality Coordinator receives the data and carefully QA's them before they are entered into the AWW database. Our program history indicates that the strongest vested interest in quality data lies with the monitors. As new data are submitted, monitors are able to see real-time graphs that include data from the last twelve months. These graphs, along with site history graphs, enable monitors to view trends quickly, and to use these data to take action if needed. The mainstreaming of QA'd citizen data to achieve maximum impact on policy and decision makers is a major effort of AWW. Much of the work in designing the new database has gone toward that end. AWW citizen groups are using the data in a variety of ways to make positive things happen in their area.

AWW citizen data are being used in Clean Water Partnership activities and Total Maximum Daily Load development, as well as for other professional uses. During 2002, eight requests were made for data by agencies involved in CWP activities and developing TMDLs for waterbodies in different regions of the State. Twelve such requests were made in 2003. One local government agency requested data for use in developing a watershed management plan. AWW is seeing an expanding use of the citizen data. See Appendix A for examples of requests for AWW citizen data.

6 PROJECT/TASK DESCRIPTION

AWW water chemistry monitors perform their tests for up to nine parameters – **water** and **air temperature**, **pH**, **dissolved oxygen**, **total alkalinity**, **total hardness**, **turbidity, salinity** and **water clarity**. Each parameter measured is considered to be critical to the overall effort of establishing trend data about the monitored waterbodies. The monitors also record information about weather, water level, and tide for tidally influenced streams. Comments about color and odor are included by many monitors.

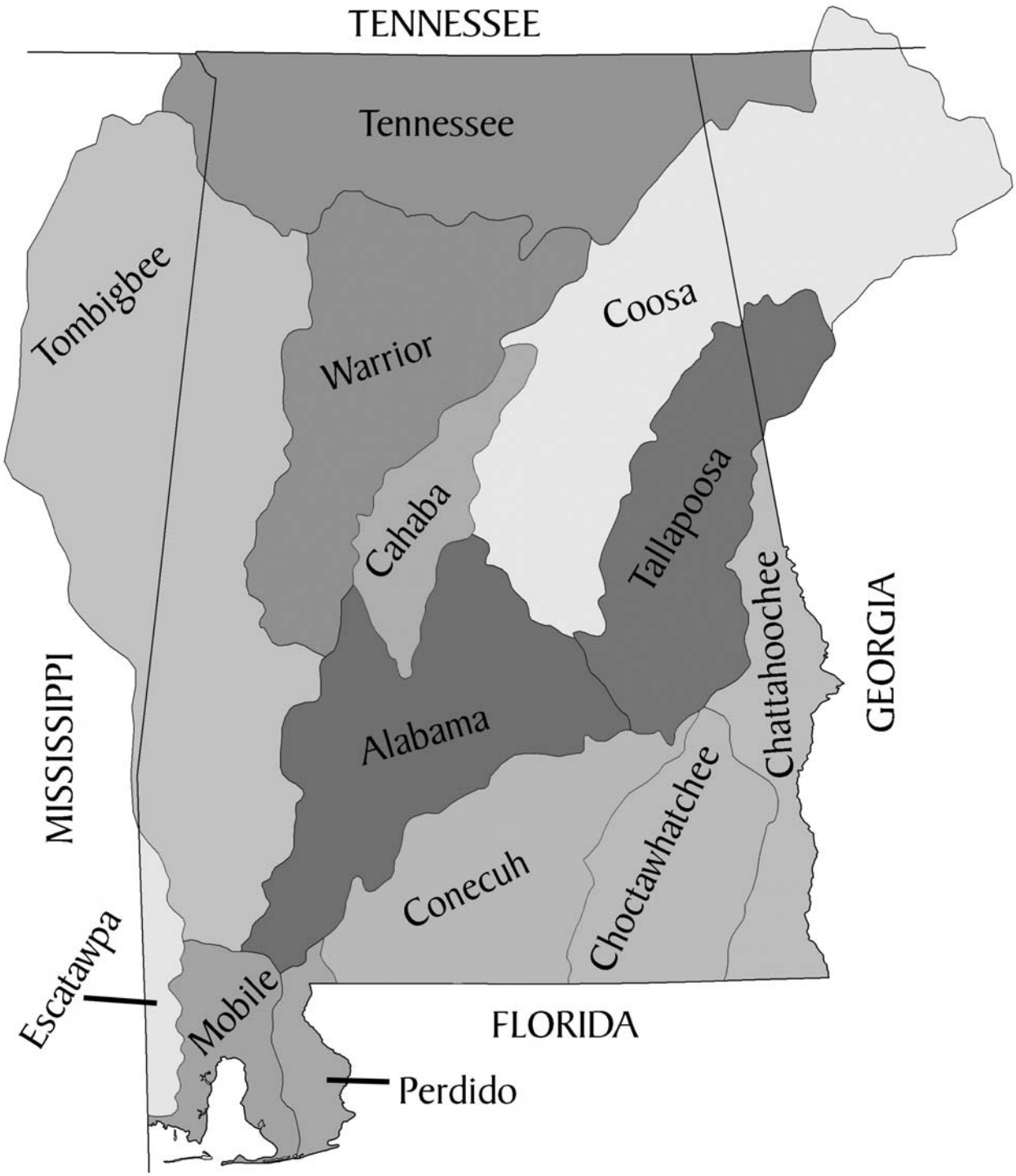
Monitoring is done by volunteers in streams and reservoirs in the major watersheds identified in Figure 2. Typically, monitoring is done on a monthly basis throughout the year, but some groups monitor more or less frequently.

Major task categories are listed as follows, and are ongoing:

- Volunteer recruitment, training and retraining
- Monthly monitoring by citizen volunteers
- Data processing and evaluation

Evaluation of data submitted by monitors is done by comparison of the data to established standards including data from the Alabama Department of Environmental Management (ADEM), and from the Rivers and Reservoirs Laboratory in the Fisheries Department at Auburn University. All data are entered into the database, and monitors are able to view trends at their sites from the database on an immediate basis. The AWW Program staff meets with groups upon request during the year for analysis and interpretation of their data.

Figure 2. Major Watersheds of Alabama



7 Data Quality Objectives for Measurement Data

Volunteers can collect data that are credible, reliable and usable. Water chemistry data are accepted only from monitors who receive training and certification from AWW Certified Trainers. However, in order to maintain interest and participation in a large and diverse, statewide volunteer program, accuracy and precision levels must not be too stringent or intimidating. The Alabama Water Watch Program deals with hundreds of volunteers from about 70 groups, with varying levels of education, scientific background and expertise. Table 1 illustrates the **precision**, **accuracy**, and **measurement range** for the parameters measured by AWW citizen monitors.

Table 1. Precision, Accuracy and Measurement Range (MR) for AWW Measured Parameters

MATRIX	PARAMETER	UNITS	PRECISION	ACCURACY	MR
Water/Air	Temperature	°C	80%	+/- 1.0 °C	0 - 100
Water	pH	SIU	80%	+/- 1 unit	3.5 - 10
Water	Dissolved oxygen	ppm	80%	+/- 2.0 mg/L	0 - 20
Water	Total alkalinity	mg/L	80%	+/- 10 mg/L	0 - ↑
Water	Total hardness	mg/L	80%	+/- 20 mg/L	0 - ↑
Water	Turbidity	JTU	80%	+/- 10 JTU	0 - 200
Water	Water clarity	m	80%	+/- .5 m	0 - ↑
Water	Salinity	ppt	80%	+/- . 005	0 - 47.4

REPRESENTATIVENESS

AWW citizen monitors sample waterbodies of all sizes throughout the state. Some groups are large enough to organize their sampling in such a manner to provide more representative data for their waterbody or watershed, while others are limited by their numbers and are more focused on one or two sites. Each data set from the approximately 450 active sites represents a unique record that is added to the database, and becomes part of the trend for the site. Citizen monitors are given instruction on site selection during their initial training that points to the need for sampling above and below a known pollution source. The watershed approach is used in training sessions to help give monitors an understanding of how pollutants in one part of the watershed may affect the downstream portion of the basin.

COMPARABILITY
Standard units are used by citizen monitors in reporting their data. The data are frequently compared to similar data from the Alabama Department of Environmental Management and laboratories in the Fisheries Department at Auburn University. The comparisons are normally quite favorable.

COMPLETENESS
No standard is set for the determining the completeness of the data. Each monitoring group decides the level of activity for their group. All data submitted to AWW are quality assured and entered into the database for analysis, summary, and dissemination.

8 TRAINING REQUIREMENTS/CERTIFICATION

Alabama Water Watch Citizen Volunteers initially attend a six-hour Alabama Water Watch workshop in which they are trained and certified to use water quality test kits to perform specified chemical measurements of water. They are trained in principles of water quality monitoring, proper data collection techniques and data reporting by Water Watch Trainers. Each trainee is given a copy of the AWW Water Chemistry Monitoring Manual, and instructed how to use it (See Appendix B). After completing the six-hour workshop, the volunteer monitors are given a certification card.

AWW Citizen Trainers, who conduct a majority of the training workshops, are carefully selected and trained by the AWW program staff. Potential trainers must have monitored for at least one year before being invited to the Training of Trainers (TOT) Workshops in chemistry or QA Officer. Each workshop is carefully structured to demonstrate and explain the philosophy of the AWW Program and the effort expected of the trainers. Emphasis is placed on assuring the quality of the data collected by the monitors.

Training of Trainer workshops and Trainer Refresher workshops are generally held every one or two years. Many monitoring groups desire to have their own Chemical Monitoring Trainer as well as a QA Officer.

9 DOCUMENTATION AND RECORDS

This project involves the collection of water quality data using the parameters described previously. These data may be submitted to AWW in two ways:

1) The data may be recorded on data forms as shown in Appendix C. These forms provide two carbonless copies: the original, white data sheet is mailed to the Alabama Water Watch Office at Auburn University where it is retained on file; the yellow copy is kept by the monitor's group for their records; and the pink copy is retained by the monitor. The data are kept in three places for security and to facilitate resolution of problems/questions that may arise.

2) The data may be submitted to AWW online via the AWW website. The data entry form used for web entry is almost identical to the hardcopy form (See Appendix C). Hard copies of the web-entered data are made, and kept in the AWW office along with the mail submitted forms.

Final QA'd data are entered under the supervision of the Data Quality Coordinator, maintained on the AWW database, and regularly archived on the Auburn University mainframe computer.

10 SAMPLING PROCESS DESIGN

Alabama Water Watch monitors typically sample their sites monthly throughout the year. Some groups monitor more frequently, e.g. every two weeks. The monitors measure the parameters listed earlier.

SITE SELECTION CRITERIA
Several factors are used for site selection, including:

1. Safety—This is discussed carefully during certification workshops to encourage monitors to let this be a primary concern in site selection.

2. Accessibility—Monitors are instructed to be aware of being legally permitted to access sites, as well as being concerned about ease of getting to a site. Sites must be changed occasionally because property owners no longer allow access, and because shorelines or creek banks are altered by flowing water in such a way that monitors can no longer access a site.

3. Monitor group site preferences—Many times monitors prefer to monitor specific sites because of special interests, or the group may choose sites as an overall plan for a given waterbody.

4. 303(d) listing—Monitors are encouraged to choose sites on the 303(d) List of Impaired Streams in an effort to assist the Alabama Department of Environmental Management in gathering data for these sites.

5. Presence of known water quality degrading activity—Some monitors begin their monitoring for this reason and they choose sites that will provide data about this type of activity.

6. Strategic choices—Monitors may choose sites that are designated by their group as important for providing representative data for a waterbody. For example, lake groups may choose sites in open water, embayments, and in creeks leading into the lake. Stream monitors are urged to sample on the upstream side of bridge crossings to avoid the effects of materials that may have been thrown into the water from the bridge.

Each site is identified with a unique eight-digit code. The first two represent a major watershed in the state. The next three numbers identify the group, and the last three identify a specific site of the group (see example).

Watershed	Group	Site
07	015	001

All information queries from the AWW database are based on the unique site codes. Monitors are required to provide a map or adequate location description for AWW site code assignment and for the establishment of a georeference (latitude/longitude) of the site, if not provided by the monitor. The site code is assigned by the Data Quality Coordinator after a site description and at least one data record are received.

Monitors are instructed to try to sample their sites between 10 a.m. and 2 p.m. at approximately the same time each month, to standardize measurements. An interval of at least two weeks should occur between monthly samples. More than 90% of all currently active sites (active site is one from which at least one data record has been received in the previous 12 months) have sufficient water depth for year-round monitoring. If a stream is dry or pooled, the report entry is recorded as "Dry," and this condition is indicated on graphs.

11 SAMPLING METHODS REQUIREMENTS

The water quality parameters measured are **air** and **water temperature**, **pH**, **dissolved oxygen**, **total alkalinity**, **total hardness**, and **turbidity**. In lakes and reservoirs, the turbidity measurement is usually not used, but **water clarity** is measured using a Secchi disk. Coastal groups also measure **salinity,** using a hydrometer. If salinity is detected, a measurement of hardness is usually not taken.

Along with these basic parameters, the field observations noted include site location, time, weather conditions, stream/lake condition (above or below normal levels), and stream appearance (e.g. odors, foam, debris, erosion, dead aquatic organisms). Although these observations do not undergo QA/QC, they are carefully checked and recorded because they may be important.

Monitoring kits specifically designed for the AWW Program and supplied by the LaMotte Company are used to measure the parameters listed. Specific instructions for each measurement are shown in the AWW Water Chemistry Monitoring Manual (Attachment 1). Some monitors are using remote samplers to sample sites that are difficult to access directly (e.g. from bridges, high docks, pontoon boats, etc.). These samplers custom-made for AWW monitors. Monitors rinse the glassware in their kits with sample water at their sites as they complete their measurements. They later wash the glassware with tap water. A brush is included in the kits to clean the turbidity tubes.

The Water Chemistry Monitoring Manual was recently revised to include many recommendations/protocols in addition to the LaMotte instructions on the use of their kits.

12 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

"Chain-of-custody" procedures do not apply to this program because volunteers measure water quality parameters in the field and no samples are retained or analyzed in a laboratory.

13 Analytical Methods Requirements

All water quality parameters are measured in the field by certified monitors using certified test kits designed specifically for the Alabama Water Watch Program. The kits are illustrated in the AWW Water Chemistry Monitoring Manual on page 18. Secchi disks are used to determine water clarity by some groups, and hydrometers are used by coastal groups to determine salinity. No samples are collected for laboratory analysis. Field measurements of the parameters are based on protocols established for the AWW Program. The AWW Water Chemistry Monitoring Manual contains details for all protocols used by monitors (Attachment 1).

14 Quality Control Requirements

Early in the of the AWW Program, the reliability of the LaMotte monitoring kits and the techniques taught on the use of these kit was established by comparisons with Standard Methods in certified labs at Auburn University. Quality control procedures were submitted to, and approved by EPA in 1994. The same test kits and protocols have been maintained since the beginning of the program. The AWW Program makes every effort to ensure data quality by:

1) Carefully checking techniques of monitors in recertification workshops—new monitors after the first year, then every two years if the monitor remains active.

2) Maintaining freshness of reagents in monitoring kits.

3) Introducing new techniques/materials as they are made available. For example, a new titrator was developed by LaMotte for analysis of dissolved oxygen. The old titrator occasionally malfunctioned in the field, so it was replaced. The protocols for dissolved oxygen analysis remain unchanged.

15 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Preventive maintenance is constantly done in an effort to prevent the use of faulty equipment or inadequate reagents. Special emphasis is given during training workshops on the regular inspection of the kits in order to keep them in good working order. A supply of monitoring kit replacement parts, glassware, titrators, etc., is maintained at the AWW office, and these items are sent to monitors upon request. Thermometers are checked by monitors in ice for accuracy, and they are regularly checked for bubbles in the fluid. Hydrometers are checked in distilled water at recertifications to ensure their accuracy.

Reagents are replenished before the expiration date. On each reagent container the manufacture date is shown as a part of the lot number. Using this, and information about the shelf life of each reagent, monitors are able to determine the expiration date of the reagents. Stick-on labels to be attached inside monitoring kits have been supplied to monitors to aid them in this replacement process (See Appendix D). At the request of the AWW Program, the LaMotte Company is taking steps to print the expiration dates on each reagent bottle. This will be of great assistance to the monitors in maintaining fresh reagents.

Replacement is done through recertification workshops, through group coordinators, or by way of individual monitors contacting the AWW Office. A few, established AWW groups with access to laboratories have synchronized the time their test kits need replacement chemicals, and have ordered chemicals in bulk from the LaMotte Company. Bulk reagents are identical to those in smaller containers used by other AWW groups.

The protocol established for replacing chemicals in a test kit from a bulk supply (e.g. 500 mL bottle) is to empty all, old reagent from the test kit bottle, rinse the bottle at least two times with 5-10 mL of the fresh reagent and fill. This procedure saves the group and /or the AWW Program considerable expense and helps to ensure that all kits have fresh chemicals.

On the AWW data form, monitors are required to designate that they are currently certified and that their reagents are fresh before their data will be accepted by the AWW office.

16 INSTRUMENT CALIBRATION AND FREQUENCY

The citizen kits do not have instruments that need constant calibration. In the early years of the program, special attention was given to comparing the LaMotte Water Quality Monitoring Kits with Standard Methods in Auburn University laboratories. (See Table 2 for the methods used in these comparisons.) Results indicated that the tests were accurate within the lifespan of the reagents. With the maintenance of fresh reagents, and with the instrument inspections done during recertifications, the Accuracy and Precision objectives listed in Table 1 of Element Seven are being met.

Multiple-year comparisons of citizen monitor data with professional data support the accuracy of the citizen data. These comparisons are usually very favorable, and are presented in AWW Waterbody Reports (Attachment 2). Figure 3 illustrates the comparability of AWW and professional data for alkalinity measurements. The five sites represented streams in three physiographic regions with a wide range of alkalinities, and both methods detected this variability.

Table 2. Methods used to compare AWW LaMotte Kits to Standard Methods

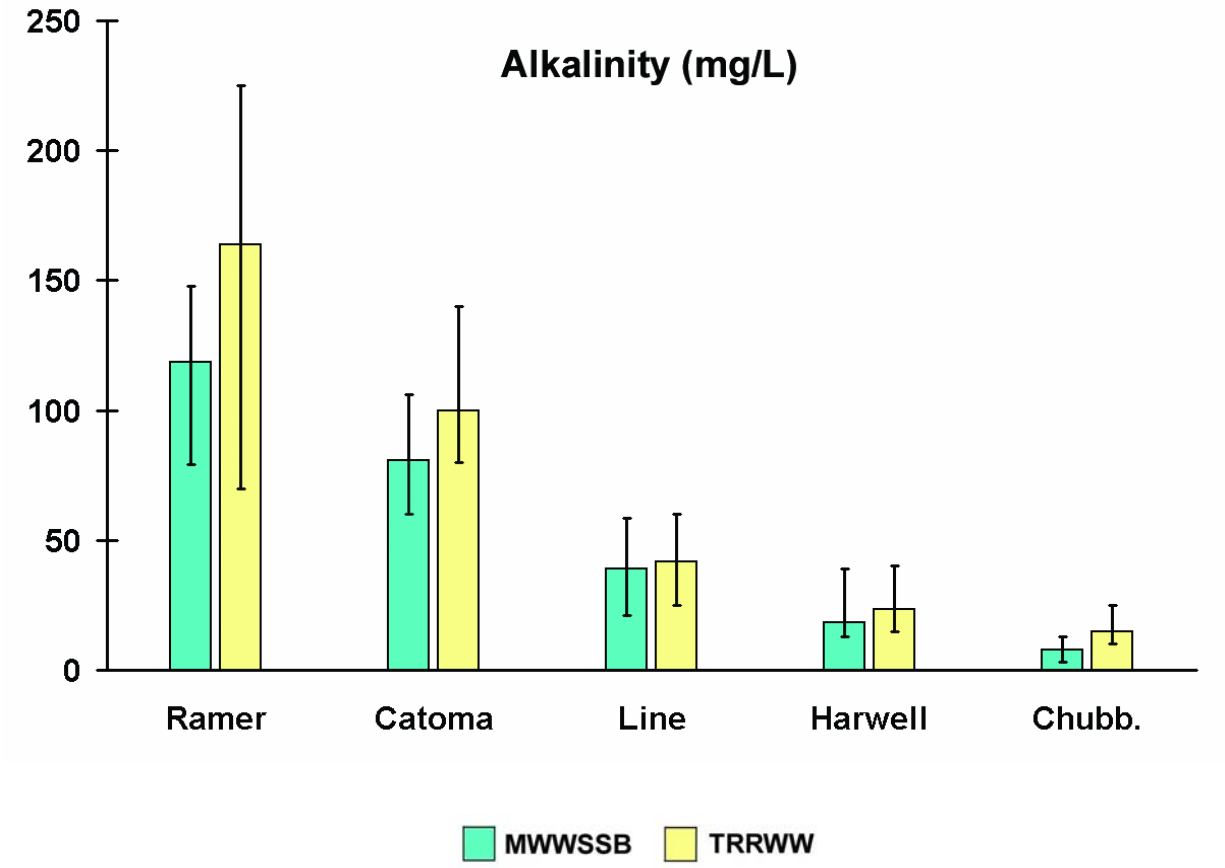
Parameter	**Method Used**	**Standard Used**	**Sensitivity**
Temperature	Certified thermometer, Fisher 15-043D	Ice bath	0.1^{o} C
pH	Corning Ion Analyzer Model 250	pH 4, 7 and 10 standard buffer solutions	0.01 units
Total Alkalinity	Corning Ion Analyzer Model 250	0.05 N HCl	0.05 mL
Total Hardness	Titration	EDTA	0.05 mL
Turbidity	Hach Ratio Turbidimeter, Model 18900	NA	0.01 JTU
Dissolved Oxygen	Winkler titration	NA	0.05 mL

References:

American Public Health Association, et al. 1992. Standard Methods for the Examination of Water and Wastewater. 18th Edition.

Boyd, C. and Tucker, C.S. June, 1992. "Standard EDTA Titration for Total Hardness."p. 97, Water Quality and Pond Soil Analysis for Aquaculture. Alabama Agriculture Experiment Station, Auburn University. 183 p.

Figure 3. Comparison of Total Alkalinity in Five Creeks Measured by Staff of Montgomery Waste Water and Sanitary Sewer Board (MWWSSB) and Tri-River Region Water Watch (TRRWW), an AWW Monitoring Group, 1999-2002



17 Inspection and Acceptance Requirements for Supplies

Supplies are inspected as they are received from suppliers. Broken or defective supplies are returned for replacement. Over the ten-year history of the AWW Program, the materials used in the LaMotte monitoring kits have been well-tested by hundreds of monitors, and some changes have been made based on their suggestions. The original glass titrator for dissolved oxygen measurements malfunctioned frequently, and needed replacement often. This titrator has been replaced with a plastic model. Currently the instruments, glassware, pipettes, thermometers, titrators and reagents are all working well for our monitors.

18 Data Acquisition Requirements

Site location information is obtained by monitors from verbal descriptions and from several different types of maps. This information is verified on several types of maps available in the AWW Office and is used to determine georeference for sites if that information is not provided by monitors. The AWW Office has global positioning system (GPS) units for loan to monitors to assist in this effort.

A "Stream Walk" guide, for recording watershed and stream characteristics, is provided to all trainees during the AWW training workshops. The information recorded by monitors when developing a new site is kept on file at the AWW office. The AWW website has links to many other types of data (water quality, weather, EPA/ADEM Impaired Stream lists, and stream use classification) that monitors may use for analyzing their data and understanding their watershed.

19 DATA MANAGEMENT

Data may be submitted to the AWW Program two ways, by mail or electronically via the AWW website (see Figure 4). The forms received by mail (Appendix C) provide an original and two carbonless copies: the original white data form is received at the AWW Office after each sampling; the yellow copy is kept by the monitor's organization; and the pink copy is kept by the individual monitor. The multiple copies facilitate the resolution of questions or other problems that may arise and as a backup in case data forms are lost.

RECEIPT OF MAILED DATA FORMS

Mailed data forms are logged in by the Data Quality Coordinator (Figure 4, Box 1). This includes:

1) Stamping date received on each form.

2) Careful screening for errors or problems, such as missing data, dates, times, incorrect units, illegible handwriting, improper decimal placement, nonsensical data or obvious outliers. The Data Quality Coordinator is aware of "typical" water quality ranges of the different physiographic regions in the State. "Typical" ranges are based on both the citizen data and water quality data collected by the Rivers and Reservoirs Laboratory in the Department of Fisheries and Allied Aquacultures at AU. Most errors are resolved by contacting the volunteer monitors by phone, mail, or e-mail. If extreme readings are found that are not "typical" for the region or that cannot be obviously explained (e.g. high turbidity readings recorded after heavy rains), the volunteer monitor will be requested to test the parameters again, preferably using a different test kit. An additional recommendation is to ask another monitor to test the parameter to rule out inaccurate testing technique.

3) Indicating the year each form was received so that when the data are entered, the form will be automatically assigned a record number by the computer.

DATA ENTRY OF MAILED FORMS

The next step for the mail-submitted forms is data entry (Figure 4, Box 2). Forms are entered into the AWW ACCESS database, and are automatically assigned individual record numbers. This number indicates the year and the number of the form for that year, i.e. (02-0020) is the twentieth form for the year 2002.

PROOFING

Following data entry, the data forms are used to proof the entered data from printouts generated by the database (Figure 4, Box 3). Corrections are made immediately, if needed. The proofing and correction process is done by an AWW office staff member who has not entered the data.

Another effort is made to reduce data entry errors by returning graphs and data tables to monitors (Figure 4, Box 4). Each year six parameter graphs and the data tables for the previous year are returned to monitors for their review. This is done for all sites for which we have at least six separate months of data. This was done primarily to provide monitors with a graphic view of their data, but it has proven to be a very important part of our QA process. A two month period is allowed for monitors to review the data tables, make any needed corrections in the data tables, and return them to AWW. All corrections received are then made in the database.

ONLINE DATA ENTRY

Online submission of water quality data began on October 18, 2002, the 30th Anniversary of the Clean Water Act. Monitors may go to the Data Forum Page on the AWW website (see Appendix E) and, using an individually assigned password and ID number, enter their data (Figure 4, Box 5). The data form for online entry (Appendix C) is almost identical to the regular data form used by monitors. One of the notable advantages for the monitors and the relational database is that the parts of the data form requiring waterbody, watershed, site description and name and address of the monitor are automatically filled in from the database after the monitor indicates the site code. This has significantly reduced errors, compared with key punching all data from handwritten forms.

Monitors have the opportunity to verify their numbers on a data verification page before submitting the data to AWW. They may also copy their data before sending it to AWW. As a valuable QA tool, also through the Data Forum Page, the monitors are able to observe real-time 12-month graphs of their site data (Figure 4, Box 10). This better enables them to catch outliers and entry errors, if made. They are instructed to keep their data in case AWW requests it, but they are not required to mail the copies of their data form each month.

The data are submitted to AWW via a server file (Figure 4, Box 6), then into a separate holding file before being entered into the database (Figure 4, Box 7). These two steps (6 & 7) provide security to the database, and prevent the entry of trash data. The database is going to be placed on the AU SQL Server which will greatly increase security from hackers and viruses. The Data Quality Coordinator carefully screens each form in the same fashion as the mail-submitted forms (Figure 4, Box 8). Then, a hard copy is made with an assigned record number, before adding it to the database (Figure 4, Box 9).

The database contains formulae which make calculations formerly required by monitors. For instance, to calculate dissolved oxygen, duplicate measurements are required. The database averages the two readings, and this eliminates errors of this type. Also, % saturation for DO is calculated by the database, based on DO concentration and water temperature. Other measurements such as alkalinity and hardness are calculated by the database after the monitor enters the number of drops required to reach the end point of the test. Calculation errors by the monitors are thus largely eliminated.

DATABASE DETAILS

A copy of the AWW ACCESS database is currently located on Auburn University's FrontPage Server. Security of data stored on the server is maintained by the University's Office of Information Technology (OIT).

The AWW Office version of the ACCESS database is located on a Dell Optiplex GX240 computer in the AWW Office.

The Web Forum is programmed in ASP.NET, the new Microsoft run time environment for windows/web development. Many new security features are inherent in this system, and these are in place by virtue of using the software.

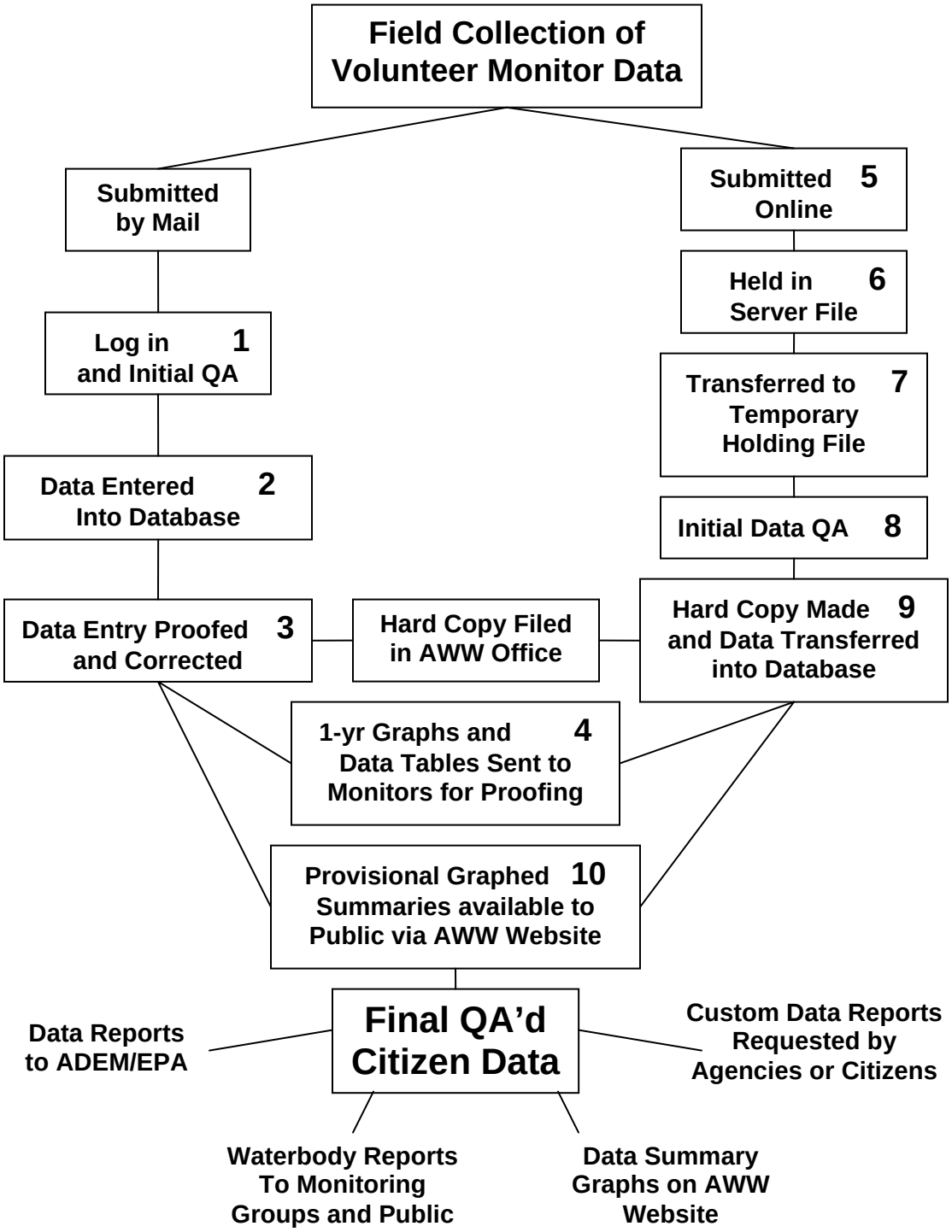
The AWW Data Forum, the web page through which online data entry is done, is physically separated from the database that is maintained in the AWW Office. Public access to graphs of AWW data is available through the AWW Data Forum. Data are updated weekly only from the AWW Office version of the database. During weekly updates, data are imported (rather than linked) so there is never any physical connection with the AWW Office version of the database and the web version. All code running the Data Forum is in VB.NET.

The Data Forum will soon be moved to an SQL 2000 Server Cluster maintained by the OIT at Auburn University, a highly secure system. With the security of FrontPage and SQL and the physical separation of the AWW Office database from the server, the system has a high degree of security. If the web Data Forum is corrupted it can quickly be regenerated from the AWW Office backup copy of the code that runs the Data Forum.

Further protection is provided by "passing" a Session variable (currently this variable is not random) from one page to the next, in situations in which a page opening has the potential to "insert" or "alter through editing" any records on the server. This prevents co-lateral entrance by an outside link. Data entry requires the use of a password and ID number unique to each monitor.

In addition to the hard copies of data forms being maintained in the AWW Office, data are regularly backed up and archived onto the Auburn University mainframe computer. If any data are lost, they can be easily recovered from the AU mainframe.

Figure 4. AWW Data Management



20 ASSESSMENTS AND RESPONSE ACTIONS

The AWW Program regularly reviews the performance of monitors and data management activities through Recertification Workshops. After the first year of monitoring, monitors go through a recertification session conducted by a QA Officer. A careful review of the sampling procedures is done, and the monitors are observed by the Trainer as they conduct each test. Following this initial recertification, if the monitors remain active, recertification is required every two years. A monitor is considered active if he/she submits data records for six separate months in the previous twelve.

The QA Officers who conduct the Recertification Workshops are instructed to use the following guidelines in their workshops:

1) Have no more than 10 monitors per workshop.
2) Observe monitors' techniques carefully.
3) Update monitors on AWW Program.
4) Examine monitoring kits and replace any items needed along with renewing reagents.

Optional guidelines used by many QA Officers include:

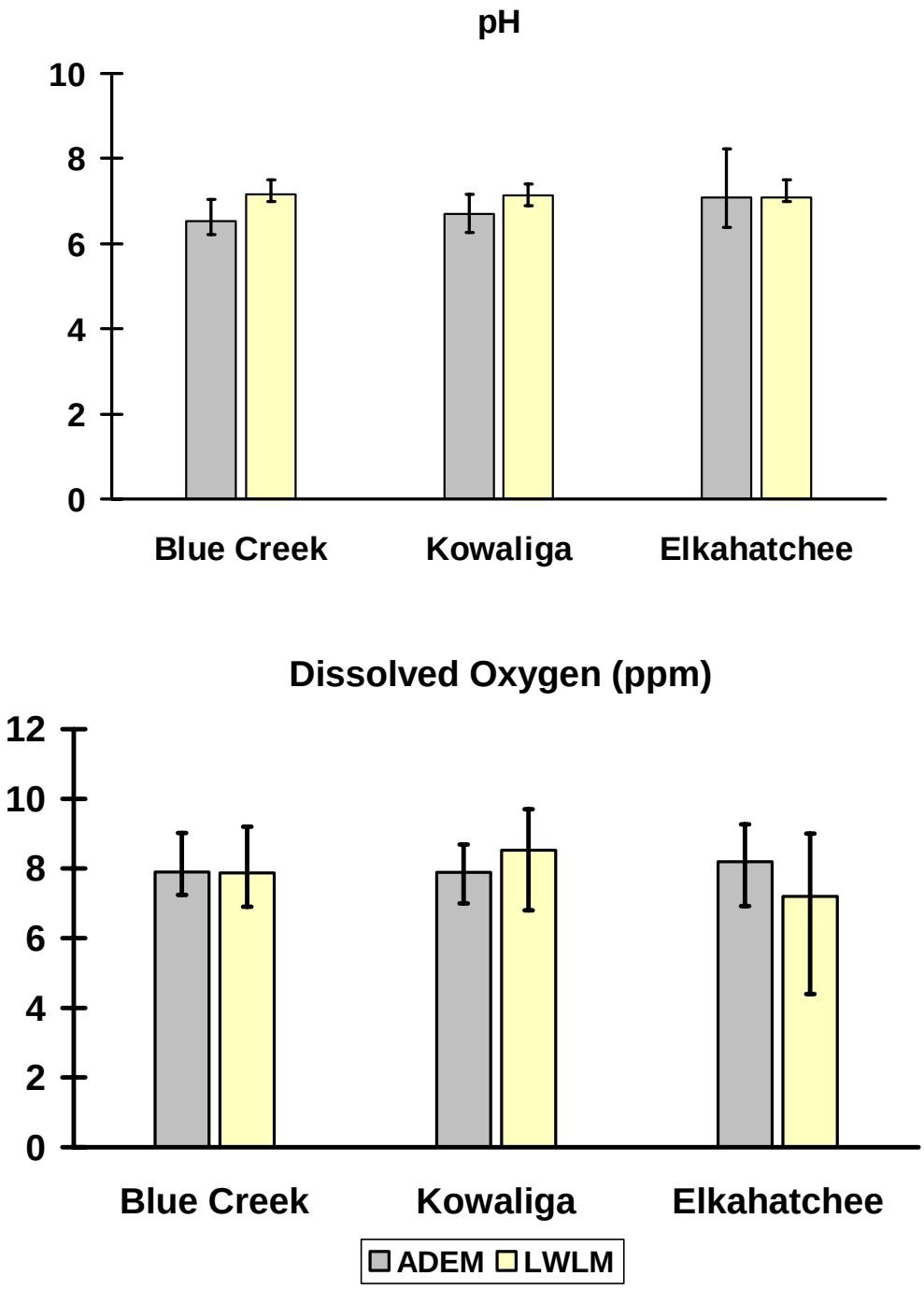
1) Use known standard solutions for some parameters.
2) Use ice to check the accuracy of thermometers.
3) Have everyone measure the same parameter simultaneously and check for any outliers. Determine reason for any outliers.

Data are constantly checked against project quality objectives. The Data Quality Coordinator carefully reviews data forms submitted by mail or online for problems, and contacts monitors if necessary. Data outside acceptable ranges are not entered if no resolution can be achieved with monitors. For example, AWW protocols require a difference of no greater than 0.6 ppm for the two measurements of dissolved oxygen. If a larger discrepancy is submitted on the form, the data are not entered.

Comparisons with data from the Alabama Department of Environmental Management and from the Rivers and Reservoirs Laboratory at Auburn University also provide good checks on data quality. These comparisons of volunteer monitor data with ADEM and AU data readily demonstrate a very positive view of the quality of these data (see Figure 5). If data quality problems are suspected from a monitor, then contact is made, with discussions of procedures and/or reagent problems. Occasionally a Citizen QA Officer may be asked to visit with the monitor for a review of technique and/or kit viability.

The AWW toll-free telephone number and e-mail address are provided to all monitors to facilitate communications regarding techniques, water quality problems, or other concerns.

Figure 5. Comparisons of pH and Dissolved Oxygen at Three Sites Measured by ADEM and Lake Watch of Lake Martin (LWLM), an AWW Monitoring Group, 1997-1998



21 REPORTS

Summaries of water chemistry data are presented in Semi-annual and Annual reports, prepared by the AWW Program Office and submitted to ADEM (Office of Education and Outreach and Chief of Water Division). These reports contain an overall assessment of the program's activities, including QA/QC protocol implementation, results of QC activities from recertification workshops, replacement of reagents and equipment, number of data reports received, and status of the data. The reports also summarize the number of monitoring sites and samples by group, watershed, and county. ADEM includes AWW water chemistry data in their 305(b) Report to the U.S. Congress. Newsletters, the AWW listserve, the AWW website, emails, telephone calls, and letters are used to communicate with monitors about QA problems.

AWW also uses the water chemistry data to generate Waterbody Reports (Attachment 2). These reports are distributed by the featured monitoring groups in their specific regions of the state.

22 Data Review, Validation, and Verification Requirements

All AWW field data must be reviewed by the Data Quality Coordinator to determine if they meet the QAPP objectives. After following protocols explained in Element 19, decisions to reject data are made by the Data Quality Coordinator. This may require additional review by the Program Manager.

23 VALIDATION AND VERIFICATION METHODS

Careful attention is given to data validation and verification. This process begins even before the data are received by the AWW office. Many groups have a QA person who reviews the data forms before submitting them. For the online entered data, the monitor reviews the data before submitting to AWW. As described in Element 19, the Data Quality Coordinator continues this process as mail submitted data forms are logged in and as online submitted data are reviewed prior to adding to the database. Data forms are carefully reviewed for outliers and nonsensical measurements. If such items are found, the monitor is contacted to resolve any questions about the data. Monitors retain copies of their data whether submitted by mail or online. In the online data entry process, the database is programmed to not accept nonsensical data, i.e. a pH of 15 will not be accepted. The monitor is prompted that an error has been made, which then can be corrected by the monitor.

The proofing process described in Element 19 serves to verify the accuracy of data entry. This is done by someone who has not entered the data. Immediate corrections are made if errors are found.

Another important process is the distribution of summarized data to monitors. This is done for all sites with at least six separate months of data for the previous year. Monitors review the data tables, and return any needed corrections to the AWW Office where corrections are made. Corrected data tables and graphs are returned to monitors. With the new database, AWW monitors are able to view real-time and summary graphs of their data via the AWW website. This is proving to be helpful because monitors occasionally ask questions about their graphed data, and errors are discovered. Corrections are quickly made.

When errors are discovered in data that have been sent to any of the growing number of AWW data users, corrections are made and sent to the users.

The longevity of the AWW Program monitoring efforts and the capabilities of the Program in analysis and data processing facilitate comparisons of citizen data with professional data. These comparisons are illustrating high levels of validity for the AWW citizen monitor data.

24 Reconciliation With Data Quality Objectives

The data quality objectives are set conservatively to allow non-specialists to collect valid data and to permit the largest number of monitors to collect data from as many sites as possible. Given the nature of the AWW Program, the quality of the data ultimately rests with the conscientiousness of monitors. The citizens have demonstrated that they have the strongest vested interest in their data quality. The vast majority are careful and meticulous about data collection.

Procedures for validation and verification of the data are carefully followed throughout each year. Data that fall outside stated quality objectives are rejected, and not entered into the AWW database.

In spite of considerable changes in protocols relative to the new AWW database and online data entry, the objectives and monitoring techniques of the original QAPP approved in 1994 have not been changed.

Appendix A

Examples of Data Request Letters

Appendix B

Cover Page and Table of Contents of AWW Water Chemistry Monitoring Manual

Appendix C

AWW Water Chemistry Data Reporting Forms

Appendix D

Reagent Shelf-Life Labels for Monitoring Kits

Appendix E

Copy of Data Forum on AWW Website Page

Attachments

1. **Alabama Water Watch Water Chemistry Monitoring Manual**
2. **Examples of AWW Waterbody Reports**