WATER MONITORING
QUALITY ASSURANCE PROJECT PLAN

FOR THE YUBA WATERSHED COUNCIL
MONITORING COMMITTEE

Revision 1
November 12, 2003

Original and Revision Page

CITIZEN WATER MONITORING QUALITY ASSURANCE PROJECT PLAN FOR THE YUBA WATERSHED MONITORING COMMITTEE

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Original and Revision History

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Deer Creek Coordinated Resources Management Project

Signature: ____Date: _______________

Yuba River Monitoring Project

Signature: ____Date: _______________

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3. Distribution List

All group leaders and technical advisors will receive copies of this Quality Assurance (QA) plan, and any approved revisions of this plan. Once approved, this QA plan will be available to any interested party by requesting a copy from John van der Veen (see address on title page).

4. Project Organization

The Yuba Watershed Monitoring Project is a multiorganizational project. These organizations are the Bear River Watershed Group Group, Deer Creek Group, and Yuba River Monitoring Project Group.

4.1. Bear River Watershed Monitoring Organization

The Bear River Watershed Group has identified personnel/positions whose responsibility it will be to perform the following functions:

4.1.1. Project Management (Leaders and Trainers)

Tamara Gallentine and Cyndi Brinkhurst are the Watershed Group's staff and project leaders. They are responsible for organizing training sessions, locating trainers, and ensuring compliance with training procedures. Other trainers include Clean Water Team Member of the State Water Resources Control Board (SWRCB), the SWRCB Quality Assurance Program Manager, and Cyndi Brinkhurst for Macroinvertebrates and Habitat Assessment.

4.1.2. Technical Advisors

The technical advisors are resource professionals from the Yuba Watershed Council Monitoring Committee are named below in section 4.4.

4.1.3. Field Data Collection (rank and file volunteers)

Each team will be responsible for collection of data at their site(s). Tamara Gallentine and Cyndi Brinkhurst will be responsible for verification of procedures and data results.

4.1.4. Equipment and Supply Management (including calibration)

There will be four sets of equipment for monitoring that will be rotated among the field teams. The staff and volunteer project leaders are responsible for ensuring that all equipment is in good working order before it is used for sampling. Volunteers will be trained for the proper use and cleaning of equipment. Equipment calibration will take place at the semi-annual intercalibration studies.

4.1.5. Data Management

Tamara Gallentine and Cyndi Brinkhurst are responsible for data management. Data will be stored and analyzed following the Data Management procedures described in the Data Management manual of the Yuba Watershed Council and stored at the Yuba Watershed Council office, both electronically and physically.

4.1.6. Quality Assurance and Quality Control

Tamara Gallentine and Cyndi Brinkhurst will be responsible for the quality assurance program and for establishing the appropriate guidelines for the Quality Assurance program for the biological, chemical and physical parameters.

4.2. Deer Creek Project Monitoring Organization

The Deer Creek Project Monitoring Organization has identified personnel/positions whose responsibility it will be to perform the following functions:

4.2.1. Project Management (Leaders and Trainers)

Joanne Hild is the staff project leader and John van der Veen is the volunteer project leader. They are responsible for organizing training sessions, locating trainers, and ensuring compliance with training procedures. Trainers include John van der Veen for Water Quality, Joanne Hild for Macroinvertebrates and habitat assessment.

4.2.2. Equipment and Supply Management (including calibration)

There will be three sets of equipment for monitoring that will be rotated among the field teams. The staff and volunteer project leaders are responsible for ensuring that all equipment is in good working order before it is used for sampling. Volunteers will be trained for the proper use and cleaning of equipment. Equipment calibration will take place at the semi-annual intercalibration studies.

4.2.3. Field Data Collection (rank and file volunteers)

Each team will be responsible for collection of data at their site(s). John van der Veen and Joanne Hild will be responsible for verification of procedures and data results.

4.2.4. Data Management

John Van der Veen and Joanne Hild are responsible for data management. Data will be stored and analyzed following the Data Management procedures described in the Data Management manual of the Yuba Watershed Council and stored at the Yuba Watershed Council office, both electronically and physically.

4.2.5. Quality Assurance and Quality Control

Joanne Hild and Susan McCormick, professional taxonomist, will be responsible for the macroinvertebrate quality assurance program and for establishing the appropriate guidelines. John van der Veen will be responsible for the Quality Assurance program for the biological, chemical and physical parameters.

4.2.6. Technical Advisors

The technical advisors are resource professionals from the Yuba Watershed Council Monitoring Committee are named below section 4.4.

4.3. Yuba River Monitoring Program Organization

The Yuba River Monitoring Program has identified personnel/positions whose responsibility it will be to perform the following functions.

4.3.1. Project Management (Leaders and Trainers)

Cara Wasilewski and Kayle Martin of SYRCL are the Yuba River Monitoring Program Director and staff. They are responsible for organizing and completing training sessions on Water Quality, Macroinvertebrates, and Habitat Assessment, and ensuring compliance with training procedures. Other trainers may include SWRCB Clean Water Team Members for Water Quality, Joanne Hild for Macroinvertebrates, and Habitat Assessment. Sara Yarnell of UC Davis may assist in Channel Morphology training.

4.3.2. Equipment and Supply Management (including calibration)

All equipment will be stored at the South Yuba River Citizens League office. Cara Wasilewski will work with Kayle Martin to ensure that all equipment is calibrated and that all equipment is in good working order before it is used for sampling. Volunteers are responsible for the proper use and cleaning of equipment after it has been used for sampling. Equipment calibration will occur before every monthly sampling day per steps outlined below in this document.

4.3.3. Field Data Collection (volunteers)

Volunteer Coordinator is Kathy Dotson of the South Yuba River Citizens League. Kathy Dotson and Kayle Martin are responsible for organizing the 70 volunteers.

4.3.4. Data Management

Cara Wasilewski is responsible for evaluating and analyzing all data generated by the Yuba River Monitoring Program. Data will be stored electronically at the South Yuba River Citizens League office at 216 Main Street, Nevada City, CA 95959. Data will also be stored at the Yuba Watershed Council office at 132 Main Street, Nevada City, CA 95959.

4.3.5. Quality Assurance and Quality Control

Cara Wasilewski will be responsible for the quality assurance program and for establishing the appropriate guidelines and for Quality Assurance and Quality Control for the biological, chemical and physical parameters.

4.3.6. Technical Advisors

The technical advisors are resource professionals from the Yuba Watershed Council Monitoring Committee are named below in section 4.4.

4.4. Technical Advisors

Several resource agencies have assisted in the development of this project from its conception. Additional partnerships will be developed to ensure adequate technical support to all participating citizen monitoring groups. The QA plan reflects the diversity of monitoring and organizational support involved in this project. For the elements of this QA plan, we have addressed aspects that are shared with all groups as well as those aspects that are unique to individual groups. While the goals of monitoring may vary, the data quality objectives are consistent allowing us to compare data collected by different organizations.

4.4.1. Technical Advisors of the Yuba, Bear, and Deer Creek Monitoring Programs

- The technical advisors of the Yuba, Bear, and Deer Creek Monitoring Programs will oversee and review the tasks associated with watershed assessment and water quality monitoring. They will recommend, review, and comment on quality assurance/quality control procedures, help solve technical problems with the monitoring, review and comment on drafts of manuals and training materials, review protocols and recommend changes as needed, and assist in interpreting the results. The technical advisors consist of people with different specialties including geology, biology, hydrology, forestry, fisheries, and recreation. The technical advisors are:

- John van der Veen - Friends of Deer Creek, Chemist, Statistician*
- Joanne Hild - Deer CreekKeeper, Biologist*
- Holly Sheradin – Statewide Clean Water Team Citizen Monitoring Coordinator, SWRCB
- Cara Wasilewski – SYRCL – Biologist*
- Fraser Shilling - UC Davis, Environmental Science and Policycheck
- Cyndi Brinkhurst – Co-Manager, Nevada County Resource Conservation District*
- Tamara Gallentine – Co-Manager, Nevada County Resource Conservation District*
- William Ray, Quality Assurance Program Manager, State Water Resources Control Board
- Rick Weaver or designee, United States Forest Service
- Lorna Dobrovolny – California Department of Parks and Recreation, Water Quality Specialist
- Pat Ditrovati – Nevada County Environmental Health Department, Microbiology
- Cathy Johnson – Contaminate Specialist, U.S. Fish and Wildlife
- Lori Webber – Environmental Scientist, Regional Water Quality Control Board, Central Valley Region

*--project leaders will not be allowed to vote on their own projects.

5. Problem Definition/Background

5.1. Problem Statement

Originally there was insufficient information to adequately assess the status of aquatic resources in the Yuba, Deer Creek, and Bear River watersheds. After several years of monitoring, the water quality of these watersheds has been recorded. Continued monitoring is needed for trend analysis, especially. Citizen monitoring organizations have been formed in local watersheds to address their own water quality concerns. If quality assurance is adequate, valuable information will be provided for watershed management, and pollution prevention and restoration.

5.1.1. Regional Citizen Monitoring Mission and Goals

5.1.1.1. Mission

The mission of citizen monitoring is to produce environmental information, which is needed to protect the condition of the Yuba and Bear River watersheds and aquatic resources. Citizen monitoring will also inform and engage the community in effective watershed stewardship.

5.1.1.2. Watershed Goals

The general goals of citizen monitoring are:

- Identifying valued resources and watershed characteristics for setting management goals,
- Identifying physical watershed characteristics influencing pollutant inputs, transport and fate,
- Identifying the status and trends of biological resources in and around an aquatic environment,
- Screening for water quality problems,
- Identifying pollution sources and illegal activities (spills, wetland fill, diversions, discharges),
- Establishing trends in water quality for waters that would otherwise be un-monitored,
- Evaluating the effectiveness of restoration or management practices,
- Evaluating the effect of a particular activity or structure, and
- Evaluating the quality of water compared to specific water quality criteria.
- Evaluating hydro-geomorphology

In addition, citizen monitors build awareness of water quality issues, aquatic resources and pollution prevention.

This project will supplement existing agency information by monitoring streams in the Bear River, Deer Creek, and Yuba River watersheds. The focus of the project is on habitat and chemical, physical and biological water quality measures that will identify the status of these aquatic resources. The results of this work will be provided to the regulatory agencies. It is their responsibility to ensure that adequate and valid data are collected to meet their regulatory requirements.

The following statements identify the specific missions and goals of the Yuba, Deer, and Bear Monitoring Programs.

5.1.2. Goals and Objectives of the Bear River Monitoring Program:

- To design and carry out scientifically credible studies to establish a time-referenced condition of the Bear River Watershed.
- To use data collected on watershed disturbances to identify economically feasible solutions to site specific and region wide problems in the Bear River Watershed.
- To create a land use and natural resource database of the Bear River Watershed.
- To identify the relationship, if any, between land and riparian resource management and hydrologic and ecological conditions.
- To initiate and sustain a long-term monitoring program for the Bear River Watershed for the purpose of assessing and improving natural resource management.
- To involve residents in a hands on process of monitoring and improving the specific watershed in which they live.

5.1.3. Goals and Objectives of the Yuba River Monitoring Program:

- To design and execute scientifically credible studies which assess the condition of the Yuba River ecosystem.
- To empower citizens to be responsible stewards and decision-makers.
- To identify valued resources and watershed characteristics for setting management goals,
- To identify physical watershed characteristics influencing pollutant inputs, transport and fate,
- To identify the status and trends of biological resources in and around an aquatic environment,
- To screen for water quality problems,
- To identify pollution sources and potentially illegal activities (spills, wetland fill, diversions, discharges),
- To establish trends in water quality for waters that would otherwise be un-monitored,
- To evaluate the effectiveness of restoration or management practices,
- To evaluate the effect of a particular activity or structure, and
- To evaluate the quality of water compared to specific water quality criteria.

5.1.4. Goals and Objectives of the Deer Creek Monitoring Program

- To design and execute scientifically credible studies that assesses the condition of the Deer Creek watershed ecosystem.
- To improve the overall health of the Deer Creek watershed.
- To identify pollution sources.
- To empower citizens to be responsible stewards and decision-makers.

- To identify valued resources and watershed characteristics for setting management goals.
- To identify additional demonstration sites
- To evaluate the effectiveness of restoration and management practices.
- To evaluate the quality of water compared to standard water quality criteria.
- To understand and document the relationship between water quality/hydrologic function and land use/watershed management by monitoring indices of terrestrial and aquatic ecosystem health.
- To initiate and sustain a continuing process for collecting data for the purpose of assessing and modeling watershed condition over a decades-long scale.
- To educate residents about the Yuba watershed processes and to strengthen their connection to the ideal of a healthy watershed.
- To make information available to decision-makers and the public about whether the condition of the landscape, creeks, fisheries and water intended for drinking meet social and legal standards.
- To develop educational watershed programs to help inform and empower citizens

5.2. Intended Storage of Data

Bear River data will be compiled at 113 Presley Way, Suite 1, Grass Valley, CA, 95945. Deer Creek data will be compiled at 132 Main Street, Nevada City, CA, 95959. Yuba River data will be compiled at 216 Main Street, Nevada City, CA, 95959. The information will be collated and shared with the State Water Resources Control Board, the Central Valley Regional Water Quality Control Board, and upon request, to other state, federal, and local agencies and organizations. A regional database will be maintained at 132 Main Street, Nevada City, CA, 95959, the Yuba Watershed Council offices.

6. Project/Task Description

The citizen monitoring organizations are monitoring water quality in the Yuba, Deer Creek, Bear River watershed. Physical, chemical and biological parameters are measured, although not all groups are measuring all parameters. Table 6.1 identifies the monitoring design of the participating groups.

6.1. Parameters to be monitored by Participating Citizen Groups

This QA plan only addresses citizen data quality objectives for the following parameters:

- Temperature
- Dissolved Oxygen
- pH
- Conductivity
- Turbidity
- Ammonia (nitrogen)
- Nitrate (nitrogen)

- ortho-Phosphate
- Benthic Macroinvertebrates
- Total Coliform Bacteria
- *E. Coli* bacteria
- *Enterococcus* bacteria
- Algae

For stream and urban storm drain environments, flow will be determined by using the protocol described in the U.S. EPA Volunteer Stream Monitoring Manual and/or in the Bear River, Yuba River, and Deer Creek Watershed Monitoring Manuals.

This program has a systematic method for visual and other sensory observations. A Streamwalk Visual Assessment observation sheet, with instructions, is included in the Bear River, Yuba River, and Deer Creek Watershed Monitoring Manuals. Observations using the Stream Walk Visual Assessment observation sheet will be made, at a minimum, on a quarterly basis. Observational data includes color, odor, presence of oil or tar, trash, and foam. In addition, the stream habitat quality may be assessed, once per year, using the California Dept. of Fish and Game Physical Habitat Assessment Form. Observational data includes epifaunal substrate/available cover, embeddedness, velocity/depth regimes, sediment deposition, channel flow status, channel alteration, frequency of riffles, bank stability, vegetative protection, and riparian vegetative zone width.

6.2. Parameters to be analyzed by Outside Laboratory

The sampling plan contains references and instructions for the collection of samples for the following substances.

- Pesticides
- Total Suspended Solids
- Copper
- Zinc
- Arsenic
- Cadmium
- Chromium
- Iron
- Lead
- Manganese
- Mercury
- Nickel
- Total Petroleum Hydrocarbons (TPH)

It has been determined that there will be no project-specific quality assurance and data quality objectives developed for the data generated for the above listed substances. Samples may be sent to any laboratory capable of performing analysis. The project accepts the data generated that is within the analyzing laboratory's internal quality assurance program and the project will not comment on its quality relative to data from the same test generated by other laboratories.

Coliform and *enterococcus* bacteria samples will be sent out to a contract lab until the equipment is purchased to perform this type of analysis directly by participating monitoring groups.

Table 6.1 Types and Frequency of Monitoring in the Bear River, Deer Creek, and Yuba River Citizen Monitoring Programs

	Bear	Deer	Yuba	Water Quality Standard Available	Agency or Historical Data Available
Discharge	S	X	X	N	Y
Temperature	M	M	M	Y	Y
Dissolved Oxygen	M	M	M	Y	Y
pH	M	M	M	Y	Y
Conductivity	M	M	M	Y	Y
Turbidity	M	M	X	Y	Y
Total Suspended Solids	X	X	M	Y	Y
Ammonia	M	X	X	Y	Y
Nitrate	M	S	X	Y	Y
ortho-Phosphate	M	S	X	Y	Y
e. coli Bacteria	X	X	M	Y	Y
Enterococcus		X	X	Y	
Benthic Macroinvertebrates	X	S	S		
Mercury	X	X	X	Y	Y
Zinc		X	M	Y	Y
Arsenic		X	M	Y	Y
Iron			M	Y	Y
Chromium			M	Y	Y
Copper		X	M	Y	Y
Lead		X	M	Y	Y
Nickel			M	Y	Y
Manganese		X	X	Y	Y
Cadmium			X	Y	
Total Petroleum Hydrocarbons		X	X	Y	
Visual Observations	S	S	S	N/A	N/A
Trash	S	S	S	N/A	N/A
Dumping/Spills	X	X	X	N/A	N/A

Frequency: M: Monthly, S: Seasonal, depending on flows, X: Irregular N/A= not available General Overview of Project

The following paragraphs identify the specific overviews of the citizen monitoring projects included in this plan.

The Bear River Monitoring Program was created to satisfy the monitoring elements of the Watershed Planning Grant received under Proposition 204. Chemical and biological monitoring is being done by volunteer teams on a monthly, seasonal, or annual basis depending on the criteria being collected. Monthly monitoring is being done at 8 volunteer sites on the Bear River and two main tributaries. The results of monitoring helps us to focus conservation, restoration, and monitoring efforts in the future on specific reaches of the watershed. These sites will continue to be monitored in the long term, thereby, allowing us to also monitor the effectiveness of any watershed protection practices that have been implemented. A map is available in Appendix 3.

The Deer Creek Monitoring Program was created to provide the monitoring elements in the watershed plan for Deer Creek, as funded under Proposition 204. Chemical and biological monitoring will be done by trained volunteer teams on a monthly basis under the guidance of trained staff. Monthly monitoring will be done at each of 15 sites along Deer Creek. In addition, trained citizen volunteers will do streamwalks 4 times/year, once during each season. This monitoring will give us baseline water quality and bioassessment data for Deer Creek, will help recognize specific concerns that need to be addressed, and will give a long term perspective of seasonal and annual changes in the watershed including potential human impact. A map is available in Appendix 3.

The Yuba River Monitoring Program was created to provide the monitoring elements required in the coordinated watershed plan for the Yuba River Basin, as funded under Proposition 204. The watershed is composed of the interacting landscapes and river systems. This plan describes procedures for assessing land use/land cover and impacts of particular water quality stressors. By monitoring conditions in both aquatic and terrestrial environments, the "health" of the watershed can be periodically determined relative to standards for water quality and land cover disturbance. "Watershed health" in this case refers to the relative state of the combined landscape and river systems in terms of maintenance of natural ecological, geological, and hydrological processes. The performance standards for a watershed will depend on a combination of legal minim and regional social expectations for ecosystem services and aesthetics. A map is available in Appendix 3.

6.3. Project Timetable

The following tables identify the specific timetables of the citizen monitoring projects included in this plan. See Tables 6.2 – 6.4 below

Table 6.2 Project Schedule, Bear River

Activity	Task Completion
Identify monitoring leaders	Completed
Obtain training for monitoring leaders	On-going
Recruit monitors	On-going

Obtain and check operation of instruments	On-going
Train monitors	On-going
Initiate monitoring	Completed
Initiate data entry	Completed
Data entry	On-going
Calibration and quality control sessions	On-going
Review data with technical advisors	On-going

Table 6.3 Project Schedule, Deer Creek

Activity	Task Completion
Identify monitoring leaders	Completed
Obtain training for monitoring leaders	On-going
Recruit monitors	On-going
Obtain and check operation of instruments	On-going
Train monitors	Ongoing
Initiate monitoring	Completed
Initiate date entry	Completed
Data entry	On-going
Calibration and quality control sessions	On-going
Review data with technical advisors	On-going
Training volunteers to classify/identify macroinvertabrates	On-going

Table 6.4 Project Schedule, Yuba River

Activity	Task Completion
Identify monitoring leaders	Completed
Obtain training for monitoring leaders	On-going
Recruit monitors	On-going
Obtain and check operation of instruments	On-going
Train monitors	On-going
Initiate monitoring	Completed
Initiate data entry	Completed
Data entry	On-going
Calibration and quality control sessions	On-going
Review data with technical advisors	On-going

7. Data Quality Objectives

This section identifies how accurate, precise, complete, comparable, sensitive and representative our measurements will be. Objectives for these data characteristics are summarized in the Tables 7-1 to 7-4. Data quality objectives were derived by reviewing the QA plans and performance of other citizen monitoring organizations' (e.g. Chesapeake Bay, Texas Watch, Coyote Creek Riparian Station, Southern California Citizen Monitoring Steering Committee, Heal the Bay Malibu StreamTeam).

Table 7.1. Data Quality Objectives for Conventional Water Quality Parameters

Parameter	Method/range	Units	Detection Limit	Precision	Accuracy	Completeness
Temperature	Thermometer (-5 to 50)	^{o} C	-5	±1^{o}C	1^{o}C	80%
Dissolved oxygen	Electronic meter/probe	mg/L	<0.1	± 10%	± 10%	80%
Dissolved Oxygen	Micro-Winkler Titration	mg/L	<0.2	± 10%	± 10%	80%
pH	pH meter	pH units	2	± 0.2 units	± 0.2 units	80%
Conductivity	Conductivity meter	uS	10	5 uS or 10%, whichever is greater	10 uS or 10%, whichever is greater	80%
Turbidity	Nephelometer	NTU's	<0.1	0.2 NTU or 10%, whichever is greater	0.2 NTU or 10%, whichever is greater	80%

Table 7.2. Data Quality Objectives for Nutrients Using Colorimeters or Spectrophotometers

Parameter	Method/range	Units	Detection Limit	Precision	Accuracy	Completeness
Ammonia Nitrogen	Nessler method	mg/L	0.05	± 10%	± 10%	80%
Nitrate Nitrogen	Cadmium reduction	mg/L	0.05	± 10%	± 10%	80%
Ortho-Phosphate	Ascorbic acid	mg/L	0.05	± 10%	± 10%	80%

Table 7.3. Data Quality Objectives for Nutrients Using Comparators

Parameter	Method/range	Units	Detection Limit	Precision	Accuracy	Completeness
Ammonia Nitrogen	Salicylate method	mg/L	<0.25	± 0.5 mg/L	+ 20%	80%

Nitrate Nitrogen	Cadmium reduction	mg/L	0.25	± 0.5 mg/L (0-6) ± 1 mg./L (6-10)	+ 20%	80%
Ortho-Phosphate	Stannous Chloride	mg/L	1.0	± 0.5 mg/L	+ 20%	80%

Some test kits vary in sensitivity over the range of detection. The specific range of readings is noted in parentheses. For example, the ammonia kit has a sensitivity of 0.25 in the range of 0 to 0.5 mg/L, but a sensitivity of 0.5 between 0.5 and 1.0 mg/L. The kit has color comparisons at 0, 0.25, 0.5, 1.0, 2.0, and 4.0 mg/L.
NA = Not Applicable

Table 7.4. Data Quality Objectives for Biological Parameters

Parameter	Method/range	Units	Detection Limit	Precision	Accuracy	Completeness
Benthic Macro-invertebrates	Calif. Stream Bioassessment Protocol	N/A	Family level	<5% difference	<5% difference	80%
Total Coliform Bacteria	Colilert 18 hour	MPN/ 100 mL	10	Duplicates within 95% confidence limits	Positive standard within ½ of an order of magnitude	80%
E. coli Bacteria	Colilert 18 hour	MPN/ 100 ML	10	Duplicates within 95% confidence limits	Positive standard within ½ of an order of magnitude	80%
Enterococcu s Bacteria	Enterolert (24 hour)	MPN/ 100 ML	10	Duplicates within 95% confidence limits	Positive standard within ½ of an order of magnitude	80%

7.1. Accuracy

Description: Accuracy describes how close the measurement is to its true value. Accuracy is the measurement of a sample of known concentration and comparing the known value against the measured value. Performing tests on standards at the quality control sessions held twice a year will check the accuracy of chemical measurements. A standard is a known concentration of a certain solution. Standards can be purchased from chemical or scientific supply companies. A professional partner, e.g. a local analytical laboratory, certified for water or wastewater analysis by EPA might also prepare standards. Single or double blind samples may be submitted at the discretion of the Quality Assurance Officer.

Procedures: For all chemical water quality parameters volunteers shall obtain results within the stated data quality objectives in Tables 7.1 – 7.4. Note that all testing for nitrate includes measurement of nitrite. Testing will be done through the analysis of a solution of known concentration, which will be within 25% to 75% of the range of measurable values.

Accuracy for bacterial parameters will be determined by analyzing a positive control sample. A positive control is similar to a standard, except that a specific discreet value is not assigned to the bacterial concentrations in the sample. This is due to the fact that bacteria are alive and capable of mortality and reproduction. Instead of a specific value, an approximate target value of the bacterial concentration is assigned to the sample by the laboratory preparing the positive control sample.

For benthic macroinvertebrate analysis, accuracy will be determined by having 20% of the samples re-analyzed and validated to Level 3 by a professional taxonomist.

Instructions for determining accuracy (chemical analyses):
Record all results from the test for each instrument. Determine the average value. Compare the average value to the true value. Compare this difference to the accuracy objective set in the previous tables. If the absolute difference is greater, corrective action will be taken to improve performance. We will consult our technical advisors to determine the appropriate corrective action.

EXAMPLE: ACCURACY			
During a recent training session, volunteer monitors checked their pH meters against a standard buffer solution of pH 7.0. The following results were read:			
7.5	7.2	6.5	7.0
7.4	6.8	7.2	7.4
6.7	7.3	6.8	7.2

Determine the average result. Most calculators will determine an average. To calculate:

Average : $\bar{x} = \frac{1}{n}\sum_{i}^{n} x_i$

ACCURACY = average value - true value

To obtain a percent reading: Divide the ACCURACY BY the true value and multiply by 100.

The average of these measurements is equal to 7.08. Since we know that the reference or true value is 7.00, the difference between the mean pH value is off or biased by +0.08 units or 1%. This level of accuracy is within the objective of ± 10 percent.

Record these results on your QA Form: Data accuracy, Detection Limit, Precision.

Table 7.6 Example of QA Form: Data accuracy

Parameter/ units	Date	Objective	Deviation	Meet Objective? Yes or No	Corrective action planned	Date Corrective Action taken
Temperature ^{O}C	5/21/ 96	±1°C	1.5 °C -0.5%* * after correction factor given.	Yes	One thermometer was way off, it was discarded. All other thermometers were given a correction factor to improve their accuracy	5/21/96
Dissolved Oxygen (mg/L)	5/21/ 96	sodium thiosulfate 20.00± 0.2mL	+1.00 mL	No	replace reagent	6/15/96
PH Standard units	5/21/ 96	±10%	-5%	yes	none needed	
Conductivity (µS/cm)	5/21/ 96	±10%	+10%	yes	none needed	
Turbidity (NTU)	5/21/ 96	± 5	+1.4	yes	none needed	

7.2. Standardization of Instruments and Test Procedures (chemical and physical parameters)

The temperature measurements will be standardized by comparing our thermometers to a NIST-certified or calibrated thermometer. All meters (pH, conductivity, oxygen) will be evaluated twice a year using standards of known value. The dissolved oxygen (Winkler method) will be checked by standardizing the sodium thiosulfate solution in the test kit, and/or by comparing the entire kit to saturated oxygen standard. Instructions for checking the sodium thiosulfate are included in the test kit (Additional reagents and glassware must be purchased separately however.) If the result is unsatisfactory, as indicated in the instructions, the sodium thiosulfate and/or other reagent will be discarded and replaced with new reagents. The validity of the dissolved oxygen test will also be assured by taking these steps:

- Care is taken not to aerate water samples during collection,
- Water is added gently to the dissolved oxygen bottle,
- No air bubbles are present in the sample,
- The titration sample will be measured carefully with a graduated cylinder,
- The sample is swirled thoroughly after each drop of titrant,
- If the endpoint is overrun, another 20 ml. of the sample will be titrated.

Comparators, nephelometers, colorimeters or spectrophotometers and associated reagents will be evaluated twice a year using standards of known value.

7.3. Comparability

Description: Comparability is the degree to which data can be compared directly to similar studies.

Procedures: We will use the following methods to ensure that their data can be compared to others:

- SWRCB Citizen Monitoring Draft Compendium for Water Quality Monitoring and Assessment,
- U.S. EPA's Volunteer Monitoring Manuals for Streams, Lakes or Estuaries,
- California's Department of Fish and Game's (CDFG) Stream Bioassessment Protocol for Citizen Monitors.

Before modifying any measurement method, or developing alternative or additional methods, technical advisors will evaluate and review the effects of the potential modification. It will be important to address their concerns about data quality before proceeding with the monitoring program.

7.4. Completeness

Description: Completeness is the fraction of planned data that must be collected in order to fulfill the statistical criteria of the project. There are no statistical criteria that require a certain percentage of data. However, it is expected that 80% of all measurements could be taken when anticipated. This accounts for adverse weather conditions, safety concerns, and equipment problems.

Procedures: We will determine completeness by comparing the number of measurements we planned to collect compared to the number of measurements we actually collected that were also deemed valid. An invalid measurement would be one that does not meet the sampling methods requirements and the data quality objectives. Completeness results will be checked every six months. This will allow us to identify and correct problems. Completeness measurements shall meet the requirements stated in Tables 7.1 – 7.4. Table 7.7 will be used to record our completeness information.

Instructions for Determining Completeness:

To determine the percent completed divide the number of valid samples collected and analyzed by the number of samples anticipated in the monitoring design then multiply by 100%. In the example below, the volunteers met their objective of 80% completeness for temperature, but not dissolved oxygen. The volunteers reviewed their sampling methods and realized that some volunteers were not fixing the dissolved oxygen samples correctly. When they corrected this activity their completeness improved.

Table 7.7 Example QA Form: Completeness

Parameter	Collection Period	No. of Samples Anticipated	No. Valid Samples Collected and analyzed	Percent Completed	Comments
Temperature	6/1/96 - 9/1/96	35	33	94.3%	
Dissolved oxygen	6/1/96 - 9/1/96	35	27	77.1%	Volunteers were not fixing samples correctly in field.
Temperature	9/1/96 - 12/1/96	35	32	91.4%	
Dissolved oxygen	9/1/96 - 12/1/96	35	32	91.4%	

7.5. Precision

Description: Precision describes how well repeated measurements agree. The precision objectives described here refer to repeated measurements taken by different, trained volunteers or the same volunteer on the same water sample. Additional variability would be expected if comparisons were made between different samples taken at the same location.

Procedures: These precision objectives apply to duplicate and split samples taken as part of the QC session or as part of periodic in-field QC checks. For chemical and physical parameters measurements on the same sample read by different volunteers using the same equipment shall meet the data quality objectives stated in Tables 7.1 – 7.4.

Precision for bacterial parameters will be determined by having the same analyst complete the IDEXX procedure for two or more replicates of the same sample. At a minimum this should be done once for every 20 samples. The results of the replicates shall meet the data quality objectives stated in Table 7.4.

For benthic macroinvertebrate analysis, precision will be determined by having the technical advisor perform an evaluation on the citizen analysts as discussed in Section 14.2 of this QAPP and the results shall meet the data quality objectives stated in Table 7.4.

Instructions for Determining Precision (chemical analyses):

All volunteers run tests on the same sample. Record all results from the test for each instrument. Determine the average value. Calculate the standard deviation and determine the percent precision. Compare the percent precision result to the precision objective set in Tables 7.1- 7.4. If the precision is outside of the objectives, corrective action will be taken to improve performance. We will consult our technical advisors to determine the appropriate corrective action.

During a recent training session, volunteer monitors checked their pH meters against a standard buffer solution of pH 7.0. The following results were read:

7.5	7.2	6.5	7.0
7.4	6.8	7.2	7.4
6.7	7.3	6.8	7.2

Determine the average result. Most calculators will determine a standard deviation. To calculate:

standard deviation: $S = \sqrt{\frac{1}{n-1}\sum_{1}^{n}(x_i - \overline{x})^2}$

Precision = (standard deviation / average) X 100

The standard deviation of these measurements is 0.32. The average is 7.08. The precision is 4.5%. This level of precision is within the objective of 10 percent.

Table 7.8 Example: Data Quality Form: Precision

Parameter/ units	Date	Mean (x)	Standard Deviation (s.d.)	s.d./ x (%)	Precision Objective	Meet Objective? yes or No	Corrective action planned	Date Corrective Action taken
Temperature ^{o} C	5/21/96	22.0	0.53	2.4%	± 10%	Yes	Precision calculated on corrected thermometers (see accuracy info).	
Dissolved Oxygen (mg/L)	5/21/96	8.4	1.0	11.9 %	± 10%	No	Re-training needed. Volunteers were over-titrating, need to stir thoroughly and add drop by drop near endpoint.	6/15/96

pH standard units	5/21/96	7.8	0.39	5.0%	± 10%	Yes	none needed	
Conductivity (umhos/cm)	5/21/96	735	59	8.0%	± 10%	Yes	none needed	

7.6. Representativeness

Description: Representativeness describes how relevant the data are to the actual environmental condition.

Problems can occur if:

- Samples are taken in a stream reach that does not describe the area of interest (e.g. a headwaters sample should not be taken downstream of a point source).

- Samples are taken in an unusual habitat type (e.g. a stagnant backwater instead of in the flowing portion of the creek).

- Samples are not analyzed or processed appropriately, causing conditions in the sample to change (e.g. water chemistry measurements are not taken immediately).

Representativeness will be ensured by processing the samples in accordance with Section 10, 11 and 12, by following the established methods, and by obtaining approval of this document.

Procedures: the Team leaders will conduct A review of sampling procedures and audits of sampling events. Any deviations noted are to be reported to the Scientific and Technical Advisory committees.

8. Training Requirements and Certification

All citizen monitoring leaders must participate in three hands-on training sessions on water quality monitoring conducted by the State Water Quality Control Board or have equivalent training as specified by the Technical Advisory Committee on a case by case basis. The following topics are covered under this training:

- General hydrology
- Ecology
- Safety
- Quality Assurance and Quality Control Measures
- Sampling Procedures
- Field Analytical Techniques
- Data recording.

For macroinvertebrate bioassessment citizen monitoring leaders must also participate in a three-day training course provided by the California Department of Fish and Game, the Sustainable Lands Stewardship Institute, the American Fisheries Society, or the State Water Resources Control Board.

Trained citizen monitoring leaders may then train their rank-and-file volunteers. Individual trainees are evaluated by their performance of analytical and sampling techniques, by comparing their results to known values, and to results obtained by trainers and other trainees.

In addition to completion of the above-described training course, the citizen monitoring leaders must participate in semi-annual quality control sessions conducted by through the Yuba Watershed Council Monitoring Committee. The semi-annual quality control sessions will provide an opportunity for citizen monitoring groups to check the accuracy and precision of their equipment as well as of their own testing techniques. The monitor will bring his/her equipment to the session. The monitor will conduct duplicate tests on all analyses and meet the data quality objectives described in Section 7. If a monitor does not meet the objectives, the trainer will re-train and re-test the monitor. If there is insufficient time at the QC session to re-train and re-test monitors, the monitor will be scheduled for an additional training session. The monitor will be encouraged to discontinue monitoring for the analysis of concern until training is completed.

The quality control trainer will examine kits for completeness of components: date, condition, and supply of reagents, and whether the equipment is in good repair. The trainer will check data quality by testing equipment against blind standards. The trainer will also ensure that monitors are reading instruments and recording results correctly. Sampling and safety techniques will also be evaluated. The trainer will discuss corrective action with the volunteers, and the date by which the action will be taken. The citizen monitoring leader is responsible for reporting back that the corrective action has been taken. Certificates of completion will be provided once all corrective action has been completed.

Quality control trainers are defined as water quality professionals from the U.S. Environmental Protection Agency, the State Water Resources Control Board, and the Regional Water Quality Control Boards. Additional qualified trainers will be recruited and designated by these agencies from experienced citizen monitoring organizations, universities and colleges, commercial analytical laboratories, and other federal, state, and local agencies.

9. Documentation and Records

All field results will be recorded at the time of completion, using the data sheets (see Appendix 2). Data sheets will be reviewed for outliers and omissions before leaving the sample site. The citizen monitoring leader will sign data sheets after review. Data sheets will be stored in hard copy form at a specified location unique to each citizen monitoring group. Field sheets are archived for three years from the time they are collected. These data sheets can be found in Appendix 2.

If data entry is performed at another location, duplicate data sheets will be used, with the originals remaining at the headquarters site. Data will be stored electronically every month. Hard copies of all data, as well as computer back-up , are maintained at each group's center of operations. For the Bear River it is 113 Presley Way, Suite 1, Grass Valley, CA, 95945. For the Deer Creek it is 132 Main St, Nevada City, CA, 95959. For the Yuba River it is 216 Main St, Nevada City, CA, 95959.

Each citizen monitoring group will also keep a maintenance log. This log details the dates of equipment inspection and calibrations, as well as the dates reagents are replaced.

Data will be protected using an electronic back-up system along with a battery surge protection, which will automatically back-up incoming data for any power loss and shut down the system.

10. Sampling Process Design

10.1. Rationale for Selection of Sampling Sites

Sampling sites are indicated on the maps in Appendix 3. The following criteria were evaluated when choosing sampling locations:

- access is safe,
- permission to cross private property is granted,
- sample can be taken in main river current or where homogeneous mixing of water occurs,
- sample is representative of the part of the water body of interest,
- location complements or supplements historical data,
- location represents an area that possesses unique value for fish and wildlife or recreational use.

If the monitoring program requires reference sites these locations are chosen upstream of any potential impact. A site chosen to reflect the impact of a particular discharge, tributary or land use should be located downstream of the impact where the impact is completely integrated with the water, but upstream of any secondary discharge or disturbance.

Volunteers are instructed to work in teams of at least two people. If a scheduled team cannot conduct the sampling together, the available team member will call an additional member.

Prior to final site selection, permission to access the stream is obtained from all property owners. If access to the site is a problem, the citizen monitoring leader will select a new site. Safety issues are included in Monitoring Manual.

The leader will review sample sites. A short report will be made about the site. The report will describe conditions and include photographs. Methods for photographic monitoring can be found in the SWRCB Draft Compendium for Citizen Water Quality Monitoring and Assessment.

10.2. Sample Design Logistics

Volunteers are instructed to work in teams of at least two people. If a scheduled team cannot conduct the sampling together, the team captain is instructed to contact the citizen monitoring leader so that arrangements can be made for a substitute trained volunteer.

Prior to final site selection, permission to access the stream is obtained from all property owners. If access to the site is a problem, the citizen monitoring leader will select a new site following the site selection criteria identified in Section 10.1.

Safety measures will be discussed with all volunteers. No instream sampling will be conducted if there are small creek flood warnings or advisories. It is the responsibility of the citizen monitoring organization to ensure the safety of their volunteer monitors. Safety issues are included in the individual watershed monitoring manuals.

11. Sampling Method Requirements

The individual watershed monitoring manuals describe the appropriate sampling procedure for collecting samples for water chemistry. Samples will be taken with either a Van Dorn, Niskin, or Kemmerer sampling device, a LaMotte dissolved oxygen sampling device, or by dipping a plastic container or glass sediment sampler (DH48 style) into the midstream of a wadeable creek.

Sampling devices will be rinsed three times with sample water prior to taking each sample except for prepared bottles provided by laboratory. Whenever possible, the collector will sample from a bridge so that the creek is not disturbed from wading. All samples are taken in mid-stream, at least one inch below the surface. Sampler will wear gloves when taking dissolved oxygen (Winkler Titration Method), metals, and bacteria samples. If it is necessary to wade into the water, the sample collector stands downstream of the sample, taking a sample upstream. If the collector disturbs sediment when wading, the collector will wait until the effect of disturbance is no longer present before taking the sample.

The following table describes the sampling equipment, sample holding container, sample preservation method and maximum holding time for each parameter.

Table 11.1 Sampling Method Requirements

Parameter	Sampling Equipment	Preferred / Maximum Holding Times
Conventional Parameters		
Temperature	Digital, plastic or glass container or sample directly	Within 15 minutes
Dissolved Oxygen	glass D.O. bottle	Within 15 minutes / fix per protocol instructions, continue analysis within 8 hr. Sampler will wear gloves.
PH	plastic or glass container	Within 15 minutes
Conductivity	plastic or glass container	Within 15 minutes/ refrigerate up to 28 days

Turbidity	plastic or glass container	Within 15 minutes/ store in dark for up to 24 hr.
Nutrients		
Ammonia	Van Dorn, LaMotte or plastic sampling bottle	Within 15 minutes or within 8 hours if the sample is acidified with sulfuric acid to less than 3.0 pH
Nitrates	Van Dorn, LaMotte or plastic sampling bottle	Within 15 minutes / refrigerate in dark for up to 48 hr.
Orthophosphate	Van Dorn, LaMotte or plastic sampling bottle	Within 15 minutes or refrigerate immediately and analyze within 8 hours
Laboratory Analysis of Chemical Parameters		
Metals	Acid and d.i. water rinsed plastic sampling bottle	Send to lab immediately; fix with Ultrapure (or comparable) nitric acid. Sampler will wear gloves.
Total Petroleum Hydrocarbons	Solvent rinsed and dried rinsed glass sampling bottle, Teflon liner in lid	Send to lab immediately
Toxicity	Acid and DI water rinsed. Triple rinsed with sample	Refrigerate to 4^{o}C, send to lab immediately
Pesticides	Solvent and DI water triple rinsed with sample water glass sampling bottle, Teflon liner in lid	Refrigerate to 4 degrees C, send to lab immediately
Biological Samples		
Bacteria	sterile plastic sampling bottle or whirl-pack	Refrigerate to 4 degrees C in the dark; delivered to the lab within 4 hours, start analysis within 6 hours, unless precluded by distant transportation issues in which case no later than 24 hours from sampling; sampler will wear gloves.
Benthic macroinvertebrates	wide mouth plastic bottles	Fixed with ethanol immediately

12. Sample Handling and Custody Procedures

12.1. Sample Handling

Identification information for each sample will be recorded on the field data sheets (see Appendix 2) when the sample is collected. Samples are normally processed in the field. Split samples and samples that are not processed immediately will be labeled with the waterbody name, sample location, sample number, data and time of collection, sampler's name, and method used to preserve sample (if any).

12.2. Custody Procedures

The conventional water quality monitoring tests do not require specific custody procedures since they will, in most cases, be conducted immediately by the same person who performs the sampling. In certain circumstances (such as driving rain or extreme cold), samples will be taken to a nearby residence for analysis. The dissolved oxygen samples will be fixed prior to transport.

When samples are transferred from one volunteer to another member of the citizen monitoring group for analysis, or from the citizen monitoring program to an outside professional laboratory, then a Chain of Custody form should be used. This form identifies the waterbody name, sample location, sample number, data and time of collection, sampler's name, and method used to preserve sample (if any). It also indicates the date and time of transfer, and the name and signature of the sampler and the sample recipient. It is recommended that the Chain of Custody form used be the one provided by the outside professional laboratory. When a professional lab performs quality control checks, their samples will be processed under their chain of custody procedures with their labels and documentation procedures.

For benthic macroinvertebrate samples, the California Department of Fish and Game Aquatic Bioassessment Laboratory Chain of Custody form will be used.

12.3. Disposal

All analyzed samples (except for waste from the nitrate/cadmium reduction test and the Nessler ammonia test) including used reagents, buffers or standards will be collected in a plastic bottle clearly marked "Waste" or "Poison". This waste material will be disposed of according to appropriate state and local regulations. This will usually mean disposal into a drain connected to a sewage treatment plant.

Liquid waste from the cadmium reduction nitrate test will be kept separate and disposed of at a facility that is permitted to handle, transport, or dispose Cd waste. Liquid waste from the Nessler ammonia test (which contains mercury) likewise will be kept separate and disposed of at a facility that is permitted to handle, transport, or dispose Hg waste. Waste from the zinc reduction nitrate test and the salicylate ammonia test can be held in the regular waste container and disposed of as described in the previous paragraph.

13. Analytical Methods Requirements

Water chemistry is monitored using protocols outlined in the SWRCB compendium. The methods were chosen based on the following criteria:

- capability of volunteers to use methods,
- provide data of known quality,
- ease of use,
- methods can be compared to professional methods in Standard Methods.

If modifications of methods are needed, comparability will be determined by side-by-side comparisons with a US EPA or APHA Standard Method on no less than 50 samples. If the results meet the same precision and accuracy requirements as the approved method, the new method will be accepted.

Table 13.1 outlines the methods to be used, any modifications to those methods, and the appropriate reference to a standard method.

Table 13.1 Analytical Methods for Water Quality Parameters

Parameter	Method	Modification	Reference (a)
Temperature	Thermometric	Alcohol-filled thermometer marked in 0.5^{o}C increments	2550 B.
Dissolved Oxygen	Winkler Method, Azide Modification	Prepackaged reagents, 20 ml sample size	4500-O C.
Dissolved Oxygen	Membrane Electrode	none	4500-O G.
pH	Electrometric	none	4500-H B.
Turbidity	Nephelometric	none	2130 B
Ammonia	Phenate	Prepackaged reagents, Salicylate with color comparator	4500 - NH3 F.
Ammonia	Nessler or phenate/salicylate	Prepackaged reagents, colorimeter or spectrophotometer	4500 – NH3 C 18th edition only (1992)
Nitrate	Cadmium Reduction or Zinc reduction	Prepackaged reagents, color comparator	4500 – $NO3^-$ E.
Nitrate	Cadmium Reduction or Zinc reduction	Prepackaged reagents, colorimeter or spectrophotometer	4500 – $NO3^-$ E.
Ortho-Phosphate	SnCl2	Prepackaged reagents, color comparator	4500-P D
Ortho-Phosphate	Ascorbic acid	Prepackaged reagents, colorimeter or spectrophotometer	4500 – P E.
Total Suspended Solids	Filter, Dehydrate, Weigh	none	2540 D

Enterococcus Bacteria	Enterolert 24 hour	none	Idexx
E. Coli Bacteria	Colilert 18 hour	none	9223 B
Benthic Macroinvertebrates	California Stream Bioassessment Protocol	Level 2 (to family only)	Harrington, Jim, CDFG, 1997

All of the above cited methods, with the exception of enterococcus bacteria, and benthic macroinvertebrates are described in Standard Methods for the Examination of Water and Wastewater: Andrew D. Eaton, Lenore S. Clesceri, Arnold E. Greenberg, Mary Ann H. Franson.
Standard Methods for the Examination of Water and Wastewater, prepared and published jointly By American Public Health Association, American Water Works Association, Water Environment Federation, 20th edition, Washington, DC: American Public Health Association, 1998.

14. Quality Control Requirements

Quality control samples will be taken to ensure valid data are collected. Depending on the parameter, quality control samples will consist of field blanks, replicate samples, or split samples. In addition, quality control sessions (a.k.a. intercalibration exercises) will be held twice a year to verify the proper working order of equipment, refresh volunteers in monitoring techniques and determine whether the data quality objectives are being met.

14.1. Cautions Regarding Test Procedures

14.1.1. Dissolved Oxygen Test

The Winkler method is not appropriate for highly alkaline waters.

Other citizen monitoring groups have noted problems with short shelf-life of the sodium thiosulfate reagent. Field measurements should be evaluated immediately to determine whether they are reasonable.

14.1.2. Nutrients

The nitrate test measures nitrite as well as nitrate. When mixing nitrate reagents take care not to agitate aggressively. The LaMotte phosphate reagents have been shown to degrade well within their listed shelf life once opened.

14.2. Field/Lab Blanks, Duplicate Field Samples, and Split Samples

Table 14.1 describes the quality control regimen.

Field/Laboratory Blanks: For turbidity and specific chemical analysis (see Table 14.1) performed in the field blanks (a.k.a. reagent blanks) will be taken once every 20 samples, or quarterly whichever comes first except for nutrient sampling. For nutrients and chlorine using comparators, a reagent blank sample will be analyzed every sampling trip. Color can sometimes appear in these nutrient blanks, suggesting that the real samples may be overestimating the true nutrient concentration. When colorimeters or spectrophotometers are used at the group's facility for nutrient analysis, a laboratory reagent blank will be analyzed and recorded for each day of analysis.

Instructions for Field and Lab Blanks: Distilled water is taken into the field or used in the laboratory and handled just like a sample. It will be poured into the sample container and then analyzed. Field blanks are recorded on the normal sampling datasheet. For nutrients measured with comparators, results from the field blanks should be "not detected". If nutrients are detected, corrective action will be taken to eliminate the problem. For nutrients measured with colorimeters, the reagent blanks should be less than 0.05 ppm and the specific value should be recorded and subtracted from the field sample result.

Duplicate Field Samples: For chemical, physical, and bacterial analysis duplicate field samples will be taken once every 20 samples, or quarterly whichever comes first. Duplicate samples will be collected as soon as possible after the initial sample has been collected, and will be subjected to identical handling and analysis.

No duplicate field samples for benthic macroinvertebrate sampling.

Benthic Identification Verification. A minimum 20% of the benthic macroinvertebrate samples will be subjected to validation by an outside professional taxonomist. Following analysis by the citizen group the selected samples will be reconstituted and sent out for professional level 3 taxonomic analyses. Reconstituted means opening the vials containing the 100 identified specimens, pouring the specimens back into the original sample jar, and gently stirring the contents. In addition, once a year, citizen macroinvertebrate analysts will participate in an intercalibration exercise in which their subsampling/sorting and taxonomic skills will be evaluated. A minimum of two teams of analysts will each inspect each other's processed grids immediately following completion of the subsampling procedure. There should be no more than 10% missed organisms. A technical advisor should then evaluate each of the citizen analysts by testing their identification to order and family level on at least 20 specimens, including at least one representative from each of the major orders and families as determined by the technical advisor for that watershed. Accuracy and precision can be determined by the results of these validation and evaluation measures.

Table 14.1 Quality Control Requirements

Parameter	Blank	Duplicate Sample	Split Sample to lab	QC session
Water quality				
Temperature	None	5% or a minimum of once a year	none	twice a year
Dissolved Oxygen	None	5% or a minimum of once a year	none	twice a year
pH	None	5% or a minimum of once a year	none	twice a year

Conductivity	5%	5% or a minimum of once a year	twice a year	twice a year
Turbidity	5%	5% or a minimum of once a year	twice a year	twice a year
Nutrients comparators				
Ammonia	daily	5% or a minimum of once a year	twice a year	twice a year
Nitrate	daily	5% or a minimum of once a year	twice a year	twice a year
Orthophosphate	daily	5% or a minimum of once a year	twice a year	twice a year
Nutrients (colorimeters or spectrophotometers)				
Ammonia	daily	5% or a minimum of once a year	twice a year	twice a year
Nitrate	daily	5% or a minimum of once a year	twice a year	twice a year
Phosphate	daily	5% or a minimum of once a year	twice a year	twice a year
Biological Parameters				
Benthic Invertebrates	none	None, instead conduct verification of identification by outside professional service	20% per year	once a year
e. coli Coliform	Daily	5% or a minimum of once a year	twice a year	twice a year
Enterococcus Bacteria	Daily	5% or a minimum of once a year	Twice a year	

15. Instrument/Equipment Testing, Inspection and Maintenance Requirements

The monitoring group leader keeps a maintenance log. This log records reagent use, and any problems noted with equipment. Calibration information is recorded on the datasheets.

15.1. Temperature

Before each use, thermometers are checked for breaks in the column. If a break is observed, the alcohol thermometer will be placed in nearly boiling water so that the alcohol expands into the expansion chamber and the alcohol forms a continuous column. Verify accuracy by comparing with a calibrated or certified thermometer.

15.2. Dissolved Oxygen

Before each use, bottles, droppers, and color comparators are checked to see if they are clean and in good working order. Reagents are replaced according to manufacturer's recommendation.

15.3. pH and Conductivity

Before each use, pH and conductivity meters are checked to see if they are clean and in good working order. pH and conductivity meters are calibrated before each use. pH buffers and conductivity standards are replaced at least annually or prior to expiration date, whichever is sooner. Conductivity standards are stored with the cap firmly in place and in a dry place kept away from extreme heat. Do not re-use pH or conductivity standards.

15.4. Turbidity

Before each use, turbidity tubes are checked to ensure that they are clean. The turbidity standard will be replaced prior to expiration date.

15.5. Nutrients

Before each use, test kits are checked to ensure that droppers, sample containers, and color comparators are clean and in working condition. Reagents are replaced according to manufacturer's instructions.

16. Instrument Calibration and Frequency (chemical and physical parameters)

Instruments will be calibrated accordingly to the following schedule. Standards will be purchased from a chemical supply company or prepared by a laboratory certified by U.S. EPA for chemical analysis of water or wastewater. Calibration records will be kept at a location where they can be easily accessed before and after equipment use. This will likely be at the citizen monitoring organization's main office or the volunteer monitor's home.

Table 16.1 Instrument Calibration and Frequency Conventional Water Quality Parameters

Equipment Type	Calibration Frequency	Standard or Calibration Instrument Used
Temperature	Every 6 months	NIST calibrated or certified thermometer
Dissolved Oxygen (Winkler)	Prepare fresh solution or check sodium thiosulfate, or check against a saturated oxygen standard every 6 months	titration
Dissolved Oxygen Meter	Every sampling day	At a minimum, water saturated air, according to manufacturer's instructions.
pH	Every sampling day	pH 7.0 buffer
Conductivity	Every sampling day	conductivity standard

Turbidity meter (nephelometer)	Every sampling day	For clear ambient conditions use an 1.0 NTU standard, for turbid conditions use an 10.0 NTU standard

Nutrients (using comparators)

Equipment type	Standardization frequency (test standard)	Standard or Calibration Instrument Used
Ammonia	every 6 months or when reagents replaced	ammonia standard
Nitrate	every 6 months or when reagents replaced	nitrate standard
Ortho-Phosphate	every 6 months or when reagents replaced	phosphorous standard

Nutrients (using colorimeters or spectrophotometers)

Equipment type	Standardization frequency (test standard)	Standard or Calibration Instrument Used
Ammonia	Every day of analysis	ammonia standard
Nitrate	Every day of analysis	nitrate standard
Ortho-Phosphate	Every day of analysis	phosphorous standard

17. Inspection/Acceptance Requirements

Upon receipt, buffer solutions, standards, and reagents used in the field kits will be inspected by the citizen monitoring leader for leaks or broken seals, and to compare the age of each reagent to the manufacturer's recommended shelf-life. All other sampling equipment will be inspected for broken or missing parts, and will be tested to ensure proper operation.

Before usage, thermometers are inspected for breaks. Breaks can be eliminated by heating (see Section 15.1). If not, they will be returned to the manufacturer.

Reagents are replaced before they exceed manufacturer's recommended shelf life. These shelf lives are typically one to two years. However, specific replacement dates can determined by providing the reagent lot number to the LaMotte Company by phone at (800) 344-3100 or facsimile at (410) 778-6394. Reagent replacement dates are noted in the maintenance log.

18. Data Acquisition Requirements

18.1. Analytical Data

Only certified analytical laboratories or academic laboratories (with approval of State and/or Regional Board staff) will be used for quality assurance checks. The Technical Advisory

Committee (TAC) or technical advisors will review these laboratories' data as well as the volunteers'. They will review the lab's own quality control data to ensure data validity.

18.2. Geographical Information/ Mapping

USGS maps will be used to verify watershed boundaries and river courses. NOAA navigation charts can be used for mapping marine sampling sites. Additional information on distribution of natural resources will be obtained from the National Park Service and the CDFG's Biodiversity database. Land use information will be obtained from local planning offices. When information is requested, the agency will be asked to provide appropriate metadata and any information on data limitations. This information will be maintained with the data files.

19. Data Management

Field data sheets are checked and signed in the field by the citizen monitoring leader. The citizen monitoring leader will flag as unusable any results where holding times have been exceeded, sample identification information is incorrect, samples were inappropriately handled, or calibration information is missing or inadequate.

Independent laboratories will report their results to the citizen monitoring leader. The leader will verify sample identification information, review the Chain-of-Custody forms, and identify the data appropriately in the database. These data are also reviewed by the technical advisors(in terms of assessing the environmental implications of that data, but not in terms of data quality).

The data management coordinator will review the field sheets and enter the data deemed acceptable by the citizen monitoring leader and the technical advisors. Data will be entered into an MS Excel or Access format spreadsheet or a database using a format that is compatible with the State Water Resources Control Board or Regional Water Quality Control Board's database guidelines. The data coordinator will review electronic data, compare to the original data sheets and correct entry errors. After performing data checks, and ensuring that data quality objectives have been met, data analysis will be performed.

Raw data, once approved by the TAC, will be provided to the SWRCB and RWQCB in electronic form at least once every year, so that it may ultimately be included in the 305(b) report. Appropriate quality assurance information can be provided upon request.

20. Assessment and Response Actions

Review of all field and data activities is the responsibility of the citizen monitoring leader, with the assistance of the technical advisory committee. Volunteers will be accompanied by the citizen monitoring leader, or a technical advisor on at least one of their first 5 sampling trips. If possible, volunteers in need of performance improvement will be retrained on-site. All volunteers must attend a refresher course offered by the citizen monitoring group or Yuba Watershed Council Monitoring Committee. If errors in sampling technique are consistently identified, retraining may be scheduled more frequently.

State and EPA quality assurance officers as requested may review all field and laboratory activities, and records.

21. Reports

The technical advisors will review raw data to be included in reports to ensure accuracy, precision, and proper data analysis. After approval by the TAC raw data reports will be made available to data users per their request. The individual citizen monitoring organizations will report their data to their constituents after quality assurance has been reviewed and approved by their technical advisors. Every effort will be made to submit approved data and/or reports to the State and/or Regional Board staff in a fashion timely for their data uses (e.g. 305(b) report or special watershed reports) on an annual basis minimum.

22. Data Review, Validation and Verification

Data sheets or data files are reviewed every six months by the technical advisors to determine if the data meets the Quality Assurance Project Plan objectives. They will identify outliers, spurious results or omissions to the citizen monitoring leader. They will also evaluate compliance with the data quality objectives. They will suggest corrective action that will be implemented by the citizen monitoring leader. Problems with data quality and corrective action will be reported in final reports. A quorum should be established (1/2 + 1) and used for technical advisory committee decisions. If a quorum does not show up at the meeting, work can still proceed. The work product (e.g., review and comments on monitoring results) must then be sent out to the whole committee for approval with a 30-day review period. This approach will prevent delays and make for efficient and timely feedback to the monitors.

23. Validation and Verification Methods

As part of standard field protocols, any sample readings out of the expected range will be reported to the citizen monitoring leader. A second sample will be taken as soon as possible to verify the condition. It is the responsibility of the citizen monitoring leader to re-train volunteers until performance is acceptable.

24. Reconciliation with DQOs

The Technical Advisory Committee will review data every six months to determine if the data quality objectives (DQOs) have been met. They will suggest corrective action. If data do not meet the project's specifications, the following actions will be taken. First, the technical advisors will review the errors and determine if the problem is equipment failure, calibration/maintenance techniques, or monitoring/sampling techniques. If the problem cannot be corrected by training, revision of techniques, or replacement of supplies/equipment, then the technical advisors and the TAC will review the DQOs and determine if the DQOs are feasible. If the specific DQOs are not achievable, they will determine whether the specific DQO can be relaxed, or if the parameter should be eliminated from the monitoring program. Any revisions to

DQOs will be appended to this QA plan with the revision date and the reason for modification. The appended QA plan will be sent to the quality assurance panel that approved this plan. When the appended QA plan is approved, the citizen monitoring leader will work with the data coordinator to ensure that all data meeting the new DQOs are entered into the database. Archived data can also be entered.

APPENDIX 1. Data Quality Forms

Data Quality Form: Accuracy Quality Control Session

Monitoring Group Name	Type of Session (field or lab)
Your Name	Quality Assurance Leader
Date	

Parameter/ units	Sensitivity	Accuracy Objective	Standard Conc.	Analytical Result	Estimated Bias	Meet Objective? Yes or No	Corrective action planned	Date Corrective Action taken
Temperature ^{o} C								
Dissolved Oxygen (mg/L)								
pH standard units								
Conductivity (uS)								

Comments:

Data Quality Form: Completeness Quality Control Session

Monitoring Group Name			Type of Session (field or lab)	
Your Name			Quality Assurance Leader	
Date				
Parameter	Collection Period	No. of Samples Anticipated	No. Valid Samples Collected and Analyzed	Percent Complete
Temperature ^{o}C				
Dissolved Oxygen (mg/L)				
pH standard units				
Conductivity (uS)				

Comments:

Data Quality Form: Precision Quality Control Session

Monitoring Group Name	Type of Session (field or lab)
Your Name	Quality Assurance Leader
Date	

Parameter/ units	Mean (x)	Standard Deviation (s.d.)	s.d./x	Precision Objective	Meet Objective? Yes or No	Corrective action planned	Date Corrective Action taken
Temperature ^{o} C							
Dissolved Oxygen mg/L							
pH standard units							
Conductivity (uS)							

Comments:

APPENDIX 2. Data and Observation Sheets

APPENDIX 3. Maps of Sampling Sites