QUALITY ASSURANCE PROJECT PLAN FOR THE SACRAMENTO WATERSHED COORDINATED MONITORING PROGRAM

February 2009

FINAL

State of California The Resources Agency Department of Water Resources

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3.0 Distribution List

All project staff at the Department of Water Resources (DWR) Northern District and all Central Valley Regional Water Quality Control Board (Regional Board) staff listed in the table below will receive copies of this Quality Assurance Project Plan (QAPP) and any approved revisions of the plan. The plan will be held at the DWR Northern District and will be available to any interested parties after final approval. To receive a copy a request can be made to the DWR Northern District Technical Leader.

Table 3.1 Distribution list

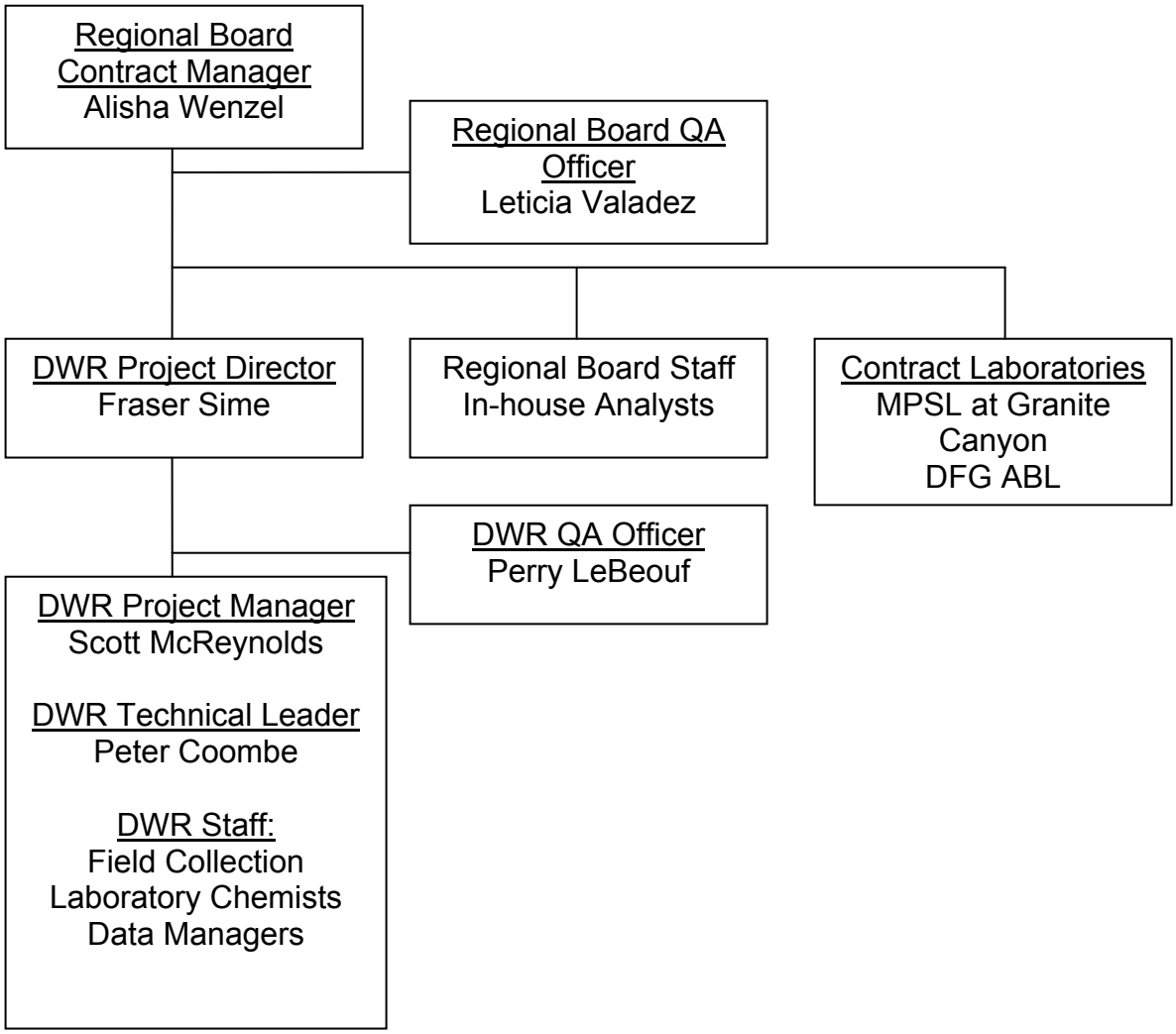
Title	Name and Affiliation	Telephone Number	QAPP Copy Number
Contractor Project Director	Fraser Sime (DWR)	(530) 529-7374	1-1
Contractor Project Manager	Scott McReynolds (DWR)	(530) 529-7304	2-1
Contractor QA Officer	Perry Lebeouf (DWR)	(530) 529-7345	3-1
Contractor Technical Leader	Peter Coombe (DWR)	(530) 529-7377	4-1
Contract Manager	Alisha Wenzel (Regional Board)	(916) 464-4717	Original
QA Officer	Leticia Valadez (Regional Board)	(916) 464-4634	5-1
Technical Advisor	Dennis Heiman (Regional Board)	(530) 224-4851	6-1

4.0 Project-Task Organization

A coordinated monitoring program has been initiated by the Regional Board and DWR Northern District. The Regional Board has contracted the DWR Northern District to conduct all field activities, including the collection of field measurements. The DWR Northern District is responsible for laboratory analyses of inorganic and conventional analytes, with the exception of pathogens. These constituents will be analyzed at DWR Bryte Laboratory in West Sacramento. The Regional Board is responsible for the laboratory analyses of pathogens, water column toxicity, and bioassessment. Pathogen analyses will be conducted in house by the Regional Board. The Regional Board has contracted the UC Davis Marine Pollution Studies Laboratory (MPSL) at Granite Canyon to analyze water column toxicity and Department of Fish and Game (DFG) Aquatic Bioassessment Laboratory (ABL) to analyze bioassessment samples. Below is a list of all necessary Project Personnel roles to assure data quality and timely delivery of reliable and usable monitoring data.

- The **Project Director** will provide supervision of all tasks and people related to the project. The director will be responsible for various project audits at their discretion in order to ensure the Monitoring Plan and QAPP directives are met.

Figure 4.1 Project organizational chart



- The **Project Manager** will be responsible for all contract management tasks including; invoicing and reporting, oversight of project progress, and for collaboration with other agencies and stakeholders active in the watershed.

- The **Technical Leader** of this Project is the author of the QAPP and co-author of the Monitoring Plan and will be responsible for the scientific integrity of the data collection effort throughout the duration of the project. The Technical Leader is responsible for maintaining the official, approved quality assurance project plan. The Technical Leader is also responsible for technical dialogs with advisors and experts related to the project.

- The **Quality Assurance Officer** works independently from the Project Manager and Technical Leader and is responsible for the data meeting all quality objectives.

- CA DWR Field Data Collectors, Laboratory Personnel, and Data Managers will provide the workforce for all field collection activities, laboratory analyses, and data management functions of the project.

5.0 Problem Definition and Background

The California Department of Water Resources (DWR) has monitored water quality at sites in the Northern Sacramento River Watershed of California since its formation in 1956. Water quality data in the region had been collected previously by the Department's water quality predecessor, the Division of Water Resources of the Department of Public Works since the early 1900's.

Water quality data collected by DWR is used by a wide range of individuals, public and private agencies, and is ultimately the foundation on which these agencies base water planning and management decisions. This monitoring provides data and reports that are useful for determining long-term changes in water quality, as well as to determine if water quality parameters are meeting Basin Plan Objectives established by the California Regional Water Quality Control Boards.

Due to technological improvements and budgetary constraints, parameters assessed have varied over the course of monitoring throughout the northern Sacramento River Watershed. During much of the earlier monitoring at water quality stations, field measurements were taken and samples were submitted for laboratory analyses for mainly a few mineral parameters only when a general indicator such as conductivity was outside the range of previous measurements. This practice tended to skew the data to the extremes outside of normal measurements and provided data on only a very limited set of parameters.

Currently samples are collected on a more regular basis where timing plays a key role in providing representative data. Samples and field data are collected quarterly at defined water quality stations in the Northern Sacramento Watershed. DWR now has the ability to analyze a wide range of physical, chemical, and biological parameters with its own in-house lab, Bryte Laboratory, located in West Sacramento.

As the importance and scope of water quality regulations increase over time in the California, we will need to provide the State and its constituents with easily accessible, current, and defensible water quality data in the DWR's Water Data Library (WDL). The WDL database is managed by DWR which has streamlined the process of organizing and distributing water quality data. (www.wdl.water.ca.gov).

A coordinated monitoring program has been initiated between the Central Valley Regional Water Quality Control Board and the Northern District office of the Department of Water Resources to continue water quality data collection in the

Northern Sacramento Region. The new monitoring program has been designed to coincide with many of DWR's historical water quality stations. Several new stations which are of concern to the Regional Board have been added. The program will include 41 stations selected to meet the requirements of the Program Design Concept.

5.1 Decision Statement

This monitoring effort will address long term water quality issues and 303(d) reporting needs of the Northern Sacramento Watershed. The effort will provide critical water quality data needed to determine if stream and river conditions over time are getting generally better or worse. Two key questions will be addressed in this Monitoring Program:

1. What are the ambient water quality conditions and are current management activities protecting beneficial uses?

2. What does the evaluation of trends with respect to water quality and the biological communities tell us about the state of the watershed?

In order to answer these questions monitoring work will be performed at designated stations on a quarterly basis. Samples will be acquired using the guidelines of this QAPP document.

6.0 Project Task / Description

Sample events will be scheduled to represent the winter runoff, spring snowmelt, irrigation, and dry seasons. During the 2008-2009 fiscal year samples will be collected two times. During the 2009-10 and 2010-11 fiscal years, samples will be collected four times. Table 6.1 lists target completion dates for key products.

Table 6.1 Project schedule

Product	Target Completion Date
Field Sampling	Beginning March 2009 and repeating quarterly through June 2011
Access to Field and Laboratory Data	3 months sampling event*
Annual Data Summary Reports to Contract Manager	June 15 of each project year
Fact Sheets Summarizing Project Findings	
-Year 1 Data	June 2010
-Completed Project Data	September 2011

*Toxicity and bioassessment data may take longer

Table 6.2 lists minimum constituents which will be measured at all sample sites. Information on the sampling schedule is in the Monitoring Plan.

Table 6.2 Minimum constituents to be monitored

Conventional Analytes	
Physical Parameters:	**Nutrients:**
Temperature- 15 Minute Continuous	Total Ammonia as Nitrogen
pH	Total Kjeldahl Nitrogen
Electrical Conductivity	Total Organic Nitrogen
Dissolved Oxygen	Dissolved Ammonia
Turbidity	Dissolved Nitrate + Nitrite
Total Suspended Solids	Dissolved Ortho-phosphate
Minerals:	Total Phosphorus
Alkalinity	Total Organic Carbon
Total Hardness	Dissolved Organic Carbon
Inorganic Analytes	
Metals:	
Total Arsenic	
Dissolved Arsenic	
Total Copper	
Dissolved Copper	

As funding permits, the Regional Board will analyze additional constituents listed in Table 6.3. Limited funding and logistics may require that fewer sites are sampled and/or that sites are samples less frequently for these constituents. The sites are prioritized in the Monitoring Plan. Sample sites and coordinates are listed in Table 6.4.

Table 6.3 Optional constituents to be monitored

Pathogens
Total Coliform
E. Coli
Toxicity
96-Hour Ceriodaphnia dubia
96-Hour Hyalella azteca
Bioassessment
Benthic Macroinvertebrates

6.1 Constraints

While making the best effort to collect data project constraints include:

- Intermittent streams and rivers can not be sampled certain times of year when water is not present.
- Flow data may be unavailable at some locations, and flow data gaps may exist when using data from other agencies.
- Inclement weather- snow or flooding may cause station to be inaccessible or unsafe to sample.
- Vandalism or theft of in-situ temperature loggers will result in loss of continuous data.

In the event one of these project constraints or unforeseen constraints occur the Project Manager will be notified immediately; the problem will be addressed and recorded in the project notes.

6.2 Study Site Description

The Sacramento River Watershed is approximately 27,000-square-miles and covers 17 percent of California's land area. The watershed consists of a major valley (Sacramento Valley) bounded by several mountain ranges: the Coast Range to the west, the Cascade and Klamath Ranges to the north and the Sierra Nevada Mountains to the east. The watershed drains from northern California from the Oregon border to the Delta, where it joins the San Joaquin River and San Francisco Bay.

The Sacramento River is the largest river in the watershed, with an annual average stream flow volume of 22 million acre-feet. The river is also the longest in the State, extending over 327 miles Major tributaries to the Sacramento River include the Feather, Yuba, American, and Pit Rivers. The main stem of the Sacramento River and most if its major tributaries have been developed for water storage, flood control, and power generation.

As California's most productive watershed more than 2 million acres of irrigated agriculture are sustained in the watershed. In the Sacramento Valley, the river is a main water source for irrigating the valley's crops including: rice, orchard crops, vegetables and grains. The Sacramento River is also an important source of drinking water for people in the watershed, and for millions of Californians south of the Delta, including those living in Southern California.

The Sacramento Valley and its tributaries provide important habitat for many varieties of fish, birds and terrestrial species. The river corridor is a critical part of the Pacific Flyway, one of four main North American bird migration routes between the Arctic and Central and South America. The river and its tributaries are also important conduits for salmon migrating between spawning grounds.

Table 6.4 Sample sites description and coordinates

Station #	Station Name	DWR Station Number	LATITUDE	LONGITUDE
1	North Fork Pit River at Alturas	A1210000	41.48198393	-120.5385893
2	South Fork Pit River near Alturas	A1415000	41.46114992	-120.5499788
3	Pit River near Canby	A1168000	41.40009903	-120.9349596
4	Fall River at Glenburn	A1723000	41.08848464	-121.4931669
5	Pit River at Pittville	A1127000	41.04555265	-121.3317534
6	McCloud River above Shasta Lake	A2215000	40.94034040	-122.2452817
7	Sacramento River at Delta	A2130000	40.93828017	-122.4169114
8	Pit River near Montogomery Creek	A1102000	40.84027902	-122.0163045
9	Cow Creek near Millville	A4811000	40.53210129	-122.2384127
10	Clear Creek near mouth near Redding	A3601000	40.50922234	-122.3799984
11	Churn Creek near Anderson	A0079000	40.48031800	-122.3067090
12	Stillwater Creek near Anderson	A0079500	40.47981100	-122.2590940
13	Bear Creek near Anderson	A0407000	40.44772800	-122.1966070
14	Sacramento River at Balls Ferry	A0281500	40.41761741	-122.1933392
15	Battle Creek at Jelly's Ferry Road Bridge	A4708000	40.39197613	-122.1785906
16	Cottonwood Creek at Cottonwood	A0352050	40.37636267	-122.2824620
17	Paynes Creek near Red Bluff	A4605001	40.31462347	-122.0712628
18	Sacramento River at Bend Bridge	A0278500	40.26363967	-122.2231135
19	Sacramento River below Red Bluff	A0275890	40.15336978	-122.1993204
20	Red Bank Creek at Highway 99W near Red Bluff	A0025800	40.14158373	-122.2121252
21	Antelope Creek near mouth near Red Bluff	A0452050	40.10900306	-122.1102875
22	Elder Creek at Gerber	A0332000	40.05086555	-122.1666056
23	Mill Creek near mouth near Los Molinos	A0442050	40.04294563	-122.1002747
24	Thomes Creek at Hall Road	A0321800	39.97557881	-122.2233350
25	Deer Creek at Hwy 99E near Vina	A0432101	39.94680910	-122.0533036
26	Sacramento River at Vina bridge	A0270000	39.90881935	-122.0918883
27	Sacramento River at Hamilton City	A0263000	39.75110185	-121.9979773
28	Big Chico Creek at Chico	A0425000	39.72716425	-121.8630784
29	Butte Creek below Western Canal Siphon	A0416000	39.72573570	-121.7088705
30	Stony Creek at The Nature Conservancy	A0290000	39.69427000	-121.9896040
31	Honcut Creek at Highway 70	A0571001	39.30929300	-121.5954400
32	Sacramento River at Colusa	A0242000	39.21414646	-122.0003096
33	Butte Slough near Meridian	A0297200	39.17007343	-121.9004622
34	Yuba River at Marysville	A6101050	39.12862241	-121.5970337
35	Bear River near mouth	A6501050	38.95135045	-121.5610630
36	Sacramento River above CBD near Knights Landing	A0223002	38.80502695	-121.7237114
37	Colusa Basin Drain near Knights Landing	A0294710	38.79923112	-121.7250358
38	Feather River near Verona	A5101050	38.79251941	-121.6275467
39	Sutter Bypass at RD-1500 Powerplant	A0292700	38.78455606	-121.6543868
40	Sacramento River at Verona	A0215000	38.77965008	-121.6037306
41	Sacramento River below Knights Landing	A0219501	38.76064223	-121.6782414

7.0 Data Quality Objectives and Acceptability Criteria for Measurement Data

There are two types of quality objectives. Measurement Quality Objectives (MQOs) relate to the quality of the measurement itself (e.g. accuracy or precision). The Data Quality Objectives (DQOs) relate to the entire data set its ability to answer a study question (e.g. completeness or representativeness).

DQOs for the proposed project will be based on MQOs for the analytes listed in Tables 7.1 through 7.2. All monitoring data obtained will be SWAMP-comparable.

The MQOs for field measurements are listed in Table 7.1. Table 7.2 lists the MQOs for laboratory analyses. Because the method for pathogen analysis in this study does not require filtering, the MQOs listed in Table 7.2 differ from those listed in the SWAMP QAPrP. Details on the specific pathogens method and quality assurance procedures can be found in Appendix E, and were reviewed and approved by SWAMP in August, 2007.

Toxicity analyses will comply with all SWAMP protocols. Additional MQOs for data acceptability, test conditions, water chemistry, and sample handling are listed in Appendix A of the SWAMP QAPrP.

MQOs for the equipment used to measure water temperature, dissolved oxygen, conductivity, pH, and turbidity in this project are detailed in Table 7.1. With proper calibration, the range, accuracy, and resolution of each instrument will meet the manufacturer's specifications and meet the MQOs for individual parameters. These parameters are:

- **Accuracy**: A measure of confidence that the data collected in the field and in the laboratory reflect the true value of a given parameter.
- **Range**: Expected values of instruments used to obtain a range of water quality parameters.
- **Resolution**: A measure of how repeatable the data collected is between samples. It determines the consistency of repeated samples that are tested.

Adherence to the three data quality objectives of accuracy, range, and resolution is essential to the QA/QC objectives of the project; these objectives will be monitored by the QA officer to produce viable data of known and accepted quality.

Acceptability criteria for previously collection information are described in Element 18.

7.1 Representativeness and Bias

Representativeness describes how relevant the data are to the actual environmental condition. An important role of the Technical Advisory Personnel is required to actively participate in sample design development, training, and assessment of representativeness of the resulting data. Bias or lack of representativeness can occur if:

- Samples are taken in a stream reach that fails to describe the area of interest,
- Samples are collected in an unusual location, for example: a stagnant pool instead of the flowing portion of the creek,
- Samples are not preserved, stored, or analyzed appropriately, causing conditions in the sample to change, for example: bacteria samples not being analyzed within the 24 hour holding time from collection.

Representativeness and resulting bias will be controlled by appropriate sample site selection and collection as described in this document, the Monitoring Plan, and the SWAMP QAPrP, and by strictly adhering to all aspects of these documents and method SOPs (Appendix A and B).

7.2 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system as compared to the expected amount – usually expressed as a percentage. Completeness will affect our ability to assess ambient water quality conditions at all sites and to interpret water quality trends over time. This project will comply with SWAMP's completeness MQO of 90%.

7.3 Action Limits

An Action Limit is a measurement threshold at which a decision is made to take management action. The primary purposes of this study are to assess beneficial use protection and water quality trends; no management actions will be taken as part of this study. However, where potential concerns are detected in the assessment, the information will be provided to the appropriate Regional Board program for follow-up. Additionally, all data collected in this study will be assessed in the 2010 or 2012 cycle of the Clean Water Act Section 305(b) and 303(d) Integrated Report. Exceedences will be determined by the criteria in *The Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin* and the listing criteria for the current Integrated Report cycle.

Table 7.1 Measurement quality objectives for field measurements

Parameter	Instrument	Units	Range	Detection Limit	Resolution	Accuracy	Completeness	Calibration	Calibration Interval
Temperature	YSI 85	°C	-5 to 65	0.1	0.1	± 0.1	90%	not required	not required
Temperature	Onset HOBO Logger	°C	-20 to 70	0.2	0.02	± 0.2	90%	not required	not required
Dissolved Oxygen	YSI 85	mg/l	0 to 20	0.1	0.01	± 0.3	90%	saturated air	each station
Specific Conductivity	YSI 85	µS/cm	0 to 499.9	1	1	± 0.5	90%	1000 uS/cm standard	one month
pH	Hach sension1	pH Units	-2.00 to 19.99	0.1	0.01	± 0.2	90%	buffer solutions pH 4,7, and 10	weekly
Turbidity	Hach Model 2100P	NTU	0 to 1,000	0.1	0.01	± 0.2	90%	StablCal 2100P Calibration Set	three months

Table 7.2 Measurement quality objectives for laboratory analyses

Quality Control	Frequency of Analysis	Measurement Quality Objective
Conventional Analytes		
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	80-120% recovery RPD<25% for duplicates
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample is <RL)
Internal Standard	Accompanying ever analytical run as method appropriate	Per method
Field Duplicate	5% of project sample count	RPD<25% (n/a if native concentration of either sample<RL)
Field Blank, Equipment Blank	One per field run or per method	<RL for target analyte
Conventional Analytes - Solids		
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Field Duplicate	5% of project sample count	RPD<25% (n/a if native concentration of either sample<RL)

Quality Control	Frequency of Analysis	Measurement Quality Objective
Field Blank, Equipment Blank	One per field run or per method	<RL for target analyte
Conventional Analytes - Pathogens		
Calibration	Temperature recorded at beginning and end of incubation period. Tested with a NIST Certified or NIST Traceable thermometer semiannually.	35°C +/- 0.5°C
Laboratory Blank	Per analytical batch	< RL for target analyte
Laboratory Duplicate	Per 10 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Comparison Counts	Monthly	>90% agreement
Colilert Media Verification	Per lot	Per kit instructions
Field Duplicate	Per 10 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample<RL)
Field Blank	One per field run or per method	<RL for target analyte
Inorganic Analytes		
Calibration Standard	Per analytical method or manufacturer's specifications	Per analytical method or manufacturer's specifications
Continuing Calibration Verification	Per 10 analytical runs	80-120% recovery
Laboratory Blank	Per 20 samples or per analytical batch, whichever is more frequent	<RL for target analyte
Reference Material	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery
Matrix Spike	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery
Matrix Spike Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	75-125% recovery RPD<25% for duplicates
Laboratory Duplicate	Per 20 samples or per analytical batch, whichever is more frequent	RPD<25% (n/a if native concentration of either sample is <RL)
Internal Standard	Accompanying ever analytical run as method appropriate	Per method
Field Duplicate	5% of project sample count	RPD<25% (n/a if native concentration of

Quality Control	Frequency of Analysis	Measurement Quality Objective
		either sample<RL)
Field Blank, Equipment Blank	One per field run or per method	<RL for target analyte
Toxicity Testing		
Laboratory Control Water	Laboratory Control Water consistent with Section 7 of the appropriate EPA method must be tested with each analytical batch	Laboratory Control Water must meet all test acceptability criteria for the species of interest
Conductivity Control Water	A conductivity control must be tested with each analytical batch when the conductivity of any freshwater ambient sample approaches the species' tolerance for conductivity per method	Follow EPA guidance on interpreting data
Reference Toxicant Tests	Reference Toxicant Tests must be conducted monthly for species that are raised within a laboratory. Reference Toxicant Test must be conducted per analytical batch for species from commercial supplier settings.	Last plotted data point must be within 2 SD of the cumulative mean (n=20)
Field Duplicate	5% of project sample count	RPD<25% (n/a if native concentration of either sample<RL)
Field Blank, Equipment Blank	One per field run or per method	<RL for target analyte
Bioassessment		
Taxonomy Verification	20% of samples	
Field Duplicate	10% of project sample count	

8.0 Special Training Requirements/Safety

Specialized training required for this project is an eight hour DWR water quality basics training course. This will be required for all the leaders of field crews and for other crew members. Course participants will receive a completion certificate that will be maintained with periodic updates, for this or other projects that require this kind of specialized training.

Field operators will be required to review the SWAMP training manuals on field measurements, water, sediment, and tissue sampling techniques.

Technical leaders will be required to take a data validation class, a course on Data Quality Objectives (DQOs) and Measurement Quality Objectives (MQOs), and a study design development course, if they have not previously had this training.

8.1 Training and Certification Documents

If additional funds become available and aquatic macroinvertebrate sampling is initiated, a valid CA DFG scientific collecting permit will be required. DWR also requires anyone the works in the field to attend an environmental responsibility course.

8.2 Training Personnel

The Project Manager and the QA Officer will ensure all field collection personnel are appropriately trained in field collection techniques, protocols, and the use of equipment in the field.

9.0 Documentation and Records

Documents and records generated from this project will be organized and stored in compliance with this QAPP. This will allow for future retrieval, and to specify the location and holding times of all records.

9.01 Data Records

All field data gathered by this project will be recorded on weather resistant SWAMP compliant field data entry forms. Field data sheets will be scanned to .PDF format after each sampling run and stored on the Northern District servers indefinitely.

Documentation for analytical data will be kept on file at the laboratory and will be available for review during any external audits by the SWAMP QA Program. The laboratory records will include the analyst's comments on the condition of the

sample and progress of the analysis, raw data, instrument printouts, and results of calibration and QC checks.

9.1 QAPP Updates and Distribution

The Technical Leader will be responsible for developing, maintaining, and updating the Quality Assurance Project Plan (QAPP).
All original QAPPs will be held at DWR Northern District. This QAPP and its revisions will be distributed to all parties involved with the project. Copies will also be sent to the Bryte Laboratory manager for internal distribution. Upon revision, the replaced QAPPs will be discarded.

9.2 Data Archival

Hard copy SWAMP field sheets will be stored in the DWR Northern District's Water Quality and Biology library. After being scanned to a PDF format field sheets will be stored in ring binders for at least 10 years. All PDF files will be stored on the DWR Northern District's servers, which are backed up on a daily basis. PDF files will be stored indefinitely on DWR Northern District's servers or until they are incorporated into the WDL.

9.2.1 Sample Collection Records

Hard copy SWAMP field sheets which outline what samples were collected at each sampling event will be stored in the DWR Northern District's Water Quality and Biology library. After being scanned to a PDF format, field sheets will be stored in ring binders for at least 10 years. All PDF files will be stored on the DWR Northern District's servers which are backed up on a daily basis. PDF files will be stored indefinitely on DWR Northern District's servers or until they are incorporated into the WDL.

9.2.2 Field Records

Hard copy SWAMP field sheets containing field observations and field data entries will be stored in the DWR Northern District's Water Quality and Biology library. After being scanned to a PDF format, field sheets will be stored in ring binders for at least 10 years. All PDF files will be stored on the DWR Northern District's servers which are backed up on a daily basis. PDF files will be stored indefinitely on DWR Northern District's servers or until they are incorporated into the WDL.

9.2.3 Analytical Record Chain of Custody

Chain of Custody forms will be completed for samples received by the laboratory which will follow the samples throughout the analysis and data management

processes. Copies of chain of custody forms will be archived by the labs and accompany the hard copy analysis reports.

9.2.4 Assessment Records

Inspection or assessment reports, corrective action reports, interim progress reports, final reports, evaluation summaries, and copies of presentations made during and after the project will all be stored digitally in a dedicated directory on the DWR Northern District servers. These documents will be organized and kept up-to-date by the Project Manager.

Annually, the Project Manager will prepare a brief report summarizing the data analyzed to date. This report will be submitted to the Contract Manager. The Contract Manager will prepare Fact Sheets summarizing the project findings. All assessment reports will be store digitally in a dedicated directory on the Regional Board server. Fact Sheets will be made available to the public on the Regional Board website. More information on project assessment can be found in Element 20.

9.3 Records Responsibility

The DWR Project Manager will oversee the maintenance of all records and will arbitrate any issues related to records retention. The Bryte Laboratory Director will be responsible for maintaining and retaining all analytical records, including sample receipt records, chain-of-custody forms, and printed and electronic data from laboratory analyses.

9.4 Archive Location and Duration

All records generated by this project will be stored at Northern District DWR. All lab records will also be stored at Bryte Laboratory in West Sacramento. All records will be forwarded to the State Board contract manager upon project completion. Copies of the records will be maintained at Northern District DWR and Bryte Laboratory in West Sacramento for five years following project completion. Data files will be maintained indefinitely without discarding.

9.5 Records Responsibility

DWR’s Bryte Laboratory will archive all analytical records generated for this project. The DWR Project Manager or other assigned DWR staff will be responsible for archiving all other records.

9.6 Electronic Records Responsibility

All field operation records will be entered into electronic formats and maintained in a dedicated directory at www.wdl.water.ca.gov. The lab will have a dedicated directory for the project in their data repository. They will deliver data in electronic format to the WDL, and the WDL administrators Eric Senter and Bruce Agee will be responsible for storage, backup and safekeeping of these records.

10.0 Sampling Process Design

To address the decision statement in section 5.1 a Program Design Concept was created to address the stated questions.

10.1 Program Design Concept

The Program Design Concept for this project by which stations were selected is based on the following criteria:

1. At least one monitoring station on all significant tributaries to the Sacramento River (generally near the mouth) and at selected mainstem Sacramento River locations.
2. To the extent possible, sites are selected with previous monitoring history (including flow gaging).
3. Sites generally coincide with an established watershed management program and or restoration projects within the watershed.
4. Select parameters that are repeatable, not overly burdensome to sample, and are the most information rich with regard to evaluating water quality/beneficial use protection.
5. Focus of the program will be on evaluation of long-term trends, with respect to water quality and the biological community.

10.1.1 Station Selection Rationale

41 stations were selected using the Program Design Concept to adequately cover the Northern Sacramento River Watershed. Stations are listed from the northernmost to the southernmost with rationale for selection:

1. North Fork Pit River at Alturas

- 303d listed for: nutrients, organic enrichment / low dissolved oxygen, and temperature
- Impacted by agriculture, agriculture-grazing
- Water quality data has been collected from this site by DWR since 1959

2. South Fork Pit River near Alturas

- 303d listed for: nutrients, organic enrichment / low dissolved oxygen, and temperature
- Impacted by agriculture, agriculture-grazing

- Water quality data has been collected from this site by DWR since 1962

3. Pit River near Canby
- Characterizes upper portion of the Pit River system
- Historic flow data and active gage site
- Historic water quality data set
- 303d listed for: temperature, dissolved oxygen, and nutrients
- Water quality data has been collected at this site by DWR since 1951
- USGS gaging station has been recording flow since 1904

4. Fall River at Glenburn
- Fall River is nationally known as a Blue Ribbon trout stream – high public demand for protection
- Located within river reach of concern with easy year round access
- Historic water quality data set
- 303d listed for: sedimentation/siltation
- Impacted by agriculture-grazing, silviculture, road construction

5. Pit River at Pittville
- Characterizes lower portion of the Pit River system
- Historic flow data (no gage station but flow can be calculated from PG&E records)
- 303d listed for: nutrients, organic enrichment / low dissolved oxygen, and temperature
- Pit River is heavily monitored by PG&E downstream to Shasta Lake
- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring

6. McCloud River above Shasta Lake
- Major Northern California river system, near pristine condition
- High public demand for protection
- Historic flow data and active gage site
- Water quality data has been collected at this site by DWR since 1951
- USGS gaging station has been recording flow since 1945

7. Sacramento River at Delta
- Characterizes upper Sacramento River water quality above Shasta Lake
- Historic flow data and active gage site
- Historic water quality data set
- High use watercourse for contact recreation and trout fishing
- Water quality data has been collected at this site by DWR since 1951
- USGS gaging station has been recording flow since 1944

8. Pit River near Montgomery Creek

- 303d listed for: temperature, dissolved oxygen, and nutrients
- Water quality data has been collected at this site by DWR since 1990
- USGS has been recording flow since 1944

9. Cow Creek at USGS Gage
- Major Northern Sacramento Valley tributary (1.6 million acres)
- Significant aquatic resources (trout, steelhead, salmon)
- Historic and active gage site
- Active watershed improvement programs
- Mix of land use including: timber, grazing, rural residential
- Heavy use for contact recreation

10. Clear Creek near mouth near Redding
- Major agency investments in restoration for anadromous fish
- Historic and active gage site
- Urban runoff impacts from the City of Redding
- Water quality data has been collected from this site by DWR since 1993

11. Churn Creek near Anderson
- Recently completed Watershed Assessment and Watershed Management Plan
- Active watershed improvement program
- Anticipate future stream improvement projects
- Major Redding urban area watershed with potential water quality issues

12. Stillwater Creek near Anderson
- Recently completed Watershed Assessment and Watershed Management Plan
- Active watershed improvement program
- Anticipate future stream improvement projects
- Major Redding urban area watershed with potential water quality issues

13. Bear Creek near Anderson
- Active locally directed watershed management program
- Significant salmon and steelhead tributary to the Sacramento River
- Potential water quality issues from irrigation agriculture and rural residential development

14. Sacramento River at Balls Ferry
- 303d listed for: unknown toxicity
- Historic and active gage site
- Historic water quality data set

- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring

15. Battle Creek at Jelly's Ferry Road Bridge
- Major agency investments in restoration for anadromous fish
- Water quality concerns related to the operation of the Coleman Fish Hatchery
- Significant aquatic resources (anadromous fish)

16. Cottonwood Creek at Cottonwood
- Largest western watershed tributary
- Significant aquatic resources (trout, steelhead, salmon)
- Historic and active gage site
- Active watershed improvement programs
- Heavy use for contact recreation

17. Paynes Creek near mouth
- Department of Fish and Game investments in restoration for anadromous fish
- Water quality data has been collected from at site by DWR since 1958
- Watershed Assessment and Watershed Management Plan currently under development

18. Sacramento River at Bend Bridge
- Historic and active gage site
- Historic water quality data set
- Water quality data has been collected from this site by DWR since 1961

19. Sacramento River downstream from Red Bluff Diversion
- 303d listed for: unknown toxicity
- Historic water quality data collected by DWR

20. Red Bank Creek at Hwy 99 near Red Bluff
- Water quality data has been collected from this site by DWR since 1959
- Drainage basin of about 73,000 acres

21. Antelope Creek near mouth near Red Bluff
- Water quality data has been collected at this site by DWR since 1955
- Anadromous fish concerns

22. Elder Creek near mouth
- 303d listed for: Chlorpyrifos, Diazinon
- Impacted by urban runoff / storm sewers and agriculture

- Water Quality data has been collected at this site by DWR since 1955

23. Mill Creek near mouth near Los Molinos
- Major eastside tributary with spring run salmon
- Historic and active gage site
- Concern with metals from Lassen geology, chronically turbid
- Water quality data has been collected from this site by DWR since 1952
- USGS has been recording flow since 1909

24. Thomes Creek at Hall Road
- Major Westside tributary to the Sacramento River
- Gravel extraction activities in watershed
-

25. Deer Creek at Hwy 99E near Vina
- Major eastside tributary with spring run salmon
- Historic and active gage site
- 1993-1994 DWR intensive water quality study
- Active watershed improvement program

26. Sacramento River at Vina Bridge
- 303d listed for: unknown toxicity
- Historical DWR water quality site

27. Sacramento River at Hamilton City
- Strategic main stem site as the river transitions into irrigated agriculture land use
- Basin plan objectives associated with this site (metals, dissolved oxygen, and temperature)
- Water quality data has been collected from this site by DWR since 1951
- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
- 303d listed for: unknown toxicity, mercury (from Hamilton City downstream to Knights Landing)

28. Big Chico Creek at Chico
- Significant eastside tributary with spring run salmon
- Urban runoff impacts from the City of Chico
- Historic and active gage site
- Active watershed program with concerns about urban runoff
- Water quality data has been collected at this site by DWR since 1956
- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring

29. Butte Creek downstream from Western Canal Siphon
- Major agency investments in restoration for anadromous fish
- Major eastside tributary (510,000 acres) with spring run salmon
- Gravel and tree encroachment issues
- Concerns with habitat and temperature above Chico, urban runoff from Chico, and irrigated agriculture below Chico
- Active watershed improvement programs (Butte Creek Watershed Conservancy, Butte County RCD, Friends of Butte Creek, and the Butte Environmental Counsel)
- Heavy use for contact recreation

30. Stony Creek near mouth (USGS gage)
- Second largest Westside watershed
- Major local concerns with watershed condition (erosion and invasive species)
- Active watershed improvement program
- Historic and active gage site
- Gravel extraction activities in watershed

31. Honcut Creek at Hwy 70
- Potential salmonid spawning and rearing habitat enhancement projects
- Watershed Assessment currently under development and anticipate future development of a Watershed Management Plan
- Likely to see future watershed improvement work

32. Sacramento River at Colusa
- Critical main stem station location
- Historic and active gage site
- Water Quality data has been collected from this site by DWR since 1955
- USGS gaging station has recorded flow since 1921
- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring

33. Butte Slough near Meridian
- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
- 303d listed for: Diazinon
- Impacted by agricultural activities
- Prime migration route and rearing area for Butte Creek spring run salmon

34. Yuba River at Marysville
- Major eastside tributary with spring run salmon
- Historic and active gage site

- 2002-2004 DWR intensive water quality study
- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring

35. Bear River near Mouth
- 303d listed for: Diazinon
- Agriculture impacts
- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring

36. Sacramento River above CBD near Knights Landing
- One mile upstream from the mouth of the Colusa Basin Drain
- Water quality data collected by DWR since 1960

37. Colusa Basin Drain at Knights Landing
- The single largest source of agricultural return flows to the Sacramento River
- 303d listed for: Azinphos-methyl, Carbofuran/Furadan, Diazinon, Malathion, Methyl Parathion, Molinate/Odram
- Water quality data collected by DWR since 1957
- Runoff and agricultural return flows from about 1 million acres of watershed
- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring

38. Feather River near Verona
- 303d listed for: Chlorpyrifos, Group A Pesticides, Mercury, Unknown Toxicity
- Impacted by agriculture, urban runoff/storm sewers, resource extraction (abandoned mines)
- Upstream from the main stem Sacramento River near the mouth
- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring

39. Sutter Bypass at RD-1500 Power plant
- Integrator site for SWAMP Statewide Stream Contaminant Trend Monitoring
- Prime migration route and rearing area for Butte Creek spring run salmon

40. Sacramento River at Verona
- 303d listed for unknown toxicity, mercury
- Historical water quality data

41. Sacramento River below Knights Landing
- 303d listed for unknown toxicity, mercury

- Water quality data has been collected from this site by DWR since 1960

10.2 Station Type

All stations are on rivers or streams. Samples will not be collected when water body is clearly not flowing or dry. A no-sample event will be recorded on the field data sheet.

10.3 Station Selection Intent

Station selection criteria include the following:

- Source identification – to identify the source of a given constituent within the Sacramento River network and/or related to land use activities.
- Impact assessment - monitoring to determine whether an impact to the ecosystem has occurred through watershed management and or restoration activities.
- Water quality criteria compliance monitoring - monitoring for the purpose of comparison with water quality benchmarks to determine if criteria are meeting state and federal standards.
- Characterization of spatial variability - measurements to determine how the values of selected water quality parameters change when you move to lower order streams, or how concentrations of selected analytes change within the Sacramento Watershed.
- Fixed station for long term monitoring - monitoring at the same location each time to create a long-term record of conditions at each selected location.

10.4 Timing Selection Intent

The purpose behind the timing of the monitoring at the selected stations includes the following reasons:

- Routine monitoring – Repeated quarterly monitoring on a year to year basis to provide long-term data.
- Snapshot - One-time monitoring of multiple stations. This provides a "snapshot" in time of the conditions at the selected stations each season or quarter of the year.
- Pre-monitoring – Many of the chosen sampling locations have historical water quality data collection; therefore, basic conditions and / or locations are well characterized.

10.5 Reach Selection Design

The reach selection design is a knowledge-based approach where selection is:

- Directed (to the environment) - A deterministic approach in which locations are selected deliberately based on knowledge of their attributes of interest as related to the environmental site being monitored. Additional documentation can be found in the Station Selection Rational Section 10.1.1.

10.6 Station Selection Design

The station selection design is a knowledge-based and systematic approach where selection is:

- Directed (to the environment) - A deterministic approach in which locations are selected deliberately based on knowledge of their attributes of interest as related to the environmental site being monitored.
- Systematic - A deterministic approach in which station locations are selected deliberately due to the existence of a previously established water quality location.

Additional documentation can be found in the Station Selection Rational Section 10.1.1.

10.7 Seasonal Sampling Design

- Systematic - A deterministic approach where temporal sampling points are selected deliberately on a seasonal or quarterly basis. Sample events will be scheduled to represent the winter runoff, spring snowmelt, irrigation, and dry seasons.

10.8 Diurnal Sampling Design

- Non-deliberate - Points are selected anecdotally (when you happen to be there), or opportunistically (additional stations may be sampled if there is more time in a given sampling day). Samples will typically be sampled on or near the same time at each station in each sampling run; however, if unforeseen circumstances arise, samples and measurements may be collected at different times.

10.9 Field Measurements to Support Lab Data

Interpretation of laboratory data often requires knowledge of the ambient conditions at the time samples were collected; so, DWR field crews will conduct field measurements at the same time and the same place when water samples are collected for analysis at the lab.

The DWR field crew will measure Dissolved Oxygen, Temperature, Specific Conductivity, pH, and Turbidity at the same spot and the same time where/when they collect grab water samples for lab analyses. The crew will also record site conditions by completing the SWAMP Field Data Sheets at each station visit.

10.10 Number of Site Visits

Each site will be visited every quarter for the duration of the contract, each visit will include three basic types of field activities (observations, field measurements, and sample collection). Additional information and tables are presented in the Monitoring Plan.

10.11 Sampling Frequency

Sampling will occur 4 times per year, with the exception of the HOBO temperature loggers which will be recording continuous temperature every 15 minutes for the duration of the project. Additional information and tables are presented in the Monitoring Plan.

10.12 Sampling Interval

The sampling interval for this project is 3 months, where each site occupation will occur.

10.13 Continuous Monitoring

Continuous monitoring data loggers will be employed to collect water temperature data for the project. The following list gives details about the temperature monitoring portion of the project:

- Hobo Temp Loggers will be installed at each of the 41 station locations.
- Hobo Temp Loggers are already deployed at existing stations and will be deployed at new stations effective of the November 2008 sampling run.
- Each Station will have 1 Hobo Temp Logger deployed.
- Deployment duration will last for the length of the project
- 15 minute measurement intervals will be used for the project.
- Each logger will be secured in an inconspicuous location with stainless steel cables and hardware.
- Data will be downloaded onto a Hobo shuttle at every station occupation event.

10.14 Sampling Work Statement

DWR field crews will:

- Prepare field equipment and label appropriate bottles for water collection.

- Two crews will visit 41 Stations at each event.
- Fill sample bottles according to EPA and SWAMP protocols.
- Measure: DO, temperature, specific conductivity, pH, and turbidity.
- Fill out SWAMP data sheets recording field data and site observations
- Download Hobo temperature logger data onto Hobo Shuttle

10.15 Sources of Uncertainty

There are major sources of uncertainty in environmental monitoring that are independent of each other. These sources are below as follows:

- 1. Measurement error- combines all sources of error related to the entire sampling and analysis process, i.e., to the Measurement System. The actions you will take to assure sample integrity and to reduce measurement error is described in other Elements of this QAPP.
- 2. Natural (inherent) - variability occurs in any environment you will monitor, and is often much wider than the measurement error. Natural variability includes seasonal changes in flow levels and source waters. One of the goals of this study is to characterize seasonal and interannual trends in water quality within the study area.
- 3. Sample misrepresentation- happens at the level of an individual sample or field measurement (e.g., collecting a water sample at a backwater pool that does not represent the bulk of the flow) and will be minimized by using SWAMP compliant training and sampling methods. Representativeness and bias are addressed in more detail in Element 7.1.

10.16 Logistics, Constraints, and Contingencies

Following each quarterly sampling event, all samples will be delivered or shipped to the appropriate laboratory in a timely manner to ensure adequate time for analysis within the holding time. Additional information on logistics, constraints, and contingencies is in the Monitoring Plan.

10.17 Relative Importance of Components

Critical information for this project includes all parameters listed in Table 6.1 and optional parameters listed in Table 6.2. All other information collected for the project such as field observations or additional laboratory analyses will be treated as for informational purposes only.

11.0 Sampling

Field personnel will adhere to recommended SWAMP sample collection protocols or approved and documented alternative protocols, in order to ensure

the collection of representative, uncontaminated (contaminants not introduced by the sample handling procedure itself) water, sediment, tissue, and biological samples for laboratory analyses. If protocols are revised or altered, the deviations from the standard protocols will be documented.

Any problems occurring during field collection will be reported directly to the Program Manager. Problems will be documented on the field collection sheets. If necessary the QA Officer will be informed and corrective measures will be put in place to mitigate the sampling issue.

11.2 Field Preparation Description

Certain samples require filtering in the field. SOPs for these procedures are in Appendix A- Field Sampling Procedures.

11.3 Sample Containers

Selection of the appropriate sample containers is an important part of the sampling plan. In order to ensure sample integrity, the SWAMP Quality Assurance Program Plan (QAPrP) specifies the types of containers that are acceptable for each kind of sample. The QAPrP also suggests the amount of sample that needs to be collected for each analyte. See Table 11.1 for a list of sample containers and sample volume. The laboratories will supply all necessary sampling containers to the DWR Northern District Water Quality and Biology Section.

11.4 Sample Preservation and Holding Times

Using properly cleaned containers and correct preservatives, as well as adhering to proper holding times, is essential to maintaining sample integrity and correctness. Requirements for sample containers, preservation techniques, and holding times are found in one of the following references (or later editions):

• *Standard Methods for the Examination of Water and Waste Water.* American Public Health Association, et al., 19th Edition, or later
• Federal Register Volume 49, No. 209, Friday, October 26, 1984, EPA, 40 Code of Federal Regulations, Part 136
• *Handbook for Sampling and Sample Preservation of Water and Wastewater.* EPA 600/4-82-029, September 1982.

Sufficient sample volumes must also be collected to ensure that the required detection limits can be met, the QC samples can be analyzed, and any necessary sample re-analyses can be performed. Sample holding times, and preservation methods are listed in Table 11.1.

Table 11.1 Sample containers, preservation, and holding times

Analyte	Holding Time	Container	Sample Volume	Field Filtered	Preservation
Conventional Analytes					
Total Suspended Solids	7 days	Polyethylene Bottle	900 mL	Yes	Cool to 4° C
Alkalinity	14 days	Polyethylene Bottle	900 mL	No	Cool to 4° C and store in the dark
Total Hardness	6 months	Polyethylene Bottle	200 mL	No	Cool to 4° C and store in the dark. Acidify with HNO_3 to pH<2
Total Ammonia as Nitrogen	48 hours; 28 days if acidified	Polyethylene Bottle	200 mL	Yes	Cool to 4° C and store in the dark. May be preserved with 2 mL H_2SO_4 per L
Total Kjeldahl Nitrogen	7 days; 28 days if acidified	Polythylene Bottle	600 mL		Cool to 4° C and store in the dark. May be preserved with 2 mL H_2SO_4 per L
Total Organic Nitrogen	7 days; 28 days if acidified	Polythylene Bottle	600 mL		Cool to 4° C and store in the dark. May be preserved with 2 mL H_2SO_4 per L
Dissolved Ammonia	48 hours; 28 days if acidified	Polyethylene Bottle	200 mL	Yes	Cool to 4° C and store in the dark. May be preserved with 2 mL H_2SO_4 per L
Dissolved Nitrite + Nitrate	48 hours, 28 days if acidified	Polyethylene Bottle	200 mL	Yes	Cool to 4° C and store in the dark. May be preserved with 2 mL H_2SO_4 per L
Dissolved Ortho-phosphate	48 hours	Polyethylene Bottle	200 mL	Yes	Cool to 4° C and store in the dark
Total Phosphorus	28 days	Polyethylene Bottle	200 mL	No	Cool to 4° C and store in the dark
Total Organic Carbon	28 days	Glass Vial	40 mL	No	Cool to 4° C and store in the dark. Acidify with H_3PO_4 to pH<2
Total Dissolved Carbon	28 days	Glass Vial	40 mL	Yes	Cool to 4° C and store in the dark. Acidify with H_3PO_4 to pH<2
Inorganic Analytes					

Analyte	Holding Time	Container	Sample Volume	Field Filtered	Preservation
Total Arsenic	6 months	High Density Polyethylene Bottle	250 mL	No	Cool to 4° C and store in the dark. Acidify with HNO_3 to pH<2
Dissolved Arsenic	6 months	High Density Polyethylene Bottle	250 mL	No	Cool to 4° C and store in the dark. Acidify with HNO_3 to pH<2
Total Copper	6 months	High Density Polyethylene Bottle	250 mL	No	Cool to 4° C and store in the dark. Acidify with HNO_3 to pH<2
Dissolved Copper	6 months	High Density Polyethylene Bottle	250 mL	No	Cool to 4° C and store in the dark. Acidify with HNO_3 to pH<2
Pathogens					
Total Coliform	24 hours	Factory-sealed Sterile High Density Polyethylene Bottle pretreated with Sodium Thiosulfate	100 mL	No	Cool to 4° C and store in the dark.
E. Coli	24 hours	Factory-sealed Sterile High Density Polyethylene Bottle pretreated with Sodium Thiosulfate	100 mL	No	Cool to 4° C and store in the dark.
Toxicity					
96-Hour Ceriodaphnia dubia	48 hours	2.5 L Amber Glass	500 mL	No	Cool to 4° C and store in the dark.
96-Hour Hyalella azteca	48 hours	2.5 L Amber Glass	500 mL	No	Cool to 4° C and store in the dark.
Bioassessment					
Benthic Macroinvertebrates	n/a	Wide-mouth 500 mL or 1000 mL Plastic Jar(s)	n/a	No	Fill jars with 95% ethanol

Upon returning to the DWR Northern District office following field collection activities, staff place samples into the appropriate storage location (for example, refrigerator, freezer, or locked cabinet) until they are transported or shipped to the laboratory performing the analyses. Properly completed chain-of-custody forms corresponding to the samples are placed into boxes next to the storage locations. The chain-of-custody forms accompany the corresponding samples when they are transported or shipped to the laboratories.

Samples will be delivered to the laboratories in a timely manner, which will allow sample analysis to proceed before holding times are exceeded. If samples are not delivered by staff, they will be packed in ice to preserve them and then shipped via FedEx Next-Day Air.

11.4.1 Sample Preservation Description

Some samples will require preservation in the field. Preservation of certain samples is achieved by fixing with concentrated acid then storing on ice at less than 4° C. See Table 11.1 for a detailed description.

11.5 Sample Container Sterilization

Collection of pathogens in water requires the use of sterilized sample containers. Containers will be purchased factory sealed and pre-sterilized

11.5.1 - Sample Container Cleaning

Pre-cleaned containers will be used if they are required for ultra low level metals sampling or pathogen sampling. The lab performing the analyses will provide the field crew with the appropriate clean containers.

11.6 Sample Container Labels

Before they are used to collect water samples, containers are labeled with laser printer labels that include the following information: location of collection (station name), the DWR Field and Laboratory Information Management System (FLIMS) sample number, sampling date and time (Pacific Standard Time), type of sample or requested analysis, any acids used for preservation, and holding instructions (for example, on ice, 4 °C, or frozen). The sample tracking system (FLIMS) generates printed labels with this information for samples analyzed at Bryte Laboratory.

11.7 Sample Equipment

A list of equipment required for this study is found in Table 13.2.

11.8 Responsible Person

If monitoring equipment fails, DWR personnel will report the problem in the comment section of their field notes and will not record data values for the variables in question. Actions will be taken to replace or repair broken equipment prior to the next field use. No data will be entered into the WDL database that was known to be collected with faulty equipment.

11.9 Standard Operating Procedures

DWR Northern District Standard Operating Procedures (SOPs) Field Sampling Procedures are listed in Appendix A. This SOP complies with all SWAMP requirements.

Pathogen sample collection will be conducted according to the Regional Board's *San Joaquin River Bacteria Monitoring Program* (Appendix E). Bioassessment sample collection will be conducted according to *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California* available at http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/phab_sopr6.pdf.

12.0 Sample Handling and Custody

- The Project Manager will be responsible for custody of samples during field sampling.

- Field crews will keep a field log, which will consist of project sampling forms and sampling forms for each sampling event. In the field log the following items will be recorded: time of sample collection, sample identification numbers, results of any field measurements and the time that they were made, qualitative descriptions of relevant water and weather conditions at the time of sample collection, and a description of any unusual occurrences associated with the sampling event (especially those that could affect sample or data quality).

- Field crews will have custody of samples during field sampling and chain-of-custody forms will accompany all samples to the analyzing laboratory. Chain-of-custody procedures require that possession of samples be traceable from the time the samples are collected until completion and submittal of analytical results. The chain-of-custody form to be used for samples to be submitted to Bryte Laboratory included in Appendix F. The chain-of-custody form in Appendix G will be used for all remaining samples.

- The analytical laboratory will maintain custody logs sufficient to track each sample submitted and to analyze or preserve each sample within specified holding times. The analytical laboratory has a sample custodian who examines the samples for correct documentation, proper preservation and holding times. The laboratories will follow sample custody procedures outlined in its QA plans, which are on file.

- In the field, all samples will be packed in wet ice or frozen ice packs during shipment, so that they will be kept at approximately 4°C. Samples will be stored on ice or refrigerated at approximately 4°C in the laboratory or office. Where appropriate, samples may be frozen to prevent biological degradation.

- All samples will be handled, prepared, transported and stored in a manner so as to minimize bulk loss, analyte loss, contamination or biological degradation. Sample containers will be clearly labeled. All caps and lids will be checked for tightness prior to shipping. Ice chests will be sealed with tape before shipping. Samples will be placed in the ice chest with enough ice, or frozen ice packs, to completely fill the ice chest. COC forms will be placed in an envelope and taped to the top of the ice chest or they may be placed in a plastic bag and taped to the inside of the ice chest lid.

- Transport of samples to the laboratory will be by commercial carriers (FedEx). Transport of the samples to the analytical laboratory may also be by DWR or Regional Board staff.

13.0 Analytical Methods and Field Measurements

Table 13.1 outlines methods to be used, any modifications to those methods, and reference to the standard method. Information on the necessary equipment and instrumentation for the project analyte can be found in the following documents:

- Conventional and inorganic analytes: Bryte Laboratory Quality Assurance Manual A(ppendix C)
- Pathogens: San Joaquin River Bacteria Monitoring Program (Appendix E)
- Toxicity and bioassessment: will comply with Stand Operating Procedures and Standard Methods applicable to each constituent.

Table 13.1 Analytical methods and reporting limits

Analyte	Analytical Method	Reporting Limit (mg/L)
Conventional Analytes		
Total Suspended Solids	EPA 160.2	1
Alkalinity	SM 2320 B	1
Total Hardness	SM 2340 B (Total by calculation)	n/a

Analyte	Analytical Method	Reporting Limit (mg/L)
Total Ammonia as Nitrogen	EPA 350.1	0.01
Total Kjeldahl Nitrogen	EPA 351.2	0.1
Total Organic Nitrogen	EPA 351.2 (total by calculation)	n/a
Dissolved Ammonia	EPA 350.1	0.01
Dissolved Nitrite + Nitrate	SM 4500-NO_3 (DWR modified)	0.01
Dissolved Ortho-phosphate	EPA 365.1 (DWR modified)	0.01
Total Phosphorus	EPA 365.4	0.01
Total Organic Carbon	EPA 415.1 (T)	0.5
Total Dissolved Carbon	EPA 415.1 (D)	0.5
Inorganic Analytes		
Total Arsenic	EPA 1638 (T)	0.1 µg/L
Dissolved Arsenic	EPA 1638 (D)	0.1 µg/L
Total Copper	EPA 1638 (T)	0.05 µg/L
Dissolved Copper	EPA 1638 (D)	0.05 µg/L
Pathogens		
Total Coliform	IDEXX Colilert Quanti-Tray / 2000	1 MPN/100 mL
E. Coli	IDEXX Colilert Quanti-Tray / 2000	1 MPN/100 mL
Toxicity		
96-Hour Ceriodaphnia dubia	EPA 821-R-02-012	n/a
96-Hour Hyalella azteca	EPA 821-R-02-012	n/a
Bioassessment		
Benthic Macroinvertebrates	Safit STE Level II Taxonomy	n/a

Table 13.2 Field instrument measurement principles and major attributes

Parameter	Instrument	Measurement Principle	Units	Range	Detection Limit	Resolution
Temperature	YSI 85	Thermistor method	°C	-5 to 65	0.1	0.1
Temperature	Onset HOBO Logger	Thermistor method	°C	-20 to 70	0.2	0.02
Dissolved Oxygen	YSI 85	Diaphragm galvanic battery method	mg/l	0 to 20	0.1	0.01
Specific Conductivity	YSI 85	4 AC electrode method	µS/cm	0 to 499.9	1	1
pH	Hach sension1	Glass electrode method	pH Units	-2.00 to 19.99	0.1	0.01
Turbidity	Hach Model 2100P	Penetration and scattering method	NTU	0 to 1,000	0.1	0.01

Table 13.2 describes the field instruments to be used in this project. The MQOs listed in Element 7 will serve as performance criteria for both laboratory methods and field measurements.

13.1 Continuous Monitoring Potential Problems and Solutions

There are no known or expected physical impediments that would impair obtaining data that is representative of stations where in-situ monitoring is planned.

However, continuous monitoring at all stations is subject to vandalism and equipment failure. We will provide downloads of the temperature loggers and inspections of the instruments at each site occupation to ensure continuous monitoring. If there are any periods of interruption due to vandalism, equipment failure, or any other problems, then data from that interval will not be used.

13.2 Laboratory Name

DWR Bryte Laboratory will provide the analyses for all inorganic and conventional analytes, with the exception of pathogens. MPSL at Granite Canyon will provide analyses for water column toxicity. DFG ABL will provide analyses for bioassessment samples. The Regional Board will conduct pathogen analyses in house.

13.3 Responsible Person's Name corrective action at the laboratory

Table 13.1 identifies the person at each laboratory who will be responsible for corrective action in the event that a method fails to provide SWAMP-comparable data during the analysis of the proposed project's samples.

Table 13.3 Laboratory responsible persons

Laboratory	Responsible Person	Title
DWR Bryte	Bill Nickels	Laboratory Manager
MPSL Granite Canyon	Bryn Phillips	Research Faculty
DFG ABL	James Harrington	Staff Environmental Scientist
Regional Board	Leticia Valadez	Laboratory Director

13.4 Laboratory Method Failure

Failures in laboratory measurement systems include, but are not limited to: instrument malfunction, califbration failure, sample container breakage, contamination, and QC sample failure. If the failure can be corrected, the analyst must document it and its associated corrective actions in the laboratory record and complete the analysis. If the failure is not resolved, it is conveyed to the

respective supervisor who should determine if the analytical failure compromised associated results. Sepcific laboratory corrective actions are detailed in Appendix D of the SWAMP QAPrP.

13.5 Documenting Method Failure

When a method fails to provide SWAMP-comparable data, the nature and disposition of the problem must be documented in the data report that is sent to the Project Manager.

13.6 Sample Disposal

After analysis of the project samples the laboratories will dispose of samples in compliance with all federal, state, and local regulations. The laboratory has standard procedures for disposing of its waste, including left over sample materials.

13.7 Turn Around Time

Turn around times for sample analyses will be as fast as possible based on the laboratory's work load. However, the turn around times will not exceed the SWAMP-comparable holding times that are listed in Table 11.1. The laboratories understand and agree to meet the turn around times needed for our proposed sample analyses.

14.0 SWAMP-comparable QA/QC

SWAMP-comparable quality assurance and quality control activities for the sampling process include the collection of field replicates, as applicable, and the preparation of field blanks.

Blanks will be prepared by pouring water known to be free of the parameters being monitored for into a sample collection container and then subsampling into the appropriate number of replicate sampling containers. Ultrapure water (ASTM Type III) will be used for non-biological sample blanks and sterile phosphate dilution water (prepared according to Standard Methods 9020B) will be used for biological sample blanks.

All field measurements will be made in triplicate. Each result will be recorded along with the average of the three results, the difference between the largest and smallest result, and the percent difference between the largest and smallest result.

When pH and conductivity are measured the measurement devices will be checked against a standard whose source is different than that selected for

calibration and this will be done about the middle of a sample run and again at the end. When dissolved oxygen is measured it will be checked against aerated water whose oxygen content is established by the Winkler method. Triplicate measurements, the average of the results, the difference, and percent difference will be recorded. The differences will be calculated as follows:

Difference = Average - True Value

Relative Percent Difference (RPD) = 100*(largest-smallest)/average

The difference or RPD, as appropriate, will be compared against the Resolution criteria established in Element 7. Additional formulas for calculating results for specific quality control samples are found in Appendix A of the SWAMP QAPrP.

Necessary quality control samples, frequency requirements, and control limits are defined in Tables 7.1 and 7.2.

Corrective actions for laboratory analytes and field measurements can be found in Appendix D of the SWAMP QAPrP. Failures of laboratory measurement systems include, but are not limited to: instrument malfunction, calibration failure, sample container breakage, contamination, and QC sample failure. If the failure can be corrected, the analyst must document it and its associated corrective actions in the laboratory record and complete the analysis. If the failure is not resolved, it is conveyed to the respective supervisor who should determine if the analytical failure compromised the associated results. The nature and disposition of the problem must be documented in the data report that is sent to the Project Manager. Field corrective actions are described in Element 15.1.

14.1 QC Sample Descriptions

- Field blanks - Field blanks provide bias information for field handling, transport, and storage operations. They will be collected to evaluate whether contaminants have been introduced into the samples during sample collection due to exposure from ambient conditions or from the sampling containers. These blanks will be obtained by pouring de-ionized water into a sampling container at the sampling location. Field blanks will be preserved, packaged, and sealed exactly like the surface water samples and will be submitted blind to the lab. The lab results must be less than the MDL of the target analytes to be acceptable.

- Equipment blanks - Equipment blanks (also known as "rinsate blanks") provide bias information for sampling equipment that may be contaminated. They will be prepared by rinsing sampling equipment in between its use with one or more samples in order to document that it will not contaminate samples with the target analytes that may have been present in a previous sample that the equipment was used to obtain. The

rinsate water will be preserved, packaged, and sealed exactly like the surface water samples and will be submitted blind to the lab. The lab results must be less than the MDL of the target analytes to be acceptable.

- Bottle blanks - Bottle blanks provide bias information for sample containers that may be contaminated. They will be prepared in the laboratory by rinsing randomly selected sample bottles with a small amount of the solvent that is used for sample preparation. If no solvent is used for sample preparation then the sample bottles will be rinsed with a small amount of reagent grade water that has no detectable quantities of the target analytes. Bottle blank data is qualitative, not quantitative, and the objective is to detect any potential contamination by target analytes that may be in the sample bottles. The lab results must show no detectable levels of the target analytes in the bottle blank rinsates.

- Method blanks - Method blanks (also known as laboratory blanks) provide bias information on possible contaminants for the entire laboratory analytical system. These samples will be a matrix similar to the project samples (i.e., water, sediment or tissue) that are known to have no detectable levels (or acceptably low levels) of the target analytes. Method blanks will be analyzed along with the project samples to document background contamination of the analytical measurement system. The lab results must be less than the MDL of the target analytes to be acceptable.

- Temperature blanks - Temperature blanks provide information to ensure that the samples in a particular cooler were maintained at the temperature appropriate for the selected analytical parameter. These samples will be marked "Temperature Blank" and one will be placed in each cooler that will be transported to the laboratory. These blanks will be prepared by the laboratory in the same type of sampling containers that will be used to sample ambient water and they will be used by the laboratory's sample custodian to check and record the temperature of samples upon receipt at the lab. The recorded temperature must not exceed that specified for an analytical parameter by Table 11.1.

- Field replicates - Field replicate samples provide precision information on all steps after sample acquisition. These samples will be collected as duplicates at designated sample locations by alternately filling two distinct sample containers for each analysis. The field duplicate samples will be preserved, packaged, and sealed in the same manner described for the surface water samples. A separate sample number and station number will be assigned to each duplicate and the samples will be submitted blind to the lab. The replicate values must have a RPD of less than 25% to be acceptable.

- Laboratory control samples - Laboratory control samples (LCS, which SWAMP refers to as "Reference Materials") provide bias information

about a laboratory's ability to perform acceptable analyses on a clean matrix with the chosen methods. The LCS will be prepared by the laboratory using an aliquot of the clean matrix (i.e., water, sediment or tissue with no detectable levels of the target analytes) that is spiked with the analytes at known concentrations. The lab results must be within 80 - 120% recovery or control limits based on 3 times the standard deviation of a lab's actual method recoveries for the target analytes in order to be acceptable.

- Matrix spikes - Matrix spikes (MS) provide bias information on sample preparation and analysis. MS will be used to verify that the lab can determine if the sample matrix is causing either a positive or negative bias on sample results. MS samples will be prepared by the laboratory using an aliquot of the sample matrix (i.e., water, sediment or tissue) that is spiked with the analytes at known concentrations. The lab results must be within 80 - 120% recovery or control limits based on 3 times the standard deviation of a lab's actual method recoveries for the target analytes in order to be acceptable.

- Matrix spike duplicates - Matrix spike duplicates (MSD) provide precision information on sample preparation and analysis. The laboratory will prepare separate spiked matrix samples (MS) for analysis. Acceptable lab results for bias are the same as described for matrix spikes. The duplicate values must have a RPD of less than 25% to be acceptable.

- Laboratory duplicates - Laboratory duplicates provide precision information on the analytical methods with the target analytes. The laboratory will generate the duplicate samples by splitting one sample into two parts, each of which will be analyzed separately. The duplicate values must have a RPD of less than 25% to be acceptable.

15.0 Instrument/Equipment Testing, Inspection and Maintenace

The Project Manager will be responsible for Element 15 instrument/equipment testing, inspection and maintenance. This will include maintaining the logs that document what was done, who did the work, and when the work was done.

15.1 Field Measurements

Field measurement equipment will be checked for operation in accordance with manufacturer's specifications. This includes battery checks and routine replacement and/or cleaning of parts as specified by the manufacturer. All equipment will be inspected for damage when first employed and again when returned from use. Maintenance logs will be kept and each piece of equipment

will have its own log that documents the dates and description of any problems, the action(s) taken to correct problem(s), maintenance procedures, system checks, follow-up maintenance dates, and the person responsible for maintaining the equipment.

Failing equipment must be replaced or repaired prior to subsequent sampling events. It is the combined responsibility of all members of the field organization to determine if the performance requirements of the specific sampling method have been met, and to collect additional samples if necessary. More information on field corrective actions can be found in Appendix D of the SWAMP QAPrP.

Spare parts for field equipment are stored at the DWR Northern District Water Quality and Biology section office. Equipment and spare parts are inventoried and purchased on an annual basis to ensure there are sufficient parts to repair defective or broken equipment.

15.2 Laboratory Analyses

Laboratory measurement equipment will be maintained in accordance with the lab's Standard Operating Procedures (SOPs). This includes procedures specified by the manufacturer and also any that are specified by the methods used. Maintenance logs will be kept and each piece of equipment will have its own log that documents the dates and description of any problems, the action(s) taken to correct problem(s), maintenance procedures, system checks, follow-up maintenance dates, and the person responsible for maintaining the equipment. More information on lab corrective actions can be found in Appendix D of the SWAMP QAPrP.

15.3 Biological Measurements

Equipment associated with bacterial analysis will be checked using the specifications in the Regional Board's *San Joaquin River Basin Bacteria Monitoring Program* (Appendix E). In particular, incubators will have their temperature recorded before samples are added or removed and the temperature must be 35°C +/- 5°C. Semiannually incubator temperatures will be checked with a NIST certified or NIST traceable thermometer. Additionally, sealers and UV lamps will be checked monthly.

There are no checks of benthic measuring equipment that are required by SWAMP.

16.0 Instrument/Equipment Calibration and Frequency

The Project Manager will be responsible for Element 16 instrument/equipment calibration and frequency. This will include documenting and checking that the

specified calibration procedures were performed for each of the selected parameters being measures.
Deficiencies will be documented by the Project Manager and reported to the DWR QA Officer. After resolution of the deficiency the Project Manager will document the problem and will provide recommendations to prevent future occurrences

16.1 Field Measurements

- DO - Although there are no SWAMP requirements for instrument calibration and frequency with dissolved oxygen (DO) measurements, the SWAMP suggestion to perform this function at the start of each sample run will be followed.
- Temperature - Even though there are no SWAMP requirements for instrument calibration and frequency with temperature measurements, the SWAMP suggestion to perform this function at least twice a year against a NIST certified thermometer will be followed.
- Conductivity - Although there are no SWAMP requirements for instrument calibration and frequency with conductivity measurements, the SWAMP suggestion to perform this function at the start of each sample run will be followed. If this is not possible then a calibration correction factor table will be used.
- pH - There are no SWAMP requirements for instrument calibration and frequency with pH measurements using a meter. However, the SWAMP suggestion to perform this function at the start of a sample run will be followed.

Turbidity - Although there are no SWAMP requirements for instrument calibration and frequency with turbidity measurements, the SWAMP suggestion to perform this function at the start of a sample run will be followed.

16.2 Laboratory Analyses

Prior to sample analysis of conventional and inorganic constituents in water, external calibrations will be made using 3 - 5 standards that cover the range of sample concentrations. The lowest standard will be at or near the Method Detection Limit (MDL). Linear regression will be <0.995 or better. Calibration verification will be run after every 20 samples after the initial calibration and will use a standard source that is different from that used for the initial calibration. Acceptable recovery for conventional analytes is 80 - 120% and for inorganic analytes is 90 – 110%.

There are no SWAMP requirements for equipment calibration and frequency for toxicity tests. All performance criteria will be followed that are listed in the toxicity method.

16.3 Biological Measurements

There are no SWAMP requirements for instrument/equipment calibration and frequency for bacteria. The guidance provided in the Regional Board's *San Joaquin River Basin Bacteria Monitoring Program* (Appendix E) will be followed.

There are no SWAMP requirements for instrument/equipment calibration frequency for benthic macroinvertebrates.

17.0 Inspection/acceptance of Supplies and Consumables

–The QA Officer will be responsible for Element 17 inspection/acceptance of supplies and consumables. They will be examined for damage as they are received and document their state as well as the date they were received.

All supplies will be examined for damage as they are received and then again as they are obtained for use with the proposed project. Containers will be inspected for breakage and proper sealing of caps. Standards and other consumables will be inspected for conformance with any labeled expiration dates. Reusable supplies (e.g., coolers and safety equipment) will be examined for acceptable cleaning and reuse. Any supplies deemed to be in unacceptable condition will be replaced.

18.0 Non-direct Measurements

Multiple sample sites in this study are historic DWR stations (see Element 10.1.1). Water chemistry and field measurement data collected by DWR from 1998 is stored in DWR's Water Data Library (WDL). Where appropriate, this data may be assessed in this study in order to better characterize long term trends. Because WDL is readily accessible through the internet, no additional resources or support facilities are needed.

Data Quality Indicators (DQIs) will be used to judge whether the external data meets acceptance criteria. These include, for example, precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity.

Measurement performance information such as method detection limits (MDLs), method quantitation levels, and the selectivity of a method (or lack of selectivity) for the target analytes will be used to judge whether the external data meets acceptance criteria.

Acceptance of external data for use will depend on the relevance of the matrix, location of the samples, and the methods that were used for collection and/or

analysis (for example, field versus laboratory-based methods, the method of collection and analysis, etc.).

18.1 Usage Limits

External data that fails to meet acceptance criteria will not be used in the proposed project.

If and when external data does not meet acceptance criteria it will, at the very least, be flagged as such. Flagged data may possibly be used under some conditions, but its use will be limited and clearly designated.

19.0 Data Management

Data management for the constituents in Table 6.1 will follow the data management scheme outlined in the DWR Field and Laboratory Information Management System (FLIMS) Manual. FLIMS will be used for data entry, data format, record keeping, tracking, and uploading into the DWR Water Data Library (WDL). The SWAMP Information Management System (IMS) will be used for bioassessment, toxicity, and pathogen data. Field data will be stored in both the WDL and SWAMP IMS database.

To ensure information is readily accessible, all records, assessments and reports will be created and stored in Microsoft Excel, Access or Word format.

19.1 Field Data Record Keeping

Field data sheets are filled out and checked in the field by the field sample collection staff. The Project Manager will verify sample identification and review the chain of custody forms. Working with field and laboratory staff, the Project Manager will identify any problems where holding times have been exceeded, sample identification is incorrect, where samples were inappropriately handled, calibration information is missing, or data quality objectives have not been met.

If problems are identified by the Project Manager, they will be brought to the attention of the QA Officer for review, and will be flagged.

19.2 Field Data SOP

DWR Field and Laboratory Information Management System (FLIMS) Manual is the SOP that will be referred to for managing field data with the proposed project.

19.3 Field Data Sheets

The SOP references the SWAMP documentation for producing field data sheets and these protocols will be followed so that SWAMP-comparable data will be produced.

19.4 Responsibility for Field Measurements Data

The Project Manager will be responsible for field measurements data management. All field data sheets, lab submittal sheets, and other documentation will be securely stored in duplicate at the DWR Northern District Water Quality and Biology Section.

19.5 Continuous Monitoring Data Record Keeping

Continuous water temperature data will be kept in raw format. Data will be uploaded to the WDL after a QA/QC process using Hydstra software. Raw format data will be housed on DWR Northern District Servers indefinitely.

19.6 Responsibility for Continuous Monitoring Analytical Data

The Project Manager will be responsible for continuous monitoring analytical data management.

19.7 Laboratory Data Management SOP

The DWR Field and Laboratory Information Management System (FLIMS) Field Manual is the SOP that will be used for managing laboratory analytical data for all inorganic and conventional analytes, with the exception of pathogens. The *Surface Water Ambient Monitoring Program Information Management Plan* will be used for managing laboratory analytical data for the SWAMP IMS.

19.8 Lab Measurement Types

Chemical/Biological Analyses - Our SOP and/or referenced documents describes how we will manage data involving analysis of chemicals and pathogens.

Toxicity Analyses - Our SOP and/or referenced documents describes how we will manage data involving toxicity analyses.

19.9 Responsibility for Laboratory Data Management

The Bryte Laboratory will be responsible for data management involving laboratory analytical data for the constituents in Table 6.1. ABL will be

responsible for data management for bioasessment data. MPSL will be responsible for data management involving toxicity data.
The Regional Board will be responsible for data management for pathogen data.

20.0 Assessments and Response Actions

Assessment and oversight involves both field and laboratory activities to ensure that the QA Project Plan is being implemented as planned and that the project activities are on track. By implementing proper assessment and oversight, finding critical problems toward the end of the project is minimized, when it may be too late to apply corrections to remedy them.

The Project Manager will report any problems detected and the corrective measures taken to the Project Manager as part of the quarterly project status reports and annual summary reports.

20.1 Types of Field Assessments

- Readiness reviews assess field team preparations prior to starting field activities;
- Field activity audits assess field team activities during their execution; and
- Post sampling event reviews assess field sampling and measurement activities methodologies and documentation at the end of all events or a selected event.

20.1.1 Responsibility for Readiness Reviews

The Project Manager will be responsible for reviewing all field equipment, instruments, containers, and paperwork in order to ensure that all will be ready prior to each sampling event. Any problems that are noted will be corrected before the field measurement activities begin.

20.1.2 Frequency for Readiness Reviews

Before every sampling event a readiness review will be conducted. All sampling personnel will be given a brief review of the goals and objectives of the sampling event and the sampling procedures and equipment that will be used to achieve them.

20.1.3 Readiness Review Activities

- Equipment checks - It is important that all field equipment be clean and ready to use when it is needed. Therefore, prior to using all sampling and/or field measurement equipment, each piece of equipment will be checked to make sure that it is in proper working order.

- Equipment maintenance records - Equipment maintenance records will be checked to ensure that all field instruments have been properly maintained and that they are ready for use.
- Supply checks - Adequate supplies of all preservatives, bottles, labels, waterproof pens, etc. will be checked before each field event to make sure that there are sufficient supplies to successfully support each sampling event.
- Paperwork checks - It is important to make sure that all field activities and measurements are properly recorded in the field. Therefore, prior to starting each field event, necessary paperwork such as logbooks, chain of custody record forms, etc. will be checked to ensure that sufficient amounts are available during the field event.

20.1.4 Readiness Review Corrections

If there is a problem discovered during a readiness review for field activities, then it must be corrected before the team deploys.

In the event that a problem is discovered during a readiness review, it will be noted in the field log book and corrected before the field crew is deployed. The actions taken to correct the problem will also be documented in the field log book.

20.1.5 Responsibility for Field Activity Audits

Scott McReynolds will be responsible for reviewing all field activity audits. Any problems that are noted will be documented along with recommendations for correcting the problem.

20.1.6 Frequency for Field Activity Audits

Field activity audits will be held quarterly during the project's field sampling activities.

20.1.7 Types of Field Activity Audits

Field activity audits will assess the sample collection methodologies, field measurement procedures, and record keeping of the field crew in order to ensure that the activities are being conducted as planned and as documented in this QA Plan.

20.1.8 Field Audit Corrections

In the event that a problem is discovered during a field audit it will be corrected immediately (or as soon as possible) so that all subsequent samples and field

measurements collected are valid. The problems and the actions taken to correct them will become a part of the field audit report.

20.1.9 Authority for Field Activity Stop Work

The QA Officer will have the authority to stop any sampling or field measurement activity that could potentially compromise data quality.

20.1.10 Responsibility for Post Sampling Event Reviews

The Project Manager will be responsible for post sampling event reviews. Any problems that are noted will be documented along with recommendations for correcting the problem.

20.1.11 Frequency of Post Sampling Event Reviews

Post sampling event reviews will be conducted following each sampling event in order to ensure that all information is complete and any deviations from planned methodologies are documented.

20.1.12 Post Sampling Event Reviews

Post sampling event reviews will include field sampling activities and field measurement documentation in order to help ensure that all information is complete.

20.1.13 Post Sampling Event Documentation

The reports for each post sampling event will be used to identify areas that may be improved prior to the next sampling event. A combined post sampling event report will be an integral part of the final report on this proposed project.

20.2 Laboratory Assessments

Laboratory oversight and assessments may involve two types of activities.

- Data reviews of each data package submitted by a laboratory; and
- Audits of laboratory practices and methodology.

20.2.1 Responsibility for Laboratory Data Review

The QA Officer will be responsible for reviewing the laboratory's data for completeness and accuracy. The data will also be checked to make sure that the specified methods were used and that all related QC data was provided with the sample analytical results.

20.2.2 Frequency of Laboratory Data Reviews

Laboratory data reviews will be conducted following receipt of each data package from a laboratory in order to ensure that all information is complete and any deviations from planned methodologies are either corrected or the reasons for change are documented.

20.2.3 Laboratory Data Corrections

Any laboratory data that is discovered to be incorrect or missing will immediately be reported to the laboratory's QA officer. The laboratory's QA manual details the procedures that will be followed by laboratory personnel to correct any invalid or missing data.

20.2.4 Lab Re-testing Authority

The Project Director has the authority to request re-testing if a review of any of the laboratory data is found to be invalid or if it would compromise the quality of the data and resulting conclusions from the proposed project.

20.2.5 Responsibility for Laboratory Audits

The QA Officer will be responsible for reviewing all laboratory audits. Any problems that are noted will be documented along with recommendations for correcting the problem.

20.2.6 Frequency of Lab Audits

Laboratory audits will be held annually during the project's analytical activities.

20.2.7 Laboratory Audit Corrections

In the event that a problem is discovered during a laboratory audit the laboratory QA officer will be notified. Problems will be corrected immediately (or just as soon as possible) so that all subsequent laboratory analyses are valid. The procedures for implementing such corrections are covered in the laboratory's QA SOP. The problems and the actions taken to correct them will become a part of the laboratory audit report.

20.2.8 Laboratory Proficiency

Blind samples will be submitted as part of a laboratory audit for a proficiency test. The results of the lab's analysis will be compared to the known analytes and their concentrations in those samples. Periodic proficiency tests will ensure that the

laboratory's staff is able to accurately analyze samples from the proposed project using the methods specified for them.

21.0 Reports to Management

1. Three months after each sample submission the Project Director shall provide an update to the Contract Manager describing activities undertaken, accomplishment of milestones, and any problems encountered, and delivery of intermediate products, if any.

2. Not later than June 15 each year, the Project Director shall submit an Annual Report to the Contract Manger summarizing all analytical data collected to date.

22.0 Data Review

Data review, verification, and validation procedures helps to ensure that project data will be reviewed in an objective and consistent manner. Data review is the in-house examination to ensure that the data have been recorded, transmitted, and processed correctly.

22.0.1 Responsibility for Data Reviews

The Project Manager and the QA Officer will be responsible for data review. This includes checking that all technical criteria have been met, documenting any problems that are observed and, if possible, ensuring that deficiencies noted in the data are corrected.

22.0.2 Checking for Typical Errors

In-house examination of the data produced from the proposed project will be conducted to check for typical types of errors. This includes checking to make sure that the data have been recorded, transmitted, and processed correctly. The kinds of checks that will be made will include checking for data entry errors, transcription errors, transformation errors, calculation errors, and errors of data omission.

22.0.3 Checking Against MQOs

Data generated by project activities will be reviewed against method quality objectives (MQOs). This will ensure that the data will be of acceptable quality and that it will be SWAMP-comparable with respect to minimum expected MQOs.

22.0.4 Checking Against QA/QC

QA/QC requirements were developed and documented in Elements 14, 15, 16, and 17 and the data will be checked against this information. Checks will include evaluation of field and laboratory duplicate results, field and laboratory blank data, matrix spike recovery data, and laboratory control sample data pertinent to each method and analytical data set. This will ensure that the data will be SWAMP-comparable with respect to quality assurance and quality control procedures.

22.0.5 Checking Field Data

Field data consists of all information obtained during sample collection and field measurements, including that documented in field log books and/or recording equipment, photographs, and chain of custody forms. Checks of field data will be made to ensure that it is complete, consistent, and meets the data management requirements of the data management section of this QAPP.

22.0.6 Checking Lab Data

Lab data consists of all information obtained during sample analysis. Initial review of laboratory data will be performed by the laboratory QA/QC Officer in accordance with the lab's internal data review procedures. However, once we receive the lab data then we will perform independent checks to ensure that it is complete, consistent, and meets the data management requirements of the data management section of this QAPP.

22.1 Data Verification

Data verification is the process of evaluating the completeness, correctness, and conformance / compliance of a specific data set against the method, procedural, or contractual specifications. We will conduct data verification, as described in the Quality Control section, in order to ensure that it is SWAMP-comparable with respect to completeness, correctness, and conformance with minimum requirements.

22.1.1 Responsibility for Data Verification

The Project Manager will be responsible for verification of data going into the WDL. Regional Board staff and the SWAMP Data Management Team will be responsible for verification of data going into the SWAMP IMS.

22.2 Data Validation

Data validation is an analyte- and sample-specific process that evaluates the information after the verification process (i.e., determination of method, procedural, or contractual compliance) to determine analytical quality and any limitations. We will conduct data validation in order to ensure that the data is SWAMP-comparable with respect to its end use.

22.2.1 Responsibility for Data Validation

The Project Manager will be responsible for validation of data going into the WDL. Regional Board staff and the SWAMP Quality Assurance Team will be responsible for validation of data going into the SWAMP IMS.

22.3 Data Separation

Data will be separated into three categories for use with making decisions based upon it. These categories are:

1. data that meets all acceptance requirements,
2. data that has been determined to be unacceptable for use, and
3. data that may be conditionally used and that is flagged as per US EPA specification.

23.0 Verification and Validation Methods

Defining the methods for data verification and validation helps to ensure that project data are evaluated objectively and consistently. Information on these methods is provided below.

All data records for the proposed project will be checked visually and will be recorded as checked by the checker's initials as well as with the dates on which the records were checked. For data in the SWAMP IMS, the Regional Board will perform an independent re-check of at least 10% of these records as the validation methodology.

All of the laboratory's data will be checked as part of the verification methodology process. At least 10% of the laboratory's data will be independently checked as part of the validation methodology. For data in the SWAMP IMS, the Regional Board will perform independent re-checks of at least 10% of them as the validation methodology.

Any data that is discovered to be incorrect or missing during the verification or validation process will immediately be reported to the Project Director. If errors involve laboratory data then this information will also be reported to laboratory's QA officer. The laboratory's QA manual details the procedures that will be

followed by the laboratory personnel to correct any invalid or missing data. For data in the SWAMP IMS, the Regional Board and SWAMP DMT will be responsible for reporting and correcting any error s that are found in the data during the verification and validation process.

If there are any data quality problems we will try to identify whether the problem is a result of project design issues, sampling issues, analytical methodology issues, or QA/QC issues (from laboratory or non-laboratory sources). If the source of the problems can be traced to one or more of these basic activities then the person or people in charge of the areas where the issues lie will be contacted and efforts will be made to immediately resolve the problem. If the issues are too broad or severe to be easily corrected then appropriate people involved will be assembled to discuss and try to resolve the issue(s) as a group. The Contract Manager has the final authority to resolve any issues that may be identified during the verification and validation process.

During the process of verification and validation for data in the SWAMP IMS, the methods that will be used are described in the *Surface Water Ambient Monitoring Program Information Management Plan.*

24.0 Reconciliation with User Requirements

Information from field data reports (including field activities, post sampling events, corrective actions, and audits), laboratory data reviews (including errors involving data entry, transcriptions, omissions, and calculations and laboratory audit reports), reviews of data versus MQOs, reviews against Quality Assurance and Quality Control (QA/QC) requirements, data verification reports, data validation reports, independent data checking reports, and error handling reports will be used to determine whether or not the project's objectives have been met.

Data from monitoring measurements will not be statistically analyzed. Descriptions of the data will be made with no extrapolation to more general cases.

Data from all monitoring measurements will be summarized in tables. In addition, data that show significant changes over time during the monitoring period will be plotted in graphs and charts. There are no known limitations that are inherent to the data to be collected for this study. Explanations will be provided for any data determined unacceptable for use or flagged for QA/QC concerns.

The proposed project will provide SWAMP-comparable data for the selected analytes described in Element 6. All data will be readily available to the public, and data for the analytes in Table 6.2 will be available from SWAMP's IMS and, subject to physical habitat limitations, the data generated will be useable for comparative purposes by other water monitoring projects within the various components of SWAMP.

The above evaluations will provide a comprehensive assessment of how well the project meets its objectives. No other evaluations will be used.

The Project Manager and Contract Manager will be responsible for reporting project reconciliation. This will include measurements of how well the project objectives were met and the degree to which the data is SWAMP-comparable.

25.0 References

Federal Register Volume 49, No. 209, Friday, October 26, 1984, EPA, 40 Code of Federal Regulations, Part 136

Handbook for Sampling and Sample Preservation of Water and Wastewater, EPA 600/4-82-029, September 1982.

Standard Methods for the Examination of Water and Waste Water, American Public Health Association, et al., 19th Edition, or later. http://www.standardmethods.org/

The Water Quality Control Plan for the Central Valley Region, California Regional Water Quality Control Board, Central Valley Region. 4th Edition.

http://www.waterboards.ca.gov/water_issues/programs/swamp/qamp

Appendix A. DWR Northern District Standard Operating Procedures Field Sampling Procedures

Bacteria

To collect for bacteria, a sterile Corning Brand Coliform Water Test Sample Container of 100mL volume with a sodium thiosulfate tablet is filled to the 100mL mark with sample water. For surface water, dip the container about 0.15 m below surface if possible, open the lid and then seal the lid again once the appropriate amount of water has filled the container. Do not rinse container and do not remove sodium thiosulfate tablet. After collection, Cap container and pull tie-down through the hole in front top of the container to seal the container until the sample is processed. Leave room in the top of the container for mixing. Sample can be stored below 10°C for up to 24 hours before filtering.

Standard minerals ,Total Hardness,TDS/ Suspended Solids

Two polyethylene (PE) ½ pint bottles and two PE quart bottles are used for collection of standard minerals, TDS, and suspended solids. A quart (Suspended Solids) and a ½ pint (Total Hardness) are used for unfiltered sample water, the remaining quart (TDS) and ½ pint are used for filtered sample water. The unfiltered samples are collected directly from the water body. Subsurface samples are collected similarly using a 2.2 liter, acrylic Van-Dorn Bottle Sampler. The bottles are rinsed with sample water and then filled full and the cap replaced. Filtered samples are obtained by filtering sample water from a grab sample, collected into a sample-rinsed PE ½ gallon bottle, through a 142 mm diameter 0.45μm HA nitrocellulose filter. Filter head is rinsed with a ½ pint of field blank water (distilled water). The filter is placed onto the filter head and then rinsed with another ½ pint of field blank water. The samples are filtered into the ½ pint and quart bottles after a rinse with filtered sample water. TDS and suspended solid samples are stored at 4°C for up to 7 days before holding time expires. Total hardness and Code 1 (filtered) are preserved with 1.0 ml of 70% nitric acid in the field and stored at 4°C for up to 180 days before holding time expires.

Ultra-Low Level Metals (EPA Method 1638)

Collection requires two people, a “dirty hands” that handles the outer bag, and a “clean hands” that handles the inner bag and the collection of the water sample. Both people wear polyethylene or “poly” gloves, with the “clean hands” sampler having shoulder length poly gloves. The person who has “dirty hands” opens the outer bag for the person who has “clean hands” to open the inner bag and remove the clean plastic sample bottle. Clean hands then re-close the inner bag and dirty hands re-close the outer bag. The sample bottle is submerged into the sample water or collected from the spigot of a well or from a Teflon sampler until the bottle is partially filled. The cap is replaced, the sample bottle is shaken, and then the rinse water is discarded. This rinse is performed a total of three times. After the rinse, the sample bottle is filled, the cap replaced and the sample bottle is placed back into the re-opened inner bag by clean hands. The inner bag is sealed with dirty hands holding the outer bag with the inner bag within it. Clean

hands does not touch the outer bag and dirty hands does not touch the inner bag. The outer bag is then sealed by dirty hands and the previously labeled sample is stored at 4 °C. See EPA Method 1669. Dissolved samples should be delivered to the lab within 2 days for filtration/fixing of the dissolved aliquot. The total and filtered/fixed dissolved samples have a 180 day holding time.

Mercury / Methyl Mercury

Collection procedures are as described for Ultra-Low Level Metals (EPA Method 1638). The samples are collected into 250 ml clear glass bottles that are provided by the laboratory, pre-cleaned, and pre-bagged. Mercury and methyl mercury samples are shipped, on ice, next-day air to the analyzing Laboratory the within 48-hours where the samples are fixed with preservative. Fixed samples have a 180 day holding time.

Nutrients

Two PE ½ pint bottles are used for collection of nutrients. The first is unfiltered sample water and the second is used for filtered sample water. The unfiltered sample is collected directly from the sample body. Subsurface samples are collected similarly using a 2.2 liter, acrylic Van-Dorn Bottle Sampler. The ½ pint is rinsed with sample water and then filled 2/3-3/4 full and the cap replaced. Samples are stored at 4°C for 24 hours or frozen for 28 days. The filtered sample is obtained by filtering sample water through a 142 mm diameter 0.45μm HA nitrocellulose filter. Filter head is rinsed with a ½ pint of field blank water (distilled water). The filter is placed onto the filter head and then rinsed with another ½ pint of field blank water. The sample is filtered into the ½ pint bottle after a rinse. Nutrient Field Blanks are processed the same way with lab-prepared blank water instead of ambient site water. Samples are stored at 4°C for up to 24 hours. If delivery to the laboratory will take longer than 24 hours, the sample is frozen for up to 28 days before the holding time expires.

Total Ammonia

Use a PE pint to collect total ammonia samples. First, unscrew lid, fill partially bottle with sample water and shake bottle with lid for a rinse. Fill the pint sample bottle, add 1.0 ml of 1:1 sulfuric acid, and then replace cap. Sample is stored at 4°C for up to 28 days before holding time expires.

Total Organic Carbon (TOC)/Dissolved Organic Carbon (DOC)

Use 40mL, clear vials that are provided by Bryte with phosphoric acid preservative already added (Avoid touching opening of vial or cap to prevent contaminating the samples). Collect water sample into sample rinsed PE ½ pint bottle and slowly add sample water from the ½ pint to the **un-rinsed** TOC vial until the meniscus is below the rim **(Do not over-fill).** The DOC vial is filled during filtration of dissolved mineral and nutrient samples from the same ½ gallon grab (again, do not rinse the vial prior to filling). Samples are stored at 4°C and have a 28 day holding time.

Organics and pesticides – Note short holding times for these samples and arrange delivery to Bryte Laboratory to prevent holding time exceedence.

Chlorinated Organic Pesticides (OCP), Organic Phosphorus Pesticides (OPP), and Chlorinated Phenoxy Acid Herbicides)
Use 1L amber glass bottles to collect these samples (OCP and OPP samples are combined into one bottle, chlorinated phenoxy acid herbicide sample in its own bottle). First, unscrew lid, fill partially bottle with sample water and shake bottle with lid on for a rinse. Repeat twice for a total of three rinses. Submerge sample bottle in water and fill; replace cap and store on ice. Samples have a 7 day holding time. Include triplicate samples for every tenth monitoring location that is sampled for laboratory QA/QC (MS/MSD).

Volatile Organics in Water (Purgeable Organics)
Use two 40mL, amber vials that are provided by Bryte with 1:1 HCl preservative already added. Collect water sample into sample rinsed PE ½ pint bottle and slowly add sample water to one vial at a time until the meniscus just tops the rim **(Do not over-fill; leave no head space/air in vial)**. Samples are stored at 4°C and have a 14 day holding time.

Carbamate Pesticides
Use 125mL clear glass bottle provided by Bryte with monochloroacetic acid preservative already added. Open bottle, submerge into water column and fill **(Do not rinse)**. Re-cap bottle and store at 4 °C. Samples have a 28 day holding time.

Glyphosate
Use 125mL amber glass bottle provided by Bryte Laboratory. Open bottle, submerge into water column and fill **(Do not rinse)**. Re-cap bottle and store at 4 °C. Samples have a 28 day holding time.

Oil and grease
Scan waters visually at each sampling location for oil sheen; record into field notebook if a sheen is present. If oil sheen is present, collect sample from sheened area into a properly labeled, pre-cleaned, wide-mouth, clear glass jar. Transport sample on ice and add oil and grease analysis request to FLIMS laboratory submittal for analysis. Samples have a 28 day holding time.

Toxicity
Use one pre-cleaned, 5-gallon HDPE carboy, (or five 1-gallon collapsible containers for remote, hike-in locations), provided by Pacific EcoRisk Laboratory (PER) for each toxicity sampling location. Partially fill sample container in well-mixed ambient site water, re-cap, and vigorously shake container. Empty container and repeat rinse process twice more for a total of three rinses. Fill

container to full and affix label provided by PER, filling in the sampling date, time (PST), and sampler's name. Place clear shipping tape over the label to prevent loss of label/information during transport. Store on ice at 4 °C and deliver to PER laboratory within 24 hours of collection.

Appendix B. DWR Northern District Standard Operating Procedures
Basic Field measurements

pH

Hach SensION1 portable pH meter with model 51935-00 SensION pH probe

The pH probe is placed into sample and measurement read off the console. To auto-calibrate, two pH buffer solutions will be prepared, 4.01 and 7.00 or 7.00 and 10.0, depending on expected sample pH. After turning on the meter, press MODE until the pH indicator mode is displayed. Place the pH electrode into one of the buffer solutions and push the CAL key so that CALIBRATE is on the display and P1 is visible in the lower field. When the reading has stabilized, the meter will beep and YES should be pressed to accept the reading. Remove the probe from the first buffer solution, rinse with DI water and then place the probe into the second buffer while the display says P2. When reading has stabilized, the meter will beep and again, YES should be pressed to accept the reading. Readings can now be taken. Measurements from -2.0 to 19.99 pH are possible.

Electrical Conductivity

YSI Model 85 handheld oxygen, conductivity, and temperature system

1. Turn the meter on- the instrument will activate all segments of the display for a few seconds, which will be followed by a self-test procedure that will last for several more seconds. During this power on self-test sequence, the instruments microprocessor is verifying that the instrument is working properly.

2. Select a measurement mode (dissolved oxygen %, dissolved oxygen mg/L, conductivity, specific conductance, or salinity). Temperature is always displayed. Selecting a measurement mode is accomplished by simply pressing and releasing the mode button. If the instrument is reading specific conductance (temperature compensated), the large numbers on the display will be followed by µS or mS. additionally, the small portion of the display will show the ^{o}C flashing on and off. If the instrument is reading conductivity (NOT temperature compensated), the large numbers on the display will be followed by either a µS or an mS; however, the small portion of the display will show the ^{o}C NOT flashing.

3. Lower electrode to the desired depth. Be sure not to disturb bottom substrates prior to or during measurement.

4. Record measurement

5. Cycle to the next measurement mode and record the next parameter. This step should be continued until measurements for all parameters are recorded.
6. Turn meter off and place electrode into storage chamber.

Water Temperature

YSI Model 85 handheld oxygen, conductivity, and temperature system

1. Turn the meter on- the instrument will activate all segments of the display for a few seconds, which will be followed by a self-test procedure that will last for several more seconds. During this power on self-test sequence, the instruments microprocessor is verifying that the instrument is working properly.

2. Select a measurement mode (dissolved oxygen %, dissolved oxygen mg/L, conductivity, specific conductance, or salinity). Temperature is always displayed. Selecting a measurement mode is accomplished by simply pressing and releasing the mode button. If the instrument is reading specific conductance (temperature compensated), the large numbers on the display will be followed by µS or mS. Additionally, the small portion of the display will show the ^{o}C flashing on and off. If the instrument is reading conductivity (NOT temperature compensated), the large numbers on the display will be followed by either a µS or an mS; however, the small portion of the display will show the ^{o}C NOT flashing.

3. Lower electrode to the desired depth. Be sure not to disturb bottom substrates prior to or during measurement.

4. Record measurement

5. Cycle to the next measurement mode and record the next parameter. This step should be continued until measurements for all parameters are recorded.
6. Turn meter off and place electrode into storage chamber.

Dissolved oxygen

Winkler Method

To determine dissolved oxygen, a 300mL sample of water is collected with no air bubbles in a BOD bottle. To the bottle, one small power pillow of alkaline-iodide azide reagent and 1 medium powder pillow of manganous sulfate are added. The stopper is placed in the bottle and the whole thing is inverted repeatedly until solution is mixed. The bottle is left undisturbed until the precipitation has settled to about ½ the bottle and then 1 large powder pillow of sulfamic acid is added. The stopper is replaced and the bottle is again inverted repeatedly until mixed (a clear yellow to orange solution appears). The sample contents are poured into a 500mL Erlenmeyer flask and the sample solution is titrated (while flask is being agitated or stirred) with 0.037N sodium thiosulfate solution until sample is a pale straw color. A few drops of starch solution are added to the sample solution and the sample is titrated with the thiosulfate until the sample solution is clear and colorless. The dissolved oxygen measurement is read off the buret that dispenses the sodium thiosulfate and 1.0 ml of thiosulfate used to titrate equals 1.0 mg/L of dissolved oxygen. No calibration is needed and range is 0 to ~ mg/L dissolved oxygen. Note: chemicals used in this procedure are toxic, wear protective gloves while performing the titration.

YSI Model 85 handheld oxygen, conductivity, and temperature system

1. Turn the meter on- the instrument will activate all segments of the display for a few seconds, which will be followed by a self-test procedure that will last for several more seconds. During this power on self-test sequence, the instruments microprocessor is verifying that the instrument is working properly.

2. Select a measurement mode (dissolved oxygen %, dissolved oxygen mg/L, conductivity, specific conductance, or salinity). Temperature is always displayed. Selecting a measurement mode is accomplished by simply pressing and releasing the mode button. If the instrument is reading specific conductance (temperature compensated), the large numbers on the display will be followed by µS or mS. Additionally, the small portion of the display will show the ^{o}C flashing on and off. If the instrument is reading conductivity (NOT temperature compensated), the large numbers on the display will be followed by either a µS or an mS; however, the small portion of the display will show the ^{o}C NOT flashing.

3. Lower electrode to the desired depth. Be sure not to disturb bottom substrates prior to or during measurement. If water is not moving sufficiently, then physically move the probe at least 1ft/second.

4. Record measurement

5. Cycle to the next measurement mode and record the next parameter. This step should be continued until measurements for all parameters are recorded.
6. Turn meter off and place electrode into storage chamber.

Note: If sampling sites are relatively close together, it is acceptable to leave the meter on until all measurements are recorded.

Odor

At the sample site, a plastic container is filled with sample water and then smelled by the collector. Odor, if any, is then noted. No calibration necessary. No range other than that of the smeller.

Color

Hach Color CO-1

Place the color wheel into the color comparator. Filter sample water through a nitrocellulose 0.45µm HA filter into a sample vial to the top line. Fill the second vial to the line with colorless field blank water. While looking at color comparator, place sample water in right top opening. Place the colorless blank tube into opening on the left. Hold the comparator towards a light source (sun) and turn the wheel until it matches the color of the sample. No calibration is necessary. Range is 0-100 APHA Platinum Cobalt Units.

Turbidity

Hach Model 2100P Portable Turbidimeter

Samples are collected at a depth of 0.15 m with ½ pint bottles. An aliquot of each ½ pint is used for turbidity determination with a Hach Model 2100P Portable Turbidimeter. Sample water is gently mixed by turning the sample container over a few times, taking care not to create air bubbles. Water is then gently poured (again with no air bubbles) into a clean sample cell up to the line, the cell is capped and the sample cell is allowed to sit undisturbed for a few moments until any air bubbles that may have occurred have dissipated. Wipe any water off outside of glass with lint free tissue such as Kimwipes. Trail a thin line of silicon oil down side of glass and rub oil, enough to coat the sample cell, with provided black cloth. The Hach Model 2100P Portable Turbidimeter is turned on and sample cell is placed with downward arrow towards line near front of meter and lid is closed. The READ button is pressed and the average turbidity is recorded in NTUs.

Bryte Chemical Laboratory Quality Assurance Manual

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1. Introduction

The Bryte Chemical Laboratory's primary role within the Department of Water Resources is to provide analytical, chemical, and biological laboratory services for DWR. As a secondary role, the laboratory provides these same services to other governmental agencies. This manual addresses the quality assurance and quality control measures used by the laboratory in determining the organic, inorganic, and biological entities found in California waters.

This QA manual addresses all activities that are essential in the operation of the analytical laboratory.

The principles presented in this manual are used to ensure the laboratory is providing information that is factual, precise, accurate, reliable, and adequate for its intended use.

This manual is designed to meet the U.S. Environmental Protections Agency policy guidelines as outlined in the *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80, and also to meet the California Department of Health Services, Environmental Laboratory Accreditation Program.

2. Definition, Purpose, and Scope

Definition of Terms

Quality Assurance Program: An orderly assemblage of management policies, objectives, principles, and general procedures by which an agency or laboratory outlines how it intends to produce data of known and accepted quality.

Quality Assurance: The total integrated program for assuring the reliability of monitoring and measurement data. QA is a system for integrating the quality planning, quality assessment, and quality improvement efforts to meet user requirements.

Quality Control: The routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process.

Quality Assessment: The overall system of activities to provide assurance that the QC task is being performed effectively. Quality Assessment involves a continuing evaluation of performance of the production system and the results produced.

Standard Operating Procedure: A detailed written procedure designed to systematize and standardize the performance of the procedure.

Purpose of Manual

The purpose of this manual is to describe the QA/QC program for all laboratory practices in order to generate the most precise and accurate data possible. To achieve this purpose, a comprehensive and scientifically sound QA plan has been implemented and is now used.

Scope - Objectives

The ultimate goal of the laboratory is to produce quality data that is accurate, precise, complete, representative, and compatible. While proper validated methodologies are necessary, these alone are not sufficient to assure data quality. The QA plan is designed to control and monitor laboratory activities, ensuring the laboratory meets the data quality objectives listed above.

The QA program will be carried out under the direction of the Laboratory QA Officer who reports directly to the Chief of the Bryte Chemical Laboratory. It covers all aspects of sample receiving, storage, preparation, analysis, and reporting.

Standard QC procedures, data reduction, and reporting will be in compliance with requirements in *Standard Methods for Examination of Water and Wastewater*, 19th ed. or later editions. Written SOPs for sample receipt, chain of custody, preservation, storage, preparation, analysis, safety, and reporting shall be followed. Log books, printed documents, data, or other written documentation shall be available to describe the work performed in each of the following stages of analysis:

- Chain of custody
- Sample preservation
- Sample receipt
- Sample storage
- Sample preparation
- Sample Analysis
- Data reduction
- Data reporting
- QA/QC

3. Organization and Responsibility

Executing an effective QA program in the laboratory demands the commitment and attention of both management and staff. All laboratory personnel within the organization play a vital role in assuring a continued commitment to the quality of work accomplished. (See Figure 1, Bryte Chemical Laboratory Organizational Chart). The laboratory staff is highly qualified and trained in the following areas:

- Gas chromatography/mass spectrometry (GC/MS)
- Gas chromatography (GC)
- High performance liquid chromatography (HPLC)
- Purge and trap techniques
- Ion chromatography (IC)
- Flame atomic absorption spectroscopy (AA)
- Graphite furnace atomic absorption spectroscopy
- Colorimetric analytical techniques
- Carbon analysis (TOC, DC)
- Wet chemical analysis
- Analytical method development
- Emission spectroscopy (ICP, ICP/MS)
- Sample preparation
- Fecal coliform
- Chlorophyll and pheophytin
- Phytoplankton

Chief of the Bryte Chemical Laboratory

The Chief of the Bryte Chemical Laboratory is responsible for all operational activities within the laboratory and is accountable for all data generated by the laboratory. QA responsibilities consist of:

- Final review of all data generated by the laboratory
- Final authority to release data to requestor
- Final authority on all analytical procedures and SOPs used by laboratory personnel
- Coordinates with the Laboratory QA Officer in implementing the laboratory QA plan and its policies, revisions, and any corrective action to ensure compliance
- Periodic audits of the QA plan to ensure the objectives and procedures are being followed

Laboratory QA Officer

The Laboratory QA Officer is independent and reports only to the Chief of the Bryte Chemical Laboratory. The Laboratory QA Officer:

- Recommends QA policy to the Chief of the Bryte Chemical Laboratory
- Develops and manages the laboratory QA plan, revises it as needed
- Oversees QC practices in the laboratory and data management
- Helps develop analytical procedures
- Develops precision and accuracy guidelines/criteria
- Reviews data quality and laboratory performance audits
- Conducts data quality and laboratory performance audits
- Prescribes and monitors corrective actions
- Recommends QC training for personnel
- Coordinates all QC/QA activities
- Approves SOPs
- Monitors laboratory performance, turnaround, and holding times

Data Control Section

The Data Control Section is responsible for all data coordination and review. Staff performs the following:

- Reviews all analysis report forms for completeness
- Reviews all analysis request forms to ensure compliance within contractual obligations
- Ensures requestor receives the final completed data report
- Maintains records and archives of all data reports

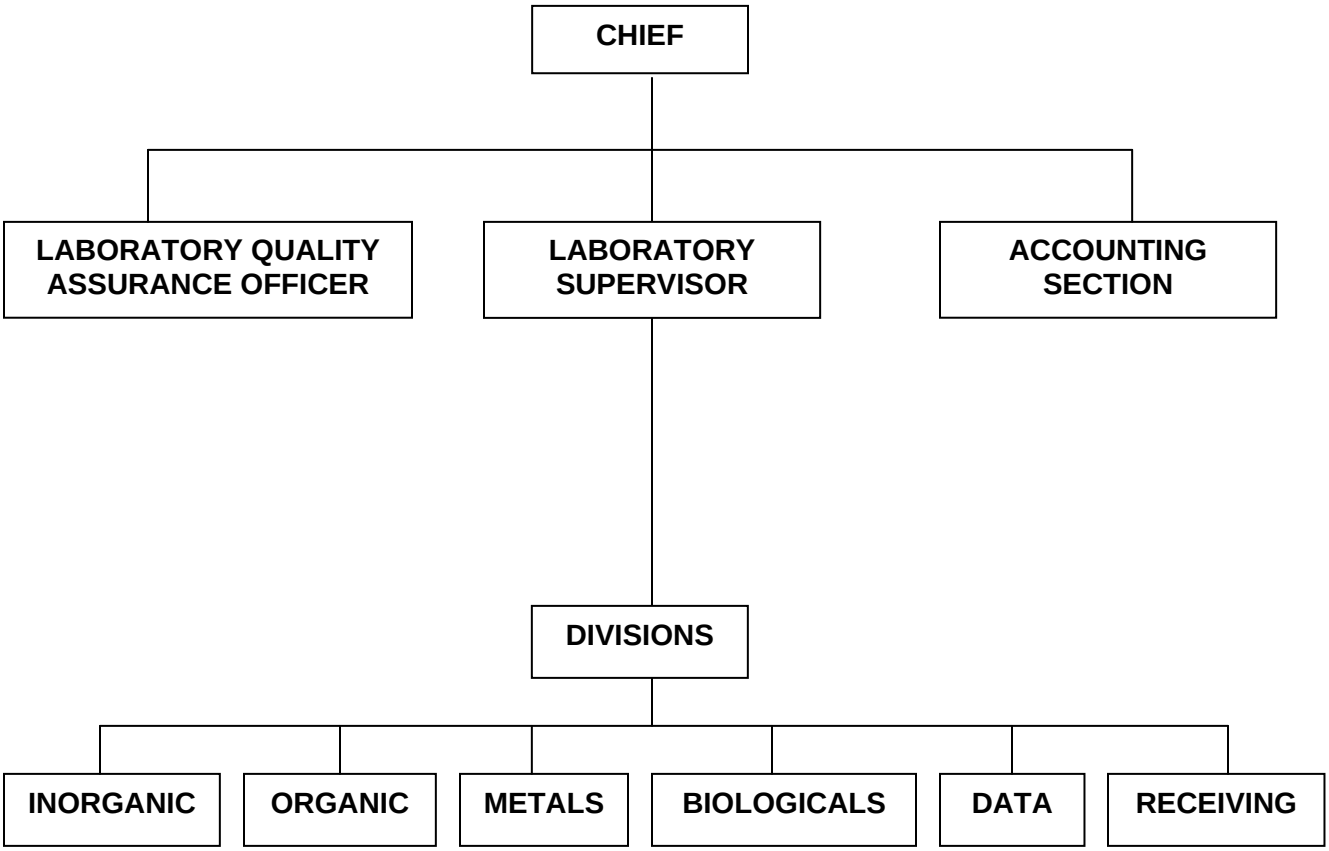
Laboratory Staff

Since the greatest amount of responsibility for a successful QA program rests with the analysts, it is important that they be highly qualified and competent. New and experienced laboratory personnel shall be carefully trained for new specific work assignments. Laboratory personnel have on-site access to technical journals and textbooks as well as access to the Resources Agency Library services. Combined administrative and technical staff meetings will be held to help provide a good

information exchange forum. Laboratory personnel are responsible for:

- Having a working knowledge of the QA plan
- Ensuring that all work generated is in compliance with QC acceptance criteria
- Performing all work according to written SOPs
- Ensuring that all documentation to their work is complete and accurate
- Ensuring that acceptance of any data outside QC criteria must be approved by laboratory management
- Maintaining records for a all QC data
- Notifying management immediately of any QC issues
- Writing and updating SOPs
- Meeting holding and turnaround times

Figure 1. Bryte Chemical Laboratory Organizational Chart



4. Sample Procedures

The laboratory does not take part in any of the actual sampling activities, but the sample collection process is a major concern of the laboratory. Since the ultimate quality of data generated begins with the sample collection process, the laboratory can assist in the sampling procedure by providing consultation and assistance to project managers and any contractors involved in a project. (See DWR Sampling Manual.)

Sample Containers and Holding Times

The laboratory supplies all necessary sampling materials to DWR field sampling units. Using properly cleaned containers and correct preservatives as well as adhering to proper holding times are essential factors for maintaining sample integrity and representativeness. Requirements for sample containers, preservation techniques, and holding times are found in one of the following references (or later editions):

- *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, et al., 19th Edition, or later
- *Federal Register* Volume 49, No. 209, Friday, October 26, 1984, EPA, 40 Code of Federal Regulations, Part 136
- *Handbook for Sampling and Sample Preservation of Water and Wastewater*, EPA 600/4-82-029, September 1982 (Does not apply to drinking water)

SOPs for cleaning and preparing glassware and sample containers are strictly complied with to ensure that the sample is not contaminated during the collection process due to containers.

Appropriate volumes of the sample must also be collected to ensure that the required detection limits can be met, the QC samples analyzed, and any necessary sample reanalysis performed.

For proper containers, holding times, preservation techniques, and volumes required, see Appendix A (Water Sample Collection Information).

Sample Submittal

Samples are brought to the laboratory by delivery services or field sampling crews. Any sample taken in a nonstandard container, improperly preserved, or shipped in an unacceptable manner may be rejected. Each sample or group of samples needs to be entered into the Field and Laboratory Information Management System (FLIMS). This can be done either manually in the laboratory or in the field and then electronically transferred directly into FLIMS. All pertinent field data is tracked by FLIMS such as the date, time, location, field sampler, field data, laboratory tests requested, etc. When the samples are completely logged in, FLIMS notifies the laboratory personnel that samples need to be analyzed.

Sample Storage and Handling

The samples received by the laboratory are placed in appropriate storage or sent directly to the test area. The storage areas are located in the receiving room and consist of refrigerators at 4°C, freezers at -10°C, and designated storage cabinets for sample types (i.e., metals, standard minerals, etc.). Once the analysis is completed, the remaining sample is kept for 30-60 days in storage, and then discarded. If a contracting officer should request return of a sample prior to the expiration interval, it will be returned in a manner that meets the required criteria.

Quality Assurance Sample

To evaluate and ensure acceptable results, the laboratory requires that samplers submit travel blanks, field blanks, and/or duplicate samples with their samples. For specific requirements, see DWR Water Quality Sampling Procedures.

5. Sample Custody Procedures

A Chain of Custody form must be completed for samples received by the laboratory which may be used as evidence for enforcement purposes. Once a sample is received, the Chain of Custody Officer or the alternate is notified. All information is then transcribed to the Chain of Custody form and the sampler signs the form, witnessed by the Chain of Custody Officer or alternate. The sample is then transferred to the appropriate location to wait for analysis. For each transfer of physical custody, an entry of disposition and one of receipt is made on the custody form.

While in the laboratory, samples are stored in a secure area under appropriate preservation and environmental conditions. Following the completion of the analysis, the samples are stored until the results are submitted to the Program Manager and permission to discard has been received. A notation of completion is made on the Chain of Custody form, and the document is then filed with the analysis report. Copies of the files are maintained in the DWR archives.

6. Calibration and Measurement Procedures

Calibration of instruments is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established detection limits. In general, calibration is accomplished by measuring instrument response to standards containing the analytes in known concentrations while being in compliance with manufacturer's recommendations.

Instrument Calibration and Frequency

Today's complex instrumentation and calibration frequencies are extremely varied; therefore, a bound notebook is assigned to each instrument to log the following:

- All maintenance performed
- All daily sensitivity checks and/or calibration results where applicable according to methodology found in SOP
- All manufacturer's maintenance and repairs

Each log entry will contain the date, operator's name, and operation performed (i.e., maintenance, sensitivity check, etc.).

Calibration is accomplished on a daily basis or whenever the following instruments are used:

- Atomic Absorption (flame and furnace)
- Spectrophotometers
- Gas-Liquid Chromatographs
- Ion Chromatographs
- Mass Spectrometers
- Auto Titrators
- Auto Analyzers
- Atomic Emission (ICP and ICP/MS)

Other instruments may require weekly, monthly, quarterly, or even semiannual calibration (i.e., balances, ovens, exhaust hoods, etc.). Once a standard calibration range has been established, at least three standards are normally used in daily standardization where applicable. For specifics, see the SOP for a particular analytical procedure. If a problem arises which cannot be corrected by the instrument operator, then the Laboratory QA Officer is notified. The officer will coordinate the necessary diagnostic and corrective measures to be implemented. Documentation will be provided a in the instrument log book.

Calibration Standards/Reagents Preparation

A critical area in the generation of quality data is the quality, purity, and traceability of the standards and reagents used in analytical calibration procedures. All primary reference standards and standard solutions used by the laboratory are obtained from the National Institute of Standards and Technology or commercial manufacturers. All standards, standard solutions, and reagents are validated prior to being used. Validation procedures range from a check for chromatographic purity to verification of concentration of the standard using standards prepared at a difference time or from a different source.

All Stock Standards are labeled as to the following:

- Name and concentration of stock
- Method of preparation
- Date prepared/Preparer's name
- Supplier, purity, lot number, and expiration date
- Any other pertinent information

New working standards are compared to the remainder of the current working standards for any concentration differences, formation of precipitates, and any signs of deterioration. Reagents are also examined for purity by subjecting an aliquot to the analytical method for its intended use. For example, reagent water, organic solvents, or acids are analyzed for possible contamination prior to use.

7. Analytical Procedures

Analytical methods are derived from the latest editions of one of the following references:

- *Methods for Chemical Analyses of Water and Wastes*, EPA-600/4-79-020 (revised March 1983) (Not used for drinking water.)
- *Standard Methods for the Examination of Water and Wastewater*, 19th Edition or later, APHA, American Water Works Association, Water Pollution Control Federation, Washington, D.C. (1992)
- *Methods for Determination of Inorganic Substances in Water and Fluvial Sediments, Techniques of Water Resources Investigations*, USGS, Book 5, Washington, D.C. (1985)
- *Annual Book of American Society for Testing and Material Standards*, Volumes 11.01 and 11.02, ASTM, Philadelphia, Pennsylvania (1988)
- *Official Methods of Analysis*, 14th Edition, AOAC International, Arlington, Virginia (1984)
- *Methods for Organic Chemical Analysis and Municipal and Industrial Wastes*, EPA 600/4-82-057, (1982)
- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under Clean Water Act*, Federal Register, EPA, 40 CFR, Part 136, (1984)
- *Biological Field and Laboratory Methods*, EPA-670/4-73-001, (1973)
- *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods*, EPA, SW846, Volumes 1A, 1B, 1C, and II, (1986)

For a specific analytical method used, see Appendix F.

Standard Operating Procedure

Analytical methods chosen are dependent upon certain objectives, some of which consist of precision and accuracy, type of sample matrix, and quantitative sensitivity. Each analytical method routinely used is documented in the form of a SOP which contains complete detailed instructions to standardize the expected performance of the analytical method. Contents of a laboratory SOP are given in Appendix B. Any deviations from published methodology are documented in the SOP.

Analytical Methodology Verification

Before any analytical method is routinely used to generate data, the method is validated. Criteria used to validate a method consist of the following:

- Method selection by senior staff
- Testing of method verifying reporting limits, dynamic range, matrix effects, precision, and accuracy criteria
- Data acceptance criteria must be approved by the Laboratory QA Officer and Chief of the Bryte Chemical Laboratory
- Final documentation of the method in a written SOP

8. Data Reduction, Validation, and Reporting

The final step in analyzing samples is to review the data collected prior to reporting. The analytical data generated within the laboratory are extensively checked and cross-checked for their accuracy, precision, and completeness. The validation process consists of data generation, reduction review, and finally reporting results to the submitter.

The primary responsibility for the generation of accurate data rests with the analyst. The analyst performs the data calculation functions and is responsible for the initial examination of the finished data. All data reduction steps applied to the raw data is outlined in the appropriate analytical SOPs. Each analyst reviews the quality of their work based on the following guidelines:

- The appropriate SOP has been followed
- Sample preparation is correct and complete
- Analytical results are correct an complete
- Blank correction procedures and followed, if applicable
- QC samples are within established QC limits
- All documentation is complete, including analysis report, QC form and QC charts

The QC procedures outlined in the analytical SOP are used for the preliminary validation of the results along with any historical data, if available. When applicable, correlation checks are used to validate the data, such as anion-cation balances, specific conductance versus dissolved solids, dissolved solids versus calculated dissolved solids, Biological Oxygen Demand versus suspended solids, Chemical Oxygen Demand or Total Organic Carbon, etc. After data reduction and validation steps are computed, the analyst enters the data into the FLIMS and releases the QC batch.

The data package is the forwarded electronically in the FLIMS to the QA Officer who evaluates the data along with all pertinent QC results such as laboratory control standards, matrix spikes, surrogates, duplicates, blind duplicates, blind Performance Evaluation samples, and laboratory performance records, as well as historical records to help form a basis for acceptance of data. If the data package passes QA/QC criteria, it is released in the FLIMS to the senior staff.

A data package containing the required QC batches for each sample submittal is then reviewed by senior staff for final validation, completeness, and acceptance. The final review is based on the following criteria:

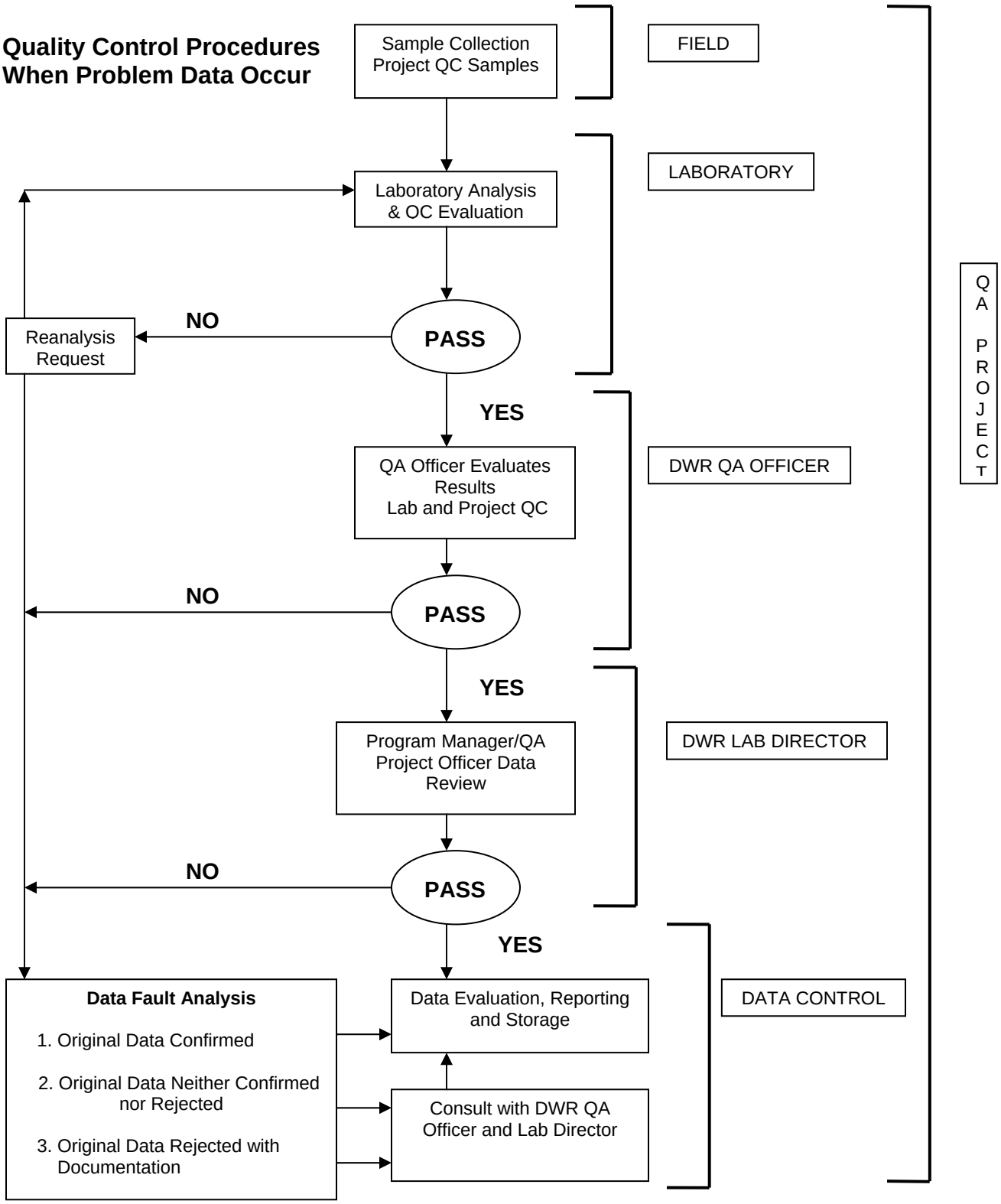
- Calibration data reviewed
- Appropriate methodologies used
- QC samples within established guidelines
- Comparison of historical data when available
- Correlation checks reviewed (i.e., anion-cation balance, electrical conductivity versus total dissolved solids, etc.,) when applicable.
- Evaluation of data in general by comparability, assessment, and reasonableness of sample types, (i.e., wastewaters, surface waters, groundwaters, etc.)
- Ensures completion of all analytical work requested

After validation and review by senior staff, the approved data package is incorporated into a final analysis report. The final report is released to the submitter either in a printed format with all the appropriate information or sent to the submitter by FLIMS in electronic format. The full data package is then archived for possible future use.

Errors or problems which may occur are documented and transmitted to the appropriate section. The cause of the errors is then addressed either by further training or reevaluation of the analytical method SOPs to ensure quality data is generated at the analyst level.

See Figure 2. Data Validation Flowchart on the following page.

Figure 2. Data Validation Flowchart



9. Internal Quality Control Checks

Internal QC is the routine activities and checks such as calibrations, duplicate analysis, spiked samples, etc. included in normal procedures to control accuracy and precision of the measurement process. It determines whether the laboratory operations are within acceptable QC guidelines during sample analysis.

Blanks

Field Blanks are check samples which monitor contamination originating from the collection, transport, and storage of environmental samples. Laboratory prepared blank water is supplied to field personnel for processing in the same manner as samples; this includes field filtration and addition of preservatives.

Travel Blanks are prepared in the laboratory from ultra-pure water. They are supplied to field personnel with each batch of empty sample bottles and are returned with the collected samples. Travel blanks are routinely used for volatile organic samples to determine whether sample transport has contaminated the samples collected.

Method Blanks are prepared from laboratory blank water, substituted for samples, and analyzed with every sample set. Method blanks are used to determine the level of contamination that exists in the analytical procedure. Contamination may or may not lead to elevated concentration levels or false positive data. Ideally, the concentration of an analyte in the method blank is below the method detection level for the analyte. However, for some analytical methods, elimination of blank contamination is extremely difficult; therefore, each analytical SOP has a method blank level of acceptance. If the acceptance contamination level is exceeded, the sample set is reanalyzed.

Calibration Standards

Calibration standards are routinely run with every sample set. Calibration standards must fall within established QC limits before any sample results can be accepted. The limits are found in the particular analytical method SOP being used. If the calibration standards are unacceptable, the sample results are rejected, corrective action taken, and the samples reanalyzed.

Check Standards

The check standard is usually a midrange calibration standard used to monitor the analytical method. The check standard is analyzed every ten samples to provide evidence that the laboratory is performing the method within accepted QC guidelines. As long as check standard results fall within established control limits, the analysis can continue. If check standard results fall outside the control limits, the data are suspect and the procedure is stopped. The analytical procedure is checked for error step by step by the analyst. Once the procedure is again acceptable, reanalysis of samples begins with the last check standard that was within acceptable control limits.

Laboratory Control Sample

When one is available, the LCS is analyzed routinely to verify the analytical method is in control and to also serve as a second source verification for the calibration standards of all routine analyses. The concentration of the LCS is within the working range of the analytical method and does not require extensive pretreatment, dilution, or concentration prior to analysis. The sources include, but are not limited to: QC samples, EPA, commercially prepared samples, or samples prepared in-house with different sources than those used in the calibration standards. Recovery data from the LCS are compared to the control limits which are established for those analytes monitored by the LCS. Before any data can be accepted, the analytes of interest in the LCS must fall within their expected control limits. If, for any reason, the results fall outside those limits, the sample results in the associated batch are unacceptable. Corrective steps are taken and filed with the QA/QC Officer. After the corrective action has been proven effective and the LCS is within the specified control limits, the samples are the reanalyzed.

Internal Standards

An internal standard is used in the more difficult analyses such as ICP, ICPMS, GC and GCMS. The internal standard is similar in analytical behavior to the analytes of interest and is added to all samples, standards, and blanks. Usually, more than one internal standard is added to each sample to evaluate the measurement of the sample throughout the entire time of analysis. The internal standards help determine the individual response factors used to calculate the concentrations of the analytes of interest.

$$RF = (A_s)(C_{is})/A_{is})(C_s)$$

where:

A_s = Area for reference analyte to be measured

A_{is} = Area for the internal standard

C_{is} = Concentration of the internal standard (µg/L)

C_s = Concentration of the reference analyte to be measured (µg/L)

The concentration of the analyte is calculated by:

$$C_a = (A_a/A_{is})(C_{is}/RF)$$

where:

C_a = Concentration of the analyte in sample (µg/L)
A_a = peak area of the analyte
RF = Response factor

The monitoring of the internal standards area counts is also used as a continuing check on instrument system performance. An average area count is established for each internal standard and any analytical run in which the internal standard area count falls outside the established criteria, the run is aborted, the cause is corrected, and the sample is reanalyzed.

Surrogate Compounds

Surrogate compounds are used in the analysis of organic compounds by gas chromatography (GC) and/or by a combination of gas chromatography and mass spectrometry (GC/MS). Like the internal standard, the surrogate compounds are similar in analytical behavior to the compounds of interest and are added to all samples, standards, and blanks. A known amount of surrogate is added to monitor the analytical performance of the method. The results of the surrogate compounds must fall within the established QC criteria for the analytical method. Samples that are outside the QC limits are reprepped and analyzed. If the reanalysis confirms the original analysis, both sets of data are reported with a flag attributing the out of control data to matrix interference.

Samples Duplicates

Duplicates are environmental samples divided into two separate aliquots analyzed independently to determine the repeatability or precision of the analytical method. The difference in the duplicate results must be within established control limits to ensure the generated data meet the quality assurance objectives for the particular analytical method.

Matrix Spike/Matrix Spike Duplicates

A spiked environmental sample is used to check for any matrix effects on the precision and accuracy of an analytical measurement. One out of every 20 samples or one per batch is spiked twice with a known concentration of the analyte of interest, and then analyzed in a normal manner. The percent recovery and relative percent difference are calculated and the results must fall within established control limits to ensure the generated data meets the QA objectives for the particular analytical method used.

Performance Evaluation Samples

PE samples are routinely issued to the analyst to monitor both the analyst's work and analytical procedure. The recorded results are reviewed by both the Laboratory QA Officer and senior staff. If any problems occur, follow-up corrective action is taken. PE samples may be in the form of blanks, previously analyzed environmental samples, split samples, or standard reference materials such as EPA, USGS, etc.

Standard Method of Additions

Standard method of additions is the practice of adding known concentrations of analyte to a sample so that matrix effects (interferences) are minimized. Whenever sample interference is suspected, the method of standard additions is employed to verify the quality of the data.

Bracketing

Bracketing is the use of standards to bracket the apparent concentration of the analyte in the sample. The sample is bracketed between a high and low standard, the standards being as close to the measured sample value as possible, usually ±10 percent. The calculated results are then done by interpolation as follows:

$$C_s = [((R_s - R_{ls})(C_{hs} - C_{ls})/(R_{hs} - R_{ls})) + C_{ls}](\text{dilution})$$

where:

C_s = Sample concentration
R_s = Response of sample
R_{hs} = Response of High Standard
R_{ls} = Response of Low Standard
C_{hs} = Concentration of High Standard
C_{ls} = Concentration of Low Standard

Normally, bracketing is used where precision of the methodology is poor. By bracketing, verification of the data quality can be obtained.

10. Performance and System Audits

Performance and system audits are an essential part of QA to ensure that the laboratory is statistically generating consistent valid data. A system audit consists of reviewing laboratory conditions, practices, equipment, staff, and procedures used to generate quality data. Performance audits verify the ability of the laboratory to correctly identify and quantitate compounds in blind check samples. The laboratory currently participates in several ongoing auditing programs on a regular basis. The audits can be categorized into external and internal audits.

External Audits
The laboratory participates in the following external audit programs:

- Water Pollution/Supply Performance Evaluation Studies, U.S. Environmental Protection Agency
- Standard Reference Water Sample Project, U.S. Geological Survey
- San Joaquin Valley Drainage Program interlaboratory comparison studies
- Split sample analysis with other laboratories both public and private

Internal Audits
Regular audits using an in-house blind reference sample are conducted for specific routine procedures. The results of the analyses are evaluated by the Laboratory QA Officer and the Chief of the Bryte Chemical Laboratory. System audits are conducted to assess the QA implementation in the laboratory. Inspection of QC charts, analytical procedures, equipment logs, and QA documentation in general is evaluated and reviewed for compliance and any needed operational changes.

In addition, informal audits are conducted by the Laboratory QA Officer as required when accuracy and precision of analyses appear to be drifting out of control. These audits may include the use of QC samples, varied matrices, calibration of instruments, and observation of the analyst to identify additional training of clarification needs, and may require changes in the analytical SOP.

The control limits are determined by calculating the mean (X) of a minimum of 20 data points and the standard deviation (S_d) to generate a control chart that has a center line X and an upper and lower line S_d. Control charts are used to monitor trends in the data which could result in corrective actions.

$$X = \frac{\sum D}{n}$$

D = data points
n = number of data points

$$S_d = \sqrt{\frac{n\left(\sum x^2\right) - \left(\sum x\right)^2}{n(n-1)}}$$

Upper Control Limit (UCL) = $x + 3S_d$
Lower Control Limit (LCL) = $x - 3S_d$
Upper Warning Limit (UWL) = $x + 1.5S_d$
Lower Warning Limit (LWL) = $x + 1.5S_d$

11. Preventative Maintenance

Preventative maintenance is routinely performed on all analytical equipment and instruments to minimize the amount of downtime and to maintain data quality. Equipment manuals, troubleshooting guides, and log books are available for maintenance support. Critical spare parts are kept on hand for laboratory instrumentation that is routinely repaired by laboratory staff. The inventory is monitored and maintained to avoid extended periods of downtime.

Service Contracts

The laboratory maintains service contracts with manufacturers and specialty companies for complex analytical equipment (i.e., GC and ICP/MS).

General Maintenance

Chemists are responsible for the routine daily maintenance of their instruments per the manufacturer's recommendations and for documenting repairs in the equipment maintenance log books. Designated laboratory personnel are trained and responsible for more complex maintenance procedures. All necessary repairs are performed by trained staff or factory service engineers. The Chief of the Bryte Chemical Laboratory will be informed of the need for, and the performance of all major maintenance activities that may directly impact sample analysis schedules.

Equipment Log Books

Equipment log books are maintained for all analytical instruments and equipment used in the laboratory. Each entry in the log book includes the date, the nature of the entry, and the name of the individual responsible for the entry. The following information is recorded in the log books:

- Results of all sensitivity checks (verifying the equipment is operating according to QA criteria for the method and/or meets the manufacturer's specifications)
- All scheduled maintenance performed
- Any major or minor problem encountered, a brief description, corrective action required, and a list of any parts replaced
- Verification of equipment operation after any maintenance is performed by designated laboratory staff

The equipment log books are periodically reviewed by the Laboratory QA Officer for compliance and problem areas in the equipment.

12. Routine Procedures Used to Assess Data Quality

The effectiveness of data quality assessment in a QA program is measured by the quality of the data generated by the laboratory. Data quality is evaluated in terms of precision, accuracy, comparability, and completeness.

Precision and Accuracy

Precision is the degree to which the measurement is reproducible among replicate observations, and accuracy is a determination of how close the measurement is to the true value. Laboratory precision and accuracy have been established for all analytical procedures used and are assessed for each sample set that is analyzed. The precision of analytical data is determined routinely by running duplicate tests in samples, laboratory control standards, and matrix spikes within the sample set. Accuracy is evaluated by analysis of spiked samples. Sample spikes are prepared by addition of a known amount standard solution to a sample. The spiked sample and unspiked sample are then analyzed for the parameter of interest. Precision and accuracy assessment utilize control charts and well established statistical procedures found in the following reference publications:

- *Handbook for Analytical Quality Control in Water and Wastewater Laboratories* (EPA 600/4-79-019, March 1979)
- *Quality Assurance Practices for the Chemical and Biological Analyses of Water and Fluvial Sediments, Techniques of Water Resources Investigations,* USGS, Book 5, Chapter A6, 1982
- *Manual of Analytical Quality Control for Pesticides and Related Compounds in Human and Environmental Samples* (EPA-600/1-79-008, January 1979)

Comparability

Comparability expresses the confidence with which the data set can be compared to other data sets measuring the same properties. See Section 8.1, Data Validation and Reporting, for procedures used to evaluate comparability for assessment of data quality.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. For data quality assessment procedures used to evaluate the completeness of data, see Section 8.1, Data Validation and Reporting.

Detection Limits

The sensitivity of any analytical method is related to the detection limits, the lowest concentration of analyte that can be detected at a specified confidence level. Definitions of Instrument Detection Limit, Method Detection Limit, Method Quantification Limit, and Practical Quantification Limit follow. The relationship of these terms is expressed graphically in Figure 3.

Instrument Detection Limit

Definition: The smallest signal above background noise that the instrument can detect reliably at 99 percent confidence level.

Measurement: Analyze replicate blank samples to determine the extent which the analyte signal exceeds the peak-to-peak noise.

Calculation: The mean value plus two standard deviations for a normal distribution or three for data distribution.

Method Detection Limit

Definition: The lowest possible concentration of a substance that can be identified, measured, and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing analyte.

Measurement: Analyze several replicates of a sample, digestate, or extracted sample with no detectable analyte to establish the estimated MDL. Prepare a concentration between three to five times the estimated MDL. Analyze seven aliquots and process each through the entire analytical method then calculate the standard deviation (S_d).

Calculation:

$$S_d = \sqrt{\frac{n\left(\sum x^2\right) - \left(\sum x\right)^2}{n(n-1)}}$$

$$MDL = 3.143(S_d)$$

The value 3.143 is from a table of the one-sided t distribution values where t = 6 degrees of freedom at the 99 percent confidence level.

Practical Quantification Limit

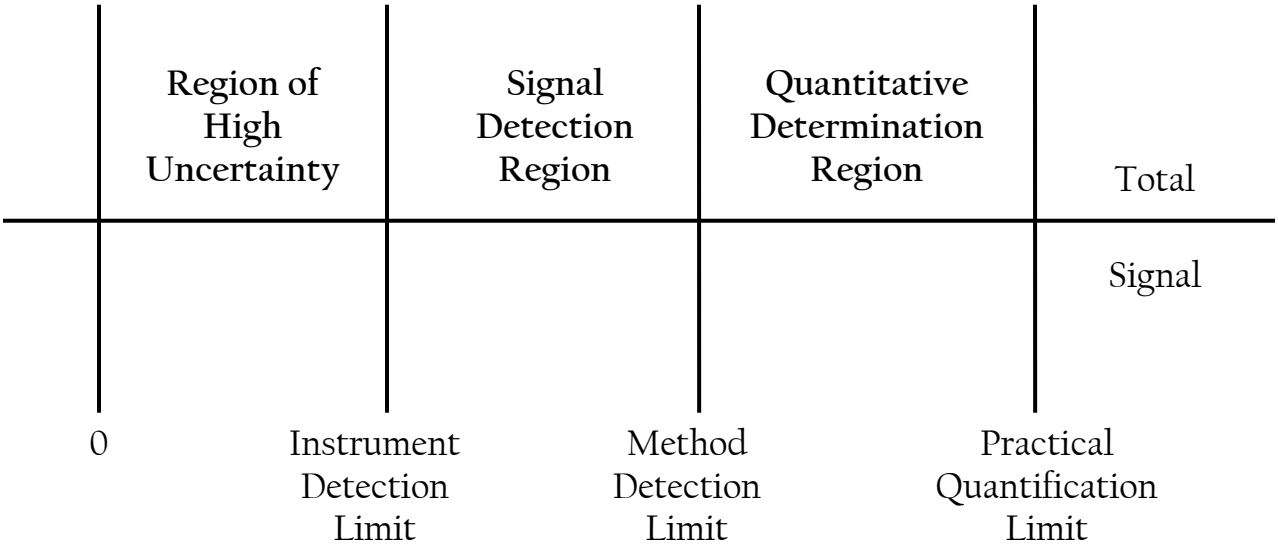
Definition: The minimum level that can be reliably achieved by the analytical method within specified limits of precision and accuracy during routine laboratory operating conditions.

Measurement: The PQL is 5 to 10 times the MDL.

Reporting Limits

The reporting limit is the PQL value of the specific analytical method. For specific reporting limits, see Appendix F.

Figure 3. Graphical Representation of Detection Limits



Relationships shown are not meant to indicate any absolute signal values.

13. Corrective Action

When errors, deficiencies, or out of control conditions are encountered, corrective actions are necessary. The need for corrective action may be identified in any number of ways:

- QC data outside acceptable limits for a given sample set
- Rising or falling trends that are detected in spike recovery or duplicate control charts
- Unacceptable levels of contamination in blanks and reagents
- Unusual changes in detection limits
- Calibration standards with low sensitivity
- Nonlinear or misshapen calibration curves
- Deficiencies detected by Laboratory QA Officer or senior staff reviewing analytical data
- Deficiencies detected during internal or external audits by Laboratory QA Officer, outside agency, or from performance evaluation studies

Since each analytical SOP has a QA section that outlines corrective actions to be taken, problems which may arise are usually handled at the analyst's level. If the problem persists and cannot be handled by the analyst, the matter is referred to the Laboratory QA Officer. The following corrective action steps are then taken:

- Identification of the problem
- Investigation and determination of the cause of the problem
- Corrective action determined to eliminate the problem
- Assigning responsibility for implementing corrective action
- Evaluation of the effectiveness of the corrective action
- Verification that the corrective action has eliminated the problem
- Documentation of the problem and corrective action needed

All suspect analytical results will be evaluated. The Laboratory QA Officer will not permit the analysis to go on-line until the corrective action has been completely successful. Corrective action documentation is routinely reviewed by the Laboratory QA Officer and Chief of the Bryte Chemical Laboratory for recurring problems which may require changes in analytical procedures, methods, or additional training of analysts.

14. Quality Assurance Reports

QA reports are generated by the Laboratory QA Officer with assistance form senior staff. These reports are used in evaluating the overall QA program, identifying problems and trends, and planning for future needs and requirements. These reports will usually include the following:

- All audit results including any necessary corrective action required
- Performance evaluation results and commentary
- Problems encountered and corrective action taken
- Any significant QA problems encountered
- Comments and recommendations

External reference samples from USGS, USEPA, DHS, or University of California, Davis are analyzed a minimum of three times per year. A QA report is generated after each external reference is completed. If special problems arise involving more than normal corrective action, a special QA report will be issued. The reports will be routed to specific staff members and finally, the Chief of the Bryte Chemical Laboratory.

15. Facilities and Laboratory Equipment

The Bryte Chemical Laboratory, located in West Sacramento, California contains a fully equipped 8,700 square foot facility. The fully air conditioned laboratory contains one large main room and smaller individual rooms with adequate hood area that is appropriately spaced with sufficient room to accommodate all personnel and equipment. The laboratory is divided into sections to handle the wide spectrum of chemical analyses performed on waters and wastewaters. The major sections consist of receiving, volatile organics, semi-volatile organics, trace metals, wet chemistry, nutrients, biological, and storage. Most of the instrumentation used in the chemical laboratory is fully automated and computerized (see Appendix H, Laboratory Equipment).

Appendix A
Water Sample Collection Information

Water Sample Collection Information

Determination	Method	Container	Sample Prep	Sample Size	Preservative	Hold Time
Alkalinity	SM 2320B	Polyethylene	Filtered	500 ml	4°C	14 days
BOD	EPA 405.1	Polyethylene	Unfiltere	2000 ml	4°C	48 hours
Carbamate Pesticides	EPA 531.1	Glass, Clear	Unfiltere	125 ml, Teflon septa	4°C, chloroacet Acid	28 days
COD	SM 5220A	Glass, Clear	Unfiltere	100 ml	4°C, H_2SO_4, pH<2	28 days
Chlorinated Pesticides	EPA 608	Glass, Amber	Unfiltere	1000 ml, Teflon septa	4°C	7d ext, 40d after ext
Chlorinated Phenoxyacid Herbicides	EPA 615	Glass, Amber	Unfiltere	1000 ml, Teflon septa	4°C	7d ext, 28d after ext
Chlorophyll	SM 10200H	Manila Envelopi	Filtered	1000 ml	-20°C, dark	28 days
Chromium, hexavalent	EPA 218.6	Glass, Clear VO	Unfiltere	40 ml	4°C	24 hours
Coliform, Fecal (Escherichia)	SM 9223 Colilert	Plastic, Sterile	Unfiltere	100 ml	4°C, $Na_2S_2O_3$	6 hours
Color	EPA 110.2	Polyethylene	Filtered	500 ml	4°C	48 hours
EDB/DBCP	EPA 504	Glass, Amber VO	Unfiltere	40 ml x 2, Teflo no air	4°C, HCl, pH<2	28 days
Electrical Conductivity (EC)	SM 2510B	Polyethylene	Filtered	500 ml	4°C	28 days
Glyphosate	EPA 547	Glass, Amber	Unfiltere	125 ml, Teflon septa	4°C	28 days
Haloacetic Acids (HAA)	EPA 552.2	Glass, Amber VO	Unfiltere	40 ml x 2, Teflo no air	4°C	7d ext, 14d after ext
Haloacetic Acids Formation Potenti (HAAFP)	EPA 510.1	Glass, Amber VO	Filtered	40 ml x 3, Teflo no air	4°C	7d ext, 14d after ext
Hardness by Calculation	SM 2340B	Polyethylene	Filtered	250 ml	HNO_3, pH<2	6 months
Hardness, Total by Calculation	SM 2340B	Polyethylene	Unfiltere	250 ml	HNO_3, pH<2	6 months
ICP Cations, Dissolved – Na, Ca, Mg, K B, Si	EPA 200.7	Polyethylene	Filtered	250 ml	HNO_3, pH<2	6 months
ICP Cations, Total – Na, Ca, Mg, K, B,	EPA 200.7	Polyethylene	Unfiltere	250 ml	HNO_3, pH<2	6 months
ICP/MS Trace Metals, Dissolved	EPA 200.8	Polyethylene, Ac Washed	Filtered	500 ml	HNO_3, pH<2	6 months
ICP/MS Trace Metals, Total	EPA 200.8	Polyethylene, Ac Washed	Unfiltere	500 ml	HNO_3, pH<2	6 months
IC Anions – Cl, SO_4, NO_3, Br, F	EPA 300.0	Polyethylene	Filtered	500 ml	4°C	28 days
Mercury by Cold Vapor	EPA 245.1	Polyethylene, Ac Washed	Unfiltere	500 ml	4°C, HNO_3, pH<2	28 days
Mercury by ICP/MS	EPA 200.8	Polyethylene, Ac Washed	Filtered	500 ml	4°C, HNO_3, pH<2	28 days

Water Sample Collection Information

Determination	Method	Container	Sample Prep	Sample Size	Preservative	Hold Time
Methylene Blue Active Substances (MBAS)	EPA 425.1	Polyethylene	Unfiltere	500 ml	4°C	48 hours
Nitrate, Nitrite (Nutrient)	SM 4500-NO_3-F	Polyethylene	Filtered	250 ml	-20°C, dark	48 hours
Nitrate, Nitrite (Nutrient DWR Modified)	SM 4500-NO_3-F DW	Polyethylene	Filtered	250 ml	-20°C, dark	28 days
Nitrate, Nitrite (Std Mineral-IC Anions)	EPA 300.0	Polyethylene	Filtered	500 ml	4°C	48 hours
Nitrate, Nitrite (Std Mineral DWR Modified)	EPA 300.0 DWR	Polyethylene	Filtered	500 ml	4°C	28 days
Nitrogen/Phosphorus Pesticides	EPA 614	Glass, Amber	Unfiltere	1000 ml, Teflon Septa	4°C	7d ext, 40d after ext
Nitrogen, Ammonia	EPA 350.1	Polyethylene	Filtered	250 ml	-20°C, dark	28 days
Nitrogen, Kjedahl, Total (TKN)	EPA 351.2	Polyethylene	Unfiltere	250 ml	-20°C, dark	28 days
Nitrogen Organic, Dissolved (DON)	EPA 351.2	Polyethylene	Filtered	250 ml	4°C	28 days
Oil and Grease	EPA 1664	Glass	Unfiltere	1000 ml	4°C, H_3PO_4, pH<2	28 days
Organic Carbon Dissolved (DOC)	EPA 415.1 (D)	Glass, Clear VO	Filtered	40 ml	4°C, H_3PO_4, pH<2	28 days
Organic Carbon Total (TOC)	EPA 415.1 (T)	Glass, Clear VO	Unfiltere	40 ml	4°C, H_3PO_4, pH<2	28 days
Orthophosphate	SM 4500-P-F	Polyethylene	Filtered	250 ml	4°C	48 hours
Orthophosphate DWR Modified	SM 4500-P-F DWR	Polyethylene	Filtered	250 ml	-20°C, dark	28 days
pH	EPA 150.1	Polyethylene	Unfiltere	250 ml	4°C	15 minutes
Phosphorus Total	EPA 365.4	Polyethylene	Unfiltere	250 ml	-20°C, dark	28 days
Simulated Distribution System THM	SM 5710C SDS-THM	Glass, Amber VO	Filtered	40 ml x 3, Teflc no air	4°C	7 days after FP
Simulated Distribution System HAA	SM 5710D SDS-HAA	Glass, Amber VO	Filtered	40 ml x 3, Teflc no air	4°C	7d ext, 14d after ext
Solids, Settleable	EPA 160.5	Polyethylene	Unfiltere	2000 ml	4°C	7 days
Solids, Total Dissolved (TDS)	SM 2540C	Polyethylene	Filtered	500 ml	4°C	7 days
Solids, Total Suspended (TSS)	EPA 160.2	Polyethylene	Unfiltere	500 ml	4°C	7 days
Solids, Volatile Suspended (VSS)	EPA 160.4	Polyethylene	Unfiltere	500 ml	4°C	7 days
Trihalomethanes (THMS)	EPA 501.1	Glass, Amber VO	Unfiltere	40 ml x 2, Teflc no air	4°C, HCl, pH<2	14 days
Trihalomethane Formation Potentl (THMFP)	EPA 510.1	Glass, Amber VO	Filtered	40 ml x 3, Teflc no air	4°C	7 days after FP
Turbidity	EPA 180.1	Polyethylene	Unfiltere	500 ml	4°C	48 hours
UVA	SM 5910B	Polyethylene	Filtered	250 ml	4°C	14 days
Volatile Organic Analysis (VOA)	EPA 502.2	Glass, Amber VO	Unfiltere	40 ml x 2, Teflc no air	4°C, HCl, pH<2	14 days

Appendix B
Standard Operating Procedure

Analytical methods SOP must include:

1. Title
2. Scope and application
   - 2.1. Analytes
   - 2.2. Reporting limits
   - 2.3. Applicable matrices
   - 2.4. Calibration range
   - 2.5. Analysis time
3. Method Summary
4. Comments (interference or helpful hints)
5. Safety issues
6. Sample collection, preservation, containers, and holding times
7. Apparatus
8. Reagents and standards
9. Procedure
10. QA/QC requirements (QC samples, acceptance criteria, and corrective action)
11. Calculations
12. Reporting requirements (units, limits, significant figures, data entry)
13. References (method source, deviations from method source, and rationale for deviation)
14. Additional information as appropriate

Appendix C
Standard Labeling Requirements

A. Label must be written with waterproof ink

1. Directly on sample container
2. On gummed label
3. On attached sample tag

B. Label information requested when applicable

1. Sample number
2. Sample type (either by name or code number) i.e., metal, mineral, pesticide, biological, Code 7, etc.
3. Date sample collected
4. Location of sample
5. Filtered or unfiltered
6. Fixed (acidified)

C. Examples of label information used includes:

N04217	FQ03112	D08112
Nutrient	Metals	Method code 1
Unfilt.	Fixed & Filt.	Filtered
Clear Lake, Bot.	HMH2462, sump.	Bryte Bend
2/20/06	3/21/06	4/29/06

Appendix D
Precision and Data Accuracy

Precision – precision will be expressed in terms of RPD of the duplicate results from the original results. The equation for expressing precision is:

$$\text{RPD} = \frac{[A-B]\times 100}{\left(\frac{(A+B)}{2}\right)}$$

where RPD = Relative Percent Difference
A = First sample value
B = Second sample value (duplicate)

Accuracy – accuracy will be expressed in terms of spiked samples. Recovery of the spike will be used to assess the data accuracy. Recovery is calculated as follows:

$$\text{Rec} = \frac{(CD-D)x100}{C}$$

where Rec = Relative Percent Recovery
C = Amount of spike added
D = Sample concentration
CD = Value of sample with spike

Appendix E
Acceptable Quality Control Limits
Sample Matrix Spike

DETERMINATION	CONTROL LIMIT %REC	RPD
MINERAL		
ALKALINITY AS $CaCO_3$ (TITRATION)	78-116	20
pH	-	20
SPECIFIC CONDUCTANCE (EC)	-	20
DISSOLVED SOLIDS (TDS) @ 180	-	20
TURBIDITY	-	20
SILICA AS SiO_2 (ICP)	75-107	20
NITRATE (IC)	78-118	20
BORON (ICP)	79-112	20
FLUORIDE (IC)	85-117	20
CHLORIDE (IC)	89-116	20
SULFATE (IC)	82-120	20
CALCIUM (ICP)	84-117	20
MAGNESIUM (ICP)	86-113	20
POTASSIUM (ICP)	82-108	20
SODIUM (ICP)	82-116	20
TOTAL SUSPENDED SOLIDS	-	20
VOLATILE SUSPENDED SOLIDS	-	20
BROMIDE (IC)	82-118	20
UVA (254NM UV ABS.)	-	20
NUTRIENTS		
TOTAL KJEDAHL NITROGEN (AUTOMATED, COLORIMETRIC)	74-127	30
AMMONIA (AUTOMATED, COLORIMETRIC)	86-118	20
(NITRITE + NITRATE) AS N (AUTOMATED, COLORIMETRI	79-119	20
ORTHO-PHOSPHATE AS P (AUTOMATED, COLORIMETRIC)	83-112	20
TOTAL PHOSPHORUS (AUTOMATED, COLORIMETRIC)	70-124	30

Determination	Control Limit %RE	RPD
METALS-EPA 1638 (DISSOLVED)		
Aluminum	78-121	20
Arsenic	86-113	20
Cadmium	84-111	20
Chromium	86-108	20
Copper	84-107	20
Iron	76-121	20
Lead	80-106	20
Manganese	81-109	20
Nickel	84-106	20
Selenium	86-117	20
Silver	79-108	20
Zinc	86-110	20
METALS-EPA 1638 (TOTALS)		
Aluminum	81-119	20
Arsenic	89-112	20
Cadmium	87-109	20
Chromium	87-110	20
Copper	86-108	20
Iron	84-115	20
Lead	82-109	20
Manganese	82-112	20
Nickel	88-107	20
Selenium	89-115	20
Silver	87-105	20
Zinc	88-111	20

Determination	Control Limit %RE	RPD
METALS-EPA 200.8 (DISSOLVED)		
Aluminum	89-118	20
Antimony	86-110	20
Arsenic	87-110	20
Barium	80-112	20
Beryllium	77-123	20
Cadmium	87-109	20
Chromium	82-114	20
Cobalt	89-101	20
Copper	85-111	20
Iron	79-120	20
Lead	78-114	20
Manganese	80-116	20
Mercury	89-111	20
Molybdenum	84-107	20
Nickel	84-112	20
Selenium	87-112	20
Silver	80-111	20
Strontium	80-110	20
Thallium	94-106	20
Vanadium	87-115	20
Zinc	87-114	20
METALS EPA 200.8 (TOTALS)		
Aluminum	85-124	20
Antimony	91-104	20
Arsenic	90-105	20
Barium	80-111	20
Beryllium	81-120	20
Cadmium	91-104	20

DETERMINATION	CONTROL LIMIT %RE	RPD
METALS EPA 200.8 (TOTALS)		
CHROMIUM	85-111	20
COBALT	84-109	20
COPPER	88-107	20
IRON	80-124	20
LEAD	85-107	20
MANGANESE	78-118	20
MOLYBDENUM	88-109	20
NICKEL	86-109	20
SELENIUM	85-110	20
SILVER	89-104	20
STRONTIUM	75-116	20
THALLIUM	87-105	20
VANADIUM	86-111	20
ZINC	88-109	20
MERCURY (TOTAL) EPA 245.1	83-121	20
VOLATILE ORGANICS		
BENZENE	86-108	20
CHLOROBENZENE	92-110	20
1,1-DICHLOROETHENE	82-102	20
MTBE	86-112	20
TOLUENE	86-108	20
TRICHLOROETHENE	86-109	20
CHLOROFORM	84-124	20
CHLORODIBROMOETHANE	84-106	20
BROMODICHLOROETHANE	78-111	20
BROMOFORM	94-116	20

DETERMINATION	CONTROL LIMIT %RE	RPD
SEMIVOLATILE ORGANICS		
ALDICARB	73-128	30
CARBARYL	95-112	20
OXAMYL	87-121	30
GLYPHOSATE	88-110	30
CYANAZINE	63-84	30
TRIFLURALIN	57-122	40
ALDRIN	57-120	40
LINDANE	65-119	40
DIELDRIN	87-143	40
HEPTACHLOR	84-132	40
2,4,5-T	106-133	40
2,4-D	94-112	20
DICAMBA	89-127	30
DICHLORPROP	76-110	30
MCPA	92-105	20

Notes:

1. List is not complete; as data becomes available, results will be entered.
2. Values listed are subject to change.
3. Limits were derived from surface, ground, and saline waters, and from agricultural wastewater.

Appendix F
Acceptable Quality Control Limits
Laboratory Control Samples

DETERMINATION	CONTROL LIMIT %REC	RPD
MINERALS		
CALCIUM	85-125	20
MAGNESIUM	85-125	20
SODIUM	85-125	20
POTASSIUM	85-125	20
ALKALINITY	85-125	20
SULFATE	85-125	20
CHLORIDE	85-125	20
NITRATE	85-125	20
FLUORIDE	85-125	20
BORON	85-125	20
TURBIDITY	85-125	20
TOTAL DISSOLVED SOLIDS	85-125	20
SPECIFIC CONDUCTANCE	-	20
SILICA	85-125	20
pH	85-125	20
BROMIDE	85-125	20
SUSPENDED SOLIDS	-	20
VOLATILE SUSPENDED SOLIDS	-	20
TOC	85-125	20
OIL AND GREASE	70-130	30
ORGANICS		
VOLATILE ORGANICS (VOA, THM, EDB, DBCP)	80-120	20
SEMIVOLATILE ORGANICS (OCP, OPP, NPP, HERB)	60-140	40
CARBAMATE, GLYPHOSATE	70-130	30

Determination	Control Limit %REC	RPD
NUTRIENTS		
Total Phosphorus	70-130	30
Total Kjedahl Nitrogen	70-130	30
Dissolved ortho-phosphate as P	80-120	20
Dissolved (Nitrate + Nitrite) as N	80-120	20
METALS		
Aluminum	80-120	20
Antimony	80-120	20
Arsenic	80-120	20
Barium	80-120	20
Beryllium	80-120	20
Cadmium	80-120	20
Chromium	80-120	20
Cobalt	80-120	20
Copper	80-120	20
Iron	80-120	20
Lead	80-120	20
Lithium	80-120	20
Manganese	80-120	20
Mercury	80-120	20
Molybdenum	80-120	20
Nickel	80-120	20
Selenium	80-120	20
Silver	80-120	20
Strontium	80-120	20
Thallium	80-120	20
Vanadium	80-120	20
Zinc	80-120	20

Appendix G
Analytical Methods and Reporting Limits

Constituent		Method	Reporting Limit (mg/L)
MINERAL			
Calcium	EPA	200.7 ICP	1
Magnesium	EPA	200.7 ICP	1
Sodium	EPA	200.7 ICP	1
Potassium	EPA	200.7 ICP	0.5
Sulfate	EPA	300.0 Ion Chromatography	1
Chloride	EPA	300.0 Ion Chromatography	1
Nitrate	EPA	300.0 Ion Chromatography	0.1
Bromide	EPA	300.0 Ion Chromatography	0.01
Fluoride	EPA	300.0 Ion Chromatography	0.1
Boron	EPA	200.7 ICP	0.1
Silica	EPA	200.7 ICP	0.1
Total Dissolved Solids	Std Methods	2540-C Gravimetric, Dried at 180°C	1
	EPA	160.1 Gravimetric, Dried at 180°C	1
Alkalinity	Std Methods	2320-B Titrimetric	1
	EPA	310.1 Titrimetric	1
pH	Std Methods	4500-H+ Electrometric	0.1 pH Unit
	EPA	150.1 Electrometric	0.1 pH Unit
Specific Conductance	Std Methods	2310-B Wheatstone Bridge	1 umhos/cm
	EPA	120.1 Wheatstone Bridge	1 umhos/cm
Turbidity	Std Methods	2130-B Nephelometric	1 NTU
		180.1 Nephelometric	1 NTU

	EPA		
UV Absorbance	Std Methods	5910-B UV-Absorbing Organics	0.001 abs/cm at 254 nm

Constituent		Method	Reporting Limit (mg/L)
NUTRIENTS			
Ammonia	Std Methods EPA	4500-NH_3 B, H Automated Phenate 350.1 Automated Phenate	0.01 0.01
Total Kjedahl Nitrogen	EPA	351.2 Colorimetric, Semi-Automated	0.10
Nitrate*	Std Methods EPA	4500-NO_3-F CD Reduction 353.2 CD-Reduction, Automated	0.01 0.01
Nitrite*	Std Methods EPA	4500-NO_3-F CD Reduction 353.2 CD-Reduction, Automated	0.01 0.01
Nitrite + Nitrate*	EPA	353.2 CD-Reduction, Automated	0.01
o-Phosphate as P	Std Methods EPA	4500-P-E Colorimetric, Ascorbic Acid 365.1 Colorimetric, Ascorbic Acid	0.01 0.01
Phosphorus, Total	EPA	365.4 Colorimetric, Semi-Automated	0.01
METALS			
Aluminum	EPA	200.7 ICP 200.8 ICP/MS 1638	0.050 0.010 0.10 ug/L
Antimony	EPA	200.7 ICP 200.8 ICP/MS 1638	0.025 0.001 0.02 ug/L
Arsenic	EPA	200.7 ICP 200.8 ICP/MS 1638	0.010 0.001 0.10 ug/L
Barium	EPA	200.7 ICP 200.8 ICP/MS	0.010 0.050
Beryllium	EPA	200.7 ICP 200.8 ICP/MS	0.005 0.001
Cadmium	EPA	200.7 ICP 200.8 ICP/MS 1638	0.005 0.001 0.10 ug/L

CHROMIUM (VI)	EPA	218.6 ION CHROMATOGRAPHY	0.005

* as N

Constituent		Method	Reporting Limit (mg/L)
Chromium (All valencies)	EPA	200.7 ICP 200.8 ICP/MS 1638	0.01 0.005 0.05 ug/L
Cobalt	EPA	200.7 ICP 200.8 ICP/MS	1 0.005
Copper	EPA	200.7 ICP 200.8 ICP/MS 1638	0.01 0.001 0.05 ug/L
Iron	EPA	200.7 ICP 200.8 ICP/MS 1638	0.01 0.005 0.10 ug/L
Lead	EPA	200.7 ICP 200.8 ICP/MS 1638	0.050 0.001 0.04 ug/L
Lithium	EPA	200.7 ICP 200.8 ICP/MS	0.01 0.005
Manganese	EPA	200.7 ICP 200.8 ICP/MS 1638	0.010 0.005 0.05 ug/L
Mercury	EPA	245.1 AA Flameless, Cold Vapor 200.8 ICP/MS	0.001 0.0002
Molybdenum	EPA	200.7 ICP 200.8 ICP/MS	0.01 0.005
Nickel	EPA	200.7 ICP 200.8 ICP/MS 1638	0.025 0.001 0.10 ug/L

Constituent		Method	Reporting Limit (mg/L)
Selenium	EPA	200.7 ICP 200.8 ICP/MS 1638	0.01 0.001 0.20 ug/L
Silver	EPA	200.7 ICP 200.8 ICP/MS 1638	0.01 0.001 0.03 ug/L
Strontium	EPA	200.7 ICP 200.8 ICP.MS	0.01 0.005
Thallium	EPA	200.7 ICP 200.8 ICP/MS 1638	0.10 0.001 0.02 ug/L
Vanadium	EPA	200.7 ICP 200.8 ICP/MS	0.01 0.005
Zinc	EPA	200.7 ICP 200.8 ICP/MS 1638	0.01 0.005 0.10 ug/L

MISCELLANEOUS

Settleable Solids	Std Methods EPA	2540-F Volumetric, Imhoff 160.5 Volumetric, Imhoff	0.10 0.10
Suspended Solids	Std Methods EPA	2540-D, Gravimetric, 105°C 160.2 Gravimetric, 105°C	1 1
Color	Std Methods EPA	2120-D Visual Comparison, Pt-Co 110.2 Colorimetric, Pt-Co	5 Color Units 5 Color Units
Surfactants, MBAS	Std Methods EPA	5540-C Colorimetric 425.1 Colorimetric	0.10 0.10
COD (Chemical Oxygen Demand)	EPA	410.2 Titrimetric, low-level	1.0
Oil and Grease	Std Methods EPA	5520-B Gravimetric 1664 Gravimetric	5.0 5.0

BOD (Biological Oxygen Demand)	EPA	405.1 Incubation, 20°C	0.10

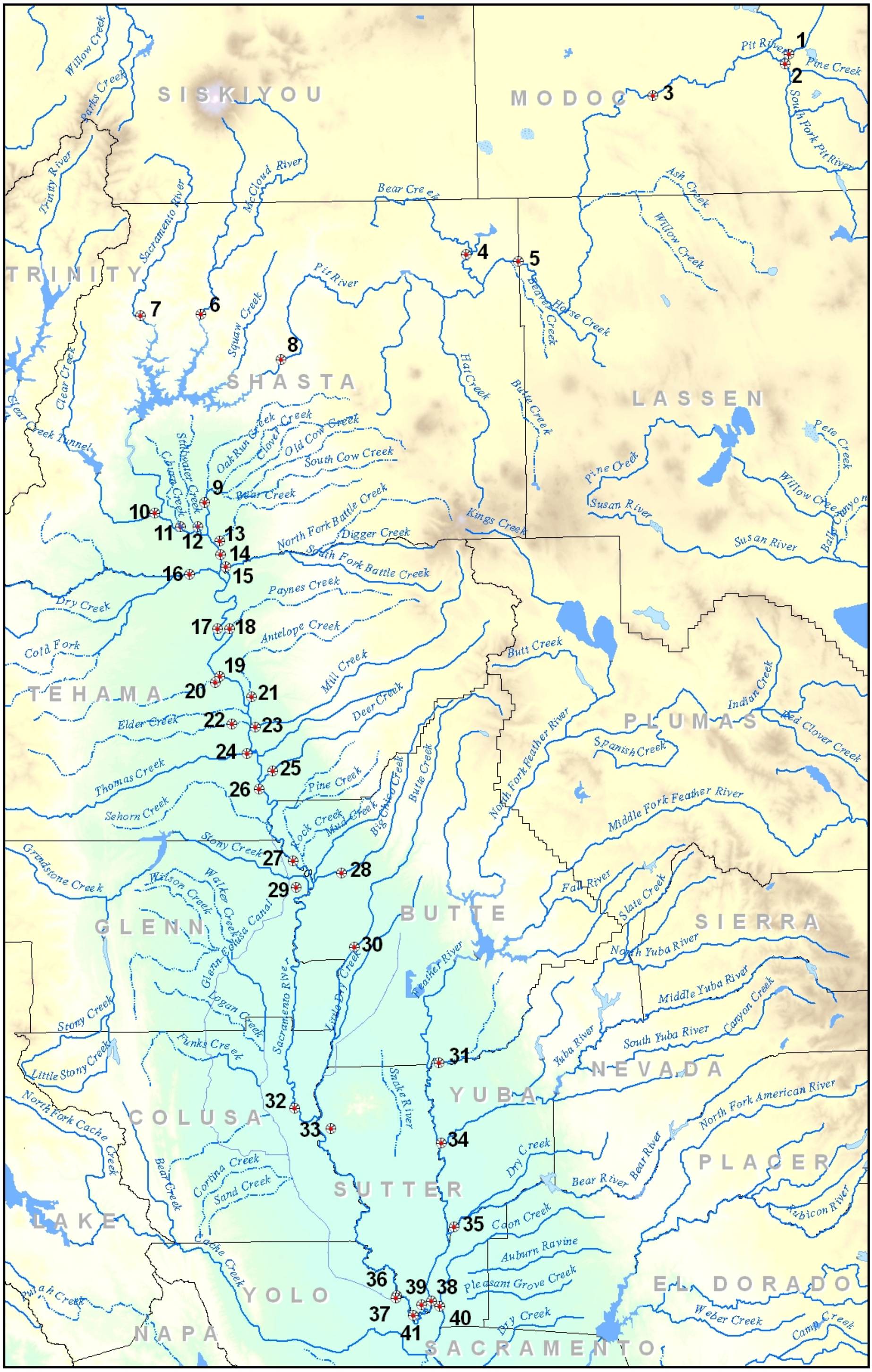
Constituent		Method	Reporting Limit (mg/L)
Organic Carbon (TOC)	Std Methods EPA	5310-D Wet Oxidation, IR, Automated 415.1 Wet Oxidation, IR, Automated 415.1 Combustion, IR, Automated	0.50 0.50 0.50
Tannin & Lignin	Std Methods	5550-B Colorimetric	1
Volatile Suspended Solids	Std Methods EPA	2540-E Gravimetric, 500°C 160.4 Gravimetric, 500°C	1 1
ORGANICS			**(ug/L)**
Trihalomethane Potentials (THMFP)	EPA	510.1 (Modified) GC, Purge and Trap	1.0
1,2-Dibromoethane (EDB)	EPA	504 Gas Chromatography (GC)	0.02
1,2-Dibromo-3-Chloropropane (DBCP)	EPA	504 Gas Chromatography (GC)	0.01
Volatile Organics	EPA	502.2 Purge and Trap	0.5
Carbamates	EPA	531.1 High Pressure Liquid Chromatography (HPLC)	2.0-4.0
Glyphosate	EPA	547 HPLC	25.0
Haloacetic Acids	EPA	552.2 Gas Chromatography (GC)	1.0
Chlorinated Pesticides	EPA	608 Gas Chromatography (GC)	0.01-1.0
Nitrogen/Phosphorus Pesticides	EPA	614 Gas Chromatography (GC)	0.01-5.0
Chlorinated Phenoxy Acids (Herbicides)	EPA	615 Gas Chromatography (GC)	0.1-1.0

Appendix H
Laboratory Equipment

Organic Section	Quantity
Agilent 5973 GCMS with a PTV/LVI injector and split/splitless injector	1
Finnigan INCOS 50 GCMS with purge and trap and split/splitless capability	1
Varian 2200 Saturn Ion Trap GCMS with a Combipal SPME/PTV/LVI autosampler	1
Varian 2100 Saturn Ion Trap GCMS with purge and trap capability	1
Varain 8100 GC with dual ECD detectors	1
HP 5890 GC with dual ECD detectors	1
HP 5890 GC with dual ELCD detectors	1
HP 5890 GC with dual PID/ELCD detectors	1
Tekmar LSC 2000 purge and trap with an ALS 2016 autosampler	1
Tekmar LSC 3000 purge and trap with an ALS 2016 autosampler	1
Agilent 1100 HPLC with diode array and fluorescence detectors	1
Pickering Labs PCX 5200 post column derivatizer	1
Horizon 4970 SPE automated liquid solid phase extractor	1
OIC 1010 persulfate wet oxidation TOC analyzer with an OIC 1051 autosampler	1
OIC 1020A combustion TOC analyzer with an OIC 1051 autosampler	1
OIC 1030D wet oxidation/combustion TOC analyzer with an OIC 1051 autosampler	1
Inorganic Section	
Perkin Elmer ELAN 6000 ICP/MS DRC-e with a PE AS-91 autosampler	1
Perkin Elmer Optima 4300DV ICP with a PE AS-90 autosampler	1
Perkin Elmer 5000 AA spectrophotometer with a AS-91 autosampler	1
Varian Spectra 55 AA spectrophotometer with a SPS-5 sample prep station	1
Perkin Elmer Lambda 11 UV/VIS spectrophotometer with an autosampler	1
Technicon Auto Analyzer II segmented flow system with an autosampler	6
Lachat 8000 flow injection analyzer (FIA) with an XYZ autosampler	1

Inorganic Section (cont.)	Quantity
Thermo Konelab Aqua20 discrete analyzer with an autosampler	1
Braun & Luebbe Traccs 800 continuous flow system with an autosampler	1
Brinkmann Metrohm autotitrilyzer with a 712 conductometer, 719 titrator, and 745 autosampler	1
Fisher Scientific Model 400 computer aided autotitrimeter with a multisampler	1
Dionex DX500 ion chromatograph (IC) with an A540 autosampler	2
Dionex ICS2000 ion chromatograph (IC) with an AS autosampler	2
Dionex DX4 ion chromatograph (IC) with a BioRad AS48 autosampler	1
Thermo Separation Products 3200 mercury analyzer with an autosampler	1
Bausch and Lomb Spectronic 88 UV/VIS spectrophotometer	1
Hach DR/4000U spectrophotometer	1
Hach 2100N turbidimeter	1
CEM Mars 5 microwave digestion unit	1
Thermo Orion 4 Star electroconductivity meter	1
Beckman sigma 63 pH meter	1
Fisher Scientific Accumet 25 pH/ion meter	2

Biological Section	
Perkin Elmer Lambda UV/VIS spectrophotometer	1
Colilert total and fecal coliform testing equipment – quanti-tray, sealer, incubator and UV lamp	1
Wild Heerbrugg inverted microscope with a Nikon camera attachment	1



Sacramento Watershed Coordinated Monitoring Program Sampling Locations

Appendix E

San Joaquin River Basin
Bacteria Monitoring Program

Verified SWAMP Compliant 28 August 2007
Updated 7 January 2008

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INTRODUCTION

The San Joaquin River Watershed Unit (SJRWU) of the Central Valley Regional Water Quality Control Board (Regional Board) conducts water quality monitoring programs throughout the San Joaquin River Watershed. Monitoring of the Grassland Area was initiated in May 1985 to evaluate the effects of subsurface agricultural drainage on the beneficial uses of the water bodies contained in the study area. The monitoring program and other data assemblages were developed to provide a basis for agricultural regulatory recommendations and to provide evidence for further studies. In accordance with the Basin Plan 5C (State Water Resources Control Board, 1989); compliance monitoring is included in the objectives of the program. In October of 2000, the Surface Water Ambient Monitoring Program (SWAMP) was initiated and provided the much needed funding to continue these monitoring efforts as well as allow for the expansion of monitoring for other constituents, including bacteria, within the Watershed. This manual is a companion to the Procedures Manual for the San Joaquin River Water Quality Monitoring to be utilized by stakeholder groups and other agencies conducting bacteria monitoring using the Colilert-18.

Accuracy and consistency are critical to ensuring validity of the database and any actions or recommendations resulting from the data. To ensure the accuracy and consistency of the data, the procedures presented in this program manual must be followed. The procedures have been laid out in a stepwise format and includes preparation, sampling, processing, and detailed descriptions where needed. This manual also briefly discusses lab and field maintenance, sample tracking, and data entry.

In this program, above all else, field and lab personnel safety is more important than any sample collected. Any concerns with this program or suggestions for improvement should be brought to the attention of the monitoring supervisor.

FIELD RUN PREPARATION

Safety of field personnel and the collection of quality samples rely heavily on field preparation, therefore, it is essential that field preparation be completed with care and accuracy. In addition, it is important to think ahead for any potential problems that may be met in the field such as weather conditions, road conditions, poison oak, ticks, rattlesnakes, hornets, mosquitoes and black widow spiders.

Field preparation is generally assigned to a specific person, however, it is each sampler's responsibility to know what will be needed in the field and inspect the field equipment prior to leaving the office. If there are any special circumstances, such as leaving early or needing special equipment, ample notice must be given to those in charge of preparation so they can prioritize accordingly.

All procedures must be followed in order to preserve the consistency and validity of results and information. Analytical results will only be as good as the sample collected.

The following outlines the standard preparation procedures for each sampling run:

1. Fill out the field sheet and bacteria-processing sheet (samples of blank and completed sheets can be found in Appendix A).
2. Fill out labels for Quanti-trays
3. Count out the number of each bottle type needed
4. Retrieve the sampling bottles and an appropriate sized ice chest to hold them.
5. Premark the sampling bottles according to the completed bacteria-processing sheet.
6. Fill travel and lab blanks.
7. Assemble field equipment
8. Check the vehicle's tires, oil, etc. before leaving to avoid delays out on the road.

Details for each procedure are given below:

Bacteria-processing Sheets and sample labels:

Bacteria samples require a field sheet, processing worksheet and labels to be filled out during field run set up. These sheets contain space for the sample id, sample processing date, samplers, sample identification, Chain of Custody, and QA/QC samples. For consistency and to ensure non-biased laboratory analyses, samples are identified using one of the sampler's initials, date of collection, and a numbering and lettering system, as follows:

- INTYYMMDD-# Bac
- INT=sampler's initials
- YY=year code (example: 2006=06)
- MM=month code (example: January=01)
- DD=date code (day of the month)
- #=arbitrary number assigned to each site, normally 10 through 60
- Bac=bacteria

Duplicate samples are used for quality assurance programs. The monitoring program supervisor will determine the duplicate sample locations prior to set up. Duplicate sample locations will be identified in the QA sample sections of the field sheet and the bacteria processing worksheet.

Labels are made by copying the sample ID's from the field sheet onto Avery 5160 labels, which are then set aside for later processing.

Bottles:

Retrieve bottles from SJRWU laboratory drawers along with an ice chest(s) in which the bottles can all fit **standing up**. All bottles are factory sealed and sterilized polyethylene bottles.

Table 1 Bottle Sizes Based on Type of Sample

Bottle Size	Type of Sample	Frequency
120 ml	Normal Samples, Field Blank Lab Blank Field Duplicate	Each 1 Per Run 1 Per Run 1 Set Per 10 samples
290 ml	Lab Duplicate	1 Set Per 10 samples

- For lab duplicate samples, 1-290 mL bottle and 2-120 mL bottles will be prepared.
    - The field sample will be collected in the 290 mL bottle.
    - The 2-120 mL bottles will be used to split the 290 mL bottle during sample processing.

    - If the samples will be processed by the same organization collecting the samples, the 2-120 mL bottles will remain in the lab, sealed.
    - If the samples will be processed by a different organization, the 2-120 mL bottles will remain sealed and be shipped with the full sample bottles the CVRWQCB lab.
- For field duplicate samples 2-120 mL bottles will be collected at the same site.

Labeling:

Write the sample ID on the side of the bottle with a waterproof marker. Write the sample number and suffix on the cap so both the sampler and those processing the collected samples can easily read it. Mark lab duplicate bottles with the normal and duplicate sample ID numbers.

Place the bottles **standing up** in the ice chest(s) in order (either by number or site). Ensure bottles are arranged so they will not tip over and that water from melted ice cannot seep in under the cap.

Include extra empty bottles for potential problems that may arise and to keep the sample bottles from tipping while in transit.

Blanks:

Travel and lab blanks are included with every run where bacteria samples are collected. Travel blanks are with the samples at all times in the coolers. Lab blanks are processed with travel blanks but are left in the laboratory refrigerator until sample processing and transfer. Phosphate Buffered Solution (PBS) should be used when available for blanks. If unavailable, de-ionized water can be used.

For making bacteria blank, see below (Be sure to wear nitrile gloves and a lab coat):

PBS Blank Preparation Procedures:

(Note this procedure is used when bacteria blanks processed in a 30-day period are sufficient to justify mixing our own. When mixing our own, we will obtain Type II water from the Tate Lab in the LAWR department at UC Davis campus and media from Sigma-Aldrich, item # P3813-10PAK, Phosphate Buffered Saline Powder, pH7.4 (lit.). When we are not mixing our own, we will obtain PBS from the Tate Lab.)

1. Remove shrink-wrap from the sample bottle.

2. Shake PBS bottle to ensure homogenous mixture.
3. Place PBS bottle and 120 ml sample bottle(s) on the workspace.
4. Sterilize nitrile gloves and workspace with alcohol.
5. Allow alcohol to air dry.
6. Remove caps from both bottles, ensuring not to touch the inside of either cap, and place, with inside down, on the sterilized workspace.
7. Fill 120-ml sample bottle with PBS water to the 100-ml line, ensuring to not touch inside of either bottle.
8. Recap both bottles.
9. Place both bottles in the refrigerator, and label with a Post-It: the acronym "PBS", initials of the person who mixed or obtained the PBS from the Tate lab and the expiration date - 30 days from the date the PBS was mixed or obtained.

Place a note on the small bacteria cooler to remind field crew to grab the bacteria travel blank out of the lab refrigerator before leaving the laboratory.

Field Equipment:

Each sampler is responsible to inform the appropriate personnel of any problems relating to equipment. See equipment maintenance (Appendix D) for detailed instructions for proper use and maintenance of equipment.

The CVRWQCB San Joaquin River Watershed Unit for the bacteria monitoring uses the following list of recommended equipment:

Table 2 Field Equipment

Equipment	Description
Ag/RB/SWAMP Field Books	The field monitoring books contain summarized monitoring information (e.g. site location maps, contact information, etc.), access keys and emergency information for field personnel. Should there be any changes made to the monitoring schedules, the field monitoring books should be updated as well. Attach the field data sheet to the clipboard with a pencil, extra blank labels, and a photograph sheet of the monitoring sites.
Clipboards w/field sheets	
Roadside Emergency Kit	
Toolbox	Inspect the toolbox and road emergency box to ensure that the appropriate contents are present and in working order (Table 1).
First Aid Kit	

Jumper Cables	
pH/EC Kit	The pH/EC kit is an ice chest containing items used for QA/QC during field sampling runs. Reorganize this cooler and augment any supplies as needed. The supplies include: ▪ Calibration solutions ▪ DI Water ▪ Tap Water ▪ Disposable nitrile gloves (small, medium, large & extra large) ▪ Waterproof marker, ball point pen, pencil, safety glasses, paper towels ▪ Myron L EC/pH meter ▪ Liquid soap
Bucket (w/ Rope and Insect Repellant)	A stainless steel bucket (triple rinse) and rope can be used for sampling off a bridge when there is no safe access to the bank. Additionally, the bucket can be used to carry sampling bottles to and from the site.
Potable Water	
Rain Gear (as needed)	
Floatation Vests (1 per sampler)	
Camera (charged battery)	
Cell Phone (charged)	While in the field, each sampling team must have a phone for emergencies.
Map Books of sampling sites and areas	
Sample Poles	
Shovel	
Life vests	**Even the best swimmers can succumb to hypothermia.** Life vests should be worn when sampling from bridges, boats, unstable banks, or during periods of extremely high flow.
Sample Coolers	
Polyethylene 5-gal Bucket	
Sampling poles	Sampling poles are used to retrieve a sample up to six feet from the bank. The pole used for bacteria sample collection utilizes a clamp to hold the sample bottle.
Shovel/spades	Carry a shovel or spade in the truck in case the truck gets stuck and must be dug out.
Boots:	Each sampler is responsible for being fit for his or her own rubber boots. Boots or hip waders may be required for

	wading to sample collection location.
Ice	

Table 3 Tool Box and Road Emergency Box Contents

Tool Box	Road Emergency Box
Screwdriver, pliers	Flares
Flashlight	Reflector triangles
Graduated cylinder	Fire extinguisher
Duct tape	
Utility knife	
Chain w/ locks	
W-D 40	
Sigma tubing	
Toilet paper	
Spare C Batteries w/ YSI Cover	
Utility Saw	
Dessicant	

Water and food:

Drinking water is necessary to maintain normal bodily functions. Bring plenty of water for a day. During the summer, double the amount of water you bring to avoid dehydration. While in the field, convenience food stores are not always available, therefore, pack a lunch and some snacks for the day. **Wash your hands prior to eating as we are sampling waterways that may contain unknown contaminants.**

Personal protective gear:

It is the responsibility of each sampler to think ahead and watch the weather forecast in order to dress appropriately for field monitoring. Items that you may want to consider bringing from home are:

- Hiking boots
- Heavy coat/sweater/sweatshirt
- Hat
- Warm gloves
- Sunglasses
- Sunscreen

Other personal items:

Money is also helpful for those unexpected necessities.

Double Check: After coolers with samples and the appropriate equipment are set up, check all equipment off the checklist. An example checklist can be found in Appendix B.

Vehicle check:

Check the vehicle's tire pressure, oil, coolant, lights, etc. in order to avoid problems and/or delays while in the field. Report any major maintenance needed to the appropriate personnel and if possible retrieve an alternate truck.

SAMPLE COLLECTION

While in the field you must depend on your own instincts and remember that no sample is worth injury. Therefore, the best rule of thumb is:

WHEN IN DOUBT, GET OUT!!!
Be aware of your surroundings at every site
and remember that safety comes first.

All procedures must be followed in order to preserve the consistency and validity of results and information. Analytical results will only be as good as the sample collected.

Photos should be taken at each site to visually document conditions. If possible, include a marker so that others can reference the site, such as a bridge, and so that future photos can be taken so that they capture the same frame. Photo documentation should occur monthly for ongoing projects and per sampling event for short-term studies.

Bacteria Collection*:*

Two people will be needed for this procedure; one to collect the sample (Sampler 1) and one to hold the cap (Sample 2). This procedure is used to minimize potential for contaminants to fall in the cap or bottle, and in lieu of uncapping the bottle under the water surface.

1. Using the clamp pole either person can secure the bacteria bottle on the clamp and remove the shrink band from bottle.
2. Sampler 1 will then dunk the clamped bottle into the water three times, downstream of the sample site, to condition the bottle and pole.
3. Sampler 2 will remove the cap from the bottle, ensuring the inside of the cap is kept away from contaminants during the sample collection.
4. Sampler 1 will then collect the sample.

a. Do not turn the bottle upside down – The bottles contain sodium thiosulfate, which is necessary for neutralizing chlorine that might be in the sample water.
b. Tilt the bottle so that the opening is facing upstream.
c. If there is debris on the water body surface, create a clear sampling zone by artificially creating a current. Push the bottle forward, horizontally, under the water body surface.
d. Collect the sample deep enough so that surface debris is not collected (one to two inches below the surface of the water).
e. Fill the bottle as close to the 100 ml mark (or 250ml if duplicate) as possible, without going under the line. Remove excess sample water from the bottle by tilting slowly to dump any extra sample water and then re-check.

5. Sampler 2 then caps the bacteria bottle, and unclamps sample.

Duplicates:

- Duplicate samples are collected to comply with QA/QC programs to ensure the precision of contract laboratories' results. Duplicate samples are submitted blindly along with other samples at a frequency of 1 field duplicate and 1 lab duplicate per 10 samples collected.

Lab duplicate samples are collected in 250 ml sterile polyethylene bottles that contain sodium thiosulphate and split in the laboratory during processing. See bacteria processing for splitting procedure.

Field duplicate samples are collected by collecting 2-125 ml polyethylene bottles at the same site. Note the site that the Field duplicates are collected at can differ from the Lab duplicate site.

Before leaving site:

The following information should be recorded on the field sheet before leaving each site:

Time (24 hour clock) the sample was collected.
Field data, if available (Temperature, pH, Dissolved Oxygen, Electrical Conductivity, Photo Number)
Any relative factors that may influence results such as change in flow (low, medium, or high), diversions or other uses being made of the water, weather, or overland flow.
Double-check the area for any equipment that may have been left or not properly secured for the remaining trip.
Keep all samples on ice until they can be processed in the laboratory.

SAMPLE PROCESSING

To maintain sample integrity and ensure viable laboratory results, appropriate handling of samples after collection is essential. It is necessary to commence sample processing promptly after the collection of samples in case there are any unusual developments or questions in regards to the samples collected, such as excessive amounts of sediment or pungent odors. Note any abnormalities of samples on the bacteria-processing sheet in addition to alerting program staff, as there may be a need for immediate action. Maximum hold time allowed is 6 hours at 4°C for regulatory purposes. For non-regulatory purposes, samples must be processed within 24 hours at 4°C. Samples must be kept in a dark location while they are being held. **All personnel must wear nitrile gloves while handling samples**. Wearing safety glasses is required when processing and pulling bacteria samples.

Bacteria processing is completed in house. Any significant changes (such as changing a procedure or the type of water used for blanks) must be annotated in the Significant Events Log in the front of the bacteria QAQC binder located in the lab, on the shelf above the sealer. There are three parts for bacteria processing:

1. Processing
2. Pulling trays
3. QA/QC

Each of these steps is elaborated in detail below:

Processing:

Sterile technique is important to reduce cross-contamination between samples as well as for personal protection from possible pathogenic organisms. Wear protective nitrile gloves, lab coat, and goggles during processing. Always wear closed-toed shoes while in the lab. Food and drinks are not allowed in the lab. Always remember to turn on the fume hood.

Equipment:

- Nitrile gloves
- Protective Eyewear
- Lab Coat
- Full sample bottles
- Bacteria processing worksheet (Appendix A)
- Spray Bottle filled with Alcohol
- Bag of 97 Well Quantitrays
- Snap packs of Colilert-18 media (QA/QC checked, see bacteria processing)

Equipment Preparation:

Prior to the field crew returning to the lab after a field run, processor should ensure that the sealer, incubator, and fume hood are turned on. The sealer and incubator take approximately 15 minutes to warm up. However, for a uniform air temperature in the incubator, plan on a general warm up time of 90 minutes.

Bacteria samples processed without delay should be removed from the cooler to warm to room temperature. (If processing samples are delayed to wait for the arrival of a second run, samples should be left in the cooler, with the time of their arrival noted on the bacteria processing form.)

Prior to working with the samples, the processor must wear the necessary safety gear; lab coat, nitrile gloves and UV protected goggles. (The UV goggles are manufactured by UVEX and can be identified by the imprint "UVEX" on the goggle arms. UVEX = UltraViolet Excluded)

Preparation for processing:

1. Ensure that one of the samplers sign the bacteria processing form under the 'Sampler' heading and annotates the date and time the samples arrived in the lab. This will serve as the chain of custody for bacteria samples.
2. Annotate the time processing began along with the name of the processor.
3. Disinfect the work area with alcohol from the spray bottle and let air-dry.
4. Remove the bottles from the cooler. Note for consistency, this action initiates the two-hour processing time window.
5. Set bottles from the cooler and the empty bottles prepared during set up for the duplicate samples on a rack over the sink. Remember to grab the Lab Blank from the refrigerator.
6. Triple rinse outside of the bottles with DI water, if available. If DI water is not available, distilled water can be used.
7. Dry the bottles with a paper towel and line them up on the work area in either ascending or descending order.
8. Gather the antifoam solution bottle and place in the work area.

Split the Lab duplicate samples:

- Note splitting is done prior to processing the batch to ensure all samples are treated the same.

1. Place the corresponding120ml bottles (Already made in preparation) in front of the corresponding 290ml sample bottle.
2. Remove the shrink bands from the two 120ml bottles.
3. Remove the 120 ml bottle caps.

4. Invert the 290ml bottle at least ten times to re-suspend any matter that settled.
5. Pour sample into the 120ml bottles to the 100ml line, alternating bottles with equal amounts of sample in approximately 50 ml increments, and swirl the 290ml bottle between pours.
6. Line up the 120ml bottles with the rest of the sample set.

Sample Processing:

1. Ensure samples are at the correct volume.
    a. The bottom of the meniscus should be on the 100ml line.
    b. If the sample is over 100 ml, pour out sample water into the sink until the appropriate amount is in the bottle, being careful to not pour out too much sample. Pour the sample water into cap, if necessary to ensure that sample water can be added back if too much has been poured off . The preference is to have enough sample to fill all Quanti-tray wells.
2. Collect the necessary number of snap-packs. Detach them from one another and place one in front of each bottle.
3. Add the contents of the snap pack to the sample container.
    a. Tap each snap-pack on the counter to shake the contents to the bottom.
    b. Loosen the bottle cap, but do not remove it.
    c. Open the snap pack by holding the foil side toward you and pull the top toward you to break the perforations.
    - A slight tinge (light yellow-brown) may be observed when snap pack is added to the sample
    - In samples with excessive chlorine, a blue flash may be seen when adding the snap pack. If this is seen, consider the sample invalid and discontinue testing the sample. Annotate on the processing worksheet that the blue flash was observed.
4. Remove bottle cap and pour the contents of the snap pack into the sample bottle with the other. Ensure that the snap pack does not touch the bottle and that the entire contents of the pack are emptied into the bottle.
5. Add Antifoam Solution to the sample container.
    a. Invert the Antifoam Solution bottle 3 times prior to dispensing.
    b. Add 2 drops of Antifoam to the sample bottle.
6. Recap the bottle.
7. Mix the Media from the snap pack and Antifoam Solution with the sample by swirling the bottle.
8. Repeat steps 1-7 for all samples.
9. Once the media has been mixed with all the samples, continue swirling the bottles until the contents of the snap packs have completely dissolved.

a. While waiting for the media to dissolve, attach the pre made labels to the Quanti-trays, ensuring nothing comes in contact with the opening of the tray.
b. Place the Quanti-trays in a stack in the order that corresponds to the bottles, and to the side of the work area.

Transfer samples to tray:

- The sealer is ready once the green light is on.

1. Place the pre-made labels on the back side (paper side) of trays.
2. Swirl the bottle contents and loosen but do not remove the cap from the bottle.
3. Hold the Quanti-tray with the label that corresponds to the sample ID open and at a 45º angle, keeping the wells facing upwards.
4. Remove the cap from the bottle and slowly pour the contents of the bottle down the foil side of the tray so as not to create excess air bubbles.
5. Hold the tray so it is vertical with the opening upward, and tap it to bump any air bubbles out of the small wells.
6. Place the tray, small wells first, into the sealer insert. .
    a. Slide the insert into the sealer – release once the sealer starts to pull the insert through.
    b. Do not push the insert into the sealer once the sealer pulls the insert. Allowing the sealer the pull the insert at its own speed minimizes the chance of empty wells.
7. Remove the insert and tray from the rear of the sealer.
    a. Do not pull tray until the sealer has released it from the rollers.
    b. Stack the trays so they can all be placed in the incubator at the same time.
8. Repeat steps 2-7 until all trays are sealed.

Placing the samples in the incubator:

- Opening the incubator door must be kept to a minimum to maintain a constant temperature within the incubator.

1. Before opening the incubator to put in the first sample, note the incubator temperature (should be 35ºC +/- 0.5) on the processing sheet.
    a. If incubator is not within +/- 0.5ºC, verify the temperature with a second thermometer.
        i. If second thermometer is also not 35ºC +/- 0.5, adjust incubator settings as appropriate.
        ii. If second thermometer reads differently than 1st
            1. Annotate on the bottom of the bacteria processing worksheet what occurred and which thermometers and incubator was used.

2. Use a different incubator, if available.
3. Notify the Program Manager.

iii. If another incubator is not available, proceed with using the current incubator, ensuring to annotate the temperature on the processing worksheet and notify the Program Manager.

2. Place the trays, wells facing down, on the counter in 4-6 stacks to be inserted in the incubator as bunches.
3. Arrange the trays in the incubator so they are evenly distributed, wells facing down, and spaced to allow air circulation within the chamber.
4. On the bacteria processing worksheet fill in the name of the person who placed the samples in the incubator, and the date and time the samples were placed in the incubator.

Laboratory clean-up:

1. Disinfect all work surfaces with alcohol.
2. Rinse sample bottles with tap water and dispose of bottles in the garage-recycling bin.
3. Remove nitrile gloves by rolling them inside out and discard them in the trashcan.

Pulling trays:

The bacteria trays are typically pulled after 18 hours incubation and must be pulled between 18 and 22 hours.

Equipment:

- Nitrile gloves
- UV/UVEX Goggles (located in the top drawer to the right of the bacteria processing counter)
- Lab coat
- Bacteria results worksheets
- Black Sharpie Marker
- Comparator (located in the second drawer down to the right of the bacteria processing counter)
- UV Light (located in the third drawer down to the right of the bacteria processing counter)
- UV Viewing Cabinet (located on the shelf above the bacteria processing counter)

Note: Items to watch for.

- More positive fluorescent wells than positive yellow wells.
- Empty wells.

- Number of wells recorded does not exceed 48 small wells and 49 large wells.
- All positive wells are marked.
- All items at the bottom of the bacteria processing worksheet are filled in. This form is the chain of custody and provides information on how each batch was handled.

Sample Results Procedures:

1. Before working with bacteria samples, laboratory personnel should wear the appropriate safety gear: nitrile gloves, plastic UV protective goggles, and white lab coat.
2. Pull the Quanti-trays from the incubator and place them in a stack to one side of the work area. (Note ending temperature.)
3. On the bacteria processing sheet under "Pulled from incubator by" fill in the name of the puller, the date, the time the trays were pulled, and the ending incubator temperature prior to opening the incubator door.
4. Place the UV light in the UV Viewing cabinet. This will automatically place the light at six inches above the trays necessary for proper viewing.
5. View trays under normal indoor lighting to determine total coliform.
    a. Wells that are positive for total coliform will be yellow in appearance equal to or greater than the yellow of the comparator.
    b. Using a sharpie marker, mark positive wells with a vertical line (|).
    c. Write the number of positive wells on the upper right corner of the set of large wells and small wells.
6. View trays under UV lighting to determine *E. coli*. It is recommended that the lights be turned off during the *E. coli* analysis.
    a. Wells that are positive for E. coli will fluoresce equal to or greater than the fluorescence of the comparator.
    b. Using the sharpie marker, mark positive wells with a horizontal line (-).
    c. Write the number of positive wells on the lower right corners of the set of large wells and the set of small wells.
7. If it cannot be determined if a well is positive or not, and the trays were pulled at 18 hours incubation, place the tray back in the incubator for an additional four hours. If after that time the well has not increased in the yellow color or fluorescence, then it is negative. If it has increased, it is positive.
8. The total positive yellow and fluorescent wells, empty wells, and false positive wells will then be marked on the bacteria processing worksheet. **Note false positive wells are fluorescent but not yellow.**

Duplicate Samples QA Verification

1. Duplicate QA is checked once all sample results are annotated on the bacteria processing worksheet.

a. In the QA section of the bacteria processing, there is space for one set of blanks and two sets of duplicates: Field and Lab. Annotate the Duplicates and Normal Samples based on the field sheet.
b. Run the MPN generator program (Can be downloaded from www.idexx.com/water/quantitray. Look for the blue link that says, "free download".)
    i. Information to be entered is the number of large wells and the number of small wells per sample included in QA, as indicated on the field sheet.
    ii. Once the numbers of large and small wells are entered, the Calculate button will be active. Mash the calculate button for the program to respond with the MPN and Upper and Lower Confidence Limits.
    iii. Enter results in the corresponding boxes of the bacteria processing worksheet QA section.
c. QA verification
    i. Calculate each set of Normal and Duplicate means
    ii. Verify the mean is within the confidence limit for the Normal and Duplicate Samples for each set
    iii. Passing QA
        1. Mean MPN falls within both confidence limits
        2. Transfer QA data to the log sheet in the Bacteria QA binder located in the SJR Unit lab.
        3. Follow distribution in 12, below.
    iv. QA doesn't Pass
        1. Mean MPN falls outside one or both confidence limits
        2. Verify sample numbers
        3. Verify data entry
        4. If needed, contact the program manager to verify tray counts
        5. Transfer QA data to the log sheet in the Bacteria QA Binder located in the SJR Unit lab.
        6. If tray counts are still outside the passing criteria, flag the data as questionable, pending resolution of SWAMP Laboratory Duplicate QA

2. When finished reading the batch of trays, deposit the used trays in the biohazard trashcan in the lab. The trays must be properly disposed of due to their having been live microorganisms in the samples indicate the potential presence of infectious organisms. The following outlines the procedure used by the San Joaquin River Watershed Unit:
    a. The used trays are taken to the Sacramento Regional County Sanitation District (SRCSD) laboratory to be autoclaved and disposed of at least **monthly**. A map to the wastewater treatment facility can be found at: <http://www.srcsd.com/srwtp-map.html>.

b. Trays should be taken to the lab at the beginning of the week as requested by SRCSD lab staff.
c. Regional Wastewater Treatment Plant Phone Number: 916/875-9000

3. On the bacteria processing sheet under “Trays read by” fill in the name of the reader and the date.

4. Processing worksheet distribution:
   a. The original bacteria processing worksheet will go in the binder with the original bacteria processing worksheet, maintained by the program manager
   b. Copy of the bacteria processing worksheet will go to database entry
   c. Copy of the bacteria processing worksheet will go to QA entry in the QA Log.

Laboratory Clean-up

1. Disinfect all work surfaces and anything that has been touched (i.e., markers, UV light, comparator, etc.).
2. Disinfect the inside of the incubator.
3. Remove nitrile gloves by rolling them inside out and discard them in the trashcan.

BACTERIA MONITORING PROGRAM QUALITY ASSURANCE/QUALITY CONTROL MEASURES:

The following measures are included in the San Joaquin River Watershed Bacteria Monitoring Program. Logs for each of the measures are kept in a bacteria log that is kept with the bacteria analysis equipment in the lab. Each bacteria-monitoring program should maintain a logbook for QA/QC records.

QA/QC measures are conducted at the frequency specified in Table 3:

Table 4 Equipment Quality Assurance Measures and Frequency

QA/QC Procedures	Frequency
Comparison Counts	Monthly
Quanticult (Media)	Once per lot
Incubator	Before samples are placed in and taken out of the incubator
Incubator Thermometer	Semiannually
Sealer	Monthly
UV Lamp	Monthly
Lab Duplicate	1 Set Per 10 samples

Field Duplicate	1 Set Per 10 samples
Lab and Travel Blanks	Per Run

Comparison Counting

Bacteria comparison counting is done to ensure consistency of positive well counts between analysts, and that the results generated from bacterial tray counting are reliable. On a **monthly** basis, two analysts will perform counts on the same tray. One of those two analysts will then perform counts with a different analyst the following month and so on.

On a monthly basis, 20% of the analysts will perform counts on one tray. Two analysts will perform comparison counts for the month. One of the two will perform counts with a different analyst the following month and so on. This will continue until everyone has compared counts twice.

- For routine evaluation, repeat counts on 10% of positive samples **at least monthly** and compare the counts with those of other analysts who perform the same analysis.
- Replicate counts by the same analyst should agree within 5% and those between analysts should agree within 10%.
- If results disagree more than the prescribed limit, notify the program supervisor – remedial training may be required.

Materials

Lab Coat
Gloves
UV Safety Goggles
Quanti-Trays to be read
Plastic Numbered Overlay
Viewing Cabinet
UV Lamp
Comparison Counting Worksheets

Procedures

1. Analysts should wear a lab coat, gloves and UV safety goggles.
2. Spray down the processing area with alcohol and allow to air dry.
3. Place viewing cabinet within the workspace.
4. Place the UV lamp on the viewing cabinet and plug it in.
5. Remove trays to be read from the incubator and place in order, face down on the left side of the cabinet and turn over the first tray.
6. Place the numbered plastic overlay over the wells of the tray to be read.

7. Count the number of positive yellow wells and record the number on the comparison counting worksheet. A sample worksheet can be found in Appendix C.
8. Place the tray in the viewing cabinet and count the number of positive fluorescing wells and record the number on the comparison counting worksheet.
9. Another analyst will then repeat the above procedures.
10. Compare worksheets of the two analysts.
11. Record the results on the Comparison counts log sheet under the Comparison counts tab in the QA/QC Log Book.

Table 5 Logbook Header - Comparison Counting

Date	Sample ID	Analyst 1			Analyst 2			Percent Accuracy	
		Initials	T. Coli	*E. coli*	Initials	T. Coli	*E. coli*	% T. coli	% *E. coli*

Bacteria Colilert Media

When a new lot of Colilert media arrives in the lab, it is tested for effectiveness using a Quanti-Cult kit that is provided by IDEXX. The kit contains preserved cultures of three species of bacteria, pre-measured re-hydration media contained within vials, and a foam rack for holding the vials during incubation. The kit provides both negative and positive control factors to test substrate performance and staff technique (a blank is added). *Escherichia coli* must have both positive yellow and florescent wells; *Klebsiella pneumoniae* must have positive yellow wells but negative florescent wells and *Pseudomonas aeruginosa* must have all negative yellow and florescent wells. The media must pass the above QA/QC acceptance criteria to be utilized in this program. If the media fails the QA/QC acceptance criteria it is disposed of. Note there may be more than one lot number within a single shipment; therefore snap packs from each lot should be tested. For test procedures see the Bacteria Analysis: Procedures / Changes to Program / QA Measures and Log binder located in the SJRWU laboratory.

NOTE: There may be more than one lot number within a single shipment. Therefore, QA/QC should be performed on snap packs from each different lot.

Preserved Cultures	Diagnostic Purpose:
Escherichia coli	+ Yellow Indicator + Florescent Indicator
Klebsiella pneumoniae	+ Yellow Indicator - Florescent Indicator
Pseudomonas aeruginosa	- Yellow Indicator - Florescent Indicator

Materials Per Lot:

4 – Snap-packs of Colilert-18 from the lot being QA'd
4 – 120 ml Idexx sample bottles
1 set – Quanticult (1each of *E. coli, K. pneumoniae, P. aeruginosa)*
400 ml - PBS
1 set re-suspension vials (3 total)
Bacteria Processing Worksheet
Lab safety gear (gloves, goggles)
Foam rack

Set Up:

*Caution: this kit should only be used by or under the immediate supervision of individuals familiar with aseptic methods and the following procedures. Organisms contained within the kit are known human pathogens and should be handled accordingly.

1. Heat the incubator to 35°C.
2. Put on protective gloves.
3. Disinfect the workspace by spraying it down with rubbing alcohol and allowing it to air dry.
4. Select one 120 mL sterile IDEXX bottle per culture plus one extra to run as a blank and label appropriately.
5. Assign each bottle a sample number containing the analyst's initials, the date, a dash and "01" followed by "EC" for *E. coli*, "KP" for *K. pneumonia,* "PA" for *P. aeruginosa*, and "BL" for Blank (Example :ARP040609-01EC). Label bottles and processing sheet accordingly.
6. Fill culture-containing IDEXX bottles with approximately 98 mL of PBS water. Fill the blank with 100 mL of PBS water.
7. Place all bottles in the pre-warmed incubator.
8. Remove zip lock bag containing the Quanti-Cult kit from the laboratory refrigerator ensuring not to retouch the refrigerator handle with potentially contaminated hands.
9. Place the zip lock bag containing the kit to the side the workspace and remove the kit.
10. Select the following dehydrated cultures: *E. coli, K. pneumoniae,* and *P. aeruginosa.*
11. Select one unused vial containing 2 mL of re-suspension fluid per culture and place within the designated workspace only.
12. Return the kit to the zip lock bag and ensure that the bag is closed.
13. Remove one glove and grasp the zip lock bag with the remaining gloved hand. Use the ungloved hand to open the laboratory refrigerator door.
14. Deposit the zip lock bag inside the laboratory refrigerated with the biohazard label clearly visible.
15. Remove the remaining glove by grasping the cuff and rolling the glove off of the hand, folding the exterior surface inside.

16. Dispose of the glove in the trashcan and wash hands thoroughly
17. Once hands are completely dry put on a fresh set of gloves.

Processing:

1. Place unused vials of re-suspension fluid upright in the pre-warmed incubator (35°C), allowing vials to incubate for 5-10 minutes.
2. Select one culture, remove its vial from the foil packaging and place upright in the workspace.
3. Select one vial of re-suspension fluid from the incubator and remove the blue cap.
4. Transfer the colorless cap of the culture vial onto the vial containing the re-suspension fluid and tighten cap.
5. Place the blue cap on the uncapped culture vial and dispose of it in the biohazard trashcan.
6. Invert the vial and place it in the foam rack.
7. Place the foam rack with the three vials in the incubator for 10 minutes.
8. After 10 minutes remove vial from the incubator and tap on the cap gently to mix.
9. Remove the cap and examine the inside surface. If any un-dissolved black particles remain, return the cap to vial, invert and incubate for another 10 minutes.

Repeat steps 4-11 for the remaining cultures.

10. Remove labeled pre-warmed pre-filled bottles from the incubator and place within workspace.
11. Loosen but do not remove the lids.
12. Invert each re-suspended culture vial gently to mix and add the entire contents of the vial into the appropriate sample vessel.
13. Return the lid to the vial and dispose in the biohazard trashcan.

Once the vial contents have been added to each bottle the samples can be processed using the general Sample Processing Procedures with the exception that the bottles used must be discarded in the biohazard trashcan as they contained live bacterial cultures.

Disinfect all work surfaces when finished and remove gloves by rolling them inside out and discard them in the trashcan.

Recording:

Annotate the bacteria processing worksheet with the time and date the samples were placed in the incubator, the name of the processor, the date and time the samples were processed, the time the samples are to be removed from the incubator on the following day, and the incubator temperature prior to sample incubation.

After an incubation time of 18 hours, the Quantitrays should be removed from the incubator and processed using the general Sample Results Procedures. Annotate the bacteria processing worksheet with the time and date the samples were removed from the incubator, the name of the processor reading the trays and the incubator temperature prior to sample removal.

- Boxes of Colilert-18 media snap-packs that have met the QA/QC standard using the Quanti-Cult cultures should be labeled, in permanent marker, "QA/QC'd by:" printed in clear view followed by the processor's initials and the date.

- If the media does not meet the QA/QC requirements outlined above, the box should be labeled "Failed QA/QC" and include the analyst's initials and the date. Boxes of media that fail QA/QC should then be disposed in the trashcan.

- Annotate the Quanti-cult Quality Assurance Sheet with the appropriate information.

Table 6 Logbook Header – Quanticult for Colilert-18 Media

Date	Lot Number	Yellow				Yellow + Fluorescence				Analyst	QA/QC Pass/Fail
		E. Coli	K. pneumoniae	P. aeruginosa	Blank	E. Coli	K. pneumoniae	P. aeruginosa	Blank		
		+/+	+/-	-/-		+/+	+/-	-/-			

Incubator

Three types of incubators are used in this program. The primary unit used by the SJR Watershed Unit is Fisher Scientific Isotemp Forced Air Incubator, Model 650F. The second incubator is the Binder® Incubator used by the CVRWQCB-Sacramento office lab. The Type I42300 Incubator manufactured by Barnstead/Thermolyne Corp. is also included in our program for use of stakeholder groups where bringing samples to our office for processing is impractical due to hold time issues. The Colilert-18 Test Kit requires a temperature of 35°C +/- 0.5^{o}C to meet bacteriological analysis requirements. The incubator temperature should be written on the bacteria processing worksheet **each time** samples are put in and again when samples are removed.

Initial Set up

- Chose a location that will provide an area that allows at least 2" of open space on all sides of the unit.
- Place the incubator in a convenient, level location.

- If using the Barnstead/Thermolyne Type I42300, ensure that the area is **FREE OF DRAFTS** and extraneous vibration.
- Leave incubator off (if using Fisher Scientific Isotemp or Binder Incubator) or unplugged (if using the Barnstead/Thermolyne I42300 incubator) when not in use.
- Ambient temperature must be at least 5-C below operating temperature. (Binder)

Fisher Scientific Isotemp Forced Air Incubator, Model 650F

Safety concerns

- **This unit is not explosion proof,** do not use in the presence of flammable or combustible materials; fire or explosion may result. Unit contains components, which may ignite such materials.
- Fumes and spillage from acidic solutions cause corrosion of the stainless steel chamber and other components. Care should be taken to maintain a neutral pH at all times.
- The heater is in the bottom of the unit. Surface temperatures at the bottom cover may be higher than set point temperature.
- A deviation alarm alerts the operator and interrupts heater power whenever the actual incubator temperature differs from the set temperature by more than 3-C. The operator cannot adjust this set limit.
    - If the actual temperature exceeds the alarm limit, the alarm indicator LED will light and the Display will flash “EEE”.
    - The reference point for the alarm is the set temperature.
    - Changing the set temperature to a value more than 3-C below the present incubator temperature will trip the alarm. Power is removed from the heater when an alarm condition occurs until the actual temperature is within 3-C of the set temperature, at which point the unit alarm LED will turn off and the display will resume normal operation.

Setting the temperature

1. In control mode operation, the incubator maintains a set temperature until that set temperature is changed. The Actual and Set Displays will indicate current chamber temperature and the temperature set point, respectively. To set a temperature and initiate Control mode operation, perform the following:
2. Place the power switch in the ON position. All 8’s will flash as a test of the display
3. Press and hold the SET key.
4. Observe the set temperature in the Set Display window.
5. To decrease the set temperature, press the DECREASE Key while holding the SET key.

6. To increase the set temperature, press the INCREASE Key while holding the SET Key.
7. When the desired set temperature is shown, release the INCREASE OR DECREASE Key. Finally, release the SET Key. The incubator automatically begins to control at the set temperature
8. NOTE: Upon initial heat up to temperature, the over range alarm indicator light may illuminate briefly (several minutes) until the temperature stabilizes at the set point. The incubator temperature should be allowed to stabilize prior to loading samples.

Calibrating the offset of the Fisher Scientific Isotemp Forced Air Incubator, Model 650F

1. This incubator must be calibrated to ensure the digital readout offset is correct. (Allows the operator to measure and calibrate the digital display so that the display indicates the temperature at a specific point or zone within the incubator, rather than the temperature measured at the control thermocouple)
2. Place at least one thermometer in the incubator.
    a. If one thermometer is being used, place it on the middle shelf.
    b. If more thermometers are available, place one on each shelf.
3. Press the MENU key, the display will indicate CAL
4. To view the present offset value, press and hold the SET Key.
5. To change the display offset, press and hold the SET Key. Press the INCREASE arrow key or DECREASE arrow key until the display indicates the desired offset.
6. Release the SET Key.
7. Press MENU Key once to return to normal temperature control.

QA Specifications:

Average Uniformity @ 37-C	+/- 0.3 –C
Resolution	0.1 –C
Control Sensitivity	+/- 0.1 –C
Recovery Time @ 37 –C	3 minutes

If the incubator is not working within these specifications, contact the program manager and advise of the concern. The program manager will inspect the incubator to determine if the malfunction can be identified and fixed or if the concern needs to be elevated to the manufacturer.

Troubleshooting

Table 7 Fisher Scientific Isotemp 650F Troubleshooting

Symptom	Probable Cause	Action
No Power	Unit not plugged in or turned on	Plug in or turn on
	Defective circuit	Replace circuit breaker

	breaker	
	Wire disconnected	Replace loose wires
Incubator temperature erratically high	Defective control thermocouple	Replace control thermocouple
Failure to heat	Defective control board	Replace control board
	Set temperature less than actual temperature	Refer to *Operation*
	Defective control thermocouple	Replace control thermocouple
	Poor heater connections	Tighten connections at terminal strip and/or heater
	Defective heater element	Check heater resistance on schematic at back of manual. Replace heater unless approximately the same as schematic.
	Defective solid state relay or safety relay	Refer to schematic and replace relay.
	Defective controller	Replace controller
Alarm LED stays on and control is higher than set temperature	Set temperature has been changed to a value less than the actual temperature minus the alarm limit	Wait for actual temperature to cool to the set temperature. (To set plus 3 degrees and LED will go out and EEE display back to normal operation.)
	Defective controller	Replace controller
	Defective solid state relay or safety relay	Refer to schematic and replace relay.
Set Display Shows “EEE”	Alarm LED also lit	Allow incubator to cool to set point See above.
	Alarm LED not on; Faulty or broken connections	Check thermocouple connections at rear of temperature controller

	Defective control	Replace control if thermocouple is OK
Temperature off from Independent thermometer	Calibration offset needs adjusted.	Begin by setting offset to 0. (See Display Offsets.)

- Service procedures involve exposure to line voltage and should be done only by qualified service personnel. Disconnect incubator from power source before attempting repairs. The procedures for replacing the Door Gasket, Replacing the door handle, and adjusting the door handle may be performed by most users. Details for these procedures and replacement part numbers can be found in the Fischer Isotemp Incubator User's Manual.

- For Technical Assistance, Call 1(800) 926-0505
- For Field Service Division Assistance, Call 1(800) 395-5442

Binder BD53 Incubator

Safety Concerns

- Keep safety labels complete and legible.
- The incubator must not be operated in hazardous locations.
- This incubator does not dispose of any measures of explosion protection.
- The unit must NOT become wet during operation or maintenance
- Do NOT touch the inner surfaces, the door window, the access ports, exhaust duct, and the charging material during operation, as they will become hot.
- Respecting the instructions in the operating manual and conducting regular maintenance work is part of the intended use.
- Do NOT use the unit for drying purpose, especially if greater quantities of steam leading to condensation will be set free.
- Do NOT lift or transport the unit using either the door handle or the door.
- Lifting the incubator requires two people.
- The ambient temperature should not be substantially higher than the indicated ambient temperature of +25 –C to which the specified technical data relate.
- Do NOT exceed the maximum temperature set point of 50 –C.
- Change the door gasket in cold condition only. Otherwise the door gasket will be damaged.
- Do NOT spill water or cleaning agents over the inner and outer surfaces.
- Put off-circuit the unit before cleaning. Pull the power plug.
- Completely dry the appliance before switching it on again. Do NOT use acidic or chlorine cleaning detergents
- Safety Device

Calibrating the thermostat

- The safety control thermostat must be calibrated once the incubator reaches the set point
  1. Turn the control knob of the safety devise using a coin or a screwdriver to its end-stop (position 10).
  2. Turn the control knob back until its trip point - (turn it counter clockwise)
  3. The trip point is identifiable by the red alarm lamp lighting up
  4. The optimum setting of the safety device is obtained by turning the knob clockwise by around one graduation mark on the scale.
  5. If the safety device has assumed the regulation function, proceed as follows;
     a. Disconnect the unit from the mains.
     b. Have the cause of the fault examined and rectified by a technician
     c. Restart the unit

Setting the temperature

1. Air change control
   a. This is adjusted using the lever under the control buttons.
   b. The air change adjusts the amount of fresh air entering the incubator.
   c. This needs to be kept in the closed position since an open-air flap can negatively influence the spatial temperature accuracy.
2. Switch on the incubator – the green “Standby” LED illuminates. (To the left of the temperature display).
3. Press the power button (circle with a line pointing up)
   a. The actual temperature value will be displayed.
   b. If the display alternately shows the actual temperature value and “tOFF”, the incubator is in timer operation mode and will need to be set to continuous operation.
      i. If the display only reads the temperature, go to “Controller setting”. If not follow the directions below:
      ii. To switch back to continuous operation:
         1. Press the time management button (circle with one line pointing up and one pointing to the 3 o’clock position)
         2. Press the down arrow button for 2 seconds. The display should alternate between “t1” and “tInF”.
         3. Press the X/W button to return to normal display/actual value display.
   c. Controller Setting
      i. Press X/W button
      ii. The display will alternately show “SP” and the previous temperature set-point.

iii. With the up and down arrow buttons, enter a set-point of 34.5-C.
iv. Wait 2 seconds until the entered temperature value is taken over (display will flash once)
v. Press the X/W button to return to normal display.

Table 8 Fisher Scientific Isotemp 650F QA Specifications

Temperature variation at 37 –C (without outer glass door)	0.5 +/- –C
Temperature fluctuation at 37 –C	0.1 </- +/- –C
Heating up Time to 37 –C (up to 98% of the set value)	38 Minutes
Recovery time after door was opened for 30 seconds (up to 98% of the set value)	5 Minutes

If the incubator is not working within these specifications, contact the program manager and advise of the concern. The program manager will inspect the incubator to determine if the malfunction can be identified and fixed or if the concern needs to be elevated to the manufacturer.

Barnstead/Thermolyne Corp. Type I42300 Incubator:

Safety Concerns

- **NOTE**: Leave unit disconnected when not in use.
- **DANGER:** Do not use in the presence or flammable or combustible materials or explosive gases. Do not use in the presence of pressurized or sealed containers. Fire or explosion may result, causing death or severe injury.
- **WARNING:** Do not heat any substance above a temperature that will cause it to emit toxic fumes – death or severe injury may result.

Setting the temperature

1. Make sure the power switch is in the OFF position
2. Plug the cord set into a grounded outlet that provides the electrical specifications listed on the unit's nameplate.
3. Place grommet into the center of the thermometer holder. Install the thermometer, supplied with the unit, through the grommet. Adjust the immersion depth to 3 inches or 76 mm (measured from the bulb to the top of the grommet). Insert the assembly into the vent on top of the incubator.
4. The incubator requires approximately 90 minutes to warm to 35 °C.
5. Adjust the temperature knob according to the temperature of the thermometer.
6. Wait for temperature on the thermometer to stabilize.
7. Make further adjustments as necessary.

QA:

1. To determine the ability of the incubator to produce and maintain a constant temperature, check the temperature prior to placing samples in the incubator and again just before sample removal 18 hours later. The temperature should read 35°C +/- 0.5^{o}C. **This should be performed each time the incubator is used.**
2. Record both temperatures on the Bacteria Processing Sheet under the Incubator Maintenance heading.
3. If temperatures are beyond the specified limits, samples must be moved to a properly functioning incubator. Samples that remain at improper temperatures longer than two hours must be discarded and not reported.
4. Unplug the incubator when finished.

Incubator QA Performed with each run

Materials:

Bacteria processing sheet
Incubator
Thermometer

Record the temperature on the thermometer (if using the Barnstead/Thermolyne Incubator) or on the digital display (if using the Binder or Fisher Scientific Incubators) at the start of sample incubation and when the samples are pulled from the incubator.

Cleaning

1. Always unplug unit prior to cleaning
2. During cleaning take precautions to prevent cleaning agents from contacting electrical components
3. Use a mild, non-abrasive cleaner (i.e. damp cloth and mild soap or alcohol based solution) to clean all normally accessible surfaces
4. Clean the shelves and interior with water and mild detergent solution only. Do not use abrasives, cleansers or scouring pads. Rinse and dry completely.
5. Make sure unit is dry before re-connecting to power source

Thermometer

For general purposes, thermometers are graduated in 0.5^{o}C increments or less (11). The incubator thermometer should be checked against a NIST certified or NIST traceable thermometer within or near the temperature ranges of intended use on a **semi-annual basis** (11).

Materials:

2 50ml beakers
Tap water
NIST Certified or NIST Traceable Thermometer (See Lab Supervisor)
Incubator thermometer
Incubator
Tape

Procedure:

1. Plug in Incubator (approximate warm-up time: 90 minutes). Do not adjust the temperature setting knob.
2. Fill two 50 mL beakers about half way with tap water
3. Place the beakers side by side on the bottom shelf within the incubator.
4. Place the NIST thermometer in one beaker and lab incubator thermometer in the other and close the incubator door.
    a. The water prevents erratic changes in the temperature and allows a more accurate reading.
5. Make certain that the door is completely closed.
6. Allow the thermometers to set until their temperatures stabilize.
7. Label a piece of tape with the date, NIST reading, Lab thermometer reading and NIST serial number and place it on the lab thermometer.
8. Record the date, time, NIST reading, Lab thermometer reading, NIST serial number and analyst on the Incubator/Thermometer Maintenance sheet found in the QC Log book.

Table 9 Logbook Header - Thermometer

Date	Time	NIST Thermometer Reading	Incubator Thermometer Reading	NIST Serial Number	Analyst	Comments

Sealer

The purpose is to ensure the trays are properly sealed and the sealer is functioning correctly. The Quanti-tray® Sealer by IDEXX automatically distributes the sample/substrate mixture into separate wells. If the sealer is malfunctioning, it will not completely seal the wells of the Quanti-tray, allowing leakage between wells. This may cause results to be inaccurate since Most Probably Number (MPN) reporting is quantitative. QA/QC should be performed on the sealer on a monthly basis to assess its effectiveness. If the sealer is not operating correctly, another sealer should be obtained. For IDEXX technical assistance call 1-800-321-0207 or 207-856-0496.

Materials:

Gloves
Lab Coat
1 100ml IDEXX bottle
1 Quanti-tray
100ml of tap water
1-2 drops of food coloring
Rubber insert
Sealer

Procedures:

For personal safety in the lab, gloves and a lab coat should be worn.

Tray Seal Check

1. Turn on Sealer (takes ~ 15 minutes to warm up)
2. Fill a 120 mL IDEXX bottle to the 100 mL line with tap water
3. Add 1-2 drops of food coloring
4. Swirl bottle until color is mixed
5. Pour into a Quanti-Tray and tap tray bottom to remove air bubbles
6. Place tray in rubber insert
7. Feed the tray and insert through the sealer
8. Examine the sealed Quanti-tray for evidence of leakage between wells.
    a. If there is no leakage, the sealer is in proper working order.
    b. If leakage has occurred, consult owner's manual for repair information and/or troubleshooting.
    c. Label the back of the Quantitray "Sealer QA/QC", the date and the analyst's initials in permanent marker.
9. Record the date, time, analyst initials and whether there was dye between the wells of the tray on the Sealer Maintenance sheet. This can be found in the QC Log book.
10. Dispose of tray in trashcan.

Sealer Cleaning

1. Ensure power supply is off, sealer is unplugged, and unit has completely cooled down for at least 90 minutes. Remove input tray shelf. Loosen four quarter-turn fasteners and remove the access panel.
2. Check roller for yellow/caramel color deposits. If deposits are not present, replace access panel. If deposits are present, follow these steps:
    a. Loosen hold-down screws, which secure the lower roller assembly to the bottom plate of the sealer.
    b. Remove lower roller by lifting straight up and then out, to ensure roller clearance of locating pins on the bottom plate of the sealer.
        i. Be careful not to touch the upper roller if it is hot.

c. Use mild detergent, diluted bleach, or isopropyl alcohol to clean all accessible surfaces inside the sealer and the lower roller assembly.
    i. Never use abrasive materials for cleaning
    ii. Never use caustic cleaners
    iii. Use alcohol only on cool sealer.
    iv. For stubborn deposits, allow soak time for cleaner to work.
    v. Do not disassemble lower roller assembly.
d. Dry interior and roller assembly with paper towels or soft cloth.
e. Reinstall bottom roller assembly on locating pins and tighten hold-down screws.
f. Fasten access panel and reattach tray shelf.

Table 10 Logbook Header - Sealer

Date	Check Seal Effectiveness	Replace Roller	Check Feed	Clean Sealer	Check Rubber Insert	Comments

UV Lamp

The UV lamp used to view samples positive for *E. coli* is Model EA-160 Spectroline® 6-watt long wave ultraviolet lamp which produces a wavelength of 365 nm. Preventive maintenance steps come from Laboratory Quality Assurance Guidance for Colilert® Analysis under the Clean Rivers Program. UV protective goggles must be worn when using the lamp. The bulb should be replaced after approximately 6,000 hours or daily use for about 5 years if used a few hours a day continuous usage or when it fails to pass QA/QC.

Materials:

Gloves
Lab Coat
UV Goggles
Comparator
UV Light
UV Viewing Cabinet

Test UV lamp for proper fluorescence **monthly** using a known *E. coli* positive MMO-MUG comparator.

Procedures:

1. Place the UV light on the UV viewing cabinet. This will automatically place the light at six inches above the trays, the height necessary for proper viewing of fluorescing wells.

   a. To turn on the UV light, press the red button so that it pops up and then press the white button.
   b. Press down on the red button to turn the UV light off.
2. Place the comparator within the viewing cabinet
3. The comparator should fluoresce under the UV light
4. Record the date, whether the lamp causes fluorescence, and the analyst on the UV Lamp Maintenance sheet found in the QA/QC Log book located in the lab.
5. Record all maintenance and tube replacement on the UV Lamp Maintenance sheet. Additional sheets can be found at W:\nps\San Joaquin River\IBP\Bacteria\ QA_QC\Bacti Equipment.

Table 11 Logbook Header - UV Lamp

Date	Check Lamp Fluorescence	Check Bulb	Replace Bulb	Analyst	Comments

Information on quality assurance and procedures regarding data completeness, accuracy, and precision can be found in Appendix A: Quality Assurance Project Plan Intensive Basin Investigation, CVRWQCB, 2004.

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Appendix A: Sample Field and Bacteria Processing Worksheets

This Appendix provides examples of the following:

- Blank Field Sheet
- Completed Set up Field Sheet
- Blank Bacteria Processing Worksheet
- Completed Set up Bacteria Processing Worksheet

Run:

(revised 12/12/07)

Sampler: Date: YSI METER #

Project: Vehicle #

YSI

Sample ID - Code		Site Code	Site Description	Sampling Type	Time	Temp (C)	Field SC	DO mg/L	pH	Dry	Lab SC	Pic #
	Bac	541		G								
	Bac	541		G								
	Bac	**541**		G								
	Bac	541		G								
	Bac	541		G								
	Bac	541		G								
	Bac	**541**		G								
	BacLD	541		G								
	Bac	541		G								
	Bac	541		G								
	Bac	**541**	DUP #	A								
	BacLD	541	Lab Dup#	A								
	Bac	PBS	Travel Blank	A								
	Bac	PBS	Lab Blank	A								

			pH	**pH MV**			**DO**		**Conductivity**		**Recal**	**Lab**
Time	**Calibrations**	**Initials**	7.0	4.0	7.0	10.0	Charge	Gain	Sp. Cond	Cal Const.	Y/N	**EC**
	Beginning											
	End											
	ph slope 165-180 MV		+/- 0.2	+177	+/-50	-177	50 +/-25	-0.7to1.4	+/- 20	5.0 +/- 0.45		

BAC- Bacteria

BacLD + BacLD = ONE P/250 mL, split in lab into TWO P/120 mL

NOTES: WEATHER CONDITIONS, WATER LEVELS

G-Grab Sample

A- Refer to LabQA.xls

Run: Ag/GBP-4

*Note YSI: #1=19869; #2=19859; #3=18243; #4=18471

SJRWU Monitoring Data Sheet
(revised 12/12/07)

Sampler: VAW Date: 12/16/2007 YSI METER # 1

Project: Ag/GBP Vehicle # 1

Sample ID - Code		Site Code	Site Description	Sampling Type	Time	Temp (C)	YSI Field SC	YSI DO mg/L	YSI pH	Dry	Lab SC	Pic #
24	Bac	541MER 522	SJR @ Lander	G								
10	Bac	541MER 531	Salt Sough @ Lander	G								
11	**Bac**	**541MER535**	***Dschrg from S L D (evidence)***	G								
12	Bac	541MER542	Mud Slough downstream of SLD	G								
13	Bac	541MER536	Mud Slough Upstream of SLD	G								
14	Bac	541MER538	SJR @ Fremont Ford	G								
15	**Bac**	**535STC504**	***SJR @ Crows Lndng (evidence)***	G								
16	BacLD	541STC507	SJR @ Patterson	G								
17	Bac	541STC510	SJR @ Maze	G								
18	Bac	541SJC501	SJR @ Airport Way	G								
21	**Bac**	**541MER535**	DUP # **11** ***SLD***	A								
20	BacLD	541STC507	Lab Dup# 16 SJR@Patterson	A								
22	Bac	PBS	Travel Blank	A								
23	Bac	PBS	Lab Blank	A								

			pH	**pH MV**			**DO**		**Conductivity**		**Recal**	**Lab**
Time	**Calibrations**	**Initials**	7.0	4.0	7.0	10.0	Charge	Gain	Sp. Cond	Cal Const.	Y/N	**EC**
	Beginning											
	End											
	ph slope 165-180 MV		+/- 0.2	+177	+/-50	-177	50 +/-25	-0.7to1.4	+/- 20	5.0 +/- 0.45		

BAC- Bacteria

BacLD + BacLD = ONE P/250 mL, split in lab into TWO P/120 mL

NOTES: WEATHER CONDITIONS, WATER LEVELS

G-Grab Sample

A- Refer to LabQA.xls

Run:										Sample Processing Date:					
Sample ID #:			12		14		16		18		21		23		
Site Code:			MER 542		MER 538		STC 507		SJC 501		STC 507		PBS		
Yellow +	# Small Wells														
	# Large Wells														
	Empty Wells														
	MPN														
Yellow + Fluorescence (+)	# Small Wells														
	# Large Wells														
	False Positives														
	MPN														
Temp/Time	Start		4Hr. Check			14 Hr. Check			18 Hr. Check			22 Hr. Check, if needed			

	FIELD DUPLICATES				LAB DUPLICATES			
	Normal Sample #				**Normal Sample #**			
	Duplicate Sample #				**Duplicate Sample #**			
		MPN	95% CI			MPN	95% CI	
			Lower	Upper			Lower	Upper
TOTAL COLIFORM	*Normal*				*Normal*			
	Duplicate				*Duplicate*			
	Mean		Pass	Needs Review	*Mean*		Pass	Needs Review
E. COLI	*Normal*				*Normal*			
	Duplicate				*Duplicate*			
	Mean		Pass	Needs Review	*Mean*		Pass	Needs Review
BLANKS	*Field Sample #*		Pass	Needs Review	*Lab Sample #*		Pass	Needs Review

Mean = Mean of Normal and Duplicate, which is then compared to the individual corresponding CI's to determine acceptability of data

Sampler Signature / Date / Time Arrived:	Placed in Incubator By / Date / Time:	Trays Read By:
Processor / Date / Time:	Pulled from Incubator By / Date / Time:	Entered into database:
NOTES:		

Run: Ag/GBP Run-4										Sample Processing Date: 12/26/07					
Sample ID #: VAW071216-		10	11	12	13	14	15	16	17	18	20	21	22	23	24
	Site Code:	MER 531	MER 535	MER 542	MER 536	MER 538	STC 504	STC 507	STC 510	SJC 501	STC 507	MER 535	PBS	PBS	MER 522
Yellow +	# Small Wells														
	# Large Wells														
	Empty Wells														
	MPN														
Yellow + Fluorescence (+)	# Small Wells														
	# Large Wells														
	False Positives														
	MPN														
Temp/Time	Start		4Hr. Check			14 Hr. Check			18 Hr. Check			22 Hr. Check, if needed			

	FIELD DUPLICATES				LAB DUPLICATES			
	Normal Sample #	**16**			**Normal Sample #**	**11**		
	Duplicate Sample #	**20**			**Duplicate Sample #**	**21**		
		MPN	95% CI			MPN	95% CI	
			Lower	Upper			Lower	Upper
TOTAL COLIFORM	*Normal*				*Normal*			
	Duplicate				*Duplicate*			
	Mean		Pass	Needs Review	*Mean*		Pass	Needs Review
E. COLI	*Normal*				*Normal*			
	Duplicate				*Duplicate*			
	Mean		Pass	Needs Review	*Mean*		Pass	Needs Review
BLANKS	*Travel Smpl # **22***		Pass	Needs Review	*Lab Sample # **23***		Pass	Needs Review

Mean = Mean of Normal and Duplicate, which is then compared to the individual corresponding CI's to determine acceptability of data

Sampler Signature / Date / Time Arrived:	Placed in Incubator By / Date / Time:	Trays Read By:
Processor / Date / Time:	Pulled from Incubator By / Date / Time:	Entered into database:

NOTES:

Appendix B: Equipment Checklist

Please check all boxes that apply

	Date							
	Initials							
Field Sheets								
Field - AG, SWAMP, IB								
Sigma - SLD/SLDB, CRW								
Clipboard								
Pencils, labels, photo sheets								
COCs								
CLS, Sierra, Twinning, Basic								
Field Binders								
Green AG - Weekly Runs								
Green AG & SWAMP - Monthly Runs								
Keys to access sites								
IB Binder - Weekly & Monthly IB Runs								
Camera								
Extra/charged batteries								
3-1/2 disk - Cannon								
Phone								
Charged battery								
Maps								
Southern and Northern								
YSI								
Full service kit								
Screwdriver								
Charged battery								
Cleaned w/good DO membrane								
Truck								
Blue truck bag								
Keys, Credit card, Travel log								
Tire Inspection: Pressure/Tread								
Windshield Washer/ Oil/ Coolant								
Tire Kit: Full Spare/ Jack/ Tire Iron								
Bacteria								
Bacteria processing sheet								
Incubator turned on								
Bacteria cooler								
Ice pack								
Labeled bacteria bottles								
PBS Lab and Field blanks								
Reminder to pick up PBS Field blank								
Sigma Bases - AG runs								
Labeled Bottles								
DI Blanks								
G1 - SLD, CRW								
G1 EC - SLD, CRW								
Charged batter - SLDb, CRW								

	Date							
	Initials							
AG/Swamp Coolers								
Labeled bottles								
DI Blanks - Monthly Runs								
Spare bottles								
Duplicate split bottles - A, B, S								
Bags of ice in ice machine								
Panoche Cooler - AG runs								
7 large sigma wedges								
7 EC pints								
2-COCs - _____								
2-Field sheets - SLDA, Panoche								
9-labels								
Blue ice pack								
pH Kit								
Blue Myron								
pH 4, 7, 10								
EC 3900, 1417								
DI, Tap H20								
Alcohol spray bottle								
Soap								
Stainless steel & glass cups								
Gloves - Sm, Med, Lrd, X-Lrg								
Safety glasses, pens, paper towels								
EC Box								
Quarts, Pints, Bacteria bottles								
Garage Equipment								
Backup Sigma - Ag runs								
Tool Box								
Jumper Cables/ Flares (Red Box)								
First Aid Kit								
Bucket w/Rope & Insect Spray								
Extra bucket (for Tox)								
Shovel								
Potable Water								
Life Vests (1 for each sampler)								
Rubber Boots - *if needed*								
Rain Suits - *if needed*								
Sampling Poles								
Clamp - TOC, BAC								
Standard - pints, Quarts								
PVC - TOX								
Trach Bag & ER Bottles								

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Appendix C. Comparison Counting worksheet

Comparison Counting Worksheet

(Updated 4 April 2008)

Total Coliform										*E. coli*									
Large Wells					Small Wells					Large Wells					Small Wells				
	1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4
1					1					1					1				
2					2					2					2				
3					3					3					3				
4					4					4					4				
5					5					5					5				
6					6					6					6				
7					7					7					7				
8					8					8					8				
9					9					9					9				
10					10					10					10				
11					11					11					11				
12					12					12					12				
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40					40					40					40				
41					41					41					41				
42					42					42					42				
43					43					43					43				
44					44					44					44				
45					45					45					45				
46					46					46					46				
47					47					47					47				
48					48					48					48				
49										49									

Sample ID

Date of Comparison Count

Analyst ID

Time From Start of Incubation

Results:

Total Coliform		
	Large Wells	Small Wells
1		
2		
3		
4		
E. coli		
	Large Wells	Small Wells
1		
2		
3		
4		
MPN Totals		
Total Coliform		
E. coli		

Comparison Counting Key:
1 = Dark Yellow/Dark Fluorescence
2 = Light Yellow/Light Fluorescence (Need Comparator to
3 = Colorless/No Fluorescence
4 = Colorless/No Fluorescence (Need Comparator to Determine)

Directions:
Complete the information for Sample ID, Analyst ID, and Time from start of incubation. Place the Quantitray-2000 numbered overlay over the tray to be used for Comparison Counting. Match the well to be analyzed with the well type and number identified on this worksheet. Using the Comparison Counting Key, place a "1" in the column that best fits your interpretation of the well. Once all wells have been analyzed for total coliform and *E. coli*, tally the number of each well fitting each description, and enter the result in the corresponding "Results" section. Analyst results should be

Chemical Laboratory Test Request

Submittal ID: NA0109B0003 - SWCMP

Date: 1/20/2009

Customer:

Mail To: Perry J. LeBeouf Mail Stop:
DWR/Northern District
2440 Main Street

Red Bluff CA 96080
Activity Unit: 4804

Container Summary

Glass, Clear, 40 ml Vial, H2PO4, pH <2, Filt	43
Glass, Clear, 40 ml Vial, H3PO4, pH <2	43
Polyethylene, 1 Quart, Filt	43
Polyethylene, 1 Quart	43
Polyethylene, 1/2 Pint, Filt	44
Polyethylene, 1/2 Pint, HNO3, pH <2, Filt	43
Polyethylene, 1/2 Pint	44
Polyethylene, 1/2 Pint, HNO3, pH <2	43
Polyethylene, 250 ml, Filt	44
Polyethylene, 250 ml	44
Total	434

Submittal Instructions:

Date Received: _____

INFORMATION ONLY

Submitted By: _____ **Received By:** _____

Notice: Deliver samples to the lab as soon as possible. Some sample holding times EXPIRE within 168 Hr / 7 Days of collection. Allow time for lab handling and preparation after delivery. The lab is not responsible for missed holding times due to late delivery.

1/20/2009 : **Cost Code.**

NA0109B0023 **Station No.** A1210000 PIT R NF A ALTURAS L3123960009D **Matrix:** Water, Natural

Priority: 5 **Instructions:**

Alkalinity	Filt		168 Hr / 7 Day
Dissolved Aluminum			168 Hr / 7 Day
Dissolved Boron	Filt		168 Hr / 7 Day
Dissolved Calcium	Filt		168 Hr / 7 Day
Dissolved Chromium			168 Hr / 7 Day
Dissolved Iron			168 Hr / 7 Day
Dissolved Magnesium	Filt		168 Hr / 7 Day
Dissolved Nickel			168 Hr / 7 Day
Dissolved Potassium	Filt		168 Hr / 7 Day
Dissolved Silver			168 Hr / 7 Day
Dissolved Sulfate	Filt		168 Hr / 7 Day
DWR Othro-Phosphate (Dissolved)	Filt		168 Hr / 7 Day
Hardness By Calculation	Filt		168 Hr / 7 Day
Organic Carbon (Dissolved) by Combustion	Filt		672 Hr / 28 Da
Phosphorus (Total)			168 Hr / 7 Day
Total Arsenic			168 Hr / 7 Day
Total Calcium			168 Hr / 7 Day
Total Copper			168 Hr / 7 Day
Total Iron			168 Hr / 7 Day
Total Magnesium			168 Hr / 7 Day
Total Nickel			168 Hr / 7 Day
Total Silver			168 Hr / 7 Day
Total Zinc			168 Hr / 7 Day

Ammonia, Nitrogen (Dissolved)	Filt		168 Hr / 7 Day
Dissolved Arsenic			168 Hr / 7 Day
Dissolved Cadmium			168 Hr / 7 Day
Dissolved Chloride	Filt		168 Hr / 7 Day
Dissolved Copper			168 Hr / 7 Day
Dissolved Lead			168 Hr / 7 Day
Dissolved Manganese			168 Hr / 7 Day
Dissolved Nitrite + Nitrate	Filt		168 Hr / 7 Day
Dissolved Selenium			168 Hr / 7 Day
Dissolved Sodium	Filt		168 Hr / 7 Day
Dissolved Zinc			168 Hr / 7 Day
Electrical Conductivity (EC)			168 Hr / 7 Day
Hardness by Calculation (Modified, Total)			168 Hr / 7 Day
Organic Carbon (Total) by Combustion			672 Hr / 28 Da
Total Aluminum			168 Hr / 7 Day
Total Cadmium			168 Hr / 7 Day
Total Chromium			168 Hr / 7 Day
Total Dissolved Solids (TDS)	Filt		168 Hr / 7 Day
Total Lead			168 Hr / 7 Day
Total Manganese			168 Hr / 7 Day
Total Selenium			168 Hr / 7 Day
Total Suspended Solids			168 Hr / 7 Day

Weck Laboratories, Inc.
Environmental and Analytical Services - Since 1964

CHAIN OF CUSTODY RECORD

14859 East Clark Aveue : Industry : CA 91745
Tel 626-336-2139 : Fax 626-336-2634 : www.wecklabs.com

CLIENT NAME: CA Department of Water Resources

PROJECT:

ADDRESS: 2440 N. Main Street, Red Bluff, CA 96080

PHONE #:

FAX #:

PROJECT MANAGER

SAMPLER

ANALYSIS REQUESTED

SPECIAL HANDLING

- ☐ Same Day Rush
- ☐ 24 Hour Rush
- ☐ 48-72 Hour Rush
- ☐ 4 - 5 Day Rush
- ☐ 10- 15 Business Days
- ☐ QA/QC Package

Reporting Agency:

Method of Shipment:

ID# (For lab Use Only)	DATE SAMPLED	TIME SAMPLED	SMPL TYPE	SAMPLE ID / SITE LOCATION	# OF CONT.	Total Ammonia N	Total Kjeldahl Nitrogen TKN	Organic Nitrogen By Calc.								REMARKS

INFORMATION ONLY

RELINOUISHED BY	DATE / TIME	RECEIVED BY	DATE / TIME
RELINQUISHED BY	DATE / TIME	RECEIVED BY	DATE / TIME
RELINQUISHED BY	DATE / TIME	RECEIVED BY	DATE / TIME

SAMPLE CONDITION:

Actual Temperature:

Received On Ice	Y / N
Preserved	Y / N
Evidence Seals Intact	Y / N
Container Attacked	Y / N
Preserved at Lab	Y / N

SAMPLE TYPE CODE:

AQ=Aqueous
NA= Non Aqueous
SL = Sludge

DW = Drinking Water
WW = Waste Water
RW = Rain Water
GW = Ground Water

SO = Soil
SW = Solid Waste
OL = Oil
OT = Other Matrix

SPECIAL REQUIREMENTS / BILLING INFORMATION

REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION
11020 SUN CENTER DRIVE #200 RANCHO CORDOVA, CA 95670
PHONE: (916) 464-3291 FAX:(916) 464-4800

CHAIN OF CUSTODY

TO:

Program	Project Name
Sampler (Name)	Sampler (Signature)

SAMPLE INFORMATION				CONTAINER		SAMPLE TYPE				INTERGRATED	INTEGRATED GRAB	GRAB	TOTAL	DISSOLVED	ANALYSIS REQUIRED								
LAB ID	IDENTIFICATION	DATE	TIME	TYPE	NO.	SW	WW	Sed															

SPECIAL INSTRUCTIONS / SUSPECTED CONSTITUENTS	Contact Name and Number

RELINQUISHED BY (Signature) DATE/TIME	RECEIVED BY (Signature) DATE/TIME	RELINQUISHED BY (Signature)	RECEIVED BY (Signature)
RELINQUISHED BY (Signature) DATE/TIME	RECEIVED BY (Signature) DATE/TIME	RELINQUISHED BY (Signature)	RECEIVED BY (Signature)