Quality Assurance Project Plan

For

Inland Empire Canyons Baseline Monitoring Project

Prepared for

Inland Empire **WATERKEEPER®**
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Prepared by

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August 8, 2007

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Quality Assurance Project Plan

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Inland Empire Canyons Baseline Monitoring Project

Inland Empire **WATERKEEPER®**

July 11, 2007

Grant Organization: Resources Legacy Fund Foundation

2. APPROVALS

Title:	Name:	Signature:	Date:
Project Director	Lee Reeder		
Project Manager	Autumn DeWoody	[signature]	
Quality Assurance (QA) Officer	Justin Luedy		
Contract Lab Director	Centrum Analytical Labs		

3. DISTRIBUTION LIST

Table 1: Document distribution list

Title:	**Name (Affiliation):**	**Telephone Number:**
Project Director	Lee Reeder (IEWK)	(951) 689-6842
Project Manager	Autumn DeWoody (IEWK)	(951) 689-6842
QA Officer	Justin Luedy (OCCK)	(714) 850-1965
Contract Laboratory	Centrum Analytical Labs	(951) 779-0310
TAC[1] Member 1	Dr. James Sickman (UC Riverside)	(951) 827-4552
TAC Member 2	Pat Kilroy (City of Lake Elsinore)	(951) 674-7730
TAC Member 3	Mary Thomas (US Forest Service)	(951) 736-1811, ext. 3244
TAC Member 4	Ronald Young (Elsinore Valley Municipal Water District)	(951) 674-3146, ext. 8251
Interested Regulatory Contact	Cindy Li (Santa Ana RWQCB)	(951) 782-4130

[1] TAC = Technical Advisory Committee

4. PROJECT ORGANIZATION

4.1 Contact Information

Table 2: Contact information

Name	Organizational Affiliation	Title	Contact Information
Lee Reeder	Inland Empire Waterkeeper	Project Director	Phone: (951) 689-6842 Fax: (951) 689-6273 Email: Lee@iewaterkeeper.org
Autumn DeWoody	Inland Empire Waterkeeper	Project Manager	Phone: (951) 689-6842 Fax: (951) 689-6273 Email: Autumn@iewaterkeeper.org
Justin Luedy	Orange County Coastkeeper	QA Officer	Phone: (714) 850-1965 Fax: (714) 850-1592 Email: Justin@coastkeeper.org
Staff	Centrum Analytical Labs	Contract Laboratory	Phone: (951) 779-0310
Dr. James Sickman	University of California, Riverside	TAC Member 1	Phone: (951) 827-4552 Email: james.sickman@ucr.edu
Pat Kilroy	City of Lake Elsinore	TAC Member 2	Phone: (951) 674-7730 Email: PKilroy@lake-elsinore.org
Mary Thomas	U.S. Forest Service, Trabuco Ranger District	TAC Member 3	Phone: (951) 736-1811, ext. 3244 Email: MLThomas@fs.fed.us
Ronald Young	Elsinore Valley Municipal Water District	TAC Member 4	(951) 674-3146, ext. 8251 Email: RYoung@evmwd.net

4.2 Project Manager Responsibilities

Autumn DeWoody of Inland Empire Waterkeeper (IEWK) will be the overall project manager responsible for developing and completing the sampling plan and QAPP and will make financial decisions on various project expenses. Autumn will supervise the tasks to be performed by various contractors and agencies involved in this project and will resolve any issue of concern related to it. Autumn will also serve as the field team leader, providing direction on field sampling logistics, personnel assignments, and field operations. Specifically, Ms. DeWoody will supervise all field collection and testing activities and will be responsible for ensuring accurate sample positioning, recording sample locations and identification, ensuring conformity to sample handling, processing and testing requirements (including physical observations and evaluations), and chain-of-custody through delivery to the analytical laboratory. Ms. DeWoody will be responsible for documenting collection of water samples, observations, and chain-of-custody up until the time samples are analyzed at the Waterkeeper lab or are delivered for chemical analysis to the analytical laboratory. She will also ensure that collected samples are stored under proper conditions until analysis or delivery and be responsible for documenting field sampling activities. This report provides details of the sampling effort, sample preparation, sample storage/transport procedures, lab analysis, and field and lab quality assurance. Ms. DeWoody will be responsible for preparation of progress reports and the final report which will include analysis of sampling data, the sampling effort, analytical methods, QA narrative, and analytical testing results.

4.3 Quality Assurance Officer Responsibilities

Justin Luedy of Orange County Coastkeeper (OCCK) will serve as the Quality Assurance (QA) manager for this project. He will provide quality assurance oversight for both the field sampling and laboratory programs. He will receive the laboratory reports and assure that a copy of the raw data is sent directly from the contract lab to the Project Manager. He will be kept fully informed of field program procedures and progress during sample collection and laboratory activities during sample preparation and analysis. Mr. Luedy will record and correct any activities that vary from the QAPP and, upon completion of the sampling and analytical program; he will review the contract laboratory QA results and incorporate findings into the final report. Any QA problems will be brought to the attention of the QA officer as soon as possible to discuss issues related to the problem and to evaluate potential solutions. The QA Officer can stop work if there are irreconcilable deviations from the QAPP, and he will conduct a minimum of two audits throughout the life of the project to ensure that sampling and analyses are being carried out as specified in the QAPP until corrective action is carried out.

4.4 Laboratory Director Responsibilities

The contract laboratory director shall be responsible for generating the raw chemical data in accordance to the laboratory methods as stated in the QAPP. Any laboratory problem in regard to this project will be addressed to them. The contract lab will receive and analyze the submitted samples in accordance with state approved protocol and the terms of the project QAPP, their internal QA requirements, and requirements as specified in this or any subsequently revised sampling plan. A report of analytical results and QA procedures will be prepared by the contract lab upon completion of the analyses.

4.5 Technical Advisory Committee (TAC) Responsibilities

The TAC members will assist in site selection, developing the sampling plan and QAPP, and will review the data and final report for accuracy.

4.6 Persons Responsible for QAPP Update and Maintenance

Changes and updates to this QAPP may be made after a review of the evidence for change by Autumn DeWoody. Justin Luedy will be responsible for submitting drafts for review, preparing a final copy, and submitting the final QAPP for signature.

4.7-4.8 Organizational Chart and Project Team

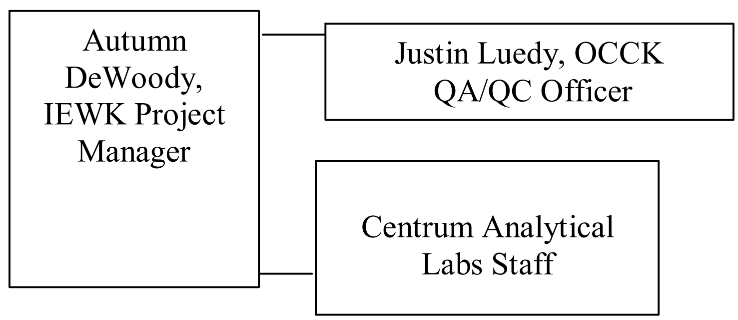

Figure 1. Organizational chart showing lines of authority and reporting responsibilities

5. PROBLEM STATEMENT AND PROJECT BACKGROUND

5.1 Problem Statement, Decisions, Outcomes

Several large development projects are planned for the Cleveland National Forest (i.e., Santa Ana Mountains) including a hydroelectric generation facility (dam) with associated transmission lines, a freeway tunnel through the mountains from Riverside County to Orange County, and a toll road extension in South Orange County. The goal of this project is to develop baseline water quality data for streams that may be affected by these projects so that the impact from such projects (measured as the change in water quality compared to baseline) can be documented. Never before has such monitoring taken place in these mountains.

The outcome of this project will be the development of a database containing accurate, quality-controlled data on the physical, chemical and biological conditions of selected forest streams. The data will be used by Inland Empire Waterkeeper (IEWK) to identify beneficial uses and impairments of the streams (if any) and the data will be provided to the Santa Ana Regional Water Quality Control Board (RWQCB) for regulatory use. Additionally, the general public will benefit through the public outreach the project will provide, including the training of volunteers in water monitoring techniques and education on the impacts of the proposed projects on water quality.

5.2 Site History

Four canyon streams have been selected on the east side of the Santa Ana Mountains and two canyon streams have been selected on the west side, for a total of six sampling sites. The sites are undeveloped and, based on aerial images and site visits are located high enough in each canyon to be representative of "natural" conditions. Preference was given to sites with water (as of July 1), sites with easy access, and sites located near the proposed path of said projects.

The proposed tunnel through the Santa Ana Mountains is currently designed as an extension of Cajalco Road at Interstate 15 in Riverside County to the junction of State Route 241 and State Route 133 in Orange County. It will likely impact Bedford Wash and McBride Canyon in Corona, Silverado Creek and Ladd Creek in Orange County. Although we have been denied access to Bedford wash by Eagle Glen Golf Course, we are able to monitor/sample in McBride canyon. Silverado and Ladd Creeks are not proposed sampling locations because Orange County Coastkeeper (OCCK) has already completed multiple reconnaissance trips and 2.5 years of sampling in Silverado creek, and some reconnaissance trips and two samples in Ladd Creek. We feel that the water quality of these two Orange County creeks has already been determined.

The hydroelectric dam is proposed for either Morrell Canyon or Decker Canyon directly above Lake Elsinore. These canyons are prohibitively difficult to access for sampling purposes, therefore Leach Canyon, which is north of Lake Elsinore but still a significantly-sized canyon and wash is proposed for monitoring/sampling.

The proposed extension of the State Route 241 toll road will impact San Mateo and Christianos Creeks located in Orange County. This document proposes sampling in these two creeks.

5.3 Water Quality Regulatory Criteria

This water quality monitoring program is designed to accurately determine pollutant concentrations and/or loads from the selected forest streams. Table 3 lists the potential contaminants, their water quality thresholds, and threshold sources that will be used to determine whether the streams are currently meeting regulatory requirements. All of the target pollutants are critical to water quality as each of them has the potential to adversely affect the beneficial uses of the waters that receive them. In addition, biological assessments (or bio-assessments) will be conducted so that not only the chemical conditions of the streams are measured but also the physical and biological conditions. Water quality of these streams is expected to be very good since sampling is taking place above known urban discharge points.

Table 3. Water Quality Criteria

Parameter	Objective	Source
Conductivity	2,000 µS/cm	Adapted from Basin Plan TDS objective
Dissolved oxygen (DO)	< 6 mg/L	Basin Plan[1]
Flow rate	n/a	n/a
pH	6.5 to 8.5	Basin Plan
Temperature	< 20°C (< 68°F)	Basin Plan
Total suspended solids (TSS)	No objective at this time	-
Turbidity	*Narrative objective only*[2] Secondary drinking water standard is 5 NTU[3]	Basin Plan
Ammonia-Nitrogen	0.4 mg/L (maximum)[4]	Basin Plan
Nitrate-Nitrogen	< 10 mg/L	Basin Plan
Soluble Reactive Phosphorous (SRP)	0.10 mg/L	USEPA
Total Coliform	10,000 mpn[5]/100 ml	AB411[6]
E. coli	235 mpn/100 ml	USEPA
Enterococcus	104 mpn/100 ml	AB411
Total Petroleum Hydrocarbons (TPH)	-	No numerical standard exists
Total Metals	California Toxics Rule (CTR)	USEPA[7]
Polycyclic Aromatic Hydrocarbons (PAH)	-	No numerical standard for water exists

[1] Refers to Santa Ana Regional Water Quality Control Board's Basin Plan (1995) available at http://www.waterboards.ca.gov/santaana/html/basin_plan.html.
[2] Natural turbidity range of 0-50 NTU can not increase more than 20%, 50-100 NTU can not increase more than 10 NTU, and more than 100 NTU can not increase more than 10%.
[3] nephelometric turbidity units (NTU)
[4] Varies according to formula in Basin Plan
[5] mpn = most probable number
[6] Refers to California Assembly Bill 411 (1999)
[7] Federal Register, Vol. 65, No. 97, May 18, 2000.

6. PROJECT AND TASK DESCRIPTION

6.1 Work Statement and Measurement Techniques

The first step of the project is to identify the streams and canyons that are most likely to have flow during dry weather and typical rain events and conduct a site inspection of each to measure ease of accessibility, and closeness to the proposed mountain projects. Due to proximity of the proposed mountain projects, San Mateo Creek, Christianos Creek, and McBride Canyon are three sites that require sampling. The remaining three sites in Riverside County are left up to the discretion of the TAC.

The second step of the project is to contact property owners where sampling may require access to their land. Final access approvals will not be obtained until the TAC has decided upon the sampling locations.

The third phase of the project is the implementation period where site visits, physical observations, water sampling and testing will take place – depending on the presence of water. If no water is present, basic site conditions will be noted. It is likely that a maximum of two creeks will be sampled on the same day. Sampling shall take place once per month, per sampling site (one sampling site per Creek). The day on which sampling occurs will vary each month depending on the availability of volunteer monitors and the Project Manager. Bio-assessments for each creek will be performed by OCCK or IEWK staff once in the Spring of 2008, although basic site conditions will be noted for each monthly site visit.

The final phase of the program will consist of summarizing the sampling results, discussing any observed changes in site conditions and bio-assessments for each site in a report that will be posted on the IEWK and OCCK websites. Results will be shared with volunteers, pertinent City and County officials (such as the Riverside County Transportation Commission, Orange County Transportation Authority, City of Lake Elsinore, U.S. Forest Service Trabuco Ranger Station, and the City of Corona) and the RWQCB.

Table 4. Monitoring Schedule Summary

Parameter	Type of monitoring[1]	Frequency of monitoring[2]
Conductivity	F	M
Dissolved Oxygen (DO)	F	M
Flow Rate	F	M
pH	F	M
Temperature	F	M
Total suspended solids (TSS)	C	E
Turbidity	L	M
Ammonia-Nitrogen	L	M
Nitrate-Nitrogen	L	M
Soluble reactive phosphorous (SRP)	L	M
Total coliform *E. coli* Enterococcus	L	M
Total petroleum hydrocarbons (TPH)	C	E
Total Metals	C	E
Polycyclic aromatic hydrocarbons (PAH)	C	E
Bio-assessment	F	S

[1] "F"= field analysis, "L" = in-house lab analysis, "C" = sample only and sent to contract lab.
[2] "M" monthly, "S" = seasonal, "E" = by event.

All of the water quality data will be compared to Santa Ana Regional Water Quality Control Board Basin Plan objectives or USEPA guidelines. Results that are not comparable to Basin Plan objectives or USEPA guidelines will be reviewed by the Technical Advisory Committee. Chemical, physical, and bacterial parameters will be monitored using protocols outlined in Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Management Plan (QAMP) (http://www.waterboards.ca.gov/swamp/qamp.html).

Specific Tasks, Details and Coordination

Task 1: Project Planning and Monitoring Program Development

a. Assemble a representative Technical Advisory Committee (TAC) to review data collected, testing methods, QA procedures, and assist in selecting sampling sites, procedures and sampling parameters.
b. Develop a Quality Assurance Project Plan (QAPP) with TAC input. Develop all documents necessary for water quality analysis and site inspections.
c. Assemble five to six groups of volunteer monitors, conduct training sessions and coordinate sampling schedules.
d. Confirm appropriate sampling equipment.
e. Select contract lab for water quality analysis and develop procedure for delivering samples to the lab for analysis.
f. Update website(s) as needed.

Task 2: Initial Site Inspections and Final Site Selection

a. Conduct initial site inspections of selected creeks; note presence of water during summer, accessibility, private property issues, and local environment conditions.
b. Finalize sampling locations and procedures with TAC input.

Task 3: Sampling

a. Conduct sampling at one site per Creek, once per month and during three storm events for a period of 12 months.
b. Input results into database and publish results on website each quarter.

Task 4: Spring Biological Assessment

a. In Spring of 2008, staff of IEWK or OCCK will conduct a bio-assessment of each sampling location and publish results on website.

Task 5: Final Documentation of Forest Canyon Water Quality

a. Prepare a draft final project report that includes the results of the sampling, site visits and bioassessments for the TAC.
b. Publish final project report in coordination with two other components of grant funding: (1) Wildland and Water Quality Advocacy and (2) Outreach and Education.

6.2 Project Schedule

Table 5. Project Schedule Timeline

Activity	Anticipated Start Date	Anticipated Completion Date
Task 1 1. Assemble Technical Advisory Committee (TAC) 2. Develop Quality Assurance Project Plan (QAPP) 3. Identify Forest Canyon sampling Sites 4. Assemble sampling teams of volunteers, conduct training sessions and coordinate sampling schedules. 5. Confirm sampling equipment 6. Identify and coordinate with contract lab 7. Update and prepare website for future reports.	June 1, 2007	August 1, 2007
Task 2 1. Initial Site inspection 2. Finalize sampling locations with TAC	June 1, 2007	August 1, 2007
Task 3 1. Conduct sampling: one site per Creek, once per month. 2. Input results of chemical analyses into database. 3. Input site visit notes into database. 4. Publish results on website quarterly.	August 1, 2007	July 1, 2008
Task 4 1. Conduct bioassessment at each sample site in Spring of 2008	April 1, 2008	May 31, 2008
Task 5 1. Prepare a draft final project report including all results from chemical, physical and biological investigations for TAC 2. Publish final version on website. 3. Coordinate with final report for entire grant funding.	Ongoing	July 1, 2008

6.3 Geographical Setting

Figure 2: Sampling locations

6.4 Constraints

Southern California rainfall in 2007 has been some of the lowest levels ever recorded; therefore, we expect most creeks to be dry until the 2008 storm season. Storm-event sampling will be conducted when possible. Sites will likely not be sampled all on the same day or the same time of day due to the distances between them. Additionally runoff may not occur at all sites during wet or dry weather. In this case, the lack of runoff will be documented in the field data sheets. Other constraints include the potential unwillingness of property owners to provide access or unexpected access blockages.

7. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

7.1 Data Measurement Objectives

This water quality monitoring program is designed to accurately determine pollutant concentrations and/or loads from six Forest streams. Data measurement objectives are summarized in Table 6. Whenever possible the methods with the greatest sensitivity and lowest detection limit will be employed as the primary methods. Methods with lesser sensitivity and higher detection limits, such as color comparators, will be used for field confirmations or as back-up methods in the case that the primary methods are not available or functioning properly for a particular sampling event. Data quality information will be attained by maximizing and documenting the accuracy and precision of the methods used. Any changes in procedures due to equipment changes or to improved precision and accuracy will be documented. Only methods and techniques which have been determined to produce measurement data of a known and verifiable quality and which are of quality sufficient to meet the overall objectives of the water quality monitoring investigation will be used.

Table 6. Data Measurement Objectives for Water Quality Parameters

<table>
<tr><th>Parameter</th><th>Method or Range</th><th>Units</th><th>MDL[1]</th><th>Sensitivity[2]</th><th>Measurement Splits/Duplicates</th><th>Accuracy</th><th>Completeness</th></tr>
<tr><td colspan="8">CONVENTIONAL PARAMETERS</td></tr>
<tr><td>Conductivity</td><td>conductivity meter</td><td>µS/cm</td><td>2.5</td><td>10 µS/cm</td><td>± 10%</td><td>± 10%</td><td>90%</td></tr>
<tr><td>DO</td><td>DO meter</td><td>mg/L</td><td>0.01</td><td>0.01</td><td>± 10%</td><td>±0.3</td><td>90%</td></tr>
<tr><td>Flow rate</td><td>Orange peel</td><td>ft^3/sec</td><td>-</td><td>-</td><td>-</td><td>-</td><td>90%</td></tr>
<tr><td>pH</td><td>pH meter</td><td>pH units</td><td>2.0</td><td>0.1 unit</td><td>±0.2 units</td><td>±0.2 units</td><td>90%</td></tr>
<tr><td>Temperature</td><td>Thermometer</td><td>°C</td><td>-5</td><td>0.5 °C</td><td>±0.5 °C</td><td>±0.5 °C</td><td>90%</td></tr>
<tr><td>TSS</td><td>SM 2540-D</td><td>mg/L</td><td>0.5</td><td>0.5</td><td>+/- 25%</td><td>+/- 25%</td><td>90%</td></tr>
<tr><td>Turbidity</td><td>colorimeter</td><td>FAU</td><td>40</td><td>0.5</td><td>+/- 25%</td><td>+/- 25%</td><td>90%</td></tr>
<tr><td colspan="8">NUTRIENTS (using a colorimeter)</td></tr>
<tr><td>Ammonia Nitrogen</td><td>Clin. Chim. Acta., 14 403 (1966)</td><td>mg/L</td><td>0.02</td><td>0.02</td><td rowspan="2">Matrix Spike/ Duplicates every 20 samples</td><td>±0.2 (<2.0) ±10% (>2)</td><td>90%</td></tr>
<tr><td>Nitrate Nitrogen</td><td>SM4500</td><td>mg/L</td><td>0.01</td><td>0.03</td><td>±0.2 (<2.0) ±15% (>2)</td><td>90%</td></tr>
<tr><td>SRP</td><td>Stannous Chloride</td><td>mg/l</td><td>0.05</td><td>0.2 (0-1.0) 0.5 (1.0-2.0)</td><td>Matrix Spike/ Duplicates every 20 samples</td><td>± 1.0</td><td>90%</td></tr>
<tr><td colspan="8">Biological PARAMETERS</td></tr>
<tr><td>Total coliform

E. coli</td><td>Colilert 18 hour</td><td>Organism</td><td>2 mpn/ 100ml</td><td>2 mpn/ 100ml</td><td>Duplicates every 20 samples</td><td rowspan="2">Positive results for target organisms. Negative results for non-target organisms</td><td>90%</td></tr>
<tr><td>Enterococcus</td><td>Enterolert</td><td>Organism</td><td>2 mpn/ 100ml</td><td>2 mpn/ 100ml</td><td>Duplicates every 20 samples</td><td>90%</td></tr>
<tr><td colspan="8">INORGANIC PARAMETERS</td></tr>
<tr><td>TPH</td><td>EPA Method 8015</td><td>ng/L</td><td>1 ng/L</td><td></td><td rowspan="3">Field replicate, laboratory duplicate, or MS/MSD+/- 25% RPD</td><td rowspan="3">Matrix spike 75%- 125%.</td><td rowspan="3">90%</td></tr>
<tr><td>Total Metals</td><td>EPA Title 22</td><td>µg/L</td><td>0.025 µg/L</td><td>standard reference materials (SRM, CRM, PT) 75% to 125%.</td></tr>
<tr><td>PAH</td><td>EPA Method 8270</td><td>ng/L</td><td>1 ng/L</td><td></td></tr>
</table>

[1] MDL: minimum detection limit

[2] Some test kits vary in sensitivity over the range of detection. The specific range of readings is noted in parentheses.

7.2 Project Action Limits for All Parameters of Interest

Action Limits are the level at which regulatory action or other such "action" is warranted. Action limits are based on Basin Plan Objectives, USEPA guidance or state legislated objectives.

Table 7. Project Action Limits for All Parameters of Interest

Parameter	Action Limit	Minimum Detection Limit
Conductivity	2000 µS/cm	2.5 µS/cm
DO	< 6 mg/L	0.01 mg/L
Flow rate	n/a	n/a
pH	6.5 to 8.5	2
Temperature	< 20^{0}C	-5 $^{\circ}$C
TSS	150 mg/L	0.5 mg/L
Turbidity	> 100 FAU	40 FAU
Ammonia-Nitrogen	0.09 mg/L	0.02 mg/L
Nitrate-Nitrogen	< 10 mg/L	0.05 mg/L
SRP	0.10 mg/L	0.02mg/L
Total coliform *E. coli* Enterococcus	10,000 mpn/100mL 235 mpn/100mL 104 mpn/100mL	2 mpn/100 ml
TPH	1 ng/L	1 ng/L
Total Metals	California Toxics Rule	0.025 µg/L
PAH	1 ng/L	1 ng/L

7.3 Acceptance Criteria for All Previously Collected Data

No previously collected data will be used.

7.4-7.7 Data Quality Objectives Discussion

Accuracy is how close the measured values are to the true value. Accuracy will be determined by measuring one or more selected performance testing samples or standard solutions other than those used for calibration. Accuracy will be the degree of agreement of an analytical measurement with an accepted reference value. Accuracy is assessed using fortified samples and external samples of known concentration.

Precision is a measurement of how often a reading can be repeated. Precision will be the measure of mutual agreement between individual analytical results of replicate analyses. Precision will be determined on both field and laboratory measurements. Recovery measurements will be determined by laboratory spiking of a replicate sample with a known concentration of analyte.

Completeness is the number of analyses generating useable data for each analysis divided by the number of samples collected for analysis. Completeness is important component due to the necessity to track reductions in pollutant concentrations.

Representativeness is how close the samples collected match the actual composition of the forest creek water. The project design assures representativeness by including six streams in the project. With our sample design, we will be able to determine baseline concentrations of forest streams. Representativeness of the samples collected will be assessed by the completeness of the sample collection effort. Bias is defined as the deviation of an average value from a reference value. This project eliminates sample site bias by including six streams in the project.

All methods will establish precision and accuracy standards that must be met by the laboratory and EPA's approved methods. The contract laboratory will fulfill the method limits to establish their analysis within control.

8. SPECIAL TRAINING NEEDS AND CERTIFICATIONS

8.1 Specialized Personnel Training

Ray Hiemstra of OCCK will conduct the training sessions for sampling and OCCK lab personnel. Mr. Hiemstra has been conducting this type of work for six years and has undergone specific training in effluent and stormwater monitoring from the University of Washington and is well-known in this field. He will also be present in the field during sampling to reinforce his training. Contract laboratory personnel will be trained by the contract lab QA officer.

8.2 QA Officer Training Role

The QA officer, Justin Luedy, will be responsible for overseeing the training and maintaining the training documentation.

8.3 Specialized Training or Certifications

All personnel will be trained in state approved methods for sample collection and the handling of sampling equipment (including cleaning and use). They will also be trained in the proper techniques for collecting and processing samples in the field and packaging them for shipment to the lab. Training will occur during regularly scheduled training classes held in the field and at the IEWK office. All personnel attending the training classes will be documented with attendance sheets. Training effectiveness will be verified through biannual inter-calibrations sessions where monitoring personnel will be observed testing samples against standards and the results documented. Although no specialized safety training is necessary, all personnel participating in the sampling will receive verbal training in safety issues.

8.4 Training Adequacy

The QA officer will be responsible for determining the effectiveness of the training and certification of the project personnel by review of their attendance at training sessions.

8.5 Training and Certification Documentation

The training of personnel involved in the sampling will be documented with a training session attendance list at IEWK.

9. DOCUMENTS AND RECORDS

9.1 Report Format and Report Package Information

Documents and records created for this project will include a field sampling form detailing the sampling process in the field including: station ID, GPS coordinates, observations, water quality data, such as color and odor, and a chain of custody form for transporting the samples to the lab. The data analysis results from the labs including all QC data will be included in the reports from the lab detailing all calibration data, duplicates, matrix spikes, etc. IEWK will be responsible for maintaining these documents. A data analysis report will be generated by IEWK as a tool to produce the final report that is the primary product for this project. IEWK will be responsible for these documents. The QAPP and sampling plan will be produced by Mr. Ray Hiemstra of OCCK and distributed to everyone on the distribution list contained in this document at its completion for their signature by QA Officer Justin Luedy. Any changes to the QAPP will be completed by Ms. Autumn DeWoody. Any revised QAPP will be distributed to everyone on the distribution list after approval of changes by Justin Luedy. Mr. Luedy will develop a QA/QC report that verifies all the procedures within the QAPP were followed.

Report Package Information

A progress report will be generated by the OCCK every quarter throughout the life of this project and will be provided to the TAC for review and posted on IEWK and OCCK websites. This quarterly report will contain hard copies as well as electronic documents. The format of such report will be as follows:

- Lists the project tasks by name
- Each task is identified by a due date, percentage of work complete and date submitted
- Each task is broken down into sub-tasks by name and number
- Subtasks will be briefly explained and supported with copies of pertinent documents.

9.2 Project Documents List

Table 8. Document and Record Retention, Archival, and Disposition Information

	Document Type	Retention	Archival	Disposition
Sample Collection Records	Field sampling forms	IEWK	Hardcopies	Hardcopies kept for 5 years. Digital data indefinitely
Analytical Records	Calibration and Q/C Report	IEWK, OCCK and contract lab	Hardcopies and digital Records	Hardcopies kept for 5 years. Digital data indefinitely
Data Records	Contract Lab Data Report	IEWK and contract lab	Hardcopies and digital Records	Hardcopies kept for 5 years. Digital data indefinitely
Data Analysis	Data Analysis Report	IEWK and OCCK	Hardcopies and digital Records	Hardcopies kept for 5 years. Digital data indefinitely
Project level Q/C Documents	QAPP	IEWK and OCCK	Hardcopies and digital Records	Hardcopies kept for 5 years. Digital data indefinitely

9.3 Project Information Storage

Hardcopies of all documents will be stored at the IEWK office along with digital copies (if available). QA Officer Justin Luedy will be responsible for all hardcopies. Backup copies will be kept at the office of the producer of the document.

9.4 Information Back Up

All electronic records will be backed up on a removable hard drive that is stored outside of the office. The hard drive is stored at the project manager's home during weekends to ensure the safety of data in case of fire or other disasters.

9.5 QA Plan Distribution

All individuals listed in Table 1 will receive digital copies via email and hardcopies via mail of the approved QAPP along with any revisions from Justin Luedy.

GROUP B: DATA GENERATION AND ACQUISITION

10. SAMPLING PROCESS DESIGN

10.1 Sample Design Information

The design strategy for this project is to collect water samples from six creeks flowing out of the Cleveland National Forest in order to document baseline forest water quality conditions so that the impacts from future developments projects can be measured.

Site selection

Potential sampling sites (pending the TAC approval) have been selected based on their relevance to the proposed tunnel project and toll road extension project. In addition, we selected creeks that are known to carry dry-weather flows (below development) so that the water quality above development can be known. We have found the proposed hydroelectric dam location to be in a canyon that is prohibitively difficult to access either by car or on foot; therefore samples will not be taken from either Morrell Canyon or Decker Canyon (http://www.evmwd.com). Ease of accessibility, both in terms of private property and physical accessibility (via car and foot), was also considered during site selection.

Initial sample collection

Dry and wet season samples, including storm-event samples when feasible, will be collected for bacteria, nutrients and sediment at all six sites once a month and during three storm events when available. Due to cost constraints metals, oil and grease, and PAH testing will be done less often.

Analysis

See section A.7. The data collected will be compared to Basin Plan objectives, USEPA recommendations or AB 411 objectives (bacteria) to determine if thresholds are exceeded.

10.2 Conceptual Sampling Plan

The sampling plan is designed to collect as much data as possible from streams draining the east side of the Santa Ana Mountains region of the Cleveland National Forest. The goal is to document baseline conditions of these streams for use in future determinations of degradation.

Sample Locations

The sites considered for sampling are shown in Figure 2 and listed in Table 9. The final list of sample stations is listed in Table 10. Sampling locations along each creek will be selected to ensure that the samples collected are all the result of forest runoff with no dilution from storm drain or other developed area runoff.

Table 9. Total Possible Sites Considered for Sampling in Riverside County

Canyon	Nearest Street Access and Point of Interest	Restrictions?
Main Street	Main Street, Corona	May be on private property, near Song Residence construction. Easy access.
Bedford	Eagle Glen Parkway (Eagle Glen golf course)	Must cross golf course – access denied.
McBride	Sanctuary Road (The Retreat golf course)	Must cross golf course – in process of obtaining access agreement. Easy access.
Brown	Camino Terraza (Montecito Ranch Park)	Must cross Riverside County flood control fence to access. No charge. Easy access.
Coldwater	Glen Ivy Road (private Glen Ivy community)	Private property. Access needed from private community. Water year-round!
Mayhew	Maitri Road (Werner Corp. mine)	Absolutely no access through mine property is allowed. No access.
Indian	Glen Eden Road (Glen Eden Sun Club)	Difficult to clearly locate.
Horsethief	Mountain Road (Horsethief Canyon Ranch development)	Private property (pass through gate with Sun on it) but expect no problem accessing it. Easy access.
Rice	Mountain Street, Lake Elsinore (Rice Canyon Elementary School)	Private property but expect no problem accessing it. Easy access.
McVicker	McVicker Canyon Park Road (McVicker Park Fire Stn. No. 85)	Long, rough dirt road to get up canyon – difficult to get through brush to creek.
Leach	Leach Canyon Road above Amorose Street	Private property with locked gate, but access can be provided by EVMWD.

After site visits and consultation with the TAC, the total potential sampling locations were narrowed down to Table 10 that lists the final six sample creeks.

Table 10: Final List of Sample Sites in Riverside and Orange County

Canyon	Nearest Street Access and Point of Interest	Sample Location ID[1]
Orange County		
San Mateo	-	San Mateo 1 (SM)
Christianos	-	Christianos 1 (CR)
Riverside County		
McBride	Softwinds Drive, Corona (The Retreat golf course)	McBride 1 (MB)
Coldwater	Glen Ivy Road (private Glen Ivy community)	Coldwater 1 (CW)
Main Street	Main Street, Corona	Main Street 1 (MS)
Leach	Top of Amorose Street, Lake Elsinore	Leach 1 (LC)

[1] In the event that more than one sample location on a creek is used for sample collection, it will be assigned a 2, 3, etc.

Sample Site Positioning

Horizontal positioning will be determined using a hand held Global Positioning System (GPS). Measured station positions will be converted to latitudinal and longitudinal coordinates (WGS84) to the nearest second. The accuracy of measured and recorded horizontal coordinates will be within three meters. In the case that a sampling station becomes inaccessible, a new station will be selected as close to the original station as possible and the site change will be documented.

Sample Collection, Processing and Analysis

IEWK will provide all necessary field training, including sampling methods, sample collection, and processing required completing the project. Before sampling begins, all personnel will be trained in safety requirements. Training will be held for field personnel on SWAMP approved Standard Operating Procedures (SOP) for conventional water quality parameters for sampling and all equipment will be cleaned prior to use. Training will be held for IEWK lab personnel on all bacteria, nutrients, and standard parameters using EPA or standard methods. The contract lab(s) will be notified and ready to receive the samples prior to sample collection. Water samples will be collected from a minimum of six sites using bottles provided by IEWK or the contract lab for water samples. The target depth of the water samples is below the surface. Water Samples will be collected using an acid washed bottle provided by the contract lab and then will be placed in a cooler containing ice until delivery to the contract lab.

10.3 Number of Samples

When available, at least one water sample per target class for each sampling event will be collected from a minimum of six identified as part of the project using bottles provided by the IEWK or contract lab for a minimum of 78 target class samples by the end of the project if runoff is available.

10.4 Site Identification and Sample Collection Location

Site identification codes are listed in the last column of Table 10. Each sample sites' group of sample bottles, shall be marked with the following sample ID's: creek acronym followed by the 2-digit month, 2-digit day and 2 digit year (e.g., AB-071107). Sample forms located in Appendix C shall also use these same IDs.

- San Mateo: SM-(month)(day)(year)
- Christianos: CR-(month)(day)(year)
- McBride: MB-(month)(day)(year)
- Coldwater: CW-(month)(day)(year)
- Main Street: MS-(month)(day)(year)
- Leach: LC-(month)(day)(year)

10.5 Sample Site Changes

Sample sites may be changed if impractical for use as a sampling site due to changes in runoff patterns or if unsafe conditions require site changes. In the case of site changes, a similar site as close as possible as the original will be used, and the change will be documented.

10.6 Sampling Schedule

Sample collection will occur after approval of the QAPP by the TAC. It is anticipated that after allowing sufficient time for sampling plan and QAPP review/revision/approval, the initial sampling events will occur in July 2007. Additional sampling will occur through April 2008. The project manager will direct the sampling effort and ensure the proper analysis of the samples at the IEWK lab and transfer of the samples to the contract lab. Samples will be collected from canyon runoff at the project sites during wet and dry weather. Parameters such as pH, conductivity and temperature will be measured onsite. Samples will be collected and placed on ice in a cooler for analysis at the IEWK laboratory within six hours of collection for bacteria and within 48 hours for ammonia, nitrate and orthophosphate. Samples for pesticide analysis will be delivered to the contract lab within 48 hours of collection by either IEWK staff or the contract lab courier.

10.7 Critical information

Critical information includes the number and location of sampling stations the identification of rain events, and of dry weather runoff. Additionally, all the bacteriological and chemical analyses are critical. Non-critical information includes incidental observations about water conditions such as odor and color.

10.8 Natural Variability

Variability is an important issue in water quality monitoring. The project is designed to deal with variability by collecting multiple samples of wet and dry weather runoff from each site. Variability in the flow will be addressed by taking replicates per canyon, variability within each sample will be dealt with by taking splits, and variability due to sample collection techniques will be dealt with training and using the same staff for sample collection.

10.9 Bias

The project has been designed to eliminate bias by collecting runoff samples at canyons that are likely to be impacted by proposed development projects. Samples will be tested for the presence of numerous constituents.

11. SAMPLING METHODS

Table 11. Analytes and Sampling Methods

Water Analysis	Method	Holding Time; Analysis	MDL	Bottle	Preservation Chemical or Temperature
Conductivity	Conductivity Meter	n/a	2.5 µS/cm	in field	None
DO	DO Meter	n/a	0.01 mg/L	in field	none
pH	pH Meter	n/a	2	in field	None
Temperature	Thermometer	n/a	-0.5 ^{0}C	in field	None
TSS	EPA 160.2	7 days	0.5 mg/L	500 mL poly or glass	4 °C
Turbidity	EPA 180.1	48 hrs	40 FAU	500 mL poly or glass	4 °C
Ammonia- Nitrogen	Clin. Chim. Acta., 14 403 (1966)	48 hrs	0.02 mg/L	100 ml amber glass	4 °C
Nitrate-Nitrogen	SM4500	48 hrs	0.05 mg/L	100 ml amber glass	4 °C
SRP	EPA 365.2	48 hrs	0.02 mg/L	100 ml amber glass	4 °C
Bacteria (total coliform, E. Coli, enterococcus)	Colilert (Enterolert for *Enterococcus)*	5 hrs	2 mpn/ 100 ml	100 ml poly	Sodium Thiosulfate/ 4 °C
TPH	EPA Method 8015	7 days	1 ng/L	2 L amber glass	4 °C
Total Metals	EPA Method 6020	7 days	0.025 ug/L	500 ml poly	4 °C
PAH	EPA Method 8270	7 days	1 ng/L	2 L amber glass	4 °C

11.1-11.2 Sample Collection

Water samples will be collected by the procedures outlined in Appendix D of the SWAMP QAMP 2002 "Field Collection of Water Samples." Samples will be collected by using clean sample collection containers to collect flow from project streams and then immediately placing it on ice in a cooler. A log shall be kept of basic site information, taken during actual sampling.

At a minimum, the following information will be included in this log:

- Location of each station as determined by GPS

- Date and time of collection of each sample and person collecting sample
- Observations made during sample collection including: weather conditions, complications, traffic, and other details associated with the sampling effort
- Sample station number
- Any deviation from the approved sampling plan

11.3 Sample Processing

No field processing is necessary for water samples.

11.4-11.5 Sample Containers/Preservation

100 ml or 1 L amber glass, 500 ml poly and 100 ml Whirl-Pak® containers will be used to collect the water samples at each site. After placement of the water sample into sample bottles, each container will be firmly sealed and clearly labeled with the name of the project, sample number, type of analysis, date, time, and initials of the person preparing the sample. This information will be recorded in the data sheet and on the chain-of-custody forms. Following proper sealing and labeling, all sample containers will be placed on ice in a cooler or container for immediate delivery to the analytical laboratory. Any problems will be reported to the project manager and documented along with corrective actions. No equipment and support facilities are needed for this project.

11.6 Equipment Decontamination Procedures

All sample collection containers and equipment will be pre cleaned with HCL before use in the field.

11.7 Equipment/ Support Facilities

A complete list of the instruments and equipment that will be used in the field is available in Appendix A. No support facilities will be necessary for the sampling. All samples will be collected in the field and delivered to the IEWK lab within 5 hours, or the contract lab within twenty-four hours.

11.8 Corrective Actions

Any problems will be reported to the project manager, who will determine the appropriate action and document the corrective action on the field data sheets, and report them to the QA manager if deemed necessary.

12. SAMPLE HANDLING AND CUSTODY

The following sections describe the sample containers and holding times, sample transport and chain-of-custody procedures, and waste management

12.1 Sample Containers and Holding Times

The IEWK lab or contract lab will provide pre-cleaned containers. The container size and type, maximum holding times for each sample type, and preserving agent for the complete analyte list is provided in the table in section 11.1. Prior to use the laboratory will add preservative, where required.

12.2 Sample Transport

All samples will be transported to the IEWK or contract analytical laboratory as follows:

> Each cooler or container containing the samples for analysis will be brought to the IEWK lab within five hours of collection. At the IEWK lab the samples will be processed and preserved as necessary. Samples that are not analyzed at the IEWK lab will be shipped to the laboratory within 24 hours of being collected. Individual sample containers will be placed and transported in a sealed ice chest. The ice chest will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container) to enable positive identification. A generous amount of ice will be sealed in separate plastic bags and placed into the cooler. A temperature blank will be placed in the cooler prior to sealing. A sealed envelope containing chain-of-custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler. The cooler lids will be secured by wrapping the coolers in strapping tape. Signed and dated chain-of-custody seals will be placed on all coolers prior to shipping.

12.3 Sample information

All sample and custody information will be documented on field data sheets and chain-of-custody forms created for this project (see Appendix C).

12.4 Chain-of-Custody Procedures

Upon transfer of sample possession to the analytical laboratory, the persons transferring custody of the sample container will sign the chain-of-custody form. Upon receipt of samples at the laboratory, the shipping container seal will be broken and the condition of the samples recorded by the recipient. Chain-of-custody forms will be used internally in the lab to track sample handling and final disposition. The IEWK project manager or QC Manager will be notified immediately of any discrepancies in the chain-of-custody documentation.

Refer to Table in section 11.1 for sample method, volume, container and holding time.

13. ANALYTICAL METHODS

Element 11 (Sampling Methods) of this QAPP described the sample-collection process of the project and lists all the instruments and kits that will be used in the field. Table 7 contains the Project for all parameters of interest while Table 6 contains the Method Detection Limits for all tests to be performed.

13.1 Field/Laboratory SOPs

The only parameters that will be measured in the field will be flow rate, conductivity, DO, temperature and pH. The methods used for determining these parameters are detailed in Appendix B and is from the State QAPP (Appendix E). The parameters and the methods for measuring these parameters are listed in Table 13 of this document.

13.2. Field Equipment

The field equipment to be used includes Oakton Conductivity, DO, and pH meters and thermometers. The conductivity meter works by measuring the conductance of water between two probes. The range of the conductivity meter is 0-19.9 ms/cm with a resolution of 0.1ms/cm. For the pH meter the measuring electrode, which is sensitive to the hydrogen ion, develops a potential (voltage) directly related to the hydrogen ion concentration of the solution. The reference electrode provides a stable potential against which the measuring electrode can be compared. For the thermometer, resistive temperature devices capitalize on the fact that the electrical resistance of a material changes as its temperature changes. Two key types are the metallic devices (commonly referred to as RTDs), and thermistors. As their name indicates, RTDs rely on resistance change in a metal, with the resistance rising more or less linearly with temperature.

13.3-13.4 In Situ /Continuous Monitoring

The project will not utilize *in situ* or continuous monitoring.

13.5-13.7 Lab Equipment/Methods/Procedures

The contract laboratory for this project will utilize the appropriate equipment or instrumentation that is necessary for state approved laboratory analyses The IEWK lab will use a Hach 860 Colorimeter to conduct lab analysis for nitrate-nitrogen (method Clin. Chim. Acta., 14 403 (1966)), soluble reactive phosphorous (EPA method 365.2) and ammonia-nitrogen(method SM4500).

13.8 Corrective Action and Individuals Responsible

Contract laboratory corrective actions will be the responsibility of the Lab Director. The following is the corrective action procedures required of the contract laboratory for this project:

Corrective action is the process of defining- root-cause, identifying and implementing corrective action plans, educating - and training to provide system-wide solutions, and verifying that the improved system is being followed. The investigation of the corrective action will cover using a non-conformance investigation report. The report will cover the nature of the failure and the experience and judgment of the analyst or supervisor will be relied upon to determine the best course of action to resolve the problem. The investigation may consist of but not limited to 1) calculation errors, 2) equipment malfunctions (i.e. properly calibrated 3) use of incorrect standard or methodology and 4) check against know controls. An immediate corrective action using the non-conformance investigation format will be issued. A final report will be issued 30 days from the initial date of the investigation. The corrective action plan requires a detailed plan showing clearly defined milestones, task descriptions, and responsibilities. The contract lab Quality Assurance Specialist must approve all immediate and long-term corrective action plans. Closure of corrective actions require verifiable, objective evidence that the corrective action be thorough, comprehensive, and will permanently prevent the problem from reoccurring. Corrective actions result from a wide variety of situations including:

A. Inspection of the sample indicates the: samples are 1) not representative of their source, 2) deteriorated, 3) improperly labeled, 4) damaged in transport, or 5) collected in an inappropriate container. In this case, the MQL's sample custodian or Quality Assurance Specialist will notify the sample collector of the- problem(s) and request a new sample(s) to be collected following proper sample collection and handling methods.

B. Samples that are not properly preserved, stored at incorrect temperatures, or exhibit deficiencies in the chain-of-custody records are not analyzed. The contract lab Sample Custodian or Quality Assurance Specialist will reviews the discrepancy with appropriate personnel and new samples are collected employing correct methods.

C. The required QAPP test method has not been followed correctly. The supervisor reviews the Method with the analyst and requests the analyst to rerun the analysis, per the method, under the supervisor's direct observation. The analyst repeats the procedure until it is correctly performed. The analyst's performance of the method's protocol and results are evaluated randomly over a minimum of a two week period to ensure adherence to all requirements of the method.

D. Instrumentation malfunctions are immediately noted in the instrument logbook and the supervisor is notified. Senior technical staff with specific in-depth knowledge of the particular instrument reviews the problem and attempt to fix the instrument. Major problems may require trained field service personnel from the manufacturer to be brought in to fix the problem. If the projected downtime will extend beyond the samples required holding time, the sample will be either analyzed on another instrument or sent to an approved contract laboratory for analysis.

E. When duplicate results, spike recovery results, or Quality Assurance reference samples are outside their acceptance limits, the supervisor is notified and the complete analytical procedure is reviewed with the analyst. The data entry and calculations are reviewed for transcription errors. Reagents and standards are checked to see if they were properly prepared and whether they are within their shelf life. The equipment is examined for proper performance. The calibration and maintenance record is reviewed to ensure the instrumentation is performing optimally. The methodology is reviewed to make sure that it is properly applied. Sampling and sample handling protocols are verified to ensure that the sample was collected properly and the recommended preservation and holding times were observed. If the cause of the problem is found, the Quality Assurance Specialist sends a Quality Assurance reference sample to the analyst for analysis. If the Quality Assurance check sample is acceptable, the duplicate or spike analysis is reanalyzed. However, if the same result is obtained in the repeat analysis, the problem is probably due to matrix interference effect. The results of the sample batch are reported with an accompanying explanation of possible matrix interference. If the precision of duplicate spike analyses improves and are in control, the sample batch run with the initial duplicate spike analysis sample is reanalyzed. A different scenario must be followed in circumstances such as insufficient sample or analysis of the sample after the prescribed holding time exists. In these situations, the original result is reported and accompanied by a failure report stating the circumstances that occurred in the initial and repeat analysis. If the results for the Quality Assurance reference sample are not satisfactory, a team will be formed to identify and correct the problem. The analysis will not be resumed until the system is in control.

F. The contract labs internal evaluation and corrective action program and external agency audits can result in corrective actions. The response to these evaluation studies requires a written corrective action plan that has been accepted by the Quality Assurance Specialist. Closure requires objective evidence that the corrective action be thorough, complete, and will permanently solve the problem.

The contract lab Continuous Measurable Improvement program is designed to identify opportunities for improvements systematically. This program leads to specific corrective actions initiated by either a combination of senior technical staff and analysts or a team established to address the specific problem. A quantitative measurement is applied to ensure that the corrective action has had a positive impact on eliminating the problem.

Field sample collection and IEWK lab analysis will be conducted directly under the supervision of the Project Manager Autumn DeWoody. Any problems with equipment, sample collection and lab or field activities will be brought to his attention immediately. Any corrective action including re-sampling activities, chemical re-testing, and database analysis and data validation will be brought to the attention of Autumn DeWoody the Project Manger at IEWK, and any such corrective action will be documented by QA Officer Justin Luedy.

13.9 Waste Management

The goal is to use all of the water collected for the analysis. All disposable sampling materials and personnel protective equipment used in sample processing, such as disposable coveralls, gloves, and paper towels, will be placed in heavy duty garbage bags or other appropriate containers. Any leftover sample water or lab chemicals will be disposed of to the sanitary sewer or a hazardous waste container for legal disposal.

13.10 Laboratory Turnaround Time

This project requires a laboratory turnaround time of sixty days and the contract lab will meet this requirement.

13.10-13-11 Nonstandard SOP's/PBMS Method Development

No nonstandard SOP's will be used as part of this project and no PBMS methods will need to be developed.

14. QUALITY CONTROL

This section addresses the QA/QC procedures for the project. A strong QA/QC program is necessary to insure data accuracy. Laboratory and field blanks will have no detectable amount of substance in blanks. Accuracy, precision, recovery, and blanks will be at 1 in 20 (5%) with at least one in every batch.

14.1 QC Activities

Method Blank: is used to assess the presence or absence of analytical target constituents the analytical process.
Matrix Spike: is used to assess accuracy and provides information about the performance of target analytes in the subject matrix.
Matrix Spike Duplicate: An exact replicate of the matrix spike. Used to assess precision in the subject matrix relative to the matrix spike. Especially useful if no target analytes are present in the subject sample duplicates.
Sample Duplicate: is used to assess precision.
Instrument Quality Control: to assess initial and continuing instrument performance, including:
Initial Calibration: for establishing a reliable (linear) analytical range. Analyzed as a prerequisite to sample analysis.

Field instruments will be calibrated within 24 hours of use, a duplicate and field blank reading will be taken at one site for each instrument used(minimum of 5%)

14.2 Control Limits

When control limits are exceeded the quality control will be repeated until the desired accuracy is reached. This study has been designed in a fashion to avoid bias and misrepresentations. However, in the case of occurrence of outliers and missing data, the problem will be discussed with the project manager and appropriate project team members. Consequently, any change and correction to the data will be reformatted and documented for the project use.

14.3 Procedures for Calculating Data Quality Indicators

The formulas for assessing whether data quality objectives are being met:

Accuracy:
The Relative Percent Difference = (measured value-known value)/ known value x100
Completeness:
%Completeness = data collected /data expected to be collected x 100
Recovery:
Recovery = (matrix plus spike result-matrix result) x 100/expected matrix plus spike result

The following statements are the IEWK QC procedures and explain the procedures for assessing the Data Quality Indicators.

IEWK utilizes several methods to monitor precision and accuracy. These are designed to determine the reproducibility of the analysis (precision) or agreement of the result to the actual value of the analyte (accuracy). IEWK routinely performs analysis of blind samples. The following definitions describe the types of analyses performed to assess precision and accuracy:

A. Duplicate analyses involve performing two separate analyses of a particular parameter on the same sample. Precision is measured by the degree of agreement between the two sample results. Duplicate analyses are designed to measure the precision of a determination when the sample contains detectable amounts of the constituent

B. Laboratory control material or certified reference materials are samples that have known concentrations of the target analytes. These concentrations are either based on a series of analyses or are certified by an external laboratory such as NIST. Accuracy is determined by comparing the measured amount of analyte recovered during analysis to the known value.

C. Sample spikes are samples that a known amount of the analyte has been added. Accuracy is determined by the amount of the added material recovered during analysis.

D. Blank spikes or water spikes are used if poor recovery from a spiked sample occurs; analysis of blank spikes is useful to determine if the poor performance is a function of the sample matrix or the analytical process. These consist of the usual sample portion of deionized water spiked with the constituent at a concentration equivalent to that of the sample spike.

E. Replicate spike analyses are employed to determine the precision and accuracy of an analysis when some or all of the parameters being determined are below the detection limit. The replicate spike procedure involves analyzing the sample and two portions of the sample spiked with a measured portion of the same analyte. Relative precision of the spikes can be determined as well as the accuracy of the analysis. Spike concentrations are sufficient to eliminate the bias that would be created by the undetectable quantity of the parameter being determined.

One set of duplicate samples or spike duplicates, a LCM or CRM sample, and a method blank are analyzed with each batch of samples.

15. INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

15.1. Testing, Inspection, Maintenance of Sampling Equipment and Analytical Instruments

Table 12 lists the equipment used for this project and its frequency of necessary maintenance or calibration.

Table 12. Maintenance of Sampling Equipment

Equipment	Maintenance Activity	Responsible Person	Frequency	SOP Reference
Conductivity/pH Meter	Calibration	Autumn DeWoody	Before each Sample Event	Appendix B
Contract Laboratory Instruments	Maintenance/ Calibration	Lab Manager	As needed	
Waterkeeper Lab Instruments	Maintenance/ Calibration	Autumn DeWoody	As needed	Appendix B

15.2 Testing Criteria

The testing criteria for field and Coastkeeper lab equipment are outlined in the instrument SOPs in Appendix B.

15.3 Spare Parts

Spare parts, tools and necessary materials for the sampling collection will be held at the IEWK office or lab.

15.4 Equipment Inspection

Equipment inspection procedures are outlined in Appendix B.

15.5 Individuals Responsible for Testing, Inspection and Maintenance

Autumn DeWoody is responsible for testing, inspection and maintenance of equipments for field activities. The contract lab manager is responsible for such testing of equipments for any contract laboratory activities.

15.6 Deficiency Resolution

Deficiencies will be resolved through the replication of appropriate procedure until the desired outcome is reached. A report indicating the nature of the problem and the corresponding corrective action will be generated and documented for future references

16. INSTRUMENT AND EQUIPMENT CALIBRATION AND FREQUENCY

16.1 Equipment and Calibration

The Conductivity, DO, and pH meters used for the field sampling will be calibrated before each sampling event using the procedures outlined in Appendix B. For contract lab equipment, the following QC requirements are from the SWAMP guidelines produced by the State Water Resources Control Board (SWRCB). QA guidelines require that initial calibrations must be completed before any samples are analyzed (External calibration with 3 – 5 standards covering the range of sample concentrations prior to sample analysis. At the low end, the lowest standard at or near the MDL Linear regression is $r^2 < 0.995$, after each major disruption of equipment, and when on-going calibration fails to meet acceptance criteria. Calibration will occur every 10 samples after initial calibration. The Standard source will be different than that used for the initial calibration. Recovery will be 90% - 110%, except for mercury which will be 85% - 115%. Five percent of all samples will be duplicates. All samples are diluted and re-analyzed if target compounds are detected at levels that exceed their respective established calibration ranges. Any cleanups will be conducted prior to the dilutions. Re-analyses will be performed if internal standard or spike recoveries are outside of the data quality objective parameters. QC samples may be reanalyzed if results are not within control limits and it cannot be determined that the sample matrix is the cause. Calibration of the filed equipment used in this project will occur within 24 hours of use.

The colorimeter used at the IEWK lab cannot be validated by IEWK staff. Its accuracy is confirmed by an annual inspection and validation by the manufacturer. Calibration and verification will occur every 10 samples after initial calibration. The Standard source will be different than that used for the initial calibration. Recovery will be 90% - 110%, except for mercury which will be 85% - 115%. Five percent of all samples will be duplicates. All samples are diluted and re-analyzed if target compounds are detected at levels that exceed their respective established calibration ranges. Any cleanups will be conducted prior to the dilutions. Re-analyses will be performed if internal standard or spike recoveries are outside of the data quality objective parameters. QC samples may be reanalyzed if results are not within control limits and it cannot be determined that the sample matrix is the cause. Calibration of the filed equipment used in this project will occur within 24 hrs of use.

16.2 Calibration of Equipment, Tools and Instruments

This project does not require field calibration for the equipments used during the field sampling. The colorimeter used at the IEWK lab cannot be calibrated by IEWK staff. Its accuracy is confirmed by an annual inspection and calibration by the manufacturer. Calibration of the conductivity and pH meters is documented on calibration forms at the IEWK lab. Contract laboratory calibration is required as stated in the contract laboratory SOP as follows:

Calibration Procedures and Frequency

All instrumentation is calibrated to ensure the validity of the results. Calibration may be performed by a qualified individual in house or contracted to an outside service for third party verification. Where feasible, calibration tags are properly applied to instrumentation or equipment in a visible location. Calibration records/logs must be maintained in the calibration Validation Folder. These procedures are carried out following FDA, USEPA, AOAC and USP guidelines as applicable and the recommendations of the instrument manufacturer.

In-house calibration standards are prepared either from purchased stock standards or from stock standards prepared in-house. When available, calibration standards are prepared from starting materials that are certified traceable to the National Institute of Standards Technology (NIST).

The following is a brief summary of the instrumentation calibration procedures to be employed at the contract lab. Detailed descriptions of these procedures are contained with the appropriate method.

The gas chromatograph or gas chromatograph mass spectrometer is calibrated using either an external calibration procedure or internal standard. For each parameter of interest, at least three to five different concentrations of standards are employed. One of the concentrations is near the Method Detection Limit (MDL) for each parameter. Concentrations of the remaining standards correspond to the expected range of concentrations found in the samples analyzed. Calibration standards are prepared by utilizing secondary dilution standards and/or stock solutions. Calibration standards may include a set of internal standards at a known constant amount. The base peak m/z shall be used as the primary m/z for quantification of the standards. Sensitivity of the instrument is checked every 10 samples by analyzing the external reference samples. If the result is not within a predetermined range, the problem is corrected, and the samples immediately following the last acceptable check are reanalyzed.

The Inductively Coupled Mass Spectrometer (ICPMS) is calibrated before each use. For each parameter of interest, at least three to five different concentrations of standards are employed. One of the concentrations is near the Method Detection Limit (MDL) for each parameter. Concentrations of the remaining standards correspond to the expected range of concentrations found in the samples analyzed. Calibration standards are prepared by utilizing secondary dilution standards and/or stock solutions. Calibration standards may include a set of internal standards at a known constant amount. Sensitivity of the instrument is checked every 10 samples by analyzing the external reference samples. If the result is not within a predetermined range, the problem is corrected, and the samples immediately following the last acceptable check are reanalyzed.

The performance of the balances is monitored against a set of calibration weights that are traceable to NIST (a log is maintained of these inspections) and is calibrated annually by a third-party contractor for verification.

Temperature records are maintained for all refrigerators, incubators, water baths, and ovens. The temperatures are monitored daily for all incubators, refrigerators, water baths, and ovens. They are all calibrated by an outside service to verify calibration annually.

16.3 Deficiency resolution

Deficiencies will be resolved through the replication of appropriate procedure until the desired outcome is reached. Any deficiency will be reported on the non-conformance investigation with the appropriate correct action related to deficiency.

17. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

17.1-17.2 Accepted Testing Requirements for Consumables and Supplies

Table 13 lists the conditions that project supplies and consumables should be upon delivery to IEWK office or sampling sites.

Table 13. Inspection/Acceptance Testing Requirements for Consumables and Supplies

Project Supplies[1] and Consumables	Inspection Specifications	Acceptance Criteria	Frequency	Responsible Individual
Sample bottles	Sealed, Clean, proper type	Accept if they meet criteria	On delivery	Project Manager, Autumn DeWoody
Reagents	Sealed, Clean, proper type	Accept if they meet criteria	On delivery	
Laboratory Calibration Standards	Sealed, Clean, proper type	Accept if they meet criteria	On delivery	
Monitoring Equipment	Clean, proper type	Accept if they meet criteria	On delivery	
Sterile Bacteria Analysis supplies	Clean, proper type	Accept if they meet criteria	On delivery	

[1] Critical supplies will include pH and conductivity meters, thermometer, sample bottles and GPS. For a complete list of equipment and supplies see Appendix A.

18. NON-DIRECT MEASUREMENTS (EXISTING DATA)

18.1-18.3 Data Sources/Uses/Acceptance Criteria

Non-direct data will not be used in this project.

18.4-18.5 Support Facilities/Beta Testing

The support facility for the project will be the IEWK lab in Riverside, CA.

19. DATA MANAGEMENT

19.1-19.2 Data Management

The data management effort for this project will involve a comprehensive methodology that will bring all the data to one location, analyze it for completeness and compliance to data quality standards and make it readily available to the data users. After each field day the sampling field data sheets will be checked by IEWK project manager Autumn DeWoody for completeness. Any missing information will either be filled in if possible or flagged for remedial action. When the contract lab submits their data and QC reports, Mr. Luedy will review the reports carefully to see that the required matrix spikes, duplicates and all other required QC procedures were conducted as required. Any deviations from the QC guidelines will be documented and reported to the project manager, who will tag the data related to the problem as not meeting standards or will have the questionable processes redone if possible. After the data has all been checked for completeness and has met QC standards, it will be put into a project database that will be made available to all data users for the project. All original records will be kept at the IEWK office for five years.

19.3-19.4 Data Handling/Record-Keeping Practices

All records will be inspected by the project manager daily or upon receipt. After the data is judged to be correct it will be entered into the database immediately and hardcopies put on file in the IEWK office. A record of all documents received from the field and contract labs will be kept with the date received and where the document was generated. Digital copies of all documents will also be kept when available.

After entry into the project ACCESS database, the data will be processed and analyzed as necessary by the project data manager. Ms. DeWoody will be responsible for the database. A copy of the database along with corresponding metadata, detailing the components of the data base will be submitted to the TAC for their review. IEWK and the SARWQCB will be the primary users of the database and IEWK will do the analysis.

All project data will be archived at the IEWK office for five years. Hardcopies can be retrieved by IEWK personnel as necessary. All digital files will be kept in standard formats such as Microsoft Word, Microsoft Excel, or Microsoft ACCESS that are readily available to potential users.

19.5 SWAMP Database

The database for this project contains laboratory and field data. No continuous monitoring data is planned for this project. Appendix C includes necessary forms that should be used for this project.

19.6 Data Management Responsibilities

Data management will be handled by Justin Luedy and Ms. DeWoody with Mr. Luedy examining all documents for completeness and reporting any abnormalities to Ms. DeWoody. All data will be handled by Mr. Luedy, who will also be responsible for maintaining all records. The

SWAMP compatible database will be created by Orange County Coastkeeper and will be submitted to the Regional Board along with each quarterly report. Mr. Luedy will be responsible for the accuracy and completeness of this database by performing a minimum of two audits over the course of the project.

19.7 Hardware and Software Configurations

Before any data management activities begin, all computers that will be used for the project will be inspected and tested to insure proper operation and configuration for the project tasks. This will include inspection to assure all software is legally obtained and licensed and that all of the necessary software is properly installed and working on the machine. All database, GIS, spreadsheet, and word processing software will be tested for compatibility with the hardware on which they are installed and test runs of data entry and analysis will be done before project data is entered. After the project manager has accepted the above inspections and tests, data entry and analysis may proceed.

19.8 Checklists and Forms

See Appendix C.

GROUP C: ASSESSMENT AND OVERSIGHT

20. ASSESSMENTS AND RESPONSE ACTION

20.1-20.2 Assessment Activities/Responsible Individuals

There are two basic assessments of whether the project is meeting its goals. The first is whether the project is proceeding under the agreed timeline. This project is on a fast track, and falling behind on the timeline may result in the project not reaching its goals. The second and more important assessment is whether the project is collecting accurate and useable data to determine the water quality in the project streams. The project will be assessed continuously by Ms. DeWoody through its adherence to the timeline and the completeness and accuracy of the data collected. Ms. DeWoody has the authority to issue stop work orders. If the project falls behind schedule, the project manager will, immediately to discuss the delay and what, if anything, can be done to put the project back on schedule. A second assessment, done in June of 2008, will be completed at the conclusion of the data collection and analysis for the project and will determine if the data is sufficiently accurate and robust to complete the analysis. This assessment will be carried out by Ms. DeWoody of IEWK. After concurrence of the data meeting project objectives, the project will proceed to the analysis stage.

20.3-20.4 Assessment Information/Corrective Actions

All assessment information will be reported to the project manager through email communication. Any corrective action found to be necessary through the assessment process will be documented and distributed to all other project personnel and contractors.

21. REPORTS TO MANAGEMENT

21.1 Quality Assurance Report Chart

A QA report will be prepared that summarizes the compliance with this QAPP.

Table 14. Quality Assurance Management Reports

Type of Report	Frequency[1]	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Contract Report	Biannual	December 2007 July 2008	Autumn DeWoody	RLFF Contract Manager
QAPP	On approval and with each revision	July 2007	Autumn DeWoody	Technical Advisors
Contract Lab Reports	One	July 2007 December 2007 July 2008	Centrum Analytical Labs	Project Manager Data Manager
Project Final Report	Once	September 2008	Autumn DeWoody	RLFF

[1] Daily, weekly, monthly, quarterly, annually, etc.,

GROUP D. DATA VALIDATION AND VALIDATION REQUIREMENTS

22. DATA REVIEW, VERIFICATION AND VALIDATION REQUIREMENTS

22.1 Criteria for Project Data

All data for this project will be reviewed and verified for compliance to the data quality requirements outlined in this QAPP and in section D1 (Data Review, Validation, and Verification Requirements) of the State QAMP. Only data that meets the requirements of these plans will be accepted for use in the final report for the project. The verification and validation process will insure that the data used is sufficient to determine if the water flowing out of the Cleveland National Forest in selected canyons is of high quality, and not contributing to downstream exceedance.

23. VERIFICATION AND VALIDATION METHODS

23.1-2 Data Verification and Validation Process/Responsible Individual

All data will be checked for errors in transcription, calculation, computer input, completeness, and accuracy by Mr. Justin Luedy, OCCK QA Officer. As all forms and reports come in from the field and labs, Mr. Luedy will first check to see that the forms have been filled out completely and correctly, and are legible. Any problems that can be directly corrected at this stage will be. Any problems that cannot be corrected will be reported to the project manager and the related data flagged if necessary. Mr. Luedy will also review all of the labs quality control procedures to make sure all of the required quality control requirements meet calibrations, duplicates, matrix spikes, etc. Any outliers, deviations from the requirements, or other questions will be reported to the project manager and the data flagged. Mr. Luedy will prepare a Q/C error report that will be passed along with the data collected so that all data users will be aware of any data quality issues that come up. To assist in the data validation process, Mr. Luedy will create an Excel spreadsheet detailing all expected data and the associated DMOs, and, as the data comes in, Mr. Luedy will verify its receipt on the spreadsheet and document whether the DMOs from Tables 4 to 8 of this document have been met. If any data does not meet these requirements, the project manager will be notified immediately and the lab will be required to take corrective action.

24. RECONCILIATION WITH USER REQUIREMENTS

24.1 Evaluation Procedures

The data collected for this project will be determined to have met user requirements if it meets the needs of Ms. DeWoody of IEWK for preparing the Final Report, the primary product for this project. To prepare a proper report, IEWK requires a level of data that accurately documents the water quality of the project streams.

24.2 Reporting Limitations

Any issues with limitation on data use will be promptly addressed by the Quality Assurance manager. Upon the corrective action, a report documenting the changes will be generated. Additionally, any data limitations will be noted in the database and discussed in the final report.

24.3 Data Application to the SWAMP

The data will be compliant with the SWAMP requirements and will be of sufficient quality for entry into the SWAMP database.

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APPENDIX A

List of Lab Equipment and Field Instruments	Quantity Needed
Lab Equipment	
Colilert 18, Enterolert packets	-
Pipettes, 100 mL graduated cylinder (for dilutions)	1
Latex or nitrile gloves	1/person
Black light	1
incubator	1
IDEXX sealer	1
coolers	1
IDEXX trays	-
IDEXX sample bottles	-
25 ml sample vials (cuvettes)	-
colorimeter	1
Scissors	1
Reagents	-
Plastic sample cups	2
Waste container	1
Squeeze bottle, distilled water	2
Data sheet	1
Hydrochloric acid, gloves	1
Phosphate-free soap/scrubber	1
Field Equipment	
100 ml sealed poly bottles (for bacteria)	4
100 ml amber glass bottles (for nutrients, turbidity)	2
500 ml poly bottle (for Total Metals and TSS)	2
1 L amber glass bottle (for TPH and PAH)	2
Ice or frozen blue gel	Fill ½ ice chest
COC forms	1
first aid kit	1/team
clipboard	1/team
backpack	1/team
pH Meters	1
thermometer	1
Electrical conductivity meter	1
Dissolved oxygen meter (with paper towels)	1
Stadia rod	1
Stopwatch	1
Boots (or waders)	1 set /person
Measuring tape	1
Markers (sharpies & pens)	2
bobber	1
Field data sheets	-
latex gloves-	1/person
camera	1
GPS	1

APPENDIX B

Sampling Operation Plans (SOP's)

STANDARD OPERATING PROCEDURE FOR WATER SAMPLE COLLECTION

Scope and Application

This protocol describes the techniques used to collect water samples in the field in a way that neither contaminates, loses, or changes the chemical form of the analytes of interest. The samples are collected in the field into previously cleaned and tested (if necessary) sample bottles of a material appropriate to the analysis to be conducted. Pre-cleaned sampling equipment is used for each site, whenever possible and/or when necessary. Appropriate sampling technique and measuring equipment may vary depending on the location, sample type, sampling objective, and weather. Trade names used in connection with equipment or supplies do not constitute an endorsement of the product.

Summary of Method

Appropriate sample containers and field measurement gear as well as sampling gear are transported to the site where samples are collected according to each sample's protocol. Water velocity, temperature, pH, conductivity, dissolved oxygen as well as other field data are measured and recorded using the appropriate equipment, and recorded using the forms in Appendix C. Samples are put on ice and appropriately shipped to the processing laboratories. [1]

Water Sample Collection

Water chemistry and bacteriological samples, as requested, are collected at the same location. *Water samples are best collected before any other work is done at the site*. If other work (i.e., sediment sample collection, flow measurement or biological/habitat sample collection or assessment) is done prior to the collection of water samples, it might be difficult to collect representative samples for water chemistry and bacteriology from the disturbed stream. Care must be taken, though, to not disturb sediment collection sites when taking water samples.

The following general information applies to all types of water samples, unless noted otherwise:

Sample Collection Depth	**Sub-Surface Grab Sample:** Samples are collected at 0.1m below the water surface. Containers should be opened and re-capped under water in most cases. **Depth-integrated Sample:** If a depth-integrated sample is taken, the sample is pumped from discrete intervals within the

[1] This procedure has been modified from the "Texas Natural Resources Conservation Commission's Procedure Manual for Surface Water Quality Monitoring", with major input from the "USGS NAWQA protocol for collection of stream water samples", for which due credit is herewith given.

entire water column.

Surface Grab Sample: Samples are collected at the surface when water depth is <0.1m.

Where to Collect Samples

Water samples are collected from a location in the stream where the stream visually appears to be completely mixed. Ideally this would be at the centroid of the flow (*Centroid* is defined as the midpoint of that portion of the stream width, which contains 50% of the total flow), but depth and flow etc., do not always allow this. For stream samples, the sampling spot must be accessible for sampling physicochemical parameters, either by bridge, boat or wading. Sampling from the shoreline of any water body (meaning standing on shore and sampling from there) is the least acceptable method, but in some cases is necessary.

In reservoirs, lakes, rivers, and coastal bays, samples are collected from boats at designated locations provided by RWQCB's.

Sampling Order if Multiple Media are Requested to be Collected

The order of events at every site has to be carefully planned. For example, if sediment is to be taken, the substrate can not be disturbed by stepping over or on it; water samples can not be taken where disturbed sediment would lead to a higher content of suspended matter in the sample. *For the most part, water samples are best collected before any other work is done at the site*. This information pertains to walk-in sampling.

Sample Container Labels

Label each container with the station ID, sample code, matrix type, analysis type, project ID, and date and time of collection (in most cases, containers will be pre-labeled). After sampling, secure the label by taping around the bottle with clear packaging tape.

Procedural Notes

For most water samples (not for organics, inorganics or bacteria), prior to collecting sample, rinse the container with ambient water, unless protocol for specific analytical procedure dictates otherwise.

If applicable to the sample and analysis type, the sample container should be opened and re-capped under water.

Sample Short-term Storage and Preservation

Properly store and preserve samples as soon as possible. Usually this is done immediately after returning from the collection by placing the containers on bagged, crushed or cube ice in an ice chest. Sufficient ice will be needed to lower the sample temperature to at least 4°C within 45 minutes after time of collection. Sample temperature will be maintained at 4°C until delivered to the laboratory. Care is taken at all times during sample collection, handling and transport to prevent exposure of the sample to direct sunlight. Samples are preserved in the laboratory, if necessary, according to protocol for specific analysis (acidification in most cases).

Field Safety Issues

Proper gloves must be worn to prevent contamination of the sample and to protect the sampler from environmental hazards (disposable polyethylene, nitrile, or non-talc latex gloves are recommended, **however, metals and mercury sample containers can only be sampled and handled using polyethylene gloves as the outer layer**). Wear at least one layer of gloves, but two layers help protect against leaks. One layer of shoulder high gloves worn as first (inside) layer is recommended to have the best protection for the sampler. Safety precautions are needed when collecting samples, especially samples that are suspected to contain hazardous substances, bacteria, or viruses.

Sample Handling and Shipping

Due to increased shipping restrictions, samples being sent via a freight carrier require additional packing. Although care is taken in sealing the ice chest, leaks can and do occur. Samples and ice should be placed inside a large plastic bag inside the ice chest for shipping. The bag can be sealed by simply twisting the bag closed (while removing excess air) and taping the tail down. Prior to shipping the drain plug of the ice chests have to be taped shut. Leaking ice chests can cause samples to be returned or arrive at the lab beyond the holding time. Although glass containers are acceptable for sample collection, bubble wrap must be used when shipping glass.

Chain of Custody Forms (COC)

Every shipment must contain a complete Chain of Custody Form (see Appendix C) that lists all samples taken and the analyses to be performed on these samples. Make sure you include a COC for every laboratory you ship to, every time you send a shipment. Include region and trip information as well as any special instructions to the laboratory.

The original COC sheet (not the copies) is included with the shipment (insert into zip lock bag); one copy goes to the sampling coordinator; and the sampling crew keeps one copy. Samples collected should have the salinity (in ppt), depth of collection, and date/time collected on every COC. Write a comment on this form, if you want to warn the laboratory personnel about a possibly hazardous sample, or samples, which contain high chlorine or organic levels.

Field QC Samples for Water Analyses

Field duplicates are currently submitted at an annual rate of 5%. Field travel blanks are required for volatile organic compounds at a rate of one per cooler shipped. Field blanks are required for trace metals (including mercury and methyl mercury), DOC, and volatile organic compounds in water at a rate of 5%. See Appendix C for detailed Field QC requirements.

Field Site Data Sheets

Each visited field site requires a completed Field Data Sheet (Station Occupation Data Sheet, Appendix C), even if no samples are collected (i.e. at a site which is found to be dry). If water and/or sediment samples are taken, a Water Quality Data Sheet/Sediment Data Sheet (Appendix C) must be filled out as well.

General Pre-Sampling Procedures

Instruments: All instruments must be in proper working condition. Make sure all calibrations are current. YSI sondes should be calibrated every morning prior to sampling. Conductivity should also be calibrated between stations if there is a significant change in salinity.

Calibration Standards: Pack all needed calibration standards.

Sample Storage Preparations: A sufficient amount of cube ice, blue ice and dry ice as well as enough coolers of the appropriate type/size, must be brought into the field, or sources for purchasing these supplies identified in advance.

Sample Container Preparation: After arriving at the sample station, pack all needed sample containers for carriage to the actual collection site, and label them with a pre-printed label containing Station ID, Sample Code, Matrix info, Analysis Type info, Project ID and blank fields for date and time (if not already pre-labeled).

Safety Gear: Pack all necessary safety gear like waders, protective gloves and safety vests.

Walking To The Site: For longer hikes to reach a sample collection site, large hiking backpacks are recommended for transport of gear, instruments and containers. Tote bins can be used, if the sampling site can be accessed reasonably close to the vehicle.

GPS: At the sampling site, compare/record reconnaissance GPS reading with current site reading and note differences. GPS coordinates should be in Decimal Degrees i.e. 38.12345 -117.12345.

COLLECTION OF WATER SAMPLES FOR ANALYSIS OF CONVENTIONAL CONSTITUENTS

In most streams, near-surface water is representative of the water mass. A water sample for analysis of conventional constituents is collected by the grab method in most cases, immersing the container beneath the water surface to a depth of 0.1 m. Sites accessed by bridge can be sampled with a sample container-suspending device. Extreme care must be taken to avoid contaminating the sample with debris from the rope and bridge. Care must also be taken to rinse the device between stations. If the centroid of the stream cannot be sampled by wading, sampling devices can be attached to an extendable sampling pole.

In some cases, depth-integrated sampling is required, as requested by Regional Boards. This is useful when lakes or rivers are stratified and a sample is wanted that represents the entire water column. Depth-integrated sample collection is explained later in this document.

Conventional Water Constituents, Routinely Requested in SWAMP	Chloride, sulfate, nitrite, nitrate (or nitrate+nitrate), orthophosphate, fluoride, total phosphorus, ammonia, TKN, alkalinity, chlorophyll *a*.
Conventional Water Constituents, Occasionally Requested in SWAMP	Total Suspended Solids (TSS) or Suspended Sediment Concentration (SSC), Total Dissolved Solids (TDS--especially if total metals requested), Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC), hardness (if trace metals analysis is requested).
Conventional Water Constituents Sample Volume	Due to the potential for vastly different arrays of requested analyses for conventional constituents, please refer to table at the end of this document, as well as the Sample Handling Requirements Tables in Appendix C of this QAPP, for information on the proper volume to collect for the various types of analyses.

Conventional Water Constituents Sample Container Type

Due to the potential for vastly different arrays of requested analyses for conventional constituents, please refer to table at the end of this document, as well as the Sample Handling Requirements Tables in Appendix C of this QAPP, for information on the proper type of sample containers.

Field QC Samples

If required, field Duplicates and field blanks are submitted with every twentieth sample. Refer to Appendix C for details on required blanks and duplicates.

Whirl-Pak Bags

Label the bottle as previously described for SWAMP.

Tear off the top of the bag along the perforation above the wire tab just prior to sampling. Avoid touching the inside of the bag. If you accidentally touch the inside of the bag, use another one.

If wading into the stream, try to disturb as little bottom sediment as possible. Be careful not to collect water that has sediment from bottom disturbance. Stand facing upstream. Collect the water sample on your upstream side, in front of you. You may also tape your bottle to an extension pole to sample from deeper water.

Hold the two white pull-tabs in each hand and lower the bag into the water on your upstream side with the opening facing upstream. Open the bag midway between the surface and the bottom by pulling the white pull-tabs. The bag should begin to fill with water. You may need to "scoop" water into the bag by drawing it through the water upstream and away from you. Fill the bag no more than 3/4 full.

Lift the bag out of the water. Pour out excess water. Pull on the wire tabs to close the bag. Continue holding the wire tabs and flip the bag over at least 4-5 times quickly to seal the bag. Don't try to squeeze the air out of the top of the bag. Fold the ends of the wire tabs together at the top of the bag, being careful not to puncture the bag. Twist them together, forming a loop.

If the samples are to be analyzed in the lab, place them in a cooler with ice or cold packs for transport to the lab.

Summary of Sample Container, Volume, Initial Preservation, and Holding Time Recommendations for Water Samples

Parameters for Analysis in Water Samples	**Recommended Containers** (all containers pre-cleaned)	**Typical Sample Volume** (ml)	**Initial Field Preservation**	**Maximum Holding Time** (analysis must start by end of max)
Conventional Constituents in Water				
Nitrate + Nitrite ($NO_3 + NO_2$)	Polyethylene bottles[1]	150 ml	Cool to 4°C, dark	48 hours at 4°C, dark
Ammonia (NH_3)	Polyethylene bottles[1]	500 ml	Cool to 4°C, dark	48 hours at 4°C dark; if acidify, 28 days at 4°C, dark
[1] The volume of water necessary to collect in order to analyze for the above constituents is typically combined in four 1-liter polyethylene bottles, which also allows enough volume for possible re-analysis and for conducting lab spike duplicates. This is possible since the same laboratory is conducting all of the above analyses; otherwise, individual volumes apply.				
Total Suspended Solids (TSS)	500 ml amber glass jar	1000 ml (two jars)	Cool to 4°C, dark	7 days at 4°C, dark
Bacteria and Pathogens in Water Samples				
***E. Coli,* Enterococcus**	Factory-sealed, pre-sterilized, disposable Whirl-pak bags or 125 ml sterile plastic (high density polyethylene or polypropylene) container	100 ml volume sufficient for both E. coli and Enterococcus analyses	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine elimination). Cool to 4°C; dark.	STAT: 6 hours at 4°C, dark if data for regulatory purposes; otherwise, 24 hrs at 4C, dark if non-regulatory purpose.
Total Coliform	Factory-sealed, pre-sterilized, disposable Whirl-pak® bags or 125 ml sterile plastic (high density polyethylene or polypropylene) container	100 ml volume sufficient for both fecal and total coliform analyses	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine elimination). Cool to 4°C; dark.	STAT: 6 hours at 4°C, dark if data for regulatory purposes; otherwise, 24 hrs at 4C, dark if non-regulatory purpose.

FIELD OBSERVATIONS

Upon arrival at a sampling site, record visual observations on the appearance of the water and other information related to water quality and water use.

Other Observations

Water Appearance	Color, unusual amount of suspended matter, debris or foam, etc.
Weather	Note recent meteorological events that may have impacted water quality; heavy rains, cold front, very dry, very wet, etc.
Unusual Odors	Note if hydrogen sulfide odor, musty odor, sewage odor, etc. This should be recorded for sediment as well.
Specific Sample Information	Specific comments about the sample itself that may be useful in interpreting the results of the analysis; number of sediment grabs, or type and number of fish in a tissue sample. If the sample was collected for a complaint, or fish kill, make a note of this in the observation section.

Field Measurements

After collecting water samples (see Appendix C), record appropriate field measurements. When field measurements are made with a multiparameter instrument, it is preferable to place the sonde in the body of water to be sampled and allow it to equilibrate in the D.O. mode while water samples are collected. Field measurements are made at the centroid of flow, if the stream visually appears to be completely mixed from shore to shore. *Centroid* is defined as the midpoint of that portion of the stream width which contains 50% of the total flow. For routine field measurements, the date, time and depth are reported as a grab.

Recommended Depths for Conducting Field Data Measurements

Water Depth Less than 5 feet (<1.5m)	If the water depth is less than 5 feet (1.5m), grab samples for water are taken at approximately 0.1m (4 inches), and multi-probe measurements are taken at approximately 0.2m (8 in). This is because all sensors have to be submerged, so 0.1m would not be deep enough. But taking a grab sample at 0.2m is not always feasible, as it is difficult to submerge bottles to that depth, and in many cases the bottle will hit the stream bottom.

Water Temperature (^{O}C)

Water temperature data are recorded for each visit in final form in a Field Data Logbook.

Temperature Measuring Equipment

- Centigrade Thermometer
- Electronic Temperature Sensor

Temperature Sampling Procedures

- Temperature is measured in-stream at the depth(s) specified in Field Measurements above.
- Measuring temperature directly from the stream by immersing a multiprobe instrument or thermometer is preferred.

Hand Held Centigrade Thermometer

- If an electronic meter is not available, the temperature is measured with a hand-held, centigrade thermometer (Rawson, 1982).
- In wadeable streams, stand so that a shadow is cast upon the site for temperature measurement.
- Hold the thermometer by its top and immerse it in the water. Position the thermometer so that the scale can be read.
- Allow the thermometer to stabilize for at least one minute, then without removing the thermometer from the water, read the temperature to the nearest 0.1^{o} C and record.
- Do not read temperature with the thermometer out of the water. Temperature readings made with modern digital instruments are accurate to within $\pm 0.1^{o}$ C.

Temperature Measurement from a Bucket

- When temperature cannot be measured in-stream, it can be measured in a bucket- Nalgene or plastic. Care must be taken to insure a measurement representative of in-stream conditions.
- The bucket must be large enough to allow full immersion of the probe or thermometer.
- The bucket must be brought to the same temperature as the water before it is filled.
- The probe must be placed in the bucket immediately, before the temperature changes.
- The bucket must be shaded from direct sunlight and strong breezes prior to and during temperature measurement.
- The probe is allowed to equilibrate for at least one minute before temperature is recorded.
- After these measurements are made, this water is discarded and another sample is drawn for water samples which are sent to the laboratory.

pH (standard units)

pH data is recorded for each visit in a Field Data Logbook.

pH Sampling Equipment

- The pH meter should be calibrated according to the Recommended Procedures for Calibration and Maintenance of SWAMP Field Equipment, found in Appendix D of the QAMP (http://www.waterboards.ca.gov/swamp/qamp.html).

- The pH function is calibrated each day of use for multiparameter instruments.

pH Sampling Procedure, In-stream Method

- Preferably, pH is measured directly in-stream at the depth(s) specified earlier in this document. Allow the pH probe to equilibrate for at least one minute before pH is recorded to the nearest 0.1 pH unit.

pH Measurement from a Bucket

- When pH cannot be measured in-stream, it can be measured in a bucket-Nalgene or plastic, following precautions outlined under Temperature Measurement from a Bucket above.

Potential Problems

- If the pH meter value does not stabilize in several minutes, out gassing of carbon dioxide or hydrogen sulfide, or the settling of charged clay particle may be occurring (Rawson, 1982).
- If out gassing is suspected as the cause of meter drift, collect a fresh sample, immerse the pH probe and read pH at one minute.
- If suspended clay particles are the suspected cause of meter drift, allow the sample to settle for 10 minutes, then read the pH in the upper layer of sample without agitating the sample.
- With care, pH measurements can be accurately measured to the nearest 0.1 pH unit.

<u>Specific Conductance (μmhos/cm)</u>

Specific conductance should be recorded for each visit in the Field Data Logbook or field form.

Specific Conductance Sampling Equipment

- Conductivity meter
    - <u>Calibration Procedure</u> (from Oakton Conductivity Meter Manual)
      The conductivity meter should be calibrated once each sampling day within twenty-four hours of use. Calibrate the meter by submerging the tip in a standard solution similar to what you will encounter in the field and adjusting the reading using the up or down buttons under the meter battery cap until it reads the same as the standard solution.

Specific Conductance Sampling Procedure

- Preferably, specific conductance is measured directly in-stream at the depth(s) specified in Field Measurements. Allow the conductivity probe to equilibrate for at least one minute before specific conductance is recorded to three significant figures (if the value exceeds 100). The primary physical problem in using a specific conductance meter is entrapment of air in the conductivity probe chambers. The presence of air in the probe is indicated by unstable specific conductance values fluctuating up to $\pm$100 μmhos/cm. The entrainment of air can be minimized by

slowly, carefully placing the probe into the water; and when the probe is completely submerged, quickly move it through the water to release any air bubbles.
- If specific conductance cannot be measured in-stream, it should be measured in the container used for collection of water samples (a bucket) using the precautions outlined on prior pages, Temperature Measurement from a Bucket.

Turbidity

- Nephlometric turbidity can be determined by measuring the amount of scatter when light is passed through a sample using a turbidity meter. The LaMotte 2020 Turbidity meter is a suitable instrument for example.
- Meters should be calibrated using a standard close to the expected sample value.
- For instructions on how to operate the instruments refer to the manufacturer's manual. Turbidity measurements can be executed together with water sampling. The turbidity sample has to be representative for the sampled water mass. Make sure that no gas bubbles are trapped in the vial for the reading and that the outside of the vial is wiped completely clean, meaning free of moisture, lint and fingerprints. Take several measurements to assure an accurate reading. Do not record values that vary greatly. If variations are small, record an average. If settling particles are present, record a reading before and one after settling. The meter might have to be recalibrated with a different standard, if the sample water readings are outside of the calibration standard limits.

Significant Precipitation (days since last)

- Significant precipitation is defined as any amount that visibly influences water quality. Water quality in small to medium streams and in the headwaters of many reservoirs is influenced by runoff during and immediately after rainfall events. This influence is site specific and poorly studied. As part of a new initiative to understand and regulate the adverse effects of runoff, the SWAMP Program would like to associate recent rains or melted snow with ambient water quality, using a parameter defined as "days since last significant precipitation". Record the number of days, rounded to the nearest whole number, since a rain has occurred that, in the best professional judgment of monitoring personnel, may have influenced water quality. If it's raining when the sample is collected, or has rained within the last 24-hours, report a value of <1. If it has been a long time since a significant rain, record this as greater than that particular value, for example >7 days. If confidence about the recent history of precipitation is low, draw a line through the space on the data form.

Flow Severity

- Flow severity should be recorded for each visit to non-tidally influenced flowing streams. It should be recorded even if flow is not measured on that sampling visit. There are no numerical flow guidelines associated with flow severity. This is an observational measurement that is highly dependent on the knowledge of monitoring personnel. It is a simple but useful piece of information when assessing water quality data. For example, a bacteria value of 10,000 with a flow severity of 1 would represent something entirely different than same value with a flow severity of 5.

- Flow information for over 200 USGS sites is available at **http://water.usgs.gov/index.html**. This is useful information in determining flow conditions prior to sampling. This information may be included in general observations.

- The six flow severity values are; 1=No Flow, 2= Low Flow, 3 = Normal Flow, 4 = Flood, 5 = High Flow, and 6 = Dry. The following are detailed descriptions of severity values:

1 **No Flow:** When a flow severity of one (1 = no flow) is recorded for a sampling visit, then a flow value of zero ft^3/s should also be recorded for that sampling visit. A flow severity of one (1) (no flow) describes situations where the stream has water visible in isolated pools. There should be no obvious shallow subsurface flow in sand or gravel beds between isolated pools. Low flow does not only apply to streams with pools. It also applies to long reaches of bayous and streams that have no detectable flow but may have water from bank to bank.

2 **Low Flow:** When stream flow is considered low a flow severity value of two (2) is recorded for the visit and the corresponding flow measurement is also recorded for that visit. In streams to shallow for a flow measurement but water movement is detected, record a value of < 0.10 cfs. Note: Use a stick or other light object to verified the direction of water movement, i.e., movement is downstream and not the affect of wind. What is low for one stream could be high for another.

3 **Normal Flow:** When stream flow is considered normal, a flow severity value of three (3) is recorded for the visit and the corresponding flow measurement is also be recorded for that visit. Normal is highly dependent on the stream. Like low flow, what is normal for one could be high or low for another stream.

4 and 5 **Flood and High Flow:** Flow severity values for high and flood flows have long been established by USEPA and are not sequential. Flood flow is reported as a flow severity of four (4) and high flows are reported as a flow severity of five (5). High flows would be characterized by flows that leave the normal stream channel but stay within the stream banks. Flood flows are those which leave the confines of the normal stream channel and move out on to the flood plain.

6 **Dry:** When the stream is dry a flow severity value of six (6 = dry) is recorded for the sampling visit. In this case the flow is not reported. This will indicate that the stream is completely dry with no visible pools.

The method (or instrument) used to measure flow is noted by reporting a method number. The method numbers are:

1	Flow gage station (USGS/IBWC)
2	Mechanical (e.g., Pigmy meter)
3	Electric (e.g., Marsh-McBirney)
4	Weir/flume
5	Other (e.g., orange peel)

Flow (ft^3/s)

If requested, flow data should be recorded for each monitoring visit to non-tidal, flowing streams. Flow data should be recorded in the Field Data Logbook. The following are two exceptions to the flow reporting requirement:

Flow/ Pools If there is no flow at a stream site and accessible, isolated pools remain in the stream bed, collect and report the required field data and laboratory samples from the pools and report instantaneous flow. Under these conditions, flow (ft^3/s) should be reported as zero. The reported flow severity value should be one. Pools may represent natural low-flow conditions in some streams and the chemistry of these pools will reveal natural background conditions.

Dry If the stream bed holds no water, the sampling visit is finished. Report that the stream was "dry" in the observations and record a value of six (meaning "dry") for flow severity. No value is reported for flow since there is no water.

- If a flow measurement is required at a site, measure and record flow after recording visual observations. The intent of measuring flow first, is to delay collection of chemical and biological water samples with limited holding times. Care must be taken not to collect water samples in the area disturbed during flow measurement. There are several acceptable flow measurement methods that can be used.

Flow Measurement Equipment

Flow meter

One of the following or an equivalent:

- Marsh-McBirney Electronic meter
- Montedoro-Whitney Electronic meter
- Price Pigmy meter (with timer and beeper)
- Price meter, Type AA (with Columbus weight)

Additional Equipment

- Top-setting wading rod (preferably measured in tenths of feet)
- Tape measure (with gradations every tenth of a foot).

Flow Measurement Procedure (USGS, 1969)

Select a stream reach with the following characteristics:

- Straight reach with laminar flow (threads of velocity parallel to each other) and bank to bank. These conditions are typically found immediately upstream of riffle areas or places where the stream channel is constricted.
- The site should have an even streambed free of large rocks, weeds, and protruding obstructions that create turbulence. The site should not have dead water areas near the banks, and a minimum amount of turbulence or back eddies.

Flat Streambed Profile (cross section)

Stretch the measuring tape across the stream at right angles to the direction of flow. When using an electronic flow meter, the tape does not have to be exactly perpendicular to the bank (direction of flow). When using a propeller or pigmy type meter, however, corrections for deviation from perpendicular must be made.

If necessary and possible, modify the measuring cross section to provide acceptable conditions by building dikes to cut off dead water and shallow flows, remove rocks, weeds, and debris in the reach of stream one or two meters upstream from the measurement cross section. After modifying a streambed, allow the flow to stabilize before starting the flow measurement.

Record the following information on the flow measurement form (see example Flow Measurement Forms at end of this document):

- Station Location and Station ID
- Date
- Time measurement is initiated and ended
- Name of person(s) measuring flow
- Note if measurements are in feet or meters
- Total Stream Width and Width of Each Measurement Section
- For each cross section, record the mid-point, section depth and flow velocity

Measuring the Stream Width

- Measure and record the stream width between the points where the tape is stretched (waters edge to waters edge).

Determining the Number of Flow Cross Sections

Determine the spacing and location of flow measurement sections. Some judgement is required depending on the shape of the stream bed. Measurements must be representative of the velocity within the cross-section. If the stream banks are straight and the depth is nearly constant and the bottom is free of large obstructions, fewer measurements are needed, because the flow is homogeneous over a large section. Flow measurement sections do not have to be equal width. However, flow measurement sections should be of equal width, unless an obstacle or other obstruction prevents an accurate velocity measurement at that point. ***No flow measurement section should have greater than 10% of the total flow.***

If the *stream width is less than 5 feet*, use flow sections with a width of 0.5 feet. See Example 1 on page 2-34. If the *stream width is greater than 5 feet*, the minimum number of flow measurements is 10. The preferred number of flow measurement cross sections is 20-30. See Example 2 at the end of this document: The total stream width is 26 feet with 20 measurements, section widths will be 1.3 feet (26/20 = 1.3).

Determining the Mid-Point of the Cross Section

To find the mid-point of a cross section, divide the cross section width in half. Using Example 2 (see forms at end of document);

- The total stream width is 26 feet with 20 cross sections and each cross section width is equal to 1.3 feet.
- Divide 1.3 feet in half and the mid-point of the first section is 0.65 feet. In this example the tape at waters edge is set at zero (0) feet.
- By adding 0.65 to zero the mid-point of the first section is 0.65 feet.
- Each subsequent mid-point is found by adding the section width (1.3 feet) to the previous mid-point. For example; MIDPOINT #1 is 0.65 + 0.0 = 0.65; MIDPOINT #2 is 0.65 + 1.3= 1.95 feet; MIDPOINT #3 is 1.95 + 1.3 = 3.25 feet and ....MIDPOINT # 20 is 24.05 +1.3.
- Place the top setting wading rod at 0.65 feet for the first measurement.
- Using a top setting wading rod, measure the depth at the mid-point of the first flow measurement section and record to the nearest 0.01 feet.
- In cases where the flow is low and falling over an obstruction, it may be possible to measure the flow by timing how long it takes to fill a bucket of known volume.

Calculating Flow

To calculate flow, multiply the width x depth (ft^2) to derive the area of the flow measurement section. The area of the section is then multiplied by the velocity (ft/s) to calculate the flow in cubic feet per second (cfs or ft^3/sec) for that flow measurement section. When flow is calculated for all of the measurement sections, they are added together for the total stream flow.

Q = Total Flow (or discharge), W=Width, D=Depth, V=Velocity.

$Q = (W_1 * D_1 * V_1) + (W_2 * D_2 * V_2) + ... (W_n * D_n * V_n)$

What to Do with Negative Values

Do not treat cross sections with negative flow values as zero. Negative values obtained from areas with back eddies should be subtracted during the summation of the flow for a site.

Flow Estimate (ft^3/s)

Flow estimate data may be recorded for a non-tidally influenced stream when it is not possible to measure flows by one of the methods described above. Flow estimates are subjective measures based on field personnel's experience and ability to estimate distances, depths, and velocities. If flow can not be measured at a routine non-tidal station, a new site should be selected where flow can be measured.

Procedure

- Observe the stream and choose a reach of the stream where it is possible to estimate the stream cross section and velocity.
- Estimate stream width (feet) at that reach and record.
- Estimate average stream depth (feet) at that reach and record. Estimate stream velocity (ft/s) at that reach and record. A good way to do this is to time the travel of a piece of floating debris. If doing this method from a bridge, measure the width of the bridge. Have one person drop a floating object (something that can be distinguished from other floating material) at the upstream side of the bridge and say start. The person on the downstream side of the bridge will stop the clock when the floating object reaches the downstream side of the bridge. Divide the bridge width by the number of seconds to calculate the velocity. The velocity can be measured at multiple locations along the bridge. These velocities are averaged. If this is done alone, watch for road traffic.
- Multiply stream width (feet) times average stream depth (feet) to determine the cross sectional area (in ft^2) which when multiplied by the stream velocity (in ft/s) and a correction constant, gives an estimated flow (ft^3/s).

Example: A stream sampler conducted a sampling visit to a stream while the flow meter was being repaired. The sampler looked at the creek downstream from the bridge and saw a good place to estimate flow. The stream width was around 15 feet. It appeared the average depth on this reach was about 0.75 feet. The sampler timed a piece of floating debris as it moved a distance of ten feet in 25 seconds downstream over the reach. An estimated flow with a smooth bottom was calculated using the following formula.

Width x Depth x Velocity x A (correction factor)= estimated flow
15 ft (width) x 0.75 ft (depth) x 2.5 ft/s (velocity) x A =25 ft^3/s (cfs)

A is a correction constant: 0.8 for rough bottom and 0.9 for smooth bottom

Estimated flow should be reported to one or two significant figures.

Experienced field personnel are able to estimate flow to within 20% of actual flow for total flows less than 50 ft^3/s. The best way to develop this skill is to practice estimating flow before making measurements at all monitoring visits to non-tidally influenced flowing streams and then compare estimated flows with those obtained from USGS gages or from instantaneous flow measurements.

APPENDIX C

FIELD DATA FORMS:

- **Chain of Custody**
- **SWAMP Sampling Site Information Form**
- **Testing Result Form**
- **Flow Rate Form**

SWAMP Station Occupation Results

PG: OF PGS | Entered Dbase

*Station ID:

*Date: M M / D D / Y Y Y Y

*Project ID:

*Sample Time: (time of first sample)

Arrival Time:

Departure Time:

*Sample Season:

Event Type

Sample Type
FieldObs

SampleDepthCollection
-88

DistanceFromBank
-88

***Crew:**

***Habitat**
dry
non-wadeable stream
wadeable stream
wadeable concrete channel
standing water
other________________

Photos (RB & LB are assigned when facing downstream)
RB/LB/BB/ US/DS/##
RB/LB/BB/ US/DS/##
RB/LB/BB/ US/DS/##

***Precipitation**
dry
drizzle
rain
thunderstorm

Sea State (if applicable):
Calm
Rough
Choppy

***Sky**
clear
partly cloudy
overcast
fog

Wind Direction (from) / no wind = xx :
N
W E
S

Wind Speed (kts) :

***Water Color**
clear
green
yellow
brown
other

***Water Clarity**
clear
semi-clear
turbid

***Water Odor**
hydrogen sulfide
sewage
petroleum
mixed
none

***Sediment Color**
black
brown
gray
yellow
mixed
other

*** Sediment Composition**
course sand
fine sand
silt / clay
cobble
gravel
mixed
other

***Sediment Odor**
none
hydrogen sulfide
sewage
petroleum
mixed
other

Station Occupation Comments

Access key required Yes / No
Contact info:

Gaging Station #:

*Elevation (ft or m) :

* required field; underlined fields used as primary keys in dbase

SWAMP SOFDS 1/02/2003

Sample Collection:				
Sample ID:	**Time Collected:**	**Collected by:**	**Type:**	**Container type :**
			Bacteria	
			Nutrient	
			________	
			________	
			________	
			________	
			________	
			________	

Sample Custody:	
Relinquished By:	**Received By:**
Date /Time:	**Date /Time:**

	Temp. (°C)	Dissolved Oxygen (mg/L)	Conductivity (uS Low) (mS high)	pH	Nitrate-Nitrogen Test#50	Phosphate Test#79	Turbidity	Ammonia -Nitrogen Test#64
Equip#								
Reagent#								
Result 1								
Result 2								
Result 3								
Blank								
Split								
Duplicate								
Backup Reading								
Meet Objective? Y or N								

Comments:____

____

Data Entered by: ________________________

Data Entry Date: ________________________

UPSTREAM

Wetted Width of Stream _______________(feet, inches)

Cross Sectional Area (measure points at every foot across width of stream, start at opposing side).

Point #	Depth	Point #	Depth	Point #	Depth	Point #	Depth
1		11		21		31	
2		12		22		32	
3		13		23		33	
4		14		24		34	
5		15		25		35	
6		16		26		36	
7		17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

DOWNSTREAM

Wetted Width of Stream _______________(feet, inches)

Cross Sectional Area (measure points at every foot across width of stream, start at opposing side).

Point #	Depth	Point #	Depth	Point #	Depth	Point #	Depth
1		11		21		31	
2		12		22		32	
3		13		23		33	
4		14		24		34	
5		15		25		35	
6		16		26		36	
7		17		27		37	
8		18		28		38	
9		19		29		39	
10		20		30		40	

VELOCITY FLOAT TRIALS:
Length of reach (distance along stream)__________should be 20ft

Trial #	1	2	3	4	5
Time					

Quality Assurance

Field Supervisor Signature: ___________________________________ Date: ______________

Data Entry Completed by: ___________________________________ Date: _______________

Notes and Observations : (include any equipment comments/problems or observations such as water color, trash composition, etc...)