GROUP A ELEMENTS: PROJECT MANAGEMENT

1. TITLE AND APPROVAL SHEETS

Quality Assurance Project Plan

For

PROJECT NAME: Upper Santa Ana River Watershed Water Quality Assessment

Proposal Identification Number: R8-USARA-08

Version 1

Date: June 25, 2008

NAME OF RESPONSIBLE ORGANIZATION : Inland Empire Waterkeeper, a chapter of Orange County Coastkeeper

APPROVAL SIGNATURES

GRANT ORGANIZATION: Inland Empire Waterkeeper

Title:	Name:	Signature:	Date*:
Project Director	Lee Reeder		
Project Manager	Autumn DeWoody		
QA Officer	Zehava Purim-Adimor		
Contract Lab Manager (E.S. Babcock & Sons)	Lorenzo Rodriguez		

REGIONAL BOARD: Santa Ana Region (Region 8)

Title:	Name:	Signature:	Date*:
Contract Manager	William Rice		
QA Officer	Pavlova Vitale		

* This is a contractual document. The signature dates indicate the earliest date when the project can start.

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3. DISTRIBUTION LIST

Title:	Name (Affiliation):	Tel. No.:	QAPP No*:
Project Director	Lee Reeder (I.E. Waterkeeper)	(951) 689-6842	1
Project Manager	Autumn DeWoody (I.E. Waterkeeper)	(951) 689-6842	2
Field Technician	Eric Emerson (I.E. Waterkeeper)	(951) 689-6842	3
QA/QC Officer	Zehava Purim-Adimor (O.C. Coastkeeper)	(714) 850-1965	4
Regional Board Contract Manager	William Rice (Region 8)	(951) 782-4459	5
Regional Board QA Officer	Pavlova Vitale (Region 8)	(951) 782-4130	6
Contract Lab Project Manager	Lorenzo Rodriguez (Babcock Labs)	(951) 653-3351 ext. 252	7

4. PROJECT/TASK ORGANIZATION

4.1 Involved parties and roles.

Inland Empire Waterkeeper (IEWK) is a non-profit environmental organization with a mission based on protecting water quality through programs of advocacy, education, restoration/research and enforcement. Our foci for this project are the waterways of the Santa Ana River watershed, which includes San Timoteo Creek, Warm Creek and City Creek. IEWK is a chapter of Orange County Coastkeeper, but an independently licensed affiliate of the international Waterkeeper Alliance.

Autumn DeWoody is IEWK's Project Manager and will oversee all aspects of the project including field tests, sample collection and bacteria testing. IEWK staff will also courier samples to the contract laboratory, E.S. Babcock & Sons ("Babcock"). Results of all tests done at Babcock Labs will be sent to the Regional Board first, and then to IEWK second for incorporation into reports and analysis. Reports prepared by IEWK and presented to Regional Board staff will be used for determining the quality of said creeks.

The contract laboratory will be Babcock Laboratories, centrally located in Riverside. It is a certified lab who will analyze samples for non-bacteria tests once a month for 9 specified months of the project. Babcock Labs will analyze submitted samples in accordance with all method and quality assurance requirements found in this QAPP, and act as a technical resource to IEWK staff.

Table 1. (Element 4) Personnel responsibilities.

Name	Organizational Affiliation	Title	Contact Information (Telephone number, fax number, email address.)
Lee Reeder	Inland Empire Waterkeeper	Project Director	951-689-6842 (office) 951-689-6273 (fax) Lee@iewaterkeeper.org
Autumn DeWoody	Inland Empire Waterkeeper	Project Manager	951-689-6842 (office) 951-515-1526 (cell) Autumn@iewaterkeeper.org
Eric Emerson	Inland Empire Waterkeeper	Field Technician	951-689-6842 (office) 909-534-2838 (cell) Eric@iewk.org
Zehava Purim-Adimor	Orange County Coastkeeper	QA/QC Officer	714-850-1965 (office) 714-850-1592 (fax) Zehava@coastkeeper.org
William Rice	Santa Ana Regional Board	Contract Manager	951-782-4459 (office) 951-781-6288 (fax) wrice@waterboards.ca.gov
Pavlova Vitale	Santa Ana Regional Board	QA/QC Officer	951-782-4130 (office) 951-781-6288 (fax) pvitale@waterboards.ca.gov
Lorenzo Rodriguez	E.S. Babcock & Sons Environmental Lab	Contract lab project manager	951-653-3351 ext. 252 lrodriguez@babcocklabs.com

4.2 Quality Assurance Officer role

Ms. Zehava Purim-Adimor is IEWK's Quality Assurance Officer for this project. Zehava is located at our parent organization's office in Costa Mesa (Orange County Coastkeeper) where she is their Field Supervisor and Quality Assurance officer for various sampling projects. Zehava will not participate with IEWK staff in gathering the data. She will provide support to Project Manager, Autumn DeWoody to ensure QA standards are being met on at least a monthly basis. She will review drafts of quarterly reports and the final reports for IEWK. She will also communicate all quality assurance and quality control issues contained in this QAPP to Babcock Labs.

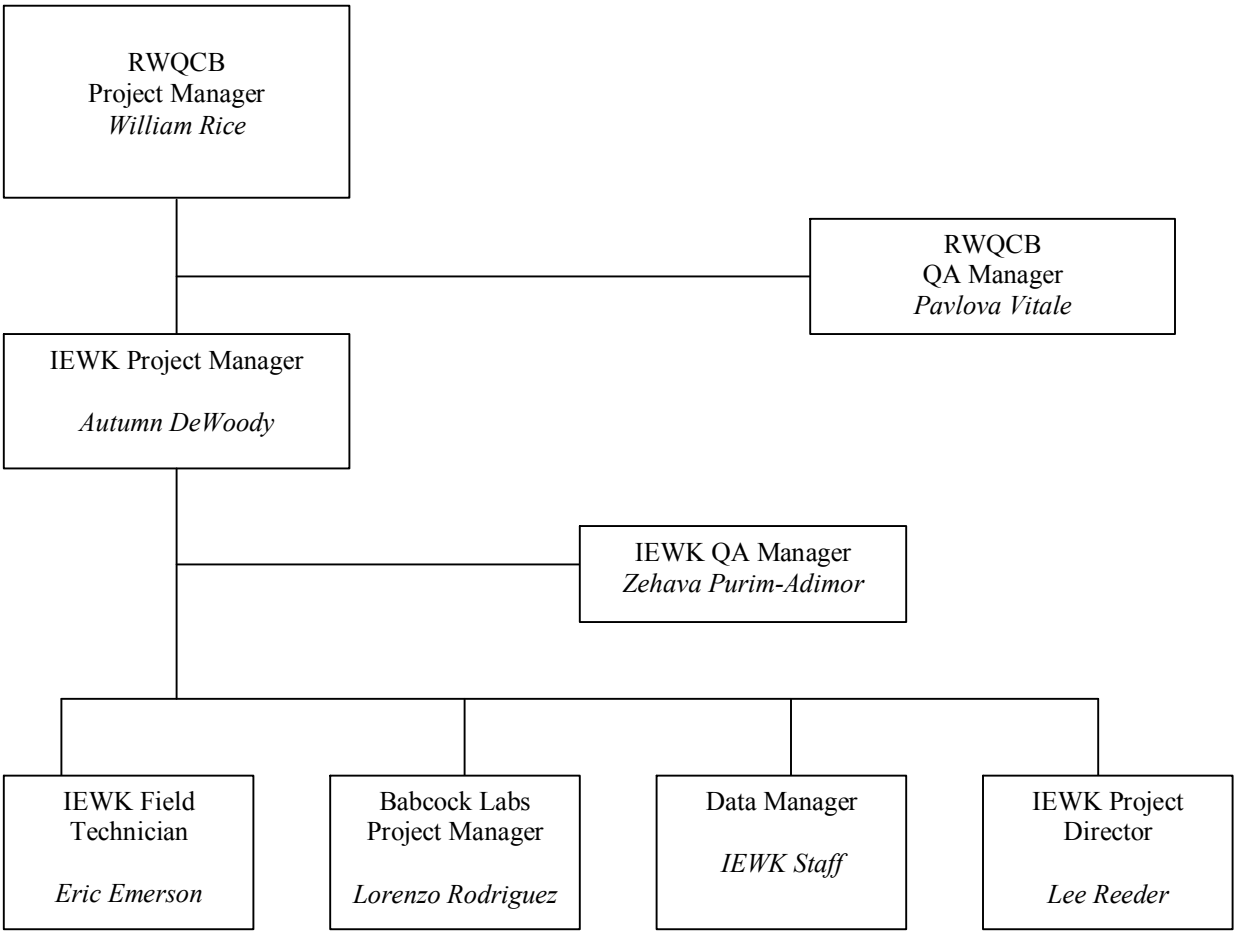
4.3 Persons responsible for QAPP update and maintenance.

Changes and updates to this QAPP may be made after a review of the evidence for change by IEWK's Project Manager, Autumn DeWoody and Quality Assurance Officer, Zehava Purim-Adimor and with the concurrence of both the Regional Board's Contract Manager, William Rice and Quality Assurance Officer, Pavlova Vitale. IEWK's Quality Assurance Officer, Zehava Purim-Adimor will be responsible for making the changes, submitting drafts for review, preparing a final copy, and submitting the final for signature.

4.4 Organizational chart and responsibilities

E.S. Babcock & Sons (Babcock Labs) will be contracted by the Regional Board to perform analytical studies for 9 monthly samples. Mr. Lorenzo Rodriguez will be the project manager and point of contact at Babcock Labs.

Figure 1. Organizational chart.



5. PROBLEM DEFINITION/BACKGROUND

5.1 Problem statement.

Reach 4 of the Santa Ana River is currently listed for pathogens from nonpoint sources. The hypothesis of this project is that some of the impairment may be derived from San Timoteo Creek, Warm Creek and/or City Creek that discharge into Reach 5 of the River. Currently, very little water quality information is available to approximate the relative contribution of pollutants into Reach 5 of the Santa Ana River from San Timoteo Creek, Warm Creek and City Creek. The purpose of this project is to gather usable, current data on these creeks to determine whether or not (1) further focused study on any one creek is needed, (2) any one creek is not contributing to existing or potential impairments of Reach 4, or (3) a TMDL is needed. Data on pathogens, particularly *E. Coli* is desired in addition to basic field parameters (i.e., flow rate, pH, conductivity, dissolved oxygen, temperature), and broad scan metals, pesticides and minerals.

5.2 Decisions or outcomes.

The outcome of this project will be 14 months of weekly physical measures of creek health: pH, flow rate, electrical conductivity, temperature and dissolved oxygen. In addition, 14 months of weekly bacteria tests for E. Coli bacteria. For 9 of those months, the project will produce monthly results of chemical oxygen demand (COD) tests, broad scan nutrient tests, metal tests, pesticide and PCB tests and partial mineral analyses. The data will be combined and used for trend analysis. All results will be put into a SWAMP-comparable database for use by Regional Board staff and the SWAMP Information Management System.

Bacterial monitoring for E. Coli is of particular interest and will be used to determine if the creeks are a source of pathogens for Reach 4 and Reach 5 of the Santa Ana River. All results from all tests, significant or not, will be transmitted to the Regional Board for consideration for 303(d) listing and TMDL development.

5.3 Water quality or regulatory criteria

This water quality monitoring program is designed to accurately determine pollutant concentrations and/or loads at 2 to 4 locations on 3 unique streams in Reach 5 of the Santa Ana River. Table 2 lists the potential contaminants, their water quality thresholds (also known as “action limits”), and threshold sources that will be used to determine whether the creeks 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.

Table 3. (Element 5) Water Quality Criteria or Action Limits

Parameter	Objective	Source
Standard Field Tests		
Dissolved oxygen (DO)	San Timoteo & Warm Creeks: 5 mg/L City Creek: 6 mg/L	Page 4-15, Basin Plan[1]
Electrical conductivity (aka Specific Conductance)	San Timoteo & Warm Creeks: 462 µS/cm City Creek: 308 µS/cm	Adapted from Basin Plan TDS objective [TDS (mg/L) ≈ 0.65 EC (µS/cm)][2]
Flow rate	n/a	n/a
pH	6.5 to 8.5	Page 4-15, Basin Plan
Temperature	< 90°F June-October, and < 78°F otherwise.	Page 4-17, Basin Plan
Nutrients		
Ammonia-Nitrogen	0.098 mg/L	Page 4-9, Basin Plan
Organic Nitrogen	San Timoteo & Warm Creeks: 5 mg/L City Creek: 1 mg/L	Pages 4-35 & -38, Basin Plan
Ortho Phosphate-P	-	-
Total Inorganic Nitrogen (Nitrate-N and Nitrite-N)	San Timoteo & Warm Creeks: 5 mg/L City Creek: 1 mg/L	Pages 4-35 & -38, Basin Plan
Total Kjeldahl Nitrogen (TKN)	-	-
Total Phosphate-P	-	-
Partial Mineral Analysis		
Calcium	-	-
Chloride	San Timoteo & Warm Creeks: 20 mg/L City Creek: 10 mg/L	Page 4-38, Basin Plan Page 4-35, Basin Plan
Magnesium	-	-
Potassium	-	-
Sodium	30 mg/L	Pages 4-35, 4-38, Basin Plan
Specific Conductance	See electrical conductivity	-
Sulfate	San Timoteo & Warm Creeks: 60 mg/L City Creek: 20 mg/L	Page 4-38, Basin Plan Page 4-35, Basin Plan
Total Dissolved Solids (TDS)	San Timoteo Creek & Warm Creek: 300 mg/L City Creek: 200 mg/L	Page 4-38, Basin Plan Page 4-35, Basin Plan
Total Hardness	San Timoteo & Warm Creeks: 190 mg/L City Creek: 115 mg/L	Page 4-38, Basin Plan Page 4-35, Basin Plan
Low-Detection Limit Priority Pollutant Metals Analysis		
Antimony (Sb)	City Creek: 14 µg/L San Timoteo & Warm Creeks: 4300 µg/L *(expressed as total recoverable)*	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters[3].
Arsenic (As)	Freshwater CMC: 340 µg/L Freshwater CCC: 150 µg/L *(expressed as dissolved)*	CTR Freshwater Aquatic Life Protection[3]
Beryllium (Be)	4 µg/L	CDPH Primary MCL[3]
Cadmium (Cd)	City Creek: 5 µg/L San Timoteo & Warm Creeks: SSO = $0.85[e^{(0.7852*\ln(TH)-3.490)}]$ (*expressed as dissolved)*	CDPH Primary MCL Page 4-13, Basin Plan

Copper (Cu)	City Creek: 1300 µg/L (*expressed as total recoverable)* San Timoteo & Warm Creeks: SSO = $0.85[e^{(0.8545*\ln(TH)-1.465)}]$	CTR Inland Surface Waters, Human Health (30-day average), Drinking Water Sources Page 4-13, Basin Plan
Lead (Pb)	City Creek: 15 µg/L San Timoteo & Warm Creeks: SSO= $0.25[e^{(1.237*\ln(TH)-3.958)}]$	CDPH Primary MCL Page 4-13, Basin Plan
Inorganic Mercury (Hg)	2 µg/L	CDPH Primary MCL
Nickel (Ni)	City Creek: 610 µg/L San Timoteo & Warm Creeks: 4600 µg/L *(expressed as total recoverable)*	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
Selenium (Se)	Freshwater CMC: 20 µg/L Freshwater CCC: 5 µg/L *(expressed as total recoverable)*	CTR Freshwater Aquatic Life Protection
Silver (Ag)	100 µg/L	CDPH Secondary MCL[3]
Thallium (Ti)	City Creek: 1.7 µg/L San Timoteo & Warm Creeks: 6.3 µg/L (*expressed as total recoverable)*	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
Zinc (Zn)	5000 µg/L	CDPH Secondary MCL
Organochlorine Pesticides & PCBs (EPA Method 608)		
Aldrin	City Creek: 0.00013 µg/L San Timoteo & Warm Creeks: 0.00014 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
α-BHC (Hexachlorocyclohexane)	City Creek: 0.0039 µg/L San Timoteo & Warm Creeks: 0.013 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
β-BHC	City Creek: 0.014 µg/L San Timoteo & Warm Creeks: 0.046 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
γ-BHC (aka Lindane)	City Creek: 0.019 µg/L San Timoteo & Warm Creeks: 0.063 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
δ-BHC	500 µg/L *(exposure of 7 days or less)*	National Academy of Sciences - Drinking Water Health Advisory or Suggest No-Adverse-Response Levels for toxicity other than cancer risk[3]
Chlordane	City Creek: 0.00057 µg/L San Timoteo & Warm Creeks: 0.00059 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
4,4'-DDD (Dichlorodiphenyldichloroethane)	City Creek: 0.00083 µg/L San Timoteo & Warm Creeks: 0.00084 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
4,4'-DDE (Dichlorodiphenyldichloroethylene)	City Creek: 0.00059 µg/L San Timoteo & Warm Creeks: 0.00059 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
4,4'-DDT (Dichlorodiphenyltrichloroethane)	City Creek: 0.00059 µg/L San Timoteo & Warm Creeks: 0.00059 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
Dieldrin	City Creek: 0.00014 µg/L San Timoteo & Warm Creeks: 0.00014 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.

Endosulfan I (α)	City Creek: 110 µg/L San Timoteo & Warm Creeks: 240 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
Endosulfan II (β)	City Creek: 110 µg/L San Timoteo & Warm Creeks: 240 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
Endosulfan sulfate	City Creek: 110 µg/L San Timoteo & Warm Creeks: 240 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
Endrin	City Creek: 0.76 µg/L San Timoteo & Warm Creeks: 0.81 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
Endrin aldehyde	City Creek: 0.76 µg/L San Timoteo & Warm Creeks: 0.81 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
Heptachlor	City Creek: 0.00021 µg/L San Timoteo & Warm Creeks: 0.00021 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
Heptachlor epoxide	City Creek: 0.0001 µg/L San Timoteo & Warm Creeks: 0.00011 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
Toxaphene	City Creek: 0.00073 µg/L San Timoteo & Warm Creeks: 0.00075 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
PCBs (Polychlorinated biphenyls 1016, 1221, 1232, 1242, 1248, 1254, 1260)	City Creek: 0.00017 µg/L San Timoteo & Warm Creeks: 0.00017 µg/L	CTR Inland Surface Waters, Human Health Criteria (30-day average). Drinking Water Source. Other Waters.
Other		
Chemical Oxygen Demand (COD)	City Creek: 5 mg/L San Timoteo & Warm Creeks: 25 mg/L	Page 4-38, Basin Plan Page 4-35, Basin Plan
E. Coli	126 mpn[4]/100 mL *(geomean of 5 or more samples per 30 day period and not more than 10% of the samples exceed 235 organisms/100mL for any 30 day period)*	Resolution No. R8-2005-0001
Total Coliform	10,000 mpn/100 mL	AB 411[5]

[1] Updated 02/2008.
[2] Harter, Thomas. (2003) *Groundwater Quality and Groundwater Pollution.* University of California Division of Agriculture and Natural Resources Publication 8084. Farm Water Quality Planning Reference Sheet 11.2.
[3] From Marshack, J. (updated August 2007). *A Compilation of Water Quality Goals.* California Regional Water Quality Control Board, Central Valley Region, Cal-EPA.
[4] mpn = most probable number
[5] Refers to California Assembly Bill 411 (1999)

6. PROJECT AND TASK DESCRIPTION

6.1 Work statement and produced products.

Inland Empire Waterkeeper staff will collect field data from a total of 10 sampling sites located along San Timoteo Creek, Warm Creek and City Creek in Reach 5 of the Santa Ana River (Figure 2), starting in summer 2008 and completing in winter 2010. Table 4 details the community, cross streets, site names and site ID's for each sample site. Sampling locations were picked in coordination with Regional Board staff, and exact GPS coordinates confirmed by Waterkeeper staff. There are 4 sampling locations along San Timoteo Creek, which correlate to reach boundaries. There are 2 sampling locations for City Creek; one that represents "natural" conditions coming out of the mountains and the second representing "urban" conditions within the city. Likewise, there are 4 sampling locations for Warm Creek representing both "natural" and "urban" conditions.

Table 4. (Element 6) Sample Site Identifiers

Town	Identifier	Site Name	ID
Cherry Valley	Noble Creek/ Little San Gorgonio Creek confluence	San Tim 1	ST 1
Redlands	Redlands Blvd./San Timoteo Canyon Rd./Live Oak Canyon Rd.	San Tim 2	ST 2
Redlands	San Timoteo Canyon Rd./ Fern St.	San Tim 3	ST 3
San Bernardino	Waterman/Hospitality	San Tim 4	ST 4
Above Highland	Hwy 330 white flag / access "road" and boulders	City Ck 1	CC 1
Highland	Baseline Ave. and Boulder St.	City Ck 2	CC 2
Arrowhead Springs	Waterman basin/Twin Creek basin/40th Street	Warm Ck 1	WC 1
Highland	Tippecanoe/Waterman/Upper Warm Creek & Del Rosa Channel	Warm Ck 2	WC 2
San Bernardino	Shack on east side of Twin Creek, just north of Highland	Warm Ck 3	WC 3
San Bernardino	Fairway Dr. /Mt. Vernon Rd.	Warm Ck 4	WC 4

This project will produce extensive weekly data on E. Coli concentrations, flow rate, pH, dissolved oxygen, temperature and conductivity over a 14 month period from each site. It will also generate monthly data from 9 months of testing for nutrients, minerals, pesticides, PCBs, metals, and chemical oxygen demand from each site. This data will be analyzed to deduce typical concentrations of pollutants and the relative contributions of pollutants to the Santa Ana River.

6.2. Constituents to be monitored and measurement techniques.

The critical data from this project will be the E. Coli bacteria tests, which will be conducted at Waterkeeper's lab located at 1020 Cabot Road, Riverside, 92501. Total Coliform can be measured at the same time using the IDEXX Colilert® method with Quanti-Tray®/2000 so both will be recorded, but E. Coli is the focus for this project. The SOP is included in Appendix D. All tests are listed below, separated by their unique method numbers.

Monitoring will consist of field measurements for flow rate, pH, conductivity, temperature, and dissolved oxygen. GPS coordinates, air temperature and photo documentation of upstream/downstream site conditions will be obtained during every sampling event. Samples will be collected for the tests listed below, many of which require separate jars for individual analytes. Samples of everything except bacteria will be delivered by IEWK staff to Babcock Labs for analysis. A copy of the methods used by Babcock labs is attached.

- E. Coli bacteria
- Metals and Metalloids in Liquid (EPA method 200.8)
- Organochlorine Pesticides and PCBs in Liquid (EPA method 608)
- Ammonia (Standard method 4500-NH3(H))
- Nitrate, Chloride, Sulfate (EPA method 300)

- Nitrite (Standard method 4500 NO2(B))
- Kjeldahl nitrogen (EPA method 351.2)
- Orthophosphate (Standard method 4500-P(E))
- Total phosphate (standard method 4500-B(E))
- Chemical Oxygen Demand (Standard method 5220D)
- Calcium, Magnesium, Sodium, Potassium (EPA method 200.7)
- Total dissolved solids (Standard method 2540C)
- Total hardness (Standard method 3120B)
- Specific Conductance (Standard method 2510B)
- FIELD DATA
  Flow rate, Dissolved oxygen, pH, electrical conductivity, temperature

6.3 Project schedule

Bacteria sampling will occur at each site (total of 10) on 3-4 different days of the week, for each week of the following months: July – October, 2008; December 2008 – February 2009; May 2009 – November 2009. We have defined a week from Sunday to Saturday. Field parameters will be measured during every sampling event resulting in one complete set of results each week for all 10 sites. Due to the short hold-time for bacteria samples (max. 6 hours), only one creek will be visited per day, resulting in a total of 3-4 full days of sampling, in-house lab analysis and follow-up results reading.

Non-bacteria sampling will occur at each site on different days of the week at random times of day once per month for the following months: September 2008, December 2008, January 2009, February 2009, May 2009, June 2009, July 2009, September 2009 and November 2009.

No sampling will take place in the months of November 2008, March 2009, April 2009 and December 2009.

Quarterly reports that summarize the previous 4 months of sampling will be due the last week of the following month to the Regional Board. First quarter report will be due November 30, 2008, second quarter report will be due March 31, 2009, and third quarter report will be due September 30, 2009. No sampling will occur past November 2009 in order for data analysis and report writing to take place. The draft final report will be due March 31, 2010 and the final report due April 30, 2010. All invoices and outstanding matters will be settled by May 31, 2010.

INSERT FIGURE 2 (ALL SAMPLING LOCATIONS)

Table 4. (Element 6) Sampling Schedule

Bacteria Sampling Months	Non-Bacteria Sampling Month and Week	Report Dates
July 2008	-	
August 2008	-	
September 2008	September 2008, Week 2	
October 2008	-	
*November 2008**	-	Quarterly Report 1 (11/30/08)
December 2008	December 2008, Week 3	
January 2009	January 2009, Week 4	
February 2009	February 2009, Week 1	
*March 2009**	-	Quarterly Report 2 (3/31/09)
*April 2009**	-	
May 2009	May 2009, Week 2	
June 2009	June 2009, Week 3	
July 2009	July 2009, Week 4	
August 2009	-	
September 2009	September 2009, Week 1	Quarterly Report 3 (9/30/09)
October 2009	-	
November 2009	November 2009, Week 2	
Total months: 14 Total no. weeks: 61 Average no. weeks/month: 4.3	Total Months: 9	Final Report due no later than 1/31/2010

**No sampling will take place during these months.*

We expect 61 data points of bacteria and field parameters, and 9 data points of non-bacteria data for each site. Our goal from the PAEP is 90% success rate, which translates to 55 data points and 8 data points per site at a minimum. Table 4 details when the sampling should and should not take place, while Table 5 lists when tasks that are based on the project contract should be accomplished.

Table 5. (Element 6) Project Schedule

Activity	Anticipated Date of Initiation	Anticipated Date of Completion	Deliverable	Deliverable Due Date
Project Assessment Evaluation Plan	Day 1	Day 30	PAEP to Regional Board	06-25-08
GPS information for monitoring locations	Day 1	Day 90	QAPP	06-25-08
Monitoring Plan with Quality Assurance Project Plan	Day 1	Day 90	Monitoring Plan	06-25-08
Quarterly Reports	Day 1	9-30-09	Quarterly Reports	11-30-08 3-31-09 9-30-09
Copy of final CEQA documentation	Day 1	TBD	Notice of Exemption	TBD
Riverside and San Bernardino County Flood Control permits	Day 1	Day 100	Permits and keys	07-01-08
Characterize water quality	Day 100	1-1-2010	SWAMP-comparable database of results	05-31-10
Draft Project Report Final Project Report	12-1-09 12-1-09	3-31-10 04-30-10	Draft project report Final project report	3-31-10 04-30-10

6.4 Geographical setting

Figure 2 illustrates the locations of all 10 sites based upon on-the-ground GPS coordinates. Table 6 below provides the Thomas Guide page (Riverside or San Bernardino County), GPS coordinates and a short description of the area upstream of the sample for which the data shall represent based on site reconnaissance.

Table 6. (Element 6) Geographical Setting

Site ID	Thomas Guide Page, Grid	GPS Coordinates	Creek section that samples will represent
ST 1	RivC p. 690, J-4	33°58.037 N, 116°58.432 W	Mountain headwaters to Little San Gorgonio and Noble Creeks' confluence-natural condition.
ST 2	RivC p. 688, E-1	33°59.754 N, 117°09.567 W	Land uses include urban under-construction, horse farms, ranching, open space.
ST 3	SBD p. 647, J-4	34°01.976 N, 117°12.491 W	Increasing urban influence, some ranches/farms, more road traffic.
ST 4	SBD p. 606, J-6	34°03.987 N, 117°16.702 W	Heavy urban, bottom of creek watershed, expected to be most polluted.
CC 1	SBD p. 578, A-1	34°10.088 N, 117°10.884 W	From mountain headwaters through canyon, below Highway 330 above Highland. "Natural" condition.
CC 2	SBD p. 578, A-5	34°07.027 N, 117°11.582 W	From natural condition through Highland, half-way to river with some urban influence.
WC 1	SBD p. 547, A-6	34°09.895 N, 117°16.038 W	Mountain headwaters through Waterman canyon basin – natural condition. Before Twin Creek Basin where most infiltrates.
WC 2	SBD p. 577, B-6	34°07.076 N, 117°15.648 W	Heavy urban, concrete box channel. Below confluence of natural channel (Upper Warm Ck) and concrete-lined (Del Rosa Channel).
WC 3	SBD p. 577, A-3	34°08.1811 N, 117°16.1078 W	Heavy urban, concrete-lined box. Mostly urban runoff during dry-weather.
WC 4	SBD p. 606, F-6	34°04.084 N, 117°18.449 W	Heavy urban, large concrete channel. Bottom of creek watershed right before meeting river. Mostly urban runoff during dry weather.

6.5 Constraints

The successful execution of this project is dependent upon many factors, for example the field equipment could fail, sporadic dangers could prohibit sampling for a day (e.g., irate vagrants), lack of adequate flow, and the weather could cause unsafe field conditions.

Sampling will be postponed and rescheduled on rainy days (wet-weather events large enough to generate runoff) for the protection of staff.

For some sites, it is likely that flows will not be present during the summer months. Sampling will not be rescheduled for sites where flow is absent. Forms will be completed by stating, "No Flow."

Several access points are controlled by the County Flood Control District that may, at any time, prohibit entrance for safety reasons or maintenance activities. Sampling would then be postponed and rescheduled to ensure a complete data set.

7. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

7.1 Data Quality Objectives

Data quality objectives for this project will consist of the following:

Measurement or Analyses Type	Applicable Data Quality Objective
Field Testing (flow rate, dissolved oxygen, electrical conductivity, pH, temperature)	Accuracy, Precision, Completeness
E. Coli bacteria	Precision, Presence/Absence, Completeness
Combined nutrients	Accuracy, Precision, Recovery, Completeness
Combined metals	Accuracy, Precision, Recovery, Completeness
Combined minerals (inc. TDS, hardness)	Accuracy, Precision, Recovery, Completeness
Chemical Oxygen Demand (COD)	Accuracy, Precision, Recovery, Completeness
Pesticides and PCBs	Accuracy, Precision, Recovery, Completeness

Acceptance criteria are the standards for either accepting or rejecting previously collected data, supplies or consumables. This project will not be considering previously-collected data so an acceptance criteria has not been developed. However, see Element 17 for our acceptance criteria of supplies and consumables.

Accuracy (aka bias) 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. Accuracy criteria for bacteria testing will be based on presence/absence testing rather than numerical limits owing to the difficulty in preparing solutions of known bacterial concentration. The lab will perform a bias test or "lab control sample (LCS)" for every 20 samples or 1 per analysis batch, whichever is greater.

- Spikes: Samples are spiked with a known concentration by the lab to test the lab's accuracy.

Action limits will be the same as the Water Quality Criteria listed in Table 3 (Element 5).

Blanks are used to determine where along the process contamination is introduced into the sample. See Element 14.

Completeness is the number of analyses generating useable data for each analysis divided by the number of samples collected for that analysis. The ratio of useable results and total number of samples. Our goal for this project is 90% completeness; for example, if 100 samples are collected we want 90 samples to be viable.

(Matrix Spike) Recovery is the recovery of an analyte used to measure the inaccuracy of the test method. Recovery is measured by assaying a sample after adding a known amount of the analyte and the same sample without added analyte.

Minimum Detection Limit (MDL) is the minimum concentration detected by the testing instrument with a known level of confidence.

Precision measurements will be determined for both field and laboratory duplicates. The degree of precision is measured with the RPD or "relative percent difference" between the splits or duplicates.

- Splits: Two aliquots of the same sample are sent to two different labs for the same test to measure the primary lab's precision (done by sampler). No lab or field splits will be performed for this project.

- Duplicates: A sample is divided and sent to the same lab for the same test to measure the lab's precision (done by lab). The lab will perform a duplicate analysis every 20 samples or one per analysis batch, whichever is greater. The site from which the duplicate is taken will rotate between all sites.

Reporting Limit (RL) is the lowest concentration at which an analyte is reported.

Representativeness is how close the samples collected match the actual composition of the studied creeks. The project design assures representativeness by including multiple sampling locations on each creek, which represent different surrounding land uses and environments. With our sample design, we will be able to determine if target indicators exceed water quality standards (where standards exist) in different reaches as compared to the whole creek. Representativeness of the samples collected will be assessed by the completeness of the sample collection effort.

Tables 7 through 11 list the parameter, method, range (of the method), units, minimum detection limit, precision (as relative percent difference), duplicate frequency, accuracy (as percent recovery), matrix spike recovery (as percent recovery), reporting limit and completeness (as percent of total samples). This information was put together from a combination of the SWAMP QAMP, equipment user manuals, and Babcock Labs.

Field and Laboratory Measurements Data Quality Objectives Tables

Table 7. (Element 7) Data quality objectives for field measurements and bacteria test.

Parameter	Method (range)	Units	MDL	Precision (RPD)	Duplicates	Accuracy (bias)	Recovery	Target Reporting Limit	Completeness
Dissolved Oxygen	Extech® heavy duty DO meter (0.0-19.9 mg/L)	mg/L	0.01	±0.5	Reading at 3 unique locations across width of creek per site for average result.	±0.4 mg/L	NA	0.2	90%
Temperature	Taylor® commercial compact waterproof digital thermometer (-40°C to 230°C)	°C	0	± 0.1°C		± 1°C	NA	-	90%
Electrical Conductivity	Eutech/Oakton® ECTestr11+ meter (0-2000 µS/cm)	µS/cm	0	± 5%		± 1% of full scale	NA	2.5	90%
pH	Eutech/Oakton® pHTestr 30 meter (-1.00-15.00 pH)	pH units	-1.00	± 0.5		0.01 pH	NA	-	90%
Flow Rate	Velocity-Area method with Orange Peel	ft^3/sec (cfs)	-	-	-	-	NA	-	90%
Bacteria (E. Coli)	IDEXX Colilert®/Quanti-Tray®2000. 24 hour (1-2419 coliforms)	organism	1 per 100 mL	±20%	IEWK Lab duplicates every 10 samples (1 per week-rotating between all sites)	Positive results for target organisms	NA	2	90%

Table 8. (Element 7) Data quality objectives for combined nutrients.

Parameter	Method (range)	Units	MDL	Precision as RPD	Duplicates	Accuracy % Recovery (RPD)	Matrix Spike % Recovery	Reporting Limit	Completeness
Ammonia-N	SM 4500-NH_3 (H) (0.1 to 2.0 mg/L)	mg/L	0.0591	20%	1 duplicate for one site per batch, rotating between sites.	90-110%	80-120%	0.1	90%
Nitrate-N	EPA 300.0 (1-100 mg/L)		0.11	20%		90-110%	80-114%	0.20	90%
Nitrite-N	SM 4500-NO_2 (B) (0.01 to 1.0 mg/L)		0.017	20%		90-110% (RPD = 20)	80-120%	0.10	90%
Total Kjeldahl Nitrogen (TKN)	EPA 351.2 (0.1 to 5.0 mg/L)		0.062	20%		80-120%	37-153%	0.10	90%
Organic Nitrogen	Calculation		0.021	-		-	-	0.10	90%
Total Nitrogen	Calculation		-	-		-	-	0.10	90%
Ortho Phosphate-P	SM 4500-P (E) (0.05 to 1.0 mg/L)		0.0028	20%		90-110%	80-120%	0.050	90%
Total Phosphate-P	SM 4500-B (E) (0.05 to 1.0 mg/L)		0.014	20%		80-120%	80-120%	0.050	90%

Table 9. (Element 7) Data quality objectives for minerals.

Parameter	Method (Range)	Units	MDL	Precision as RPD	Duplicates	Accuracy % Recovery (RPD)	Matrix Spike Recovery	Reporting Limit	Completeness
Chemical Oxygen Demand	SM 5220D (10 to 500 mg/L)	mg/L	6.3	20%	1 duplicate for one site per batch, rotating between sites.	95-105%	80-120%	10	90%
Calcium (Ca)	EPA 200.7 (10-500 µg/L)		0.50			85-115% (RPD=20)	70-130%	1.0	90%
Chloride (Cl^-) (iodometric)	EPA 300.0 (1-250 mg/L)		0.17			90-110%	89-115%	1.0	90%
Magnesium (Mg)	EPA 200.7 (10-500 µg/L)		0.50			85-115% (RPD=20)	70-130%	1.0	90%
Sodium (Na)	EPA 200.7 (10-500 µg/L)		0.50			85-115% (RPD=20)	70-130%	1.0	90%
Sulfate (SO_4)	EPA 300.0 (0.5-400 mg/L)		0.17			90-110%	89-120%	0.50	90%
Total Dissolved Solids (TDS)	SM 2540C (10 to 2000 mg/L)		5.5			90-110%	-	10	90%
Potassium (K)	EPA 200.7 (10-500 µg/L)		0.50			85-115% (RPD=20)	70-130%	1.0	90%
Total Hardness (as $CaCO_3$)	SM 3120B (3-1800 mg/L)		0.35			-	-	3.0	90%
Specific Conductance	SM 2510B (1.0-200,000 µmhos/cm)	µmhos/ cm	1.0			90-110% (RPD=20)	-	1.0	90%

Table 10. (Element 7) Data quality objectives for metals.

Parameter	Method (range)	Units	MDL	Precision as RPD	Duplicates	Accuracy % Recovery (RPD)	Matrix Spike Recovery	Reporting Limit (µg/L)	Completeness
Antimony	EPA 200.8 (Reporting limit – 2000 µg/L)	µg/L	3.0	20%	1 duplicate for one site per batch, rotating between sites.	85-115% (RPD=20)	70-130%	3.0	90%
Arsenic			1.6					5.0	
Beryllium			0.17					10	
Cadmium			0.077					2.0	
Copper			1.9					10	
Lead			0.084					10	
Mercury			0.039					0.50	
Nickel			1.5					20	
Selenium			2.5					5.0	
Silver			5.0					10	
Thallium			0.98					200	
Zinc			1.4					10	

Table 11. (Element 7) Data quality objectives for pesticides and PCBs.

Parameter	Method (range)	Units	MDL	Precision as RPD	Duplicates	Accuracy % Recovery (RPD)	Matrix Spike % Recovery	Reporting Limit (µg/L)	Completeness
Aldrin	EPA 608 (single peak pesticides: 0.01-5 Toxaphene: 1.0–40.0 Chlordane: 0.1-40.0 PCBs: 1.0-4.0 µg/L)	µg/L	0.0094	40%	Dup. every 40 samples (Feb, Nov)	42-122% (RPD=31)	42-122%	0.040	90%
α-BHC			0.015			37-134% (RPD=20)	37-134%	0.030	
β-BHC			0.050			17-147% (RPD=20)	17-147%	0.060	
δ-BHC			0.038			19-140% (RPD=20)	19-140%	0.090	
Chlordane			0.045			- (RPD=40)	-	0.10	
4,4'-DDD			0.016			31-141% (RPD=20)	31-141%	0.11	
4,4'-DDE			0.010			30-145% (RPD=20)	30-145%	0.040	
4,4'-DDT			0.016			25-160% (RPD=32)	25-160%	0.12	
Dieldrin			0.011			36-146% (RPD=20)	36-146%	0.020	
Endosulfan I (α)			0.011			45-153% (RPD=20)	45-153%	0.14	

Table 11. Continued

Parameter	Method (range)	Units	MDL	Precision as RPD	Duplicates	Accuracy % Recovery (RPD)	Matrix Spike % Recovery	Reporting Limit (µg/L)	Completeness
Endosulfan II (β)	EPA 608 (single peak pesticides: 0.01-5 Toxaphene: 1.0–40.0 Chlordane: 0.1-40.0 PCBs: 1.0-4.0 µg/L)	µg/L	0.017	40%	Dup. every 40 samples (Feb, Nov)	10-202% (RPD=24)	10-202%	0.040	90%
Endosulfan sulfate			0.46			- (RPD=20)	-	0.66	
Endrin			0.010			30-147% (RPD=20)	30-147%	0.060	
Endrin aldehyde			0.073			40-184% (RPD=23)	10-210%	0.23	
Heptachlor			0.010			34-111% (RPD=20)	34-111%	0.010	
Heptachlor epoxide			0.010			37-142% (RPD=20)	37-142%	0.010	
Toxaphene			0.83			- (RPD=40)	-	1.0	
PCBs (1016, 1221, 1232, 1242, 1248, 1254, 1260)			0.17, 1.0, 0.81, 0.70, 0.73, 0.92, 0.063			- (PCB 1016 RPD=33, PCB 1260 RPD=37, otherwise RPD=40)	-	1.0 (2.0 for PCB 1254)	

8. SPECIAL TRAINING NEEDS AND CERTIFICATION

8.1 Specialized training or certifications.

No formal, specialized training or certification is required for this project; however that does not suggest that Field Technicians will not receive trainings. Every Field Technician will be instructed by the Project Manager on (1) personal health and safety while in the field and lab; (2) hazard analysis and critical control point (HACCP) safety to minimize the spread of non-native, invasive species from site to site; (3) field and lab paperwork protocols (e.g., chain of custody, GPS); (4) sample collection methods, and (5) sample transport and hold-time protocols.

Project Manager, Autumn DeWoody attended a QAPP course on 9/14/08 hosted by the SWRCB Clean Water Team and taught by staff from Moss Landing Marine Labs. Also, she attended SWAMP Field Sampling Safety Training course on 4/16/08 hosted by the Regional Board. She holds a B.S. and M.S. in environmental sciences and has been active in the environmental field for almost 10 years. Autumn will be present in the field until it is clear the Field Technicians are capable on their own. She has been performing the IDEXX Enterolert® and Colilert® Quanti-Tray®/2000 methods herself, monthly for more than a year. In addition she has led field sampling for the last year and has received training on field sampling from Orange County Coastkeeper staff.

Quality Assurance Officer, Zehava Purim-Adimor has held the role of QA Officer for three Orange County Coastkeeper projects: (1) Prop. 13 Coastal Watershed Monitoring Project from 2003 to 2006; (2) Orange County Nurseries Water Quality Improvement Project; and (3) Lower Newport Bay Metals/Storm Drain Study. She participated in the following: a Citizen Water Monitoring workshop in 2001 led by the SWRCB Clean Water Team, a Water Ecology class led by Dr. Dave Bontenager, received training from Charles McGee at OC Sanitation District lab to run duplicate bacteria tests, attended a QAPP training and Field Methods course taught by SWAMP staff in 2007, and a HACCP Water Sampling and Safety course in March 2008 led by US Fish and Wildlife staff. She received a certificate in Hazardous Material management (OSHA 2015) from UC San Diego Extension and holds a B.S in Chemical Engineering from the University of Ben Gurion, Israel. Zehava will be responsible for overseeing training for IEWK personnel that will be working in the field and lab on this project.

Field Technicians will attend Health & Safety courses offered by the Regional Board and receive one-on-one training from IEWK and OCCK staff. Field Technician, Eric Emerson has received training for lab experiments (GC, HPLC, spectrometer, centrifuge) and field work (groundwater sampling, air sampling, thermal oxidizers, carbon vessels). He is certified in CPR and First Aid, and certified to work with hazardous materials (OSHA 40 hour Hazwoper and Lab Hazardous Materials Course at UCR).

Babcock Labs is certified through the National Environmental Laboratory Accreditation Program (NELAP #02101CA) and California Department of Public Health (CDPH ELAP #1156). A list of tests they are accredited for is available upon request.

8.2 Training and certification documentation.

Documentation of trainings, classes or certifications obtained during the course of this project will be kept on file at Inland Empire Waterkeeper in a spreadsheet format listing the date, duration, instructor, attendees and topics covered. Babcock Lab maintains their own internal record of trainings and certifications at their office in Riverside that are available upon request.

8.3 Training personnel.

Project Manager, Autumn DeWoody will conduct the training sessions for the IDEXX method with the expertise of Ms. Angie Bera of Hydrophix, Inc. Angie is formerly with Santa Monica Baykeeper where she led a wet-weather bacteria sampling project of the entire South Bay coastline. Autumn and Zehava will train Field Technicians on how to conduct standard field tests.

Quality Assurance Officer, Zehava Purim-Adimor will provide instruction to Field Technicians on proper QA procedures while in the field and IEWK lab. This will be done by meeting with the staff prior to project start and regularly throughout the project, or any time that a question or inconsistency arises.

9. DOCUMENTS AND RECORDS

IEWK will collect records for sample collection, field analyses, analytical lab testing and bacterial testing. Field records will be kept in a water-proof notebook and transferred to an electronic database at the office. All original field notes will be kept on-file at IEWK. Samples sent to Babcock Labs will include a Chain of Custody form and copies will be kept at IEWK. Babcock Labs will generate records for sample receipt and storage, analysis, and reporting. IEWK will develop and maintain a SWAMP-compatible database of field measurements for this project. The data will be managed jointly by Project Director, Lee Reeder and Project Manager, Autumn DeWoody.

All records generated by this project will be stored at IEWK's office. Babcock labs' records pertinent to this project will be maintained at their main office. Copies of all records held by Babcock will be provided to IEWK and stored in the project file.

Copies of this QAPP will be distributed to all parties involved with the project, including field technicians (hard copy), project manager at Babcock Labs (electronic), Regional Board staff (electronic or hard copy), IEWK's QA officer (electronic) and IEWK office staff (hard copy). Any future amended QAPPs will be held and distributed in the same fashion. All originals of the first and subsequent amended QAPPs will be held at IEWK.

Persons responsible for maintaining records for this project are as follows. Autumn DeWoody, Project Manager will maintain all sample collection, sample transport, chain of custody, and field analyses forms as they're generated and received from the IEWK Field Technician. The assigned project manager at Babcock Labs will maintain all records associated with the receipt and analysis of samples analyzed for said parameters. IEWK Project Director, Lee Reeder will oversee the actions of these persons and will arbitrate any issues relative to records retention and any decisions to discard records. All records will be passed to the Regional Board Contract Manager Bill Rice at project completion. Copies of the records will be maintained at IEWK and Babcock Labs for five years after project completion then discarded, except for the database, which will be maintained without discarding.

Table 12. (Element 9) Document and record retention, archival, and disposition information.

	Identify Type Needed	Retention	Archival	Disposition
Sample Collection Records	Field sampling form	IEWK	Hardcopies Electronic	5 years Indefinitely
Field Records	Photo logs/photos	IEWK	Hardcopies/digital	Indefinitely
	Site observation notes	IEWK	Hardcopies	5 years
	Flow rate, pH, DO, EC and temperature	IEWK	Original hardcopies, transferred to electronic	Hardcopies – 5 years Electronic-indefinitely
Analytical Records	Chain of custody	Babcock Labs IEWK	Hardcopies	5 years
	Calibration log	IEWK	Hardcopies	5 years
	Bacterial results	IEWK	Hardcopies Electronic	5 years Indefinitely
Data Records	Quarterly reports	IEWK and Regional Board	Electronic	Indefinitely
	QAPP, Monitoring Plan and revisions	IEWK and Regional Board	Electronic	Indefinitely
	Final Report (draft/final) and QA/QC report	IEWK and Regional Board	Electronic	Indefinitely
	Project Assessment and Evaluation Plan	IEWK and Regional Board	Electronic	Indefinitely

GROUP B: DATA GENERATION AND ACQUISITION

10. SAMPLING PROCESS DESIGN

Please refer to the Monitoring Plan (June 2008) prepared for this project.

The design strategy for this project is to collect representative water samples and field data from selected sites along San Timoteo Creek, Warm Creek and City Creek within Reach 5 of the Santa Ana River watershed, in order to document existing water quality conditions and determine where, when, and what water quality objectives are being exceeded, if at all.

10.1 Site Selection

Sites were selected mutually by IEWK staff and Regional Board staff that are involved with the project. Regional Board staff desired to collect data from each creek that represent both the "natural" or "pre-urban" condition and the "urban" condition that discharges into the Santa Ana River. Using a San Bernardino County Flood Control map of the area, sample site selection was also based on known access points, representativeness of the creeks chosen for this project and driving distances. Specifically for San Timoteo Creek, which has designated Reaches, site selection was based on the dividing lines of each Reach. IEWK staff then performed a site reconnaissance to confirm accessibility and only one site, located along Warm Creek at Baseline and Barton, was found to be inaccessible and needed to be changed. After consultation with Regional Board staff and a second site reconnaissance by IEWK, the site was changed to an access point on the east side of East Twin Creek, roughly 200 feet north of Highland Avenue.

Over the course of the project, if any particular sampling location changes in such a way to prohibit sampling as described herein, IEWK will consult with Regional Board staff to select an alternative location that still represents the creek of interest.

One to two test runs will be conducted by the Project Manager and Field Technician prior to project start, and whenever a change in Field Technicians may occur.

10.2 Sample Collection

This project will only involve testing of surface water. Randomness in the time of day and day of the week that samples are collected from week to week and month to month is very desirable for the project, and will be kept foremost when scheduling sampling events. One creek per day (all 3 or 4 sites) will be sampled for bacteria (and by default, field measurements) to ensure the strict hold time of 6 hours is met. Therefore, each week's sampling event will last a total of 3 full days. We will change which days each creek is sampled from week to week. For example, Week 1 might be Sunday, Monday, Tuesday and Week 2 would be Monday, Tuesday, Wednesday, and so on. Samples will be kept at 4 °C during transport to the IEWK Lab located at 1020 Cabot Road, Riverside, 92501. Initially, all samples will be diluted to 1:100 and 1:10. As time goes on, we can reduce the number of dilutions as we get a grasp of the typical organism concentrations. For example, upstream samples may not need any dilution. Sample sites are detailed in Table 6, which is where samples should be taken and how to identify sites.

Each month one bacterial sampling event, which occurs over 3-4 days will include sampling each site of each creek for the other previously mentioned constituents listed in Section 6.2. We expect between the second and third day, the non-bacteria samples from the first and second creek will need to be taken to Babcock Labs to meet their hold times. After the third day, the non-bacteria samples from the third creek will be taken to Babcock Labs. This extra sampling will be done on a different week for each month. For example, the first week of Month 1, the second week of Month 2, and so on. See Table 4 for details.

In total, we are expecting 61 data points (corresponds to the number of weeks) for bacteria and field data, and 9 data points (months) on the other analytes. We aim for 90% completeness, meaning a minimum of 55 results for bacteria and field data, and 8 results for the other analytes. E. Coli results are critical information, while other analytes are somewhat secondary.

There is the possibility of high naturally-occurring concentrations of certain minerals and metals will exist in the creeks, especially after a storm event or downstream of some type of disturbance. Anomalies will be reported in the quarterly reports to the Regional Board for consideration of a focused sub-study. In addition, with any data collection activity there is a possibility of bias and misinterpretation. This will be minimized through equipment maintenance, routine QA/QC checks, communication with the lab and field personnel.

10.3 Results Reporting

This project will include three quarterly reports and one final report.

- The first quarterly report will be due November 30, 2008 for the results gathered in July, August, September and October, 2008.
- The second quarterly report will be due March 31, 2009 for the results gathered in December, January, and February, 2009.
- The third quarterly report will be due September 30, 2009 for the results gathered in May, June, July, and August, 2009.
- The draft version of the final report will be due to the Regional Board project manager March 31, 2010.
- The final version of the final report will be due April 30, 2010 and any outstanding deliverables due before May 31, 2010. The final report will contain results gathered in September, October, and November, 2009. Also, it will contain, (1) summary of project background, development, administration, implementation and completion activities; (2) evaluation comparing project results to the Project Assessment and Evaluation Plan (PAEP, under separate cover); (3) Analysis of results including the number and location of samples exceeding water quality standards, a comparison with the State's listing policy requirements (on the number of samples needed to list a water body segment), and graphs depicting the data over time for each stream, and identify any trends; (4) conclusions/recommendations; (5) final project QC report.

11. SAMPLING METHODS

This project will follow the SWAMP Standard Operating Procedures (SOP) for Water Sample Collection and Field Measurements (Appendix B and C – not required, but included for completeness). The list of field and IEWK lab equipment is included in Appendix A.

11.1 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 that will then be used to transfer the sample to sample bottle, and then immediately placing it on ice in a cooler**.** Samples will be collected as grab samples from approximately midstream and mid depth. Depending on the volume, either a sterile WhirlPak bag or specimen cup will be used for sample collection. One bag or cup will be sacrificed for each site. Table 13 below details the sampling method for each analyte or analysis. Babcock Labs will provide sufficient volume of containers for the generation of replicates. There will be sufficient sample collector bottles so that each bottle is used once during a collection run. Once collected, samples will be dispersed into appropriate sample containers by the pour method.

Each sample container will be labeled at a minimum, with the following:

1) Site ID
2) Date of sample collection
3) Time of sample collection
4) Analytical test for which this sample is being collected
5) Any preservative present
6) Initials of sampler

Also, the field log book shall be completed at this time with the following information, at a minimum:

1) Site ID and GPS coordinates of sampling location
2) Date and time of collection, and person collecting sample
3) Observations such as weather conditions, complications, traffic, color and odor of flow.
4) Any deviation(s) from the approved sampling plan.

The chain of custody form(s) shall be completed after the sample containers have been marked and the log book filled out. Samples shall be put on ice as quickly as possible.

The sampling plan will be approved by the IEWK QA Officer prior to the collection of any samples. Refer to Element 20 for addressing problems, identifying responsible individuals and documentation.

Field data log sheets are located in Appendix E. Laboratory and calibration log sheets for the IEWK lab are included in Appendix F.

11.2 Sample Processing in Field

Sample processing such as filtering, homogenizing, compositing or split will not be needed for this project. In the event that the lab requires some sample processing in the field, the lab will instruct the IEWK staff member collecting the sample in the proper method.

Table 13 summarizes the sample collection standards, which are applicable to all sites. One sample will be collected from each location for analysis, with an additional duplicate sample collected for every batch or 40 samples as shown in the Data Quality Objective tables.

Table 13. (Element 11) Sampling Methods.

Analytical Parameter	Sampling SOP	Sample Volume (minimum vol. / preferred vol.)	Container type	Preservation	Max. Hold Time
E. Coli bacteria	See Appendix B for water sample collection and See Appendix D for analysis	100 mL	Sealed 100 mL poly	$Na_2S_20_3$; 4°C, dark	6 hours
Ammonia	See Appendix B for water sample collection SOP	100 mL	100 mL poly or glass	H_2SO_4; 6°C, dark	28 days
Nitrate-N		5 mL/100 mL	Quart poly No preservative	6°C, dark	48 hours
Nitrite-N		5 mL/50 mL	Quart poly No preservative	6°C, dark	48 hours
Total Kjeldahl Nitrogen (TKN)		20 mL/200 mL	500 mL poly	H_2SO_4 6°C, dark	28 days
Organic Nitrogen		100 mL	-	-	28 days
Total Nitrogen		100 mL	-	-	28 days
Ortho Phosphate-P		5 mL/50 mL	Quart poly No preservative	6°C, dark	48 hours
Total Phosphate-P		50 ml/200 mL	Quart poly	H_2SO_4 6°C, dark	28 days
Chemical Oxygen Demand		2 mL/10 mL	Quart poly	H_2SO_4 6°C, dark	28 days
Calcium (Ca)		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Chloride (Cl^-) (iodometric)		5 mL/100 mL	Quart poly	6°C, dark	28 days
Magnesium (Mg)		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Sodium (Na)		100 mL	500 mL poly	HNO_3 6°C, dark	180 days

Sulfate (SO_4)		5 mL/100 mL	Quart poly No preservative	6°C, dark	28 days
Total Dissolved Solids (TDS)	See Appendix B for water sample collection SOP	100 mL/500 mL	Quart poly No preservative	6°C, dark	7 days
Potassium (K)		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Total Hardness (as $CaCO_3$)		5 mL/50 mL	Quart poly	HNO_3 6°C, dark	180 days
Specific Conductance		25 mL/100 mL	Quart poly No preservative	6°C, dark	28 days
Antimony		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Arsenic		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Beryllium		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Cadmium		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Copper		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Lead		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Mercury		100 mL	500 mL poly	HNO_3 6°C, dark	28 days
Nickel		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Selenium		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Silver		25 mL/100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Thallium		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Zinc		100 mL	500 mL poly	HNO_3 6°C, dark	180 days
Organochlorine Pesticides and PCBs by EPA Method 608 in liquid		1 L/ 3 L	1 L amber	$Na_2S_20_3$ (dechlorinate); 6°C, dark	7 days (min.)

12. SAMPLE HANDLING AND CUSTODY

Inland Empire Waterkeeper and Babcock Labs will provide cleaned, dried and sterilized sample collection containers (such as poly or glass bottles or WhirlPak bags) to fill labeled sample bottles that contains preservatives, which may be harmful to the creek if immersed. Samplers will be gloved during all stages of handling samples: transfer to labeled containers, transfer from creek to car, storage in the cooler and transfer from cooler to lab. Samplers will collect samples just before leaving the site in order to minimize the time from creek to cooler back at the car. A thermometer will be kept in the cooler to ensure samples are at 6°C (per Babcock Labs SOP Q14, "Sample Container, Preservation Techniques, and Holding Time for Aqueous Matrices" (6/1/08).

Bacteria samples will be brought to the IEWK lab by IEWK samplers within 5 hours of collection and processed within 6 hours of collection. All efforts will be made to keep these samples in the dark until processing. All other samples will be brought to Babcock Labs within 48 hours of collection, during which time all samples will be stored in a cooler at 6°C and accompanied by a chain of custody form.

Refer to Table 13 above for container volumes, preservatives and holding times.

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 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.

13. ANALYTICAL METHODS

The analytical methods used for this project are listed in the second column of Tables 7-11 in Element 7. Appendix C contains the SWAMP SOP for Field Measurements (not required, but included for completeness) and Appendix D contains the SOP for the IDEXX Coliform test procedure.

13.1 Field and Laboratory SOPs

The only measurements taken in the field will be conductivity, pH, dissolved oxygen, flow rate and temperature. The methods for determining these parameters are detailed here in Appendix C, "Field Measurements" based on the SWAMP QAPP.

The analyte measured in the IEWK lab will be E. Coli bacteria. The method for measuring this parameter is listed in Tables 7 through 11 of Element 7. The SOP for measuring the E. Coli is included here in Appendix D, "IDEXX Colilert® Method for Coliforms and E. Coli Bacteria".

The analytes measured in Babcock Labs (the contract laboratory) are nutrients, metals, minerals, COD, pesticides and PCBs. The methods for measuring these parameters are listed in Tables 8-11 of Element 7, and none of those methods are non-standard. The lab uses SOPs based on the various methods with no significant variations.

13.2 Field Equipment

The field equipment to be used includes Oakton conductivity and pH meters each with thermometers. The conductivity meter works by measuring the conductance of water between two probes. The pH meter electrode 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. The field equipment also includes Extech heavy duty dissolved oxygen meter (Model 407510) with thermometer. Dissolved oxygen meters interface to one of three common types of dissolved oxygen sensing probes: polarographic sensors, galvanic sensors or optical fluorescence sensors. This model has a polarographic sensor (as in polarography, an electrochemical method of chemical analysis) that uses an external voltage where the difference in potential between the cathode and anode is less than 0.5 volts. The last piece of field equipment is for calculating flow rate, which includes measuring tapes, timer, orange peels (or water-soaked blocks of wood), and stadia rod. We will use the Float Method of velocity that measures the time it takes for an object to float a known distance. The known distance will be 10 feet. The width of the creek will be subdivided by at least 5 sections and the depth measured at each.

This project will not utilize continuous monitoring.

13.3 IEWK Lab Equipment, Methods and Procedures

The IEWK lab will be used for bacteria measurements (E. Coli) using the IDEXX and Colilert® Quanti-Tray®/2000 method. Quanti-Tray®/2000 are pre-sterilized trays with 97 wells into which the 100 mL sample is poured with one Colilert® (reagent to detect E. Coli bacteria) packet (one per every 100 ml). Sealed and pre-filled IDEXX vessels with 90 mL or 99 mL of sterile water are used for sample dilutions of 1:10 and 1:100. The tray is tapped to release any bubbles and placed into the Quanti-Tray® sealer machine that permanently seals the sample evenly into the 97 wells. Samples are then stored in an incubator for 24 hours at 35°C. Samples are read for E. Coli by using a UV viewing cabinet that blocks out the lab's lights. To be positive for E. Coli the cell must be more yellow in color and fluoresce more than the comparator. The number of large and small cells that meet both criteria are recorded. Using the MPN (most probable number) table, a concentration of organisms can be deduced and multiplied by the dilution factor – if applicable. Colilert results are definitive at 24-28 hours. In addition, positives for E. Coli observed before 24 hours and negatives observed after 28 hours are also valid. Although results from all dilutions will be recorded, only one per site will be reported that is usually the least diluted sample with a readable result and a mix of positive and negative wells. Based on Chapter 11, Section 4 of Methods for General and Molecular Biology (Gerhardt et. al., 1994), a result of 80% positive wells and 20% negative wells is the rule of thumb. It should be kept in mind that sensitivity is lost and the introduction of contamination and human error increases with each dilution.

13.4 Contract Lab Equipment, Methods and Procedures

The contract laboratory for this project will utilize the appropriate equipment or instrumentation that is necessary for state approved laboratory analyses. The analytical methods are listed in Tables 7-11, the details of the equipment methods and procedures are detailed in each method's SOP, which are standard EPA or SM methods.

13.5 Waste Management

Our goal is to use the entire sample collected for the analysis. All disposable sampling materials and protective equipment, such as gloves or paper towels will be placed in a heavy duty garbage bag in a covered trash container. In the IEWK lab, any leftover sample water can be disposed of to the sanitary sewer because it will not contain a toxic or caustic material. The contract lab will properly dispose of any hazardous waste as deemed necessary by state and federal laws.

13.6 Contract Lab Corrective Actions and Responsible Individuals

Babcock labs maintains an SOP on Corrective Action (Q06, "Corrective Action for Chemical Analysis") that demonstrates how responsibility starts with the analyst, the data goes through peer review, and finally supervisory review. Any questions through the process are answered by the QA department and/or lab director.

13.7 IEWK Lab Correction Actions and Responsible Individuals

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 her attention immediately. Any corrective action including re-sampling activities, chemical re-testing, database analysis and data validation will also be brought to the attention of Autumn DeWoody, and any such corrective action will be documented by QA Officer Zehava Purim-Adimor.

13.8 Laboratory Turnaround Time

The contract lab can provide a turn around time (TAT) of 10 working days for analyses performed in-house, and 20 working days for analyses sent to sub-contractor labs.

Results for E. Coli bacteria will be ready in 24 hours, with a 24-28 hour window.

13.9 Non-Standard SOP's and PBMS Method Development

The SOP for the IDEXX Colilert® method for Coliforms and E. Coli is approved by the EPA but could be considered non-standard. Therefore, it is included in Appendix D. PBMS or "probability-based measurement system" conveys what needs to be accomplished, but not prescriptively how will it get done. It allows flexibility in method selection however, for this project no PBMS will need to be developed.

14. QUALITY CONTROL

14.1 QC Activities

A strong QA/QC program is necessary to insure data accuracy. The table below lists all possible QC checks and the information they provide that are acknowledged in the SWAMP QAPP. This project will utilize a select few from blanks, spikes, calibration checks, and duplicates, as described below.

QC Check	Information Provided By QC Check
BLANKS	
Rinsate or equipment blank	Contaminated equipment (done in lab)
Field blank	Transport, storage, and field handling bias
Reagent blank	Contaminated reagent
Trip blank	Volatiles only. Shipping contamination
Method blank (lab)	Response of an entire laboratory analytical system
Instrument blank (lab)	Laboratory contamination
Temperature blank	Temperature during shipping
SPIKES	
Matrix Spike	Analytical (preparation + analysis) bias
Matrix spike replicate	Analytical bias and precision
Analysis matrix spike	Instrument bias
Surrogate spike	Analytical bias
CALIBRATION CHECKS	
Zero check	Calibration drift and memory effect
Span check	Calibration drift and memory effect
Mid-range check	Calibration drift and memory effect
DUPLICATES, SPLITS, ETC.	
Field collocated samples	Sampling + measurement precision
Field duplicates	Precision of all steps after acquisition
Field splits*	Shipping + inter-laboratory precision
Laboratory splits*	Inter-laboratory precision
Laboratory duplicates	Analytical precision
Analysis duplicates	Instrument precision

*Due to budget constraints, this project will not include field or lab splits.

SWAMP requirements for QC of the lab data are listed below, which should be followed unless more stringent procedures are developed:

Conventional Constituents in water	Blanks – Laboratory and field blanks. No detectable amount of substance in blanks. Frequencies – Accuracy, precision, recovery, and blanks at 1 in 20 (5%) with at least one in every batch. All quality assurance and quality control procedures and criteria specified by selected method.
Synthetic organic compounds (non-volatiles, PCBs, PAHs, pesticides) in water	Blanks – Laboratory and field blanks. No detectable amount of substance in blanks. Frequencies – Accuracy, precision, recovery, and blanks at 1 in 20 (5%) with at least one in every batch. Surrogate spike (similar structure or isotopically labeled) – determined by project manager. All quality assurance and quality control procedures and criteria specified by selected method.

Trace metals, including mercury in water	Blanks – Laboratory and field blanks. No detectable amount of substance in blanks. Frequencies – Accuracy, precision, recovery, and blanks at 1 in 20 (5%) with at least one in every batch. All quality assurance and quality control procedures and criteria specified by selected method.
Bacteria – pathogen indicators	Field and sterility checks (laboratory blanks) no detectable amounts or less than 1/5 of sample amounts for field blanks. Frequency – accuracy at 1 per culture medium or reagent lot. Precision at 1 in 10 (10%) with at least one per batch. All quality assurance and quality control procedures found in Standard Methods (18th, 19th, or 20th editions) section 9020 and in the selected analytical method including confirmation practices.

The primary purpose of "blanks" is to trace sources of artificially introduced contamination. This project will incorporate the following blanks to measure contamination:

Field blank: A sample of clean water poured into the container in the field, preserved and shipped to the laboratory with field samples.
Frequency: 1 blank/day/matrix

Temperature blank: Small sample bottle with distilled water is placed in each cooler. Upon arrival at lab, temperature is measured to ensure samples adequately cooled.
Frequency: 1 blank/cooler

Method blank (lab): A blank prepared to represent the matrix as closely as possible. It is prepared/extracted/digested and analyzed exactly like the field samples.
Frequency: 1 blank/batch

Instrument blank (lab): A blank analyzed with field samples.
Frequency: Defined by the analytical method or discretion of analyst (usually done after measuring high concentration samples)

Samples are "spiked" with a known amount of analyte to measure instrument precision. SWAMP recommends surrogate spikes for PCBs and pesticides in water. This is done at the lab at a frequency defined by the analytical method or discretion of analyst.

Calibration checks are needed to ensure the calibration standards are accurate. IEWK meters will be calibrated before each sampling day and recorded on the Equipment Calibration Form (see Appendix F). Also, we annually participate in inter-calibration sessions with other sampling groups and send equipment back to the manufacturer for annual maintenance. The contract lab conducts calibration checks on a regular basis as specified by the manufacturer and method needs.

Duplicates are discussed in Element 7 but generally, one field duplicate will be taken for every 10 samples – or in other words, one every week for bacteria (rotating between all sites). A field duplicate will also be collected per batch for non-bacteria tests for the contract lab to test (rotating between all sites). Also, the contract lab will perform one lab duplicate per batch.

There is no SWAMP requirement for QC activities for field data; however, it does suggest the following, which we have incorporated into the sampling design:

Dissolved Oxygen	Suggest 3 replicate measurements plus maintenance practices.
Temperature	Suggest 3 replicate measurements plus maintenance and calibration practices.
Conductivity	Suggest 3 replicate measurements plus maintenance and calibration practices
pH by meter	Suggest 3 replicate measurements, check against second pH buffer, plus maintenance and calibration practices
Depth (and width, flow rate)	Rely on maintenance and calibration practices

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.

Procedures and formulas for calculating data quality indicators (DQI) include precision that is quantitatively expressed as the relative percent difference (RPD):

RPD = [(C1-C2) / (average of C1 and C2)] x 100

Where C1 = larger of two duplicate results
C2 = smaller of two duplicate results

Bias and outliers can be identified simply by plotting the data results, calculating the regression line or correlation coefficient and finding those results that are (statistically) significantly different.

15. INSTRUMENT AND EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

15.1 Testing Criteria

The testing criteria for field and IEWK lab equipment are outlined in the instrument SOPs in Appendix C. Likewise, the equipment testing criteria for Babcock Labs are identified in the instrument user manuals or SOPs for their instruments.

15.2 Spare Parts

Spare parts, tools and necessary materials for the sampling collection will be held at the IEWK office. Parts will be ordered far enough in advance as to avoid delay of sampling. In the event that a piece of equipment is unusable, for a period of time and to avoid sampling delays, we will borrow the tool from Orange County Coastkeeper who uses the same tools. Procedures in place for inspecting laboratory equipment are stated in Babcock Lab SOP Q21, "Equipment Maintenance".

15.3 Equipment Inspection

Equipment inspection procedures are outlined in the SOPs referenced in Table 15. Procedures in place for inspecting laboratory equipment are stated in Babcock Lab SOP Q21, "Equipment Maintenance".

15.4 Individuals Responsible for Testing, Inspection and Maintenance

Autumn DeWoody is responsible for overseeing testing, inspection and maintenance of equipment for IEWK field and lab activities.

The QA Department or Lab Director of Babcock labs is responsible for testing, inspecting and maintaining equipment in the contract laboratory.

15.5 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. For identifying how deficiencies should be resolved and documented, see Babcock Labs SOP Q06.

Table 14. (Element 15) Testing, inspection, maintenance of sampling equipment and analytical instruments.

Equipment / Instrument	Maintenance Activity	Responsible Person	Frequency	SOP Reference
• Conductivity meter • pH meter • dissolved oxygen meter	Calibration	Autumn DeWoody	Before each sample event	Appendix C
Other field equipment	Inspection/replacement	Field Technician	Weekly	N/A
IEWK lab instruments	Maintenance	Autumn DeWoody	As needed	Refer to instrument manual
Contract Lab instruments	Maintenance/calibration	QA Department or Lab Director	As needed	Refer to method SOP available at lab

16. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Laboratory equipment calibration for conventional constituents in surface water must be completed before any samples are analyzed. SWAMP Guidelines require external calibration with 3 to 5 standards covering the range of sample concentrations prior to sample analysis. At low end, the lowest standard should be at or near the MDL. Calibration verification should be every 10 samples after initial calibration. The standard source will be different than that used for initial calibration. 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 field equipment and the IDEXX system are discussed in Table 14.

Table 15. (Element 16) Testing, inspection, maintenance of sampling equipment and analytical instruments.

Equipment / Instrument	SOP reference	Calibration Description and Criteria	Frequency of Calibration	Responsible Person
Digital thermometer	Appendix C See Appendix F for IEWK calibration log.	Suspend probe >1" in crushed ice and water for at least 30 s Inter-calibration session	Once a week Each Fall	IEWK Field Technician Project Manager
Dissolved Oxygen meter		Calibrates to 0_2 in air. Ship to manufacturer annually for inspection/calibration.	24 hours before sampling event Each June	IEWK Field Technician Project Manager
pH meter		Automatic 3-point calibration using USA standards (4, 7, 10) Inter-calibration session	24 hours before sampling event Each Fall	IEWK Field Technician Project Manager
EC meter		Automatic 3-point calibration (84 µS, 1413 µS, 12.88 mS) Inter-calibration session	24 hours before sampling event Each Fall	IEWK Field Technician Project Manager
IDEXX Colilert®	Appendix D	Use Quanti-Cult® QC Kit	Every 6 sampling months	IEWK Field Technician

Babcock Labs maintains a regular and consistent calibration schedule for their equipment as stated in Section 23.2.2 of the Lab QA Manual:

> All instruments/equipment are calibrated and maintained in accordance with manufacturer's specifications, method requirements, and well-established quality assurance practices. A copy of the manufacturer's instructions, when available, is kept with the instrument. The analyst using the instrument/equipment maintains the instrument in clean and operating order. Problems are reported immediately so that they can be corrected. When an instrument is taken out of use due to a maintenance problem, a sign is placed on the instrument indicating the instrument is out of service. All major instruments are kept on maintenance contracts. Maintenance logs are kept for all major analytical equipment.

17. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

For a complete list of equipment, please see Appendix A. IDEXX supplies are shipped from the nearest IDEXX facility directly to the IEWK lab. Calibration standards and "other sample bottles" are purchased by IEWK from Cole-Parmer when needed.

Table 16. (Element 17) Inspection/acceptance testing requirements for consumables and supplies.

Project-Related Supplies / Consumables	Inspection / Testing Specifications	Acceptance Criteria	Frequency	Responsible Individual
IDEXX sealed sampling vessels (100 mL poly)	Sealed	Accept if sealed	On delivery	Autumn DeWoody
Other sample bottles	Clean; proper type, size and preservative	Accept if criteria met	Upon acceptance from contract laboratory	Autumn DeWoody
IDEXX Colilert® Reagents	Sealed, proper type	Accept if criteria met	Upon delivery	Autumn DeWoody
IDEXX dilution vessels (90 mL or 99 mL)	Sealed, proper volumes	Accept if criteria met	Upon delivery	Autumn DeWoody
Calibration standards	Sealed, proper type	Accept if criteria met	Upon delivery	Autumn DeWoody
Monitoring equipment	Clean, proper type	Accept if criteria met	Daily	Autumn DeWoody

IDEXX equipment and calibration standards used for IEWK meters are stored on dry, closed shelves in temperature-controlled rooms at the IEWK lab. Since the IDEXX materials are donated by Hydrophix® for this project, we will track all items consumed to make an accurate estimate of their in-kind donation. Other purchases will be recorded by keeping all receipts/invoices in the administrative file at IEWK.

Babcock Labs will inspect and determine whether their supplies and consumables are acceptable based on internal specifications and SOPs.

18. NON-DIRECT MEASUREMENTS (EXISTING DATA)

The February 2008 update to the Basin Plan was consulted to determine the locations of the San Timoteo Creek reaches. The Basin Plan and "A Compilation of Water Quality Goals" (updated August 2007) by Jon Marshack, D.Env. of the Central Valley Regional Water Quality Control Board were consulted to determine water quality benchmarks by which to measure results. A map of the "Flood Control System, Southwest Portion" (March, 1996) from the San Bernardino County Flood Control District was consulted to help determine sampling locations. These resources were recommended by the Regional Board staff.

Key resources to this project include the QA managers at Moss Landing Laboratories who manage the SWAMP database. They will be utilized for assisting the development of the final results database. Additional assistance will come from our parent organization, Orange County Coastkeeper.

19. DATA MANAGEMENT

19.1 Data Handling from Field to Office

For each sampling event, IEWK staff will use several data sheets to record field observations, field measurements, and sample collection details for the bacteria testing. IEWK staff will also use Chain of Custody forms provided by the contract lab. Original forms will be reviewed for completeness by the Project Manager upon return to the IEWK office. Any missing information will be filled in if possible or flagged for remedial action. When the contract lab submits their data and QC reports, the QA Officer 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 an Excel spreadsheet with column and row headings based on the need of the Regional Board staff. The 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. Field data sheets are in Appendix E and IEWK lab logs and calibration logs are in Appendix F.

19.2 Standard Record-Keeping and Tracking 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 Excel 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 Excel database, the data will be processed and analyzed as necessary by the Project Manager and Project Director. A copy of the database along with corresponding metadata, detailing the components of the data base will be submitted to the Regional Board for their review. IEWK and the Regional Board will be the primary users of the database and IEWK will do the analysis.

At some point after the sampling task of the project is complete, the data will be imported from Excel to ACCESS for use by the SWAMP IMS. This will be done by IEWK staff in consultation with Regional Board staff.

19.3 Processing, Compiling, Analyzing and Transmitting Data Reliably

The Project Manager will either supervise the input of data by the Field Technician or perform the duty herself. The Excel sheet will be a SWAMP-compatible Excel application, a template of which and the appropriate training document were downloaded from the following website: http://mpsl.mlml.calstate.edu/swdbase.htm. Final datasets will be transmitted to Regional Board staff on CD. Once the final datasets are approved by Regional Board staff, IEWK will post the findings on their Web site in a PDF format that can not be altered.

19.4 Data Archival and Retrieval

Hard copies of electronic versions of data collected for this project will be kept in the project's administrative file at the IEWK office. Working electronic files of the data will be backed-up daily at the IEWK office. IEWK computers are PC's protected by NOD 32 virus software and use Microsoft Office Standard 2007.

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.

GROUP C: ASSESSMENT AND OVERSIGHT

20. ASSESSMENTS AND RESPONSE ACTIONS

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 relative contributions of pollutants from San Timoteo Creek, City Creek and Warm Creek – three major tributaries of the Santa Ana River in San Bernardino.

The project will be assessed continuously by the Project Manager and Project Director through its adherence to the timeline and the completeness and accuracy of the data collected. The Project Manager has the authority to issue stop work orders along with Project Director and the Regional Board Contract Manager. Project completeness will be evaluated with Regional Board staff upon submittal of quarterly reports (see Element 6). If the project falls behind schedule, the project manager will work with the Regional Board Contract Manager to discuss the delay and what, if anything, can be done to put the project back on schedule. An internal assessment of the data will also be completed at the conclusion of the data collection to determine if the data is sufficiently accurate and robust to complete the analysis. This assessment will be carried out by the IEWK Project Manager and Regional Board staff Mr. Bill Rice and Ms. Pavlova Vitale. After concurrence by these individuals of the data meeting project objectives, the project will proceed to the analysis stage.

20.1 Process for Corrective Action

All assessment information will be reported to the Regional Board contract manager through email and phone communication. Any corrective action found to be necessary through the assessment process will be documented in memo format and distributed to all other project personnel and contractors.

21. REPORTS TO MANAGEMENT

A QA report will be prepared for the Final Project Report that summarizes compliance with this schedule.

Table 17. (Element 21) Reports to Management.

Type of Report	Frequency	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Monitoring Plan with QAPP	On approval and with each revision	July 1, 2008	IEWK Project Manager, Autumn DeWoody	Regional Board staff: Contract Manager and QA Officer
First Quarterly Report	Quarterly	Nov. 30, 2008		
Second Quarterly Report		March 31, 2009		
Third Quarterly Report		Sept. 30, 2009		
Contract lab result reports	10 to 20 days after receiving samples	10/2008, 1/2009, 2/2009, 3/2009, 5/2009, 7/2009, 8/2009, 9/2009, 11/2009	Babcock Labs project manager, Lorenzo Rodriguez	
Draft Project Report	-	March 31, 2010	IEWK Project Manager, Autumn DeWoody	
Final Project Report (inc. 4th quarter report) with QA Report and SWAMP-comparable database	-	April 30, 2010		

GROUP D: DATA VALIDATION AND USABILITY

22. DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS

Data Verification is confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Data verification is the process of evaluating the completeness, correctness, and conformance or compliance of a specific data set against the method, procedural, or contractual requirements.

Data Validation is confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. Data validation is an analyte-and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set.

Based on Section D1 and Appendix C of the SWAMP QAMP, data for conventional constituents in water will be accepted into the database if:

- Equipment is calibrated properly
- Calibrations are verified
- Spiked matrix samples are used to confirm/determine MDLs
- Accuracy and precision of test methods are assessed using spikes, replicates and duplicates
- Contamination assessed with laboratory and field blanks
- External QA assessments are performed
- CCV recoveries within control limits
- Either SRM or spiked matrix recoveries within control limits

All data for this project will be reviewed and verified for compliance to the data quality requirements outlined in this QAPP. 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 outlined will insure that the data used is sufficient to determine if San Timoteo Creek, Warm Creek, City Creek or any reach thereof contribute pollutants to the watershed.

23. VERIFICATION AND VALIDATION METHODS

23.1 Project Data Verification and Validation Process

All data will be checked for errors in transcription, calculation, computer input, completeness, and accuracy in a two-step process, first by Project Manager Autumn DeWoody and then by Project QA Officer Zehava Purim-Adimor. As all forms and reports come in from the field and labs, Autumn 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 reported to Zehava and the related data flagged if necessary. Zehava 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. Zehava 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, Zehava will create an Excel spreadsheet detailing all expected data and the associated DMOs, and, as the data comes in, Autumn will verify its receipt on the spreadsheet and document whether the DMOs from Tables 7 to 11 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 Procedure

The data collected for this project will have met user requirements if it meets the needs of the Santa Ana Regional Board through Mr. William Rice and Ms. Pavlova Vitale for preparing the Final Report and SWAMP-comparable database– the primary products of this project. By May 31, 2010 the SWAMP-comparable database will be complete and turned over to the Regional Board to send on to the SWAMP team at Moss Landing Laboratories.

24.2 Data Analysis Methods

To prepare a proper report, IEWK requires a level of data that accurately documents the monthly, seasonal and spatial variations in analyte concentrations in San Timoteo Creek, Warm Creek and City Creek. A statistical analysis is requested from the data by Regional Board staff, which is only possible if a robust level of data is obtained. Specifically, IEWK will:

- Count the number of samples exceeding water quality standards at each sample location at each stream.
- Compare the State's Listing Policy requirements for listing a water body segment
- Graph the data for each stream over time
- Identify outliers, dispersion and trends

Data limitations will be disclosed to users as appropriate as table footnotes or narrative of the quarterly reports and Final Project Report.

APPENDICES

APPENDIX A

List of Field Equipment

Equipment	Quantity on Hand	Total Quantity Needed
Ice chest	1	1
Ice or blue ice containers	2 bags ice	370 bags
1 quart poly, no preservative	2	18
1 quart poly, with preservative	2	18
500 ml poly with preservative	5	45
1liter amber glass bottles w/ preserv.	4	36
Sterile Whirl-Pak bags or specimen cups	20	1220
IDEXX 100 mL sealed poly w/ $Na_2S_20_4$	20	600
Backpack	1	1
Scissors	1	1
Clipboard	1	1
Field data sheets	20	600
COC forms	20	200
Pens	2	2
Black Sharpie markers	2	2
Nitrile gloves	1 box	5 boxes
Digital Camera	1	1
Camera (film)	1	1
Film	1 box	5 boxes
Non-digital camera batteries (3V)	1 box	3 boxes
Hand-held GPS	1	1
First Aid kit	1	1
Sunscreen	1	1
Waders and boots	1	1
Dissolved Oxygen meter	1	1
pH meter	1	1
Thermometer	1	2
Conductivity meter	1	1
Open reel tape measure (100')	1	1
Soaked cube of wood or orange peel	1	600
Stadia rod	1	1

List of IEWK Laboratory Equipment

Equipment	Quantity on Hand	Total Quantity Needed
Incubator (35°C)	1	1
IDEXX sealer	1	1
IDEXX Quanti-Tray®	1 box	10 boxes
IDEXX dilution vessels (90 mL)	1 box	10 boxes
IDEXX dilution vessels (99 mL)	1 box	10 boxes
IDEXX pipette (1 mL)	1 box	5 boxes
IDEXX pipette (10 mL)	1 box	5 boxes
IDEXX Colilert® reagent	1 box	5 boxes

APPENDIX B

STANDARD OPERATING PROCEDURE – 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, but these field data measurement protocols are provided in Appendix E of the SWAMP QAMP. Samples are put on ice and appropriately shipped to the processing laboratories. 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.

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.

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.

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 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

centroid collection. 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. 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. See Appendix H of the SWAMP QAMP for detailed safety precautions.

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 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 of the SWAMP QAMP for detailed Field QC requirements.

Field Site Data Sheets

Each visited field site requires a completed Field Data Sheet (Station Occupation Data Sheet), even if no samples are collected (i.e. at a site which is found to be dry). If water samples are taken, a Water Quality Data Sheet 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. They should be calibrated every morning prior to sampling. Conductivity should also be calibrated between stations if there is a significant change in salinity. Appendix E of the SWAMP QAMP contains detailed information on field measurements/instrument calibration.

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. Refer to Appendix H of the SWAMP QAMP for proper safety gear and health/safety guidelines for sampling.

Walk 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.

Field Observations: Color, unusual amount of suspended matter, debris or foam, etc.

Water appearance

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.

Significant Precipitation (days since last rain)

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.
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 is 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 and submitted to the staff. 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 on the Internet. The address is **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.

APPENDIX C

STANDARD OPERATING PROCEDURE – FIELD MEASUREMENTS

Field Measurements

After collecting water samples, record appropriate field measurements. When field measurements are made with a multi-parameter 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, grab samples for water are taken at approximately 4 inches, and multi-probe measurements are taken at approximately 8 inches. This is because all sensors have to be submerged, so 4 inches would not be deep enough. But taking a grab sample at 8 inches 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.

A. Water Temperature (^{O}C)
Water temperature data are recorded for each visit in final form in a Field Data Logbook and submitted to the staff.

Temperature Measuring Equipment
- Centigrade Thermometer
- Electronic Temperature Sensor

Temperature Sampling Procedures
Temperature is measured in-stream at the depth(s) specified 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 following conditions must be met when measuring temperature from a bucket:

- 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.

B. pH (standard units)

pH data is recorded for each visit in final form in a Field Data Logbook and submitted to the staff.

pH Sampling Equipment

- The pH meter should be calibrated according to factory specifications in the user manual for the device.

pH Sampling Procedure

- Calibrate the pH sensor. The pH function is calibrated each day of use for multiparameter instruments.
- 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 particles 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.

C. Electrical Conductivity (μS/cm)

EC should be recorded for each visit in final form in a Field Data Logbook or field form and submitted to the staff.

Sampling Equipment

- Conductivity meter, calibrated within 24 hours of use according to the user manual included with the device.

  Calibration Procedure (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.

Sampling Procedure

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

D. Flow Rate (ft^3/s)

Flow data should be recorded for each monitoring visit to non-tidal, flowing streams. Flow data should be recorded in final form in a Field Data Logbook and submitted to the staff. The following are two exceptions to the flow reporting requirement:

No 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.

Flow Measurement

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.

- **Instantaneous Flow Measurement**

  Water quality monitoring visits to sites where there are no nearby USGS flow gauges will require water quality monitoring personnel to measure flow, when requested by RWQCB's.

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).

Record the following information on the flow measurement form:

- 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

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.

1) 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.

2) Measuring the Stream Width
Measure and record the stream width between the points where the tape is stretched (waters edge to waters edge).

3) Determining the Number of Flow Cross Sections
Determine the spacing and location of flow measurement sections. Some judgment 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. 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. Example: The total stream width is 26 feet with 20 measurements, section widths will be 1.3 feet (26/20 = 1.3).

4) 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 the Example:

1. The total stream width is 26 feet with 20 cross sections and each cross section width is equal to 1.3 feet.
2. Divide 1.3 feet by 2 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.
3. By adding 0.65 to zero the mid-point of the first section is 0.65 feet.
4. 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.
5. Place the top setting wading rod at 0.65 feet for the first measurement.
6. 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.
7. 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 Rate
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 = Flow Rate, 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.

Flow Estimate Procedure

- Observe the stream and choose a reach of the stream where it is possible to estimate the stream cross section and velocity.

1. Estimate stream width (feet) at that reach and record.
2. Estimate average stream depth (feet) at that reach and record.
3. 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.
4. 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.

E. Dissolved Oxygen (DO)

Dissolved oxygen (D.O.) data is recorded for each visit in final form in a Field Data Logbook and submitted to the staff.

Dissolved Oxygen Sampling Equipment

- Dissolved oxygen meter, calibrated according to the specifications in the equipment user manual.

D.O. Measurement from a Bucket

When D.O. cannot be measured in-stream, it can be measured in a bucket-Nalgene or plastic, following precautions outlined in "Temperature Measurement from a Bucket" on prior pages. During equilibration and reading, water should be moved past the membrane surface at a velocity of one ft/s (0.3m/sec), either by automatic stirrer or manual stirring. If stirred manually in a bucket, the water surface is not agitated (Rawson, 1982).

Summary of Significant Figures for Reporting Field Parameters

Parameter	Field Data Reporting Requirements
Water Temperature (^{o}C)	Report temperature to the nearest tenth of a degree. Round insignificant figures 0 through 4 down and 5 thru 9 up.
pH (s.u.)	Report pH to the nearest tenth of a pH standard unit.
D.O. (mg/L)	Report dissolved oxygen to the nearest tenth of a mg/L.
EC (μS/cm or μm/cm)	Report specific conductance to only three significant figures if the value exceeds 100. Do not report ORP which is displayed by some multiprobes.
Days Since Last Significant Precipitation(days)	Report whole numbers. If it is raining when the sample is collected or has rained within the last 24 hours, report a value of <1. If it has been over a week since a rainfall event, report a value of > 7.
Flow Rate (ft^3/s)	Report instantaneous flow values less than ten ft^3/s to two significant figures. Report flow values greater than 10 ft^3/s to the nearest whole number, but no more than three significant figures. When there is no flow (pools), report as 0.0. When there is no water, don't report a value, but report as "dry" in the observations.
Flow Severity (1-no flow, 2-low, 3-normal, 4-flood, 5-high, 6-dry)	When there is no flow (pools), report the severity as 1, and the instantaneous flow as 0.0 ft^3/s. If the stream is dry, record only flow severity, as a value of 6.

APPENDIX D

STANDARD OPERATING PROCEDURE – IDEXX Colilert® METHOD FOR COLIFORM AND E.COLI BACTERIA

COLIFORM & *E.COLI* IN DRINKING WATER

Presence/Absence Detection

SCOPE AND SUMMARY OF THE METHOD

Colilert reagent is used for the simultaneous detection and confirmation of total coliform and *E.coli* in drinking water. It is based on the IDEXX patented Defined Substrate Technology®(DST™). This product utilizes nutrient indicators that produce yellow color and/or fluorescence when metabolized by total coliforms and *E. coli*. When reagent is added to the sample and incubated, it can detect these bacteria at 1CFU/100ml within 24 hours with as many as 2 million heterotrophic bacteria/100ml present.

APPARATUS

Incubator

Incubator must be capable of maintaining 35°C +/- 0.5°C

Thermometer

NIST traceable thermometers that are immersed in glycol fluid are to be utilized in the incubator. Incubator thermometer shall be capable of 0.5°C increments. All thermometers are to be checked and tagged in accordance with a QA procedure depicting deviation, date/time, analyst, and NIST or equivalent thermometer serial number.

UV Light

Long-wave UV lamp 365 nm for the examination of Colilert MUG fluorescence for *E.coli.*

Sample containers

Sample containers are purchased presterilized with sodium thiosulfate already added. Each lot of sample containers must pass the QA sterility and suitability tests prior to use. *Be sure to fill the container all the way to the lid (120 mL max. volume) to be able to do some dilutions.*

REAGENTS

Colilert Reagent

Colilert is supplied by IDEXX Laboratory, Inc. Colilert is purchased in the 100ml P/A format in individual snap pack packaging. Each lot of Colilert must pass the Quality Control described in section VIII.

STORAGE

Store Colilert at 4°C - 30°C away from light

SAMPLE HANDLING AND PRESERVATION

Aseptically collect, store and transport water samples as described in the 20th edition, *Standard Method for the Examination of Water and Wastewater*.

PROCEDURE

Presence/Absence Test Procedure-

Carefully separate one Snap Pack from the strip taking care not to accidentally open adjacent pack
Tap the Snap Pack to ensure that all of the Colilert powder is in the bottom part of the pack.
Open one pack by snapping back the top at the scoreline as shown. *Caution: do not touch the opening of the pack.*
Add the reagent to the water sample in a sterile, transparent, non-fluorescent vessel (100ml for WP020 and/or WP200 Colilert)
Aseptically cap and seal the vessel
Shake until dissolved
Incubate for 24 hours at 35°C +/- 0.5°C
Read the results at 24 hours. Compare each result against the comparator dispensed into an identical vessel.

- If no yellow color is observed, the test is negative.

- If the sample has yellow color equal to or greater than the comparator, the presence of total coliforms is confirmed. If color is not uniform, mix by inversion then recheck.
- If the sample is yellow, but lighter than the comparator, it may be incubated an additional 4 hours (but no more than 28 hours total). If the sample is coliform positive, the color will intensify. If it does not intensify, the sample is negative.
- If yellow is observed, check the vessel for fluorescence by placing a 6 watt 365 nm UV light within five inches of the sample in a dark environment. Be sure the light is facing away from your eyes and towards the vessel. If fluorescence is greater or equal to the fluorescence of the comparator, the presence of *E. coli* is confirmed.

CALCULATIONS

There are no calculations required for this method.

QUALITY PROCEDURE

THE FOLLOWING QUALITY CONTROL PROCEDURE IS RECOMMENDED FOR EACH LOT OF COLILERT, OR MORE OFTEN AS REGULATIONS REQUIRE.

Inoculate 3 sterile vessels filled with 100ml sterile (DI or distilled) water with the following:

A. One with Quanti-Cult™ * *E.coli* or a sterile loop of ATCC** 25922 or 11775(*E.coli*)
B. One with Quanti-Cult *Klebsiella pneumoniae* or a sterile loop of ATCC 31488(total coliform)
C. One with Quanti-Cult *Pseudomonmas aeruginosa* or a sterile loop of ATCC 10145 or 27853 (non coliform)

2. Follow the P/A procedure in section VI.
3. Results should be:

Organism	**Expected result**
E.coli	yellow & fluorescent
Klebsiella pneumonia	yellow & no fluorescence
Pseudomonmas aeruginosa	clear, no fluorescence

REFERENCES

Standard methods for the Examination of Water and Wastewater. Method 9223B. 20th edition.

- Quanti-Cult™ cultures available from IDEXX Catalogue # WKIT1001
- American Type Culture Collection 1-800-638-6597

APPENDIX E

S.W.A.M.P. FIELD DATA LOG SHEETS

1. Stream Flow (Discharge) Measurement Form

Stream:____Date:_____________

Station Description:____

Time Begin:__________ Time End:____________ Meter Type:________________________

Observers:__________________Stream Width*:_____________ Section Width:___________

Observations:____

Section Midpoint (ft) (m)	**Section Depth (ft) (m) (cm)**	**Observational Depth** ft-m-cm**	**Velocity**		**Area W x D (ft^2) (m^2)**	**Flow (Q) V x A (m^3/s) (ft^3/s)**
			At Point (ft/s) (m/s)	**Average (ft/s)(m/s)**		

$m^3/s \times 35.3 = ft^3/s$

Total Flow (Discharge) (∑Q) (ft^3/s)	

* Make a minimum of 10 measurements when the total width is > 5.0 ft, 20 measurements preferred.

** When water is < 2.5 ft deep take one measurement at each cross section. When water is > 2.5 ft deep, take two measurements at each cross section; one at the total depth and the other at 2 x the total depth. Average the two velocity measurements. See SWAMP Procedures Manual for a detailed flow measurement method.

2) SWAMP Water Quality Form for Shallow Water Sampling Event

SWAMP Shallow Water Sampling Event

*Station ID: | *Project ID: | *Sample Season: | PG: OF PGS | Entered Dbase

*Date: M M D D Y Y Y Y | *Sample Time: | Field Duplicates yes / no | SampleType= FieldBLDup

Event Type	Sample Type	*Sample Device:	*Occupation Method	*Sample Location
WaterTox_Chem WaterChem WaterTox	Grab Integrated	Indiv. Bottle by hand Indiv. Bottle by pole sampler Indiv. Bottle by bucket sampler Teflon Tubing Kemmer Sampler other_____	Walk In From Bridge R/V _____	Bank MidChannel Thalweg Open Water

*GPS / DGPS	Lat Degrees	sec / hunds	Long Degrees	sec / hunds
Nominal			-	
*Actual dec degrees			-	

*Starting Bank: LB / RB (facing downstream)

Accuracy (ft / m) | 5 decimals | *GPS Model: | 5 decimals | Datum: NAD 83 other _____

*Station Water Depth (m) : (point of sample) | *Stream Width (m) : (point of sample)

Samples Taken (# of containers filled)

	DepthCollect (m)	*Inorganics	*Bacteria	*Chl a/Boron	*TSS	*TOC /DOC	*Total Mercury	*Dissolved Mercury	*Dissolved Metals	*Total Metals	*Organics	*Toxicity	TIE	
SUBSURF/MID/ BOTTOM ABOVE/THERMO/ BELOW														
				Vol Filt: (ml)				Preservative time						
								*Preserved	In lab	In lab				

Integrated; -88 in dbase; (describe depths in comments)

Event Type: WaterChem | Sample Type: FieldMeasure

Only enter if multiple distances are taken

	*Depth Collect (m or f)	*Distance from Bank (m or f)	Velocity (fps / mps)	Air temp C	H2O temp C	pH	O2 mg/L	O2 %	Specific Conductivity (mS uS /cm)	Turbidity ntu	
SUBSURF/MID/BOTTOM ABOVE/THERMO/ BELOW											
SUBSURF/MID/BOTTOM ABOVE/THERMO/ BELOW											
SUBSURF/MID/BOTTOM ABOVE/THERMO/ BELOW											
		*Instrument:									
		*Calibration date									

Sample Comments: (failure of probe parameter should be marked as "probe failure")

Meter Used:_____

Prop used: AA / Mini

_____ rev. @ _____ (sec)

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

SWAMP WQFDS 1/02/2003

3) SWAMP Field Data Sheet

SWAMP Station Occupation Results

*Station ID:

*Date: M M D D Y Y Y Y

PG: OF PGS

Entered Dbase

*Project ID:

*Sample Season:

*Sample Time: (time of first sample)

Arrival Time:

Departure Time:

Event Type
FieldDescription

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**

APPENDIX F

INLAND EMPIRE WATERKEEPER LAB AND CALIBRATION FORMS

EQUIPMENT CALIBRATION FORM

Instrument ID	Date	Time	Name	Standard	Standard Temp.	Initial Read	Final Read	Drift

REPEAT UNTIL READING IS WITHIN RANGE.

Project Name:_____ **IEWK LAB RESULTS FORM Total Coliform/ E Coli** **Date:_____ Time:_____**

Site ID, dilution	Time in (incubator temp.)	Time read (incubator temp.)	Total Lg wells	Total Sm wells	Total MPN	E Coli Lg wells	E Coli Sm wells	E Coli MPN

Total Large possible: 49
Total small possible: 48 (for total of 97 wells)

Colilert® read between 24 and 28 hours at 35°C +/- 0.5°C
Multiply MPN by dilution factor.