

**Upper Santa Ana River Watershed
Water Quality Assessment Project
(Project # R8-USARA-08)**

Quality Assurance & Quality Control Final Report

The following is a summary of the quality assurance and quality control tests conducted over the entire project period, beginning on July 14, 2008 and ending November 24, 2009. It includes 60 weeks of data.

Equipment Calibration

As shown in Table 14 of the QAPP, the conductivity, pH and dissolved oxygen meters are to be calibrated at least 24 hours before each sampling event. Each calibration was performed the morning of the sampling event and documented on the “Equipment Calibration Form” (Appendix F of QAPP). A copy of the calibration logs may be provided upon request. Therefore, this QA/QC goal was met.

Calibration Range and Drifts.

<i>Low Limit</i>	<i>Standard</i>	<i>High Limit</i>	Number of calibration drifts out of total number of calibrations
Dissolved Oxygen (± 0.4 mg/L)			
20.5 mg/L	20.9 mg/L	21.3 mg/L	20 of 181 (11%)
Conductivity ($\pm 1\%$)			
83.16 μ S	84 μ S	84.84 μ S	34 of 185 (18%)
1398.87 μ S	1413 μ S	1427.13 μ S	40 of 178 (22%)
12.75 mS	12.88 mS	13.01 mS	48 of 185 (26%)
pH (± 0.01 pH units)			
4	4.01 \pm 0.01 (at 25°C)	4.02	9 of 181 (5%)
6.99	7.00 \pm 0.01 (at 25°C)	7.01	11 of 181 (6%)
9.99	10.01 \pm 0.01 (at 25°C)	10.02	14 of 178 (8%)

The final read during calibration with each standard is recorded and compared to the chart above. If the value is outside of the range, it is noted as drift. The instruments were each calibrated an average of 181 times during this reporting period. Calibration standards were kept in the dark at room temperature and replaced as needed. Batteries were replaced often, including the electrode on the pH meter.

Waterkeeper staff attended two inter-calibration sessions hosted at Orange County Coastkeeper by the Citizen Monitors of Orange County on April 30, 2009 and October 7, 2009 that allowed our meters to be measured for accuracy to a common standard and compared for precision to other meters. The results from both sessions show that our dissolved oxygen meter generally produced the same results for dissolved oxygen concentrations and temperature as the other meters. For three of four tests, the thermometer was 0.02 degrees higher than the standard. The

pH meter was 0.01 unit out of range 50% of the calibrations using the pH 10 standard. The same meter was 0.01 unit out of range for one of six calibrations using the pH 4 standard. The conductivity meter was out of range 100% of the time for both sessions.

The IDEXX method was calibrated on January 30, 2009 using the QC kit available for purchase from IDEXX (as reported in the second status report). It contained three vials with 1-50 organisms of three different types of bacteria: *E. coli*, *Klebsiella oxytoca*, and *Pseudomonas aeruginosa*. According to the manufacturer, the *E. coli* is a pure strain so all of the yellow cells should also fluoresce, and this is what we observed. The *Klebsiella oxytoca* is not a form of *E. coli* so the yellow cells should not fluoresce, and this is also what we observed. Lastly, the *Pseudomonas aeruginosa* is not a form of coliform bacteria so it should not be yellow or fluoresce, and this is what we observed.

Results of IDEXX Calibration

ID	Time In 1/30/09	Time Out 2/1/09	Yellow large wells	Yellow small wells	Fluoresce large wells	Fluoresce small wells	Meet QC Objective?
EC-1	17:00	17:26	5	2	5	2	Y
EC-2	17:00	17:27	14	0	14	0	Y
EC-3	17:00	17:28	9	1	9	1	Y
KP-1	17:00	17:28	6	0	0	0	Y
KP-2	17:00	17:29	14	1	0	0	Y
KP-3	17:00	17:30	11	3	0	0	Y
PA-1	17:00	17:30	0	0	0	0	Y
PA-2	17:00	17:30	0	0	0	0	Y
PA-3	17:00	17:30	0	0	0	0	Y
Lab Blank	17:00	17:30	0	0	0	0	Y

Bacteria Hold Time

As specified on page 32 of the QAPP, the hold time for bacteria is 5 hours. Using the “sample time” recorded on the “SWAMP Field Data Sheet” (Appendix E of QAPP) and comparing it to the “time in” located on the “IEWK Lab Results Form” (Appendix F of QAPP) I am able to confirm that all samples during the entire project period were processed before the 5 hour limit. Therefore, this QA/QC goal was met for the entire project period.

Bacteria Travel Temperature

As specified in Element 10 of the QAPP, bacteria samples shall be kept on ice when carried from the field to the lab. A digital thermometer (different than the thermometer used to measure creek water and ambient air temperatures) was kept in the ice chest to confirm that samples were kept at 6°C when placed in the ice chest, and when removed. It does not, however, mean the samples dropped to 6°C in the relatively short amount of time between collection and processing.

Bacteria Read Time

As specified in Appendix D of the QAPP, the bacteria counts can be read between 24 and 28 hours of incubation at 35°C. Using the “time in” and “time out” recorded on the “IEWK Lab Results Form” (Appendix F of QAPP) I can confirm whether the results were read between 24 and 28 hours. A log of the actual times can be provided upon request.

In several instances, the results were not read by the 28 hour limit:

- One set of samples from the Warm Creek sites that were incubated on 12/5/08
- One set of samples from the San Timoteo Creek sites were incubated on 1/20/09
- One set of samples from the San Timoteo Creek sites that were incubated on 6/26/09
- One set of samples from the San Timoteo Creek sites that were incubated on 8/28/09
- One set of samples from the Warm Creek sites that were incubated on 10/21/09
- One set of samples from the City Creek sites that were incubated on 11/17/09

These samples were not analyzed and instead thrown away, which resulted in losing some data points; however, make-up samples were done to replace the two most recent samples in October and November. No other sample was read outside of the 24 to 28 hour range.

Incubation Temperature

The incubator was adjusted to maintain a constant temperature of 35°C. A digital thermometer was kept inside the incubator and the temperature checked when samples were put in, and taken out. The incubation temperature never varied beyond one degree.

Triplicate Readings

As shown on the “SWAMP Water Quality Form for Shallow Water Sampling Event” (Appendix E of QAPP) it is standard practice to obtain 3 readings at each site using the temperature, pH, conductivity and dissolved oxygen meters. The final reported result is an arithmetic average of the three readings. The sample sheets indicate this was done when flow was adequate, however when flow was so small that a WhirlPak bag was used to collect water then only one reading was taken, which is standard practice as shown in Appendix C. Therefore, this QA/QC goal was met.

Bacteria Duplicates

Element 7 of the QAPP specifies that one field duplicate will be taken for bacteria from one site per week on a rotating basis. This was accomplished for all sites except for San Timoteo 1 (ST1) because it never had flow from which to sample. The purpose of this field duplicate is to deduce any sample contamination from travel and lab practices. The *E. coli* bacteria count of the field duplicate was compared to the source sample, and recorded as within or beyond the 95% confidence interval of the source sample result. Eleven field duplicates were not recorded due to field and/or lab error. Ten field duplicates were outside of the 95% confidence interval and therefore considered significantly different than the source bacteria result.

Bacteria Sample Field Duplicates and Lab Blanks.

Week	Site of Duplicate Sample	Sample Result (mpn)	Duplicate Result (mpn)	Meet Dup. Objective?	Date of Lab Blank	Meet Blank Objective?
1	None	-	-	-	None	-
2	ST-2	517.2	579.4	Y	7/23/2008	Y
3	ST-3	344.8	410.6	Y	7/31	Y
4	ST-4	>2419.6	>2419.6	Y	8/7	Y
5	CC-1	1	2	Y	8/14	Y
6	CC-2	19.9	22.3	Y	8/22	Y
7	WC-1	78.9	83.6	Y	8/27	Y
8	None	-	-	-	9/6	Y
9	WC-3	<1	<1	Y	9/12	Y

Week	Site of Duplicate Sample	Sample Result (mpn)	Duplicate Result (mpn)	Meet Dup. Objective?	Date of Lab Blank	Meet Blank Objective?
10	None	-	-	-	9/16	Y
11	WC-3	980.4	1553.1	N	9/24	Y
12	None	-	-	-	10/4	Y
13	ST-4	1553.1	1046.2	Y	10/10	Y
14	WC-4	435.2	365.4	Y	10/18	Y
15	ST-2	22.3	32.7	Y	10/26	Y
16	ST-3	36.4	31.3	Y	11/1	Y
17	ST-2	1553.1	1732.9	Y	12/5	Y
18	ST-3	275.5	920.8	N	12/14	Y
19	ST-4	2419.6	816.4	N	12/21	Y
20	None	-	-	-	None	-
21	None	-	-	-	None	-
22	WC-1	10.9	10.9	Y	1/10/2009	Y
23	WC-2	1203.3	1553.1	Y	1/17	Y
24	None	-	-	-	None	-
25	None	-	-	-	1/30	Y
26	WC-3	4.1	<1.0	N	2/5	Y
27	WC-4	76.3	62	Y	2/11	Y
28	CC-1	3.1	3	Y	None	-
29	CC-2	<1.0	2	Y	2/28	Y
30	None	-	-	-	3/20	Y
31	ST-2	167	187.2	Y	5/9	Y
32	ST-3	191.8	172.5	Y	5/11	Y
33	None	-	-	-	5/22	Y
34	WC-1	73.3	54.6	Y	None	-
35	WC-2	488.4	517.2	Y	6/4	Y
	ST -4	435.2	261.3	N		
36	WC -3	547.5	613.1	Y	None	-
37	WC -4	920.8	980.4	Y	6/16	Y
38	CC -1	4.1	5.2	Y	None	-
39	CC -2	85.7	71.2	Y	7/2	Y
40	ST -2	1046.2	920.8	Y	7/9	Y
41	ST -3	1299.7	1413.6	Y	7/15	Y
42	ST -4	1119.9	1046.2	Y	7/22	Y
43	WC -1	88.2	81.3	Y	7/30	Y
44	WC -2	1986.3	387.3	N	8/7	Y
45	WC -3	387.3	214.3	N	8/13	Y
46	WC -4	17.3	18.9	Y	8/20	Y
47	CC -1	7.4	9.6	Y	8/28	Y
48	ST-2	39.9	57.3	N	9/4	Y
49	ST-3	1413.6	1732.9	Y	9/9	Y
50	ST-4	261.3	410.6	N	9/15	Y
51	ST-2	410.6	517.2	Y	9/24	Y
52	ST-3	1986.3	1986.3	Y	9/28	Y
53	ST-4	1046.2	920.8	Y	10/8	Y
54	CC-1	2.0	2.0	Y	10/17	Y
55	None	-	-	-	10/23	Y

Week	Site of Duplicate Sample	Sample Result (mpn)	Duplicate Result (mpn)	Meet Dup. Objective?	Date of Lab Blank	Meet Blank Objective?
56	CC-2	35.5	43.2	Y	10/27	Y
57	WC-4	32.7	22.8	Y	11/5	Y
58	ST-2	67.7	93.3	N	11/14	Y
59	ST-3	166.4	214.3	Y	11/18	Y
60	ST-4	157.6	116.2	Y	11/24	Y
Percent Success						
-	49/60 = 82%	-	-	40/50 = 80%	52/60 = 87%	52/52=100%

As shown above, the project obtained 82% of planned field duplicates, and of those, 80% were within a 95% confidence interval indicating that the duplicate is not significantly different than the source. The project also obtained 87% of planned lab blanks, of which 100% contained no measurable *E. coli* or Total Coliform bacteria.

Bacteria Lab Blanks

As detailed in Element 14 of the QAPP, one lab blank was prepared per week to measure process and material contamination from IDEXX materials. No lab blanks were prepared in eight of the 60 weeks due to a lab oversight. All lab blanks were found to have < 1.0 mpn/100 mL suggesting no measurable lab equipment or material contamination into the samples.

For the Future

Several questions arose during the preparation of this report for the Regional Board to consider in similar future projects. First, is the result an exceedance if equal to the objective? Second, how should calibration drift be handled? Third, when streams are braided should the largest be measured alone, or each summed together?