January 11, 2013

Dave Gibson, Executive Director
Regional Water Quality Control Board
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Wayne Chiu
Regional Water Quality Control Board
9174 Sky Park Court
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COMMENTS - TENTATIVE ORDER NO. R9-2013-0001, REGIONAL MS4 PERMIT, PLACE ID: 786088Wchiu

Dear Mr. Gibson:

The City of Laguna Niguel appreciates this opportunity to comment on the draft Regional MS4 Permit for the San Diego Region (Tentative Order No. R9-2013-0001 – NPDES No. CAS0109266). The City is generally very supportive of the proposed re-organization of the Permit and the consolidation of programs within the Water Quality Improvement Plan framework. Your staff is to be commended for their extensive re-writing and outreach efforts.

However, there are still significant unresolved issues, and the City continues to believe that the Draft Permit should be considered a work in progress. The County of Orange, as the Principal Permittee for South Orange County, is addressing key issues in a letter being forwarded separately, and is providing detailed redline text edits. The City of Laguna Niguel has reviewed the legal, technical and monitoring comments being submitted by the County of Orange as Lead Permittee. The City of Laguna Niguel concurs with, adopts and incorporates into this letter the comments, concerns, and recommended deletions and modifications to the Draft Permit that are being submitted by the County of Orange.

New Bacteria Data and Implications

As Laguna Niguel's urban runoff program manager, I have actively participated as South Orange County's representative to the San Diego Region's Beaches & Creeks Bacteria TMDL Stakeholder Advisory Group (SAG) since 2002. I would like to bring to your attention the fact that **some critical new information, specifically related to the Bacteria TMDLs provisions, has become available in the last two weeks.** The new information strongly supports the understandings reached through 10 years of workshops, hearings, drafts and re-drafts of the Bacteria TMDL I for Beaches and Creeks, and for the Bacteria TMDL Implementation Provisions, both of which have been formally incorporated as Basin Plan Amendments. Your staff, the Permittees, the environmental groups, the Federal EPA, and the Regional Board put extensive work into to negotiating specific ideas and delicately-phrased language into the Basin Plan Amendment (BPA), to which all parties could commit. **The new information demonstrates the wisdom and prescience of the existing Basin Plan Amendment language**.

Our concern is that the TMDL Provisions in Attachment E of the Draft Regional Permit do not honor that hard-won consensus, and instead are contrary, in critical ways, to the Board-approved assumptions and requirements of the Basin Plan Amendments. In essence, **Attachment E sets several bars in wrong places**. If the language is not corrected, the net results are highly likely to be:

- It will be infeasible for us as Permittees to get or stay in compliance with the TMDLs.
- We will violate Numeric Effluent Limitations, which have been built into the Draft MS4 Permit as Water Quality Based Effluent Limitations.
- Under Porter-Cologne, local city governments will therefore be subject to potentially enormous Mandatory Minimum Penalties, and the Regional Board may not have discretionary authority to circumvent the situation.

Some parties have questioned whether these assertions, which have already been raised in several workshops, have been more melodramatic than technically accurate. Much of the quandary surrounds the question of whether it is or is not, in fact, reasonably feasible for Permittees to achieve the indicator bacteria concentration objectives as consistently as the Draft Permit requires (i.e., 100% of the time in dry weather, and at least 78% of the time in wet weather). Fortunately, within the last two weeks, new sets of bacteria data have become available that help answer this question, specifically for San Diego Region creeks. In short, the answer is: ***no***.

Attached to this letter is a copy of the Year 1 Data Summary from the San Diego Regional Stream Reference Study. This study, which is still in progress, is being conducted, compiled and analyzed by the highly-respected non-partisan scientific organization, the Southern California Coastal Waters Research Project (SCCWRP), in cooperation with the Permittees, the Regional Board, and Federal EPA. The Study was undertaken as a direct procedural outcome of provisions incorporated into the Bacteria TMDL I and Implementation Provisions Basin Plan Amendments (BPAs), both of which stipulate that "*it is not the intent of these bacteria TMDLs to require treatment of natural sources of indicator bacteria";* the BPA-defined purpose of the Study was to find out whether, how often, and by how much *"natural sources cause exceedances of indicator bacteria water quality [concentration] objectives on their own, without contributions from anthropogenic sources."* **The preliminary Study data demonstrated that *natural***

bacteria exceedance frequencies in creeks were up to 71% in dry weather (versus the 0% required in the Draft Permit), and up to 100% in wet weather (versus the 22% allowed in the Draft Permit). *Natural* creek bacteria concentrations jump around a lot, ranging up to 15 times higher than the concentration objectives in both wet and dry weather. In other words, the indicator bacteria concentration objectives and "allowable" exceedance frequencies currently proposed in the Draft Permit are *unnatural* for San Diego Region creeks. Requiring Permittees to achieve them is asking us to do battle with Mother Nature herself. It would be a battle we would almost certainly lose.

Waste Loads vs. Concentrations

Understanding this reality provides insight into why determining impacts or compliance through concentration objectives, as proposed in the Draft Permit, is not feasible: such an approach only takes into account how many bacteria might happen to be caught in a random sampling vial, regardless of whether there is only a trickle of water or a flood. The Waste Load Allocations in the TMDLs Basin Plan Amendments, in contrast, describe the total number of *controllable anthropogenic* bacteria that are allowed to be discharged from an MS4 over the course of a specified time period (i.e. monthly for dry weather, and annually for wet weather). The Waste Load Allocations are determined as a function of total flow volume and bacteria concentrations that *on average overall* meet the concentration objectives.

Compliance Determination

For an MS4 manager trying to stay in compliance with the Permit, the difference between being judged on grab-sample concentrations and Waste Load Allocations is really insurmountable. Aside from the inherent jumpiness and high exceedance frequency of *natural* bacteria populations that the Permittees (pursuant to the Basin Plan Amendments) aren't supposed to have to control, the International Stormwater BMP Database, which compares the performance of various stormwater BMP types in achieving wet-weather effluent concentrations of indicator bacteria, identifies *no* BMPs that can achieve the effluent bacteria concentrations required for creeks under the draft Permit. The Database does, however, identify several stormwater BMPs that could feasibly achieve significantly more than the currently-required -22% as a bacteria *load* reduction in treated stormflows from individual sites. With respect to dry weather, several Permittee-implemented projects have demonstrated the ability to achieve 90% or greater reductions in anthropogenic dry weather bacteria *loads* through a combination of BMP treatments and flow reduction techniques; but none are consistently perfect in terms of bacteria concentrations. Achieving the implementation of Waste Load Allocations through appropriately-designed and appropriately-distributed systems of prevention, treatment and volume reduction BMPs targeting overall anthropogenic flow volumes and bacteria sources over time will be really the only feasible way for Cities to comply with the TMDLs – and is exactly what was envisioned in the approved Basin Plan Amendments. TMDL compliance determination needs to be based on load reductions achieved through BMP programs.

Water Quality Based Effluent Limits

The calculated TMDL Waste Load Allocations were incorporated directly into the TMDL Basin Plan Amendments. Federal law requires that Water Quality Based Effluent Limits set forth in an MS4 Permit, which make the TMDLs enforceable, have to be consistent with any available TMDL Waste Load Allocations. By leaving the Waste Load Allocations out of the Draft Permit and instead defining bacteria concentrations as Water Quality Based Effluent Limits, the Draft Permit contradicts Federal law, and establishes the concentrations as Numeric Effluent Limits under Porter-Cologne. **Exceedance of a Numeric Effluent Limit established in an MS4 Permit triggers Mandatory Minimum Penalties under Porter-Cologne.** Because natural bacterial exceedances and BMP performance limitations mean that the bacteria objective concentrations cannot feasibly be attained with adequate consistency, the **Permittees are being set up for failure and exposure to Mandatory Minimum Penalties, which the Regional Board would not have discretion to modulate.** Mandatory Minimum Penalties, which could easily run into hundreds of thousands of dollars daily, serve no good purpose for MS4s Permittees, the Board or the environment. Even the State Water Board's own Blue Ribbon Panel has concluded that incorporating Numeric Effluent Limits in MS4 Permits is *not feasible*. The WQBELs need to be *load-based*, and compliance needs to be based on implementing BMPs that achieve *load reductions.*

Provision for Re-Opener

When the Board approved the Bacteria TMDL Basin Plan Amendment in 2009, it committed specifically to a 5 year re-opener. The Board made that commitment because it recognized the TMDL had inherent flaws, principally because there were large gaps in the data used to inform the TMDL calculations. The plan was, that the Permittees would use the 5 years to do research to flesh out the local data, do some number-crunching, and bring back more locally appropriate Waste Load Allocations and exceedance frequency targets. With the re-opener, the updated allocations and frequencies would re-set the bar that Permittees would have to jump over – whether it was higher or lower. The Permittees are doing their part: we put funding together and started the research last winter to close the data gap, in conjunction with the Southern California Coastal Waters Research Project. Already, we have preliminary data demonstrating just how necessary that re-setting of the bar is likely to be. But the Permit, as currently drafted, doesn't keep the Board's part of the bargain, and doesn't recognize the course-correction that this Board had agreed was appropriate and necessary. An explicit commitment to the re-opener is needed.

Baseline for Improvement

Adding to the problem, the Draft Permit changes our starting line for measuring dry weather compliance. The Bacteria TMDL BPA specifically states that the "*available historical monitoring data from the years 1996-2002 shall be used to calculate the "existing" dry weather exceedance frequency of the 30-day geometric mean REC-1*

WQOS for each watershed." The Draft Permit proposes changing the baseline to between 2002 and 2011. The Permittees have already spent millions of dollars between 2002 and 2011 on efforts to reduce anthropogenic bacteria waste loads. In some cases, Permittees are already close to achieving the final percent waste load reductions defined as numeric targets in the TMDLs, and some Permittees have attained 303(d) de-listings as a result of their efforts. Think about the math of it: if the final load reduction target was set at 75% in the approved TMDL BPA, and a Permittee had achieved a 70% bacteria load reduction prior to 2011, changing the starting date to 2011 would effectively change the overall load reduction needed from 75% to 92.5% - which would be a huge amount of unjustified additional work. Permittees have spent the last 2 years developing Bacteria Load Reduction Plans, based on the percent reductions that were agreed to in the TMDL Basin Plan Amendments. The Draft Permit needs to honor the agreed-upon starting date.

In summary: the City of Laguna Niguel requests correction of all the Attachment E TMDL provisions in the Draft Permit that are inconsistent with Federal law, contrary to the intent of the Basin Plan Amendments, and will result in non-discretionary Mandatory Minimum Penalties. The necessary corrections are all delineated in the redline/strike-out Permit text that the County of Orange is attaching to its comment letter on behalf of the Co-Permittees.

Thank you for the opportunity to provide comments. I would be happy to meet with you to discuss any of these issues. I can be reached at (949)362-4384 or npalmer@cityoflagunaniguel.org.

Sincerely,

Nancy R. Palmer
City Landscape Architect/Environmental Programs Manager

Attachment: San Diego Regional Stream Reference Study – Monitoring Progress Report #3 and Year 1 Data Summary (October 2011 through November 2012)

`SAN DIEGO REGIONAL STREAM REFERENCE STUDY MONITORING PROGRESS REPORT #3 AND YEAR 1 DATA SUMMARY OCTOBER 2011 THROUGH NOVEMBER, 2012

This Monitoring Progress Report is a summary of work completed from October 1, 2011 to November 31,2012. A data summary is provided and represents results based on calculation of Year 1 data. These will change as Year 2 data are included and are considered to be preliminary.

1 QAPP Approval and Amendment

The QAPP was submitted to the San Diego Regional Board in October 2011 and approved in December 2011.
A QAPP amendment was submitted and approved by the San Diego Regional Board in February 2012. The QAPP was amended to reflect the following changes:

- Laboratories and responsibilities (i.e. mobile lab)
- Updated sites including Prima Deschecha sediment basin and storm drain study
- Toxicity sampling approach
- Analyte list
- Sample volumes

2 Summary of Wet Weather Monitoring Activities:

Site installations were completed at all selected wet weather monitoring locations in late-January 2012 and as of February 2012, the project team was prepared for mobilization. To mobilize for a storm, AMEC reviews National Weather Service (NWS) San Diego, Los Angeles and other weather predictions and communicates with SCCWRP to assist in a go-no-go decision to mobilize. Additional site reconnaissance was conducted during the December and March timeframe to gain a better understanding of flow conditions at a particular site.

Six wet weather locations were finalized for stream monitoring (Table 1). Two of the original wet weather monitoring locations were rejected due to access issues: (1) San Clemente Canyon located within the Rose Canyon Watershed and (2) Cedar Creek located within the San Diego River Watershed. Two additional locations in the Prima Deschecha subwatershed will be monitored during wet weather only to isolate potential inputs to Cristianitos Creek.

Table 1 – Monitoring Locations. IM – Igneous/Metamorphic, SED – Sedimentary; Size: S – Small, M – Medium, and L – Large

Station Code	Stream Name	Watershed	Size	Geology	County
LCC	Long Canyon Creek	Tributary to Kitchen Creek	S	IM	San Diego
KC	Kitchen Creek	Kitchen Creek-Cottonwood Creek	M	IM	San Diego
SJC	San Juan Creek	Upper San Juan Creek	L	IM	Orange
BCC-1	Bell Canyon Creek-1	Middle San Juan Creek	S	SED	Orange
JC	Jardine Creek	San Onofre Creek	M	SED	Orange
CCCP	Cristianitos Creek	Lower San Mateo Creek	L	SED	Orange

2.1 Summary of Monitored Wet Weather Events

Since the inception of sampling, four storm events (February 13, 2012, March 17, 2012, March 25, 2012, April 26, 2012) have met the mobilization criteria and project field crew mobilized for each event. Cumulatively, since the program began in December 2010, project staff have monitored one wet weather event 1 at 3 sites (Cristianitos Creek+Prima Deschecha Golf Course+ Sediment Basin, San Juan Creek, and Long Canyon Creek).This section provides a summary of the monitored events, false-start events, and hydrographs for each monitored event.

Table 2 provides a summary of the wet weather event data including site, event date, total rainfall, flow, and total number of primary samples collected per site. The event hydrographs for Cristianitos Creek, Prima Deschecha, Golf Course, and Prima Deschecha, Sediment Basin and San Juan Creek are provided in Figures 1-5, respectively.

Table 2: Wet Weather Event Monitoring Summary

Date	Event Number	Site	Total Event Rainfall (inches)	Flow (cf)	Flow Start Time (MM/DD/YYYY hh:mm)	Flow End Time (MM/DD/YYYY hh:mm)(1)	Storm Size Category	Season	Total Primary Samples	Comment
2/13/2012	False Start	KC	0.56	N/A	N/A	N/A	Medium	Late	0	Forecast rain resulted in snow. Due to safety concerns, field crews stood-down. Rainfall data as measured at Cameron Fire Station. Accuracy of rainfall total may have been affected by snow melt.
2/13/2012	False Start	LCC	0.56	N/A	N/A	N/A	Medium	Late	0	Forecast rain resulted in snow. Due to safety concerns, field crews stood-down. Rainfall data as measured at Cameron Fire Station. Accuracy of rainfall total may have been affected by snow melt.
2/14/2012	Recon.	JC	N/A	N/A	N/A	N/A	N/A	Late	0	Post storm reconnaissance conducted.
2/14/2012	Recon.	CCCP	N/A	N/A	N/A	N/A	N/A	Late	0	Post storm reconnaissance conducted.
2/14/2012	Recon.	BCC-1	N/A	N/A	N/A	N/A	N/A	Late	0	Post storm reconnaissance conducted.
3/17/2012	Wet Event 1	CCCP	0.81	17,392,876	3/17/2012 13:38	3/18/2012 09:43	Medium	Late	9	Successfully completed.
3/17/2012	Wet Event 1	PDGC	0.81	57,079	3/17/2012 08:23	3/18/2012 10:31	Medium	Late	1	Successfully completed. AMEC needs to verify concurrent sampling approach with CCCP.
3/17/2012	Wet Event 1	PDSB	0.81	394,277	3/17/2012 07:32	3/18/2012 09:42	Medium	Late	1	Successfully completed. AMEC needs to verify concurrent sampling approach with CCCP.
3/17/2012	False Start	SJC	2.15	N/A	N/A	N/A	Large	Late	0	Equipment Malfunction – SCCWRP was not charged for this event.
3/17/2012	False Start and Recon.	JC	1.21	N/A	N/A	N/A	Large	Late	0	Creek was dry; therefore a sample could not be collected. Post storm reconnaissance conducted.
3/17/2012	False Start	BCC-1	1.63	N/A	N/A	N/A	Large	Late	0	Creek did not have sufficient flow within approximately 16 hours of mobilization. SCCWRP and AMEC agreed to stand-down. Additional verification from Starr Ranch and visual observation recon.
3/25/2012	Wet Event 1	SJC	1.05	892,288	3/25/2012 16:08	3/29/2012 08:49(2)	Large	Late	13	Successfully completed.
4/26/2012	False Start	KC	0.46	N/A	N/A	N/A	Medium	Late	0	Creek did not have sufficient increase in stage to initiate sampling.
4/26/2012	Wet Event 1	LCC	0.46	226,095	4/26/2012 00:20	4/29/2012 09:20	Medium	Late	11	Successfully completed.

Note:
Flow stop time based upon completion of sampling event when storm flow returned to approximately 25% above pre-storm base flow.
Storm Category: Trigger 0.1-0.2 inches of rainfall; Medium 0.2-1 inch of rainfall; Large >1 inch of rainfall.

Season: Early (before December) or Late (after December).
N/A = Flow data not generated for false start events.
Recon. = Reconnaissance.
Site IDs: BCC-1-Bell Canyon Creek, CCCP- Cristianitos Creek, JC Jardine Creek , KC-Kitchen Creek, LCC-Long Canyon Creek, PDGC -Prima Deschecha Golf Course, and PDSB -Prima Deschecha Sediment Basin

Figure 1: Cristianitos Creek (CCCP) – Wet Weather Event 1 Hydrograph (March 17 – 20, 2012)

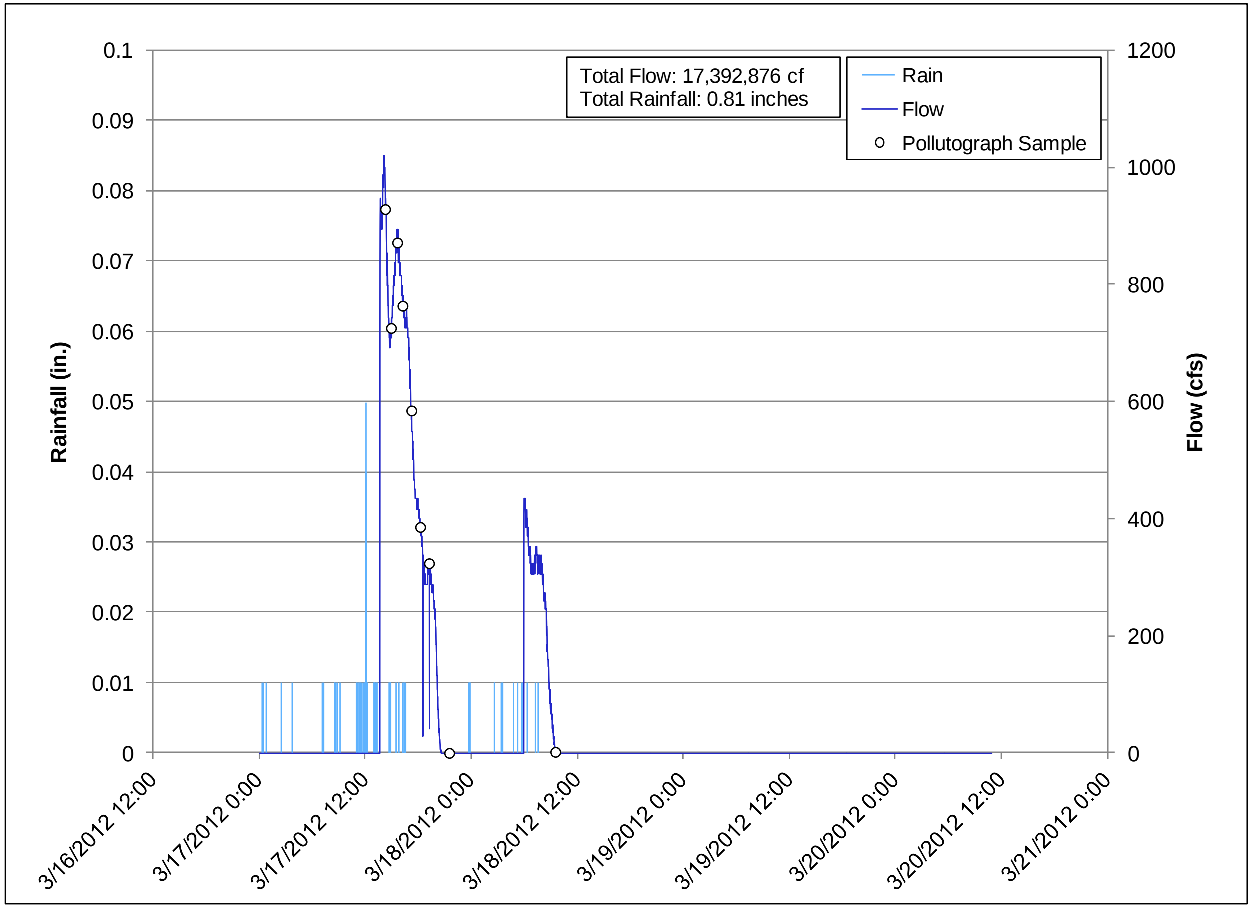


Figure 2: Prima Deschecha Golf Course Outlet (PDGC) – Wet Weather Event 1 (March 17, 2012)

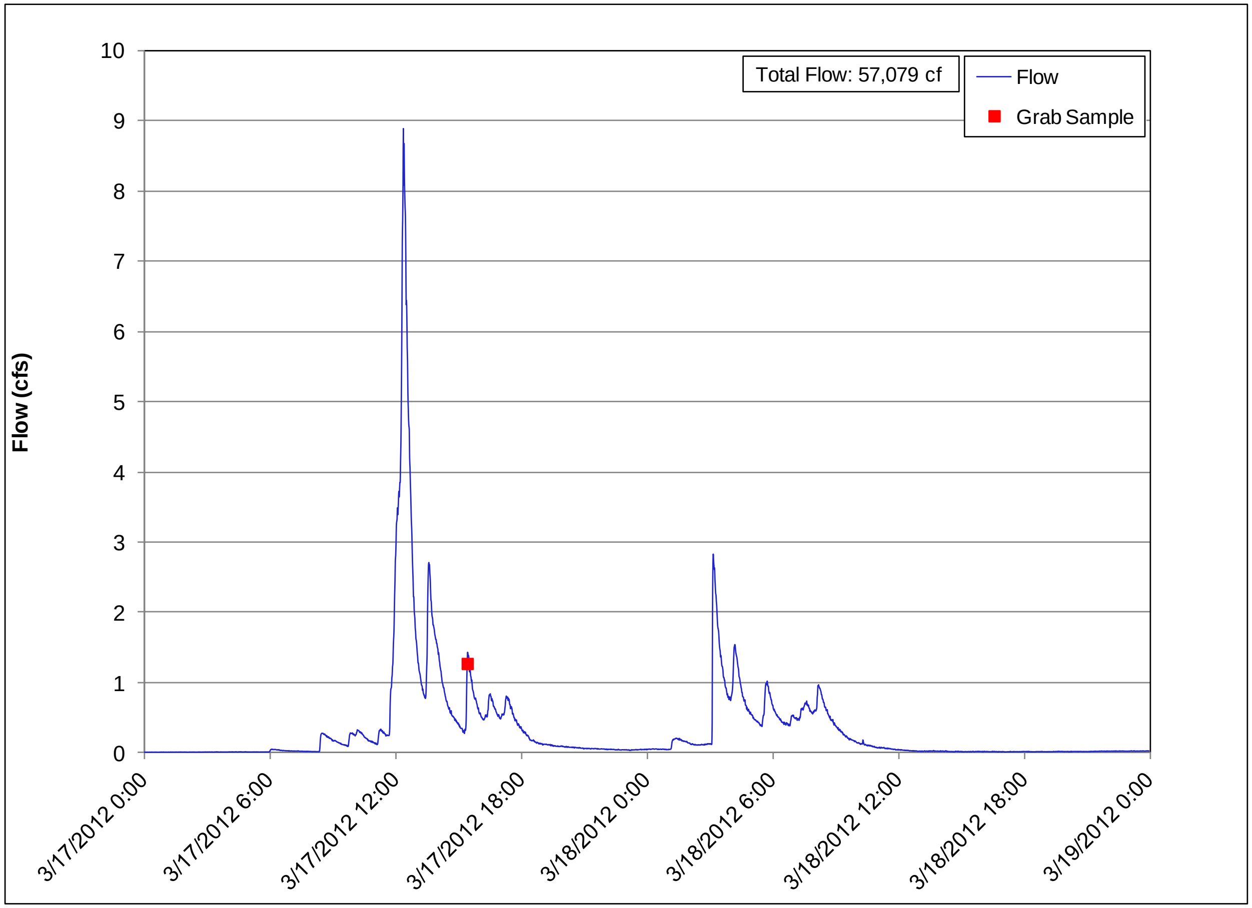


Figure 3: Prima Deschecha Sediment Basin (PDSB) – Wet Weather Event 1 Hydrograph (March 17, 2012)

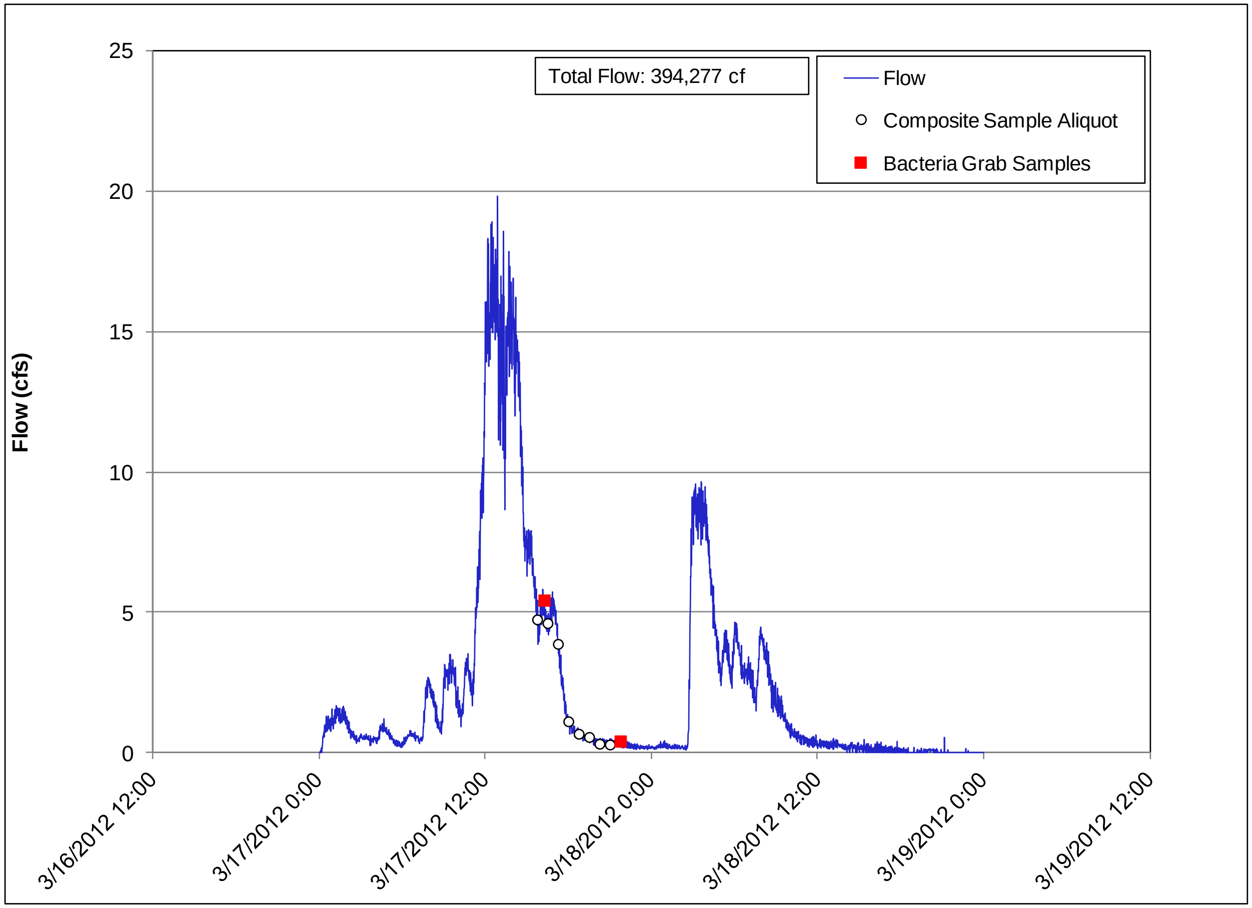


Figure 4: San Juan Creek (SJC) – Wet Weather Event 1 (March 25 – 28, 2012)

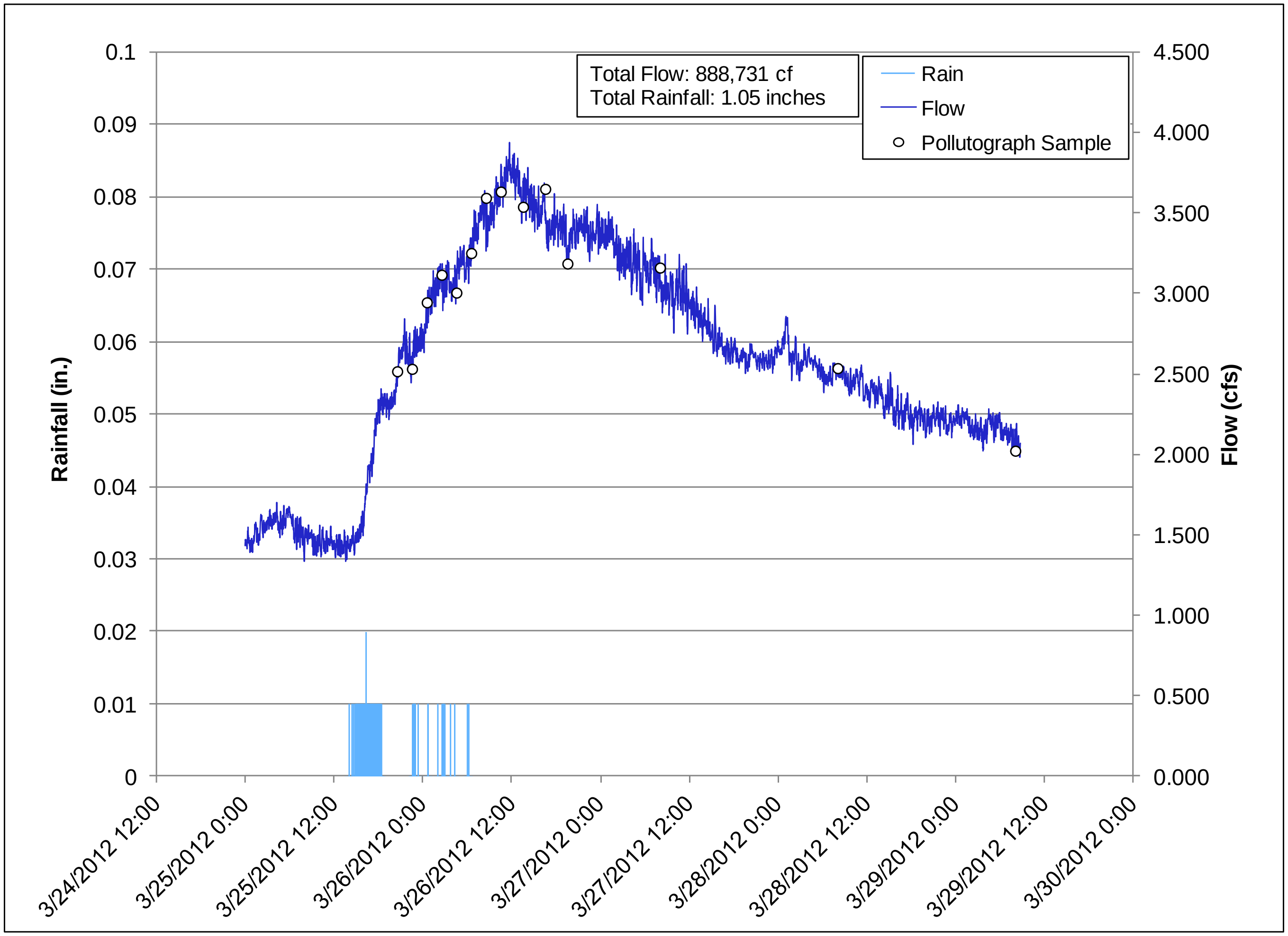
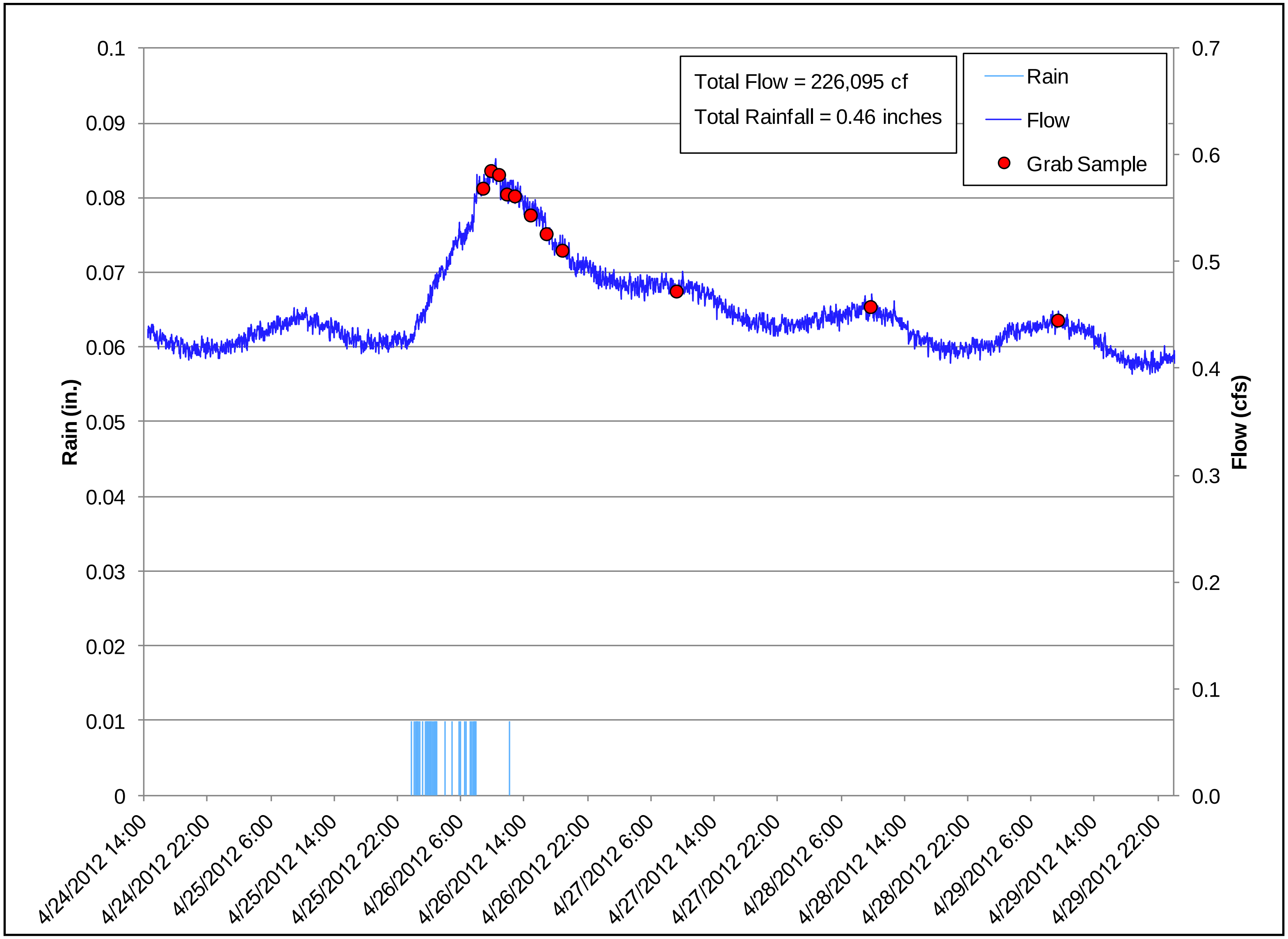


Figure 5: Long Canyon Creek (LCC) – Wet Weather Event 1 Hydrograph (April 26 – 29 2012)



3 Summary of Dry Weather Monitoring Activities and Events

3.1 Sampling Sites

Recon of dry weather sites selected in Fall 2011 began in March 2012. Of these initial set of sites, 6 were dry and 3 were considered not to be reference because of evidence of human disturbance (Table 3). The sites that were dry will be observed beginning next fall and sampling reinitiated if flow returns.
Dry weather sampling was initiated the first week of April 2012 at seven reference streams located in both Orange and San Diego counties (Table 4). Further site reconnaissance was conducted during the April - May timeframe to target additional reference streams that met the San Diego Reference Stream monitoring program criteria. During this reconnaissance, two new streams located in San Diego, CA were added to the dry weather sampling regime (Agua Caliente Creek and Conejos Creek located in the El Capitan Reservoir) (Table 4). **No additional sedimentary sites were found within the study area.** Dry weather sampling commenced the third week of May at Conejos Creek and the fourth week of May at Agua Caliente Creek.

Reconnaissance on additional sedimentary and replacement dry weather sites have been conducted outside of the current study area. The decision on whether to add these sites to dry weather sampling was discussed with stakeholders in a meeting held September 26, 2012. During this meeting four streams were accepted to be added to the dry weather sampling regime: Fremont Canyon Creek and Santiago Creek in Orange County, Aliso Canyon Creek in Riverside and Dazur Creek in San Diego, CA. (Table 5).

3.2 Sampling Activities

For dry weather sampling, a site was eligible for sampling if it had not received measurable rainfall for at least 24 h and flow was no more than 20% above baseflow. Weekly sampling continued as long as there was measurable stream flow. For intermittent streams (i.e. Conejos Creek), sampling was suspended once the stream was too low to sample or ceased flowing (i.e. dry creek bed). Based on these criteria, the duration of sampling at the six reference sites and 3 non-reference sites has ranged from 4 to 19 weeks.

Currently, weekly dry-season bacteria and bi-weekly sampling for nutrients, trace metals and conventional constituents (i.e. total suspended solids (TSS)) has ceased at all sites; Table 6). Six to 18 weekly primary FIB samples were collected, 2 to 9 bi-weekly nutrient, trace metals, and conventional samples were collected, and 1 to 2 algal assessments have been measured at each natural stream with an overall total of 129, 58 and 9 primary samples collected respectively (Table 6). Mean stream flow during the sampling period for all sites combined was 0.013 ± .009 SD (Table 6).

Table 3: Original Dry Weather Reference Stream Monitoring Locations

Station Code	Stream Name	HUC_12_ Watershed	Latitude	Longitude	Area (Km2)	Size	Geology	Types	County
BCC-1[a]	Bell Canyon Creek-1	Middle San Juan Creek	33.6359	-117.5558	18.2	S	SED	Wet/dry	Orange
ATC[b]	Arroyo Trabuco	Arroyo Trabuco	33.6745	-117.5469	31.0	S	SED	Dry	
JC[a]	Jardin Creek	San Onofre Creek	33.39991	-117.4983	33.0	M	SED	Wet/dry	Orange
BCC-2[a]	Bell Canyon Creek-2	Middle San Juan Creek	33.56420	-117.5640	48.8	M	SED	Dry	Orange
BCC-3[a]	Bell Canyon Creek-3	Middle San Juan Creek	33.54489	-117.5613	52.2	M	SED	Dry	Orange
ASC[a]	Arroyo Seco Creek	Arroyo Seco Creek	33.45752	-116.9708	33.6	M	IM	Dry	Riverside
CCCP[a]	Cristianitos Creek	Lower San Mateo Creek	33.42739	-117.5698	80.0	L	SED	Wet/dry	Orange
SJC[b]	San Juan Creek	Upper San Juan Creek	33.58799	-117.5165	96.9	L	IM	Wet/dry	
LPC[b]	La Posta Creek	La Posta Creek	32.7002	-116.4801	115.3	L	IM	Dry	

(a) Six streams (BCC-1, JC, BCC-2, BCC-3, ASC & CCCP) were dry prior to the onset of dry season sampling in April 2012.
(b) Three locations (ATC, SJC and LPC) were considered not to be reference because of evidence of human disturbance (HWY 74 repaved) and/or grazing, however, sampling was initiated & continued at these sites to verify the validity of this assessment.

Table 4. April - July 2012 Dry Weather Monitoring Locations. IM – Igneous/Metamorphic, SED – Sedimentary; Size: S – Small, M – Medium, and L – Large

Site Code	Stream Name	Watershed	Size	Geology	County
USJ	Upper San Juan Creek	Upper San Juan Creek	S	IM	Orange
LCC	Long Canyon Creek	Tributary to Kitchen Creek	S	IM	San Diego
KC	Kitchen Creek	Kitchen Creek-Cottonwood Creek	M	IM	San Diego
PVC	Pine Valley Creek	Upper Pine Valley Creek	M	IM	San Diego
ACC	Agua Caliente Creek	Laguna Creek/ San Luis Rey River	M	IM	San Diego
LPC	La Posta Creek	La Posta Creek	L	IM	San Diego
CONC	Conejos Creek	San Diego River	L	IM	San Diego
SJC	San Juan Creek	Upper San Juan Creek	L	IM	Orange
ATC	Arroyo Trabuco Creek	Arroyo Trabuco	S	SED	Orange

Table 5. Additional Sedimentary and Replacement Dry Weather Monitoring Locations Accepted by Stakeholders in September 2012. IM – Igneous/Metamorphic, SED – Sedimentary; Size: S – Small, M – Medium, and L – Large

Site Code	Stream Name	Watershed	Size	Geology	County
SANT	Santiago Creek	Santiago Canyon Creek	S	SED	Orange
FCC	Fremont Canyon Creek	Fremont Canyon Creek	M	SED	Orange
ALIS	Aliso Canyon Creek	Aliso Canyon Creek	M	SED	Riverside
DULZ	Dulzura Creek	Otay River	L	IM	San Diego

Table 6. Dry season (2012) event monitoring summary including site, sampling start and end dates, total number of primary fecal indicator bacteria (FIB), trace metals, nutrients, conventionals (i.e. total suspended solids) and total number of algal assessments collected per site.

Site Code	Dry Weather Sampling Start Date	Dry Weather Sampling End Date	Total Sampling Weeks/yr	Total Bacteria Samples Collected (includes 30 d geomean)	Total Nutrient, Trace Metals and Conventional Samples Collected	Total No. Algal Assessments	Mean flow (m^3/sec)	Comment
LCC	4/2/2012	7/30/2012	18	19	9	2	0.0159	
LPC	4/2/2012	7/30/2012	18	19	9	0	0.0264	Evidence of grazing observed at site
KC	4/2/2012	6/25/2012	13	15	6	2	0.0369	
PVC	4/2/2012	7/2/2012	14	17	7	2	0.0242	
ACC	5/22/2012	6/12/2012	4	6	2	1	0.0013	
CONC	5/16/2012	6/14/2012	5	6	2	2	0.0006	
USJ	4/30/2012	7/3/2012	10	11	5	0	0.0024	
SJC	4/2/2012	7/31/2012	18	18	9	0	0.0032	Road repaved, sampling suspended
ATC	4/2/2012	7/31/2012	18	18	9	0	0.0066	Evidence anthropogenic disturbance
	Overall Total		**18**	**129**	**58**	**9**	0.0131 ± 0.0087	**Mean ± SD**

4 Quality Assurance/Quality Control (QA/QC) of Year 1 Monitoring Data

The primary goal of the quality assurance/quality control (QA/QC) effort was to ensure that the sediment chemistry, nutrient and bacteria data generated by the three study participants were complete and met common data quality objectives (DQOs) for criteria pertaining to sensitivity, accuracy, and precision.

4.1 Reporting Limits

To achieve study goals, minimum target reporting limits (RLs) for each analyte were set forth in the San Diego Regional Reference Stream QAPP (Table 6-1). These RLs were set to achieve the Surface Waters Ambient Monitoring Program (SWAMP) target thresholds. Overall, participant-specific minimum RLs were lower than the target RLs, indicating that the analyses performed provided adequate sensitivity.

4.2 QA/QC Goals and Success

The sample storage conditions and maximum hold time requirements and success achieved are summarized in Table 7. Except for 25 grain size samples, all participating labs performed their analyses within the specified holding times.

The remaining criteria and corresponding DQOs, along with the degree of project success in attaining these goals, are summarized in Tables 8-9. Of the 125 samples delivered to the laboratories, over 97% of the samples were analyzed and data reported attaining our completeness DQO of 90%. Of the 85 laboratory analyses run for chemical contamination, approximately 99% had no detectable chemical measurements in blank samples. Of the remaining samples with detectable blanks values, no batch had a value more than three times the detection limit. Laboratories also attained success in accuracy DQOs for blank spiked samples (100.0% for trace metals and nutrients), matrix spiked samples (100% for trace metals and nutrients), and CRMs (96.0% for trace metals and 98.5% for nutrients). Finally, laboratories attained success in precision DQOs for laboratory duplicate samples (97.4% for trace metals, 98.0% for nutrients, and 100% for bacteria, TOC, TDS and TSS) and matrix spike duplicate samples (98.5% for trace metals and 97.6% for nutrients).

Overall, the majority of QA/QC criteria were met with greater than 90% success and completeness. For those few instances where specific criteria were not met, deviations did not impart additional uncertainty in the measurements and therefore did not warrant removal or exclusion of any data from the study database. All of these deviations, however, were noted in the study database for individual users to make their own decisions regarding data quality.

Table 7: Achievement of sample storage conditions and maximum holding time criteria.

Parameter	Storage Condition	Maximum Holding Time	Actual Hold Times (days)	Percent Success
Alkalinity (Total Alkalinity as CaCO3)	< 6°C and store in the dark	14 days	3-14	100%
Chloride		28 days	3-25	100%
Hardness (Total Hardness as CaCO3)		6 months	3-25	100%
Sulfate		28 days	3-25	100%
TDS		7 days	3-30	94%
TSS		7 days	3-30	94%
Enterococcus	< to 6°C in the dark[b]	8 hours[a]	8	100%
E. coli			8	100%
Total Coliform			8	100%
Bacteroides			8	100%
M. smithii			8	100%
Bacteria community			8	100%
Nitrate + Nitrite (as N)	Cool to 4°C, store in the dark, filter and freeze at -20°C	48 hours; 28 days if frozen	10-26	100%
Ammonia (as N)		48 hours; 28 days frozen	10-26	100%
Total Dissolved Nitrogen	Cool to 4°Cand store in the dark, filter and freeze at -20°C	28 days if frozen	10-26	100%
Orthophosphate (dissolved; Soluble Reactive Phosphorus)	Cool to 4°C and store in the dark	48 hours	48 hours	100%
TDP		28 days	10-26	100%
Particulate Nitrogen & Carbon (PN, POC)	Keep at 4°C, dark, but must filter within 24 hours, freeze until dried	12 months after drying at 80°C for 24 hours	10-26	100%
Particulate Phosphorus (PP)	Keep at 4°C, dark, but must filter within 24 hrs, freeze until dried	12 months after drying at 80°C for 24 hours	10-26	100%
Dissolved Organic Carbon (DOC)	< to 6°C and store in the dark	28 days	10-26	100%
Trace Metals	< 6°C; Acidify to pH<2 with pre-tested nitric acid (HNO_3) w/in 48 h	6 months at room temperature following acidification	7-26	100%

Table 8: Summary of performance-based QC criteria and project success in performing within those criteria for trace metals and nutrients.

	Trace Metals		Nutrients	
Quality Control Parameter	**DQO**	**Success**	**DQO**	**Success**
Completeness	100%	100.0%	100%	100%
Blanks				
Frequency	10% of total samples	100%	10% of total samples	100%
Accuracy	< RL	100%	< RL	100%
Precision	RPD<25%	100%	RPD<25%	100%
Spiked Blanks				
Frequency	10% of total samples	100%	10% of total samples	100%
Accuracy	Recovery within 75-125%	100%	Recovery within 80-120%	100%
Precision	RPD<25%	98.0%	RPD<25%	98.0%
CRM[1]				
Frequency	10% of total samples	100%	10% of total samples	100%
Accuracy	within lab specified limits	96.0%	within lab specified limits	98.5%
Matrix Spikes				
Frequency	10% of total samples	100%	10% of total samples	100%
Accuracy	Recovery within 75-125%	100%	Recovery within 80-120%	100%
Precision	Within ± 25% RPD[2]	98.5%	RPD<25%	96.7%
Sample Duplicates				
Frequency	10% of total samples	100%	10% of total samples	100%
Precision	Within ± 25% RPD	97.4%	Within ± 25% RPD	98.0%

[1]N/A=no DQO set, data are for evaluation purposes only as part of ongoing QA/AC efforts

Table 9: Summary of performance-based QC criteria and project success in performing within those criteria for bacteria, total dissolved and total suspended solids (TDS/TSS).

	Bacteria		TDS/TSS	
Quality Control Parameter	**DQO**	**Success**	**DQO**	**Success**
Completeness	100%	100%	100%	100%
Blanks				
Frequency	10% of total samples	100%	10% of total samples	100%
Accuracy	Positive control within 80-120% recovery; Negative control = no growth on filter	100%	NA[1]	NA[1]
Precision	Lab Replicate RPD<25%	100%	Lab Replicate RPD<25%	100%
Spiked Blanks				
Frequency	NA[1]	NA[1]	NA[1]	NA[1]
Accuracy	NA[1]	NA[1]	NA[1]	NA[1]
Precision	NA[1]	NA[1]	NA[1]	NA[1]
CRM[1]				
Frequency	NA[1]	NA[1]	NA[1]	NA[1]
Accuracy	NA[1]	NA[1]	NA[1]	NA[1]
Matrix Spikes	-	-	-	-
Frequency	NA[1]	NA[1]	NA[1]	NA[1]
Accuracy	NA[1]	NA[1]	NA[1]	NA[1]
Precision	NA[1]	NA[1]	NA[1]	NA[1]
Sample Duplicates	-	-		
Frequency	10% of total samples	100%	10% of total samples	100%
Precision	Within ± 25% RPD	100%	Within ± 25% RPD	100%

[1]N/A=no DQO set, data are for evaluation purposes only as part of ongoing QA/AC efforts

5 Preliminary Data Summary

A summary of exceedances are given for provided for bacterial indicators, trace metals, and nutrients for Year 1 sampling.

5.1 Wet Weather Data Summary

Table 10 provides a comparison of median constituent event mean concentration (EMCs) at open space sites during the 1983 Nationwide Urban Runoff Program (NURP, U.S. EPA 1983a), to the 1990 National Stormwater Quality Database (NSQD, Pitt et al. 2003) monitoring study, the San Diego Regional Reference Stream Study 2011-2012 wet season results and to the San Diego Regional Water Quality Control Board (SD RWQCB) Basin Plan. Comparison of bacteria, trace metals and nutrient concentrations in stormwater from reference streams from this study reveal overall median *E. coli*, total cadmium, copper, lead, nickel and zinc, nitrate + nitrite, total nitrogen and total phosphorus EMCs that are lower to current U.S. averages reported in the NSQD and SD RWQCB Basin Plan. The exception is that median constituent values from Cristianitos Creek are substantially higher than those observed in the rest of the U.S. Table 11 provides a comparison of exceedences of single sample maximum standards at reference stream sites for the three storms.

Figures 6-8 show the results of FIB pollutagraphs for each of the three storms captured during the 2011-2012 wet season.

5.2 Dry Weather Data Summary

5.2.1 Fecal Indicator Bacteria

Two analyses were used to characterize FIB levels from natural streams. First the 30-d geomeans, variances, and ranges of concentrations, were calculated to provide an estimate of expected baseline bacterial levels. Second, dry weather FIB concentrations were compared with the state of CA standards for single-sample and 30-d geomean maximum allowable densities (Table 12). Cumulative density frequency plots (CDFs) were produced to compare observed bacterial concentrations to the CA quantitative standards and to calculate accumulated relative exceedance percentages.

A total of 36.3% of the indicator bacteria dry season samples (for all three indicators) from the natural sites exceeded daily (single sample) water quality standards. Approximately 34.1% of enterococci exceeded the daily threshold of 104 MPN/100 ml (Figure 9). The average enterococci level of these exceedances was 141 MPN/100 ml, with a maximum of 1553 MPN/100 ml (La Posta Creek) and a minimum of 2 MPN/100 ml (Arroyo Trabuco Creek). For *E. coli*, 4.2% of the measurements exceeded the single sample standard of 235 MPN/100 ml with a maximum and a minimum of 727 MPN/100 ml and 1 MPN/100 ml, respectively (La Posta Creek; both Kitchen and Long Canyon Creeks). For total coliforms, no sites exceeded the single sample standard of 10,000 MPN/100 ml.

A total of 71.0% of enterococci samples from the natural sites exceeded the 30-d geomean water quality standard of 33 MPN/100 ml. The average enterococci level of these exceedances was 107 MPN/100 ml, with a maximum of 843 MPN/100 ml and a minimum of 7.2 MPN/100 ml (Table 13; Appendix A1). For *E. coli*, approximately 3.3% exceeded the 30-d geomean threshold of 126 MPN/100 ml with a maximum and a minimum of 261 MPN/100 ml and 2 MPN/100 ml, respectively (Table 12; Appendix A2). For total coliforms, 61.3% exceeded the 30-d geomean of 1000 MPN/100 ml with a maximum and a minimum of 2419.6 MPN/100 ml and 345 MPN/100 ml, respectively (Table 13; Appendix A3).

Water temperature varied by about 5-10°C at each of the sites, increasing during the summer months reaching a mean of 17.3°C and a maximum of 19°C on warm sunny afternoons (Figure 10a). A negative correlation was observed between dissolved oxygen and stream temperature (Figure 10a and Appendix B, Table B1). Bacteria levels for all three indicators were substantially higher during the month of July than during all other months (Figures 10-13). For example, 30-d geomeans for enterococci at Long Canyon Creek were near the water quality standard in April 2012 with levels approximately 28.7 MPN/100 ml ± 3.2 SD, increased substantially during the summer, exceeding the criterion, peaking in July at 311.7 MPN/100 ml ± 3.1 SD as streams stopped flowing (Figure 10b). Similar enterococci exceedance patterns were observed for all streams with the exception of Upper San Juan Creek (Figure 8). Observed *E. coli* concentrations responded similarly to enteroccoci however none of the streams sampled showed exceedances for *E. coli* during the summer months (Figure 12). A similar exceedance pattern was observed for total coliforms (Figure 13).

5.2.2 Trace Metals Results

Metals occurred predominantly in the dissolved phase during the 2012 dry season, although the dissolved fraction varied by metal (Figure 14). Upper San Juan Creek had the highest mean dissolved copper concentration at 4.0 µg/L ± .06 followed by Arroyo Trabuco and Pine Valley at 0.38 ± .05 and 0.36 ± .01 µg/L respectively (Figure 14). Mean total and dissolved metals concentrations for each reference stream are provided in Appendix C. Reference stream metals concentrations varied considerably both spatially and temporally. Results indicate that for copper reference stream mean dissolved concentrations were substantially higher in April (0.3 ± .1 µg/L) than during the other three sampling events (Figure 15). Mean dissolved copper for all reference streams for the entire 2012 dry season was 0.3 ± .1 µg/L.

Comparison of reference stream samples to standards can be instructive in estimating the likelihood that inherent variability of reference concentrations may result in periodic exceedences. The concentrations of metals from filtered storm water and dry season samples were evaluated using the California State Water Quality Standards for Surface Waters (Federal Register, EPA Part III, 40 CFR Part 131). Toxicity of many metals is dependent upon the hardness of the water. Hardness of each water sample was calculated from its calcium and magnesium concentrations and, using the calculated hardness, calculations for chronic toxicity of the sampled metals were then done. Equations for calculating hardness and chronic toxicity criteria are as follows (Federal Register, EPA Part III, 40 CFR Part 131):

- **Hardness**:
  using the values for calcium (mg/L) and magnesium (mg/L): Hardness = (2.497*Ca)+(4.1189*Mg).

- **Chronic toxicity criteria**:

  Copper $\leq (.960)(e^{(.8545(\ln(\text{hardness}))-1.702)})$ Freshwater
  $\leq (.830)(e^{(.8545(\ln(\text{hardness}))-1.702)})$ Saltwater

  Lead $\leq (.791)(e^{(1.237(\ln(\text{hardness}))-4.705)})$ Freshwater
  $\leq (.791)(e^{(1.237(\ln(\text{hardness}))-4.705)})$ Saltwater

  Zinc $\leq (.986)(e^{(0.8473(\ln(\text{hardness}))+0.884)})$ Freshwater
  $\leq (.946)(e^{(0.8473(\ln(\text{hardness}))+0.884)})$ Freshwater

Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. *Federal Register* Vol. 65, No. 97/ May 2000 Rules and Regulations.

Concentrations of dissolved copper, and zinc in reference streams were generally below the freshwater and saltwater chronic toxicity standards established under the California Toxics Rule (Figures 15 and 17). Of the 121 individual reference stream samples for each dissolved metal, four copper samples (2 dry weather; one in early April and one in early May; and 2 wet weather), and one dry weather zinc sample exceeded the CTR standards. Reference stream dissolved copper concentrations exceeded CTR standards in 4.1% and 11.2% of the wet and dry weather samples, respectively. In contrast, only 2.9% of dry weather reference stream samples exceeded CTR standards for zinc. No wet weather samples exceeded the CTR standards for zinc.

5.2.3 Total Solids Results

Increased levels of total dissolved solids (TDS) and/or suspended solids (TSS) can block out light and thus reduce photosynthetic activity and, depending on the amount of surface agitation (oxygenation), gradually decrease the amount of oxygen produced by the plants and lead to an increase in water temperature. Mean total dissolved solids exceeded the drinking water quality standard in June at both Arroyo Trabuco and La Posta creeks (548 and 564 mg/L, respectively; Figure 18). San Juan Creek had the highest TDS exceedance observed during the 2012 dry season (in July) with a concentration of 1066 mg/L. The source of this exceedance was probably due to soil erosion caused by the road construction on Ortega HWY above the sampling site. None of the reference stream sites exceeded the TSS water quality threshold of 100 mg/L (Table 12).

5.2.4 Nutrient Results

For this discussion total nitrogen (TN) and total phosphorus (TP) were selected as the factors representing the water quality of the reference streams. Based upon ninety samples collected between April and July 2012, the mean total phosphorus (TP) concentration in all reference streams was 0.03 mg/L and the mean total nitrogen (TN) concentration was 0.16 mg/L (Table 14). Exceedance frequency of SD RWQCB basin plan standards of 1 mg TN L-1 and 0.1 mg TP L-1 was 0% and 11% respectively. The mean TN:TP (by weight) was 7.6:1 (Table 14).

Similar to metals, nutrients occurred predominantly in the dissolved and particulate phase during the 2012 dry season, although the dissolved and particulate fraction varied by nutrient (Figures 19 and 20; Tables D1-D3).

There was a slight positive relationship between the concentration of total nitrogen and the concentration of total phosphorus in the rivers (r^2 = 0.3) (Figure 21). Both TN and TP showed a negative relationship (r^2 = 0.6 and 0.2, respectively) when compared with proportion of underlying watershed geology (%) during the 2012 dry season (Figure 21).

Dissolved oxygen (DO) concentrations in reference streams averaged 7.9 mg/L. The mean value for Upper San Juan Creek was considerably less (5.3 mg/L) but higher than the minimal DO criteria of 5.0 mg/L established for class III (intermediate) waters.

6 References

California Toxics Rule Environmental Protection Agency. 1997. Federal Register, EPA Part III, 40 CFR Part 130. California State Water Quality Standards for Surface Waters. Establishment of numeric criteria for priority toxic pollutants for the State of California: Proposed Rule. Federal Register 62:42159-42208.

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SD RWQCB basin plan standards. Water Quality Control Plan California Regional Water Quality Control Board, San Diego. For the San Diego Basin Region (9). 1994. San Diego, CA. http://www.waterboards.ca.gov/sandiego/programs/basinplan.html

Surface Waters Ambient Monitoring Program (SWAMP)
Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. *Federal Register* Vol. 65, No. 97/ May 2000 Rules and Regulations.

Table 10. Comparison of median event mean concentrations (EMCs) for Open/ Non-Urban Land Uses. ND = not detected; NA = not analyzed. Note that Cristianitos Creek (CCCP) results are not adjusted for inputs from Prima Deschecha and Golf Course storm drain inputs.

	Reference Stream			Open/Non-Urban Land Use			SD RWQCB Basin Plan
	CCCP[1]	LCC[2]	SJC[3]	SDRS[4] Overall	NSQD[5]	NURP[6]	
Constituant	EMC			Median EMCs			
TSS (mg/L)	**619**	0.8	0.3	0.8	78	70	100
Bacteria (MPN/100 mL)							
E. coli	2,212	36	193	193	7,200	NA	235
Enterococi	8,577	124	314	314	NA	NA	104
Total coliforms	**24,176**	1163	1746	1746	NA	NA	10,000
Trace Metals (mg/L)							
Total Cadmium	**2.1**	ND	0.01	0.01	0.50	NA	0.05
Total Copper	**22**	0.5	0.8	0.8	5.3	NA	0.01
Total Lead	4.3	0.04	0.05	0.05	5.0	30	0.02
Total Nickel	25	0.2	0.4	0.4	ND	NA	0.10
Total Zinc	**169**	0.6	1.6	1.6	39	195	0.02
Nutrients (mg/L)							
Nitrate + Nitrite	0.57	0.06	0.00	0.06	0.60	0.54	10
Total Nitrogen	**1.1**	0.21	0.09	0.21	1.9	NA	1.0
Total Phosphorus	**0.18**	0.04	0.01	0.01	0.25	0.12	0.1

Reference Streams: [1]CCCP = Cristianitos Creek, [2]LCC = Long Canyon Creek, [3]SJC = San Juan Creek

Source: [4]SDRS = San Diego Reference Stream study;

[5]NSQD = The National Storm water Quality Database, Pitt et al. (2003)

[6]NURP = Nationwide Urban Runoff Program (US EPA 1983)

Table 11. Comparison of exceedences of single sample maximum standards at reference stream sites for the three storms during the 2011-2012 wet season.

	% Exceedance		
	E. coli	Enterococci	Total Coliforms
Stream	(MPN/100 ml)		
Cristianitos Creek	89	100	100
Long Canyon Creek	33	89	0.0
San Juan Creek	7.1	71	0.0

Table 12. State of California water quality standards for fecal indicator bacteria, trace metals and nutrients as established in Assembly Bill 411, the California Basin Plan and SD RWQCB Basin plan biostimulatory objectives for flowing waters.

Constituent	Reference Stream									CA Basin Plan/ Water Quality Threshold
	ACC[1]	ATC[1]	CONC[1]	KC[1]	LCC[1]	LPC[1]	PVC[1]	SJC[1]	USJ[1]	
	Mean Result									
Total Suspended Solids (mg/L)	0.7	2.5	2.2	1.5	4.5	1.2	1.2	10.6	9.7	**100**
Total Dissolved Solids (mg/L)	226	410	360	224	235	451	265	499	295	**500**
Bacteria										
E. coli	115	81	14	74	37	102	42	65	28	**235**
Enterococci	**283**	67	32	80	**169**	**298**	38	116	19	**104**
Total Coliforms	1,886	2,098	1,548	2,078	1,302	2,420	1,683	1,058	828	**10,000**
Total Metals (ug/L)										
Cadmium	nd[2]	0.03	nd[2]	nd[2]	nd[2]	0.02	nd[2]	0.06	0.03	**5.0**
Chromium	0.02	0.05	0.05	0.07	0.09	0.05	0.05	0.07	0.03	**50**
Copper	0.21	0.52	0.29	0.26	0.25	0.14	0.37	0.59	0.30	**5.83**
Iron	103	29.3	178	57.7	221	82.5	94.5	**596**	28.1	**300**
Lead	0.03	0.05	0.02	0.02	0.02	0.02	0.01	0.11	0.02	**15**
Manganese	14.3	2.3	**98.53**	5.25	44.7	32.6	9.52	**152**	0.74	**50**
Nickel	0.80	0.29	0.27	0.21	0.10	0.12	0.57	0.36	0.15	**100**
Selenium	0.10	1.1	0.15	0.07	0.04	0.19	0.18	0.20	0.42	**50**
Zinc	0.80	1.2	0.51	25.9	18.5	16.2	37.2	2.3	1.2	**16.91**
Dissolved Metals (ug/L)										
Copper	0.27	0.39	0.27	0.24	0.19	0.17	0.36	0.19	0.42	**5.6**
Zinc	0.46	0.53	0.29	**17.5**	15.9	**16.1**	**34.0**	0.64	0.86	**16.0**

Table 12 continued.

Constituent	Reference Stream ACC[1]	ATC[1]	CONC[1]	KC[1]	LCC[1]	LPC[1]	PVC[1]	SJC[1]	USJ[1]	SD RWQB Basin Plan/ Water Quality Threshold
	Mean Result									
Nutrients (mg/L)										
Total Nitrogen	0.19	0.04	0.29	0.15	0.11	0.27	0.24	0.07	0.05	**1.0**
Nitrate (as NO3)	1.3E-03	1.1E-02	1.9E-03	2.3E-03	1.1	1.2E-01	1.5E-03	6.2E-03	3.2E-03	**45**
Nitrate + Nitrite (sum as Nitrogen)	1.6E-03	1.1E-02	2.0E-03	2.4E-03	1.1	1.2E-01	1.7E-03	6.5E-03	3.6E-03	**10**
Nitrite (as Nitrogen)	3.0E-04	1.0E-04	8.8E-05	1.5E-04	4.9E-04	8.6E-04	2.3E-04	2.8E-04	4.0E-04	**1.0**
Total Phosphorus	0.03	0.01	0.02	0.08	0.02	**0.10**	0.01	0.02	0.01	**0.1**

[1]Agua Caliente Creek; Arroyo Trabuco; Conejos Creek; Kitchen Creek; Long Canyon Creek; La Posta Creek; Pine Valley Creek; San Juan Creek; Upper San Juan

[2]nd = not detected

Table 13. List of natural stream sampling sites, characteristics and their median monthly fecal indicator bacteria densities (MPN/100 ml). 30-d geomean exceedances are bolded.

Site Name	Watershed	County	Catchment size (km^2)	Mean flow (m^3/sec)	Geomean					
					E. coli		Enterococci		Total coliforms	
					(MPN/100 ml)	SD	(MPN/100 ml)	SD	(MPN/100 ml)	SD
Long Canyon Creek	Tributary to Kitchen Creek	San Diego	23.3	0.0159	8.8	81.0	**116.1**	35.3	**1,131.9**	325.9
Kitchen Creek[a]	Kitchen Creek-Cottonwood Creek	San Diego	39.9	0.0369	13.0	22.1	**64.1**	36.1	**1,999.3**	273.9
Pine Valley Creek[a]	Upper Pine Valley Creek	San Diego	43.1	0.0242	16.9	31.3	30.6	21.2	**1,486.9**	359.7
Agua Caliente Creek[a]	Laguna Creek/ San Luis Rey River	San Diego	46.1	0.0013	15.6	108.3	**131.5**	219.0	**2,419.6**	0.0
La Posta Creek	La Posta Creek	San Diego	115.3	0.0264	47.2	14.2	**133.0**	216.4	**1,685.9**	345.9
Conejos Creek[a]	San Diego River	San Diego	116.0	0.0006	10.8	7.8	26.7	22.9	**1,993.1**	481.7
Upper San Juan Creek[a]	Upper San Juan Creek	Orange	19.3	0.0024	14.3	14.7	21.3	12.3	691.9	350.2
San Juan Creek	Upper San Juan Creek	Orange	96.9	0.0032	16.1	14.3	**59.9**	76.2	856.1	364.0
Arroyo Trabuco	Arroyo Trabuco	Orange	31.0	0.0066	30.5	92.7	**37.9**	92.1	**1,392.4**	342.6
[a]Intermittent stream		**Mean**	59.0	0.0130	19.3	42.9	**69.0**	81.3	**1,517.4**	316.0
		SD	39.2	0.0087	6.1	20.0	23.2	41.3	287.7	66.0
				Overall Geomean	18.0		**56.9**		**1,231.2**	
				SD	17.8		40.3		142.4	

Table 14. Water quality results at reference streams during the 2012 dry season.

Reference Stream	DO	TN	TP	TN:TP
	Mean (mg/L)			
Agua Caliente	8.2	0.19	0.03	6.3
Arroyo Trabuco	8.7	0.05	0.01	5.0
Conejos	6.4	0.29	0.02	15
Kitchen Creek	9.7	0.15	0.08	1.9
Long Canyon	9.0	0.11	0.02	5.5
La Posta	7.7	0.27	0.10	2.7
Pine Valley	8.5	0.24	0.01	24
San Juan	7.8	0.07	0.02	3.5
Upper San Juan	5.3	0.05	0.01	5.0
Mean	**7.9**	**0.16**	**0.03**	**7.60**

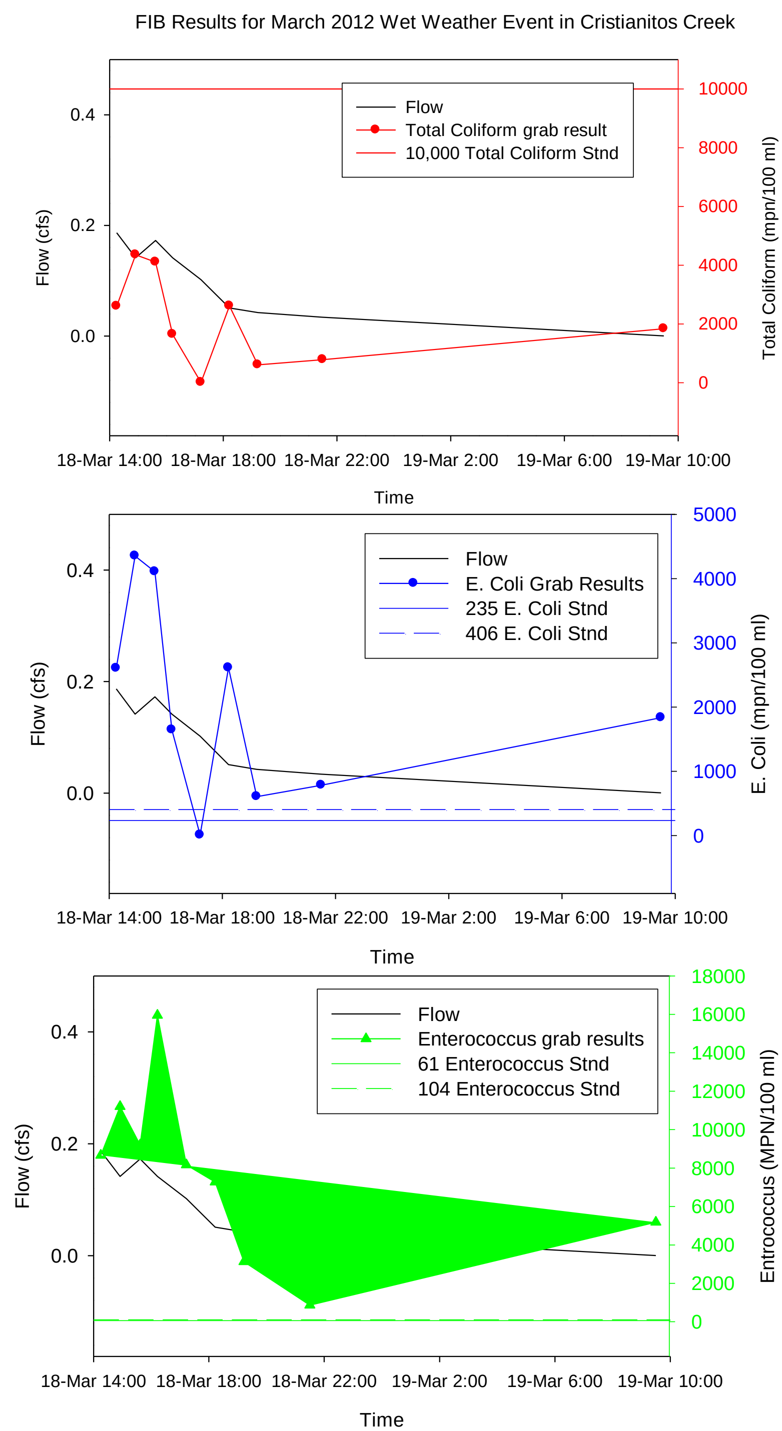

Figure 6. Pollutagraph of flow and FIB grab sample results relative to California standards for single grab samples for Cristianitos Creek March 18, 2012 wet weather event.

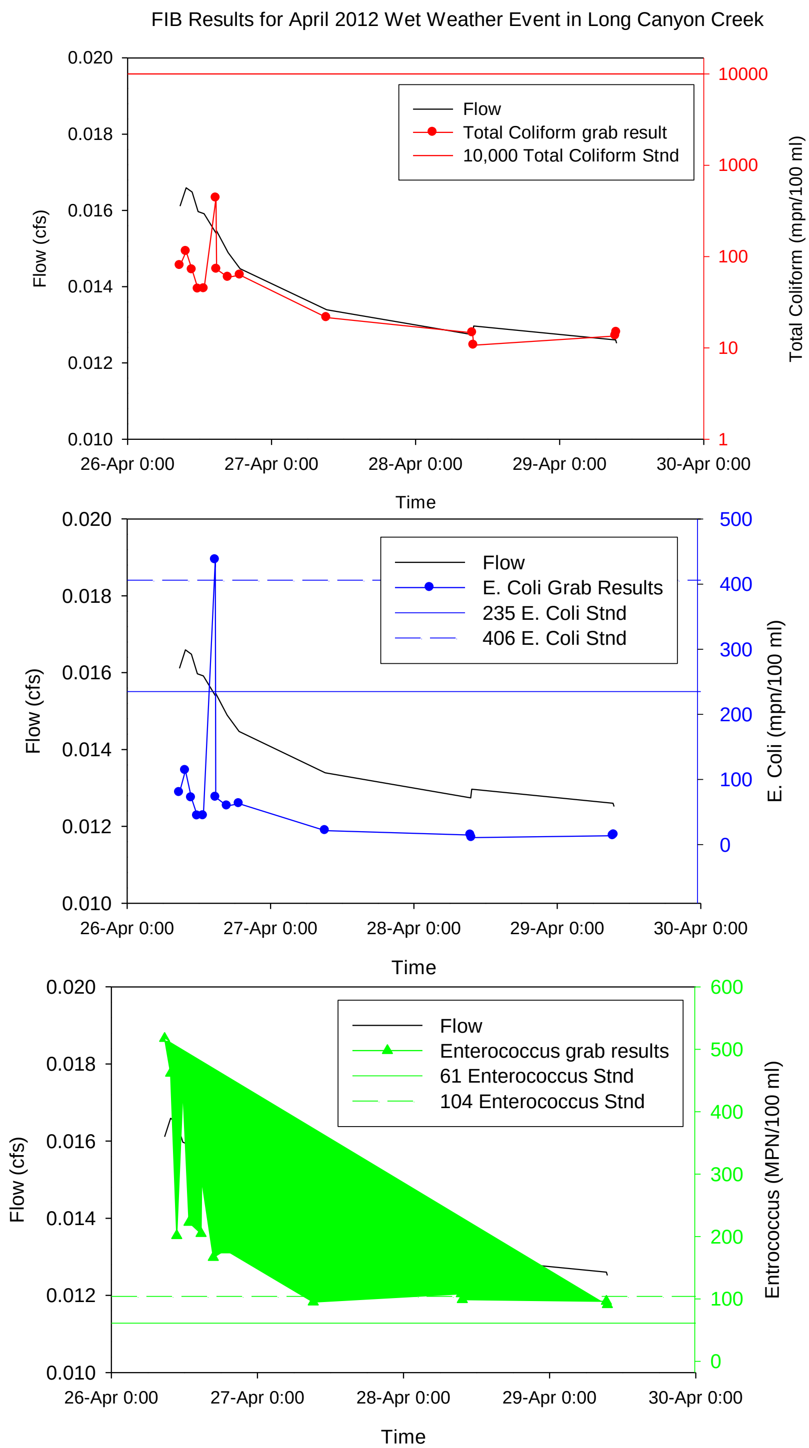

Figure 7. Pollutagraph of flow and FIB grab sample results relative to California standards for single grab samples for Long Canyon Creek April 26, 2012 wet weather event.

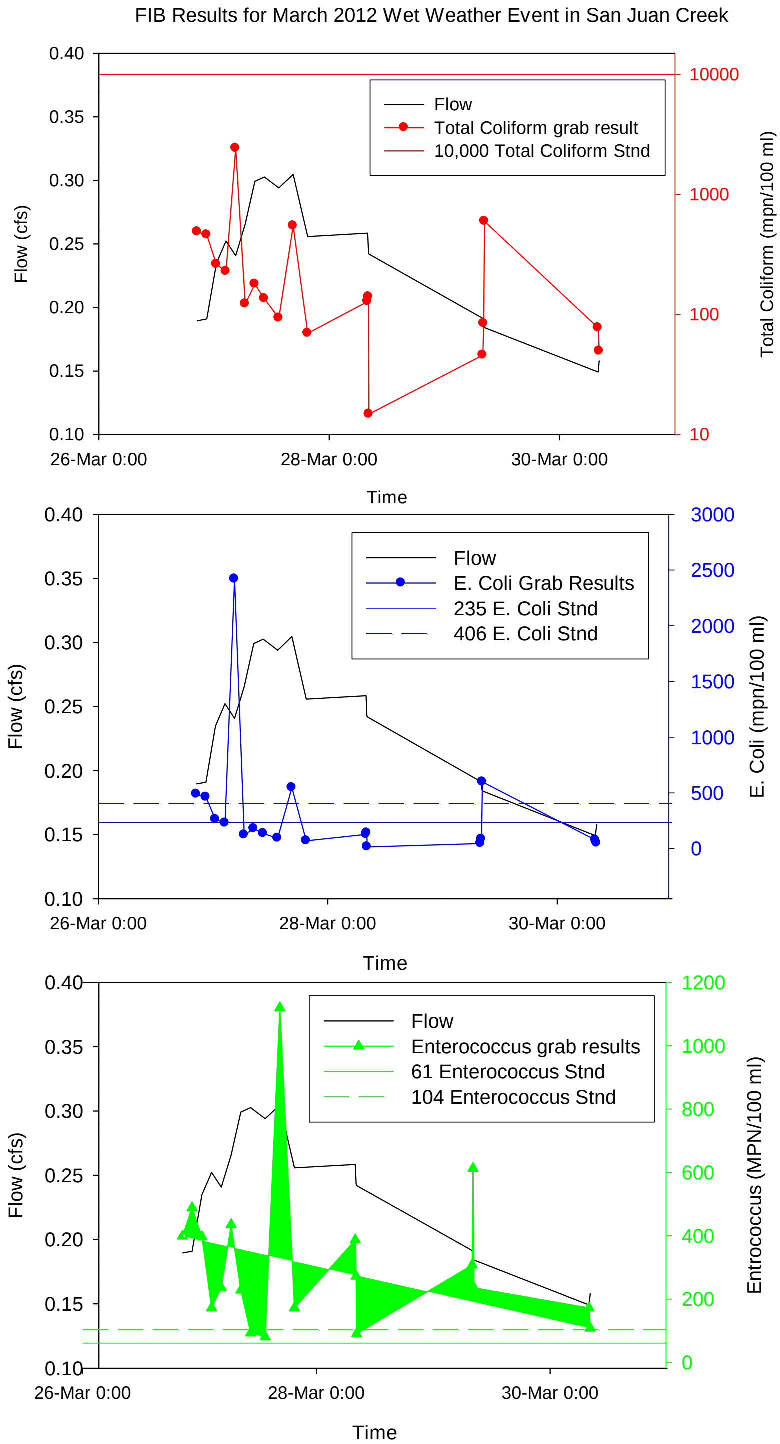

Figure 8. Pollutagraph of flow and FIB grab sample results relative to California standards for single grab samples for San Juan Creek March 20, 2012 wet weather event.

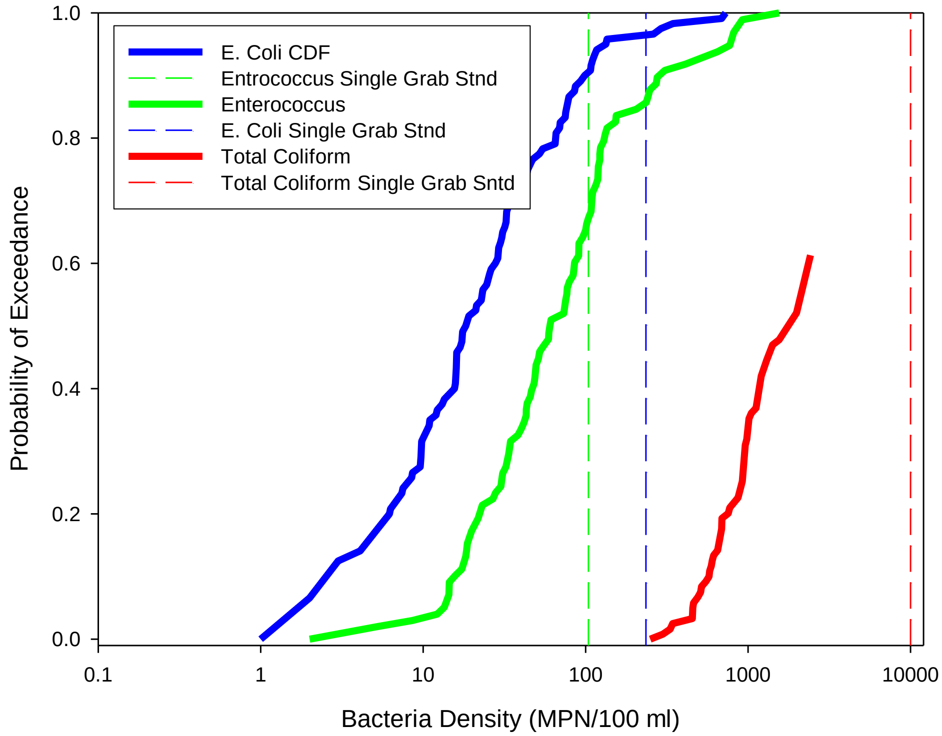

Figure 9. Cumulative density frequency plot (CDF) of dry weather FIB in natural streams relative to State of California marine water quality standards (dotted lines).

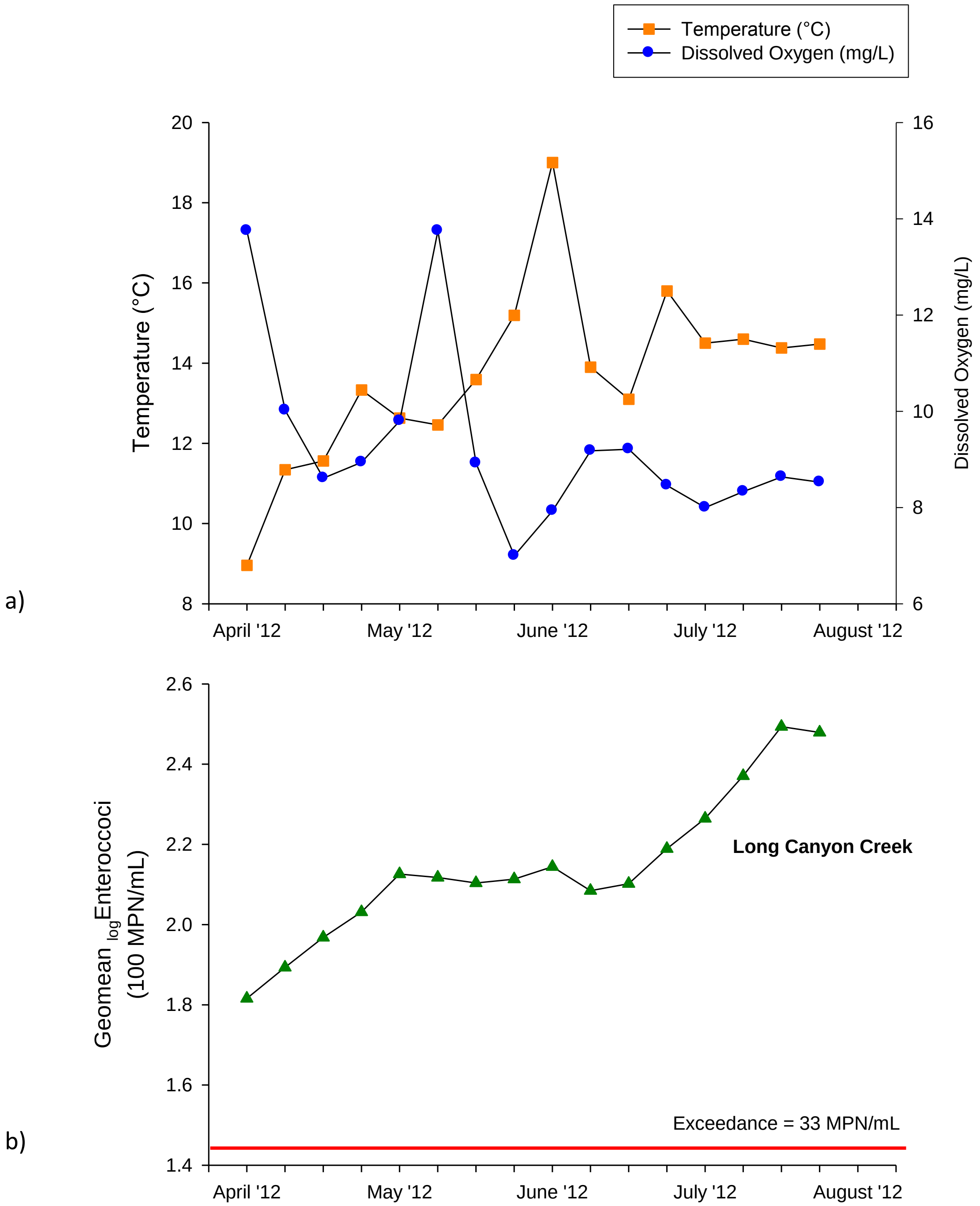

Figure 10. Monthly temperature (°C) and dissolved oxygen (mg/L) comparison (top pane, (a)) and geomean enterococci densities in natural streams in southern California (bottom panel, (b)) between April 2012 and July 2012. May-July were substantially higher than April. The solid line indicates the 30-d geomean for enterococci equal to 33 MPN/100 mL. All points above the line represent bacteria water quality exceedances.

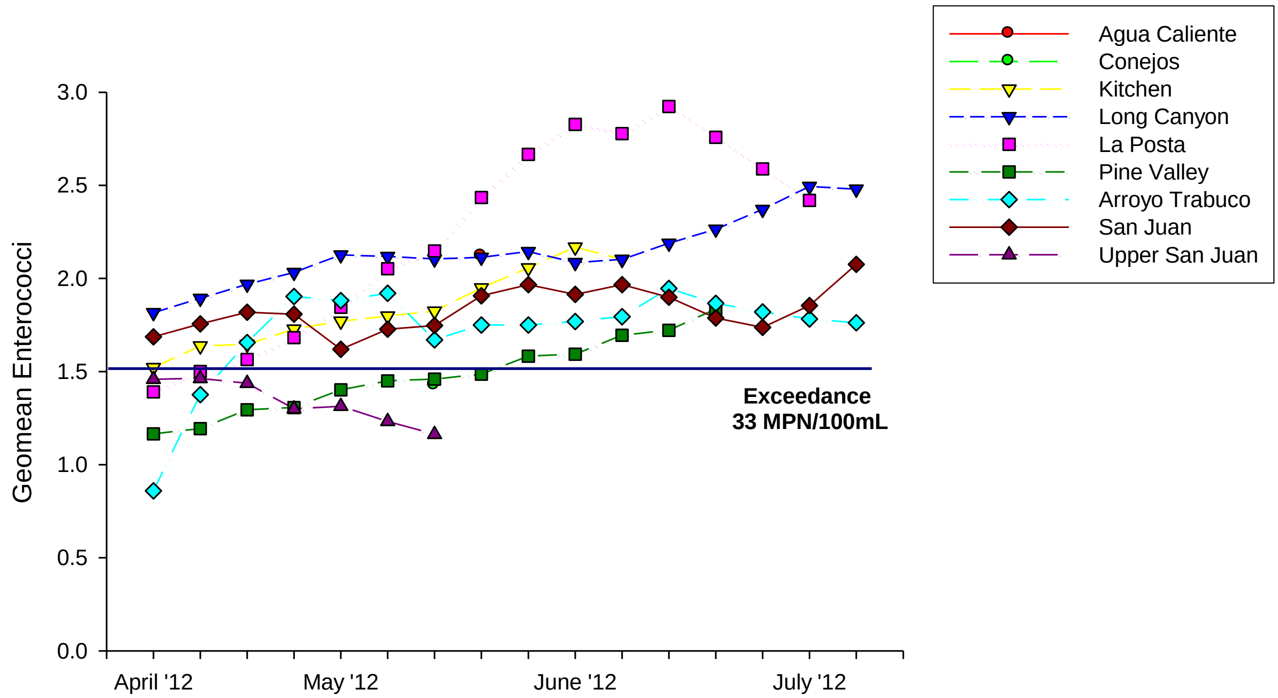

Figure 11. Geomean enterococci densities in natural streams in southern California between April 2012 and July 2012. The solid line indicates the 30-d geomean for enterococci equal to 33 MPN/100 mL. All points above the line represent bacteria water quality exceedances.

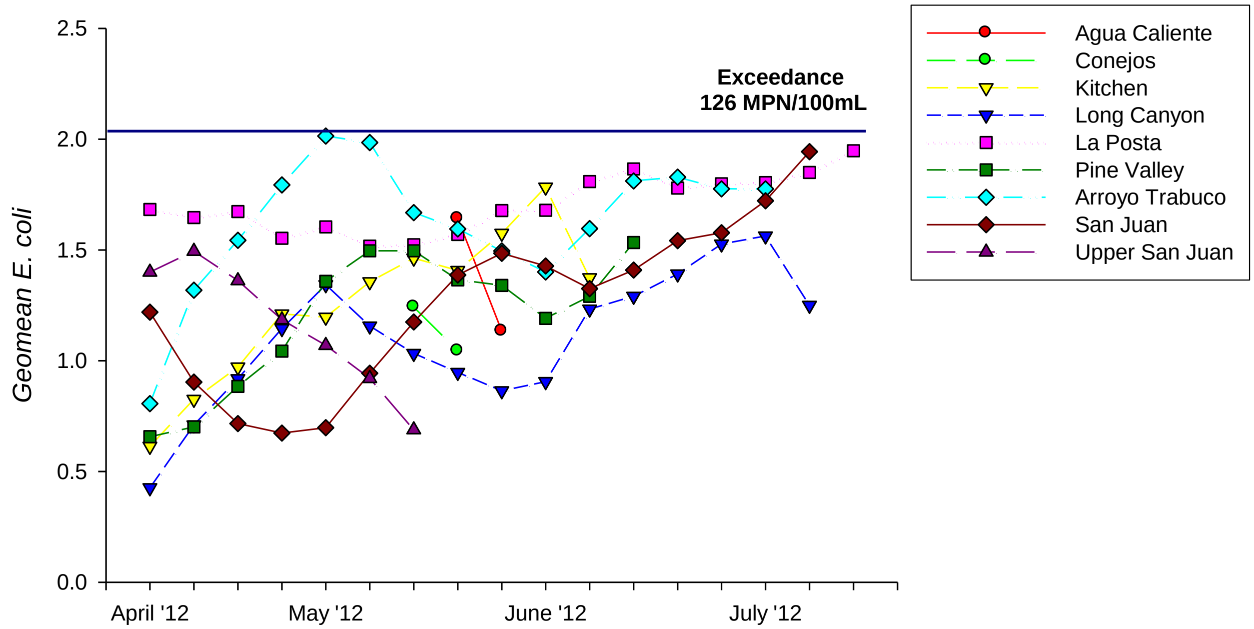

Figure 12. Geomean *E. coli* densities in natural streams in southern California between April 2012 and July 2012. None of the streams exceeded water quality standards. The solid line indicates the 30-d geomean for *E. coli* equal to 126 MPN/100 mL. All points above the line represent bacteria water quality exceedances.

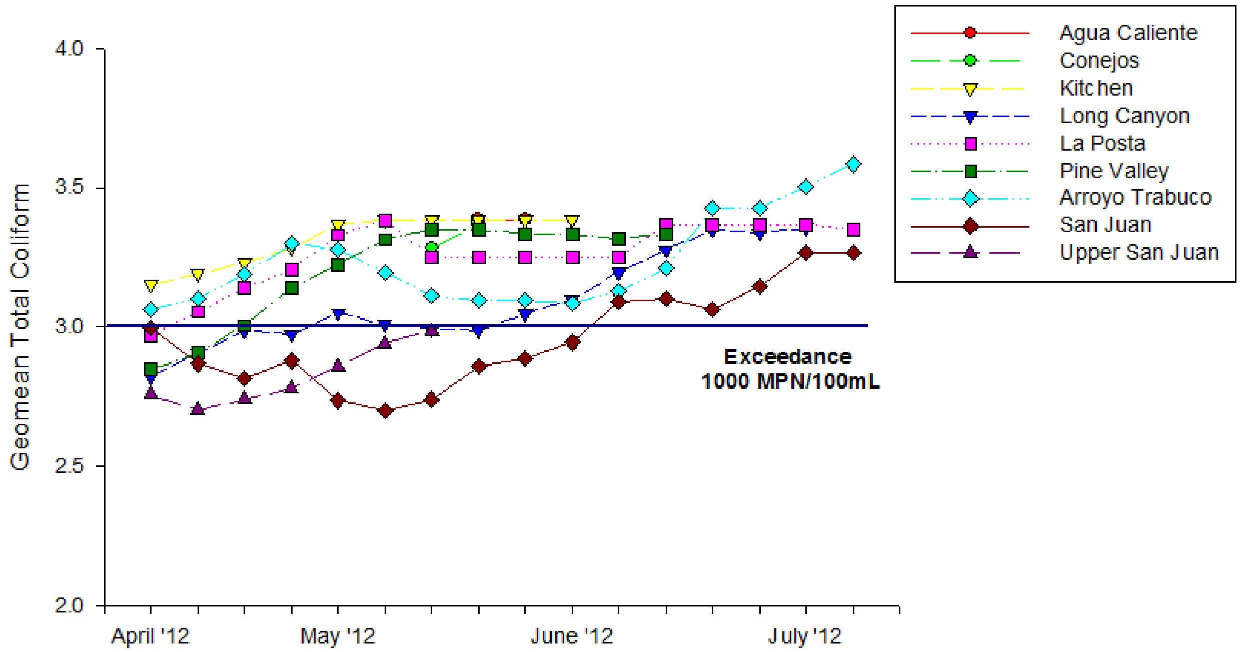

Figure 13. Geomean total coliform densities in natural streams in southern California between April 2012 and July 2012. The solid line indicates the 30-d geomean for total colifom equal to 1000 MPN/100 mL. All points above the line represent bacteria water quality exceedances.

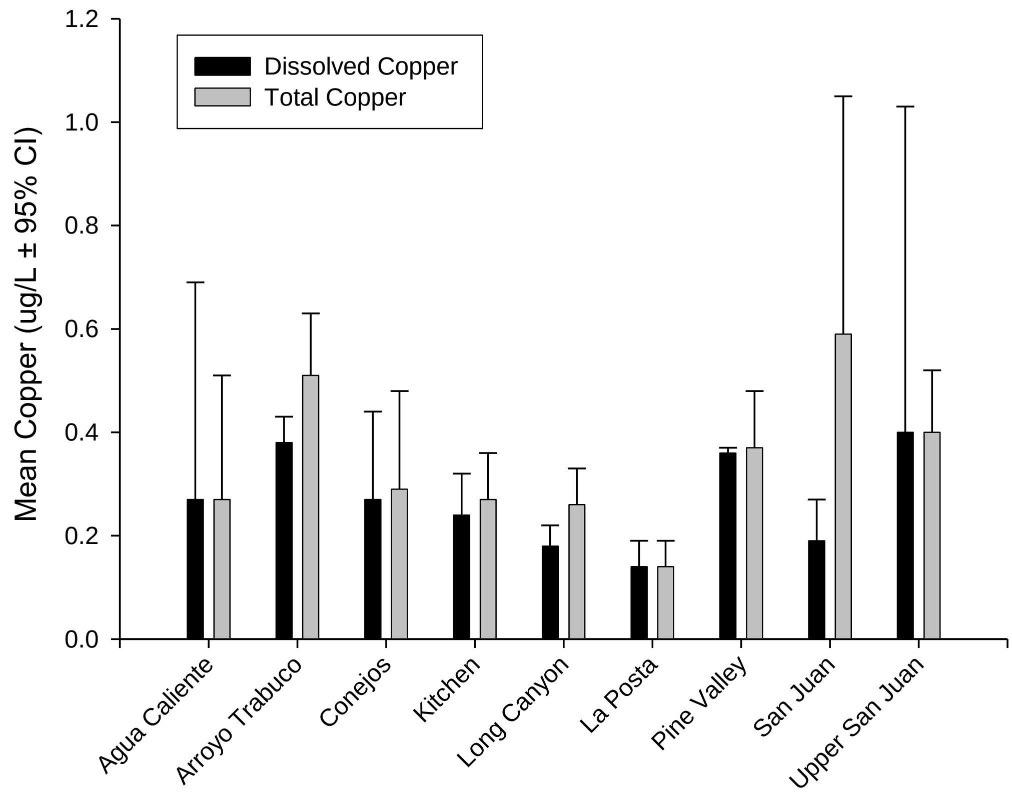

Figure 14. Comparison of dissolved and total copper concentrations in reference streams during the 2012 dry season, n = 68.

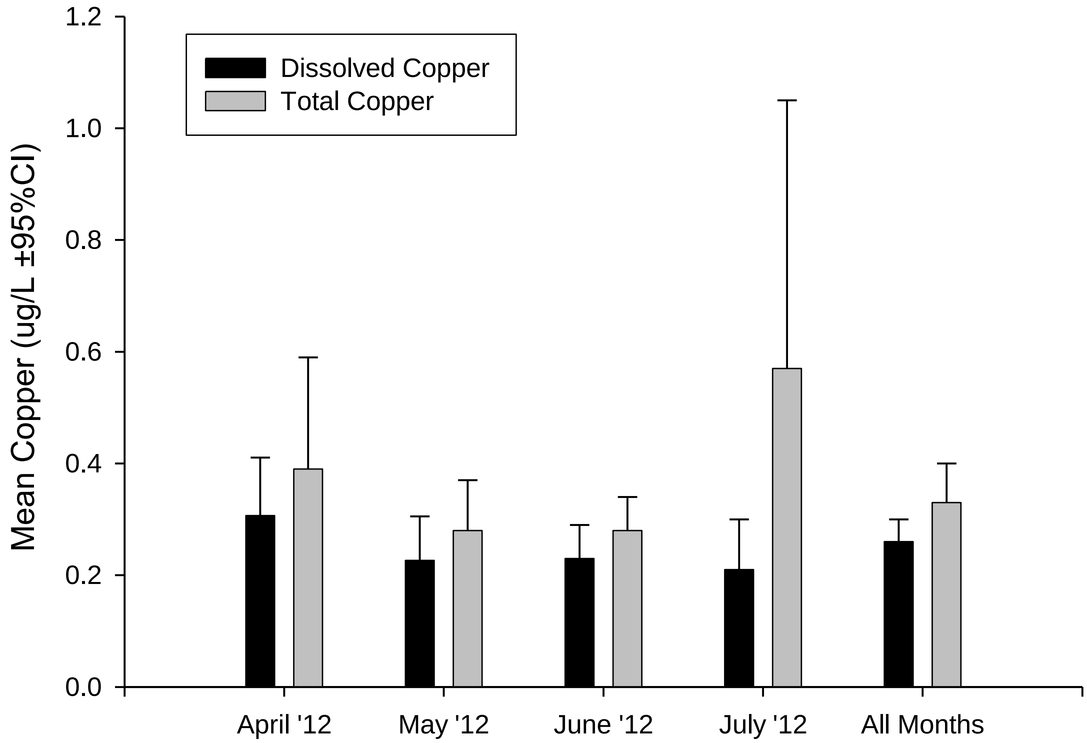

Figure 15. Inter-annual variability in copper concentrations in reference streams during the 2012 dry season. For the month of April n=12, May n=30, June n = 17, and July n=8.

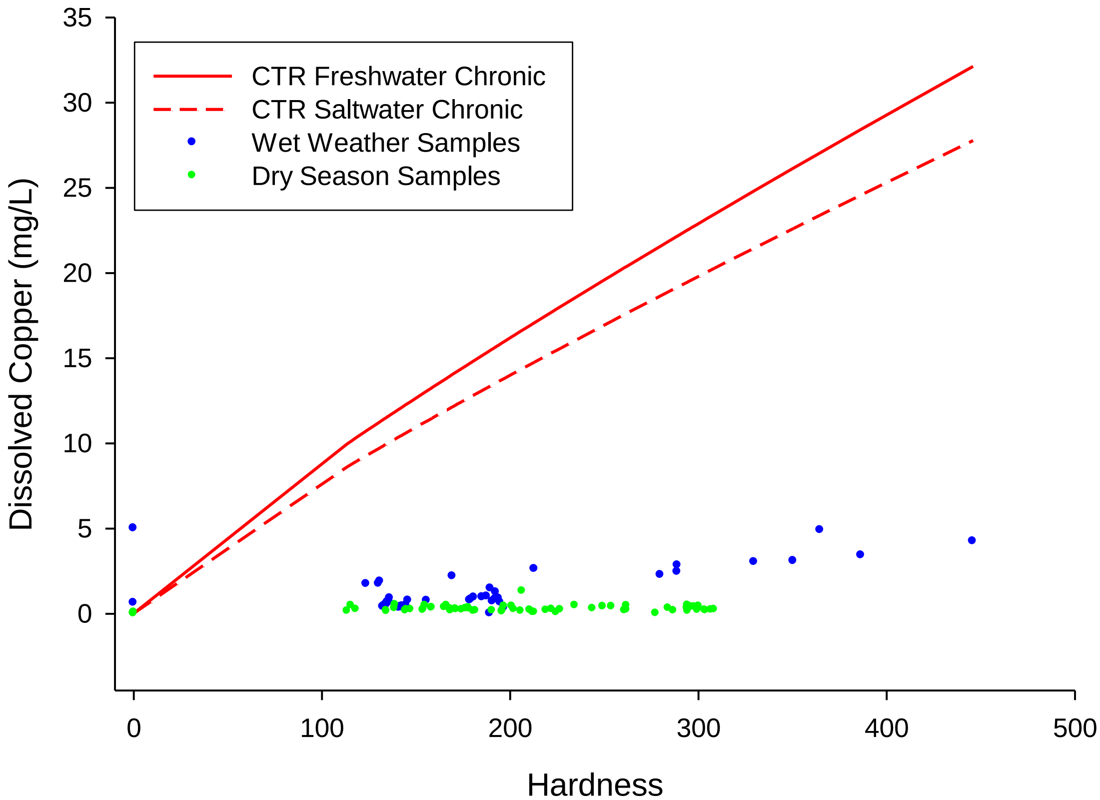

Figure 16. Comparison of reference stream dissolved copper concentrations to the California Toxics Rule (CTR). Concentrations relative to CTR standards for both wet weather and dry weather reference stream samples.

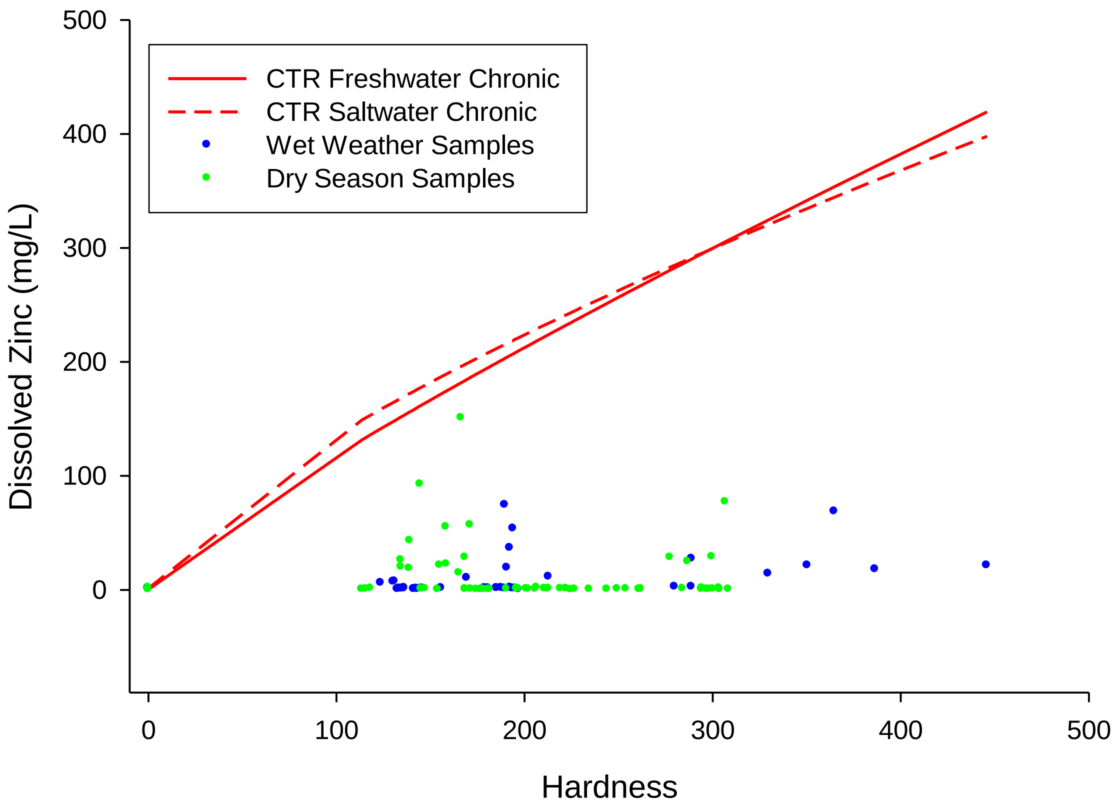

Figure 17. Comparison of reference stream dissolved zinc concentrations to the California Toxics Rule (CTR). Concentrations relative to CTR standards for both wet weather and dry weather reference stream samples.

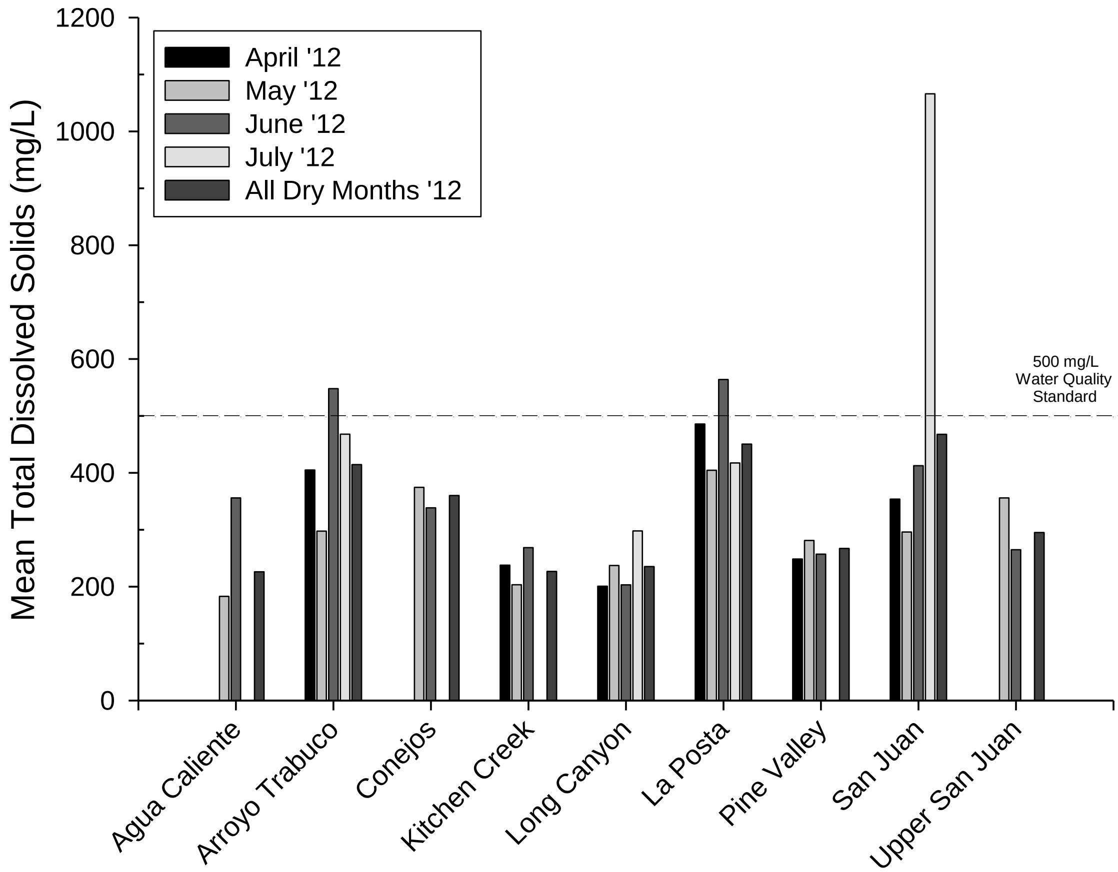

Figure 18. Comparison of mean concentrations of reference steam total dissolved solids for the four dry season sampling months and all months combined in 2012. Units are in mg/l. For the month of April n=12, May n=30, June n = 17, and July n=8.

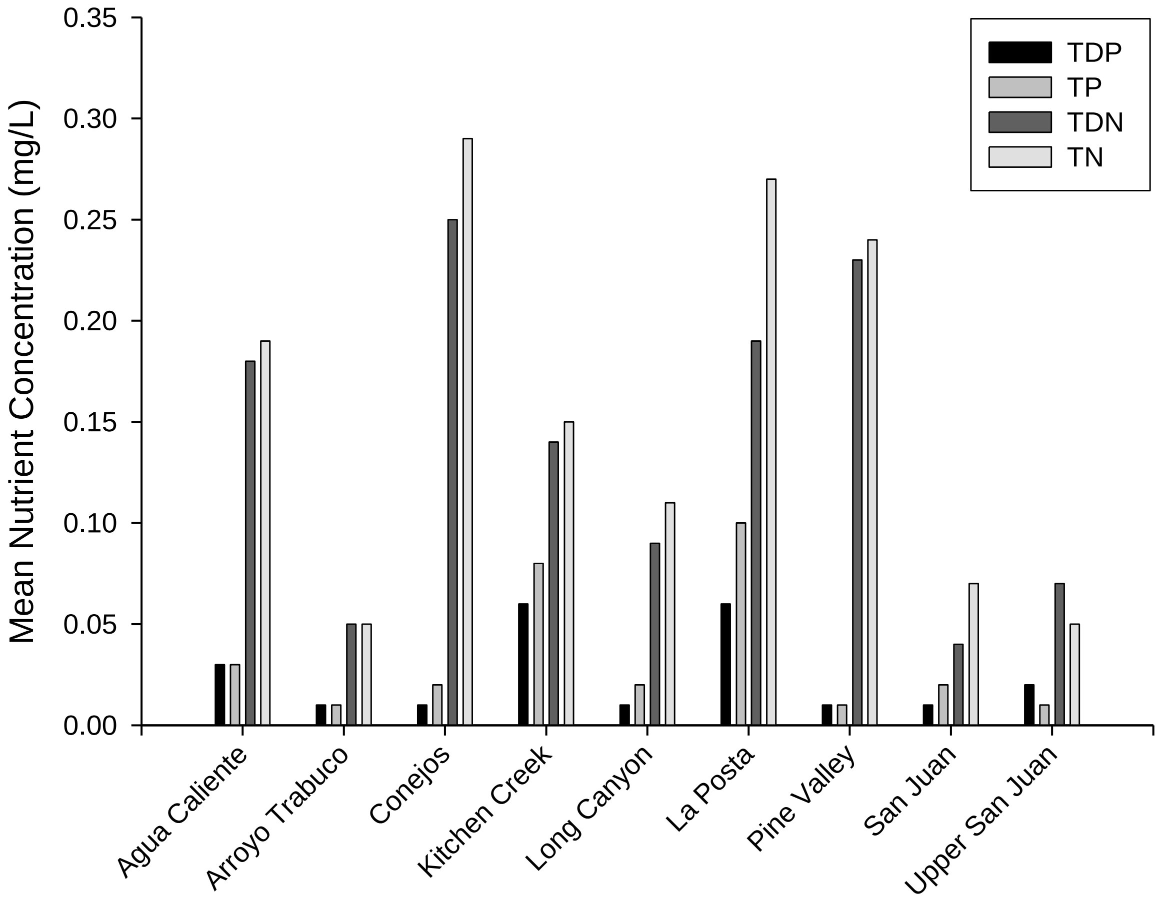

Figure 19. Comparison of reference stream nutrient concentrations (total dissolved phosphorus (TDP), total phosphorus (TP), total dissolved nitrogen (TDN), and total nitrogen (TN)) during the 2012 dry season. Units are mg/L.

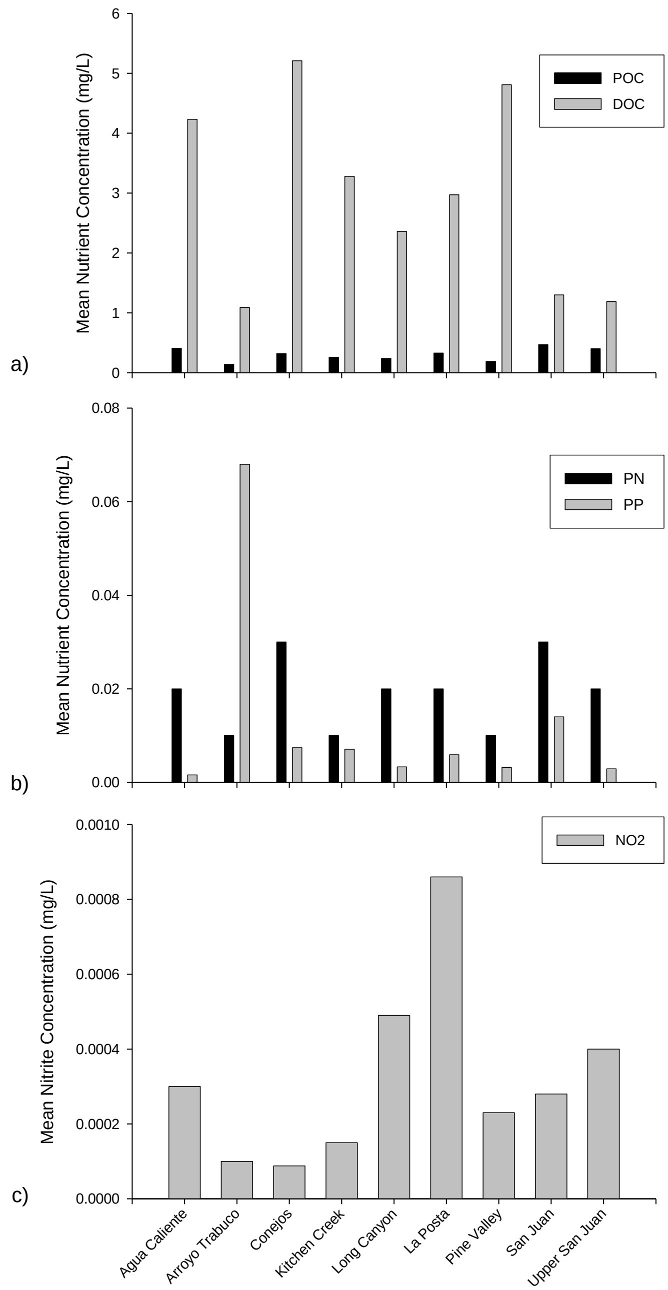

Figure 20. Comparison of reference stream nutrient concentrations a) particulate organic carbon (POC) and dissolved organic carbon (DOC); b) particulate nitrogen (PN) and particulate phosphorus (PP); and c) nitrite (NO_2) during the 2012 dry season. Units are mg/L.

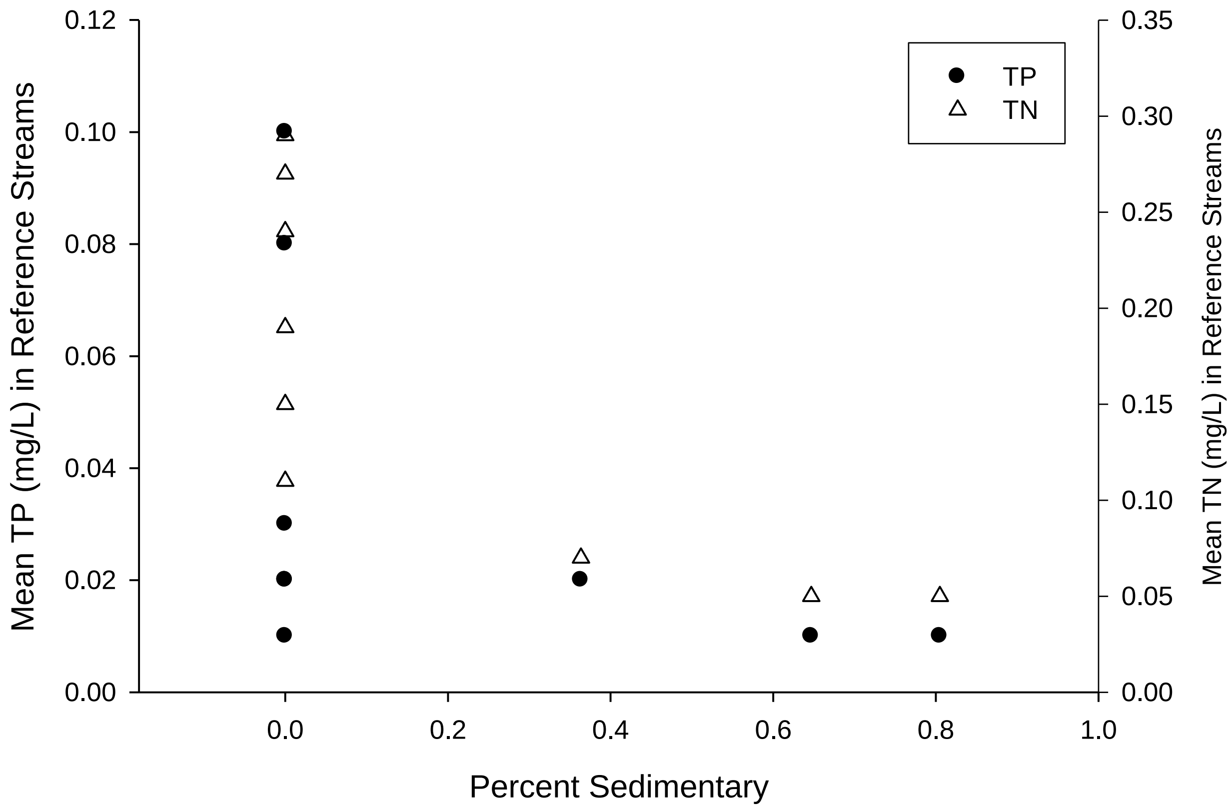

Figure 21. Relationship between total nitrogen (TN) and total phosphorus (TP) to proportion (%) sedimentary geology in reference streams during the 2012 dry season. Units are mg/L.

APPENDIX A - SUMMARY BACTERIA DATA FOR ALL REFERENCE STREAM SITE

Table A1. Monthly Enterococci geomeans (MPN/100 ml) in natural streams during April 2012-July 2012 in southern California, USA. State of California water quality standards exceedances are bolded. [a] = intermittent stream. NA = not analyzed.

			Enteroccoci Geomean							
Site Name	Watershed	County	April (MPN/100 ml)	SD	May (MPN/100 ml)	SD	June (MPN/100 ml)	SD	July (MPN/100 ml)	SD
Long Canyon Creek[a]	Tributary to Kitchen Creek	San Diego	**72.3**	27.7	**127.0**	50.0	**133.7**	14.6	**291.1**	31.5
Kitchen Creek[a]	Kitchen Creek- Cottonwood Creek	San Diego	**38.1**	26.1	**66.8**	36.9	**132.7**	96.5	NA	NA
Pine Valley Creek[a]	Upper Pine Valley Creek	San Diego	15.0	2.5	28.8	13.9	**52.7**	16.2	**195.6**	-
Agua Caliente Creek[a]	Laguna Creek/ San Luis Rey River	San Diego	NA	NA	**150.8**	348.1	**100.0**	-	NA	NA
La Posta Creek	La Posta Creek	San Diego	27.8	22.1	**140.6**	323.1	**843.0**	436.9	**315.9**	680.3
Conejos Creek[a]	San Diego River	San Diego	NA	NA	**38.0**	57.2	21.1	15.9	NA	NA
Upper San Juan Creek[a]	Upper San Juan Creek	Orange	30.5	-	29.0	24.6	14.6	2.2	14.5	-
San Juan Creek	Upper San Juan Creek	Orange	**48.6**	222.5	**53.4**	12.4	**88.8**	88.3	**61.1**	73.9
Arroyo Trabuco	Arroyo Trabuco	Orange	7.2	15.8	**83.3**	282.2	**67.0**	38.9	**107.3**	197.7
San Diego Geomean ± SD			32.7	13.9	**74.2**	75.2	**121.5**	161.2	**277.8**	295.7
Orange Co. Geomean ± SD			19.6	112.1	**50.5**	95.1	**77.2**	37.3	**57.4**	83.3
Overall Geomean ± SD			27.8	35.8	**63.5**	58.6	**101.1**	107.1	**126.3**	153.4

Table A2. Monthly *E. coli* geomeans (MPN/100 ml) in natural streams during April 2012-July 2012 in southern California, USA. State of California water quality standards exceedances are bolded; [a] = intermittent stream. NA = not analyzed.

			***E. coli* Geomean**							
Site Name	**Watershed**	**County**	**April (MPN/100 ml)**	**SD**	**May (MPN/100 ml)**	**SD**	**June (MPN/100 ml)**	**SD**	**July (MPN/100 ml)**	**SD**
Long Canyon Creek[a]	Tributary to Kitchen Creek	San Diego	3.9	39.8	12.3	2.3	6.8	5.3	47.9	440.4
Kitchen Creek[a]	Kitchen Creek-Cottonwood Creek		5.9	9.6	29.0	48.7	15.9	50.0	NA	NA
Pine Valley Creek[a]	Upper Pine Valley Creek		5.6	4.0	31.4	28.5	20.5	7.6	**261.3**	-
Agua Caliente Creek[a]	Laguna Creek/ San Luis Rey River		NA	NA	22.0	8.8	11.1	224.0	NA	NA
La Posta Creek	La Posta Creek		42.0	22.0	33.3	15.9	82.1	21.5	50.8	47.4
Conejos Creek[a]	San Diego River		NA	NA	10.4	1.5	11.2	24.3	NA	NA
Upper San Juan Creek[a]	Upper San Juan Creek	Orange	9.7	-	31.2	8.0	10.5	34.1	2.0	-
San Juan Creek	Upper San Juan Creek		16.5	24.6	8.8	6.7	30.0	32.2	19.8	68.8
Arroyo Trabuco	Arroyo Trabuco		6.4	12.7	96.5	260.8	33.4	20.9	70.9	268.1
San Diego Geomean ± SD			8.56	13.5	22.6	12.4	27.0	31.4	62.6	182.6
Orange Co. Geomean ± SD			10.2	15.7	29.8	91.8	18.8	16.7	20.8	107.4
Overall Geomean ± SD			9.6	10.3	25.1	35.3	23.8	20.6	39.6	114.0

Table A3. Monthly total coliforms geomeans (MPN/100 ml) in natural streams during April 2012-July 2012 in southern California, USA. State of California water quality standards exceedances are bolded; [a] = intermittent stream. NA = not analyzed.

			Total Coliforms Geomean							
			April		May		June		July	
Site Name	Watershed	County	(MPN/100 ml)	SD	(MPN/100 ml)	SD	(MPN/100 ml)	SD	(MPN/100 ml)	SD
Long Canyon Creek[a]	Tributary to Kitchen Creek		732.3	316.1	981.8	168.5	**1,418.3**	551.2	**2,419.6**	0.0
Kitchen Creek[a]	Kitchen Creek-Cottonwood Creek		**1,550.1**	419.4	**2,419.6**	0.0	**2,419.6**	0.0	NA	NA
Pine Valley Creek[a]	Upper Pine Valley Creek	San Diego	778.5	225.5	**2,236.0**	208.0	**2,086.7**	212.3	**2,419.6**	-
Agua Caliente Creek[a]	Laguna Creek/ San Luis Rey River		NA	NA	**2,419.6**	0.0	**2,419.6**	0.0	NA	NA
La Posta Creek	La Posta Creek		**1,094.2**	512.4	**1,776.5**	746.1	**2,419.6**	0.0	**2,265.6**	283.1
Conejos Creek[a]	San Diego River		NA	NA	**1,753.4**	979.2	**2,265.6**	283.1	NA	NA
Upper San Juan Creek[a]	Upper San Juan Creek		648.8	-	501.8	266.0	**1,098.2**	792.4	**1,524.6**	1,429.8
San Juan Creek	Upper San Juan Creek	Orange	991.4	711.3	500.9	131.7	**1,038.0**	807.1	**1,540.2**	1,410.4
Arroyo Trabuco	Arroyo Trabuco		**1,152.8**	326.5	**1,566.1**	767.8	**1,454.4**	721.9	579.4	-
San Diego Geomean ± SD			991.6	225.0	**1,864.6**	259.1	**1,486.5**	260.2	**2,352.3**	121.3
Orange Co. Geomean ± SD			**1,021.6**	354.3	732.9	400.0	876.4	418.0	**1,261.5**	771.1
Overall Geomean ± SD			**1,001.0**	187.5	**1,313.7**	270.7	**1,233.6**	265.5	**1,814.4**	401.7