Draft Technical Report | **2010**

San Joaquin River Basin Rotational Sub-basin Monitoring: Westside Basin, November 2004 – November 2005 (Orestimba, Del Puerto, Salado, Ingram and Hospital Creeks)

DRAFT
February 2010

This project was made possible by the coordination effort between SWAMP and the Westside Coalition.

www.waterboards.ca.gov/swamp

State of California
Arnold Schwarzenegger, Governor

California Environmental Protection Agency
Linda S. Adams, Secretary for Environmental Protection

REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

Katherine Hart, Chair
Cheryl K. Maki, Vice- Chair
Nicole M. Bell, Member
Julian C. Isham, Member
Karl E. Longley, Member
Sandra O. Meraz, Member
Dan Odenweller, Member
Robert G. Walters, Member

Pamela C. Creedon, Executive Officer

11020 Sun Center Drive #200
Rancho Cordova, CA 95670

Phone: (916) 464-3291
E-mail: info5@waterboards.ca.gov
Web site: http://www.waterboards.ca.gov/centralvalley/

DISCLAIMER

This publication is a technical report by staff of the California Regional Water Quality Control Board, Central Valley Region.
No policy or regulation is either expressed or intended.

REPORT PREPARED BY:
Calvin Yang, Project Assistant
Jay Rowan, Environmental Scientist*
Victoria Bowles, Environmental Scientist
Jeremy Starr, Project Assistant
Lee Xiong, Student Intern

Under the Direction of:
Jeanne Chilcott
Senior Environmental Scientist

REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

ACKNOWLEDGEMENTS:

This report has been many years in the making and would not be possible without support from the students and staff that have contributed tremendously during the project. Major portions of the field, lab and analytical work were funded through coordination and cooperation with other Board Programs (e.g. Agricultural Subsurface Drainage Program, Total Maximum Daily Load Program, Watershed Management Initiative Program, and Grant Program), in addition to the Westside Coalition as part of the Irrigated Lands Regulatory Program.

*Formerly Environmental Scientist with Central Valley Water Board and currently a Staff Environmental Scientist with Department of Fish and Game

TABLE OF CONTENTS **PAGE**

List of Figures

List of Tables

1.0 EXECUTIVE SUMMARY

From October 2004 through September 2005, staff from the Central Valley Regional Water Quality Control Board (Central Valley Water Board) conducted the third rotation of the Intensive Basin Program (IBP) as part of the Surface Water Ambient Monitoring Program (SWAMP) for the San Joaquin River (SJR). The IBP was the final layer in the 3-tiered monitoring framework developed as part of the San Joaquin River Basin SWAMP. In the first two tiers, the main stem of the SJR and the major inflows to the river were monitored. During the IBP, the upper watersheds of the SJR were intensively monitored for one year on a rotational basis. The SJR Basin was divided into five sub-basins, based on similar management practices and hydrologies. The purpose of each rotation was to identify current monitoring efforts within the sub-basin (agency and local) as well as any local water quality concerns, evaluate spatial and temporal trends of key constituents, and determine whether there was any evidence that beneficial uses were not being protected.

This third rotation of monitoring focused on the watersheds draining the west portion of the San Joaquin River Watershed, and includes the area west of the San Joaquin River from the Orestimba Creek watershed in the south to the legal boundary of the Sacramento-San Joaquin Delta to the north. The Westside Basin is comprised mainly of ephemeral water bodies flowing from the eastern side of the coastal range (Westcot *et al* 1991). The majority of the water bodies on the valley floor are either constructed or modified natural water bodies and carry agricultural supply and return flows. Many of the water bodies in the valley floor reaches are kept wet year round with irrigation supply or return flows and/or operational spills. Surface water used on the valley floor in the Westside Basin comes from withdrawals of the San Joaquin River or the Delta Mendota Canal, with some ground water blended in.

Land uses within the basin are mainly agriculture in the valley floor section including orchards and row crops with native vegetation, recreation areas, and cattle grazing in the upper watershed areas.

Prior to initial water quality sampling, 58 state, federal, and local agencies as well as known watershed groups were surveyed to identify current monitoring efforts and local concerns. The majority of existing water quality monitoring had just been initiated by the Westside Coalition under conditions of the Irrigated Lands Regulatory Program. Local concerns were focused on potential impacts to aquatic life and recreation in the upper watershed, in particular concerns with temperature, sedimentation, and pathogens, with additional concerns of irrigation supply (elevated salt) and drinking water (elevated total organic carbon) in the lower watershed. The final sampling design incorporated the initial survey findings and included coordination and collaboration with the Westside Coalition.

Sampling within each basin was conducted twice a month for a twelve-month period. Core constituents sampled consist of temperature, dissolved oxygen, pH, Specific Conductance (SC), total coliform and *E. coli*. As funding permitted, additional constituents were added including total suspended solids (TSS), total organic carbon (TOC), and water column toxicity.

For this study, the two largest of thirteen watersheds, Orestimba and Del Puerto Creeks, were sampled from their upper watershed downstream to the San Joaquin River. Valley floor drainage sites from three other watersheds, Hospital Creek, Ingram Creek, and Salado Creek, and two major agricultural drains that discharge directly to the San Joaquin River, were utilized to represent the remaining watershed and to compare the valley floor drainage sites with the two fully sampled watersheds. Similarities between the five watersheds, two agricultural drains, and source water were evaluated based on their overall physical characteristics and chemistry.

Sampling in the Westside Basin occurred from November 2004 through November 2005, primarily Water Year 2005. Water Year 2005 was classified a wet year based on the San Joaquin River Index (DWR, 2009), and followed four consecutive dry and below normal water years.

Temporal and Spatial Trend Findings:

During 2005, constituents monitored displayed some general temporal and spatial variations throughout the basin. For instance, temperature at all sites increased during the summer months regardless of flow or land use. Conversely, dissolved oxygen decreased at all sites during the warmer summer months. Other constituents, such as specific conductivity, TOC and E. coli displayed seasonal patterns and were greatly influenced by storm events. The magnitude of the influence increased if the site experienced a dry period. The pH was variable throughout the year, regardless of season or location in the watershed. The TSS was influenced by both storm events and the irrigation season, with TSS concentrations greater in the valley floor creeks and agricultural drains sites. Both the Orestimba and Del Puerto Creek sites just upstream of valley floor irrigated acreage were dry during the summer months. Some additional patterns between areas were noted as follows:

Orestimba Creek

Orestimba Creek has the largest watershed area in the Westside Basin (141-square miles). While pH, DO, temperature, and SC showed little spatial variability moving downstream TSS and TOC increased moving downstream and correlated with both rain events and irrigation patterns.

Del Puerto Creek

Del Puerto Creek was the only watershed to have year-round access in the upper elevations of the coast range and off the valley floor. The SC was higher in the upper watershed than in the lower watershed sites while TOC demonstrated increased summer variability due to low water levels and large clumps of filamentous algae. *E. coli* levels were consistently higher in the lower watershed sites than at the upper watershed sites.

Valley Floor (Salado, Ingram, Hospital Creeks, Agricultural Drains)

These sites are dominated by agricultural flows and were dry during periods of time between irrigation and precipitation events. With the exception of Salado Creek, overall medians and ranges of the constituents measured were comparable between sites for all but TSS, TOC and E. coli. The upstream Salado Creek site demonstrated dramatically higher median SC and DO than the remaining sites. In contrast, the upper Salado Creek site reported all TSS values below 100 mg/L except for three storm events, while the other Valley Floor sites reported median TSS values between 280 and 370 mg/L. Between all the Valley Floor sites, TSS, TOC and E. coli did not show any distinct pattern and were highly variable. Concentrations at specific sites in both Del Puerto and Ingram Creeks were directly influenced by inflows from adjacent agricultural fields for the short period of drainage. The inflows did not have an immediate effect on downstream concentrations but did produce localized spikes.

Temporally, DO, SC, and pH all were erratic from sample event to sample event in the non-irrigation season, then the flows picked up and trends developed as the irrigation season began.

Source Water

Although winter runoff will flow from the upper watershed to the valley floor, between April and October, water from a mixture of the San Joaquin River, DMC, and groundwater, supply most Valley Floor flows. Tail water from agriculture runoff may also be reused. Median SC for the source water at SJR @ Patterson was higher than all of the valley floor sites except for Salado Creek. Temperature, DO, pH, and TOC were all similar for both the CCID Main Canal and SJR at Patterson sites as well as the Valley Floor sites. Differences were evident for TSS, which was lower in the source water than in the Valley Floor sites except Salado Creek. The *E. coli* readings were lowest in the source water for the Westside Basin.

Preliminary Assessment of Potential beneficial Use Concerns:

Potential impacts to key beneficial uses were evaluated by using selected indicators and comparing results against published water quality goals, targets and/or guidelines as follows:

- Drinking Water (SC, TOC, and *E. coli*)
- Aquatic Life (pH, temperature, DO, water column toxicity)
- Irrigation water supply (SC)
- Recreation (*E. coli*)

In summary:

<u>Drinking Water/Municipal Supply</u>: Of the 1002 samples evaluated for potential impacts to drinking water, 345 (34%) indicated a potential concern. Of those 345, 93% were elevated concentrations of TOC and 7% were elevated concentrations of SC. Source water accounted for 21% of the elevated TOC concentrations, while 88% of the elevated samples for specific conductivity were in Salado Creek. Although there is no specific drinking water objective for bacteria, 51% of the samples contained *E. coli* indicating that the water should be treated prior to consumption.

<u>Aquatic life</u>: Of the 1721 samples evaluated for potential impacts to aquatic life, 91% did not show a potential impact. Of the remaining 162 samples, 31% were related to elevated temperatures, 29% to elevated pH, 23 % to low DO, and 16% to indicator organism toxicity. The source and upper watershed sites accounted for 33% of the elevated temperature samples and 45% of the elevated pH. The Orestimba Creek

watershed accounted for 53% of the low DO samples. The Del Puerto Creek at Del Puerto Road mile 3.9 site reported 73% (8 out of 11) toxic samples.

Irrigation Water Supply: Using the irrigation water goal of 700 umhos/cm, 40% of the 583 samples evaluated exceeded the goal. Of these 583, 47% of the elevated SC concentrations were in the upper watershed and source water sites. Salt is an ongoing concern for the Westside Basin and the San Joaquin Valley.

Recreation: Using the USEPA guideline of 235 MPN/100mL E. coli, 51% of the 545 samples evaluated contained concentrations high enough to impact designated beaches. The highest percentages of *E. coli* concentrations above the guideline were found in the Valley Floor sites, including the lower watersheds of Orestimba and Del Puerto. *E.coli* spikes were documented during both winter storm events when it would be unlikely to find people swimming and during the warmer summer season when most recreational contact would occur.

Future Activities

By the end of this study (2005), other Central Valley Water Board surface water monitoring efforts had expanded—notably the Irrigated Lands Regulatory Program (ILRP) and monitoring conducted under various grant efforts. The Central Valley Water Board SWAMP efforts became more focused on internal and external monitoring coordination rather than continuing to maintain a separate monitoring strategy with shrinking resources. Some of these efforts relating to the Westside Basin are listed below.

- Continued water quality monitoring support for the multi-agency Grassland Bypass Project (selenium control program)
- Leveraging funds with a separate USEPA project to continue development of a web-based monitoring directory designed to display active monitoring within the entire Central Valley (http://www.centralvalleymonitoring.org)
- Providing resources to insure ILRP water quality information is captured in the state-wide SWAMP master data base
- Developing a region-wide, long-term trend monitoring framework based on the 30-sites within the Central Valley that are part of the state-wide SWAMP contaminant trend monitoring effort.
- Coordinating with the San Joaquin River Restoration Program monitoring program development.

Efforts related specifically to the elevated *E. coli* concentrations found within the SJR Basin as well as in other areas of the Central Valley as part of ILRP monitoring, include:

- A survey of *E. coli* concentrations in local swimming holes before during and after a holiday weekend (coordinated with Central Valley watershed groups during 2007, 2008, and 2009)
- A pilot bacteria source identification project with the University of California, Davis, in selected streams demonstrating elevated *E. coli* concentrations
- Continued, seasonal *E. coli* monitoring at 30-major integrator sites throughout the Central Valley.

Recommendations for future monitoring for the Westside sub-basin include parameters listed in Table 9 with a particular focus on specific conductance, *E. coli*, and TOC. For *E. coli* a majority of the sites with high percentages of samples exceeding the USEPA guideline may need further evaluation to determine actual level of potential recreational use.

Specific studies that would help further characterize the Westside basin include:

- Collecting turbidity at all sites;
- Expanded studies in the Salado Creek watershed to determine background and sources of elevated SC and potentially super-saturated concentrations of DO;
- Focused toxicity monitoring in Del Puerto Creek;
- Bacteria Source Identification Studies; and
- More detailed temperature and pH profiles in the upper watershed to determine appropriate background conditions.

All SWAMP data collect for this project and other San Joaquin Valley studies has been posted annually on the Central Valley Water Board website since 2003 and was utilized in combination with other available data for assessment in the Clean Water Act Sections 305(b) and 303(d) Integrated Report for the Central Valley Region (CVRWQCB, 2008/2010 Draft).

2.0 GLOSSARY/ KEY TERMS

CCID – Central California Irrigation District

Central Valley Water Board - Central Valley Regional Water Quality Control Board

DMC- Delta-Mendota Canal

DO- Dissolved Oxygen

ILRP- Central Valley Water Boards Irrigated Lands Program

MCL- Maximum Contamination Level

MUN - Municipal and Domestic Supply

QA- Quality Assurance

QC- Quality Control

SC- Specific Conductance

SJR – San Joaquin River

State Water Board – State Water Resources Control Board

SWAMP – Surface Water Ambient Monitoring Program

TOC- Total Organic Carbon

TSS-Total Suspended Solids

3.0 INTRODUCTION

The Surface Water Ambient Monitoring Program (SWAMP) for the San Joaquin River (SJR) Basin is built upon a monitoring framework, developed in 1985 as part of the agricultural subsurface drainage management program for selenium, salt and boron. Between 2000 and 2005 the SWAMP program in the SJR Basin contained three layers. The first layer was a selection of sites along the main stem of the SJR, downstream of major inflows. The second layer was a series of sites representing inflows from specific sub-watersheds into the main stem of the river. The final layer was the Intensive Basin Monitoring Program (IBP) which is a detailed, yearlong survey of the water quality within each of the sub-watersheds once every five years.

To accomplish the monitoring objectives for the IBP, the SJR Watershed was divided into five sub-basins. Each of these basins included water bodies with similar hydrologies, geologies, management issues, land use and land cover. A sixth basin was identified, the Sacramento – San Joaquin Delta (South Delta Basin). The South Delta Basin has not been included as part of the rotation due to the extensive monitoring and modeling already conducted by other programs.

Once every five years, funding permitting, expanded monitoring "rotated" into one of the sub-basins. The purpose of each rotation was to identify current monitoring efforts within the sub-basin (agency and local) as well as any local water quality concerns, evaluate spatial and temporal trends of key constituents, and determine whether there was any evidence that beneficial uses were not being protected. Resulting information was incorporated into the 2008/2010 statewide 305b/303d integrated water quality assessment report (CVRWQCB, 2008/2010 Draft).

During the rotation, sampling sites were selected based on land use, management practices, local stakeholder input, and coordination with ongoing monitoring in the basin. The sites were then monitored twice a month for one year. Constituent selection was based on historic information, data gathered as part of the Drainage Basin Inflows component (Bowles 2009), stakeholder response to a monitoring survey, and available funding. At a minimum, each site was analyzed for standard field measurements: specific conductance (SC); pH; temperature; dissolved oxygen (DO); total coliform and *E. coli*. Turbidity was historically collected as part of the IBP, but was not collected in the Westside basin due to equipment malfunction. Additional water column parameters monitored in the Westside Basin included 3-species acute toxicity tests (U.S. EPA, 1986), 2-species chronic toxicity tests: *Ceriodaphnia dubia*, and *Pimephales promelas*, total suspended sediment (TSS) and total organic carbon (TOC).

Sediment analysis was conducted at a sub set of sites in the Westside and included 10-day *Hyalella azteca* sediment toxicity tests, pyrethroid, organophosphate (OP) and organochlorine (OCl) pesticides as well as grain size and TOC. These results are discussed separately in the Sediment Toxicity Report (Grover 2007).

Monitoring in this phase was coordinated with monitoring conducted by the Westside Coalition as part of the Irrigated Land Regulatory Program (ILRP), to allow for greater coverage and more frequent sample collection at specific sites. This coordination also allowed for Toxicity Identification Evaluation (TIE's) for some of the ILRP sediment samples with elevated toxicity. Results for the TIE's are also discussed separately in the

Sediment Toxicity report (Grover 2007). In addition, monthly photo documentation was taken at each site.

This study focuses on the Westside Basin, consisting of the Ingram Creek, Del Puerto Creek, Salado Creek, Orestimba Creek, and Hospital Creek Watersheds. Water quality monitoring conducted by outside agencies during the time of the study was limited to selected gauges maintained by the California Department of Water Resources and US Geological Survey, and targeted studies conducted by the University of California, the Westside Coalition, and others. Data for the targeted studies other than the Westside Coalition was not readily accessible. Based on responses to initial surveys SWAMP focused on potential impacts to aquatic life and recreation in the upper watershed, in particular concerns with temperature, sedimentation, and pathogens. The main recreation area in the upper watershed is the 800-plus-acre Frank Raines Off Highway Vehicle Park (OHV) and the Deer Creek Campground of the Del Puerto Creek Watershed. The upper portions of the watersheds represent sites upstream of the CCID Main Canal.

The main concerns in the lower watershed (downstream of the CCID Main Canal) based on potential beneficial uses included drinking water (Specific conductivity, total organic carbon, trace elements i.e. total arsenic total chromium, total lead, total nickel and total mercury, *E. coli* and nitrate), Aquatic life (pH, temperature, dissolved oxygen, turbidity, total copper, and water column toxicity) irrigation supply (elevated salt and minerals) and Recreation (*E. coli*) (Bowles, 2009).

This report presents and evaluates the results of field measurements and analyses on samples collected for the Westside Basin from November 2004-November 2005.

Available funding and coordination with ongoing efforts allowed for monitoring twice a month. The combination of parameters allowed for development of initial baseline data as well as a preliminary assessment of potential impacts to the following beneficial uses:

Drinking Water	(Specific Conductivity, Total Organic Carbon, *E. coli*,)
Aquatic Life	(Toxicity, Temperature, Dissolved Oxygen, pH)
Recreation	*(E. coli)*
Irrigation Supply	(Salt/Specific Conductivity)

Sampling in the upper watershed was conduced by SWAMP staff while sampling in the lower watershed was coordinated with the Westside Coalition.

Details for SWAMP monitoring objectives and indicators, as well information on basins not included in this study can be found on the San Joaquin River SWAMP website at:

http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_studies/surface_water_ambient_monitoring/sjr_swamp.shtml

4.0 STUDY AREA

The focus of this report is on water quality in the Westside Basin, one of 5 sub-basins draining into the San Joaquin River. More details on the overall hydrology of the SJR Basin and details of the Westside Basin follow.

4.1 San Joaquin River Basin Hydrology

The San Joaquin River (SJR) is the principal drainage artery of the San Joaquin Valley. The basin covers approximately 16,000 square miles and yields an average annual surface runoff of about 1.6 million-acre feet. (CVRWQCB, 2007) The SJR Basin drains the portion of the Central Valley south of the Sacramento-San Joaquin Delta and north of the Tulare Lake Basin.

The SJR flows westward from the Sierra Nevada Range and turns sharply north at Mendota Pool near the town of Mendota. Most of the SJR flow is diverted into the Friant-Kern Canal, leaving the river channel upstream of the Mendota Pool dry except during periods of wet weather flow and major snow melt. The river continues past Mendota Pool to form a broad flood plain, as it turns northward, for a distance of approximately 50 miles until the river is narrowed by the constrictions of the Merced River and Orestimba Creek alluvial fans.

Flows from the east side of the Basin to the San Joaquin River are dominated by discharges from the Merced, Tuolumne, and Stanislaus Rivers which primarily carry snowmelt from the Sierra Nevada. Flows from the west side of the river basin are dominated by agricultural return flows since west side streams are ephemeral and their downstream channels are used to transport agricultural return flows to the main river channel. Poorer quality (higher salinity) water is imported from the Delta for irrigation along the west side of the river to replace water lost through diversion of the upper SJR flows.

The principal streams in the SJR Basin are the San Joaquin River and its larger tributaries: the Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, and Fresno Rivers which all drain the east side of the Basin. Major land use along the San Joaquin Valley floor is agricultural, with 2.0 million acres, representing approximately 23% of the irrigated acreage in California (DWR, 2001). Urban growth is rapidly converting historical agricultural lands leading to an increased potential for storm water and urban impacts to local waterways. Timber activities, grazing, abandoned mines, rural communities, and recreation can impact upper watershed areas.

4.2 San Joaquin River Sub-Basins

To help characterize the SJR watershed and develop a monitoring program targeting specific problems affecting water quality, the watershed was broken into six smaller sub-basins bound by the Sierra Nevada to the east or the Coast Range to the west and comprised of similar land use and drainage patterns (Figure 1). All of the agricultural dominated and constructed water bodies within each of the sub-basins have been identified (Chilcott, 1992), as well as the potential water quality concerns and major representative discharges to the lower SJR. These sub-basins are similar to and based on, Total Maximum Daily Load (TMDL) efforts for salinity and boron in the lower SJR.

1. The **Northeast Basin** consists of the Cosumnes, Mokelumne, and Calaveras River Watersheds, providing a combined drainage of 4,360 square miles.

2. The **Eastside Basin** contains the three largest SJR tributaries, in terms of flow: the Merced, Stanislaus, and Tuolumne River Watersheds, along with the Farmington Drainage Basin and the lower Valley Floor Drainage Area, which drain directly to the SJR. The Eastside Basin is approximately 6,091 square miles.

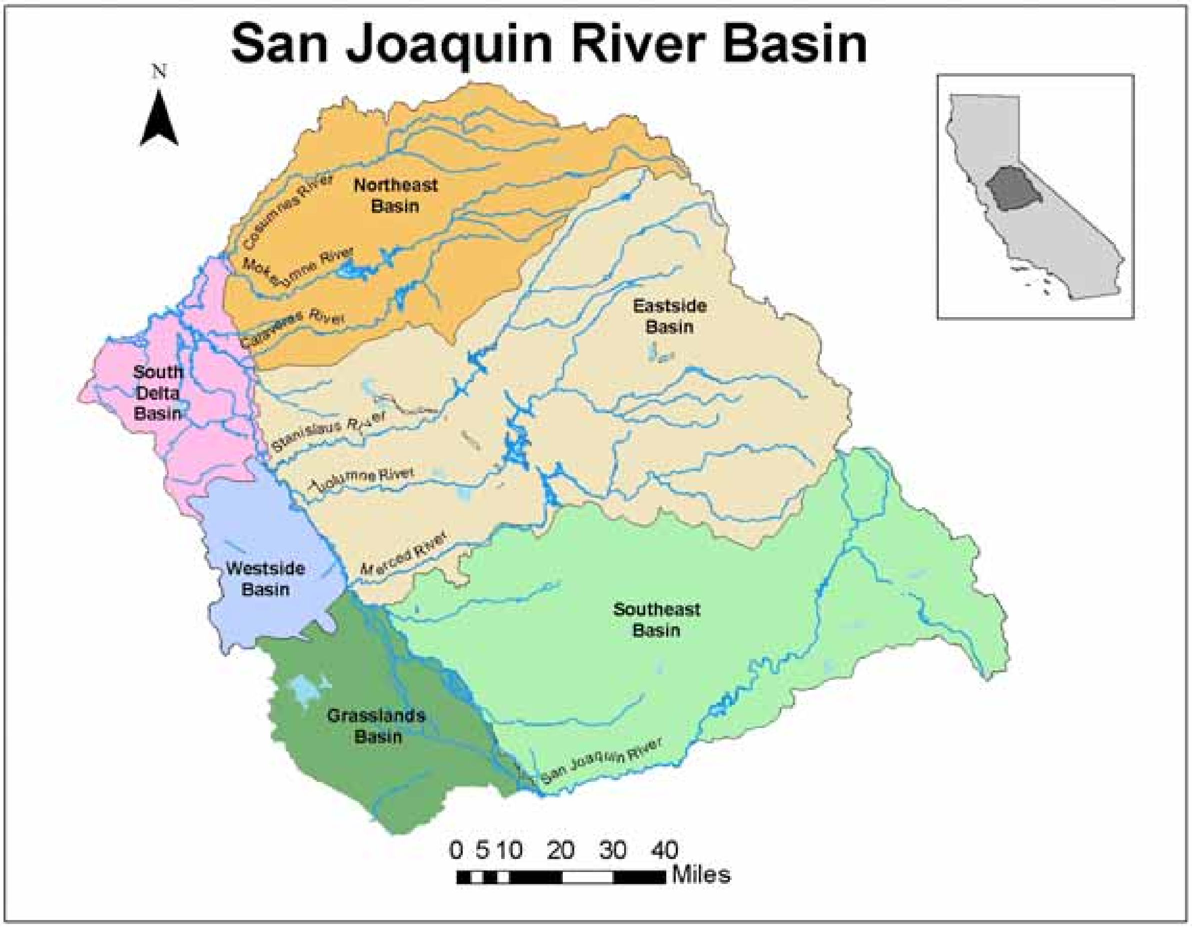
3. The **Southeast Basin** is approximately 4,338 square miles and reaches from the headwaters of the SJR north to the watershed divide between Bear Creek and the Merced River in Merced County.

4. The **Westside Basin** encompasses the watersheds of the creeks draining the eastern slope of the coast range from the Orestimba watershed in the south to the Lone Tree Creek in the north. The Westside basin is approximately 670 square miles.

5. The **Grasslands Basin** is a valley floor sub-basin of the SJR Basin, south of the Orestimba watershed, covering approximately 1,360 square miles. This basin lies on the Westside of the SJR in portions of Merced, San Benito, and Madera Counties.

6. The **South Delta Basin** covers approximately 677 square miles and includes creeks on the northwest side of the SJR, as well as the southern portion of the Sacramento-San Joaquin Delta waterways down toward the confluence of the SJR and the Sacramento River. Waters inside the Delta boundaries are tidal influenced and typically higher in salinity than other surface water throughout the SJR Basin.

Figure 1: San Joaquin River Sub-Basins



4.3 Westside Basin Study Area

The Westside Basin includes the area from the Orestimba Creek watershed in the south to the legal boundary of the Sacramento-San Joaquin Delta. The eastern boundary is the San Joaquin River and the western boundary is the eastern slope of the Coastal Range (Westcot *et al*, 1991) watersheds. The Westside Basin covers approximately 670 square miles, 13 small watersheds, seven water districts, and is almost entirely contained within Stanislaus County.

Communities within the study area include, Newman, Crows Landing, Patterson, Westley and Grayson. As with other central valley areas, urban development is overtaking the traditional agricultural fields, this is most notable in the area between Patterson and I-5. In the upper Salado Creek watershed there is a 33,000-acre vineyard, golf course, hotel, and resort community was under development during the study period.

Rather than sampling all 13 watersheds of the Westside basin, for this study, the two major watersheds were sampled from upper watershed downstream to the lower watershed as it flowed into the valley floor and ultimately the SJR. These two watersheds were the Orestimba Creek and Del Puerto Creek watersheds. The Valley floor drainage sites from three other watersheds, Hospital Creek, Ingram Creek, and

Salado Creek, were chosen to compare to the valley floor drainage sites of the two fully sampled watersheds of Orestimba Creek and Del Puerto Creek. Correlations could then be analyzed regarding the similarity of all five ephemeral watersheds based on their downstream chemistry.

Geology and Hydrology

The Diablo Range that creates the upper watersheds is formed by mix of marine sedimentary rocks mainly of the Cretaceous age, dominated by Moreno shale and the Panoche formation, as well as, the Franciscan formation (Westcot, *et al*.,1991). Shallow valley floor sediments in the Westside Basin are, as expected, a mix of alluvium washed down from the Coastal Range (Bertoldi, 1987).

The mountains and streams in the upper portion of the watersheds are steep and rugged with many areas of exposed and eroding rock and soils. The topography quickly transitions to rolling foothills then abruptly flattens out at the valley floor. The upper portions of the watersheds, those sections west of I-5, are fairly well vegetated in the higher elevations with grasses, and shrubs such as manzanita, as well as, large trees such as oaks and conifers. The woody plants give way to grasses in the lower foothills and agriculture and urban development supplant natural vegetation in the valley floor.

The eastern slope of the Diablo Range suffers from a rain shadow effect from the rest of the coast range. Higher elevations in the Westside Basin average only 14 inches of rainfall per year while the valley floor average is only 9 inches per year.

There are 13 watersheds that drain the Diablo Range in the study area, all of which are ephemeral throughout most of their range. The two largest watersheds in terms of size and water flow to the valley floor are the upper Orestimba Creek watershed at 141 square miles and the upper Del Puerto Creek watershed at 76.2 square miles. These two watersheds account for approximately 60% of the total upper watershed area in the Westside Basin and approximately 95-100% of the flow entering the valley floor mainly in the winter and spring months (Westcot, *et al*.,1991).

The majorities of the water bodies on the valley floor downstream of the CCID is either constructed or modified natural waterbodies and carry agricultural supply and return flows. Many of the water bodies in the valley floor reaches are kept wet year around with supply or return irrigation flows and/or operational spills. The majority of the surface water used on the valley floor in the Westside basin comes from withdraws from the San Joaquin River or the Delta Mendota Canal, which is exported from the Sacramento-San Joaquin Delta near Tracy, California. Some ground water is also blended in with surface water for irrigation.

5.0 SAMPLING PROGRAM

5.1 Program Objectives

In keeping with the overall Central Valley Regional Board SWAMP goals of being able to coordinate with existing efforts in order to answer water quality questions related to spatial and temporal trends as well as weather or not there is evidence of beneficial use impairment, the following objectives were adopted for this effort:

1. Collaborate with ongoing monitoring, conducted by the Westside Coalition
2. Evaluate Spatial and Temporal Trends in water quality
    a. Spatial includes the evaluation of the creeks moving downstream within a specific watershed as well as between watersheds
    b. Temporal includes seasonal variations
3. Evaluation of Beneficial Use Protection
    a. Using selected indicators to determine whether there is evidence of potential impairment

5.2 Program Design

This water quality-monitoring program was conducted in the Westside Basin from November 2004 - November 2005. One of the major objectives of this rotation was to collaborate with the Westside Coalition to allow for greater coverage and more frequent sample collection at specific sites. Figure 2 depicts which sites had coordination between SWAMP and the Westside Coalition. Sampling locations (Table 1 and Figure 2) were chosen in an effort to provide integrator sites at the lower end of sub-watersheds.

Table 1: Site Key for Westside Basin Map (Figure 2)

Map Number	Site Name	Monitored by		Station ID	Lat	Long
		SWAMP	ILRP			
1	SJR @ Patterson	X		541STC507	37.497778	-121.081667
2	Hospital Creek @ River Rd	X	X	541STC042	37.610556	-121.228611
3	Hospital Creek @ Hwy 33	X		541STC529	37.604190	-121.259130
4	Ingram Creek @ River Rd	X	X	541STC040	37.600278	-121.224167
5	Ingram Creek @ Hwy 33	X		541STC528	37.588870	-121.242440
6	Del Puerto Creek @ Deer Creek camp ground. Mi 16 (approx. 35 min. from I-5)	X		542STC527	37.423700	-121.378690
7	Del Puerto Creek @ mile 13.6	X		542STC526	37.424470	-121.342850
8	Del Puerto Creek @ mile 3.9	X		542STC525	37.472470	-121.240690
9	CCID Main Canal @ JT Crow Rd	X		541STC522	37.367780	-121.050880
10	Del Puerto Creek @ Rodgers Rd	X		541STC524	37.499030	-121.177330
11	Del Puerto Creek @ Hwy 33	X	X	541STC523	37.513820	-121.159860
12	Del Puerto Creek @ Vineyard	X		541STC516	37.521389	-121.148611
13	Del Puerto Creek near Cox Rd		X	535STC533	37.539400	-121.122100
14	Salado Creek @ Hwy 33	X		541STC515	37.481389	-121.135556
15	Salado Creek at Oak Flat Rd	X		541STC532	37.420960	-121.155920
16	Orestimba Creek @ Orestimba Rd	X		541STC521	37.319290	-121.120930
17	Orestimba Creek @ Bell Rd	X		541STC517	37.332810	-121.102880
18	Orestimba Creek @ Anderson	X		541STC520	37.362140	-121.061610
19	Orestimba Creek @ Hwy 33	X	X	541STC519	37.377150	-121.058120
20	Orestimba Creek @ Kilburn	X		541STC518	37.399250	-121.032450
21	Orestimba Creek @ River Rd	X	X	541STC019	37.413889	-121.014167
22	Grayson Drain	X		541STC030	37.561944	-121.174167
23	Blewitt MWC Drain at Hwy 132	X		541STC531	37.640530	-121.229310
	Gauging Stations					
24	Del Puerto C NR Patterson CA (Flow)	NA	NA	11274630 [1]	37.486667	-121.208056
25	Ingram Creek at River Road (Flow)	NA	NA	541STC040 /541XICARR[4]	37.600278	-121.224167
26	Orestimba C NR Newman CA(Flow)	NA	NA	11274500 [1]	37.315556	-121.124167
27	Orestimba CK At River RD NR Crows LNDG (Flow)	NA	NA	OCL[3]	37.413611	-121.015000
28	Diablo Canyon (precipitation)	NA	NA	DBC[3]	37.329000	-121.302000
29	Newman (precipitation)	NA	NA	NEWMAN.C[2]	37.300000	-121.033333
30	Patterson (precipitation)	NA	NA	PATTERSON.A	37.433333	-121.133333

Data Gathered from:

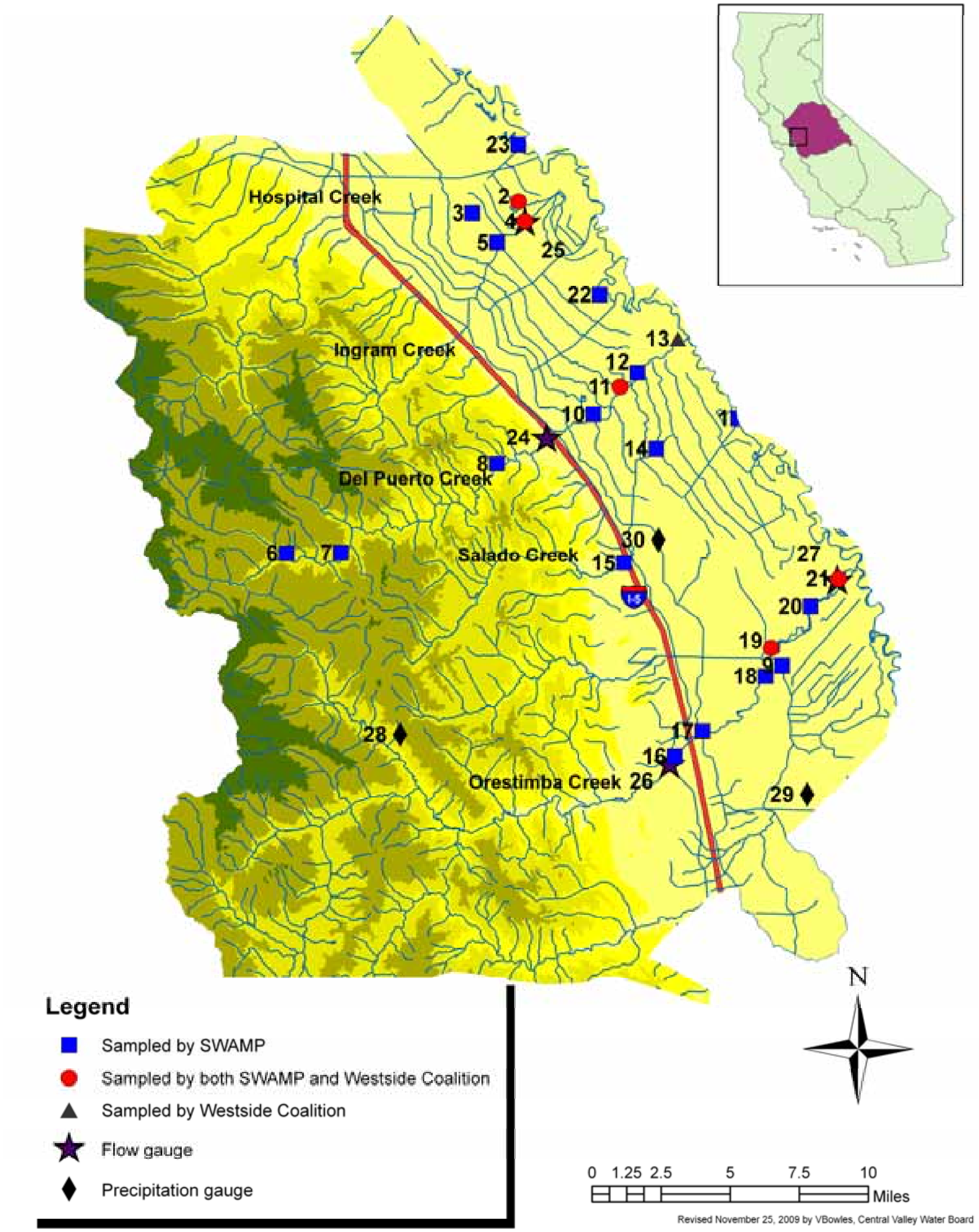
[1] USGS Stations

[2] California Weather Data

[3] CDEC

[4] Irrigated Lands Regulatory Data (Westside Coalition)

Figure 2: Westside Basin



In order to maximize limited resources and facilitate information exchange, other stakeholders involved in monitoring in this area were contacted directly and by survey. These entities include University of California, Davis (UC Davis), United States Geological Survey (USGS), the Westside Coalition for the Irrigated Lands Program (ILP), local water and drainage districts, and various Municipalities and Utility companies. These agencies were contacted during the developmental stage of the program to determine existing and historic sampling locations, available information, and local community concern. Information gathered was combined with land use data, hydrologic characteristics and available resources to determine site locations, constituents of concern, and sampling frequency. Since the data generated by the other groups working in this sub basin is not available in one location, the sampling design had to be complete in itself to answer spatial, temporal, and beneficial use questions. In addition, the study design attempted to capture sites that were identified as of particular concern to local stakeholders such as the Westside Coalition.

The Westside Coalition was monitoring water quality of representative agricultural discharges under a conditional waiver to Waste Discharge requirements in compliance with the ILRP. The coalition sites were all located on the valley floor. SWAMP's monitoring focused on potential impacts to aquatic life and recreation in the upper watershed, in particular concerns with temperature, sedimentation, and pathogens, with additional concerns of irrigation supply (elevated salt) and drinking water (elevated total organic carbon) in the lower watershed.

SWAMP and the Westside Coalition combined field measurements, TSS, TOC, and toxicity data that had passed QA. For most sites SWAMP and the Westside Coalition alternated sampling runs so that one week SWAMP sampled the site and then the next week the Westside Coalition sampled the site. The site would be sampled up to twice a month, but by different groups. This coordination allowed leveraging of resources and resulted in expanded monitoring within two watersheds.

Grab samples were collected twice a month at most sites and included field measurements of dissolved oxygen (DO), specific conductivity (SC), pH, temperature, total coliform, and *Escherichia coli (E. coli)*. Additional samples were collected bi-monthly or less frequently for total suspended solids (TSS), total organic carbon (TOC), including some monthly toxicity samples using acute 48 hour water flea (*Ceriodaphnia dubia*), acute 96 hour fathead minnow (*Pimephales promelas*), acute 96 hour algae at some sites.

Depending on the site and constituent of interest, monitoring was conducted twice per month (biweekly), quarterly, or on an annual basis. Detailed information on the monitoring locations and constituents for each sampling event are contained in Table 2.

Table 2: FY 04-05 MONITORING SITES, SAMPLING FREQUENCIES, AND PARAMETERS MEASURED

TABLE SJR-2. FY 04-05 MONITORING SITES, SAMPLING FREQUENCIES, AND PARAMETERS MEASURED: San Joaquin River Basin--SWAMP Program Water Year 2005

INTENSIVE ROTATIONAL BASIN SAMPLING [3rd Rotation: Westside Basin 24 Sites (Nov '04 - Nov '05)]

				Water Column Analyses									
Site Location	**SITE CODE CVRWQCB**	**Latitude**	**Longitude**	**SC**	**pH**	**Temp**	**DO**	**Bacti**	**TSS**	**TOC**	**96-hr Fathead**	**48-hr Cerio**	**96-hr Algae**
Orestimba Creek Sub-Watershed													
Orestimba Creek @ River Road	541STC019	37.4139	-121.0142	BM	BM	1	BM	BM	M	M	M	M	
Orestimba Creek @ Kilburn	541STC518	37.3993	-121.0325	BM	BM	1	BM	BM	BM	BM			
Orestimba Creek @ Hwy 33	541STC519	37.3772	-121.0581	BM	BM	1	BM	BM	M	M	M	M	
Orestimba Creek @ Anderson	541STC520	37.3621	-121.0616	BM	BM	1	BM	BM	BM	BM			
Orestimba Creek @ Bell Rd	541STC517	37.3328	-121.1029	BM	BM	1	BM	BM	BM	BM			
Orestimba Creek @ Orestimba Rd	541STC521	37.3193	-121.1209	BM	BM	1	BM	BM	BM	BM			
Del Puerto Creek Sub-Watershed													
Del Puerto Creek @ Vineyard	541STC516	37.5214	-121.1486	BM	BM	1	BM	BM	BM	BM			
Del Puerto Creek @ Hwy 33	541STC523	37.5138	-121.1599	BM	BM	1	BM	BM	M	M	M	M	M
Del Puerto Creek @ Rodgers	541STC524	37.4990	-121.1773	BM	BM	1	BM	BM	BM	BM			
Del Puerto Creek @ mile 3.9	542STC525	37.4725	-121.2407	BM	BM	1	BM	BM	BM	BM			M
Del Puerto Creek @ mile 13.6	542STC526	37.4245	-121.3429	BM	BM	BM	BM	BM	BM	BM			
Del Puerto Creek @ Deer Creek camp ground.	542STC527	37.4237	-121.3787	BM	BM	BM	BM	BM	BM	BM			M
Del Puerto Creek Near Cox Road	541STC533	37.5394	-121.1221	M	M	M	M	M	M	M			
Valley Floor													
Hospital Creek Sub-Watershed													
Hospital Creek @ River Rd.	541STC042	37.6106	-121.2286	BM	BM	1	BM	BM	M	M	M	M	
Hospital Creek @ 33	541STC529	37.6042	-121.2591	BM	BM	BM	BM	BM	BM	BM			
Ingram Creek Sub-Watershed													
Ingram Creek @ River Rd.	541STC040	37.6003	-121.2242	BM	BM	1	BM	BM	M	M	M	M	
Ingram Creek @ Hwy 33	541STC528	37.5889	-121.2424	BM	BM	B	BM	BM	BM	BM			
Salado Creek Sub-Watershed													
Salado Creek @ Hwy 33	541STC515	37.4814	-121.1356	BM	BM	1	BM	BM	BM	BM	M	M	
Salado Creek at Oak Flat Road	541 STC532	37.4210	-121.1559	BM	BM	BM	BM	BM	BM	BM			
Ag Drains													
Grayson Drain	541STC030	37.5619	-121.1742	BM	BM	1	BM	BM	BM	BM	M	M	
Blewitt MWC Drain at Hwy 132	541STC531	37.6405	-121.2293	BM	BM	BM	BM	BM	BM	BM	M	M	
Source Water													
CCID Main Canal @ JT crow	541STC522	37.3678	-121.0509	BM	BM	1	BM	BM	BM	BM	M	M	
SJR @ Patterson	541STC507	37.4978	-121.0817	W	W	W	W	BM	BM	BM			M

MS= Monthly (Feb thru August)
W+= Weekly in-season period April 01-Aug 01
M+ = Monthly (2x/month Feb thru August)
1=Gauged Site

F = Field Analys
W = Weekly
BM= 2x/month
M = Monthly

B = 2x/year
QS = Quarterly plus 4x during one storm event
B$= Proposed 2x/year OP synoptic sampling
D= Daily composite samples

▨ =Long-term SWAMP trend monitoring site

5.3 Sampling Sites

Each site was assigned a site code and a site name. The site code begins with three numbers representing a hydrological state based code. It is then follwed by either the first three letters of the county in which the site is located (e.g., CAL represents Calaveras County), or the first letters of each word in the county name, plus ‘C’ for county (e.g., STC represents Stanislaus County). The three numbers in the site code are arbitrarily chosen, but unique to each site in that county.

Site locations are depicted in Figure 2, with site codes matching those listed in Table 1. Monthly photo documentation of each site is included in Appendix B. Six sites included in this sampling effort are also long-term SWAMP sites (Hospital Creek at River Road, Ingram Creek at River Road, Salado Creek at Highway 33, Del Puerto Creek at Vineyard, Orestimba Creek at River Road, and Grayson Drain). Long-term monitoring sites were sampled on a monthly basis between 2000 and 2005, to provide information for comparison of water quality data during different water year types and help determine which constituents to monitor during rotations into the various drainage basins. Detailed site descriptions, including photo documentation of each site, is located in Appendix B.

The sites monitored within the Westside Basin are described by watershed below. Details for each site have primarily been obtained from geographic information system (GIS) and the Inland Surface Waters Report (1991).

5.3.1 Orestimba Creek Watershed

Orestimba Creek is the largest watershed in the Westside study area. The watershed covers 141 square miles above the point where it passes under Interstate 5. Orestimba Creek originates along an extensive area of the crest of the coastal Range. The North Fork drains the western ridgeline south to Black Mountain near the 3,600-foot elevation and the north ridge boundary with the Del Puerto Creek watershed east to the Miles Peak area. The North Fork drains into a steep creek canyon. The South Fork originates in a high plateau area in the southeast corner of the South Fork prior to it joining the North Fork. The North and South Forks come together near Jackass Flat at the base of Wilcox Ridge, one of several high plateau ridges that are widespread in the upper Orestimba Creek watershed. After the confluence, Orestimba Creek flows in an eastward direction with lesser tributaries entering after draining the Wilcox Ridge, Orestimba Peak, and the Black Mountain areas. (Westcot, *et al*., 1991) As the Creek begins to enter the valley floor it becomes very wide and considerable amounts of sand and gravel are deposited in the streambed.

Rainfall in the watershed is strongly influenced by topography. Average annual rainfall ranges from 18 inches or greater in the higher elevation areas to 10 inches in the eastern extreme of the basin. The majority of the Orestimba Creek watershed is near the western crest (drainage divide); therefore, more than 65 percent of the watershed receives an annual rainfall in excess of 15 inches. USGS (1985) records indicate that the maximum flow rates as the creek crosses under Interstate 5 have been in excess of 10,000 cfs, but there are many days, especially in summer, when there is no flow being recorded. The average annual discharge for 59 years of record (1932-1990) is 12,320 acre-feet per year. This average discharge has varied from 32,646 to zero depending upon the rainfall year, but the average yield is approximately 90 acre-feet per square mile. Similar to the other Westside creeks that have their origins in the Coast Range, water in Orestimba Creek is high is salts and conductivity (Westcot, *et al*., 1991).

The majority of the upper watershed is covered by natural vegetation, which follows the rainfall and elevation patterns. The highest elevations for the upper watershed (above 2,000 feet) are covered with chaparral and mountain brush. In the high plateau areas the predominant vegetation is hardwood forest area interspersed with grasses. (Westcot, *et al*., 1991) Grazing is the dominant land use in the upper watershed and there are several small orchards in the lower section of the upper watershed.

Lower Orestimba Creek below Eastin Road is an agriculturally dominated water body with flow consisting almost completely of tail water discharges and operational spills from the Central California Irrigation District Main Canal. Natural flows from the upper watershed only reach the lower portions of the creek during high winter and spring flows. The lower portions of the creek channel have been modified or channeled to varying degrees along its path to the San Joaquin River.

Orestimba Creek at Orestimba Rd. (541STC521) is approximately 0.5 mile west of I-5 on Orestimba Road. The sampling location is on the northwest side of the road, upstream from the bridge. Orestimba Creek at Orestimba Road is a natural ephemeral stream with surface flow predominately in the winter and spring months. During the summer and fall there will be some ponding in the creek channel, but the majority of the flow goes sub-surface. There is a wide riparian zone on both sides of the creek including trees, grasses, and some shrubbery. The creek itself is approximately 5 to 7 meters wide and has a small gravel substrate. The land use in the area is mainly livestock grazing although there is a small orchard area upstream from the sample site. This site is the furthest upstream accessible site in the Orestimba Creek Watershed and represents the land uses in the upper watershed.

Orestimba Creek at Bell Rd. (541STC517) is approximately 0.25 mile north of the intersection of Bell Road and Stuhr Roads. The sample site is on the eastern side of Bell road on the north bank of the creek approximately 200 feet down stream of the road. The land immediately surrounding Orestimba Creek at Bell Road is a former gravel mining area. Upstream influences are similar to the Orestimba Road site and the creek does not receive tail water from upstream agriculture at this point. Surface flows from the upper watershed only reach the site during winter months, however due to the engineering of the under-crossing under Bell Road and the DMC, subsurface flow comes out of the pipes under Bell Road keeping the creek channel at the site flowing or ponded throughout the summer months. The channel at Bell Road is predominantly braided hardpan clay about 1-3 meters wide with some areas of cobble. The bank full channel is about 20 meters wide at this location. The channel is deeply incised and has a wide riparian zone dominated by grasses and some 4-5 year old trees and shrubs. This site has been a long-term low gradient control site for the Central Valley Water Board SWAMP and TMDL bioassessment monitoring.

Orestimba Creek at Anderson Rd. (541STC520) is approximately 1 mile west of Highway 33 on Anderson Road. The sample site is accessed on the northwest side of the road. There is a narrow 5-6 meter riparian zone on both sides of the creek consisting mainly of grasses, trees, and small shrubs growing on man made levees with concrete rip rap along both sides of the bridge crossing. The creek channel itself is about 5 to 7 meters wide, braided at lower flows, and consists of a mud and soft sand substrate. Land uses in the area are agricultural, including row crops and orchards. This is one of the first sampling locations on Orestimba Creek to be dominated by agricultural tail water and storm runoff from agricultural lands.

Orestimba Creek at Highway 33 (541STC519) is approximately 1 mile south on Highway 33 from Eastin Road, and is sampled on the northeastern side of the road between the highway and railroad tracks. The creek channel has been realigned from its natural course to go under the rail line and Highway 33. The creek channel is braded at higher flows and is approximately 7-8 meters wide, with a hardpan to soft sand and small gravel substrate. The riparian zone consists mostly of grasses on either side of the creek as well as some small shrubs. Land use in the area immediately surrounding this site includes the rail tracks as well as a horse grazing area. Upstream land use is mainly row crops and orchards. Orestimba Creek at this site is dominated by agricultural return flows that consist of tail water discharges and operational spills from the CCID Main Canal. This site is sampled by the Westside Coalition ILP as well as the Central Valley Water Board IBP, and is the first site down stream of the inflow from the CCID Main Canal

Orestimba Creek at Kilburn Rd. (541STC518) is approximately 0.5 mile southeast of the intersection of Crows Landing Road on Kilburn Road. The sample site is located on the northeast side of the road. The creek is deeply incised, and the narrow riparian zone consists mostly of large, mature trees, as well as some blackberries grasses. The creek is about 3 to 4 meters wide and has a mud and soft sand bottom over hardpan clay. Land uses in the area are mostly agricultural, including row crops and orchards. The Central Valley Water Board ILRP also monitored this location as a compliance check-point.

Orestimba Creek at River Road (541STC019) is approximately 0.5 mile southeast of Crows Landing Road (Hwy 140), on River Road and is located on the southeastern side of the road. From spring through early fall the water in Orestimba Creek at River Road consists almost exclusively of tail water from orchards and row crops, as well as, operational spills from the CCID Main depending upon the intensity of irrigation in the area. In the winter, water in the channel is mainly operational spills from the CCID main or storm runoff. There is a narrow riparian zone on both sides of the creek with grasses and large mature trees on both sides of its steep banks. There are several places along the creek banks that have been shored with concrete riprap and curb erosion. The creek channel is approximately 3-5 meters wide and has a mud, sand, and small gravel substrate over a hardpan clay bed This site is monitored regularly by the Central Valley Water Board SWAMP and TMDL programs, the Westside Coalition for the ILRP, the USGS and others. This site is the last easily accessible location before Orestimba discharges into the SJR and has a large amount of historic water quality data.

5.3.2 Del Puerto Creek Watershed

Del Puerto Creek begins high in the Diablo Range and flows east to the San Joaquin River in the Valley Floor. Del Puerto Creek can be divided into two very different stream segments based on land use and gradient.

Upper Del Puerto Creek is a natural channel that cuts deep through the marine sedimentary rocks of the Diablo Range leaving steep, exposed clay and rock walls. Vegetation is limited to sparse oak and conifer trees, small shrubs and grasses. There are many areas of exposed rock and soil in the canyon walls with obvious signs of erosion and sloughing. The main land uses in the upper Del Puerto Creek watershed include cattle grazing, recreation, rural homes and several abandoned mercury and manganese mines. The main recreation area in the upper watershed is the 800-plus-acre Frank Raines Off Highway Vehicle Park (OHV) and the attached Deer Creek Campground, both run by Stanislaus County. Winter rains bring large volumes of sediment to the creeks from the OHV area, and abandoned mines that can be seen from the road show obvious signs of runoff from the mine openings. During the summer months flow in the upper section of Del Puerto Creek is usually intermittent or subsurface, with short stretches of surface flow and standing pools. Due to the marine nature of the underling soils, the water in Del Puerto Creek is high in salts and specific conductivity (Westcot *et al* 1991).

Lower Del Puerto Creek has been modified to some extent or completely realigned, to carry agricultural irrigation supply and return water to the SJR. The valley floor reach of Del Puerto Creek from I-5 to its confluence with the SJR has little to no riparian zone and is surrounded on both sides by orchards or field and row crops. The lower section of Del Puerto Creek is historically ephemeral with water from the upper watershed only reaching the lower section of the creek during high rainfall and runoff events. During the irrigation season of March through September, the majority of the water in the lower section of Del Puerto Creek, down stream of Rogers Road, consists of tail water discharges from surrounding agricultural lands with some operational spills from Patterson and West Stanislaus Irrigation Districts.

Del Puerto Creek at Deer Creek Campground (542STC527) is 16.2 miles up Del Puerto Canyon Road west of I-5, located in Deer Creek Campground in the Frank Raines Off Highway Vehicle (OHV) Area. The site is at the northeastern corner of the campground where there is a break in the fencing to access the creek. There is a small, approximately 1-2 meter, riparian zone along both sides of the creek with large oak trees and grasses. The south bank butts against the parking lot for the campground and the north bank is a steep near vertical wall with a sparse covering of grasses. The immediate land use in the area is mining and day and overnight recreation including camping and off highway vehicle use. There are many areas of raw, eroded banks, and rutted roads in the OHV area leading to large amounts of sediment entering the creek during rain fall events. Del Puerto Creek flows year round at this location and is fed by upstream ground water seepage and natural springs. This site was selected because it is an easily accessible location near the top of the watershed and has perennial flow.

Del Puerto Creek at Del Puerto Canyon Rd. mile 13.6 (542STC526) is 13.6 miles up Del Puerto Canyon Road west of I-5, and is located on the right (northwest) side of the road. There is a wide riparian zone to both sides of the creek with grasses, shrubs and large trees on the south bank and mostly grasses and shrubs with few trees on the steeper north bank. Land uses in the area include mining, cattle grazing and recreation. There was a major fire just upstream of this site in 2003, which caused extensive damage to the upstream riparian zone as well as the upland areas around the creek channel. Many of the large trees still showed some signs of damage during the sampling period but most were not killed. Annual grasses had returned to cover most of the exposed soil by the start of sampling in 2004. Water at the site is mostly storm water runoff from the upper watershed with the flow going sub-surface for most of the summer months. The site was selected because it was one of the few locations in the upper portion of the watershed that could be accessed safely year round.

Del Puerto Creek at Del Puerto Canyon Rd. mile 3.9 (542STC525) is 3.9 miles up Del Puerto Canyon Road just off of I-5, and is located on the west side of the road. The creek channel is high gradient, and narrow at 1-2 meters wide. The channel substrate at the site is worn bedrock. There is no riparian zone between the road and the creek, and the bank opposite the road is a near vertical bedrock outcropping. Upstream and surrounding land use is mainly cattle grazing with several houses and abandoned mines up stream. Water in the creek contains storm runoff, ground water seepage, and natural spring water that are high in salts due to the marine nature of the underling soils. This site was chosen because it is the last perennial section of the creek near the bottom of the upper watershed.

Del Puerto Creek at Rodgers Rd. (541STC524) is approximately 0.4 mile north of the intersection of Zacharias Road and Rodgers Road. The creek channel appears to have been channelized but is still in its natural location. The channel is very braided and is 4-5 meters wide, with embedded gravel to small cobble substrate. There is no riparian zone and apricots surround both upstream sides of the creek channel and row crops on the downstream side of the road. Very little irrigation tail water reaches the creek at this site so the creek channel is dry except for storm flows from the upper watershed during the rainy season. The site was dry for approximately half the year. Upstream uses would be the same as the upper watershed sites with the inclusion of the apricot orchards and under crossings of I-5, DMC, and California Aqueduct. This site represents the transition from the upper-watershed to the Valley Floor.

Del Puerto Creek at Highway 33 (541STC523) is approximately 100 feet south of the intersection of Mulberry Ave. and Highway 33. The sample site is located on the southwest side of the road between the highway and railroad tracks. The creek channel has been realigned from its natural course to go under the rail line and Highway 33. The creek channel is braded at higher flows and is approximately 1.5-2 meters wide, with a soft sand to mud bottom. There is a very narrow riparian zone at this site with only grasses covering the banks. Land use in the area immediately surrounding the site include, rail tracks and a cement processing plant on the southwest bank and holding ponds for the northwest bank. Near upstream use are mainly orchard and row crops. This site is one of the first accessible locations on lower Del Puerto Creek that receives agricultural tail water. SWAMP sampling at this site was coordinated with the Westside Coalition for ILRP.

Del Puerto Creek at Vineyard Rd. (541STC516) is approximately 400 feet southeast of the intersection of Mulberry Ave. and Vineyard Ave. on the northeastern side of the road. The creek at this location is channelized and appears that it has been realigned from its natural course. The creek channel is approximately one meter wide and has a tightly consolidated, small gravel substrate with soft mud in depositional areas. There is little riparian zone with only grasses, and concrete riprap on the bank. Apricot and almond orchards are on the north side of the creek and field crops to the south of the creek at the site location. This is the last publicly accessible location on Del Puerto Creek. This site is also a long-term SWAMP drainage basin monitoring location.

Del Puerto Creek near Cox Rd. (541STC533) is approximately 1.5 miles northeast of the intersection of Cox Road and Condit Ave. along a dirt access road. The creek channel is 1.5 to 2 meters wide and has been only slightly modified at this location. The streambed consists of a hard packed, small gravel bottom with minimal areas of soft deposits. The creek channel has a narrow but well covered riparian zone, with large trees, shrubs and grasses. The East Stanislaus Resource Conservation District (ESRCD) has recently installed a flow and salinity monitoring station at this site by way of a grant from the Central Valley Water Board. The creek at this site is in a conservation habitat zone and is managed for native grasses. This site is the last sample point before Del Puerto Creek discharges into the SJR and is only sampled by the Westside Coalition for the ILRP.

5.3.3 Valley Floor Water Bodies

In addition to the sites listed in the two watersheds above, there are a group of agriculturally dominated sites in the Westside Basin that drain directly to the SJR. These sites consist of modified-natural streams and constructed sites used for the conveyance of agricultural water supply and drainage. These waterbodies get very little to no surface water from their upper-watersheds. Flow in these channels is dependent on irrigation tail water and operational spills during the irrigation season, runoff from agricultural lands during rain events and some groundwater seepage.

Salado Creek at Oak Flat Rd. (541STC532) is approximately 0.25 mile west of Interstate 5 on Oak Flat Road, and is located on the north side of the road. The riparian zone consists mainly of grasses and some trees. The creek channel is about 1 meter wide and has hardpan clay bottom and is filled with cattails and other emergent macrophytes. Immediate land use is mainly livestock grazing with cows frequently in the stream. Upstream of the grazing area there are orchards, and a new development under construction consisting of 40 acres of vineyards, a winery, hotel, golf course, and 50 plus homes. This site was selected as representative of upstream uses in this watershed before it enters the valley floor.

Salado Creek at Highway 33 (541STC515) is approximately 0.25 mile south of Olive Ave. on Highway 33, and is located on the east side of the highway and the rail road tracks. Salado Creek has been completely reconstructed at this point and carries agricultural return flows and urban runoff from the City of Patterson that is then piped underground from Highway 33 until it discharges into the San Joaquin River near Olive Avenue. There is little to no riparian zone, and grasses sparsely cover the banks of the creek. The creek bed is mostly soft sand to mud until it reaches the closed pipeline from which it enters through a screening grate into the underground pipeline. This site is a long term SWAMP drainage basin inflow site and represents the agricultural and urban drainage in this area.

Grayson Road Drain at Grayson Road Bridge (541STC030) is approximately 0.1 mile west of the intersection of Grayson Road and Cox Road, located under the Grayson Road Bridge as it cross the old San Joaquin River channel now called Laird Slough. All water entering this closed pipeline is tail water from the West Stanislaus Irrigation District. During periods of no flow, some seepage does enter the pipeline due to high groundwater in the area, but the flow is small compared to the total discharge volume. The drain pipe discharges into Laird Slough that is an oxbow leading to the SJR. There is a large riparian area around the site that is dominated by willows and cottonwoods. Field crops and orchards dominate land use in the area. The Grayson Drain is a long term SWAMP drainage basin inflow monitoring station and was selected because it discharges a high volume of tail water to the SJR via Laird Slough and is representative of other tail water discharges in the area.

Blewitt Mutual Water Company (MWC) Drain near Hwy 132. (541STC531) is approximately 100 yards southwest of the Hwy 132 over crossing of the San Joaquin River. The drain carries agricultural tail water, mainly from field and row crops and discharges directly to SJR. There is no riparian zone around the drain except at its discharge point into the SJR where it is surrounded by several large trees and shrubs. This site was selected as a representative discharge in the northern portion of the study area draining a small portion of the West Stanislaus Irrigation District and a small group of fields served by the Blewitt Mutual Water Company.

The water in the Central California Irrigation District (CCID) Main Canal at JT Crow Road (541STC522) is a mixture of the San Joaquin River, DMC, and groundwater supply. Tail water from agriculture runoff is also mixed in. The land uses around the canal are agricultural, including row crops and orchards. This site represents typical supply water flows entering agricultural areas.

Ingram Creek at Highway 33 (541STC528) is approximately 0.5 mile south of Oaklea Road on Highway 33, and is located on the northeast side of the road. The creek channel is about 1 to 2 meters wide with a sand to mud bottom. There is little to no riparian zone on either side of the creek and row crops are on the edge of the creek channel. Flow in the creek consists mainly of agricultural tail water from the surrounding row crops and orchards. This site is representative of the drainage from the northern portions of Del Puerto Water District and West Stanislaus Irrigation District west of Highway 33

Ingram Creek at River Road (541STC040) is approximately 0.5 mile south of Oaklea Road on River Road. The sample site is located on the west side of the road. The water in Ingram Creek at this site is mainly tail water. There is little to no riparian zone on either side of its steep embankments that consists of grasses and some small shrubs. The creek channel is about 1 to 2 meters wide with a soft sand to mud bottom. Land use in the area is agricultural including orchards and row crops. Row crops contribute the majority of flow in the creek from tail water. This site is a long term SWAMP monitoring station, and is also sampled by the Westside Coalition for the ILRP. There is a flow station at the site but it was inoperable for most of the study period.

Hospital Creek at Highway 33 (541STC529) is approximately 0.25 mile south of Orchard Road, and is located on the northeast side of the road. There is no riparian zone on either side of its banks, which consists mainly of grasses. The creek channel at this location has been extensively reconstructed and is about 1 to 2 meters wide and has a soft mud bottom. Water in the creek consists mainly of agricultural tail-water and some storm flows in the winter months from the surrounding agricultural lands. Land uses in the area are agricultural, mainly row crops with some orchards upstream. This site represents the drainage upstream of Highway 33.

Hospital Creek at River Road (541STC042) is approximately 0.5 mile south of Center Road, and is located on the east side of River Road. Hospital Creek carries storm runoff and tail water from irrigated lands upslope. There is no riparian zone on either side of the creek at this point and the creek channel has been realigned from its natural course. The creek channel is about 1 to 2 meters wide with a soft sand to mud bottom. Land use in the area is agricultural, including row crops and orchards. This site is a long term

SWAMP drainage basin inflow monitoring station and is also sampled by the Westside Coalition for ILRP. There is also a stream gauge at this site.

5.4 Sampling Procedures

Collection of all water samples occurred in compliance with the Agricultural Subsurface Drainage Program Procedures Manual (Chilcott, 1996). A Quality Assurance Project Plan (QAPP) is on file and is based on the Procedures Manual. The Procedures Manual was later reviewed by the SWAMP QA team and found to be compliant with statewide data quality objectives.

All water samples were collected as grab samples approximately three feet from the bank. After collection, all samples were kept at $4^{o}C$ until processing for analysis. Sierra Foothill Laboratories in Jackson, California conducted all contracted laboratory analysis on SWAMP collected water samples.

Samples collected for total coliform and *E. coli* were analyzed using the IDEXX® Colilert-18 method (Analytical methods 9223B in STANDARD METHODS, EDITION 20) at the Central Valley Water Board laboratory. A detailed description of the Colilert-18 method and the methodology for collection and analysis of the bacteria samples can be found in Appendix C of the Procedures Manual (Chilcott, 1996). Results using the Colilert method are reported in terms of Most Probable Number (MPN/100 mL).

Total suspended solids (TSS) samples were collected at varying intervals dependant upon available funding. The samples were collected in polyethylene bottles, which were triple-rinsed with source water prior to sample collection.

Total organic carbon (TOC) samples were collected at most sites either monthly or twice a month. Each TOC sample was collected in a stainless steel cup that was attached to a sampling pole and triple rinsed with source water prior to sample collection. Sample water was then slowly poured into a 100 mL, pre-acidified (H_3CO_4) amber glass container.

Three types of toxicity tests were performed in the Westside rotation: 48-hour acute toxicity of *Ceriodaphnia dubia*, 96-hour acute toxicity of *Pimephales promelas* (Fathead Minnow), and 96-hour acute toxicity of *Selenastrum capricornutum* (algae). *Ceriodaphnia* and Fathead Minnow results are reported as the percent survival at the conclusion of the test. Algae tests are reported as percent reduction in algal cell growth. Samples were collected for toxicity at selected sites once per month; the toxicity tests that were performed depended on the site. Each toxicity sample was collected in two 1-liter glass bottles, one for each *Ceriodaphnia* and Fathead toxicity tests, and four bottles for the algal test. Sierra Foothill Laboratories provided glass amber bottles, which were sterilized prior to use. In the field each bottle was triple-rinsed with source water, filled and kept at $4^{o}C$ in the dark until submittal to the laboratory. Samples were submitted to Sierra Foothill Laboratories for analysis. All samples were submitted to the laboratory for analysis within 24 hours of collection.

Sediment samples were collected according to SWAMP protocols, in depositional areas where approximately the top 5cm of recently deposited fines were collected. Sediment analytical results and discussion can be found in the Sediment Toxicity Report (Grover 2007).

Field measurements included temperature, pH, dissolved oxygen (DO), and specific conductivity (SC), and were collected using Yellow Springs Instruments (YSI) Sonde Model 600XLM and Logger Model 650 MDS.

The Westside Coalition collected TSS, TOC, bacteria, and field measurements which included temperature, pH, DO, and SC. The Coalition had also collected water column toxicity samples, however, the toxicity results were not included in this report due to failed QA quality controls.

6.0 Quality Assurance and Quality Control

Quality assurance (QA) and quality control (QC) logs for constituents analyzed by outside labs are maintained by the Contract Manager or designee. The QA/QC logs for bacteria analysis is recorded in the QA/QC logbook, found in the Central Valley Water Board laboratory where samples are analyzed.

Field and handling contamination were evaluated by submitting blind travel blanks on a monthly basis, and on each run for bacteria monitoring. For TOC and TSS tests, the travel blank consisted of a sample of deionized water that was collected at the Central Valley Water Board laboratory. The contract laboratory provided travel blanks for toxicity tests. For bacteria monitoring, the travel blanks were made from Type II water prepared by the Plant and Animal Sciences Laboratory at UC Davis under the supervision of Ken Tate. Type II water is autoclaved double deionized water. All blanks made with Type II water were negative for contamination.The travel blanks traveled through the sampling run, and were processed with the sample set. Travel blanks for bacteria tests switched from Type II water to Phosphate Buffered Saline (PBS) starting in August of 2005. With one exception, all results for travel blanks fell below the analytical detection limits for the elements of concern. Part way through the sampling year a TOC bottle contamination issue was found. All samples in the sample sets that had detections in the travel blanks were disqualified and not used in this report.

Consistency in analysis and sample handling was evaluated by splitting samples for all samples needing laboratory analysis. The Central Valley Water Board San Joaquin River Watershed Unit uses a SWAMP compliant standard quality assurance procedure that includes 10% split samples. Consistency in sample collection was insured through a series of trainings of field crews and field audits. Analytical methods used in this program are identified in Appendix C.

Analytical precision and accuracy were evaluated using blind duplicate and split samples. Blind duplicate or split samples were collected at a 10% frequency for each sampling event. Split samples are used to check the accuracy of the lab. Duplicate samples were collected in two separate containers. Split samples were collected in a container double the normal sample volume and splitting that sample into two equal amounts for submittal to the analyzing laboratory. Toxicity samples were collected as duplicates, but then composited and split at the lab. Potential contamination from the reagent grade nitric acid used to control pH was evaluated by submitting a deionized water matrix preserved with 1-ml of acid per 500-ml of sample, to the contract laboratories at monthly intervals to be analyzed for the constituent of concern. All reported recoveries for these acid check samples were below the analytical detection limit.

Only data from sample sets whose blind QA/QC met specifications outlined in Appendix C have been included in this report. These specifications are consistent with the data quality objectives for this program.

Samples collected by the Westside Coaliiton followed QA/QC requirements outlined in the Westside San Joaquin River Watershed Coalition, Quality Assurance Project Plan for Monitoring, August 2004. None of the toxicity samples taken by the Westside Coalition passed QA/QC, thus their results were not included in the analysis. The coalition's TSS, TOC, *E. coli*, and field measurement samples all passed QA/QC. These data sets were included in the analysis.

Field Equipment and Analytical Methods

The Central Valley Water Board San Joaquin River Watershed Unit practices a standard quality assurance procedure with all its sampling programs that includes calibration of sampling equipment prior, during, and after each sampling run. Calibration procedures can be found in the Ag Procedures Manual (Chilcott, 1996). Analytical methods utilized are listed in Appendix C.

Bacterial Analysis

Results for total coliform and *E. coli* were recorded as Most Probable Number (MPN) per 100 ml of sample water and were detectable between 1 to 2419.6 MPN. Results above and below the counting limit were recorded as >2419.6 and <1, respectively. Replicate bacteria samples were initially collected and analyzed at a 10 percent frequency (1 replicate per 10 samples) in an effort to evaluate analytical precision. However, a review of sampling methodologies indicated that replicate bacteria samples provided information on inherent stream variability rather than analytical precision. The IDEXX methodology does not require duplicates or replicates and reports a 95% Confidence Interval for precision. Therefore, all data collected during this study has been reported, and variability in replicate samples noted. In April 2005, to address variation in replicate samples, 290 ml bottles were used to collect and split samples.

7.0 PRECIPITATION AND FLOW: NOVEMBER 2004 – NOVEMBER 2005

The San Joaquin River is the principal drainage artery of the San Joaquin Valley, draining the area south of the Sacramento-San Joaquin Delta and north of the Tulare Lake Basin, approximately 16,000 square miles. Precipitation varies throughout the SJR Watershed and occurs as both rainfall and snow. Mean annual precipitation on the valley floor ranges from less than 5 inches in the south to 15 inches in the north. Average annual precipitation in the Sierra Nevada, mostly in the form of snow, ranges from about 20 inches in the lower foothills to more than 80 inches at some higher altitude sites. Precipitation in the Coast Ranges varies from less than 10 inches to more than 20 inches. As in the valley, precipitation in the Sierra Nevada and Coast Ranges increases from south to north (Dubrovsky, *et al*., 1998).

The San Joaquin River Index, as described in the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary is used to classify the water year type in the river basin based on runoff. The 60-20-20 Index includes five classifications: wet, above normal, below normal, dry, and critical, based on millions of acre-feet of calculated unimpaired flow. (DWR, 2007)

A Water Year (WY) begins 1 October and ends 30 September of the following year. The majority of this study period, November 2004 through November 2005, falls within WY2005 with two months continuing into WY2006. Table 3 lists the Water Year Classifications from 2001-2006 based on unimpaired runoff in the SJR Watershed during the project. Water year 2005 was the first wet year after three dry and one below normal runoff year.

Data from the California Data Exchange Center, ILRP, and the University of California Statewide Integrated Pest Management Program were used to create Figures 3 through 6. Flow data was recorded at Del Puerto Creek @ Hwy 5, Orestimba Creek near Orestimba road, Orestimba Creek @ River Road, and Ingram Creek @ River Road. Gauges locations are represented in Table 1 and Figure 2. Precipitation data was available at the cities of Patterson, Diablo Canyon and Newman.

Figure 3 shows average monthly measured flows for Orestimba, Del Puerto, and Ingram Creeks compared to cumulative monthly precipitation for Diablo Canyon, Newman, and Patterson sites contained within the Westside Basin. Highest precipitation was seen in February 2005 at Diablo Canyon, with storm events also occurring from December 2004 – February 2005.

Figures 4, 5, and 6 show the daily flow at 3 different sites compared against, precipitation at Patterson and sampling events. Patterson was used for all of the figures as it contained the most complete dataset in the vicinity of the flow sites.

Table 3: Water Year Classifications

Water Year 2001 – Dry
Water Year 2002 – Dry
Water Year 2003 – Below normal
Water Year 2004 – Dry
Water Year 2005 – Wet
Water Year 2006 – Wet

(Data source DWR, 2007)

Figure 3: Monthly Average Flow vs. Cumulative Monthly Precipitation, Westside Basin (November 2004 – November 2005)

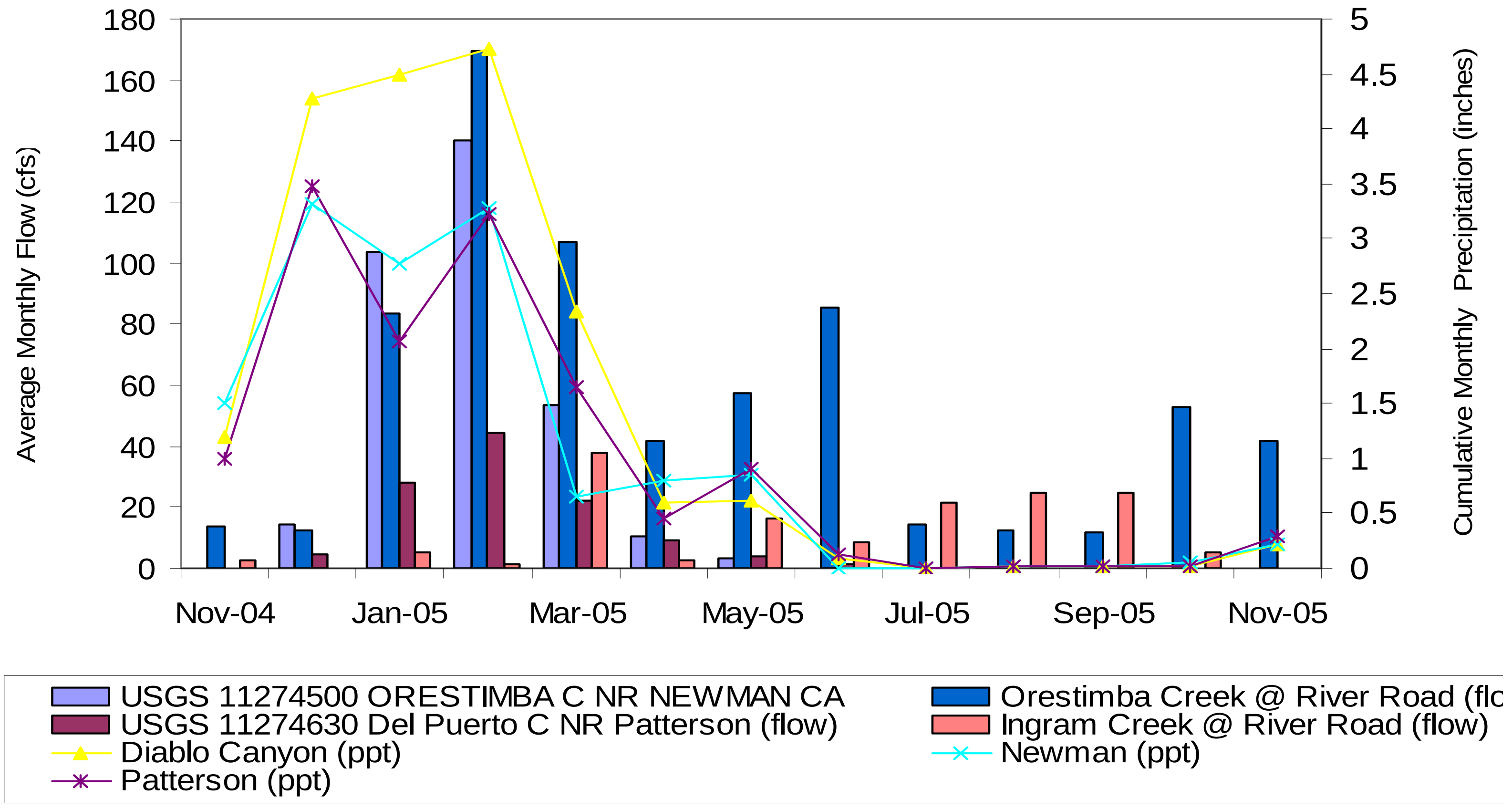


Figure 4: Del Puerto Creek at Hwy 5 Daily Flow vs. Daily Precipitation (November 2004 – November 2005)

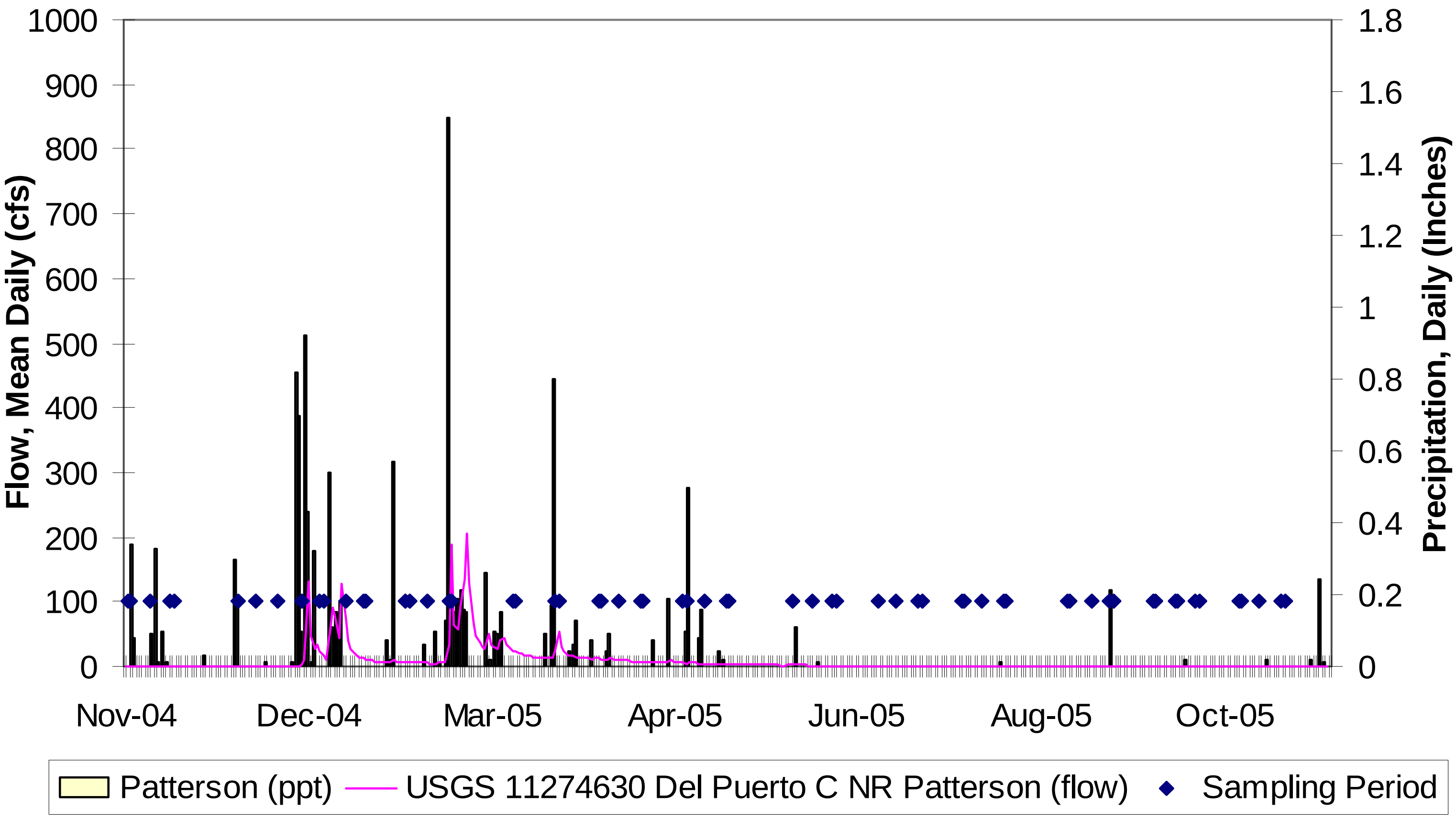


Figure 5: Orestimba Creek NR Orestimba Road Daily Flow vs. Daily Precipitation (November 2004 – November 2005)

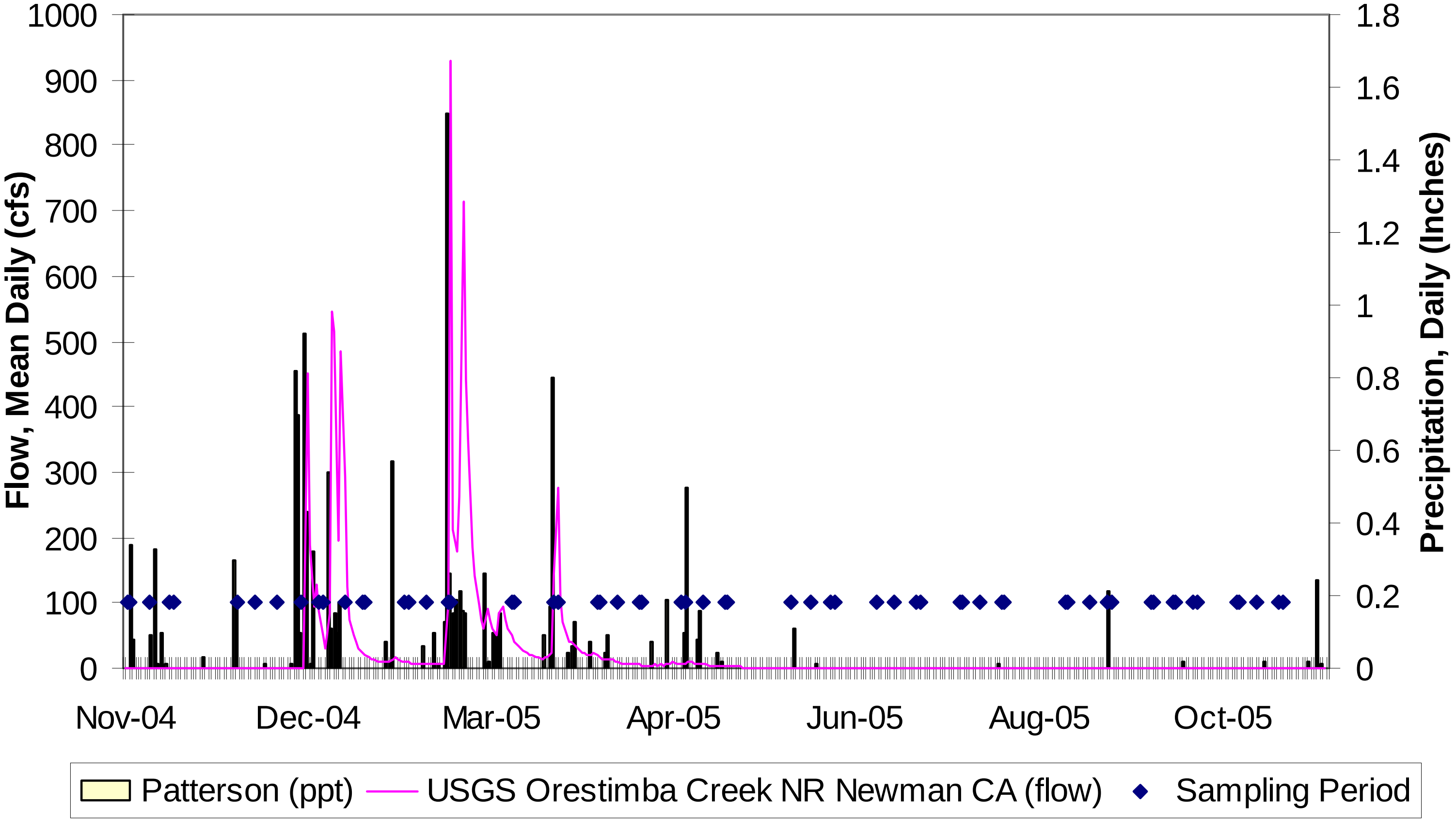
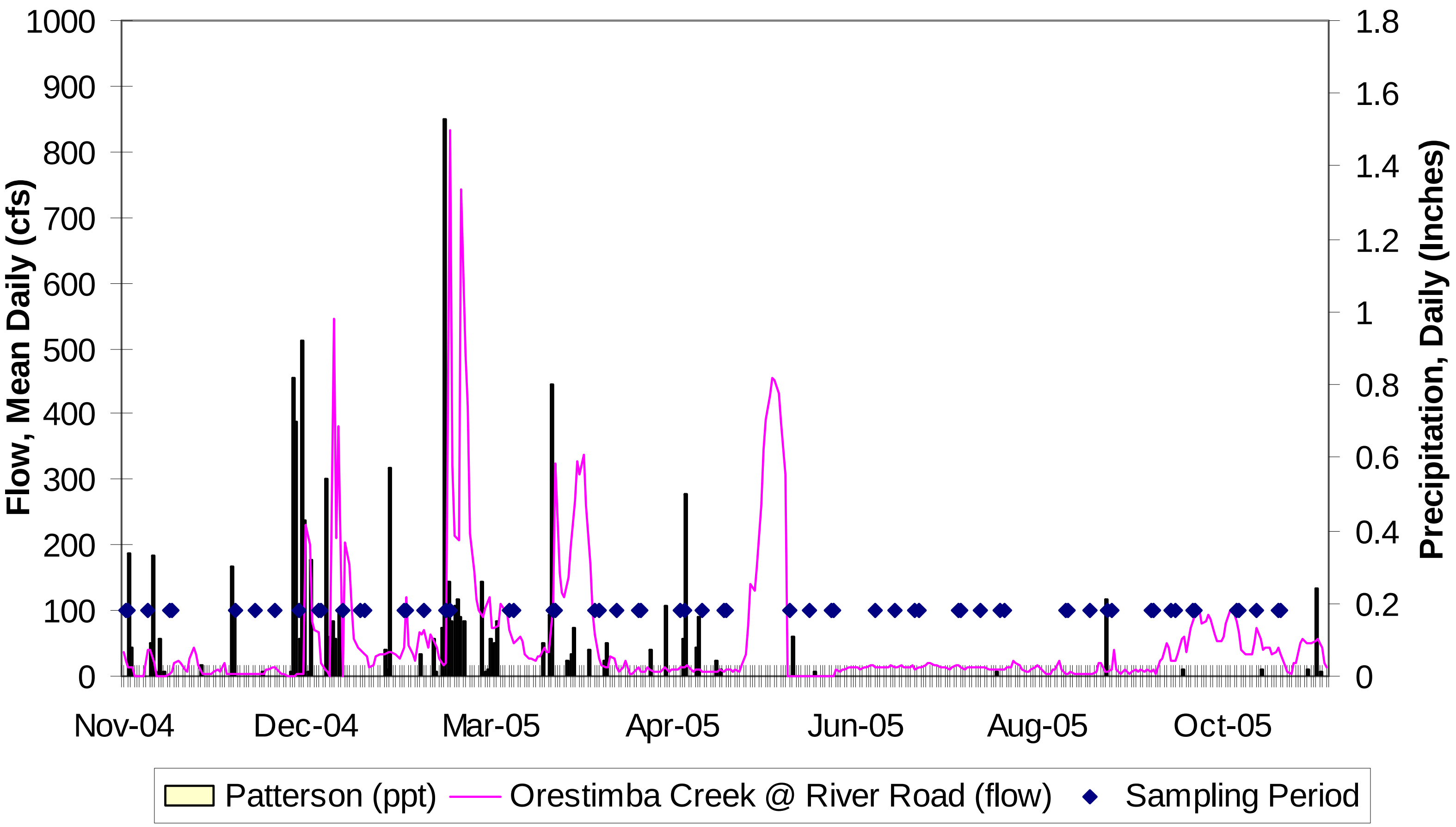


Figure 6: Orestimba Creek at River Road Daily Flow vs. Daily Precipitation (November 2004 – November 2005)



8.0 BENEFICIAL USES AND APPLICABLE WATER QUALITY GOALS AND OBJECTIVES

Water quality information collected during this study was evaluated using water quality objectives adopted in the Sacramento River and San Joaquin River Basin Plan (CVRWCB, 2007), a compilation of water quality goals identified by state and federal agencies (Marshack, 2003) and targets developed by the Bay-Delta Authority. The Basin Plan objectives are enforceable criteria that are linked to protecting designated beneficial uses such as domestic, municipal, agricultural and industrial supply, recreation, and preservation and enhancement of fish, wildlife and other aquatic resources. These objectives are both numeric and narrative and may be specific to certain reaches of various water bodies or apply to entire basins.

The water quality goals are scientifically defensible, numeric criteria developed by diverse agencies to protect specific uses, primarily aquatic life, drinking water, and irrigation supply. In many cases, the goals are national guidelines. These goals may be used to determine compliance with some of the narrative Basin Plan objectives (e.g. toxicity).

Appendix E lists the applicable Basin Plan water quality objectives for this study. For pH, temperature, and total suspended sediment, the listed objectives refer to changes impacting “normal” and “natural” conditions. Appendix E includes targets identified by the Bay-Delta Authority (a joint State and Federal agency) to protect fish passage (temperature) and drinking water (TOC).

Both the objectives and the goals are related to types of beneficial uses. The applicable beneficial uses for each sampling site have been summarized in Table 4 under the general headings of Contact Recreation Use, Drinking Water, Aquatic Life, Irrigation Water Supply and. The beneficial uses of any specifically identified water body generally apply to its tributary streams. Table 4 also indicates whether the use has been specifically designated or is being applied as a tributary. Appendix E3 provides more detail on the subcategories of use that have been specifically designated in the Sacramento-San Joaquin Basin Plan.

The objectives, goals and targets apply to the indicators used to evaluate beneficial use protection. A summary of the general groups of indicators that can be utilized to evaluate a beneficial use and the most limiting use (e.g. if the objective/goal is met for that use than it would be met for the remaining uses) is listed in Table 5.

Table 4: Applicable Beneficial Uses

Site Specific Monitoring by Program and Sub-Watershed	Site ID	Drinking Water	AGRICULTURE		INDUSTRY			Recreation			Aquatic Life								
			AGR		PROC	IND	POW	REC-1		REC-2	Freshwater Habitat		Migration		Spawning			WILD	NAV
		Municipal and Domestic Supply (MUN)	Irrigation	Stock Watering	PROCESS	SERVICE SUPPLY	POWER	Contact	Canoeing and Rafting	Other Non-Contact	Warm	Cold	Warm	Cold	Warm	Cold	Designated (D) or Tributary (T)	Wild Habitat	NAVIGATION
SJR Main Stem Sites																			
SJR @ Patterson	541STC507	P	E	E	E			E	E	E	E		E	E	E		D	E	
SJR @ Vernalis	541SJC501	P	E	E	E			E	E	E	E		E	E	E		D	E	
SJR @ Crows Landing	535STC504	P	E	E	E			E	E	E	E		E	E	E		D	E	
Valley Floor Drainage																			
Hospital Creek @ River Rd. *	541STC042	P	E	E	E			E	E	E	E		E	E	E		T	E	
Hospital Creek @ 33 *	541STC529	P	E	E	E			E	E	E	E		E	E	E		T	E	
Ingram Creek @ River Rd. *	541STC040	P	E	E	E			E	E	E	E		E	E	E		T	E	
Ingram Creek @ Hwy 33 *	541STC528	P	E	E	E			E	E	E	E		E	E	E		T	E	
Salado Creek @ Hwy 33 *	541STC515	P	E	E	E			E	E	E	E		E	E	E		T	E	
Salado Creek at Oak Flat Road *	541 STC532	P	E	E	E			E	E	E	E		E	E	E		T	E	
Del Puerto Creek																			
Del Puerto Creek @ Vineyard *	541STC516	P	E	E	E			E	E	E	E		E	E	E		T	E	
Del Puerto Creek @ Hwy 33 *	541STC523	P	E	E	E			E	E	E	E		E	E	E		T	E	
Del Puerto Creek @ Rodgers *	541STC524	P	E	E	E			E	E	E	E		E	E	E		T	E	
Del Puerto Creek @ mile 3.9 *	542STC525	P	E	E	E			E	E	E	E		E	E	E		T	E	
Del Puerto Creek @ mile 13.6 *	542STC526	P	E	E	E			E	E	E	E		E	E	E		T	E	
Del Puerto Creek @ Deer Creek camp ground. Mi 16 (approx. 35 min. from I-5) *	542STC527	P	E	E	E			E	E	E	E		E	E	E		T	E	
Orestimba Creek																			
Orestimba Creek @ River Road *	541STC019	P	E	E	E			E	E	E	E		E	E	E		T	E	
Orestimba Creek @ Kilburn *	541STC518	P	E	E	E			E	E	E	E		E	E	E		T	E	
Orestimba Creek @ Hwy 33 *	541STC519	P	E	E	E			E	E	E	E		E	E	E		T	E	
Orestimba Creek @ Anderson *	541STC520	P	E	E	E			E	E	E	E		E	E	E		T	E	
Orestimba Creek @ Bell Rd *	541STC517	P	E	E	E			E	E	E	E		E	E	E		T	E	
Orestimba Creek @ Orestimba Rd *	541STC521	P	E	E	E			E	E	E	E		E	E	E		T	E	
Ag Drains and Hydromodifications																			
Grayson Drain *	541STC030		E	E	E			E	E	E	E		E	E	E		T	E	
CCID Main Canal @ JT crow *	541STC522		E	E	E			E	E	E	E		E	E	E		T	E	
Blewitt MWC Drain at Hwy 132 *	541STC531		E	E	E			E	E	E	E		E	E	E		T	E	

* = Beneficial uses not specifically designated, therefore current listing based on downstream beneficial use
E = Existing beneficial use
P = Potential beneficial use

Table 5: Indicator and Beneficial Uses

INDICATOR(S)	SJR BENEFICIAL USE(S)			
	Drinking Water	Aquatic Life	Irrig. Water Supply	Rec. Use
Water Column Analyses				
SC	**X**	**X**	▨ **X**	
pH	▨ **X**	▨ **X**	**X**	
Temp.		**X**		
DO		▨ **X**		
Turbidity	**X**	▨ **X**	**X**	
Minerals		▨ **X**	▨ **X**	
Trace Elements (Total & Diss.)	**X**	▨ **X**	**X**	▨ **f**
Nutrient Scan	▨ **X**	▨ **X**	**X**	
TSS	**X**	▨ **X**	**X**	**X**
TDS	**X**		▨ **X**	
TOC	▨ **X**	**X**	**X**	
BOD		▨ **X**		
Bacteria	▨ **X**		**X**	**X**
Toxicity				
P. promelas 96 hr	**X**	▨ **X**	**X**	**X**
C. dubia 48 hr	**X**	▨ **X**	**X**	**X**
S. capricornutum Acute	**X**	▨ **X**	**X**	**X**
P. promelas Chronic	**X**	▨ **X**	**X**	**X**
C. dubia Chronic	**X**	▨ **X**	**X**	**X**

f=Major recreational use concern is in fish consumption
Minerals= B, Ca, Cl, CO3, HCO3, K, Mg, Na, SO4, Alkalinity, TDS, Total Hardness, pH, Conductivity
Trace Elements (Total & Diss.)= As, Cd, Cr, Cu, Hg, Ni, Pb, Zn,
Nutrient Scan= K, P, PO4, NH3-N, NO3, TKN
▨ = Most limiting beneficial use(s). For reference of actual numerical values of water quality objectives see "*A Compilation of Water Quality Goals*" (Marshack, 2000)

9.0 RESULTS

Summary tables for each constituent monitored are listed in this section. These summary tables are sorted by constituent and provide a snap shot of the total number of samples collected as well as the, minimum, median, and maximum concentrations detected for field measurements, TSS, TOC, total coliform, *E. coli* and the number and percent of significant data points for toxicity samples. For samples with concentrations less than the Reporting Limit (RL), the concentration is set to one-half the RL to calculate the median, rather than using a null value.

Data was limited depending on the ephemeral nature of some sites. Data sets for Del Puerto Creek at Rogers, Del Puerto Creek at mile 13.6, Del Puerto Creek near Cox Road, Orestimba Creek at Anderson, Orestimba Creek at Bell Road, Orestimba Creek at Orestimba Road, Hospital Creek at Hwy 33, and Ingram Creek at Hwy 33 showed reduced number of sampling events due to dry periods. Data was also limited at times due to major storm events where sites were flooded due to rainfall which impeded sampling at some locations.

Tables 6, 7 and 8 list sites sorted by the two focus watersheds, Orestimba and Del Puerto Creek, the valley floor sites that discharge directly to the SJR, and source water sites. In addition, the two focus watersheds are sorted and grouped by their upper, non-agriculturally dominated, and lower, agriculturally dominated, watershed sites. Sites are only listed if the parameters for the particular table were measured. The Orestimba and Del Puerto creek sites are arranged from top to bottom, upper watershed to lower watershed, respectively. Table 6 provides a statistical summary for field constituents. Table 7 statistically summarizes TSS, TOC, Total Coliform and *E. coli* . Table 8 summarizes toxicity showing acute toxic events for fathead minnows (*Pimephelas promelas*, sensitive to elevated nutrients, especially ammonia), *Ceriodaphnia dubia* (sensitive to organic chemicals such as orthophosphorus-pesticides), and algae (such as *Selanastrum capricornutum*, sensitive to trace elements**).** A toxic event is defined as statistically significant and at least a 20% difference from the control. For acute algae toxicity only a reduction in growth is summarized only.

All data collected, sorted by site, can be found in Appendix A.

Photo monitoring was also conducted at each site monthly, or more frequently when the weather or other factors changed the site substantially from the previous photo date. Photos, sorted by site, can be found in Appendix B.

Table 6: Westside Basin Summary Results, November 2004 – November 2005, Temp, SC, pH, DO

Site name	Site Code	Site Visit	Number of visits site was dry	Number of times site was sampled	Temp C				SC (umhos/cm)				pH				DO (mg/L)			
					Count	Min	Median	Max	Count	Min	Median	Max	Count	Min	Median	Max	Count	Min	Median	Max
Orestimba Creek Watershed																				
Orestimba Creek at Orestimba Rd. [1]	541STC521	26	14	12	12	8.1	14.1	20.5	12	242	620	781	12	7.5	8.2	8.4	12	6.4	11.2	14.3
Orestimba Creek at Bell Rd. [1]	541STC517	26	9	17	17	8.5	14.2	21.2	17	250	731	1280	17	6.9	8.1	8.2	17	2.2	9.6	14.6
Orestimba Creek at Anderson [2]	541STC520	26	9	17	17	8.4	18.0	29.2	17	252	708	1113	17	6.7	8.1	8.4	17	5.7	9.6	11.3
Orestimba Creek at Hwy 33 [2]	541STC519	42	0	42	42	6.2	16.8	29.3	42	155	501	834	42	6.9	8.0	8.8	42	5.2	10.2	14.0
Orestimba Creek at Kilburn [2]	541STC518	26	0	26	26	7.6	16.3	24.7	26	299	610	823	26	7.3	8.0	8.8	26	6.8	9.8	12.9
Orestimba Creek at River Rd. [2]	541STC019	43	0	43	43	7.7	16.1	25.3	43	145	524	820	43	6.7	8.0	8.9	43	6.7	9.5	18.4
Summary Upper Orestimba Watershed		**52**	**23**	**29**	**29**	**8.1**	**14.1**	**21.2**	**29**	**242**	**676**	**1280**	**29**	**6.9**	**8.1**	**8.4**	**29**	**2.2**	**10.4**	**14.6**
Summary Lower Orestimba Watershed		**137**	**9**	**128**	**128**	**6.2**	**16.5**	**29.3**	**128**	**145**	**567**	**1113**	**128**	**6.7**	**8.0**	**8.9**	**128**	**5.2**	**9.7**	**18.4**
Del Puerto Creek Watershed																				
Del Puerto Creek at Deer Ck. Campground [1]	542STC527	26	0	26	26	8.2	14.4	24.0	26	536	852	948	26	8.2	8.5	8.7	26	7.0	9.7	14.0
Del Puerto Creek at Del Puerto Rd mi 13.6 [1]	542STC526	26	8	18	18	8.0	13.0	24.3	18	536	824	1023	18	8.0	8.4	8.6	18	2.9	10.8	13.3
Del Puerto Creek at Del Puerto Rd mi 3.9 [1]	542STC525	26	0	26	26	7.5	13.4	22.3	26	659	1367	2330	26	7.8	8.2	8.6	26	8.3	10.9	17.8
Del Puerto Creek at Rogers [2]	542STC524	26	19	7	7	7.1	11.9	12.5	7	399	772	1010	7	8.2	8.5	8.7	7	10.4	12.4	17.9
Del Puerto Creek at Hwy 33 [2]	541STC523	40	1	39	39	6.9	14.3	24.7	39	157	494	945	39	6.4	7.8	8.9	39	5.1	10.4	17.3
Del Puerto Creek at Vineyard Ave. [2]	541STC516	26	1	25	25	6.8	13.5	23.6	25	207	577	1029	25	7.3	7.9	8.5	25	6.6	10.0	17.8
Del Puerto Creek near Cox Rd. [2]	541STC533	16	5	11	11	13.0	15.8	22.3	11	295	367	860	11	6.8	7.9	8.6	11	7.4	10.1	20.0
Summary Upper Del Puerto Watershed		**78**	**8**	**70**	**70**	**7.5**	**13.4**	**24.3**	**70**	**536**	**852**	**2330**	**70**	**7.8**	**8.4**	**8.7**	**70**	**2.9**	**10.8**	**17.8**
Summary Lower Del Puerto Watershed		**108**	**26**	**82**	**82**	**6.8**	**13.9**	**24.7**	**82**	**157**	**536**	**1029**	**82**	**6.4**	**7.9**	**8.9**	**82**	**5.1**	**10.2**	**20.0**
Valley Floor Sites																				
Salado Creek at Hwy 33	541STC515	26	0	26	26	8.9	16.7	23.4	26	123	756	4156	26	7.9	8.2	8.7	26	6.0	10.6	11.8
Salado Creek at Oak Flat Rd.	541STC532	26	0	24	24	8.9	14.2	23.2	24	1034	3061	3230	24	7.5	8.1	8.4	24	8.5	12.3	19.1
Ingram Creek at Hwy 33	541STC528	26	14	12	12	7.7	17.7	24.2	12	188	459	1097	12	7.5	8.0	8.4	12	8.3	9.7	13.1
Ingram Creek at River Rd.	541STC040	42	1	41	41	7.4	14.3	24.5	41	101	695	1973	41	6.6	7.7	8.1	41	7.0	9.7	14.8
Hospital Creek at Hwy 33	541STC529	26	10	16	16	11.0	16.0	23.6	16	172	395	596	16	6.1	7.8	8.6	16	8.5	10.3	15.3
Hospital Creek at River Rd.	541STC042	42	11	31	31	9.5	15.7	22.4	31	125	413	739	31	6.5	7.7	8.7	31	4.8	9.8	13.3
Blewitt Drain	541STC531	27	5	22	22	9.5	16.3	26.0	22	73	413	724	22	7.7	8.0	8.5	22	8.2	10.1	12.6
Grayson Road Drain	541STC030	26	7	19	19	11.7	17.9	26.6	19	145	595	1840	19	7.5	8.1	8.4	19	3.4	9.8	12.0
Summary Valley Floor Sites		**241**	**48**	**191**	**191**	**7.4**	**16.1**	**26.6**	**191**	**73**	**527**	**4156**	**191**	**6.1**	**8.0**	**8.7**	**191**	**3.4**	**10.0**	**19.1**
Source Water																				
CCID Main Canal at JT Crow Rd.	541STC522	26	0	26	26	7.2	16.7	24.9	26	251	529	828	26	6.8	7.9	8.9	26	4.6	9.0	12.4
SJR at Patterson Fishing access	541STC507	57	0	57	57	8.9	17.0	26.3	57	140	885	1790	56	7.1	7.7	8.0	57	7.3	9.6	14.4

[1] = Site in Upper Watershed

[2] = Site in Lower Watershed

Table 7: Westside Basin Summary Results, November 2004 – November 2005, TSS, TOC, Total Coliform, and E. coli

Site name	Site Code	Site Visit	Number of visits site was dry	Number of times site was sampled	Temp C				SC (umhos/cm)				pH				DO (mg/L)			
					Count	Min	Median	Max	Count	Min	Median	Max	Count	Min	Median	Max	Count	Min	Median	Max
Orestimba Creek Watershed																				
Orestimba Creek at Orestimba Rd. [1]	541STC521	26	14	12	12	8.1	14.1	20.5	12	242	620	781	12	7.5	8.2	8.4	12	6.4	11.2	14.3
Orestimba Creek at Bell Rd. [1]	541STC517	26	9	17	17	8.5	14.2	21.2	17	250	731	1280	17	6.9	8.1	8.2	17	2.2	9.6	14.6
Orestimba Creek at Anderson [2]	541STC520	26	9	17	17	8.4	18.0	29.2	17	252	708	1113	17	6.7	8.1	8.4	17	5.7	9.6	11.3
Orestimba Creek at Hwy 33 [2]	541STC519	42	0	42	42	6.2	16.8	29.3	42	155	501	834	42	6.9	8.0	8.8	42	5.2	10.2	14.0
Orestimba Creek at Kilburn [2]	541STC518	26	0	26	26	7.6	16.3	24.7	26	299	610	823	26	7.3	8.0	8.8	26	6.8	9.8	12.9
Orestimba Creek at River Rd. [2]	541STC019	43	0	43	43	7.7	16.1	25.3	43	145	524	820	43	6.7	8.0	8.9	43	6.7	9.5	18.4
Summary Upper Orestimba Watershed		**52**	**23**	**29**	**29**	**8.1**	**14.1**	**21.2**	**29**	**242**	**676**	**1280**	**29**	**6.9**	**8.1**	**8.4**	**29**	**2.2**	**10.4**	**14.6**
Summary Lower Orestimba Watershed		**137**	**9**	**128**	**128**	**6.2**	**16.5**	**29.3**	**128**	**145**	**567**	**1113**	**128**	**6.7**	**8.0**	**8.9**	**128**	**5.2**	**9.7**	**18.4**
Del Puerto Creek Watershed																				
Del Puerto Creek at Deer Ck. Campground [1]	542STC527	26	0	26	26	8.2	14.4	24.0	26	536	852	948	26	8.2	8.5	8.7	26	7.0	9.7	14.0
Del Puerto Creek at Del Puerto Rd mi 13.6 [1]	542STC526	26	8	18	18	8.0	13.0	24.3	18	536	824	1023	18	8.0	8.4	8.6	18	2.9	10.8	13.3
Del Puerto Creek at Del Puerto Rd mi 3.9 [1]	542STC525	26	0	26	26	7.5	13.4	22.3	26	659	1367	2330	26	7.8	8.2	8.6	26	8.3	10.9	17.8
Del Puerto Creek at Rogers [2]	542STC524	26	19	7	7	7.1	11.9	12.5	7	399	772	1010	7	8.2	8.5	8.7	7	10.4	12.4	17.9
Del Puerto Creek at Hwy 33 [2]	541STC523	40	1	39	39	6.9	14.3	24.7	39	157	494	945	39	6.4	7.8	8.9	39	5.1	10.4	17.3
Del Puerto Creek at Vineyard Ave. [2]	541STC516	26	1	25	25	6.8	13.5	23.6	25	207	577	1029	25	7.3	7.9	8.5	25	6.6	10.0	17.8
Del Puerto Creek near Cox Rd. [2]	541STC533	16	5	11	11	13.0	15.8	22.3	11	295	367	860	11	6.8	7.9	8.6	11	7.4	10.1	20.0
Summary Upper Del Puerto Watershed		**78**	**8**	**70**	**70**	**7.5**	**13.4**	**24.3**	**70**	**536**	**852**	**2330**	**70**	**7.8**	**8.4**	**8.7**	**70**	**2.9**	**10.8**	**17.8**
Summary Lower Del Puerto Watershed		**108**	**26**	**82**	**82**	**6.8**	**13.9**	**24.7**	**82**	**157**	**536**	**1029**	**82**	**6.4**	**7.9**	**8.9**	**82**	**5.1**	**10.2**	**20.0**
Valley Floor Sites																				
Salado Creek at Hwy 33	541STC515	26	0	26	26	8.9	16.7	23.4	26	123	756	4156	26	7.9	8.2	8.7	26	6.0	10.6	11.8
Salado Creek at Oak Flat Rd.	541STC532	26	0	24	24	8.9	14.2	23.2	24	1034	3061	3230	24	7.5	8.1	8.4	24	8.5	12.3	19.1
Ingram Creek at Hwy 33	541STC528	26	14	12	12	7.7	17.7	24.2	12	188	459	1097	12	7.5	8.0	8.4	12	8.3	9.7	13.1
Ingram Creek at River Rd.	541STC040	42	1	41	41	7.4	14.3	24.5	41	101	695	1973	41	6.6	7.7	8.1	41	7.0	9.7	14.8
Hospital Creek at Hwy 33	541STC529	26	10	16	16	11.0	16.0	23.6	16	172	395	596	16	6.1	7.8	8.6	16	8.5	10.3	15.3
Hospital Creek at River Rd.	541STC042	42	11	31	31	9.5	15.7	22.4	31	125	413	739	31	6.5	7.7	8.7	31	4.8	9.8	13.3
Blewitt Drain	541STC531	27	5	22	22	9.5	16.3	26.0	22	73	413	724	22	7.7	8.0	8.5	22	8.2	10.1	12.6
Grayson Road Drain	541STC030	26	7	19	19	11.7	17.9	26.6	19	145	595	1840	19	7.5	8.1	8.4	19	3.4	9.8	12.0
Summary Valley Floor Sites		**241**	**48**	**191**	**191**	**7.4**	**16.1**	**26.6**	**191**	**73**	**527**	**4156**	**191**	**6.1**	**8.0**	**8.7**	**191**	**3.4**	**10.0**	**19.1**
Source Water																				
CCID Main Canal at JT Crow Rd.	541STC522	26	0	26	26	7.2	16.7	24.9	26	251	529	828	26	6.8	7.9	8.9	26	4.6	9.0	12.4
SJR at Patterson Fishing access	541STC507	57	0	57	57	8.9	17.0	26.3	57	140	885	1790	56	7.1	7.7	8.0	57	7.3	9.6	14.4

[1] = Site in Upper Watershed

[2] = Site in Lower Watershed

Table 8: Westside Basin Summary Results, November 2004 – November 2005, TOX: Algae, Ceriodaphnia dubia, Pimephales promelas

Site Name	Site Code	Site Visit	Number of visits site was dry	Number of times site was sampled	96-hr Acute Algae Cell Growth			48-hr Acute *Ceriodaphnia dubia*			96-hr Acute *Pimephales promelas*		
					Count	# Of Samples with Sig. TOX[1]	% of Samples Toxic	Count	# Of Samples with Sig. TOX	% of Samples Toxic	Count	# Of Samples with Sig. TOX	% of Samples Toxic
Orestimba Creek Watershed													
Orestimba Creek at River Rd.	541STC019	13	0	13				13	1	8%	13	0	0%
Del Puerto Creek Watershed													
Del Puerto Creek at Deer Ck. Campground	542STC527	13	0	13	13	5	38%						
Del Puerto Creek at Del Puerto Rd mi 3.9	542STC525	11	0	11	11	8	73%						
Del Puerto Creek at Hwy 33	541STC523	13	0	13	13	4	31%	13	1	8%	13	0	0%
Total Sites in Upper Watershed		**24**	**0**	**24**	**24**	**13**	**54%**						
Total Sites in Lower Watershed		**13**	**0**	**13**	**13**	**4**	**31%**	**13**	**1**	**8%**	**13**	**0**	**0%**
Valley Floor Sites													
Salado Creek at Hwy 33	541STC515	13	0	13				13	0	0%	13	1	8%
Blewitt MWC drain at Hwy 132	541STC531	13	2	11				11	1	9%	11	0	0%
Grayson Road Drain	541STC030	13	4	9				9	2	22%	9	0	0%
Ingram Creek at River Rd.	541STC040	13	0	13				13	0	0%	13	0	0%
Hospital Creek at River Rd.	541STC042	13	2	11				11	3	27%	11	0	0%
Source Water & CCID													
CCID Main Canal at JT Crow Rd.	541STC522	13	0	13				13	0	0%	13	0	0%
SJR at Patterson Fishing access *	541STC507	13	0	13	11	0	0%						

[1] Note this is a reduction in algae growth

10.0 DISCUSSION

The Westside Basin monitoring effort had three main objectives: 1) collaborate with ongoing monitoring, 2) evaluate overall water quality, both spatially and temporally; and 3) assess whether there is any indication that beneficial uses are not being protected. This section discusses the results in the context of those objectives.

This study included a wide variety of potential influences to water quality, ranging from extremely diverse land use to highly managed water systems. The study area drained the eastside of the coast range with elevations reaching up to 3,804 feet at Mt. Stakes (Westcot *et al,* 1991). Upper watershed sites, above the CCID Main Canal, in both the Del Puerto Creek and Orestimba Creek watersheds, were chosen to provide background or source water characteristics for the study area. Additional sites were then located progressively downstream in the main stem channels, below major inflows and land use changes. Additional sites were located at the confluence of five streams with the San Joaquin River.

In the following sections, data is analyzed in several contexts, including: spatial and temporal changes as water moves downstream through various land uses, between the sub-watersheds and for the Westside Basin as a whole; and against water quality objectives, goals, and targets.

For the paired figures presented to discuss spatial and temporal analysis, the first figure shows the minimum, maximum, median and 1st and 3rd quartiles for the parameters for each site, moving downstream for Orestimba and Del Puerto Creeks and moving south to north for the Valley floor sites. The second figure shows actual data points collected during the course of the study as compared to time and season. Water quality objectives, goals and targets have been included in the second figure for context but are not discussed until section 10.3.

Figures used to discuss the Westside Basin as a whole are summaries similar to summaries used in the spatial and temporal analysis. However, the sites are arranged based on what the site was chosen to represent: upper watershed; lower watershed; source water; or valley floor sites.

10.1 Coordination Efforts

One of the major objectives of this rotation was to collaborate with ongoing monitoring efforts. The Westside Coalition was conducting monthly monitoring of selected parameters on the valley floor portion of the basin. Coordination allowed for greater coverage and more frequent sample collection at specific sites including twice a month sampling and expanding into the upper watershed sites to provide some natural background context for valley floor water quality trends. Figure 2 depicts which sites had coordination between SWAMP and the Westside coalition. This coordination also allowed for SWAMP funded Toxicity Identification Evaluation (TIE's) for some of the ILRP sediment samples with elevated toxicity. Results for the TIE's are discussed separately in the Sediment Toxicity report (Grover 2007). All collected data was exchanged between entities once QA/QC had been reviewed.

10.2 Spatial and Temporal Trends

10.2.1 Orestimba Creek Watershed

Orestimba Creek has the largest watershed area in the Westside Basin study area with the upper basin at over 140 square miles. The upper watershed areas are privately owned and there are no public roads leading into the upper portions so access for sampling was limited. The two uppermost sites sampled in the watershed, at Orestimba Road and Bell Road, are below 200 foot elevation, however they are above the influences of irrigated agriculture. These two sites are fed by natural runoff and subsurface groundwater flows. Downstream of this point, the creek is dominated by irrigation tail water returns and operational spills. The CCID Main Canal spills into Orestimba Creek just upstream of the Highway 33 site. During the winter months, flows in Orestimba Creek from Highway 33 to its confluence with the SJR, are almost completely CCID Main Canal operational spills and surface runoff during storm events. Several of the parameters measured reflect a difference in sites that are above and below the areas of irrigated agriculture as well as trends between seasons.

Field Measurements

In general, the field measurements of pH, temperature and DO showed little spatial variability moving downstream through the watershed. The SC was an exception to this observation. The median SC at Orestimba Road was 620 umhos/cm and the next site down stream at Bell road had a higher median at 731 umhos/cm. The SC increases between these two sites during the summer months as the water between these two points goes subsurface. The subsurface water is then collected by the pipes going under Bell Road, routing the stream around and under the DMC and Bell Road and discharging at the sampling site.

Figure 7 shows photos of the Bell Road site in May 2005, during normal spring base flow and the creek spilling over Bell Road on February 15, 2005 during a major rain event. The creek channel upstream of Bell Road between the sample site and I-5 in the May picture is completely dry. The water coming through the pipes in this picture is entirely from subsurface groundwater flow.

Downstream of the Bell Road site, the creek again goes sub-surface or will dry up completely during most summers. Near Eastin Road, upstream of the Anderson sampling site, irrigation tail water begins to enter the channel. From this point downstream to its confluence with the SJR, water quality in Orestimba Creek is solely dependent on the quality of the tail water returns and operational spills during the irrigation season.

Downstream of the Bell Road site, median SC's decrease. At the first sampling site in the agriculturally dominated lower portions of Orestimba Creek at Anderson Road, the median SC was 708 umhos/cm (Figure 8). At the most downstream site in the watershed at River Road, the median SC was 524 umhos/cm. Flow at the sites downstream of Anderson Road is maintained year round by operational spill water from the CCID Main Canal. The Anderson Road site has very little to no water in the non-irrigation season months unless there is a storm event (Figure 9). The only water at this site is irrigation tail water returns or flow from the upper sites during high flow events. The Anderson Road site was not sampled on 9 out of the 26 visits because it was dry.

Minimum dilution flows would help explain why the median SC at the Anderson Road site is higher than the medians at the other three sites on Orestimba Creek downstream of agricultural influence.

The data did not show a significant spatial pattern in the field measurements of temperature or DO (Figures 10 and 14) in Orestimba Creek, however these two parameters did show a temporal pattern in 2005. The temperature at all the sites rose with the onset of summer (Figure 11), and was accompanied by a corresponding drop in DO (figure 15). In addition, although temperature ranges were comparable between sites, the DO concentration was substantially lower at the Kilburn site prior to the onset of rain in the Fall of 2004 and again during the beginning of the irrigation season in 2005—just before the site went dry. The low DO may reflect the dominance of local ground water at the site.

The pH (figure 12 and 13) did not show significant spatial or temporal patterns in the Orestimba Creek Watershed during the study period, with the median concentrations ranging from 7.95 to 8.19. Two sites, Orestimba Creek at Hwy 33 and at River Road, showed great variability in concentrations during December 2004 and January 2005, ranging from 6.66 to 8.30. The higher concentrations correspond to samples collected during storm events.

Figure 7: Normal Flow versus Major Rain Event at Orestimba Creek @ Bell Road

(May 4, 2005) **(February 15, 2005)**

Figure 8: Orestimba Creek Watershed SC Spatial (November 2004 – November 2005)

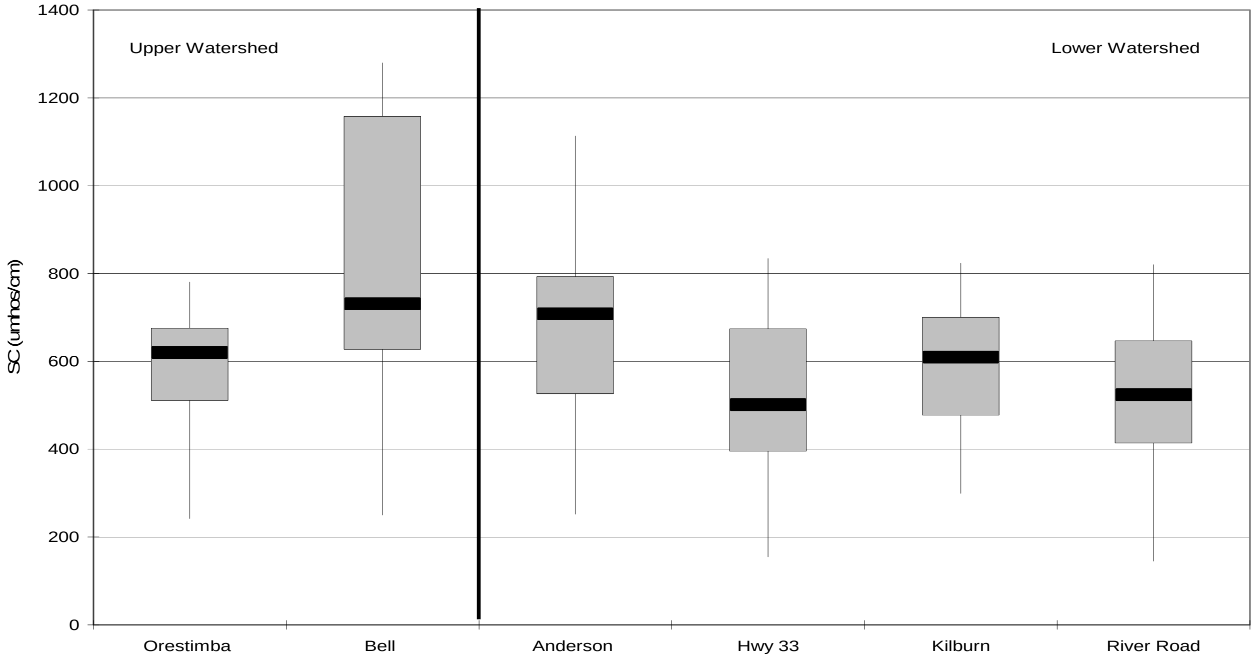


Figure 9: Orestimba Creek Watershed SC Temporal (November 2004 – November 2005)

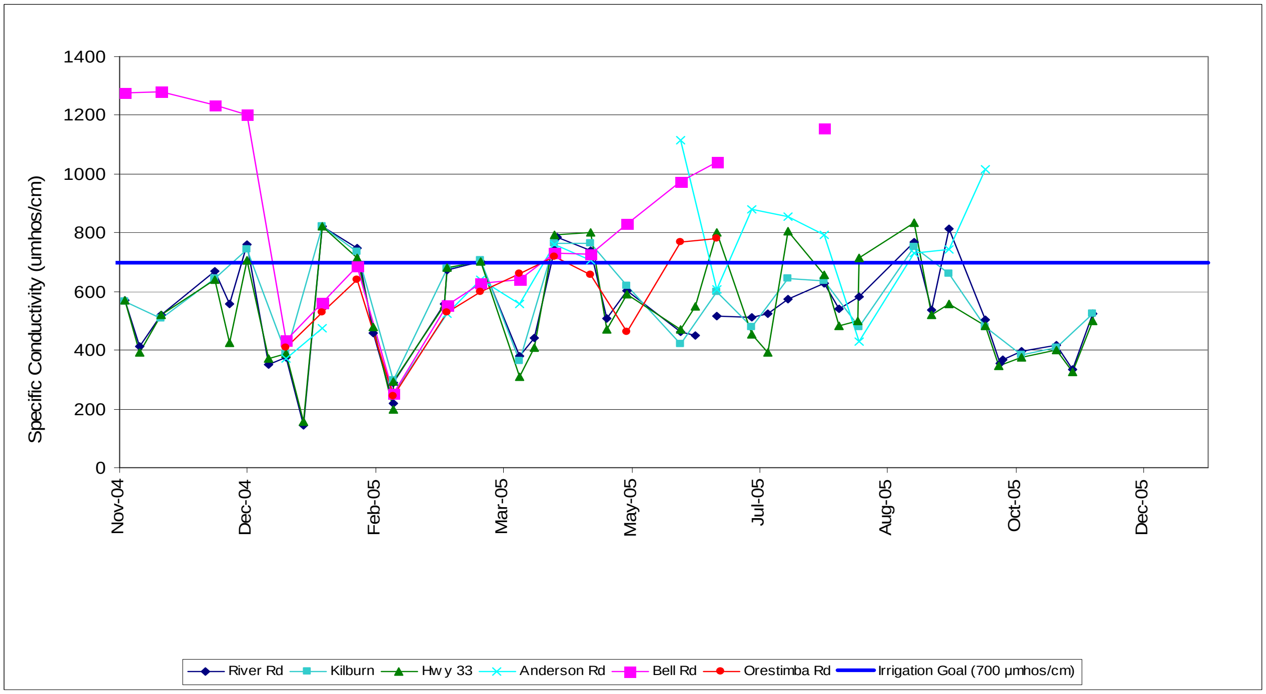


Figure 10: Orestimba Creek Watershed Temperature Spatial (Nov 2004 – Nov 2005)

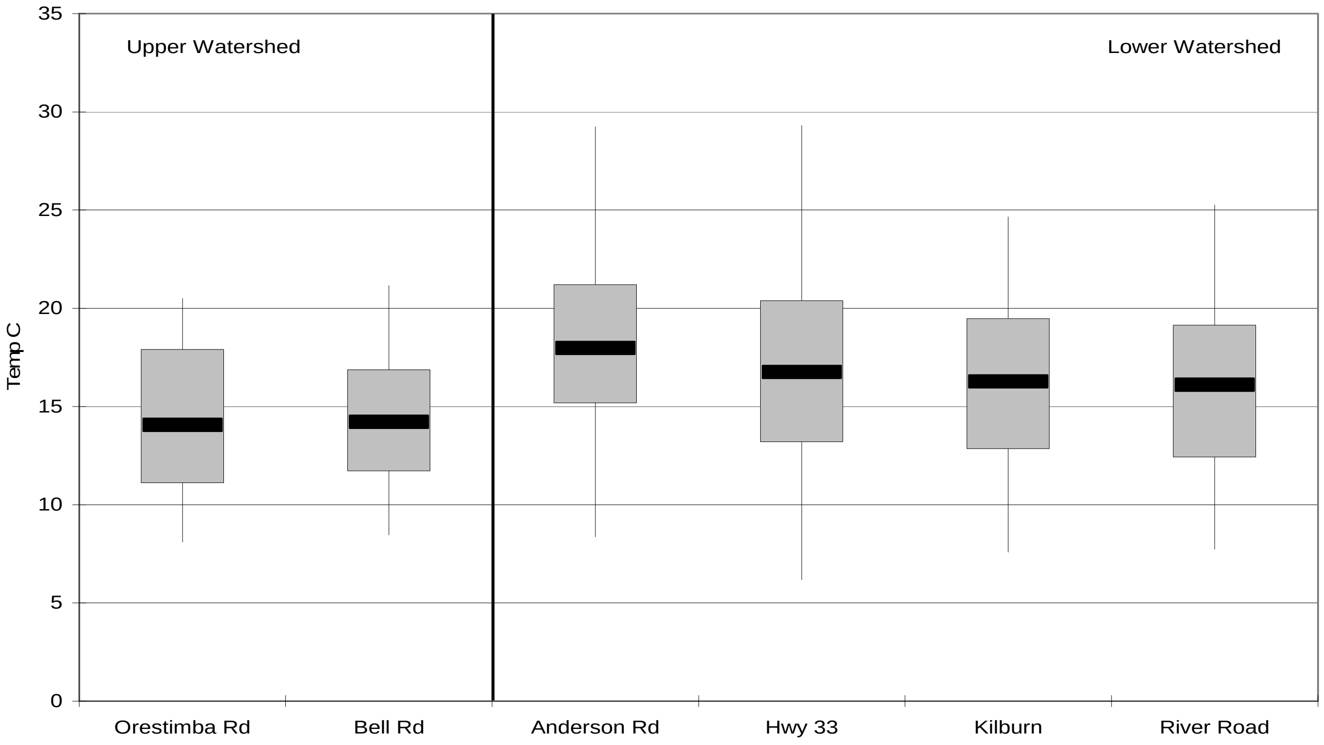


Figure 11: Orestimba Creek Watershed Temperature Temporal (Nov 2004 – Nov 2005)

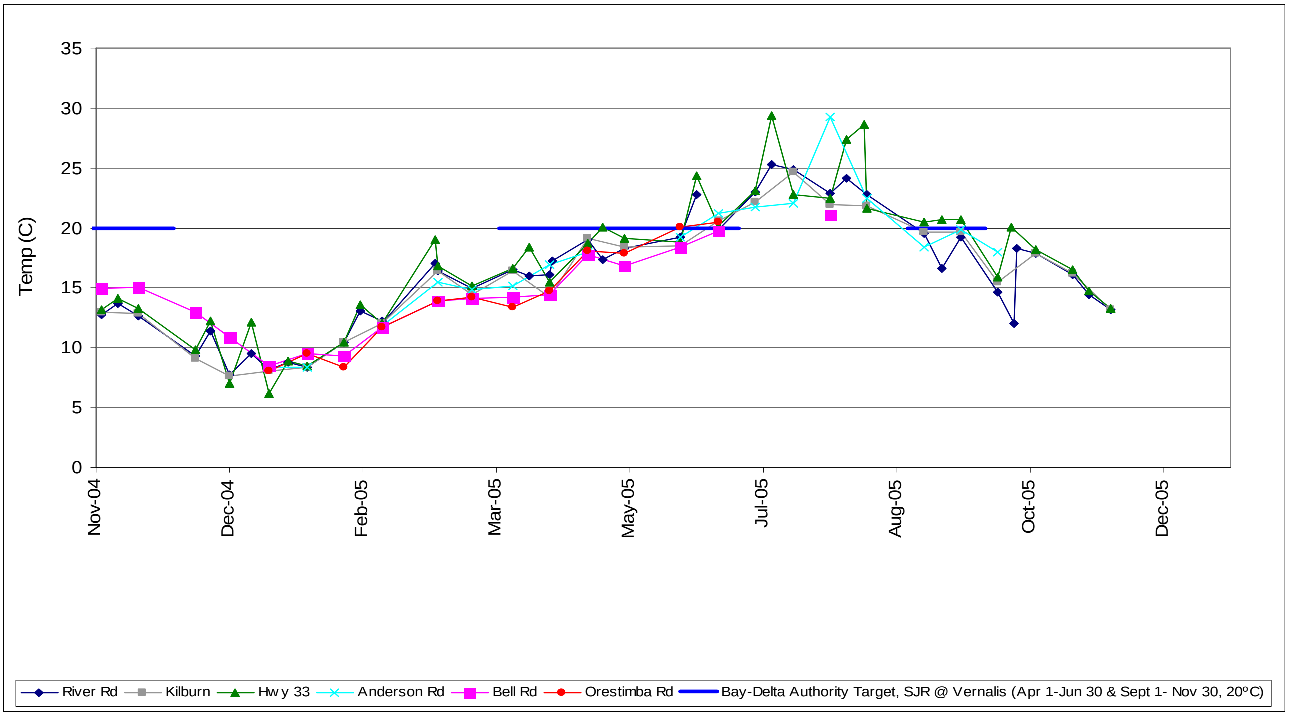


Figure 12: Orestimba Creek Watershed pH Spatial (November 2004 – November 2005)

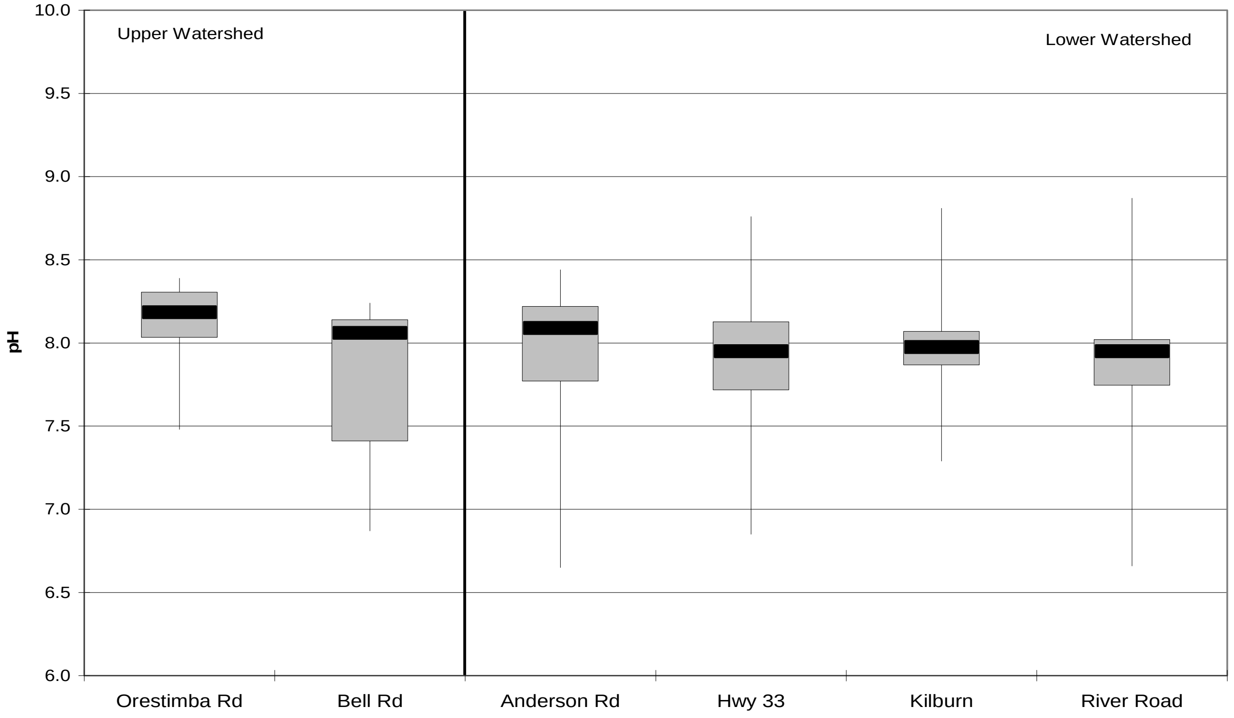


Figure 13: Orestimba Creek Watershed pH Temporal (November 2004 – November 2005)

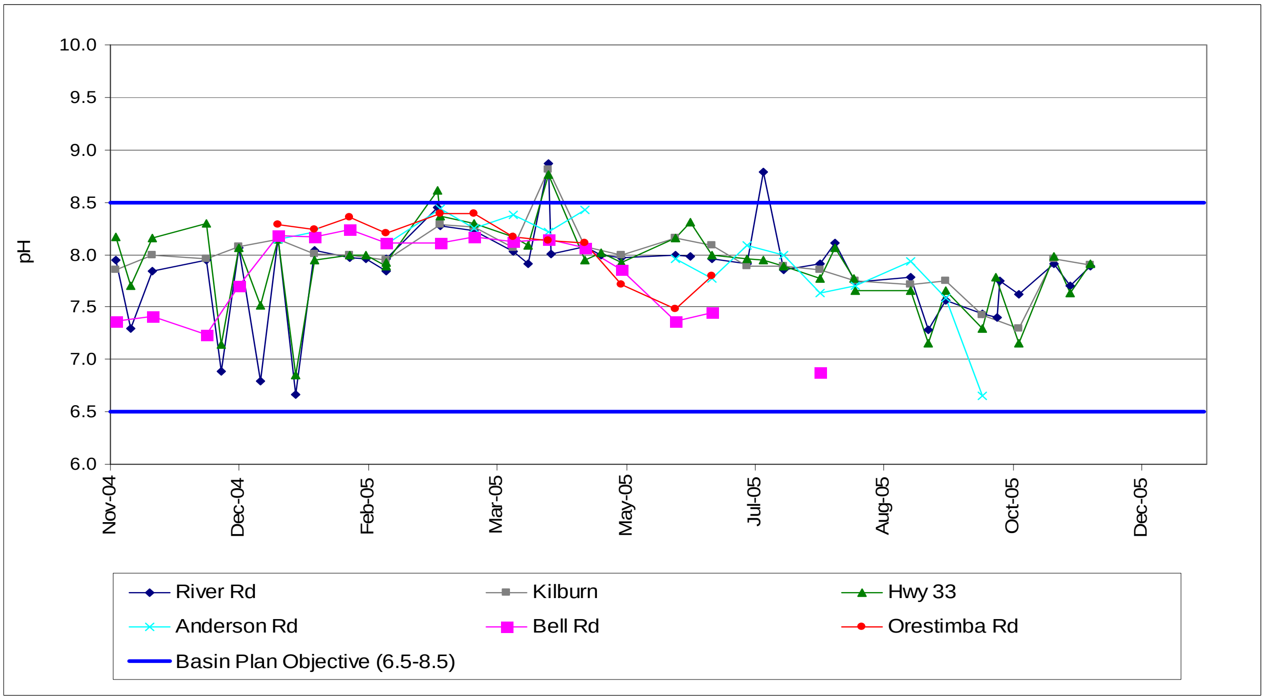


Figure 14: Orestimba Creek Watershed DO Spatial (November 2004 – November 2005)

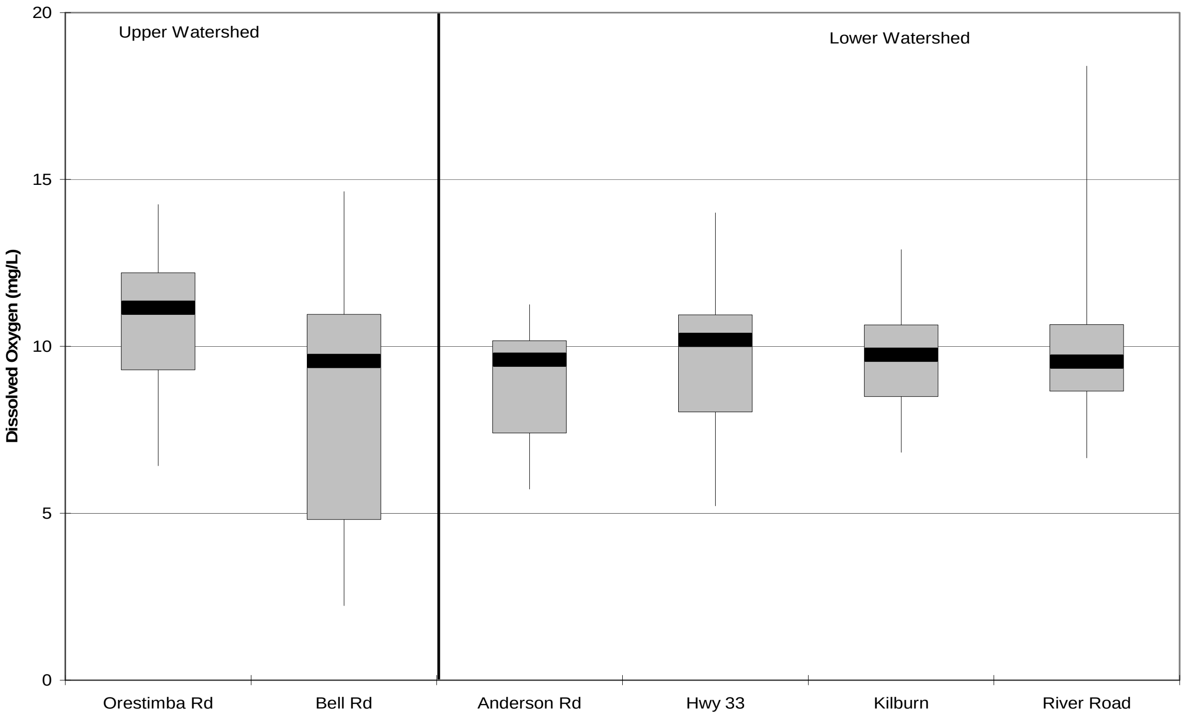
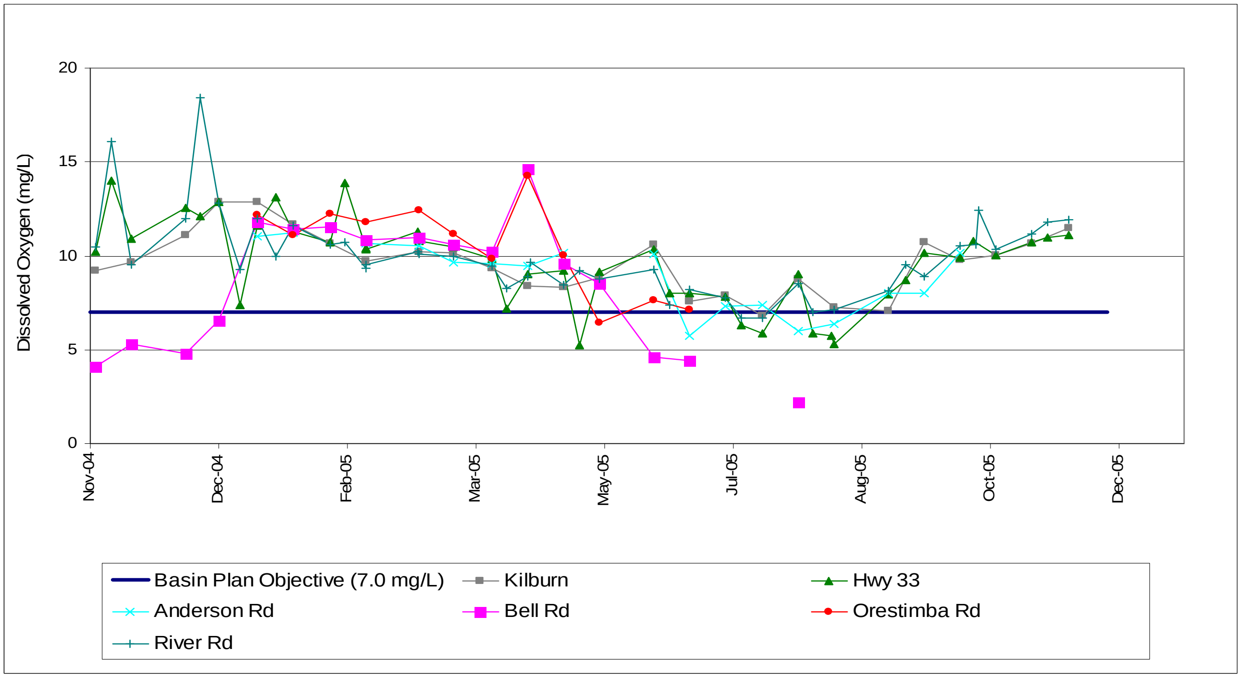


Figure 15: Orestimba Creek Watershed DO Temporal (November 2004 – November 2005)



Total Suspended Solids (TSS)

Orestimba Creek showed mixed spatial trends with a tendency for increasing TSS moving downstream in the lower watershed (Figure 16). The temporal trends at individual sites correlated with both rain events and irrigation patterns (Figure 17).

Medians for TSS in the two upper watershed sites at Orestimba and Bell Roads were 86 mg/L and 4.0 mg/L, respectively, with maximum concentrations of 170 mg/L and 120 mg/L, respectively, during the February 16, 2005 storm event (Figure 7). The Bell Road site is dominated by local groundwater much of the year, resulting in the low median and tight range (4.0 to 120 mg/L) of all the storm related TSS samples. In the agriculturally dominated downstream sections, the median TSS for all four sites ranged from 58 to150 mg/L. Maximum concentrations were higher at the sites down stream of irrigated agriculture ranging from 610 to 1500 mg/L. The two single highest TSS concentrations in the watershed were 1500 mg/L on August 9, 2005 at Highway 33, and 1400 mg/L on September 7, 2005 at the Anderson Road site. On both occasions the TSS concentration at the next site sampled down stream dropped significantly, down to 240 mg/L at River Road on August 9, and 110 mg/L at Kilburn on September 7. The most consistent elevated TSS concentrations correlated with the February 2005 storm event.

Total Organic Carbon (TOC)

The TOC results in Orestimba Creek showed lower median concentrations upstream of the influence of irrigated agriculture (Figure 18). The median TOC concentrations for the two upstream sites were 2.8 mg/L and 3.0 mg/L, where as the medians for the four sites downstream ranged from 3.1 to 5.1 mg/L. Maximum concentrations were also higher in the lower watershed sites (ranging from 7.4 to 11.0 mg/L) as opposed to 6.0 mg/L at the two upper sites.

Temporally, TOC concentrations fluctuated with the two highest TOC concentrations in the watershed at 10.0 and 11.0 mg/L during the mid February storm event (figure 19). The samples were collected at Highway 33 and River Road, respectively, and were the only sites in the watershed with TOC samples collected on that day. All sites showed spikes in TOC concentrations during the December 29, 2004 storm event with the Highway 33 site reaching a concentration of 10 mg/L.

E. coli.

Spatially, overall medians were similar between the sites ranging from 177.9 to 365.4 MPN/100ml, with the exception of the Anderson site (median of 109.5 MPN/100ml). The lower watershed sites did have a broader 50 percentile range in concentration with many samples exceeding 500 MPN/100ml (Figure 20).

Temporally, the most extreme instances of elevated *E. coli.* levels occurred during rain events at both the upper and lower watershed sites, with *E. coli.* concentrations over the maximum detection level of 2419.6 at all sites except River Road during the February 16th storm event (Figure 21).

During the summer months and irrigation season, *E. coli.* levels at the sites within agricultural influence were elevated compared to the rest of the year except during storm events. Median values of samples collected in the irrigation season from March 2005 through September 2005 show an increasing pattern from the most upstream site within agricultural influence, Anderson Road, to the most downstream site at River Road (109.5, 300, 336.5 and 365.4 MPN/100ml, respectively). Anderson Road is the first site to receive tail water discharges and River Road is the last site sampled before the confluence with the SJR.

Figure 16: Orestimba Creek Watershed TSS Spatial (November 2004 – November 2005)

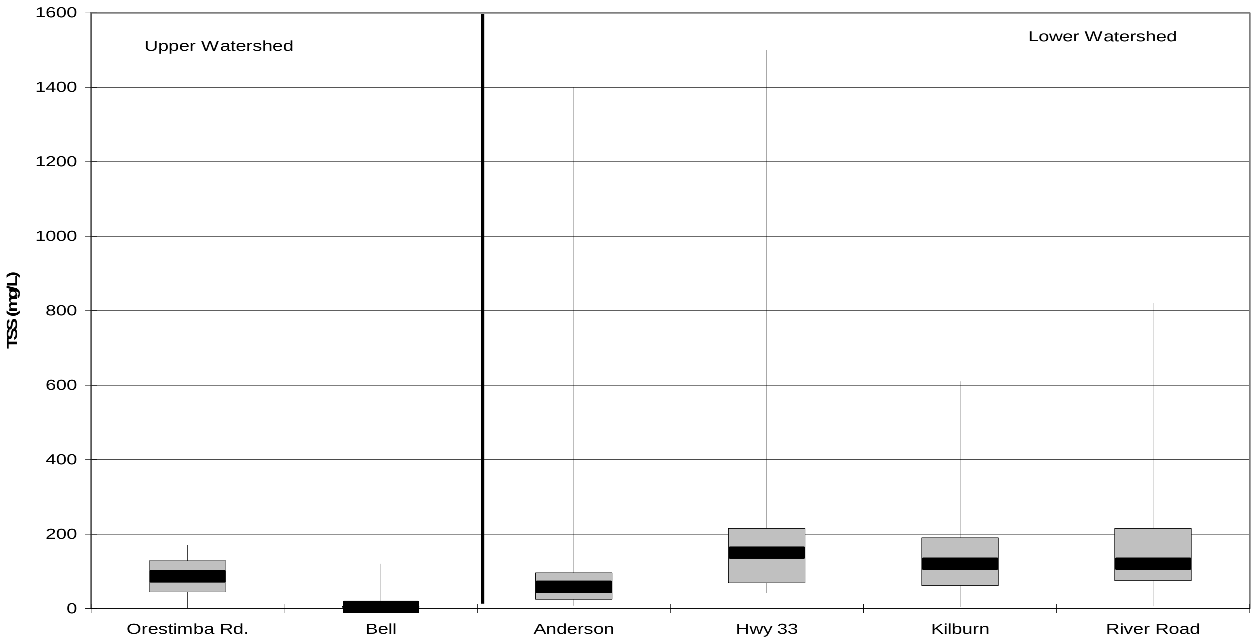


Figure 17: Orestimba Creek Watershed TSS Temporal (November 2004 – November 2005)

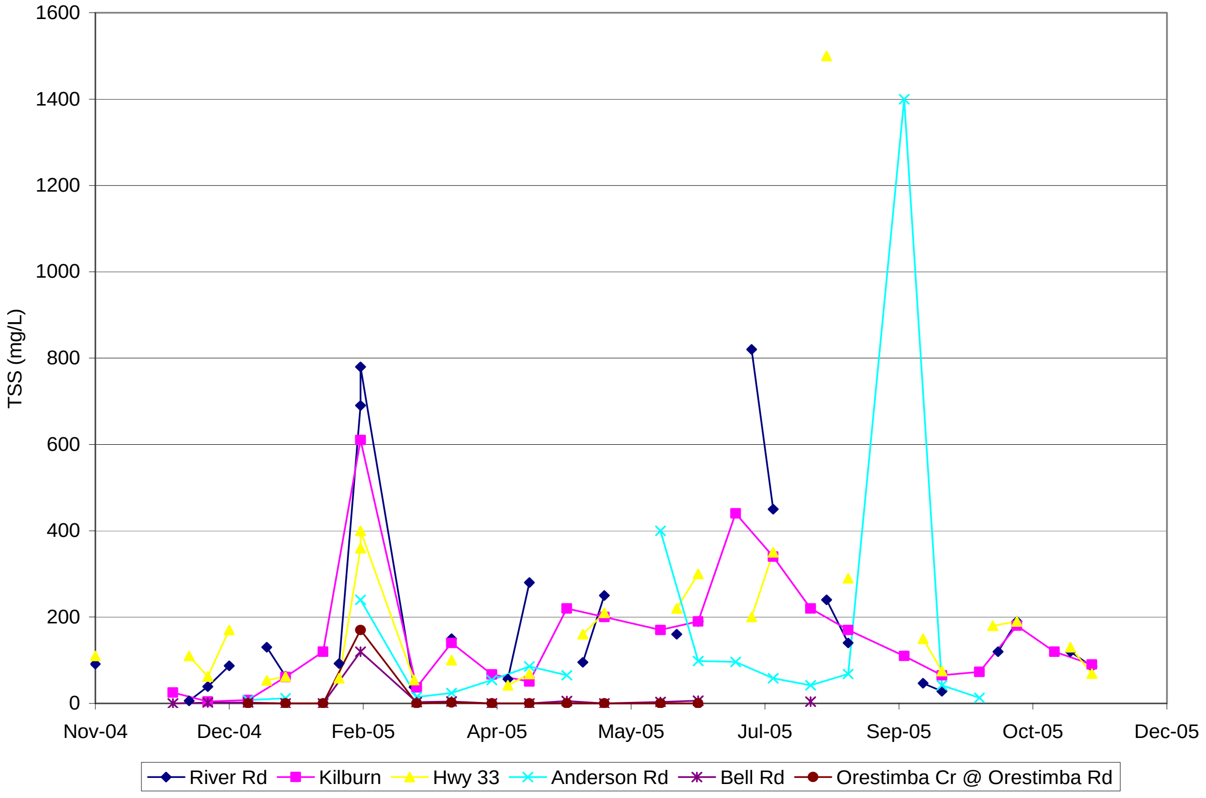


Figure 18: Orestimba Creek Watershed TOC Spatial (November 2004 – November 2005)

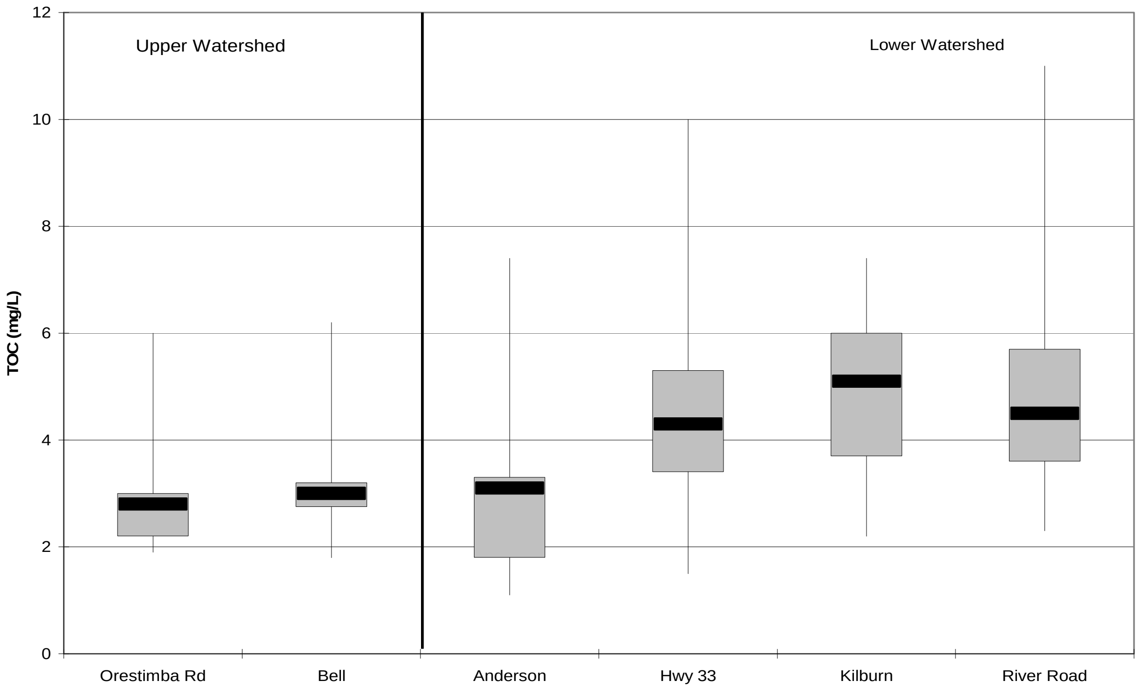


Figure 19: Orestimba Creek Watershed TOC Temporal (November 2004 – November 2005)

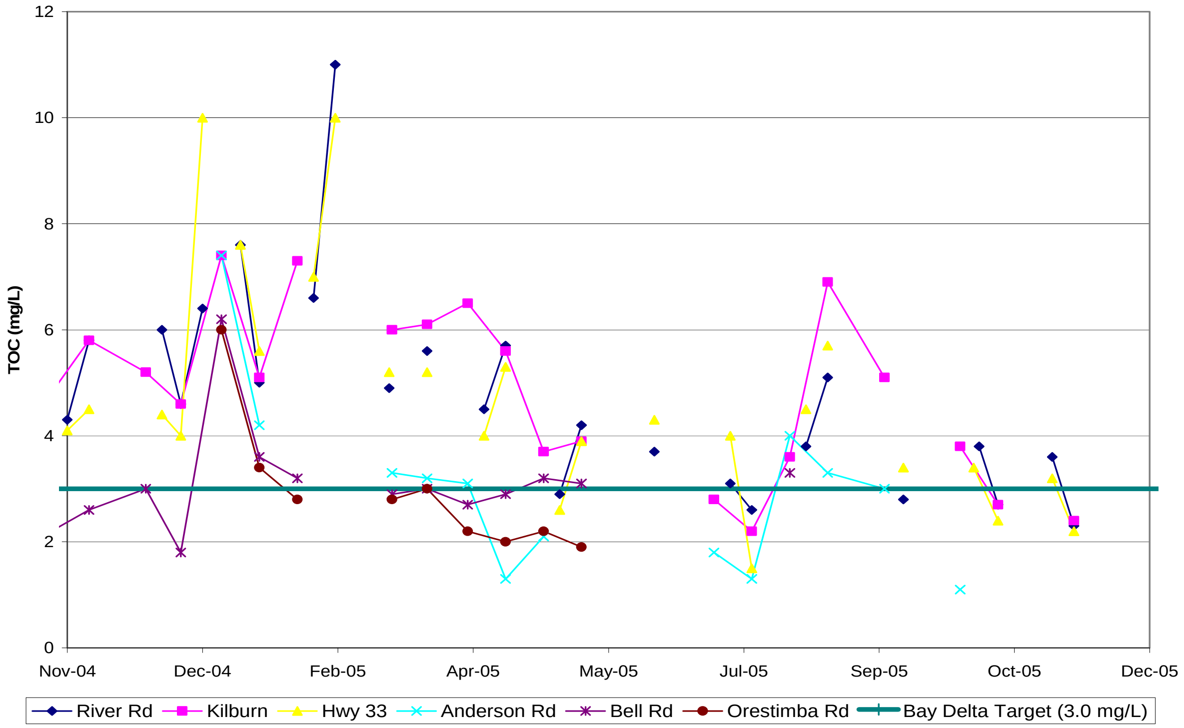


Figure 20: Orestimba Creek Watershed E.coli Spatial (November 2004 – November 2005)

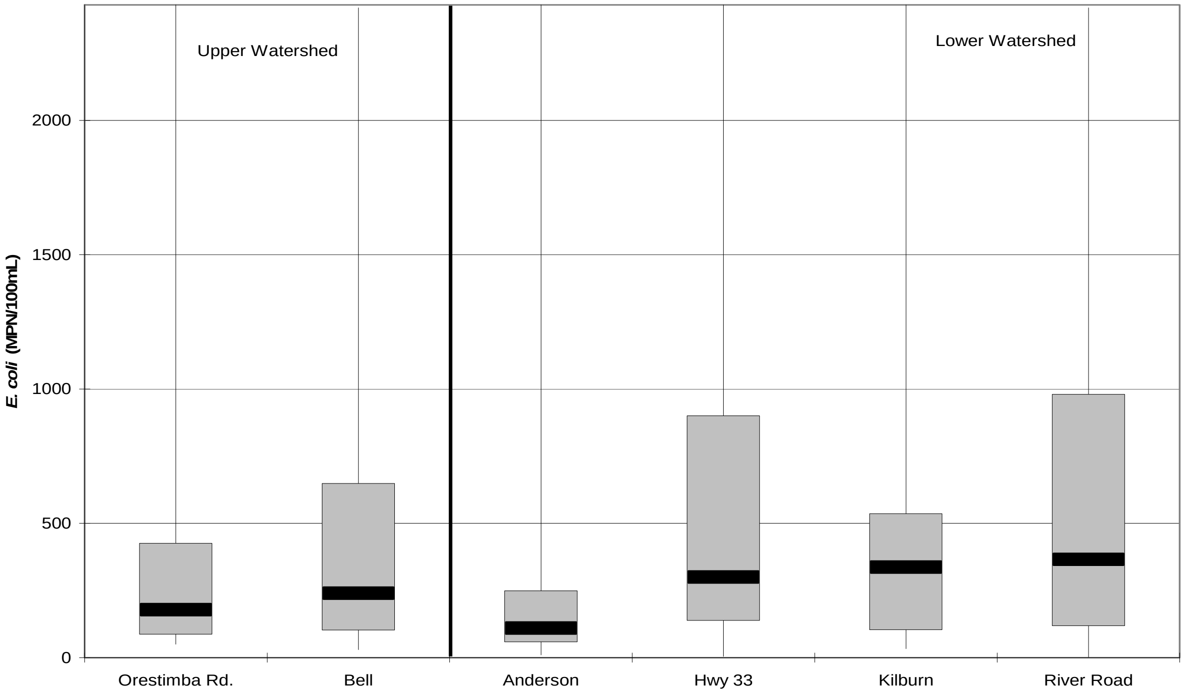
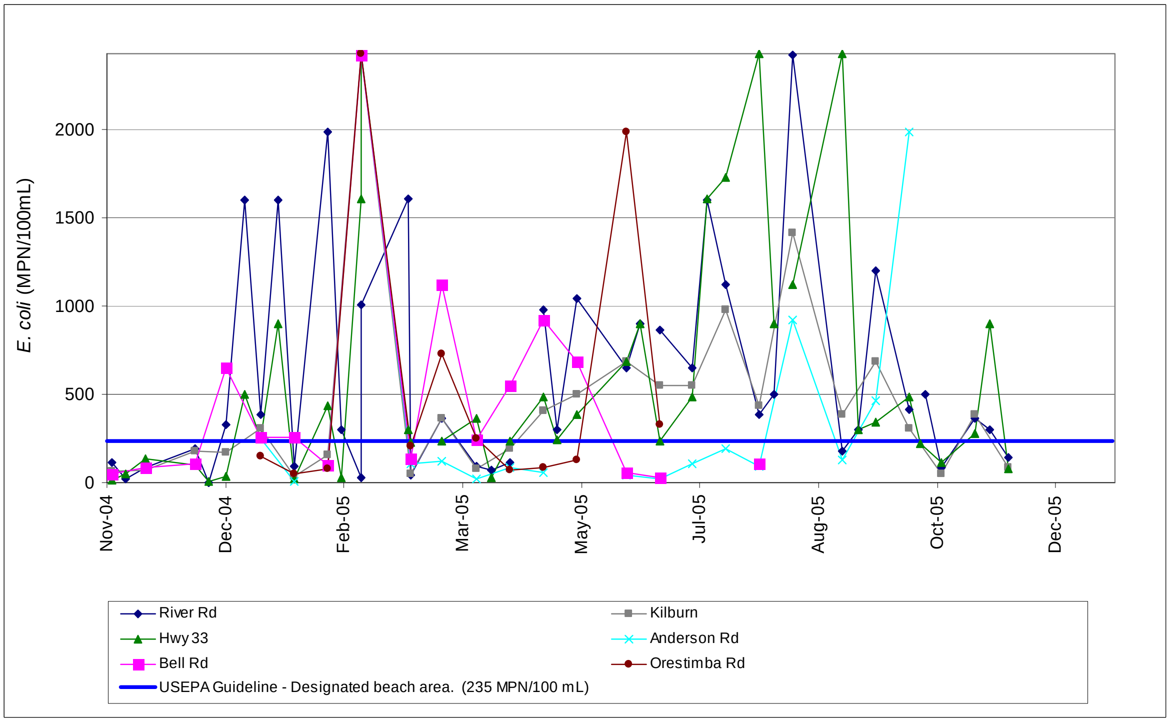


Figure 21: Orestimba Creek Watershed E. coli Temporal (November 2004 – November 2005)



Water Column Toxicity

A toxicity sample was classified as toxic if it was considered statistically significant and had greater than or equal to a 20% difference from the control. Thirteen samples were collected for acute *Ceriodaphnia* toxicity testing at River Road, with only one considered toxic (8%) during the sampling period. There was no acute toxicity found in Fathead Minnow (*Pimephelas promelas*) out of 13 samples collected.

10.2.2 Del Puerto Creek Watershed

The Del Puerto Creek Watershed was the only watershed in this rotation that had year-round access into the upper elevations of the coast range and off the valley floor. There is a marked difference in some of the parameters between the upper watershed sites and the valley floor sites on Del Puerto Creek. These differences seemed to follow a temporal scale as much as a spatial scale down the creek, so the spatial and temporal aspects of the watershed will be discussed together. For all discussions it should be noted that the Rogers Road site was dry for the majority of the year, except during the late winter to early spring, so the Highway 33 site was generally the first site in the lower watershed to be sampled from April through the summer irrigation season.

Field Measurements

Specific conductivity was higher in the upper Del Puerto Creek watershed sites with medians ranging from 787.5 to 1367 umho/cm, compared to medians of 367 to 772 umho/cm at the lower watershed sites (Figure 22). The highest SC concentrations were at mile 3.9 with 50% of the recorded concentrations between 905.0 and 1837 umhos/cm. The SC at mile 3.9 showed a steadily increasing pattern through the summer dry season before any substantial rain fall occurred, from a low of 659 umho/cm in March to a high of 2330 umho/cm in mid December (Figure 23). The flow at the mile 3.9 site was essentially ground water seepage much of the year. Other sites in the upper watershed showed the same temporal pattern to a lesser extent. The SC in the lower watershed did not show a distinct seasonal pattern.

The field measurements of temperature (Figures 24) and DO (Figures 26) did not show a distinct spatial pattern aside from the Rodgers Road site having the lowest overall temperature and highest DO. Typical temporal patterns were followed for temperature and DO at all the sites in Del Puerto Creek (Figures 25 and 27). Temperature tended to be lowest during the winter months, increasing over the summer, peaking in July, and then decreasing in the fall. The DO concentrations followed an inverse pattern.

The pH in the upper watershed was consistently higher than the pH measured in the lower watershed for all sites except Rogers Road (medians ranging from 8.19 to 8.45 vs. 7.80 to 7.90, respectively). The pH at the Rogers Road site had a median of 8.50 units with 50% of the concentrations falling between 8.40 and 8.55 units (Figure 28). The pH for all sites except Rogers Road tended to track fairly consistently from December 2007 through mid April when runoff from the upper watershed was reaching the SJR (Figure 29). There was some separation between the sites starting in the spring and going through the summer season, especially in the lower watershed where the variable concentrations likely reflected alternating supply/drainage water.

Figure 22: Del Puerto Creek Watershed SC Spatial (November 2004 – November 2005)

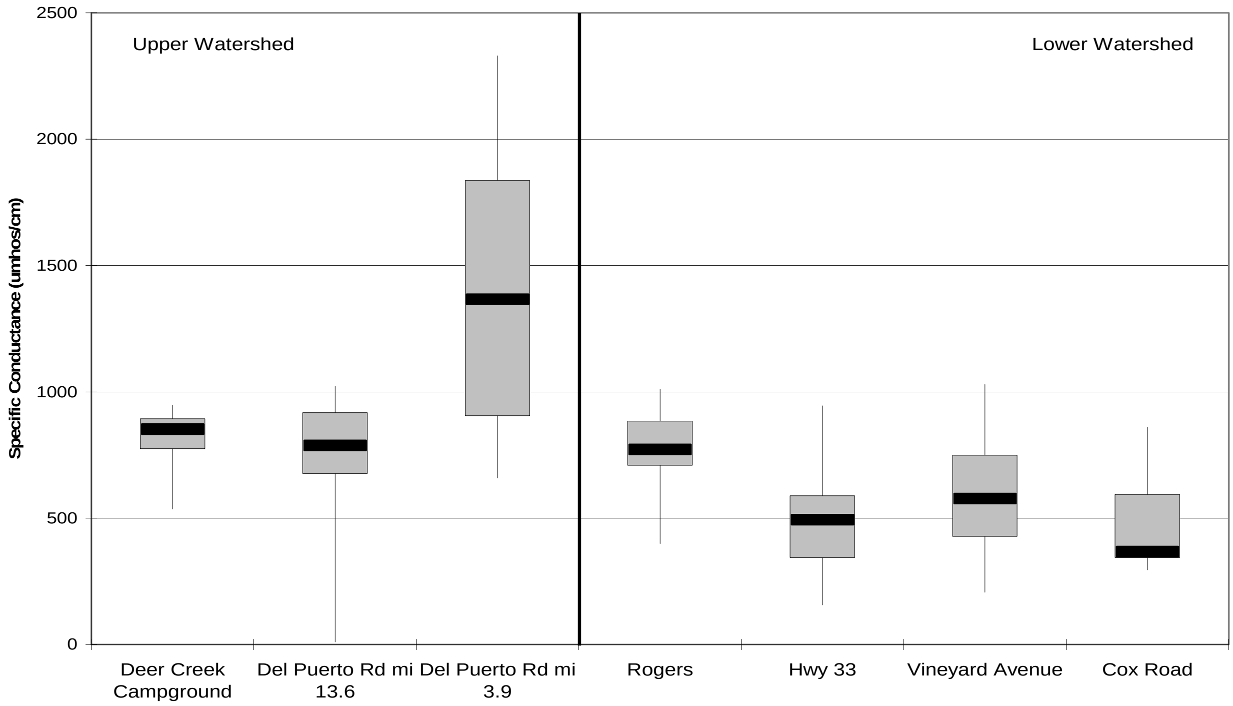


Figure 23: Del Puerto Creek Watershed SC Temporal (November 2004 – November 2005)

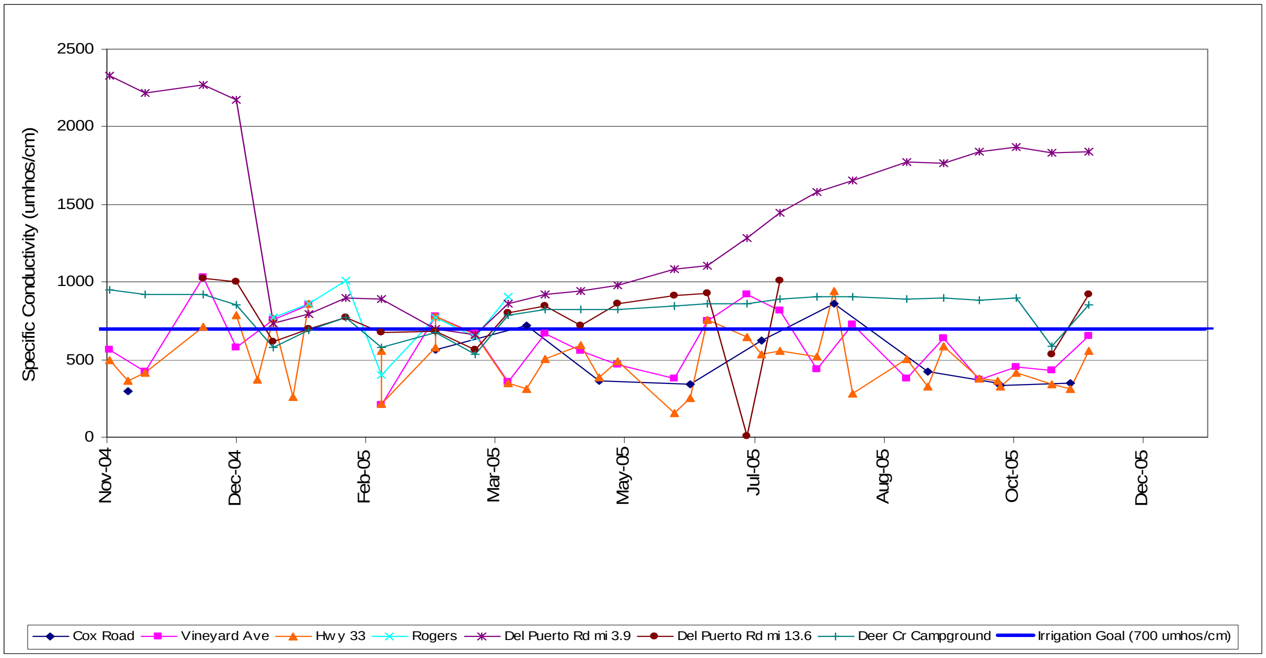


Figure 24: Del Puerto Creek Watershed Temperature Spatial (Nov 2004 – Nov 2005)

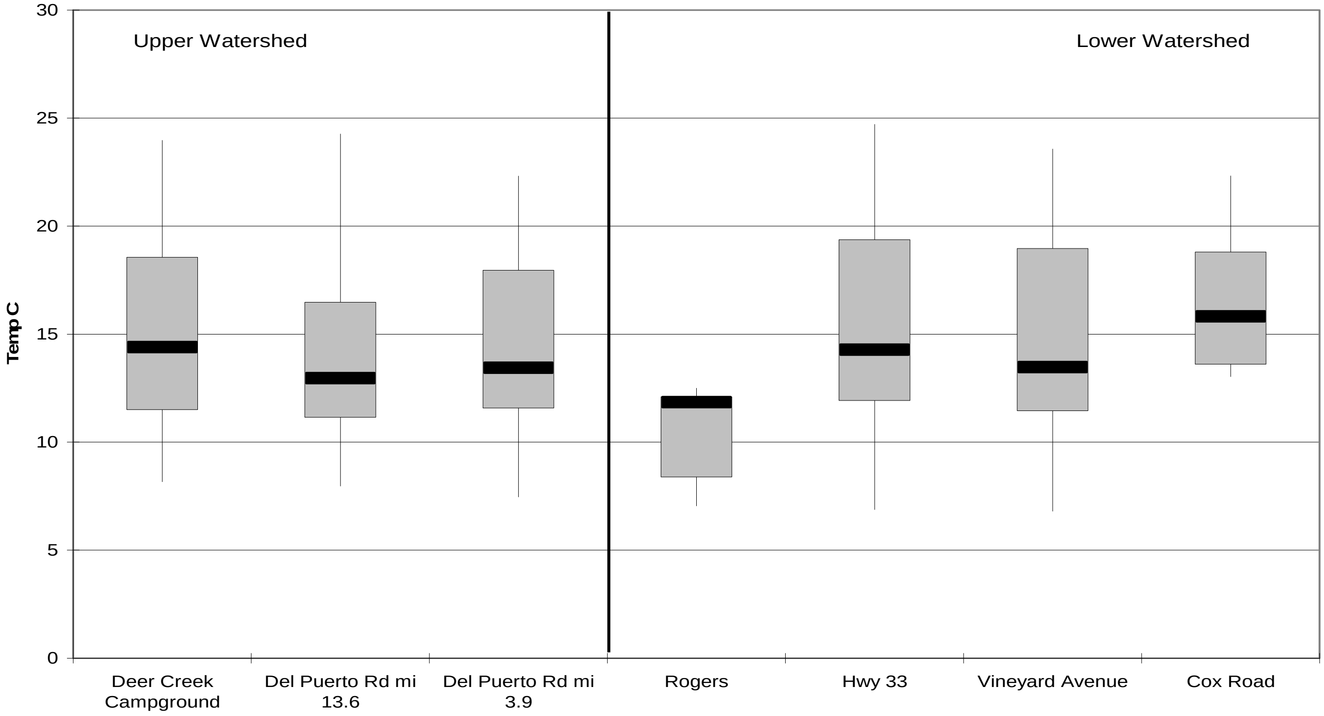


Figure 25: Del Puerto Creek Watershed Temperature Temporal (Nov 2004 – Nov 2005)

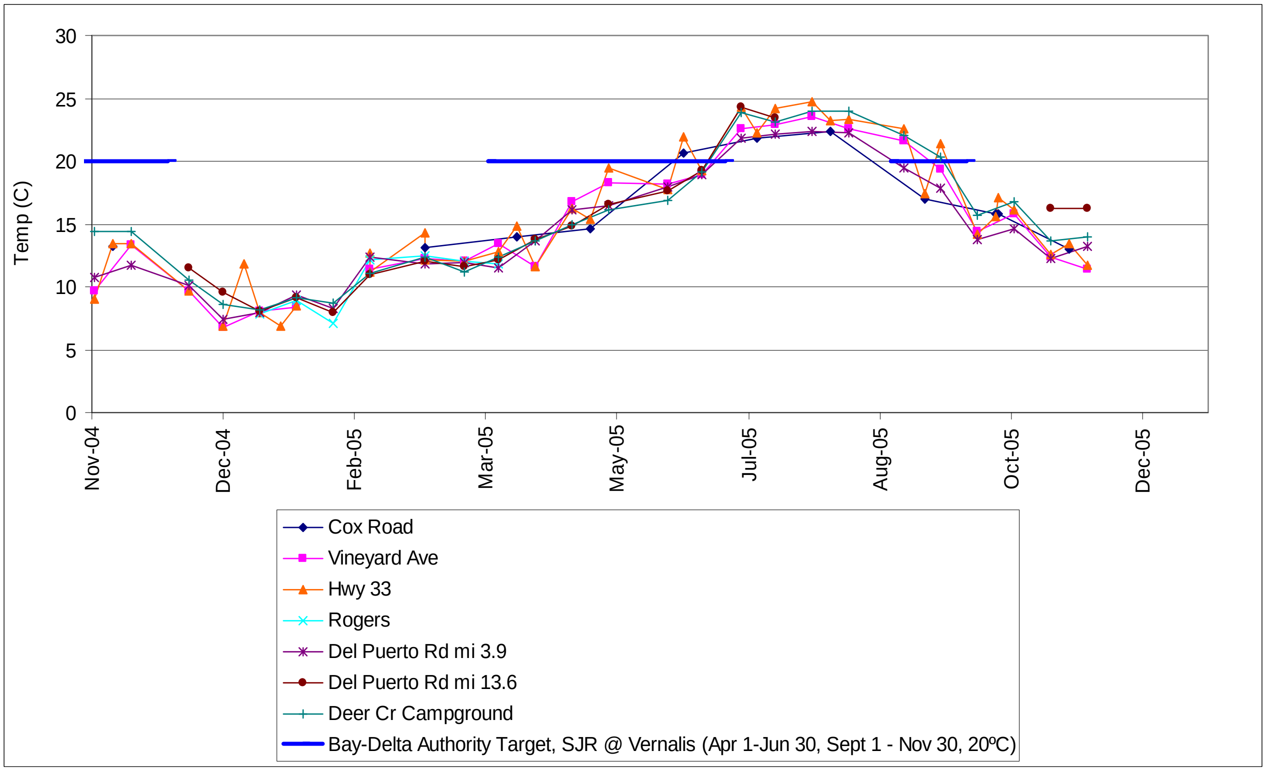


Figure 26: Del Puerto Creek Watershed DO Spatial (November 2004 – November 2005)

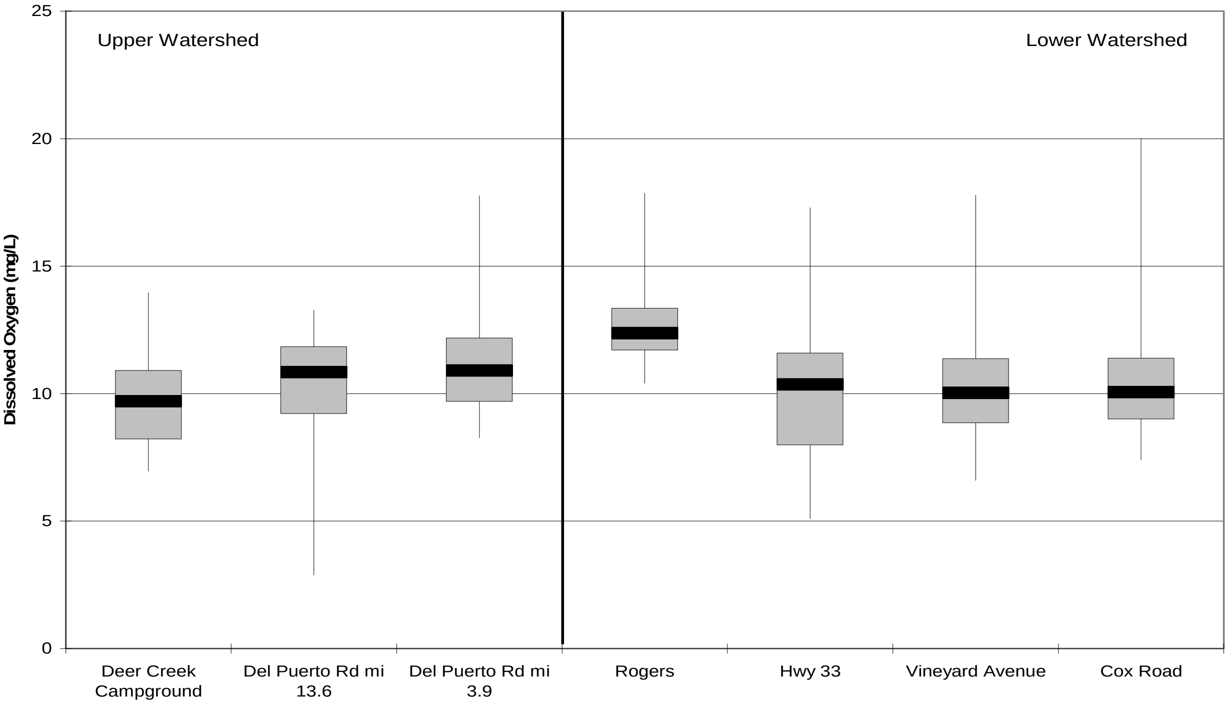


Figure 27: Del Puerto Creek Watershed DO Temporal (November 2004 – November 2005)

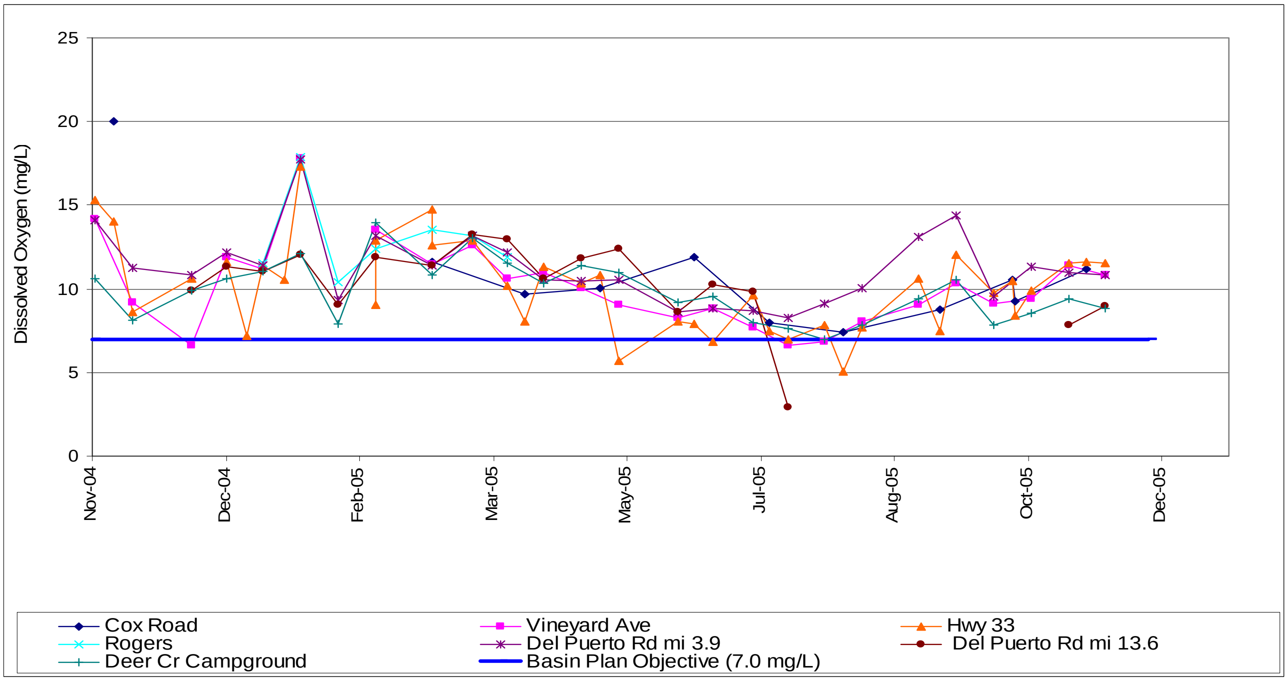


Figure 28: Del Puerto Creek Watershed pH Spatial (November 2004 – November 2005)

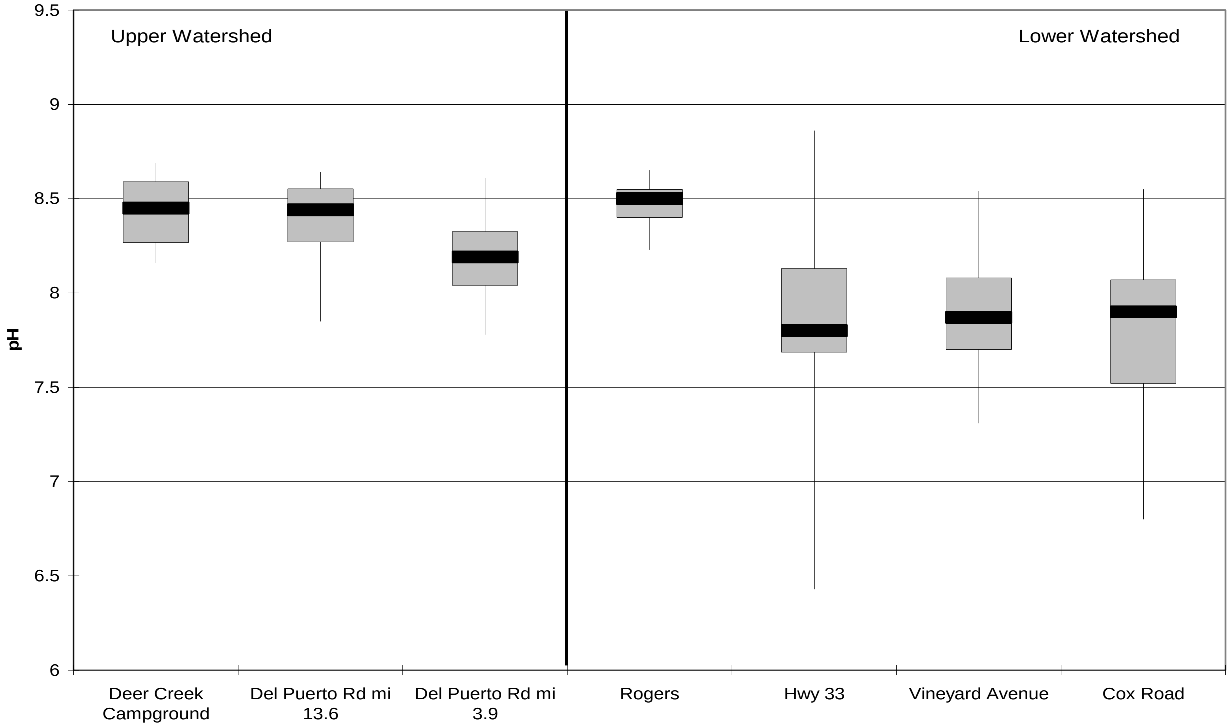
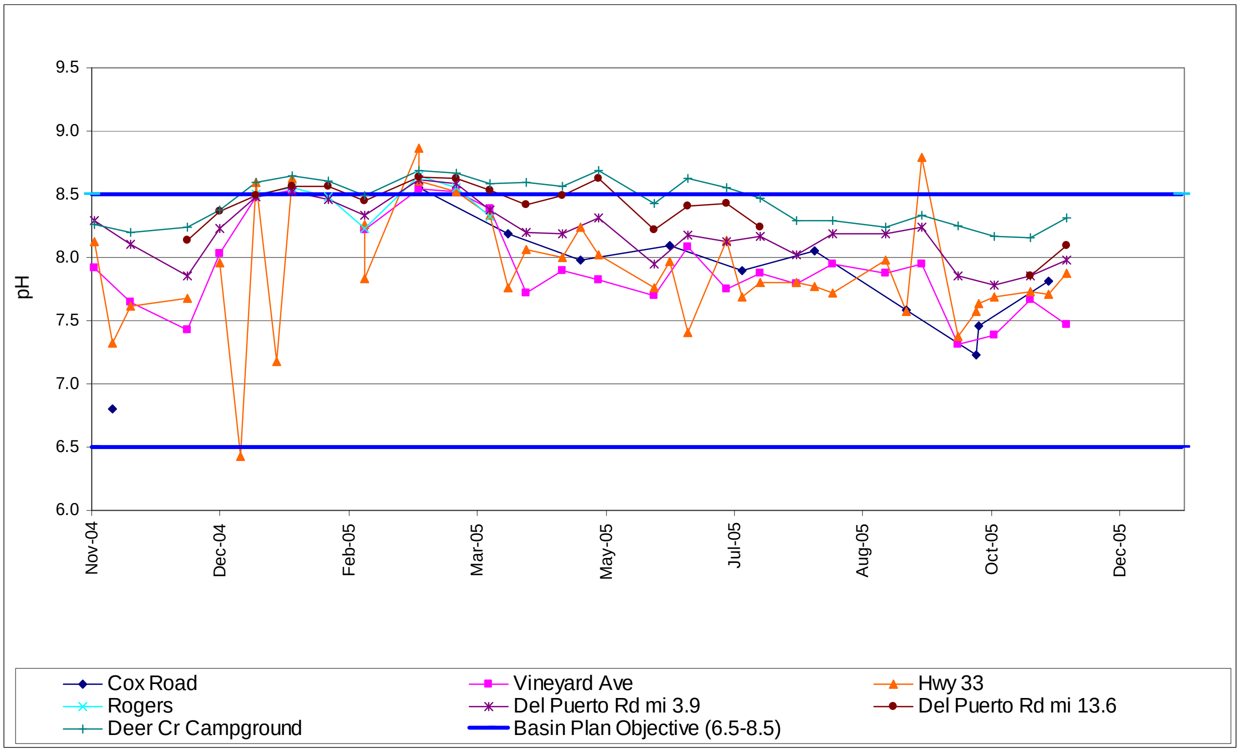


Figure 29: Del Puerto Creek Watershed pH Temporal (November 2004 – November 2005)



Total Suspended Solids (TSS)

Overall TSS concentrations were higher in the lower watershed (medians ranging from 5.8 to 66 mg/L) than the upper watershed (medians ranging from 1.4 to 2.6 mg/L) (Figure 30). Once in the lower watershed, concentrations steadily increased moving downstream.

Temporal trends in the upper watershed tended to follow rainfall events. Spikes in TSS occurred at the Dear Creek Campground site when there was enough rainfall to cause sheet runoff and rill and gully erosion (Figure 31). There are miles of exposed dirt roads at the Frank Reigns Off Highway Vehicle Area (OHV), which is the likely source of the majority of the TSS load in the upper watershed during rainfall events.

High sediment loading was expected between the Deer Creek Campground site and the Mile 13.6 site from the July 2003 fire area that burned 5,909 acres (CDF, 2003) in this stretch. Although all sites showed a spike in TSS concentrations during a major storm event in February 2005, there was very little sediment entering the creek from the fire area. LargeTSS spikes were seen at two of the lower Del Puerto Creek sites during this rain event. Vineyard Road had a site high of 660 mg/L, and Highway 33 had the second highest result seen at that site at 570 mg/L. In general, the TSS results in the lower watershed sites followed a pattern consistent with agricultural irrigation with elevated overall concentrations but few spikes during the irrigation season.

On May 17th 2005 there was a discharge coming in from a drainage ditch on the north side of the creek and west of the railroad tracks at the Highway 33 site. The field crew was unable to trace the discharge back to its source, however it is believed to be of agricultural origin because of the time of year, location, and type of drainage ditch. A sample taken upstream of the discharge showed the TSS in Del Puerto Creek at 66 mg/L. Below the discharge, at the normal sampling location for this site, the TSS was 1240 mg/L. Further down stream at the Vineyard Road site the TSS was 77 mg/L. This event points to the major impacts that localized discharges may have on sections of valley floor water ways.

Total Organic Carbon (TOC)

Similar to TSS, overall TOC concentrations were higher in the lower watershed (medians ranging from 3.3 to 3.8 mg/L) than in the upper watershed (medians ranging from 1.8 to 3.3 mg/L) (Figure 32).

The TOC in Del Puerto Creek ranged from a high of 29.0 mg/L to a low of 0.90 mg/L, all at the mile 13.6 site (Figures 33). The creek at mile 13.6 is ephemeral and the high TOC value came in mid June and was followed up by a sample at 1.2 mg/L in early July, then a mid-July sample at 19.0 mg/L. This pattern was not evident at the other upper watershed sites, therefore the high summer variability may be due to the low water levels at the site or large clumps of filamentous algae at the site, which may have inadvertently been included with the sample water.

On October 18, 2005 the field crew sampled a tail water discharge from an alfalfa field going into Del Puerto Creek about 10 meters upstream of the normal sampling site at Vineyard Road. The tea color of the water indicated that the tail water discharge could be high in tannins. The measured TOC was 33 mg/L with an SC of 1289 umho/cm. The background in Del Puerto Creek above the discharge that day was 3.3 mg/L TOC and had an SC of 454 umho/cm. The concentrations at the Vineyard Road site was 3.7 mg/L TOC and 577 umhos/cm SC. Figure 34 shows the tannins in the water as it enters the pipe connecting the alfalfa field to Del Puerto Creek

There was no temporal trends that can be seen for the upper and lower watersheds of Del Puerto Creek for TOC. Almost all sites from Del Puerto Creek watershed were at 5 mg/L throughout the study period. The two spikes in December were for Vineyard Ave and Hwy 33 sites where there was no major rainfall. The Hwy 33 site had one more spike in August when there was still no major rainfall. Del Puerto road at 13.6 mile had two spikes in June and July, but with no major rainfall. There were no other spikes for Del Puerto road at 13.6 mile throughout the study period.

Figure 30: Del Puerto Creek Watershed TSS Spatial (November 2004 – November 2005)

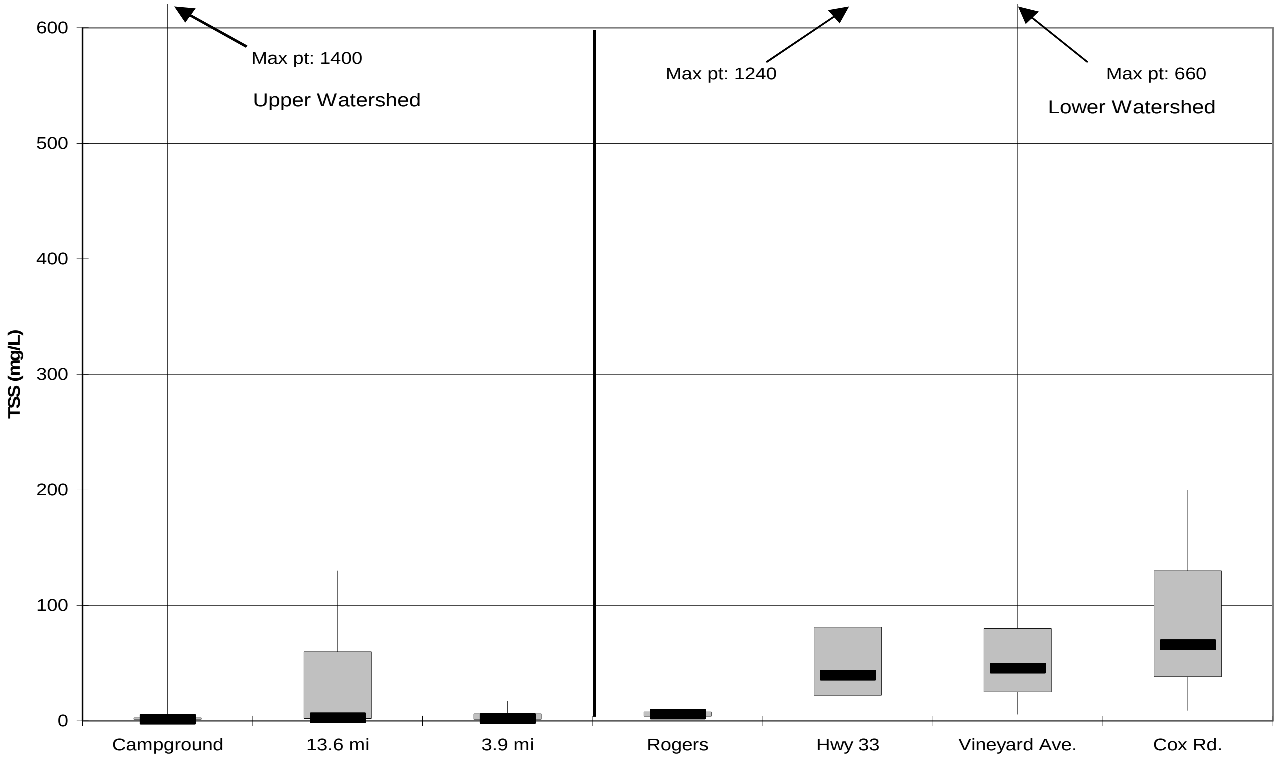


Figure 31: Del Puerto Creek Watershed TSS Temporal (November 2004 – November 2005)

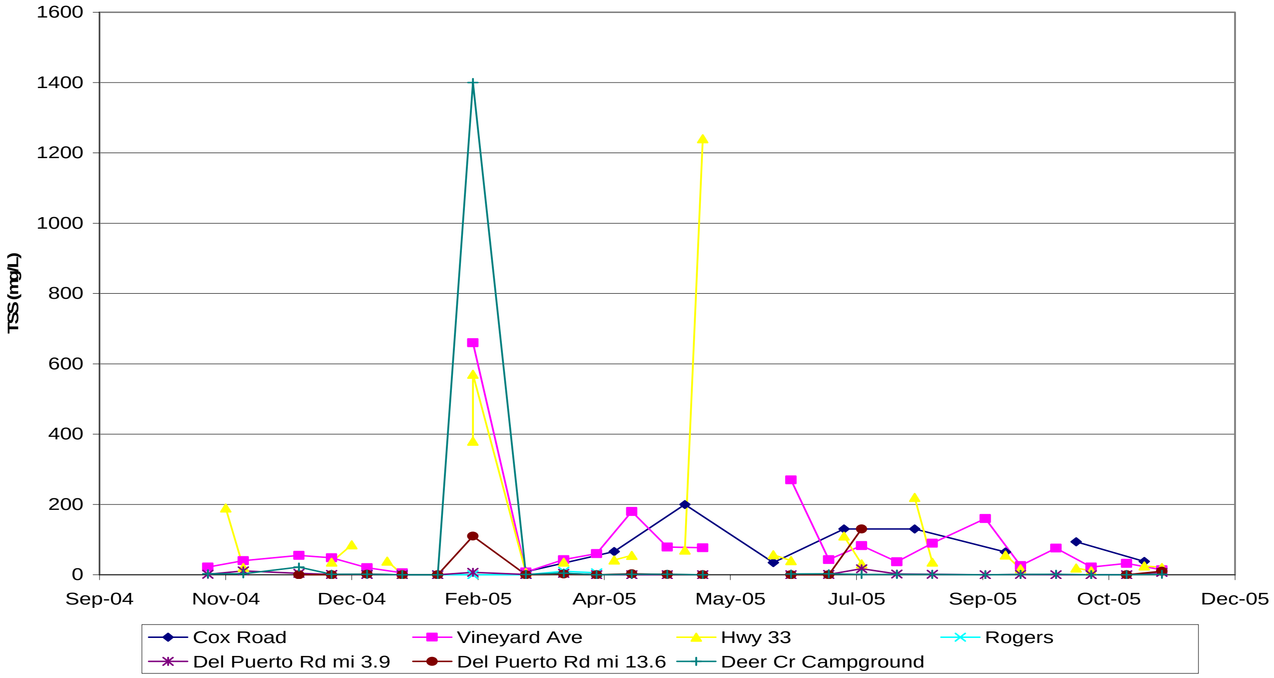


Figure 32: Del Puerto Creek Watershed TOC Spatial (November 2004 – November 2005)

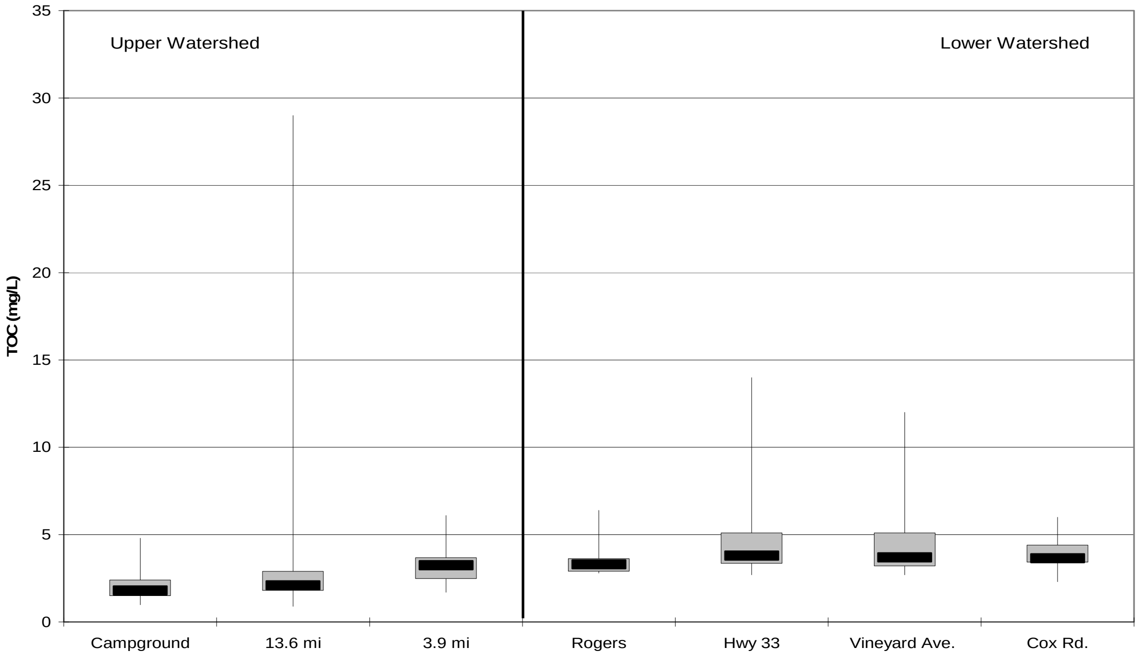


Figure 33: Del Puerto Creek Watershed TOC Temporal (November 2004 – November 2005)

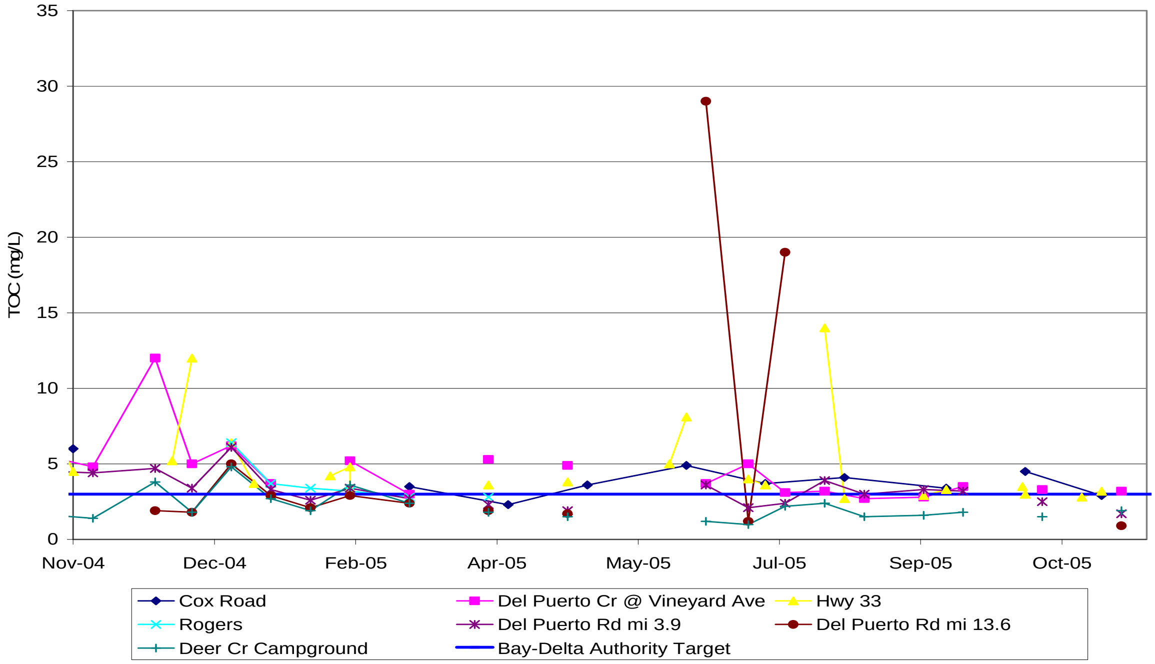


Figure 34: Del Puerto Creek 10 meters upstream of Vineyard Road

E. coli.

A spatial trend was apparent in the *E. coli.* data between the Del Puerto Creek upper and lower watershed sites (Figure 35). From the Rogers Road site, which is a transition site that is in the valley floor but does not receive tail water during the irrigation season and was typically dry, to the integrator site at the bottom of the watershed near Cox Road, *E. coli.* levels were consistently higher than in the upper watershed sites east of I-5. Median concentrations ranged from 260.3 to 727.0 MPN/100ml for the lower watershed sites and 34.1 to 75.7 MPN/100ml for the upper watershed sites. The sites at Highway 33 and Vineyard Road on the valley floor had the highest median concentrations at 312.75 MPN and 727.0 MPN respectively.

Temporal trends in the upper watershed tended to follow rainfall events. Spikes in *E. coli* occurred at the Dear Creek Campground, Del Puerto Rd mi 3.9 and Del Puerto Rd mile 13.6 sites during the month of February which had the major storm event. The lower watershed sites did not follow a temporal trend as many of them had high variability throughout the study period.

It should be noted that the Cox road site was only sampled by the Westside Coalition and was often inaccessible during periods of wet weather therefore, the number of data points for this site is significantly less than the other lower watershed sites. In addition the maximum detection limit for the Cox Road site is 1600 MPN where as all the other sites in the study have maximum detection limit of 2419.60 for samples collected by SWAMP. There were also a low number of samples collected from the Rogers Road site because it was dry or not flowing on 19 out of the 26 sample collection visits.

Figure 36 indicates that each site had high variability in E. coli concentrations with no distinct temporal pattern

Figure 35: Del Puerto Creek E. coli Spatial (November 2004 – November 2005)

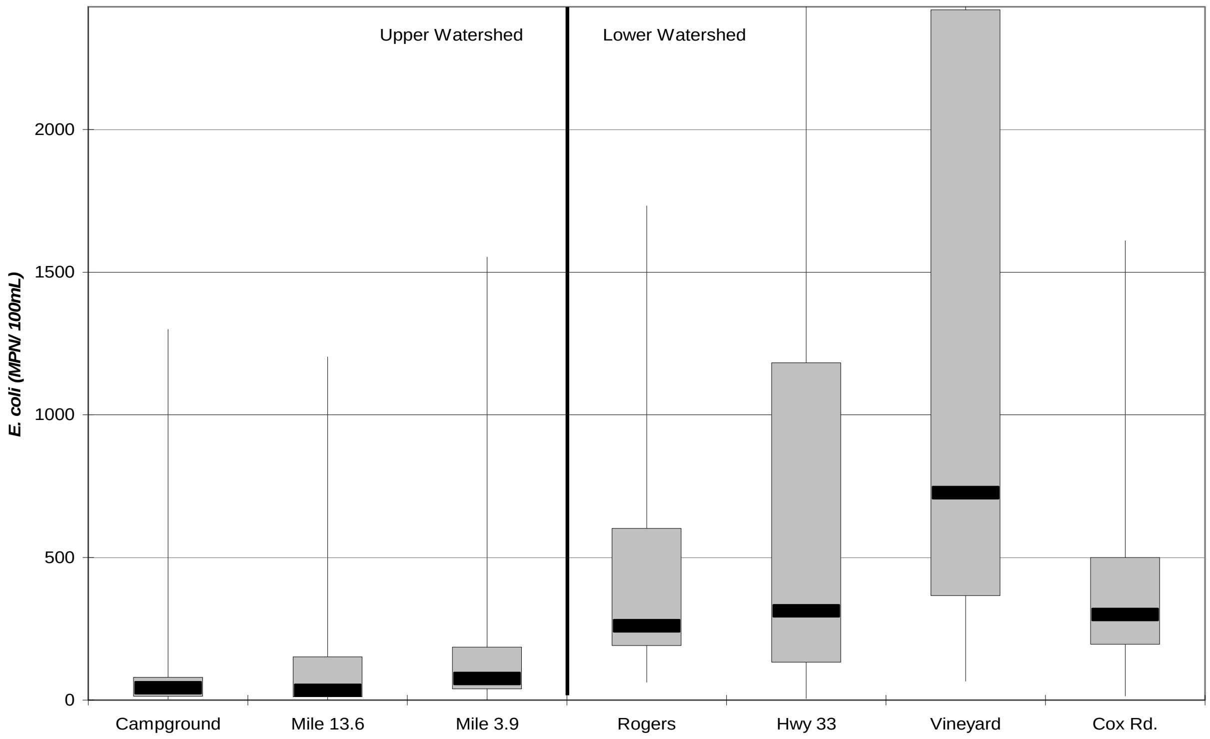
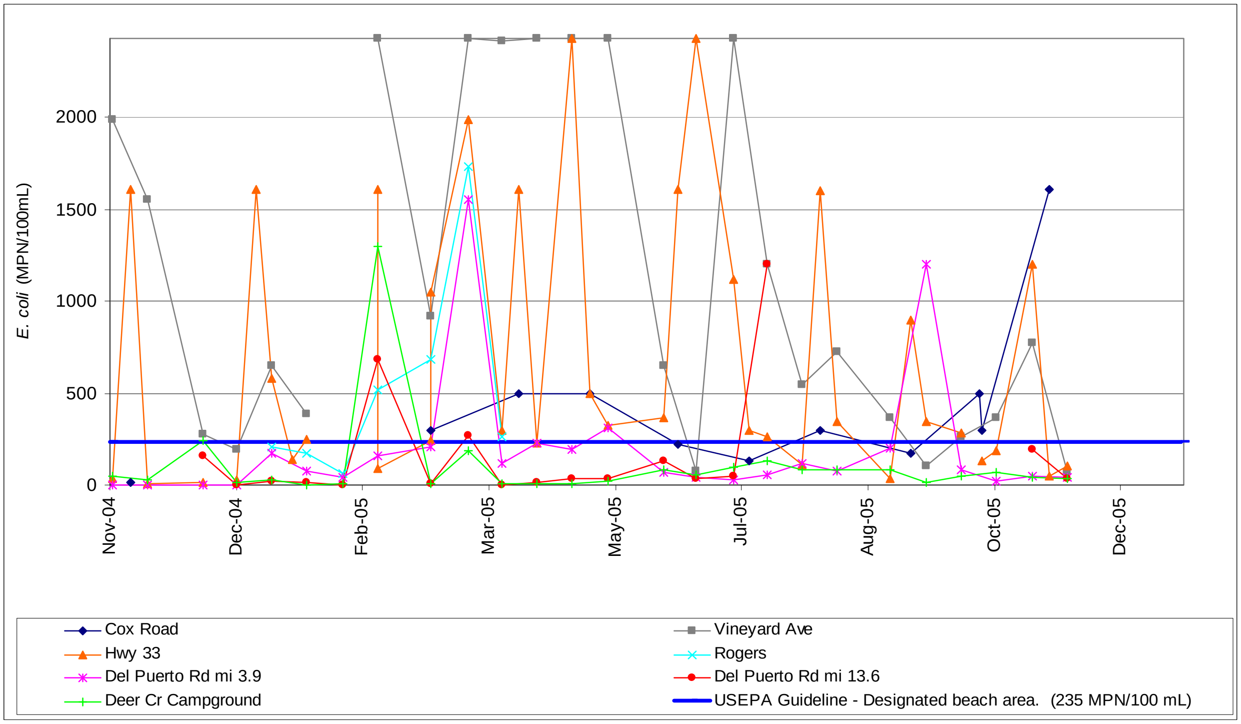


Figure 36: Del Puerto Creek E. coli Temporal (November 2004 – November 2005)



Water Column Toxicity

Three sites on Del Puerto Creek were sampled for water column toxicity. Two sites in the upper watershed, Deer Creek Campground and Mile 3.9, were sampled for toxicity to *Selenastrum capricornutum* (an algae sensistive to elevated levels of trace elements). One site was sampled in the lower watershed, Hwy 33, for three species toxicity tests (algae, Ceriodaphnia dubia which is sensistive to organics, and fathead minnows which are sensitive to nutrients). The *Selenastrum* tests showed some toxicity at all the sites sampled. At the Deer Creek Campground site in the upper watershed, five out of thirteen, or 38% of samples had a significant reduction in growth, and at the Mile 3.9 site, eight out of eleven, or 73% of samples were significantly reduced. At Highway 33, four out of thirteen, or 31% of samples showed a reduction in growth to *Selenastrum*, while 8% or one out of thirteen *Ceriodaphnia dubia* samples were significantly toxic. None of the thirteen collected at Highway 33 had significant toxicity to Fathead Minnows.

10.2.3 Valley Floor Sites

The Valley floor of the Westside Basin is dominated by intensive agriculture. Irrigation supply water in the Westside basin is normally a blend of withdrawals from the San Joaquin River, water from the Delta Mendota Canal (DMC), and pumped groundwater. This water is used to irrigate the various crops and is then discharged as tail water into a series of creeks or constructed drains, which then convey the water to the SJR.
The creeks and drains discussed in this section are completely dominated by runoff from agricultural lands during the irrigation season (typically May through September). There are no inputs from any other sources to these channels and drains.

There are eight Valley Floor sites, which capture agricultural runoff from portions of West Stanislaus Irrigation District, El Solyo Water District, Del Puerto Water District and the Blewitt Mutual Water Company (Blewitt MWC). Four of the eight sites are on Ingram and Hospital Creeks, two at Highway 33 and two at River Road. Ingram and Hospital Creeks are natural creeks that have their headwaters in the Diablo Range west of I-5, however little to no water from the upper watersheds ever reach the valley floor. On the valley floor the creek channels have been modified and realigned to carry agricultural tail water. The two creeks merge together east of River Road then run through the San Joaquin River National Wild Life Refuge before discharging into the SJR.

Two additional sites are located on Salado Creek, one at Oak Flat Road and one at HWY 33. Salado Creek at Oak Flat Road is in an open pasture area and may be impacted by cattle as well as drainage from upstream land uses such as orchards and a newly developed urban area onsisting of vineyards, a winery, hotel, golf course and 50 plus homes. Salado Creek at HWY 33 has been completely reconstructed and carries agricultural return flows and potentially urban runoff from the City of Patterson.

The final two Valley Floor sites, the Blewitt MWC Drain and the Grayson Road Drain, are constructed waterways that were built to convey agricultural discharges. The Grayson Road Drain discharges into Laird Slough, an ox bow of the SJR near the town of Grayson, and the Blewitt MWC Drain discharges directly into the SJR south of Highway 132.

Because agricultural flows dominate these sites, there are periods of time between irrigation and precipitation events that there is no flow. Out of the 241 combined visits to the eight sites during the study period there were 48 times, or approximately 20% of the visits, that a site was dry and not sampled. The one site out of the six that almost always had flowing water was Ingram Creek at River Road, which was only dry one time out of the 41 combined visits by the Westside Coalition ILP and SWAMP. In contrast the site that was dry on the most number of visits, 14 out of 26, was just a mile upstream on Ingram Creek at Highway 33. Hospital Creek at River Road was dry on 11 out of the 42 site visits by both SWAMP and the Westside Coalition. Hospital Creek at Highway 33 was dry on 10 out of the 26 site visits. The sites on Hospital Creek were dry on most of the sampling visits from the first sampling event in November 2004 through early April of 2005.

Field Measurements

Spatially, overall SC concentrations were similar for all the Valley Floor sites except for Salado Creek, where all measured concentrations at Oak Flat were above 1,000 umhos/cm and 50% of the concentrations ranged from 2407 to 3151 umhos/cm; and at HWY 33 where the highest overall SC was recorded (4156 umhos/cm). For all sites except the Oak Flat site, 50% of the reported SC concentrations were between 303 and 1056 umhos/cm (Figure 37).

During the winter months, the flow in the channels was dependent on surface water runoff or ground water seepage. Ingram Creek at River Road and the Salado Creek sites were the only sites in this group that consistently had water in the winter and early spring months.   Concentrations varied rapidly with marked decreases during rainfall events. All three sites had relatively high SC values from December 2004 through March 2005 when compared to the values collected during the irrigation season—except that Salado Creek at Oak Flat Road continued to show SC concentrations above 3000 umhos/cm when water was present in the channel. The SC at all the remaining sites during the irrigation season was dependent on the blend of supply water at the time and ranged from 300 to 800 umhos/cm (Figure 38).

Median temperature for all the valley floor sites ranged from 14.2 to 17.9 degrees-C (Figure 39). All the sites tended to run cooler during the winter months and warmer between May and September. The two drain sites, Grayson Road Drain and the Blewitt MWC Drain tended to run a few degrees warmer in the spring and summer months than the creek sites (Figure 40). Seasonal temperatures at the sites tended to group together closely.

Median DO concentrations at all the sites were very high during the sampling period ranging from 9.7 mg/L in Ingram Creek at Highway 33 to 12.3 mg/L in Salado Creek at Oak Flat Road (Figure 43). Salado Creek at Oak Flat Road consistently reported the highest DO concentrations with 50% of the values between 10.8 and 13.4 mg/L. Seasonally, the readings were very erratic from sample event to sample event during the non-irrigation season for all sites, but became more consistent except in Hospital Creek and Grayson Road Drain, after the irrigation season began (figure 44). The lowest minimum reading in this group of sites was 3.42 mg/L at the Grayson Road Drain on 3, August 2005. This reading was a much lower than was normal at this site, and corresponded to a large volume of sediment being discharged during sample collection, as discussed in the TSS and TOC sections.

Median pH values ranged from 7.7 to 8.2 units in the Valley Floor sites. The range in 50% of the pH concentrations at each individual site was fairly small except for samples collected in Hospital Creek where the 50% range at HWY 33 was 7.2 to 8.1 units, while at River Road 50% of the pH values fell between 7.4 and 7.9 units (Figure 41). Ingram Creek at River Road and Hospital Creek at River Road saw some dramatic pH shifts through out the sampling duration (Figures 42). Hospital Creek at River Road had it's lowest pH reading of 6.51 on 29 December 2004, and it's highest reading of 8.74 just six days later on 4, January 2005. On these same two days the pH in Ingram Creek at River Road went from a site low of 6.56 on the 29th up to its fourth highest reading of 7.92 on January 4th 2005. This sudden change in pH reading corresponds to rainfall events in December and January.

Figure 37: Valley Floor Sites SC Spatial (November 2004 – November 2005)

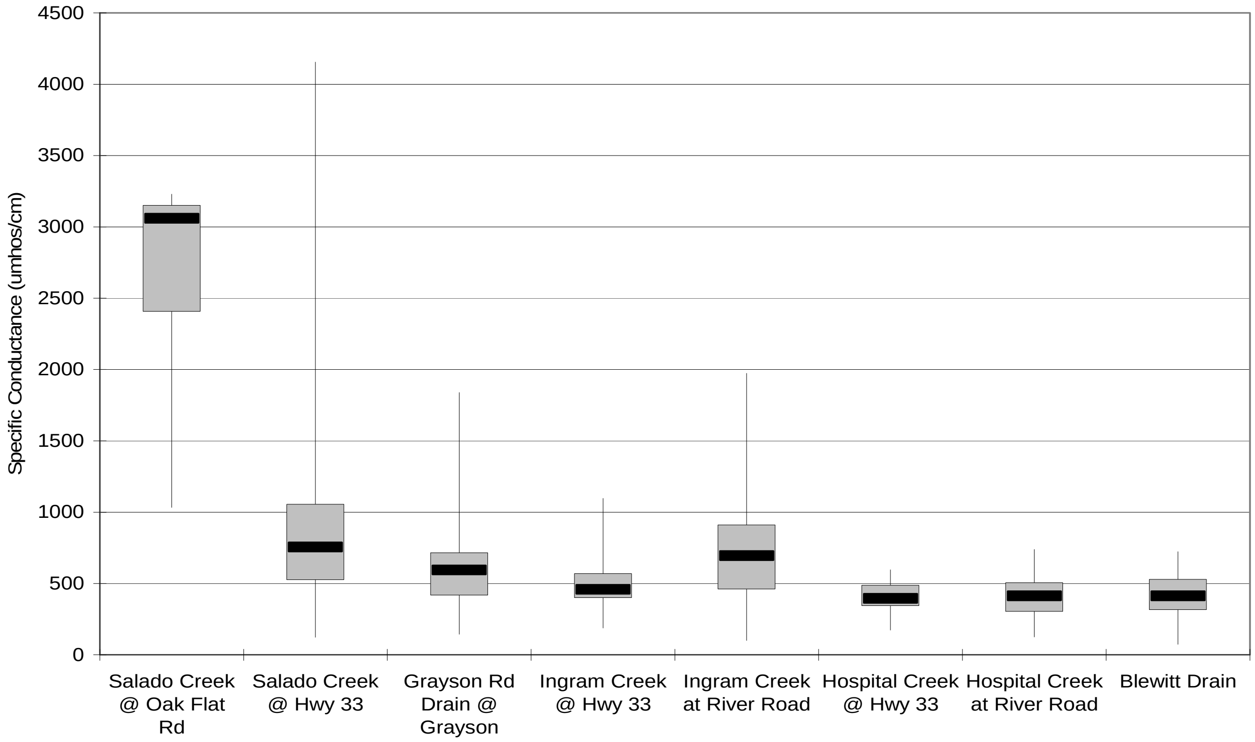


Figure 38: Valley Floor Sites SC Temporal (November 2004 – November 2005)

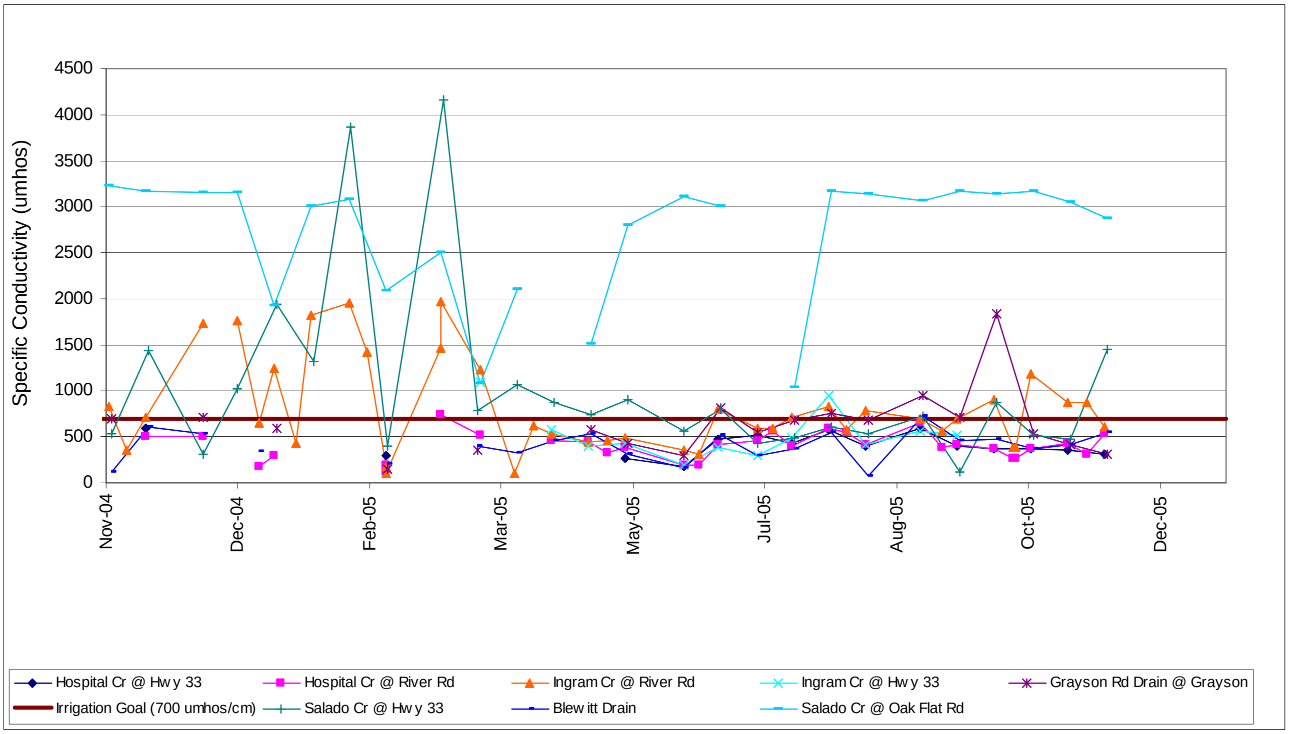


Figure 39: Valley Floor Sites Temperature Spatial (November 2004 – November 2005)

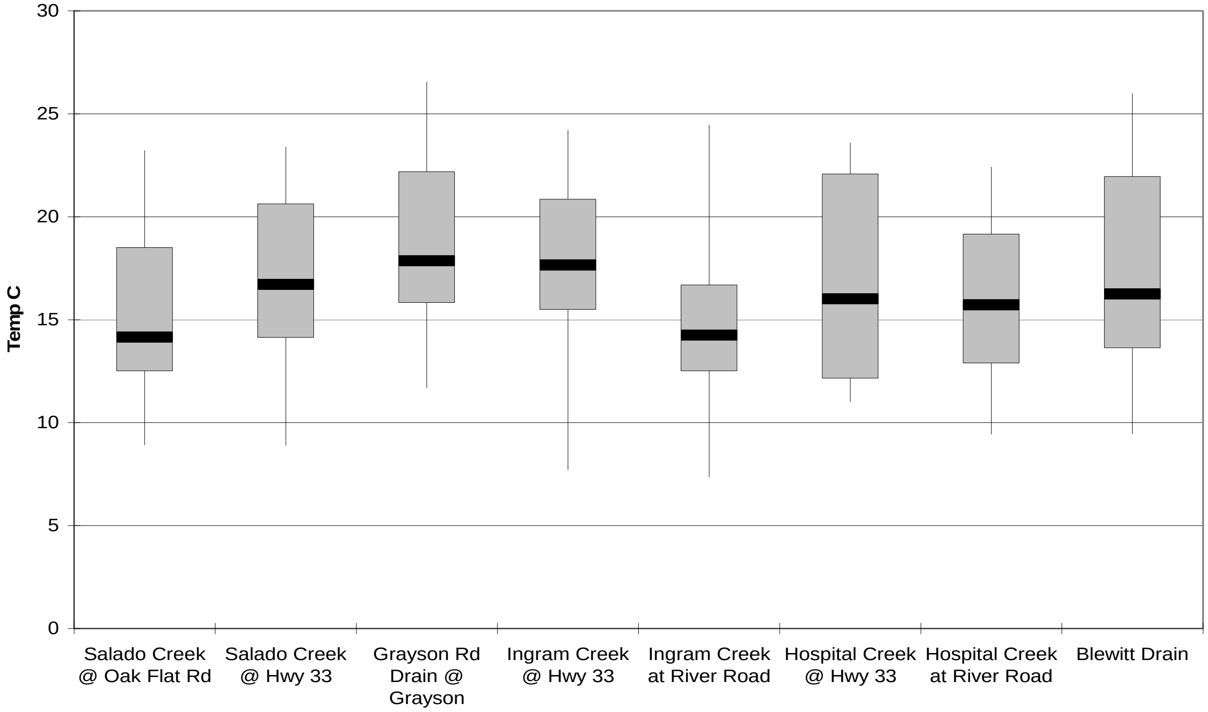


Figure 40: Valley Floor Sites Temperature Temporal (November 2004 – November 2005)

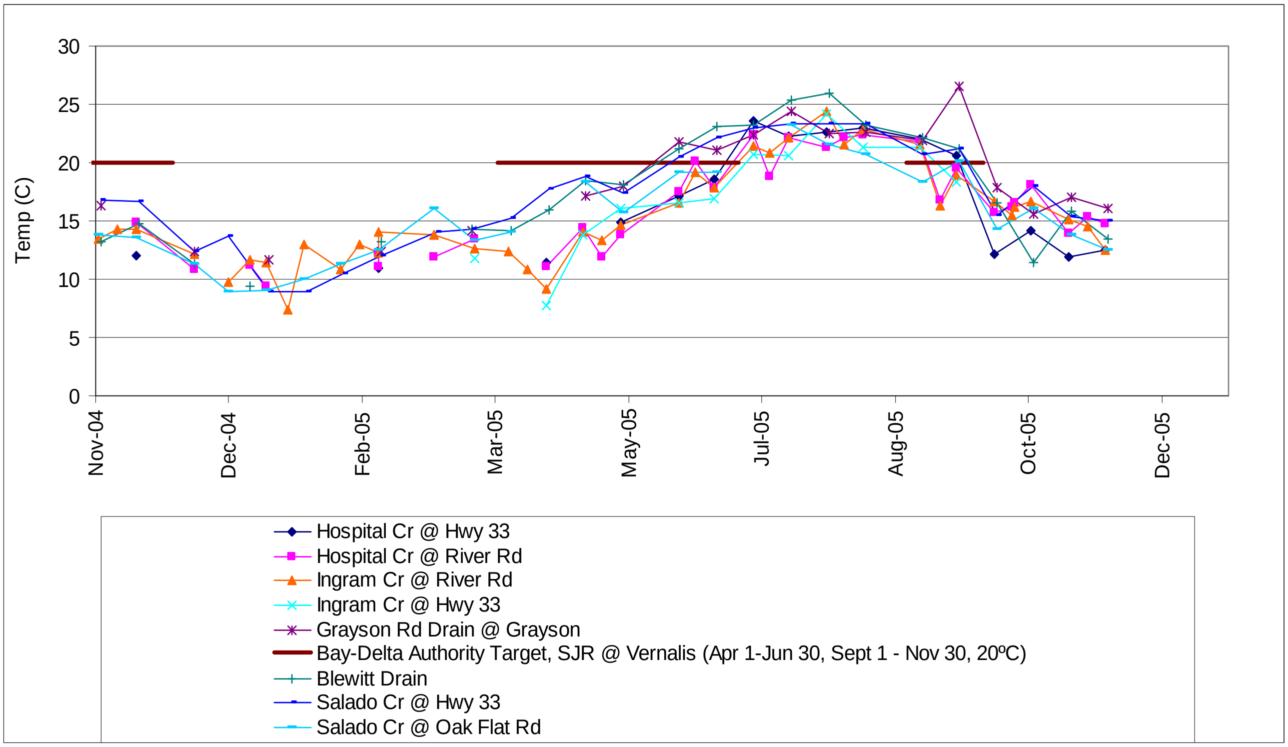


Figure 41: Valley Floor Sites pH Spatial (November 2004 – November 2005)

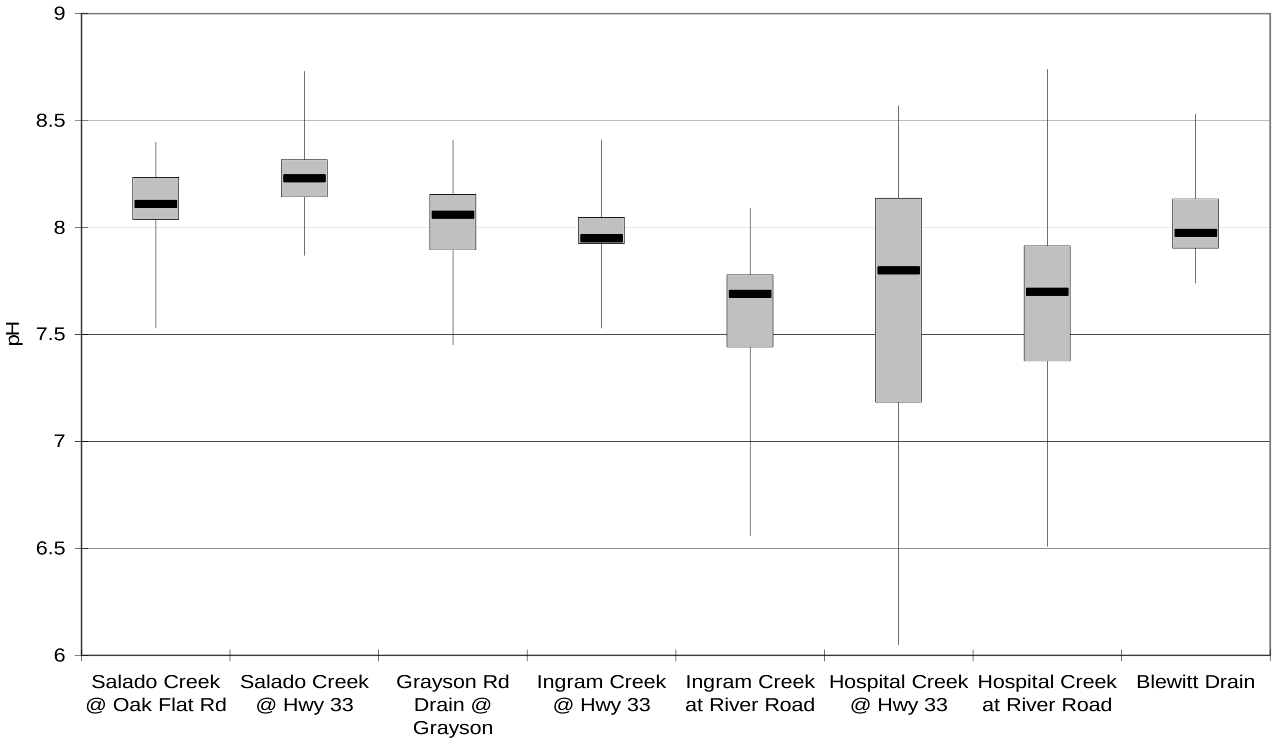


Figure 42: Valley Floor Sites pH Temporal (November 2004 – November 2005)

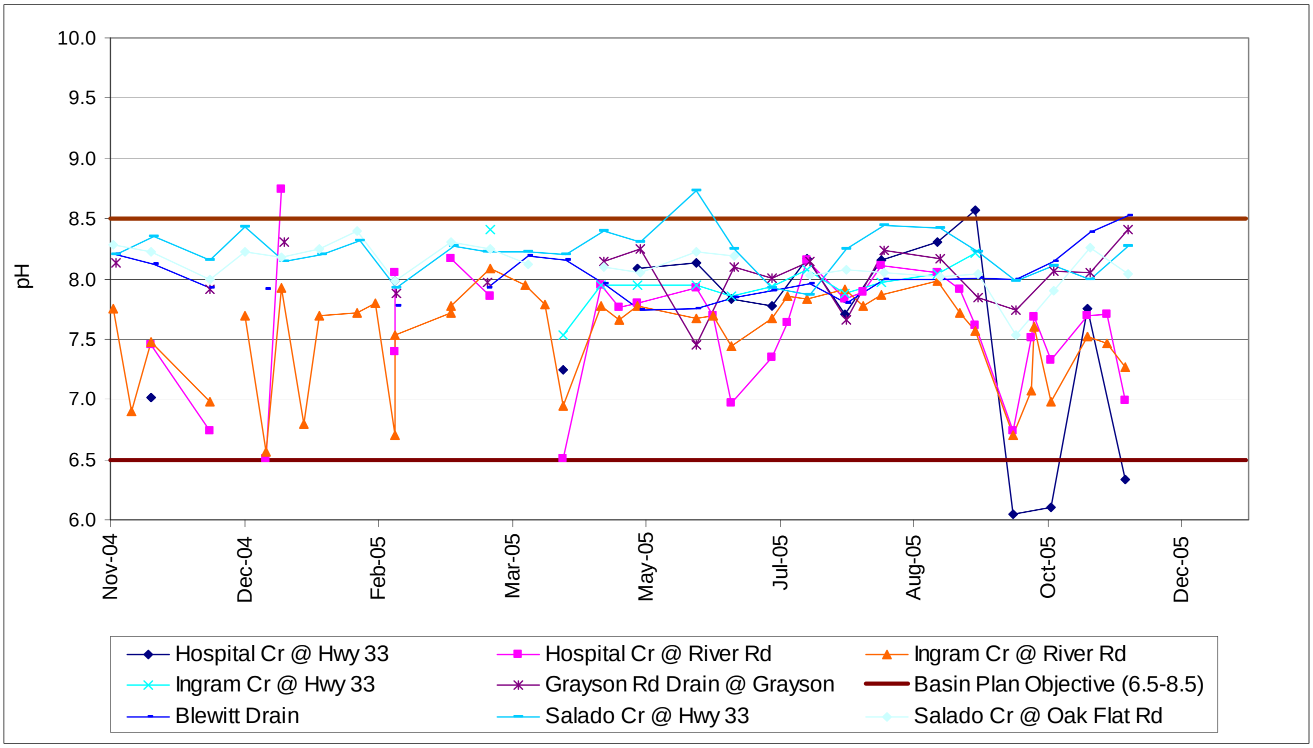


Figure 43: Valley Floor Sites DO Spatial (November 2004 – November 2005)

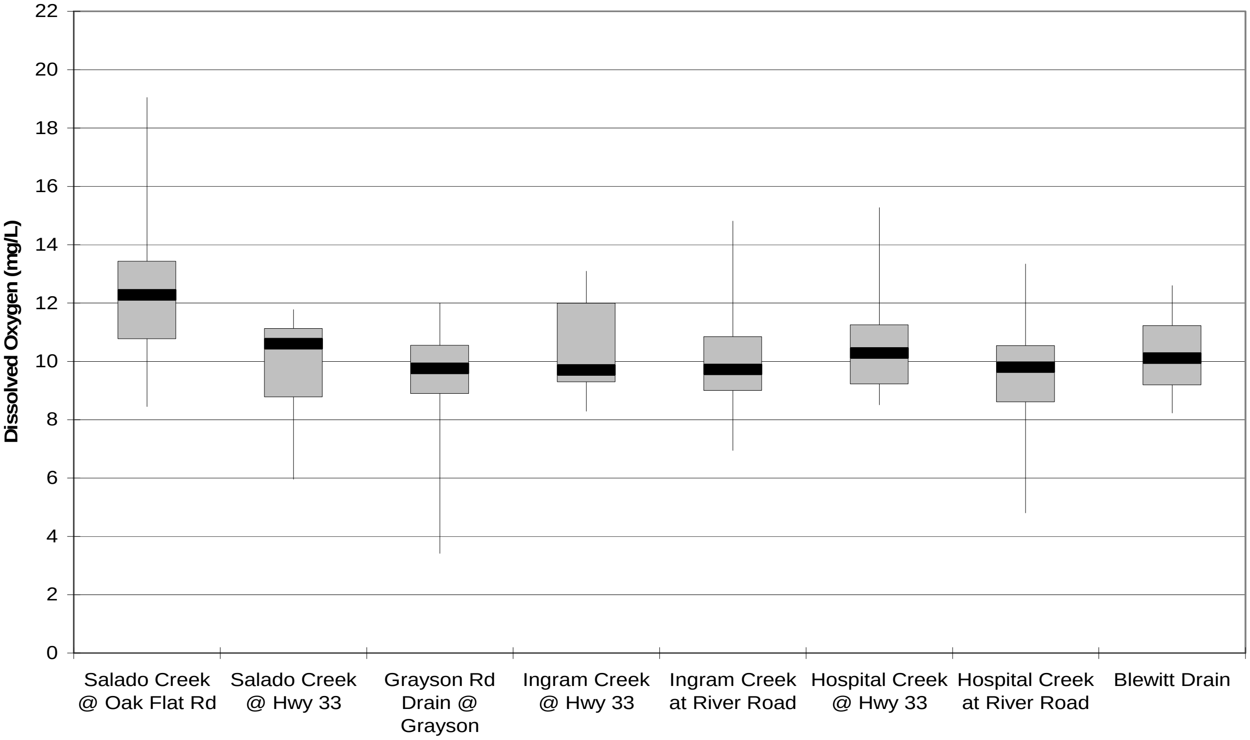
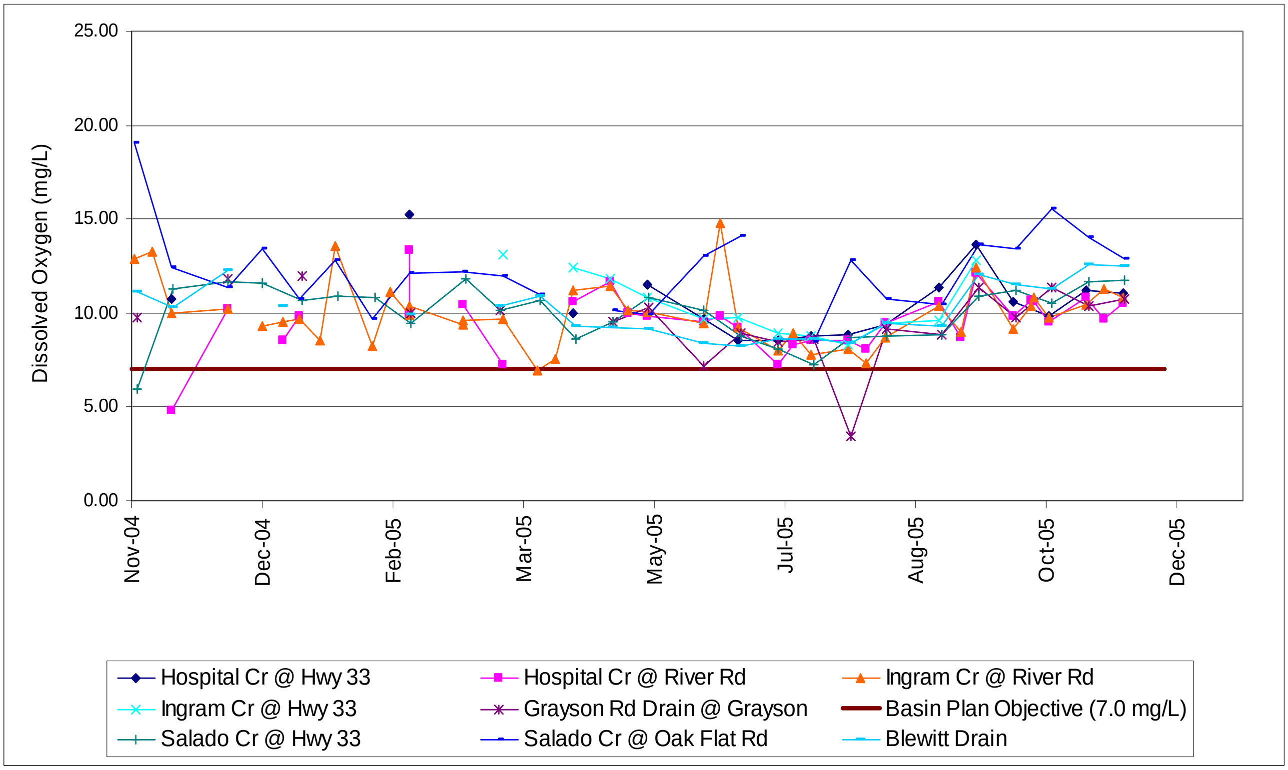


Figure 44: Valley Floor Sites DO Temporal (November 2004 – November 2005)



Total Suspended Solids (TSS)

Although median TSS concentrations for all the Valley Floor sites ranged from 6.4 to 680 mg/L, maximums at half of the sites exceeded 1500 mg/L, with the highest TSS concentration reported in the Grayson Drain at 28,000 mg/L (Figure 46). The two sites on Ingram Creek had the highest median TSS at 680 and 320 mg/L, respectively, while all but three TSS samples in Salado Creek had concentrations below 100 mg/L. All three elevated concentrations occurred in Salado Creek at HWY 33 (1500 mg/L during the February 2005 storm event and 175 mg/l and 200 mg/l during September 2005).

Seasonal patterns were not distinct except for lower overall concentrations with storm related spikes during the non-irrigation season and higher but sporatic TSS concentrations between April and September (Figure 47). Ingram Creek at Highway 33 had elevated TSS concentrations for the majority of the irrigation season. The sediment appeared to be coming from the tail water ditch at the end of tomato fields south of Ingram Creek along Highway 33 (Figure 45). Polyacrylamide (PAM) had reportedly been applied to the field as a management practice to keep sediment on the field (e-mail communication with Joe McGahan).

Figure 45: Polyacrylamide (PAM) applied to field

The discharge was reported to the Westside coalition and a debris basin was constructed shortly after the report was made. TSS levels in the creek dropped after the installation of the basin from a high of 2380 mg/L in May when the discharge was reported, down to 350 mg/L on the next sampling event in June and down further to 290 mg/L in early July. The debris basin filled with sediment by mid July and was not maintained for the remainder of the irrigation season. By the second sampling event in July the TSS in the creek channel had risen to 800 mg/L then to 1600 mg/L on the first sampling event of August.

Further down stream on Ingram Creek, at River Road, the overall median TSS was lower than the upstream Highway 33 site at 680 mg/L, however, as mentioned earlier, this site was one of the few in this group that had flow in the winter months. Except for the large February 15, storm event, the TSS in the winter months at River Road was generally low. When the median is adjusted for the typical months that Ingram Creek had irrigation tail water flows, April through September, the median TSS rises to 860 mg/L. This site also had a constant discharge of high TSS water during the irrigation season, from a group of tomato fields situated north of the Creek along River Road.

In July, August and September TSS samples of the discharge, and an upstream sample were collected. Samples were also collected downstream of the discharge in August and September. On July 6, 2005 the TSS in the Creek upstream of the discharge was 500 mg/L, and the discharge was 3200 mg/L. On August 2, 2005 the creek TSS was 610 mg/L, the discharge was 1400 mg/L and the down stream sample was 810 mg/L. On September 6, 2005 the Creek upstream of the discharge was 590 mg/L, the discharge was 1400 mg/L and the downstream sample was 790 mg/L.

TSS values at Hospital Creek, both at Highway 33 and River Road, were very high during the irrigation season and during the February 15, storm event. Hospital Creek at River Road had the highest sample period median TSS of the two sites at 310 mg/L as opposed to 190 mg/L upstream at Highway 33. TSS was much higher in the irrigation runoff dominated season. From April through September the medians jump to 700 mg/L at River road and 370 mg/L at Highway 33. Maximum concentrations measured in Hospital Creek were 2200 mg/L at Highway 33 and 3300 mg/L at River Road.

The Grayson Road Drain had a relatively low median TSS value at 90 mg/L, and an April through September irrigation median of 345 mg/L. This change for the irrigation season median is generally being driven by two samples, one on July 7, 2005 that was 3,500 mg/L, and the other an extremely high 28,000 mg/L on August 8, 2005. It is unknown what caused the extremely high TSS event in August. In the non-irrigation months from November through April, the TSS was generally low at the site except for a small raise during the storm on February 15, 2005.

The Blewitt MWC Drain had a relatively low median TSS at 110 mg/L. The drain had flowing water for most of the year but was dry or had very low flow for about 90 days from late December 2004 to early March 2005. This site had a maximum TSS of 660 mg/L on May 18, 2005, and a minimum of 1.8 mg/L on November 16, 2005. Similar to the other irrigation tail water dominated sites in this group, the TSS values tended to increase going into the irrigation season then fall back down as the irrigation season winded down.

Total Organic Carbon (TOC)

Median TOC concentrations ranged from 3.2 to 5.6 mg/L in the Valley Floor sites. Ranges in concentrations varied greatly depending on the site, with Salado at HWY 33, Grayson Drain and the two Hospital Creek sites having the greatest range (Figure 48). The spikes in concentrations above 10 mg/L (ranging up to 30 mg/L) were closely related to rain fall events. The maximum readings at all sites came during or shortly after large precipitation events. The highest measurements in this group of sites were 30 mg/L at Hospital Creek at River Road on December 29, 2004 and at Salado Creek at Highway 33. The high TOC result at Hospital Creek at River Road came on a day after almost an inch of rain had fallen over the previous two days. The highest reading at the Blewitt MWC Drain of 11 mg/L also came during this storm. High readings at the two Hospital Creek sites, a 26 mg/L at Highway 33 and 23 mg/L at River Road, occurred during the February 15 2006 storm event (Figures 49). The highest reading of 21 mg/L at the Grayson Road drain on December 8, 2004, also occurred during a storm event that dropped just over an inch of rain in two days (December 7 and 8, 2004). Over the rest of the year TOC concentrations tended to remain in the 3.0 to 6.0 mg/L range with the occasional reading in the 7.0-10.0 mg/L range.

E.coli.

All the sites in the Valley Floor Drains section had elevated *E. coli.* levels throughout the year (Figures 50). Ingram Creek at River Road had the lowest median at 170 MPN/100ml and the Grayson Road Drain had the highest median at 727 MPN/100ml. All the sites in this group had samples over the maximum detection limit of 2419.6 MPN/100ml. The Blewitt MWC Drain at Highway 132 had the highest percentage of samples over the maximum reporting limit of 2419.6 MPN/100ml with 19%, and Ingram Creek at River Road had the lowest number over the reporting limit with 8%. Figure 51 shows that there were many sporatic spikes throughout the year at various times for each of the different sites. The only times that all sites showed relative spikes were during storm events (e.g. February 2005).

Figure 46: Valley Floor Sites TSS Spatial (November 2004 – November 2005)

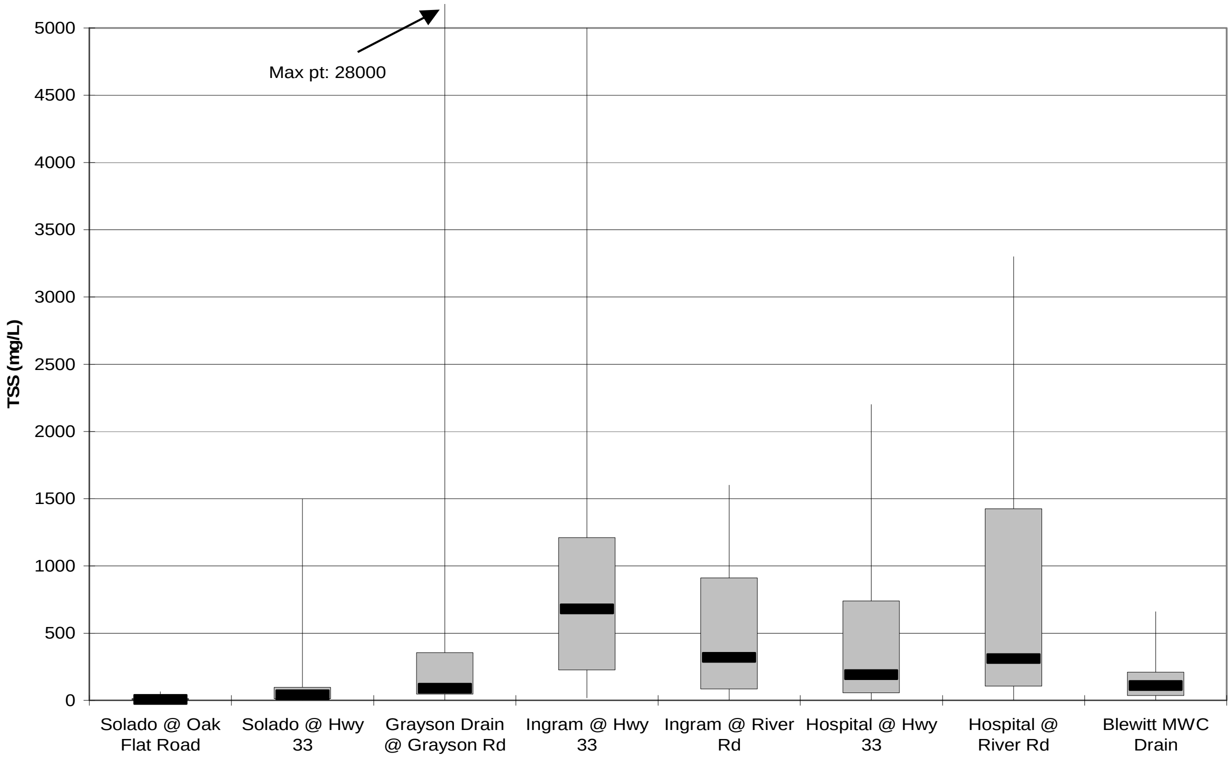


Figure 47: Valley Floor Sites TSS Temporal (November 2004 – November 2005)

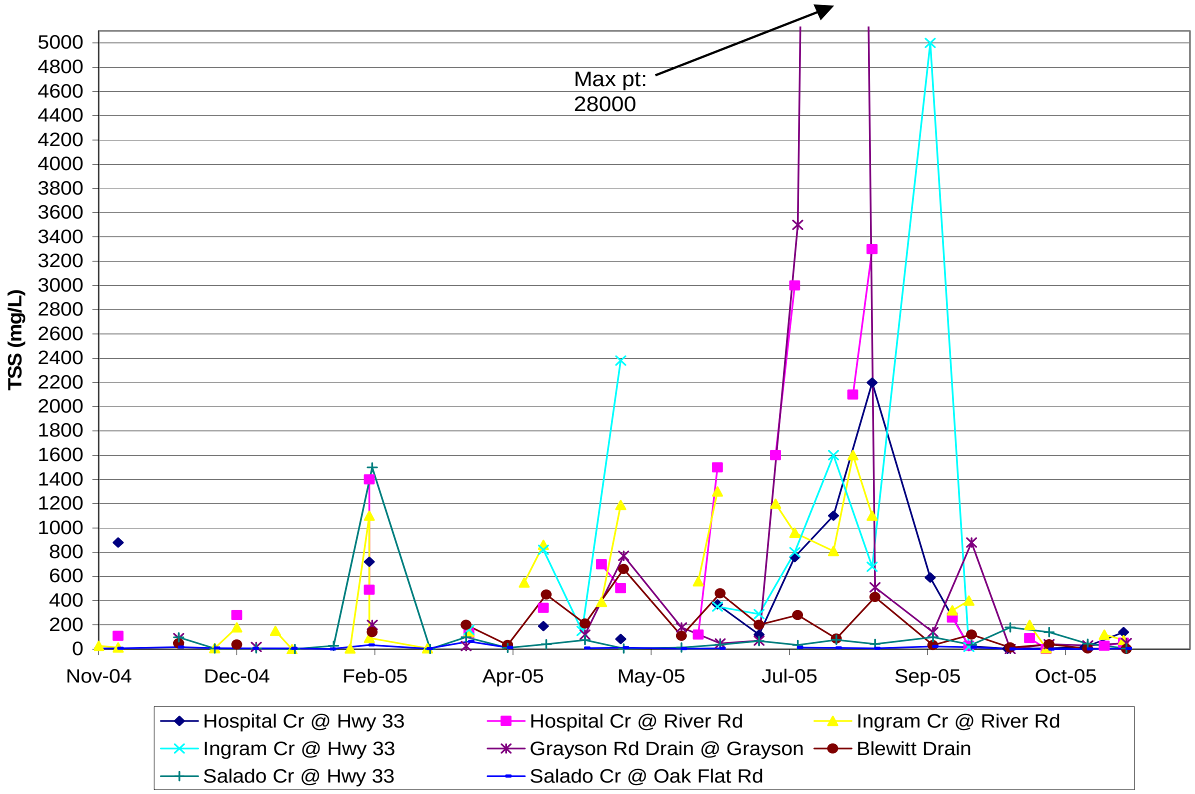


Figure 48: Valley Floor Sites TOC Spatial (November 2004 – November 2005)

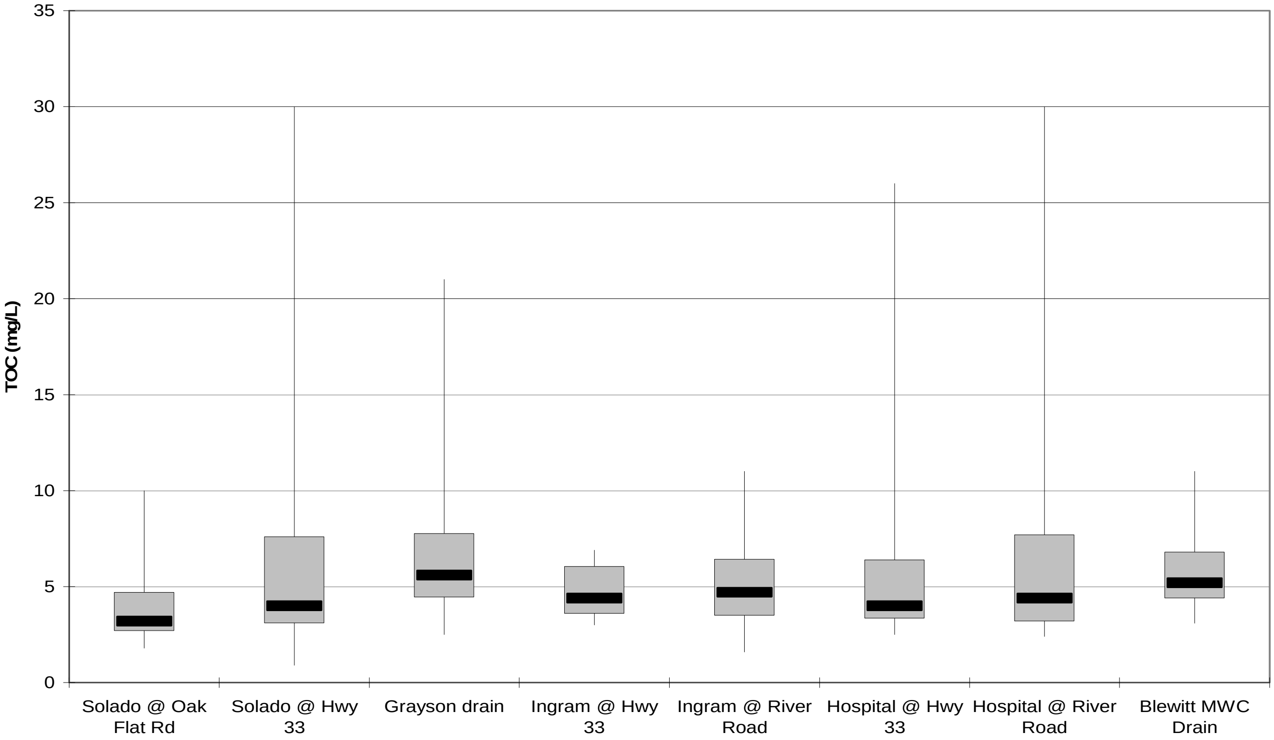


Figure 49: Valley Floor Sites TOC Temporal (November 2004 – November 2005)

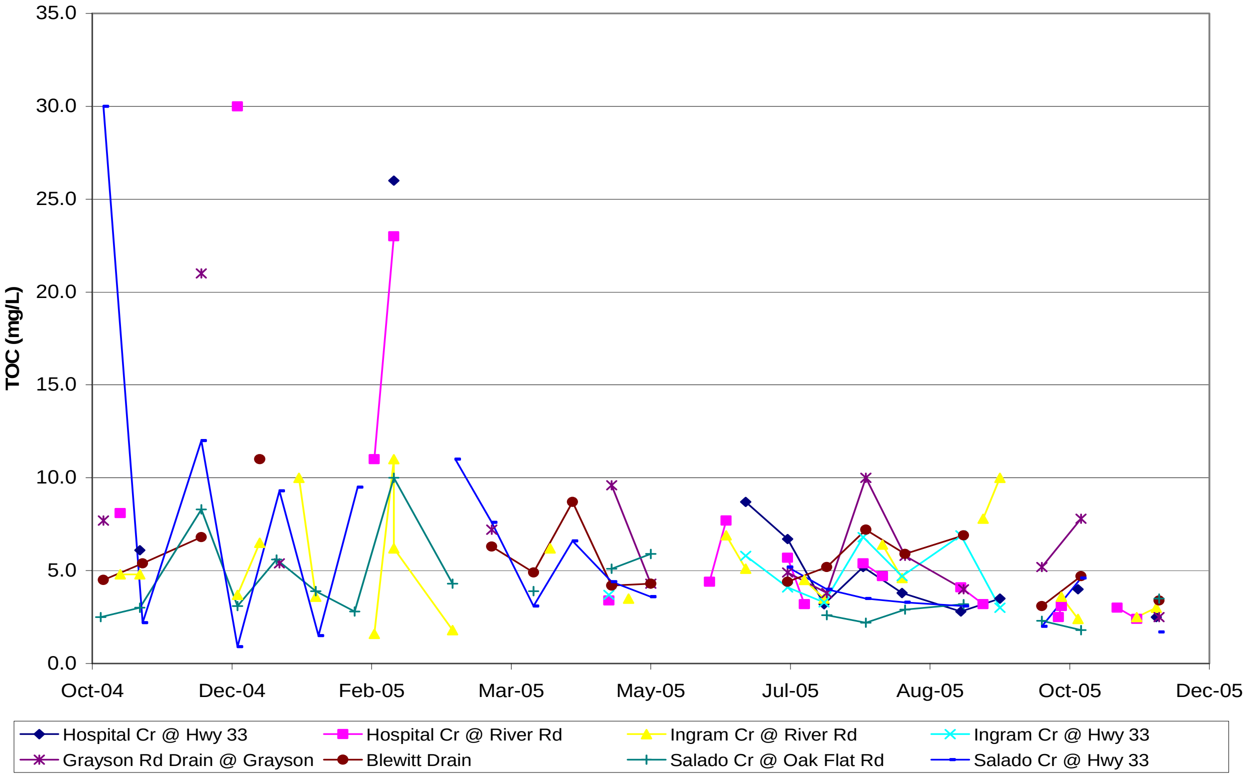


Figure 50: Valley Floor Sites *E. coli* Spatial (November 2004 – November 2005)

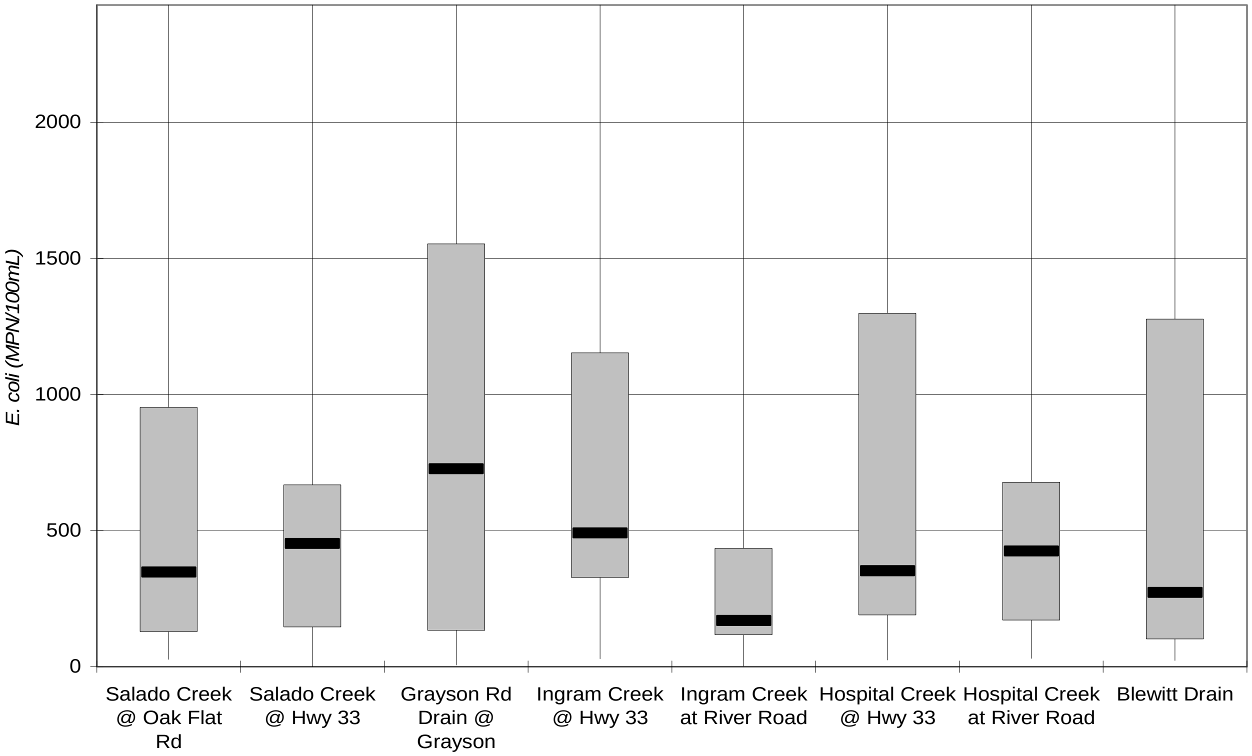
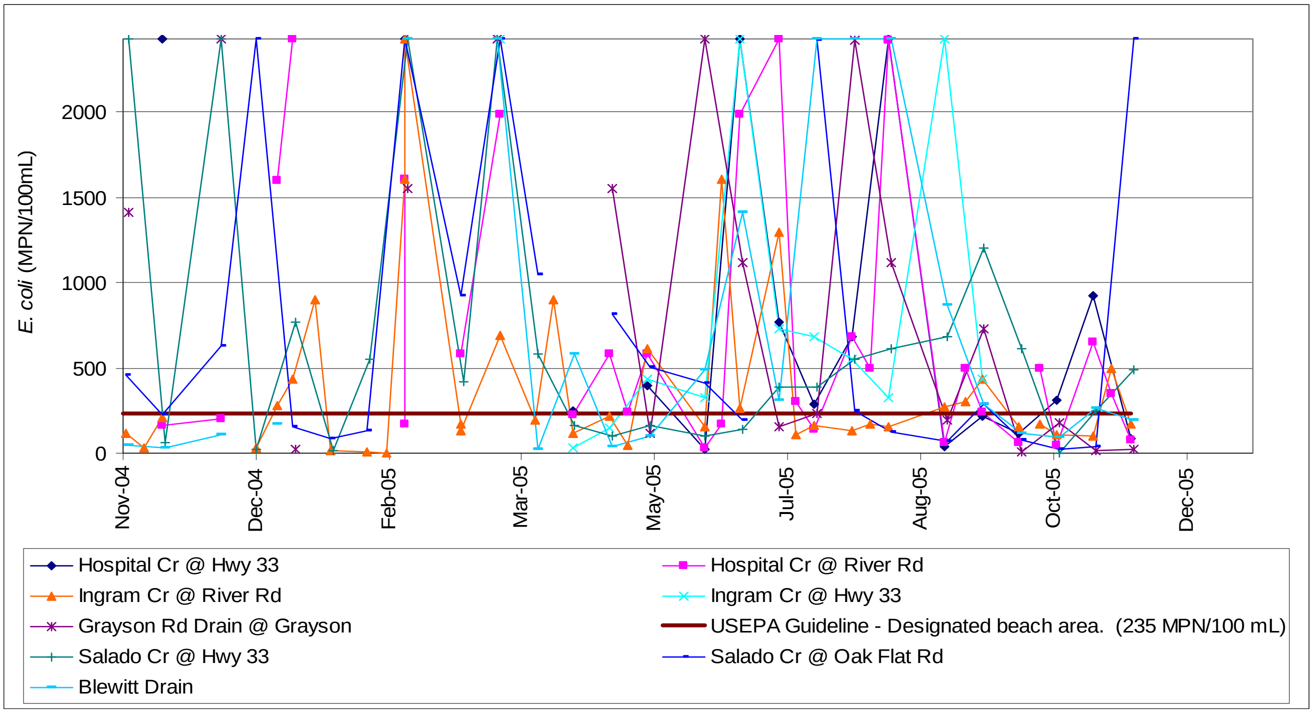


Figure 51: Valley Floor Drains *E. coli* Temporal



Water Column Toxicity

Acute water column toxicity tests were performed monthly at five of the eight Valley Floor sites using *Ceriodaphia dubia* as an indicator species sensitive to organics and Fathead Minnows as an indicator species sensitive to nutrients..

Out of the 57 samples collected for toxicity testing to *Ceriodaphnia dubia* at the five sites, six samples were significantly toxic to the test organism. Hospital Creek at River Road and the Grayson Road Drain had the highest frequency of toxic events. Three out of the eleven samples collected at Hospital Creek at River Road, or 27%, had significant toxicity. Two out of the nine samples collected at the Grayson Road Drain showed significant toxicity. The two hits at the Grayson Road Drain both had 0% survival. Three out of the four toxic samples at Hospital Creek had 0% survival . The Blewitt MWC Drain had 5% survival in one sample collected during the February 15, 2005 storm event. Salado Creek at Highway 33 and Ingram Creek at River Road had no toxicity to *Ceriodaphnia* out of the 13 samples.

Out of 57 samples collected for acute toxicity to Fathead Minnow, there was one sample that showed significant toxicity at Salado Creek at Highway 33 on October 19, 2005.

10.2.4 Assessing Watershed Similarity

Funding and logistics prevented sampling all 13 watersheds of the Westside Basin for this study. To allow some level of comparison, the two major watersheds, Orestimba and Del Puerto, were sampled from the upper watershed to the lower watershed as they flowed into the valley floor and ultimately the SJR. Valley floor drainage sites from three other watersheds, Hospital Creek, Ingram Creek, and Salado Creek, as well as two agricultural drains (Blewitt and Grayson) were also sampled to allow comparison to upper and lower watershed conditions as well as to source water.

Grayson Drain is included because it represents tail water discharges from the valley floor area into the SJR at Laird Slough. Blewitt Drain represents agricultural discharge from the northern portion of the study area.

The sites were merged into their respective watershed to give a better overall picture of the watershed and not just the final discharge point (figure 52). The merge was used to compensate for the fact that not every site was sampled the same number of times. The disparity in number of samples comes from sites being dry.

Figure 52: Upper and Lower Watershed Key

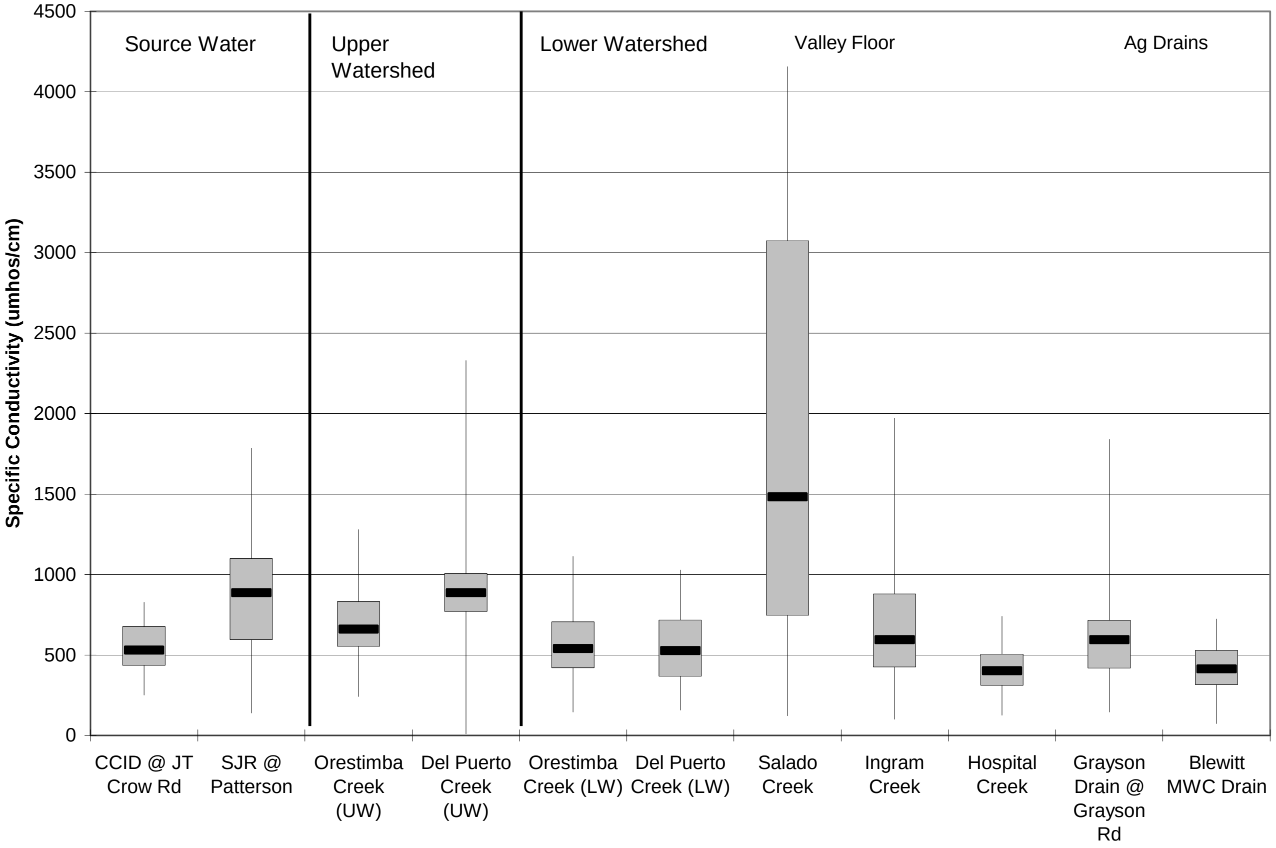
		Number of Samples	
Watershed	Site	Per Site	Per Watershed
Orestimba Creek (UW)	Orestimba Rd	12	29
	Bell Rd	17	
Del Puerto Creek (UW)	Deer Creek Campground	26	70
	mile 13.6	18	
	mile 3.9	26	
Orestimba Creek (LW)	Anderson Rd	17	128
	Hwy 33	42	
	Kilburn	26	
	River Rd	43	
Del Puerto Creek (LW)	Rogers	7	82
	Hwy 33	39	
	Vineyard Ave	25	
	Cox Rd	11	
Salado Creek	Oak Flat Rd	24	50
	Hwy 33	26	
Ingram Creek	Hwy 33	12	53
	River Rd	41	
Hospital Creek	Hwy 33	16	47
	River Rd	31	

Field Measurements

Specific Conductivity

Median SC concentrations ranged from 402 to 1482 umhos/cm across the watersheds, source water, and agricultural drains. The highest SC reading was 4156 umhos/cm at Salado Creek at Highway 33. Salado Creek had the highest median at 1482 umhos/cm and 50% of its results ranged from 745 to 3074 umhos/cm (Figure 53). The source water had high SC readings mainly at the SJR at Patterson site with a median of 886 umhos/cm. Orestimba and Del Puerto Creeks upper watershed had medians of 661 and 887 umhos/cm. Orestimba and Del Puerto Creeks lower watershed had lower and more similar SC medians. Ingram Creek had a relatively similar median to Orestimba and Del Puerto Creeks lower watershed at 595 umhos/cm. Hospital Creek having the lowest median at 402 umhos/cm could be the result of the Highway 33 site being dry most of the year. The agricultural drains both had low median SC results below 600 umhos/cm. With the exception of Salado Creek, the trend showed that source water had the highest SC reading while in the lower watershed the SC decreased.

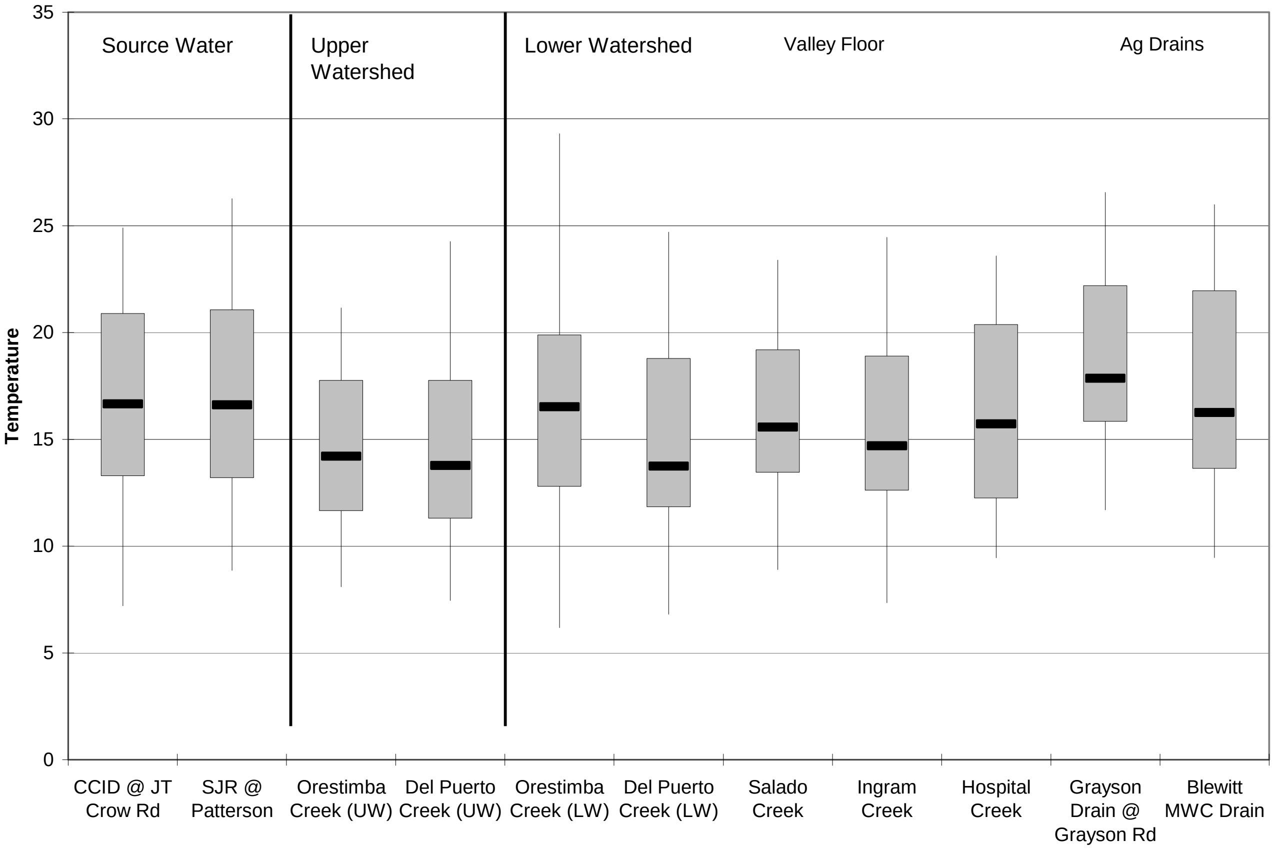
Figure 53: Assessing Watershed Similarity, SC (November 2004 – November 2005)



Temperature

Median temperature readings ranged from 13.7 to 17.9 degrees Celsius across the watersheds, source water, and agricultural drains. The highest temperature was 29.3 °C at Orestimba Creek at Highway 33. The temperature was relatively consistent throughout the source water, upper and lower watershed, valley floor, and agricultural drains. Del Puerto Creek Upper and Lower Watersheds had the same median temperature at 13.8°C. The Grayson Drain had the highest median at 17.9°C and 50% of its results ranged from 15.8 to 22.2°C (Figure 54). The source water had median temperature readings at 16.7°C. Orestimba and Del Puerto Creeks upper watershed had medians of 14.2 and 13.8°C.

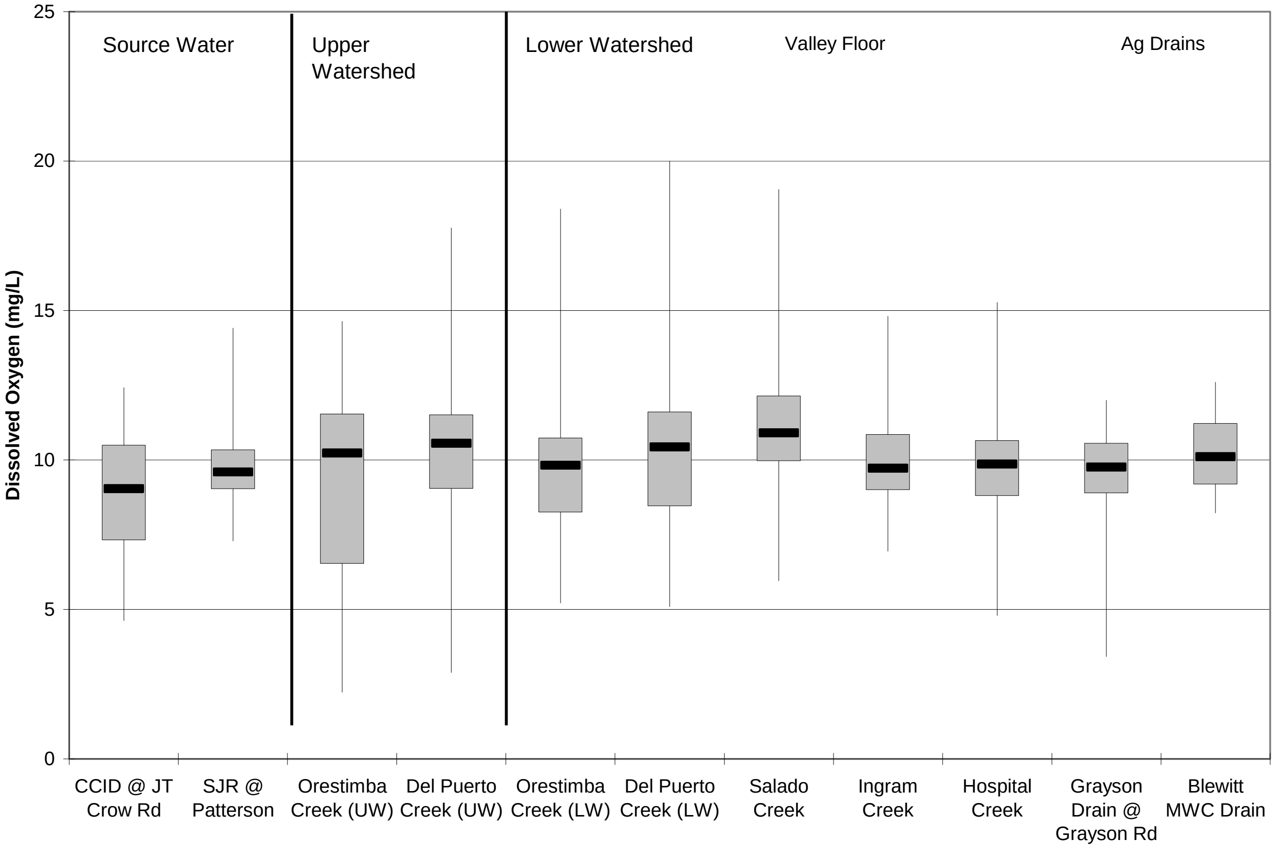
Figure 54: Assessing Watershed Similarity, Temperature (Nov 2004 – Nov 2005)



Dissolved Oxygen

Median DO concentrations ranged from 9.0 to 10.9 mg/L across the watersheds, source water, and agricultural drains. The lowest DO reading was 2.2 mg/L at Orestimba Creek at Bell Road on August 3, 2005. The low DO reading can be attributed to a very high temperature of 21.2°C that day with low flow and little precipitation and the site being mostly dry from July 2005 to November 2005. The source water from CCID at JT Crow Road had the lowest median at 9.0 mg/L and 50% of its results ranged from 7.3 to 10.5 mg/L (Figure 55). DO was consistent throughout the study area with all the medians near 10 mg/L. DO in the upper watershed of Del Puerto and Orestimba Creeks can be expected for the upper watershed of Salado, Ingram, and Hospital Creeks because of the similar median DO readings.

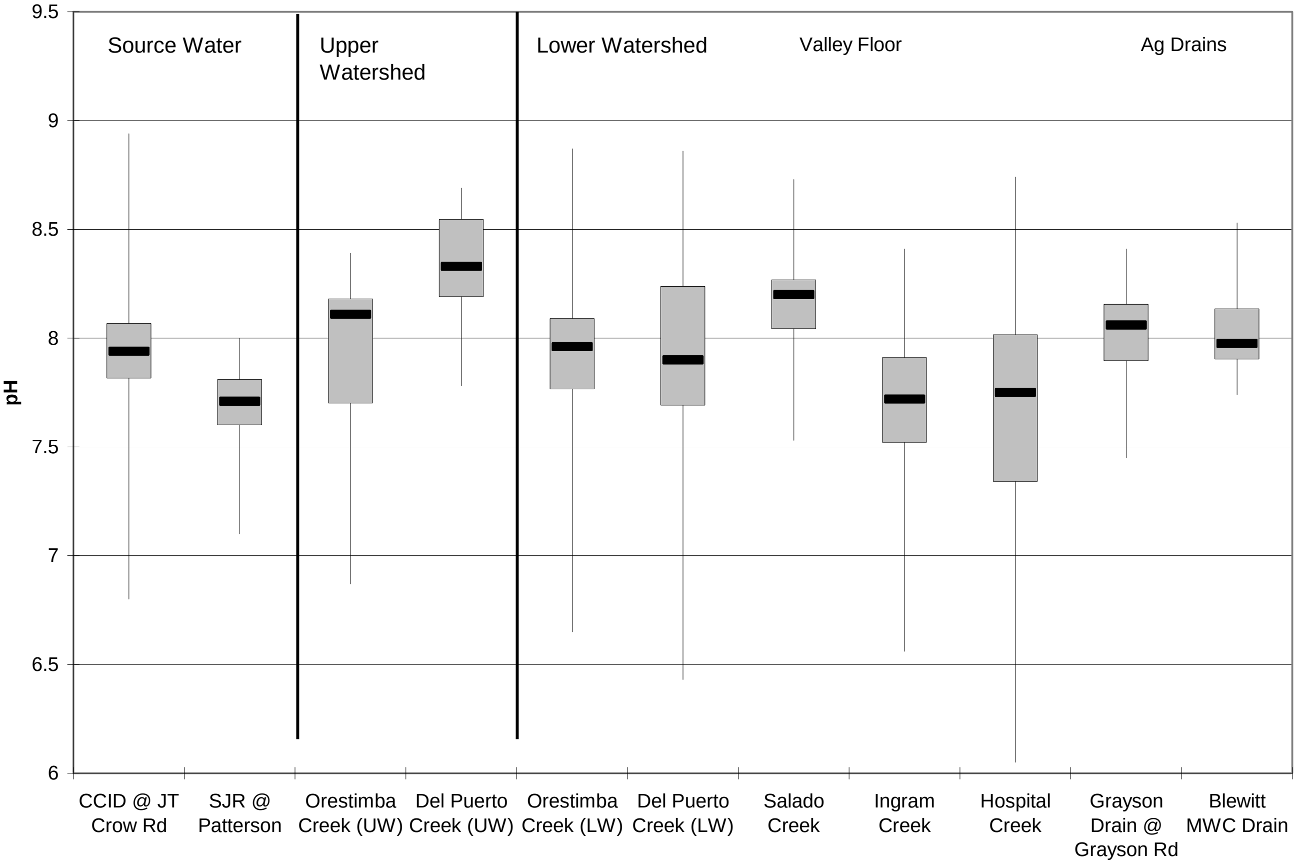
Figure 55: Assessing Watershed Similarity, DO (Nov 2004 – Nov 2005)



pH

Median pH concentrations ranged from 7.7 to 8.3 across the watersheds, source water, and agricultural drains. The highest pH reading was 8.9 at CCID @ JT Crow Road. The lowest pH reading was 6.1 at Hospital Creek at Highway 33. Del Puerto Creek Upper Watershed had the highest median at 8.3 and 50% of its results ranged from 8.2 to 8.5 (Figure 56). The pH was consistent throughout the study area with all the medians near eight.

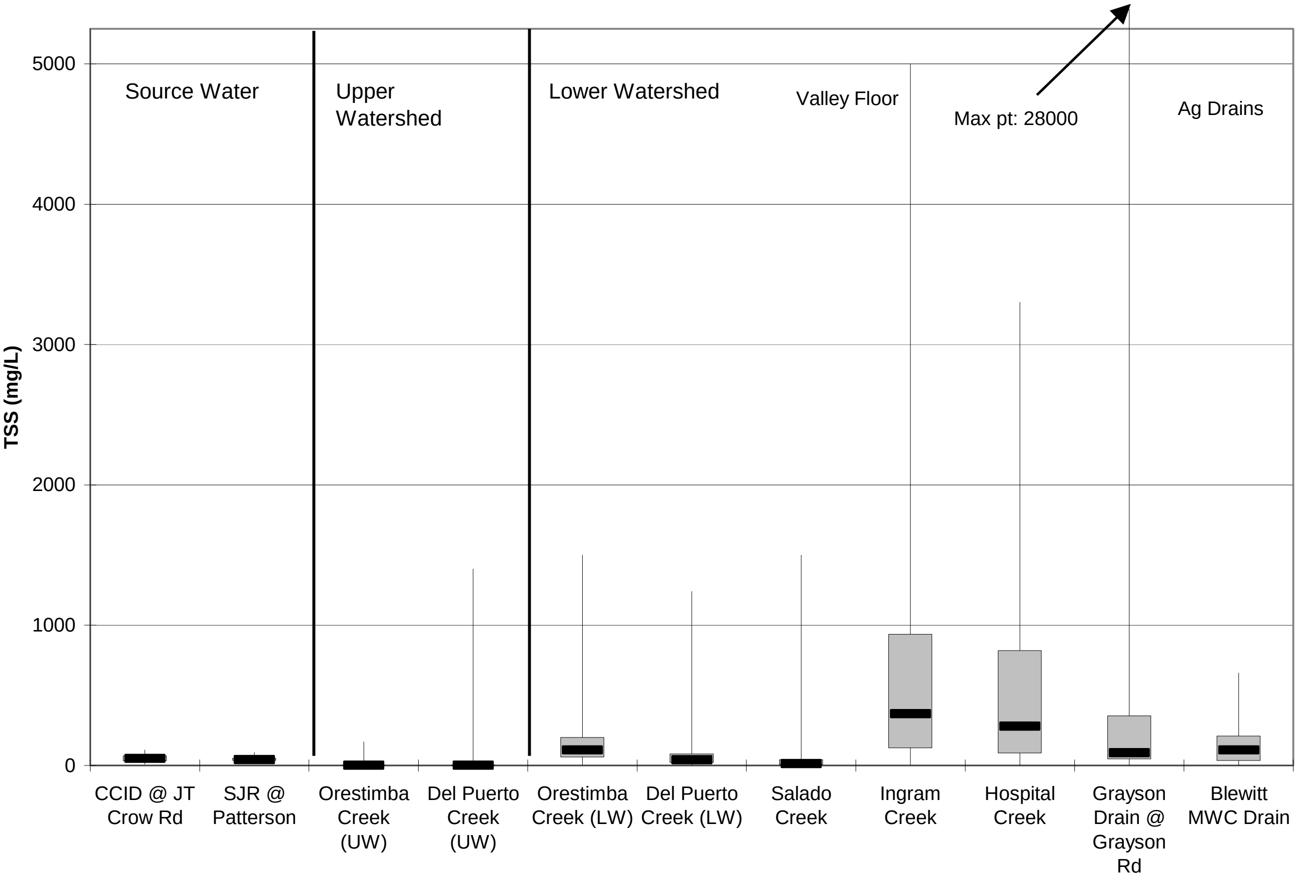
Figure 56: Assessing Watershed Similarity, pH (Nov 2004 – Nov 2005)



Total Suspended Solids

Median TSS concentrations ranged from 1.0 to 370.0 mg/L across the watersheds, source water, and agricultural drains. The highest TSS reading was 28000 mg/L at Grayson Drain at Grayson Road. Ingram Creek had the highest median at 370 mg/L and 50% of its results ranged from 125 to 935 mg/L (Figure 57). The TSS conctrations increased only in the Hopital and Ingram Creeks and the agricultural drains. This signifies that most of the TSS comes from tail water drainage in the north and valley floor areas than from the five watersheds. In one sample taken from the Grayson Drain, the TSS result was 28000 mg/L, almost 20 times higher than the second highest TSS result.

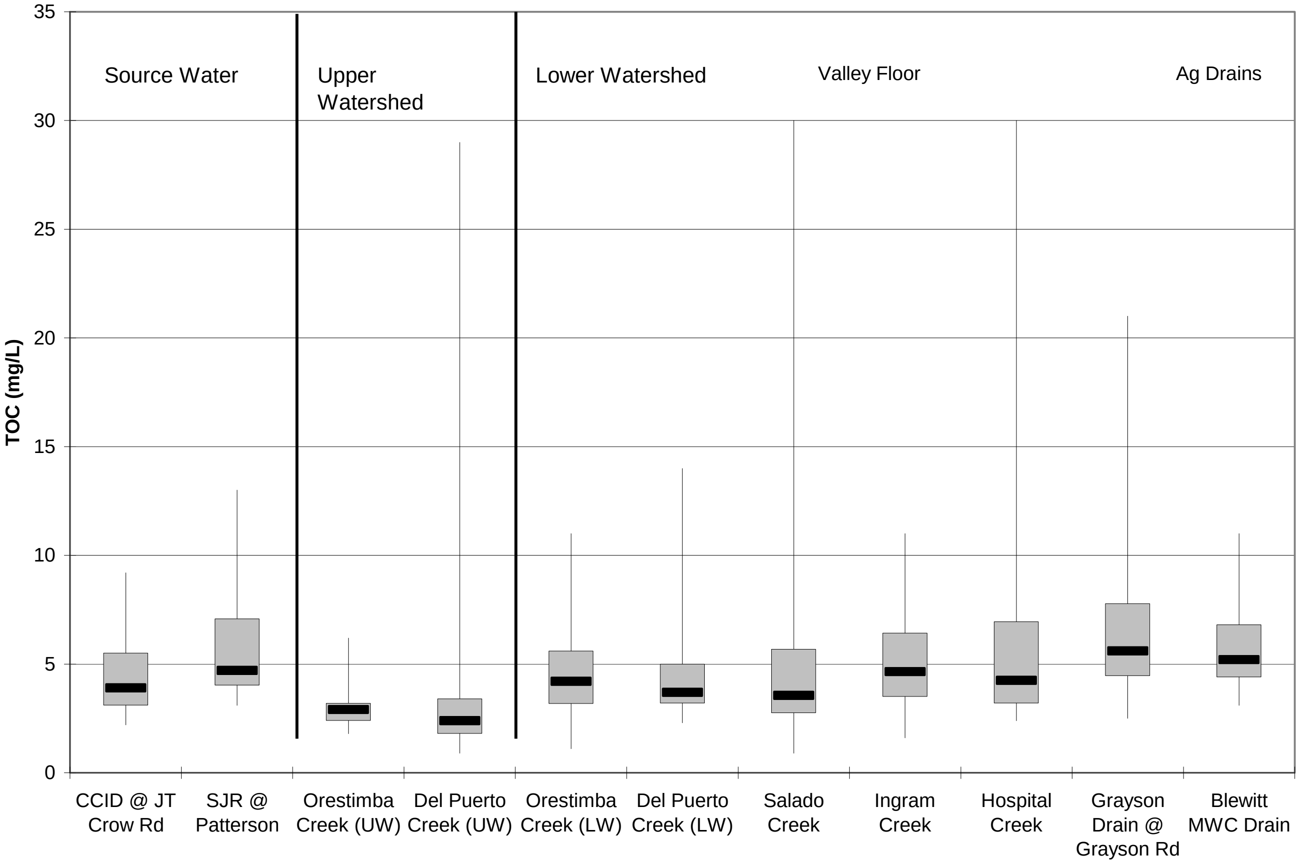
Figure 57: Assessing Watershed Similarity, TSS (Nov 2004 – Nov 2005)



Total Organic Carbon

Median TOC concentrations ranged from 2.4 to 5.6 mg/L across the watersheds, source water, and agricultural drains. The highest TOC reading was 30 mg/L at Salado Creek at Highway 33 and Hospital Creek at River Road. Grayson Drain at Grayson Road had the highest median at 5.6 mg/L and 50% of its results ranged from 4.5 to 7.8 mg/L (Figure 58). The source water, lower watershed of Del Puerto and Orestimba Creeks, the valley floor, and the agricultural drains all had increased TOC concentrations. The TOC levels were below 3 mg/L (Bay-Delta Authority Target) only at the upper watershed of Orestimba and Del Puerto Creeks.

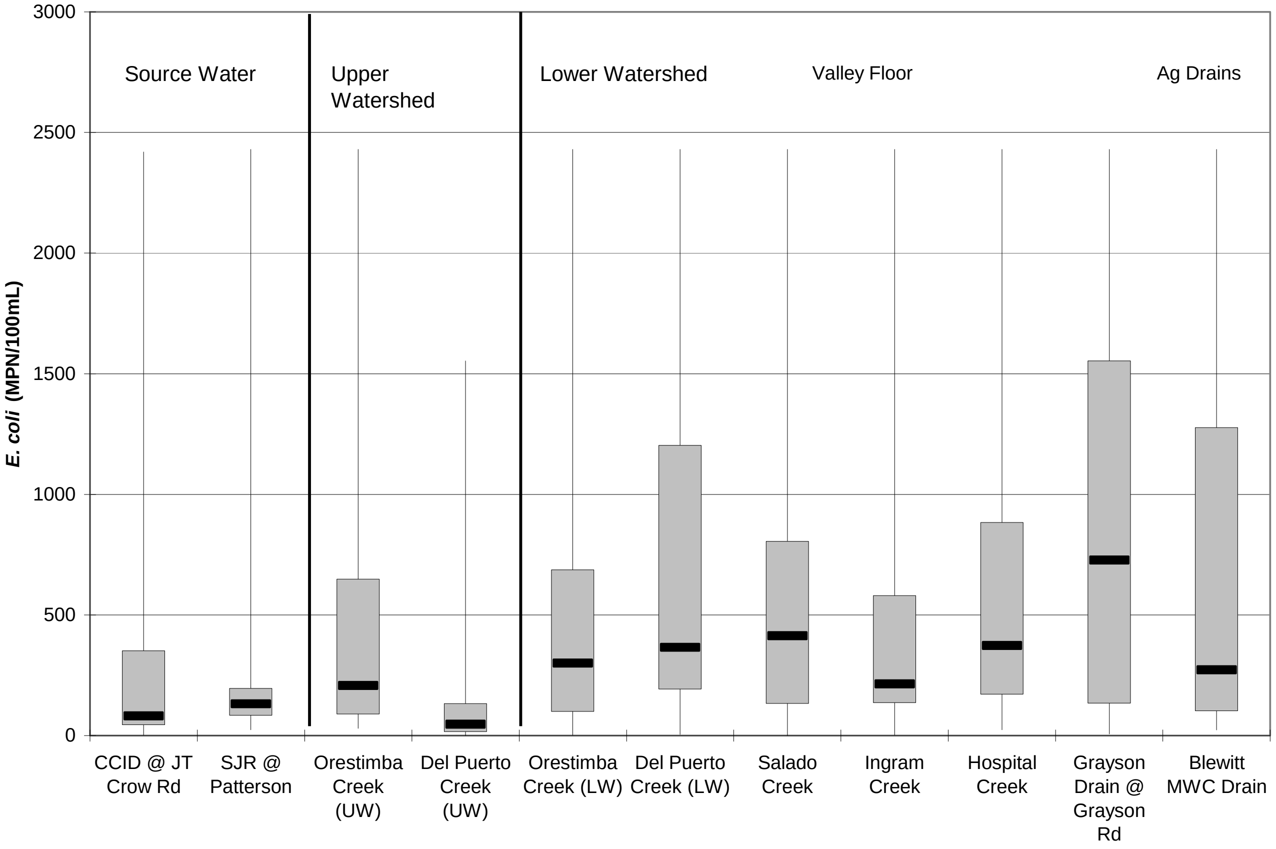
Figure 58: Assessing Watershed Similarity, TOC (Nov 2004 – Nov 2005)



E. coli

Median *E. coli* concentrations ranged from 47.2 to 413.3 MPN/100mL across the watersheds, source water, and agricultural drains. The highest *E. coli* number was >2419.6 MPN/100mL at every site except the CCID at JT Crow Road and the upper watershed sites of Del Puerto Creek. Salado Creek had the highest median at 413.3 MPN/100mL and 50% of its results ranged from 132.1 to 804.8 MPN/100mL (Figure 59). The source water and upper watershed of Orestimba and Del Puerto Creeks all had medians below 235 MPN/100mL, while all lower watershed, valley floor, and agricultural drains had medians above 235 MPN/100mL. Ingram Creek is the exception where it had only 214.2 MPN/100mL. The Grayson drain had a very high median at 727 MPN/100mL meaning that there is a lot of *E. coli* in the tail water discharges in the valley floor area to the SJR. The CCID drain had a median of 80 mpn signifying that the supply water entering agricultural areas had little *E. coli*. The Blewitt Drain had a median of 272.7 MPN/100mL signifying that there was *E. coli* in the tail water discharge from upstream of the watersheds.

Figure 59: Assessing Watershed Similarity, *E. coli* (Nov 2004 – Nov 2005)



10.3 Evaluation of Beneficial Uses

To evaluate potential impact, indicators were chosen for four broad beneficial uses as shown in Table 5:

1. Drinking water (Specific Conductivity, Total Organic Carbon and Bacteria);
2. Aquatic life (pH, Temperature, Dissolved Oxygen and Water Column Toxicity);
3. Irrigation water supply (Specific Conductivity); and
4. Recreation (Bacteria).

Exceedances/elevated levels tables were created with the data collected using the applicable water quality goals, targets and objectives as described in section 7. Appendix D provides the elevated levels tables which compare the total number of samples collected with the total number showing elevated levels for temperature, pH, SC, TOC, DO, and bacteria. Constituents in Appendix D are evaluated against multiple objectives, targets and goals, when applicable, for comparison of beneficial use impacts.

Drinking Water (Specific Conductivity, Total Organic Carbon, *E. coli*,)

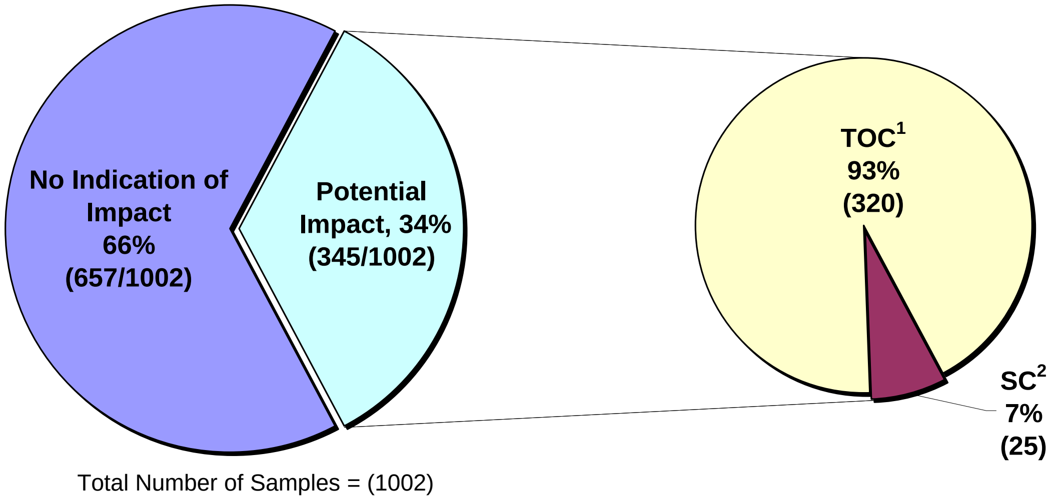
Indicators used to evaluate a potential impact to drinking water (sources of municipal and domestic supply) included salt measured as specific conductivity (umhos/cm), total organic carbon (TOC) and *E. coli*. For all of the indicators except *E. coli*, there are specific numeric objectives or targets for drinking water that results can be evaluated against (Appendix E1 and E2). There are no specific numeric criteria for *E. coli* related to consumption but the presence of *E. coli*, which was found in 51% of the samples, would indicate that the water would need to be treated prior to consumption.

For specific conductivity, the California Secondary MCL of 2200 umhos/cm for short-term exposure was utilized. Elevated levels were found at Salado Creek at Oak Flat Rd 83% of the time (20 out of the 24 samples). Salado Creek at Highway 33 (2 out of 26 samples) and Del Puerto Creek @ mile 3.9 (3 out of 26 samples) were the only other sites that showed elevated levels. Only 4% of the total SC samples within the basin were above the California Secondary MCL; with 88% of the elevated samples being from Salado Creek (Figure 61).

The TOC target of 3.0 mg/L is based on the Bay Delta Authority's target for source water quality in the Sacramento-San Joaquin Delta (Cal Fed Bay-Delta Program, 2000). This indicator was chosen to help identify potential sources of TOC to the Delta since all the water bodies monitored eventually flow into the San Joaquin River and ultimately into the Delta. Overall TOC concentrations were reported above 3.0-mg/L throughout the Westside Basin, with 21% of the elevated results occurring in source water to the valley floor (Figure 62). The far upper reaches of the Del Puerto Basin reported lower percentages of concentrations above 3.0 mg/L (Figure 63 and 62). Storm events and agricultural runoff during the irrigation season correlated well with many of the spikes in concentration, but the target was surpassed in the majority of the sites at other times of the year as well and at sites that were not identified as receiving agricultural return flows.

Figure 60 is a quick summary that shows the percentages of Westside Basin samples found to have concentrations above drinking water objectives and/or targets. Elevated levels of TOC are found throughout the basin and are the major concern for drinking water within the Westside Basin.

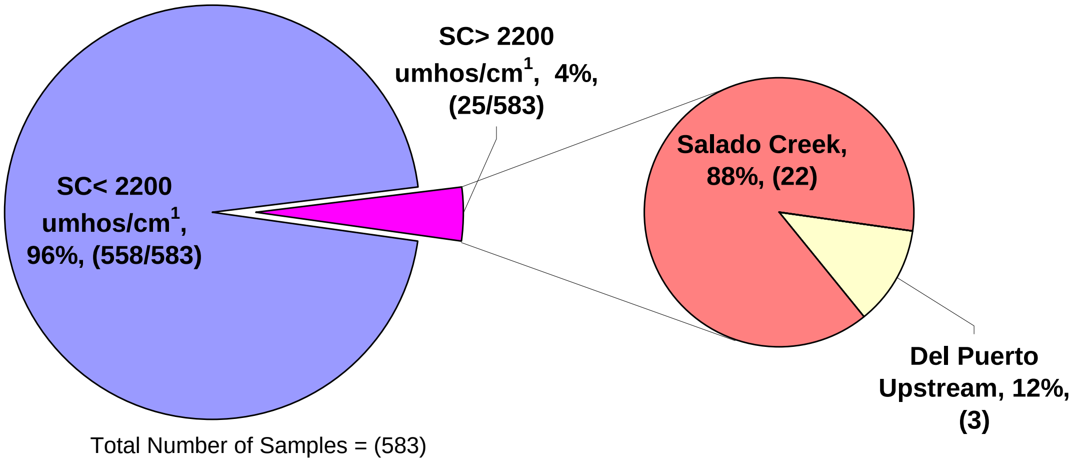
Figure 60: Percentage of Samples Indicating Potential Impact to Drinking Water Beneficial Use



[1] TOC was evaluated against the Bay Delta Authority Target of 3 mg/L

[2] SC was evaluated against the California Secondary MCL of 2200 umhos/cm for short term exposure

Figure 61: Percentage of SC Samples with Concentrations Above California Secondary MCL of 2200 umhos/cm (for Short Term Exposure)



[1] SC was evaluated against the California Secondary MCL of 2200 umhos/cm for short term exposure

Figure 62: Percentage of TOC Samples with Concentrations Above Bay Delta Authority Target of 3 mg/L

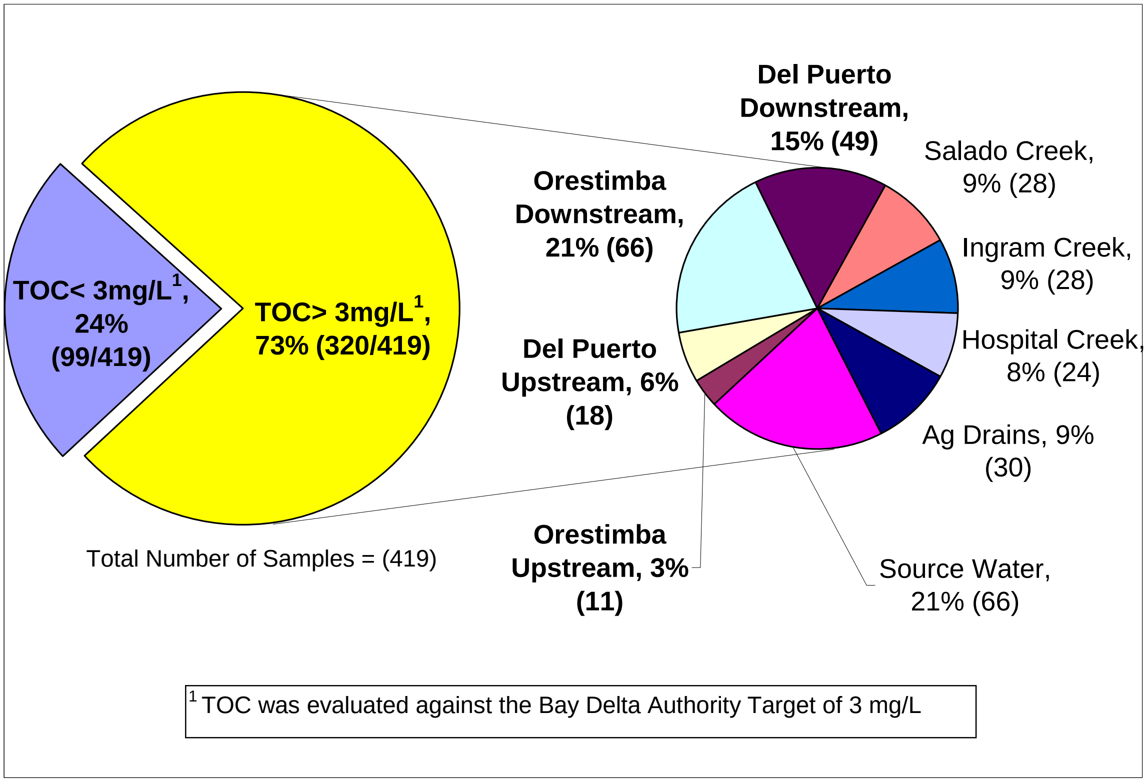
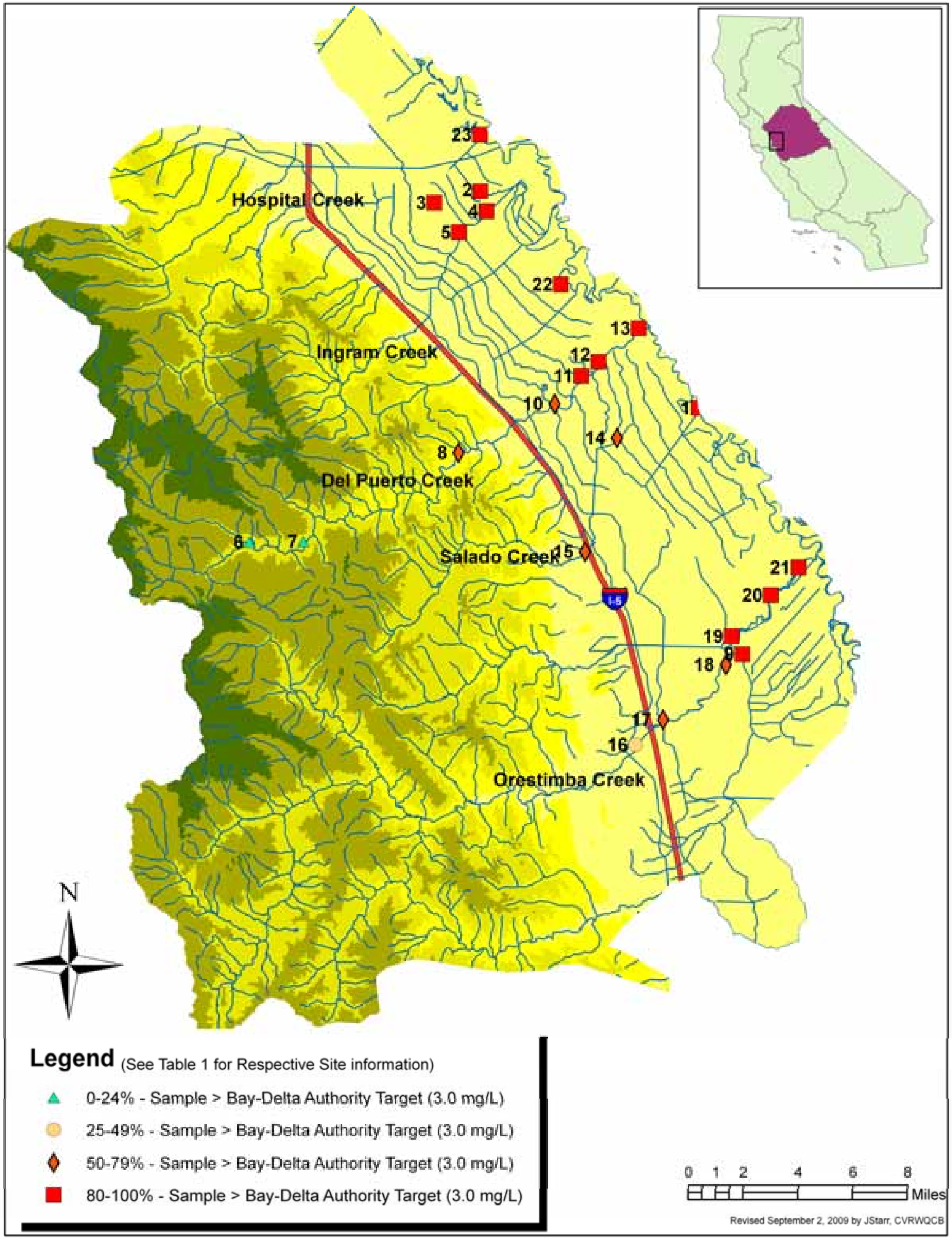


Figure 63: Percentages of Total Organic Carbon samples greater than the Bay-Delta Authority Target (3.0 mg/L)



Aquatic Life (pH, Temperature, Dissolved Oxygen and Water Column Toxicity)

The Basin Plan objective for pH for freshwater with COLD or WARM beneficial uses is a range between 6.5 to 8.5 units (CVRWQCB 2007). Del Puerto Creek @ Deer Creek Campground (mile 16) had the highest number of exceedances with 42% (11 out of 26) of the site's samples outside the objective. Orestimba Creek sites and the Valley Floor sites exceeded the objective randomly no more than 4% of the time when evaluating individual sites. Throughout the Basin only 8% of the samples exceeded this objective with 73% of these exceedances within the Del Puerto Creek watershed (Figure 65).

The Bay-Delta Authority target for temperature (20ºC from April 1 – June 30 and from September 1 – November 30), applies to the San Joaquin River at Vernalis. Every site within the Westside Basin had temperatures above this target at least once except at Del Puerto Creek @ mile 13.6, Del Puerto Creek @ mile 3.9, Del Puerto Creek @ Rogers Rd, and Orestimba Creek @ Bell Rd. When evaluating the whole basin, source water had the highest percentage of the elevated temperatures (25%), which when combined with elevated temperatures reported at upper watershed sites, comprised 33% of the total (Figure 66). For individual sites, Grayson Road Drain at Grayson Road Bridge reported the highest percent of samples above 3.0 mg/L, 36% (4 out of 11).

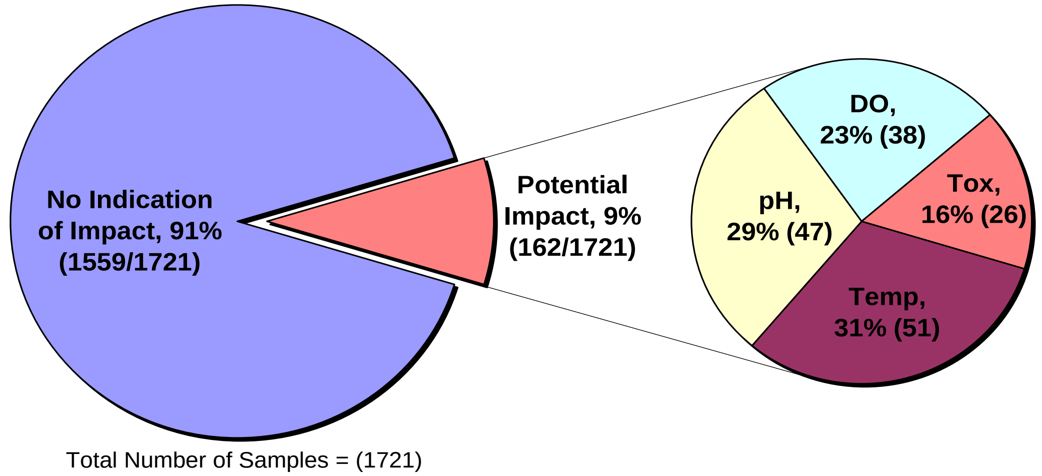
The Basin Plan objective of a minimum 7.0-mg/L for dissolved oxygen was exceeded most frequently at Orestimba Creek @ Bell Rd with 7 out of 17 samples containing less than 7.0-mg/L DO. The Orestimba Creek watershed encompassed 53% of the values throughout the Basin that contained less than 7.0-mg/L DO (Figure 67), Other sites tended to sporadically fall below 7.0-mg/L DO during the hot summer months when flow and precipitation was minimal.

Water column toxicity was defined as a toxic event when a sample was statistically significant and at least a 20% difference from the control. The highest percentages of toxic samples for a reduction in algae growth (sensitivity to trace elements) were found in Del Puerto Creek (Table 8). Del Puerto Creek at Del Puerto Rd mi 3.9 was the site with the most (73% or 8 out of 11) samples having a reduction in algae growth. The upper watershed sites had a higher percentage of samples statistically toxic to algae than the lower watershed (Figure 68).

For *Ceriodaphnia dubia* (sensitivity to organics) fewer toxic events were found at the stations sampled when compared to algae toxicity. Hospital Creek at River Road had the highest percentage of samples toxic to *Ceriodaphnia dubia* (27% or 3 out of 11). Salado Creek at Hwy 33, Ingram Creek at River Road and CCID Main Canal at JT Crow Road had no evidence of *Ceriodaphnia dubia* toxicity during the sampling. Only one sample (8%, 1 out of 13) at Salado Creek at Hwy 33, on October 19th, 2005, was found to be acutely toxic to fathead minnows (*Pimephales promelas*) which are sensitive to nutrients. No other sites demonstrated a toxicity to fathead minnows during the sampling period.

Figure 64 is a quick summary depicting the percentages of samples found to potentially impact aquatic life beneficial uses in the Westside Basin.

Figure 64: Percentage of Samples Indicating Potential Impact to Aquatic Life Beneficial Use



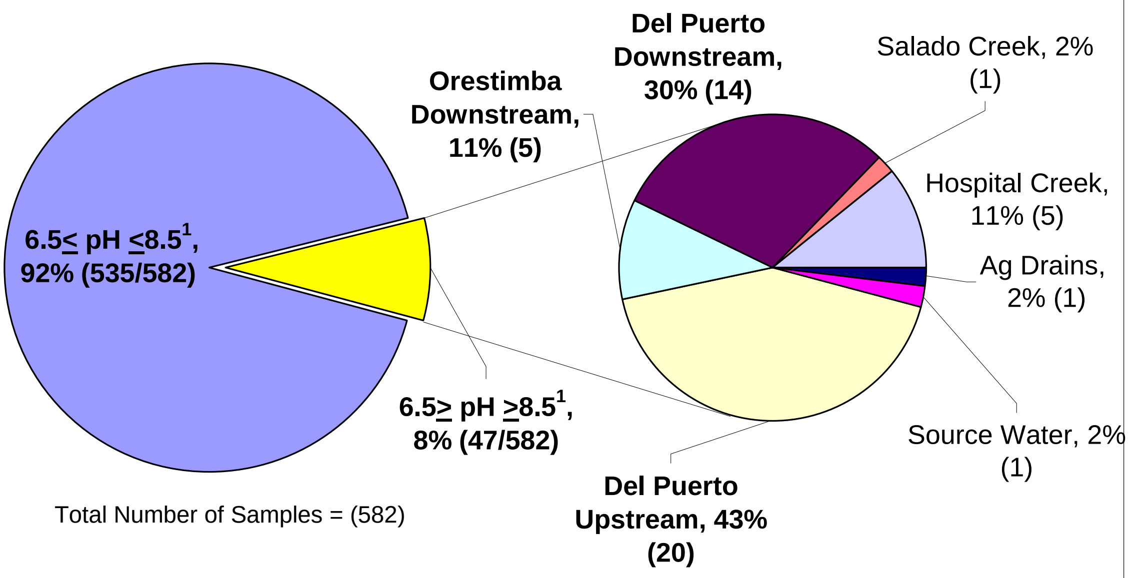
[1] pH was evaluated against the Basin Plan objective for freshwater with COLD or WARM beneficial uses of 6.5 to 8.5 units.

[2] DO was evaluated against the Basin Plan objective of 7.0-mg/L

[3] Temperature was evaluated against the Bay-Delta Authority target of 20ºC from April 1 – June 30 and from September 1 – November 30

[4] Tox was evaluated by defining a toxic event as statistically significant and at least a 20% difference from the control

Figure 65: Percentage of Samples with pH Values Outside of the Basin Plan Objective (6.5 to 8.5 Units)



[1] pH was evaluated against the Basin Plan objective for freshwater with COLD or WARM beneficial uses of 6.5 to 8.5 units.

Figure 66: Percentage of Temperature Samples Above the Bay-Delta Authority Target of 20ºC from 1 April – 30 June and 1 September – 1 November

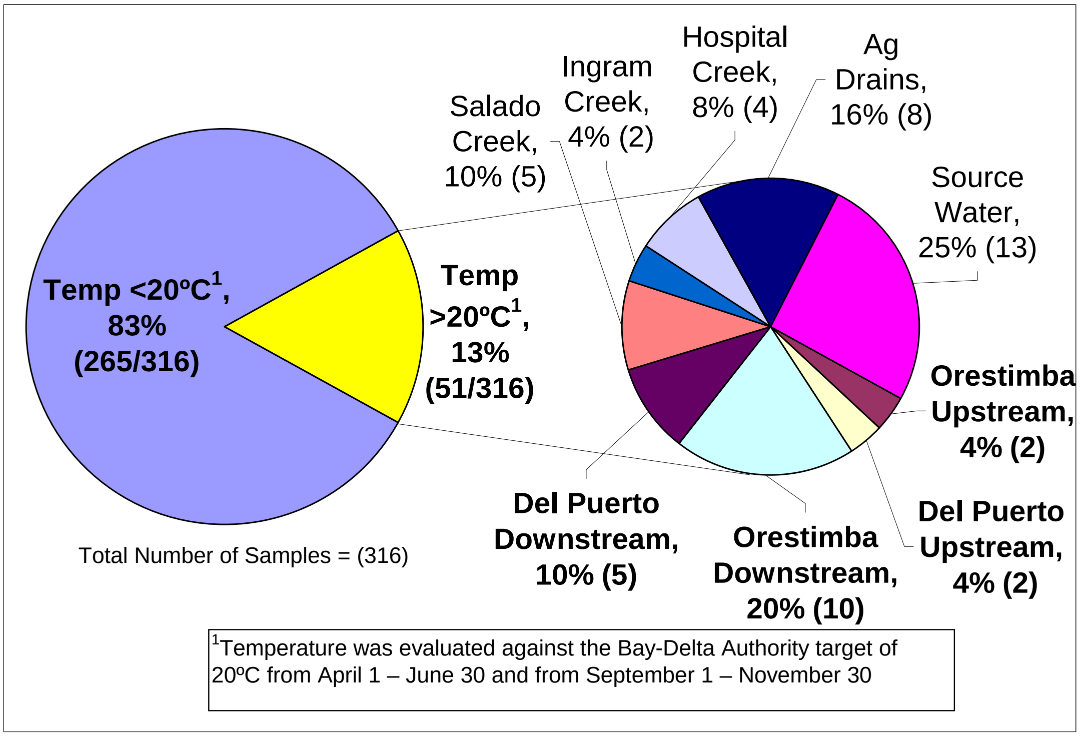


Figure 67: Percentage of DO Samples with Concentrations Below the Basin Plan Objective of 7.0 mg/L

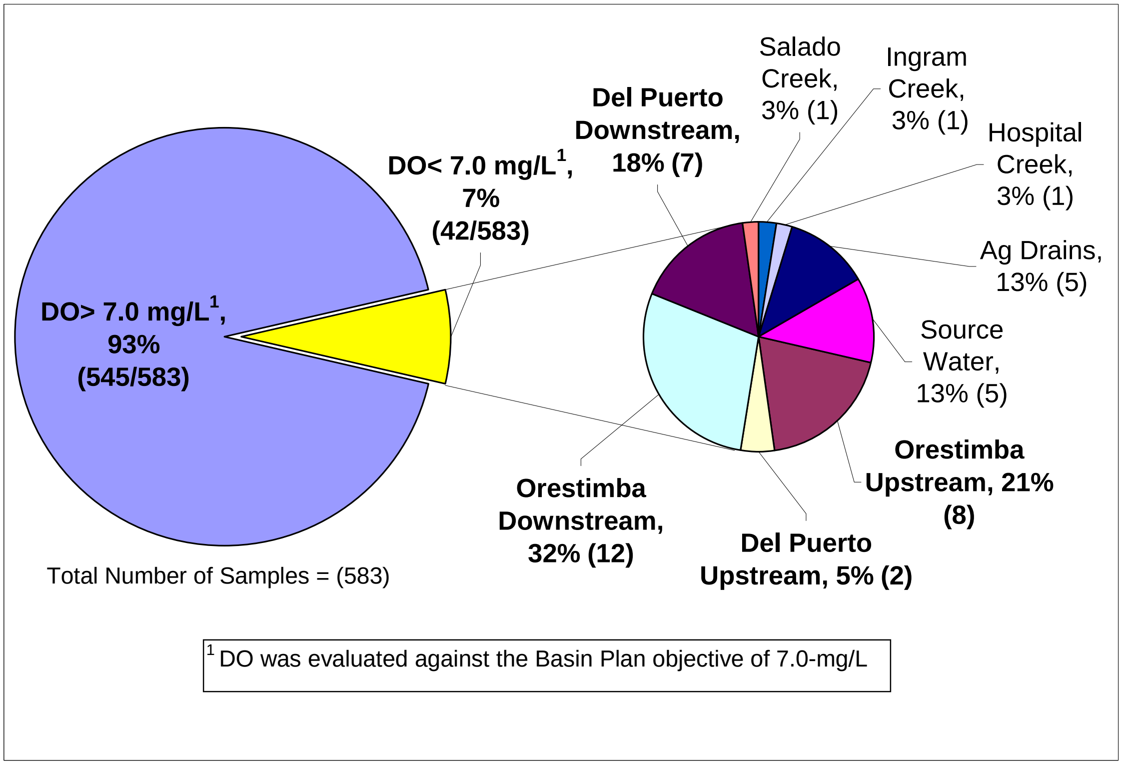
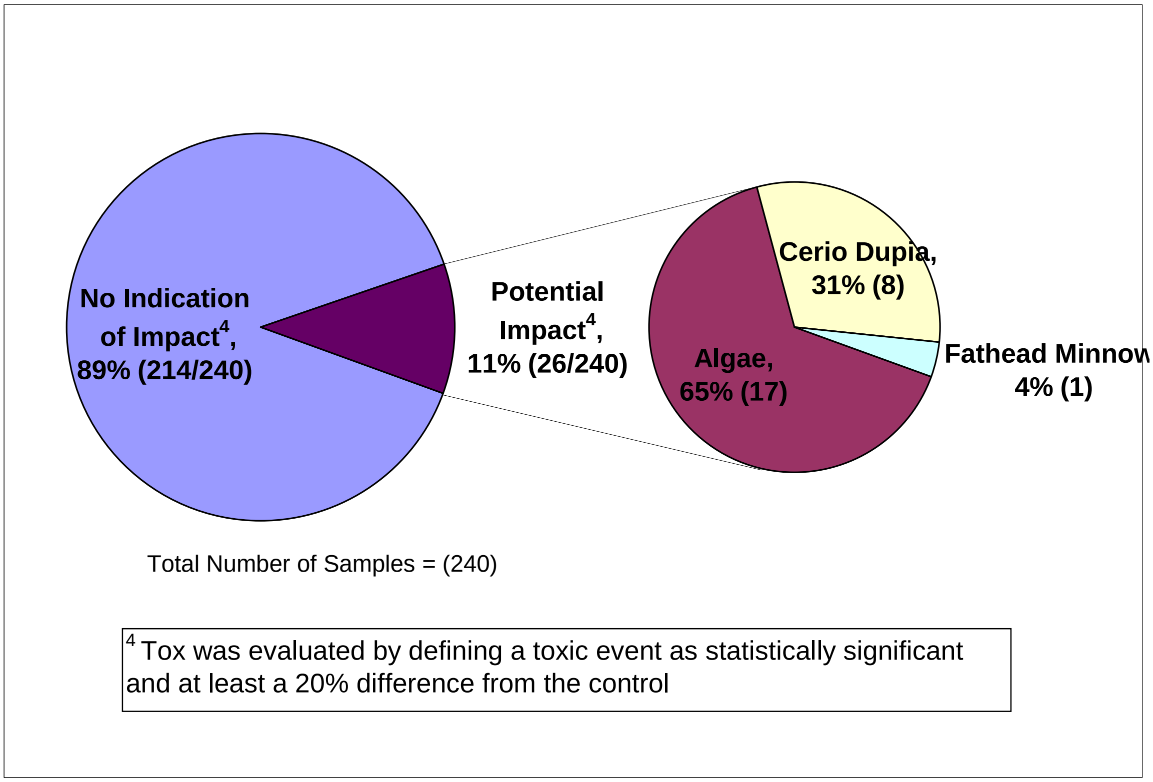


Figure 68: Percentage of Toxicity Samples Found with Statistically Significant Toxic Events



Total Number of Samples = (240)

[4] Tox was evaluated by defining a toxic event as statistically significant and at least a 20% difference from the control

Irrigation Water Supply (Specific Conductivity)

For specific conductivity the Basin Plan has an objective of 700 umhos/cm April through August and 1000 umhos/cm September through March for SJR at Airport Way (also known as Vernalis). This objective only applies as a maximum thirty day running average. Although multiple individual samples collected throughout the Westside Basin had concentrations above the noted objective during the sampling period, exceedances can not be determined using the limited grab samples.

Samples were found at concentrations above the Water Quality Goal for Agriculture of 700 umhos/cm (Marshack, 2003) at all sites except Hospital Creek @ Highway 33. The upper reaches of the Del Puerto Creek had significantly higher percentages of elevated concentrations compared to the sites within the valley floor (figure 69).

Figure 70 is a quick summary that shows the percentages of samples found to have concentrations above 700 umhos/cm throughout the Westside Basin that may impact the Irrigation Water Supply beneficial use. Overall, upper watershed and source water sites accounted for 47% of the total number of elevated concentrations.

Recreation (Bacteria)

All the sites monitored during this study are either specifically designated or tributary to a water body designated for full contact recreation (e.g. swimming). As a conservative approach, the USEPA Guideline for designated beach area of 235 MPN/100ml *E. coli* was used to evaluate the entire Westside basin. Many of sites may not support full recreational contact due to physical attribute (e.g. ankle deep water, irrigation canal), however, the use of a single guideline provided consistency for the review.

Figure 71 is a quick summary depicting the percentages of *E. coli* samples throughout the Westside Basin at concentrations that may impact Recreational use.

The highest percentages of *E. coli* concentrations above 235 MPN/100ml were found in the Valley Floor sites, including the lower watersheds of Orestimba and Del Puerto (Figure 72). *E. coli* spikes were documented during high and low flow events indicating that *E. coli* spikes are randomly present during both winter storm events when it would be unlikely to find people swimming and during the warmer summer season when most recreational contact would occur.

Figure 69: Percentage of Specific Conductivity samples greater than the Water Quality Goal for Agriculture (700 umhos/cm)

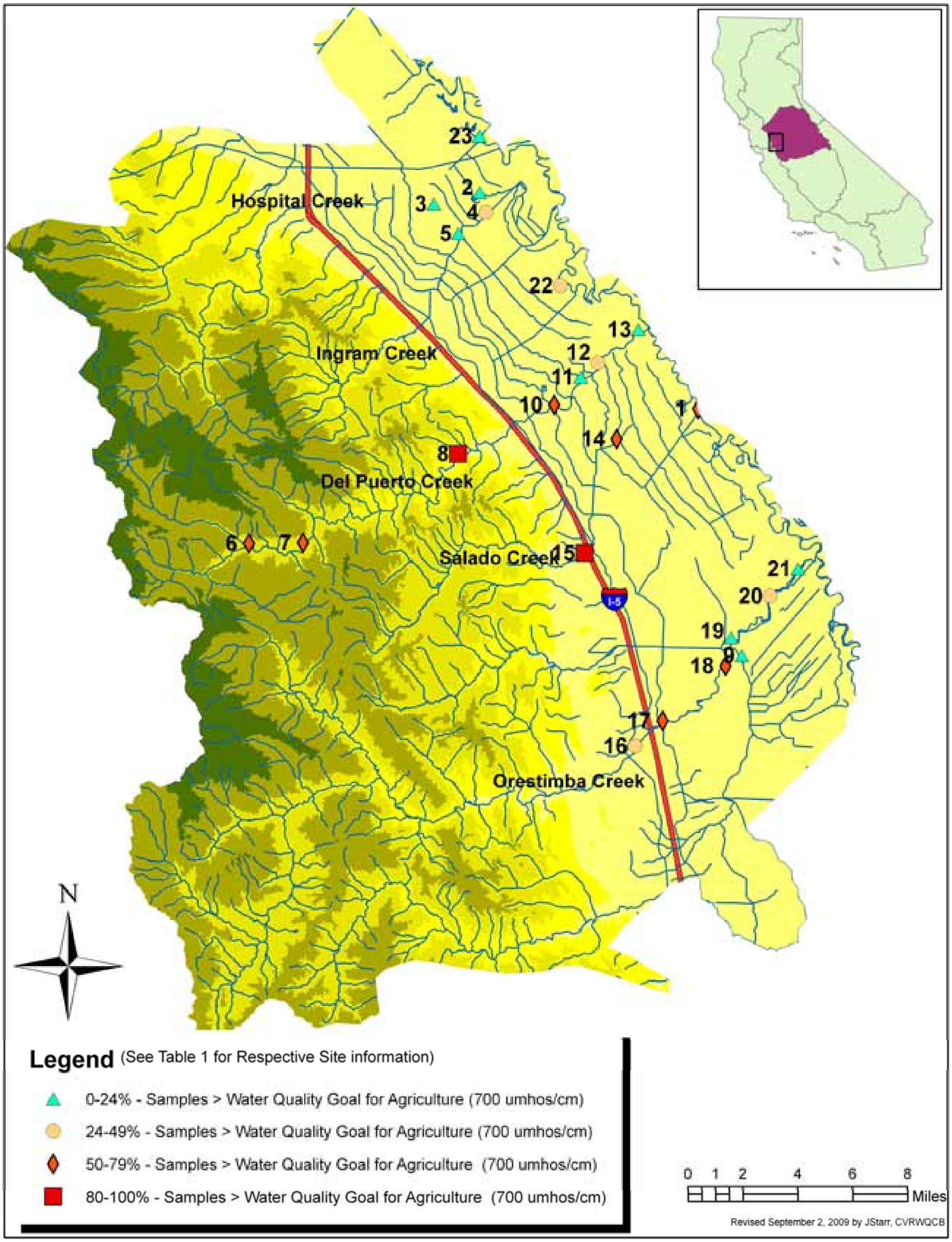
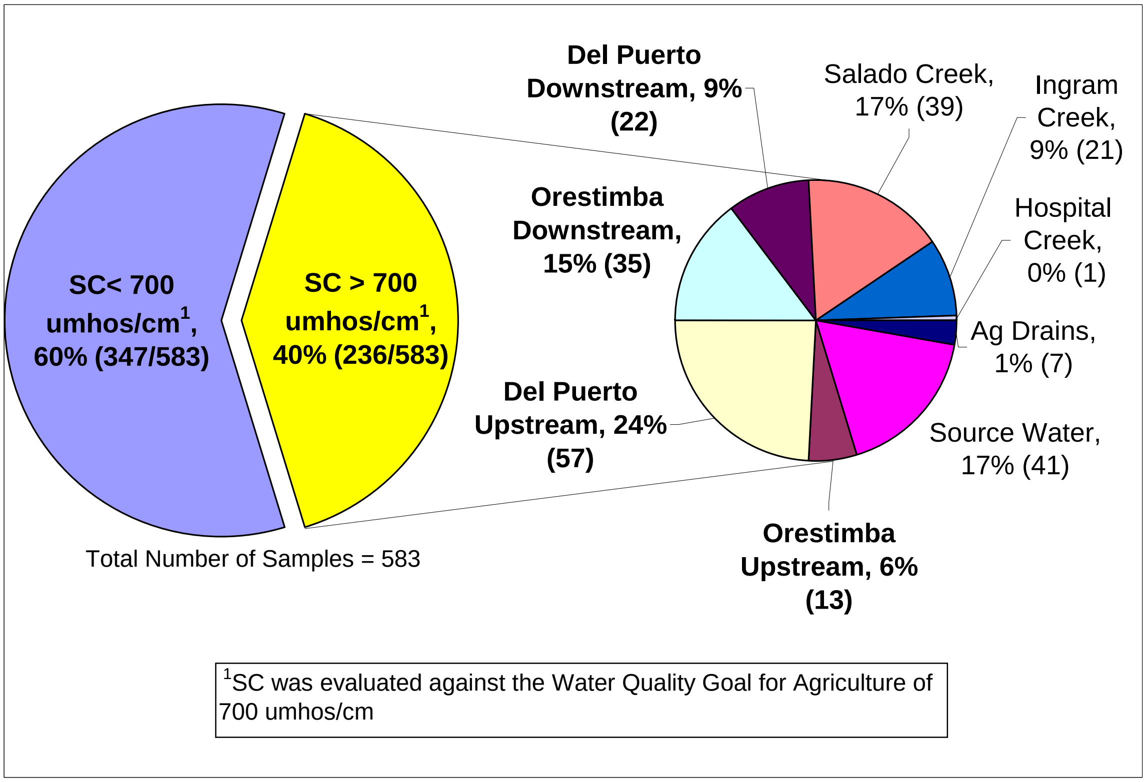
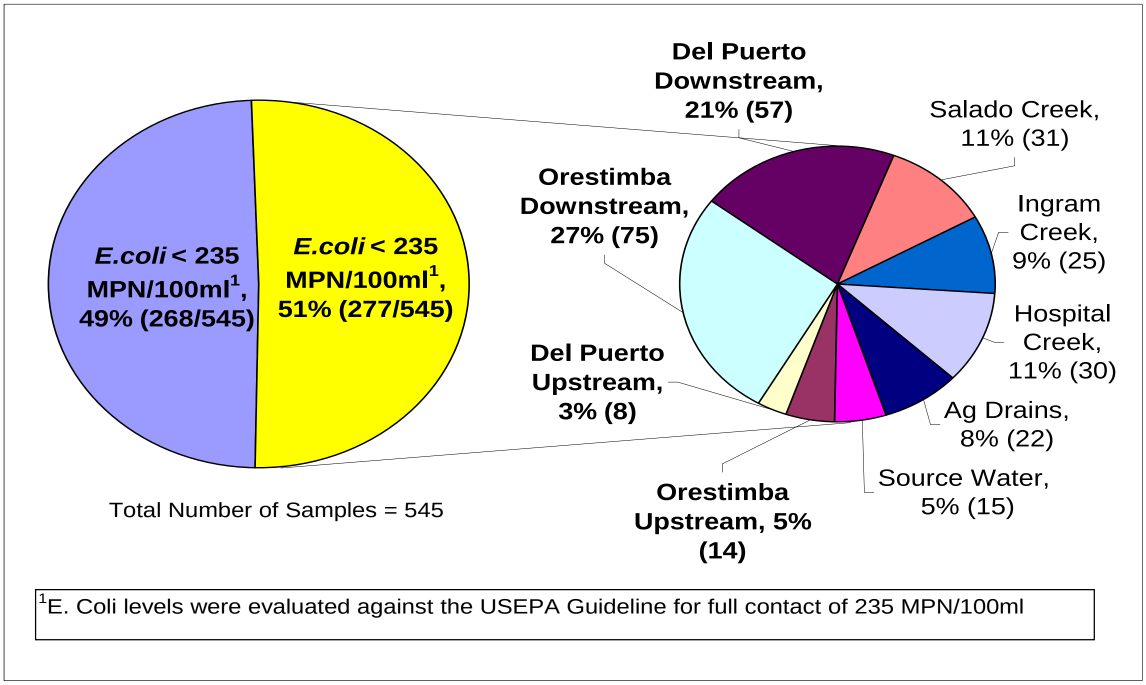


Figure 70: Percentage of SC Samples with Concentrations above Irrigation Water Supply Goals



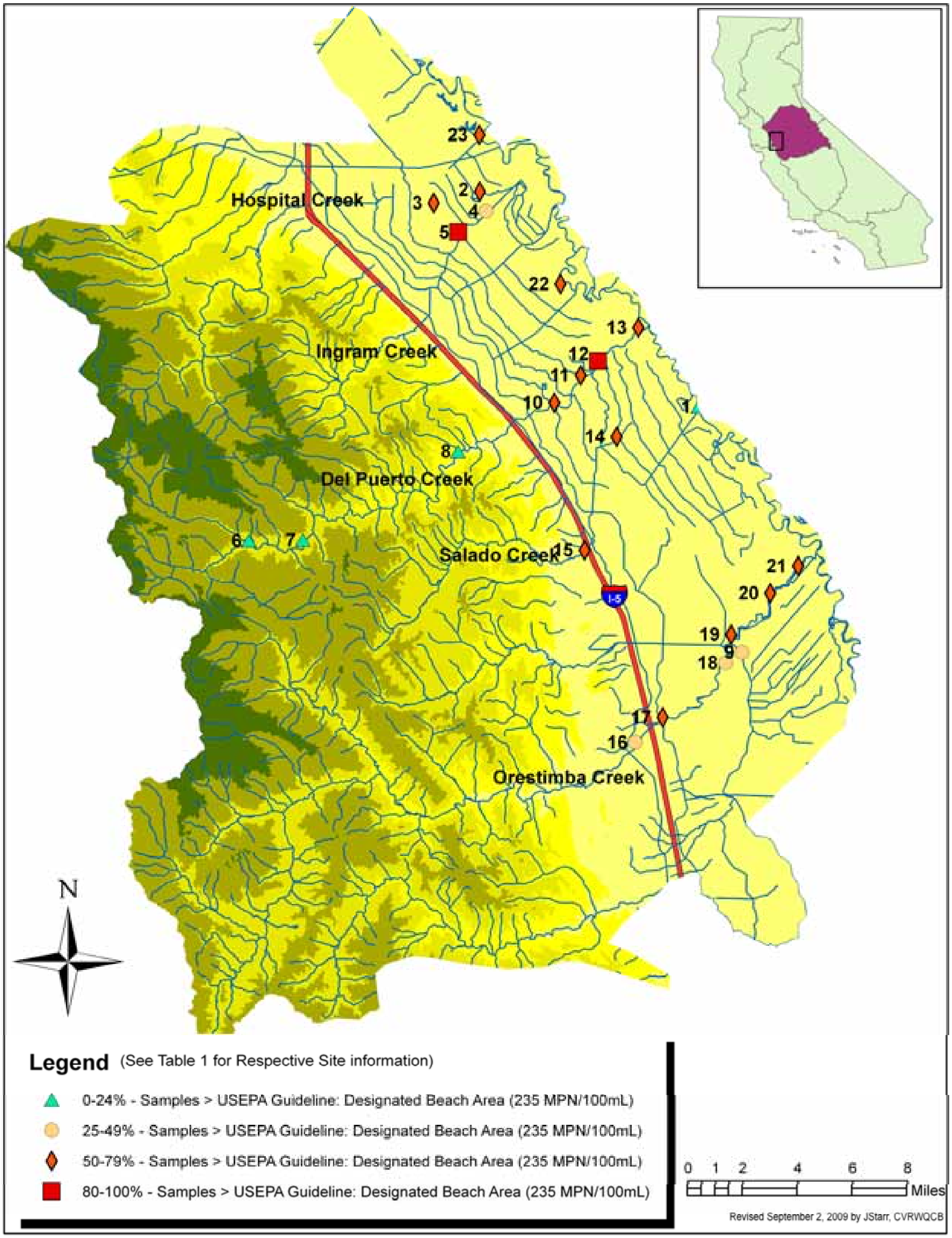
[1] SC was evaluated against the Water Quality Goal for Agriculture of 700 umhos/cm

Figure 71: Percentage of *E. coli* Samples at Concentrations that May Impact Recreational Use



[1] E. Coli levels were evaluated against the USEPA Guideline for full contact of 235 MPN/100ml

Figure 72: Percentage of E. coli Samples greater than the USEPA Guideline: Designated Beach Area (235 MPN/100ml)



11.0 SUMMARY/ CONCLUSION

This report evaluated the results of analyses on water samples collected in the Westside Basin from November 2004-November 2005. Only two of thirteen ephemeral watersheds, Orestimba and Del Puerto Creeks, were sampled from upper watershed downstream through the valley floor prior to discharge into the San Joaquin River. Valley floor drainage sites from three other watersheds, Hospital Creek, Ingram Creek, and Salado Creek and two major agricultural drains that discharge directly to the San Joaquin River, were utilized to represent the remaining watershed and to compare the valley floor drainage sites with the two fully sampled watersheds. Similarities between the five watersheds, two agricultural drains, and source water were evaluated based on their overall physical characteristics and chemistry. Sampling for the study occurred during Water Year 2005, the first wet year after four consecutive dry and below normal water years.

Objectives for the study were to:

- Coordinate with ongoing monitoring efforts;
- Evaluate spatial and temporal trends both within and between sub-watersheds;
- Identify potential beneficial use concerns; and
- Recommend future studies.

Coordination

Coordination with the Westside Coalition allowed for greater coverage and more frequent sample collection at specific sites including twice a month sampling and expanding into the upper watershed sites to provide some natural background context for valley floor water quality trends. The coordination also allowed for SWAMP funded Toxicity Identification Evaluation (TIE's) for some of the ILRP sediment samples with elevated toxicity. Although the coordination allowed an expanded data set, merging the resulting information and verifying results proved extremely time consuming since the data was stored by two agencies in two separate systems.

Summary Spatial and Temporal Trends

During 2005, constituents monitored displayed some general temporal and spatial variations throughout the basin. Spatially, Del Puerto and Orestimba Creeks were not similar to each other or to any of the valley floor sites for SC, TSS, TOC, or *E. coli*. In contrast, Del Puerto and Orestimba Creeks were similar to each other and to Salado, Ingram, and Hospital Creeks for pH, DO, and temperature. Both TSS (except Salado Creek) and overall E. coli concentrations were higher in the valley floor sites, but all sites demonstrated spikes during storm events.

Temporally, temperature at all sites increased during the summer months regardless of flow or land use, while dissolved oxygen decreased. Other constituents, such as specific conductivity, TOC, TSS and E. coli displayed seasonal patterns and were greatly influenced by storm events. The magnitude of the influence increased if the site experienced a dry period. The pH was variable throughout the year, regardless of season or location in the watershed. Both the Orestimba and Del Puerto Creek sites just upstream of valley floor irrigated acreage were dry during the summer months, although the valley floor sites for both water bodies contained water from irrigation activities.

Findings by individual watersheds included:

Orestimba Creek

Orestimba Creek has the largest watershed area in the Westside Basin. The pH, DO, temperature, and specific conductivity values showed little spatial variability moving downstream the watershed while TSS and TOC increased as it moved downstream. The reported TSS and TOC also correlated with both rain events and irrigation patterns.

Del Puerto Creek

Del Puerto Creek was the only watershed to have year-round access in the upper elevations of the coast range and off the valley floor. The SC was higher in the upper watershed than in the lower watershed sites. The TSS trends followed rainfall events in the upper watershed, while TOC demonstrated increased summer variability due to low water levels and large clumps of filamentous algae.

Valley Floor (Salado, Ingram, Hospital Creeks, Ag Drains)

These sites are dominated by agricultural flows and most Valley Floor sites were dry during periods of time between irrigation and precipitation events. With the exception of Salado Creek, overall medians and ranges of the constituents measured were comparable between sites for all but TSS, TOC and E. coli. The upstream Salado Creek site demonstrated dramatically higher median SC (3,000 umhos/cm as compared to approximately 500 umhos/cm) and DO (12 mg/L as compared to approximately 10 mg/L). In contrast, the upper Salado Creek site reports all TSS values below 100 mg/L except for three storm events, while the other Valley Floor sites reported median TSS values between 280 and 370 mg/L. Between all the Valley Floor sites, TSS, TOC and E. coli did not show any distinct pattern and were highly variable. Concentrations at specific sites in both Del Puerto and Ingram Creeks were noted to be directly influence by inflows from adjacent agricultural fields for the short period of drainage. The inflows did not have an immediate effect on downstream concentrations but did produce localized spikes.

Temporally, DO, SC, and pH all were erratic from sample event to sample event in the non-irrigation season, then the flows picked up and trends developed as the irrigation season began. The valley floor had much higher overall TSS results than other sites in the Westside Basin, with the highest spikes occurring during storm events but a number of lower spikes occurring throughout the irrigation season. The TOC levels were closely linked to rain fall events and irrigation patterns, with the highest concentrations during storm events. Similar patterns were documented for E. coli concentrations.

Source Water

Although winter runoff will flow from the upper watershed to the valley floor, between April and October, water from a mixture of the San Joaquin River, DMC, and groundwater, supply most Valley Floor flows. Tail water from agriculture runoff may also be reused. Median SC for the SJR at Patterson was higher than all of the valley floor sites except for Salado Creek. Temperature, DO, pH, and TOC were all similar for both the CCID Main Canal and SJR at Patterson sites as well as the Valley Floor sites. Differences were evident for TSS, which was lower in the source water than in the Valley Floor sites except Salado Creek. Source water had the lowest *E. coli* readings within the Westside Basin.

When evaluated against the water quality objectives, goals and targets found in Appendix E2, there are multiple areas of concern within the Westside Basin.

Drinking Water/Municipal Supply:

Of the 1002 samples evaluated for potential impacts to drinking water, 345 (34%) indicated a potential concern. Of those 345, 93% were elevated concentrations of TOC and 7% were elevated concentrations of SC. Source water accounted for 21% of the elevated TOC concentrations, while 88% of the elevated samples for specific conductivity were in Salado Creek. Although there is no specific drinking water objective for bacteria, 51% of the samples contained *E. coli* indicating that the water should be treated prior to consumption.

Aquatic life:

Of the 1721 samples evaluated for potential impacts to aquatic life, 91% did not show a potential impact. Of the remaining 162 samples, 31% were related to elevated temperatures, 29% to elevated pH, 23 % to low DO, and 16% to indicator organism toxicity. The source and upper watershed sites accounted for 33% of the elevated temperature samples and 45% of the elevated pH. The Orestimba Creek watershed accounted for 53% of the low DO samples. The Del Puerto Creek at Del Puerto Road mile 3.9 site reported 73% (8 out of 11) toxic samples.

Irrigation Water Supply:

Using the irrigation water goal of 700 umhos/cm, 40% of the 583 samples evaluated exceeded the goal. Of these 583, 47% of the elevated SC concentrations were in the upper watershed and source water sites. Salt is an ongoing concern for the Westside Basin and the San Joaquin Valley.

Recreation:

Using the USEPA guideline of 235 MPN/100mL *E. coli*, 51% of the 545 samples evaluated contained concentrations high enough to impact designated beaches. The highest percentages of *E. coli* concentrations above the guideline were found in the Valley Floor sites, including the lower watersheds of Orestimba and Del Puerto. *E. coli* spikes were documented during both winter storm events when it would be unlikely to find people swimming and during the warmer summer season when most recreational contact would occur.

Table 9 summarizes the potential beneficial use concerns within the Westside Basin for each constituent evaluated above by sub-watershed.

Table 9. Summary of Potential Beneficial Use Concerns for Westside Basin

Beneficial Use/Indicator	Orestimba Creek		Del Puerto Creek		Valley Floor					Source Water	
								Ag Drains			
	Upstream[1]	Downstream[2]	Upstream[3]	Downstream[4]	Salado Creek	Hospital Creek	Ingram Creek	Grayson Drain	Blewitt MWC Drain at Hwy 132	CCID Main Canal @ JT Crow Rd	SJR @ Patterson
Drinking Water											
Specific Conductivity			☒		☒						
Total Organic Carbon	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
E. coli	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Aquatic Life											
pH		☒	☒	☒	☒	☒			☒	☒	
Temperature	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Dissolved Oxygen	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	
Water Column Toxicity	NA	☒	☒	☒	☒	☒		☒	☒		
Irrigation Water Supply											
Specific Conductivity	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Recreation (Swimming)											
E. coli	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

☒ =One or more result above a goal or objective

NA = No samples were collected in this location

[1] Orestimba @ Orestimba Rd, Orestimba Creek @ Bell Rd, and Orestimba Creek @ Anderson

[2] Orestimba @ Hwy 33, Orestimba @ Kilburn and Orestimba @ River Rd

[3] Del Puerto Creek @ mile 13.6, Del Puerto Creek @ mile 3.9, Del Puerto Creek @ Deer Creek Campground

[4] Del Puerto @ Rogers, Del Puerto @ Hwy 33, Del Puerto @ Vineyard and Del Puerto nr Cox Rd

12.0 FUTURE ACTIVITIES

After WY 2005 the SJR SWAMP effort was not able to continue the Drainage Basin or Intensive Rotational Basin sites due to funding reductions. Since 2005, the majority of SJR SWAMP sampling has been limited to maintaining the water quality monitoring for the multi-agency Grassland Bypass Project (GBP), with addition of *E. coli* analyses twice a month at the GBP sites.

Ongoing monitoring efforts in the basin include the expanded monitoring of agricultural drainage inflows to the SJR that are conducted by various Agricultural Coalition Groups as part of the Irrigated Lands Regulatory Program (ILRP). SWAMP is providing resources to ensure ILRP water quality information is captured in the statewide SWAMP master database.

To address the salt issue within the SJR Basin the Central Valley Water Board formed the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS). This program is an effort to address the salinity problems within the Central Valley and will adopt long-term solutions to improve water quality and economic sustainability. The following website has up-to-date information about CV-SALTS:

http://www.swrcb.ca.gov/centralvalley/water_issues/salinity/index.shtml .

The Central Valley Water Board SWAMP effort has refocused limited resources on better identifying current monitoring efforts conducted by both internal programs (GBP, ILRP, NPDES receiving water requirements, TMDL, and others) and major external efforts (Department of Water Resources, US Bureau of Reclamation, US Geological Survey, University of California and watershed groups) through the development of a web-based surface water monitoring directory. The directory builds off of a pilot project with the San Francisco Estuary Institute (SFEI) begun by the US EPA within the San Joaquin River Basin, and has been expanded by the Central Valley Water Board SWAMP to include the entire Central Valley (Sacramento, San Joaquin, and Tulare Basins and Delta). The web-based monitoring directory is designed to only display active monitoring efforts and to identify what is being monitored where, how frequently, for how long, and by which agency. While actual data is not captured, the directory will provide links to any web based database and contact information for the monitoring program manager.

Initial feeding of the directory has focused on multi-agency efforts within the Sacramento-San Joaquin Delta to help identify available water quality information in order to facilitate a more thorough evaluation of water quality. In addition, the directory has been beta-tested by loading information on the internal GBP, ILRP, NPDES, statewide SWAMP, and DWR Northern District efforts for the entire Central Valley. The directory can currently be viewed at the following website http://www.centralvalleymonitoring.org/. It is anticipated that beta testing will be complete and the directory will be available for data entry from interested parties during late spring 2010.

Central Valley SWAMP is also currently:

- Providing resources (staff and contract dollars) to facilitate development of a Regional Monitoring Program for the Sacramento-San Joaquin Delta.

- Supporting the Department of Water Resources staff to continue long-term trend monitoring at 41-sites in the northern Sacramento River Basin in exchange for the addition of selected constituents of concern identified through Central Valley Regional Board efforts (TOC, nutrients, and toxicity) and realignment of 11-sites to correspond with sites utilized by the statewide SWAMP sediment toxicity study.

- Developing a region-wide, long-term trend monitoring framework based on the 30-sites within the Central Valley that are part of the state-wide SWAMP contaminant trend monitoring effort

- Improving the Central Valley Regional Board SWAMP website that documents monitoring activities supported by SWAMP and provides links to final reports and selected water quality data (http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_studies/surface_water_ambient_monitoring/index.shtml)

Efforts related specifically to the elevated *E. coli* concentrations found within the SJR Basin as well as in other areas of the Central Valley as part of ILRP monitoring, include:
- A survey of *E. coli* concentrations in local swimming holes before, during and after a holiday weekend (coordinated with Central Valley watershed groups during 2007 and 2008 with follow-up studies at selected sites in 2009)
- A pilot bacteria source identification project with the University of California, Davis, in selected streams with a history of elevated *E. coli* concentrations
- Continued, seasonal *E. coli* monitoring at 30-major integrator sites throughout the Central Valley.

Recommendations for future monitoring for the Westside sub-basin include parameters listed in Table 9 with a particular focus on specific conductance, *E. coli*, and TOC because these three parameters were consistently at elevated levels across all the watersheds. For *E. coli* a majority of the sites with high percentages of samples exceeding the USEPA guideline may need further evaluation to determine actual level of potential recreational use.

In addition to the benefit consolidating water quality data in a centralized system would have, specific studies that would help further characterize the Westside basin include:
- Turbidity collection at all sites;
- Expanded studies in the Salado Creek watershed to determine background and sources of elevated SC and potentially super-saturated concentrations of DO;
- Focused toxicity monitoring in Del Puerto Creek;
- Bacteria Source Identification Studies; and
- More detailed temperature and pH profiles in the upper watershed to determine appropriate background conditions.

All SWAMP data collect for this project and other San Joaquin Valley studies has been posted annually on the Central Valley Water Board website since 2003 and was utilized in combination with other available data for assessment in the Clean Water Act Sections

305(b) and 303(d) Integrated Report for the Central Valley Region (CVRWQCB, 2008/2010 Draft).

13.0 REFERENCES

1. Bertoldi, G.L., R.H. Johnson, et al. 1987. Groundwater in the Central Valley of California – A Summary Report A2-A5. U.S. Geological Survey
2. Bowles, Victoria, Dibble, Chad, Starr, Jeremy, Xiong, Lee, Chilcott, Jeanne. 2009. *San Joaquin River Basin: Main Stem and Drainage Basin Sites October, 2000 – September 2005*. Regional Water Quality Control Board, Central Valley Region Report
3. Cal Fed Bay-Delta Program. 2000. Water Quality Program Plan. 3-52, D-5.
4. California Code of Regulations. Register 2006, No 38. Title 22, Division 4, Chapter 15, Article 4, s 64431; Article 16, s 64449; Article 18, s 64468.1. Updated 9/22/06. http://ccr.oal.ca.gov/linkedslice/default.asp?SP=CCR-1000&Action=Welcome. Accessed 9/29/06.
5. CDF. 2003. Del Puerto Canyon fire page. Accessed 16 Nov. 2005: http://www.fire.ca.gov/cdf/incidents/Del%20Puerto%20Fire_90/incident_info.html
6. Central Valley Regional Water Quality Control Board (CVRWQCB). 2007. Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins, Fourth Edition, August 2006.
7. Central Valley Regional Water Quality Control Board (CVRWQCB). 2008/2010 Draft. The 2008 Update to the 303(d) List and Development of the 2008 303(d)/305(b) Integrated Report. http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/impaired_waters_list/303d_list.shtml
8. Chilcott, J., Laguna, C., Dinkler, L., 1996*. Agricultural Subsurface Drainage Program Procedures Manual.* Regional Water Quality Control Board, Central Valley Region Report
9. Chilcott, J., 1992. *Consideration of Water Body Designations to Comply with Provisions of the Water Quality Control Plan for Inland Surface Waters of California (ISWP)*. Regional Water Quality Control Board, Central Valley Region Report
10. Dubrovsky, Neil M., Kratzer, Charles R., Brown, Larry R., Gronberg, Jo Ann M., Burow, Karen R. 1998 *Water Quality in the San Joaquin-Tulare Basins, California, 1992-1995.* United States Geological Survey. Circular 1159. p. 5

11. DWR. 2001. Annual Land and Water Use Data: Irrigated Crop Area. State of California http://www.landwateruse.water.ca.gov/annualdata/landuse/2001/landuselevels.cfm . (Accessed: April 2, 2009)

12. DWR. 2007. California Cooperative Snow Surveys. Chronological Reconstructed Sacramento and San Joaquin Valley Water Year Hydrologic Classification Indices. http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST

13. DWR. 2007. California Data Exchange Center (CDEC). Access to the Department of Water Resources Operational Hydrologic Data http://cdec.water.ca.gov/

14. Grover, Joshua, Rowan, Jay, Chilcott, Jeanne. 2007. *Sediment Toxicity Testing in the San Joaquin River Basin*. Regional Water Quality Control Board, Central Valley Region Report

15. Johnson, M.L., B.J. Landis, K.L. Woodside, and B.G. Hammock. 2006. Quality Assurance Project Plan (QAPP) CVRWQCB Central Valley Bioassessment Project: San Joaquin Component. Aquatic Ecosystems Analysis Laboratory (AEAL). University of California, Davis.

16. Diablo Grande Golf & Country Club. 2005. Course Trends. Accessed 17 Nov. 2005: http://www.golfdiablogrande.com/Map-Directions-to-Diablo-Grande.html

17. Marshack, J.B., 2003. A Compilation of Water Quality Goals. California Environmental Protection Agency, Regional Water Quality Control Board, Central Valley Region. Sacramento, CA.

18. McGahan, J., Clark. S.L., Ogle, S. August 2004. Westside San Joaquin River Watershed Coalition Quality Assurance Project Plan for Monitoring.

19. Puckett, M. 2002. Quality Assurance Program Plan for the State of California's Surface Water Ambient Monitoring Program ("S.W.A.M.P."). California Department of Fish and Game, Monterey, CA. 145 pages plus Appendices.

20. U.S. Environmental Protection Agency. 1986. Ambient Water Quality Criteria for Bacteria. *Bacteriological Ambient Water Quality Criteria for Marine and Fresh Recreational Waters*.14-15.

21. Westcot, D.W. et al 1991. CVRWQCB Staff Report: PRELINIARY ESTIMATE OF SALT AND TRACE ELEMENT LOADING TO THE SAN JOAQUIN RIVER BY EPHEMERAL STREAMS DRAINING THE EASTERN SLOPE OF THE COAST RANGE (DIABLO RANGE)

CALIFORNIA
Water Boards

STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

State Water Resources Control Board
Location: 1001 I Street, Sacramento, CA 95814
Mail: P.O. Box 100, Sacramento, CA 95812-0100
www.waterboards.ca.gov • info@waterboards.ca.gov

Office of Public Affairs:	(916) 341-5254
Office of Legislative Affairs:	(916) 341-5251
Financial Assistance information:	(916) 341-5700
Water Quality information:	(916) 341-5455
Water Rights information:	(916) 341-5300

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARDS

NORTH COAST REGION (1)
www.waterboards.ca.gov/northcoast
5550 Skylane Blvd., Suite A
Santa Rosa, CA 95403
info1@waterboards.ca.gov
(707) 576-2220 TEL • (707) 523-0135 FAX

SAN FRANCISCO BAY REGION (2)
www.waterboards.ca.gov/sanfranciscobay
1515 Clay Street, Suite 1400
Oakland, CA 94612
info2@waterboards.ca.gov
(510) 622-2300 TEL • (510) 622-2460 FAX

8/21/07
Printed on Recycled Paper

CENTRAL COAST REGION (3)
www.waterboards.ca.gov/centralcoast
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401
info3@waterboards.ca.gov
(805) 549-3147 TEL • (805) 543-0397 FAX

LOS ANGELES REGION (4)
www.waterboards.ca.gov/losangeles
320 W. 4th Street, Suite 200
Los Angeles, CA 90013
info4@waterboards.ca.gov
(213) 576-6600 TEL • (213) 576-6640 FAX

CENTRAL VALLEY REGION (5)
www.waterboards.ca.gov/centralvalley
11020 Sun Center Drive, Suite 200
Rancho Cordova, CA 95670
info5@waterboards.ca.gov
(916) 464-3291 TEL • (916) 464-4645 FAX

Fresno branch office
1685 E Street, Suite 200
Fresno, CA 93706
(559) 445-5116 TEL • (559) 445-5910 FAX

Redding branch office
415 Knollcrest Drive
Redding, CA 96002
(530) 224-4845 TEL • (530) 224-4857 FAX

LAHONTAN REGION (6)
www.waterboards.ca.gov/lahontan
2501 Lake Tahoe Blvd.
South Lake Tahoe, CA 96150
info6@waterboards.ca.gov
(530) 542-5400 TEL • (530) 544-2271 FAX

Victorville branch office
14440 Civic Drive, Suite 200
Victorville, CA 92392
(760) 241-6583 TEL • (760) 241-7308 FAX

COLORADO RIVER BASIN REGION (7)
www.waterboards.ca.gov/coloradoriver
73-720 Fred Waring Dr., Suite 100
Palm Desert, CA 92260
info7@waterboards.ca.gov
(760) 346-7491 TEL • (760) 341-6820 FAX

SANTA ANA REGION (8)
www.waterboards.ca.gov/santaana
California Tower
3737 Main Street, Suite 500
Riverside, CA 92501-3339
info8@waterboards.ca.gov
(951) 782-4130 TEL • (951) 781-6288 FAX

SAN DIEGO REGION (9)
www.waterboards.ca.gov/sandiego
9174 Sky Park Court, Suite 100
San Diego, CA 92123
info9@waterboards.ca.gov
(858) 467-2952 TEL • (858) 571-6972 FAX

State of California
Arnold Schwarzenegger, Governor

California Environmental Protection Agency

State Water Resources Control Board
Tam M. Doduc, Chair
Dorothy Rice, Executive Director