SWAMP
Surface Water Ambient Monitoring Program

Technical Report 2009

San Joaquin River Basin: Main Stem and Drainage Basin Sites, October 2000 – September 2005

October 2009

This project was jointly funded by SWAMP and other partners, including Agricultural Subsurface Drainage Program, Total Maximum Daily Load Program, Watershed Management Initiative Program and the Grant Program

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1.0 EXECUTIVE SUMMARY

The Central Valley Regional Water Quality Control Board's (Central Valley Water Board) San Joaquin River Surface Water Ambient Monitoring Program (SWAMP) was implemented in October 2000 as part of the statewide effort to assess and monitor California's surface water quality. The San Joaquin River (SJR) Basin covers 17,720 square miles (CVRWQCB, 1998) with fresh water flows originating from the Sierra Nevada along the east side and ephemeral streams providing seasonal flows along the west side and within the foothill regions. The hydrology of the basin has been highly modified and regulated since the advent of the Central Valley Project in the late 1940's, and the valley floor is dominated by irrigated agriculture (approximately 2.0 million acres (DWR, 2001)).

The SWAMP within the SJR Basin was designed with a 3-tiered monitoring framework: 1) long-term monitoring in the main stem of the river; 2) long-term monitoring in selected tributaries draining major sub-basins; and 3) more intensive monitoring on a 5-year rotation within the sub-basins themselves. This report focuses on the results for the first two tiers of the SWAMP effort, the main stem of the San Joaquin River and the major inflows from sub-watersheds, between October 2000 and September 2005. Results for the third tier, the Intensive Basin Monitoring Program (IBP), can be found on the following website:

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

The final sampling design for the first two tiers included eight SJR main stem sites and 30 drainage basin sites, which were sampled monthly or weekly depending on the site, with a total of 39 separate constituents sampled over the course of the sampling period. At a minimum, each site was analyzed for standard field measurements (specific conductance, pH, temperature, turbidity, and dissolved oxygen) as well as total coliform and *E. coli*. Monthly photo documentation was taken at each site. Sampling expanded to include total organic carbon, total suspended sediments, trace elements (arsenic, copper, chromium, lead, nickel, zinc, and mercury), biochemical oxygen demand, mineral data (chloride, sulfate, calcium, magnesium, total dissolved solids, carbonate, bicarbonate, total alkalinity and sodium) and water column toxicity when additional funding was available.

The purpose of this report is to summarize the data gathered over the five year sampling period and attempt to address the SJR SWAMP's main questions within the SJR valley, which include evaluating spatial and temporal trends and providing a preliminary assessment of potential beneficial use concerns.

Constituents monitored displayed distinct spatial and temporal trends within the SJR watershed and some areas were identified for further review of potential impacts to beneficial uses.

Spatial Trend Findings:

Within the river, the majority of constituents, i.e. specific conductance, TSS, turbidity, and most minerals and metals demonstrated increasing concentrations from Sack Dam (essentially the headwaters of the lower SJR) to Hills Ferry (a main stem site just upstream of the first freshwater flow from the Sierra Nevada). Many of the increases corresponded with inflows from the Grassland sub-basin. A pattern of decreasing concentrations from Hills Ferry to Vernalis (the boundary of the Sacramento-San Joaquin Delta) corresponded to dilution from the high volume fresh water flows from the east-side rivers that drain the Sierras. Most constituent concentrations decreased to roughly the same concentrations at Sack Dam after the 110-mile journey to Vernalis.

Comparing tributary sub-basin inflows, those from the western side of the SJR Basin had higher concentrations of most constituents than those on the eastern side. The distribution may in part be due to minimal natural run off from the Coastal Range and replacement supply water from the Delta along the west side and more continuous fresh water flows and captured snowmelt as supply water for the east side.

Temporal Trend Findings:

Strong seasonal trends were found for temperature i.e., temperatures increase in the summer and decrease during the winter. Dissolved oxygen (DO) had the opposite seasonal trend of temperature with a decrease in DO in the summer months and an increase in the winter months. Specific conductivity (SC), total organic carbon (TOC), turbidity, and total suspended solids (TSS) were influenced both by storm events, especially SC during the first storm runoff, and the irrigation season. Concentrations tended to spike during storm events, but remain at a lower but still elevated level during the irrigation season.

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, Nitrate, trace elements (arsenic, cadmium, copper, mercury, nickel, lead and zinc) and *E. coli*)
- Aquatic Life (pH, temperature, DO, turbidity, trace elements (cadmium, copper, nickel, arsenic, lead, zinc, and mercury), chloride and water column toxicity)
- Irrigation water supply (SC, and minerals (chloride, sodium and total dissolved solids))
- Recreation (*E. coli*)

In summary:

Drinking Water/Municipal Supply: Total organic carbon was found to be elevated throughout the SJR Basin when compared to the 3.0 mg/L Bay Delta Authority's guideline for water quality in the Sacramento-San Joaquin Delta (Delta). The entire SJR Basin drains into the southern portion of the Delta.

Aquatic Life: Elevated temperatures during the spring and fall were a concern for fish passage along the SJR when compared to the Bay-Delta Authority target for the San Joaquin River at Vernalis of 20ºC from April 1–June 30 and from September 1–November 30. Higher levels of turbidity in the Westside basin were a concern but the current Basin Plan objective is based on background concentrations so it was difficult to evaluate for the existing ephemeral streams. Various levels of water column toxicity were reported sporadically on multiple occasions around the basin. A higher percentage of chronic toxicity was reported as compared to acute toxicity. Samples for acute algae toxicity were collected less frequently but had a higher percentage (50 percent excluding Fremont Ford) of reduction and an increase in growth toxic events. For information on sediment toxicity around the basin see Sediment Toxicity Testing in the San Joaquin River Basin, October 2001 through September 2005 (http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_studies/surface_water_ambient_monitoring/swamp_water_quality_reports/index.shtml).

Irrigation Water Supply: Specific conductance was found elevated above optimal irrigation water supply concentrations throughout most of the SJR Basin when compared to the Water Quality Goal for Agriculture of 700 umhos/cm. In addition, individual samples were at times elevated above the Basin Plan objective for Vernalis of 700 umhos/cm April through August and 1000 umhos/cm September through March, although it should be noted that the objective is to be applied as a 30-day maximum running average and was not intended to determine impairment using a single grab sample. The highest SC concentrations were measured within the Grasslands and Westside Basin. High salt concentrations can be attributed to a variety of components not limited to local geology/hydrology, importation and deportation of water from and to different basins, waste products from urban, industrial, and agricultural practices—and is being evaluated separately under the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) project.

Recreation: Occasional spikes of *E. coli* above the USEPA guideline of 235 MPN/100 ml (full contact recreation) were detected sporadically throughout the year, but the summer months were of particular concern due to the potential for recreational use increases for most of the waterways.

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 are listed below.

- Development of 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)
- 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 (staff and contract dollars) to facilitate development of a Regional Monitoring Program for the Sacramento-San Joaquin Delta
- Supporting 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 state-wide SWAMP sediment toxicity study
- 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.
- Providing assistance to other monitoring efforts to facilitate SWAMP comparability (e.g. reviewing quality assurance project plans)

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, are as follows:

- A survey of *E. coli* concentrations in local swimming holes before during and after a holiday weekend (coordinated with Central Valley watershed groups during both 2007 and 2008)
- 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 each sub-basin and river site are summarized in Table 8 within the discussion and conclusion section of this report. Data collected as part of this study has been posted annually on our website since 2003 and was assessed in combination with other available data during the development of the Clean Water Act Sections 305(b) and 303(d) Integrated Report for the Central Valley Region (CVRWQCB, 2009 Draft).

2.0 GLOSSARY/KEY TERMS

Central Valley Water Board – Central Valley Regional Water Quality Control Board (CVRWQCB)

IBP – Intensive Basin Program

ILRP- Irrigated Lands Regulatory Program

MCL- Maximum Contamination Level

MUN - Municipal and Domestic Supply

NPDES - National Pollutant Discharge Elimination System

SC- Specific Conductance

SJR – San Joaquin River

SWAMP – Surface Water Ambient Monitoring Program

State Water Board – State Water Resources Control Board

TKN- Total Kjeldahl Nitrogen

TOC- Total Organic Carbon

TSS-Total Suspended Solids

QA- Quality Assurance

QC- Quality Control

WY- Water Year

3.0 INTRODUCTION

The San Joaquin River Watershed Unit of the Central Valley Regional Water Quality Control Board (Central Valley Water Board) initiated a water quality monitoring program in October of 2000 as part of California Assembly Bill AB 982 (Chapter 495, Statutes of 1999). AB 982 focuses State Water Resources Control Board (State Water Board) efforts on developing a comprehensive ambient surface water quality monitoring program known as the Surface Water Ambient Monitoring Program (SWAMP).

At the Central Valley Water Board, SWAMP is attempting to answer the following overarching question and related sub-questions.

> What is/are the status and trends of ambient water quality in streams and rivers in the Sacramento River, San Joaquin River, and Tulare Lake Basins?
>
> --Are there spatial and temporal trends in water quality?
> --What is the location and extent of various levels of water quality?
> --Is there evidence of beneficial use impairment?
>
> (and over the long-term)
>
> --Is water quality getting better or worse?
> --Are Board programs (regulatory/non-regulatory) and management actions effective?

The SWAMP for the San Joaquin River (SJR) Basin (Figure 1) is built upon a monitoring framework developed as part of the agricultural subsurface drainage management program that focuses on selenium, salt and boron and has evolved since 1985 (discussed in more detail in section 4.0). The current SWAMP program contains 3 tiers. The first tier is a selection of sites along the main stem of the river, downstream of major inflows. The second tier is a series of sites representing inflows from specific sub-watersheds into the main stem of the river (drainage basin inflows component). These first two tiers consist of long term trend sites where monitoring is conducted weekly to monthly, depending on site and constituent.

The final tier, the Intensive Basin Monitoring Program (IBP), is a more detailed, yearlong survey of the water quality within each of six sub-watersheds once every 5-years. Each of these sub-basins included water bodies with similar hydrologies, geologies, management issues, land use and land cover. The sixth basin, the southern Sacramento – San Joaquin Delta (South Delta), has not been included as part of the rotation due to the extensive monitoring and modeling already conducted by other agencies. A detailed discussion of the design of the 3-tier monitoring program is presented in section 6.2.

This study focuses on the results for the first two tiers of the effort, the main stem San Joaquin River and inflows from sub-watersheds, between October 2000 and September 2005. Prior to initial water quality sampling, state, federal, and local agencies as well as known watershed groups were surveyed to identify current monitoring efforts and local concerns. These contacts included but were not limited to the Department of Water Resources, Department of Fish and Game, University of California, US Geological Survey, US Environmental Protection Agency, US Fish and Wildlife Service, Natural Resources Conservation Service, CalFed, San Luis Delta-Mendota Water Authority, Grassland Area Farmers, local Resource Conservation Districts, and groups receiving water quality improvement bond grants.

Concerns were varied, but most consistently included potential impacts to aquatic life and recreation, in particular concerns with temperature, sedimentation, selenium, off-site movement of pesticides, and pathogens, with additional concerns of irrigation supply (elevated salt) and drinking water (elevated total organic carbon). The final sampling design incorporated the survey findings as funding permitted. At a minimum, each site was analyzed for standard field measurements (SC, pH, temperature, turbidity, and DO) as well as total coliform and *E. coli*. Monthly photo documentation was taken at each site. Sampling expanded to include total organic carbon, total suspended sediments, trace elements (arsenic, copper, chromium, lead, nickel, zinc, selenium, molybdenum, and mercury), biochemical oxygen demand, mineral data (chloride, sulfate, calcium, magnesium, total dissolved solids, carbonate, bicarbonate, total alkalinity and sodium) and water column toxicity when additional funding was available.

Data gathered over the five year period provides information on the spatial and temporal trends in water quality and preliminary indications on potential beneficial use impairments. Key beneficial uses evaluated and the indicators utilized are listed below.

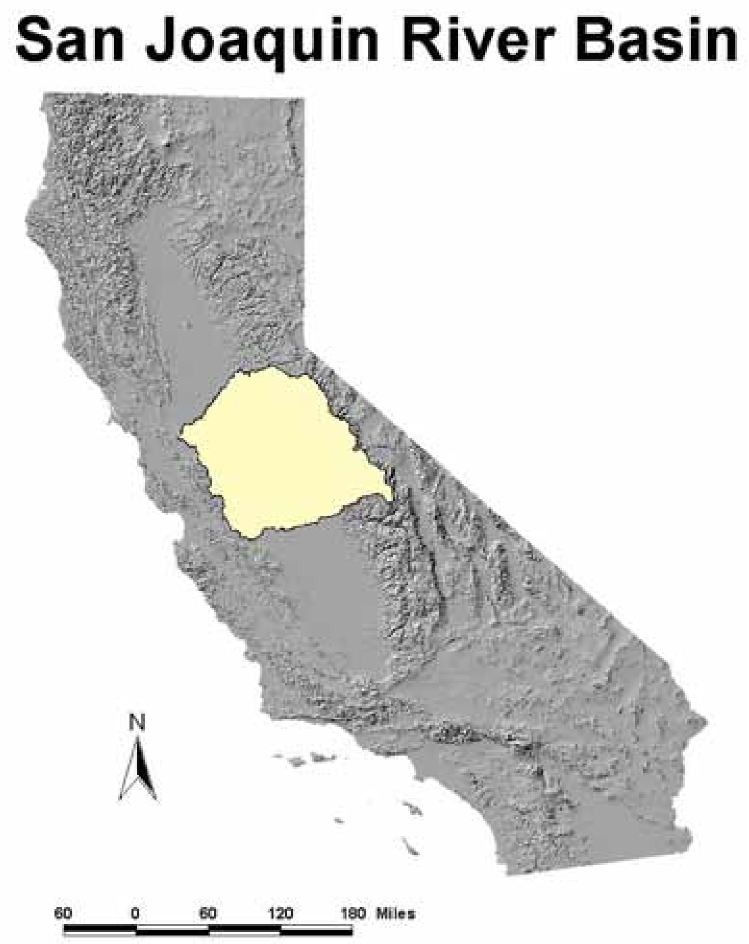
- Drinking Water (Salt/Specific Conductance, Total Organic Carbon, Trace Elements, Nutrients, *E. coli*)
- Aquatic Life (Toxicity, Temperature, Dissolved Oxygen, Trace Elements, Ammonia, pH)
- Recreation (*E. coli)*
- Irrigation Supply (Salt/Specific Conductance)

Details for overall SWAMP monitoring objectives and indicators, as well as data for expanded subbasin monitoring and the selenium control program, can be found on the Central Valley Regional Water Quality Control Board SWAMP website at:

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

Since 2003, all data collected as part of the San Joaquin River SWAMP effort that met quality assurance requirements, has been posted annually at the above website.

Figure 1: San Joaquin River Basin



4.0 BACKGROUND

In 1985, an extensive water quality survey to evaluate the impacts of agricultural drainage on the lower San Joaquin River (SJR) was initiated. Although a number of issues of concern were identified, salt, boron and selenium impacts were the priority and a resulting multi-agency water quality monitoring program was created focusing its limited resources on evaluating these constituents. The area has since been the focus of the Region's subsurface agricultural drainage program and considerable staff effort and resources have been directed to the effort of developing a comprehensive monitoring program, ensuring stakeholder involvement, and adopting Basin Plan Amendments and Waste Discharge Requirements in order to develop a workable and comprehensive selenium control program.

The compliance monitoring portion of this effort is the responsibility of the Data Collection and Reporting Team (DCRT) whose members include representatives from the US EPA, US Geological Survey, US Bureau of Reclamation, US Fish and Wildlife Service, CA Department of Fish and Game, Central Valley Water Board, and Grassland Area Farmers. The DCRT monitoring program evaluates selenium concentrations, loading, and potential impacts in water, sediment, and biota. Water quality analyses for selenium salt and boron are conducted at nine sites within the Grassland Watershed and seven sites along the main stem of the SJR. Grab samples are collected weekly, with daily composites also collected at two key sites: the consolidated agricultural subsurface drainage discharge point on the San

Luis Drain; and at Crows Landing on the SJR. (See Grassland Bypass Program on the Central Valley Regional Board SWAMP website for more detailed information.) The SJR SWAMP program was built upon this established framework.

Basin priorities include maintaining the Grassland Bypass Program and expanding it to facilitate real-time monitoring activities. Other issues of concern include: aquatic toxicity from waterborne pesticides; aquatic life impacts from pesticides in bed sediment; habitat impacts from sedimentation; elevated nutrient and BOD levels; pathogens; elevated temperatures; impacts from abandoned mines, timber harvesting and grazing; and establishing baseline condition in rural Coastal Range streams in areas slated for future urban development.

5.0 STUDY AREA

5.1 San Joaquin River Hydrology

The San Joaquin River (SJR) is the principal drainage artery of the San Joaquin Valley. The basin covers 17,720 square miles (CVRWQCB, 1998) and yields an average annual surface runoff of about 1.6 million acre-feet. 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 lower Basin (below Millerton Reservoir) has had a highly managed hydrology since implementation of the Central Valley Project (CVP) in 1951. From the Sierra Nevada, the river channel drains westward to the Mendota Pool near the town of Mendota. As the river channel continues past the Mendota Pool it turns northward to narrow by the constrictions of the Merced River and Orestimba Creek alluvial fans. From there, the river channel makes its way north to the Sacramento-San Joaquin Delta and out to the Suisun Bay.

Most of the flow released from Friant Dam 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, which was the case in early 2005. The majority of the water in the Mendota Pool has been transported from the Delta via the Delta Mendota Canal (DMC) for irrigation use and to replace water lost thru diversion of the upper SJR flows. The majority of that poorer quality (higher salinity) water is then discharged to irrigation supply channels along the west side of the river, while some flows are released to the main river channel and continue to Sack Dam. Remaining flows not diverted for agricultural use out of the main channel are then diverted at Sack Dam leaving flows in the lower San Joaquin River (below Sack Dam) mainly dependent on releases from upstream reservoirs, agricultural return flows, and groundwater seepage, although wetland releases and storm water run-off can have considerable impacts on the flows as well. During the irrigation season, the flows in the river between Sack Dam and Salt Slough consist largely of groundwater accretions.

Salt Slough and Mud Slough (north) are the principal drainage arteries for the Grassland Sub-Basin and add significantly to the flows and waste loads in the SJR upstream of its confluence with the Merced River. Eastside discharges dominate flows in the SJR, as higher quality (lower salinity) water is released from reservoirs on the Merced, Tuolumne, and Stanislaus Rivers. 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 (Steenson, *et al.*, 1998)

The principal streams in the 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, occupying approximately 2.0 million acres, representing approximately 23% of the irrigated acreage in California (DWR, 2001). Urban growth along the I-5 corridor between Fresno and Stockton is rapidly converting historical agricultural lands to urban areas. As more and more people choose to commute from the Central Valley to the Bay Area, the rapid conversion of land is leading to increasing potential for storm water and urban impacts to local waterways. Timber activities, grazing, abandoned mines, rural communities, and recreation can impact upper watershed areas (Graham, 2009).

5.2 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 Mountains or the Coastal Range and comprised of similar land use and drainage patterns (Figure 2). 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 west side 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 tidally influenced and typically higher in salinity than other surface water throughout the SJR Basin.

Figure 2: San Joaquin River Sub-Basins

6.0 SAMPLING PROGRAM

6.1 Program Objectives

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

1. Spatial and Temporal Trends
    a. Spatial includes the evaluation of the SJR moving progressively downstream as well as comparisons between sub-basins
    b. Temporal includes seasonal variations and annual variations (by water year type)
2. Evaluation of Beneficial Use Protection
    a. Using selected indicators to determine whether there is evidence of impairment
3. Utilizing information gathered from the long-term trend sites within each sub-basin to help direct future monitoring program design within that sub-basin.

6.2 Design

The SJR SWAMP program was designed as a trend-monitoring program that used a tiered approach. By using a tiered approach the SJR SWAMP program was able to adjust sampling constituents and monitoring frequencies to coincide with the year-to-year fluctuations in funding, as well as adjust for time delays associated with contracting to analytical laboratories. The use of available funds was then prioritized based on these tiers and the objectives of the program. This design resulted in less interruption to monitoring activities that were considered higher priority for the program. Creating a tiered monitoring design and selecting long-term sites and constituents also allows for the monitoring data to be evaluated over different water year types and facilitates assessment of implementation efforts going on throughout the valley. Monitoring sites for this program were selected from information gathered through existing monitoring efforts, historic data sets, the *Inland Surface Waters Plan* (Chilcott, J.,1992), the report *Water Diversion and Discharge Points Along the San Joaquin River* (James, E. W., *et al.*,1989), and reconnaissance done by Regional Board staff prior to initiation of any monitoring efforts.

The first tier of the program is the Main Stem Program. In that program, eight sites were selected along the lower section of the SJR and monitored on a daily, weekly, monthly, or quarterly basis, depending on the constituent. Those sites were selected as long-term sites and are located downstream of major influences to the river. Those sites were the most important to the program since they represent the "bottom" of the system and could show potential changes to the river over time. Many of the sites selected were already being monitored as part of the Grassland Bypass Program (multi-agency selenium control effort), so coordination with those monitoring and data management efforts was incorporated.

The second tier of the program is the Sub-Basin Program. The Sub-Basin Program moved the monitoring away from the main stem of the SJR and up into lower sections of the valley floor. In this program, 29 sites were selected as long-term trend sites representing the main inflows to the SJR from each of six sub-basins.

The third tier, the Intensive Basin Program, was not directly part of the trend monitoring, but rather focused on a 5-year rotational approach. This program contained approximately 20 sites per sub-basin, in addition to sites already part of the Sub-Basin Program, and focused solely on one sub-basin at a time. Sites selected within a sub-basin were monitored for one year, with the intent to rotate through the sub-basins once every 5 years.

To evaluate potential impact to beneficial uses, indicators were chosen for five broad beneficial uses: drinking water; recreation (swimming); aquatic life; irrigation; and waterfowl. The choice of indicators came from an evaluation of USEPA EPIC indicators (USEPA, 2003), water quality objectives and goals, and the fact that many of the indicators monitored as part of the SJR SWAMP efforts support high priority region-wide program assessments as listed in the 2005 Triennial Review of the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins. Regional programs utilizing SJR SWAMP monitoring data include: Drinking Water Policy, Water Quality Objectives for Bacteria Indicators, Salinity and Boron TMDL, Central Valley Salinity Policy Development, Erosion/Sediment guidelines, and SJR Dissolved Oxygen TMDL.

In general, the first five years of the program were set-up to continually monitor sites on the SJR as part of the main stem program on a weekly basis, monthly for certain constituents, with the Sub-Basin sites being monitored on a monthly basis. The remaining funding was utilized in the Intensive Basin Program. At the end of Water Year 2002 (i.e., 30 September 2002), a preliminary evaluation of the data collected as part of the first two years of the program was done and showed that the monthly monitoring frequency for nutrients, trace metals, minerals and TSS was not sufficient to develop useful trend information due to insufficient funding. Those analyses were then dropped from the program for a majority of the sites (mainly the Sub-Basin sites). Table 1 lists the monitoring sites and sampling frequencies associated with the constituents monitored for each site.

As funding permitted, samples were collected for: total suspended solids (TSS); total organic carbon (TOC); total coliform; *E. coli*; nutrients, including nitrate, nitrate-N, total kjeldahl nitrogen (TKN), ammonia, phosphorus, ortho-phosphate, and potassium; biochemical oxygen demand (5 and 10 day); chloride; sulfate; calcium; magnesium; total dissolved solids (TDS); carbonate; bicarbonate; total alkalinity; sodium; water column toxicity [*Pimephales promelas* (*P. promelas*), *Ceriodaphnia dubia* (*C. dubia*), *Selenastrum capriconutum* (algae)]; hardness; arsenic; cadmium; chromium; copper; lead; nickel; zinc; and mercury.

Figure 3 displays the distribution of the sites within the SJR Basin. For more information on the monitoring sites location including specific sampling location, summary of land-use, available water quality information, and monthly photograph documentation over the course of WY 2004-2005 for each site see Appendix I-O or refer to the central valley water quality web site:

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

The results presented in this report focus on the first and second tier monitoring of the SJR SWAMP effort. Reports on the first three Intensive Basin Programs (Northeast Basin, Eastside Basin, and Westside Basin), the third tier of the program, as well as all water quality data can be found at:

http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_studies/

Figure 3: Monitoring Site Locations

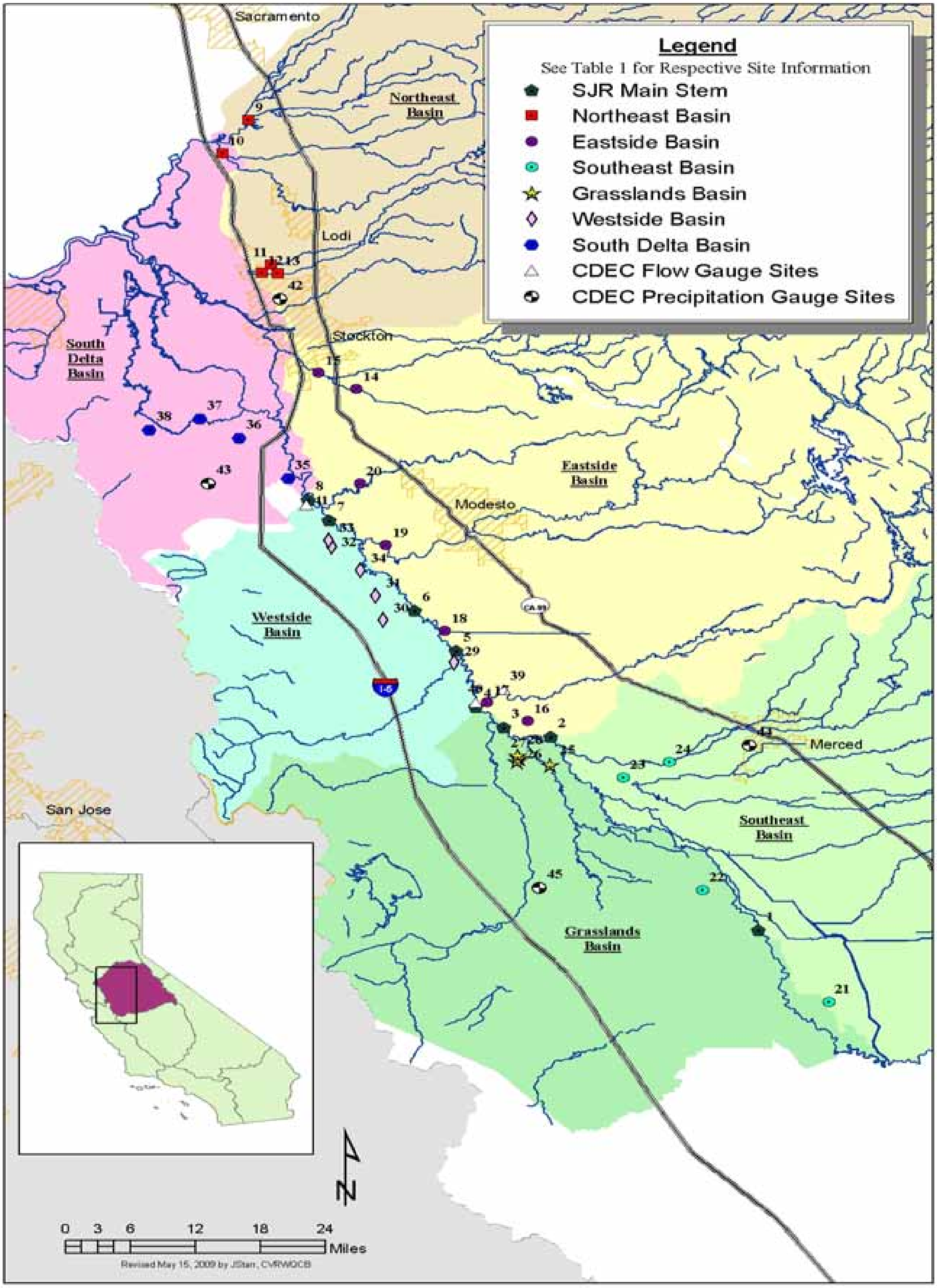


Table 1: SJR SWAMP Station Information and Sampling Frequencies*

Corresponding Map Number	Station Name	Station Code	Water Body Type	Target Lat	Target Long	SC (specific conductance)	pH	DO (dissolved oxygen)	Temp	*E.coli*	Total Coliform	TOC (total organic carbon)	TSS (total suspended solids)	Nutrients +	Trace Metals (Total & Dissolved)	Minerals **	Chronic Toxicity	Acute Toxicity	BOD (biochemical oxygen demand)
	Main Stem																		
1	SJR @ Sack Dam	541MAD007	R	36.98361	-120.50027	M	M	M	M	M	M	M	M	M	M	M			M
2	SJR @ Lander Avenue	541MER522	R	37.29527	-120.85027	W	W	W	W	M+	M+	W	W	M	M	M	M	M	M
3	SJR @ Fremont Ford	541MER538	R	37.30944	-120.92916	W	W	W	W	M+	M+	W	W	M	M	M			M
4	SJR @ Hills Ferry	541STC512	R	37.3425	-120.97722	M	M	M	M	M	M	M	M	M	M	M	M	M	M
5	SJR @ Crows Landing	535STC504	R	37.43194	-121.01166	W	W	W	W	M+	M+	W	W	M	M	M	M	M	M
6	SJR @ Patterson	541STC507	R	37.49777	-121.08166	W	W	W	W	M+	M+	W	W	M	M	M	M	M	M
7	SJR @ Maze	541STC510	R	37.64194	-121.22777	W	W	W	W	M+	M+	W	W	M	M	M			M
8	SJR @ Airport Way	541SJC501	R	37.67555	-121.26416	W	W	W	W	M+	M+	W	W	M	M	M	M	M	M
	Drainage Basin																		
Northeast Basin																			
9	Cosumnes River at Twin Cities Road	531SAC001	ER	38.29083	-121.37583	M	M	M	M	M	M	M	M	M	M	M		M	M
10	Mokelumne River at New Hope Road	544SAC002	ER	38.23611	-121.41889	M	M	M	M	M	M	M	M	M	M	M		M	M
11	Pixley Slough at Davis Road	531SJC507	Eph/SL	38.05611	-121.33305	M	M	M	M	M	M	M	M	M	M	M		M	M
12	Bear Creek at Thornton Road (J8)	544SJC508	Eph/SL	38.04305	-121.34861	M	M	M	M	M	M	M	M	M	M	M			M
13	Bear Creek at Lower Sacramento Road	531SJC515	Eph/SL	38.04277	-121.32139	M	M	M	M	M	M	M	M	M	M	M		M	M
Eastside Basin																			
14	Lone Tree Creek at Austin Road	531SJC503	Eph	37.85555	-121.185	M	M	M	M	M	M	M	M	M	M	M		M	M
15	French Camp Slough at Airport Way	531SJC504	SL	37.88166	-121.24944	M	M	M	M	M	M	M	M	M	M	M		M	M
16	Turner Slough at Fourth Ave.	535MER576	Eph/SL	37.32055	-120.88916	M	M	M	M	M	M	M	M	M	M	M		M	M
17	Merced River @ River Road	535MER546	ER	37.34972	-120.95777	M	M	M	M	M	M	M	M	M	M	M		M	M
18	TID 5 Harding Drain @ Carpenter Road	535STC501	Eph	37.46444	-121.03028	M	M	M	M	M	M	M	M	M	M	M		M	M
19	Tuolumne River at Shiloh Fishing Access	535STC513	ER	37.60305	-121.13166	M	M	M	M	M	M	M	M	M	M	M		M	M
20	Stanislaus River at Caswell Park	535STC514	ER	37.7025	-121.17722	M	M	M	M	M	M	M	M	M	M	M		M	M
Southeast Basin																			
21	Lone Willow Slough at Road No. 9	545MAD006	Eph	36.86694	-120.38194	M	M	M	M	M	M	M	M	M	M	M			M
22	Santa Rita Slough at HWY 152	541MER015	Eph	37.0475	-120.59361	M	M	M	M	M	M	M	M	M	M	M			M
23	Deep Slough at Green House Road	535MER577	Eph	37.22972	-120.72833	M	M	M	M	M	M	M	M	M	M	M			M
24	Bear Creek near Bert Crane Road	535MER007	Eph	37.25555	-120.65194	M	M	M	M	M	M	M	M	M	M	M		M	M

Table 1: SJR SWAMP Station Information and Sample Frequencies* continued...

Corresponding Map Number	Station Name	Station Code	Water Body Type	Target Lat	Target Long	SC (specific conductance)	pH	DO (dissolved oxygen)	Temp	E.coli	Total Coliform	TOC (total organic carbon)	TSS (total suspended solids)	Nutrients +	Trace Metals (Total & Dissolved)	Minerals **	Chronic Toxicity	Acute Toxicity	BOD (biochemical oxygen demand)
Grasslands Basin																			
25	Salt Slough @ Lander Avenue	541MER531	Eph	37.24861	-120.85111	M	M	M	M	M	M	M	M	M	M	M	M	M	M
26	Mud Slough Upstream of SLD Terminus	541MER536	Eph	37.25416	-120.90694	M	M	M	M	M	M	M	M	M	M	M			M
27	San Luis Drain @ Terminus	541MER535	SD	37.25944	-120.90388	M	M	M	M	M	M	M	M	M	M	M			M
28	Mud Slough @ San Luis Drain	541MER542	Eph	37.26388	-120.90611	M	M	M	M	M	M	M	M	M	M	M			M
Westside Basin																			
29	Orestimba Creek @ River Road	541STC019	Eph	37.41388	-121.01416	M	M	M	M	M	M	M	M	M	M	M		M	M
30	Salado Creek at HWY 33	541STC515	Eph	37.48138	-121.13555	M	M	M	M	M	M	M	M	M	M	M		M	M
31	Del Puerto Creek at Vineyard Avenue	541STC516	Eph	37.52138	-121.14861	M	M	M	M	M	M	M	M	M	M	M		M	M
32	Ingram Creek at River Road	541STC040	Eph	37.60027	-121.22416	M	M	M	M	M	M	M	M	M	M	M		M	M
33	Hospital Creek at River Road	541STC042	Eph	37.61055	-121.22861	M	M	M	M	M	M	M	M	M	M	M		M	M
34	Grayson Road Drain at Grayson	541STC030	Eph	37.56194	-121.17416	M	M	M	M	M	M	M	M	M	M	M		M	M
Delta Basin																			
35	New Jerusalem Tile Drain	544SJC001	SD	37.70888	-121.29861	M	M	M	M	M	M	M	M	M	M	M		M	M
36	Tom Paine Slough at Paradise Road	544SJC505	SL	37.77416	-121.38222	M	M	M	M	M	M	M	M	M	M	M			M
37	Old River at Tracy Blvd.	544SJC506	SL	37.80472	-121.44944	M	M	M	M	M	M	M	M	M	M	M			M
38	Mt. House Creek @ Mt. House Parkway	544SJC509	Eph	37.78555	-121.53472	M	M	M	M	M	M	M	M	M	M	M		M	M
	CDEC Gauging Station Sites																		
39	Merced River Near Stevinson (Flow)	MST	NA	37.37100	-120.93100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
40	SJR near Newman (Flow)	NEW	NA	37.35000	-120.97700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
41	SJR Near Vernalis (Flow)	VNS	NA	37.66700	-121.26700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
42	Stockton Fire Station 4 (Precipitation)	STK	NA	38.00100	-121.31700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
43	Tracy Carbona (Precipitation)	TCR	NA	37.70000	-121.43300	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
44	Merced (Precipitation)	MFS	NA	37.28300	-120.51700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
45	Los Banos (Precipitation)	LSB	NA	37.05000	-120.86700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

* Sample frequencies shown indicate frequency of samples taken as funding allowed

+ Nutrient analysis includes nitrate, nitrate-N, total kjeldahl nitrogen (TKN), ammonia, phosphorus, ortho-phosphate, and potassium

** Mineral analysis includes chloride, sulfate, calcium, magnesium, total dissolved solids, carbonate, bicarbonate, total alkalinity and sodium

W = weekly
M = Monthly
M+ = 2X/Month
R = Main Stem River
ER = Eastside River Draining Sierra
Eph = Ephemeral Stream usually dominated by AG return flows during irrigation season
SL = Backwater or Slough that can experience tidal influences
SD = Subsurface Drainage (shallow groundwater)
NA = Not Applicable

6.3 Sampling Procedures

All samples were measured and collected in compliance with the *Agricultural Subsurface Drainage Program Procedures Manual* (Chilcott, *et al.*, 1996) and the *Quality Assurance Program Plan for the State of California's Surface Water Ambient Monitoring Program "SWAMP"* (SWRCB, 2002*).*

Field measurements for temperature, specific conductance, pH, dissolved oxygen and turbidity were taken using one of three meters; Myron 6P Ultra Meter II (temp, SC, and pH only, Oct 2000- July 2001) Yellow Springs Instrument (YSI) 600 XLM Sonde (no turbidity), or a YSI 6600 Sonde (turbidity). All YSI readings were read from YSI 650 data logger.

Clean sample containers were rinsed three times with ambient water prior to grab sample collection, except for sample containers that were pre-acidified (ammonia and TOC) or contained other neutralizing agents (sodium thiosulfate for total coliform and *E. coli*). Water for pre-acidified samples was collected in a stainless steel cup or a sample bottle that was being collected for a separate constituent at the same site and poured into the sample container. All samples were kept at 4 degrees Celsius by storing them on ice after collection and during transport and in a refrigerator while in-house.

Appendix H lists the laboratories, detection levels, holding times and acceptable recoveries for the parameters monitored.

7.0 QUALITY ASSURANCE AND QUALITY CONTROL

All quality assurance (QA) and quality control (QC) log-books for the constituents analyzed by outside laboratories were maintained by the Regional Board contract manager or their designee. QA/QC records for bacteria analysis and equipment maintenance are recorded in the respective QA/QC log-books, found in the Central Valley Water Board laboratory where samples were analyzed.

At a minimum, field sampling equipment was calibrated as per manufacturer's instructions at the start and end of each sampling event and/or after 10-15 sites. If it was found that calibrations were off, the instruments were recalibrated and if needed, measurements re-taken.

Field and handling contamination was evaluated by submitting blind travel blanks on a monthly basis, and on each run for bacteria monitoring. Travel blank samples traveled through the sampling run, and were processed with the sample set. For most constituents, the travel blank consisted of a sample of de-ionized (DI) water that was produced at the Central Valley Water Board laboratory. For bacteria monitoring, the travel blanks were prepared by the Department of Plant Sciences, University of California Davis (UC Davis). After thorough discussion with UC Davis, the travel blanks were initially preparations of boiled deionized water and NaCl, which was then switched to Type II water in July 2002, and ultimately, phosphate buffered saline was added to the Type II water travel blanks at the end of WY 2005. For toxicity monitoring, Sierra Foothill Labs, Inc provided de-mineralized water (DMW) to be used for travel blanks. All data sets used for this report had travel blank results that fell below the analytical detection limits for the elements of concern.

Consistency in sample collection and analysis was evaluated by collecting replicate 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% replicate samples.

Precision and accuracy were evaluated using blind split and spiked samples. Blind split samples were collected at a 10% frequency for each sampling event by collecting the sample in a container double the normal sample volume and splitting that sample into two equal amounts for submittal to the analyzing laboratory. On a monthly basis, and when appropriate, half of the blind split samples were spiked with known concentrations of constituents to be analyzed. Comparing the spiked split to the background split provided information on analytical accuracy. Comparing data from non-spiked splits provided information on analytical precision.

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 trace elements 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 H have been included in this report. These specifications are consistent with the QAPP for this program.

8.0 PRECIPITATION AND FLOW: WATER YEARS 2000-2005

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 13,500 square miles (Graham, 2009; Steensen, *et al.,* 1998). 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. (SWRCB, 1995)

A Water Year begins 1 October and ends 30 September of the following year. Because of the timing of this study, October 2000 through September 2005, five full water years are represented. Table 2 lists the Water Year Classifications based on rainfall and snow totals in the SJR Watershed during the project.

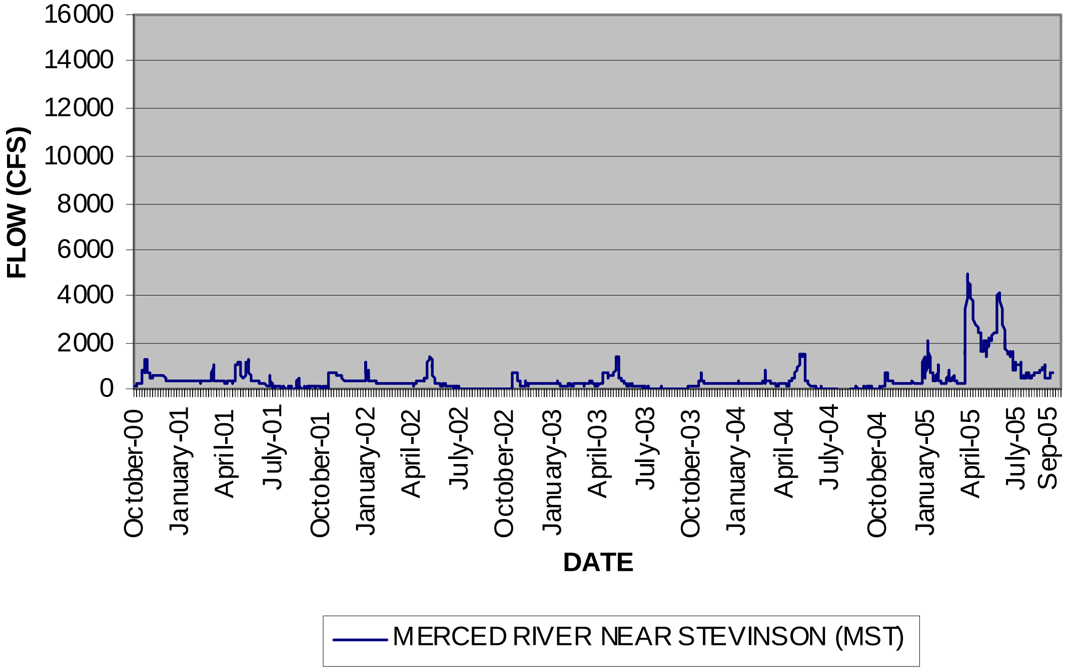
Table 2: Water Year Classifications

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

(Data source DWR, 2007)

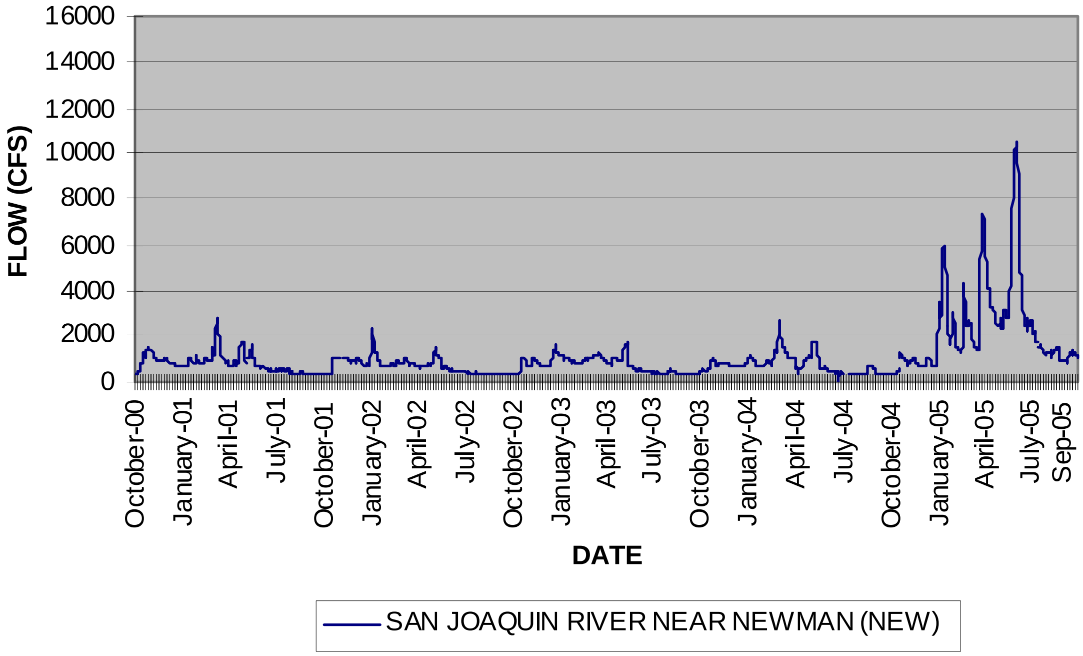
Figures 4, 5, and 6 display the mean daily flow for the Merced River and the San Joaquin River near Newman and Vernalis during this project. These sites represent the main flows coming in and out of the San Joaquin River watershed: the Merced River represents flow from the Sierras, Newman represents the upstream flow of the SJR and Vernalis represents the downstream flow from the SJR entering the Sacramento-San Joaquin Delta.

Figure 4: Merced River Near Stevinson (MST) Mean Daily Flow



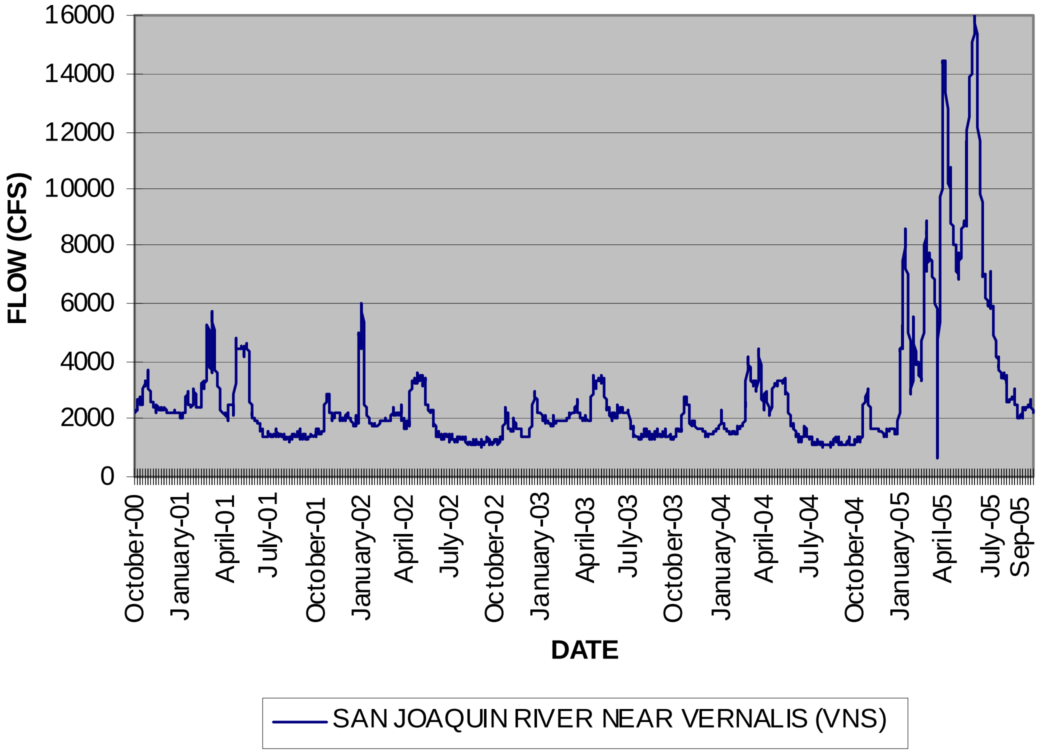
(Data Source, DWR-California Data Exchange Center (CDEC))

Figure 5: San Joaquin River Near Newman (NEW) Mean Daily Flow



(DATA SOURCE, DWR-CALIFORNIA DATA EXCHANGE CENTER (CDEC))

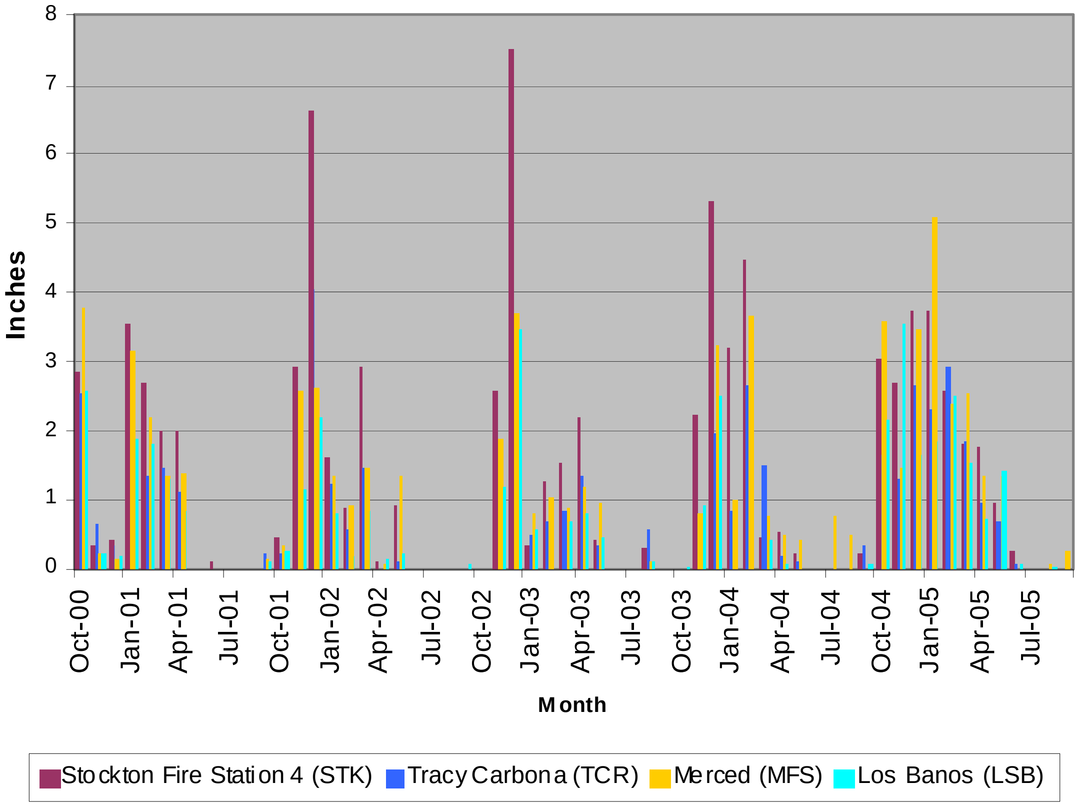
Figure 6: San Joaquin River Near Vernalis (VNS) Mean Daily Flow



(DATA SOURCE, DWR-CALIFORNIA DATA EXCHANGE CENTER (CDEC))

Figure 7 displays the San Joaquin River Watershed Monthly Rainfall Data during the project. These sites represent precipitation throughout the basin and were chosen for their extensive reliable record.

Figure 7: San Joaquin River Watershed Monthly Rainfall Data Water Year 2001-2005



(Data Source, DWR-California Data Exchange Center (CDEC))

9.0 BENEFICIAL USES AND APPLICABLE WATER QUALITY OBJECTIVES AND GOALS

One component of the Central Valley Water Boards SWAMP efforts is to evaluate ambient water quality to determine whether there is any indication that beneficial uses are being impacted. Information gathered during this study allowed analysis of a broad spectrum of water bodies at key integrator sites in order to determine existing quality at the site itself and allow some inference of the water quality within identified sub-basins. Potential beneficial uses applicable to each site monitored were identified using the designated listing from the Sacramento/San Joaquin Water Quality Control Plan (Basin Plan) (CVRWQCB, 1998). To evaluate potential impact, indicators were chosen for five broad beneficial uses: drinking water (salt, TOC, trace elements, nutrients, bacteria); aquatic life (pH, temperature, dissolved oxygen, turbidity, and water column toxicity); irrigation water supply (salt); recreation (bacteria); and waterfowl (selenium). Selenium was not assessed in this report due to the in-depth analysis of the same data through the Grassland Bypass Project. Not all of the indicators could be monitored at each site, due to funding limitations, but at least one indicator for each beneficial use evaluated was included at each site for the study.

The following two sections highlight: 1) the beneficial uses that apply to each of the water bodies sampled; and 2) the objectives and goals that were utilized when evaluating results to determine whether there was any indication that water quality was not supporting a specific beneficial use.

9.1 Applicable Beneficial Uses

In the SJR Basin, all natural water bodies have potential municipal and industrial supply designated through the statewide Sources of Drinking Water Policy (State Water Resources Control Board Resolution No. 88-63). Other specific beneficial uses have been designated to individual water bodies as well as the San Joaquin River/Sacramento-San Joaquin Delta—to which the entire SJR Basin drains. The beneficial uses of any specifically identified water body generally apply to its tributary streams.

The applicable beneficial uses for each sampling site have been summarized in Table 4, under the general headings of Drinking Water, Recreation Use, Irrigation Supply and Aquatic Life. Table 4 indicates whether the use has been specifically designated or is being applied as a tributary. Appendix Q3 provides more detail on the subcategories of use that have been specifically designated in the Sacramento-San Joaquin Basin Plan.

9.2 Applicable Water Quality Objectives and Goals

Water quality information collected during this study was evaluated using water quality objectives adopted in the Sacramento River and San Joaquin River Basin Plan (CVRWQCB, 1998), a compilation of water quality goals identified by state and federal agencies (Marshack, 2003) and targets developed by the Bay-Delta Authority (CFBDP, 2000). 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).

Both the objectives and the goals 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 3.

Appendix Q1 lists the applicable Basin Plan objectives for this study. For turbidity, pH, temperature, and total suspended sediment, the listed objectives refer to changes impacting “normal” and “natural” conditions. For this study, natural conditions have been assumed to be conditions at the furthest upstream sampling location or upstream of a specific discharge. Appendix Q1 also includes targets identified by the Bay-Delta Authority (a joint State and Federal agency) to protect fish passage (temperatures not to exceed 20-degrees Celsius) and drinking water (total organic carbon to remain below 3.0-mg/L). Appendix Q2 shows the applicable goals sorted by generalized beneficial uses.

Table 3: Indicators 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)

Table 4: Applicable Beneficial Uses

SITE SPECIFIC MONITORING BY PROGRAM AND SUB-AREA BASIN	Site ID	Drinking Water	Irrigation	Recreation			Aquatic Life						Designated (D) or Tributary (T)
				REC-1		REC-2	Freshwater Habitat		Migration		Spawning		
		Municipal and Domestic Supply (MUN)		Contact	Canoeing and Rafting	Other Noncontact	Warm	Cold	Warm	Cold	Warm	Cold	
MAIN STEM SAN JOAQUIN RIVER													
SJR @Sack Dam	541MAD007	P	E	E	E	E	E		E	E	E	P	D
SJR @ Lander	541MER522	P	E	E	E	E	E		E	E	E	P	D
SJR @ Fremont Ford	541MER538	P	E	E	E	E	E		E	E	E	P	D
SJR @ Hills Ferry	541STC512	P	E	E	E	E	E		E	E	E	P	D
SJR @ Crows	535STC504	P	E	E	E	E	E		E	E	E		D
SJR @ Patterson	541STC507	P	E	E	E	E	E		E	E	E		D
SJR @ Maze	541STC510	P	E	E	E	E	E		E	E	E		D
SJR @ Airport Way/Vernalis	541SJC501	P	E	E	E	E	E		E	E	E		D
DRAINAGE BASIN INFLOWS TO SJR													
North East Basin													
Cosumnes River @ Twin Cities Rd.	531SAC001	E	E	E	E	E	E	E	E	E	E	E	D
Mokelumne River @ New Hope Rd.	544SAC002		E	E	E	E	E	E	E	E	E	E	D
Pixley Slough @Davis Rd. *	544SJC507	E	E	E		E	E	E	E	E	E		T
Bear Creek @Thornton Rd (J8) *	544SJC508	E	E	E		E	E	E	E	E	E		T
Bear Creek @Lower Sacramento Rd. *	531SJC515	E	E	E		E	E	E	E	E	E		T
Eastside Basin													
Lone Tree Creek *	531SJC503	E	E	E		E	E	E	E	E	E		T
French Camp Slough @ Airport *	531SJC504	E	E	E		E	E	E	E	E	E		T
Merced River Hatfield Park (River Road)	541MER546	E		E	E	E	E	E	E	E	E	E	D
Turner Slough @ 4th Avenue *	535MER576	P	E	E	E	E	E		E	E	E	P	T
TID 5 (Harding Drain)*	535STC501	P	E	E	E	E	E		E	E	E		T
Tuolumne River @ Shiloh	535STC513	P	E	E	E	E	E	E		E	E	E	D
Stanislaus River @Caswell	535STC514	P	E	E	E	E	E	E		E	E	E	D
Southeast Basin													
Lone Willow Slough *	545MAD006	P	E	E	E	E	E		E	E	E	P	T
Bear Creek @ Bert Crane Rd. *	535MER007	P	E	E	E	E	E		E	E	E	P	T
Deep Slough Green House Rd. *	535MER577	P	E	E	E	E	E		E	E	E	P	T
Grassland Basin													
Discharge from San Luis Drain (SLD)*	541MER535		L	E		E	E				E		T
Mud Slough (upstream of SLD)	541MER536		L	E		E	E				E		D
Mud Slough (Downstream of SLD)	541MER542		L	E		E	E				E		D
Salt Slough @Lander/Hwy 165	541MER531		E	E		E	E				E		D
West Side Basin													
Orestimba Creek @ River Rd. *	541STC019	P	E	E	E	E	E		E	E	E		T
Solado Creek @ Hwy 33 *	541STC515	P	E	E	E	E	E		E	E	E		T
Del Puerto Creek @Vineyard *	541STC516	P	E	E	E	E	E		E	E	E		T
Grayson Drain *	541STC030	P	E	E	E	E	E		E	E	E		T
Ingram Creek @River Rd. *	541STC040	P	E	E	E	E	E		E	E	E		T
Hospital Creek @River Rd. *	541STC042	P	E	E	E	E	E		E	E	E		T
Delta Basin													
New Jerusalem Drain*	544SJC501		E	E		E	E	E	E	E	E		T
Tom Payne Slough @Paradise Rd.	544SJC505	E	E	E		E	E	E	E	E	E		D
Old River @Tracy Blvd	544SJC506	E	E	E		E	E	E	E	E	E		D
Mt. House Creek @ Mt. House Parkway	S544SJC509	E	E	E		E	E	E	E	E	E		T

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

10.0 RESULTS

10.1 Result Summaries

All data collected is presented in Appendices A-G. Summary tables of the information were created using the appendices and indicate the number of samples taken, minimum and maximum values observed, mean, geo mean, median, quartile 1 and quartile 3 for all of the sites sampled. These summary tables also include sub-basin summaries. These sub-basin summaries do not include the San Luis Drain and New Jerusalem Drain—two sites unique to the basin since they represent shallow groundwater/sub-surface drainage and not typical surface flows. Table 5a provides a summary of the field temperature, specific conductance (SC) and pH. Table 5b lists summary results for dissolved oxygen (DO), turbidity and total suspended solids (TSS). Table 5c lists total organic carbon (TOC), total coliform and *E. coli*. Table 5d summarizes nitrate, nitrate-N, and total kjeldahl nitrogen. Table 5e lists ammonia as N, phosphorus and ortho-phosphate as P. Table 5f summarizes potassium, biochemical oxygen demand (5-day and 10-day). Table 5g summarizes chloride, sulfate, and calcium. Table 5h provides summaries of magnesium, total dissolved solids (TDS), and carbonate. Table 5i lists bicarbonate, total alkalinity and sodium. Sample collection for metals and toxicity were limited, so results have been provided in the appendices and are evaluated in the discussion section of the report.

A toxic event summary table (Table 6) of the toxicity data collected was created by defining a toxic event as statistically significant and at least a 20% difference from the control. Table 6 shows toxic events for acute fathead minnows, acute *Ceriodaphnia dubia*, acute algae, chronic fathead minnow and chronic *Ceriodaphnia dubia*.

Table 5a: Temperature, Specific Conductance (SC) and pH Results Summary

		TempºC								Field SC (umhos)								pH							
Main Stem	Site Code	**Count**	**Min**	**Max**	**Mean**	**Geo Mean**	**Median**	**Q1**	**Q3**	**Count**	**Min**	**Max**	**Mean**	**Geo Mean**	**Median**	**Q1**	**Q3**	**Count**	**Min**	**Max**	**Mean**	**Geo Mean**	**Median**	**Q1**	**Q3**
SJR @Sack Dam	541MAD007	65	5.5	26.4	17.2	16.0	17.1	12.5	22.7	65	85.0	1010	553	519	558	465	661	65	6.2	8.8	7.8	7.8	7.8	7.6	8.0
SJR @ Lander	541MER522	265	7.4	30.0	18.1	17.0	18.4	12.9	23.6	265	59.0	2260	1270	1080	1360	867	1720	261	6.5	9.0	7.9	7.9	7.9	7.7	8.2
SJR @ Fremont Ford	541MER538	258	6.2	27.5	17.5	17.2	17.9	12.6	23.1	256	171	2730	1462	1340	1465	1170	1760	256	6.3	8.2	7.6	7.6	7.7	7.5	7.8
SJR @ Hills Ferry	541STC512	83	8.0	27.8	18.8	17.9	19.2	14.5	23.7	83	220	3080	1760	1650	1790	1500	2100	82	6.6	8.3	7.8	7.8	7.8	7.6	8.0
SJR @ Crows	535STC504	261	6.6	28.4	17.5	16.5	17.7	12.9	22.5	261	100	1900	1165	1078	1250	965	1430	259	6.6	8.4	7.8	7.8	7.8	7.7	7.9
SJR @ Patterson	541STC507	262	6.9	27.7	18.2	17.2	18.4	13.5	23.3	262	140	1820	1176	1110	1230	988	1420	260	6.6	8.6	7.8	7.8	7.8	7.7	8.0
SJR @ Maze	541STC510	260	7.4	27.5	17.8	16.8	17.1	13.1	23.1	260	100	1410	847	786	904	673	1020	258	6.7	9.0	7.9	7.9	7.9	7.7	8.0
SJR @ Airport Way/Vernalis	541SJC501	264	7.1	27.1	17.4	16.5	17.0	13.1	22.3	265	97.0	1200	685	636	705	496	848	263	6.1	9.1	7.9	7.9	7.9	7.7	8.1
Southeast Basin																									
Deep Slough Green House Rd	535MER577	54	5.6	29.5	17.4	16.1	17.4	12.0	23.3	54	48.0	983	484	423	470	326	601	54	6.6	8.9	8.0	8.0	7.9	7.7	8.3
Santa Rita Slough at Highway 152	541MER015	5	5.7	21.7	14.9	13.3	16.3	9.6	21.2	5	615	830	728	722	731	643	820	5	7.0	8.2	7.5	7.5	7.4	7.1	7.7
Bear Creek Bert Crane Rd	535MER007	60	5.2	27.7	16.9	15.8	17.8	12.0	22.1	60	54.0	238	116	108	106	84.0	137	60	6.8	8.7	7.9	7.9	7.9	7.7	8.1
Southeast Basin Summary		119	5.2	29.5	17.0	15.8	17.5	12.0	22.2	119	48.0	983	309	217	193	102	497	119	6.6	8.9	7.9	7.9	7.9	7.7	8.2
Grassland Basin																									
Salt Slough @Lander/Hwy 165	541MER531	262	6.7	28.1	17.3	16.4	17.5	12.4	22.6	262	769	2470	1420	1370	1400	1130	1670	260	6.3	8.6	7.7	7.7	7.7	7.6	7.8
Mud Slough (n) (upstream) @ SLD	541MER536	260	6.6	32.8	18.0	16.8	18.1	12.7	23.1	259	652	3820	1660	1540	1550	1200	2030	257	6.5	8.7	7.9	7.9	7.9	7.8	8.1
Discharge from SLD	541MER535	264	7.6	28.7	18.2	17.2	18.5	13.1	23.6	264	3250	5960	4450	4410	4430	4080	4720	261	5.5	8.9	8.1	8.1	8.2	7.9	8.4
Mud Slough (n) (downstream) @ SLD	541MER542	264	6.9	29.3	17.9	16.9	18.2	12.6	23.4	264	1200	5140	2854	2710	2805	2040	3503	261	6.6	8.7	8.0	8.0	8.0	7.8	8.3
Grassland Basin Summary*		786	6.6	32.8	17.7	16.7	17.9	12.6	22.9	785	652	5140	1420	1793	1400	1290	2460	778	6.3	8.7	7.9	7.9	7.9	7.7	8.1
Eastside Basin																									
Turner Slough at 4th Avenue	535MER576	51	5.0	29.6	18.5	17.2	19.3	12.7	24.2	51	68.0	474	230	216	212	175	269	51	6.4	9.1	7.7	7.7	7.7	7.5	8.0
Merced River Hatfield Park(River Rd)	541MER546	54	8.4	26.8	17.6	16.7	16.7	13.1	23.1	54	41.0	454	183	152	155	100	241	54	6.9	9.2	7.9	7.9	7.8	7.7	8.1
Lone Tree Creek @ Austin Rd	531SJC503	49	1.9	24.2	15.1	13.8	15.5	10.6	20.6	49	69.0	605	254	217	225	129	331	49	5.4	8.9	7.6	7.6	7.6	7.4	7.8
French Camp Slough @ Airport	531SJC504	48	5.8	25.7	16.0	15.0	15.8	11.4	20.8	48	84.0	738	215	190	171	139	256	47	6.6	8.7	7.6	7.6	7.6	7.4	7.8
Harding Drain @ SJR (TID5)	535STC501	74	10.5	26.4	19.0	18.4	18.6	16.0	22.8	74	258	1460	759	710	703	533	1015	74	7.0	8.5	7.7	7.7	7.7	7.6	7.8
Tuolumne River @ Shiloh	535STC513	84	7.7	26.4	17.3	16.5	16.4	12.5	22.1	84	45.0	396	193	175	200	160	240	84	6.7	9.0	7.9	7.8	7.9	7.6	8.1
Stanislaus River @Caswell	535STC514	49	7.3	23.8	15.5	14.9	14.7	11.7	18.9	49	60.0	183	108	104	105	88.0	125	49	6.6	9.0	7.8	7.8	7.8	7.6	8.0
Eastside Basin Summary		409	1.9	29.6	17.2	16.2	17.3	12.5	21.9	409	41.0	1460	299	221	199	133	346	408	5.4	9.2	7.7	7.7	7.7	7.6	7.9
Westside Basin																									
Orestimba Creek @ River Rd.	541STC019	197	3.6	25.8	16.6	15.6	17.3	12.7	20.9	197	8.00	1290	723	692	720	627	820	197	7.3	8.9	8.0	8.0	8.0	7.9	8.1
Solado Creek @ Hwy 33	541STC515	70	5.1	26.0	17.4	16.6	17.4	13.5	21.7	70	123	4160	961	838	827	655	1040	70	6.6	9.0	8.2	8.2	8.2	8.1	8.4
Del Puerto Creek @Vineyard	541STC516	68	6.7	27.6	17.7	16.7	19.0	12.5	22.1	68	207	1860	874	808	818	629	1090	68	7.2	8.9	8.0	8.0	8.0	7.8	8.2
Grayson Drain	541STC030	56	7.1	30.9	18.6	17.9	19.2	14.3	22.1	56	145	1630	836	745	803	649	1038	56	7.3	8.8	8.0	8.0	8.1	7.9	8.2
Ingram Creek @River Rd.	541STC040	72	4.5	25.2	16.5	15.8	16.4	13.0	20.6	72	101	2190	1202	1037	1095	800	1575	72	6.3	8.3	7.8	7.8	7.9	7.7	8.0
Hospital Creek @River Rd.	541STC042	53	8.8	25.3	17.6	17.0	17.5	14.4	21.0	53	75.0	1980	726	626	662	449	962	53	6.5	8.7	7.8	7.8	7.9	7.7	8.1
Westside Basin Summary		516	3.6	30.9	17.2	16.3	17.5	13.2	21.3	516	8.00	4160	855	765	770	633	995	516	6.3	9.0	8.0	8.0	8.0	7.8	8.2
Northeast Basin																									
Cosumnes River @ Twin Cities Rd.	531SAC001	38	5.2	24.9	13.8	12.8	12.7	9.7	19.0	38	46.0	427	106	96.2	97.5	73.3	118	38	6.0	9.3	7.6	7.6	7.8	6.9	8.1
Mokelumne River @New Hope Rd.	544SAC002	58	7.0	24.4	15.4	14.7	14.8	11.5	18.9	58	41.0	104	52.1	51.3	49.0	46.3	53.0	57	6.9	10.1	7.8	7.8	7.7	7.4	8.1
Pixley Slough @ Davis Rd	531SJC507	54	5.0	23.5	16.5	15.8	17.8	13.0	20.2	54	48.0	275	87.6	79.9	72.5	61.3	97.8	53	6.7	9.4	7.5	7.5	7.4	7.2	7.6
Bear Creek @ Thorton Road (J8)	544SJC508	26	5.6	24.2	15.8	14.7	17.2	11.0	20.2	26	57.0	481	153	132	117	87.0	207	25	6.3	8.8	7.4	7.4	7.3	7.1	7.7
Bear Creek @Lower Sacramento Rd.	531SJC515	36	7.2	25.9	16.5	15.7	16.4	12.4	21.4	36	55.0	378	151	126	107	70.5	230	36	6.9	7.8	7.3	7.3	7.3	7.1	7.5
Northeast Basin Summary		212	5.0	25.9	15.6	14.7	15.9	11.4	19.8	212	41.0	481	100	84.1	73.0	53.0	111	209	6.0	10.1	7.5	7.5	7.5	7.2	7.8
South Delta Basin																									
New Jerusalem Drain	544SJC001	52	11.0	20.7	18.0	17.9	18.4	17.4	19.2	52	1340	2790	2420	2410	2440	2300	2560	51	7.1	8.3	7.6	7.6	7.6	7.4	7.9
Tom Payne Slough @ Paradise Rd.	544SJC505	56	7.2	25.7	17.2	16.3	17.1	13.2	21.6	56	762	3180	1770	1580	1450	1070	2720	55	6.9	8.2	7.5	7.5	7.5	7.3	7.7
Old River @Tracy Blvd	544SJC506	60	8.4	26.6	17.7	16.8	18.4	13.2	22.4	60	150	1230	826	787	826	725	959	59	6.5	8.5	7.7	7.7	7.7	7.5	8.0
Mountain House Creek	544SJC509	20	6.8	23.9	15.6	14.5	17.5	10.0	20.2	20	246	2930	1280	863	666	520	1940	20	7.2	8.8	7.7	7.7	7.8	7.6	7.8
South Delta Basin Summary^		136	6.8	26.6	17.2	16.3	17.6	13.0	21.6	136	150	3180	1770	1063	1450	1070	1438	134	6.5	8.8	7.6	7.6	7.6	7.4	7.8

*Discharge from SLD not included into calculations

^New Jerusalem Drain not included into calculations

NA = Data not applicable

NOTE: For values reported as < (less than), half the detection limit was used

Table 5b: Dissolved Oxygen (DO), Turbidity and Total Suspended Solids (TSS) Results Summary

		Dissolved Oxygen (mg/L)								Turbidity (ntu)								TSS (mg/L)							
Main Stem	Site Code	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3
SJR @Sack Dam	541MAD007	51	0.6	13.9	8.8	8.3	8.4	7.7	10.1	18	7.3	112	49.8	39.1	50.7	24.8	69.1	8	18	57	36	34	33	31	43
SJR @ Lander	541MER522	217	3.4	23.3	10.2	9.8	9.7	8.5	11.6	60	12.9	114	29.9	27.1	24.5	20.8	34.7	158	15	130	32	30	30	24	37
SJR @ Fremont Ford	541MER538	214	1.6	18.5	9.0	8.7	8.7	7.7	10.1	56	12.3	176	76.7	70.4	68.7	59.1	96.5	151	24	180	72	65	66	50	90
SJR @ Hills Ferry	541STC512	67	3.9	12.6	8.9	8.7	8.8	8.1	9.7	18	27.5	194	90.8	78.5	66.1	51.4	138	6	34	150	76	66	59	46	98
SJR @ Crows	535STC504	216	5.1	15.9	9.5	9.4	9.3	8.5	10.4	55	12.3	273	53.9	48.1	47.9	36.3	61.2	162	16	120	47	44	44	35	56
SJR @ Patterson	541STC507	215	7.0	16.3	10.2	10.0	9.8	9.0	11.2	55	12.4	170	46.0	41.5	40.2	31.8	51.9	156	14	170	46	42	42	34	54
SJR @ Maze	541STC510	213	4.1	16.4	10.5	10.3	10.3	9.3	11.2	54	12.4	82.0	39.9	37.1	36.6	29.9	47.4	158	14	160	48	44	45	35	54
SJR @ Airport Way/Vernalis	541SJC501	216	1.3	16.6	10.6	10.4	10.5	9.5	11.5	54	12.3	86.6	35.2	33.2	30.8	27.2	42.2	163	11	160	44	40	42	33	52
Southeast Basin																									
Deep Slough Green House Rd	535MER577	43	4.2	15.8	8.7	8.4	8.0	7.2	10.1	17	48.6	480	127	98.8	79.3	68.3	113	8	34	220	100	89	93	77	100
Santa Rita Slough at Highway 152	541MER015	1	6.2	6.2	6.2	6.2	6.2	6.2	6.2	NA	NA	NA	NA	NA	NA	NA	NA	4	2.5	42	19	12	16	8	26
Bear Creek Bert Crane Rd	535MER007	49	6.6	13.8	9.5	9.4	9.1	8.1	10.6	21	10.1	110	43.9	37.5	42.0	20.1	53.4	8	16	170	57	46	50	33	54
Southeast Basin Summary		93	4.2	15.8	9.1	8.9	8.7	7.6	10.3	38	10.1	480	81.0	57.8	56.9	38.6	80.0	20	2.5	220	66	46	53	33	92
Grassland Basin																									
Salt Slough @Lander/Hwy 165	541MER531	216	1.2	14.9	8.3	8.0	8.1	6.8	9.6	60	18.8	330	94.2	84.3	83.2	61.9	119	10	34	170	89	78	74	60	114
Mud Slough (n) (upstream) @ SLD	541MER536	210	2.1	19.0	9.5	9.1	9.4	7.9	11.0	54	12.2	142	54.1	44.8	44.1	29.3	68.7	11	11	150	33	24	22	14	30
Discharge from SLD	541MER535	218	3.2	30.0	12.9	12.6	12.5	11.5	13.9	55	12.7	70.6	32.1	29.5	26.5	22.5	40.7	234	14	96	45	43	43	36	52
Mud Slough (n) (downstream) @ SLD	541MER542	218	2.6	27.6	9.9	9.7	9.8	8.8	10.8	55	13.3	218	45.8	39.0	38.6	26.0	52.7	12	15	72	39	35	41	27	48
Grassland Basin Summary*		644	1.2	27.6	9.2	8.9	9.2	7.7	10.6	169	12.2	330	66	53.6	54.0	34.2	84	33	11	170	52	39	37	25	60
Eastside Basin																									
Turner Slough at 4th Avenue	535MER576	47	3.2	13.3	8.1	7.7	7.8	6.2	9.9	19	62.4	515	146	127	113	94.7	154	6	28	88	46	42	35	30	56
Merced River Hatfield Park(River Rd)	541MER546	46	6.7	12.2	9.6	9.5	9.6	8.6	10.4	10	4.3	45.3	14.0	10.4	9.5	5.8	15.5	5	2.5	14	5.1	3.9	3.0	3.0	3.0
Lone Tree Creek @ Austin Rd	531SJC503	37	0.4	11.4	8.2	7.7	8.2	7.6	9.5	6	38.8	288	90.4	67.3	51.4	50.1	60.4	10	6.0	130	37	26	23	18	47
French Camp Slough @ Airport	531SJC504	38	0.4	13.2	8.6	8.0	8.7	7.5	10.1	8	7.0	335	71.4	36.4	46.1	15.9	51.9	9	3.0	80	33	23	24	15	50
Harding Drain @ SJR (TID5)	535STC501	62	5.2	15.3	9.7	9.5	9.5	8.5	10.7	27	0.7	698	53.9	11.2	7.0	5.0	17.9	14	3.0	49	13	10	9.0	7.0	13
Tuolumne River @ Shiloh	535STC513	69	6.8	12.5	9.7	9.6	9.7	8.7	10.5	30	2.1	94.5	12.4	8.1	7.1	4.9	11.8	16	2.5	32	9.0	7.1	7.5	5.3	11
Stanislaus River @Caswell	535STC514	40	7.8	15.1	10.0	9.9	9.9	9.1	10.8	9	0.8	52.3	12.8	7.5	6.2	5.1	14.3	7	2.8	16	8.8	6.9	11	3.0	13
Eastside Basin Summary		339	0.4	15.3	9.2	8.9	9.4	8.1	10.4	109	0.7	698	54.8	18.1	13.0	5.7	57.0	67	2.5	130	20	12	11	6.0	25
Westside Basin																									
Orestimba Creek @ River Rd.	541STC019	176	6.0	17.2	9.9	9.8	9.7	8.7	10.8	52	14.1	810	190	143	165	84.4	258	32	10	780	134	81	76	41	155
Solado Creek @ Hwy 33	541STC515	61	6.0	14.9	10.2	10.1	10.1	9.1	11.1	15	14.4	1990	277	82.2	43.5	26.0	224	30	2.0	3200	214	35	37	7.8	91
Del Puerto Creek @Vineyard	541STC516	56	4.5	17.8	9.6	9.3	9.2	8.1	11.1	13	5.7	244	75.5	51.0	70.4	37.3	89.0	27	6.0	660	100	52	48	32	87
Grayson Drain	541STC030	47	3.4	12.0	9.3	9.1	9.3	8.6	10.2	11	5.3	1340	450	143	477	45.4	651	23	2.5	28000	1821	195	180	59	825
Ingram Creek @River Rd.	541STC040	63	7.0	14.5	9.7	9.6	9.5	8.6	10.4	17	3.6	1900	409	132	139	27.9	580	21	0.5	6200	840	180	570	22	1100
Hospital Creek @River Rd.	541STC042	47	4.8	15.2	9.6	9.4	9.5	8.5	10.6	13	6.8	365	200	126	208	80.6	307	15	27	3300	900	310	420	85	1100
Westside Basin Summary		450	3.4	17.8	9.8	9.6	9.5	8.5	10.7	121	3.6	1990	244	117	122	53.7	280	148	0.5	28000	584	93	79	35	345
Northeast Basin																									
Cosumnes River @ Twin Cities Rd.	531SAC001	27	7.9	14.1	10.7	10.6	10.8	9.6	11.5	11	3.2	248	34.1	14.1	13.4	7.6	16.3	9	2.5	49	22	17	20	11	34
Mokelumne River @New Hope Rd.	544SAC002	48	6.6	13.4	9.6	9.5	9.6	8.7	10.8	18	2.6	42.0	11.8	9.2	8.2	6.1	13.2	10	2.5	8.0	4.2	3.7	2.8	2.5	5.8
Pixley Slough @ Davis Rd	531SJC507	47	0.7	13.5	7.8	7.3	7.7	6.2	9.1	18	16.1	124	44.3	38.0	40.8	28.4	46.9	7	2.5	57	23	16	25	12	26
Bear Creek @ Thorton Road (J8)	544SJC508	16	4.8	11.8	7.7	7.5	7.7	6.4	8.8	2	21.6	39.1	30.4	29.1	30.4	26	34.7	10	2.5	30	15	11	15	7.0	21
Bear Creek @Lower Sacramento Rd.	531SJC515	36	2.4	13.9	6.8	6.4	6.3	5.6	8.0	18	11.6	191	48.6	34.8	31.4	17.8	63.9	NA	NA	NA	NA	NA	NA	NA	NA
Northeast Basin Summary		174	0.7	14.1	8.5	8.1	8.6	6.7	10.4	67	2.6	248	34.6	21.4	21.6	12.6	42.3	36	2.5	57	15	10	11	3.8	24
South Delta Basin																									
New Jerusalem Drain	544SJC001	42	8.3	14.6	10.2	10.2	10.1	9.3	10.9	13	0.2	290	30.7	4.1	2.6	0.9	13.9	10	2.5	33	6.7	4.0	2.9	2.5	3.0
Tom Payne Slough @ Paradise Rd.	544SJC505	46	2.2	16.2	7.6	7.0	7.1	5.4	9.4	17	3.9	110	25.9	16.9	15.1	10.5	38.1	10	18	59	29	27	27	23	30
Old River @Tracy Blvd	544SJC506	50	3.3	14.4	8.8	8.5	8.8	7.4	10.1	20	19.3	55.9	34.6	33.1	32.3	26.8	42.0	10	14	44	28	26	25	21	35
Mountain House Creek	544SJC509	12	2.9	11.9	8.9	8.4	9.1	8.1	10.3	6	41.0	274	152	125	131	87.0	230	9	15	110	43	35	34	25	49
South Delta Basin Summary^		108	2.2	16.2	8.3	7.8	8.3	6.6	10.0	43	3.9	274	47.6	30.5	32.1	17.0	49.7	29	14	110	33	29	27	22	36

*Discharge from SLD not included into calculations

^New Jerusalem Drain not included into calculations

NA = Data not applicable

NOTE: For values reported as < (less than), half the detection limit was used

Table 5c: Total Organic Carbon (TOC), Total Coliform and *E. coli* Results Summary

		TOC (mg/L)								Total Coliform								E. coli							
Main Stem	Site Code	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3
SJR @Sack Dam	541MAD007	33	0.5	11	3.9	3.3	3.4	2.5	4.7	30	727	>2420	NA	1944	>2420	1986	>2420	30	19	248	NA	46	43	30	63
SJR @ Lander	541MER522	162	0.5	27	8.7	7.6	8.2	5.5	12	47	816	>2420	NA	2273	>2420	>2420	>2420	46	7	>2420	NA	59	50	22	103
SJR @ Fremont Ford	541MER538	160	0.5	22	7.9	7.1	7.6	5.3	9.9	46	870	>2420	NA	2321	>2420	>2420	>2420	46	20	>2420	NA	101	83	60	124
SJR @ Hills Ferry	541STC512	30	0.5	16	8.2	7.4	8.1	6.3	10	29	>2420	>2420	NA	>2420	>2420	>2420	>2420	29	27	>2420	NA	162	124	77	291
SJR @ Crows	535STC504	162	0.5	15	6.3	5.6	5.8	3.9	8.2	46	>2420	>2420	NA	>2420	>2420	>2420	>2420	46	30	>2420	NA	111	93	60	142
SJR @ Patterson	541STC507	161	0.5	22	6.6	5.8	5.8	4.1	8.4	46	>2420	>2420	NA	>2420	>2420	>2420	>2420	46	24	>2420	NA	129	114	75	162
SJR @ Maze	541STC510	157	0.5	16	5.1	4.4	4.3	3.0	6.4	46	961	>2420	NA	2340	>2420	>2420	>2420	46	24	>2420	NA	95	65	47	156
SJR @ Airport Way/Vernalis	541SJC501	163	0.5	18	4.5	3.9	3.8	2.8	5.2	46	457	>2420	NA	2263	>2420	>2420	>2420	46	16	>2420	NA	86	60	38	151
Southeast Basin																									
Deep Slough Green House Rd	535MER577	31	0.5	14	7.3	6.0	6.9	4.4	10	25	866	>2420	NA	2323	>2420	>2420	>2420	25	9	>2420	NA	238	199	96	980
Santa Rita Slough at Highway 152	541MER015	5	0.5	24	9.8	5.5	8.4	4.3	12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bear Creek Bert Crane Rd	535MER007	31	0.5	21	5.9	4.4	4.8	3.3	7.0	30	1553	>2420	NA	2384	>2420	>2420	>2420	30	44	>2420	NA	502	448	265	1276
Southeast Basin Summary		67	0.5	24	6.8	5.2	6.0	3.6	9.6	55	866	>2420	NA	2356	>2420	>2420	>2420	55	9	>2420	NA	358	435	122	1203
Grassland Basin																									
Salt Slough @Lander/Hwy 165	541MER531	38	0.5	21	7.5	6.1	6.9	4.8	8.8	30	613	>2420	NA	2271	>2420	>2420	>2420	30	42	921	NA	124	101	64	159
Mud Slough (n) (upstream) @ SLD	541MER536	38	0.5	27	11	9.4	10	8.3	13	29	727	>2420	NA	2295	>2420	>2420	>2420	29	33	>2420	NA	179	152	96	326
Discharge from SLD	541MER535	33	0.5	16	8.5	7.2	8.8	5.9	11	30	272	>2420	NA	1800	>2420	1905	>2420	21	1	770	NA	12	9	6	23
Mud Slough (n) (downstream) @ SLD	541MER542	39	0.5	32	12	9.6	11	8.6	13	28	1011	>2420	NA	2346	>2420	>2420	>2420	28	6	>2420	NA	76	75	44	101
Grassland Basin Summary*		115	0.5	32	10	8	9.5	6.6	13	87	613	>2420	NA	2303	>2420	>2420	>2420	87	6	>2420	NA	120	101	63	185
Eastside Basin																									
Turner Slough at 4th Avenue	535MER576	29	0.5	53	11.5	8	7.6	5.8	13	28	1414	>2420	NA	2374	>2420	>2420	>2420	28	115	>2420	NA	654	749	381	1363
Merced River Hatfield Park(River Rd)	541MER546	26	0.5	9.3	2.9	2.5	2.3	1.8	3.1	26	344	>2420	NA	1973	>2420	>2420	>2420	26	19	1986	NA	120	96	73	276
Lone Tree Creek @ Austin Rd	531SJC503	23	2.8	67	19	14	17	6.6	23	21	1011	>2420	NA	2321	>2420	>2420	>2420	21	82	>2420	NA	468	435	238	816
French Camp Slough @ Airport	531SJC504	28	0.5	34	8.9	6.3	7.4	4.5	11	22	727	>2420	NA	2291	>2420	>2420	>2420	22	17	1986	NA	182	182	81	304
Harding Drain @ SJR (TID5)	535STC501	34	2.3	24	6.9	5.9	5.4	3.9	8.9	40	1733	>2420	NA	2400	>2420	>2420	>2420	40	16	>2420	NA	422	399	258	829
Tuolumne River @ Shiloh	535STC513	34	0.5	8.7	2.7	2.2	2.2	1.7	2.7	46	179	>2420	NA	1843	>2420	>2420	>2420	46	8	649	NA	83	75	43	133
Stanislaus River @Caswell	535STC514	23	0.5	7.0	2.7	2.2	2.1	1.5	3.2	22	411	>2420	NA	1796	>2420	1472	>2420	22	30	308	NA	78	76	50	101
Eastside Basin Summary		197	0.5	67	7.5	4.6	5	2.3	8.0	205	179	>2420	NA	2118	>2420	>2420	>2420	205	8	>2420	NA	205	201	80	517
Westside Basin																									
Orestimba Creek @ River Rd.	541STC019	33	0.5	14	5.0	4.1	4.5	2.6	5.8	39	1011	>2420	NA	2340	>2420	>2420	>2420	39	40	>2420	NA	418	517	182	951
Solado Creek @ Hwy 33	541STC515	36	0.5	30	6.1	4.5	4.1	3.2	6.7	40	145	>2420	NA	2117	>2420	>2420	>2420	40	2	>2420	NA	288	387	105	782
Del Puerto Creek @Vineyard	541STC516	33	1.8	19	5.5	4.8	4.9	3.2	7.0	38	1300	>2420	NA	2368	>2420	>2420	>2420	38	73	>2420	NA	819	1203	371	>2420
Grayson Drain	541STC030	27	2.1	21	6.7	5.9	5.4	4.1	8.8	31	1120	>2420	NA	2361	>2420	>2420	>2420	31	7	>2420	NA	337	260	123	1484
Ingram Creek @River Rd.	541STC040	25	0.5	17	5.3	4.0	4.1	2.8	6.2	40	691	>2420	NA	2258	>2420	>2420	>2420	40	9	>2420	NA	214	202	131	463
Hospital Creek @River Rd.	541STC042	18	2.8	23	7.6	6.2	5.3	4.0	9.3	33	691	>2420	NA	2330	>2420	>2420	>2420	33	8	>2420	NA	353	272	162	691
Westside Basin Summary		172	0.5	30	5.9	4.8	4.7	3.2	7.5	221	145	>2420	NA	2289	>2420	>2420	>2420	221	2	>2420	NA	368	387	150	1203
Northeast Basin																									
Cosumnes River @ Twin Cities Rd.	531SAC001	21	0.5	20	3.6	2.6	2.3	1.8	3.7	16	130	>2420	NA	956	1553	431	>2420	16	29	1046	NA	93	82	42	111
Mokelumne River @New Hope Rd.	544SAC002	30	0.5	5.5	2.2	1.9	1.7	1.5	2.9	28	231	>2420	NA	1498	>2420	1147	>2420	28	28	>2420	NA	79	67	46	110
Pixley Slough @ Davis Rd	531SJC507	24	1.0	10	3.7	3.0	2.8	2.2	3.8	28	1203	>2420	NA	2316	>2420	>2420	>2420	28	51	>2420	NA	268	256	126	406
Bear Creek @ Thorton Road (J8)	544SJC508	15	2.4	23	7.4	5.9	5.8	3.9	7.7	2	411	>2420	NA	997	1416	913	1918	2	46	166	NA	87	106	76	136
Bear Creek @Lower Sacramento Rd.	531SJC515	14	2.9	16	8.9	7.7	8.5	4.5	13	28	1553	>2420	NA	2326	>2420	>2420	>2420	28	15	>2420	NA	113	96	47	151
Northeast Basin Summary		104	0.5	23	4.5	3.2	3.0	1.7	5.1	102	130	>2420	NA	1761	>2420	1733	>2420	102	15	>2420	NA	125	102	53	206
South Delta Basin																									
New Jerusalem Drain	544SJC001	28	0.1	21	3.9	1.6	2.0	0.5	2.7	23	52	>2420	NA	1052	1986	548	>2420	20	1	27	NA	6	6	4	15
Tom Payne Slough @ Paradise Rd.	544SJC505	30	0.5	31	6.2	4.5	4.9	4.2	6.2	26	313	>2420	NA	2017	>2420	>2420	>2420	26	7	816	NA	61	47	29	104
Old River @Tracy Blvd	544SJC506	31	1.4	17	5.0	4.3	4.1	3.3	5.7	30	770	>2420	NA	2169	>2420	>2420	>2420	30	25	345	NA	74	61	50	104
Mountain House Creek	544SJC509	14	2.6	14	7.2	6.1	6.0	4.3	9.7	2	>2420	>2420	NA	>2420	>2420	>2420	>2420	2	1046	1203	NA	1122	1125	1085	1164
South Delta Basin Summary^		75	0.5	31	5.9	4.7	4.6	3.7	6.5	58	313	>2420	NA	2108	>2420	>2420	>2420	58	7	1203	NA	74	60	39	116

*Discharge from SLD not included into calculations

^New Jerusalem Drain not included into calculations

NA = Data not applicable

NOTE: For values reported as < (less than), half the detection limit was used

For values reported as > (greater than), 2420 was used

Table 5d: Nitrate, Nitrate-N, and Total Kjeldahl Nitrogen Results Summary

		Nitrate (mg/L)								Nitrate-N (mg/L)								TKN (mg/L)							
Main Stem	Site Code	**Count**	**Min**	**Max**	**Mean**	**Geo Mean**	**Median**	**Q1**	**Q3**	**Count**	**Min**	**Max**	**Mean**	**Geo Mean**	**Median**	**Q1**	**Q3**	**Count**	**Min**	**Max**	**Mean**	**Geo Mean**	**Median**	**Q1**	**Q3**
SJR @Sack Dam	541MAD007	14	2.4	9.7	4.8	4.3	3.9	3.1	5.7	NA	NA	NA	NA	NA	NA	NA	NA	23	0.1	1.3	0.8	0.7	1.0	0.7	1.0
SJR @ Lander	541MER522	22	1.0	16.0	3.8	2.3	1.0	1.0	6.8	NA	NA	NA	NA	NA	NA	NA	NA	21	0.5	3.9	1.5	1.3	1.0	1.0	1.8
SJR @ Fremont Ford	541MER538	37	1.0	16.0	5.8	4.7	5.2	2.9	7.4	24	0.1	3.7	1.1	0.8	0.8	0.6	1.6	71	0.5	3.0	1.1	1.0	1.0	1.0	1.2
SJR @ Hills Ferry	541STC512	11	3.4	19.0	9.3	8.0	9.6	5.0	13.0	NA	NA	NA	NA	NA	NA	NA	NA	21	0.2	2.6	1.1	1.0	1.0	1.0	1.3
SJR @ Crows	535STC504	39	4.2	23.0	12.1	11.3	11.0	8.8	15.0	27	0.2	4.5	2.1	1.8	2.1	1.4	2.9	73	0.3	3.0	1.0	0.9	1.0	0.8	1.1
SJR @ Patterson	541STC507	20	5.0	18.0	12.7	12.1	13.5	9.1	15.3	NA	NA	NA	NA	NA	NA	NA	NA	19	0.5	2.1	1.0	1.0	1.0	1.0	1.0
SJR @ Maze	541STC510	19	5.8	15.0	10.5	10.1	11.0	9.1	12.0	NA	NA	NA	NA	NA	NA	NA	NA	18	0.5	1.2	1.0	1.0	1.0	1.0	1.0
SJR @ Airport Way/Vernalis	541SJC501	23	3.8	12.0	8.4	8.1	8.4	7.6	10.0	NA	NA	NA	NA	NA	NA	NA	NA	30	0.2	1.9	0.9	0.9	1.0	0.8	1.0
Southeast Basin																									
Deep Slough Green House Rd	535MER577	11	1.0	23.0	4.8	2.4	1.0	1.0	4.8	NA	NA	NA	NA	NA	NA	NA	NA	18	1.0	6.2	1.8	1.5	1.3	1.0	2.1
Santa Rita Slough at Highway 152	541MER015	4	1.0	10.0	4.7	2.9	4.0	1.0	7.7	NA	NA	NA	NA	NA	NA	NA	NA	3	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Bear Creek Bert Crane Rd	535MER007	11	1.0	31.0	5.5	3.1	3.0	1.8	3.9	NA	NA	NA	NA	NA	NA	NA	NA	19	0.2	9.8	1.3	0.9	1.0	0.7	1.0
Southeast Basin Summary		26	1.0	31.0	5.1	2.8	3.0	1.0	5.1	NA	NA	NA	NA	NA	NA	NA	NA	40	0.2	9.8	1.5	1.2	1.0	1.0	1.3
Grassland Basin																									
Salt Slough @Lander/Hwy 165	541MER531	14	1.0	15.0	6.0	4.3	5.4	2.4	7.9	NA	NA	NA	NA	NA	NA	NA	NA	13	0.5	1.0	1.0	0.9	1.0	1.0	1.0
Mud Slough (n) (upstream) @ SLD	541MER536	30	1.0	5.1	1.9	1.5	1.0	1.0	2.6	25	0.03	2.9	0.5	0.3	0.4	0.1	0.6	62	0.5	2.6	1.2	1.1	1.0	1.0	1.4
Discharge from SLD	541MER535	19	11.0	110	66.3	58.2	73.0	45.5	89.5	27	5.3	33.0	15.4	13.6	14.0	8.7	20.5	46	0.5	2.5	1.4	1.3	1.2	1.0	1.8
Mud Slough (n) (downstream) @ SLD	541MER542	19	4.2	84.0	34.0	23.6	35.0	11.0	53.5	27	1.4	13.0	6.2	5.2	6.1	4.2	8.0	47	0.5	4.5	1.6	1.4	1.5	1.0	1.8
Grassland Basin Summary*		63	1.0	84.0	12.5	4.4	3.9	1.0	11.5	52	0.0	13.0	3.5	1.2	1.6	0.4	6.2	122	0.5	4.5	1.3	1.2	1.1	1.0	1.6
Eastside Basin																									
Turner Slough at 4th Avenue	535MER576	9	1.0	9.9	4.9	3.8	4.2	3.9	5.7	NA	NA	NA	NA	NA	NA	NA	NA	16	0.8	32.0	3.5	1.5	1.0	1.0	1.4
Merced River Hatfield Park(River Rd)	541MER546	10	1.0	15.0	7.6	6.0	7.3	5.3	10.3	NA	NA	NA	NA	NA	NA	NA	NA	9	1.0	2.4	1.2	1.1	1.0	1.0	1.0
Lone Tree Creek @ Austin Rd	531SJC503	14	1.0	10.0	4.8	3.8	3.8	3.0	7.1	NA	NA	NA	NA	NA	NA	NA	NA	23	0.7	17.0	3.6	2.3	1.5	1.0	4.8
French Camp Slough @ Airport	531SJC504	11	2.6	29.0	10.1	7.3	7.3	3.6	12.1	NA	NA	NA	NA	NA	NA	NA	NA	19	0.6	4.1	1.4	1.2	1.0	1.0	1.1
Harding Drain @ SJR (TID5)	535STC501	14	9.9	44.0	23.1	21.2	21.0	15.0	26.5	NA	NA	NA	NA	NA	NA	NA	NA	23	0.1	16.0	5.4	3.4	4.0	2.3	8.4
Tuolumne River @ Shiloh	535STC513	14	2.5	9.3	6.5	6.2	6.7	6.0	7.5	NA	NA	NA	NA	NA	NA	NA	NA	14	0.3	2.2	1.0	1.0	1.0	1.0	1.0
Stanislaus River @Caswell	535STC514	11	1.0	3.7	2.1	1.7	1.0	1.0	3.3	NA	NA	NA	NA	NA	NA	NA	NA	11	0.1	1.0	0.9	0.8	1.0	1.0	1.0
Eastside Basin Summary		83	1.0	44.0	8.9	5.7	6.3	3.4	10.0	NA	NA	NA	NA	NA	NA	NA	NA	115	0.1	32.0	2.8	1.6	1.0	1.0	2.8
Westside Basin																									
Orestimba Creek @ River Rd.	541STC019	10	4.3	20.0	11.1	9.9	10.1	7.4	14.8	NA	NA	NA	NA	NA	NA	NA	NA	11	0.5	1.0	1.0	0.9	1.0	1.0	1.0
Solado Creek @ Hwy 33	541STC515	12	2.9	23.0	11.1	9.5	9.5	6.9	15.5	NA	NA	NA	NA	NA	NA	NA	NA	20	0.6	2.4	1.1	1.1	1.0	1.0	1.0
Del Puerto Creek @Vineyard	541STC516	11	1.0	73.0	19.5	11.0	8.5	6.2	28.5	NA	NA	NA	NA	NA	NA	NA	NA	16	0.7	16.0	2.5	1.6	1.0	1.0	2.3
Grayson Drain	541STC030	11	1.0	30.0	11.1	8.4	8.7	6.2	13.5	NA	NA	NA	NA	NA	NA	NA	NA	19	0.2	13.0	1.9	1.1	1.0	0.9	1.5
Ingram Creek @River Rd.	541STC040	12	2.3	74.0	34.7	24.6	22.5	16.3	62.0	NA	NA	NA	NA	NA	NA	NA	NA	21	0.1	5.8	2.0	1.5	1.8	1.0	2.4
Hospital Creek @River Rd.	541STC042	8	7.1	25.0	12.8	11.9	11.0	9.5	13.5	NA	NA	NA	NA	NA	NA	NA	NA	12	1.0	4.2	1.7	1.5	1.0	1.0	2.2
Westside Basin Summary		64	1.0	74.0	17.2	11.8	11.0	7.3	20.0	NA	NA	NA	NA	NA	NA	NA	NA	99	0.1	16.0	1.7	1.3	1.0	1.0	2.0
Northeast Basin																									
Cosumnes River @ Twin Cities Rd.	531SAC001	9	1.0	6.1	2.4	1.8	1.0	1.0	3.6	NA	NA	NA	NA	NA	NA	NA	NA	9	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Mokelumne River @New Hope Rd.	544SAC002	12	0.5	1.0	1.0	0.9	1.0	1.0	1.0	NA	NA	NA	NA	NA	NA	NA	NA	12	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Pixley Slough @ Davis Rd	531SJC507	9	1.0	2.1	1.2	1.2	1.0	1.0	1.0	NA	NA	NA	NA	NA	NA	NA	NA	15	0.5	1.4	1.0	0.9	1.0	1.0	1.0
Bear Creek @ Thorton Road (J8)	544SJC508	12	1.0	5.4	2.3	1.9	2.3	1.0	2.7	NA	NA	NA	NA	NA	NA	NA	NA	16	0.5	2.5	1.1	1.1	1.0	1.0	1.0
Bear Creek @Lower Sacramento Rd.	531SJC515	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4	0.8	3.7	1.7	1.4	1.2	0.8	2.1
Northeast Basin Summary		42	0.5	6.1	1.7	1.4	1.0	1.0	2.3	NA	NA	NA	NA	NA	NA	NA	NA	56	0.5	3.7	1.1	1.0	1.0	1.0	1.0
South Delta Basin																									
New Jerusalem Drain	544SJC001	10	49.0	77.0	59.1	58.6	58.0	53.0	60.8	NA	NA	NA	NA	NA	NA	NA	NA	19	0.8	4.5	1.3	1.1	1.0	1.0	1.0
Tom Payne Slough @ Paradise Rd.	544SJC505	12	1.0	8.0	3.8	2.8	3.4	1.0	5.7	NA	NA	NA	NA	NA	NA	NA	NA	20	0.6	2.1	1.1	1.1	1.0	1.0	1.3
Old River @Tracy Blvd	544SJC506	12	4.8	10.0	7.6	7.4	7.9	6.8	8.4	NA	NA	NA	NA	NA	NA	NA	NA	20	0.6	2.1	1.1	1.1	1.0	1.0	1.1
Mountain House Creek	544SJC509	10	1.0	7.6	4.5	3.9	5.1	3.1	5.5	NA	NA	NA	NA	NA	NA	NA	NA	13	0.6	3.4	1.5	1.3	1.0	1.0	2.1
South Delta Basin Summary^		34	1.0	10.0	5.3	4.4	5.4	3.1	7.6	NA	NA	NA	NA	NA	NA	NA	NA	53	0.6	3.4	1.2	1.1	1.0	1.0	1.2

*Discharge from SLD not included into calculations

^New Jerusalem Drain not included into calculations

NA = Data not applicable

NOTE: For values reported as < (less than), half the detection limit was used

Table 5e: Ammonia as N, Phosphorus and Ortho-Phosphate as P Results Summary

		Ammonia-N (mg/L)								Phosphorus (mg/L)								Ortho-phosphate-P (mg/L)							
Main Stem	Site Code	**Count**	**Min**	**Max**	**Mean**	**Geo Mean**	**Median**	**Q1**	**Q3**	**Count**	**Min**	**Max**	**Mean**	**Geo Mean**	**Median**	**Q1**	**Q3**	**Count**	**Min**	**Max**	**Mean**	**Geo Mean**	**Median**	**Q1**	**Q3**
SJR @Sack Dam	541MAD007	NA	NA	NA	NA	NA	NA	NA	NA	22	0.03	0.2	0.1	0.1	0.1	0.1	0.2	30	0.02	0.5	0.3	0.2	0.5	0.1	0.5
SJR @ Lander	541MER522	NA	NA	NA	NA	NA	NA	NA	NA	22	0.2	0.5	0.3	0.3	0.3	0.2	0.4	24	0.02	0.5	0.5	0.4	0.5	0.5	0.5
SJR @ Fremont Ford	541MER538	17	0.1	0.3	0.1	0.1	0.1	0.1	0.1	67	0.1	0.7	0.3	0.3	0.3	0.2	0.4	78	0.02	0.5	0.3	0.3	0.3	0.1	0.5
SJR @ Hills Ferry	541STC512	NA	NA	NA	NA	NA	NA	NA	NA	19	0.1	0.4	0.3	0.2	0.3	0.2	0.3	23	0.02	0.5	0.3	0.2	0.5	0.1	0.5
SJR @ Crows	535STC504	17	0.1	0.5	0.1	0.1	0.1	0.1	0.1	69	0.1	0.4	0.2	0.2	0.2	0.2	0.3	79	0.02	0.5	0.3	0.2	0.2	0.1	0.5
SJR @ Patterson	541STC507	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	19	0.2	0.5	0.3	0.3	0.3	0.2	0.3	20	0.1	0.5	0.5	0.4	0.5	0.5	0.5
SJR @ Maze	541STC510	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	19	0.1	0.4	0.2	0.2	0.2	0.2	0.3	19	0.1	0.5	0.5	0.4	0.5	0.5	0.5
SJR @ Airport Way/Vernalis	541SJC501	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	31	0.03	0.4	0.2	0.2	0.2	0.2	0.2	33	0.02	0.5	0.4	0.3	0.5	0.2	0.5
Southeast Basin																									
Deep Slough Green House Rd	535MER577	NA	NA	NA	NA	NA	NA	NA	NA	18	0.2	1.3	0.5	0.5	0.4	0.3	0.6	24	0.02	1.7	0.5	0.4	0.5	0.2	0.5
Santa Rita Slough at Highway 152	541MER015	NA	NA	NA	NA	NA	NA	NA	NA	4	0.2	1.0	0.5	0.4	0.4	0.3	0.6	5	0.5	1.5	0.7	0.6	0.5	0.5	0.5
Bear Creek Bert Crane Rd	535MER007	NA	NA	NA	NA	NA	NA	NA	NA	19	0.03	0.3	0.2	0.1	0.1	0.1	0.2	25	0.02	2.0	0.3	0.2	0.2	0.1	0.5
Southeast Basin Summary		NA	NA	NA	NA	NA	NA	NA	NA	41	0.03	1.3	0.4	0.3	0.3	0.2	0.4	54	0.02	2.0	0.5	0.3	0.5	0.1	0.5
Grassland Basin																									
Salt Slough @Lander/Hwy 165	541MER531	NA	NA	NA	NA	NA	NA	NA	NA	13	0.2	0.4	0.3	0.3	0.3	0.2	0.4	16	0.1	0.5	0.5	0.5	0.5	0.5	0.5
Mud Slough (n) (upstream) @ SLD	541MER536	18	0.1	0.5	0.2	0.2	0.2	0.1	0.3	56	0.1	0.8	0.3	0.3	0.3	0.2	0.4	62	0.02	0.6	0.3	0.3	0.5	0.2	0.5
Discharge from SLD	541MER535	19	0.1	1.0	0.2	0.1	0.1	0.1	0.1	41	0.01	0.4	0.1	0.1	0.1	0.1	0.1	35	0.01	0.5	0.3	0.1	0.5	0.02	0.5
Mud Slough (n) (downstream) @ SLD	541MER542	21	0.1	0.5	0.2	0.2	0.1	0.1	0.2	42	0.1	0.6	0.3	0.2	0.2	0.1	0.4	44	0.01	0.5	0.3	0.1	0.3	0.02	0.5
Grassland Basin Summary*		39	0.1	0.5	0.2	0.2	0.2	0.1	0.2	111	0.1	0.8	0.3	0.3	0.3	0.2	0.4	122	0.01	0.6	0.3	0.2	0.5	0.2	0.5
Eastside Basin																									
Turner Slough at 4th Avenue	535MER576	NA	NA	NA	NA	NA	NA	NA	NA	18	0.1	12.0	1.2	0.3	0.2	0.2	0.3	22	0.02	11.0	1.3	0.3	0.3	0.1	0.5
Merced River Hatfield Park(River Rd)	541MER546	NA	NA	NA	NA	NA	NA	NA	NA	8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	11	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lone Tree Creek @ Austin Rd	531SJC503	NA	NA	NA	NA	NA	NA	NA	NA	24	0.2	4.8	1.3	0.9	0.9	0.5	1.3	26	0.02	2.8	1.0	0.7	0.7	0.5	1.3
French Camp Slough @ Airport	531SJC504	NA	NA	NA	NA	NA	NA	NA	NA	21	0.1	1.5	0.5	0.3	0.3	0.2	0.5	23	0.02	1.5	0.5	0.3	0.5	0.3	0.5
Harding Drain @ SJR (TID5)	535STC501	NA	NA	NA	NA	NA	NA	NA	NA	24	0.2	7.5	1.8	1.3	1.6	0.8	2.0	27	0.02	4.4	1.6	1.0	1.4	0.5	2.3
Tuolumne River @ Shiloh	535STC513	NA	NA	NA	NA	NA	NA	NA	NA	14	0.1	0.4	0.1	0.1	0.1	0.1	0.2	15	0.1	0.5	0.5	0.4	0.5	0.5	0.5
Stanislaus River @Caswell	535STC514	NA	NA	NA	NA	NA	NA	NA	NA	11	0.1	0.1	0.1	0.1	0.1	0.1	0.1	12	0.02	0.5	0.5	0.4	0.5	0.5	0.5
Eastside Basin Summary		NA	NA	NA	NA	NA	NA	NA	NA	120	0.05	12.0	0.9	0.3	0.3	0.1	1.0	136	0.02	11.0	0.9	0.5	0.5	0.5	1.1
Westside Basin																									
Orestimba Creek @ River Rd.	541STC019	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	10	0.1	0.4	0.2	0.2	0.2	0.1	0.4	10	0.1	0.5	0.5	0.4	0.5	0.5	0.5
Solado Creek @ Hwy 33	541STC515	NA	NA	NA	NA	NA	NA	NA	NA	22	0.03	0.4	0.2	0.2	0.2	0.1	0.2	24	0.1	0.5	0.3	0.2	0.4	0.1	0.5
Del Puerto Creek @Vineyard	541STC516	NA	NA	NA	NA	NA	NA	NA	NA	17	0.1	0.6	0.2	0.2	0.2	0.1	0.3	19	0.1	3.5	0.5	0.4	0.5	0.3	0.5
Grayson Drain	541STC030	NA	NA	NA	NA	NA	NA	NA	NA	20	0.03	2.9	0.6	0.3	0.3	0.2	0.5	21	0.02	2.5	0.5	0.3	0.5	0.2	0.5
Ingram Creek @River Rd.	541STC040	NA	NA	NA	NA	NA	NA	NA	NA	23	0.03	1.4	0.3	0.2	0.2	0.1	0.5	25	0.02	0.5	0.3	0.2	0.4	0.1	0.5
Hospital Creek @River Rd.	541STC042	NA	NA	NA	NA	NA	NA	NA	NA	12	0.1	4.0	0.7	0.5	0.5	0.4	0.6	12	0.1	0.5	0.4	0.4	0.5	0.5	0.5
Westside Basin Summary		1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	104	0.0	4.0	0.4	0.2	0.2	0.1	0.4	111	0.02	3.5	0.4	0.3	0.5	0.2	0.5
Northeast Basin																									
Cosumnes River @ Twin Cities Rd.	531SAC001	NA	NA	NA	NA	NA	NA	NA	NA	9	0.1	0.4	0.3	0.3	0.3	0.3	0.4	10	0.02	1.0	0.5	0.4	0.5	0.5	0.5
Mokelumne River @New Hope Rd.	544SAC002	NA	NA	NA	NA	NA	NA	NA	NA	10	0.1	0.1	0.1	0.1	0.1	0.1	0.1	13	0.02	0.5	0.4	0.3	0.5	0.5	0.5
Pixley Slough @ Davis Rd	531SJC507	NA	NA	NA	NA	NA	NA	NA	NA	16	0.1	0.4	0.2	0.1	0.1	0.1	0.2	16	0.02	0.5	0.3	0.2	0.5	0.1	0.5
Bear Creek @ Thorton Road (J8)	544SJC508	NA	NA	NA	NA	NA	NA	NA	NA	17	0.1	1.0	0.3	0.2	0.2	0.1	0.3	19	0.10	1.1	0.4	0.3	0.5	0.2	0.5
Bear Creek @Lower Sacramento Rd.	531SJC515	NA	NA	NA	NA	NA	NA	NA	NA	5	0.1	1.4	0.6	0.3	0.4	0.1	0.8	3	0.02	0.3	0.1	0.1	0.1	0.1	0.2
Northeast Basin Summary		NA	NA	NA	NA	NA	NA	NA	NA	57	0.1	1.4	0.2	0.2	0.2	0.1	0.3	61	0.02	1.1	0.4	0.3	0.5	0.1	0.5
South Delta Basin																									
New Jerusalem Drain	544SJC001	NA	NA	NA	NA	NA	NA	NA	NA	19	0.03	0.1	0.1	0.1	0.1	0.04	0.1	21	0.02	0.5	0.3	0.1	0.5	0.1	0.5
Tom Payne Slough @ Paradise Rd.	544SJC505	NA	NA	NA	NA	NA	NA	NA	NA	22	0.1	0.4	0.2	0.2	0.2	0.2	0.3	24	0.02	0.5	0.3	0.2	0.3	0.1	0.5
Old River @Tracy Blvd	544SJC506	NA	NA	NA	NA	NA	NA	NA	NA	22	0.2	0.7	0.3	0.2	0.2	0.2	0.3	24	0.1	0.5	0.3	0.3	0.2	0.2	0.5
Mountain House Creek	544SJC509	NA	NA	NA	NA	NA	NA	NA	NA	13	0.1	0.4	0.2	0.2	0.2	0.2	0.3	14	0.02	0.5	0.4	0.3	0.5	0.2	0.5
South Delta Basin Summary^		NA	NA	NA	NA	NA	NA	NA	NA	57	0.1	0.7	0.2	0.2	0.2	0.2	0.3	62	0.02	0.5	0.3	0.2	0.4	0.1	0.5

*Discharge from SLD not included into calculations

^New Jerusalem Drain not included into calculations

NA = Data not applicable

NOTE: For values reported as < (less than), half the detection limit was used

Table 5f: Potassium, Biochemical Oxygen Demand (5-day) and Biochemical Oxygen Demand (10-day) Results Summary

		Potassium (mg/L)								BOD 5-Day (mg/L)								BOD 10-Day (mg/L)							
Main Stem	Site Code	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3
SJR @Sack Dam	541MAD007	27	3.0	6.9	4.8	4.6	4.6	4.1	5.3	24	0.3	1.2	0.8	0.8	0.8	0.7	0.9	24	0.5	2.0	1.3	1.3	1.4	1.2	1.5
SJR @ Lander	541MER522	24	5.4	10	8.1	8.0	8.3	7.1	8.8	42	1.6	9.2	5.6	5.0	6.2	3.1	8.1	42	3.1	17	9.9	8.8	10	5.5	14
SJR @ Fremont Ford	541MER538	54	3.3	12	8.3	8.1	8.7	7.7	9.3	41	1.3	4.6	2.6	2.5	2.6	2.0	3.0	41	2.5	6.8	4.5	4.4	4.4	3.6	5.4
SJR @ Hills Ferry	541STC512	21	5.4	13	9.4	9.1	10	7.7	11	22	1.7	5.4	3.1	2.9	2.9	2.2	3.9	22	2.7	10	5.6	5.2	5.4	3.8	6.9
SJR @ Crows	535STC504	53	3.4	10	6.5	6.3	6.6	5.8	7.6	40	0.7	4.1	1.9	1.7	1.6	1.3	2.5	40	1.4	6.6	3.4	3.1	2.9	2.3	4.6
SJR @ Patterson	541STC507	21	3.6	9.3	7.0	6.8	7.4	6.1	8.3	40	1.1	5.8	2.5	2.3	2.3	1.5	3.2	40	2.1	11	4.7	4.3	4.3	3.1	6.1
SJR @ Maze	541STC510	20	3.1	7.2	5.7	5.6	6.2	5.3	6.4	39	0.9	6.3	2.1	1.9	1.7	1.3	2.3	39	1.7	13	3.7	3.2	2.9	2.3	4.1
SJR @ Airport Way/Vernalis	541SJC501	33	2.4	6.7	4.6	4.4	4.6	4.1	5.2	41	0.7	5.1	1.7	1.5	1.4	1.1	1.9	41	1.3	8.5	3.0	2.6	2.3	1.9	3.3
Southeast Basin																									
Deep Slough Green House Rd	535MER577	23	4.4	16	8.1	7.7	7.4	6.0	9.9	23	2.4	8.5	5.1	4.8	4.6	3.5	6.2	23	4.0	17	9.3	8.6	8.2	6.8	11
Santa Rita Slough at Highway 152	541MER015	5	5.0	23	10.3	8.8	8.4	6.0	8.9	4	1.6	8.4	3.8	3.0	2.5	2.2	4.1	4	2.9	17	7.4	5.8	5.0	3.7	8.7
Bear Creek Bert Crane Rd	535MER007	24	1.3	11	2.7	2.4	2.0	1.8	2.9	24	0.7	7.6	2.3	1.8	1.6	1.1	1.9	24	1.4	16	4.2	3.3	2.8	2.1	4.1
Southeast Basin Summary		52	1.3	23	5.9	4.5	4.9	2.2	7.9	51	0.7	8.5	3.7	2.9	2.9	1.6	5.5	51	1.4	17	6.7	5.3	5.2	2.9	8.6
Grassland Basin																									
Salt Slough @Lander/Hwy 165	541MER531	15	8.2	10	8.9	8.9	9.0	8.6	9.2	27	1.0	4.2	2.1	2.0	2.0	1.6	2.5	27	2.0	7.1	3.6	3.5	3.3	2.8	4.3
Mud Slough (n) (upstream) @ SLD	541MER536	41	5.7	15	9.2	8.9	9.4	7.2	11	26	1.2	5.7	2.8	2.6	2.5	2.2	3.3	26	2.4	10	5.0	4.7	4.7	3.9	6.1
Discharge from SLD	541MER535	20	5.4	13	9.2	9.0	8.6	8.2	10	22	0.9	5.8	3.2	2.8	3.3	1.6	4.5	22	1.6	11	5.6	4.7	5.0	2.6	8.4
Mud Slough (n) (downstream) @ SLD	541MER542	21	8.3	12	10	10	10	9.6	11	26	1.2	7.3	3.4	3.0	3.2	2.2	4.6	26	2.3	12	5.9	5.4	5.6	3.8	7.4
Grassland Basin Summary*		77	5.7	15	9.5	9.3	9.5	8.5	11	79	1.0	7.3	2.7	2.5	2.4	1.9	3.3	79	2.0	12	4.8	4.4	4.2	3.3	5.9
Eastside Basin																									
Turner Slough at 4th Avenue	535MER576	21	2.4	100	17.1	6.8	4.2	3.4	5.6	20	2.1	8.7	4.9	4.3	3.9	2.9	7.6	20	3.6	17	8.6	7.4	6.1	5.0	13
Merced River Hatfield Park(River Rd)	541MER546	10	0.5	2.5	1.4	1.2	1.5	0.7	1.7	22	0.1	3.3	0.6	0.4	0.5	0.3	0.6	22	0.3	7.3	1.1	0.8	0.7	0.6	0.9
Lone Tree Creek @ Austin Rd	531SJC503	24	2.4	53	19	14	19	5.8	29	23	1.3	8.3	5.1	4.2	5.6	2.4	8.0	23	2.2	17	9.6	7.7	8.0	4.4	16
French Camp Slough @ Airport	531SJC504	24	1.9	37	9.8	7.5	7.2	4.6	11	23	1.0	16	3.6	2.7	2.2	1.6	3.6	23	1.8	34	6.6	4.7	3.7	2.9	6.2
Harding Drain @ SJR (TID5)	535STC501	25	1.2	21	11	9.5	9.9	7.3	15	24	1.0	8.2	5.9	5.4	6.4	4.6	7.5	24	3.3	17	12	11	13	8.4	16
Tuolumne River @ Shiloh	535STC513	14	1.1	6.2	2.4	2.1	1.8	1.6	2.9	24	0.1	5.6	0.7	0.5	0.5	0.3	0.7	24	0.2	8.4	1.2	0.8	0.8	0.7	1.2
Stanislaus River @Caswell	535STC514	11	0.5	2.3	1.5	1.4	1.7	1.2	1.8	21	0.2	6.2	0.8	0.6	0.5	0.4	0.7	21	0.4	8.8	1.3	1.0	0.9	0.8	1.0
Eastside Basin Summary		129	0.5	100	11	5.6	5.0	2.3	14	157	0.1	16.4	3.1	1.6	2.0	0.5	5.2	157	0.2	34	5.8	2.9	3.5	0.9	8.5
Westside Basin																									
Orestimba Creek @ River Rd.	541STC019	11	5.2	9.4	7.1	7.0	6.8	6.2	7.9	23	0.5	4.0	1.6	1.4	1.3	1.0	2.1	23	0.9	8.4	2.9	2.4	2.1	1.7	3.4
Solado Creek @ Hwy 33	541STC515	22	3.3	12	6.9	6.4	6.6	4.9	7.9	23	0.2	8.3	2.0	1.4	1.5	1.0	1.9	23	0.6	15	3.5	2.5	2.6	1.5	3.1
Del Puerto Creek @Vineyard	541STC516	18	2.6	16	6.7	6.1	5.9	5.4	7.5	17	0.7	6.9	2.2	1.7	1.4	0.9	3.1	17	0.9	12	4.2	3.0	2.2	1.5	6.2
Grayson Drain	541STC030	20	2.7	15	7.0	6.0	5.8	4.2	8.4	18	0.6	8.5	3.3	2.2	2.0	0.9	4.8	18	1.0	17	6.3	4.0	3.7	1.7	7.5
Ingram Creek @River Rd.	541STC040	23	0.9	15	6.6	5.1	5.2	3.0	10	23	0.2	7.6	2.2	1.3	1.7	0.6	3.1	23	0.3	16	3.7	2.1	3.1	0.8	5.0
Hospital Creek @River Rd.	541STC042	12	4.0	13	8.0	7.5	7.5	5.6	11	12	0.5	8.3	3.0	2.0	2.5	1.1	4.0	12	1.0	14	5.2	3.6	3.9	1.8	6.9
Westside Basin Summary		106	0.9	16	7.0	6.2	6.3	4.6	8.5	116	0.2	8.5	2.3	1.6	1.5	0.9	3.1	116	0.3	17	4.1	2.7	2.6	1.5	5.3
Northeast Basin																									
Cosumnes River @ Twin Cities Rd.	531SAC001	10	1.7	8.4	3.6	3.3	3.3	2.9	3.8	19	0.3	3.9	1.1	0.8	0.6	0.5	1.4	19	0.4	6.1	1.8	1.3	1.0	0.8	2.7
Mokelumne River @New Hope Rd.	544SAC002	13	0.5	1.5	0.7	0.6	0.5	0.5	0.5	24	0.1	1.2	0.4	0.4	0.4	0.3	0.5	24	0.2	1.9	0.6	0.6	0.5	0.4	0.6
Pixley Slough @ Davis Rd	531SJC507	19	1.1	5.4	2.3	2.1	2.3	1.5	2.7	18	0.7	4.8	1.9	1.6	1.4	1.0	2.6	18	1.0	8.5	3.4	2.7	2.4	1.7	4.5
Bear Creek @ Thorton Road (J8)	544SJC508	20	1.4	19	6.8	5.0	4.6	2.4	10	19	0.4	8.4	2.4	1.9	2.0	1.1	2.8	19	0.9	15	4.5	3.6	3.9	2.1	6.1
Bear Creek @Lower Sacramento Rd.	531SJC515	5	1.9	17	10	8.3	10	9.9	12	5	0.9	8.0	2.6	1.8	1.3	1.3	1.5	5	1.5	16	5.1	3.3	2.5	2.2	2.7
Northeast Basin Summary		67	0.5	19	4.1	2.5	2.5	1.4	4.3	85	0.1	8.4	1.5	1.0	0.9	0.5	1.9	85	0.2	16	2.6	1.6	1.6	0.6	3.7
South Delta Basin																									
New Jerusalem Drain	544SJC001	24	1.8	19	4.7	4.1	4.2	3.8	4.8	23	0.1	0.4	0.1	0.1	0.1	0.1	0.2	23	0.1	0.7	0.2	0.1	0.1	0.1	0.3
Tom Payne Slough @ Paradise Rd.	544SJC505	25	2.0	14	6.6	6.1	6.7	4.5	7.8	23	0.8	8.6	4.5	3.7	4.4	2.5	6.7	23	1.5	16	7.7	6.4	7.2	4.5	12
Old River @Tracy Blvd	544SJC506	25	3.0	8.1	5.3	5.1	5.3	4.4	5.9	24	1.2	6.1	3.0	2.6	2.6	1.9	3.7	24	2.5	10	5.1	4.6	4.2	3.3	6.4
Mountain House Creek	544SJC509	15	3.9	22	11	9.4	7.4	6.0	19	12	1.2	8.0	3.3	2.6	2.3	1.6	3.9	12	2.0	15	6.2	5.0	4.2	3.4	7.9
South Delta Basin Summary^		65	2.0	22	7.2	6.3	5.9	4.5	7.6	59	0.8	8.6	3.6	3.0	2.9	1.9	5.1	59	1.5	16	6.3	5.3	4.9	3.4	8.1

*Discharge from SLD not included into calculations

^New Jerusalem Drain not included into calculations

NA = Data not applicable

NOTE: For values reported as < (less than), half the detection limit was used

Table 5g: Chloride, Sulfate, and Calcium Results Summary

		Chloride (mg/L)								Sulfate (mg/L)								Calcium (mg/L)							
Main Stem	Site Code	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3
SJR @Sack Dam	541MAD007	26	24	150	86	81	89	72	100	26	27	130	66	61	55	46	87	27	17	45	28	27	25	23	32
SJR @ Lander	541MER522	20	120	390	260	240	240	200	320	20	62	210	110	100	96	84	150	21	38	96	59	58	57	52	62
SJR @ Fremont Ford	541MER538	26	150	440	260	250	240	220	300	27	130	330	210	200	200	170	240	28	51	96	68	67	67	58	75
SJR @ Hills Ferry	541STC512	25	160	460	300	290	290	250	340	24	180	550	380	360	390	290	450	25	56	130	90	88	89	72	100
SJR @ Crows	535STC504	26	49	250	164	158	160	153	180	29	49	310	206	190	210	150	270	29	20	78	56	54	60	48	70
SJR @ Patterson	541STC507	17	95	240	160	160	160	140	180	19	78	280	190	180	200	170	230	19	30	74	58	56	59	49	69
SJR @ Maze	541STC510	16	25	180	110	100	120	89	140	18	26	200	110	100	120	89	150	18	25	59	42	41	43	35	50
SJR @ Airport Way/Vernalis	541SJC501	27	18	400	100	87	97	70	110	30	19	470	100	85	90	65	100	30	18	52	35	34	36	31	40
Southeast Basin																									
Deep Slough Green House Rd	535MER577	25	7	98	38	32	32	19	53	25	16	64	37	34	36	27	47	26	20	52	34	33	34	28	40
Santa Rita Slough at Highway 152	541MER015	5	61	100	84	82	84	81	92	5	49	150	104	96	120	71	130	5	26	67	47	45	46	38	59
Bear Creek Bert Crane Rd	535MER007	26	3	8	4	4	3	3	6	25	4	13	6	6	5	5	7	27	7	18	11	11	10	9	14
Southeast Basin Summary		56	3	100	27	13	16	4	45	55	4	150	29	17	19	5	45	58	7	67	25	20	22	10	37
Grassland Basin																									
Salt Slough @Lander/Hwy 165	541MER531	18	150	310	230	220	230	200	260	19	140	290	200	200	210	160	250	19	54	79	65	64	64	59	71
Mud Slough (n) (upstream) @ SLD	541MER536	26	53	490	240	220	220	190	270	29	40	910	320	260	270	180	440	29	36	160	62	59	56	48	70
Discharge from SLD	541MER535	18	430	690	520	520	520	470	550	20	1300	1900	1490	1480	1450	1380	1600	20	230	350	290	290	290	270	310
Mud Slough (n) (downstream) @ SLD	541MER542	18	140	560	380	360	400	270	470	20	200	1700	950	810	1100	480	1300	20	61	310	170	160	190	100	220
Grassland Basin Summary*		62	53	560	230	220	250	200	345	68	40	1700	200	200	280	195	250	68	36	310	95	81	66	56	93
Eastside Basin																									
Turner Slough at 4th Avenue	535MER576	23	5	260	43	15	9	7	16	23	6	110	25	17	13	10	21	24	12	41	20	19	17	15	22
Merced River Hatfield Park(River Rd)	541MER546	11	3	35	12	9	9	6	12	10	3	17	8	7	9	4	10	11	4	20	11	10	12	8	14
Lone Tree Creek @ Austin Rd	531SJC503	23	3	41	15	11	16	4	19	22	4	21	10	9	10	5	13	24	6	37	18	17	17	13	24
French Camp Slough @ Airport	531SJC504	20	3	55	15	10	11	5	20	20	4	53	16	11	12	5	19	20	7	52	20	17	17	12	24
Harding Drain @ SJR (TID5)	535STC501	29	20	250	88	77	71	57	120	27	12	81	43	39	45	29	54	29	17	76	44	41	42	33	52
Tuolumne River @ Shiloh	535STC513	18	3	28	15	13	15	12	16	17	3	14	8	8	8	7	9	19	5	22	14	14	15	13	17
Stanislaus River @Caswell	535STC514	11	2	7	4	4	4	3	6	9	3	7	5	5	6	3	7	11	7	13	10	10	10	8	12
Eastside Basin Summary		135	2	260	34	16	15	6	42	128	3	110	20	13	12	7	24	138	4	76	22	19	17	13	28
Westside Basin																									
Orestimba Creek @ River Rd.	541STC019	15	53	120	88	86	90	75	99	17	46	150	93	88	97	59	120	17	24	66	44	41	42	28	56
Solado Creek @ Hwy 33	541STC515	26	32	150	99	94	100	89	110	24	40	380	130	110	120	71	150	26	19	80	41	39	39	31	47
Del Puerto Creek @Vineyard	541STC516	20	35	170	120	110	120	110	140	20	130	470	250	230	250	180	300	20	22	60	42	41	46	33	50
Grayson Drain	541STC030	23	35	410	130	120	120	96	150	21	32	360	130	110	130	83	140	23	17	82	46	43	40	37	58
Ingram Creek @River Rd.	541STC040	26	85	300	180	170	170	120	250	24	59	310	190	170	180	130	270	26	30	150	78	71	64	57	110
Hospital Creek @River Rd.	541STC042	16	27	160	100	90	110	80	130	14	33	160	97	86	92	66	130	16	21	79	46	43	44	32	56
Westside Basin Summary		126	27	410	124	111	110	91	140	120	32	470	153	130	130	91	183	128	17	150	51	46	46	35	59
Northeast Basin																									
Cosumnes River @ Twin Cities Rd.	531SAC001	13	2	10	6	5	5	4	9	13	1	12	7	6	7	4	9	13	5	10	8	8	8	7	8
Mokelumne River @New Hope Rd.	544SAC002	16	3	5	3	3	3	3	3	16	2	3	3	3	3	2	3	16	4	5	4	4	4	4	4
Pixley Slough @ Davis Rd	531SJC507	20	3	40	8	5	4	4	6	20	3	22	5	4	4	3	5	20	5	18	9	8	8	7	10
Bear Creek @ Thorton Road (J8)	544SJC508	17	4	17	8	7	6	5	11	17	3	14	6	5	5	4	7	17	6	21	11	10	9	8	15
Bear Creek @Lower Sacramento Rd.	531SJC515	7	4	19	9	7	5	4	14	7	3	8	5	4	3	3	6	7	5	16	10	9	7	6	16
Northeast Basin Summary		73	2	40	7	5	4	3	8	73	1	22	5	4	4	3	6	73	4	21	8	7	7	5	9
South Delta Basin																									
New Jerusalem Drain	544SJC001	25	220	360	310	310	310	290	320	25	320	610	470	460	470	420	510	25	51	180	150	150	150	140	160
Tom Payne Slough @ Paradise Rd.	544SJC505	25	100	500	280	250	240	150	450	25	95	490	280	240	220	140	450	25	42	160	94	84	74	55	150
Old River @Tracy Blvd	544SJC506	25	8	180	120	100	120	100	130	25	65	180	110	100	100	87	120	25	25	59	43	42	41	38	48
Mountain House Creek	544SJC509	15	26	410	190	129	130	63	385	15	23	490	182	87	45	32	450	15	19	86	42	35	24	22	77
South Delta Basin Summary^		65	8	500	280	250	140	100	250	65	23	490	280	240	130	87	250	65	19	160	62	52	48	38	74

*Discharge from SLD not included into calculations

^New Jerusalem Drain not included into calculations

NA = Data not applicable

NOTE: For values reported as < (less than), half the detection limit was used

Table 5h: Magnesium, Total Dissolved Solids (TDS), and Carbonate Results Summary

		Magnesium (mg/L)								TDS (mg/L)								Carbonate (mg/L)							
Main Stem	Site Code	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3
SJR @Sack Dam	541MAD007	27	8	23	16	16	16	14	18	17	260	600	385	375	380	340	430	23	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SJR @ Lander	541MER522	21	16	46	28	27	23	22	33	16	520	1200	830	810	800	710	970	17	0.5	13	1.2	0.6	0.5	0.5	0.5
SJR @ Fremont Ford	541MER538	27	25	53	39	38	39	34	43	21	600	1400	960	950	970	850	1100	24	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SJR @ Hills Ferry	541STC512	25	31	68	50	49	49	42	57	15	150	1700	1100	1000	1100	1100	1300	22	0.5	4.0	0.7	0.5	0.5	0.5	0.5
SJR @ Crows	535STC504	29	10	45	30	28	31	27	34	24	220	1100	704	667	715	625	845	25	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SJR @ Patterson	541STC507	19	15	41	29	28	31	27	34	15	390	1100	740	710	750	660	880	15	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SJR @ Maze	541STC510	18	13	33	23	22	24	18	27	14	310	690	500	500	540	480	550	14	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SJR @ Airport Way/Vernalis	541SJC501	30	9	29	18	18	19	16	22	25	180	630	420	400	410	370	510	26	0.5	4.0	0.6	0.5	0.5	0.5	0.5
Southeast Basin																									
Deep Slough Green House Rd	535MER577	26	9	30	18	17	18	13	22	17	190	530	330	320	320	290	420	22	0.5	52	3.6	0.8	0.5	0.5	0.5
Santa Rita Slough at Highway 152	541MER015	5	14	23	19	18	21	15	21	5	360	510	430	430	440	370	470	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bear Creek Bert Crane Rd	535MER007	27	3	11	5	5	4	4	7	17	50	150	97	94	92	84	110	23	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Southeast Basin Summary		58	3	30	12	9	12	4	19	39	50	530	243	195	210	96	360	50	0.5	52	1.9	0.6	0.5	0.5	0.5
Grassland Basin																									
Salt Slough @Lander/Hwy 165	541MER531	19	25	44	36	35	36	33	39	15	550	1100	880	860	880	750	1000	16	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Mud Slough (n) (upstream) @ SLD	541MER536	29	25	90	49	46	43	36	56	24	160	2700	1100	980	990	850	1400	25	0.5	10	1.2	0.6	0.5	0.5	0.5
Discharge from SLD	541MER535	20	82	110	93	93	90	86	100	89	2500	4400	3300	3300	3300	3100	3600	16	0.5	20	2.7	0.9	0.5	0.5	0.5
Mud Slough (n) (downstream) @ SLD	541MER542	20	31	110	73	69	72	52	90	16	800	3900	2400	2100	2700	1400	3200	16	0.5	20	2.2	0.9	0.5	0.5	0.9
Grassland Basin Summary*		68	25	110	52	48	43	36	70	55	160	3900	880	860	1000	855	1700	57	0.5	20	1.3	0.6	0.5	0.5	0.5
Eastside Basin																									
Turner Slough at 4th Avenue	535MER576	24	5	21	9	8	8	6	9	15	92	2000	450	260	170	140	520	20	0.5	23	2.0	0.7	0.5	0.5	0.5
Merced River Hatfield Park(River Rd)	541MER546	11	1	7	4	3	4	3	5	10	57	220	100	92	88	61	130	12	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lone Tree Creek @ Austin Rd	531SJC503	24	3	17	9	8	8	5	11	16	54	410	220	200	230	190	273	24	0.5	0.5	0.5	0.5	0.5	0.5	0.5
French Camp Slough @ Airport	531SJC504	20	3	40	11	9	9	6	12	14	84	460	210	190	200	110	240	20	0.5	30	2.5	0.7	0.5	0.5	0.5
Harding Drain @ SJR (TID5)	535STC501	29	5	18	12	11	11	9	15	17	160	760	500	460	530	330	660	25	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Tuolumne River @ Shiloh	535STC513	19	2	9	6	6	6	6	7	11	68	190	121	116	120	99	140	14	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Stanislaus River @Caswell	535STC514	11	2	6	4	4	4	3	5	9	42	120	73	69	75	52	87	12	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Eastside Basin Summary		138	1	40	9	7	8	5	11	92	42	2000	100	187	170	108	130	127	0.5	30	1.0	0.6	0.5	0.5	0.5
Westside Basin																									
Orestimba Creek @ River Rd.	541STC019	17	16	35	25	25	26	19	33	13	320	550	430	420	420	380	500	13	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Solado Creek @ Hwy 33	541STC515	26	11	69	31	28	29	21	37	15	330	940	543	520	500	430	600	23	0.5	24	2.1	0.7	0.5	0.5	0.5
Del Puerto Creek @Vineyard	541STC516	20	16	94	35	31	31	24	39	10	340	770	570	550	560	470	670	17	0.5	28	2.5	0.8	0.5	0.5	0.5
Grayson Drain	541STC030	23	12	54	30	28	27	22	42	12	240	800	500	480	480	380	630	20	0.5	2.0	0.6	0.5	0.5	0.5	0.5
Ingram Creek @River Rd.	541STC040	26	17	59	40	38	38	33	51	15	380	1700	1100	953	1300	625	1400	23	0.5	6.0	0.9	0.6	0.5	0.5	0.5
Hospital Creek @River Rd.	541STC042	16	10	62	28	25	23	18	33	6	200	740	530	490	570	480	620	13	0.5	4.0	0.8	0.6	0.5	0.5	0.5
Westside Basin Summary		128	10	94	32	29	31	22	39	71	200	1700	430	420	520	425	670	109	0.5	28	1.3	0.6	0.5	0.5	0.5
Northeast Basin																									
Cosumnes River @ Twin Cities Rd.	531SAC001	13	2	5	4	4	4	3	4	8	60	120	93	90	100	75	110	9	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Mokelumne River @New Hope Rd.	544SAC002	16	1	2	1	1	1	1	2	9	24	47	36	35	33	30	45	12	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Pixley Slough @ Davis Rd	531SJC507	20	2	5	3	3	3	2	3	10	5	140	81	62	85	59	120	16	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bear Creek @ Thorton Road (J8)	544SJC508	17	2	10	5	4	4	3	6	12	45	190	104	92	91	58	140	17	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bear Creek @Lower Sacramento Rd.	531SJC515	7	2	8	5	4	3	3	8	2	160	190	180	170	180	170	180	3	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Northeast Basin Summary		73	1	10	3	3	3	2	4	41	5	190	85	70	100	45	120	57	0.5	0.5	0.5	0.5	0.5	0.5	0.5
South Delta Basin																									
New Jerusalem Drain	544SJC001	25	5	72	61	60	61	58	67	15	1100	1900	1600	1600	1600	1600	1700	21	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Tom Payne Slough @ Paradise Rd.	544SJC505	25	21	89	53	46	43	29	83	15	450	2000	1400	1200	1800	670	1900	21	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Old River @Tracy Blvd	544SJC506	25	13	32	23	22	22	20	26	15	280	720	510	500	490	460	590	21	0.5	16	1.2	0.6	0.5	0.5	0.5
Mountain House Creek	544SJC509	15	8	64	30	23	17	14	59	9	240	1900	1157	837	1800	390	1800	13	0.5	0.5	0.5	0.5	0.5	0.5	0.5
South Delta Basin Summary^		65	8	89	36	30	26	20	44	39	240	2000	1400	1200	610	465	1900	55	0.5	16	0.8	0.5	0.5	0.5	0.5

*Discharge from SLD not included into calculations

^New Jerusalem Drain not included into calculations

NA = Data not applicable

NOTE: For values reported as < (less than), half the detection limit was used

Table 5i: Bicarbonate, Total Alkalinity and Sodium Results Summary

		Bicarbonate (mg/L)								Total Alkalinity (mg/L)								Sodium (mg/L)							
Main Stem	Site Code	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3	Count	Min	Max	Mean	Geo Mean	Median	Q1	Q3
SJR @Sack Dam	541MAD007	22	78	170	110	110	110	100	120	22	78.0	140	92.5	91.6	90.0	83.3	94.0	23	49.0	170	76.1	73.2	75.0	62.0	83.0
SJR @ Lander	541MER522	17	130	300	240	230	240	220	250	17	130	260	200	200	200	180	210	17	95.0	320	200	200	200	160	240
SJR @ Fremont Ford	541MER538	23	140	270	220	210	220	200	240	22	140	220	180	180	180	170	200	24	130	310	220	210	220	190	250
SJR @ Hills Ferry	541STC512	22	150	290	240	230	250	200	260	22	150	240	200	200	200	180	220	22	160	370	280	280	280	240	330
SJR @ Crows	535STC504	24	72.0	230	166	160	180	145	200	23	60.0	190	139	135	150	125	160	25	41.0	250	154	143	150	140	180
SJR @ Patterson	541STC507	14	80.0	220	170	160	180	150	200	13	80.0	180	150	140	150	140	160	15	62.0	200	150	140	160	140	190
SJR @ Maze	541STC510	13	68.0	290	150	140	160	120	180	12	70.0	240	130	130	140	120	140	14	47.0	140	100	100	110	89.5	120
SJR @ Airport Way/Vernalis	541SJC501	25	50.0	150	120	120	130	112	150	24	53.0	130	100	100	110	98.0	120	26	30.0	130	83.8	79.6	83.5	72.3	99.8
Southeast Basin																									
Deep Slough Green House Rd	535MER577	21	96.0	270	190	180	200	140	240	21	96.0	260	170	160	160	120	210	22	23.0	94.0	52.0	48.0	53.5	35.3	66.0
Santa Rita Slough at Highway 152	541MER015	5	100	140	122	121	120	120	130	5	80.0	120	101	100	98.0	97.0	110	5	32.0	87.0	67.8	64.3	73.0	71.0	76.0
Bear Creek Bert Crane Rd	535MER007	22	34.0	120	58.9	55.3	49.0	44.0	67.5	22	30.0	100	49.1	46.2	40.0	36.5	57.5	23	3.00	70.0	8.5	5.93	5.00	4.00	7.50
Southeast Basin Summary		48	34.0	270	123	101	120	53.0	180	48	30.0	256	105	85.7	97.5	43.0	150	50	3.00	94.0	33.6	18.9	26.0	5.00	55.0
Grassland Basin																									
Salt Slough @Lander/Hwy 165	541MER531	16	150	250	210	210	220	180	240	16	130	210	180	180	180	160	200	15	130	250	200	200	210	170	230
Mud Slough (n) (upstream) @ SLD	541MER536	24	180	400	280	270	280	250	320	23	150	330	230	230	230	200	265	25	100	630	280	250	230	190	410
Discharge from SLD	541MER535	15	76.0	260	190	180	190	150	230	14	96.0	210	160	150	160	130	200	16	560	800	660	660	670	600	708
Mud Slough (n) (downstream) @ SLD	541MER542	15	140	290	220	210	240	170	270	14	120	240	190	180	190	160	220	16	150	740	480	440	520	300	650
Grassland Basin Summary*		55	140	400	210	210	250	180	280	53	120	330	180	180	200	160	230	56	100	740	200	200	240	170	230
Eastside Basin																									
Turner Slough at 4th Avenue	535MER576	19	56.0	1290	250	150	110	83.5	150	19	56.0	1100	210	120	89	68.5	120	20	11.0	500	85.9	33.6	21.5	15.5	42.5
Merced River Hatfield Park(River Rd)	541MER546	12	18.0	120	54.8	48.1	50.0	32.3	68.3	12	15.0	96.0	46.1	41.3	42.0	29.3	56.0	12	3.00	35.0	13.1	10.5	11.0	6.00	14.8
Lone Tree Creek @ Austin Rd	531SJC503	24	34.0	300	110	93.8	96.5	59.5	140	24	28.0	250	92.3	78.6	82.0	48.8	110	24	3.00	27.0	11.1	9.39	11.5	5.75	14.3
French Camp Slough @ Airport	531SJC504	20	39.0	350	110	89.6	78.5	61.5	120	19	32.0	240	88.9	75.5	73.0	51.0	99.0	20	3.00	45.0	13.3	10.1	10.5	6.00	14.5
Harding Drain @ SJR (TID5)	535STC501	25	80.0	560	240	221	250	160	290	25	60.0	460	200	184	200	130	240	25	22.0	210	102	91.7	92.0	64.0	130
Tuolumne River @ Shiloh	535STC513	14	37.0	110	73.7	70.7	71.5	67.8	89.0	14	30.0	93.0	62.5	60.2	60.0	56.3	73.3	14	5.00	25.0	15.1	14.1	14.0	13.3	18.8
Stanislaus River @Caswell	535STC514	12	30.0	110	55.3	51.5	55.5	39.0	66.3	12	27.0	86.0	45.8	43.5	46.0	33.5	54.3	12	3.00	8.00	5.00	4.72	4.50	3.75	6.25
Eastside Basin Summary		126	18	1290	142	101	90.0	60.3	150	125	15.0	1100	118	85.3	76.0	52.0	120	127	3.00	500	41.3	18.0	14.0	7.00	38.5
Westside Basin																									
Orestimba Creek @ River Rd.	541STC019	12	110	210	140	130	120	110	160	11	90.0	170	120	120	110	92.0	140	13	56.0	94.0	74.4	73.3	75.0	62.0	86.0
Solado Creek @ Hwy 33	541STC515	23	100	220	150	140	130	120	180	23	84.0	180	120	120	120	97.0	150	23	52.0	150	97.3	94.2	94.0	82.5	110
Del Puerto Creek @Vineyard	541STC516	17	82.0	460	180	160	170	140	180	17	82.0	380	150	140	140	110	150	17	62.0	160	110	100	110	91.0	130
Grayson Drain	541STC030	20	44.0	360	160	150	160	130	180	20	54.0	290	130	120	130	110	150	20	24.0	180	98.7	90.5	110	72.0	120
Ingram Creek @River Rd.	541STC040	23	110	320	200	190	180	150	260	23	93.0	270	170	160	150	130	210	23	73.0	240	150	140	140	100	220
Hospital Creek @River Rd.	541STC042	13	100	180	140	140	150	110	160	13	80.0	150	120	120	130	100	130	13	24.0	130	95.1	88.7	99.0	80.0	120
Westside Basin Summary		108	44	460	140	130	150	120	160	107	54.0	380	120	120	130	100	150	109	24.0	240	108	100	100	80.0	120
Northeast Basin																									
Cosumnes River @ Twin Cities Rd.	531SAC001	9	43.0	70.0	51.1	50.6	50.0	46.0	51.0	9	35.0	60.0	42.8	42.3	40.0	40.0	44.0	9	4.00	15.0	10.8	10.0	12.0	7.00	13.0
Mokelumne River @New Hope Rd.	544SAC002	12	18.0	30.0	23.9	23.6	22.5	20.8	27.5	12	15.0	30.0	20.7	20.3	20.0	18.0	22.5	12	2.00	4.00	2.75	2.68	3.00	2.00	3.00
Pixley Slough @ Davis Rd	531SJC507	16	20.0	55.0	38.5	36.9	38.0	29.8	47.0	15	20.0	45.0	32.3	31.2	30.0	25.5	39.0	16	3.00	16.0	5.88	5.10	4.50	4.00	6.00
Bear Creek @ Thorton Road (J8)	544SJC508	17	26.0	130	58.0	51.4	51.0	32.0	79.0	16	21.0	110	49.0	43.1	40.0	29.3	66.3	17	4.00	17.0	7.82	6.80	7.00	4.00	12.0
Bear Creek @Lower Sacramento Rd.	531SJC515	3	29.0	100	72.0	63.2	87.0	58.0	93.5	3	24.0	84.0	59.7	52.3	71.0	47.5	77.5	3	4.00	16.0	12.0	10.1	16.0	10.0	16.0
Northeast Basin Summary		57	18.0	130	45.0	40.1	41.0	28.0	51.0	55	15.0	110	37.8	33.7	34.0	23.5	43.0	57	2.00	17.0	6.89	5.60	5.00	4.00	12.0
South Delta Basin																									
New Jerusalem Drain	544SJC001	21	260	380	360	350	370	350	370	20	210	310	290	290	300	300	310	21	210	340	300	300	310	290	320
Tom Payne Slough @ Paradise Rd.	544SJC505	21	110	410	280	260	290	190	390	20	110	340	240	220	260	160	320	21	85.0	380	240	210	270	130	360
Old River @Tracy Blvd	544SJC506	21	84.0	190	148	144	150	130	160	20	69.0	160	130	120	130	180	140	21	10.0	140	97.8	88.7	100	84.0	110
Mountain House Creek	544SJC509	13	82.0	480	238	178	110	99.0	450	12	79.0	400	208	159	94.5	83.0	373	13	35.0	490	224	135	93.0	57.0	480
South Delta Basin Summary^		55	82.0	480	280	260	170	130	345	52	69.0	400	240	220	260	160	293	55	10.0	490	240	210	120	90	310

*Discharge from SLD not included into calculations

^New Jerusalem Drain not included into calculations

NA = Data not applicable

NOTE: For values reported as < (less than), half the detection limit was used

Table 6: Toxicity Toxic Event Summary

		Acute Fathead Minnow		Acute Ceriodaphnia Dubia		Acute Algae			Chronic Fathead Minnow			Chronic Ceriodaphnia Dubia		
Main Stem	Site Code	Count	% Survival Stat Diff	Count	% Survival Stat Diff	Count	Growth Stat Diff	Reduction Stat Diff	Count	% Survival Stat Diff	Growth Stat Diff	Count	% Survival Stat Diff	Reproduction Stat Diff
SJR @ Lander	541MER522	21	0	21	0	3	2	1	14	2	1	7	0	0
SJR @ Fremont Ford	541MER538	1	0	1	0	1	0	0	0			0		
SJR @ Hills Ferry	541STC512	12	0	11	0	1	1	0	14	2	2	7	0	1
SJR @ Crows	535STC504	22	0	22		4	3	0	14	2	2	7	0	0
SJR @ Patterson	541STC507	0		0		9	7	0	8	1	0	11	0	3
SJR @ Maze	541STC510	1	0	0		0			0			0		
SJR @ Airport Way/Vernalis	541SJC501	22	0	22	0	13	8	1	15	3	5	18	0	6
Total Main Stem Count		79	0	77	0	31	21	2	65	10	10	50	0	10
Southeast Basin	Site Code	Count	% Survival Stat Diff	Count	% Survival Stat Diff	Count	Growth Stat Diff	Reduction Stat Diff	Count	% Survival Stat Diff	Growth Stat Diff	Count	% Survival Stat Diff	Reproduction Stat Diff
Bear Creek Bert Crane Rd	535MER007	11	3	12	0									
Total Southeast Basin Count		11	3	12	0	0	0	0	0	0	0	0	0	0
Grassland Basin	Site Code	Count	% Survival Stat Diff	Count	% Survival Stat Diff	Count	Growth Stat Diff	Reduction Stat Diff	Count	% Survival Stat Diff	Growth Stat Diff	Count	% Survival Stat Diff	Reproduction Stat Diff
Salt Slough @Lander/Hwy 165	541MER531	17	0	17	0	3	2	1						
Mud Slough (n) (upstream) @ San Luis Drain	541MER536	1	0	1	0									
Total Grassland Basin Count		18	0	18	0	3	2	1	0	0	0	0	0	0
Eastside Basin	Site Code	Count	% Survival Stat Diff	Count	% Survival Stat Diff	Count	Growth Stat Diff	Reduction Stat Diff	Count	% Survival Stat Diff	Growth Stat Diff	Count	% Survival Stat Diff	Reproduction Stat Diff
Turner Slough at 4th Avenue	535MER576	10	0	11	0									
Merced River Hatfield Park (River Road)	541MER546	16	0	15	0	4	2	0	9	2	3			
Lone Tree Creek @ Austin Rd	531SJC503	12	0	11	1									
French Camp Slough @ Airport	531SJC504	11	3	11	0									
Harding Drain discharge @ San Joaquin River (TID5)	535STC501	27	0	27	0	4	2	2						
Tuolumne River @ Shiloh	535STC513	16	0	15	0	4	2	2	9	6	6			
Stanislaus River @Caswell	535STC514	17	0	15	0	4	1	2	9	2	3			
Total Eastside Basin Count		109	3	105	1	16	7	6	27	10	12	0	0	0
Westside Basin	Site Code	Count	% Survival Stat Diff	Count	% Survival Stat Diff	Count	Growth Stat Diff	Reduction Stat Diff	Count	% Survival Stat Diff	Growth Stat Diff	Count	% Survival Stat Diff	Reproduction Stat Diff
Orestimba Creek @ River Rd.	541STC019	13	0	12	1									
Solado Creek @ Hwy 33	541STC515	11	0	11	0									
Del Puerto Creek @Vineyard	541STC516	7	0	6	0									
Grayson Drain	541STC030	7	0	7	1									
Ingram Creek @River Rd.	541STC040	12	0	12	0									
Hospital Creek @River Rd.	541STC042	14	0	13	3									
Total Westside Basin Count		64	0	61	5	0	0	0	0	0	0	0	0	0
Northeast Basin	Site Code	Count	% Survival Stat Diff	Count	% Survival Stat Diff	Count	Growth Stat Diff	Reduction Stat Diff	Count	% Survival Stat Diff	Growth Stat Diff	Count	% Survival Stat Diff	Reproduction Stat Diff
Cosumnes River @ Twin Cities Rd.	531SAC001	19	3	18	0	4	0	4						
Mokelumne River @New Hope Rd.	544SAC002	2	0	2	0				8	2	3			
Pixley Slough @ Davis Rd	531SJC507	10	0	10	0									
Bear Creek @Lower Sacramento Rd.	531SJC515	9	1	9	0									
Total Northeast Basin Count		40	4	39	0	4	0	4	8	2	3	0	0	0
Delta Basin	Site Code	Count	% Survival Stat Diff	Count	% Survival Stat Diff	Count	Growth Stat Diff	Reduction Stat Diff	Count	% Survival Stat Diff	Growth Stat Diff	Count	% Survival Stat Diff	Reproduction Stat Diff
New Jerusalem Drain	544SJC001	26	1	23	1	2	2	0						
Tom Payne Slough @ Paradise Rd.	544SJC505	1	0	1	0	1	0	1						
Mountain House Creek	544SJC509	12	0	11	0	2	1	0						
Total Delta Basin Count		39	1	35	1	5	3	1	0	0	0	0	0	0
Total Program Count		360	11	347	7	59	33	14	100	22	25	50	0	10

🟪 =Toxic event was present
🟨 =Toxic event was present >/= 50% of the time
🟧 =Toxic event was present 100% of the time during the sampling period

12.0 DISCUSSION

The main stem river and sub-basin tiers of the SJR SWAMP effort have two main objectives: evaluate overall water quality, both temporally and spatially, and assess whether there is any indication that beneficial uses are not being protected. A third adaptive objective is to utilize the information gathered at the long-term sites for the sub-basins to help design future monitoring efforts within that sub-basin. This section discusses the results in the context of those objectives.

This five-year study covered: three dry water years, one below normal water year, and one wet year. The final year of this study was one of the wettest years on record. The overall water year effects as well as seasonal effects between storm, snowmelt, irrigation and dry seasons are depicted in a series of paired line graphs for each constituent specifically evaluated: one graph for the SJR sites and one for the Northeast Basin sites (representing temporal trends within sub-basins). If trends within one of the other sub-basins differed greatly from the Northeast Basin, a separate figure was included within the discussion.

Similarly, spatial trends were depicted using paired box and whisker figures: one figure showing summary information for SJR sites moving downstream; and the second figure showing summary information for each sub-basin, also moving downstream, as well as summary information for the San Luis Drain and New Jerusalem Drain which represent shallow groundwater within the Grassland and Delta sub-basins, respectively. Drainage basin sites were selected as being representative of the major flows to the SJR from each basin. While graphical summary information for each sub-basin was not included within this section of the report, the figures are available in Appendix R.

Wherever possible, water quality objectives, guidelines and/or targets have been noted on the figures to help put the results in context. Evaluation of the constituents and their potential impacts on the beneficial uses is evaluated in section 12.2. The data collected was utilized in combination with other available data sets during the development of the draft 2009 Clean Water Act Section 305(b) and 303(d) Integrated Report for the Central Valley Region that identifies specific beneficial use impairments for water body segments throughout the Central Valley. A summary of potential concerns for each sub-basin that may aid future monitoring design is included in the summary/conclusion of this report.

All the sites are located relatively close together in the lower reaches of the individual sub-basin prior to discharge into the SJR, therefore have similar localized land use influences, the most notable being dominance by agricultural return flows during the irrigation season. Source water does vary widely, from Sierra snow melt to imports from the Sacramento-San Joaquin Delta and may also include storm water, wetland drainage, operational spill, and ground water discharge.

12.1 Temporal and Spatial Trends

12.1.1 TEMPERATURE

Temperature was measured in degrees Celsius and ranged from 1.9 – 32.8 throughout the Basin during the 5-year study. A very consistent seasonal oscillation was seen at all the sites and tracked those within the Northeast Basin. The lowest temperatures were seen in January around 5ºC with a gradual climb to its peak in July around 25ºC (Figures 8 and 9).

The majority of the South Delta Basin sites showed the same seasonal oscillation as the Northeast Basin except New Jerusalem Drain. The New Jerusalem Tile Drain had relatively higher temperatures and shorter amplitude oscillations then the rest of the South Delta Basin sites.

Through dry and wet years the temperature showed no significant differences.

No significant spatial differences were observed either moving upstream to downstream along the main stem of the SJR, nor between sub-basins. Figures 10 and 11 show the relatively consistent ranges in temperature within the basins and SJR, respectively.

Figure 8: San Joaquin River Northeast Basin Temperature WY01-WY05

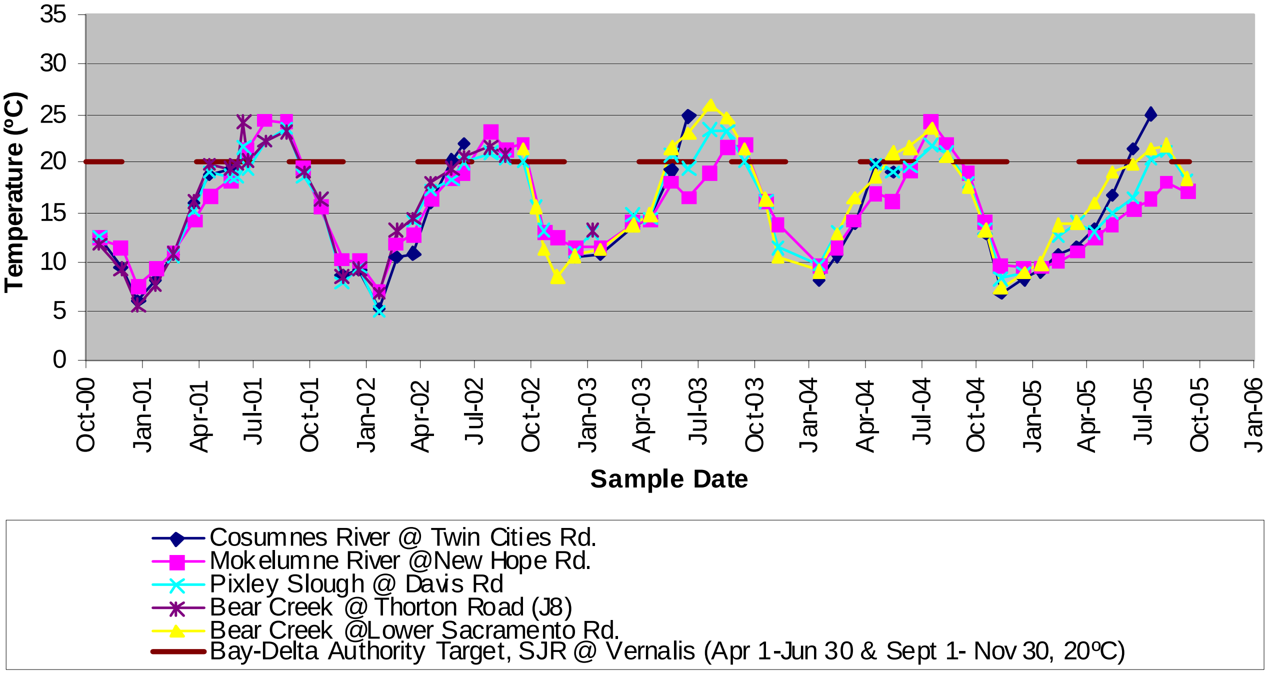


Figure 9: San Joaquin River Main Stem Temperature WY01-WY05

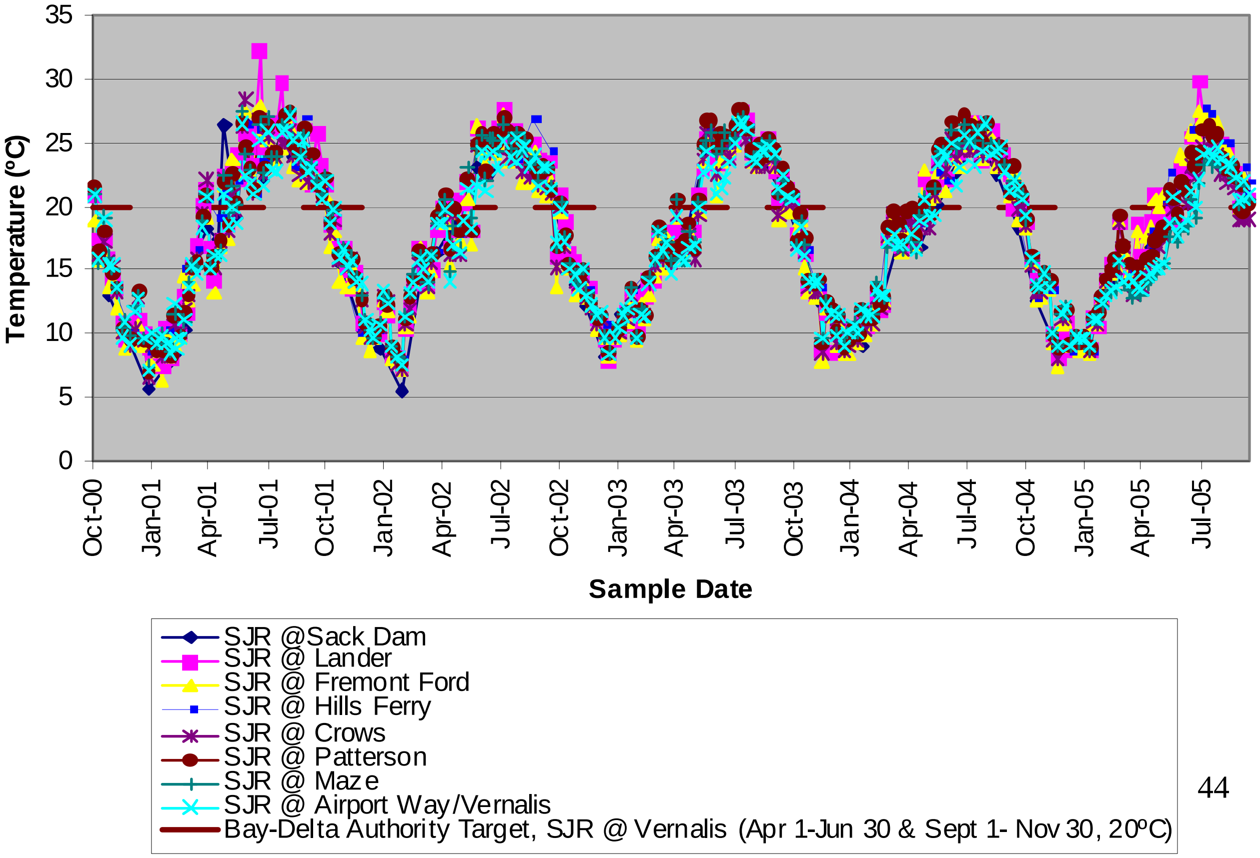


Figure 10: Basin Temperatures WY01-WY05

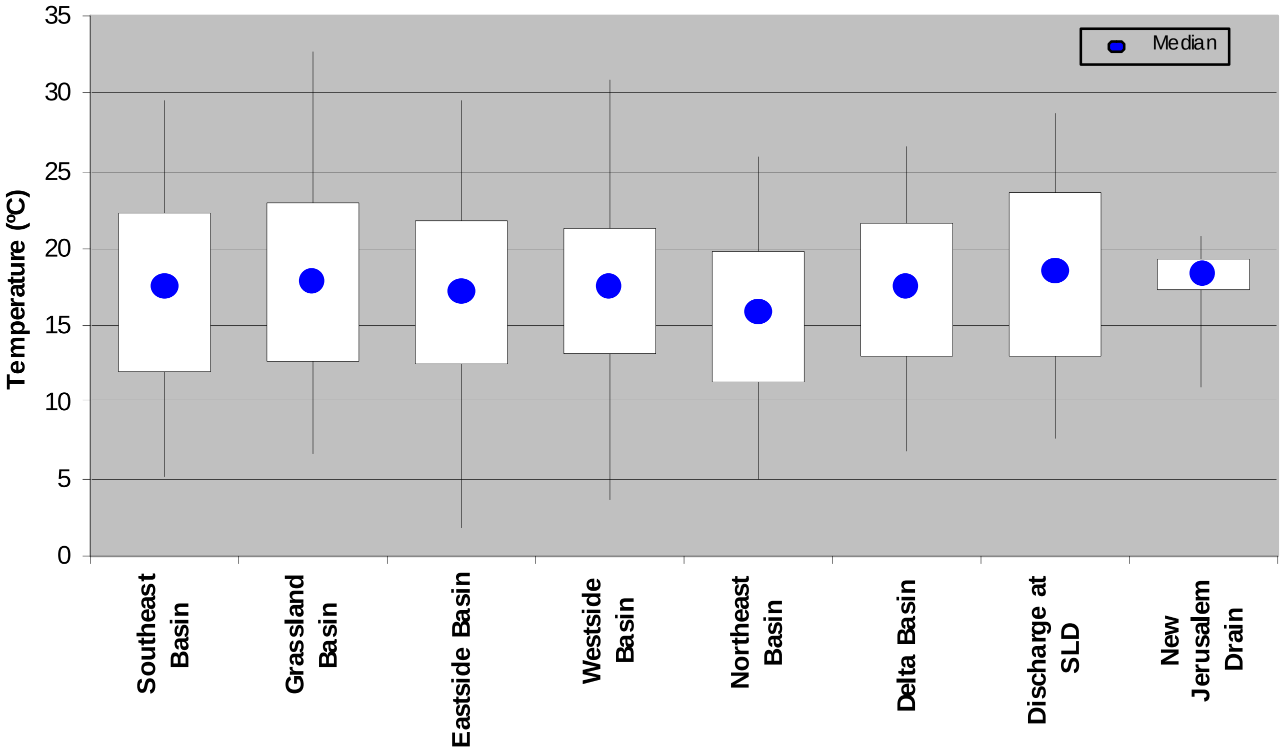
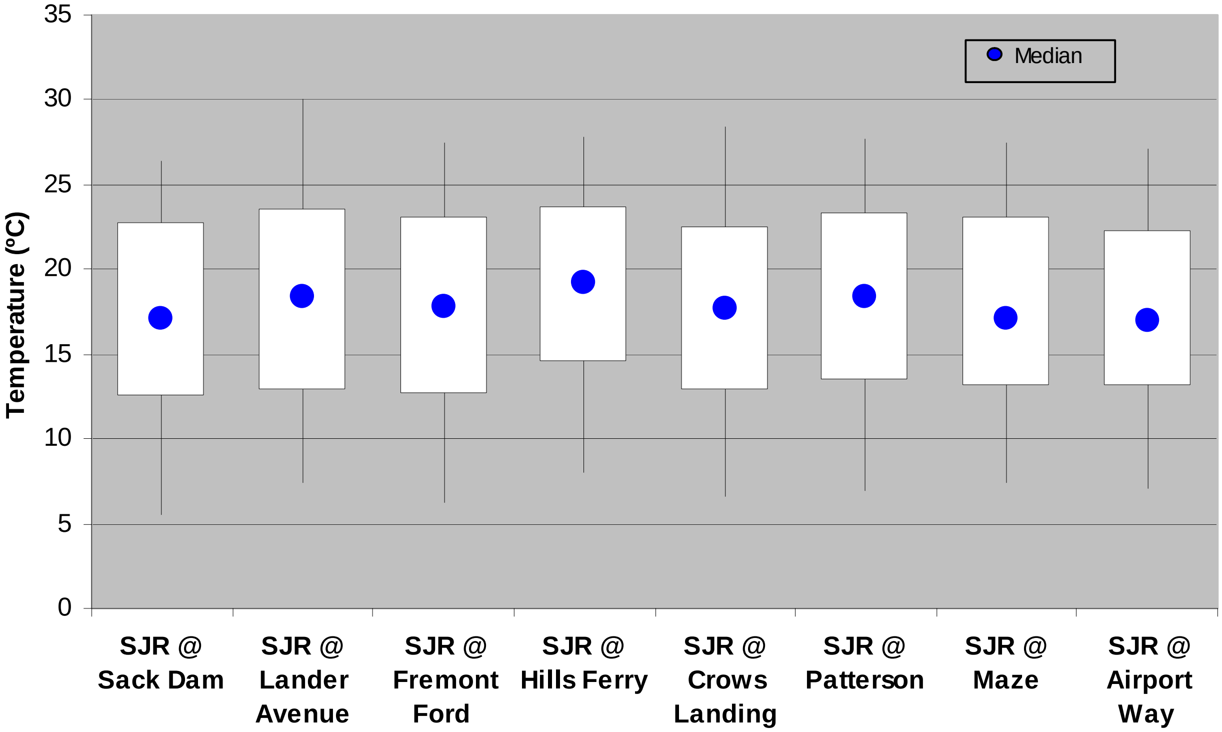


Figure 11: San Joaquin River Main Stem Temperature WY01-WY05



12.1.2 SPECIFIC CONDUCTANCE

Specific conductance (SC) values ranged from 8.0 - 5,960 µmhos/cm across the SJR Basin. Seasonal patterns in SC were not as clearly defined as for temperature. In general, SC tended to decrease during the dry season (September through November), sometimes showing a peak during the first storm runoff and then decreasing until the irrigation season began in May/June with the highest concentrations recorded during the irrigation season. Exceptions to this rule include water bodies that receive wetland releases in early spring (Grasslands sub-Basin and SJR), where additional spikes are evident (Steenson, *et al.*, 1998). This pattern is depicted in Figures 12 and 13, the NE Basin and SJR sites, respectively. In addition, overall SC values appeared to decrease during wet WY 2005, although the seasonal trend patterns remained similar. Temporal anomalies within each sub-basin are discussed below.

Northeast Basin: The Northeast basin was managed from April through October by diverting water into different channels to supply agricultural use. Each growing season, Bear Creek, which naturally would be dry for the summer months like the Cosumnes River, was dominated by agricultural supply that was diverted from the Mokelumne River. This change in water type was observed each year when the Bear Creek SC dropped to about 50 µmhos/cm, the approximate year round SC of the Mokelumne River. Pixley Slough is also dominated by agricultural supply during the growing season and seemed to follow the same trend, but it wasn't as dramatic as Bear Creek. The one notable difference between the different water year types was that Bear Creek was about 100 µmhos/cm higher during winter months of a wet year than during the dry years.

Eastside Basin: French Camp Slough and Lone Tree Creek followed the Northeast Basin's Bear Creek trend with having lower concentrations of SC in the growing season and higher concentrations during the winter. The Harding Drain also followed this same trend of higher levels during the winter months and lower levels during the agricultural season but the levels of SC are much higher than any of the other agricultural influenced sites in this basin (e.g. Turner Slough). The Eastside river sites were fairly consistent throughout the 5 years with Stanislaus River demonstrating little seasonal variability. The Tuolumne River is a little more sporadic, but always seemed to drop in April. The Merced River had the opposite trend when compared to Bear Creek in the Northeast Basin. Specific conductance levels on the Merced River went up during the growing season and down in the winter months.

Southeast Basin: Bear Creek in the Southeast Basin, like the Eastside rivers, didn't fluctuate drastically and showed sporadic levels similar to the Tuolumne River although no seasonal trends seemed to be evident in Bear Creek. Dramatic changes were identified in Deep Slough, similar to the Harding Drain, but seemed to drop drastically in the 2005 wet year when compared to the previous consecutive dry years.

South Delta Basin: The South Delta Basin's SC levels were mostly above 500 µmhos/cm unlike the Northeast basin where all the samples were below 500 µmhos/cm. The New Jerusalem Drain (discharging shallow groundwater from the basin) reported consistently high SC levels all year long fluctuating around 2500 µmhos/cm with no noticeable consistent trend.

Mountain House Creek, an ephemeral stream which historically received agricultural tail water, was dry for about half of the sampling period through 2003. In 2004, the site was removed from the sampling program due to the rapid community development with about 43,500 residents settling on the land adjacent to and surrounding the creek (Weston, 2009). The change in localized land use included rerouting storm water runoff into a collection system and resulted in continuous dry conditions for the original creek bed. During sampling conducted prior to the development (from December 2000 through February 2001), Mountain House Creek had seasonally stable SC values (typically below 1000 umhos/cm), similar to New Jerusalem Drain.

Old River is dominated by estuary flow characteristics. Old River followed the same SC characteristics of the Tuolumne River on the Eastside Basin fluctuating throughout the year with lower SC levels measured during the 2005 wet year, but overall Old River fluctuated at a higher SC level.

Tom Payne Slough fluctuated like the Harding Drain with drastic fluctuations between summer and winter months. Like the Harding Drain, Tom Payne Slough has influences other than agricultural which include NPDES discharges and tidal influences. However, similar to the rest of the Delta Basin sites, Tom Payne Slough generally reported higher SC concentrations than the Harding Drain.

Westside Basin: Like the Delta Basin, the Westside Basin had higher SC levels than the Northeast Basin. Westside sites Del Puerto Creek, Grayson Drain, Ingram Creek, Hospital Creek and Orestimba Creek are ephemeral streams dominated by irrigation return flows. Ingram Creek had the largest SC fluctuations during the irrigation season and was the only creek to have very high distinct SC values during the winter months. Orestimba Creek receives operational spill from the CCID (Central California Irrigation District) Main Canal which could result in dilution and may have contributed to the narrower range of fluctuation in SC levels when compared to the other Westside sites.

Grassland Basin: The Grassland Sites had higher values of SC than most of the other basin sites. The San Luis Drain represents shallow groundwater discharge from approximately 97,000-acres (Bureau of Reclamation, 1995) of irrigated agriculture and affects SC values observed in Mud Slough (Figure 14). All the Grassland sites had an oscillating trend that peaked in March or April, which corresponds to both wetland releases and pre-irrigation runoff (Figure 14). The Grassland Basin is highly managed and does not demonstrate a significant difference between water year types aside from slightly lower SC values during the 2005 wet year.

Spatially, the Northeast, Eastside and Southeast Basins had considerably lower levels of SC as compared to the South Delta, Westside, and Grassland Basins (Figure 15). The eastern basins draining the Sierra watershed begin with less saline water than those dependent on imports from the Delta. Although each basin had unique seasonal and temporal trends, during the 2005 wet water year there was a slight decrease in the SC values at most sites.

Inflows from the various sub-basins appear to have a dramatic overall effect on the SJR as the inflows progressively reach the river (Figures 15 and 16). As we travel downstream, Southeast Basin flows tend to be trapped at Sack Dam and diverted. The SJR at Lander Avenue is dominated by ground water accretion for much of the year and provides a background elevated SC in the river. High SC levels in Salt Slough and Mud Slough, resulting from wetland as well as surface and subsurface agricultural drainage, increase the already elevated river levels. Starting immediately downstream of the Hills Ferry site, the Eastside tributaries (Merced, Tuolumne and Stanislaus Rivers) begin to influence SC levels along the SJR and gradually lower them resulting in levels observed at Vernalis that are just slightly higher than at Sack Dam.

Figure 12: San Joaquin River Northeast Basin Specific Conductivity WY01-WY05

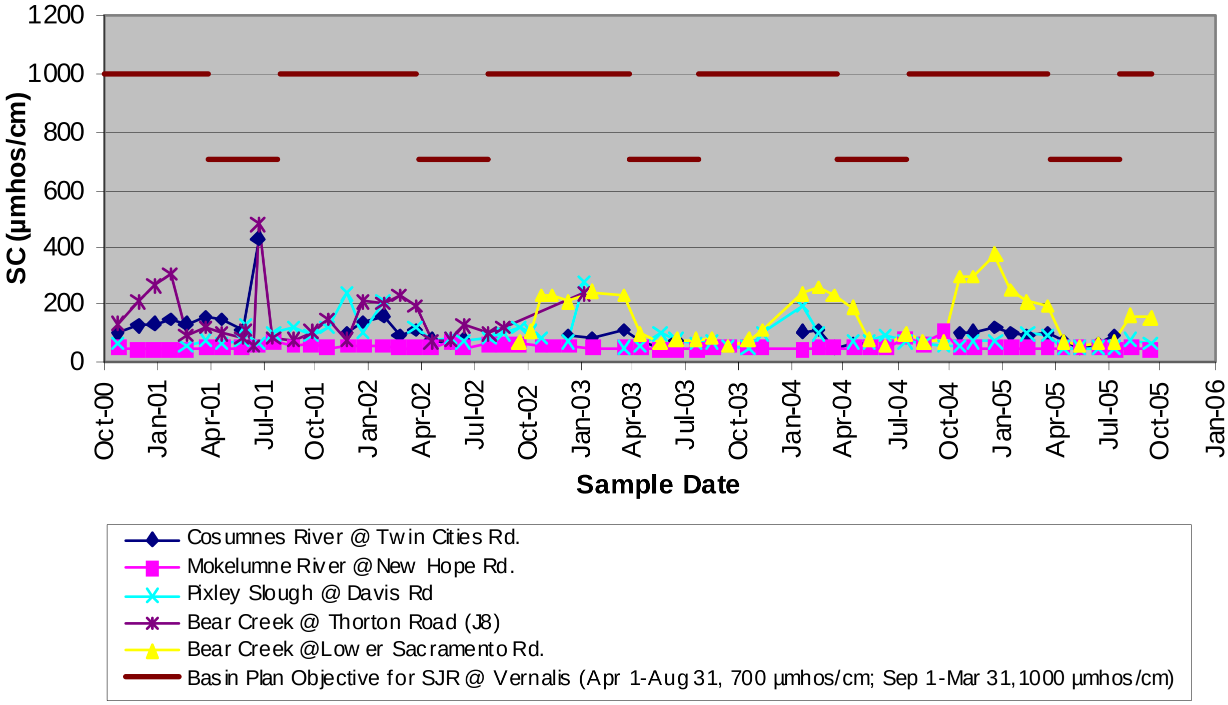


Figure 13: San Joaquin River Main Stem Specific Conductivity WY01-WY05

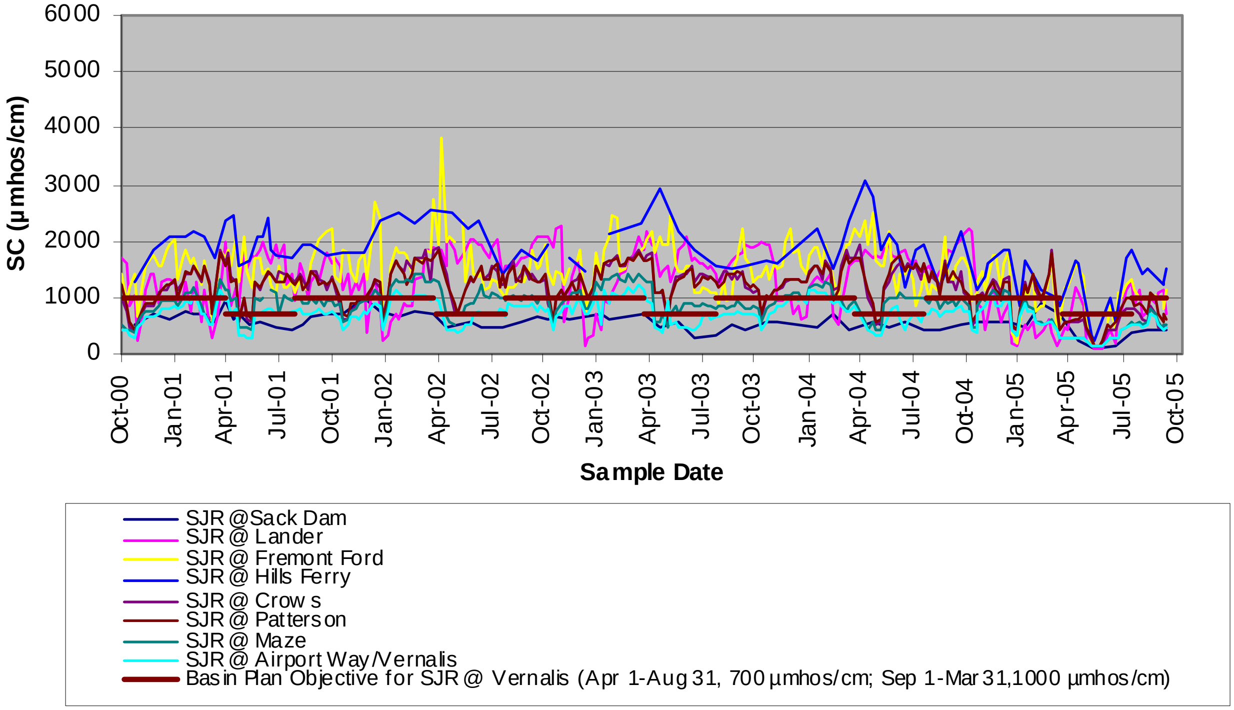


Figure 14: San Joaquin River Grassland Basin Specific Conductivity WY01-WY05

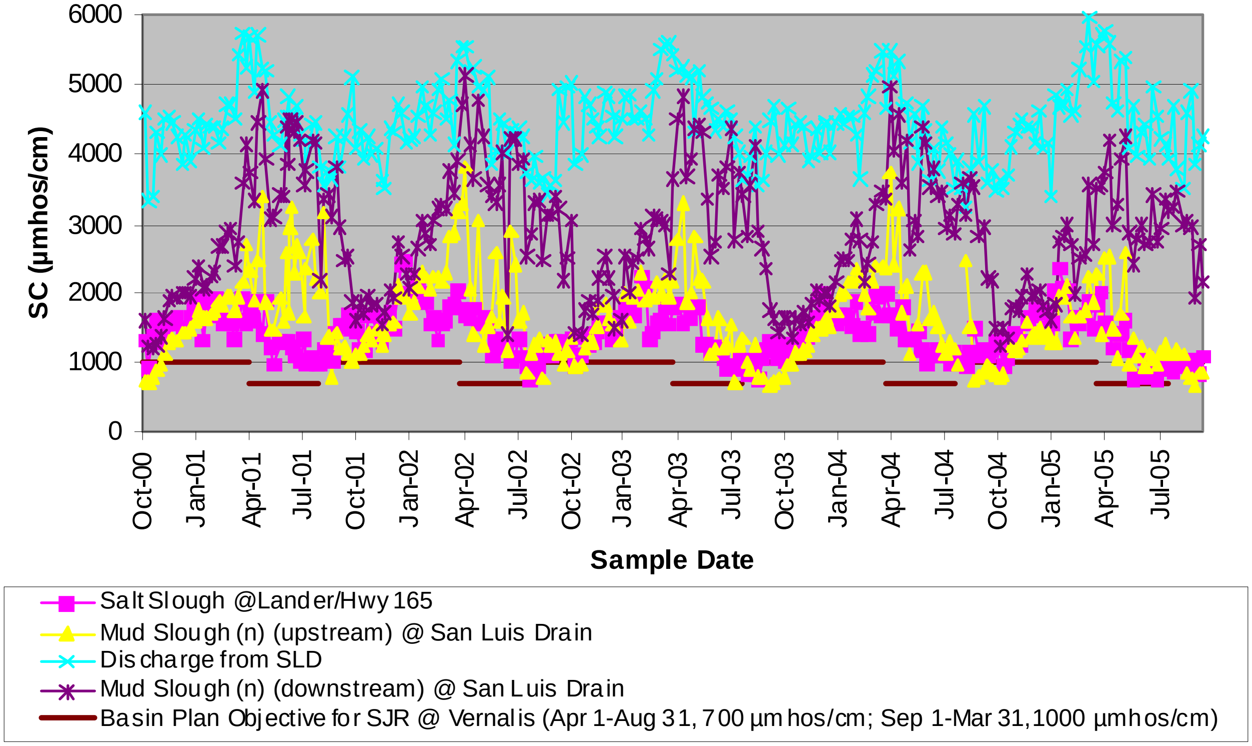


Figure 15: Basin Specific Conductivity WY01-WY05

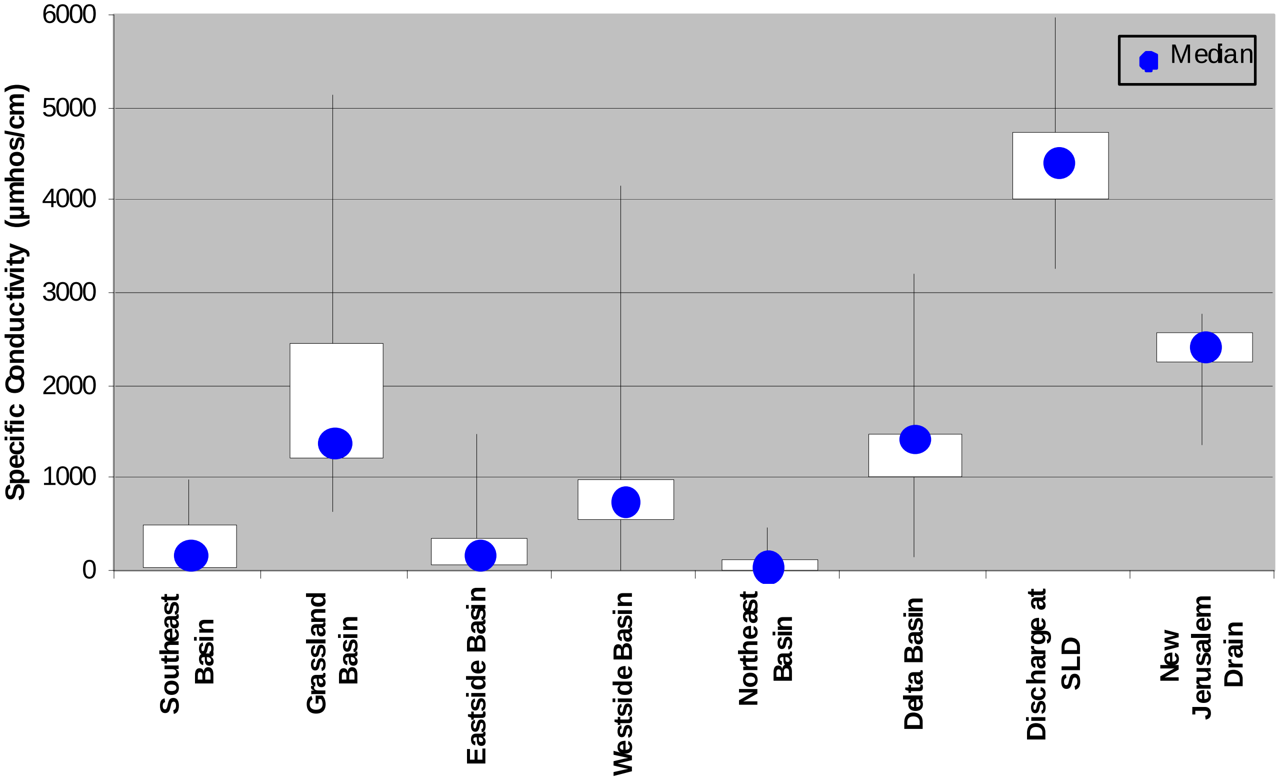
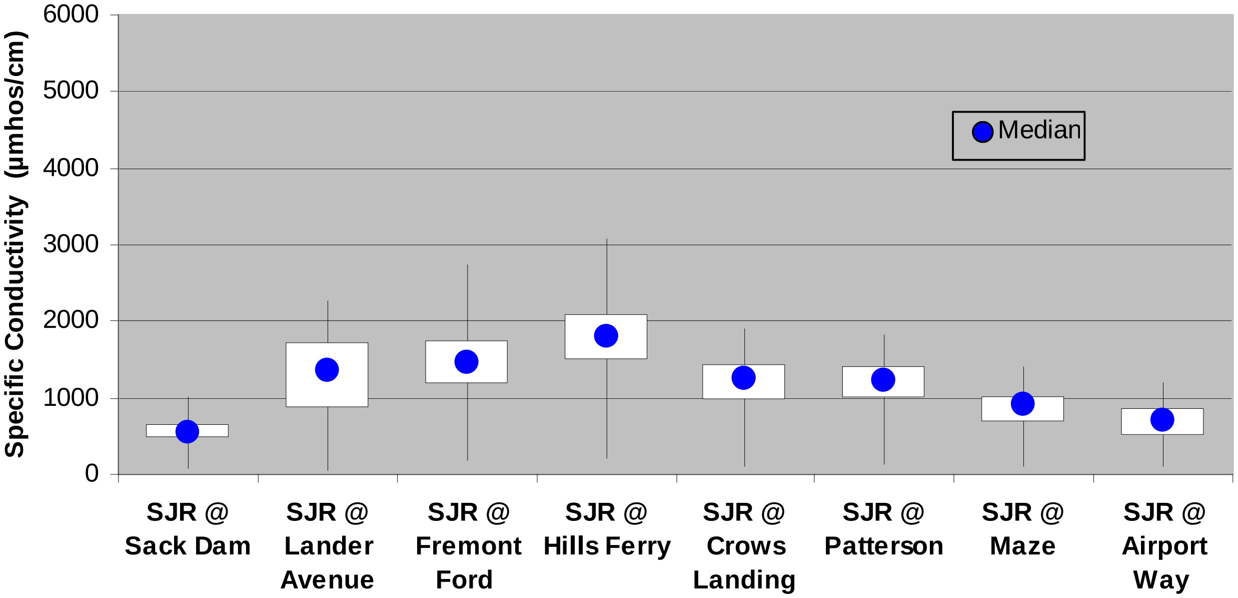


Figure 16: San Joaquin River Main Stem Specific Conductivity WY01-WY05



12.1.3 MEASURED pH

The pH values ranged from 5.4 – 10.1 across the basin. Mean values in the SJR ranged from 7.6 to 7.9 units. Few levels dropped below 6.5 pH units, though several appeared to seasonally exceed 7.5 units—during the irrigation season in the SJR and during the storm season in the Northeast Basin. Seasonal variability appeared reduced during wet WY 2005. Occasional spikes, both high and low, were seen throughout the sampling season (Figures 17 and 18).

Most of the basins appeared to follow the general trend of the Northeast Basin, with the majority of pH values falling between 7 and 8 units. The Cosumnes River had a wider range of variability compared to the Mokelumne River and the other sites. The variability seen in the Cosumnes River seemed to be most pronounced following its natural annual dry period. The Westside Basin showed similar occasional fluctuations as the Northeast Basin but reported slightly higher concentrations ranging most frequently from 7.7 to 8.4 pH units.

The Grassland Basin and the SJR sites were sampled more frequently (weekly) and demonstrated clear seasonal fluctuations with the exception of Salt Slough. The pH values found in the river and Grasslands would peak in July and drop around January, following the same trend seen in temperature results. During the 2005 wet water year, there was no peak in July which can probably be attributed to the greater flows seen during this time when compared to the previous dry years.

Spatially, the Northeast, Eastside and Southeast basins reported slightly lower pH than the Westside and Grassland Basin’s (Figure 19). Those differences did not appear to impact the SJR, as there does not appear to be any distinct difference in pH moving downstream (Figure 20). All of the river sites are approximately the same range and like the basin sites show occasional fluctuations, with the smallest minimums and greatest maximums recorded at the furthest upstream (SJR at Sack Dam) and downstream (SJR at Airport) sites.

Figure 17: San Joaquin River Northeast Basin pH WY01-WY05

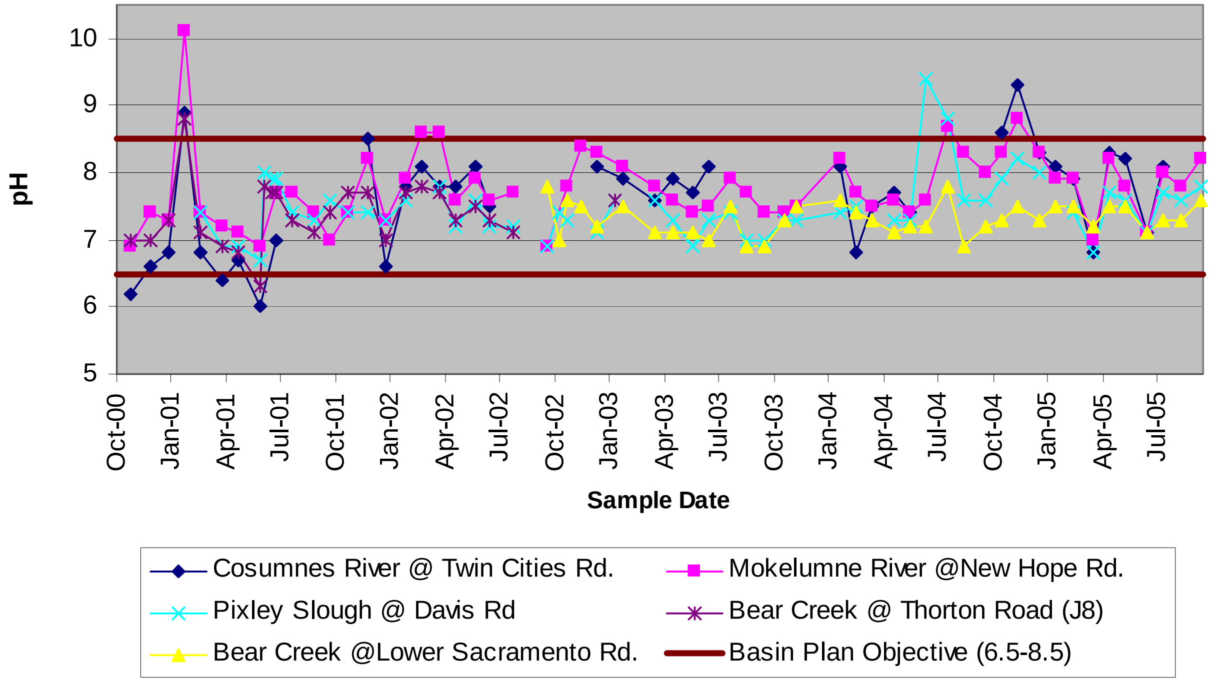


Figure 18: San Joaquin River Main Stem Specific Conductivity WY01-WY05

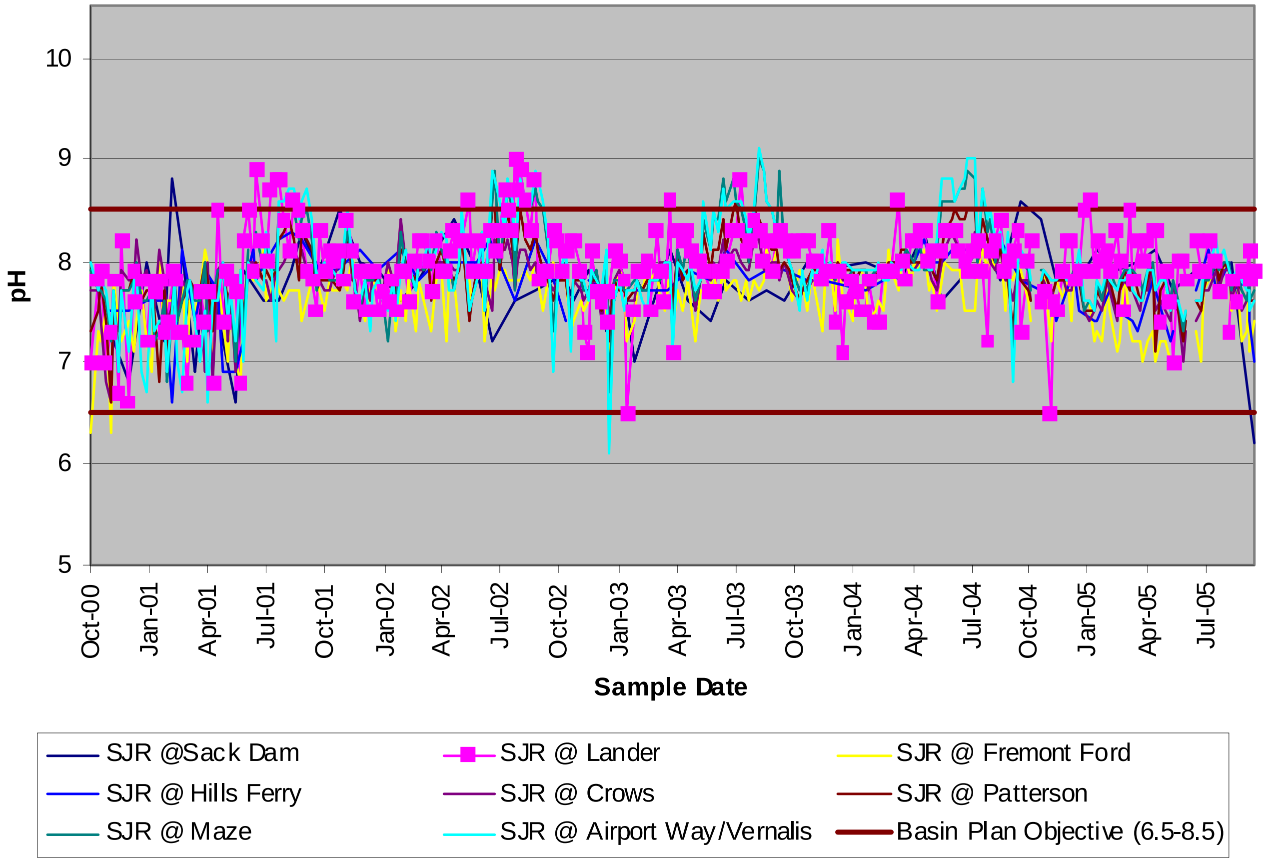


Figure 19: Basin pH WY01-WY05

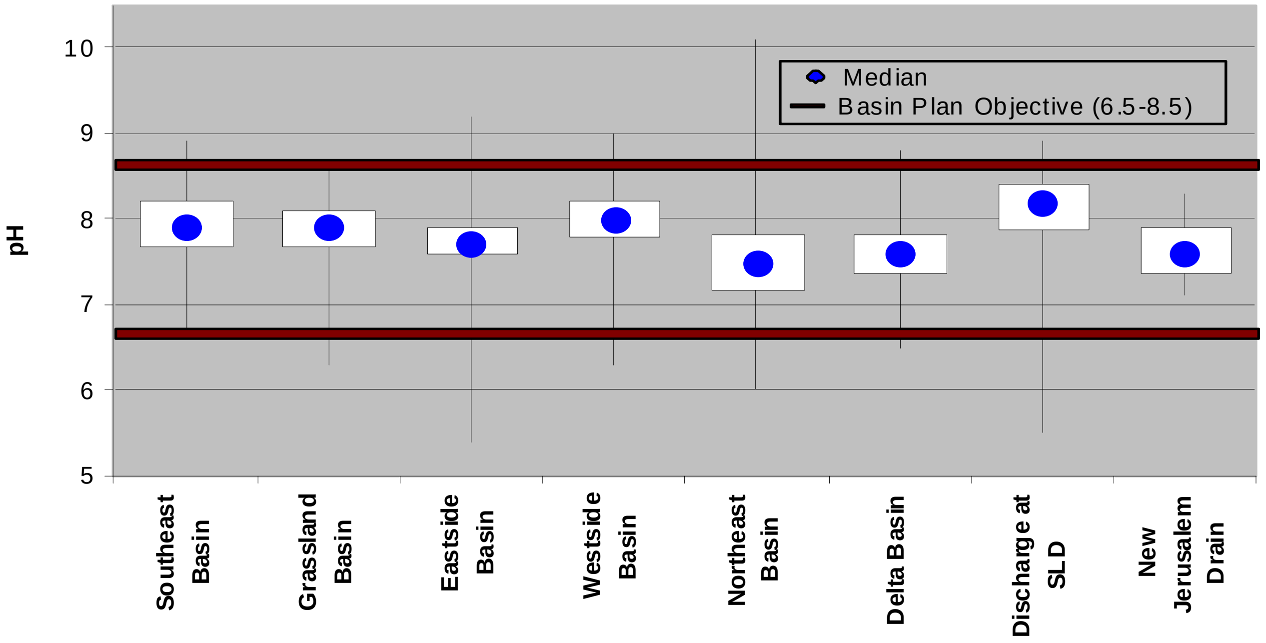
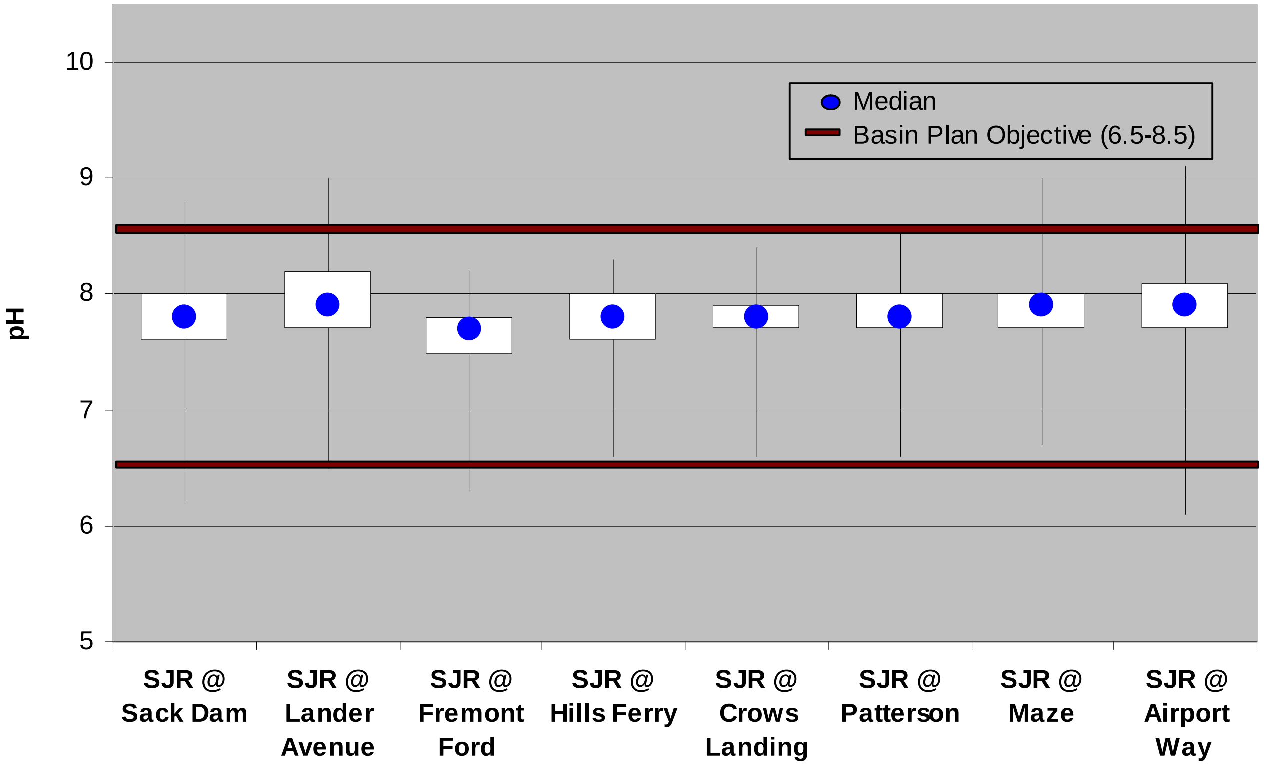


Figure 20: San Joaquin River Main Stem pH WY01-WY05



12.1.4 DISSOLVED OXYGEN

Dissolved oxygen is well known to have clear diurnal patterns which make grab sampling for trend analyses challenging, even if collecting at the same time each day. It was interesting to note that during this sampling effort, the variability in collecting weekly samples (Figure 21—the San Joaquin River sites) almost masked the seasonal pattern that was more evident with monthly sample collection (Figure 22—the Northeast Basin). In general, dissolved oxygen (DO) had a defined seasonal oscillation that is opposite of temperature. Dissolved oxygen concentrations tended to increase from October through April and decrease from May through September. The same pattern was evident during wet WY 2005, but the range in concentrations was much less. Only discharge from the San Luis and New Jerusalem Drains (both carrying shallow groundwater from their respective basins) did not appear to have significant seasonal patterns with concentrations remaining near 10 mg/L at both sites.

Spatially, the Grassland and Westside Basins had consistently higher DO levels than the Northeast Basin and non-river Eastside Basin sites, with the non-river sites of French Camp Slough and Lone Tree Creek reporting the lowest recorded DO concentration (0.4 mg/L) in May 2002 and October 2004, respectively. The highest values were observed in the San Luis Drain which had a mean of 12.5 mg/L.

The river itself did not demonstrate much spatial variability with the majority of the reported values tracking near 10 mg/L DO. The greatest overall site variability was noted at Lander Avenue, with high and low spikes that did not tend to track the remaining sites. The two lowest overall DO concentrations of 0.6-mg/L and 1.3-mg/L were recorded at Sack Dam and at Airport Way, the most upstream and most downstream sites, respectively

Figure 21: San Joaquin River Main Stem Dissolved Oxygen WY01-WY05

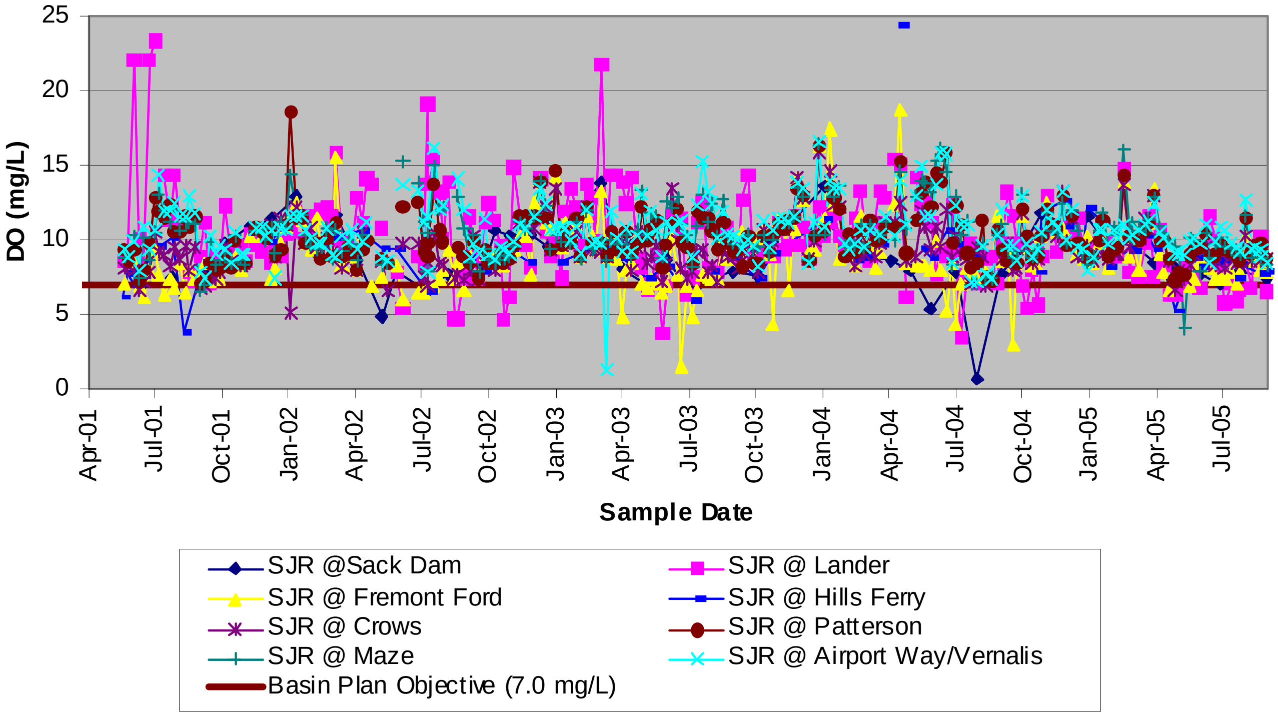
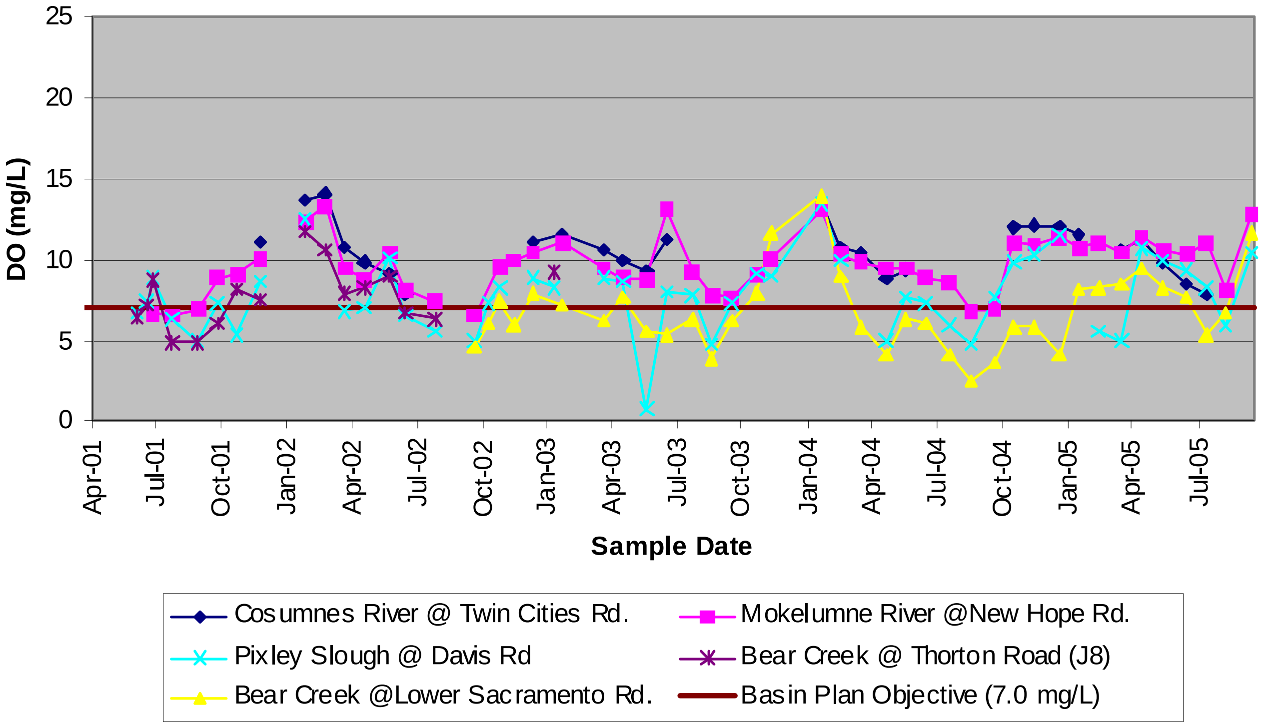


Figure 22: San Joaquin River Northeast Basin Dissolved Oxygen WY01-WY05



12.1.5 TURBIDITY

Turbidity findings are based on samples taken from July 2002 through June 2004, which encompasses portions of three water years: WY2001 (dry); WY2002 (dry); and WY2003 (below normal). The limited data set does not appear to demonstrate specific seasonal trends reporting spikes and dips throughout the year with individual sites both in the Northeast Basin and along the SJR. However, most sites did demonstrate a spike in turbidity that corresponded to a winter storm in December 2002 (Figures 23 and 24). Most of the sites appeared to show the greatest fluctuation in concentrations during the WY2003 irrigation season (April through August 2003), with a number of high values recorded. Mud Slough (north) and Salt Slough within the Grassland Sub-Basin also demonstrated increases during wetland flood-up (September) and wetland releases (April). Both these water bodies receive drainage from wetland habitat. These spikes were echoed in data for the San Joaquin River at Hills Ferry and at Fremont Ford—sites downstream of the Grasslands' inflows but upstream of the first Eastside river inflow (the Merced River).

Spatially, the Westside and Grassland Basins reported higher overall turbidity than basins draining the Sierra or the Delta. The exception was the Southeast Basin which had overall turbidity concentrations similar to the Grassland Basin. Both basins receive wetland drainage.

The Westside basin consists of ephemeral streams dominated by agricultural discharges and reported greater and more frequent fluctuations in turbidity then the rest of the Basins (Figure 25). Storm water inflows and run-off were the most evident in Salado Creek during the 2002 storm event resulting in a turbidity value of 1990 NTU.

The differences in the Basins are clearly shown by how they affect the SJR (Figure 26). Figure 27 provides an example of the impact that sub-basin inflow can have on the SJR during a pre-irrigation and wetland drainage period (23 – 27 March 2003). The dashed pink line representing a 5% increase over "background" Lander Avenue concentrations, helps visualize Westside inflows to the river increasing turbidity until the main Eastside rivers provide fresh water and bring the turbidity back down to slightly above SJR at Lander levels. Figure 28 is an example during the winter storm event (18 – 19 December 2002). The Westside influences again raise the turbidity above "background" Lander Avenue concentrations until after Hills Ferry when the Eastside Rivers enter the system. Figure 28 shows that during a winter storm event, turbidity in the SJR at Lander is greater than the turbidity downstream at Vernalis—opposite the finding during early spring.

Figure 23: San Joaquin River Northeast Basin Turbidity WY02-WY04

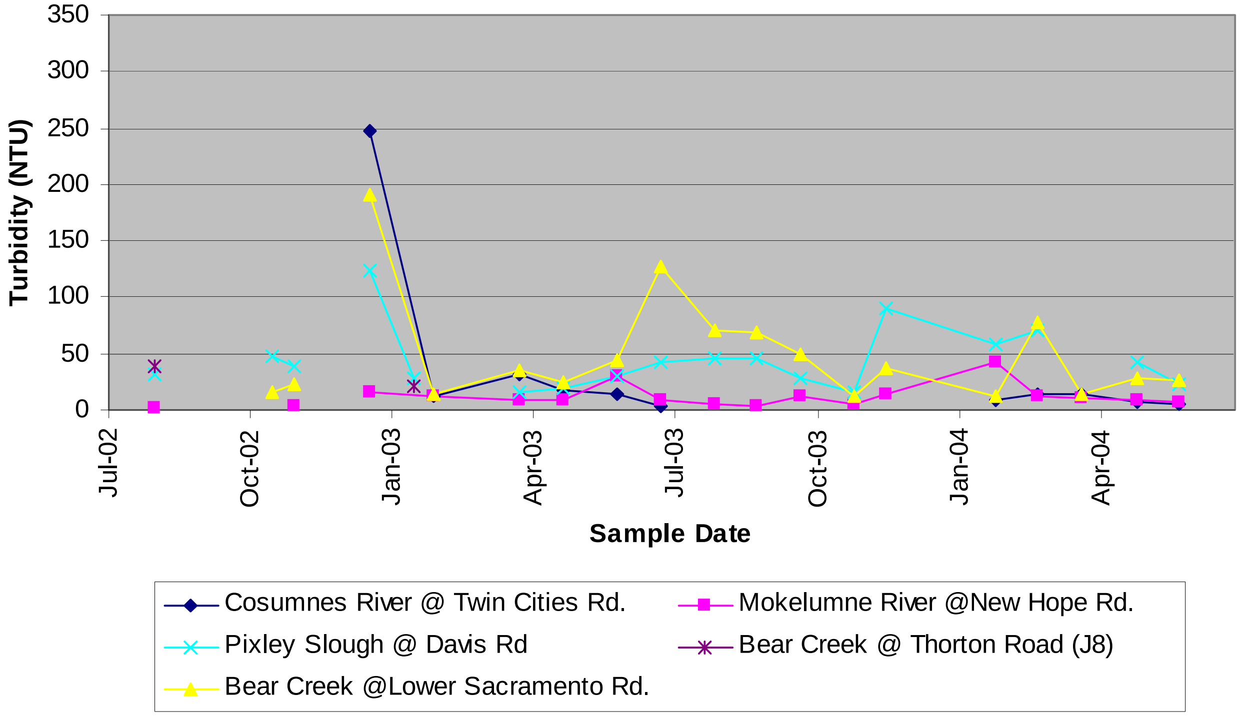


Figure 24: San Joaquin River Main Stem Turbidity WY01-WY05

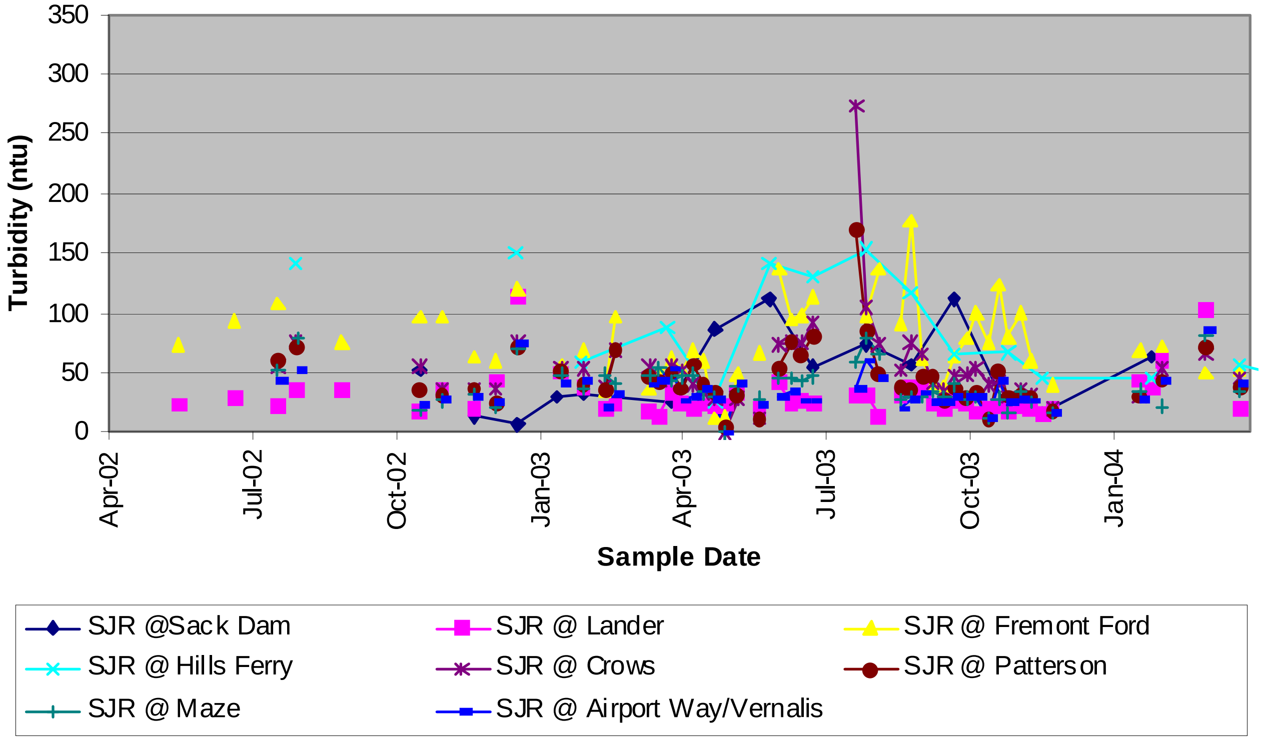


Figure 25: Basin Turbidity WY02-WY04

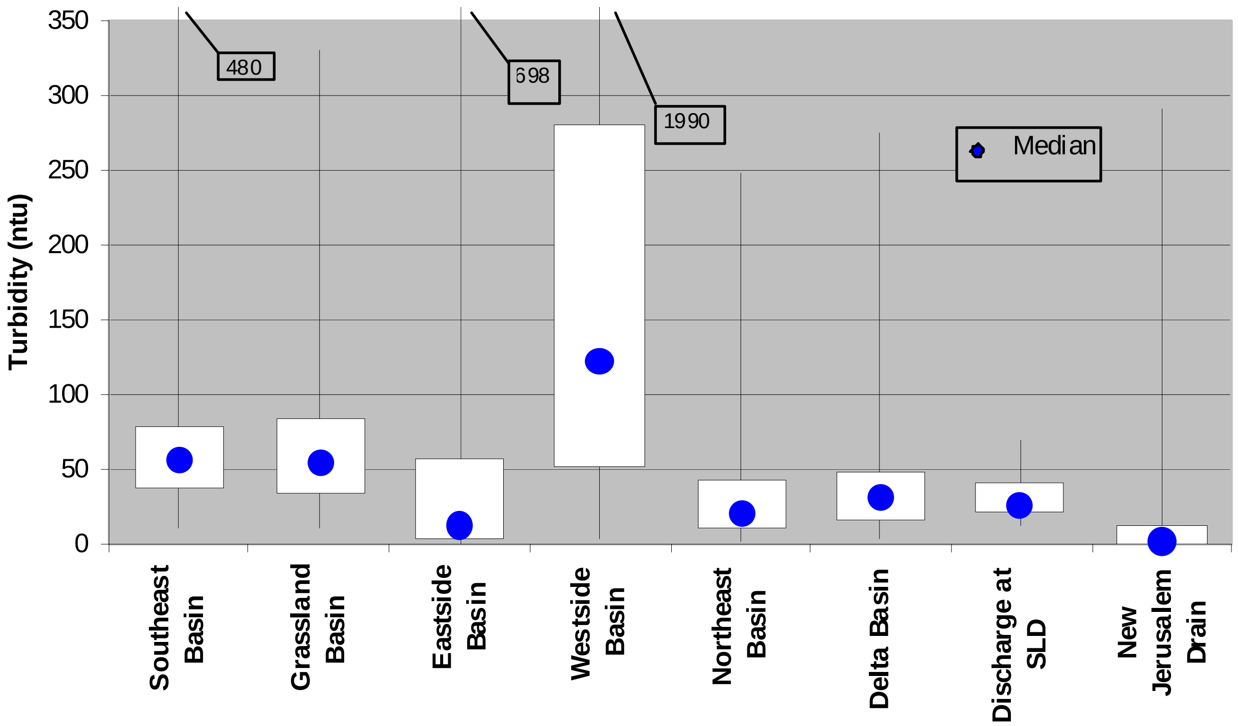


Figure 26: San Joaquin River Main Stem Turbidity WY02-WY04

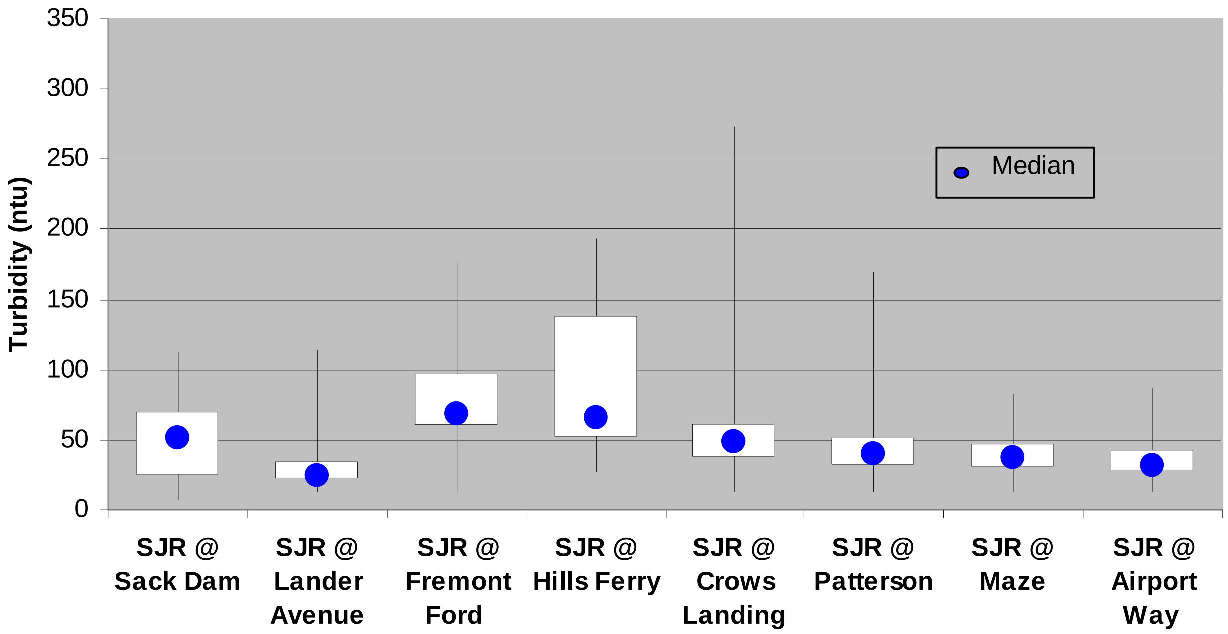


Figure 27: Turbidity Influences on the San Joaquin River from Lander to Airport Way/ Vernalis 3-25-03 and 3-27-03. Blue data points represent turbidity concentrations on the river. Pink lines are the Basin Plan objective with the river sites as background. Orange arrows represent west side influences, green arrows represent eastside influences and blue arrows represent major tributary input.

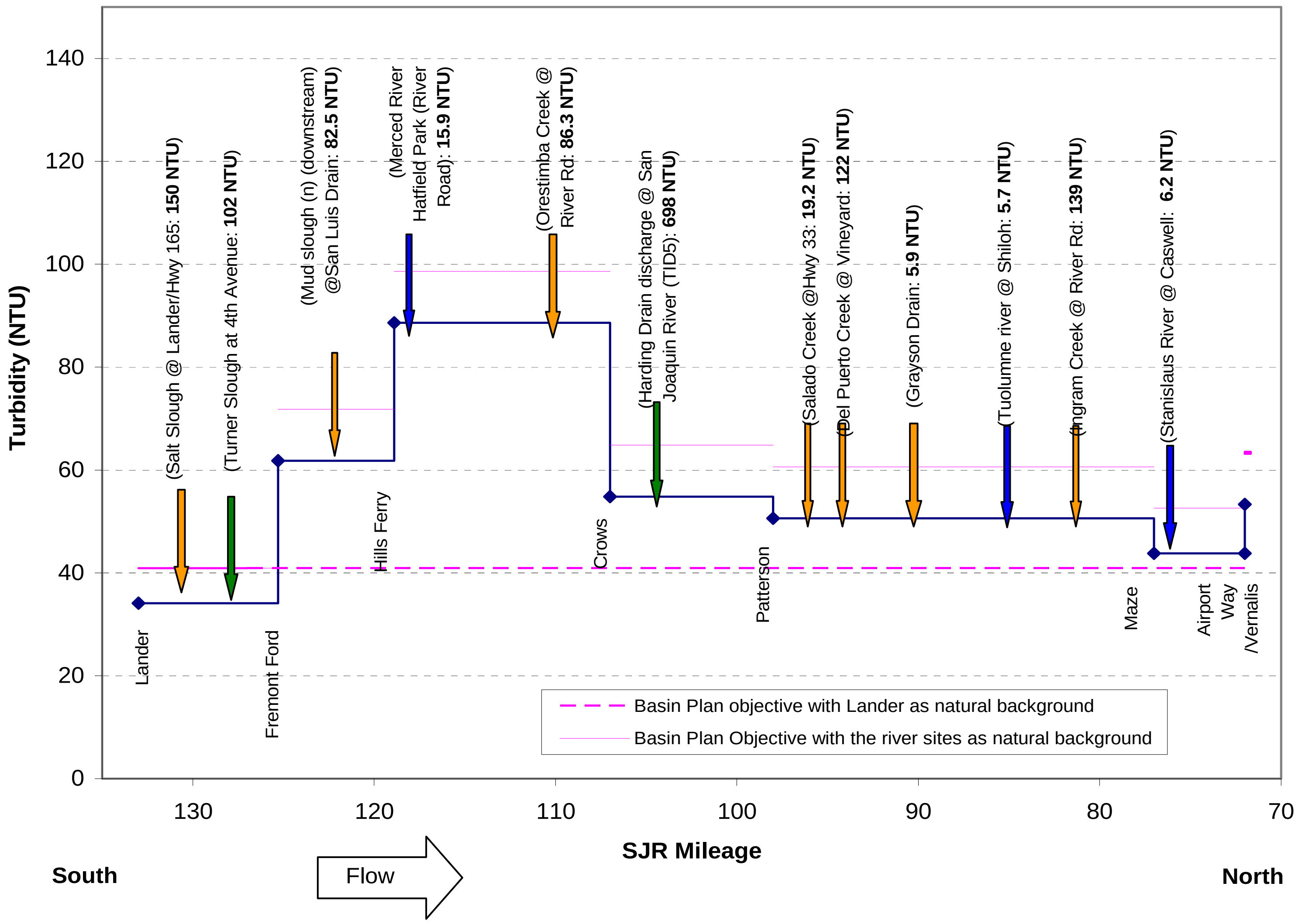
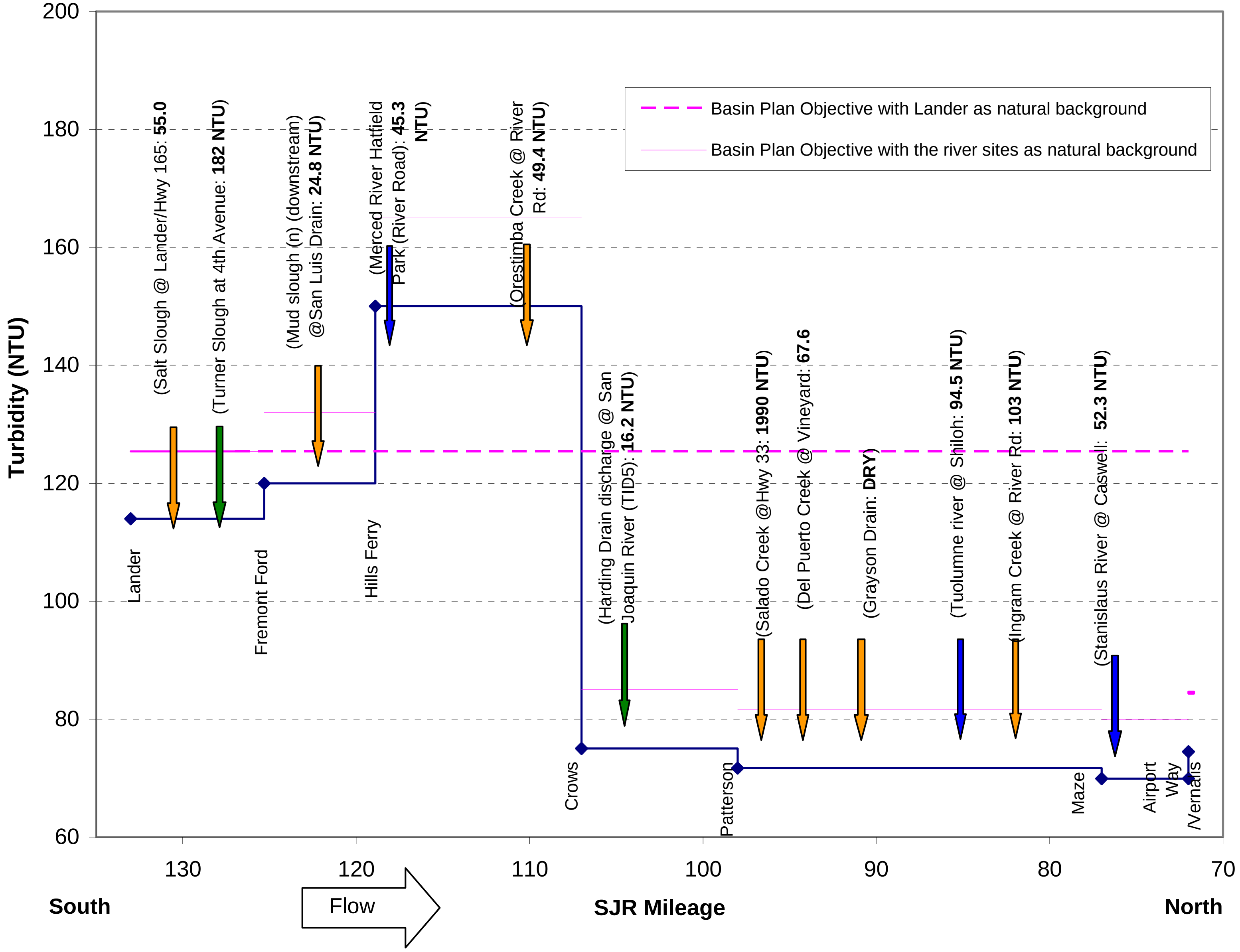


Figure 28: Turbidity Influences on the San Joaquin River from Lander to Airport Way/ Vernalis 12-18-02 and 12-19-02. Blue data points represent turbidity concentrations on the river. Pink lines are the Basin Plan objective with the river sites as background. Orange arrows represent west side influences, green arrows represent eastside influences and blue arrows represent major tributary input.



12.1.6 TOTAL SUSPENDED SOLIDS

Total suspended solids (TSS) samples were generally collected weekly at the SJR main stem sites (except during WY04 where no TSS samples were collected due to funding shortfalls) and monthly during WY01 at all the drainage basin sites. TSS was also collected monthly during the irrigation season (June thru August) in WY05 at the Westside Basin sites. Elevated levels in both the SJR and Basins between January and April 2001 correspond to a series of significant (greater than 1-inch) rainfall events. The TSS begins to climb again at the beginning of the irrigation season (June) and remain elevated, but concentrations remained lower than the spikes seen during storm events. For the SJR sites, there was no obvious difference in concentrations during wet WY 2005, except for an increased frequency of spikes during winter rainfall events (Figure 29).

Figure 30 displays the TSS data available during the irrigation season (March thru September) during both WY01 and WY05 for the Westside Basin sites. The incomplete data sets indicate increasing concentrations, particularly in Ingram and Hospital Creeks and Grayson Drain which show a number of spikes above 3,000 mg/L TSS. The variability in findings indicates the need for more continuous data sets during the irrigation season.

Spatially, similar to turbidity, the Westside and Grassland Basins had higher concentrations of TSS when compared to the other Basins (Figure 31). Most of the larger waterways seemed to track consistently with the river sites downstream of their inflows. In particular, the highest overall levels of TSS in the SJR were recorded at Fremont Ford and Hills Ferry (Figure 32)—downstream of Grassland Basin and some Westside Basin inflows, but upstream of the Merced River and other Eastside Basin influences. Overall concentrations in the SJR remained below 100-mg/L TSS with a median near 50-mg/L, as did all the sub-basins except the Westside. Although median Westside Basin TSS concentrations remained near 75-mg/L, 50% of the concentrations ranged between 40 mg/L and 345 mg/L.

Some unique findings within selected sub-basins are noted below.

Northeast Basin: Although similar in land use and size, the Cosumnes River TSS concentrations appeared to more directly track storm events when compared to the Mokelumne River (Figure 33). The one major difference between the basins is that flow from the Mokelumne River is regulated by Camanche Reservoir. Reservoirs on other major rivers in the SJR Basin likely have similar buffering effects.

Eastside Basin: Similar to turbidity, Turner Slough and Harding Drain had larger and more fluctuating TSS values than that of the rivers sites.

Grassland Basin: The Discharge from SLD was monitored for TSS weekly through the Grassland Bypass Program. Flow in the drain is specifically regulated to minimize potential for bed sediment suspension and storm event influences. The TSS concentrations in the drain remained relatively constant just below 50-mg/L and did not reflect patterns noted in other Grassland waterbodies.

Figure 29: San Joaquin River Main Stem Total Suspended Solids WY01-WY05

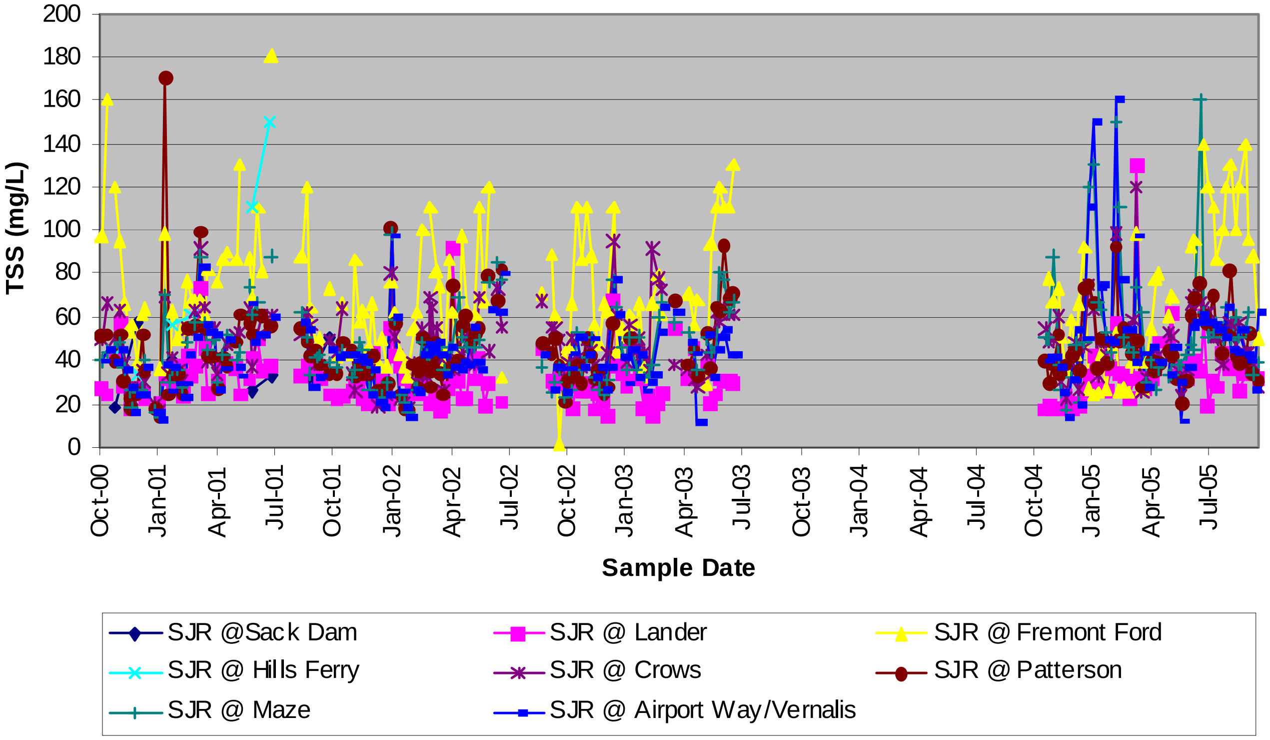


Figure 30: San Joaquin River Westside Basin Total Suspended Solids Irrigation Season WY01 and WY05

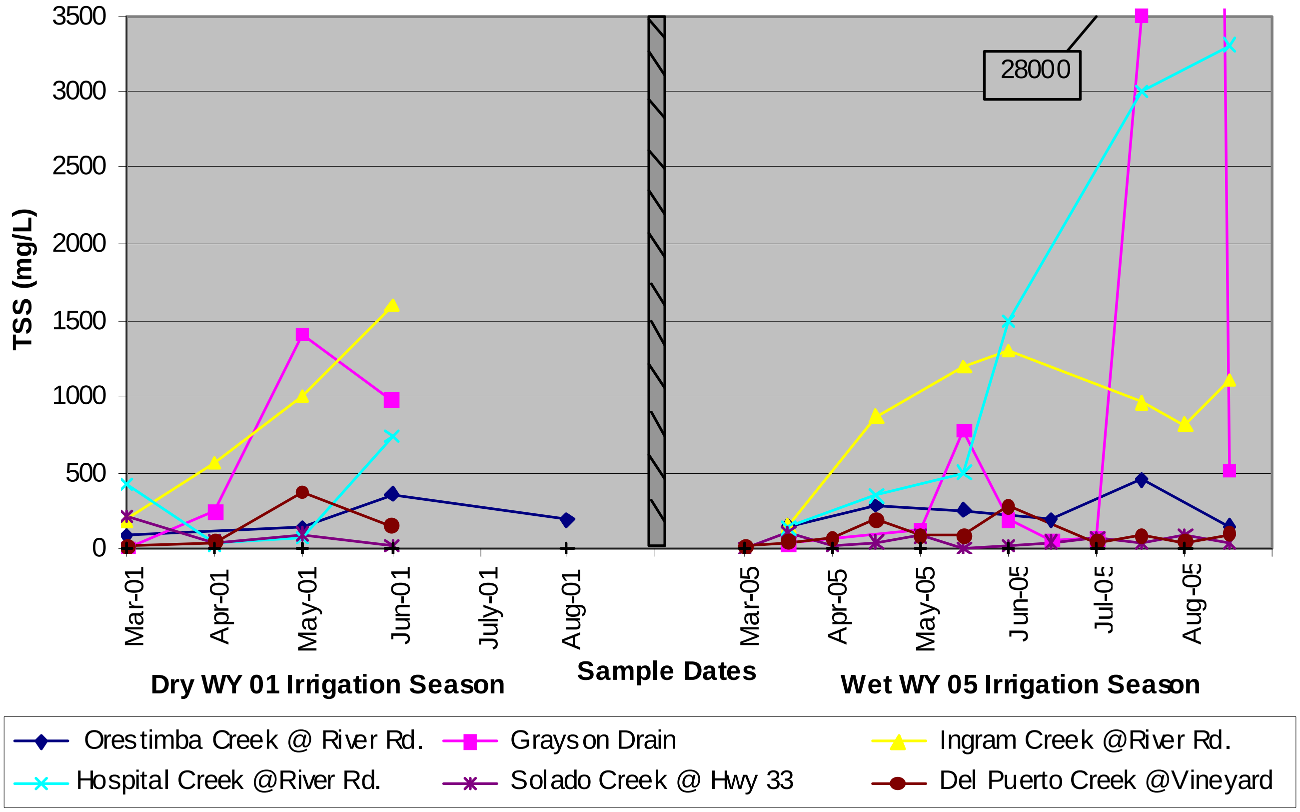


Figure 31: Basin Total Suspended Solids WY01-WY05

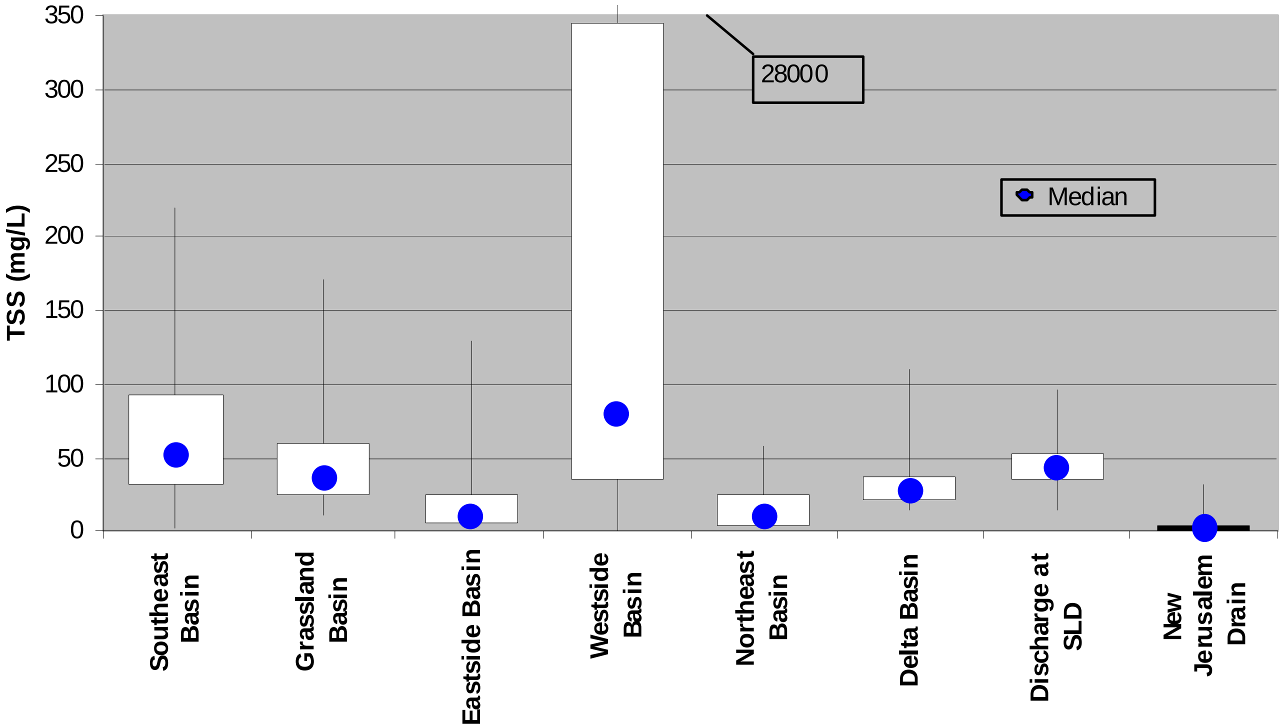


Figure 32: San Joaquin River Main Stem Total Suspended Solids WY01-WY05

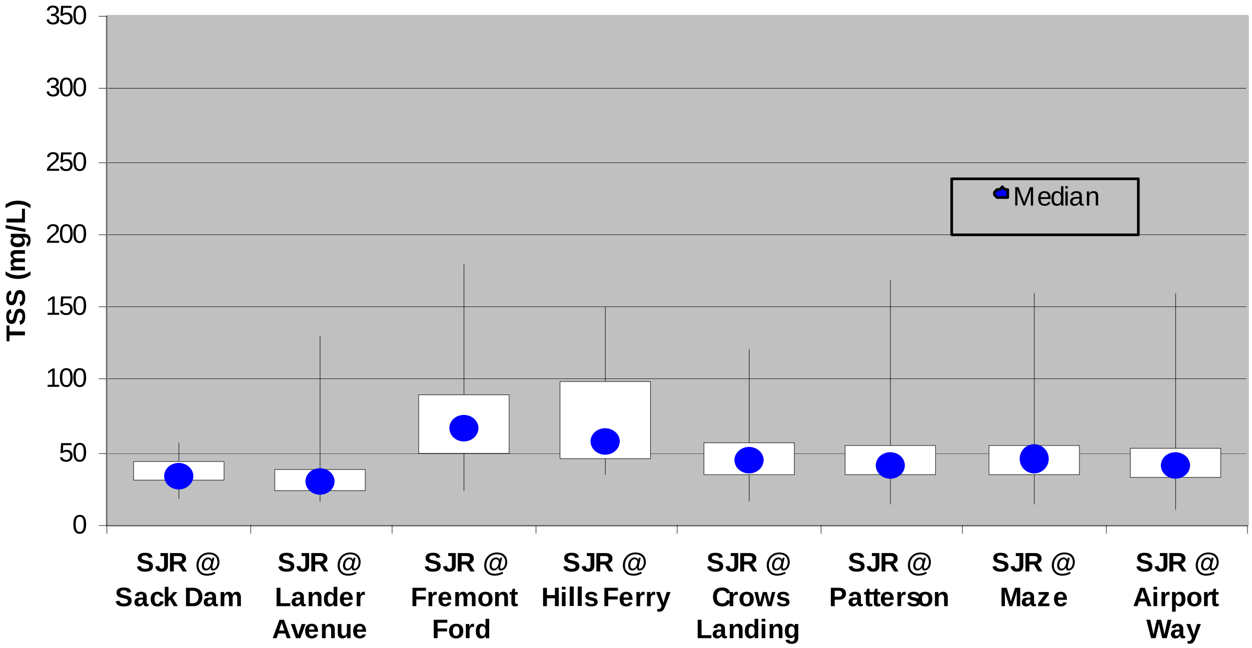
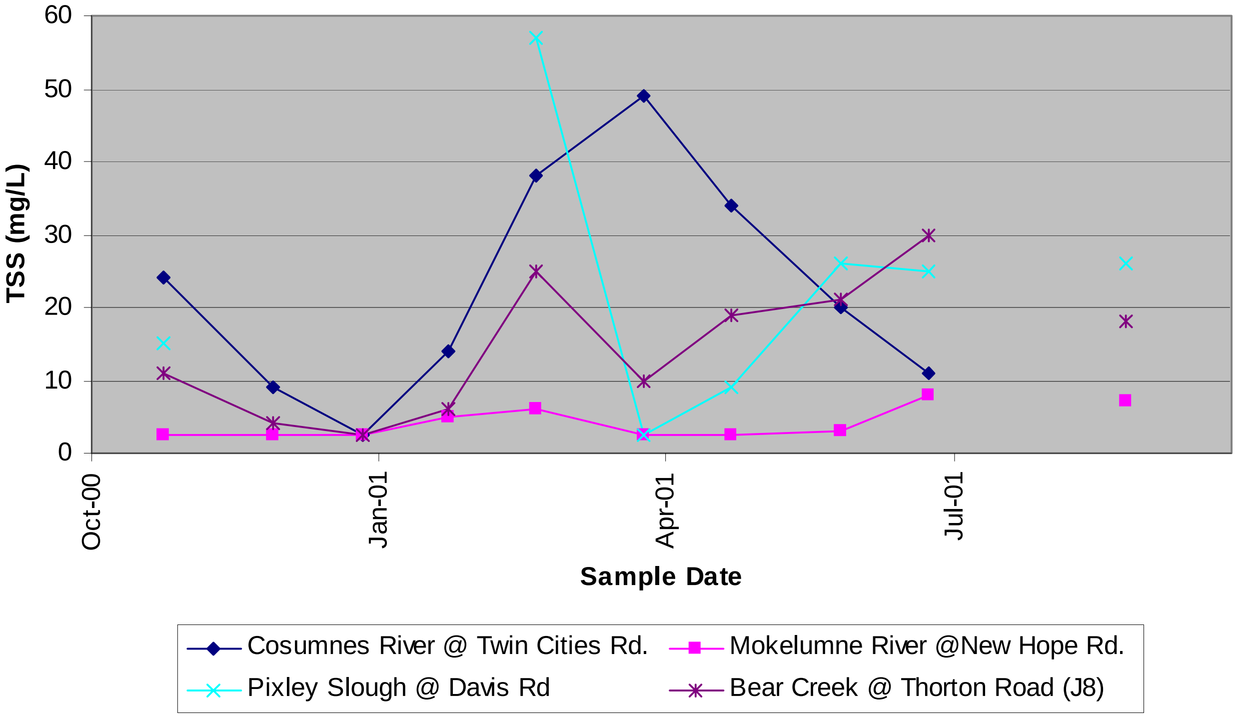


Figure 33: San Joaquin River Northeast Basin Total Suspended Solids WY01



12.1.7 TOTAL ORGANIC CARBON

Total organic carbon (TOC) samples were to be collected weekly at the SJR main stem sites and monthly at the drainage basin sites. Unfortunately, major gaps exist in the data due to both limited funding and sample quality control. Key gaps exist for the river sites during the winter storm periods (January thru March) of 2002, 2003 and 2004. Data for sites collected in the basin demonstrate the same gaps with the addition of no data between May 2003 and October 2004. The distinct data gaps make trend analyses difficult.

In general, the major river sites appear less susceptible to random spikes in concentration and demonstrate elevated levels during winter storm events and the irrigation season. Using the Eastside Basin as an example (Figure 34) the river sites (Merced and Tuolumne Rivers) do not fluctuate as drastically as Turner Slough and Lone Tree Creek. Some of the spikes in TOC concentrations correspond to storm events, such as the spike seen in Lone Tree Creek in the winter of WY2005. Other spikes (Turner Slough in Dec 2000 and French Camp Slough in May 2002) don’t correspond to a large or first-flush storm event. The Cosumnes River was an exception to the other major river sites in that it did show a dramatic spike in June of 2001, which corresponds to a small rain event just before this ephemeral stretch of the river dried (Figure 35). At no other time did TOC concentrations rise as drastically at this site before the seasonal dry periods.

Sites moving downstream along the SJR that receive wetland discharge (Lander Avenue, Fremont Ford and Hills Ferry) also show elevated concentrations during wetland releases in early spring. During wet WY05, TOC concentrations in the SJR tended to decrease after the final storms in April and did not show the same magnitude of increase during the irrigation season as was evident during previous dry years (Figure 36).

Overall, total organic carbon values ranged from <1.0 mg/L at many of the sites to a maximum of 67 mg/L at Lone Tree Creek. Between the basins, the Grassland basin has a higher median TOC than all the other basins (Figure 37). The Northeast and Eastside river sites have the lowest concentration of TOC. The non-river sites for the rest of the basins have higher concentrations, fluctuations and high spikes of TOC. These spikes could be influenced by storm events, agricultural and wetland management practices. Some unique characteristics for selected basins are discussed below:

South Delta Basin: The South Delta Basin on average had lower concentrations of TOC than the Eastside Basin non-river sites. The New Jerusalem Drain had the lowest concentration of TOC throughout the sampling period. There was one large TOC spike found in the New Jerusalem Drain, Tom Payne Slough, and Old River between the end of August and October of 2001. No rainfall was measured during August 2001, with the first rains starting in September 2001. The early spike measured in TOC could have been attributed to agricultural influence with the later part being a combination of agricultural influence and storm flows.

Westside Basin: Westside Basin TOC concentrations fluctuated like the Eastside Basin non-river sites, but without as large of spikes. In addition to spikes in June of 2001, the same distinct spike noted in the South Delta in October of 2001 also occurred in Westside water bodies—. The October 2001 spike corresponded to the first rains after a very dry summer.

Grassland Basin: The Grassland Basin’s fluctuations looked very similar to the Westside Basin’s, with major spikes in the fall of 2001. Levels of TOC were typically higher early in the fall, when local flows also increase due to spill from the seasonal flooding of surrounding wetland habitat. Levels typically dropped after the initial week of wetland flood-up and prior to the first storm event. Concentrations of TOC during wet WY of 2005 for the Grassland basin were noticeably more stable than those measured during the dry WY of 2001.

Moving down the main stem of the SJR (Figure 38), Sack Dam had a median background concentration of 3-mg/L TOC. The median TOC concentrations then peaks to 8-mg/L at the next downstream site (SJR at Lander) and progressively decreases until reaching the boundary of the Delta (Airport Way) with a median TOC back near 3-mg/L. The Lander Avenue site had the highest concentrations and most dramatic fluctuations of TOC along the SJR. Inflows from the sub-basins seem to contribute to the drop in concentration of TOC moving toward the Delta.

Figure 34: San Joaquin River Eastside Basin Total Organic Carbon WY01-WY05

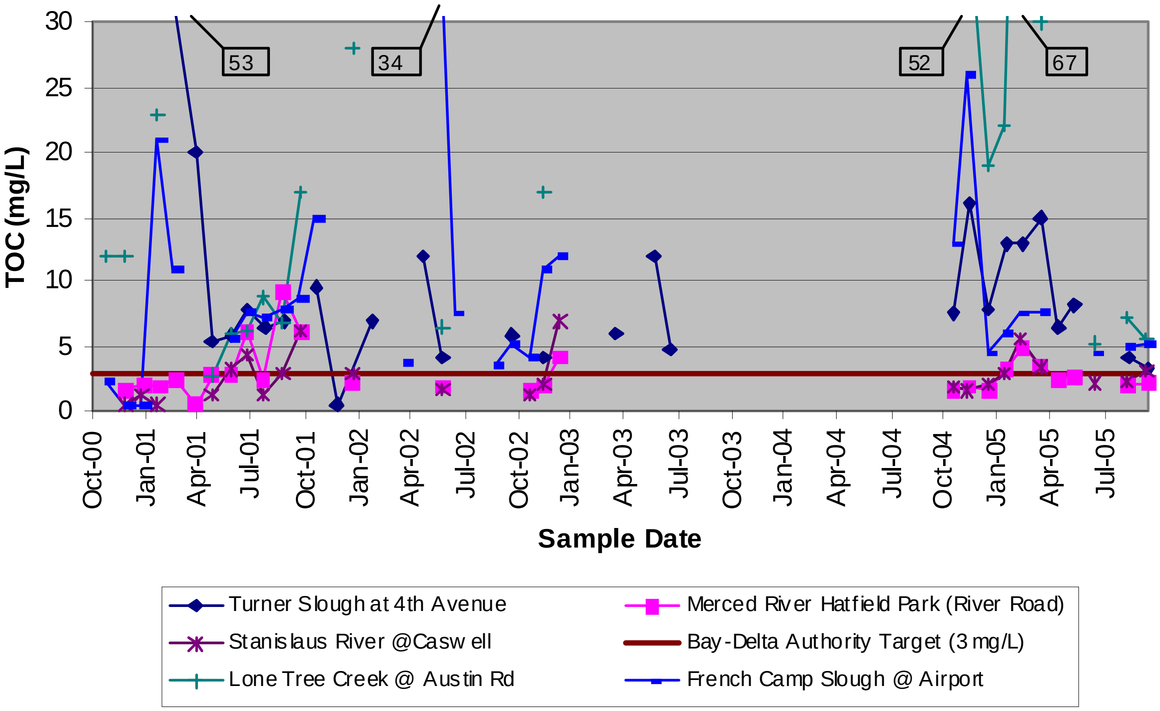


Figure 35: San Joaquin River Northeast Basin Total Organic Carbon WY01 – WY05

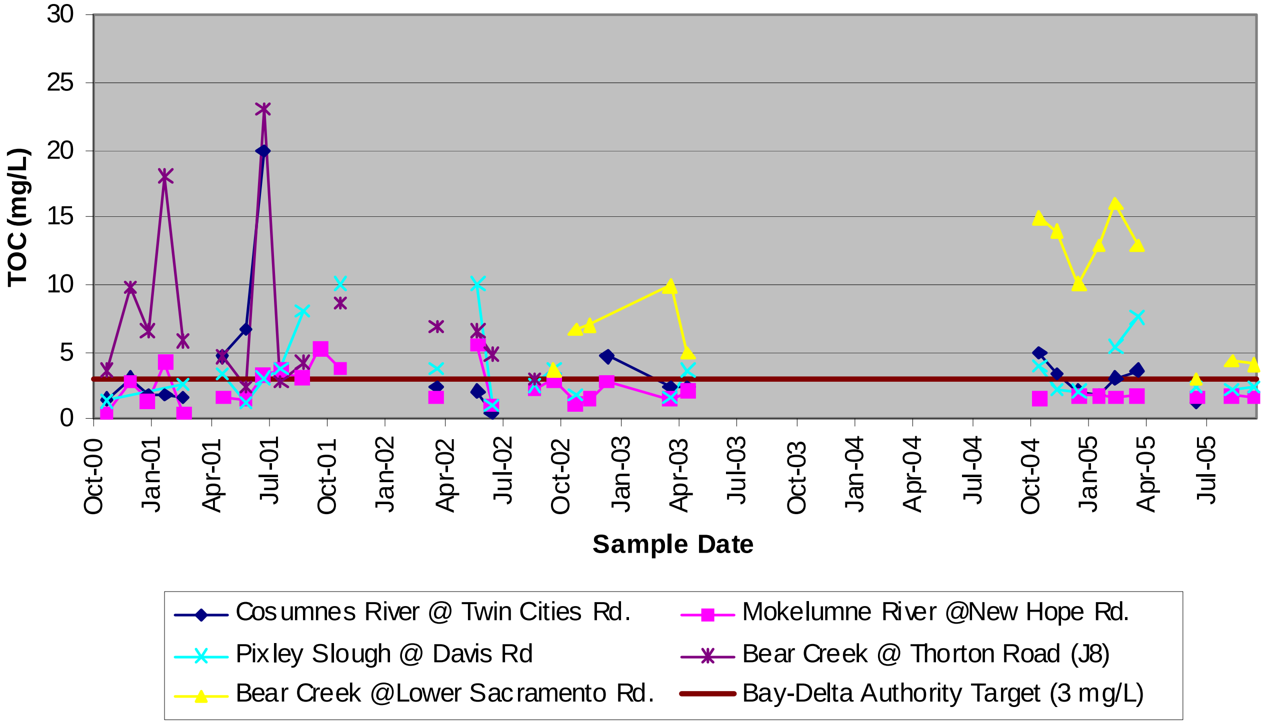


Figure 36: San Joaquin River Main Stem Total Organic Carbon WY01 – WY05

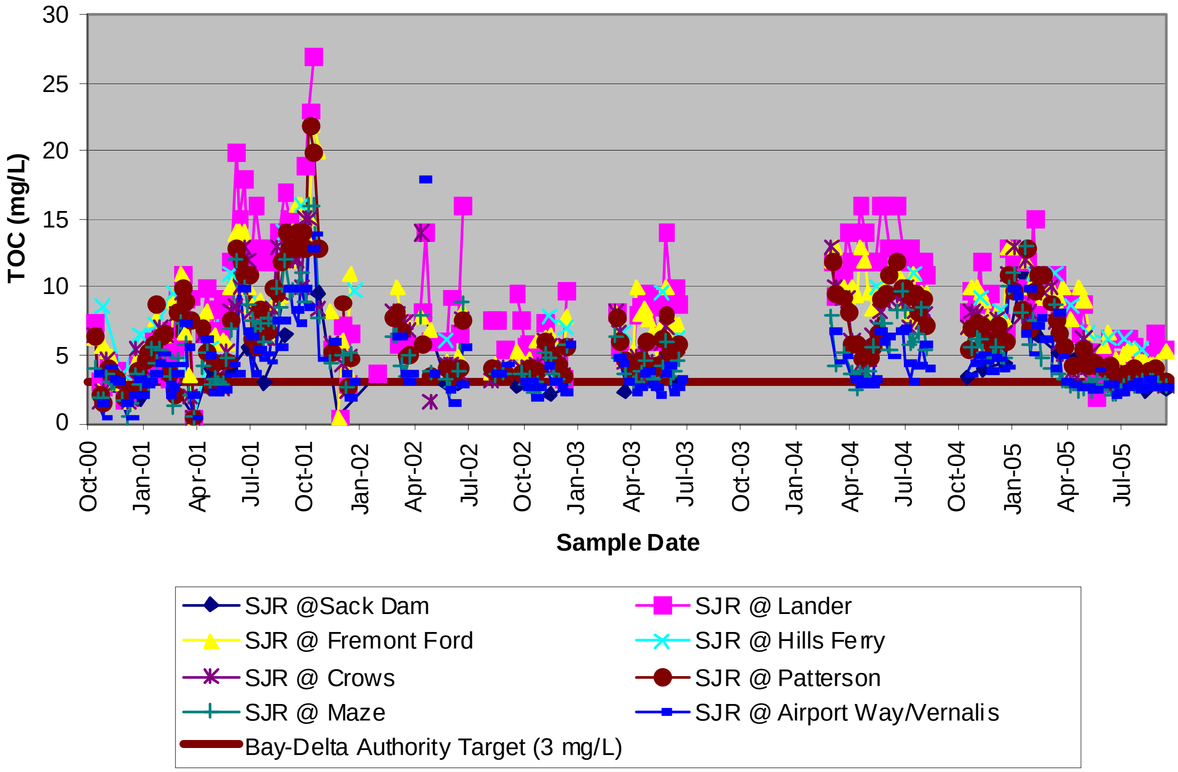


Figure 37: Basin Total Organic Carbon WY01-WY05

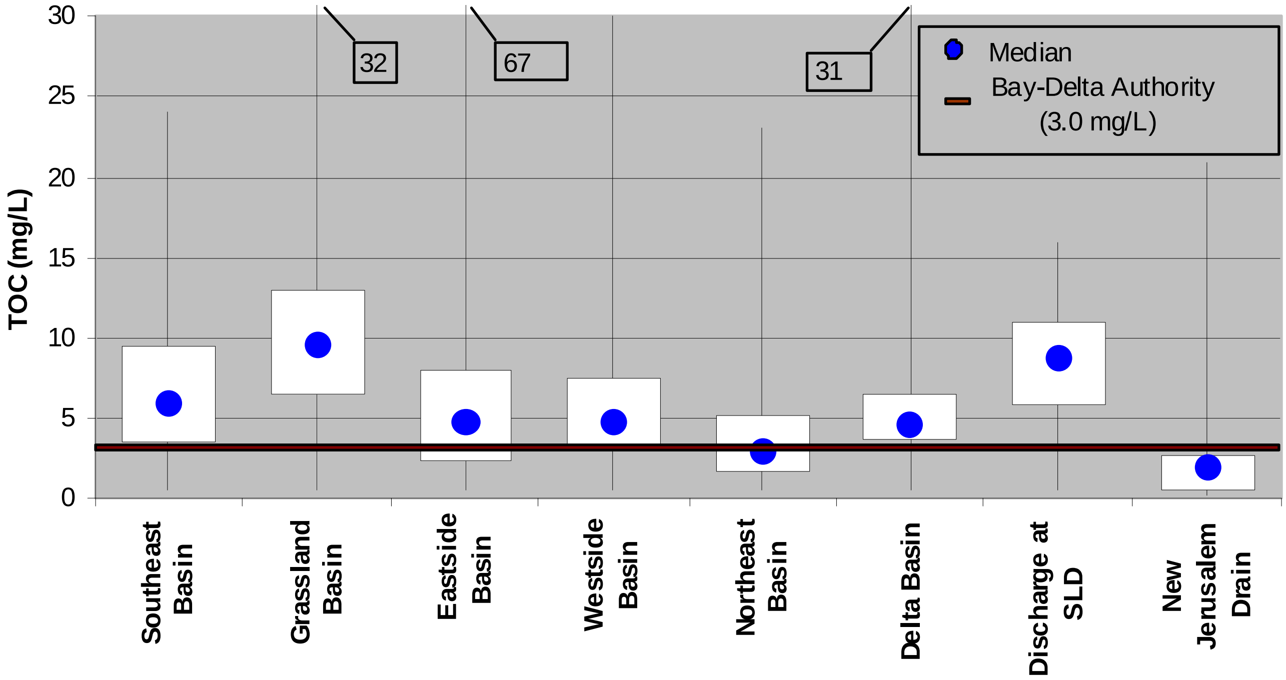
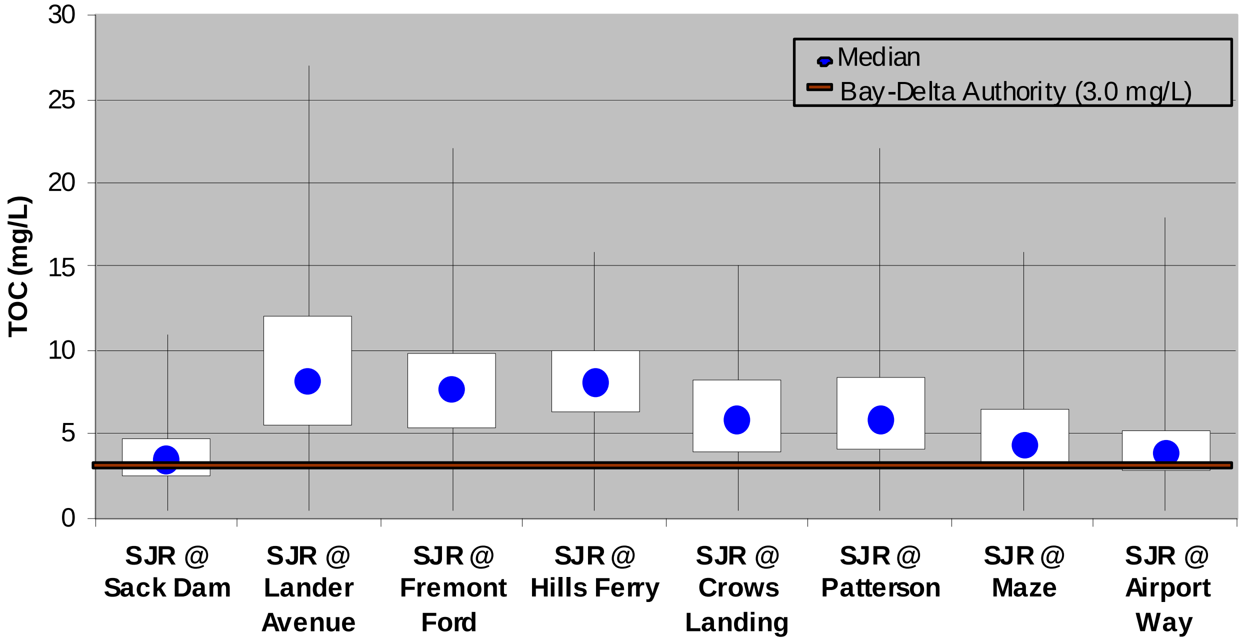


Figure 38: San Joaquin River Main Stem Total Organic Carbon WY01-WY05



12.1.8 BACTERIA

Total coliform and *Escherichia coli (E. coli)* sampling began in July 2002 and continued through WY05. The analytical method used for bacteria analyses during this study (IDEXX) has a maximum detection limit of 2419.6 MPN/100ml and a minimum detection limit of 1 MPN/100ml, numbers which were used as the upper and lower boundaries for median concentration calculations and graphs. Results ranged from 52 MPN to >2419.6 MPN for total coliform and1.0 MPN to >2419.6 MPN for *E.coli*.

Total coliform concentrations tended to exceed the maximum detection limits at most sites except during storm events—when the concentrations decreased rapidly. Figure 39 demonstrates the trend for the Northeast Basin.

In contrast, the majority of *E. coli* concentrations (a subset of total coliform) were reported within the detectable ranges and showed sporadic spikes in concentration, some related to storm events and others related to dry periods. Figures 40 and 41 demonstrate the variability seen in the results for the Northeast Basin and SJR sites, respectively. A number of the *E. coli* spikes during the winter season occurred when the sample was collected during the first flush of a major storm series—at a time when the total coliform was still above reporting limits, with subsequent samples showing much lower concentrations. Of particular note is that during WY02, sampling frequency at the Northeast Basin sites increased to twice a month as that watershed cycled into the rotational basin sampling schedule. The increased sampling related to an increase in the number of spikes reported at those sites. In addition, a greater number of elevated *E. coli* concentrations were detected in the SJR between January and June during wet WY05 when compared to previous water years.

Spatially, total coliform appeared uniformly high throughout the SJR Basin and was normally above detection limits with lower concentrations mostly seen during high flow events. For *E. coli*, the Grassland and South Delta Basin had lower concentrations compared to the rest of the basins (Figure 42). The Westside Basin had a considerable increased number of *E. coli* spikes when compared to the rest of the basins as well as higher overall spikes during low flow time periods. Both the Westside and Southeast Basins reported 50% of samples collected falling between 200 MPN/100ml and 1200 MPN/100ml—much higher than the remaining basins.

The river itself had the highest median *E. coli* concentration (124 MPN/100ml) at the Hills Ferry site, just prior to inflow from the Eastside rivers. The Hills Ferry site also had the highest overall concentrations in the SJR, but the majority of samples remained well below 235 MPN/100ml (the US EPA guideline for full contact recreation) (Figure 43).

Some unique characteristics noted for selected sub-basins follow.

Northeast Basin: The Northeast Basin's total coliform stayed mostly at the maximum detection limit until higher flow events during which the levels dropped (Figure 39). Lower concentrations during high flow events were more pronounced for the river sites than Bear Creek and Pixley Slough. *E. coli* was mostly found to be around the lower level of detection and would spike upwards during lower flow events (Figure 40). The river sites did not seem to spike as frequently as Bear Creek and Pixley Slough. *E. coli* in Bear Creek and Pixley Slough also spiked periodically during higher flow events.

South Delta Basin: South Delta Basin bacteria concentrations had a similar trend to the Northeast Basin, but overall *E. coli* had much lower concentrations. *E. coli* for the New Jerusalem Drain never went above 27 MPN/100ml, which is likely related to the fact that it is a collection system for shallow ground water (subsurface tile drainage). The two samples collect in Mountain House Creek prior to drainage diversion after urban conversion, were both very high with the lowest sample at 1046.0 MPN/100ml.

Westside Basin: The Westside Basin showed the same trend as the Northeast Basin river sites. *E. coli* found in the Westside Basin showed the greatest number of spikes throughout the whole year. Orestimba Creek had the lowest number of samples above the detection limit for *E. coli*, but the second highest geometric mean.

Grassland Basin: The Grassland Basin had lower *E. coli* levels, similar to the Delta Basin, with only two samples found above the detection limit. The discharge from SLD had the lowest levels of *E. coli* in the basin. The SLD also consists of subsurface tile drainage, similar to the New Jerusalem Drain, but for a larger area.

Figure 39: San Joaquin River Northeast Basin Total Coliform WY02-WY05

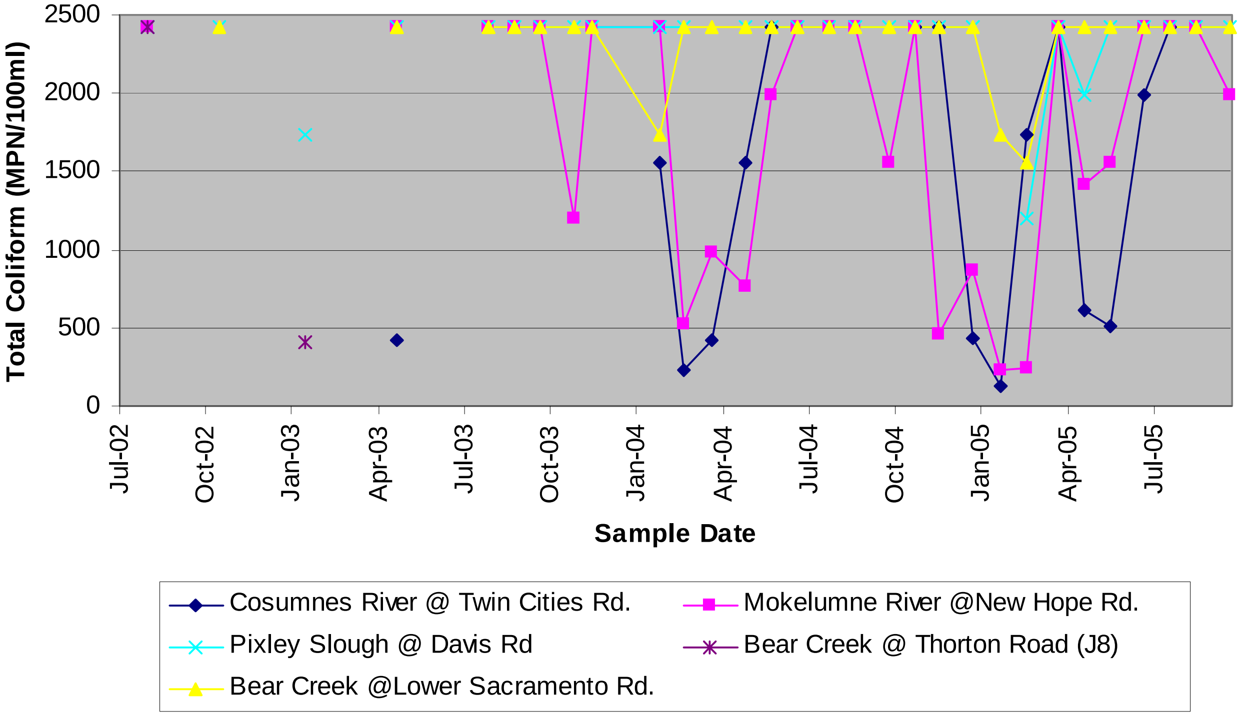


Figure 40: San Joaquin River Northeast Basin *E. coli* WY02-WY05

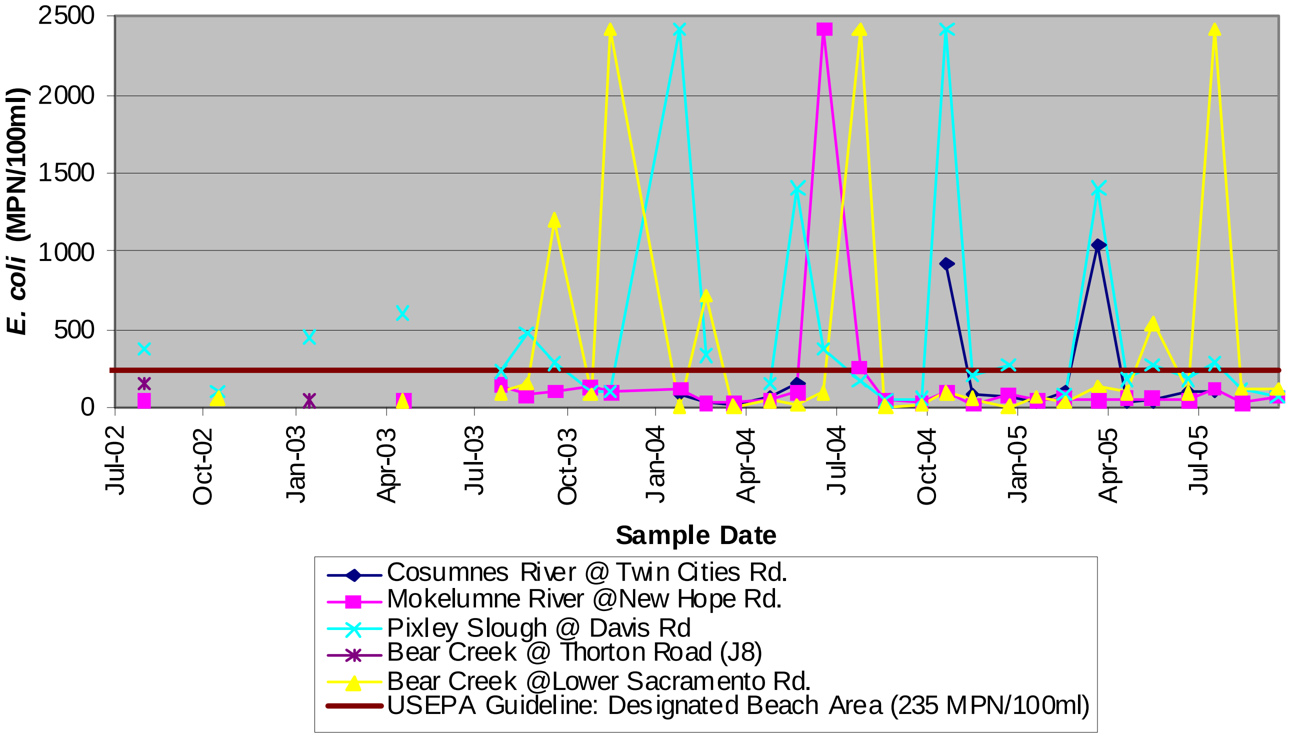


Figure 41: San Joaquin River Main Stem *E. coli* WY01 – WY05

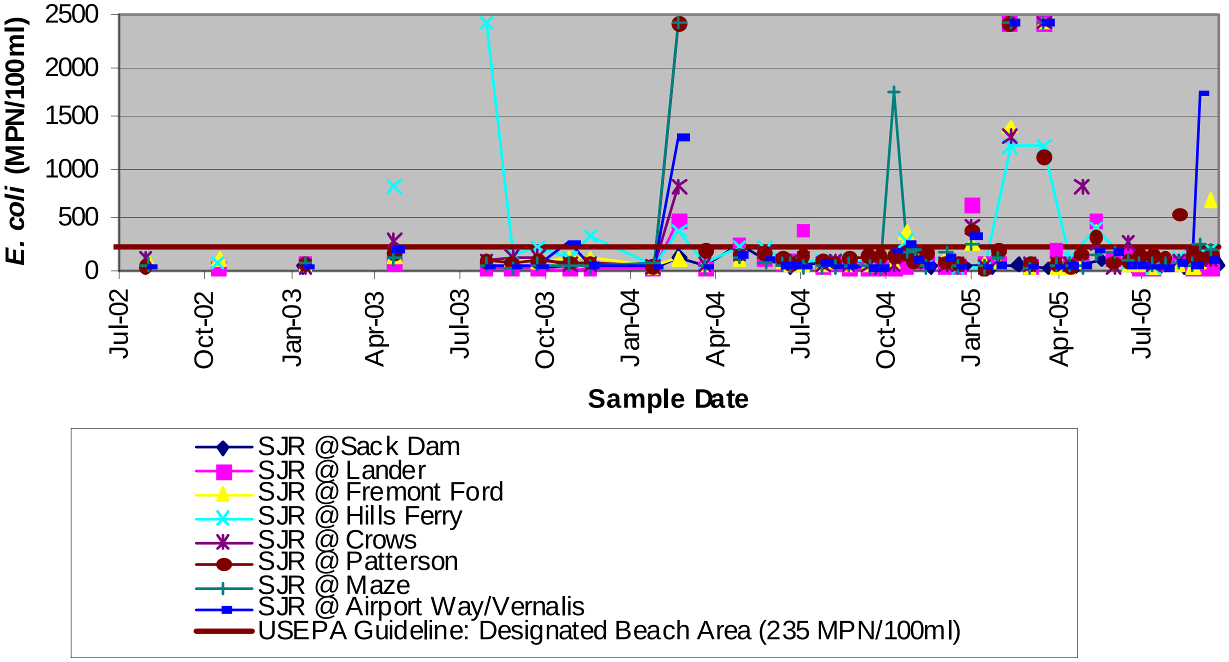


Figure 42: Basin *E. coli* WY02-WY05

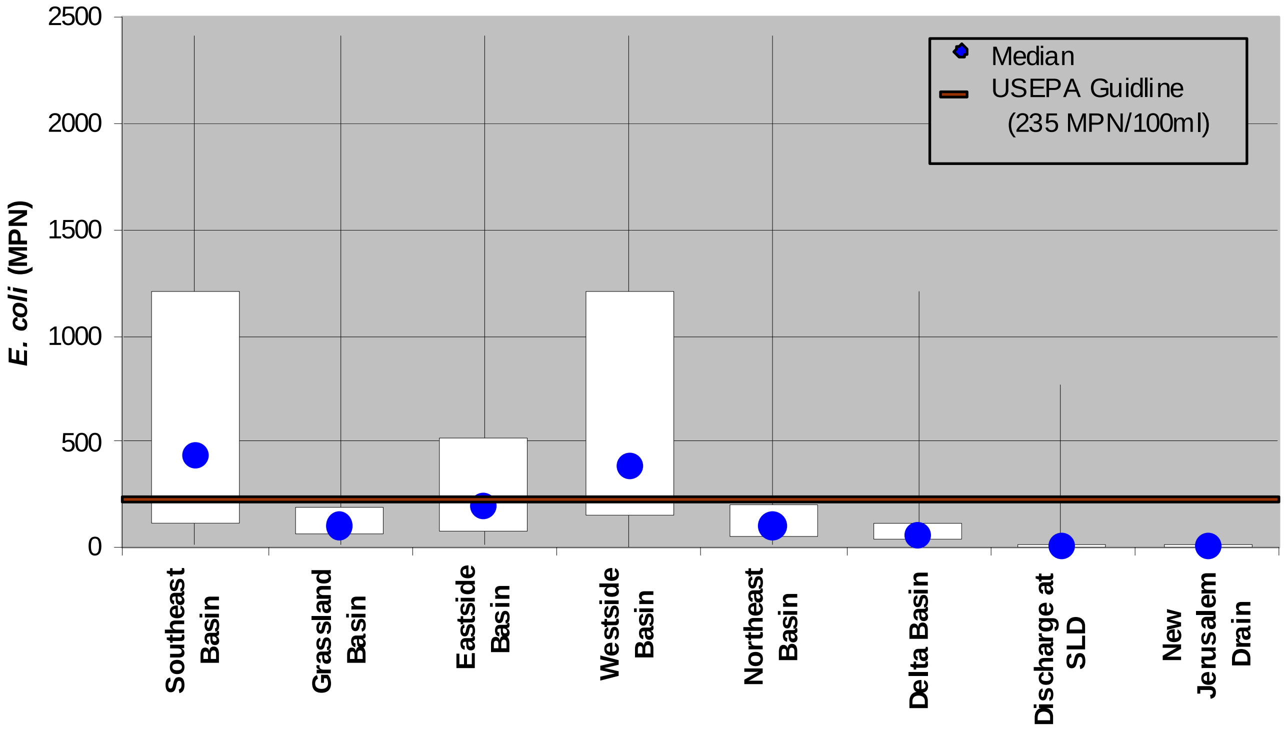
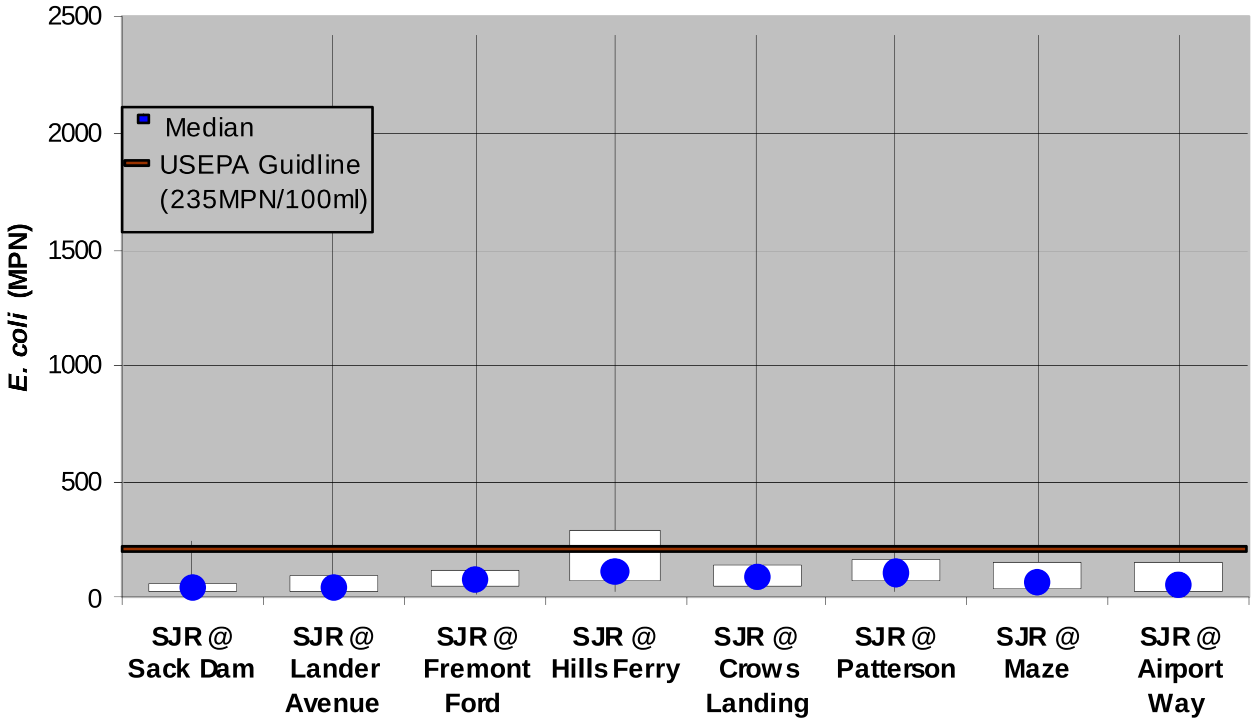


Figure 43: San Joaquin River Main Stem *E. coli* WY02-WY05



12.1.9 NUTRIENTS

Nutrient samples were collected throughout the basin on a monthly basis through WY02 (excluding nitrate-N and ammonia-N). At the end of fiscal year 02/03, an initial review of the data collected and a review of collaboration efforts with the Total Maximum Daily Load (TMDL) programs (specifically the TMDL for dissolved oxygen) were completed. With a redirection of the DO TMDL program to conduct continuous measurements at select sites and add additional monitoring for chlorophyll a, nutrient collection at most of the drainage basin sites was discontinued to avoid duplication of effort. The exceptions were Mud Slough upstream of SLD, Discharge at SLD and Mud Slough (downstream) @ SLD which are monitored in conjunction with the Grassland Bypass Program, and continued collection at the SJR main stem sites of SJR @ Fremont Ford and SJR @ Crows Landing until December 2004. Much of the data for WY02 and the first half of WY03 was removed from the data set due to failed QA/QC.

Most of the nutrients at sites within the SJR Basin had relatively low levels, with the exception of nitrate; however, the limited data set makes trend analyses difficult. Figure 44 depicts available SJR nitrate information for this program. From the information collected in WY01, nitrate increases during both the storm season (January thru March) and then again during the irrigation season. The available data mirrors portions of those trends in 2002 and 2003.

Nitrate concentrations reported for the Northeast Basin were all below 6-mg/L, with little discernible trends during the single water year of data (WY01)(Figure 45). The Westside Basin reported higher overall concentrations and a distinct spike in Orestimba Creek during the storm season and spikes in Del Puerto during April (typically a pre-irrigation period) as well as June thru September (Figure 46).

Spatially, nitrate is high at several sites throughout the basin especially the Discharge at SLD and New Jerusalem Drain—both of which carry subsurface agricultural drainage (shallow groundwater) and had the majority of concentrations reported above 45-mg/L. The Harding Drain within the Eastside Basin was also somewhat elevated with values ranging from 9.9 mg/L to 44 mg/L. Overall, the Westside Basin had the highest median nitrate concentration (12-mg/L) when compared to the rest of the SJR Basin (Figure 47). Information from the specific sub-basins is listed below.

Northeast Basin: The Northeast Basin had very low levels of nutrients and most of the collected sample results were non-detect. The Mokelumne River had only 5 samples that were just slightly above detection levels. The Cosumnes River had slightly higher levels of nitrate, phosphorus and potassium than the Mokelumne River. Pixley Slough nutrient levels, unlike Bear Creek, have lower levels of nutrients than the Cosumnes River. Bear Creek had the highest concentrations of nutrients for the Northeast Basin. Higher concentrations of nutrients mostly occurred during the winter months.

Eastside Basin: The Eastside Basin river sites had low concentrations similar to the Northeast Basin river sites. French Camp Slough and Lone Tree Creek had higher fluctuating levels than Bear Creek in the Northeast Basin. Harding Drain had higher fluctuating levels for all nutrient samples collected in the basin. Turner Slough had high levels during January 2001 through April 2001 for TKN, phosphorus, orthophosphate-P and potassium. For the rest of the sampling period the concentrations at Turner Slough were comparable to the river sites within the basin.

Southeast Basin: The Southeast Basin had fluctuating levels of nutrients similar to Bear Creek in the Northeast Basin.

South Delta Basin: All sites within the South Delta Basin reported low levels of nutrients except for nitrate levels in the New Jerusalem Drain. The nitrate levels in the New Jerusalem Drain were six times higher than the other South Delta Basin sites as well as the river sites of the Northeast Basin.

Westside Basin: Overall the Westside Basin reported higher nitrate levels than the other Basins (Figure 47). Salado and Orestimba Creeks showed higher concentrations during the winter months and Del Puerto Creek typically showed a spike during the irrigation season.

Grassland Basin: The discharge from SLD had the highest concentration of nitrate, but had lower concentrations of the other nutrients compared to the rest of the Grassland sites. Nitrate concentrations in the SLD were highly elevated in the winter and decreased somewhat but remained elevated above 45-mg/L through the irrigation season. Mud Slough (north) downstream of the SLD discharge tracked the drain's concentrations and had much higher concentrations of nitrates than Mud Slough upstream.

The Main Stem SJR showed increasing nitrate concentrations between Lander and Patterson—the stretch of river receiving inflows from the Grassland (including SLD) and Westside Basins and the Merced River (Figure 48). Nitrates decrease from SJR at Patterson to Airport Way with inflows from the Tuolumne and Stanislaus Rivers. Most other nutrient concentrations decreased in the main stem of the river moving down the system or stayed the same resulting in very low concentrations. The New Jerusalem Drain enters the SJR downstream of Airport Way.

Figure 44: San Joaquin River Main Stem Nitrate WY01 – WY04

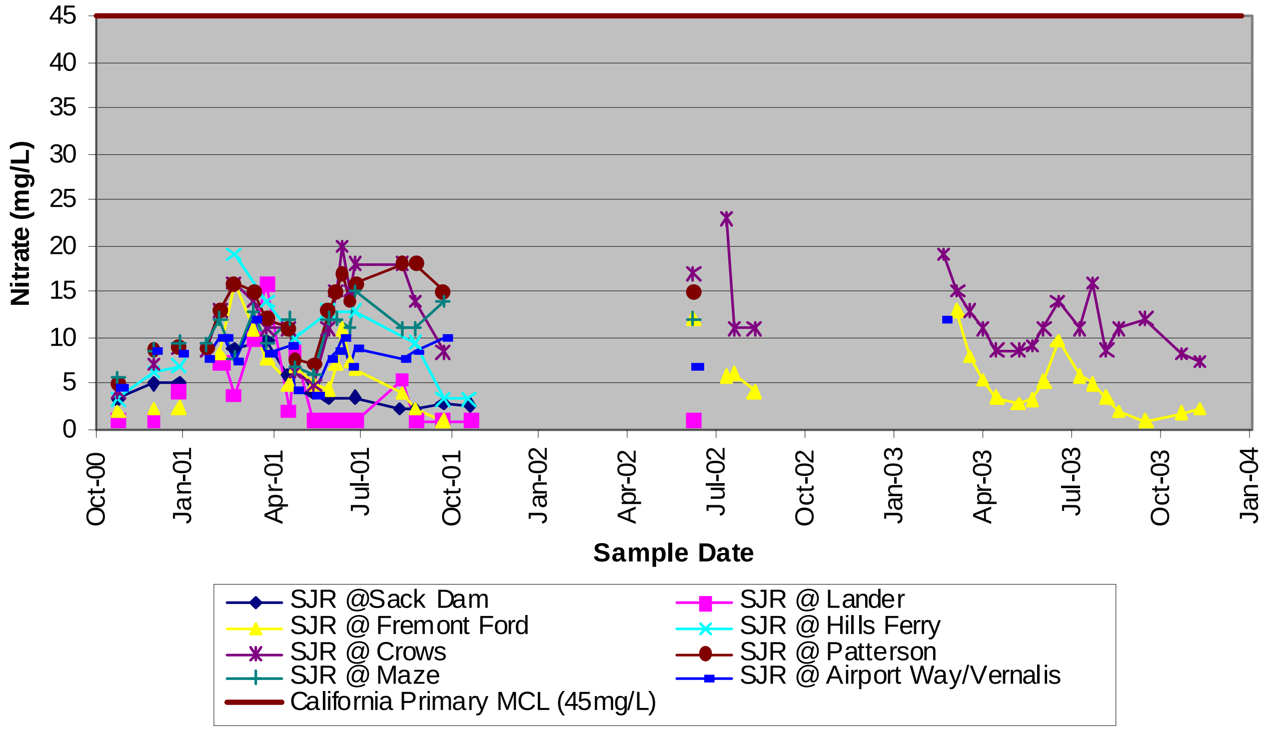


Figure 45: San Joaquin River Northeast Basin Nitrate WY01

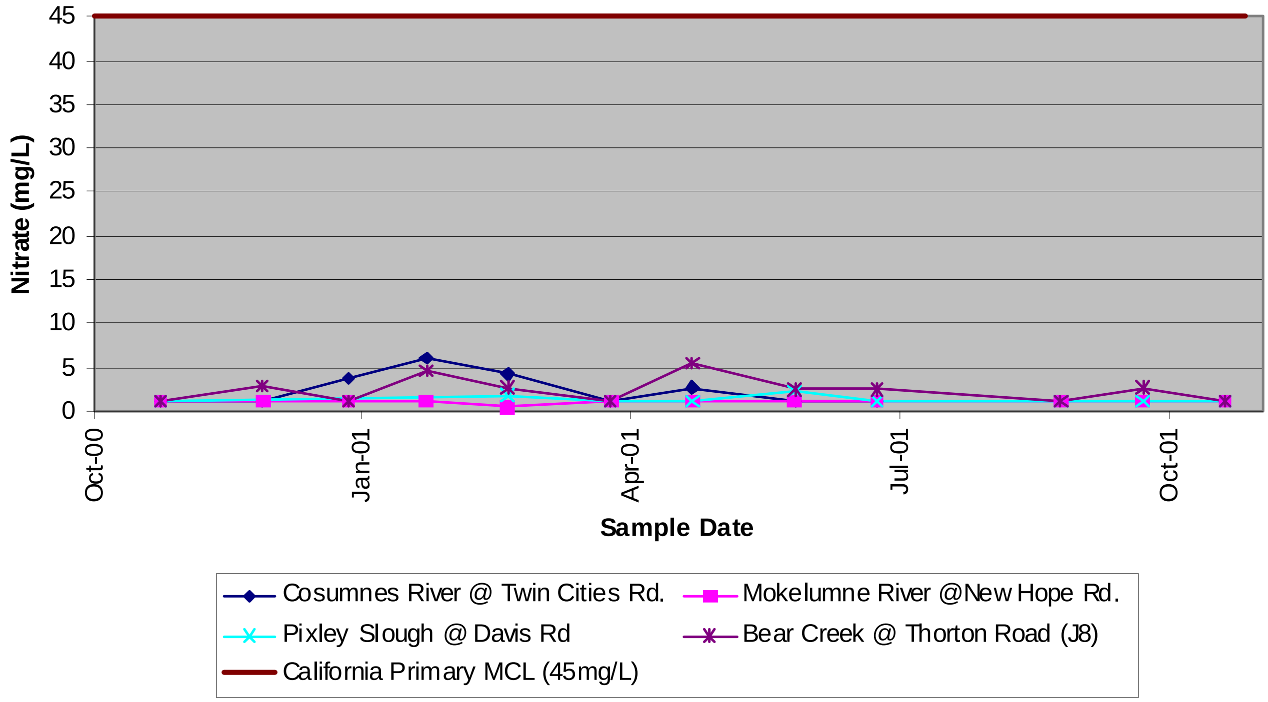


Figure 46: San Joaquin River Westside Basin Nitrate WY01

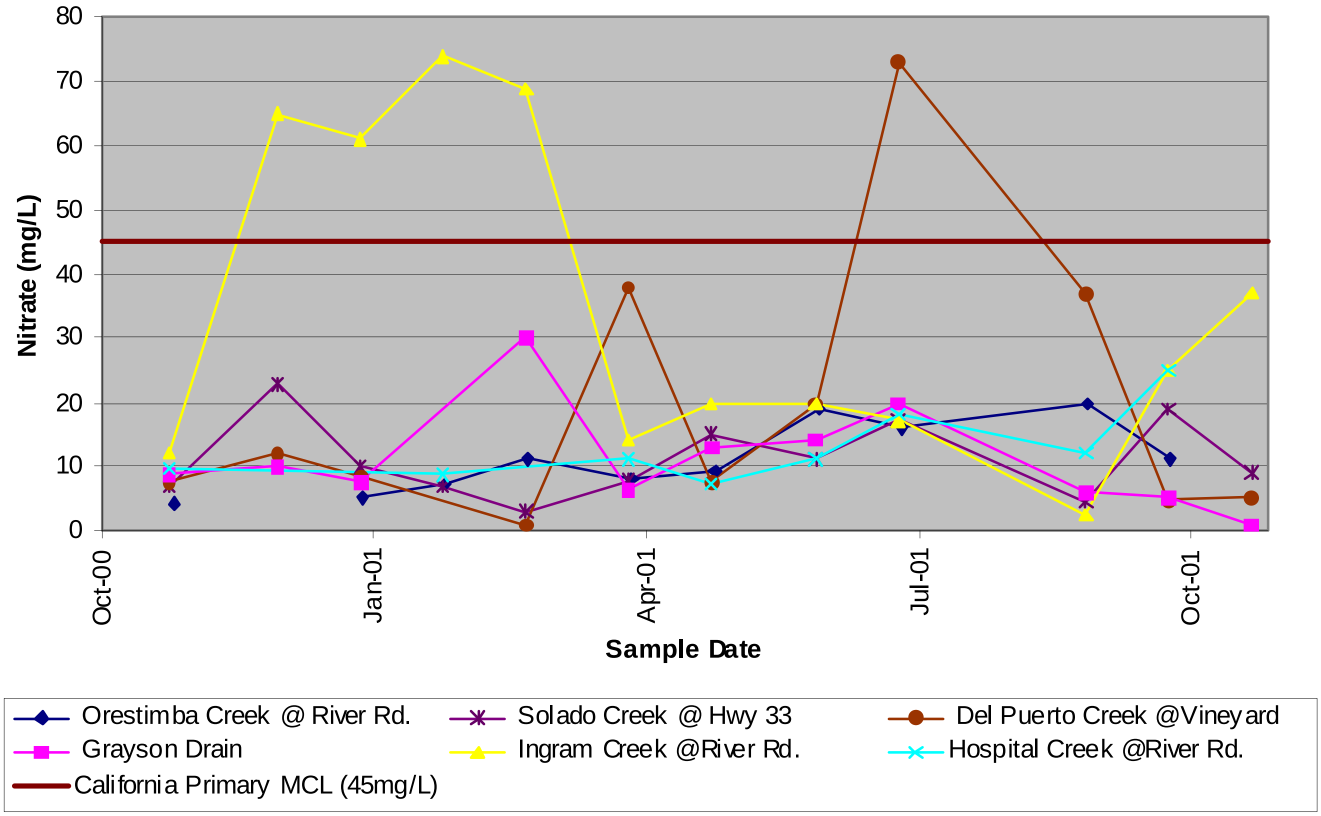


Figure 47: Basin Nitrate WY01-WY02

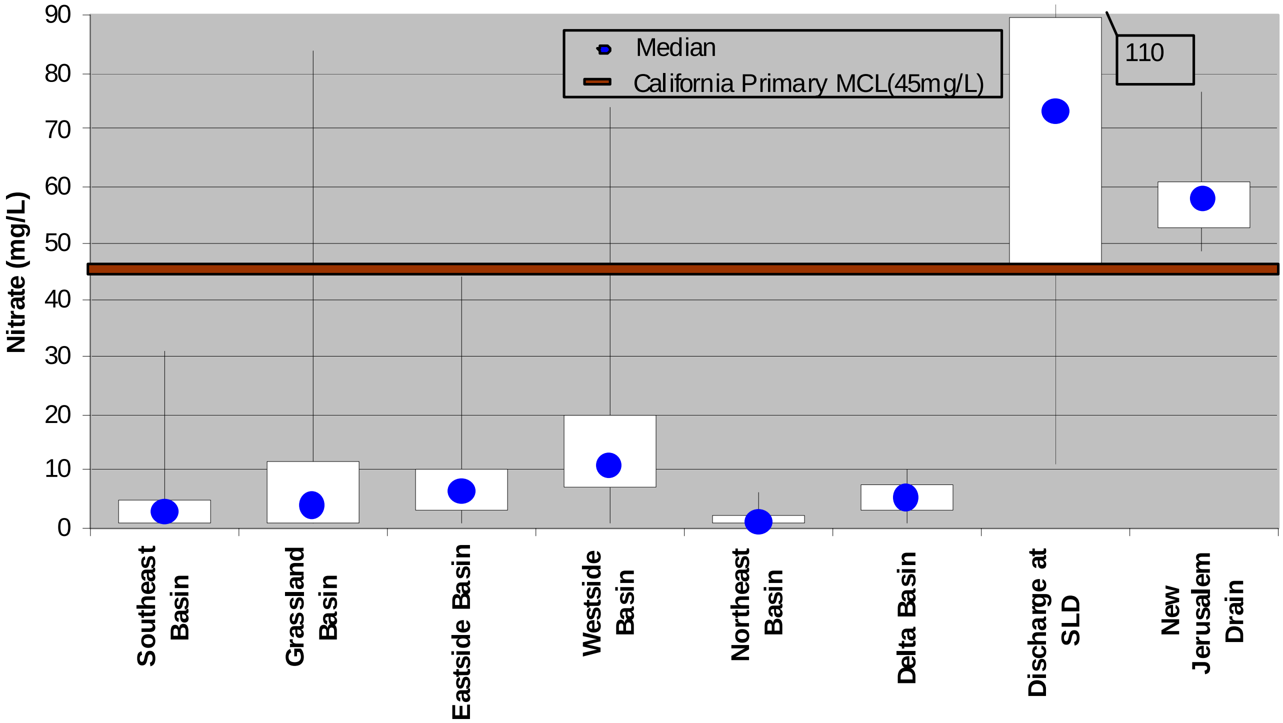
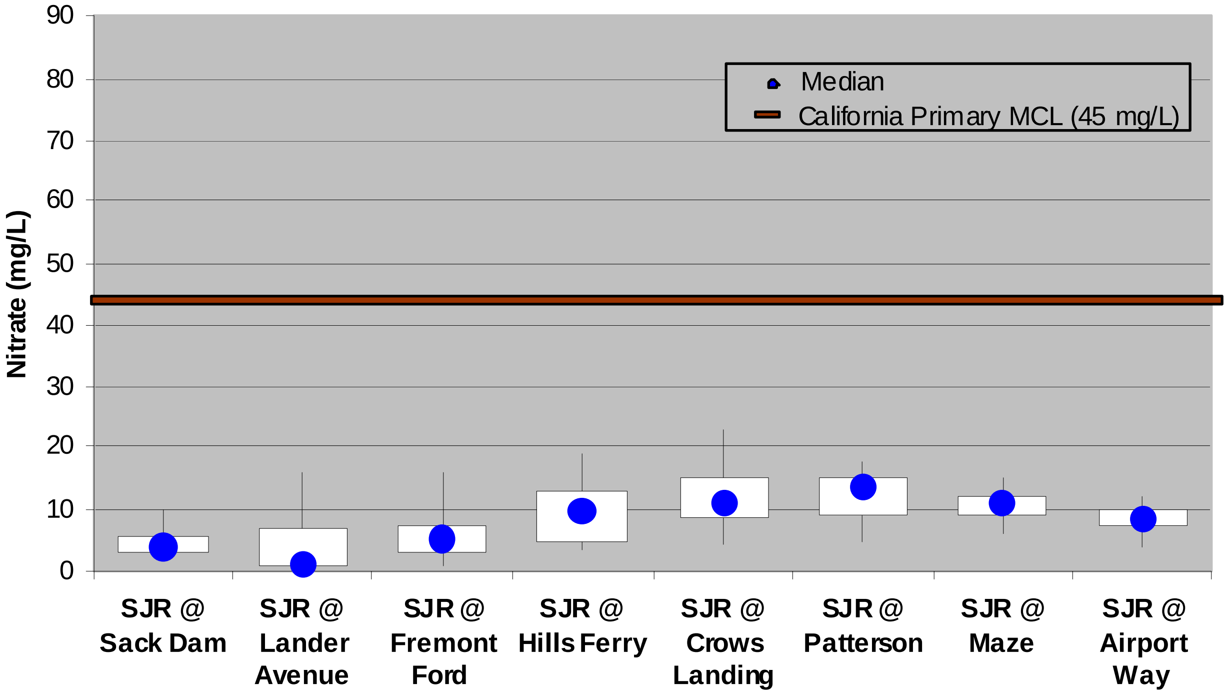


Figure 48: San Joaquin River Main Stem Nitrate WY02-WY04



12.1.10 BIOCHEMICAL OXYGEN DEMAND

As with the nutrient samples, Biochemical Oxygen Demand (BOD) samples were collected throughout the basin on a monthly basis through WY02. At the end of fiscal year 02/03, an initial review of the data collected was completed, as well as a review of collaboration efforts with the DO Total Maximum Daily Load (TMDL) effort. A change in the monitoring strategy for the DO TMDL eliminated the need for continued BOD analyses by this effort.

Biochemical Oxygen Demand (BOD) is a procedure that measures how fast biological organisms use oxygen in a body of water. Bodies of water with higher concentrations of organic matter have aerobic bacteria that decompose organic matter using the available oxygen within the water body. High nitrates and phosphates also contribute to higher BOD because they contribute to increased plant and algae growth which increase plant loss contributing to higher organic waste. Increased temperatures also contribute to higher algae growth. For this discussion we will be looking only at BOD_5 (biochemical oxygen demand 5-day test).

Higher fluctuations in BOD_5 occurred at most sites during the winter months and corresponded to spikes in flow and TOC. Concentrations of BOD_5 also increased and remained elevated during summer months, peaking during September, which again tracked TOC concentrations.

Spatially, all of the Eastside river sites had low concentrations of BOD_5 which reflect their low concentrations of TSS and TOC, when compared to the rest of the SJR Basin sites. The rest of the basin sites, except New Jerusalem Drain, had higher levels of TOC and TSS, and BOD_5. Figure 49 shows the Northeast basin as a whole had the lowest BOD_5 compared to the rest of the Basins. Some distinct findings within each sub-basin are noted below.

Northeast Basin: The Northeast Basin Mokelumne River had BOD_5 concentrations at or below 1 mg/L. The Cosumnes River had levels similar to the Mokelumne River most of the time except during June 2001, which was just before the river dried and the BOD_5 level increased to about 4 mg/L. This increase corresponds to the light rain event that occurred just before the river went dry and a similar spike in the TOC concentration. Potential inflow of nutrients and organic matter during the rain event, coupled with the already decreased flows and increased temperatures encourages algae growth, and may have contributed to higher BOD_5 levels. Pixley Slough and Bear Creek had higher fluctuations of BOD during the winter months of January and February.

Eastside Basin: The Eastside Basin river sites had BOD_5 levels mostly under 1 mg/L. There was one very large spike within all the river sites in December 2002, which corresponds to a storm event. The rest of the Eastside Basin sites fluctuate between 2 mg/L to 8 mg/L. The Harding Drain had the highest quartiles compared to the other Eastside Basin sites that had agricultural influences.

Southeast and Westside Basins: The BOD_5 concentrations in both basins fluctuated like the non-river sites of the Eastside Basin with multiple spikes in the summer and winter.

South Delta Basin: The BOD_5 concentrations at most of the South Delta Basin sites fluctuated like the non-river sites of the Eastside Basin except for the New Jerusalem Drain. Although the New Jerusalem Drain had high nitrate concentrations, it also had very low TSS and TOC concentrations, and BOD_5 levels hovering just above the detection limit of 0.1 mg/L.

Grassland Basin: The Grassland Basin fluctuated like the non-river sites of the Eastside Basin as well but fluctuated at slightly lower levels.

The Main Stem SJR sites whisker plot (Figure 50) looks very similar to the TOC whisker plot (Figure 38). BOD_5 has a very similar trend to TOC with Sack Dam having concentrations below 1 mg/L. The

SJR at Lander had the highest fluctuations of BOD_5 when compared to all the other sampling locations along the SJR. The BOD_5 concentrations tend to decrease from SJR at Lander to the SJR at Airport Way where BOD_5 is mostly under 2 mg/L.

Figure 49: Basin BOD-5 Day WY02-WY03

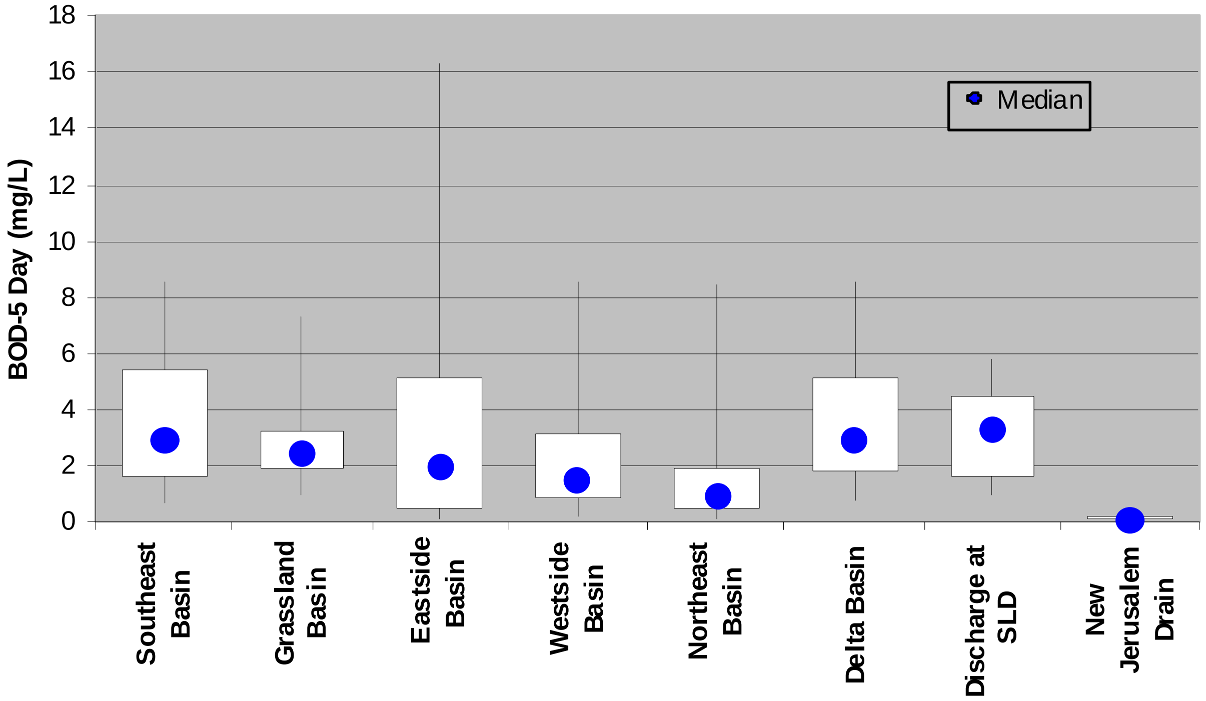
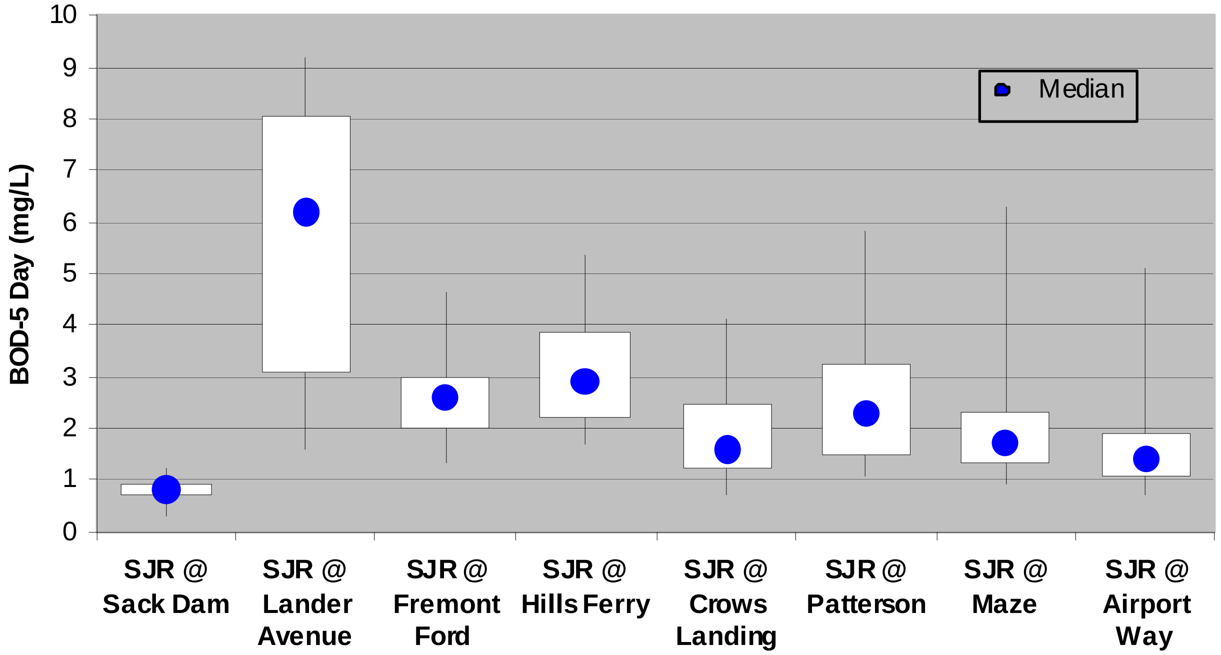


Figure 50: San Joaquin River Main Stem BOD-5 Day WY02-WY03



12.1.11 MINERAL ANALYSIS

Mineral samples were collected throughout the basin on a monthly basis during WY01 and sporadically during WY02 and WY03. At the end of fiscal year 02/03, an initial review of the data collected was done, as well as a review of collaboration efforts with other in-house programs, which resulted in a re-prioritization of monitoring efforts and the elimination of minerals from monitoring efforts.

Within the limited dataset, some general patterns are discernible. In general, the highest mineral concentrations occur along the western side of the SJR Basin, with elevated sodium concentrations and sulfate the dominant anion draining from the Grassland and Westside Basins and chloride the dominant anion from the Delta Basin. The eastern side of the SJR Basin reported much lower overall mineral concentrations with chloride the dominant anion. Carbonate was typically not detected or detected at very low levels, usually within the Westside Basin.

Along the western side of the valley, the SLD influences overall mineral discharges from the Grassland Basin, with elevated concentrations year-round. Concentrations of chloride and sulfate from the drain tend to dominate concentrations in Mud Slough (north) as winter dilution flow decreases. In contrast, during the dry season, sodium levels are elevated in Mud Slough (north) both upstream and downstream of the SLD discharge. The upstream concentrations are likely due to shallow groundwater discharge into the channel. For the remainder of the western side of the valley, mineral concentrations tended to increase during the winter then decrease but become somewhat elevated during the irrigation season. Sulfate and chloride concentrations all remained below the secondary drinking water MCL (250 mg/L), but sodium tended to remain above the irrigation supply guideline of 69-mg/L. The New Jerusalem Drain was the exception for sodium on the western side of the valley with concentrations remaining near 300 mg/L year-round.

Along the eastern side of the valley (the Southeast, Eastside, and Northeast Basins), sodium, chloride and sulfate concentrations all remained well below guidelines. Sodium did tend to show low level spiking throughout the year.

Some sites did show unique characteristics. Within the Westside Basin, Ingram Creek displayed pronounced seasonal fluctuation, similar to Tom Payne Slough of the Delta Basin, with marked increases in all minerals during storm events. Mud Slough (north) upstream of the SLD, was lower than the SLD in all mineral concentrations except total alkalinity and bicarbonate.

While seasonal fluctuations of mineral concentrations are not distinctly seen within the SJR, the Main Stem sites do reflect the inflows from the various sub-basins. Mud Slough (north)'s influence on Hills Ferry is distinctly seen with all the mineral concentrations at this site consistently higher compared to the rest of the river. Sack Dam has the lowest concentrations within the river, but with the influences from the Southeast Basin, Grassland Basin and Turner Slough, mineral concentrations peak at Hills Ferry. Once the Eastside Basin rivers enter the SJR, mineral concentrations substantially decrease moving downstream to Airport Way, even with elevated concentrations coming in from the Westside Basin.

12.1.12 TRACE ELEMENTS

Trace element samples were collected throughout the basin on a monthly basis through WY02. Hardness was analyzed simultaneously for each trace element sample in order to allow evaluation against aquatic life criteria. At the end of fiscal year 02/03, an initial review of the data collected and a review of collaboration efforts with other in-house programs were completed. Re-prioritization of monitoring efforts resulted in a removal of trace element collection. Note that during the collection period reporting limits changed for some constituents.

Many of the results for this study were below the analytical reporting level. Some trace elements did appear to show some trends, depending on the location within the SJR valley. In general, the Northeast and Eastside Basin river sites have lower concentrations than the other basins within the SJR valley. One issue to note with this finding is that the hardness levels in the northeast basin are also lower when compared to the other sub-basins. Hardness concentration is particularly important for aquatic life because hardness tends to buffer toxic impacts, allowing tolerance of higher concentrations of many trace elements. Some distinct findings within each sub-basin are listed below.

Northeast Basin: Most of the trace elements sampled in the Northeast Basin had results below the reporting limit. Copper and zinc were the only two metals that were consistently above minimum reporting levels for all the sites within the Northeast Basin. Chromium had multiple samples above detection for most sites except the Mokelumne River which only had two samples for total chromium above detection levels.

Eastside Basin: The Eastside Basin river sites were similar to the Mokelumne River with non-detect values for all metal constituents, except copper and zinc. The Eastside Basin river sites had more non-detect values for zinc than the Mokelumne River. The non-river sites were comparable to the river sites data, except for having higher concentrations of copper, zinc and total chromium. Nickel was also reported at concentrations above minimum reporting levels for the non-river sites during the winter higher flow periods.

Southeast Basin: The Southeast Basin sites were similar to the non-river sites of the Eastside Basin. One exception was Deep Slough which had high levels of arsenic and total nickel reported year-round.

South Delta Basin: The New Jerusalem Drain had non-detect values for most of the trace elements except for chromium where high concentrations were detected. Tom Payne Slough trace element concentrations were similar to that of the Deep Slough, having higher levels of arsenic, but with minimal total nickel. Old River and Mountain House Creek both had very low levels of arsenic. Mountain House Creek, similar to Deep Slough, had total nickel concentrations found throughout the sampling period.

Westside Basin: The Westside Basin unlike the Northeast Basin had more detected concentrations of total lead and had higher concentrations and major spikes of copper, zinc, and chromium. Hospital Creek had the largest spikes of copper, zinc, nickel and chromium. These very large spikes seemed to occur mostly during the irrigation season. Del Puerto Creek was the only Westside basin site that did not have any samples above the minimum detection level for lead.

Grassland Basin: Salt Slough had very similar concentrations of trace elements compared to Deep Slough with just slightly lower levels of arsenic. Mud Slough Upstream was similar to Salt Slough having detectable arsenic but at slightly lower concentrations. The dominant trace element concentrations at the Discharge from SLD site were chromium and copper.

The majority of the concentrations of trace elements that were seen in the Main Stem SJR were the dominant trace elements identified in the sub-basins including; arsenic, chromium, copper, nickel and zinc. With most of these constituents, trace element concentrations went up from Sack Dam to Hills Ferry due to the Grassland influences and from Hills Ferry downstream to Airport Way concentrations decreased due to the Eastside river influences. This trend is similar to the trend seen with minerals.

12.1.13 TOXICITY

Funding constraints limited the overall number of full (three species) water column toxicity tests. The three species tested were fathead minnow (*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). During Water Years 01, 02 and partially in 03 acute toxicity tests were run on fathead minnow and *Ceriodaphnia dubia*, and while it was encouraging to see limited if any acute effects, there was concern that dilution flows might be masking some effect. Analyzing samples for chronic toxicity was more costly, but considered a more conservative option.

With limited funding during WY 04, toxicity samples for chronic fathead minnow and chronic *Ceriodaphnia dubia* were collected in the Main Stem during the irrigation season only. During WY 05, toxicity samples for acute and chronic fathead minnows, acute and chronic *Ceriodaphnia dubia*, and acute algae were collected once a month at the various sites shown in Table 1. Funding was not available to run toxicity identification evaluations (TIE) on samples identified as a toxic event and therefore results can only be evaluated against data collected during each sampling event.

The sporadic sampling did not discern specific trends. Results in Table 6 are discussed by sub-basin below.

Northeast Basin: Northeast Basin had recorded toxicity in the Cosumnes River and Bear Creek for the acute fathead minnow test (Table 6). One hundred percent of the four samples collected at Cosumnes River for the acute algae test had a reduction of cell growth. The Mokelumne River only displayed toxicity for the chronic fathead minnow test. The rest of the samples during the sampling period displayed no toxic event.

Eastside Basin: Within the Eastside Basin acute fathead minnow toxic events were only reported for French Camp Slough. Lone Tree Creek had one toxic event for acute *Ceriodaphnia dubia*. Acute algae and chronic fathead minnow test were only conducted at the river sites, except for four acute algae samples collected at Harding drain, and each site had toxic events (for algae reduction and increase in cell growth were found). Over 50 percent of the samples collected at Tuolumne River reported toxic events for the chronic fathead minnow test.

Southeast Basin: Bear Creek at Bert Crane Road had three toxic events for the acute fathead minnow test. The remainder of the samples displayed no toxic events.

South Delta Basin: The New Jerusalem Drain had one toxic event for the acute fathead minnow test and the acute *Ceriodaphnia dubia* test. Both of the two samples collected for the acute algae toxicity had a growth statistical difference which could be due to the very high nitrate concentrations within the New Jerusalem Drain. Tom Payne Slough had one toxic event (reduction of cell growth) out of one sample collected for the acute algae test. Mountain House Creek had one toxic event (increase in cell growth) out of two samples collected for the acute algae test.

Westside Basin: Toxic events were seen at Orestimba Creek, Grayson Drain and Hospital Creek for the acute *Ceriodaphnia dubia* test. No other toxic events were observed. Note that only acute fathead minnow and *Ceriodaphnia dubia* samples were collected and analyzed within the Westside Basin.

Grassland Basin: Salt Slough had a total of three acute algae samples collected with two having a reduction in growth and one being an increase in algae growth. None of the seventeen samples collected at Salt Slough for acute fathead minnow or acute *Ceriodaphnia dubi*a had toxic events.

Spatially, not one basin stands out from the rest. As a whole, a majority of the acute algae samples within the SJR Basin had a toxic reduction or growth in algae. Only twelve samples out of 59 collected throughout the basin did not have a statistical difference from the control whether being a reduction or increase in algae growth.

The Main Stem SJR sites reflected the same finding of the Basin sites with only eight out of the 31 samples of acute algae not having a statistical reduction or increase in growth when compared to the controls. At least one toxic event was found in each of the Main Stem sites sampled for the chronic fathead minnow and chronic *Ceriodaphnia dubia* tests.

12.2 Evaluation of Beneficial Uses

To evaluate potential impact, indicators were chosen for four broad beneficial uses as shown in Table 3:

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

Exceedances/ elevated levels tables were created with the data collected using the applicable water quality goals and objectives as described in section 9.2. Appendix P provides the exceedance/ elevated levels tables which compare the total number of samples collected with the total number showing elevated levels for temperature, pH, SC, TOC, DO, turbidity (within the legal boundaries of the Delta), bacteria, nitrate, nitrate-N, ammonia-N, chloride, sulfate, TDS, sodium, total and dissolved arsenic, total and dissolved cadmium, total chromium, total and dissolved copper, total and dissolved lead, total and dissolved nickel, total and dissolved zinc and total mercury. Most of the criteria used to set trace element limits take into account the hardness of the water at the time of sample collection since increasing hardness will tend to buffer the effect of particular trace elements. The hardness calculations were taken into account in both the summary tables presented in Appendix P and the discussion here. Constituents in Appendix P are evaluated against multiple objectives and goals, when applicable, for comparison of beneficial use impacts. Turbidity outside the Delta is discussed separately below.

The Basin Plan Objective for turbidity within the San Joaquin River Basin was designed for point source discharges. When evaluating turbidity basin wide, with weeks between turbidity results and miles between sites, the following evaluations should be looked at objectively and viewed as an overall comparison of the basin. With this in mind, see Table 7 for the selected upstream sites that were chosen to describe “natural background” for this Basin Plan Objective. Note for Cosumnes River at Twin Cities Road, Bear Creek at Lower Sacramento Road, French Camp Slough at Airport, and Lone Tree Creek at Austin Rd that the sites were compared to the Delta objective because they discharge directly into the Delta. Also, upstream sites are really not applicable to compare with the Main Stem river sites and were not evaluated using the above approach. Turbidity effects along the Main Stem are discussed in section 12.1 of the discussion section. Monthly geometric means were used because of collection time differences. See Table 7 for the number of times the monthly geometric mean of a site is greater than the monthly geometric mean of the selected upstream site using the calculations of the Basin plan objective.

The following discussion highlights information from Appendix P and Table 7 to assess beneficial use status in the SJR Basin.

Table 7: Selected Upstream Site Locations and Number of Turbidity Samples Greater than Selected Upstream site

Location	Site	Selected Upstream location	Selected Upstream Site	Turbidity's Monthly GeoMean Count*	Number of samples greater than Selected Upstream site using the Basin Plan Turbidity Objective
Main Stem					
SJR @Sack Dam	541MAD007	NA	NA	NA	NA
SJR @ Lander	541MER522	NA	NA	NA	NA
SJR @ Fremont Ford	541MER538	NA	NA	NA	NA
SJR @ Hills Ferry	541STC512	NA	NA	NA	NA
SJR @ Crows	535STC504	NA	NA	NA	NA
SJR @ Patterson	541STC507	NA	NA	NA	NA
SJR @ Maze	541STC510	NA	NA	NA	NA
SJR @ Airport Way/Vernalis	541SJC501	NA	NA	NA	NA
			Total Main Stem Count	0	0
Southeast Basin					
Deep Slough Green House Rd	535MER577	SJR @Sack Dam	541MAD007	17	8
Santa Rita Slough at Highway 152	541MER015	SJR @Sack Dam	541MAD007	NA	NA
Bear Creek Bert Crane Rd	535MER007	SJR @Sack Dam	541MAD007	13	10
			Total Southeast Basin Count	30	18
Grassland Basin					
Salt Slough @Lander/Hwy 165	541MER531	SJR @ Lander	541MER522	23	21
Mud Slough (n) (upstream) @ San Luis Drain	541MER536	SJR @ Fremont Ford	541MER538	21	3
Discharge from SLD	541MER535	Mud Slough (n) (upstream) @ San Luis Drain	541MER536	21	5
Mud Slough (n) (downstream) @ San Luis Drain	541MER542	SJR @ Fremont Ford	541MER538	22	2
			Total Grassland Basin Count	87	31
Eastside Basin					
Turner Slough at 4th Avenue	535MER576	SJR @ Lander	541MER522	17	17
Merced River Hatfield Park (River Road)	541MER546	SJR @ Hills Ferry	541STC512	10	0
Harding Drain discharge @ San Joaquin River (TID5	535STC501	SJR @ Crows	535STC504	13	1
Tuolumne River @ Shiloh	535STC513	SJR @ Patterson	541STC507	16	1
Stanislaus River @Caswell	535STC514	SJR @ Maze	541STC510	9	1
			Total Eastside Basin Count	65	20
West Side Basin					
Orestimba Creek @ River Rd.	541STC019	SJR @ Hills Ferry	541STC512	17	14
Solado Creek @ Hwy 33	541STC515	SJR @ Patterson	541STC507	11	8
Del Puerto Creek @Vineyard	541STC516	SJR @ Patterson	541STC507	16	11
Grayson Drain	541STC030	SJR @ Patterson	541STC507	13	11
Ingram Creek @River Rd.	541STC040	SJR @ Patterson	541STC507	14	7
Hospital Creek @River Rd.	541STC042	SJR @ Patterson	541STC507	13	9
			Total West Side Basin Count	84	60
Northeast Basin					
Cosumnes River @ Twin Cities Rd.	531SAC001	Discharges into Delta waters	150NTU	11	0
Mokelumne River @New Hope Rd.	544SAC002	Delta Waters		NA	NA
Pixley Slough @ Davis Rd	531SJC507	Bear Creek @Lower Sacramento Rd.	531SJC515	16	6
Bear Creek @ Thorton Road (J8)	544SJC508	Delta Waters		NA	NA
Bear Creek @Lower Sacramento Rd.	531SJC515	Discharges into Delta waters	150NTU	17	0
French Camp Slough @ Airport	531SJC504	Discharges into Delta waters	150NTU	8	0
Lone Tree Creek @ Austin Rd	531SJC503	Discharges into Delta waters	150NTU	6	0
			Total Northeast Basin Count	58	6
Delta Basin					
New Jerusalem Drain	544SJC001	Delta Waters		NA	NA
Tom Payne Slough @Paradise Rd.	544SJC505	Delta Waters		NA	NA
Old River @Tracy Blvd	544SJC506	Delta Waters		NA	NA
Mountain House Creek	544SJC509	Delta Waters		NA	NA
			Total Delta Basin Count	0	0

*Number of times the monthly geomean was able to be calculated

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

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), selected trace elements (total arsenic, cadmium, copper, mercury, nickel, lead and zinc), nitrate and *E. coli*. For all of the indicators except *E. coli*, there are specific numeric objectives or goals for drinking water that results can be evaluated against (Appendix Q1 and Q2). There are no specific numeric criteria for *E. coli* related to consumption but the presence of *E. coli* 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 are found in the South Delta Basin non-river sites and in Salado Creek within the Westside Basin. The Main Stem sites that displayed elevated levels above this goal were SJR at Lander, SJR at Fremont Ford and SJR at Hills Ferry. These Main Stem sites are located upstream of the first eastside inflow (Merced River) and are therefore dominated by groundwater accretion and inflows from the Southeast and Grassland Sub-basins. Once the Eastside rivers flow into the SJR, the specific conductivity within the SJR declines until Vernalis.

The TOC goal of 3.0 mg/L is based on the Bay Delta Authority's guideline for 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 water bodies monitored flow into the San Joaquin River and ultimately into the Delta. Overall TOC concentrations were reported above 3.0-mg/L throughout the SJR Basin (Figure 51). The Northeast Basin had the lowest concentrations of TOC compared to the rest of the SJR Basins, but still exceeded 3.0-mg/L about half of the time. Storm events and agricultural runoff during the irrigation season correlated well with many of the spikes in concentration, but the goal 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.

Roughly 10-percent of the 526-nitrate samples collected exceeded the nitrate California Primary MCL (45 mg/L). All of the 10 samples collected at New Jerusalem Drain (representing shallow ground water in the Westside Basin) were above this objective. The Grasslands Basin also had elevated levels of nitrate at all sites except Mud Slough upstream of SLD. Two sites (Discharge at SLD and Mud Slough (downstream) @ SLD—both within the Grassland Basin) had samples that exceeded the nitrate-N California Primary MCL (10 mg/L).

For total arsenic two goals were evaluated for drinking water: 1) the Basin Plan Objective for the California Primary MCL of 50 µg/L and 2) the USEPA Primary MCL of 10 µg/L. No samples exceeded the Basin Plan objective during the 5 year sampling period. Thirteen samples exceeded the USEPA primary MCL. The three sites that had elevated levels above this goal were SJR at Lander, Deep Slough and the Grayson Drain.

The total cadmium Basin Plan Objective for the California Primary MCL of 5 µg/L, total copper Basin Plan Objective for the California Primary MCL of 1000 µg/L, and the total zinc Basin Plan Objective for the California Primary MCL of 5000 µg/L were never exceeded during the 5 year study.

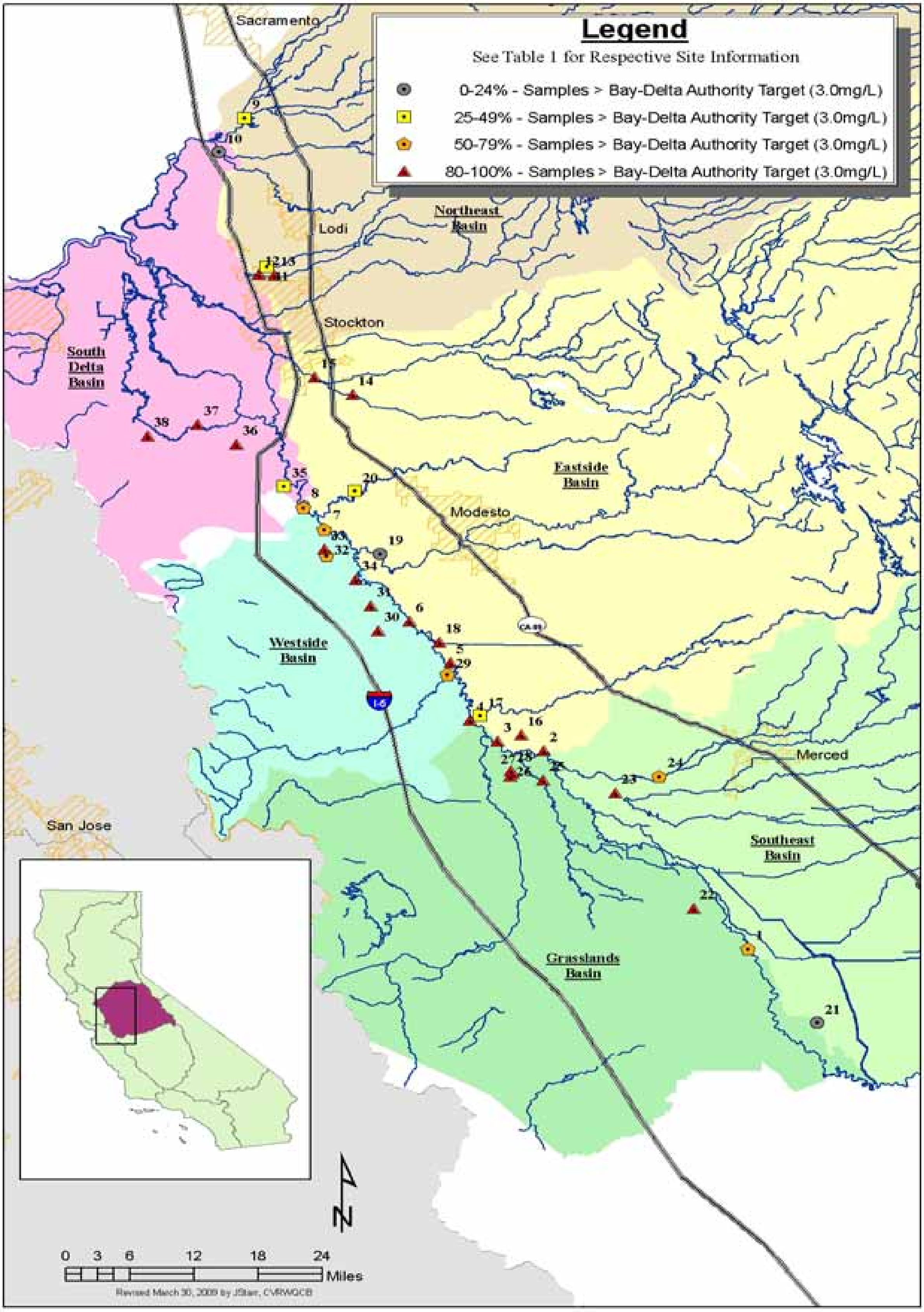
The total chromium Basin Plan Objective for the California Primary MCL of 50 µg/L, total lead Basin Plan Objective for the California Primary MCL of 15 µg/L, and the total nickel Basin Plan Objective for

California Primary MCL of 100 µg/L were all exceeded by three sites in the Westside Basin. Hospital Creek, Ingram Creek and Grayson Drain exceeded these goals during the irrigation season.

The total mercury Basin Plan Objective for the California Primary MCL of 2 µg/L was never exceeded during the 5 year sampling period. Total mercury was found elevated above the California Toxics Rule (USEPA) for sources of drinking water, 0.05 µg/L, once in Hospital Creek (0.2 µg/L).

Table 8 is a quick summary to show whether the river or any of the basins have potential beneficial use impacts based on the indicators evaluated.

Figure 51: Percentage of Total Organic Carbon samples greater than the Bay-Delta Authority Target (3.0 mg/L)



Aquatic Life (pH, Temperature, Dissolved Oxygen, Turbidity, Trace Metals, Minerals 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. Each of the Basins exceeded this objective multiple times, but no site exceeded this objective more than 18 percent of the time. The Main Stem and the Grasslands exceeded this objective during the summer irrigation season. The other basins exceeded this objective randomly with drastic fluctuations.

The Bay-Delta Authority target for a temperature of 20ºC from April 1 – June 30 and from September 1 – November 30 applies to the San Joaquin River at Vernalis. Samples collected at Vernalis had temperatures recorded above this target 41% of the time during the 5-year study. Every site within the SJR Basin reported temperatures above this target at least once during the sampling period with the highest percentages seen within the Southeast and Grassland Basins.

The dissolved oxygen Basin Plan objective of 7.0-mg/L (described in Appendix Q1 as outside the Delta for cold/spawning beneficial use) was used for all non-Delta sites. Results were found below the above objective at least once for every site except for the Cosumnes and Stanislaus Rivers. The basin with the highest percentage of results below the objective was the Northeast Basin in the non-river sites and the lowest percentages were found in the Westside Basin. Sites within the legal boundaries of the Delta were evaluated against the Basin Plan objective of 5.0 mg/L for dissolved oxygen. All Delta sites were below this objective at least once except New Jerusalem Drain. Tom Payne Slough had the highest percentage of results below this objective with 19 out of 47 samples.

Sites within the legal boundaries of the Delta were evaluated against the Basin Plan objective of 150 NTU for turbidity. This objective was only exceeded once at Mountain House Creek during a non-storm event. New Jerusalem Drain and Mountain House Creek both exceeded the objective during the December 2002 storm event, however this objective doesn’t apply for storm events. For non-Delta sites the Basin Plan objective was designed for specific discharges. As described in the turbidity results section of this report, Table 7 attempts to use the Basin Plan objective to have an overall assessment of the SJR Basin turbidity concentrations. The Westside Basin had greater turbidity 71 percent of the time compared to the selected upstream sites. Higher turbidity levels were typically associated with major storm events and irrigation seasons.

The USEPA California Toxics Rule for total and dissolved cadmium, total and dissolved nickel, dissolved arsenic, dissolved lead, and dissolved zinc was never surpassed during the sampling period. No samples were elevated above the USEPA National Ambient Water Quality Criteria for 1 hour average of 1.4 µg/L for total mercury during the sampling period.

The USEPA California Toxics Rule for total and dissolved copper was exceeded in multiple samples, primarily in the non-river sites of the Northeast and Eastside Basin, particularly in French Camp Slough, Lone Tree Creek, and Pixley Slough. In addition the Westside and Southeast Basin had a few elevated samples for total copper as well. The USEPA California Toxics Rule for total lead was exceeded once in the Mokelumne River. Pixley Slough reported one sample above the USEPA California Toxics Rule for total zinc. Even though the concentrations of the metals were lower in the Northeast and Eastside Basins when compared to the Westside Basin, the hardness levels were also comparatively low which resulted in lower concentration thresholds that could impact aquatic life.

No sample was reported above the chloride USEPA National Ambient Water Quality Criteria for 1-hour average of 860 mg/L during the study.

Various levels of water column toxicity were reported on multiple occasions (Table 6). A higher percentage of chronic toxicity was reported as compared to acute toxicity. Acute algae toxicity samples were collected less frequently than other toxicity samples, but had the highest percentage (50 percent) of toxic findings (samples having a reduction or increase in growth at all sites except for Fremont Ford).

In summary there were multiple concerns throughout the basin for aquatic life. Drastic fluctuations of pH occur at multiple locations, but for the majority of the time most sites are within range of the Basin Plan objective. Elevated temperatures during the spring and fall may impact fish migration. Low DO levels were seen in multiple sites, most consistently in non-river sites, but no overt impact (e.g. fish kills) was ever noted. Trace element results exceeding hardness adjusted criteria were mostly reported in the Northeast and Eastside basins—as were the lowest hardness concentrations. Total copper was the primary trace element of concern having higher percentages of elevated levels in French Camp Slough, Lone Tree Creek, and Pixley Slough. Turbidity concentrations can become highly elevated during storm events and the irrigation season but become difficult to interpret with the fluctuation of background concentrations.

<u>Irrigation Water Supply (Specific Conductivity, Minerals)</u>

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 to a maximum thirty day running average. Although approximately 21 percent of individual samples collected at Vernalis had concentrations above the noted objective during the sampling period, exceedances can not be determined using the limited grab samples.

Multiple samples at concentrations above the Water Quality Goal for Agriculture of 700 umhos/cm (Marshack, 2003) were found in all basins except the Northeast Basin. The Eastside Basin had the lowest percentage of elevated samples (39 out of 409—9.5%) and the Grasslands (1047 out of 1049--~100%), Westside (330 out of 516—64%) and the South Delta Basin (163 out of 188—87%) had the highest percentages of elevated samples. Multiple samples collected along the SJR also had concentrations reported above the Water Quality Goal for Agriculture. The elevated concentrations were consistently clustered between Lander Avenue (primarily ground water accretions) and Maze Blvd., a stretch of river receiving inflows from the Grassland, Eastside and Westside Basins.

Chloride and sodium concentrations that were above water quality goals of 106 mg/L and 69-mg/L, respectively, tracked elevated levels of specific conductance.

Concentrations above the total dissolved solids Water Quality for Agriculture goal of 450 mg/L occurred mostly in the Grasslands and Westside Basin. The Northeast Basin was never above this goal and most of the elevated concentrations reported in the Eastside Basin were found in the Harding Drain.

In summary, salt concentrations throughout the SJR Basin appear to be elevated above optimal concentrations for irrigation water supply, except within the Northeast and Eastside Basins. Salt is a well documented issue within the Grasslands and Westside Basins, with the natural background of the area being highly saline and high salinity water being pumped from the Delta to meet agricultural needs. Huge continuous efforts to control salt have been implemented in the past and continue to this day.

See the future actives section 14.0 of this report for more information on the current efforts being made to address salt in the SJR valley.

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), except for the San Luis Drain and New Jerusalem Drain. As a conservative approach, the USEPA Guideline for full contact of 235 MPN/100ml *E. coli* was used to evaluate the entire SJR basin. Many of sites may not support full recreational contact due to physical attribute (e.g. ankle deep water), however, the use of a single guideline provided consistency for the review.

The highest percentages of *E. coli* concentrations exceeding 235 MPN/100ml were found in the Westside Basin and the non-river sites of the Eastside Basin (Figure 52). *E. coli* spikes were seen during high and low flow events meaning *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 52: Percentage of *E. coli* samples greater than the USEPA Guideline: Designated Beach Area (235 MPN/100ml)

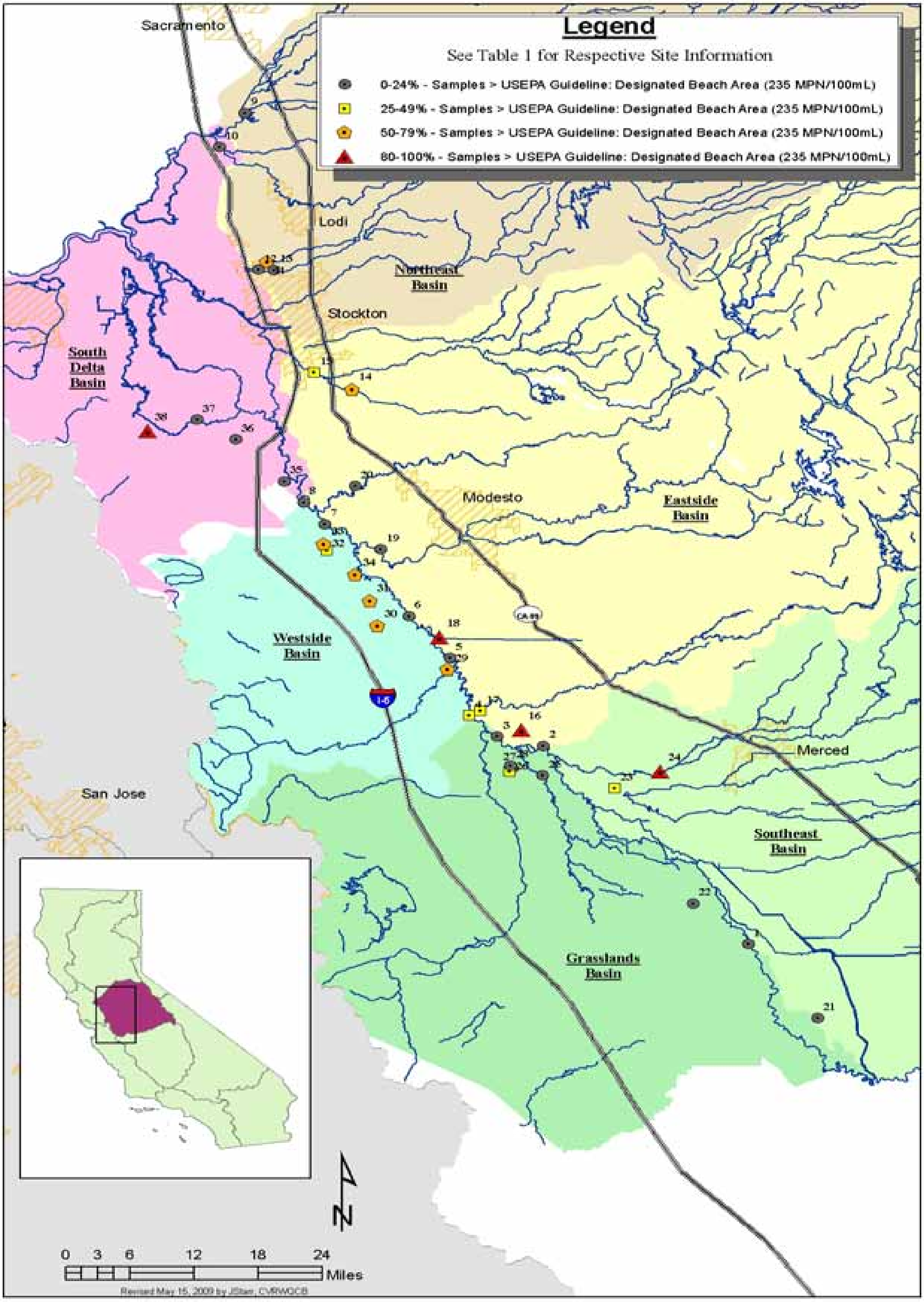


Table 8: Summary of Potential Beneficial Use Concerns: San Joaquin River and Sub-Basin Sites (2000 to 2005)

	San Joaquin River							Sub-Basins					
Beneficial Use/Indicator	Sack Dam	Lander Ave	Fremont Ford	Crows Landing	Patterson	Maze	Airport	SE	Grassland	East	West	NE	S. Delta
Drinking Water													
Specific Conductivity		☒	☒	☒					NA		☒		☒
Total Organic Carbon	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Trace Elements		T. Arsenic						T. Arsenic			4		
E. coli	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Nutrients[3]									Nitrate		Nitrate		Nitrate
Aquatic Life													
pH	☒	☒	☒		☒	☒	☒	☒	☒	☒	☒	☒	☒
Temperature	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Dissolved Oxygen	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Turbidity	NA	NA	NA	NA	NA	NA	NA	☒	☒	☒	☒	☒	☒
Trace Elements								T. Copper			T. Copper	5	
Minerals													
Water Column Toxicity	[7]	☒	[1]	☒	☒	[2]	☒	☒	☒	☒	☒	☒	☒
Irrigation Water Supply													
Specific Conductivity	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒		☒
Minerals	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒		☒
Recreation (Swimming)													
E. coli	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

☒ =One or more result above a goal or objective

NA = There is no goal or objective applicable to the location

[1] Only had three samples taken with no toxic event found

[2] Only had one sample taken with no toxic event found

[3] Found for Nitrate only

[4] total arsenic, total chromium, total lead, total nickel and total mercury results were found above drinking water goals

[5] total and dissolved copper, total lead, and total zinc were found above aquatic life goals

[6] total and dissolved copper were found above aquatic life goals

[7] no samples were taken

13.0 SUMMARY/CONCLUSION

In general the SJR receives drainage from a variety of diverse basins. For example, the Grassland Basin is a highly managed system that is dominated by agricultural influences (both traditional cropland and managed wetlands) and receives water from the Sacramento-San Joaquin Delta to support the land use. The Northeast Basin contains the Cosumnes watershed which drains snowmelt from the Sierras and is the last major water body within the Central Valley that does not have flow regulated by a major reservoir. Most of the drainage basin sites are within the valley floor which is dominated by agricultural use and urban development. Even though the land uses are similar for most of the drainage basin sites, the source water from their upper watersheds are completely different across the basins and create a truly unique and complex system.

The spatial trend for most constituents (SC, TSS, turbidity, metals, and minerals) within the SJR is that concentrations seem to increase from Sack Dam to Hills Ferry, as a result of the Grassland influences, and decrease from Hills Ferry down to Vernalis due to the Eastside Basin river sites contribution of high flow Sierra snow melt and reservoir storage flows.

Other constituents displayed strong seasonal trends that were consistent throughout the whole SJR valley floor. For instance, temperature increased at all sites during the warm summer months. Dissolved oxygen concentrations decreased at all sites during the warmer summer months, which may be offset by algal blooms as well as temperature, with a decrease in dramatic fluctuation within SJR sites during the wet WY of 2005. Specific conductivity, TOC, turbidity, and TSS were influenced by storm events, specifically for SC the first storm runoff, and the irrigation season.

Findings by individual Basins included:

Northeast Basin:

> Northeast basin had the lowest levels for most constituents compared to the rest of the SJR basin.
>
> All of the four samples collected for acute algae at Cosumnes River had a reduction of cell growth. This reduction could be due to the minimal nutrients and minerals found in the Cosumnes River watershed, but a toxicity identification evaluation was not conducted.

Eastside Basin:

> The Eastside Basin river sites (Merced, Tuolumne and Stanislaus) typically followed the Northeast basin with low levels for most constituents compared to the rest of the basins.
>
> In contrast, the Harding Drain reported the elevated levels of SC, *E. coli*, nutrients, BOD and minerals. Harding Drain also had dramatic fluctuations of DO.

Southeast Basin:

> Deep Slough had high year round levels of arsenic and total nickel which was unique for the entire SJR Basin and had the majority of detected samples during high flow events.

South Delta Basin:

New Jerusalem Tile Drain, which represents shallow ground water within the South Delta Basin, had higher temperature, SC, nitrate levels, and minerals compared to the rest of the South Delta Basin. The New Jerusalem Drain, even with its high nitrate concentrations, had very low TSS and TOC concentrations with the BOD typically just above the detection limit of 0.1 mg/L--unlike the rest of the South Delta Basin. The New Jerusalem Drain had non-detect values for most of the metals except high concentrations of chromium.

Tom Payne Slough had a consistent seasonal fluctuation of minerals. High concentrations of minerals are seen during the winter months with a drastic drop in mineral concentrations during the summer months.

Westside Basin:

The Westside Basin sites on average had greater turbidity and TSS than the remainder of the SJR Basin sites with concentrations fluctuating greatly during the irrigation season and storm events. The Westside Basin also had relatively higher concentrations of nutrients and minerals than other basin sites.

The Westside Basin had a high volume of detected values for total lead and had overall higher concentrations and major spikes of copper, zinc, and chromium.

Grassland Basin:

The Grassland Basin was sampled more frequently for every site other than those on the main stem of the SJR due to the compliance monitoring program for the Grassland Bypass Project (selenium control program). For all sites within the Grassland Basin, other than for Salt Slough, there is a clear seasonal fluctuation for pH. The pH tends to peak in July and drop to its lowest around January mirroring the temperature results.

The Grassland Basin has high levels of SC, TSS, and minerals compared to the eastern basins.

Salt Slough, having a total of three algal toxicity samples collected, had two toxic events for the increase in growth for acute algae and one toxic event for a reduction in algal growth. Of the seventeen samples within Salt Slough collected for acute fathead minnow and acute *Ceriodaphnia dubia,* no toxic events were found.

When evaluated against the water quality objectives and goals found in Appendix Q1 and Q2 there are multiple areas of concern within the SJR Basin.

Drinking Water/Municipal Supply:

High TOC levels throughout the SJR valley are elevated above guidelines for the delta intended to protect drinking water.

Aquatic life:

Elevated temperatures throughout the basin were a concern during the spring and fall. Total copper had high occurrences in French Camp Slough, Lone Tree Creek, and Pixley Slough. Turbidity was a concern within the Westside Basin, but a more applicable Basin Plan objective is needed to determine potential for impairment.

Irrigation Water Supply:

When compared against the Water Quality Goal for Agriculture of 700 umhos/cm, large areas of the basin appear to be elevated above optimal irrigation water quality guidelines for specific conductance. Salt is an overwhelming ongoing concern for most of the SJR Basin particularly the Grasslands and Westside basin.

Recreation:

E. coli had occasional spikes during the summer months when most of the waterways have a potential for recreational use. A majority of the sites with high percentages of samples exceeding the conservative level percentages may need further evaluation to determine actual level of potential recreational use.

14.0 FUTURE ACTIVITIES

While information collected during this study was utilized to help fine tune the monitoring programs for the Northeast, Eastside and Westside Sub-basins during the rotational portion of the overall effort, 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 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.

Since 2003, expanded monitoring of agricultural drainage inflows to the SJR have been 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 2009.

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

- Development of 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 both 2007 and 2008)
- 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 each sub-basin and river site include those parameters identified in Table 8. Data has been posted annually on our website since 2003 and 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, 2009 Draft).

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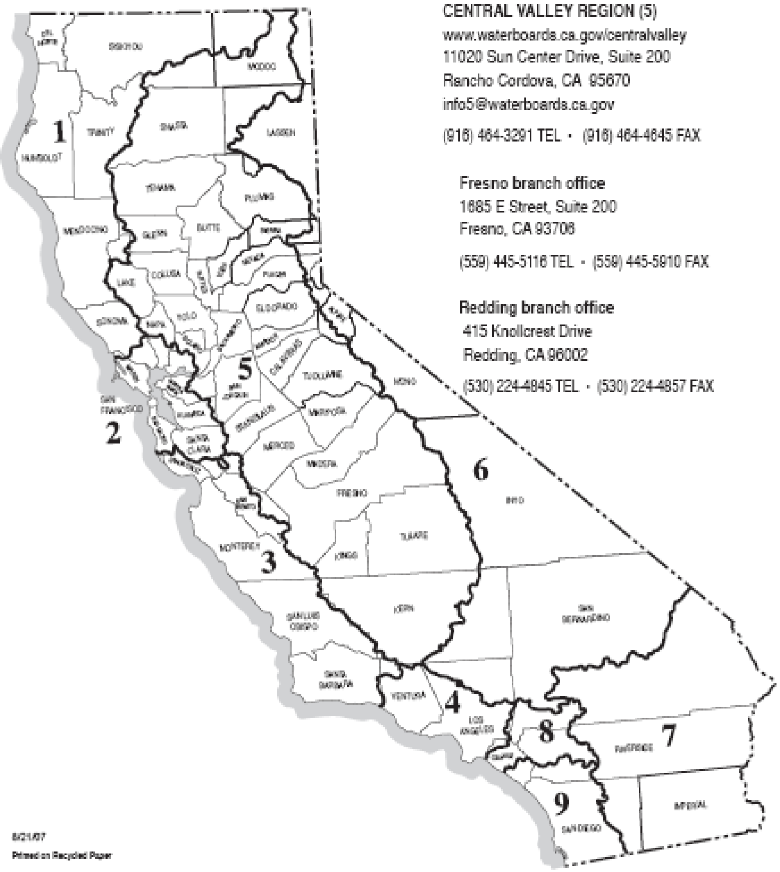

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2501 Lake Tahoe Blvd.
South Lake Tahoe, CA 96150
info6@waterboards.ca.gov
(530) 542-5400 TEL • (530) 544-2271 FAX

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

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