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# Surface Water Ambient Monitoring Program (SWAMP) Report on the San Juan Hydrologic Unit

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# SURFACE WATER AMBIENT MONITORING PROGRAM (SWAMP) REPORT ON THE SAN JUAN HYDROLOGIC UNIT

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# 1. ABSTRACT

In order to assess the ecological health of the San Juan Hydrologic Unit (San Diego, Orange, and Riverside Counties, CA), water chemistry, water and sediment toxicity, fish tissues, benthic macroinvertebrate communities, and physical habitat were assessed at multiple sites. Water chemistry, toxicity, and fish tissues were assessed under SWAMP between 2002 and 2003, and bioassessment samples were collected under other programs between 1998 and 2006. Most indicators showed evidence of widespread impact, especially in the northern and coastal areas of the watershed. For example, all sites in the Laguna Creek hydrologic subarea, as well as sites in the lower portions of the San Juan Creek watershed exceeded aquatic life thresholds for many (8) water chemistry constituents. Toxicity was moderate at most sites, and not observed at a few sites in the interior of the San Juan Creek watershed. Fish tissue collected from Aliso Creek did not indicate impairment, although no organic constituents were measured, and only one constituent (Selenium) had an applicable threshold. IBIs were poor or very poor at almost every coastal site, as well as at all sites in the Laguna Creek hydrologic subarea, meaning that biological communities characteristic of impairment were found at these sites. Sites with fair, good, or very good IBI scores were located in the interior or southern portions of the watershed. Physical habitat was very degraded at coastal and northern sites, but in moderate to good condition at interior sties. Some designated reference sites (e.g., 901SJMCC2, REF-CS, and 901SJATC2) did not appear to conform to expectations of reference condition. However, other reference sites appeared to be in good ecological health, as were sites that had not been designated as reference (e.g., 901SJBEL2). Despite limitations of this assessment (e.g., uncertain spatial and temporal variability, low levels of replication, non-probabilistic sampling, and lack of thresholds for several indicators), multiple lines of evidence support the conclusion that parts of the San Juan HU are in poor ecological condition.

# 2. INTRODUCTION

The San Juan hydrologic unit (HU 901) is in Orange, Riverside, and San Diego Counties. The hydrologic unit represents an important water resource in one of the most arid regions of the nation. Despite strong interest in the surface waters of the San Juan HU, a comprehensive assessment of the ecological health of these waters has not been conducted at this time. The purpose of this report is to provide such an analysis using data collected in 2002-2003 under the Surface Waters Ambient Monitoring Program (SWAMP), as well as additional sources, such as including data collected by National Pollution Discharge Elimination System (NPDES) permittees and by the Camp Pendleton Marine Corps Base. SWAMP monitoring efforts rotated among sets of watersheds, ensuring that each HU is monitored once every 5 years (Table 1). These programs collected data to describe water chemistry, water and sediment toxicity, fish tissues, physical habitat, and macroinvertebrate community structure. By examining these data from multiple sources, this report provides a measure of the ecological integrity of the San Juan HU.

**Table 1. Watersheds monitored under the SWAMP program.**

| Project | Indicators | Years |
|---|---|---|
| SWAMP | Water chemistry, toxicity, fish tissue | 2002-2003 |
| CA Department of Fish and Game | Bioassessment | 1998-2000 |
| Orange County NPDES | Water chemistry, bioassessment, toxicity, physical habitat | 2002-2006 |
| Camp Pendleton | Water chemistry, bioassessment | 2004-2005 |
| Laguna Niguel grant-funded projects | Water chemistry | 2004-2006 |

There are two objectives for this assessment: 1) To evaluate the condition of SWAMP sites; and 2) To evaluate the overall condition of the watershed. Evaluations were based on multiple indicators of ecological integrity, including water chemistry, water and sediment toxicity, fish tissue bioaccumulation, biological assessment of benthic macroinvertebrate communities, and physical habitat assessment.

This report is organized into four sections. The first section (Introduction) describes the geographic setting in terms of climate, hydrology, and land use within the watershed. The second section (Methods) describes the approach to data collection, assessment indicators, and data analysis. The third section (Results) contains the results of these analyses. The fourth section (Discussion) integrates evidence of impact from multiple indicators, describes the limitations of this assessment, and summarizes the overall health of the watershed.

## 2.1 Geographic Setting

The San Juan HU is a collection of coastal watersheds in Orange, Riverside, and San Diego counties draining into the Pacific Ocean (Figure 1). The watershed covers 496 $mi^2$ and ranges from the Santa Margarita mountains in the interior to the Pacific Coast.

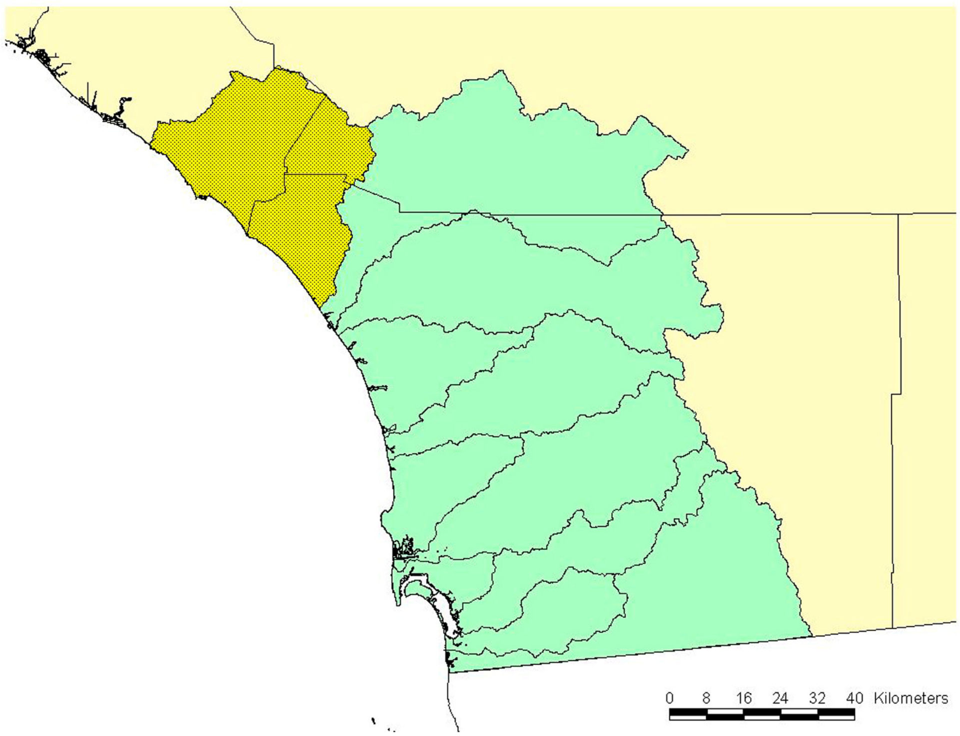



**Figure 1. San Diego region (green) includes portions of San Diego, Riverside, and Orange counties. The San Juan HU (yellow, shaded) is located within Orange, Riverside, and San Diego Counties**

### *2.1.1 Climate*

The San Juan HU, like the entire San Diego region, is characterized by a Mediterranean climate, with hot dry summers and cool wet winters. Average monthly rainfalls measured at the Lindberg Airport (SDG) in San Diego, California between 1905 and 2006 show that nearly all rain fell between the months of October and April, with hardly any falling between the months of May and September (California Department of Water Resources 2007). The wettest month was January, with an average rainfall of 2.05"). Average annual rainfall at this station was 10.37". Daily rainfall measured at John Wayne Airport (north of the HU and near the coast) and at San Juan Canyon (in the Santa Ana mountains within the HU) shows considerable variability in rainfall throughout the HU (National Oceanic and Atmospheric Administration 2007) (Figure 2).

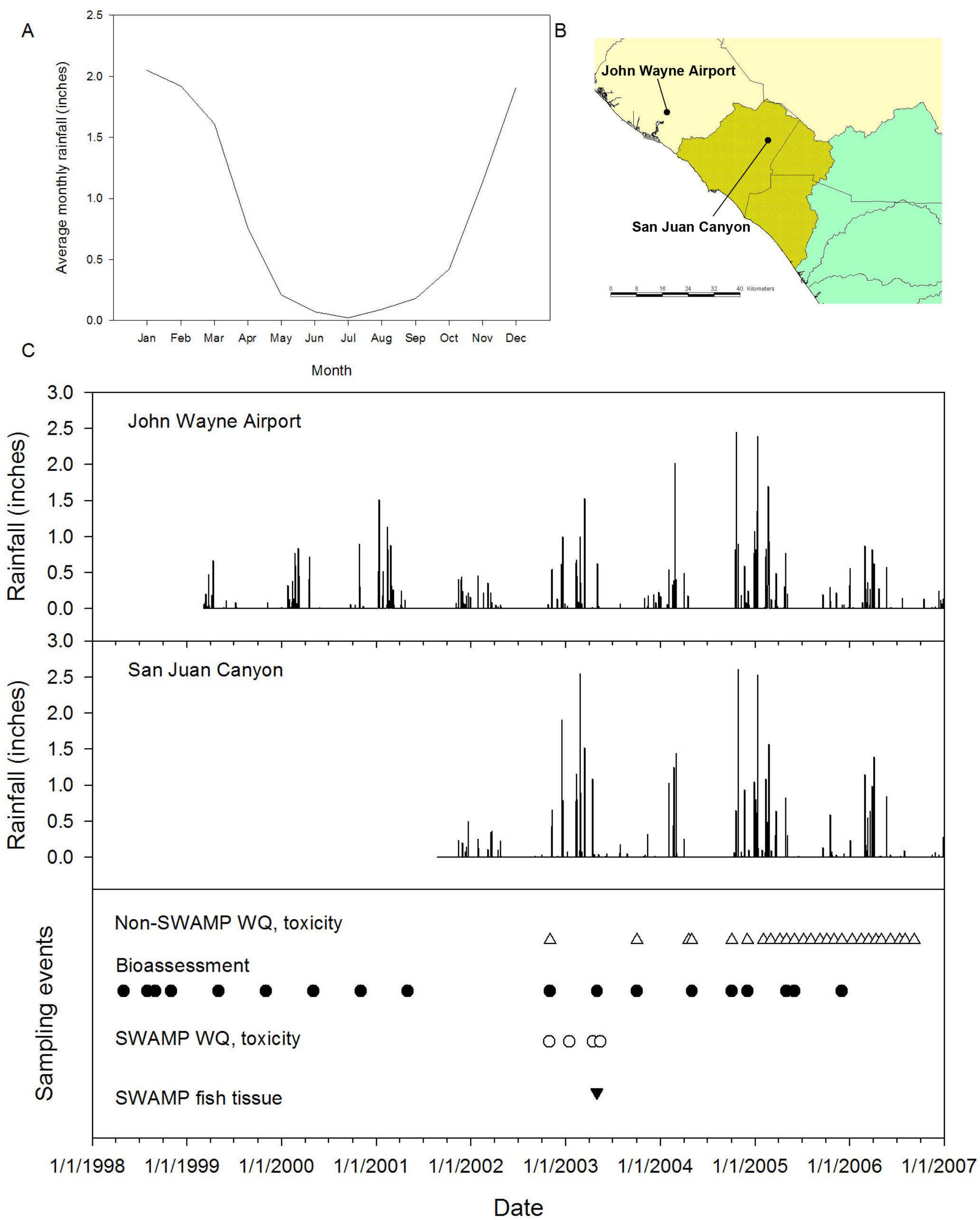



**Figure 2. Rainfall and sampling events at two stations in the San Diego region. A. Average precipitation for each month at the Lindberg Station (DWR station code SDG), based on data collected between January 1905 and November 2006. B. Location of the John Wayne Airport and San Juan Canyon gauges. C. Storm events and sampling events in the San Juan HU. The top two plots show daily precipitation between 1998 and 2007 at the three stations. The bottom plot shows the timing of sampling events. SWAMP water chemistry and toxicity samples are shown as white circles. Bioassessment samples are shown as black circles.**

*2.1.2 Hydrology*

The San Juan HU consists of several watersheds that drain directly into the Pacific Ocean. The largest watershed is San Juan Creek; its major tributaries are Bell Canyon, Arroyo Trabuco, and Oso Creeks. The second largest creek is San Mateo Creek, with Christianitos Creek as the largest major tributary. Smaller in size are Aliso, San Onofre, and Las Pulgas Creeks. Smaller still are numerous coastal streams, including Morro Canyon, Laguna Canyon, Salt Creek, Prima Deshecha, Segunda Deshecha, and several unnamed drainages (Figure 3).

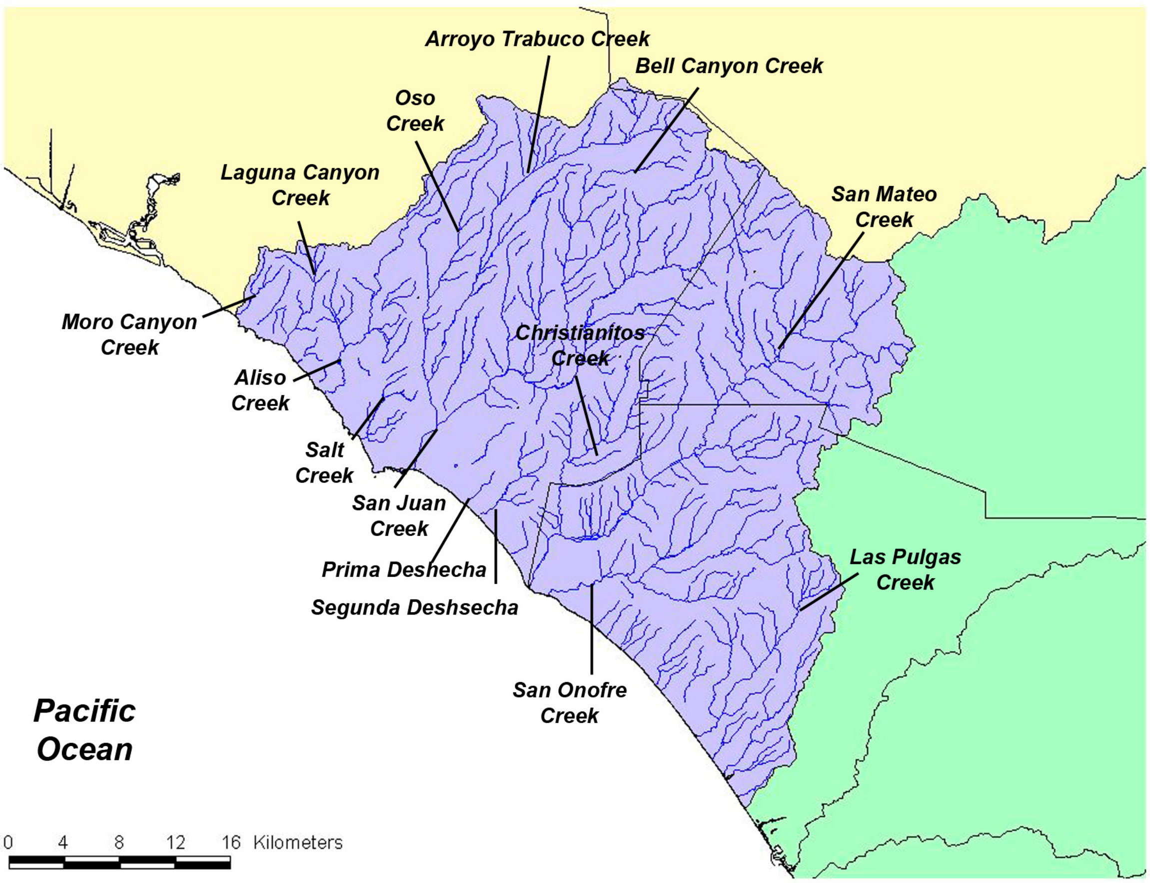



**Figure 3. The San Juan HU, including major waterways.**

*2.1.3 Land Use within the Watershed*

Three counties and several municipalities have jurisdiction over portions of the watershed. Riverside County includes a small portion (17.8%) of the San Juan HU, and no municipalities are found within this portion. More than half the watershed (51.7%) is located within Orange County, and the remainder (30.5%) is in San Diego County. In Orange County, the cities of Aliso Viejo, Mission Viejo, Laguna Beach, Laguna Woods, Laguna Niguel, Dana Point, Lake Forest, Rancho Santa Margarita, San Juan Capistrano, and San Clemente occur within the HU. Although a small portion (7.2%) of the HU is developed, most of this development is concentrated within the northern portion of the watershed. The undeveloped portion, the southern and interior portions, occupies 91.8% of the watershed. Agricultural land use occupies less than 1% of the land (Figure 4). A very large and mostly undeveloped portion of the watershed is encompassed by the Camp Pendleton Marine Corps Base in northern San Diego County. Other large areas of open space are found within the Cleveland National Forest. Caltrans is another major landowner, and it has jurisdiction over the major freeways that traverse the watershed (SANDAG 1998).

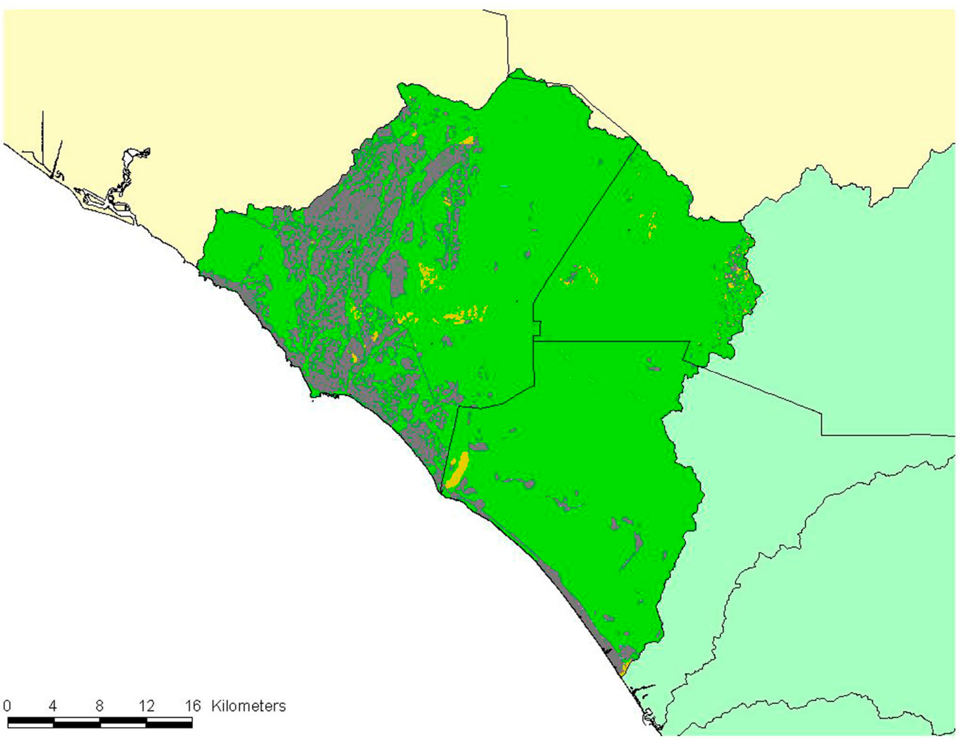



**Figure 4. Land use within the San Juan HU. Undeveloped open space is shown as green. Agricultural areas are shown as orange. Urban and developed lands are shown as dark gray.**

### *2.1.4 Beneficial Uses and Known Impairments in the Watershed*

Beneficial uses in the watershed include agriculture; industrial service supply; recreation; warm and cold freshwater habitat; wildlife habitat; rare, threatened, or endangered species; and spawning habitat. All streams in the San Juan HU have been exempted from municipal uses (Appendix I).

Several streams in the San Juan HU are listed as impaired on the 303(d) list of water quality limited segments, affecting a total of 26.7 stream miles. These streams include Aliso Creek, English Creek, Laguna Canyon Channel, Oso Creek, San Juan Creek, Prima Deshecha Creek, and Segunda Deshecha Creek. Known stressors include indicator bacteria, total dissolved solids, turbidity, benzo(b)fluoranthene, DDE, dieldrin, sulfates, chloride, phosphorus, and sediment toxicity (Appendix I).

# 3. METHODS

This report combines data collected under SWAMP with data from California Department of Fish and Game (CDFG), Camp Pendleton, and NPDES monitoring (Table 2). Eleven sites of interest were sampled under SWAMP in the San Juan HU in 2003 (Table 3; Figure 5). Water chemistry, water and sediment toxicity, and physical habitat was measured at each site. Three of these sites were designated reference sites (i.e., Upper Arroyo Trabuco, Morro Canyon, and San Mateo Creek). Water chemistry, water and sediment toxicity, and physical habitat was measured at each of the eleven sites.

**Table 2. Sources of data used in this report.**

| Project | Indicators | Years |
|---|---|---|
| SWAMP | Water chemistry, toxicity, fish tissue | 2002-2003 |
| CA Department of Fish and Game | Bioassessment | 1998-2000 |
| Orange County NPDES | Water chemistry, bioassessment, toxicity, physical habitat | 2002-2006 |
| Camp Pendleton | Water chemistry, bioassessment | 2004-2005 |
| Laguna Niguel grant-funded projects | Water chemistry | 2004-2006 |

**Table 3. SWAMP sampling site locations. Fish tissues were collected at the site marked with an asterisk (*).**

| | Site | Description | Latitude (°N) | Longitude (°E) |
|---|---|---|---|---|
| 1 | 901SJALC6 | Aliso Creek 6 (mouth) | 33.5119 | -117.7519 |
| 2 | 901SJATC2 | Upper Arroyo Trabuco Creek 2 (reference) | 33.6717 | -117.5575 |
| 3 | 901SJATC5* | Lower Arroyo Trabuco Creek 5 | 33.5266 | -117.6701 |
| 4 | 901SJBEL2 | Bell Canyon Creek 2 | 33.6327 | -117.5553 |
| 5 | 901SJENG2 | English Creek 2 | 33.6278 | -117.6806 |
| 6 | 901SJLAG2 | Laguna Canyon Creek 2 | 33.5726 | -117.7629 |
| 7 | 901SJMCC2 | Morro Canyon Creek 2 (reference) | 33.5622 | -117.8188 |
| 8 | 901SJOSO3 | Oso Creek 3 | 33.5348 | -117.6762 |
| 9 | 901SJSJC5 | Upper San Juan Creek 5 | 33.5879 | -117.5164 |
| 10 | 901SJSJC9 | Lower San Juan Creek 9 | 33.4847 | -117.6746 |
| 11 | 901SJSMT2 | San Mateo Creek 2 (reference) | 33.5497 | -117.3962 |

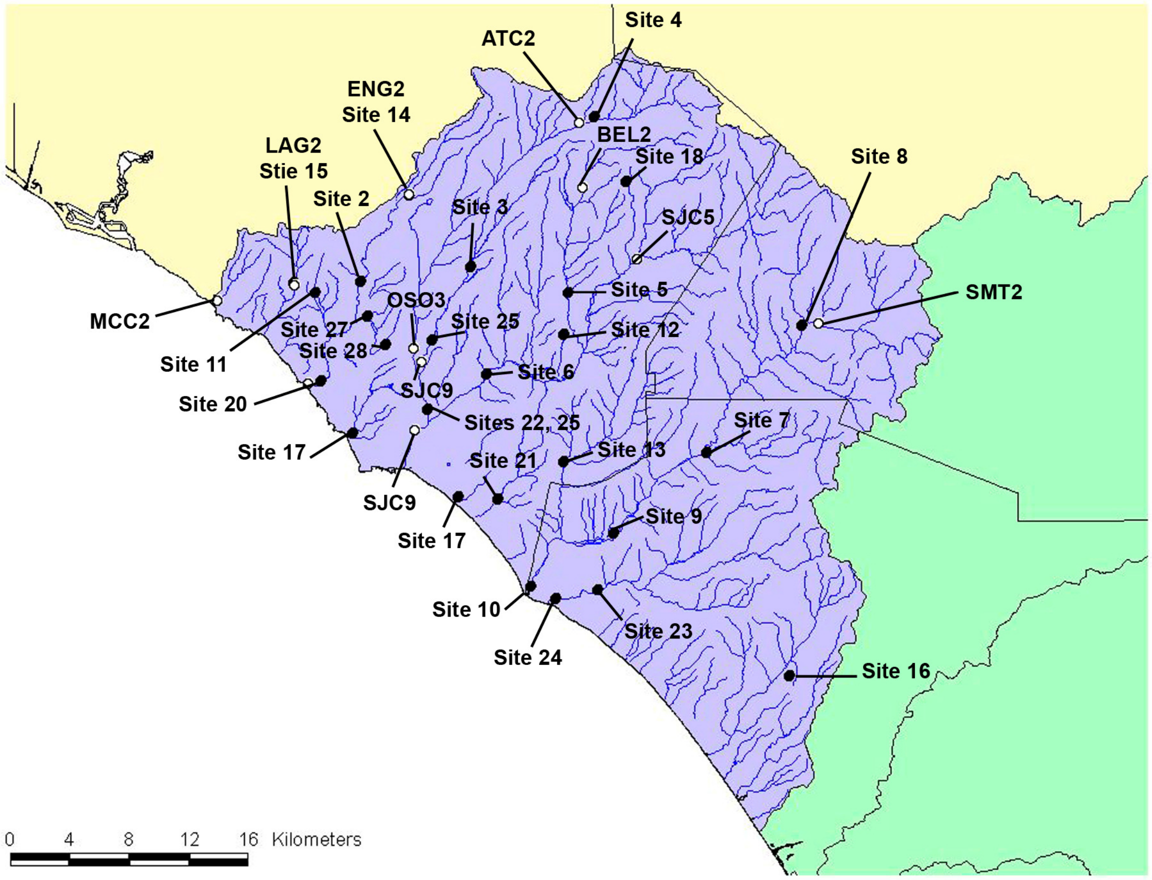



**Figure 5. SWAMP (white circles) and non-SWAMP (black circles) sampling locations. Black triangles indicate two non-SWAMP sites were bioassessment samples were not collected. The SWAMP site prefix designating the hydrologic unit (i.e., 901SJ-) has been dropped to improve clarity.**

Data from several non-SWAMP monitoring were included in this report. Twenty-eight sites were sampled under programs other than SWAMP. Orange County NPDES monitoring at 18 sites included conventional water chemistry, toxicity, bioassessment, and physical habitat. Monitoring at 3 sites at Camp Pendleton included conventional water chemistry and bioassessment. Monitoring at grant-funded projects by the city of Laguna Niguel included conventional water chemistry, nutrients and bacteria (at Upper Sulphur Creek and Narco Channel), as well as metals and organic compounds (at Narco Channel). Additional bioassessment data was collected at 10 sites by the CDFG Aquatic Bioassessment Laboratory (ABL); of these 10 sites, 5 were also sampled by Orange County NPDES. When two non-SWAMP sites were located within 500 meters of each other, they were treated as a single site. This distance was based on published measures of spatial correlation of benthic communities in streams (Gebler 2004). Non-SWAMP samples were collected between 1998 and 2006; in some cases, non-SWAMP sites were very close to SWAMP sites (Table 4; Figure 5).

**Table 4. Non-SWAMP sampling site locations. W = sites where water chemistry was sampled. T = sites where samples were collected for toxicity assays. B = sites where benthic macroinvertebrates were sampled. P = sites where physical habitat was assessed.**

| Site | Description | SWAMP site within 500 m | W | T | B | P | Sources | Lat (°N) | Long (°E) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Aliso Creek at Country Club Road | 901SJALC6 | | | X | | CDFG (901ACCCRx) | 33.5142 | -117.7430 |
| | | | X | X | X | X | OC NPDES (AC-CCR) | | |
| 2 | Aliso Creek at Pacific Park Drive | None | | | X | | CDFG (901ACPPDx) | 33.5752 | -117.7150 |
| | | | X | X | X | X | OC NPDES (AC-PPD) | | |
| 3 | Arroyo Trabuco Creek at Country Club Road | None | | | X | | CDFG (901ATCAPx) | 33.5842 | -117.6358 |
| 4 | Arroyo Trabuco Creek (reference) | None | | | X | | CDFG (901ATCTCx) | 33.6748 | -117.5471 |
| | | | X | X | X | X | OC NPDES (REF-TCAS, REF-AT2, REF-TAC, REF-ATC) | | |
| 5 | Bell Canyon Creek at Bell Canyon Trail in Caspar Wilderness Park | None | | | X | | CDFG (901BCCBCT, 901BCCSRT) | 33.5690 | -117.5651 |
| 6 | San Juan Creek at Highway 74 | None | | | X | | CDFG (901SJC74x) | 33.5192 | -117.6237 |
| | | | X | X | X | X | OC NPDES (SJC-74) | | |
| 7 | San Mateo Creek at Devil's Canyon | None | | | X | | CDFG (901SMCDCx, 901DCCDCx) | 33.4728 | -117.4648 |
| 8 | San Mateo Creek at San Mateo Canyon | 901SJSMT2 | | | X | | CDFG (901SMCSMC) | 33.5496 | -117.3962 |
| 9 | San Mateo Creek at San Mateo Road | None | | | X | | CDFG (901SMCSMR) | 33.4234 | -117.5314 |
| 10 | San Mateo Creek at I5 | None | X | | X | | OC NPDES (SMC-I5) | 33.3834 | -117.5728 |
| 11 | Wood Creek | None | | | X | | CDFG (901WCCRTx, 901WCRMMx, 901WCEOTx) | 33.5681 | -117.7477 |
| | | | X | X | X | X | OC NPDES (WC-WCT) | | |
| 12 | Aliso Creek at Aliso Creek Park | None | X | X | X | X | OC NPDES (AC-ACP, ACJ01) | 33.5435 | -117.5681 |
| 13 | Christianitos Creek at Christianitos Road | None | X | X | X | X | OC NPDES (CC-CR) | 33.4666 | -117.5681 |
| 14 | English Creek at Madera Drive | 901SJENG2 | X | X | X | X | OC NPDES (EC-MD) | 33.6275 | -117.6804 |

## 3.1 Indicators

Multiple indicators were used to assess the sites in the San Juan HU. Water chemistry, water and sediment toxicity, fish tissues, benthic macroinvertebrate communities, and physical habitat.

### *3.1.1 Water chemistry*

To assess water chemistry, samples were collected at each site. Water chemistry was measured as per the SWAMP Quality Assurance Management Plan (QAMP) (Puckett 2002). Measured indicators included conventional water chemistry (e.g., pH, temperature dissolved oxygen, etc.), inorganics, herbicides, pesticides, polycyclic aromatic hydrocarbons (PAHs), dissolved metals, pesticides, and polychlorinated biphenyls (PCBs). Appendix II contains a complete list of constituents that were measured.

Limited water chemistry was collected under non-SWAMP NPDES monitoring as well. This monitoring was restricted to physical parameters, and followed procedures described in annual reports to California Regional Water Quality Control Board, San Diego Region (e.g., Weston Solutions Inc. 2007).

### *3.1.2 Toxicity*

To evaluate water and sediment toxicity to aquatic life in the San Juan HU, toxicity assays were conducted on samples from each site as per the SWAMP QAMP (EPA 1993, Puckett 2002). Water toxicity was evaluated with 7-day exposures on the water flea, *Ceriodaphnia dubia*, and 96-hour exposures to the alga *Selenastrum capricornutum.* Both acute and chronic toxicity to *C. dubia* was measured as decreased survival and fecundity (i.e., eggs per female) relative to controls, respectively. Chronic toxicity to *S. capricornutum* was measured as changes in total cell count relative to controls. Sediment toxicity was evaluated with 10-day exposures on the amphipod *Hyallela azteca.* Both acute and chronic toxicity to *H. azteca* was measured as decreased survival and growth (mg per individual) relative to controls, respectively. Chronic toxicity endpoints (i.e., *C. dubia* fecundity, *H. azteca* growth, and *S. capricornutum* total cell count) were used to develop a summary index of toxicity at each site.

Toxicity was assessed by Orange County NPDES as well (Weston Solutions Inc. 2006). Between 2003 and 2006, water and sediment samples were collected at all sites. Procedures were similar to those used in SWAMP monitoring, with the following differences: chronic toxicity to *C. dubia* was measured as decreased growth (mg per individual) relative to controls (as opposed to reduced fecundity), and chronic toxicity to *H. azteca* was not assessed. In addition, 7-day exposures of sample water to the fathead minnow (*Pimephales promelas*) was assessed as decreased survival (acute toxicity) and growth (chronic toxicity) relative to controls.

### *3.1.3 Tissue*

To detect contamination in fish tissues in the San Juan HU, tissues from one red-ear sun fish and one crayfish were collected at Lower Arroyo Trabuco Creek. Samples were not combined so that variability among individual organisms could be estimated. Tissues were analyzed for metals and selenium as per the SWAMP QAMP (Puckett 2002). Wet-weight concentrations of each constituent were recorded.

### *3.1.4 Bioassessment*

To assess the ecological health of the streams in San Juan HU, benthic macroinvertebrate samples were collected at 26 sites. Three of these sites were designated reference sties (site 4, 18, and 19). Samples were collected using SWAMP-comparable protocols, as per the SWAMP QAMP (Puckett 2002). Three replicate samples were collected from riffles at each site; 300 individuals were sorted and identified from each replicate, creating a total count of 900 individuals per site. Using a Monte Carlo simulation, all samples were reduced to 500 count for calculation of the Southern California Index of Biotic Integrity (IBI; Ode et al. 2005), a composite of seven metrics summed and scaled from 0 (poor condition) to 100 (good condition).

### *3.1.5 Physical Habitat*

Physical habitat was assessed using semi-quantitative observations of 10 components relating to habitat quality, such as embeddedness, bank stability, and width of riparian zone. The assessment protocols are described in The California Stream Bioassessment Procedure (California Department of Fish and Game 2003). Each component was scored on a scale of 0 (highly degraded) to 20 (not degraded). Sites were assessed by the average component score.

Physical habitat was also assessed by Orange County NPDES, using methods identical to those used in SWAMP monitoring. Seventeen sites were monitored between 2002 and 2006 twice a year using the same protocols as the SWAMP program (Weston Solutions Inc. 2006).

## 3.2 Data Analysis

To evaluate the extent of human impacts to water chemistry in streams in the San Juan HU, two frequency-based approaches were employed to detecting impacts. First, established aquatic life and human health thresholds for individual constituents were evaluated for frequency of exceedances. Second, the frequency of detection for anthropogenic constituents (such as PCBs, pesticides, and PAHs) were also evaluated.

To evaluate the overall health of each site and of the watershed, three indicators were selected for analysis: number of constituents exceeding aquatic life water chemistry thresholds; frequency of chronic toxicity to *S. capricornutum, C. dubia,* and *H. azteca*; and mean IBI score. Tissue analysis was excluded because tissue samples were collected at only one site. Physical habitat assessment was excluded due to lack of agreed-upon thresholds for evaluation of physical habitat scores. These results were plotted on a map of the watershed, indicating the severity and distribution of human impacts.

Although non-SWAMP sources of water chemistry data were used, this report focuses on SWAMP data in order to maintain consistency of sampling methods and parameters measured at each site. Analyses of non-SWAMP water chemistry data is presented separately. In contrast, bioassessment data from multiple sources is analyzed together because of the high compatibility of sampling protocols used in different programs, and because of the limited availability of bioassessment data from a single source. Toxicity, fish tissue, and physical habitat data were only available from SWAMP monitoring.

### *3.2.1 Thresholds*

In order to use the data to assess the health of the watershed, thresholds were established for each indicator: water quality, toxicity, bioassessment, fish tissue, and physical habitat. Exceedance of appropriate thresholds was considered evidence for impact on watershed health.

Water chemistry data from this study were compared to water quality objectives established by state and federal agencies to protect the most sensitive beneficial uses designated in the San Juan HU. Therefore, the most stringent water quality objectives (e.g., municipal drinking water, aquatic life, etc.) for the measured constituents were used as thresholds points to evaluate the data.

The Water Quality Control Plan For the San Diego Basin (BP) was the primary source of water chemistry thresholds. Other sources for standards used in water chemistry thresholds included the California Toxics Rule (CTR), the Environmental Protection Agency National Aquatic Life Criteria (EPA), the National Academy of Sciences Health Advisory (NASHA), United States Environmental Protection Agency Integrated Risk Information System (IRIS), and the California Code of Regulations §64449 (CCR). The sources for thresholds used in this study are shown in Table 5.

**Table 5. Threshold sources**

| Indicator | Source | Citation |
|---|---|---|
| Water chemistry | Water Quality Control Plan For the San Diego Basin (BP) | California Regional Water Quality Control Board, San Diego Region. 1994. Water quality control plan for the San Diego Region. San Diego, CA. http://www.waterboards.ca.gov/sandiego/programs/basinplan.html |
| | California Toxics Rule (CTR) | Environmental Protection Agency. 1997. Water quality standards: Establishment of numeric criteria for priority toxic pollutants for the state of California: Proposed Rule. *Federal Register* 62:42159-42208. |
| | EPA National Aquatic Life Criteria (EPA) | Environmental Protection Agency. 2002. National recommended water quality criteria. EPA-822-R-02-047. Office of Water. Washington, DC. |
| | National Academy of Sciences Health Advisory (NASHA) | National Academy of Sciences. 1977. Drinking Water and Health. Volume 1. Washington, DC. |
| | US Environmental Protection Agency Integrated Risk Information System (IRIS) | Environmental Protection Agency (EPA). 2007. Integrated Risk Information System. http://www.epa.gov/iris/index.html. Office of Research and Development. Washington, DC. |
| | California Code of Regulations §64449 (CCR) | California Code of Regulations. 2007. Secondary drinking water standards. Register 2007, No. 8. Title 22, division 4, article 16. |
| Fish tissue | Office of Environmental Health Hazard Assessment (OEHHA) | Office of Environmental Health Hazard Assessment. 2006. Draft development of guidance tissue levels and screening values for common contaminants in California Sports Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene. Sacramento, CA. |
| Bioassessment | Ode et al. 2005 | Ode, P.R., A.C. Rehn and J.T. May. 2005. A quantitative tool for assessing the integrity of southern California coastal streams. *Environmental Management* 35:493-504. |

Although human health thresholds (e.g., drinking water standards) were applied to relevant water chemistry data, this report focuses on aquatic life, and does not address the risks to human health in the San Juan HU. When multiple thresholds were applicable to a single constituent, the most stringent threshold was used. Water chemistry thresholds for aquatic life and human health standards used in this study are presented in Table 6. Impacts were assessed as the total number of constituents exceeding threshold, as opposed to the fraction of constituents. The fraction of constituents exceeding thresholds is not an ecologically meaningful statistic because the number of constituents below thresholds does not degrade or improve the ecological health of a site.

**Table 6. Water chemistry thresholds for aquatic life and human health standards. San Diego Basin Plan (BP); California Toxics Rule (CTR); Environmental Protection Agency National Aquatic Life Standards (EPA); National Academy of Science Health Advisory (NASHA); Environmental Protection Agency Integrated Risk Information System (IRIS); California Code of Regulations §64449 (CCR). Sulfate threshold of 500 mg/l applies to the Laguna Creek Hydrologic Sub Area (HSU 901.1) (*).**

| | | Aquatic life | | | Human health | | |
|---|---|---|---|---|---|---|---|
| **Category** | **Constituent** | **Threshold** | **Unit** | **Source** | **Threshold** | **Unit** | **Source** |
| Inorganics | Alkalinity as CaCO3 | 20000 | mg/l | EPA | none | mg/l | none |
| Inorganics | Ammonia as N | 0.025 | mg/l | BP | none | mg/l | none |
| Inorganics | Nitrate + Nitrite as N | 10 | mg/l | BP | none | mg/l | none |
| Inorganics | Phosphorus as P,Total | 0.1 | mg/l | BP | none | mg/l | none |
| Inorganics | Selenium,Dissolved | 5 | µg/l | CTR | none | µg/l | none |
| Inorganics | Sulfate | 250* | mg/l | BP | none | mg/l | none |
| Metals | Aluminum,Dissolved | 1000 | µg/l | BP | none | µg/l | none |
| Metals | Arsenic,Dissolved | 50 | µg/l | BP | 150 | µg/l | CTR |
| Metals | Cadmium,Dissolved | 5 | µg/l | BP | 2.2 | µg/l | CTR |
| Metals | Chromium,Dissolved | 50 | µg/l | BP | none | µg/l | none |
| Metals | Copper,Dissolved | 9 | µg/l | CTR | 1300 | µg/l | CTR |
| Metals | Lead,Dissolved | 2.5 | µg/l | CTR | none | µg/l | none |
| Metals | Manganese,Dissolved | 0.05 | µg/l | none | none | µg/l | none |
| Metals | Nickel,Dissolved | 52 | µg/l | CTR | 610 | µg/l | CTR |
| Metals | Silver,Dissolved | 3.4 | µg/l | CTR | none | µg/l | none |
| Metals | Zinc,Dissolved | 120 | µg/l | CTR | none | µg/l | none |
| PAHs | Acenaphthene | none | µg/l | none | 1200 | µg/l | CTR |
| PAHs | Anthracene | none | µg/l | none | 9600 | µg/l | CTR |
| PAHs | Benz(a)anthracene | none | µg/l | none | 0.0044 | µg/l | CTR |
| PAHs | Benzo(a)pyrene | 0.0002 | µg/l | BP | 0.0044 | µg/l | CTR |
| PAHs | Benzo(b)fluoranthene | none | µg/l | none | 0.0044 | µg/l | CTR |
| PAHs | Benzo(k)fluoranthene | none | µg/l | none | 0.0044 | µg/l | CTR |
| PAHs | Chrysene | none | µg/l | none | 0.0044 | µg/l | CTR |
| PAHs | Dibenz(a,h)anthracene | none | µg/l | none | 0.0044 | µg/l | CTR |
| PAHs | Fluoranthene | none | µg/l | none | 300 | µg/l | CTR |
| PAHs | Indeno(1,2,3-c,d)pyrene | none | µg/l | none | 0.0044 | µg/l | CTR |
| PAHs | Pyrene | none | µg/l | none | 960 | µg/l | CTR |
| PCBs | PCBs | 0.014 | µg/l | CTR | 0.00017 | µg/l | CTR |
| Pesticides | Aldrin | 3 | µg/l | CTR | 1.3E-07 | µg/l | CTR |
| Pesticides | Ametryn | none | µg/l | none | 60 | µg/l | EPA |
| Pesticides | Atrazine | 3 | µg/l | BP | 0.2 | µg/l | OEHHA |
| Pesticides | Azinphos ethyl | none | µg/l | none | 87.5 | µg/l | NASHA |
| Pesticides | Azinphos methyl | none | µg/l | none | 87.5 | µg/l | NASHA |
| Pesticides | DDD(p,p') | none | µg/l | none | 0.00083 | µg/l | CTR |
| Pesticides | DDE(p,p') | none | µg/l | none | 0.00059 | µg/l | CTR |
| Pesticides | DDT(p,p') | none | µg/l | none | 0.00059 | µg/l | CTR |
| Pesticides | Dieldrin | none | µg/l | none | 0.00014 | µg/l | CTR |
| Pesticides | Dimethoate | none | µg/l | none | 1.4 | µg/l | IRIS |
| Pesticides | Endosulfan sulfate | none | µg/l | none | 110 | µg/l | CTR |
| Pesticides | Endrin | 0.002 | µg/l | BP | 0.76 | µg/l | CTR |
| Pesticides | Endrin Aldehyde | none | µg/l | none | 0.76 | µg/l | CTR |
| Pesticides | Endrin Ketone | none | µg/l | none | 0.85 | µg/l | CTR |
| Pesticides | Heptachlor | 0.0038 | µg/l | CTR | 0.00021 | µg/l | CTR |
| Pesticides | Heptachlor epoxide | 0.0038 | µg/l | CTR | 0.0001 | µg/l | CTR |
| Pesticides | Hexachlorobenzene | 1 | µg/l | BP | 0.00075 | µg/l | CTR |
| Pesticides | Methoxychlor | 40 | µg/l | BP | none | µg/l | none |
| Pesticides | Molinate | 20 | µg/l | BP | none | µg/l | none |
| Pesticides | Oxychlordane | none | µg/l | none | 0.000023 | µg/l | CTR |
| Pesticides | Simazine | 4 | µg/l | BP | none | µg/l | none |
| Pesticides | Thiobencarb | 70 | µg/l | BP | none | µg/l | none |
| Physical | Oxygen, Dissolved | 5 | mg/l | BP | none | mg/l | none |
| Physical | pH | >6 and <8 | pH | BP | none | pH | none |
| Physical | Specific Conductivity | 1600 | µS/cm | CCR | none | mS/cm | none |
| Physical | Turbidity | 20 | NTU | BP | none | NTU | none |

Several anthropogenic water chemistry constituents had no applicable threshold (e.g., malathion), and impacts from these constituents would not be detected using the threshold-based approach described above. To assess the impact from these constituents, the number of organic constituents (i.e., PAHs, PCBs, and pesticides) detected at each site were calculated. The total number of sites at which these compounds were detected was recorded.

Thresholds for toxicity assays were determined by comparing study samples to control samples(non-toxic reference samples). Samples meeting the following criteria were considered toxic: 1) treatment responses significantly different from controls, as determined by a statistical t-test; and 2) endpoints less than 80% of controls. To summarize the toxicity at a site using multiple endpoints, the frequency of toxic samples was calculated. To assign equal weight to all three indicators, a single endpoint of chronic toxicity per indicator was used (*C. dubia*: fecundity, *H. azteca*: growth, and *S. capricornutum*: total cell count).

Thresholds for tissue samples shown in Table 7 were derived from the Draft Development of Guidance Tissue Levels and Screening Values for Common Contaminant in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene (OEHHA 2006). Several constituents, including total Mercury, had no applicable threshold. Because Methylmercury accounts for more than 95% of Mercury in fish tissues, the threshold for Methylmercury was applied to Mercury concentrations (OEHHA 2006).

**Table 7. Threshold concentrations for fish tissue contaminants established by OEHHA. All thresholds apply to wet-weight concentrations.**

| Category | Constituent | Source | Threshold | Unit |
|---|---|---|---|---|
| Inorganics | Selenium | OEHHA | 1.94 | ppm |
| PCBs | PCBs | OEHHA | 20 | ppm |
| Pesticides | Chlordane | OEHHA | 200 | ng/g |
| Pesticides | DDTs | OEHHA | 560 | ng/g |
| Pesticides | Dieldrin | OEHHA | 16 | ng/g |
| Pesticides | Toxaphene | OEHHA | 220 | ng/g |
| Metals | Mercury | OEHHA | 0.08 | ppm |

*The threshold for methylmercury was used as a threshold for total mercury concentrations.

Thresholds for bioassessment samples were based on a benthic macroinvertebrate index of biological integrity (IBI) that was developed specifically for southern California (Ode et al. 2005). The results of the IBI produces a measure of impairment with scores scaled from 0 to 100, 0 representing the poorest health and 100 the best health. Based on the IBI, samples with scores equal to or below 40 are considered to be in "poor" condition, and samples below 20 are considered to be in "very poor" condition. Therefore, in this study samples with an IBI below 40 were considered impacted.

Thresholds for the evaluation of physical habitat have not been established. Therefore, measurements of physical habitat were excluded from the overall assessment of ecological health. However, because the protocol used to evaluate physical habitat qualitatively assigns scores lower than 10 (out of 20) to streams in poor condition, this number was used to determine sites with severely degraded habitat. Sites with scores below 15 were considered moderately degraded, and those with scores greater than 15 were considered unimpacted (California Department of Fish and Game 2003).

*3.2.2 Quality Assurance and Quality Control (QA/QC)*

The SWAMP QAMP guided QA/QC for all data collected under SWAMP (See SWAMP QAMP for detailed descriptions of QA/QC protocols, Puckett 2002). QA/QC officers flagged non-compliant physical habitat, water chemistry, toxicity, and tissue results. No chemistry, toxicity, or tissue data were excluded as a result of QA/QC violations. QA/QC procedures for NPDES water chemistry data and for Camp Pendleton were similar to those used in SWAMP . Non-SWAMP bioassessment samples were screened for samples containing fewer than 450 individuals. No bioassessment sample was excluded from this analysis. Details on QA/QC and on sampling methods for San Diego County NPDES can be found in Weston Solutions Inc. (2006), for Orange County NPDES in Weston Solutions Inc (2006), and for Camp Pendleton in Weston Solutions Inc. (2007).

# 4. RESULTS

## 4.1 Water Chemistry

Analysis of water chemistry at SWAMP sites indicated widespread impact to water quality from multiple constituents (Table 8; Figure 6). Across the entire watershed, 31 PAHs, 8 PCBs, and 28 pesticides were detected. The number of PAHs detected ranged from two at a site (at the Upper San Juan Creek and San Mateo Creek) to more than twenty (at English Creek and Oso Creek). PCBs were not detected at two of the reference sites (Upper Arroyo Trabuco and San Mateo Creek), as well as at Bell Canyon Creek. Between 1 and 4 PCB constituents were found at all other sites, including the Morro Canyon Creek reference site. Few pesticides (i.e., between 1 and 3) were detected at reference sites and at the upper San Juan Creek. Furthermore, no pesticides were detected at Bell Canyon Creek. However, a high number of pesticides (i.e., between 12 and 14) were detected at all other sites in the watershed. Means and standard deviations of all constituents are presented in Appendix II.

**Table 8. Number of anthropogenic organic compounds detected at each site in San Juan HU.**

| | PAHs | | PCBs | | Pesticides | |
|---|---|---|---|---|---|---|
| Site | Tested | Detected | Tested | Detected | Tested | Detected |
| 901SJALC6 | 43 | 12 | 50 | 2 | 91 | 13 |
| 901SJATC2 | 43 | 7 | 50 | 0 | 91 | 2 |
| 901SJATC5 | 43 | 17 | 50 | 1 | 91 | 14 |
| 901SJBEL2 | 43 | 3 | 50 | 0 | 91 | 0 |
| 901SJENG2 | 43 | 27 | 50 | 1 | 91 | 14 |
| 901SJLAG2 | 43 | 13 | 50 | 2 | 91 | 13 |
| 901SJMCC2 | 43 | 4 | 50 | 1 | 91 | 1 |
| 901SJOSO3 | 43 | 25 | 50 | 4 | 91 | 13 |
| 901SJSJC5 | 43 | 2 | 50 | 2 | 91 | 1 |
| 901SJSJC9 | 43 | 6 | 50 | 2 | 91 | 12 |
| 901SJSMT2 | 43 | 2 | 50 | 0 | 91 | 3 |
| Ali sites | 43 | 31 | 50 | 8 | 91 | 28 |

Several organic compounds were widespread throughout the watershed (Table 9). For example, C1- and C2-dibenzothiophenes were found at nearly every site, and many pesticides and PAHs were found at the majority of sites (the PAHs benzo(b)fluoranthene, C3-dibenzothiophene, C1-fluorene, C3- and C4-naphthalenes, C1-, C2- and C3-phenanthrene/anthracene; one PCB (PCB087); and the pesticides dacthal, p,p'-DDE, diazinon, disulfotan, delta HCH, heptachlor epoxide, hexachlorobenzene, and oxadiazon). Fifty-five additional constituents were detected at one or more sites in the San Juan HU.

**Table 9. Frequency of detection of anthropogenic organic compounds in the San Juan HU. Constituent not detected at any site (--)**

| Category | Constituent | Tested | Detected | Frequency |
|---|---|---|---|---|
| PAHs | Acenaphthene | 11 | 0 | -- |
| PAHs | Acenaphthylene | 11 | 0 | -- |
| PAHs | Anthracene | 11 | 0 | -- |
| PAHs | Benz(a)anthracene | 11 | 0 | -- |
| PAHs | Benzo(a)pyrene | 11 | 1 | 0.1 |
| PAHs | Benzo(b)fluoranthene | 11 | 6 | 0.5 |
| PAHs | Benzo(e)pyrene | 11 | 2 | 0.2 |
| PAHs | Benzo(g,h,i)perylene | 11 | 3 | 0.3 |
| PAHs | Benzo(k)fluoranthene | 11 | 1 | 0.1 |
| PAHs | Biphenyl | 11 | 0 | -- |
| PAHs | Chrysene | 11 | 2 | 0.2 |
| PAHs | Chrysenes, C1 - | 11 | 3 | 0.3 |
| PAHs | Chrysenes, C2 - | 11 | 4 | 0.4 |
| PAHs | Chrysenes, C3 - | 11 | 2 | 0.2 |
| PAHs | Dibenz(a,h)anthracene | 11 | 1 | 0.1 |
| PAHs | Dibenzothiophene | 11 | 3 | 0.3 |
| PAHs | Dibenzothiophenes, C1 - | 11 | 10 | 0.9 |
| PAHs | Dibenzothiophenes, C2 - | 11 | 10 | 0.9 |
| PAHs | Dibenzothiophenes, C3 - | 11 | 7 | 0.6 |
| PAHs | Dimethylnaphthalene, 2,6- | 11 | 0 | -- |

**Table 9, continued. Frequency of detection of anthropogenic organic compounds.**

| Category | Constituent | Tested | Detected | Frequency |
|---|---|---|---|---|
| PAHs | Fluoranthene | 11 | 2 | 0.2 |
| PAHs | Fluoranthene/Pyrenes, C1 - | 11 | 1 | 0.1 |
| PAHs | Fluorene | 11 | 0 | -- |
| PAHs | Fluorenes, C1 - | 11 | 5 | 0.5 |
| PAHs | Fluorenes, C2 - | 11 | 3 | 0.3 |
| PAHs | Fluorenes, C3 - | 11 | 7 | 0.6 |
| PAHs | Indeno(1,2,3-c,d)pyrene | 11 | 2 | 0.2 |
| PAHs | Methylnaphthalene, 1- | 11 | 0 | -- |
| PAHs | Methylnaphthalene, 2- | 11 | 0 | -- |
| PAHs | Methylphenanthrene, 1- | 11 | 0 | -- |
| PAHs | Naphthalene | 11 | 2 | 0.2 |
| PAHs | Naphthalenes, C1 - | 11 | 2 | 0.2 |
| PAHs | Naphthalenes, C2 - | 11 | 3 | 0.3 |
| PAHs | Naphthalenes, C3 - | 11 | 7 | 0.6 |
| PAHs | Naphthalenes, C4 - | 11 | 6 | 0.5 |
| PAHs | Perylene | 11 | 2 | 0.2 |
| PAHs | Phenanthrene | 11 | 0 | -- |
| PAHs | Phenanthrene/Anthracene, C1 - | 11 | 7 | 0.6 |
| PAHs | Phenanthrene/Anthracene, C2 - | 11 | 5 | 0.5 |
| PAHs | Phenanthrene/Anthracene, C3 - | 11 | 5 | 0.5 |
| PAHs | Phenanthrene/Anthracene, C4 - | 11 | 1 | 0.1 |
| PAHs | Pyrene | 11 | 3 | 0.3 |
| PAHs | Trimethylnaphthalene, 2,3,5- | 11 | 0 | -- |
| PCBs | PCB 005 | 11 | 2 | 0.2 |
| PCBs | PCB 008 | 11 | 1 | 0.1 |
| PCBs | PCB 015 | 11 | 0 | -- |
| PCBs | PCB 018 | 11 | 0 | -- |
| PCBs | PCB 027 | 11 | 0 | -- |
| PCBs | PCB 028 | 11 | 0 | -- |
| PCBs | PCB 029 | 11 | 0 | -- |
| PCBs | PCB 031 | 11 | 1 | 0.1 |
| PCBs | PCB 033 | 11 | 0 | -- |
| PCBs | PCB 044 | 11 | 0 | -- |
| PCBs | PCB 049 | 11 | 0 | -- |
| PCBs | PCB 052 | 11 | 1 | 0.1 |
| PCBs | PCB 056 | 11 | 0 | -- |
| PCBs | PCB 060 | 11 | 0 | -- |
| PCBs | PCB 066 | 11 | 0 | -- |
| PCBs | PCB 070 | 11 | 0 | -- |
| PCBs | PCB 074 | 11 | 0 | -- |
| PCBs | PCB 087 | 11 | 6 | 0.5 |
| PCBs | PCB 095 | 11 | 0 | -- |
| PCBs | PCB 097 | 11 | 0 | -- |
| PCBs | PCB 099 | 11 | 0 | -- |
| PCBs | PCB 101 | 11 | 0 | -- |
| PCBs | PCB 105 | 11 | 0 | -- |
| PCBs | PCB 110 | 11 | 0 | -- |
| PCBs | PCB 114 | 11 | 0 | -- |
| PCBs | PCB 118 | 11 | 0 | -- |

**Table 9, continued. Frequency of detection of anthropogenic organic compounds.**

| Category | Constituent | Tested | Detected | Frequency |
|---|---|---|---|---|
| PCBs | PCB 128 | 11 | 0 | -- |
| PCBs | PCB 137 | 11 | 0 | -- |
| PCBs | PCB 138 | 11 | 0 | -- |
| PCBs | PCB 141 | 11 | 0 | -- |
| PCBs | PCB 149 | 11 | 0 | -- |
| PCBs | PCB 151 | 11 | 0 | -- |
| PCBs | PCB 153 | 11 | 0 | -- |
| PCBs | PCB 156 | 11 | 0 | -- |
| PCBs | PCB 157 | 11 | 0 | -- |
| PCBs | PCB 158 | 11 | 0 | -- |
| PCBs | PCB 170 | 11 | 0 | -- |
| PCBs | PCB 174 | 11 | 0 | -- |
| PCBs | PCB 177 | 11 | 0 | -- |
| PCBs | PCB 180 | 11 | 0 | -- |
| PCBs | PCB 183 | 11 | 0 | -- |
| PCBs | PCB 187 | 11 | 2 | 0.2 |
| PCBs | PCB 189 | 11 | 0 | -- |
| PCBs | PCB 194 | 11 | 1 | 0.1 |
| PCBs | PCB 195 | 11 | 1 | 0.1 |
| PCBs | PCB 200 | 11 | 0 | -- |
| PCBs | PCB 201 | 11 | 0 | -- |
| PCBs | PCB 203 | 11 | 0 | -- |
| PCBs | PCB 206 | 11 | 0 | -- |
| PCBs | PCB 209 | 11 | 0 | -- |
| Pesticides | Aldrin | 11 | 0 | -- |
| Pesticides | Ametryn | 11 | 0 | -- |
| Pesticides | Aspon | 11 | 0 | -- |
| Pesticides | Atraton | 11 | 0 | -- |
| Pesticides | Atrazine | 11 | 0 | -- |
| Pesticides | Azinphos ethyl | 11 | 0 | -- |
| Pesticides | Azinphos methyl | 11 | 0 | -- |
| Pesticides | Bolstar | 11 | 0 | -- |
| Pesticides | Carbophenothion | 11 | 0 | -- |
| Pesticides | Chlordane, cis- | 11 | 2 | 0.2 |
| Pesticides | Chlordane, trans- | 11 | 1 | 0.1 |
| Pesticides | Chlordene, alpha- | 11 | 0 | -- |
| Pesticides | Chlordene, gamma- | 11 | 4 | 0.4 |
| Pesticides | Chlorfenvinphos | 11 | 0 | -- |
| Pesticides | Chlorpyrifos | 11 | 0 | -- |
| Pesticides | Chlorpyrifos methyl | 11 | 0 | -- |
| Pesticides | Ciodrin | 11 | 0 | -- |
| Pesticides | Coumaphos | 11 | 0 | -- |
| Pesticides | Dacthal | 11 | 5 | 0.5 |
| Pesticides | DDD(o,p') | 11 | 0 | -- |
| Pesticides | DDD(p,p') | 11 | 1 | 0.1 |
| Pesticides | DDE(o,p') | 11 | 1 | 0.1 |
| Pesticides | DDE(p,p') | 11 | 6 | 0.5 |
| Pesticides | DDMU(p,p') | 11 | 0 | -- |
| Pesticides | DDT(o,p') | 11 | 0 | -- |
| Pesticides | DDT(p,p') | 11 | 3 | 0.3 |

**Table 9, continued. Frequency of detection of anthropogenic organic compounds.**

| Category | Constituent | Tested | Detected | Frequency |
|---|---|---|---|---|
| Pesticides | Demeton-s | 11 | 0 | -- |
| Pesticides | Diazinon | 11 | 6 | 0.5 |
| Pesticides | Dichlofenthion | 11 | 0 | -- |
| Pesticides | Dichlorvos | 11 | 0 | -- |
| Pesticides | Dicrotophos | 11 | 0 | -- |
| Pesticides | Dieldrin | 11 | 3 | 0.3 |
| Pesticides | Dimethoate | 11 | 1 | 0.1 |
| Pesticides | Dioxathion | 11 | 0 | -- |
| Pesticides | Disulfoton | 11 | 5 | 0.5 |
| Pesticides | Endosulfan I | 11 | 4 | 0.4 |
| Pesticides | Endosulfan II | 11 | 1 | 0.1 |
| Pesticides | Endosulfan sulfate | 11 | 4 | 0.4 |
| Pesticides | Endrin | 11 | 2 | 0.2 |
| Pesticides | Endrin Aldehyde | 11 | 0 | -- |
| Pesticides | Endrin Ketone | 11 | 0 | -- |
| Pesticides | Ethion | 11 | 0 | -- |
| Pesticides | Ethoprop | 11 | 0 | -- |
| Pesticides | Famphur | 11 | 0 | -- |
| Pesticides | Fenchlorphos | 11 | 0 | -- |
| Pesticides | Fenitrothion | 11 | 0 | -- |
| Pesticides | Fensulfothion | 11 | 0 | -- |
| Pesticides | Fenthion | 11 | 0 | -- |
| Pesticides | Fonofos | 11 | 0 | -- |
| Pesticides | HCH, alpha | 11 | 1 | 0.1 |
| Pesticides | HCH, beta | 11 | 0 | -- |
| Pesticides | HCH, delta | 11 | 5 | 0.5 |
| Pesticides | HCH, gamma | 11 | 0 | -- |
| Pesticides | Heptachlor | 11 | 0 | -- |
| Pesticides | Heptachlor epoxide | 11 | 5 | 0.5 |
| Pesticides | Hexachlorobenzene | 11 | 5 | 0.5 |
| Pesticides | Leptophos | 11 | 0 | -- |
| Pesticides | Malathion | 11 | 0 | -- |
| Pesticides | Merphos | 11 | 0 | -- |
| Pesticides | Methidathion | 11 | 0 | -- |
| Pesticides | Methoxychlor | 11 | 0 | -- |
| Pesticides | Mevinphos | 11 | 0 | -- |
| Pesticides | Mirex | 11 | 0 | -- |
| Pesticides | Molinate | 11 | 0 | -- |
| Pesticides | Naled | 11 | 0 | -- |
| Pesticides | Nonachlor, cis- | 11 | 1 | 0.1 |
| Pesticides | Nonachlor, trans- | 11 | 2 | 0.2 |
| Pesticides | Oxadiazon | 11 | 8 | 0.7 |
| Pesticides | Oxychlordane | 11 | 4 | 0.4 |
| Pesticides | Parathion, Ethyl | 11 | 0 | -- |
| Pesticides | Parathion, Methyl | 11 | 0 | -- |
| Pesticides | Phorate | 11 | 0 | -- |
| Pesticides | Phosmet | 11 | 0 | -- |
| Pesticides | Phosphamidon | 11 | 0 | -- |
| Pesticides | Prometon | 11 | 0 | -- |

**Table 9, continued. Frequency of detection of anthropogenic organic compounds.**

| Category | Constituent | Tested | Detected | Frequency |
|---|---|---|---|---|
| Pesticides | Prometryn | 11 | 0 | -- |
| Pesticides | Propazine | 11 | 0 | -- |
| Pesticides | Secbumeton | 11 | 2 | 0.2 |
| Pesticides | Simazine | 11 | 1 | 0.1 |
| Pesticides | Simetryn | 11 | 0 | -- |
| Pesticides | Sulfotep | 11 | 0 | -- |
| Pesticides | Tedion | 11 | 2 | 0.2 |
| Pesticides | Terbufos | 11 | 0 | -- |
| Pesticides | Terbuthylazine | 11 | 0 | -- |
| Pesticides | Terbutryn | 11 | 0 | -- |
| Pesticides | Tetrachlorvinphos | 11 | 0 | -- |
| Pesticides | Thiobencarb | 11 | 1 | 0.1 |
| Pesticides | Thionazin | 11 | 0 | -- |
| Pesticides | Tokuthion | 11 | 0 | -- |
| Pesticides | Trichlorfon | 11 | 0 | -- |
| Pesticides | Trichloronate | 11 | 0 | -- |

Comparison with applicable aquatic life and human health thresholds support the conclusion that water quality is impacted by these constituents (Table 10, Figure 6, 7). Nutrients, sulfate, selenium, manganese, specific conductivity, pH, and turbidity frequently exceeded aquatic life thresholds at several sites (Table 11). At certain sites, copper, benzo(a)pyrene, and heptachlor epoxide also exceeded aquatic life standards. In general, fewer constituents exceeded human health standards, although exceedances of benzo(b)fluoranthene, p,p’-DDE, and heptachlor epoxide were widespread (Table 10; Figure 7).

**Table 10. Frequency of water chemistry threshold exceedances. A) Frequency of aquatic life threshold exceedances at SWAMP sites. B) Frequency of human health threshold exceedances at SWAMP sites. C) Frequency of aquatic life threshold exceedances at non-SWAMP sites. D) Frequency of human health thresholds at non-SWAMP sites. Freq = Frequency of samples exceeding applicable thresholds at each site. AL = Aquatic life. HH = Human health. -- = Constituent never exceeded threshold. NA = No applicable thresholds at that site. Empty cells indicate that the constituent was not measured at the site. (*) Sulfate threshold of 500 mg/l was applied to the Laguna Creek Hydrologic Subarea (HSU 901.1). This sub area includes 901SJMCC2 and 901SJLAG2.**

| A. Aquatic life | | | | 901SJALC6 | | 901SJATC2 | | 901SJATC5 | | 901SJBEL2 | | 901SJENG2 | | 901SJLAG2 | | 901SJMCC2 | | 901SJOSO3 | | 901SJSJC5 | | 901SJSJC9 | | 901SJSMT2 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Constituent | Threshold | Source | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n |
| Inorganics | Alkalinity as CaCO3 | 20000 mg/l | EPA | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Inorganics | Ammonia as N | 0.025 mg/l | BP | 0.50 | 4 | 0.50 | 2 | 0.25 | 4 | 0.50 | 2 | 0.75 | 4 | 0.50 | 4 | 1.00 | 4 | 0.75 | 4 | -- | 4 | 0.50 | 4 | -- | 2 |
| Inorganics | Nitrate + Nitrite as N | 10 mg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Inorganics | Phosphorus as P,Total | 0.1 mg/l | BP | 1.00 | 4 | 0.50 | 2 | 0.25 | 4 | 0.50 | 2 | 0.75 | 4 | 1.00 | 4 | 1.00 | 4 | 0.75 | 4 | -- | 4 | 0.25 | 4 | -- | 2 |
| Inorganics | Selenium,Dissolved | 5 µg/l | CTR | 0.75 | 4 | -- | 2 | -- | 4 | -- | 2 | 0.75 | 4 | -- | 4 | 1.00 | 4 | 0.75 | 4 | -- | 4 | 0.50 | 4 | -- | 2 |
| Inorganics | Sulfate | 250 mg/l* | BP | 0.75 | 4 | -- | 3 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | 1.00 | 4 | 0.75 | 4 | -- | 4 | 0.75 | 4 | -- | 2 |
| Metals | Aluminum,Dissolved | 1000 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Metals | Arsenic,Dissolved | 50 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Metals | Cadmium,Dissolved | 5 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Metals | Chromium,Dissolved | 50 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Metals | Copper,Dissolved | 9 µg/l | CTR | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | 0.25 | 4 | 0.50 | 4 | -- | 4 | -- | 4 | -- | 2 |
| Metals | Lead,Dissolved | 2.5 µg/l | CTR | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Metals | Manganese,Dissolved | 0.05 µg/l | BP | 0.75 | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | 0.75 | 4 | 1.00 | 4 | 0.50 | 4 | -- | 4 | 0.50 | 4 | -- | 2 |
| Metals | Nickel,Dissolved | 52 µg/l | CTR | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Metals | Silver,Dissolved | 3.4 µg/l | CTR | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Metals | Zinc,Dissolved | 120 µg/l | CTR | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Benzo(a)pyrene | 0.0002 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | 0.25 | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| PCBs | PCBs | 0.014 µg/l | CTR | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Aldrin | 3 µg/l | CTR | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Atrazine | 3 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Endrin | 0.002 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Heptachlor | 0.0038 µg/l | CTR | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Heptachlor epoxide | 0.0038 µg/l | CTR | -- | 4 | -- | 2 | -- | 4 | -- | 2 | 0.25 | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Hexachlorobenzene | 1 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Methoxychlor | 40 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Molinate | 20 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Simazine | 4 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Thiobencarb | 70 µg/l | BP | -- | 4 | -- | 2 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Physical | pH | >6 or <8 pH units | BP | 0.50 | 4 | 0.50 | 2 | 0.33 | 3 | -- | 2 | 0.75 | 4 | -- | 4 | -- | 4 | 0.75 | 4 | 0.25 | 4 | 0.25 | 4 | 0.50 | 2 |
| Physical | SpecificConductivity | 1.6 mS/cm | CCR | 0.75 | 4 | -- | 2 | -- | 4 | -- | 2 | 0.25 | 4 | 0.25 | 4 | 1.00 | 4 | 0.75 | 4 | -- | 4 | 0.50 | 4 | -- | 2 |
| Physical | Turbidity | 20 NTU | BP | 0.25 | 4 | 0.50 | 2 | 0.25 | 4 | 0.50 | 2 | 0.25 | 4 | -- | 4 | 0.50 | 4 | -- | 4 | -- | 4 | 0.25 | 4 | -- | 2 |

**Table 10, continued. Frequency of water chemistry threshold exceedances.**

| B. Human Health | | | | 901SJMCC2 | | 901SJOSO3 | | 901SJSJC5 | | 901SJSJC9 | | 901SJSMT2 | | 901SJMCC2 | | 901SJOSO3 | | 901SJSJC5 | | 901SJSJC9 | | 901SJSMT2 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Constituent | Threshold | Source | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n | Freq | n |
| Metals | Arsenic,Dissolved | 150 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Metals | Cadmium,Dissolved | 2.2 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Metals | Copper,Dissolved | 1300 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Metals | Nickel,Dissolved | 610 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Acenaphthene | 1200 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Anthracene | 9600 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Benz(a)anthracene | 0.0044 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Benzo(a)pyrene | 0.0044 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Benzo(b)fluoranthene | 0.0044 µg/l | CTR | 0.25 | 4 | 0.25 | 4 | -- | 4 | -- | 4 | -- | 2 | 0.25 | 4 | 0.25 | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Benzo(k)fluoranthene | 0.0044 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Chrysene | 0.0044 µg/l | CTR | -- | 4 | 0.25 | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | 0.25 | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Dibenz(a,h)anthracene | 0.0044 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Fluoranthene | 300 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Indeno(1,2,3-c,d)pyrene | 0.0044 µg/l | CTR | -- | 4 | 0.25 | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | 0.25 | 4 | -- | 4 | -- | 4 | -- | 2 |
| PAHs | Pyrene | 960 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| PCBs | PCBs | 0.00017 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Aldrin | 0.00000013 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Ametryn | 60 µg/l | EPA | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Atrazine | 0.2 µg/l | OEHHA | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Azinphos ethyl | 87.5 µg/l | NASHA | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Azinphos methyl | 87.5 µg/l | NASHA | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | DDD(p,p') | 0.00083 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | DDE(p,p') | 0.00059 µg/l | CTR | -- | 4 | 0.25 | 4 | -- | 4 | 0.50 | 4 | -- | 2 | -- | 4 | 0.25 | 4 | -- | 4 | 0.50 | 4 | -- | 2 |
| Pesticides | DDT(p,p') | 0.00059 µg/l | CTR | -- | 4 | 0.25 | 4 | -- | 4 | -- | 4 | 0.50 | 2 | -- | 4 | 0.25 | 4 | -- | 4 | -- | 4 | 0.50 | 2 |
| Pesticides | Dieldrin | 0.00014 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | 0.25 | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | 0.25 | 4 | -- | 2 |
| Pesticides | Dimethoate | 1.4 µg/l | IRIS | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Endosulfan sulfate | 110 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Endrin | 0.76 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Endrin Aldehyde | 0.76 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Endrin Ketone | 0.85 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Heptachlor | 0.00021 µg/l | CTR | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | -- | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Heptachlor epoxide | 0.0001 µg/l | CTR | -- | 4 | 0.25 | 4 | -- | 4 | 0.25 | 4 | -- | 2 | -- | 4 | 0.25 | 4 | -- | 4 | 0.25 | 4 | -- | 2 |
| Pesticides | Hexachlorobenzene | 0.00075 µg/l | CTR | -- | 4 | 0.25 | 4 | -- | 4 | -- | 4 | -- | 2 | -- | 4 | 0.25 | 4 | -- | 4 | -- | 4 | -- | 2 |
| Pesticides | Oxychlordane | 0.000023 µg/l | CTR | -- | 4 | 0.25 | 4 | -- | 4 | 0.25 | 4 | -- | 2 | -- | 4 | 0.25 | 4 | -- | 4 | 0.25 | 4 | -- | 2 |

**Table 10, continued. Frequency of water chemistry threshold exceedances.**

| C. Aquatic life (non-SWAMP) | | Cadmium | | Copper | | Dissolved oxygen | | Nickel | | pH | | Specific conductivity | | Total phosphorus | | Turbidity | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Constituent Threshold | 5 | ug/l | 9 | ug/l | 5 | mg/l | 52 | ug/l | >6 or <8 | | 1.6 | mS/cm | 0.1 | mg/l | 20 | NTU |
| Site | Specific location | BP | n | CTR | n | BP | n | CTR | n | BP | n | CCR | n | BP | n | BP | n |
| 1 | AC-CCR | | 0 | | 0 | -- | 6 | | 0 | 0.33 | 6 | 1.00 | 6 | | 0 | | 0 |
| 2 | AC-PPD | | 0 | | 0 | -- | 6 | | 0 | 0.67 | 6 | 1.00 | 6 | | 0 | | 0 |
| 4 | REF-AT2 | | 0 | | 0 | -- | 4 | | 0 | 0.50 | 4 | -- | 4 | | 0 | | 0 |
| 6 | SJC-74 | | 0 | | 0 | -- | 5 | | 0 | 0.60 | 5 | 0.40 | 5 | | 0 | | 0 |
| 10 | SMC-I5 | | 0 | | 0 | 0.50 | 2 | | 0 | -- | 2 | -- | 2 | | 0 | -- | 2 |
| 11 | WC-WCT | | 0 | | 0 | -- | 2 | | 0 | 1.00 | 2 | 1.00 | 2 | | 0 | | 0 |
| 12 | AC-ACP | | 0 | | 0 | -- | 6 | | 0 | 0.50 | 6 | 1.00 | 6 | | 0 | | 0 |
| 13 | CC-CR | | 0 | | 0 | -- | 4 | | 0 | 0.25 | 4 | -- | 4 | | 0 | | 0 |
| 14 | EC-MD | | 0 | | 0 | -- | 6 | | 0 | 0.83 | 6 | 0.83 | 6 | | 0 | | 0 |
| 15 | LC-133 | | 0 | | 0 | -- | 6 | | 0 | 0.83 | 6 | 0.50 | 6 | | 0 | | 0 |
| 16 | LP-BR | | 0 | | 0 | -- | 4 | | 0 | 0.25 | 4 | -- | 4 | | 0 | -- | 2 |
| 17 | PD-CGV | | 0 | | 0 | -- | 1 | | 0 | 1.00 | 1 | 1.00 | 1 | | 0 | | 0 |
| 18 | REF-BC | | 0 | | 0 | 0.25 | 4 | | 0 | 0.25 | 4 | -- | 4 | | 0 | | 0 |
| 19 | REF-CS | | 0 | | 0 | -- | 6 | | 0 | 1.00 | 6 | -- | 6 | | 0 | | 0 |
| 20 | SC-MB | | 0 | | 0 | -- | 6 | | 0 | 0.17 | 6 | 1.00 | 6 | | 0 | | 0 |
| 21 | SD-AP | | 0 | | 0 | -- | 6 | | 0 | 0.33 | 6 | 1.00 | 6 | | 0 | | 0 |
| 22 | SJC-CC | | 0 | | 0 | 0.17 | 6 | | 0 | 0.33 | 6 | 0.83 | 6 | | 0 | | 0 |
| 23 | SOC-2 | | 0 | | 0 | | 0 | | 0 | 1.00 | 1 | -- | 1 | | 0 | | 0 |
| 24 | SOC-I5 | | 0 | | 0 | -- | 2 | | 0 | -- | 2 | -- | 2 | | 0 | 0.50 | 2 |
| 25 | TC-AP | | 0 | | 0 | -- | 6 | | 0 | 0.67 | 6 | -- | 6 | | 0 | | 0 |
| 26 | TC-DO | | 0 | | 0 | -- | 6 | | 0 | 1.00 | 6 | 1.00 | 6 | | 0 | | 0 |
| 27 | Narco Downstream | 0.97 | 36 | 0.08 | 12 | | 0 | 0.97 | 36 | | 0 | 1.00 | 11 | 1.00 | 12 | | 0 |
| 27 | Narco Upstream | 1.00 | 12 | -- | 12 | | 0 | 1.00 | 12 | | 0 | 1.00 | 11 | 1.00 | 12 | | 0 |
| 28 | Lower Reach Downstream end | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| 28 | Lower Reach midreach (La Plata) | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| 28 | Middle Reach Downstream end (La Paz)-Post construction | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| 28 | Middle Reach Downstream end (La Paz)-Pre construction | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| 28 | Middle Reach upstream end (Nueva Vista) - Post construction | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| 28 | Middle Reach upstream end (Nueva Vista) - Pre construction | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |
| 28 | Upper Reach - Upper End | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 |

**Table 10, continued. Frequency of water chemistry threshold exceedances.**

| D. Human health (non-SWAMP) | | Cadmium | | Copper | | Dimethoate | | Nickel | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2.2 | ug/l | 1300 | ug/l | 1.4 | ng/l | 610 | ug/l |
| Site | Specific location | CTR | n | CTR | n | EPA | n | CTR | n |
| 27 | Narco Channel (downstream) | 1.00 | 36 | -- | 12 | -- | 4 | 0 | 36 |
| | Narco Channel (upstream) | 1.00 | 12 | -- | 12 | -- | 4 | -- | 12 |

**Table 11. Frequency of SWAMP sites with aquatic life and human health threshold exceedances of each constituent. Number of SWAMP sites included in evaluation (n). Constituent never exceeded threshold at any site (--). No applicable threshold for constituent (NA).**

| Category | Constituent | n | Aquatic life | Human health |
|---|---|---|---|---|
| Inorganics | Alkalinity as CaCO3 | 11 | -- | NA |
| Inorganics | Ammonia as N | 11 | 0.82 | NA |
| Inorganics | Nitrate + Nitrite as N | 11 | -- | NA |
| Inorganics | Phosphorus as P,Total | 11 | 0.82 | NA |
| Inorganics | Selenium,Dissolved | 11 | 0.45 | NA |
| Inorganics | Sulfate | 11 | 0.36 | NA |
| Metals | Aluminum,Dissolved | 11 | -- | NA |
| Metals | Arsenic,Dissolved | 11 | -- | -- |
| Metals | Cadmium,Dissolved | 11 | -- | -- |
| Metals | Chromium,Dissolved | 11 | -- | NA |
| Metals | Copper,Dissolved | 11 | 0.18 | -- |
| Metals | Lead,Dissolved | 11 | -- | NA |
| Metals | Manganese,Dissolved | 11 | 0.45 | NA |
| Metals | Nickel,Dissolved | 11 | -- | -- |
| Metals | Silver,Dissolved | 11 | -- | NA |
| Metals | Zinc,Dissolved | 11 | -- | NA |
| PAHs | Acenaphthene | 11 | NA | -- |
| PAHs | Anthracene | 11 | NA | -- |
| PAHs | Benz(a)anthracene | 11 | NA | -- |
| PAHs | Benzo(a)pyrene | 11 | 0.09 | 0.09 |
| PAHs | Benzo(b)fluoranthene | 11 | NA | 0.55 |
| PAHs | Benzo(k)fluoranthene | 11 | NA | 0.09 |
| PAHs | Chrysene | 11 | NA | 0.18 |
| PAHs | Dibenz(a,h)anthracene | 11 | NA | 0.09 |
| PAHs | Fluoranthene | 11 | NA | -- |
| PAHs | Indeno(1,2,3-c,d)pyrene | 11 | NA | 0.18 |
| PAHs | Pyrene | 11 | NA | -- |
| PCBs | PCBs | 11 | -- | -- |
| Pesticides | Aldrin | 11 | -- | -- |
| Pesticides | Ametryn | 11 | NA | -- |
| Pesticides | Atrazine | 11 | -- | -- |
| Pesticides | Azinphos ethyl | 11 | NA | -- |
| Pesticides | Azinphos methyl | 11 | NA | -- |
| Pesticides | DDD(p,p') | 11 | NA | 0.09 |
| Pesticides | DDE(p,p') | 11 | NA | 0.55 |
| Pesticides | DDT(p,p') | 11 | NA | 0.27 |
| Pesticides | Dieldrin | 11 | NA | 0.27 |
| Pesticides | Dimethoate | 11 | NA | -- |
| Pesticides | Endosulfan sulfate | 11 | NA | -- |
| Pesticides | Endrin | 11 | -- | -- |
| Pesticides | Endrin Aldehyde | 11 | NA | -- |
| Pesticides | Endrin Ketone | 11 | NA | -- |
| Pesticides | Heptachlor | 11 | -- | -- |
| Pesticides | Heptachlor epoxide | 11 | 0.09 | 0.45 |
| Pesticides | Hexachlorobenzene | 11 | -- | 0.09 |
| Pesticides | Methoxychlor | 11 | -- | NA |
| Pesticides | Molinate | 11 | -- | NA |
| Pesticides | Oxychlordane | 11 | NA | 0.36 |
| Pesticides | Simazine | 11 | -- | NA |
| Pesticides | Thiobencarb | 11 | -- | NA |
| Physical | Oxygen, Dissolved | 0 | nt | NA |
| Physical | pH | 11 | 0.73 | NA |
| Physical | SpecificConductivity | 11 | 0.55 | NA |
| Physical | Turbidity | 11 | 0.64 | NA |

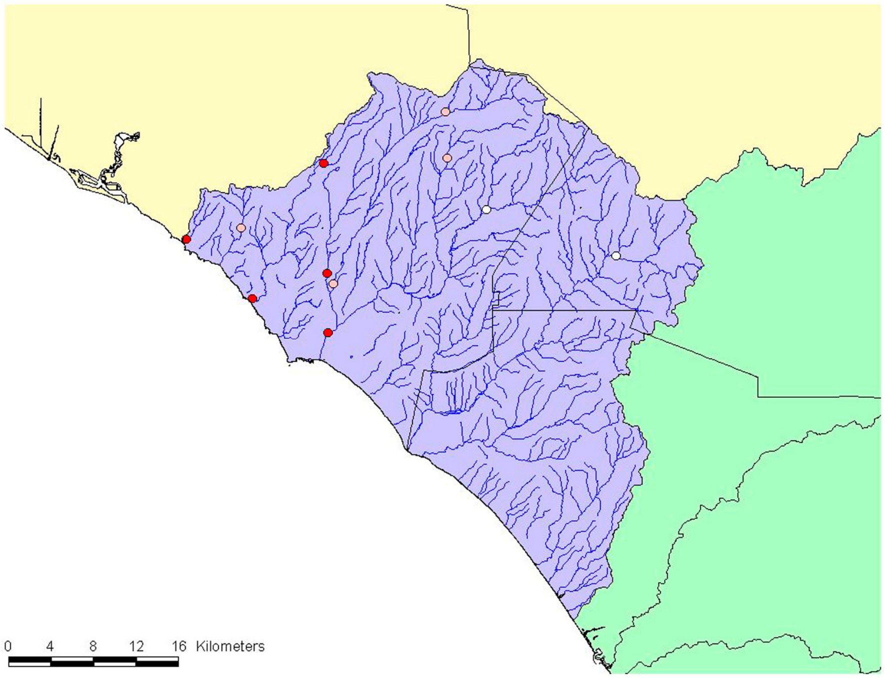



**Figure 6. Map of aquatic life threshold exceedances for water chemistry at SWAMP sites. White circles indicate sites with one or fewer exceedances. Pink circles indicate sites with 2 to 5 exceedances. Red circles indicate sites with 6 to 9 exceedances. At all sites, 31 constituents were assessed.**

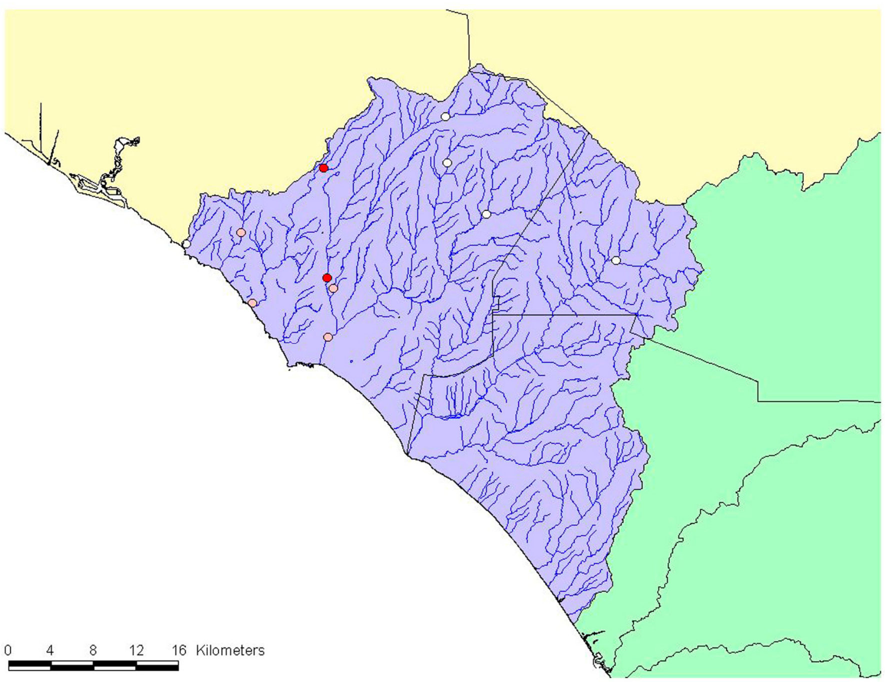



**Figure 7. Map of human health exceedances for water chemistry at SWAMP sites. White circles indicate sites with one or fewer exceedances. Pink circles indicate sites with 2 to 5 exceedances. Red circles indicate sites with 6 to 9 exceedances. At all sites, 34 constituents were assessed.**

All sites in San Juan HU exceeded certain aquatic life and human health thresholds (Table 12; Figure 6, 7). Aliso Creek (901SJALC6), English Creek, Morro Canyon Creek, Oso Creek, and the lower San Juan Creek (901SJSJC9) each had eight exceedances of aquatic life thresholds. Reference sites ranged from having few exceedances (one at San Mateo Creek), moderate (four at Upper Arroyo Trabuco Creek), to high (eight at Morro Canyon Creek) numbers of aquatic life threshold exceedances. A high number of human health exceedances (i.e., 8 or more) were observed at English Creek and Oso Creek.

**Table 12. Number of constituents exceeding thresholds at each SWAMP site.**

| Site | Aquatic life | Human health |
|---|---|---|
| 901SJALC6 | 8 | 4 |
| 901SJATC2 | 4 | 1 |
| 901SJATC5 | 4 | 3 |
| 901SJBEL2 | 3 | 0 |
| 901SJENG2 | 8 | 10 |
| 901SJLAG2 | 4 | 4 |
| 901SJMCC2 | 8 | 1 |
| 901SJOSO3 | 8 | 8 |
| 901SJSJC5 | 1 | 0 |
| 901SJSJC9 | 8 | 4 |
| 901SJSMT2 | 1 | 1 |

Results from non-SWAMP water chemistry monitoring at 23 sites were similar to results from SWAMP (Table 10C and D, above). For example, specific conductivity and pH frequently exceeded aquatic life thresholds at nearly every site. In addition, non-SWAMP monitoring found that dissolved oxygen was generally within acceptable levels. However, cadmium and nickel exceeded thresholds at Narco Channel on nearly every sampling date.

## 4.2 Toxicity

Toxicity was evident at nearly every site within the watershed, although results varied among sites and indicators (Table 13; Figure 8; Appendix III). Severity was high at English Creek, Oso Creek, and Laguna Canyon Creek, which showed evidence of toxicity to all three indicator species on at least one sampling date. No toxicity was evident at Bell Canyon Creek, although sediment toxicity was not assessed at this site. Across the watershed, chronic toxicity was observed in 30% of 96 samples.

**Table 13. Frequency of toxicity detected for each endpoint and at each site. A sample was considered toxic if the percent control of the endpoint was less than 80% of reference samples, and the difference was considered significant at 0.05. Number of samples where the endpoint was evaluated (n). Toxicity not detected in any sample (--). A. Sites sampled under SWAMP. B. Sites sampled under OC NPDES.**

| A. SWAMP sites | *C. dubia* | | | | *H. azteca* | | | | *S. capricornutum* | | Multiple indicators | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | Surival | n | Young/Female | n | Survival | n | Growth | n | Total cell count | n | Frequency | n |
| 901SJALC6 | -- | 3 | -- | 3 | 0.25 | 4 | -- | 3 | 0.75 | 4 | 0.30 | 10 |
| 901SJATC2 | -- | 2 | -- | 2 | 1.00 | 1 | no survival | 0 | -- | 2 | 0.20 | 5 |
| 901SJATC5 | -- | 4 | -- | 4 | -- | 3 | 0.33 | 3 | 0.75 | 4 | 0.36 | 11 |
| 901SJBEL2 | -- | 2 | -- | 2 | not tested | 0 | not tested | 0 | -- | 2 | 0.00 | 4 |
| 901SJENG2 | 0.50 | 4 | -- | 3 | 0.50 | 4 | 0.25 | 4 | 0.50 | 4 | 0.27 | 11 |
| 901SJLAG2 | 0.25 | 4 | -- | 4 | 0.50 | 4 | -- | 4 | 1.00 | 4 | 0.33 | 12 |
| 901SJMCC2 | -- | 2 | -- | 2 | -- | 4 | -- | 4 | 1.00 | 4 | 0.40 | 10 |
| 901SJOSO3 | 0.33 | 3 | -- | 3 | 0.50 | 2 | -- | 1 | 1.00 | 4 | 0.50 | 8 |
| 901SJSJC5 | -- | 4 | -- | 4 | -- | 1 | -- | 1 | -- | 4 | 0.00 | 9 |
| 901SJSJC9 | -- | 4 | -- | 4 | 0.25 | 4 | 0.25 | 4 | 1.00 | 4 | 0.42 | 12 |
| 901SJSMT2 | -- | 2 | -- | 2 | not tested | 0 | not tested | 0 | 0.50 | 2 | 0.25 | 4 |
| Mean of all sites | 0.12 | 34 | -- | 33 | 0.30 | 27 | 0.13 | 24 | 0.66 | 38 | 0.30 | 96 |

**Table 13, continued. Frequency of toxicity.**

| B. Non-SWAMP sites | *C. dubia* | | | | *H. azteca* | | *S. capricornutum* | | *P. promelas* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | Survival | n | Growth | n | Survival | n | Total cell count | n | Survival | n | Growth | n |
| 1 | -- | 7 | -- | 7 | -- | 7 | -- | 6 | -- | 3 | -- | 3 |
| 2 | -- | 7 | 0.14 | 7 | -- | 7 | -- | 7 | -- | 3 | -- | 3 |
| 4 | -- | 5 | 0.17 | 6 | -- | 6 | -- | 5 | | 0 | | 0 |
| 6 | -- | 7 | -- | 7 | -- | 7 | -- | 7 | | 0 | | 0 |
| 11 | -- | 2 | -- | 2 | 0.50 | 2 | -- | 2 | -- | 1 | -- | 1 |
| 12 | 0.29 | 7 | 0.29 | 7 | 0.14 | 7 | -- | 7 | -- | 3 | 0.33 | 3 |
| 13 | -- | 5 | -- | 5 | -- | 5 | -- | 4 | | 0 | | 0 |
| 14 | -- | 6 | 0.17 | 6 | -- | 6 | -- | 5 | -- | 1 | -- | 1 |
| 15 | -- | 7 | 0.14 | 7 | -- | 7 | -- | 7 | | 0 | | 0 |
| 17 | -- | 1 | 1.00 | 1 | -- | 1 | -- | 1 | | 0 | | 0 |
| 18 | -- | 5 | -- | 5 | -- | 5 | -- | 4 | | 0 | | 0 |
| 19 | -- | 7 | -- | 7 | -- | 7 | -- | 7 | | 0 | | 0 |
| 20 | 0.43 | 7 | 0.43 | 7 | 0.17 | 6 | -- | 7 | | 0 | | 0 |
| 21 | 0.67 | 6 | 1.00 | 5 | -- | 5 | -- | 4 | | 0 | | 0 |
| 22 | -- | 6 | -- | 6 | -- | 6 | -- | 5 | | 0 | | 0 |
| 25 | -- | 7 | -- | 7 | -- | 7 | -- | 6 | | 0 | | 0 |
| 26 | -- | 6 | -- | 6 | -- | 6 | -- | 5 | | 0 | | 0 |

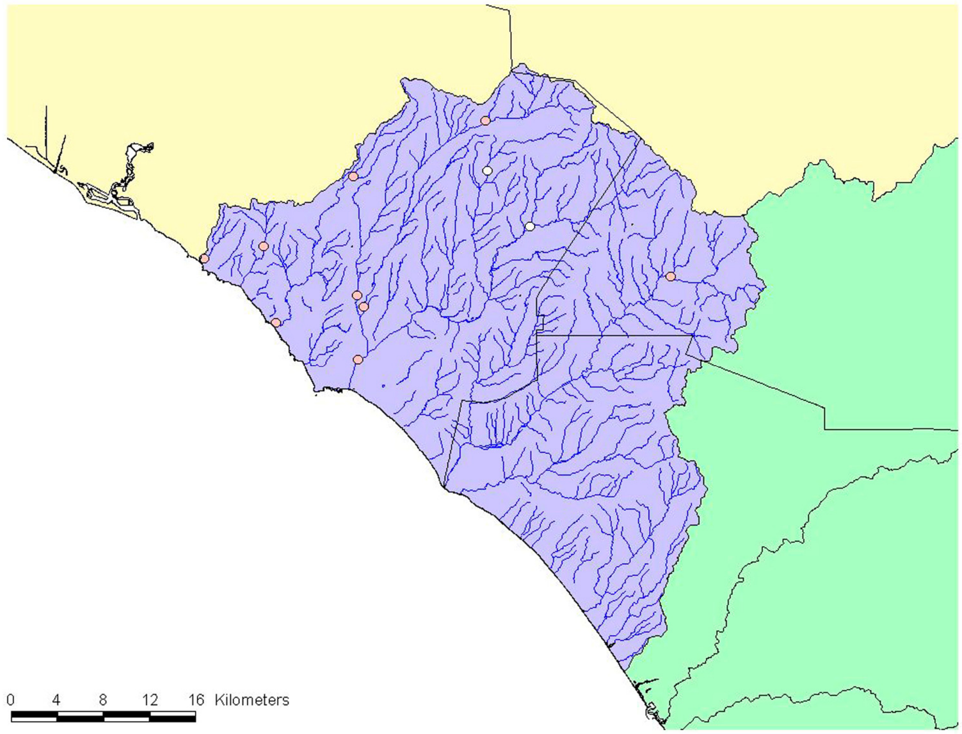



**Figure 8. Frequency of toxicity (*C. dubia* fecundity, *H. azteca* growth, and *S. capricornutum* total cell count) at SWAMP sites. White circles indicate low frequency (0.0 to 0.1) of toxicity (this value did not occur in this watershed) . Pink circles indicate moderate frequency (0.1 to 0.5) of toxicity. Red circles indicate high (0.5 to 1.0) frequency of toxicity.**

*S. capricornutum* was the most sensitive indicator, as total cell count was less than 80% of control at most sites in most samples. However, there was no evidence of toxicity to *S. capricornutum* at three sites, the Upper Arroyo Trabuco site (a designated reference site), the Upper San Juan Creek site, and Bell Canyon Creek. In contrast, at least half of all samples at all other sites were toxic to *S. capricornutum*, including the other two reference sites.

Toxicity tests using arthropod indicators showed widespread, but moderate toxicity to *H. azteca,* and more mild toxicity to *C. dubia.* Across the watershed, toxicity to *H. azteca* was observed at 7 sites. Although toxicity to *H. azteca* was not assessed at one of the reference sites (San Mateo Creek), no acute toxicity was observed at the other two. However, one sample from the Upper Arroyo Trabuco Creek reference site showed evidence of chronic toxicity in one sample. Across the entire watershed, 30% of samples were acutely toxic to *H. azteca.* Only three sites (Oso Creek, English Creek, and Laguna Canyon Creek) showed evidence of toxicity to *C. dubia.* Across the entire watershed, 12% of samples were acutely toxic to *C. dubia.*

## 4.3 Tissue

Analysis of fish tissue from Lower Arroyo Trabuco Creek did not find evidence of widespread impact (Table 14; Figure 9). Selenium did not exceed OEHHA thresholds. All other measured constituents lacked applicable thresholds. Every constituent occurred in higher concentration in crayfish tissue than sunfish tissue, particularly aluminum, cadmium, copper, and manganese. Nickel, which was not detected in either specimen, was an exception to this trend. Fish tissue concentrations of PCBs, PAHs, and pesticides were not assessed.

**Table 14. Concentrations of contaminants in fish tissues collected at Aliso Creek (901SJALC6), compared with OEHHA thresholds.**

| Category | Constituent | Threshold | Unit | Red-ear sunfish | Crayfish |
|---|---|---|---|---|---|
| Metals | Ag | | ppm | 0.00 | 0.04 |
| Metals | Al | | ppm | 0.22 | 96.10 |
| Metals | As | | ppm | 0.12 | 0.44 |
| Metals | Cd | | ppm | 0.01 | 0.18 |
| Metals | Cr | | ppm | 0.10 | 0.18 |
| Metals | Cu | | ppm | 0.35 | 13.10 |
| Metals | Mn | | ppm | 1.6 | 55.1 |
| Metals | Ni | | ppm | 0.00 | 0.00 |
| Metals | Pb | | ppm | 0.00 | 0.04 |
| Metals | Zn | | ppm | 11.2 | 15.3 |
| Inorganics | Se | 1.94 | ppm | 0.63 | 0.40 |

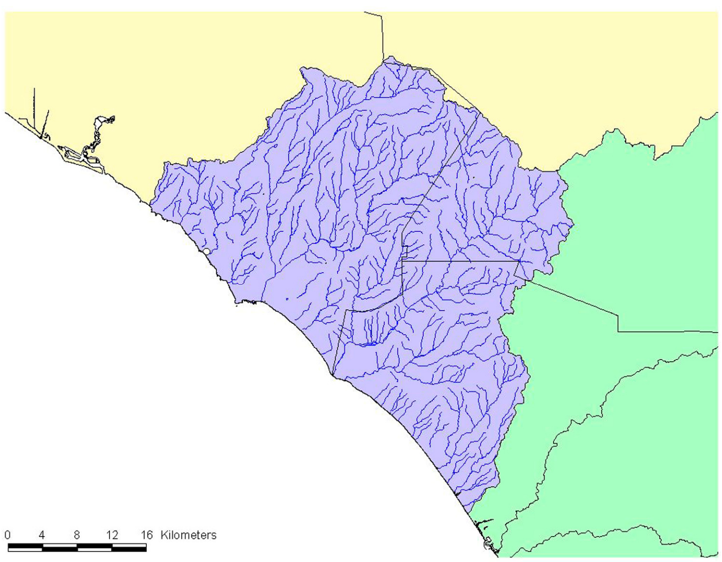



**Figure 9. Fish tissue exceedances at SWAMP sites. White circles indicate 1 or fewer exceedances. Pink circles indicate 2 to 3 exceedances (this value did not occur in this watershed). Red circles indicate 4 to 5 exceedances (this value did not occur in this watershed).**

### 4.4 Bioassessment

Biological health varied widely across the watershed. Mean annual IBI scores ranged from 7.1 (at Prima Deshecha, site 17) to 81.4 (Arroyo Trabuco Creek, site 4) (Table 15; Figure 10). Sites in poor or very poor condition were found throughout the watershed, including near designated SWAMP reference sites. However, high IBI scores were observed at most of the designated reference sites. In addition to site 4, Bell Canyon Creek (site 18) had IBI scores above 60 in both Spring and Fall. In general, headwater sites at the interior of the watersheds of San Juan and San Mateo Creeks had the highest IBI scores. In addition, a site in San Onofre Creek near the coast (site 23) also had a moderately high IBI score (50). There was no consistent effect of season in IBI scores, and the differences between seasons were slight for most sites (Table 15; Figure 11).

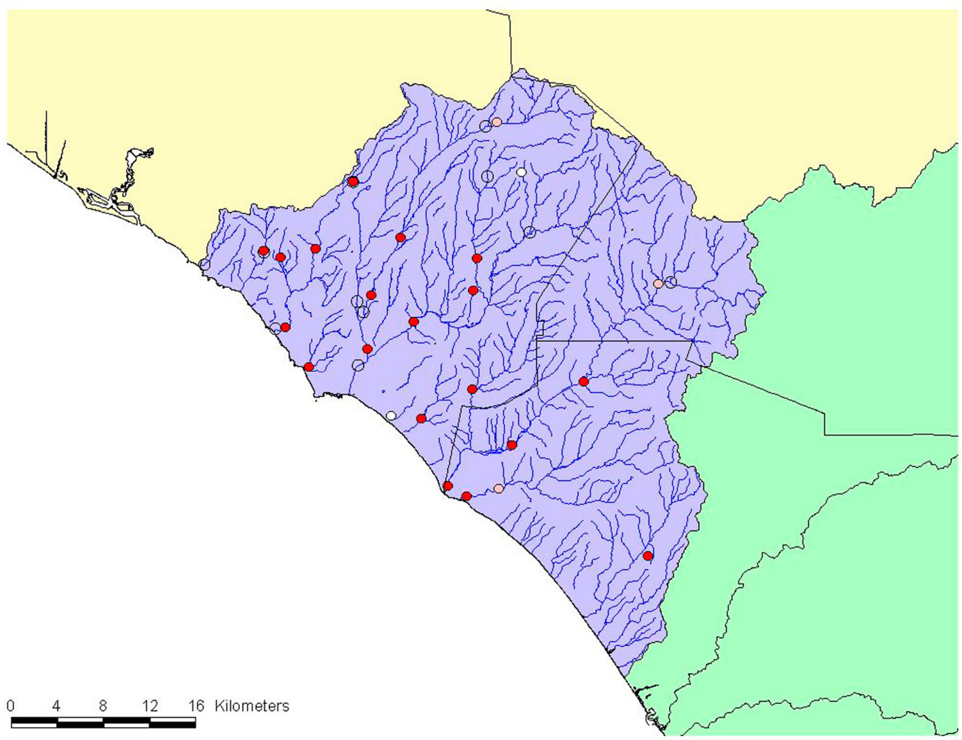



**Figure 10. IBI scores at sites in the San Juan HU. White circles indicate good or very good (60 to 100) IBI scores. Pink circles indicate fair (40 to 60) IBI scores. Red circles indicate poor (0 to 40) IBI scores. Open circles represent 500-m buffers around SWAMP sites; five of these buffers included bioassessment sites, and six of these buffers did not.**

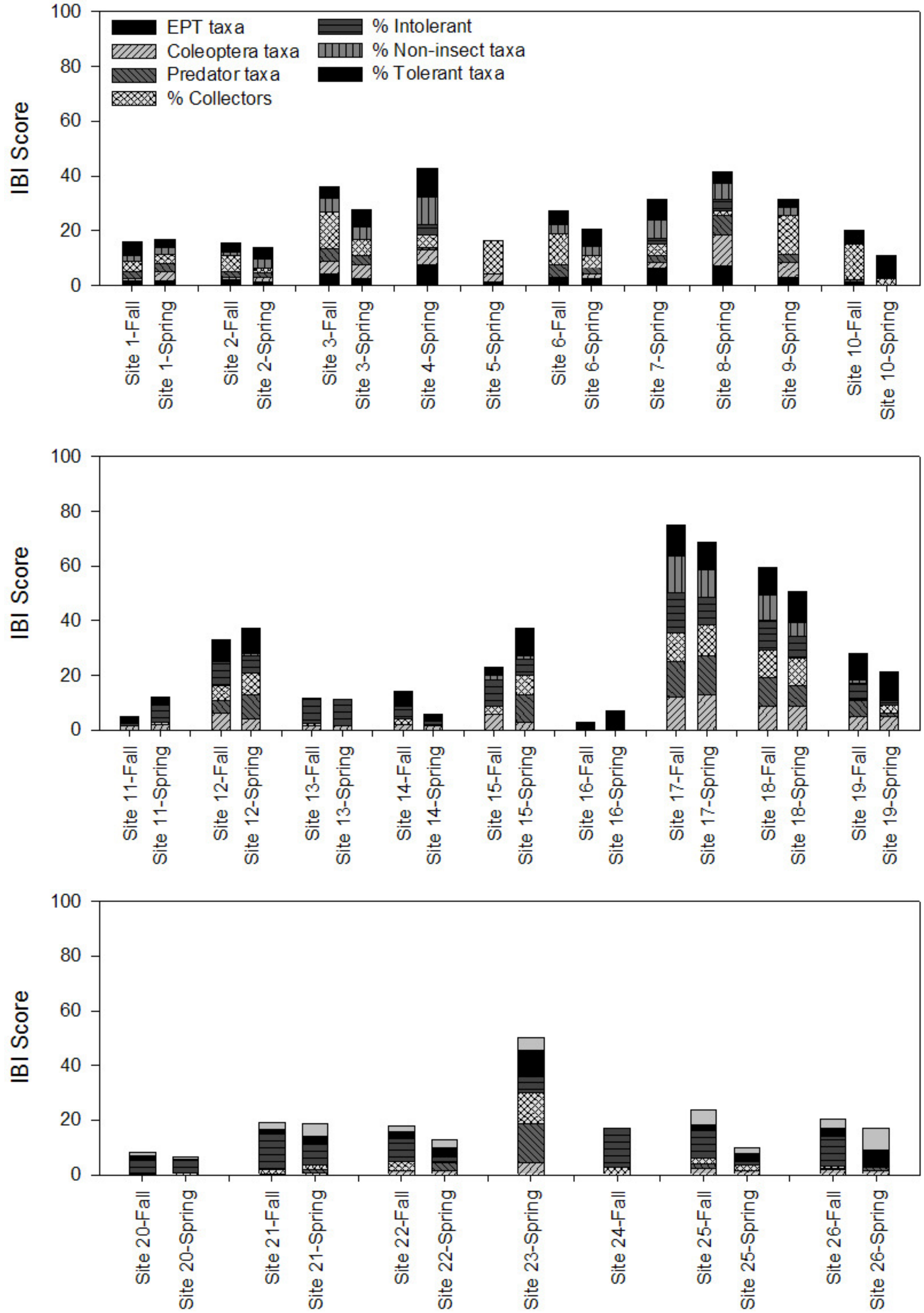



**Figure 11. Mean IBI scores at each bioassessment site and each season. The height of the bar indicates the mean IBI score, and the size of each component of the bar represents the contribution of each metric to the IBI. Sites are split over three plots to improve clarity.**

**Table 15. Mean and standard deviation of IBI scores at bioassessment sites within the San Juan HU. Number of samples collected within each season (n). Range from first to last year of sampling at each site (Years). Frequency of poor or very poor IBI scores (IBI <40) at each site and season (Frequency).**

| | | | | IBI | | | |
|---|---|---|---|---|---|---|---|
| Site | Season | n | Years | Mean | SD | Condition | Frequency |
| 1 | Average | 13 | 1998-2005 | 16.4 | 0.4 | Very poor | 0.92 |
| 1 | Fall | 7 | 1998-2005 | 16.1 | 7.4 | Very poor | 1.00 |
| 1 | Spring | 6 | 1998-2005 | 16.7 | 17.8 | Very poor | 0.83 |
| 2 | Average | 12 | 1998-2005 | 14.9 | 1.2 | Very poor | 1.00 |
| 2 | Fall | 6 | 1998-2005 | 15.7 | 9.9 | Very poor | 1.00 |
| 2 | Spring | 6 | 1998-2005 | 14 | 8.6 | Very poor | 1.00 |
| 3 | Average | 6 | 1998-2000 | 31.9 | 6.1 | Poor | 0.67 |
| 3 | Fall | 3 | 1998-2000 | 36.2 | 3.6 | Poor | 0.67 |
| 3 | Spring | 3 | 1998-2000 | 27.6 | 14.5 | Poor | 0.67 |
| 4 | Average | 6 | 2001-2005 | 68 | 23 | Good | 0.17 |
| 4 | Fall | 2 | 2003-2005 | 84.3 | 12.1 | Very good | 0.00 |
| 4 | Spring | 4 | 2001-2005 | 51.8 | 18.6 | Fair | 0.25 |
| 5 | Spring | 2 | 2001-2001 | 16.4 | 3 | Very poor | 1.00 |
| 6 | Average | 12 | 1998-2005 | 23.8 | 4.8 | Poor | 1.00 |
| 6 | Fall | 5 | 1998-2005 | 27.1 | 3.4 | Poor | 1.00 |
| 6 | Spring | 7 | 1998-2005 | 20.4 | 4.8 | Poor | 1.00 |
| 7 | Spring | 4 | 2001-2005 | 31.4 | 13.7 | Poor | 0.75 |
| 8 | Spring | 1 | 2001-2001 | 41.4 | | Fair | 0.00 |
| 9 | Spring | 1 | 2001-2001 | 31.4 | | Poor | 1.00 |
| 10 | Average | 2 | 2005-2006 | 23.6 | 27.3 | Poor | 0.50 |
| 10 | Fall | 1 | 2005-2005 | 42.9 | | Fair | 0.00 |
| 10 | Spring | 1 | 2006-2006 | 4.3 | | Very poor | 1.00 |
| 11 | Average | 5 | 2001-2004 | 15.5 | 6.4 | Very poor | 1.00 |
| 11 | Fall | 2 | 2002-2004 | 20 | 2 | Poor | 1.00 |
| 11 | Spring | 3 | 2001-2001 | 11 | 3 | Very poor | 1.00 |
| 12 | Average | 6 | 2002-2005 | 12 | 3.3 | Very poor | 1.00 |
| 12 | Fall | 4 | 2002-2005 | 9.6 | 4.7 | Very poor | 1.00 |
| 12 | Spring | 2 | 2003-2005 | 14.3 | 2 | Very poor | 1.00 |
| 13 | Average | 4 | 2003-2005 | 39.6 | 4.5 | Poor | 0.50 |
| 13 | Fall | 2 | 2003-2005 | 36.4 | 13.1 | Poor | 0.50 |
| 13 | Spring | 2 | 2003-2005 | 42.9 | 6.1 | Fair | 0.50 |
| 14 | Average | 5 | 2002-2005 | 14.5 | 0.3 | Very poor | 1.00 |
| 14 | Fall | 4 | 2002-2005 | 14.6 | 6.6 | Very poor | 1.00 |
| 14 | Spring | 1 | 2005-2005 | 14.3 | | Very poor | 1.00 |
| 15 | Average | 6 | 2002-2005 | 17 | 6.8 | Very poor | 1.00 |
| 15 | Fall | 4 | 2002-2005 | 21.8 | 6.2 | Poor | 1.00 |
| 15 | Spring | 2 | 2003-2005 | 12.1 | 3 | Very poor | 1.00 |
| 16 | Average | 4 | 2004-2006 | 36.8 | 0.5 | Poor | 0.50 |
| 16 | Fall | 2 | 2004-2005 | 36.4 | 9.1 | Poor | 0.50 |
| 16 | Spring | 2 | 2005-2006 | 37.1 | 14.1 | Poor | 0.50 |
| 17 | Average | 2 | 2002-2003 | 7.1 | 6.1 | Very poor | 1.00 |
| 17 | Fall | 1 | 2002-2002 | 2.9 | | Very poor | 1.00 |
| 17 | Spring | 1 | 2003-2003 | 11.4 | | Very poor | 1.00 |
| 18 | Average | 4 | 2003-2005 | 65.7 | 5.1 | Good | 0.00 |
| 18 | Fall | 2 | 2004-2005 | 69.3 | 9.1 | Good | 0.00 |
| 18 | Spring | 2 | 2003-2005 | 62.1 | 9.1 | Good | 0.00 |
| 19 | Average | 6 | 2002-2005 | 33.8 | 3.3 | Poor | 0.83 |
| 19 | Fall | 4 | 2002-2005 | 36.1 | 11.1 | Poor | 0.75 |
| 19 | Spring | 2 | 2003-2005 | 31.4 | 2 | Poor | 1.00 |

**Table 15, continued. Mean and standard deviations of IBI scores.**

| Site | Season | n | Years | IBI Mean | SD | Condition | Frequency |
|---|---|---|---|---|---|---|---|
| 20 | Average | 6 | 2002-2005 | 7.3 | 1.3 | Very poor | 1.00 |
| 20 | Fall | 4 | 2002-2005 | 8.2 | 7.9 | Very poor | 1.00 |
| 20 | Spring | 2 | 2003-2005 | 6.4 | 5.1 | Very poor | 1.00 |
| 21 | Average | 6 | 2002-2005 | 18.9 | 0.5 | Very poor | 1.00 |
| 21 | Fall | 4 | 2002-2005 | 19.3 | 5.5 | Very poor | 1.00 |
| 21 | Spring | 2 | 2003-2005 | 18.6 | 4 | Very poor | 1.00 |
| 22 | Average | 6 | 2002-2005 | 15.4 | 3.5 | Very poor | 1.00 |
| 22 | Fall | 4 | 2002-2005 | 17.9 | 12.4 | Very poor | 1.00 |
| 22 | Spring | 2 | 2003-2005 | 12.9 | 4 | Very poor | 1.00 |
| 23 | Spring | 1 | 2005-2005 | 50 | | Fair | 0.00 |
| 24 | Average | 3 | 2004-2006 | 27.9 | 1 | Poor | 0.67 |
| 24 | Fall | 2 | 2004-2005 | 28.6 | 16.2 | Poor | 0.50 |
| 24 | Spring | 1 | 2006-2006 | 27.1 | | Poor | 1.00 |
| 25 | Average | 6 | 2002-2005 | 17 | 9.8 | Very poor | 1.00 |
| 25 | Fall | 4 | 2002-2005 | 23.9 | 10.6 | Poor | 1.00 |
| 25 | Spring | 2 | 2003-2005 | 10 | 0 | Very poor | 1.00 |
| 26 | Average | 6 | 2002-2005 | 18.8 | 2.3 | Very poor | 1.00 |
| 26 | Fall | 4 | 2002-2005 | 20.4 | 2.1 | Poor | 1.00 |
| 26 | Spring | 2 | 2003-2005 | 17.1 | 0 | Very poor | 1.00 |

The EPT taxa metric appeared to be most sensitive component of the IBI, as it only contributed to the IBI at high scoring sites (Figure 11; Appendix IV). In contrast, the % collector and % tolerant taxa were a large component of the total IBI score at all sites, including those with very low IBI scores (e.g., Segunda Deshecha, site 21).

Examination of IBI scores over time did not indicate a trend towards improving or deteriorating biological condition (Figure 12). Variability among years was high, which may obscure trends in the data. Furthermore, a different set of sites were sampled in the early and late periods of study, increasing spatial variability and obscuring trends.

None of these sites were monitored under SWAMP, and all bioassessment data came from monitoring efforts by NPDES permittees, Camp Pendleton, or the California Department of Fish and Game.

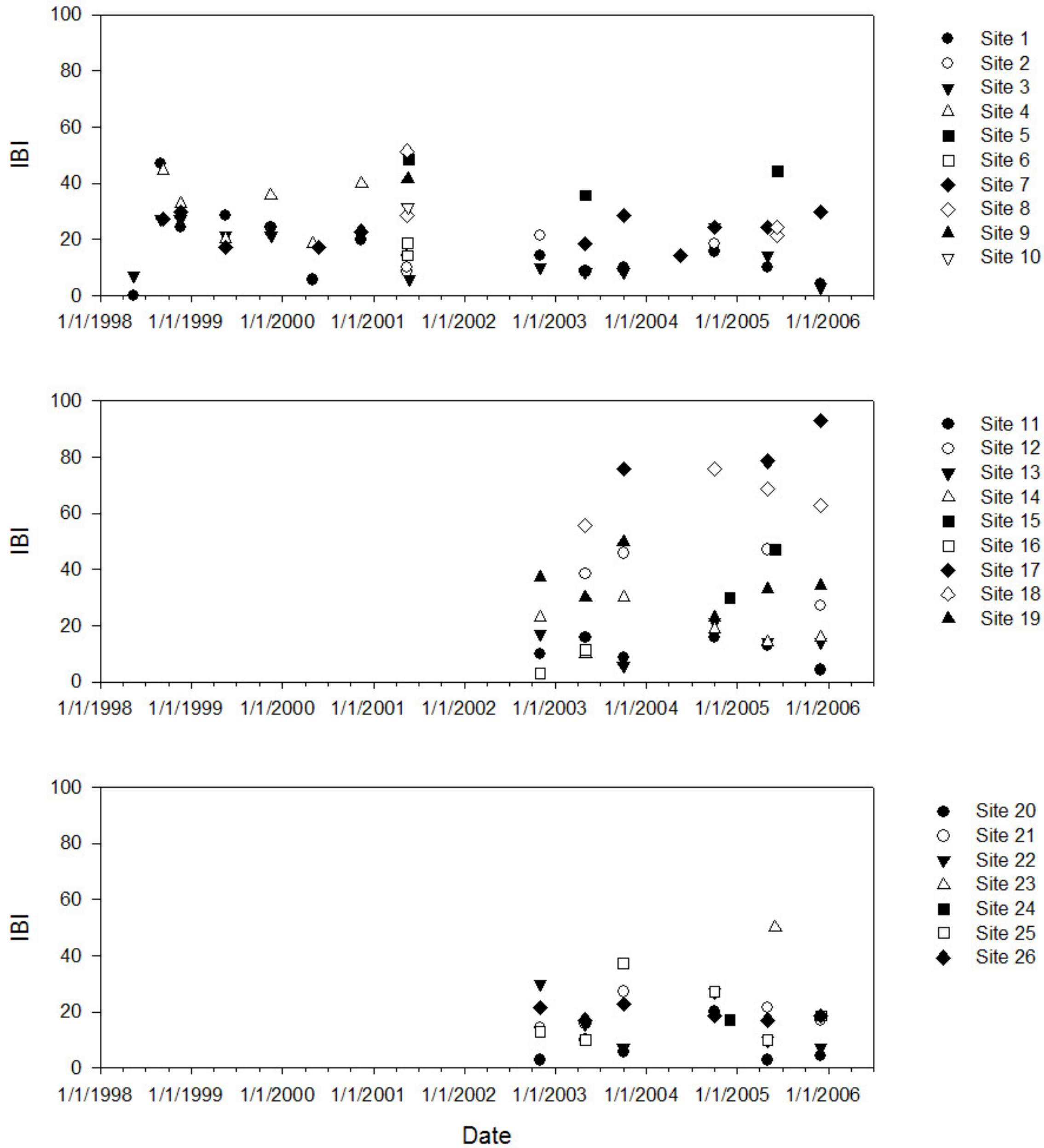



**Figure 12. IBI values for each year and site. Each symbol represents a single sampling event. Sites are split over three plots to improve clarity.**

## 4.5 Physical Habitat

Physical habitat varied among sites throughout the watershed, although human alteration was evident at every site visited. San Mateo Creek had very good physical habitat, with a mean physical habitat score of 19.6. Bell Canyon Creek also had very good physical habitat, receiving a score greater than 15 for every component of physical habitat. However, six sites in the San Juan HU received scores below 10, indicating that degraded physical habitat was widespread. More heavily degraded sites were concentrated in the northern and coastal portions of the HU. For example, Laguna Canyon Creek, Morro Canyon Creek, and Oso Creek all had mean physical habitat scores below 7. In contrast, sites at the interior or southern portions were less degraded. (Table 16; Figure 13).

**Table 16. Score and mean for each component of physical habitat. Component range: 0 (heavily impacted habitat) to 20 (unimpacted habitat). A. SWAMP sites. B. Non-SWAMP sites.**

| A. SWAMP sites | | Phab 1 | Phab 2 | Phab 3 | Phab 4 | Phab 5 | Phab 6 | Phab 7 | Phab 8 | Phab 9 | Phab 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Epifaunal | | Velocity- | Sediment | Channel | Channel | Riffle | Bank | Vegetation | Riparian | Mean |
| Sitecode | Date | cover | Embeddedness | depth regime | deposition | flow | alteration | frequency | stability | protection | zone | score |
| 901SJALC6 | 3/29/2002 | 8 | 8 | | | | 10 | 7 | 13 | 13 | 13 | 10.3 |
| 901SJATC2 | 4/10/2003 | 15 | 17 | 14 | 18 | 15 | 14 | 18 | 7 | 9.5 | 8.5 | 13.6 |
| 901SJATC5 | 3/29/2002 | 13 | 8 | 9 | 4 | | | | 1 | 10 | 13 | 8.3 |
| 901SJBEL2 | 2/1/2002 | 17 | 16 | 15 | 18 | 16 | 20 | 19 | 19 | 20 | 19 | 17.9 |
| 901SJENG2 | 10/11/2002 | 9 | 4 | 11 | 13 | 12 | 3 | 16 | 3 | 4 | 2 | 7.7 |
| 901SJLAG2 | 3/29/2002 | 5 | | 5 | | | | | 8 | 5 | | 5.8 |
| 901SJMCC2 | 3/29/2002 | 8 | | 3 | 3 | 3 | 16 | 3 | 3 | 16 | | 6.9 |
| 901SJOSO3 | 10/11/2002 | 3 | 0 | 6 | 6 | 17 | 0 | 3 | 19 | 9 | 0 | 6.3 |
| 901SJSJC5 | 10/4/2002 | 13 | 3 | 3 | 16 | 5 | 19 | 3 | 17 | 19 | 19 | 11.7 |
| 901SJSJC9 | 3/29/2002 | 10 | 15 | 8 | 10 | | 5 | 12 | | 0 | 0 | 7.5 |
| 901SJSMT2 | 10/4/2002 | 20 | 17 | | | | 20 | 20 | 20 | 20 | 20 | 19.6 |
| Mean of all sites | | 13.7 | 10.6 | 8.8 | 15.1 | 12.8 | 14.6 | 14.3 | 14.2 | 13.9 | 13.3 | 12.9 |

**Table 16, continued. Mean scores and standard deviations for each component of physical habitat.**

| B. Non-SWAMP sites | | | Phab 1 | | Phab 2 | | Phab 3 | | Phab 4 | | Phab 5 | | Phab 6 | | Phab 7 | | Phab 8 | | Phab 9 | | Phab 10 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Epifaunal cover | | Embeddedness | | Velocity-depth regime | | Sediment deposition | | Channel flow | | Channel alteration | | Riffle frequency | | Bank stability | | Vegetation protection | | Riparian zone | | Mean |
| Site | n | Years | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Score |
| 1 | 8 | 2002-2006 | 13.5 | 1.6 | 13.4 | 3.6 | 15.8 | 2 | 14.3 | 3.6 | 16.5 | 2.7 | 5.4 | 2.3 | 12.9 | 2.2 | 16.1 | 2 | 10.3 | 1.7 | 5.8 | 2.3 | 12.4 |
| 2 | 8 | 2002-2006 | 12.8 | 1.9 | 13.4 | 2.3 | 11.3 | 2.3 | 11.8 | 3.2 | 15.9 | 2.5 | 10 | 0.8 | 11.9 | 2.4 | 14.5 | 1.4 | 12.1 | 2.2 | 12 | 1.9 | 12.6 |
| 4 | 6 | 2003-2006 | 18.7 | 1.2 | 18.8 | 1 | 17 | 3.5 | 18.8 | 1 | 14.2 | 6 | 18.3 | 2.3 | 19.3 | 0.5 | 17.5 | 0.8 | 12.7 | 3.3 | 18.2 | 3.5 | 17.4 |
| 6 | 7 | 2003-2006 | 13.6 | 1.9 | 12.7 | 2.3 | 13.1 | 2.8 | 12.4 | 3.3 | 13.3 | 3.8 | 16.3 | 2.1 | 12 | 3.8 | 13.7 | 2.9 | 16.3 | 2.4 | 15.4 | 1.9 | 13.9 |
| 11 | 3 | 2002-2006 | 13.3 | 3.1 | 15 | 3 | 10.3 | 1.5 | 13 | 3.5 | 12.3 | 5.5 | 18.3 | 1.2 | 13.3 | 4.2 | 15.3 | 1.2 | 10.3 | 3.8 | 16 | 3 | 13.7 |
| 12 | 8 | 2002-2006 | 12.1 | 2.4 | 13.4 | 3 | 13.8 | 4.6 | 13.4 | 3.7 | 17.3 | 1.3 | 11.6 | 3.5 | 6.9 | 1.4 | 11.9 | 3.2 | 15.6 | 2.4 | 15.8 | 2.8 | 13.2 |
| 13 | 5 | 2003-2005 | 11 | 3 | 8.4 | 5.9 | 8.4 | 2.7 | 8 | 2.3 | 7.4 | 2.2 | 19.6 | 0.5 | 9.8 | 4.7 | 15 | 3 | 19.4 | 0.9 | 19.4 | 0.9 | 12.6 |
| 14 | 7 | 2002-2006 | 11.4 | 1.8 | 11.6 | 2.8 | 12.4 | 1.5 | 9.9 | 2.9 | 12.3 | 2.3 | 6.6 | 0.8 | 14.3 | 2.6 | 16.3 | 1.4 | 4.3 | 1.4 | 4.4 | 1.6 | 10.3 |
| 15 | 8 | 2002-2006 | 15.8 | 2.7 | 15.9 | 2.6 | 13.4 | 1.9 | 15.9 | 1.8 | 13.4 | 3.5 | 9.8 | 2.6 | 13.6 | 3.1 | 9.8 | 4.3 | 10 | 3.9 | 3.8 | 1.5 | 12.1 |
| 17 | 2 | 2002-2006 | 2 | 0 | 3 | 2.8 | 6.5 | 2.1 | 4 | 0 | 11 | 1.4 | 1 | 0 | 6.5 | 2.1 | 20 | 0 | 1 | 1.4 | 1 | 1.4 | 5.6 |
| 18 | 6 | 2003-2006 | 18.3 | 0.5 | 18.3 | 1 | 13.7 | 4.7 | 19 | 0 | 14.5 | 6.2 | 18.5 | 1.2 | 15.7 | 6.4 | 17.7 | 0.8 | 15.7 | 3.7 | 19 | 0 | 17 |
| 19 | 8 | 2002-2006 | 17 | 1.8 | 15.9 | 2.1 | 13.4 | 2.6 | 17.6 | 1.4 | 13.6 | 4.1 | 19.3 | 1.8 | 14.6 | 3.3 | 17.4 | 1.2 | 15.4 | 1.8 | 19.1 | 1.2 | 16.3 |
| 20 | 8 | 2002-2006 | 12.3 | 4.3 | 12.4 | 4.2 | 14.8 | 1.3 | 14.4 | 2.6 | 14.1 | 4.4 | 8 | 3 | 11 | 1.8 | 7.1 | 3.2 | 11.6 | 2.3 | 5 | 1.1 | 11.1 |
| 21 | 8 | 2002-2006 | 9.1 | 3.6 | 7.6 | 6.6 | 11.4 | 2.8 | 11.1 | 5.5 | 13.4 | 3.1 | 9.5 | 1.9 | 5.9 | 1.6 | 17.1 | 2.1 | 10 | 2.8 | 8.9 | 2.1 | 10.4 |
| 22 | 7 | 2002-2005 | 12.3 | 2.5 | 13.3 | 1.3 | 12.6 | 2.6 | 11.4 | 4.5 | 13.3 | 3.2 | 7.1 | 1.9 | 13 | 1 | 11.3 | 5.1 | 8 | 2 | 5.3 | 1 | 10.8 |
| 25 | 8 | 2002-2006 | 15.1 | 1.1 | 13.8 | 2.8 | 14.6 | 1.5 | 16.4 | 1.1 | 14.9 | 3 | 14.5 | 4 | 13.3 | 1.8 | 14.4 | 2.6 | 14.8 | 2.4 | 10.4 | 2.4 | 14.2 |
| 26 | 8 | 2002-2006 | 11.5 | 4 | 11.8 | 2.6 | 10.4 | 2.5 | 10 | 2.6 | 13.9 | 2 | 3.5 | 1.8 | 15 | 3.2 | 19.8 | 0.7 | 2.8 | 2.1 | 1.8 | 0.5 | 10 |

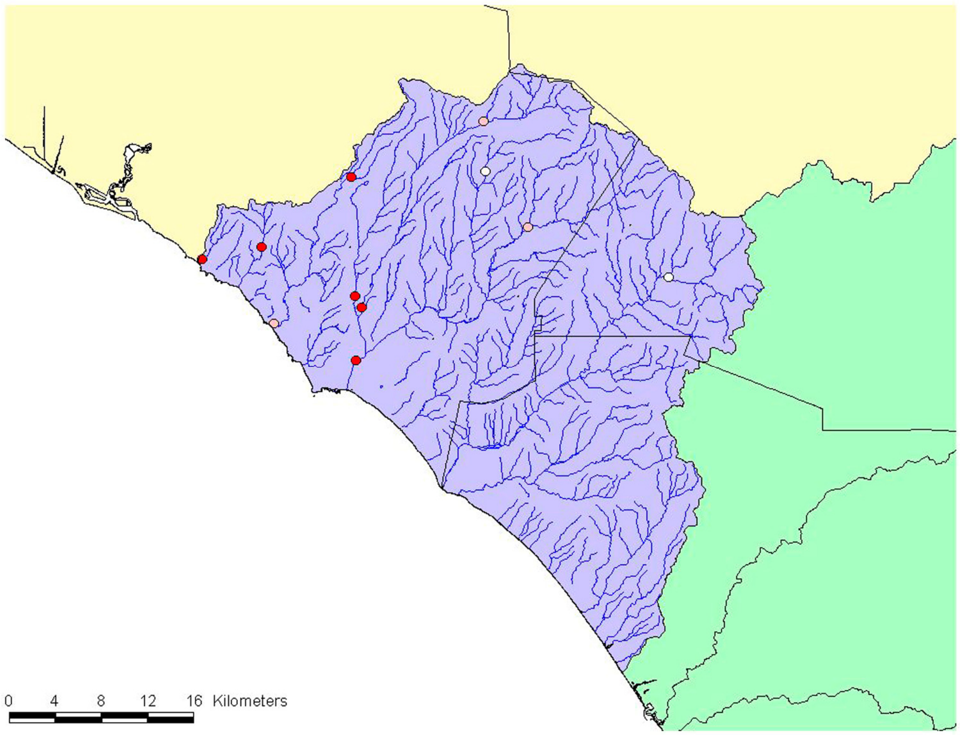



**Figure 13. Assessment of physical habitat at SWAMP sites. White circles indicate sites with a mean physical habitat scores between 15 and 20. Pink circles indicate mean scores between 10 and 15. Red circles indicate mean scores between 0 and 10.**

Embeddedness and poor velocity-depth regimes appeared to be the most widespread impacts to physical habitat. For example, although embeddedness was minimal at four of the sites (i.e., physical habitat component score was greater than 15), the remaining sites were strongly impacted (i.e. score was less than 10). Every component of physical habitat showed signs of severe degradation (i.e., score was 5 or less) at multiple sites in the watershed.

Results from monitoring by Orange County NPDES were similar, in that mean physical habitat scores were high (i.e., > 15) at reference sites (sites 4, 18, 19), and lowest (i.e., <10) at northern and coastal portions of the watershed (e.g., site 17, in Prima Deshecha). Although sites were monitored over several years (often 5), values changed little, and standard deviations were typically under 4.

# 5. DISCUSSION

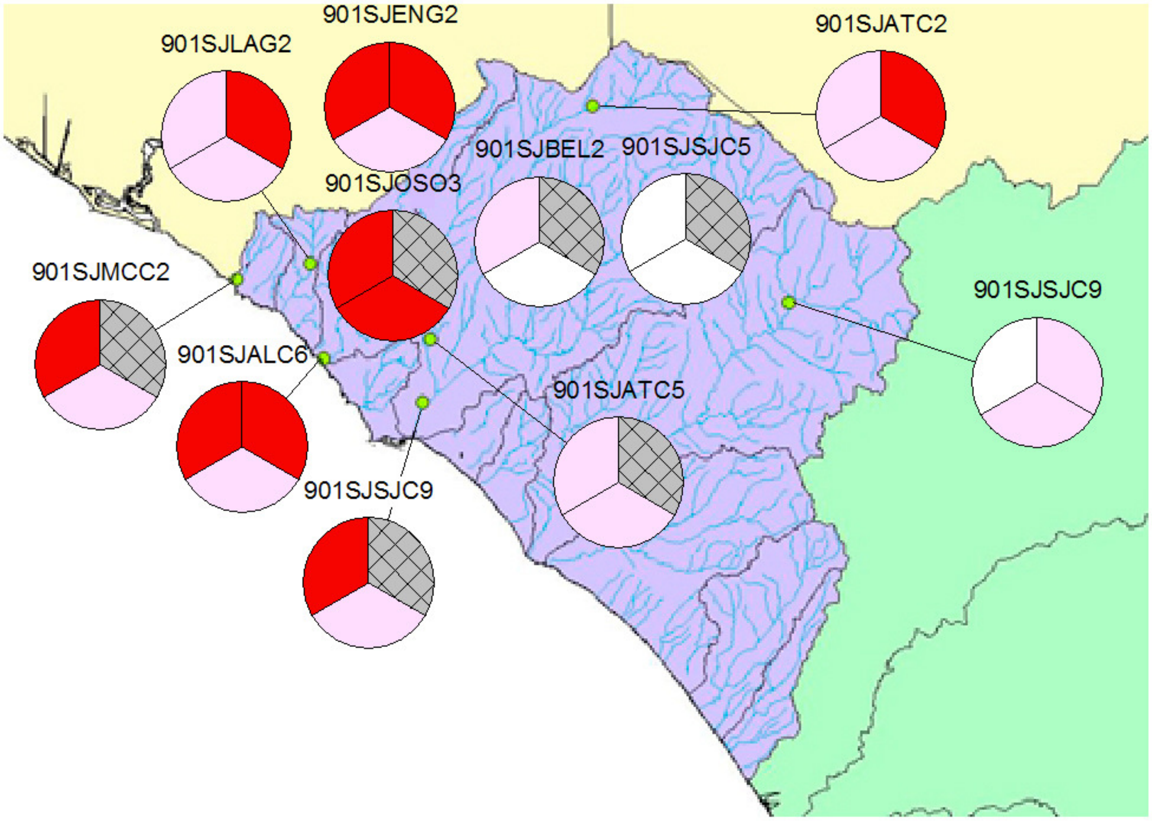
This analysis of the San Juan HU suggests that the northern and coastal portions of the watershed are in poor ecological health, but the condition of streams in the southern and interior portions are moderate to good. However, every site sampled under SWAMP in the San Juan HU showed evidence of impact from multiple indicators (Table 17; Figure 14). These impacts ranged from very sight (e.g., the Upper Arroyo Trabuco Creek reference site) to severe (e.g., English Creek).

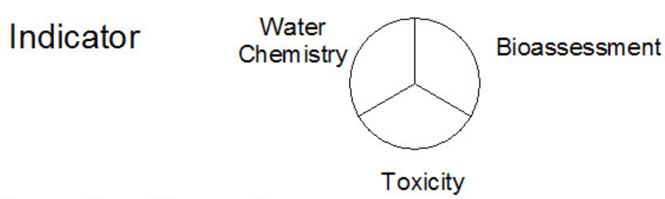
**Table 17. Summary of the ecological health for five SWAMP sites in San Juan HU. Aquatic life (AL). Human health (HH). Toxicity frequency is frequency of toxicity for three chronic toxicity endpoints: *C. dubia* (fecundity), *H. azteca* (growth), and *S. capricornutum* (total cell count). Biology frequency is the frequency of IBIs below 40. n.t. = Indicator not tested.**

| | Water chemistry | | Tissue | Toxicity | Biology | Physical habitat |
|---|---|---|---|---|---|---|
| Site | # constituents (AL) | # constituents (HH) | # constituents (OEHHA) | Frequency | Frequency | Mean score |
| 901SJALC6 | 8 | 4 | 0 | 0.30 | 0.92* | 10.3 |
| 901SJATC2 | 4 | 1 | n.t. | 0.20 | 1.00* | 13.6 |
| 901SJATC5 | 4 | 3 | n.t. | 0.36 | n.t. | 8.3 |
| 901SJBEL2 | 3 | 0 | n.t. | 0.00 | n.t. | 17.9 |
| 901SJENG2 | 8 | 10 | n.t. | 0.27 | 1.00* | 7.7 |
| 901SJLAG2 | 4 | 4 | n.t. | 0.33 | 1.00* | 5.8 |
| 901SJMCC2 | 8 | 1 | n.t. | 0.40 | n.t. | 6.9 |
| 901SJOSO3 | 8 | 8 | n.t. | 0.50 | n.t. | 6.3 |
| 901SJSJC5 | 1 | 0 | n.t. | 0.00 | n.t. | 11.7 |
| 901SJSJC9 | 8 | 4 | n.t. | 0.42 | n.t. | 7.5 |
| 901SJSMT2 | 1 | 1 | n.t. | 0.25 | 0.00* | 19.6 |

* = Estimated from data collected at nearby (within 500 meters) non-SWAMP sites.

The Laguna Creek hydrologic subarea, in the northern portion of the hydrologic unit, contained several sites in poor ecological health, including the reference site at Morro Canyon Creek. Water chemistry at this site exceeded aquatic life thresholds for numerous constituents. Furthermore, toxicity to *S. capricornutum* was observed at every sampling date at this site. In addition, physical habitat received a very low score at this site (6.9). The data collected by SWAMP do not support the designation of Morro Canyon Creek as a reference site.




Severity of impact

| Severity | Water chemistry (# aquatic life exceedences) | Toxicity (Frequency of toxicity) | Bioassessment (IBI Score) |
|---|---|---|---|
| Low | 0-1 | 0.0-0.1 | 60-100 |
| Moderate | 2-5 | 0.1-0.5 | 40-60 |
| High | 6+ | 0.5-1.0 | 0-40 |
| Not tested | | | |

**Figure 14. Summary of the ecological health of SWAMP sites in the San Juan HU, as determined by water chemistry, toxicity, and bioassessment indicators. Each pie slice corresponds to a specific indicator, as described in the inset, with darker colors corresponding to more degraded conditions (unmeasured indicators are shown in cross-hatched gray). The top-left slice corresponds to the number of water chemistry constituents exceeding aquatic life thresholds. The bottom slice corresponds to the frequency of toxicity among three endpoints: *C. dubia* (fecundity), *H. azteca* (growth), and *S. capricornutum* (total cell count). The top-right slice corresponds to the IBI of bioassessment samples.**

Other sites in the Laguna Creek hydrologic subarea were also in poor ecological health. Laguna Canyon Creek, Aliso Creek, and English Creek all had many (i.e., 8) water chemistry constituents in exceedance of aquatic life thresholds. Furthermore, English Creek also exceeded a high number of human health thresholds (8 and 10, respectively). These results were consistent with the inclusion of these streams on the 303(d) list of impaired water bodies; for example, known stressors like phosphorus, benzo(b)fluoranthene, and dieldrin exceeded thresholds at these sites. Toxicity was also evident throughout this region. Samples from all sites were toxic to *S. capricornutum*, and all but Morro Canyon Creek were toxic to *H. azteca* as well. Toxicity to *C. dubia* was observed at two sites in the Laguna Creek hydrologic subarea (i.e., English Creek and Laguna Canyon Creek), but at only one other site in the San Juan HU. These results are consistent with the listing of toxicity as a stressor at Aliso, English, and Laguna Canyon Creeks on the 303(d) list. All bioassessment samples collected within this area were in poor or very poor condition, and physical habitat ranged from moderately (i.e., Aliso Creek) to severely degraded (all other sites). Fish tissues collected from Aliso Creek did not show evidence of impact, although few constituents were measured, only one of which (i.e., Selenium) had an applicable threshold to detect impact. Water chemistry monitoring by NPDES permittees found additional water chemistry constituents, such as Cadmium, that exceed aquatic life thresholds in the watershed.

The Mission Viejo hydrologic area (i.e., San Juan Creek watershed) included many sites representing a wide range of ecological health. Oso Creek, a tributary to the San Juan Creek, was in very poor condition, comparable to many sites in the Laguna Creek hydrologic subarea. Eight water chemistry constituents exceeded both aquatic life and human health thresholds, and toxicity to all indicator species was observed on at least one sampling date. Physical habitat was also degraded at Oso Creek. Conditions were marginally less impacted at the downstream San Juan Creek site, which also had a high number (8) of aquatic life threshold exceedances. p,p'-DDE exceeded thresholds in half the samples at the downstream site, supporting the listing of DDE as a known stressor at San Juan Creek on the 303(d) list. Water and sediment samples from this site were toxic to both *S. capricornutum* and *H. azteca,* but not *C. dubia.* Physical habitat at the downstream San Juan Creek site, like Oso Creek, received one of the lowest scores in the HU. Ecological health was better at sites further inland. For example, the Upper San Juan Creek site had water chemistry comparable to reference sites, with only one constituent exceeding aquatic life thresholds. In addition, toxicity was never observed at this site. However, physical habitat was moderately degraded at this site, as embeddedness, velocity-depth regime, and channel flow all received physical habitat scores of 5 or lower. The health of other sites in the San Juan watershed was intermediate between the upper San Juan Creek site and Oso Creek. For example, toxicity was not observed at Bell Canyon Creek, but a moderate number (3) of water chemistry constituents exceeded aquatic life thresholds. This site also had very good physical habitat, with a mean score of 17.9. Bioassessment samples collected elsewhere from Bell Canyon Creek ranged from good (site 18) to very poor (site 5). Toxicity was moderately higher at other sites, such as those on Arroyo Trabuco Creek, and water chemistry slightly more impacted. Bioassessment samples collected nearby designated reference site on Arroyo Trabuco Creek (site 4) were in very good condition, although low IBI scores were sometimes observed, perhaps due to natural variability.

The reference site in the San Mateo watershed was in good ecological health. Only one water chemistry constituent exceeded aquatic life thresholds, and toxicity was not frequently observed. Physical habitat was extremely good at the San Mateo Creek site, with nearly all components of physical habitat receiving perfect scores (i.e. 20). However, the bioassessment sample collected near this site was in fair condition (IBI 41.4). This low IBI score may be caused by natural variability, and additional sampling may yield higher IBI scores, or it may indicate low-level impacts which have not yet caused major degradation of the site. All bioassessments in the lower part of the watershed were in poor or very poor ecological condition.

Bioassessment monitoring in other hydrologic areas of the San Juan HU (e.g., San Onofre hydrologic area) found poor ecological health at most sites. Apart from one site in San Onofre Creek (site 23), all bioassessment samples were in poor or very poor ecological condition, and had IBI scores below 40.

This study's assessment of the San Juan HU suggests that the northern and coastal portions of the watershed are in poor ecological health, but the inland and southern portions (particularly San Juan and San Mateo Creeks, and to a lesser extent San Onofre Creek) are in moderate to good health. Multiple lines of evidence support this conclusion. For example, several water chemistry constituents exceeded aquatic life and human health thresholds, in the northern and coastal portions. Toxicity was observed at every site in this area, but not at some sites in the interior of the San Juan Creek watershed. Bioassessment samples were in very poor ecological health along the northern and coastal regions, but fair or good at the interior. Physical habitat was degraded at coastal and northern sites but less so in the interior.

Despite the strength of the evidence, limitations of this study affect the assessment. These limitations include difficulties integrating data from SWAMP and non-SWAMP sources, the non-randomization of sample sites, small sample size, and the lack of applicable thresholds for several indicators. Although these limitations require that results be interpreted with caution, it is unlikely that they would alter the conclusion that portions of the San Juan HU are in poor ecological health.

The geographical approach to integrating SWAMP and non-SWAMP data relies on assumptions about the spatial and temporal variability of the variables measured by these programs. For example, bioassessment data may have been collected up to 500 meters away and up to 4 years before or 3 years after water chemistry, toxicity, and tissue data were collected. This study assumes that anthropogenic impacts do not change across these distances or over these spans of time. There is little published research on either of these assumptions, although there may be greater support for the assumptions about spatial variability (e.g., Gebler 2004) than for temporal variability (e.g., Sandin and Johnson 2000, Bêche et al. 2006).In this study, bioassessment data were observed to be highly variable, and the use of data collected many years before water chemistry data is questionable.

The targeted selection of sites monitored under the SWAMP program facilitated integration of pre-existing data from non-SWAMP sources, but this non-probabilistic approach severely limits the extrapolation of data from these sites to the rest of the watershed. Non-random sampling violates assumptions underlying most statistical analyses, and the sites selected in this study cannot be assumed to represent the entire watershed (Olsen et al. 1999, Stevens Jr. and Olsen 2004). Although three reference sites were designated for monitoring under SWAMP (and four for monitoring under NPDES permittees and Camp Pendleton), it is unclear if the proportion of reference sites sampled reflect the proportion of minimally degraded streams in the HU.

The small number of sites monitored under SWAMP also limits the certainty of this study's assessment. For example, tissue samples were collected at only one site, and only a small number of constituents were evaluated; therefore, tissue contamination may have gone undetected in unsampled regions of the watershed. Although SWAMP has produced a wealth of data about the San Juan watershed using limited resources, some indicators (especially those with high variability) may require more extensive sampling to produce more precise and accurate assessments.

Thresholds are an essential tool for assessing water quality and ecological health. However, their use is limited to indicators that have been well studied, and they cannot provide a holistic view watershed health. This limitation is exacerbated by the fact that many constituents and indicators lack applicable thresholds. For example, of the 54 water chemistry constituents, 20 (37%) had no applicable water quality objectives that could be used as thresholds for water quality. No thresholds exist for physical habitat scores. Furthermore, thresholds applied to IBI scores and toxicity were based on statistical distributions and professional judgment (respectively), rather than on risks to ecological health. For example, the 80% threshold used to identify toxic samples is based on the assumption that this level is ecologically meaningful, although this assumption has not been verified in the field. The development of biocriteria to establish meaningful thresholds for bioassessment is subject of active interest in California (Bernstein and Schiff 2002).

Despite these limitations, the data gathered under SWAMP and other programs strongly support the conclusion that the northern and coastal portions San Juan  HU are in poor ecological health, and that the southern and interior portions are in good ecological health. Some of these limitations (such as the lack of applicable thresholds and the small sample size) may in fact have caused this assessment to underestimate the severity of degradation in the watershed. All indicators showed signs of human impacts. Multiple stressors, including degraded water quality, sediment, and physical habitat are the likely cause of the impact. Future research (see final report on the SWAMP monitoring program for further study recommendations) is necessary to determine which stressors are responsible for the impacts seen in the watershed.

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# 7. APPENDICES

# APPENDIX I

**A. Beneficial uses of streams in the San Juan HU (California Regional Water Quality Control Board, San Diego Region 1994). B. Streams on the 303(d) list of impaired water bodies in the San Juan HU. HUC = Hydrologic Unit Code. MUN = Municipal and domestic supply. AGR = Agricultural supply. IND = Industrial service supply. REC1 = Contact recreation. REC2 = Non-contact recreation. WARM = Warm freshwater habitat. COLD = Cold freshwater habitat. WILD = Wildlife habitat. RARE = Rare, threatened, or endangered species. SPWN = Spawning, reproduction, and/or early development. X = Exempted from municipal supply. E = Existing beneficial use. P = Potential beneficial use.**

**A. Beneficial uses of streams in the San Juan HU.**

| San Juan Watershed (901) | HUC | MUN | AGR | IND | REC1 | REC2 | WARM | COLD | WILD | RARE | SPWN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Orange County coastal streams | | | | | | | | | | | |
| Moro canyon | 901.11 | X | E | | P | E | E | | E | | |
| Unnamed intermittent coastal streams | 901.11 | X | E | | P | E | E | | E | | |
| Emerald Canyon | 901.11 | X | E | | P | E | E | | E | | |
| Laguna Canyon | 901.12 | X | E | | P | E | E | | E | | |
| Blue Bird Canyon | 901.12 | X | E | | P | E | E | | E | | |
| Rim Rock Canyon | 901.12 | X | E | | P | E | E | | E | | |
| Unnamed intermittent coastal streams | 901.13 | X | E | | P | E | E | | E | | |
| Hobo Canyon | 901.13 | X | E | | P | E | E | | E | | |
| Aliso Creek Watershed | | | | | | | | | | | |
| Aliso Creek | | | | | | | | | | | |
| English Canyon Creek | 901.13 | X | E | | P | E | E | | | | |
| Sulphur Creek | 901.13 | X | E | | P | E | E | | | | |
| Wood Canyon | 901.13 | X | E | | P | E | E | | | | |
| Dana Point Watershed | | | | | | | | | | | |
| Unnamed intermittent coastal streams | 901.14 | X | E | | P | E | E | | E | | |
| Salt Creek | 901.14 | X | E | | P | E | E | | E | | |
| San Juan Canyon | 901.14 | X | E | | P | E | E | | E | | |
| Arroyo Salada | 901.14 | X | E | | P | E | E | | E | | |
| San Juan Creek Watershed | | | | | | | | | | | |
| San Juan Creek | 901.25 | X | E | E | E | E | E | E | E | | |
| Morrel Canyon | 901.25 | X | E | E | E | E | E | E | E | | |
| Decker Canyon | 901.25 | X | E | E | E | E | E | E | E | | |
| Long Canyon | 901.25 | X | E | E | E | E | E | E | E | | |
| Lion Canyon | 901.25 | X | E | E | E | E | E | E | E | | E |
| Hot Spring Canyon | 901.25 | X | E | E | E | E | E | E | E | | E |
| Cold Spring Canyon | 901.25 | X | E | E | E | E | E | E | E | | |
| Lucas Canyon | 901.25 | X | E | E | E | E | E | E | E | | |
| Aliso Canyon | 901.25 | X | E | E | E | E | E | E | E | | |
| Verdugo Canyon | 901.25 | X | E | E | E | E | E | E | E | | |
| Bell Canyon | 901.25 | X | E | E | E | E | E | E | E | | |
| Fox Canyon | 901.25 | X | E | E | E | E | E | E | E | | |
| Dove Canyon | 901.24 | X | E | E | E | E | E | E | E | | |
| Crow Canyon | 901.25 | X | E | E | E | E | E | E | E | | |
| San Juan Creek | 901.26 | X | E | E | E | E | E | E | E | | |
| Trampas Canyon | 901.26 | X | E | E | E | E | E | E | E | | |
| Canada Gobernadora | 901.24 | X | E | E | E | E | E | E | E | | |
| Canada Chiquita | 901.24 | X | E | E | E | E | E | E | E | | |
| San Juan Creek | 901.28 | X | E | E | E | E | E | E | E | | |
| San Juan Creek | 901.27 | X | E | E | E | E | E | E | E | | |
| Horno Creek | 901.27 | X | E | E | E | E | E | E | E | | |
| Arroyo Trabuco Creek | 901.22 | X | E | E | E | E | E | E | E | | E |
| Holy Jim Canyon | 901.22 | X | E | E | E | E | E | E | E | | E |
| Falls Canyon | 901.22 | X | E | E | E | E | E | E | E | | |
| Rose Canyon | 901.22 | X | E | E | E | E | E | E | E | | |
| Hickey Canyon | 901.22 | X | E | E | E | E | E | E | E | | |
| Live Oak Canyon | 901.22 | X | E | E | E | E | E | E | E | | |
| Arroyo Trabuco Creek | 901.23 | X | E | E | E | E | E | E | E | | |
| Tijeras Canyon | 901.23 | X | E | E | E | E | E | E | E | | |
| Arroyo Trabuco Creek | 901.27 | X | E | E | E | E | E | E | E | | |
| Oso Creek | 901.21 | X | E | E | E | E | E | E | E | | |
| La Paz Creek | 901.21 | X | E | E | E | E | E | E | E | | |

**Appendix Ia, continued.**

| San Juan Watershed (901) | HUC | MUN | AGR | IND | REC1 | REC2 | WARM | COLD | WILD | RARE | SPWN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Orange County Coastal Streams | | | | | | | | | | | |
| Prima Deshecha Canada | 901.31 | X | E | | P | E | E | | E | | |
| Unnamed intermittent coastal streams | 901.3 | X | E | | P | E | E | | E | | |
| Segunda Deshecha Canada | 901.32 | X | E | | P | E | E | | E | | |
| San Mateo Creek Watershed | | | | | | | | | | | |
| San Mateo Creek | 901.4 | X | | | P | E | E | E | E | E | E |
| Devil Canyon | 901.4 | X | | | P | E | E | E | E | | E |
| Cold Spring Canyon | 901.4 | X | | | P | E | E | E | E | | |
| San Mateo Canyon | 901.4 | X | | | P | E | E | E | E | E | E |
| Los Alamos Canyon | 901.4 | X | | | P | E | E | E | E | | E |
| Wildhorse Canyon | 901.4 | X | | | P | E | E | E | E | | |
| Tenaja Canyon | 901.4 | X | | | P | E | E | E | E | | E |
| Bluewater Canyon | 901.4 | X | | | P | E | E | E | E | | |
| Nickel Canyon | 901.4 | X | | | P | E | E | E | E | | |
| Christanitos Creek | 901.4 | X | | | P | E | E | E | E | | |
| Gabino Canyon | 901.4 | X | | | P | E | E | E | E | | |
| La Paz Canyon | 901.4 | X | | | P | E | E | E | E | | |
| Blind Canyon | 901.4 | X | | | P | E | E | E | E | | |
| Talega Canyon | 901.4 | X | | | P | E | E | E | E | | |
| San Onofre Creek Watershed | | | | | | | | | | | |
| San Onofre Creek | 901.51 | X | E | | E | E | E | E | E | | E |
| San Onofre Canyon North Fork | 901.51 | X | E | | E | E | E | E | E | | E |
| Jardine Canyon | 901.51 | X | E | | E | E | E | E | E | | |
| San Onofre Canyon | 901.51 | X | E | | E | E | E | E | E | | E |
| San Onofre Canyon South Fork | 901.51 | X | E | | E | E | E | E | E | E | |
| Unnamed intermittent coastal streams | 901.51 | X | E | | E | E | E | | E | | |
| Foley Canyon | 901.51 | X | E | | E | E | E | | E | | |
| Horno Canyon | 901.51 | X | E | | E | E | E | | E | | |
| Las Flores Creek | 901.52 | X | E | | E | E | E | E | E | E | |
| Piedra de Lumbre Canyon | 901.52 | X | E | | E | E | E | E | E | E | |
| Unnamed intermittent coastal streams | 901.52 | X | E | | E | E | E | | E | | |
| Aliso Canyon | 901.53 | X | E | | E | E | E | E | E | E | |
| French Canyon | 901.53 | X | E | | E | E | E | | E | E | |
| Cocklebur Canyon | 901.53 | X | E | | E | E | E | | E | | |

**B. 303(d)-listed streams in the San Juan HU.**

| Name | HUC | Stressor | Potential source | Affected length |
|---|---|---|---|---|
| Aliso Creek | 901.13 | Indicator bactera | Urban runoff/storm sewers, unknown point source, and nonpoint/point source | 19 miles |
| | | Phosphorus | Urban runoff/storm sewers, unknown point source, and nonpoint/point source | 19 miles |
| | | Toxicity | Urban runoff/storm sewers, unknown point source, and nonpoint/point source | 19 miles |
| English Canyon | 901.13 | Benzo(b)fluoranthene | Sources unknown | 3.6 miles |
| | | Dieldrin | Sources unknown | 3.6 miles |
| | | Sediment toxicity | Sources unknown | 3.6 miles |
| Laguna Canyon Channel | 901.12 | Sediment toxicity | Sources unknown | 1.6 miles |
| Oso Creek (at Mission Viejo Golf Course) | 901.2 | Chloride | Sources unknown | 1 miles |
| | | Sulfates | Sources unknown | 1 miles |
| | | Total dissolved solids | Sources unknown | 1 miles |
| Prima Deshecha Creek | 901.3 | Phosphorus | Urban runoff/storm sewers, unknown point source, and nonpoint/point source | 1.2 miles |
| | | Turbidity | Urban runoff/storm sewers, unknown point source, and nonpoint/point source | 1.2 miles |
| San Juan Creek | 901.2 | DDE | Sources unknown | 1 miles |
| | | Indicator bactera | Nonpoint/point source | 1 miles |
| Segunda Deshecha Creek | 901.3 | Phosphorus | Urban runoff/storm sewers, unknown point source, and nonpoint/point source | 0.92 miles |
| | | Turbidity | Construction/land development, urban runoff/storm sewers, channelization, flow regulation/modifications, unknown nonpoint source, unknown point source | 0.92 miles |

# APPENDIX II

**Means, standard deviations (SD), and number of samples (n) of water chemistry constituents in (A) SWAMP sites and (B) Non-SWAMP (NPDES) sites. The watershed average was calculated as the mean of the site averages. Blank cells indicate that the constituent was not analyzed at that site. -- = Constituent not detected at that site. SWAMP sites were monitored in 2002 to 2003. Non-SWAMP sites were monitored in Spring and Fall between 2002 and 2006.**

## A. SWAMP sites

| | | | 901SJALC6 | | | 901SJATC2 | | | 901SJATC5 | | | 901SJBEL2 | | | 901SJENG2 | | | 901SJLAG2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Constituent | Units | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n |
| Inorganics | Alkalinity as CaCO3 | mg/l | 180 | 71 | 4 | 112 | 80 | 2 | 186 | 45 | 4 | 162 | 22 | 2 | 179 | 98 | 4 | 309 | 119 | 4 |
| Inorganics | Ammonia as N | mg/l | 0.09 | 0.11 | 4 | 0.1 | 0.14 | 2 | 0.02 | 0.03 | 4 | 0.03 | 0.04 | 2 | 0.48 | 0.72 | 4 | 0.03 | 0.03 | 4 |
| Inorganics | Nitrate + Nitrite as N | mg/l | 0.52 | 0.35 | 4 | 0.54 | 0.35 | 2 | 0.1 | 0.1 | 4 | 0.1 | 0.03 | 2 | 0.4 | 0.24 | 4 | 0.16 | 0.13 | 4 |
| Inorganics | Nitrate as N | mg/l | 0.51 | 0.34 | 4 | 0.53 | 0.34 | 2 | 0.1 | 0.1 | 4 | 0.1 | 0.03 | 2 | 0.37 | 0.22 | 4 | 0.16 | 0.12 | 4 |
| Inorganics | Nitrite as N | mg/l | 0.02 | 0.02 | 4 | 0.01 | 0.02 | 2 | -- | -- | 4 | -- | -- | 2 | 0.03 | 0.03 | 4 | 0.01 | 0.01 | 4 |
| Inorganics | Nitrogen, Total Kjeldahl | mg/l | 0.69 | 0.38 | 4 | 1.84 | 2.27 | 2 | 0.29 | 0.27 | 4 | 0.23 | 0.15 | 2 | 1.16 | 1.13 | 4 | 1.03 | 0.94 | 4 |
| Inorganics | OrthoPhosphate as P | mg/l | 0.17 | 0.07 | 4 | 0.1 | 0.11 | 2 | 0.04 | 0.02 | 4 | 0.03 | 0.01 | 2 | 0.17 | 0.08 | 4 | 0.19 | 0.05 | 4 |
| Inorganics | Phosphorus as P,Total | mg/l | 0.24 | 0.16 | 4 | 0.71 | 1 | 2 | 0.1 | 0.11 | 4 | 0.08 | 0.11 | 2 | 0.28 | 0.25 | 4 | 0.21 | 0.05 | 4 |
| Inorganics | Selenium,Dissolved | µg/l | 22 | 22.1 | 4 | 2.8 | 0.4 | 2 | 1.5 | 0.8 | 4 | 3.1 | 0.1 | 2 | 5.5 | 3.8 | 4 | 2 | 1.1 | 4 |
| Inorganics | Sulfate | mg/l | 943 | 513 | 4 | 105 | 59 | 3 | 183 | 47 | 4 | 151 | 16 | 2 | 298 | 191 | 4 | 212 | 90 | 4 |
| Metals | Aluminum,Dissolved | µg/l | 1.6 | 0.7 | 4 | 0.5 | 0.8 | 2 | 0.8 | 1.3 | 4 | 0.4 | 0.6 | 2 | 1.6 | 1.6 | 4 | 1.5 | 2.4 | 4 |
| Metals | Arsenic,Dissolved | µg/l | 7.7 | 5.3 | 4 | 1.4 | 0.4 | 2 | 2.9 | 0.8 | 4 | 0.9 | 0.2 | 2 | 3.1 | 1.2 | 4 | 3.2 | 0.3 | 4 |
| Metals | Cadmium,Dissolved | µg/l | 0.62 | 0.25 | 4 | 0.05 | 0.01 | 2 | 0.04 | 0.01 | 4 | 0.02 | 0.01 | 2 | 0.23 | 0.13 | 4 | 0.05 | 0.01 | 4 |
| Metals | Chromium,Dissolved | µg/l | 0.63 | 0.3 | 4 | 0.1 | 0.14 | 2 | 0.15 | 0.1 | 4 | -- | -- | 2 | 0.24 | 0.06 | 4 | 0.23 | 0.11 | 4 |
| Metals | Copper,Dissolved | µg/l | 6.94 | 2.21 | 4 | 1.83 | 0.12 | 2 | 2.1 | 0.52 | 4 | 1.51 | 0.24 | 2 | 4.27 | 0.81 | 4 | 2.55 | 0.73 | 4 |
| Metals | Lead,Dissolved | µg/l | 0.02 | 0.01 | 4 | 0.01 | 0.01 | 2 | 0.02 | 0.02 | 4 | -- | -- | 2 | 0.05 | 0.03 | 4 | 0.03 | 0.02 | 4 |
| Metals | Manganese,Dissolved | µg/l | 125 | 65 | 4 | 16 | 7 | 2 | 6 | 6 | 4 | 3 | 3 | 2 | 9 | 7 | 4 | 188 | 210 | 4 |
| Metals | Nickel,Dissolved | µg/l | 14.3 | 2.7 | 4 | -- | -- | 2 | 0.9 | 0.5 | 4 | -- | -- | 2 | 2.5 | 1.4 | 4 | 1.9 | 1.3 | 4 |
| Metals | Silver,Dissolved | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | 0 | 0.01 | 4 |
| Metals | Zinc,Dissolved | µg/l | 6.5 | 1.5 | 4 | 1.2 | 0.2 | 2 | 1.6 | 0.4 | 4 | 0.8 | 0 | 2 | 5.6 | 1.9 | 4 | 2.6 | 0.5 | 4 |
| PAHs | Acenaphthene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Acenaphthylene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Anthracene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Benz(a)anthracene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Benzo(a)pyrene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.017 | 0.034 | 4 | -- | -- | 4 |
| PAHs | Benzo(b)fluoranthene | µg/l | 0.003 | 0.006 | 4 | -- | -- | 2 | 0.004 | 0.007 | 4 | -- | -- | 2 | 0.018 | 0.024 | 4 | 0.003 | 0.005 | 4 |
| PAHs | Benzo(e)pyrene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.009 | 0.018 | 4 | -- | -- | 4 |
| PAHs | Benzo(g,h,i)perylene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.024 | 0.035 | 4 | 0.012 | 0.023 | 4 |
| PAHs | Benzo(k)fluoranthene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.014 | 0.028 | 4 | -- | -- | 4 |
| PAHs | Biphenyl | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Chrysene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.003 | 0.007 | 4 | -- | -- | 4 |
| PAHs | Chrysenes, C1 - | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.004 | 0.008 | 4 | -- | -- | 4 |
| PAHs | Chrysenes, C2 - | µg/l | -- | -- | 4 | -- | -- | 2 | 0.003 | 0.005 | 4 | -- | -- | 2 | 0.006 | 0.012 | 4 | -- | -- | 4 |
| PAHs | Chrysenes, C3 - | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.178 | 0.339 | 4 | -- | -- | 4 |
| PAHs | Dibenz(a,h)anthracene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.024 | 0.047 | 4 | -- | -- | 4 |
| PAHs | Dibenzothiophene | µg/l | -- | -- | 4 | -- | -- | 2 | 0.003 | 0.007 | 4 | -- | -- | 2 | 0.008 | 0.016 | 4 | -- | -- | 4 |
| PAHs | Dibenzothiophenes, C1 - | µg/l | 0.007 | 0.014 | 4 | 0.009 | 0.012 | 2 | 0.014 | 0.021 | 4 | 0.006 | 0.008 | 2 | 0.028 | 0.055 | 4 | 0.005 | 0.01 | 4 |
| PAHs | Dibenzothiophenes, C2 - | µg/l | 0.013 | 0.025 | 4 | 0.02 | 0.005 | 2 | 0.024 | 0.035 | 4 | 0.017 | 0.004 | 2 | 0.052 | 0.103 | 4 | 0.009 | 0.018 | 4 |
| PAHs | Dibenzothiophenes, C3 - | µg/l | 0.008 | 0.016 | 4 | 0.008 | 0.011 | 2 | 0.012 | 0.024 | 4 | -- | -- | 2 | 0.03 | 0.061 | 4 | 0.006 | 0.012 | 4 |
| PAHs | Dimethylnaphthalene, 2,6- | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Fluoranthene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.003 | 0.005 | 4 | -- | -- | 4 |
| PAHs | Fluoranthene/Pyrenes, C1 - | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Fluorene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Fluorenes, C1 - | µg/l | 0.003 | 0.007 | 4 | -- | -- | 2 | 0.003 | 0.006 | 4 | -- | -- | 2 | 0.008 | 0.015 | 4 | 0.003 | 0.006 | 4 |
| PAHs | Fluorenes, C2 - | µg/l | 0.003 | 0.005 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.004 | 0.007 | 4 | 0.003 | 0.005 | 4 |
| PAHs | Fluorenes, C3 - | µg/l | 0.018 | 0.023 | 4 | 0.006 | 0.009 | 2 | 0.006 | 0.012 | 4 | -- | -- | 2 | 0.011 | 0.023 | 4 | 0.004 | 0.008 | 4 |
| PAHs | Indeno(1,2,3-c,d)pyrene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.032 | 0.053 | 4 | -- | -- | 4 |
| PAHs | Methylnaphthalene, 1- | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Methylnaphthalene, 2- | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Methylphenanthrene, 1- | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |

**Appendix IIa, continued. Means and standard deviations of water chemistry constituents.**

| | | | 901SJALC6 | | | 901SJATC2 | | | 901SJATC5 | | | 901SJBEL2 | | | 901SJENG2 | | | 901SJLAG2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Constituent | Units | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n |
| PAHs | Naphthalene | µg/l | -- | -- | 4 | -- | -- | 2 | 0.004 | 0.007 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Naphthalenes, C1 - | µg/l | -- | -- | 4 | -- | -- | 2 | 0.003 | 0.005 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Naphthalenes, C2 - | µg/l | -- | -- | 4 | -- | -- | 2 | 0.004 | 0.007 | 4 | -- | -- | 2 | 0.004 | 0.008 | 4 | -- | -- | 4 |
| PAHs | Naphthalenes, C3 - | µg/l | 0.005 | 0.011 | 4 | 0.006 | 0.008 | 2 | 0.008 | 0.016 | 4 | -- | -- | 2 | 0.008 | 0.016 | 4 | 0.003 | 0.007 | 4 |
| PAHs | Naphthalenes, C4 - | µg/l | 0.003 | 0.006 | 4 | 0.022 | 0.031 | 2 | 0.013 | 0.025 | 4 | -- | -- | 2 | 0.026 | 0.052 | 4 | 0.003 | 0.007 | 4 |
| PAHs | Perylene | µg/l | -- | -- | 4 | -- | -- | 2 | 0.007 | 0.014 | 4 | -- | -- | 2 | 0.01 | 0.021 | 4 | -- | -- | 4 |
| PAHs | Phenanthrene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PAHs | Phenanthrene/Anthracene, C1 - | µg/l | 0.004 | 0.008 | 4 | -- | -- | 2 | 0.011 | 0.016 | 4 | 0.007 | 0.009 | 2 | 0.012 | 0.017 | 4 | 0.004 | 0.008 | 4 |
| PAHs | Phenanthrene/Anthracene, C2 - | µg/l | 0.004 | 0.008 | 4 | 0.006 | 0.008 | 2 | 0.004 | 0.009 | 4 | -- | -- | 2 | 0.007 | 0.015 | 4 | -- | -- | 4 |
| PAHs | Phenanthrene/Anthracene, C3 - | µg/l | 0.003 | 0.007 | 4 | -- | -- | 2 | 0.004 | 0.007 | 4 | -- | -- | 2 | 0.008 | 0.017 | 4 | 0.004 | 0.007 | 4 |
| PAHs | Phenanthrene/Anthracene, C4 - | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | 0.004 | 0.008 | 4 |
| PAHs | Pyrene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.004 | 0.009 | 4 | -- | -- | 4 |
| PAHs | Trimethylnaphthalene, 2,3,5- | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 005 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 008 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 015 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 018 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 027 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 028 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 029 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 031 | µg/l | 0.001 | 0.002 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 033 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 044 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 049 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 052 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | 0.003 | 0.006 | 4 |
| PCBs | PCB 056 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 060 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 066 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 070 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 074 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 087 | µg/l | 0.002 | 0.004 | 4 | -- | -- | 2 | 0.001 | 0.002 | 4 | -- | -- | 2 | 0.001 | 0.002 | 4 | 0.001 | 0.002 | 4 |
| PCBs | PCB 095 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 097 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 099 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 101 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 105 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 110 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 114 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 118 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 128 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 137 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 138 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 141 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 149 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 151 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 153 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 156 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 157 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 158 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 170 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 174 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 177 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 180 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 183 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 187 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 189 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 194 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 195 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 200 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 201 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 203 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 206 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCB 209 | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| PCBs | PCBs | µg/l | 0.003 | 0.006 | 4 | -- | -- | 2 | 0.001 | 0.002 | 4 | -- | -- | 2 | 0.001 | 0.002 | 4 | 0.004 | 0.008 | 4 |

**Appendix IIa, continued. Means and standard deviations of water chemistry constituents.**

| | | | 901SJALC6 | | | 901SJATC2 | | | 901SJATC5 | | | 901SJBEL2 | | | 901SJENG2 | | | 901SJLAG2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Constituent | Units | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n |
| Pesticides | Aldrin | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Ametryn | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Aspon | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Atraton | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Atrazine | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Azinphos ethyl | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Azinphos methyl | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Bolstar | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Carbophenothion | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Chlordane, cis- | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.002 | 0.005 | 4 | -- | -- | 4 |
| Pesticides | Chlordane, trans- | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Chlordene, alpha- | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Chlordene, gamma- | µg/l | 0.001 | 0.003 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 4 |
| Pesticides | Chlorfenvinphos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Chlorpyrifos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Chlorpyrifos methyl | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Ciodrin | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Coumaphos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Dacthal | µg/l | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 2 | -- | -- | 4 | 0.001 | 0.002 | 4 |
| Pesticides | DDD(o,p') | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | DDD(p,p') | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | 0 | 0.001 | 4 |
| Pesticides | DDE(o,p') | µg/l | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | DDE(p,p') | µg/l | 0.001 | 0.001 | 4 | 0.001 | 0.001 | 2 | 0.001 | 0.001 | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 4 |
| Pesticides | DDMU(p,p') | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | DDT(o,p') | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | DDT(p,p') | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.002 | 4 | -- | -- | 4 |
| Pesticides | DDTs | µg/l | 0.001 | 0.001 | 4 | 0.001 | 0.001 | 2 | 0.001 | 0.002 | 4 | -- | -- | 2 | 0.001 | 0.003 | 4 | 0 | 0.001 | 4 |
| Pesticides | Demeton-s | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Diazinon | µg/l | 0.049 | 0.027 | 4 | -- | -- | 2 | 0.044 | 0.058 | 4 | -- | -- | 2 | 0.204 | 0.286 | 4 | 0.029 | 0.036 | 4 |
| Pesticides | Dichlofenthion | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Dichlorvos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Dicrotophos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Dieldrin | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.001 | 4 | 0 | 0.001 | 4 |
| Pesticides | Dimethoate | µg/l | 0.01 | 0.02 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Dioxathion | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Disulfoton | µg/l | 0.008 | 0.015 | 4 | -- | -- | 2 | 0.008 | 0.015 | 4 | -- | -- | 2 | 0.008 | 0.015 | 4 | 0.008 | 0.015 | 4 |
| Pesticides | Endosulfan I | µg/l | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 2 | 0.001 | 0.001 | 4 | 0 | 0.001 | 4 |
| Pesticides | Endosulfan II | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 4 |
| Pesticides | Endosulfan sulfate | µg/l | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 4 |
| Pesticides | Endrin | µg/l | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 2 | -- | -- | 4 | 0 | 0.001 | 4 |
| Pesticides | Endrin Aldehyde | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Endrin Ketone | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Ethion | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Ethoprop | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Famphur | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Fenchlorphos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Fenitrothion | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Fensulfothion | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Fenthion | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Fonofos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | HCH, alpha | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | 0 | 0.001 | 4 |
| Pesticides | HCH, beta | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | HCH, delta | µg/l | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 2 | -- | -- | 4 | 0 | 0.001 | 4 |
| Pesticides | HCH, gamma | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Heptachlor | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Heptachlor epoxide | µg/l | 0 | 0.001 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.002 | 4 | 0 | 0.001 | 4 |
| Pesticides | Hexachlorobenzene | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 4 | -- | -- | 4 |
| Pesticides | Leptophos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Malathion | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Merphos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Methidathion | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Methoxychlor | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Mevinphos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |

## Appendix IIa, continued. Means and standard deviations of water chemistry constituents.

| | | | 901SJALC6 | | | 901SJATC2 | | | 901SJATC5 | | | 901SJBEL2 | | | 901SJENG2 | | | 901SJLAG2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Constituent | Units | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n |
| Pesticides | Mirex | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Molinate | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Naled | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Nonachlor, cis- | µg/l | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Nonachlor, trans- | µg/l | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Oxadiazon | µg/l | 0.012 | 0.009 | 4 | 0.001 | -- | 2 | 0.046 | 0.061 | 4 | -- | -- | 2 | 0.006 | 0.007 | 4 | 0.052 | 0.034 | 4 |
| Pesticides | Oxychlordane | µg/l | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Parathion, Ethyl | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Parathion, Methyl | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Phorate | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Phosmet | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Phosphamidon | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Prometon | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Prometryn | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Propazine | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Secbumeton | µg/l | 0.017 | 0.034 | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | 0.013 | 0.026 | 4 |
| Pesticides | Simazine | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Simetryn | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Sulfotep | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Tedion | µg/l | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0.001 | 4 | -- | -- | 4 |
| Pesticides | Terbufos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Terbuthylazine | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Terbutryn | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Tetrachlorvinphos | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Thiobencarb | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | 0.038 | 0.075 | 4 |
| Pesticides | Thionazin | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Tokuthion | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Trichlorfon | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Pesticides | Trichloronate | µg/l | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 2 | -- | -- | 4 | -- | -- | 4 |
| Physical | Fine-ASTM,Passing No. 200 Sieve | % | 7.2 | 9.3 | 3 | 22.9 | -- | 1 | 33.3 | 17.5 | 3 | | | | 11.1 | 9.2 | 4 | 28.8 | 31.7 | 4 |
| Physical | Oxygen, Saturation | % | 145 | 30 | 4 | 94 | 8 | 2 | 127 | 22 | 4 | 95 | 6 | 2 | 132 | 28 | 4 | 94 | 15 | 4 |
| Physical | pH | pH | 8.1 | 0.6 | 4 | 7.8 | 0.4 | 2 | 8.2 | 0.5 | 3 | 8 | 0 | 2 | 8.7 | 1.5 | 4 | 7.5 | 0.6 | 4 |
| Physical | Salinity | ppt | 3.8 | 4.1 | 4 | 0.2 | 0 | 2 | 0.4 | 0.3 | 4 | 0.2 | 0 | 2 | 0.6 | 0.5 | 3 | 0.6 | 0.4 | 3 |
| Physical | SpecificConductivity | mS/cm | 6756 | 6892 | 4 | 420 | 103 | 2 | 844 | 501 | 4 | 426 | 18 | 2 | 1330 | 805 | 4 | 1299 | 638 | 4 |
| Physical | Suspended Sediment Concentration | % | 3 | -- | 1 | | | | 1 | -- | 1 | | | | 4 | -- | 1 | 321.1 | -- | 1 |
| Physical | Temperature | ºC | 16.7 | 3.1 | 4 | 18.1 | 6.8 | 2 | 16.4 | 2.4 | 4 | 15.8 | 2.9 | 2 | 19.7 | 4.4 | 4 | 14.6 | 2.2 | 4 |
| Physical | Total Suspended Solids | mg/l | 46.4 | 76.1 | 3 | 139.2 | 190.7 | 2 | 420.2 | 724.7 | 3 | 112.5 | 159.1 | 2 | 121.3 | 199.9 | 3 | 10.9 | 4.7 | 3 |
| Physical | Turbidity | NTU | 22.9 | 38.1 | 4 | 95.3 | 125.4 | 2 | 73.8 | 142.9 | 4 | 140.3 | 197.6 | 2 | 58 | 108.1 | 4 | 4.2 | 4 | 4 |
| Physical | Velocity | ft/s | -- | -- | 4 | 1.3 | 0.7 | 2 | 0.6 | 0.6 | 4 | 1.8 | 1.4 | 2 | 0.6 | 0.6 | 4 | 0.2 | 0.3 | 4 |

## Appendix IIa, continued. Means and standard deviations of water chemistry constituents.

| | | | 901SJMCC2 | | | 901SJOSO3 | | | 901SJSJC5 | | | 901SJSJC9 | | | 901SJSMT2 | | | Watershed mean | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Constituent | Units | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n |
| Inorganics | Alkalinity as CaCO3 | mg/l | 427 | 19 | 4 | 166 | 96 | 4 | 123 | 26 | 4 | 193 | 55 | 4 | 128 | 27 | 2 | 197 | 92 | 11 |
| Inorganics | Ammonia as N | mg/l | 0.32 | 0.24 | 4 | 0.81 | 1.41 | 4 | -- | -- | 4 | 0.08 | 0.1 | 4 | -- | -- | 2 | 0.18 | 0.26 | 11 |
| Inorganics | Nitrate + Nitrite as N | mg/l | 0.45 | 0.13 | 4 | 0.92 | 0.7 | 4 | 0.05 | 0.01 | 4 | 0.57 | 0.68 | 4 | 0.09 | 0.08 | 2 | 0.36 | 0.28 | 11 |
| Inorganics | Nitrate as N | mg/l | 0.42 | 0.12 | 4 | 0.87 | 0.66 | 4 | 0.05 | 0.01 | 4 | 0.55 | 0.66 | 4 | 0.09 | 0.07 | 2 | 0.34 | 0.26 | 11 |
| Inorganics | Nitrite as N | mg/l | 0.03 | 0.02 | 4 | 0.05 | 0.04 | 4 | -- | -- | 4 | 0.02 | 0.02 | 4 | 0 | 0 | 2 | 0.02 | 0.02 | 11 |
| Inorganics | Nitrogen, Total Kjeldahl | mg/l | 0.98 | 0.46 | 4 | 1.57 | 1.5 | 4 | 0.03 | 0.06 | 4 | 0.6 | 0.55 | 4 | 0.41 | 0.23 | 2 | 0.8 | 0.57 | 11 |
| Inorganics | OrthoPhosphate as P | mg/l | 0.13 | 0.01 | 4 | 0.22 | 0.18 | 4 | 0.01 | 0 | 4 | 0.1 | 0.13 | 4 | 0.04 | 0.03 | 2 | 0.11 | 0.07 | 11 |
| Inorganics | Phosphorus as P,Total | mg/l | 0.31 | 0.12 | 4 | 0.37 | 0.32 | 4 | 0.01 | 0.02 | 4 | 0.17 | 0.23 | 4 | 0.04 | 0.05 | 2 | 0.23 | 0.2 | 11 |
| Inorganics | Selenium,Dissolved | µg/l | 19.7 | 8 | 4 | 10.3 | 7.9 | 4 | 1.8 | 0.6 | 4 | 4.7 | 2 | 4 | 1.1 | 0 | 2 | 6.8 | 7.4 | 11 |
| Inorganics | Sulfate | mg/l | 1415 | 152 | 4 | 761 | 506 | 4 | 109 | 21 | 4 | 549 | 292 | 4 | 46 | 20 | 2 | 434 | 438 | 11 |
| Metals | Aluminum,Dissolved | µg/l | 1.4 | 1.1 | 4 | 8.3 | 6.1 | 4 | 1.5 | 2.1 | 4 | 1.1 | 0.9 | 4 | 1.3 | 0 | 2 | 1.8 | 2.2 | 11 |
| Metals | Arsenic,Dissolved | µg/l | 3.5 | 0.9 | 4 | 4.8 | 1.9 | 4 | 1.4 | 0.2 | 4 | 3.2 | 0.2 | 4 | 1.5 | 0.2 | 2 | 3.1 | 1.9 | 11 |
| Metals | Cadmium,Dissolved | µg/l | 0.29 | 0.05 | 4 | 0.73 | 0.7 | 4 | 0.03 | 0 | 4 | 0.26 | 0.15 | 4 | 0.03 | 0.01 | 2 | 0.21 | 0.25 | 11 |
| Metals | Chromium,Dissolved | µg/l | 0.37 | 0.18 | 4 | 0.43 | 0.09 | 4 | -- | -- | 4 | 0.26 | 0.06 | 4 | 0.05 | 0.07 | 2 | 0.22 | 0.2 | 11 |
| Metals | Copper,Dissolved | µg/l | 7.69 | 2.47 | 4 | 7.25 | 3.53 | 4 | 1.02 | 0.18 | 4 | 4.51 | 1.08 | 4 | 2.06 | 1.93 | 2 | 3.79 | 2.49 | 11 |
| Metals | Lead,Dissolved | µg/l | 0 | 0 | 4 | 0.06 | 0.02 | 4 | 0.01 | 0.01 | 4 | 0.02 | 0.01 | 4 | 0.02 | 0.01 | 2 | 0.02 | 0.02 | 11 |
| Metals | Manganese,Dissolved | µg/l | 902 | 643 | 4 | 50 | 44 | 4 | 2 | 1 | 4 | 87 | 82 | 4 | 22 | 23 | 2 | 128 | 264 | 11 |
| Metals | Nickel,Dissolved | µg/l | 15.6 | 1.5 | 4 | 8.7 | 4.8 | 4 | 0.1 | 0.1 | 4 | 3.7 | 1.4 | 4 | 0.2 | 0.2 | 2 | 4.4 | 5.8 | 11 |
| Metals | Silver,Dissolved | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Metals | Zinc,Dissolved | µg/l | 8.1 | 1.4 | 4 | 7.9 | 3.4 | 4 | 0.9 | 0.5 | 4 | 4.1 | 1.6 | 4 | 1.1 | 1.4 | 2 | 3.7 | 2.9 | 11 |

**Appendix IIa, continued. Means and standard deviations of water chemistry constituents.**

| | | | 901SJMCC2 | | | 901SJOSO3 | | | 901SJSJC5 | | | 901SJSJC9 | | | 901SJSMT2 | | | Watershed mean | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Constituent | Units | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n |
| PAHs | Acenaphthene | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PAHs | Acenaphthylene | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PAHs | Anthracene | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PAHs | Benz(a)anthracene | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PAHs | Benzo(a)pyrene | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.002 | 0.005 | 11 |
| PAHs | Benzo(b)fluoranthene | µg/l | 0.003 | 0.005 | 4 | 0.005 | 0.01 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.003 | 0.005 | 11 |
| PAHs | Benzo(e)pyrene | µg/l | -- | -- | 4 | 0.004 | 0.007 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.003 | 11 |
| PAHs | Benzo(g,h,i)perylene | µg/l | -- | -- | 4 | 0.006 | 0.012 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.004 | 0.008 | 11 |
| PAHs | Benzo(k)fluoranthene | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.004 | 11 |
| PAHs | Biphenyl | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PAHs | Chrysene | µg/l | -- | -- | 4 | 0.004 | 0.009 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.002 | 11 |
| PAHs | Chrysenes, C1 - | µg/l | -- | -- | 4 | 0.004 | 0.009 | 4 | 0.01 | 0.02 | 4 | -- | -- | 4 | -- | -- | 2 | 0.002 | 0.003 | 11 |
| PAHs | Chrysenes, C2 - | µg/l | -- | -- | 4 | 0.005 | 0.01 | 4 | 0.012 | 0.024 | 4 | -- | -- | 4 | -- | -- | 2 | 0.002 | 0.004 | 11 |
| PAHs | Chrysenes, C3 - | µg/l | -- | -- | 4 | 0.008 | 0.015 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.017 | 0.054 | 11 |
| PAHs | Dibenz(a,h)anthracene | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.002 | 0.007 | 11 |
| PAHs | Dibenzothiophene | µg/l | -- | -- | 4 | 0.005 | 0.011 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.002 | 0.003 | 11 |
| PAHs | Dibenzothiophenes, C1 - | µg/l | 0.006 | 0.006 | 4 | 0.017 | 0.025 | 4 | -- | -- | 4 | 0.005 | 0.01 | 4 | 0.02 | 0.011 | 2 | 0.011 | 0.008 | 11 |
| PAHs | Dibenzothiophenes, C2 - | µg/l | 0.007 | 0.008 | 4 | 0.033 | 0.052 | 4 | -- | -- | 4 | 0.008 | 0.017 | 4 | 0.015 | 0.008 | 2 | 0.018 | 0.014 | 11 |
| PAHs | Dibenzothiophenes, C3 - | µg/l | -- | -- | 4 | 0.024 | 0.041 | 4 | -- | -- | 4 | 0.005 | 0.01 | 4 | -- | -- | 2 | 0.008 | 0.01 | 11 |
| PAHs | Dimethylnaphthalene, 2,6- | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PAHs | Fluoranthene | µg/l | -- | -- | 4 | 0.005 | 0.011 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.002 | 11 |
| PAHs | Fluoranthene/Pyrenes, C1 - | µg/l | -- | -- | 4 | 0.004 | 0.008 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 11 |
| PAHs | Fluorene | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PAHs | Fluorenes, C1 - | µg/l | -- | -- | 4 | 0.003 | 0.005 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.002 | 0.002 | 11 |
| PAHs | Fluorenes, C2 - | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.001 | 11 |
| PAHs | Fluorenes, C3 - | µg/l | -- | -- | 4 | 0.011 | 0.021 | 4 | -- | -- | 4 | 0.003 | 0.006 | 4 | -- | -- | 2 | 0.005 | 0.006 | 11 |
| PAHs | Indeno(1,2,3-c,d)pyrene | µg/l | -- | -- | 4 | 0.005 | 0.01 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.003 | 0.01 | 11 |
| PAHs | Methylnaphthalene, 1- | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PAHs | Methylnaphthalene, 2- | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PAHs | Methylphenanthrene, 1- | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PAHs | Naphthalene | µg/l | -- | -- | 4 | 0.009 | 0.019 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.003 | 11 |
| PAHs | Naphthalenes, C1 - | µg/l | -- | -- | 4 | 0.01 | 0.02 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.003 | 11 |
| PAHs | Naphthalenes, C2 - | µg/l | -- | -- | 4 | 0.003 | 0.007 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.002 | 11 |
| PAHs | Naphthalenes, C3 - | µg/l | -- | -- | 4 | 0.004 | 0.007 | 4 | -- | -- | 4 | 0.003 | 0.007 | 4 | -- | -- | 2 | 0.003 | 0.003 | 11 |
| PAHs | Naphthalenes, C4 - | µg/l | -- | -- | 4 | 0.015 | 0.03 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.007 | 0.01 | 11 |
| PAHs | Perylene | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.002 | 0.004 | 11 |
| PAHs | Phenanthrene | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PAHs | Phenanthrene/Anthracene, C1 - | µg/l | -- | -- | 4 | 0.009 | 0.012 | 4 | -- | -- | 4 | 0.005 | 0.01 | 4 | -- | -- | 2 | 0.005 | 0.004 | 11 |
| PAHs | Phenanthrene/Anthracene, C2 - | µg/l | -- | -- | 4 | 0.006 | 0.012 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.002 | 0.003 | 11 |
| PAHs | Phenanthrene/Anthracene, C3 - | µg/l | -- | -- | 4 | 0.008 | 0.015 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.002 | 0.003 | 11 |
| PAHs | Phenanthrene/Anthracene, C4 - | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 11 |
| PAHs | Pyrene | µg/l | 0.008 | 0.015 | 4 | 0.014 | 0.016 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.002 | 0.005 | 11 |
| PAHs | Trimethylnaphthalene, 2,3,5- | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 005 | µg/l | 0.001 | 0.002 | 4 | 0.003 | 0.005 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 11 |
| PCBs | PCB 008 | µg/l | -- | -- | 4 | 0.004 | 0.008 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 11 |
| PCBs | PCB 015 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 018 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 027 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 028 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 029 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 031 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| PCBs | PCB 033 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 044 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 049 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 052 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 11 |
| PCBs | PCB 056 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 060 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 066 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 070 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 074 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 087 | µg/l | -- | -- | 4 | 0.002 | 0.003 | 4 | -- | -- | 4 | 0.002 | 0.004 | 4 | -- | -- | 2 | 0.001 | 0.001 | 11 |
| PCBs | PCB 095 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 097 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |

**Appendix IIa, continued. Means and standard deviations of water chemistry constituents.**

| | | | 901SJMCC2 | | | 901SJOSO3 | | | 901SJSJC5 | | | 901SJSJC9 | | | 901SJSMT2 | | | Watershed mean | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Constituent | Units | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n |
| PCBs | PCB 099 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 101 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 105 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 110 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 114 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 118 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 128 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 137 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 138 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 141 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 149 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 151 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 153 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 156 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 157 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 158 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 170 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 174 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 177 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 180 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 183 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 187 | µg/l | -- | -- | 4 | 0.001 | 0.002 | 4 | -- | -- | 4 | 0.001 | 0.001 | 4 | -- | -- | 2 | 0 | 0 | 11 |
| PCBs | PCB 189 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 194 | µg/l | -- | -- | 4 | -- | -- | 4 | 0.002 | 0.004 | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 11 |
| PCBs | PCB 195 | µg/l | -- | -- | 4 | -- | -- | 4 | 0.002 | 0.004 | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 11 |
| PCBs | PCB 200 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 201 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 203 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 206 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCB 209 | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| PCBs | PCBs | µg/l | 0.001 | 0.002 | 4 | 0.009 | 0.018 | 4 | 0.004 | 0.007 | 4 | 0.002 | 0.005 | 4 | -- | -- | 2 | 0.002 | 0.003 | 11 |
| Pesticides | Aldrin | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Ametryn | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Aspon | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Atraton | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Atrazine | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Azinphos ethyl | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Azinphos methyl | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Bolstar | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Carbophenothion | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Chlordane, cis- | µg/l | -- | -- | 4 | 0.001 | 0.001 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0.001 | 11 |
| Pesticides | Chlordane, trans- | µg/l | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Chlordene, alpha- | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Chlordene, gamma- | µg/l | -- | -- | 4 | 0.001 | 0.003 | 4 | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Chlorfenvinphos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Chlorpyrifos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Chlorpyrifos methyl | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Ciodrin | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Coumaphos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Dacthal | µg/l | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | DDD(o,p') | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | DDD(p,p') | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | DDE(o,p') | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | DDE(p,p') | µg/l | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 4 | 0.001 | 0.001 | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | DDMU(p,p') | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | DDT(o,p') | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | DDT(p,p') | µg/l | -- | -- | 4 | 0.001 | 0.002 | 4 | -- | -- | 4 | -- | -- | 4 | 0.001 | 0.001 | 2 | 0 | 0 | 11 |
| Pesticides | DDTs | µg/l | -- | -- | 4 | 0.001 | 0.003 | 4 | -- | -- | 4 | 0.001 | 0.001 | 4 | 0.001 | 0.001 | 2 | 0.001 | 0 | 11 |
| Pesticides | Demeton-s | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Diazinon | µg/l | -- | -- | 4 | 0.056 | 0.029 | 4 | -- | -- | 4 | 0.036 | 0.032 | 4 | -- | -- | 2 | 0.038 | 0.059 | 11 |
| Pesticides | Dichlofenthion | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Dichlorvos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Dicrotophos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |

**Appendix IIa, continued. Means and standard deviations of water chemistry constituents.**

| | | | 901SJMCC2 | | | 901SJOSO3 | | | 901SJSJC5 | | | 901SJSJC9 | | | 901SJSMT2 | | | Watershed mean | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Constituent | Units | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n |
| Pesticides | Dieldrin | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Dimethoate | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.001 | 0.003 | 11 |
| Pesticides | Dioxathion | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Disulfoton | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | 0.008 | 0.015 | 4 | -- | -- | 2 | 0.003 | 0.004 | 11 |
| Pesticides | Endosulfan I | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Endosulfan II | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Endosulfan sulfate | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Endrin | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Endrin Aldehyde | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Endrin Ketone | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Ethion | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Ethoprop | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Famphur | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Fenchlorphos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Fenitrothion | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Fensulfothion | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Fenthion | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Fonofos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | HCH, alpha | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | HCH, beta | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | HCH, delta | µg/l | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | HCH, gamma | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Heptachlor | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Heptachlor epoxide | µg/l | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Hexachlorobenzene | µg/l | 0 | 0 | 4 | 0.001 | 0.002 | 4 | 0 | 0 | 4 | 0 | 0 | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Leptophos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Malathion | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Merphos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Methidathion | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Methoxychlor | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Mevinphos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Mirex | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Molinate | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Naled | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Nonachlor, cis- | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Nonachlor, trans- | µg/l | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Oxadiazon | µg/l | -- | -- | 4 | 0.024 | 0.025 | 4 | -- | -- | 4 | 0.299 | 0.48 | 4 | 0.001 | 0.001 | 2 | 0.04 | 0.088 | 11 |
| Pesticides | Oxychlordane | µg/l | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 4 | 0 | 0.001 | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Parathion, Ethyl | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Parathion, Methyl | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Phorate | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Phosmet | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Phosphamidon | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Prometon | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Prometryn | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Propazine | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Secbumeton | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.003 | 0.006 | 11 |
| Pesticides | Simazine | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | 0.017 | 0.024 | 2 | 0.002 | 0.005 | 11 |
| Pesticides | Simetryn | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Sulfotep | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Tedion | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0 | 0 | 11 |
| Pesticides | Terbufos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Terbuthylazine | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Terbutryn | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Tetrachlorvinphos | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Thiobencarb | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | 0.003 | 0.011 | 11 |
| Pesticides | Thionazin | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Tokuthion | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Trichlorfon | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |
| Pesticides | Trichloronate | µg/l | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 4 | -- | -- | 2 | -- | -- | 11 |

**Appendix IIa, continued. Means and standard deviations of water chemistry constituents.**

| | | | 901SJMCC2 | | | 901SJOSO3 | | | 901SJSJC5 | | | 901SJSJC9 | | | 901SJSMT2 | | | Watershed mean | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | Constituent | Units | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n |
| Physical | Fine-ASTM,Passing No. 200 Sieve | % | 42.9 | 37.6 | 4 | 66.4 | -- | 1 | 7.9 | -- | 1 | 18 | 16 | 4 | | | | 26.5 | 19.2 | 9 |
| Physical | Oxygen, Saturation | % | 61 | 31 | 4 | 104 | 25 | 4 | 75 | 24 | 4 | 117 | 18 | 4 | 93 | 7 | 2 | 103 | 25 | 11 |
| Physical | pH | pH | 7.1 | 0.7 | 4 | 8 | 0.4 | 4 | 7 | 0.9 | 4 | 7.7 | 0.8 | 4 | 8 | 0.3 | 2 | 7.8 | 0.5 | 11 |
| Physical | Salinity | ppt | 2 | 0.5 | 3 | 0.9 | 0.7 | 3 | 0.2 | 0.1 | 3 | 0.7 | 0.4 | 3 | 0.2 | 0 | 2 | 0.9 | 1.1 | 11 |
| Physical | SpecificConductivity | mS/cm | 4015 | 833 | 4 | 2173 | 1418 | 4 | 473 | 184 | 4 | 1797 | 987 | 4 | 384 | 76 | 2 | 1811 | 1963 | 11 |
| Physical | Suspended Sediment Concentration | % | 50.7 | -- | 1 | 5.3 | -- | 1 | 173.6 | -- | 1 | 4.9 | -- | 1 | | | | 70.5 | 117.2 | 8 |
| Physical | Temperature | ºC | 16.5 | 1.5 | 4 | 19.1 | 3.6 | 4 | 14.2 | 1.4 | 4 | 17.6 | 4.3 | 4 | 16.2 | 0.8 | 2 | 16.8 | 1.7 | 11 |
| Physical | Total Suspended Solids | mg/l | 81.2 | 96.8 | 3 | 127.2 | 212.9 | 3 | 5.1 | 8.2 | 3 | 57.9 | 97.1 | 3 | 2.7 | 1.4 | 2 | 102.2 | 116.9 | 11 |
| Physical | Turbidity | NTU | 21 | 19 | 4 | 1.8 | 1.7 | 4 | 2.8 | 4.4 | 4 | 29.9 | 53.4 | 4 | 9.4 | 12.8 | 2 | 41.8 | 45.1 | 11 |
| Physical | Velocity | ft/s | 0 | 0.1 | 4 | 0 | 0.1 | 4 | 0 | 0.1 | 4 | 0.3 | 0.4 | 4 | -- | -- | 2 | 0.4 | 0.6 | 11 |

**Appendix IIb. Means and standard deviations of water chemistry constituents at non-SWAMP sites.**

| | 27 (Narco Downstream) | | | 27 (Narco Upstream) | | |
|---|---|---|---|---|---|---|
| Constituent | Mean | SD | N | Mean | SD | N |
| Cadmium, dissolved (ug/l) | 19.2 | 23 | 36 | 12.3 | 1.9 | 12 |
| Chlorpyrifos (ng/l) | -- | -- | 4 | -- | -- | 4 |
| Copper, dissolved (ug/l) | 1.3 | 4.3 | 12 | -- | -- | 12 |
| Diazinon (ng/l) | 5.8 | 11.5 | 4 | 6.3 | 12.7 | 4 |
| Malathion (ng/l) | 735 | 848.7 | 4 | 78.5 | 90.6 | 4 |
| Nickel, dissolved (ug/l) | 137.9 | 153.4 | 36 | 84.3 | 14.8 | 12 |
| Dimethoate (ng/l) | -- | -- | 4 | -- | -- | 4 |
| Total phophorus (mg/l) | 0.7 | 1 | 12 | 0.7 | 1 | 12 |

**Appendix IIb, continued. Means and standard deviations of water chemistry constituents at non-SWAMP sites.**

| | | Enteroccoccus (cfu / 100 ml) | | | Fecal Coliform (cfu / 100 ml) | | | Total Colilform (cfu / 100 ml) | | | TKN (mg/l) | | | Orthophosphate (mg/l) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | Specific location | Mean | SD | N | Mean | SD | N | Mean | SD | N | Mean | SD | N | Mean | SD | N |
| 27 | NarcoDownstream | 6608 | 4965 | 12 | 7905 | 12898 | 42 | 1E+05 | 114456 | 11 | 6.3 | 2.7 | 12 | | | |
| 27 | NarcoUpstream | 8236 | 6124 | 11 | 25075 | 42113 | 12 | 2E+05 | 93720 | 11 | 6 | 2.1 | 12 | | | |
| 28 | Lower Reach Downstream end | 1698 | 1438 | 56 | 1008 | 1572 | 56 | 8946 | 8231 | 56 | 6 | 27.8 | 56 | 0.4 | 0.1 | 56 |
| 28 | Lower Reach midreach (La Plata) | 2981 | 2790 | 67 | 1036 | 1358 | 67 | 15311 | 17776 | 67 | 2.6 | 0.9 | 67 | 0.4 | 0.2 | 67 |
| 28 | Middle Reach Downstream end (La Paz)-Post construction | 1559 | 2015 | 19 | 606 | 861 | 19 | 6589 | 5636 | 19 | 2.1 | 0.9 | 19 | 0.5 | 0.7 | 19 |
| 28 | Middle Reach Downstream end (La Paz)-Pre construction | 3778 | 3035 | 30 | 1672 | 2355 | 30 | 28023 | 36401 | 30 | 2.6 | 0.5 | 30 | 0.5 | 0.5 | 30 |
| 28 | Middle Reach upstream end (Nueva Vista) - Post construction | 1872 | 2677 | 19 | 498 | 627 | 19 | 9884 | 14492 | 19 | 2.4 | 0.7 | 19 | 0.4 | 0.1 | 19 |
| 28 | Middle Reach upstream end (Nueva Vista) - Pre consrtuction | 3179 | 2921 | 41 | 1248 | 1627 | 41 | 17541 | 18562 | 41 | 2.6 | 0.7 | 41 | 0.5 | 0.2 | 41 |
| 28 | Upper Reach - Upper End | 5660 | 7075 | 55 | 4761 | 6371 | 55 | 1E+05 | 107626 | 55 | 2.9 | 0.5 | 55 | 0.4 | 0.2 | 55 |

**Appendix IIb, continued. Means and standard deviations of water chemistry constituents at non-SWAMP sites.**

| | | Dissolved oxygen (mg/l) | | | pH | | | Temperature (C) | | | Relative chlorophyll (ug/l) | | | Specific conductivity (mS/cm) | | | Turbidity (NTU) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | Specific location | Mean | SD | N | Mean | SD | N | Mean | SD | N | Mean | SD | N | Mean | SD | N | Mean | SD | N |
| 1 | AC-CCR | 9.6 | 1.9 | 6 | 8.0 | 0.3 | 6 | 16.5 | 4 | 6 | 7.9 | 5.1 | 5 | 3 | 0.3 | 6 | | | |
| 2 | AC-PPD | 9 | 1.6 | 6 | 8.1 | 0.2 | 6 | 17.8 | 2.2 | 6 | 2.3 | 0.7 | 5 | 2.6 | 0.4 | 6 | | | |
| 4 | REF-AT2 | 10 | 2 | 4 | 8.0 | 0.3 | 4 | 14.6 | 2.4 | 4 | 0.2 | 0.3 | 4 | 0.5 | 0.3 | 4 | | | |
| 6 | SJC-74 | 8.2 | 2.2 | 5 | 7.7 | 0.5 | 5 | 17.4 | 2.8 | 5 | 1 | 0.3 | 5 | 1.4 | 0.4 | 5 | | | |
| 10 | SMC-I5 | 6 | 1.6 | 2 | 7.2 | 0.1 | 2 | 18.7 | 0.5 | 2 | 0.9 | 0.2 | 2 | 0.8 | 0.1 | 2 | 1.2 | 0.2 | 2 |
| 11 | WC-WCT | 12.3 | 6 | 2 | 8.2 | 0.2 | 2 | 13.1 | 1.2 | 2 | 2.5 | | 1 | 2.2 | 0.7 | 2 | | | |
| 12 | AC-ACP | 8.7 | 2.7 | 6 | 8.0 | 0.2 | 6 | 18.5 | 2.9 | 6 | 2.5 | 1.7 | 5 | 3.2 | 0.4 | 6 | | | |
| 13 | CC-CR | 12.4 | 3.6 | 4 | 7.9 | 0.1 | 4 | 15.4 | 2.5 | 4 | 0.9 | 0.7 | 4 | 1 | 0.2 | 4 | | | |
| 14 | EC-MD | 11 | 2.2 | 6 | 8.4 | 0.6 | 6 | 18 | 4.2 | 6 | 3 | 1.1 | 5 | 1.9 | 0.2 | 6 | | | |
| 15 | LC-133 | 8.9 | 2.9 | 6 | 8.2 | 0.2 | 6 | 15.8 | 2 | 6 | 3.2 | 0.9 | 5 | 1.6 | 0.4 | 6 | | | |
| 16 | LP-BR | 9.3 | 2.5 | 4 | 7.8 | 0.2 | 4 | 17.2 | 3.1 | 4 | 1.5 | 0.9 | 4 | 0.9 | 0.1 | 4 | 1.1 | 0.8 | 2 |
| 17 | PD-CGV | 10.4 | | 1 | 8.8 | | 1 | 15.2 | | 1 | | | 0 | 3.8 | | 1 | | | |
| 18 | REF-BC | 8.6 | 3.3 | 4 | 7.8 | 0.5 | 4 | 16 | 0.2 | 4 | 0.1 | 0.1 | 4 | 0.8 | 0.1 | 4 | | | |
| 19 | REF-CS | 11.6 | 0.9 | 6 | 8.4 | 0.3 | 6 | 15.5 | 2.6 | 6 | | | 0 | 0.6 | 0.1 | 6 | | | |
| 20 | SC-MB | 9.4 | 1.3 | 6 | 7.8 | 0.3 | 6 | 15.7 | 2.9 | 6 | 5.4 | 1.4 | 5 | 3.7 | 0.7 | 6 | | | |
| 21 | SD-AP | 9.8 | 3.4 | 6 | 8.0 | 0.5 | 6 | 14.1 | 3.3 | 6 | 7.6 | 2 | 5 | 4.5 | 0.9 | 6 | | | |
| 22 | SJC-CC | 8 | 2.5 | 6 | 7.8 | 0.5 | 6 | 17.5 | 4.1 | 6 | 2.5 | 1 | 5 | 2.2 | 0.8 | 6 | | | |
| 23 | SOC-2 | | | | 9.2 | | 1 | 27.3 | | 1 | 2.4 | | 1 | 0.5 | | 1 | | | |
| 24 | SOC-I5 | 8.4 | 0.9 | 2 | 7.6 | 0.1 | 2 | 13.5 | 3.8 | 2 | 2 | 0.3 | 2 | 1 | 0.1 | 2 | 412 | 580.9 | 2 |
| 25 | TC-AP | 10.2 | 4.3 | 6 | 8.2 | 0.4 | 6 | 16.3 | 2.6 | 6 | 0.9 | 0.7 | 5 | 1.1 | 0.2 | 6 | | | |
| 26 | TC-DO | 12.8 | 2.4 | 6 | 8.4 | 0.2 | 6 | 20.2 | 7.2 | 6 | 9.4 | 10.1 | 5 | 2.2 | 0.5 | 6 | | | |
| 27 | Narco Downstream | 18.3 | | | | | | | 4 | 41 | | | 0 | 73.2 | 3.4 | 11 | | | |
| 27 | Narco Upstream | 22.7 | | | | | | | 1.1 | 11 | | | 0 | 72.9 | 2 | 11 | | | |
| 28 | Lower Reach Downstream end | 15 | | | | | | | 3.8 | 56 | | | | | | | | | |
| 28 | Lower Reach midreach (La Plata) | 16.2 | | | | | | | 5 | 67 | | | | | | | | | |
| 28 | Middle Reach Downstream end (La Paz)-Post construction | 13.4 | | | | | | | 5.1 | 19 | | | | | | | | | |
| 28 | Middle Reach Downstream end (La Paz)-Pre construction | 16.8 | | | | | | | 3.2 | 30 | | | | | | | | | |
| 28 | Middle Reach upstream end (Nueva Vista) - Post construction | 11.5 | | | | | | | 3.8 | 19 | | | | | | | | | |
| 28 | Middle Reach upstream end (Nueva Vista) - Pre consrtuction | 16.8 | | | | | | | 3.6 | 41 | | | | | | | | | |
| 28 | Upper Reach - Upper End | 18.2 | | | | | | | 2 | 55 | | | | | | | | | |

## APPENDIX III

**Results from toxicity assays for each endpoint at each site in the watershed. Mean = mean percent control. SD = standard deviation. A. SWAMP sites. B. Sites assessed by Orange County NPDES.**

**A. SWAMP-Sites**

| | *C. dubia* | | | | | | *H. azteca* | | | | | | *S. capricornutum* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Survival | | | Young / female | | | Survival | | | Growth | | | Total cell count | | |
| Site | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n |
| 901SJALC6 | 104 | 6 | 3 | 84 | 43 | 3 | 86 | 20 | 4 | 135 | 64 | 3 | 52 | 34 | 4 |
| 901SJATC2 | 95 | 7 | 2 | 71 | 5 | 2 | 0 | | 1 | | | 0 | 95 | 8 | 2 |
| 901SJATC5 | 94 | 12 | 4 | 87 | 25 | 4 | 101 | 16 | 3 | 120 | 44 | 3 | 52 | 47 | 4 |
| 901SJBEL2 | 95 | 7 | 2 | 78 | 34 | 2 | | | 0 | | | 0 | 98 | 25 | 2 |
| 901SJENG2 | 60 | 49 | 4 | 94 | 18 | 3 | 67 | 34 | 4 | 88 | 36 | 4 | 84 | 15 | 4 |
| 901SJLAG2 | 78 | 45 | 4 | 91 | 36 | 4 | 66 | 41 | 4 | 123 | 34 | 4 | 49 | 11 | 4 |
| 901SJMCC2 | 101 | 15 | 2 | 79 | 10 | 2 | 97 | 6 | 4 | 338 | 478 | 4 | 10 | 8 | 4 |
| 901SJOSO3 | 77 | 40 | 3 | 102 | 38 | 3 | 52 | 71 | 2 | 82 | | 1 | 52 | 24 | 4 |
| 901SJSJC5 | 93 | 10 | 4 | 102 | 17 | 4 | 109 | | 1 | 221 | | 1 | 106 | 15 | 4 |
| 901SJSJC9 | 98 | 5 | 4 | 111 | 22 | 4 | 93 | 23 | 4 | 119 | 45 | 4 | 53 | 21 | 4 |
| 901SJSMT2 | 100 | 0 | 2 | 102 | 24 | 2 | | | 0 | | | 0 | 78 | 15 | 2 |
| Mean of all sites | 87 | 30 | 34 | 93 | 26 | 33 | 79 | 34 | 27 | 155 | 197 | 24 | 99 | 35 | 38 |

**B. Orange County NPDES**

| | *C. dubia* | | | | | | *H. azteca* | | | *S. capricornutum* | | | *P. promelas* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Survival | | | Growth | | | Survival | | | Total cell count | | | Survival | | | Growth | | |
| Site | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n | Mean | SD | n |
| 1 | 94 | 10 | 7 | 105 | 12 | 7 | 99 | 10 | 7 | 146 | 56 | 6 | 99 | 17 | 3 | 130 | 29 | 3 |
| 2 | 102 | 13 | 7 | 113 | 29 | 7 | 103 | 8 | 7 | 162 | 70 | 7 | 85 | 11 | 3 | 129 | 70 | 3 |
| 4 | 99 | 16 | 5 | 87 | 14 | 6 | 102 | 3 | 6 | 172 | 63 | 6 | | | | | | |
| 6 | 105 | 10 | 7 | 110 | 19 | 7 | 98 | 4 | 7 | 168 | 60 | 7 | | | | | | |
| 11 | 100 | 0 | 2 | 139 | 30 | 2 | 84 | 22 | 2 | 202 | 49 | 2 | 97 | | 1 | 248 | | 1 |
| 12 | 80 | 37 | 8 | 75 | 39 | 8 | 94 | 13 | 8 | 154 | 57 | 8 | 93 | 22 | 4 | 134 | 8 | 4 |
| 13 | 100 | 0 | 5 | 116 | 19 | 5 | 101 | 8 | 5 | 151 | 72 | 4 | | | | | | |
| 14 | 95 | 11 | 6 | 103 | 29 | 6 | 105 | 7 | 6 | 148 | 47 | 5 | 83 | | 1 | 150 | | 1 |
| 15 | 105 | 8 | 7 | 516 | 1030 | 7 | 99 | 5 | 7 | 200 | 110 | 7 | | | | | | |
| 17 | 0 | | 1 | 0 | | 1 | 100 | | 1 | 179 | | 1 | | | | | | |
| 18 | 97 | 5 | 6 | 104 | 14 | 6 | 100 | 7 | 6 | 161 | 42 | 5 | | | | | | |
| 19 | 102 | 4 | 7 | 124 | 29 | 7 | 100 | 10 | 7 | 185 | 66 | 7 | | | | | | |
| 20 | 67 | 46 | 7 | 65 | 60 | 7 | 91 | 20 | 6 | 160 | 67 | 8 | | | | | | |
| 21 | 38 | 44 | 6 | 9 | 8 | 5 | 100 | 0 | 5 | 129 | 48 | 4 | | | | | | |
| 22 | 98 | 4 | 6 | 111 | 11 | 6 | 106 | 5 | 6 | 147 | 49 | 5 | | | | | | |
| 25 | 124 | 62 | 7 | 131 | 25 | 7 | 113 | 21 | 7 | 157 | 68 | 6 | | | | | | |
| 26 | 100 | 7 | 6 | 118 | 24 | 6 | 102 | 6 | 6 | 147 | 46 | 5 | | | | | | |

## APPENDIX IV

**Mean IBI and metric scores for bioassessment sites in the San Juan HU. Note that the number listed under IBI is the mean IBI for each site, and not the IBI calculated from the mean metric values.**

| | | | | IBI | | Coleoptera Taxa | | EPT Taxa | | Predator Taxa | | % Collectors | | % Intolerant | | % Non-insect Taxa | | % Tolerant Taxa | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | Season | n | Years | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| 1 | Average | 13 | 1998-2005 | 16.4 | 0.4 | 1.5 | 1.4 | 1.2 | 0.1 | 1.7 | 0.2 | 2.6 | 0.2 | 0 | 0 | 1.5 | 0.2 | 2.9 | 1.2 |
| 1 | Fall | 7 | 1998-2005 | 16.1 | 7.4 | 0.6 | 1 | 1.3 | 0.5 | 1.6 | 2.1 | 2.7 | 3.7 | 0 | 0 | 1.4 | 1.5 | 3.7 | 2.7 |
| 1 | Spring | 6 | 1998-2005 | 16.7 | 17.8 | 2.5 | 4.2 | 1.2 | 0.8 | 1.8 | 4 | 2.5 | 1.8 | 0 | 0 | 1.7 | 2.6 | 2 | 1.8 |
| 2 | Average | 12 | 1998-2005 | 14.9 | 1.2 | 0.8 | 0.2 | 1.2 | 0.2 | 1.3 | 0.2 | 2.8 | 2 | 0 | 0 | 1.7 | 0.9 | 2.7 | 0.5 |
| 2 | Fall | 6 | 1998-2005 | 15.7 | 9.9 | 0.7 | 1 | 1.3 | 0.8 | 1.5 | 2.8 | 4.2 | 3.9 | 0 | 0 | 1 | 0.9 | 2.3 | 1.9 |
| 2 | Spring | 6 | 1998-2005 | 14 | 8.6 | 1 | 1.7 | 1 | 0 | 1.2 | 2.9 | 1.3 | 1.4 | 0 | 0 | 2.3 | 1.9 | 3 | 1.8 |
| 3 | Average | 6 | 1998-2000 | 31.9 | 6.1 | 3.5 | 0.2 | 2.3 | 0.9 | 2.7 | 0.5 | 6.7 | 3.8 | 0 | 0 | 3.5 | 0.2 | 3.7 | 0.9 |
| 3 | Fall | 3 | 1998-2000 | 36.2 | 3.6 | 3.3 | 1.2 | 3 | 1 | 3 | 2 | 9.3 | 1.2 | 0 | 0 | 3.7 | 0.6 | 3 | 0 |
| 3 | Spring | 3 | 1998-2000 | 27.6 | 14.5 | 3.7 | 1.5 | 1.7 | 1.2 | 2.3 | 2.1 | 4 | 5.2 | 0 | 0 | 3.3 | 1.2 | 4.3 | 0.6 |
| 4 | Average | 6 | 2001-2005 | 68 | 23 | 7.1 | 2.7 | 7.4 | 1.6 | 5 | 3.5 | 7.1 | 4.1 | 6.6 | 4.1 | 7.5 | 0.7 | 6.9 | 0.5 |
| 4 | Fall | 2 | 2003-2005 | 84.3 | 12.1 | 9 | 1.4 | 8.5 | 2.1 | 7.5 | 2.1 | 10 | 0 | 9.5 | 0.7 | 8 | 1.4 | 6.5 | 0.7 |
| 4 | Spring | 4 | 2001-2005 | 51.8 | 18.6 | 5.3 | 3.4 | 6.3 | 1.9 | 2.5 | 3.7 | 4.3 | 2.2 | 3.8 | 2.8 | 7 | 0.8 | 7.3 | 0.5 |
| 5 | Spring | 2 | 2001-2001 | 16.4 | 3 | 2 | 0 | 1 | 0 | 0 | 0 | 8.5 | 2.1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | Average | 12 | 1998-2005 | 23.8 | 4.8 | 0.6 | 0.8 | 1.9 | 0.2 | 2.6 | 1.2 | 5.4 | 3.4 | 0 | 0 | 2.3 | 0.1 | 3.9 | 0.7 |
| 6 | Fall | 5 | 1998-2005 | 27.1 | 3.4 | 0 | 0 | 2 | 1.9 | 3.4 | 1.7 | 7.8 | 2.7 | 0 | 0 | 2.4 | 1.7 | 3.4 | 2.1 |
| 6 | Spring | 7 | 1998-2005 | 20.4 | 4.8 | 1.1 | 1.6 | 1.7 | 1 | 1.7 | 1 | 3 | 2.1 | 0 | 0 | 2.3 | 2.1 | 4.4 | 2.3 |
| 7 | Spring | 4 | 2001-2005 | 31.4 | 13.7 | 1.5 | 1.9 | 4.5 | 1.7 | 1.5 | 1.9 | 3 | 3.6 | 1.5 | 1.7 | 4.8 | 1 | 5.3 | 1 |
| 8 | Spring | 1 | 2001-2001 | 41.4 | | 8 | | 5 | | 5 | | 1 | | 3 | | 4 | | 3 | |
| 9 | Spring | 1 | 2001-2001 | 31.4 | | 4 | | 2 | | 2 | | 10 | | 0 | | 2 | | 2 | |
| 10 | Average | 2 | 2005-2006 | 23.6 | 27.3 | 4.5 | 3.5 | 1 | 0 | 2.5 | 3.5 | 5 | 7.1 | 0 | 0 | 1 | 1.4 | 1 | 1.4 |
| 10 | Fall | 1 | 2005-2005 | 42.9 | | 7 | | 1 | | 5 | | 10 | | 0 | | 2 | | 2 | |
| 10 | Spring | 1 | 2006-2006 | 4.3 | | 2 | | 1 | | 0 | | 0 | | 0 | | 0 | | 0 | |
| 11 | Average | 5 | 2001-2004 | 15.5 | 6.4 | 0 | 0 | 0.5 | 0.7 | 0.3 | 0.4 | 5.3 | 5.2 | 0 | 0 | 0 | 0 | 4.8 | 1.8 |
| 11 | Fall | 2 | 2002-2004 | 20 | 2 | 0 | 0 | 1 | 0 | 0.5 | 0.7 | 9 | 1.4 | 0 | 0 | 0 | 0 | 3.5 | 2.1 |
| 11 | Spring | 3 | 2001-2001 | 11 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1.7 | 2.9 | 0 | 0 | 0 | 0 | 6 | 4 |
| 12 | Average | 6 | 2002-2005 | 12 | 3.3 | 0 | 0 | 1.3 | 0.4 | 0.3 | 0.4 | 2.6 | 2.7 | 0 | 0 | 1.9 | 0.2 | 2.4 | 1.2 |
| 12 | Fall | 4 | 2002-2005 | 9.6 | 4.7 | 0 | 0 | 1 | 0 | 0 | 0 | 0.8 | 1 | 0 | 0 | 1.8 | 1.7 | 3.3 | 2.5 |
| 12 | Spring | 2 | 2003-2005 | 14.3 | 2 | 0 | 0 | 1.5 | 0.7 | 0.5 | 0.7 | 4.5 | 0.7 | 0 | 0 | 2 | 1.4 | 1.5 | 0.7 |
| 13 | Average | 4 | 2003-2005 | 39.6 | 4.5 | 4.5 | 2.1 | 3.8 | 1.1 | 4.8 | 1.1 | 5.3 | 1.1 | 0.3 | 0.4 | 6 | 0.7 | 3.3 | 1.1 |
| 13 | Fall | 2 | 2003-2005 | 36.4 | 13.1 | 3 | 1.4 | 4.5 | 0.7 | 4 | 1.4 | 6 | 1.4 | 0 | 0 | 5.5 | 2.1 | 2.5 | 2.1 |
| 13 | Spring | 2 | 2003-2005 | 42.9 | 6.1 | 6 | 1.4 | 3 | 0 | 5.5 | 0.7 | 4.5 | 0.7 | 0.5 | 0.7 | 6.5 | 0.7 | 4 | 1.4 |
| 14 | Average | 5 | 2002-2005 | 14.5 | 0.3 | 0 | 0 | 1.1 | 0.2 | 0.3 | 0.4 | 6.5 | 0.7 | 0 | 0 | 0.3 | 0.4 | 2 | 0 |
| 14 | Fall | 4 | 2002-2005 | 14.6 | 6.6 | 0 | 0 | 1.3 | 0.5 | 0.5 | 0.6 | 6 | 3.9 | 0 | 0 | 0.5 | 0.6 | 2 | 1.4 |
| 14 | Spring | 1 | 2005-2005 | 14.3 | | 0 | | 1 | | 0 | | 7 | | 0 | | 0 | | 2 | |
| 15 | Average | 6 | 2002-2005 | 17 | 6.8 | 0 | 0 | 1.3 | 0.4 | 1 | 0.7 | 2 | 1.4 | 0 | 0 | 2.8 | 1.8 | 4.9 | 0.5 |
| 15 | Fall | 4 | 2002-2005 | 21.8 | 6.2 | 0 | 0 | 1.5 | 0.6 | 1.5 | 1.3 | 3 | 2 | 0 | 0 | 4 | 0.8 | 5.3 | 2.2 |
| 15 | Spring | 2 | 2003-2005 | 12.1 | 3 | 0 | 0 | 1 | 0 | 0.5 | 0.7 | 1 | 0 | 0 | 0 | 1.5 | 0.7 | 4.5 | 0.7 |
| 16 | Average | 4 | 2004-2006 | 36.8 | 0.5 | 2.8 | 1.1 | 3.3 | 1.1 | 3.5 | 0.7 | 4.5 | 2.1 | 1 | 0 | 4.8 | 1.8 | 6 | 1.4 |
| 16 | Fall | 2 | 2004-2005 | 36.4 | 9.1 | 2 | 2.8 | 4 | 0 | 4 | 2.8 | 6 | 1.4 | 1 | 0 | 3.5 | 2.1 | 5 | 0 |
| 16 | Spring | 2 | 2005-2006 | 37.1 | 14.1 | 3.5 | 4.9 | 2.5 | 0.7 | 3 | 2.8 | 3 | 1.4 | 1 | 0 | 6 | 1.4 | 7 | 0 |
| 17 | Average | 2 | 2002-2003 | 7.1 | 6.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5 | 2.1 | 1.5 | 2.1 |
| 17 | Fall | 1 | 2002-2002 | 2.9 | | 0 | | 0 | | 0 | | 0 | | 0 | | 2 | | 0 | |
| 17 | Spring | 1 | 2003-2003 | 11.4 | | 0 | | 0 | | 0 | | 0 | | 0 | | 5 | | 3 | |
| 18 | Average | 4 | 2003-2005 | 65.7 | 5.1 | 6.5 | 1.4 | 6 | 0 | 7 | 0 | 6.5 | 1.4 | 5 | 2.1 | 7.5 | 0.7 | 7.5 | 0.7 |
| 18 | Fall | 2 | 2004-2005 | 69.3 | 9.1 | 7.5 | 3.5 | 6 | 1.4 | 7 | 1.4 | 7.5 | 3.5 | 6.5 | 2.1 | 7 | 1.4 | 7 | 1.4 |
| 18 | Spring | 2 | 2003-2005 | 62.1 | 9.1 | 5.5 | 2.1 | 6 | 1.4 | 7 | 2.8 | 5.5 | 0.7 | 3.5 | 2.1 | 8 | 0 | 8 | 0 |

**Appendix IV, continued. Mean IBI and metric scores.**

| | | | | IBI | | Coleoptera Taxa | | EPT Taxa | | Predator Taxa | | % Collectors | | % Intolerant | | % Non-insect Taxa | | % Tolerant Taxa | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Site | Season | n | Years | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| 19 | Average | 6 | 2002-2005 | 33.8 | 3.3 | 2.5 | 2.1 | 3.5 | 0 | 1.3 | 1.1 | 2.5 | 2.1 | 0.6 | 0.2 | 6.9 | 0.2 | 6.4 | 0.9 |
| 19 | Fall | 4 | 2002-2005 | 36.1 | 11.1 | 4 | 3.6 | 3.5 | 1 | 0.5 | 1 | 4 | 3.8 | 0.8 | 0.5 | 6.8 | 1.5 | 5.8 | 2.1 |
| 19 | Spring | 2 | 2003-2005 | 31.4 | 2 | 1 | 1.4 | 3.5 | 0.7 | 2 | 1.4 | 1 | 0 | 0.5 | 0.7 | 7 | 1.4 | 7 | 1.4 |
| 20 | Average | 6 | 2002-2005 | 7.3 | 1.3 | 0 | 0 | 0.4 | 0.2 | 0.1 | 0.2 | 3.5 | 0 | 0 | 0 | 0.4 | 0.5 | 0.8 | 0.4 |
| 20 | Fall | 4 | 2002-2005 | 8.2 | 7.9 | 0 | 0 | 0.3 | 0.5 | 0.3 | 0.5 | 3.5 | 1.7 | 0 | 0 | 0.8 | 1.5 | 1 | 1.4 |
| 20 | Spring | 2 | 2003-2005 | 6.4 | 5.1 | 0 | 0 | 0.5 | 0.7 | 0 | 0 | 3.5 | 2.1 | 0 | 0 | 0 | 0 | 0.5 | 0.7 |
| 21 | Average | 6 | 2002-2005 | 18.9 | 0.5 | 0.5 | 0.7 | 0.4 | 0.2 | 1 | 0 | 7.5 | 2.8 | 0 | 0 | 1.4 | 0.9 | 2.5 | 0.7 |
| 21 | Fall | 4 | 2002-2005 | 19.3 | 5.5 | 0 | 0 | 0.3 | 0.5 | 1 | 1.4 | 9.5 | 1 | 0 | 0 | 0.8 | 1.5 | 2 | 0 |
| 21 | Spring | 2 | 2003-2005 | 18.6 | 4 | 1 | 1.4 | 0.5 | 0.7 | 1 | 0 | 5.5 | 6.4 | 0 | 0 | 2 | 1.4 | 3 | 4.2 |
| 22 | Average | 6 | 2002-2005 | 15.4 | 3.5 | 1 | 1.4 | 1 | 0 | 1.5 | 1.4 | 3.6 | 3 | 0 | 0 | 1.9 | 0.2 | 1.8 | 0.4 |
| 22 | Fall | 4 | 2002-2005 | 17.9 | 12.4 | 0 | 0 | 1 | 0 | 2.5 | 1.3 | 5.8 | 4.9 | 0 | 0 | 1.8 | 1 | 1.5 | 1.9 |
| 22 | Spring | 2 | 2003-2005 | 12.9 | 4 | 2 | 0 | 1 | 0 | 0.5 | 0.7 | 1.5 | 2.1 | 0 | 0 | 2 | 0 | 2 | 0 |
| 23 | Spring | 1 | 2005-2005 | 50 | | 10 | | 3 | | 8 | | 4 | | 0 | | 7 | | 3 | |
| 24 | Average | 3 | 2004-2006 | 27.9 | 1 | 3.8 | 0.4 | 0.8 | 0.4 | 3.5 | 0.7 | 7.5 | 3.5 | 0 | 0 | 3 | 1.4 | 1 | 0 |
| 24 | Fall | 2 | 2004-2005 | 28.6 | 16.2 | 3.5 | 4.9 | 0.5 | 0.7 | 3 | 1.4 | 10 | 0 | 0 | 0 | 2 | 2.8 | 1 | 1.4 |
| 24 | Spring | 1 | 2006-2006 | 27.1 | | 4 | | 1 | | 4 | | 5 | | 0 | | 4 | | 1 | |
| 25 | Average | 6 | 2002-2005 | 17 | 9.8 | 0.5 | 0.7 | 1.4 | 0.5 | 1.5 | 0 | 4.1 | 4.4 | 0 | 0 | 1.6 | 0.5 | 2.8 | 1.8 |
| 25 | Fall | 4 | 2002-2005 | 23.9 | 10.6 | 1 | 1.2 | 1.8 | 0.5 | 1.5 | 1.3 | 7.3 | 3.2 | 0 | 0 | 1.3 | 1 | 4 | 2.4 |
| 25 | Spring | 2 | 2003-2005 | 10 | 0 | 0 | 0 | 1 | 0 | 1.5 | 2.1 | 1 | 1.4 | 0 | 0 | 2 | 1.4 | 1.5 | 2.1 |
| 26 | Average | 6 | 2002-2005 | 18.8 | 2.3 | 0.8 | 0.4 | 1.1 | 0.2 | 0.3 | 0.4 | 3.9 | 5.5 | 0 | 0 | 3.3 | 1.8 | 3.9 | 2.3 |
| 26 | Fall | 4 | 2002-2005 | 20.4 | 2.1 | 0.5 | 1 | 1.3 | 0.5 | 0.5 | 0.6 | 7.8 | 4.5 | 0 | 0 | 2 | 2.7 | 2.3 | 1.7 |
| 26 | Spring | 2 | 2003-2005 | 17.1 | 0 | 1 | 1.4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.5 | 0.7 | 5.5 | 2.1 |