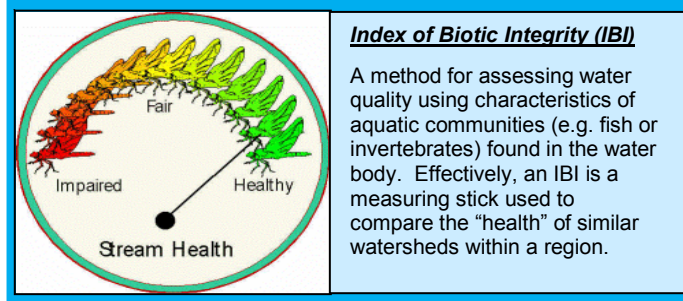


Aquatic Invertebrates as Watershed Health Indicators

Aquatic invertebrates live in creeks and creek beds. They are good indicators of watershed health because they:

- Live in the water for all or most of their life;
- Stay in areas suitable for their survival;
- Are easy to collect;
- Differ in their tolerance to amount and types of pollution;
- Are easy to identify in a laboratory;
- Often live for more than one year;
- Have limited mobility; and
- Are integrators of environmental condition.



Since 2002, the Program and other Bay Area Urban Runoff Management Programs have been collecting and analyzing aquatic invertebrates through the implementation of the Program's Multi-Year Plan. As a next step in interpreting results from aquatic invertebrate sampling, the Program is leading the development of an Index of Biotic Integrity (IBI) for Bay Area creeks through the Bay Area Macroinvertebrate Bioassessment Information (BAMBI) Network. BAMBI is a network of scientists, watershed managers, regulators and community members interested in using biological communities as indicators (i.e., aquatic invertebrates) of stream health in the San Francisco Bay Area. The goal of BAMBI is to maximize the utility of aquatic bioassessment in the Bay Area by developing a programmatic and analytical framework for the collection, sharing, analysis and use of bioassessment data. An IBI is a method for assessing water quality using characteristics of aquatic communities (e.g. fish or invertebrates) found in the water body. The Bay Area IBI is currently planned to be completed in 2006 and will provide a measuring stick to compare the "health" of similar watersheds within the region.

Watershed Assessment Activities

In FY 02-03, the Program conducted a watershed assessment in the Coyote Creek Watershed, the largest Santa Clara Basin watershed (321 square miles). The Program initiated its second watershed assessment of Saratoga Creek in FY 05-06. A summary of each watershed project is described below:

Coyote Creek Watershed

The Coyote Creek watershed assessment evaluated the condition of stream ecosystem functions using available data sources. The final report identified high-priority potential management and monitoring actions to improve the potential capacity of stream ecosystem functions in defined segments of Coyote and Upper Penitencia Creeks. In addition, the report assessed the relationship between the stream functional assessment methodology and others applied in the Bay Area.

Saratoga Creek Watershed

The Saratoga Creek watershed assessment is an ongoing Program project scheduled for completion by June 2006. Saratoga Creek, a tributary to San Tomas Aquino Creek, was previously identified by the Water Board as one of the high-priority watersheds which may be impaired by excessive sediment production from erosion due to anthropogenic activities. Therefore, the Saratoga Creek watershed assessment includes the following three objectives: 1) evaluate existing data sources to determine if Aquatic Life and Recreation beneficial uses are being protected; 2) evaluate potential sediment impacts to fish and habitat to determine if high priority ranking is warranted; and 3) identify potential investigative studies and/or management actions to improve beneficial uses.

To help address the objectives, the Program will analyze results from two years of screening-level monitoring (conducted as part of the Multi-Year Plan) in Saratoga Creek. The Program will also analyze results from the following ongoing projects: 1) fish population surveys and aquatic habitat assessments at representative reaches in the watershed, and 2) riparian corridor assessment using the Unified Stream Assessment approach, developed by the Center for Watershed Protection.

References:
 --Center for Watershed Protection 2005. *Manual 10: Unified Stream Assessment: A User's Manual, Version 2.0, February 2005.*
 --SCVURPPP 2002. *Stormwater Environmental Indicators Demonstration Project.* Prepared by Eisenberg, Olivieri and Associates for the Water Environment Research Foundation (WERF).
 --SCVURPPP 2003. *Assessment of Stream Ecosystem Functions for the Coyote Creek Watershed.* Prepared by Eisenberg, Olivieri and Associates for the Santa Clara Valley Urban Runoff Pollution Prevention Program. May 2003.
 --SCVURPPP 2004. *Revised Multi-Year Receiving Waters Monitoring Plan.* Prepared by Eisenberg, Olivieri and Associates for the Santa Clara Valley Urban Runoff Pollution Prevention Program. March 2004.
 --US EPA and Tetra Tech 2004. *SCVURPPP Monitoring Program Evaluation Report Santa Clara Valley Urban Runoff Pollution Prevention Program (NPDES Permit No. CAS029718).* Prepared by Tetra Tec, Inc. through funding by the US EPA and in coordination with the San Francisco Bay Regional Water Quality Control Board.
 --BASMAA 1996. *San Francisco Bay Area Stormwater Runoff Monitoring Data Analysis 1988-1995.* Prepared by Woodward-Clyde 1996 for BASMAA.

SCVURPPP is an association of the thirteen cities and towns (Campbell, Cupertino, Los Altos, Los Altos Hills, Los Gatos, Milpitas, Monte Sereno, Mountain View, Palo Alto, San Jose, Santa Clara, Saratoga, Sunnyvale) in the Santa Clara Valley, together with Santa Clara County and the Santa Clara Valley Water District. Program participants share a common permit to discharge stormwater to South San Francisco Bay.



Santa Clara Valley Urban Runoff Pollution Prevention Program

WATER QUALITY MONITORING AND WATERSHED ASSESSMENT

From its inception in 1987, the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP or Program) has been a regional, statewide and national leader in the collection and analysis of monitoring and assessment data used to evaluate the condition and impacts of urban runoff on water bodies. Urbanization and related impacts to water bodies typically includes municipal and industrial stormwater discharges, hydromodification, loss of riparian and aquatic habitat, creek modification projects for flood control and urban development, and stormwater runoff containing industrial chemicals, hydrocarbons, pesticides, and legacy pollutants. To begin addressing these potential impacts, the Program's initial monitoring activities established baseline water quality conditions of runoff from various urban land uses (Table 1). In addition, the Program's annual monitoring plans included assessments designed to enhance the understanding of sources and the extent of urban runoff pollution, its effects and methods for its control.

"SCVURPPP has been a leader in the development and evolution of similar programs and permits across the country."

US EPA/Tetra Tech 2004
Monitoring Program Evaluation



In 1996, Program and San Francisco Bay Water Quality Control Board (Water Board) staff agreed to redirect the Program's monitoring resources and develop a new approach that included implementation of the following specific monitoring activities: 1) gathering

information on watershed land use characteristics; 2) analyzing physical, biological and chemical indicators from water bodies; and 3) conducting special or pilot studies to assess best management practice (BMP) effectiveness. Since 1996, the Program's new emphasis has effectively integrated the management of urban runoff and watersheds.

In 1998, the Program was awarded a contract with the Water Environment Research Foundation (WERF) to evaluate the usefulness of specific stormwater indicators under semi-arid conditions, and to select, test, and refine protocols for monitoring environmental indicators in California. The demonstration project was conducted in the Coyote Creek watershed and served to meet monitoring requirements within the Program's NPDES permit.

Building on its experiences, the Program made another stride in 2002 when it developed and began implementing a Multi-Year Receiving Waters Monitoring Plan (Multi-Year Plan). Monitoring activities described in the Multi-Year Plan aim to develop and implement programs/projects designed to assess the condition of and impacts to beneficial uses of local creeks and the San Francisco Bay estuary. The Multi-Year Plan is scheduled to be implemented through 2010.

Monitoring Program Objectives

The Program's monitoring and watershed assessment activities use a limited data set to assess conditions of local water bodies and watersheds within the Santa Clara Basin. The Program's current monitoring objectives include:

- Characterization of watersheds and storm water discharges;
- Assessment of existing or potential adverse impacts on beneficial uses caused by pollutants of concern in storm water discharges;
- Identification of potential sources of pollutants;
- Detection of long-term trends;
- Compliance with NPDES Permit requirements;
- Integration with other Programs; and
- Communication of results with stakeholders.

Table 1. SCVURPPP Monitoring Program Chronology

Urban Runoff Characterization (1987-1995)
Monitoring activities focused on establishing baseline information of contaminants in urban runoff from various land uses. Assessments were conducted to enhance the understanding of the sources and extent of urban runoff pollution, its effects, and methods for its control.

Integration with Watershed Management (1996-Present)
Monitoring approach emphasized integration of urban runoff management and watershed management. This allowed collaboration between the Program and individual Co-permittees to manage and assist the Santa Clara Basin Watershed Management Initiative (SCBWM). Integration improved efficiency as the SCBWM conducts various projects related to watershed characterization, assessment and management.

Stormwater Environmental Indicators (1998-2000)
The Program was awarded a Water Environment Research Foundation (WERF) contract to evaluate the Center for Watershed Protection's stormwater indicator methodology under semi-arid conditions. The demonstration project was conducted in Coyote Creek and served to meet the Program's NPDES permit requirements.

Multi-Year Monitoring Plan (2002-2010)
In response to SCVURPPP's reissued NPDES permit, the Program developed and began implementing a Multi-Year Receiving Waters Monitoring Plan (Multi-Year Plan) in 2002. Multi-Year Monitoring Plan activities aim at developing and implementing programs/projects designed to assess the condition of beneficial uses of local creeks and the San Francisco Bay estuary.

Local and Regional Monitoring

In addition to local creek monitoring, the Program actively collaborates with a range of other programs to conduct water quality monitoring and assessment at the regional level. The Program also participates in and contributes to special, focused water quality monitoring and assessment studies. Table 2 provides examples of Program participation in local and regional monitoring activities.

Geographical Area of Focus	Example Programs/Activities	SCVURPPP Participation
Local Water Bodies (e.g., Creeks)	Multi-Year Monitoring Plan	<ul style="list-style-type: none"> Program Development and Management Implementation
	Urban Creeks Diazinon/Toxicity Monitoring	<ul style="list-style-type: none"> Financial Contribution Assistance in Sampling Plan Development Field Work Conducted by Co-permittees
Pollutant Loading to San Francisco Bay	Guadalupe River Pollutant Loading	<ul style="list-style-type: none"> Financial Contribution Actively Participated in Plan Development
San Francisco Bay	Regional Monitoring Program for Trace Substance (RMP)	<ul style="list-style-type: none"> Financial Contribution Steering Committee Representative Technical Review Committee Representative

Multi-Year Monitoring Program

Monitoring and Assessment Process

With revisions to the Multi-Year Plan in 2004, the Program established a *Monitoring and Assessment Process* that describes a systematic approach to environmental monitoring of watersheds and the nexus between environmental monitoring and watershed assessment. The idealized process has four steps (described below and illustrated in Figure 1) that ultimately lead to the implementation of BMPs by the appropriate agencies. The process provides a formal structure, or protocol, for conducting monitoring and assessments under the Multi-Year Plan. For example, the process prioritizes identification and evaluation of existing water quality and watershed-related information for each monitoring task. This reveals data gaps that are addressed with additional task-specific data collection efforts. The *Monitoring and Assessment Process* ultimately improves the Program's ability to characterize, assess and protect or restore beneficial uses in receiving water bodies.

Watershed Characterization

Watershed characterization is an important foundational activity that improves understanding of the location and extent of impacts to watersheds, water quality and beneficial uses. It entails collecting and analyzing existing water quality and watershed information to assist in the design of screening-level monitoring.

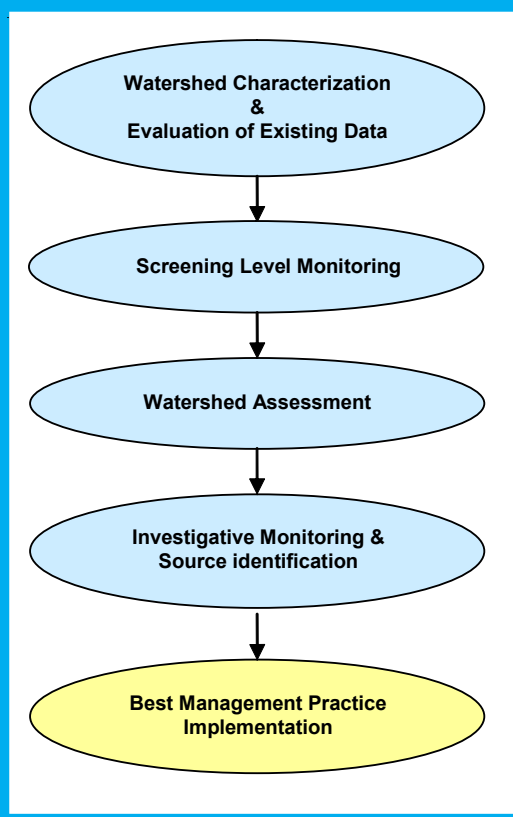
Screening Level Monitoring

An ecological indicator is a measure, an index of measures, or a model that characterizes an ecosystem or one of its critical components. An indicator may reflect biological, chemical and/or physical attributes of ecological condition, and may also be used to identify major ecosystem stress. The Program collects aquatic life use and water recreation use screening level indicators.

Watershed Assessment

Watershed assessment is the systematic review of specific water body functions and impacts in a watershed-scale context. The Program uses results of watershed assessment to establish the context for subsequent evaluations and analysis of cumulative watershed effects. Assessment helps the Program identify data gaps and potential follow-up studies; and to recommend feasible management actions. A key emphasis of any assessment will be investigating impacts to beneficial uses from hydromodification caused by new development and redevelopment.

Figure 1. SCVURPPP Multi-Year Monitoring and Assessment Process



Investigative Monitoring/Studies

Investigative monitoring/studies address specific questions related to potential impairment and include more detailed measurements at finer spatial resolution (e.g., stream segment). These focused studies help to identify the causes of potential impairment and the potential sources of pollutants.

Screening Level Monitoring Results

The Santa Clara Basin is comprised of thirteen watersheds (Figure 2). Between July 2002 and June 2005, the Program collected and analyzed screening-level water quality monitoring data from 49 creek sites located in sixteen water bodies and eight watersheds. Water samples were analyzed for conventional water quality parameters, chemical pollutants (metals and pesticides), aquatic toxicity and pathogen indicators. In addition, benthic macroinvertebrate (BMI) and fish bioassessments were conducted to better understand the status of aquatic life in these watersheds.

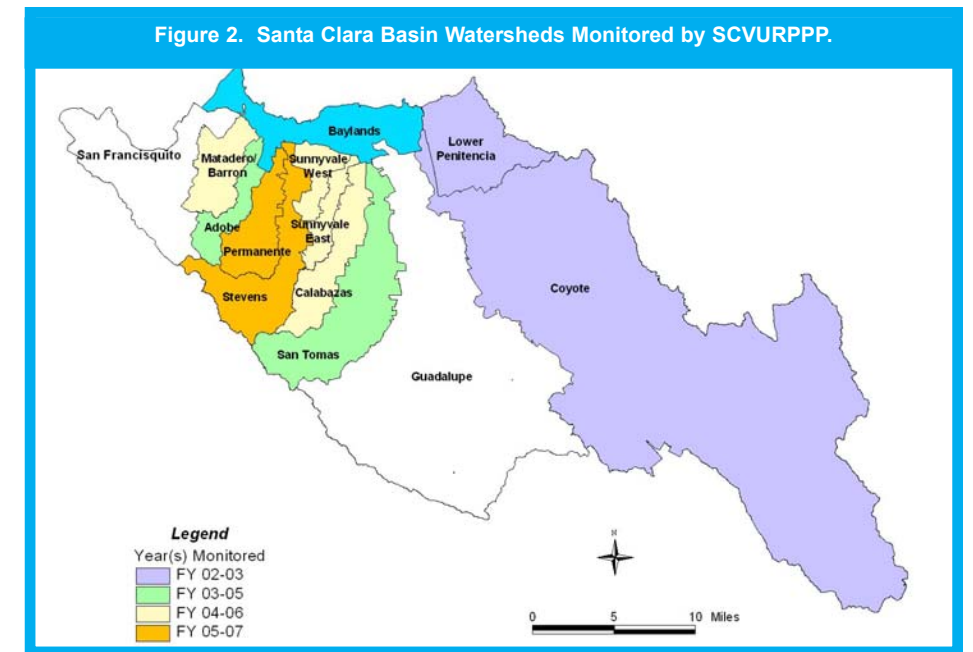
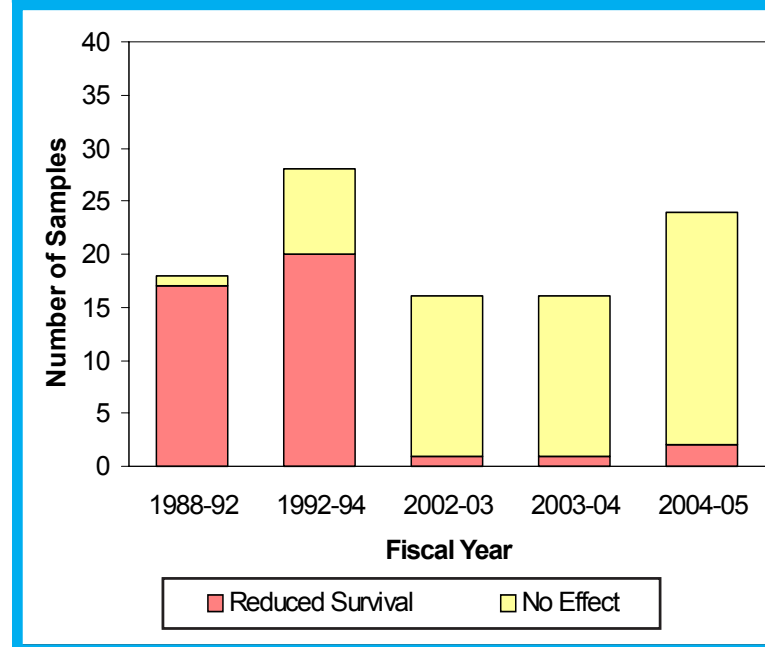


Figure 3. Number of Creek Water Samples Taken During Fiscal Years 1988-1989 Through 2004-2005 Which Indicate Aquatic Toxicity (e.g., Reduced Survival) to *Ceriodaphnia Dubia*.



In recent years, diazinon and water column toxicity occur less frequently in urban creeks. The USEPA connects the reduction in toxicity to the phase-out of diazinon. As illustrated in Figure 3, toxicity results from SCVURPPP monitoring from FY 02-03 through FY 04-05 support the USEPA finding and suggest that diazinon phase-out has reduced the impacts on Santa Clara Valley creeks.

To date, screening level monitoring results indicate that:

- Numeric Water Quality Standards (WQS) are generally met for all pollutants/parameters sampled, including mercury, copper and nickel;
- Organophosphate pesticides (including diazinon) are not generally detected in creek water;
- As generally found in most Bay Area creeks, biological and physical integrity decreases in creeks as you move towards the San Francisco Bay; and
- Beneficial uses have not been designated for many creeks in the Santa Clara Valley.

Diazinon-related Toxicity

Between FY 1988-1989 and FY 1994-1995, eighty percent of the forty-six (46) water samples collected at four creek locations in the Santa Clara Basin indicated aquatic toxicity (e.g., reduced survival) to *Ceriodaphnia dubia*, an indicator organism used in laboratory tests to assess surface water toxicity and to evaluate biological community responses (Figure 3).