Santa Clara Valley
Urban Runoff
Pollution Prevention Program

Pesticide Source Control Effectiveness Evaluation

Submitted on behalf of all SCVURPPP Co-permittees in Compliance with Provision C.9.g of Order R2-2009-0074

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LIST OF ABBREVIATIONS

BASMAA	Bay Area Stormwater Management Agencies Association
BOMA	Building Owners and Managers Association
CASQA	California Stormwater Agencies Association
CEP	Clean Estuary Partnership
DPR	California Department of Pesticide Regulation
HHW	Household Hazardous Waste
IFMA	International Facility Management Association
IPM	Integrated Pest Management
MRP	Municipal Regional Stormwater NPDES Permit (Order R2-2009-0074)
NOAEC	No Observable Adverse Effects Concentration
NOEC	No Observable Effects Concentration
NPDES	National Pollutant Discharge Elimination System
OSH	Orchard Supply Hardware
O&M	Operation and Maintenance
OWOW	Our Water Our World
PCO	Pest Control Operator
POC	Pollutants of Concern
RMC	Regional Monitoring Coalition
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SOP	Standard Operating Procedure
SPoT	Stream Pollutant Trend Monitoring Project (Statewide SWAMP)
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
WQAS	Water Quality Attainment Strategy
WQOs	Water Quality Objectives

1.0 INTRODUCTION

This *Pesticide Source Control Effectiveness Evaluation* addresses the requirements of MRP Provision C.9.g - Evaluate Implementation of Source Control Actions Relating to Pesticides. This provision requires Permittees to:

- Evaluate the effectiveness of the control measures implemented;
- Evaluate the attainment of pesticide concentration and toxicity targets for water and sediment from monitoring data generated via Provision C.8.; and,
- Identify improvements to existing control measures and/or additional control measures, if needed, to attain targets with an implementation time schedule.

The MRP includes requirements associated with pesticides because regulatory agencies have previously identified pesticides as causing water and/or sediment toxicity and impairing beneficial uses , and determined that urban stormwater is a likely or potential cause or contributor to the impairment (SFRBWQCB 2009). This Effectiveness Evaluation Report describes the source control measures implemented by the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP or Program) and the 15 participating municipalities and agencies (i.e., Co-permittees), and provides an evaluation of the effectiveness of the control measures using effectiveness assessment outcomes developed by the California Stormwater Agencies Association (CASQA) (CASQA 2007). The effectiveness of pesticide control measure is assessed using both implementation and water quality outcomes, including a comparison to receiving water quality targets established via the *Total Maximum Daily Load and Water Quality Attainment Strategy for Diazinon and Pesticide-related Toxicity in San Francisco Bay Urban Creeks* (SFRBWQCB 2005). This evaluation also identifies source control measures that the Program and Co-permittees should continue to implement, as well as new or enhanced source control measures that should be implemented to assist in achieving TMDL targets for pesticides and pesticide-related toxicity in Santa Clara Valley urban creeks. A preliminary time schedule for future implementation of source control measures is also provided.

2.0 BACKGROUND

2.1. Water Quality Impairment and the SF Bay Area Urban Creeks TMDL

During the early 1990s, organophosphate pesticides were identified as causing water toxicity in San Francisco Bay Area urban creeks (SWRCB et al. 1997). Water toxicity was observed via *Ceriodaphnia dubia*, an indicator organism used in laboratory tests to assess surface water toxicity and evaluate biological community responses. Diazinon concentrations throughout Bay Area urban creeks were often high enough to account for water toxicity and were therefore identified as the primary cause of the impairment in urban creek.

In May 1999, the U.S. Environmental Protection Agency (USEPA) listed the San Francisco Bay and 35 Bay Area urban creeks as impaired by diazinon under Section 303(d) of the Federal Clean Water Act (USEPA 1998). In 2000, because of growing concerns about the effects these chemicals have on human health, the USEPA announced an agreement with pesticide manufacturers to remove most products containing chlorpyrifos and diazinon from retail store shelves, and end most residential and professional uses by the end of 2004. Subsequently, urban uses of diazinon use began to decline substantially. The phase-out of diazinon, however, resulted in the increased use of alternative pesticides and the emergence of new

pesticides in the market place. Replacements to organophosphate pesticides have included pyrethroids, carbamates and fipronil.

In 2005, the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) adopted the *Total Maximum Daily Load (TMDL) and Water Quality Attainment Strategy (WQAS) for Diazinon and Pesticide-related Toxicity in San Francisco Bay Urban Creeks* (SFRBWQCB 2005). Because it was unknown at the time as to whether water quality improvements attributable to the phase-out of diazinon would be realized, the TMDL/WQAS targeted diazinon specifically, while concurrently addressing the potential for other pesticide-related toxicity in urban creeks. Water and toxicity targets established through the TMDL/WQAS are the following:

- **Toxicity Targets** - no pesticide-related acute or chronic toxicity in urban creeks in excess of 1.0 TU_a or 1.0 TU_c:
  where:
  TU_a = 100 / No Observable Adverse Effects Concentration (NOAEC)
  TU_c = 100 / No Observable Effects Concentration (NOEC)
  NOAEC = Statistically significant differences between acute endpoints in sample and control
  NOEC = Statistically significant differences between chronics endpoints in sample and control
- **Diazinon Target** - The one-hour average concentration of diazinon in freshwater shall not exceed 100 ng/l.

As described in the TMDL/WQAS, the goal of the implementation strategy is to eliminate and prevent pesticide-related toxicity in Bay Area urban creeks. The overarching strategy to reach this goal is to encourage pest management alternatives that do not threaten water quality and to discourage the use of pesticides that run off and threaten water quality, which can best be accomplished through the application of integrated pest management (IPM) techniques and the use of less toxic pest control methods (SFBRWQCB 2005). The TMDL includes proposed actions that focus on effective IPM implementation, proactive regulation, education and outreach, and research and monitoring. Requirements included in Provision C.9 of the MRP are consistent with the actions outlined in TMDL/WQAS.

2.2. Pesticide Regulation and Oversight

Several agencies and organizations oversee pesticide use and pesticide discharges. Those with the broadest authorities include the USEPA and the California Department of Pesticide Regulation (DPR). Gaps in pesticide regulatory program implementation allow pesticides to be used in ways that result in discharges that impair San Francisco Bay Area urban creeks and their beneficial uses. The role of the Water Board is to encourage, monitor, and enforce implementation actions, and to lead by example (SFBRWQCB 2005). Bay Area urban runoff management agencies and others are responsible for urban runoff discharges through National Pollutant Discharge Elimination System (NPDES) permits, but California law generally prohibits these agencies from regulating the registration, sale, transportation, or use of pesticides within their jurisdictions. Co-permittees are therefore limited in their ability to reduce the impacts of pesticides in discharges from stormwater conveyances. Pesticide control measures implemented by Co-permittees are focused primary on practicing and encouraging IPM, and participating in regulatory processes to ensure water quality impacts are considered during the pesticide

re-registration and approval process. Further description of these control measures in provided later in this document.

2.3. Current Use Urban Pesticides of Concern

Currently, pyrethroids, carbamate and fiprinol are the pesticides of primary concern to water quality. Depending on their use, pyrethroids can be divided into the following two groups (SFEP 2010):

- The **urban high-use pyrethroids** are the pyrethroids most heavily used in urban areas, including: bifenthrin, cyfluthrin (including beta-cyfluthrin), cypermethrin, deltamethrin, esfenvalerate, gamma-cyhalothrin, lambda-cyhalothrin, permethrin, and tralomethrin. These photostable pyrethroids are commonly applied outdoors around buildings or on landscaping via broadcast treatments. They may also be used indoors.

- The **other urban pyrethroids** are insecticides commonly used as pet flea treatments, human body treatments, fabric treatments, aerosol sprays, foggers, and manhole treatments, including: cyphenothrin, etofenprox, resmethrin, sumithrin, and tetramethrin. These pyrethroids occur primarily in low-concentration formulations like aerosols and foggers and in products designed for indoor use, probably because most of them (all except the relatively new ether pyrethroid, etofenprox) do not persist when exposed to sunlight.

Additionally, carbarmates and fiprinol also pose concerns to water quality, due to increased market share and toxicity to aquatic species (Cary et al. 2004, Chandler et al. 2004).

2.4. MRP Requirements

Provision C.9 of the MRP requires Co-permittees to implement pesticide toxicity control programs within their jurisdictions to address the use of pesticides that pose a threat to water quality and have a potential to enter the municipal stormwater conveyance system. Urban pesticides of concern include:

- Organophosphate pesticides (chlorpyrifos and diazinon);
- Pyrethroid pesticides (bifenthrin, cyfluthrin, beta-cyfluthrin, cypermethrin, deltamethrin, esfenvalerate, lambda-cyhalothrin, permethrin, and tralomethrin); and,
- Carbamates (e.g., carbaryl) and fipronil.

Consistent with the requirements within Provision C.9, the Program's and Co-permittees' approach to pesticide management focuses on the use of source control and pollution prevention actions that can potentially reduce the use of the "urban high-use pyrethroids". These actions include significant outreach efforts to residents, businesses, and municipal staff to provide education and achieve behavior changes relative to uses of pesticides and less-toxic pest control methods. Outreach efforts have been supplemented by: monitoring studies to define the problem; participation in regional efforts to address pesticide regulations and other issues; and development of local IPM ordinances and plans.

2.4.1. Source Control Measures

SCVURPPP and its participating agencies have implemented source control measures to control pesticide pollution for over 10 years. Based on requirements in its 2001 NPDES Permit, SCVURPPP developed a Pesticide Management Plan (Plan) to control pesticide-related toxicity attributable to urban runoff. The Plan identified specific source control measures, the goals of each source control

measure, specific actions, monitoring mechanisms, and implementation schedules (SCVURPPP 2002). The monitoring mechanisms are actions that measure progress toward achieving the stated goals. The Plan also identified whether actions will be implemented at the Program level, municipality level, or both.

Though the Plan was developed as a 5-year plan, implementation of tasks continued after the adoption of the MRP. Source control measures were enhanced, as needed, to meet MRP requirements. Currently, source control measures include the following:

- Adopting and implementing IPM Policies/Ordinances and establishing Standard Operating Procedures;
- Training municipal staff on IPM techniques;
- Requiring contractors to implement IPM;
- Participating in regulatory processes to ensure water quality impacts are considered in the pesticide re-registration and approval process;
- Providing free disposal of unused pesticides locally or through the County's Household Hazardous Waste (HHW) Collection Program;
- Conducting public outreach to promote IPM; and,
- Minimizing pesticide use at new development and redevelopment project sites.

These source control measures are described in detail later in this report.

2.4.2. Water Quality Monitoring Program

Water quality monitoring was also described in the SCVURPPP Pesticide Management Plan, and implemented prior to the adoption of the MRP. Monitoring consisted of pesticide monitoring and toxicity testing in receiving water and sediment at a number of sites per year. Monitoring results were summarized in a number of technical reports submitted with the Program's Annual Reports to the Water Board and summarized in SCVURPPP (2002).

With the adoption of the MRP, SCVURPPP began implementing new monitoring requirements as a participant of the BASMAA Regional Monitoring Coalition (RMC). Per MRP Provision C.8.c, SCVURPPP annually monitors pesticides in streambed sediments during the dry season and tests for toxicity in the water column and streambed sediments during wet weather and dry weather at three creek sites per year, designated through a probabilistic monitoring design (BASMAA 2011a) using standard protocols (BASMAA 2012). The suite of parameters monitored includes pyrethroid pesticides, carbaryl and fipronil in sediment; toxicity of water to three test organisms (*Pimephales promelas* (fathead minnow), *Ceriodaphnia dubia* (crustacean), and *Selenastrum capricornutum* (green algae); and the toxicity of sediment to *Hyalella azteca* (amphipod). Water toxicity and sediment chemistry and toxicity data are analyzed and evaluated to identify potential stressors (including pesticides) that may be contributing to degraded or diminished water quality. Samples are compared to water quality objectives (WQOs) and monitoring trigger thresholds as specified in the MRP. Samples that exceed WQOs or monitoring trigger thresholds may result in additional monitoring to confirm or identify stressors and/or sources of impacts and their spatial extents, and/or identify management actions to minimize the impacts associated with urban runoff.

Per MRP Provision C.8.e, SCVURPPP also conducts pollutants of concern (POC) monitoring at two sites located on the Sunnyvale East Channel and the Guadalupe River to assess inputs of POCs to the Bay from local tributaries and urban runoff, assess progress toward achieving wasteload allocations for

TMDLs, and to help resolve uncertainties associated with loading estimates for these pollutants (BASMAA 2011b). The suite of parameters monitored includes pyrethroid pesticides, carbaryl and fipronil. Water samples from these monitoring stations are also assessed for toxicity to four test organisms: *Pimephales promelas* (fathead minnow), *Hyalella azteca* (amphipod), *Ceriodaphnia dubia* (crustacean), and *Selenastrum capricornutum* (green algae).

3.0 EFFECTIVENESS EVALUATION METHODOLOGY

This report evaluates the effectiveness of source control measures implemented by the Program and Co-permittees. The evaluation uses "Outcome Levels" described by CASQA (2007) in its *Program Effectiveness Assessment Guidance Manual* (Guidance Manual). Information on the level of implementation and associated data (e.g., local implementation of IPM Policy, trends in use of pesticides impacting water quality, and number of staff trained in IPM, etc.) used to assess the effectiveness of pesticide source controls was obtained from Program and Co-permittee Annual Reports. Water quality monitoring data collected by SCVURPPP and other agencies (e.g., Regional Water Board) were also complied and summarized to assess progress towards the TMDL/WQAS targets described in Section 2.1.

3.1. Outcome Levels

The CASQA Guidance Manual defines **outcomes** as the results of implementing a stormwater control measure, program activity or element, or overall program. Each control measure or activity can lead to one or more Outcome Levels. The six Outcome Levels described in the Guidance Manual are summarized below:

- **Outcome Level 1: Documenting Activities** - Many specific activities are either prescribed by or established under stormwater NPDES permits. The most basic means of assessing effectiveness is to determine compliance with activity-based permit requirements. Level 1 Outcomes may take the form of a simple yes/no answer.
- **Outcome Level 2: Raising Awareness** - The aim of most stormwater programs is to increase the level of knowledge and awareness among target audiences. Measuring Level 2 Outcomes is a useful way of gauging whether educational efforts are progressing toward increased knowledge and awareness. Various methods and tools, both quantitative and qualitative, are utilized to measure changes in knowledge and awareness. These methods generally take the form of surveys and quizzes.
- **Outcome Level 3: Changing Behavior** - Building on increases in knowledge and awareness, a key focus of stormwater management programs is to effect changes in behavior. Level 3 Outcomes measure the effectiveness of programs in motivating target audiences to change their behaviors and implement appropriate control measures. Methods used to measure behavioral changes include those described above for Level 2 Outcomes, as well as direct observation via site visits and reporting by dischargers or third parties.
- **Outcome Level 4: Reducing Loads from Sources -** Most activities implemented through stormwater management programs are intended to reduce the loading of pollutants from targeted sources. Load reductions should in turn result in improvements to discharge and receiving water quality. Load reductions quantify changes in the amounts of pollutants associated with specific sources before and after one or more control measures are employed.

- **Outcome Level 5: Improving Runoff Quality** - A primary focus of stormwater management programs is to reduce pollutants in stormwater and non-stormwater discharges to the maximum extent practicable, and to ensure that these discharges do not cause or contribute to violations of water quality standards in receiving waters. Level 5 Outcomes may be measured as reductions in one or more specific pollutants, and may reflect effectiveness at a variety of scales ranging from site-specific to programmatic.
- **Outcome Level 6: Protecting Receiving Water Quality** - The ultimate objective of stormwater management programs is the protection of water bodies receiving discharges from MS4s. Changes to receiving water and environmental quality may be expressed through a variety of outcomes such as achievement of water quality objectives/criteria and TMDL targets, protection of biological integrity, and beneficial use attainment.

Once the desired Outcomes of program implementation have been defined, specific assessment measures are used to determine whether or how successfully a programmatic or water quality outcome has been achieved. They may be qualitative (e.g., yes/no) or quantitative (e.g., % of targeted audience reached, % reduction in a constituent level, etc.). All priority outcomes have at least one assessment measure associated with them, but some may have multiple measures.

3.2. Implementation and Water Quality Assessments

On a broader scale, there are two general categories of effectiveness assessments: 1) Implementation Assessments; and 2) Water Quality Assessments. These categories of assessments are differentiated by whether the type of outcome is implementation-based or water quality-based. Implementation assessments include those evaluations conducted at Levels 1-4, and water quality assessments are those conducted at Levels 5-6. The following sections discuss the results of both implementation and water quality assessments conducted to evaluate the effectiveness of pesticide source control measures implemented by the Program and Co-permittees.

4.0 IMPLEMENTATION ASSESSMENT RESULTS (LEVELS 1-4)

4.1. Adopting and Implementing IPM Policies/Ordinances and Establishing Standard Operating Procedures

The goal of this control measure is to establish structural and landscape pest control guidelines for municipal staff and pest control contractors. Adopting an IPM Policy/Ordinance demonstrates a local agency's commitment to reducing pesticide use. The effectiveness of this source control measure is assessed at Outcome Levels 1, 2, 3 and 4.

4.1.1 Level 1 - Documentation of Activities

All SCVURPPP Co-permittees have adopted IPM Policies/ Ordinances and established detailed IPM Plans and pesticide application Standard Operating Procedures (SOPs). The timeline for adoption of IPM Policies by SCVURPPP Co-permittees is below:

- City of Palo Alto – 2001
- Santa Clara Valley Water District – 2001, revised 2010
- West Valley Cities (Campbell, Saratoga, Monte Sereno and Los Gatos) – 2002

- City of Mountain View – 2002
- County of Santa Clara – 2002
- City of Sunnyvale – 2002, revised 2010
- City of Cupertino – 2002, updated in 2008 and 2011
- City of San Jose – 2003
- City of Milpitas - 2004, revised 2012
- City of Los Altos and Town of Los Altos Hills – 2010
- City of Santa Clara –2012[1]

4.1.2 Level 2 - Raising Awareness

Staff trainings are used to raise the awareness of and update municipal staff on IPM Policies/Ordinances and Plans. All contractors are made aware of and required to follow IPM Policies/Ordinances. Additionally, pesticide application SOPs that are utilized by Co-permittees describe the pest control procedures that municipal staff and contractors must follow, which raises the awareness of appropriate control implementation for both municipal staff and contractors.

4.1.3 Level 3 - Behavior Change and Level 4 - Source Reduction

One indicator of behavior change and source reduction associated with municipal use of pesticides of concern is the volume of pesticides applied annually by Co-permittees. Co-permittees have tracked and reported municipal use of pesticides of concern via Annual Reports to the Regional Water Board. Pesticide use data were reviewed to better understand whether pest control practices have changed, leading to a reduction in the use of pesticides of concern. The results of this evaluation are as follows:

- From FY 2004-05 onward, diazinon was not used by SCVURPPP Co-permittees.
- From FY 04–05 through FY 11-12, only one Permittee reported using small quantities of a chlorpyrifos pesticide. The last use of a chlorpyrifos pesticide by a Co-permittee was reported in FY 05-06.
- Six Co-permittees have IPM Plans that prohibit the use of organophosphate pesticides on municipal property. Six Co-permittees have placed restrictions on the use of *Category I*[2] pesticides, *Category II*[3] pesticides, and organophosphate pesticides. Three Co-permittees do not place any restrictions but have detailed IPM Plans/Guidelines for pesticide use.
- In FY 11-12, five Co-permittees reported not having used any pesticides of concern in the last three years. Two Co-permittees reported that they do not use any pesticides on municipal properties. The Co-permittee agencies that report using pesticides of concern stated that they used these pesticides only as a last resort and provided a reason for use. In most cases, these applications were in small quantities, or inside buildings, and did not pose a threat to water quality.
- All Co-permittees have been providing pesticide use summaries since FY 04-05. Four Co-permittee agencies consistently reported quantities of pesticides of concern used since FY 04-05. The

[1] The City of Santa Clara had an in-house IPM Program until 2012. The IPM Policy was officially adopted in 2012.
[2] *Toxicity Category I pesticide product* is any pesticide product that meets United States Environmental Protection Agency criteria for Toxicity Category I under Section 156.10 of Part 156 of Title 40 of the Code of Federal Regulations. These pesticides have the signal word “DANGER” on the label. Some organophosphate pesticides are under this category.
[3] *Toxicity Category II pesticide product* is any pesticide product that meets United States Environmental Protection Agency criteria for Toxicity Category II under Section 156.10 of Part 156 of Title 40 of the Code of Federal Regulations. These pesticides have the signal word “WARNING” on the label. Some organophosphate pesticides and pyrethroids are under in this category.

data reported were used to analyze the trend in the usage of pesticides of concern. Tables 1 and 2 illustrate a downward trend in their overall pesticide usage. The data indicate that pyrethroid usage increased following the ban on organophosphate pesticides, and then has declined as Co-permittees enhanced their IPM programs.

Table 1. Trends in pyrethroid pesticide use by four[a] SCVURPPP Co-permittees between FY 04-05 through FY 11-12.

	Quantity of Pyrethroids Used (ounces)				
Year	**Cupertino**	**Los Altos**	**San Jose**	**Sunnyvale**	**TOTAL**
FY 04-05	3.6	16.0	4.5	0.77	**24.8**
FY 05-06	8.0	200.5	4.8	216.6	**429.9**
FY 06-07	12.0	64.3	43.4	167.8	**287.5**
FY 07-08	0	32.9	27.4	1049.6	**1109.8**
FY 08-09	0	36.0	10.7	917.8	**964.4**
FY 09-10	0	20.0	9.9	639.8	**669.7**
FY 10-11	0	49.0	10.1	50.6	**109.6**
FY 11-12	0	0	4.8	25.6	**30.4**

[a] Only four Co-permittees have reported pesticide usage since FY 2004-05.

Table 2. Trends in Fipronil use for four[a] SCVURPPP Co-permittees between FY 04-05 through FY 11-12.

	Quantity of Fipronil Used (ounces)				
Year	**Cupertino**	**Los Altos**	**San Jose**	**Sunnyvale**	**Total**
FY 04-05	0.36	6.0	0	32.0	**38.4**
FY 05-06	7.0	0	0	0	**7.0**
FY 06-07	4.0	0	5.0	9.0	**18.0**
FY 07-08	4.0	0	3.8	0	**7.8**
FY 08-09	0.16	0	3.5	0	**3.7**
FY 09-10	1.6	0	0.4	0.3	**2.3**
FY 10-11	0	0	1.2	0	**1.2**
FY 11-12	0	0	0.7	0	**0.7**

[a] Only four Co-permittees have reported pesticide usage since FY 2004-05.

4.2. Staff Training

The intent of trainings for municipal staff is to: 1) raise awareness of all municipal employees about IPM, and 2) train employees who apply pesticides about the municipality's IPM Policy and/or IPM techniques as appropriate. The effectiveness of this source control measure is assessed at Outcome Levels 1, 2, 3, and 4 .

4.2.1. Level 1 - Documentation of Activities

All SCVURPPP Co-permittees have conducted trainings to ensure that staff responsible for applying pesticides are familiar with their agency's IPM Policy, SOPs and new and current IPM techniques. From FY 09-10 to FY 11-12, a total of 388 employees attended trainings. Co-permittees also sent staff to trainings organized by SCVURPPP (e.g., Santa Clara Valley Green Gardener Training) or other organizations (e.g., Bay Friendly Landscaper Training, Pesticide Applicators Professional Association's IPM Trainings).

4.2.2. Level 2 - Raising Awareness

The IPM trainings help increase municipal staffs' awareness of IPM techniques. Generally, training content includes topics such as overview of IPM techniques, using IPM for managing pest problems, plant selection to avoid pest problems, and available less-toxic pest control products. By attending trainings, the awareness of municipal staff of IPM and the use of less toxic pesticides was increased.

4.2.3. Level 3 - Behavior Change and Level 4 - Source Reduction

As discussed earlier, an analysis of the reported pesticide use data indicates that pest control practices have changed leading to a reduction in the use of pesticides of concern by Co-permittee staff and contractors. This can be attributed in part to the IPM training received by municipal staffs that apply pesticides.

4.3. Requiring Contractors to Implement IPM

The goal of this control measure is to ensure that all pest control contractors hired by Co-permittees are familiar with the agency's IPM policy and are able to address pest problems using IPM techniques. The effectiveness of this source control measure is assessed at Outcome Levels 1, 2, 3 and 4.

4.3.1. Level 1 - Documentation of Activities & Level 2 - Raising Awareness

- 13 of 15 Co-permittees agencies have contract specifications that require contractors to follow the IPM Policy and implement IPM. The remaining two Co-permittees do not hire contractors for pest control work.
- All contract specifications require that contractor follow the Co-permittee's IPM Policy. Six Co-permittees have IPM Plans that prohibit the use of organophosphate pesticides on municipal property. Six Permittees have placed restrictions on the use of *Category I* pesticides, *Category II* pesticides, and organophosphate pesticides. Three Co-permittees do not place restrictions, but have detailed IPM Plans/Guidelines for pesticide use.
- Three Co-permittees require that contractors be IPM certified (e.g., Eco-wise, Green Pro and Green Shield) and/or obtain training from the Green Gardener or Bay Friendly Landscaping programs. The City of Palo Alto's pest control operator is Eco-wise certified. The contractor serving Campbell and Los Gatos is in the process of obtaining a GreenPro certification.

4.3.2. Level 3 - Behavior Change and Level 4 - Source Reduction

As discussed earlier, an analysis of the reported pesticide use data indicates that pest control practices have changed leading to a reduction in the use of pesticides of concern by Co-permittee staff and contractors. This can be attributed in part to the requirements for contractors to use IPM techniques.

4.4. Participation in Regulatory Processes

The goal of this source control measure is to actively participate in regulatory processes to improve regulatory agency considerations of water quality during the pesticide approval and registration process. Improvements to the registration process, with regard to water quality, will reduce the impact that registered pesticides are having on Bay Area water bodies. Active participation by Co-permittees includes working with regional and state stormwater management organizations to communicate with the USEPA Office of Pesticide Programs and DPR regarding the need to improve the pesticide registration process. The Program and Co-permittees work collaboratively with BASMAA and CASQA to accomplish this goal. The effectiveness of this source control measure is assessed at Outcome Levels 1, 2, 3 and 4.

4.4.1. Level 1 - Documentation of Activities

Program staff actively participates in the CASQA Pesticide Subcommittee and provided input on regulatory efforts related to pesticides. Additionally, SCVURPPP has funded CASQA to "Track and Participate in Relevant Regulatory Processes" since the early-2000s via BASMAA. This project helped fund the efforts of the CASQA Pesticide Subcommittee to track regulatory efforts and comment on pesticide re-registrations and maintain other communications with State and Federal agencies. Program staff and CASQA and BASMAA representatives, on behalf of Permittees, have maintained communication with California DPR and USEPA through meetings and letters during this time. In 2012 alone, CASQA submitted 13 letters to DPR and USEPA on pesticide toxicity issues and pesticide re-registrations, on behalf of Co-permittees and other local agencies.

4.4.2. Level 2 - Raising Awareness & Level 3 - Behavior Change

Program and Co-permittee efforts, through CASQA, have led to improved awareness and behavior change with regard to pesticides. Significant changes in pesticide approval and registration processes at USEPA and DPR have recently gone into effect as a result of stormwater program actions. Some recent achievements are described below:

- DPR adopted new California regulations for "Surface Water Protection in Outdoor Nonagricultural Settings" that became effective July 19, 2012. The regulations reduce the quantities of pyrethroids applied on outdoor impervious surfaces by professional applicators, thus reducing the quantity of pyrethroids that can be washed directly into gutters and storm drains when it rains or when water such as irrigation overflow runs across treated surfaces.

- DPR agreed with water quality agencies that additional reductions in outdoor bifenthrin (pyrethroid) use, beyond what is required in the surface water regulations, are warranted because of bifenthrin's significant contribution to aquatic toxicity. These new bifenthrin labels will prohibit applications to any exposed horizontal impervious surface and any building wall that abuts impervious surfaces that drain to storm drains.

- On September 16, 2011, DPR announced a formal procedure to ensure that pesticides with potential to pollute surface water will be identified when they enter DPR's registration process and will be routed to DPR's Surface Water Program for review.

- In 2009, USEPA began working with pyrethroid manufacturers to modify pyrethroid product labels with instructions that provide additional water quality protections. The instructions direct users to apply only spot or "crack and crevice" treatments on impervious surfaces, and contain other recommendations such as to avoid applications when rain is forecast in the next 24 hours. USEPA required these changes for pyrethroids that went through the re-registration process (i.e., cypermethrin, permethrin, resmethrin, tetramethrin, sumithrin, and allethrins). For all other pyrethroids (e.g., bifenthrin, cyfluthrin and esfenvalerate), the changes are voluntary until registration reviews are completed.

- In response to comment letters from CASQA and other water protection agencies, USEPA modified its Registration Review Work Plans for Fipronil, Permethrin, Spinosad and Imiprothrin. The modified Work Plans will consider water quality risk associated with urban uses of these pesticides.

4.4.3. Level 4 - Reducing Loads from Sources

DPR's newly adopted California regulations for "Surface Water Protection in Outdoor Nonagricultural Settings" will reduce the quantities of pyrethroids applied on outdoor impervious surfaces by professional applicators, thus reducing the quantity of pyrethroids that can be washed directly into gutters and storm drains when it rains or when water such as irrigation overflow runs across treated surfaces. It is estimated that DPR's new regulations, in combination with new product labeling being implemented at DPR's request, will reduce the amount of pyrethroids insecticides in urban stormwater runoff by 80-90% (Jorgenson 2011).

4.5. Household Hazardous Waste Collection

The goal of this control measure is to prevent illegal dumping and inappropriate disposal of pesticides by providing free and convenient disposal locations, and conducting outreach to inform residents about the proper disposal of unused pesticides. The effectiveness of this source control measure is assessed at Outcome Levels 1, 2, 3, and 4.

4.5.1. Level 1 - Documentation of Activities

Co-permittees, either individually or through participation in the Santa Clara County Household Hazardous Waste Management Program (County HHW Program), have ensured that adequate pesticide disposal services are available to all residents and small businesses in the Santa Clara Valley. Disposal opportunities offered by Santa Clara Valley HHW Programs in FYs 09-10 through FY 12-13 are presented in Table 3.

Table 3. Household Hazardous Waste (HHW) disposal opportunities in Santa Clara Valley from FY 09-10 through FY 12-13.

	# of collection events at permanent facilities	# of collection events at temporary sites	# of small business sites served
FY 09-10	41	19	432
FY 10-11	41	21	521
FY 11-12	45	16	508
FY 12-13	41	15	453

4.5.2. Level 2 - Raising Awareness & Level 3 - Behavior Change

The Program's public education and outreach program is designed to raise awareness of water quality issues and promote behavior change that will reduce water quality impacts on receiving waters. Information on how to properly disposal of pesticides is posted on Program's Watershed Watch website (www.watershedwatch.org). The Program's media advertising conducted as part of the Watershed Watch Campaign has incorporated messages about proper pesticide disposal since 2001. In FY 12-13, the Program's media advertising included 19 radio advertisements promoting proper disposal of pesticides.

At outreach events, the Program uses a bean bag toss game to educate children (and their parents) about proper disposal of wastes. Children play the game by tossing bean bags that represent different wastes (e.g., soap, paint, batteries, fluorescent light bulbs, fertilizers, pesticides, etc.) into appropriate holes (sanitary sewer, storm drain, household hazardous waste collection center, recycle, or garbage). Approximately 1,200 children played the game at outreach events in FY12-13.

Between FY 09-10 and FY 12-13, 120,614 residents disposed of household hazardous waste, including unused pesticides, via the Santa Clara County HHW Program. Numbers of residents utilizing the HHW program each fiscal year during this timeframe are as follows:

- FY 09-10 - 34,629 residents
- FY 10-11 – 32,216 residents
- FY 11-12 – 29,106 residents
- FY 12-13 – 24,663 residents

The decrease in the number of residents is likely due to more residents using the HHW drop-off locations located at retail stores. Residents can drop off used fluorescent light bulbs and batteries at these stores instead of using the County's drop-off locations. The numbers of residents using these retail drop-off locations is not tracked. Therefore, while the data do not show an upward trend, the numbers indicate that Santa Clara Valley residents consistently use the HHW disposal facilities and bring their unused pesticides to HHW Program locations for proper disposal.

4.5.3. Level 4 - Source Reduction

From FY 09-10 through FY 12-13, the Santa Clara County HHW Program collected 638,938 pounds of liquid pesticides and 549,785 pounds of solid pesticides. Table 4 provides a summary by fiscal year.

Table 4. Quantity of pesticides disposed at County HHW Locations from FY 09-10 through FY 12-13.

Year	Quantity of Liquid Pesticides Disposed (pounds)	Quantity of Solid Pesticides Disposed (pounds)
FY 09-10	165,010	130,560
FY 10-11	166,193	140,250
FY 11-12	160,470	147,425
FY 12-13	147,265	131,550

The decrease in the quantity of pesticides disposed over the years could be attributed to the economic downturn which has decreased spending and waste. It is also possible that residents are buying fewer pesticides and have already disposed of old products, so a decrease in quantity over the long term may be expected.

4.6. Public Education and Outreach

The goals of the Public Education and Outreach element are to: 1) inform the general public about stormwater pollution due to pesticides, 2) educate them about using IPM techniques for pest control, and 3) help them choose the least-toxic pesticide. The Program conducts outreach through its Watershed Watch Campaign, a multi-year, multi-media outreach effort that was launched in 2000 and promotes watershed stewardship by educating the public about watersheds, urban runoff issues and pollution prevention. The Campaign conducts outreach through media advertising, outreach events, school presentations, website, social networking sites, and partnerships with local businesses and community organizations.

The Program's outreach efforts can be broadly divided into the following categories:

- **Point-of-Purchase Outreach** – The Program implements the BASMAA IPM Store Partnership Program (also known as the *Our Water Our World* Program or the OWOW Program) in local retail stores and nurseries. The aim of the OWOW Program is to partner with retail stores and nurseries to provide less-toxic pest control information to residents at the point of purchase. This involves visiting participating stores regularly (at least three times per year) to stock literature racks with "Less-Toxic Pest Management" fact sheets and update "shelf-talkers". Shelf-talkers are product identification tags that are placed on store shelves to help customers identify less-toxic products. In addition, the Program contracts with Ann Joseph (IPM Consultant) to conduct store employee training. These trainings educate store employees about IPM and selling less-toxic products.

- **Outreach to Residents** – The Program conducts a countywide multi-media outreach campaign called the Watershed Watch Campaign (Campaign) to conduct outreach to residents on watershed awareness and stormwater pollution prevention. Messages on IPM, less-toxic pest control and proper disposal of unused pesticides are included in the Campaign's media campaign, website and brochures. During the MRP term, the Program has conducted media advertising on IPM using the following media: television, transit (bus back posters), radio, print

and online. Advertising is conducted in English and Spanish. Copies of media advertisements are posted at www.MyWatershedWatch.org. In addition, Program and Co-permittee staff conduct IPM outreach at community events each year.

- **Outreach to Pest Control Operators (PCOs) and Landscapers** – The Program conducts the Santa Clara Valley Green Gardener Program for training landscape maintenance professionals on sustainable landscaping techniques. The Green Gardener Program is an educational initiative that brings quality training to professional landscapers, gardeners and landscape maintenance workers on how to "garden green". Each training session consists of ten 2-hour classes, held once a week for ten weeks. Trainings are conducted in English and Spanish. The Program has also conducted targeted outreach to structural PCOs on available IPM-certification programs.

The effectiveness of the SCVURPPP public outreach program and its components is assessed at Outcome Levels 1, 2 and 3. Results of the effectiveness assessment are grouped by outreach program component: 1) Point-of-Purchase Outreach; 2) Outreach to Residents; and 3) Outreach to Pest Control Operators and Landscapers.

4.6.1. Point-of-Purchase Outreach

4.6.1.1 Level 1 - Documentation of Activities

The Program began implementing the OWOW Program locally in FY 98–99 with 18 stores in the Santa Clara Valley participating. At present, 38 stores in the Santa Clara Valley are participating in the OWOW Program. Both small nurseries and larger retail stores such Home Depot and Orchard Supply Hardware (OSH) now participate in the OWOW Program. All Home Depot and OSH stores in the Santa Clara Valley currently participate in the OWOW Program.

Each year, Program staff visits each store at least three times to stock the literature rack and replace "shelf-talkers". Training to store employees is also provided. In FY 12-13 alone, 158 employees representing 16 stores were trained in IPM and selling less-toxic pesticides.

4.6.1.2 Level 2 - Raising Awareness

Store employees attending the training are asked to complete evaluation forms to provide feedback on the OWOW trainings. Feedback on the trainings is always very positive, suggesting that the awareness of store employees is continuing to be raised on water quality issues associated with pesticides and control measures that can be implemented. For example, highlights of the feedback from trainings conducted in FY 12-13include:

- 96% of survey respondents agreed that the training will help them sell less-toxic products.
- 90% of survey respondents said that they will recommend the training to co-workers.
- 67% of survey respondents said that the training changed their attitude toward pesticides.

In FY 09-10, Home Depots began participating in the OWOW Program and that year employees from Home Depot stores received the training for the first time. Their feedback indicated that, compared to employees from stores that had participated in the program for a number of years, Home Depot employees were less aware of IPM and pesticide-related water quality issues. Highlights of the evaluation of Home Depot employees in the Santa Clara Valley include:

- 100% of employees agreed that the training changed their attitude about pesticides; compared to 59% of employees from other stores.
- 43% of employees said that information was new to them; compared to 33% of employees from other stores.

4.6.1.3 Level 3 - Behavior Change

The increase in the number of participating stores and the willingness of store managers to participate in the OWOW Program and send employees to trainings reflects the changing attitude of pesticide sellers toward IPM and the use of less-toxic pest control methods. In addition, Home Depot and OSH stores reported an increase in the sale of less-toxic pesticides in FY 12-13 as compared to FY 11-12 . This indicates that residents are aware of the OWOW program and buying less-toxic pesticides, and store employees may be more actively promoting these products.

4.6.2. Outreach to Residents

As required in Provision C.9.h.iv - Pest Control Contracting Outreach Reporting, a separate report on evaluation of outreach to residents in included in Section 9 of the Program's FY 12-13 Program Annual Report. Some of the highlights from the effectiveness evaluation report are below:

4.6.2.1 Level 1 - Documentation of Activities

- From FY 09-10 to FY 12-13, the Program's media advertising included 3,994 advertisements about "less-toxic pest control and pesticide pollution", 1,299 advertisements on hiring a certified Santa Clara Valley Green Gardener, 93 advertisements on hiring a IPM-Certified IPM Pest Control Operator, and 20 advertisements on proper disposal of household hazardous waste.
- Information on less-toxic pest control is posted on the Watershed Watch website. The website is promoted in all outreach materials and advertisements.
- Program and Co-permittee staff attend community outreach events to interact with the public to inform them about less-toxic pest control methods and proper disposal of leftover pesticides. Annually, the Campaign participates in five or six events where information on IPM and proper disposal of pesticides is provided to residents. The events that attract a large number of families with children and/or gardeners are chosen to conduct IPM related outreach. More than 3,000 outreach materials related to less-toxic pest control methods are distributed to the public at outreach events each year.

4.6.2.2 Level 2 - Raising Awareness

- Impressions from Media Advertising - Media buyers strive to reach a designated target audience with a campaign message at least three times, which is the minimum estimated to make an impact and stimulate a response. The primary target audience for IPM outreach for the Campaign is college educated adult homeowners in Santa Clara County, aged 35-54. There are approximately 725,000 adults aged 35-54 in Santa Clara County, so in any campaign year, the Campaign strived for a minimum of 2,175,000 advertising impressions (3 x 725,000) of our messages. Advertising impressions achieved for IPM messages in recent campaign years were well above the minimum recommended impressions, as indicated below:

  - FY 11-12 – 5,590,664 targeted impressions
  - FY 12-13 – 5,430,508 targeted impressions

- Visits to the Watershed Watch website's IPM pages increase following distribution of materials at events or after specific advertising campaigns. This indicates that residents find the material useful and visit the website for more information. For example, during the month August 2012, with radio advertising promoting Green Gardener class registration and hiring a Green Gardener, Green Gardener web pages were 4 of the 10 most frequented pages on the site. In FY 12-13, the "Find a Green Gardener" and "Green Gardener Classes" web pages were continually among the top 10 most frequently visited web pages out of 150 pages of content viewed on the Watershed Watch website.
- Approximately, 1,200 children played the Program's bean bag toss game in FY 12-13 alone and learned about proper disposal of household hazardous waste. Children learn about the proper disposal of wastes by tossing bean bags that represent different wastes (e.g., soap, paint, fluorescent light bulbs, candy wrappers, pesticides etc.) into appropriate holes (sanitary sewer, storm drain, household hazardous waste collection center, recycle, or garbage). The bean bag labeled "rain" is the only one that is tossed into the hole marked "storm drain". The bean bag game is particularly useful in teaching children and accompanying adults about proper disposal of pesticides.
- Approximately every five years, the Program conducts a public opinion survey to track awareness of Santa Clara Valley residents about stormwater issues. The last survey was conducted in February 2009. The survey included telephone interviews of 565 residents ages 15 and older living in the 13 cities encompassed by the Program. Respondents were selected using random digit dial methodology. The survey included some questions about residents' awareness of pesticide pollution. The survey results showed that the number of residents that believe that pesticides enter the bay and affect its water quality increased from 1991 to 2003, and then declined slightly in 2009 (1991 – 7%, 2003 – 19%, 2009 – 18%). The decline from 2003 to 2009 could be due to the question being phrased somewhat differently in 2003, compared to 1991 and 2009. The Program is considering conducting a public opinion survey in 2014, and will track whether there is any change in the public's awareness that pesticides can flow into storm drains and impact water quality, due to the last 5 years of increased outreach efforts.

4.6.2.3 Level 3 - Changing Behavior

The public opinion surveys conducted by the Program indicate the following behavior changes:

- The number of residents saying that they take leftover household hazardous waste (e.g, paint, pesticides) to household hazardous waste collection centers has increased over the years (1996 – 21%, 1999 – 25%, 2003 – 25%, 2009 – 30%)
- The number of residents saying that they use non-toxic substances rather than pesticides and herbicides has also increased over the years (1996 – 18%, 1999 – 20%, 2003 – 20%, 2009 – 22%)

4.6.3. Outreach to Pest Control Operators and Landscapers

4.6.3.1 Level 1 - Documentation of Activities

Each year, the Program runs radio advertisements in English and Spanish radio stations to promote the Green Gardener classes. These advertisements encourage landscape maintenance professionals to sign-up for the classes. To-date, the Program has conducted six Green Gardener training sessions in English,

six in Spanish and one bilingual session (in English and Spanish). In addition, the City of San Jose conducted two trainings sessions, one in English and one in Spanish. The City's training sessions were funded through a DPR grant. Overall, these 15 training sessions certified 253 individuals as Santa Clara Valley Green Gardeners.

In August 2011, the Program developed and mailed letters to 140 Structural PCOs registered in Santa Clara County. The letter informed PCOs on the availability of IPM certification programs and encouraged them to obtain the certification. Information on the available IPM certification programs is posted on the Watershed Watch Campaign website. Program staff also developed an article about IPM certifications which was included in the Santa Clara County Division of Agriculture's *The Pesticide Review* newsletter. In December 2012, the Division of Agriculture sent the newsletter to all PCOs registered in Santa Clara County.

4.6.3.2 Level 2 - Raising Awareness and Level 3 – Changing Behavior

The Green Gardener training includes an evaluation component that supports the evaluation of Level 2 assessment measures. Students are requested to complete evaluation forms at the end of each class and a final evaluation at the end of the training session. Feedback indicates that attendees find the class very useful and will make changes to their landscape management practices based on what they have learned at the trainings. In addition, attendees are required to take a final test to receive the certificate of completion. This ensures that they understood the curriculum and will be able to implement the practices at their client locations.

Additionally, the Program began outreach to structural PCOs in late FY 11-12 and continued in FY 12-13. Outreach will be enhanced in FY 13-14 and evaluated using data from website visits, inquiries from PCOs regarding IPM certifications, and the number of PCOs obtaining IPM certifications.

4.7. Minimizing Pesticide Use at New Development and Redevelopment Sites

The goal of this source control measure is to reduce pesticide use by encouraging pest-resistant landscaping and design features in the design, landscaping, and environmental reviews of proposed development projects. This measure can be evaluated for achievement of Outcome Level 1, Level 2, and Level 3.

4.7.1 Level 1 - Documentation of Activities

The SCVURPPP Model Conditions of Approval (COAs) of Development and Redevelopment Projects include measures for incorporating pest resistant landscaping features and practices. Co-permittees have incorporated these or similar COAs into their project review and approval processes. Beneficial landscaping that minimizes pesticides, fertilizers, irrigation, and runoff is also listed as a Source Control Measure on the SCVURPPP C.3 Data Form that is used (with some modifications) by most Co-permittees.

The Program's C.3 Stormwater Handbook (April 2012) includes templates for Operation and Maintenance (O & M) of stormwater treatment measures. These templates include guidance on using IPM to maintain these treatment measures. The templates are posted on the Program's website and Co-permittees use the templates as exhibits to their stormwater treatment measure maintenance agreements.

The C.3 Handbook's Appendix D also includes a list of plants that can be used for stormwater treatment measures, and guidance on planting and maintaining these plants. The recommended plants are non-

invasive, California natives that require less water and minimum use of pesticides. The plant list is available on the Program's website.

4.7.2 Level 2 - Raising Awareness

The Program conducts a workshop each year to educate municipal staff and consultants about the MRP requirements for new and redevelopment projects. Information on Low Impact Development, green streets, landscaping with native plants, and selecting plants for stormwater treatment measures is included in the workshop. Approximately 125 municipal staff and consultants attend the workshop each year.

4.7.3 Level 3 - Behavior Change

An analysis of data submitted in Co-permittee Annual Reports from FY 09-10 to FY 11-12 indicates that an increasing number of regulated projects are including "beneficial landscaping" (landscaping that minimizes pesticides, fertilizers, irrigation, and runoff) as a source control measure. In FY 09-10, only 6% of the regulated projects included "beneficial landscaping". This increased to 22% in FY 10-11, and to 24% in FY 11-12. These data suggest that municipal staff that review projects are encouraging project applicants to include beneficial landscaping in their projects. Project applicants and developers are also more willing to incorporate these measures into their landscape plans.

5.0 WATER QUALITY ASSESSMENT RESULTS (LEVELS 5-6)

Water quality assessments are conducted using monitoring and assessment data that characterize the quality of discharges from stormwater conveyance systems (Level 5) or the chemical, physical or biological condition of receiving waters (Level 6). Based on the availability of water quality monitoring data (i.e., pesticide concentrations and toxicity in receiving water and sediment) for the Santa Clara Valley, the effectiveness of source control measures is assessed at Outcome Level 6 (Protecting Receiving Water Quality). The origins of the data used in the Level 6 water quality assessment are described below.

5.1. Monitoring Programs/Projects and Datasets

Over the course of the last decade, a number of monitoring programs have measured pesticides and toxicity in water and sediment from Santa Clara Valley urban creeks. SCVURPPP has been the primary monitoring program in the Valley since the late 1990's and continues to collect the largest number of data points in urban creeks (consistent with NPDES stormwater permit requirements) through the implementation of the *SCVURPPP Watershed Monitoring and Assessment Program*. Receiving water monitoring conducted by SCVURPPP includes the monitoring and assessment of indicators of chemical, physical, and biological condition of urban creeks. This includes measuring the concentrations of pesticides in water and sediment, and assessing the degree of toxicity to test organisms exposed to water and sediment from urban creeks in the Valley. Monitoring currently occurs via the Program's Creek Status and Monitoring and Pollutant of Concern Loads Monitoring projects.

In addition to the SCVURPPP Monitoring and Assessment Program, California's Surface Water Ambient Monitoring Program (SWAMP) has collected monitoring data at a number of sites in Santa Clara Valley urban creeks since 2002. These data have been collected through a number of projects implemented at

the regional and statewide scales. In 2002-03, the San Francisco Bay Regional Water Quality Control Board's regional-SWAMP collected water quality and toxicity data at sites in Santa Clara Valley creeks. The State Water Resources Control Board's Statewide Stream Pollutant Trend (SPoT) and Statewide Urban Pyrethroid Monitoring projects also measured pesticide concentrations and toxicity in urban creeks in the Santa Clara Valley and throughout the State from 2007 through 2013. Lastly, the concentration of pesticides and extent of toxicity in Bay Area urban creeks were monitored by the Clean Estuary Partnership (CEP) in 2005.

5.2. Pesticides of Concern in Water and Sediment

Each program or project described above has measured varying types of parameters in water and/or sediment collected from Santa Clara Valley urban creeks. Decisions regarding parameters and sample matrices are informed by project/program objectives, the chemical characteristics of the pesticides of interest, and available resources. Typically, organophosphate pesticides such as diazinon are monitored in water due to their chemical makeup and affinity to stay dissolved in the water column. Concentrations of pyrethroid pesticides, carbaryl and fipronil, however, are generally measured in bedded sediment sampled from urban creeks. Sediment is the ideal matrix for these types of pesticides due to their affinity to adsorb to particles.

5.2.1. Concentrations in Water

Table 5 summarizes the numbers of water samples collected in Santa Clara Valley urban creeks and analyzed for pesticides between 2002 and 2012. These data were generated from the studies, projects and programs described in the previous section. During this timeframe, a total of 105 water samples collected from various sites in urban creeks were analyzed for concentrations of diazinon. Samples were collected during storm events and dry weather conditions.

Table 5. Number of water samples in Santa Clara Valley Urban Creeks analyzed for pesticides between 2002 and 2012.

Monitoring Program	Data Points Collected in Santa Clara Valley Urban Creeks per Year										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SCVURPPP Monitoring and Assessment Program											
Pre-MRP Monitoring	7	20	23	19	11	8	6	-	-	-	-
BASMAA RMC Monitoring (MRP)	-	-	-	-	-	-	-	-	-	-	-
POC Loads Monitoring	-	-	-	-	-	-	-	-	-	-	-
Surface Water Ambient Monitoring Program (SWAMP)											
Region 2 (SF Bay Region) Monitoring	-	-	-	-	-	-	-	-	-	-	-
Statewide Stream Pollution Trends (SPoT) Program	6	3	-	-	-	-	-	-	-	-	-
Statewide Urban Pyrethroids Project	-	-	-	-	-	-	-	-	-	-	-
Clean Estuary Partnership (CEP)											
Urban Pesticide Monitoring Project	-	-	-	2	-	-	-	-	-	-	-
Totals	**13**	**23**	**23**	**21**	**11**	**8**	**6**	**0**	**0**	**0**	**0**

Figure 1 illustrates the concentrations of diazinon in Santa Clara Valley urban creeks in comparison to the diazinon concentration target described in the *TMDL/WQAS for Diazinon and Pesticide-related Toxicity in San Francisco Bay Area Urban Creeks.* Water quality monitoring data indicate that beginning in 2002 (during the phase out of the pesticide by USEPA), diazinon concentrations measured in urban creeks were well below TMDL targets. Furthermore, since 2006, diazinon has not been detected in Santa Clara Valley urban creeks. The lack of detection and phase out of diazinon prompted the discontinuation of sampling for this analyte in 2009.

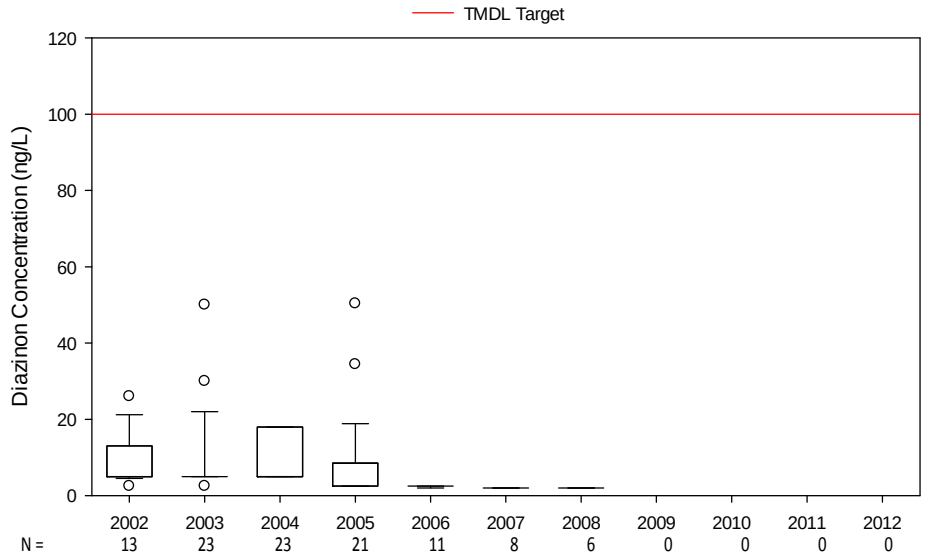

Figure 1. Diazinon concentrations in water samples collected from Santa Clara Valley Urban Creeks between 2002 and 2012. Red line is the San Francisco Bay Area Urban Creeks TMDL target for diazinon.

SCVURPPP began collecting monitoring data on pyrethroids, carbamates and Fiprinol in 2012 consistent with the POC loads monitoring requirements in Provision C.8.e of the MRP. Analyses were conducted on six water samples collected from the Guadalupe River (at the Highway 101 overpass) and the East Sunnyvale Channel (at the Highway 101 overpass) during FY 2012-13 storm events. In Table 6, concentrations of pyrethroids and Carbaryl in water collected at these sites during storm events are compared to adverse effects concentrations for the sensitive test organism *Hyalella azteca,* which were identified in the scientific literature. Adverse effects thresholds for other measured pesticides (e.g., Fiprinol) are currently not available for *H. azteca.*

Table 6. Comparison of pyrethroid concentrations in water collected during FY 12-13 storm events at Santa Clara Valley POC loading stations and adverse effects thresholds.

POC Loads Monitoring Station		Bifenthrin	Cyfluthrin	Cypermethrin	Delta/ Tralomethrin	Permethrin	Carbarlyl
Effects Concentration (LC50s in ng/L)		*7.7*[a]	*2.3*[a]	*2.3*[a]	*10*[b]	*48.9*[c]	*2100*[d]
Sunnyvale East Channel	Storm Event 1	-	-	-	-	5.79	21
	Storm Event 2	8.0	-	-	1.42	20.9	11
Guadalupe River	Storm Event 1	12.8	-	-	2.11	20.2	57
	Storm Event 2	6.16	-	-	1.90	16.8	28
	Storm Event 3	-	-	-	0.704	19.5	13
Total # Storm Events > Adverse Effects Threshold		2	0	0	0	0	0

[a] As reported by D. Weston, University of California, Berkeley; [b] LC50 values for *Hyalella azteca* unavailable. LC50 values listed are for *Daphnia magna* as reported by Xiu et al. (1989); [c] Brander et al. (2009); d USEPA (2012).; Shaded cells represent concentrations >LC50 values. Dashes represent concentrations less than method detection limits

Results indicate that all pesticides analyzed, with the exception of the pyrethroid bifenthrin, were detected at concentrations less than those known to be lethal to the highly sensitive test organism *H. azteca*. In two of the six samples analyzed, bifenthrin was detected at concentrations above those known to be lethal to invertebrates.

5.2.2. Concentrations in Sediment

Table 7 summarizes the numbers of bedded sediment samples collected in Santa Clara Valley urban creeks and analyzed for pesticides between 2002 and 2012. These data were generated from the studies, projects and programs described in Section 5.1. During this timeframe, a total of 64 sediment samples collected from various sites in urban creeks were analyzed for concentrations of pyrethroids and other types of emerging pesticides. All bedded sediment samples were collected during dry weather conditions.

Table 7. Number of bedded sediment samples from Santa Clara Valley Urban Creeks analyzed for pesticides between 2002 and 2012.

Monitoring Program	Data Points Collected in Santa Clara Valley Urban Creeks per Year										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SCVURPPP Monitoring and Assessment Program											
Pre-MRP Monitoring	4	3	-	-	12	17	16	-	-	-	-
BASMAA RMC Monitoring (MRP)	-	-	-	-	-	-	-	-	-	-	3
POC Loads Monitoring	-	-	-	-	-	-	-	-	-	-	-
Surface Water Ambient Monitoring Program (SWAMP)											
Region 2 (SF Bay Region) Monitoring	2	-	-	-	-	-	-	-	-	-	-
Statewide Stream Pollution Trends (SPoT) Program	-	-	-	-	-	2	2	1	2	-	-
Statewide Urban Pyrethroids Project	-	-	-	-	-	-	-	-	-	-	-
Clean Estuary Partnership (CEP)											
Urban Pesticide Monitoring Project	-	-	-	-	-	-	-	-	-	-	-
Totals	**6**	**3**	**0**	**0**	**12**	**19**	**18**	**1**	**2**	**0**	**3**

Figures 2 through 5 illustrate the ranges of pyrethroid pesticide concentrations in creeks in comparison to adverse effects thresholds (i.e., LC50s) identified in the scientific literature (Amweg et al. 2005, Maund et al. 2002). Only those data with values measured above method detection limits are presented in the figures. The vast majority of data points compiled from programs/projects were reported by as below method detection limits. Data presented are normalized to Total Organic Carbon (TOC) since pyrethroids are found primarily in the organic carbon fraction of sediments.

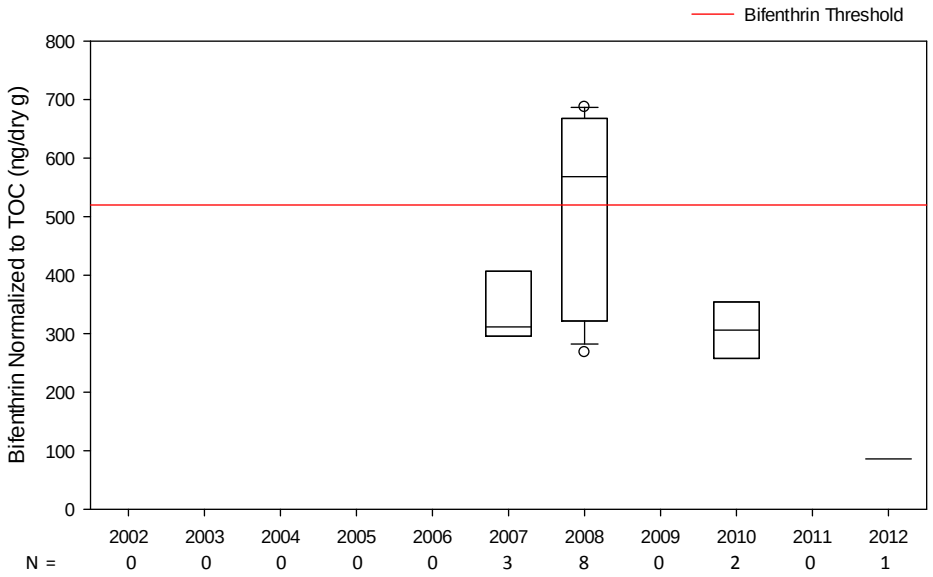

Figure 2. Bifenthrin concentrations in bedded sediment collected from Santa Clara Valley Urban Creeks between 2002 and 2012. Red line is the adverse effects concentration (i.e., LC50) for Hyalella azteca (Amweg et al. 2005).

Figure 3. Lambda-Cyhalothrin concentrations in bedded sediment collected from Santa Clara Valley Urban Creeks between 2002 and 2012. Red line is the adverse effects concentration (i.e., LC50) for Hyalella azteca (Amweg et al. 2005).

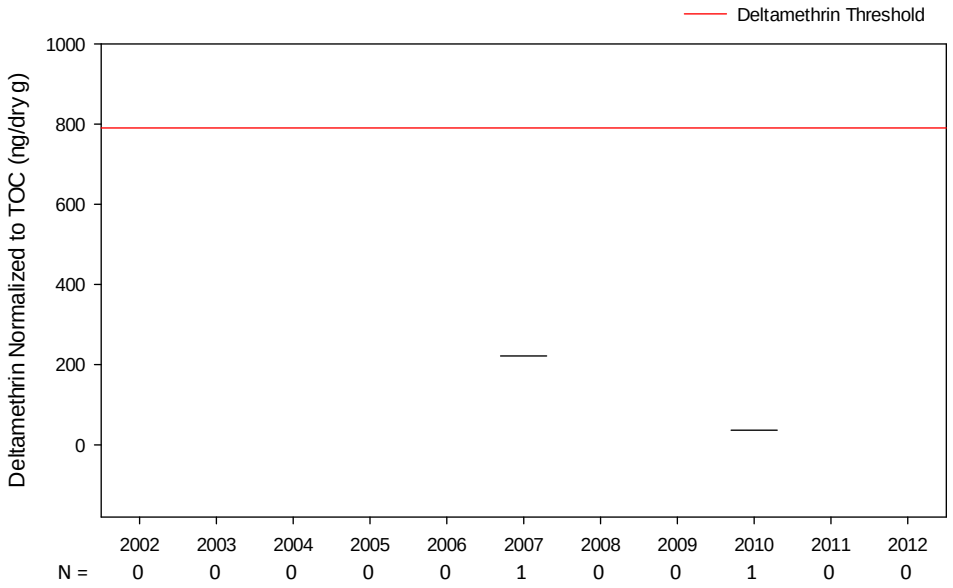

Figure 4. Deltamethrin concentrations in bedded sediment collected from Santa Clara Valley Urban Creeks between 2002 and 2012. Red line is the adverse effects concentration (i.e., LC50) for Hyalella azteca (Amweg et al. 2005).

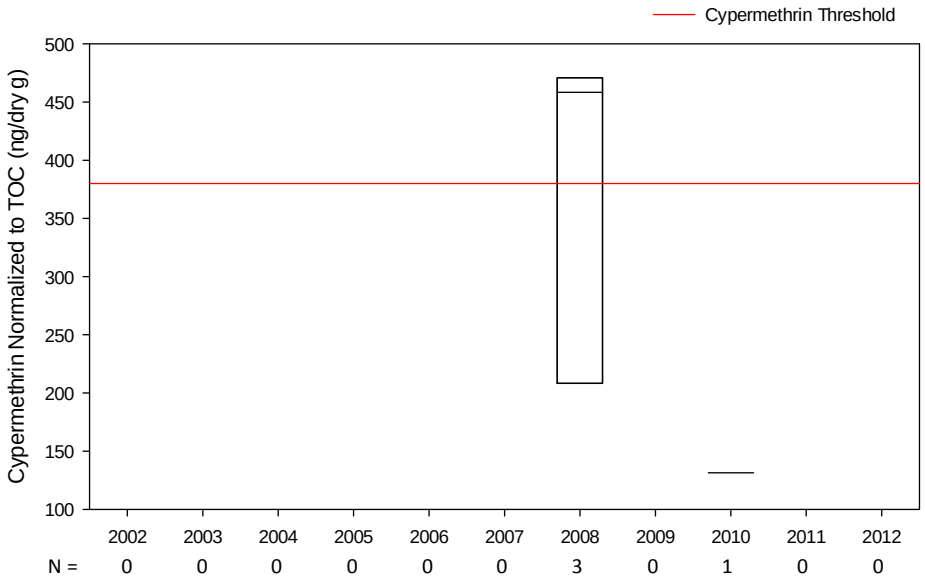

Figure 5. Cypermethrin concentrations in bedded sediment collected from Santa Clara Valley Urban Creeks between 2002 and 2012. Red line is the adverse effects concentration (i.e., LC50) for Hyalella azteca (Maund et al. 2002).

Based on the sediment data compiled, only bifenthrin (Figure 2) and cypermethrin (Figure 5) exceeded adverse effects thresholds in sediment samples with detectable concentrations of these pesticides. For bifenthrin, threshold exceedances (i.e., LC50s) were measured in 5 of 8 samples collected in 2008. Cypermethrin concentrations exceeded the adverse effects threshold in 2 of 3 samples in the same year. These two pyrethroid pesticides are known to cause adverse impacts to aquatic invertebrates at low concentrations (Amweg et al. 2005, Maund et al. 2002), making them of particular concern to stormwater managers and water quality regulators. All other pyrethroids during other years were below thresholds used to assess water quality impacts.

5.3. Toxicity in Urban Creek Water and Sediments

The types of organisms used in toxicity testing differ between water and sediment, and can respond differently to pesticides. Test organisms *Pimephales promelas* (fathead minnow), *Ceriodaphnia dubia* (crustacean), and *Selenastrum capricornutum* (green algae) are typically utilized for testing the acute and chronic toxicity of water. *C. dubia* is known to be highly sensitive to diazinon. *Hyalella azteca* (amphipod) has also been used more recently in water toxicity studies conducted at POC loads monitoring stations. *H. azteca* is typically the only organism used to evaluate toxicity in sediments from fresh water creeks and is known to be highly sensitive to pyrethroid pesticides. Results of all toxicity data collected from 2002 through 2012 in Santa Clara Valley urban creeks are presented in this section.

5.3.1. Toxicity in Water

Table 8 summarizes the numbers of water samples collected in Santa Clara Valley urban creeks and tested for toxicity to laboratory test organisms between 2002 and 2012. These data were generated from the studies, projects and programs described in Section 5.1.

Table 8. Number of water samples in Santa Clara Valley Urban Creeks analyzed for toxicity to *Ceriodaphnia dubia* between 2002 and 2012.

Monitoring Program	Data Points Collected in Santa Clara Valley Urban Creeks per Year										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SCVURPPP Monitoring and Assessment Program											
Pre-MRP Monitoring	4	8	10	11	7	8	6	-	-	-	-
BASMAA RMC Monitoring (MRP)	-	-	-	-	-	-	-	-	-	-	6
POC Loads Monitoring	-	-	-	-	-	-	-	-	-	-	4
Surface Water Ambient Monitoring Program (SWAMP)											
Region 2 (SF Bay Region) Monitoring	-	-	-	-	-	-	-	-	-	-	-
Statewide Stream Pollution Trends (SPoT) Program	8	4	-	-	-	-	-	-	-	-	-
Statewide Urban Pyrethroids Project	-	-	-	-	-	-	-	-	-	-	-
Clean Estuary Partnership (CEP)											
Urban Pesticide Monitoring Project	-	-	-	2	-	-	-	-	-	-	-
Totals	**12**	**12**	**10**	**13**	**7**	**8**	**6**	**0**	**0**	**0**	**10**

Figure 6 illustrates the number of water samples between 2002 and 2012 that were significantly toxic (i.e., Toxicity Units > 1.0) to the test organism *Ceriodaphnia dubia*. Water quality monitoring data indicate that toxicity to *C. dubia* was not observed in the 35 samples collected from Santa Clara Valley urban creeks since 2005. These results correspond to the timeframe when diazinon was phased out of use in urban areas, further suggesting that *C. dubia* toxicity exhibited in the 1990's was attributable to this organophosphate pesticide.

With regard to the test organism *Hyalella azteca* which is sensitive to pyrethroid pesticides, toxicity in water was recently observed in 4 of 5 water samples[4] collected from two Santa Clara Valley POC loading stations in FY 2012-13 during storm events (BASMAA 2013). Two of the four samples where toxicity was observed correspond to pyrethroid concentrations above adverse effects thresholds (see Table 6). These results indicate that although toxicity to typical test species (i.e., *C. dubia*) has been eliminated, sensitive species such as *H. azteca* may continue to exhibit toxic responses attributable to pesticides (e.g., pyrethroids) transported to creeks during storm events.

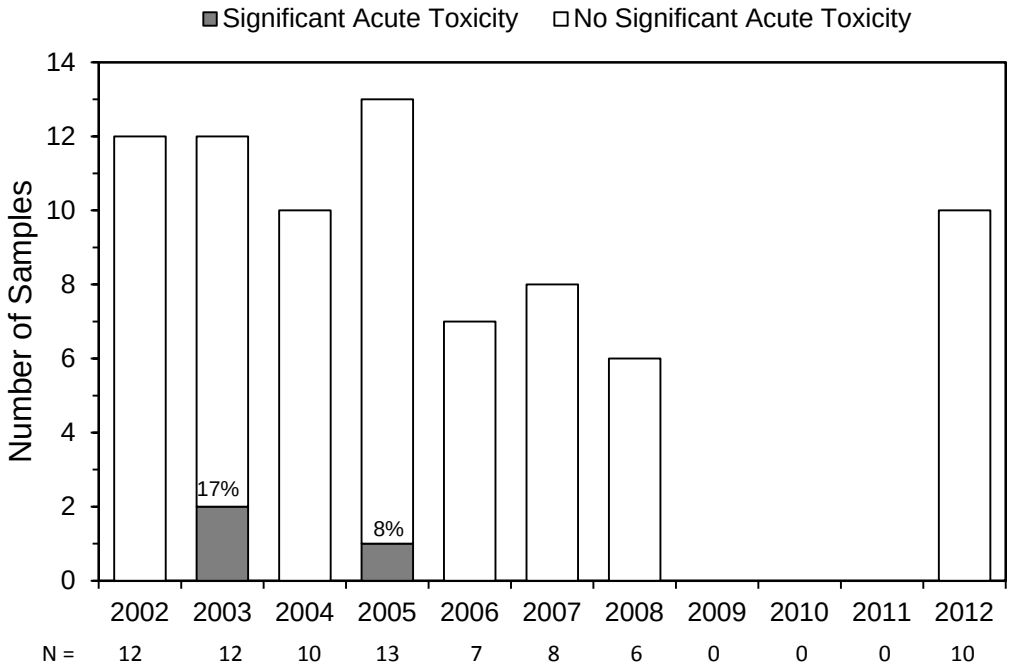

Figure 6. Numbers of water samples collected from Santa Clara Valley urban creeks between 2002 and 2012 that exhibited significant acute toxicity to *Ceriodaphnia dubia*.

5.3.2. Toxicity in Sediment

Table 9 summarizes the numbers of sediment samples collected in Santa Clara Valley urban creeks and tested for toxicity to laboratory test organisms between 2002 and 2012. These data were generated from the studies, projects and programs described in Section 5.1.

[4] Regionwide, 9 of 11 water samples collected at 4 POC loading stations during storm events in FY 2012-13 were significantly toxic to *Hyalella azteca*.

Table 9. Number of sediment samples in Santa Clara Valley Urban Creeks analyzed for toxicity to *Hyalella azteca* between 2002 and 2012.

Monitoring Program	Data Points Collected in Santa Clara Valley Urban Creeks per Year										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SCVURPPP Monitoring and Assessment Program											
Pre-MRP Monitoring	-	-	-	-	6	15	16	-	-	-	-
BASMAA RMC Monitoring (MRP)	-	-	-	-	-	-	-	-	-	-	3
POC Loads Monitoring	-	-	-	-	-	-	-	-	-	-	5
Surface Water Ambient Monitoring Program (SWAMP)											
Region 2 (SF Bay Region) Monitoring	-	-	-	-	-	-	-	-	-	-	-
Statewide Stream Pollution Trends (SPoT) Program	2	-	-	-	-	4	2	1	3	-	-
Statewide Urban Pyrethroids Project	-	-	-	-	-	-	-	-	-	-	-
Clean Estuary Partnership (CEP)											
Urban Pesticide Monitoring Project	-	-	-	-	-	-	-	-	-	-	-
Totals	**2**	**0**	**0**	**0**	**6**	**19**	**18**	**1**	**3**	**0**	**8**

Figure 7 illustrates the number of bedded sediment samples between 2002 and 2012 that were significantly toxic (i.e., Toxicity Units > 1.0) to the test organism *Hyalella azteca*. Data indicate that sediment toxicity was observed in 53% (26 of 49) of samples collected from Santa Clara Valley urban creeks during this timeframe. These results correspond to the timeframe when pyrethroid pesticides began to gain market share, with the phase out of diazinon.

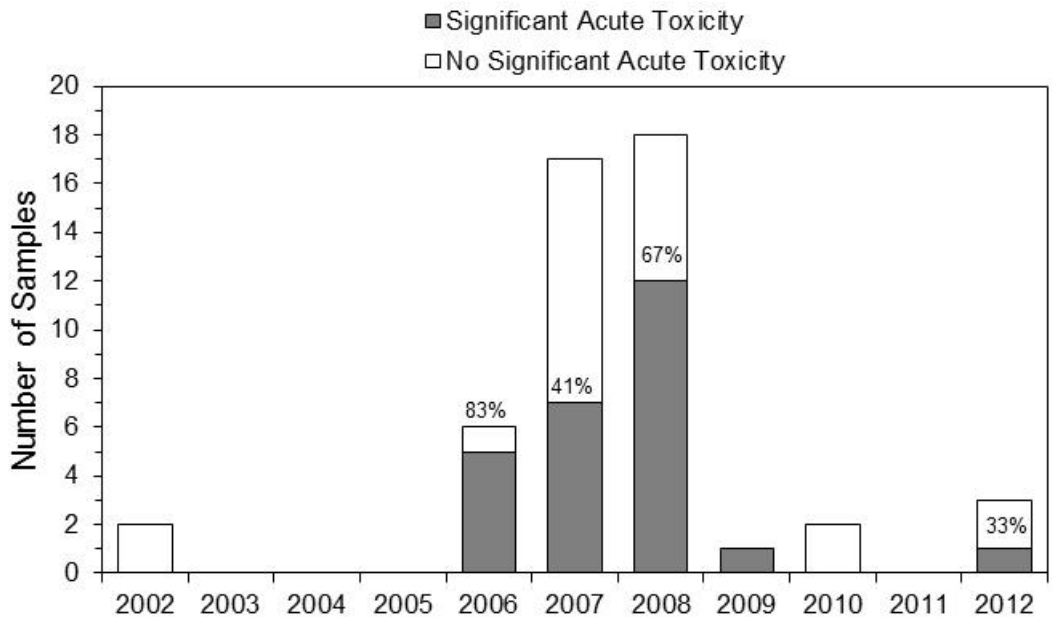

Figure 7. Sediment samples collected from Santa Clara Valley urban creeks between 2002 and 2012 that exhibited significant acute toxicity to Hyalella azteca.

6.0 CONCLUSIONS AND NEXT STEPS

Through the development of this pesticide source control effectiveness evaluation report, Co-permittees have complied with the requirements in MRP Provision C.9.g by:

- Evaluating the effectiveness of pesticide source control measures implemented; and,
- Evaluating the attainment of TMDL/WQAS pesticide concentration and toxicity targets for water and sediment.

This section summarizes the conclusions of the evaluation and identifies improvements to existing control measures and/or additional control measures needed to attain TMDL/WQAS targets. A time schedule for implementation of control measures is also provided.

6.1. Summary of Implementation Assessment Outcomes (Levels 1-4)

Co-permittees have successfully implemented a number of source control measures consistent with the SCVURPPP Pesticide Management Plan, Provision C.9 of the MRP, and the TMDL/WQAS Implementation Plan. The following Level 1 through 4 Outcomes have been achieved as a result of control measure implementation:

- All SCVURPPP Co-permittees have adopted IPM Policies/ Ordinances and established detailed IPM Plans and pesticide application Standard Operating Procedures (SOPs). IPM Policies and pesticide programs have led to an increase in awareness about pesticide impacts and a change in behavior by municipal employees and contractors, which have led to a decrease in the use of pesticides of concern on municipal properties.
- Through Co-permittee, Program and CASQA efforts, formal procedures are now in place to ensure that pesticides with potential to pollute surface water will be identified when they enter DPR's registration process and will be routed to DPR's Surface Water Program for review. As a result of this new process, as well as other improvements to the regulatory processes, it is estimated that the amount of pyrethroids in urban stormwater runoff will decrease by 80-90%.
- The Program's public education and outreach program is successful in raising the awareness of water quality issues and promoting behavior change that is reducing pesticide impacts on Santa Clara Valley urban creeks. This behavior change is exhibited in the nearly 200,000 pounds of unused pesticides that are disposed of properly by residents and small businesses annually at Co-permittee HHW facilities and events. Additionally, outreach programs that target pesticide usage by residents, professional landscape workers, and pest control operators are raising awareness and changing behavior that has resulted in an increase in the use of non-toxic substances rather than pesticides of concern in the Santa Clara Valley.
- As a result of Program and Co-permittee efforts to reduce pesticide use at new development and redevelopment sites, project developer behavior is changing and resulting in an increase in the number of development projects that use "beneficial landscaping" techniques that minimize pesticides, fertilizers, irrigation, and runoff. In FY 09-10, only 6% of regulated projects included "beneficial landscaping", compared to 24% in FY 11-12. These data suggest that Program and Co-permittee efforts are reducing the potential for water quality impacts attributable to pesticide usage at new development and redevelopment projects.

6.2. Summary of Water Quality Assessment Outcomes (Level 6)

For over a decade, the Program has successfully implemented a water quality monitoring and assessment program designed to assess the quality of water and sediment and beneficial use condition in Santa Clara Valley urban creeks. The monitoring and assessment program is consistent with Provision C.8 of the MRP and the TMDL/WQAS Implementation Plan. Monitoring data collected by the Program are supplemented by those data collected by other programs (e.g., SWAMP) and projects. The following Level 6 Outcomes have been observed in urban creeks over the last decade:

- Diazinon is no longer a concern in Santa Clara Valley urban creeks. Since 2002, diazinon has only been detected in 6 of 96 water samples (6.3%). Concentrations in all samples were well below the TMDL/WQAS target (i.e., 100 ng/L).
- Similar to diazinon concentrations in urban creeks, acute toxicity in water (as measured by the test organism *C. dubia*) has been nonexistent in Santa Clara Valley urban creeks since 2006. Of the 31 aquatic toxicity tests conducted from 2006 through 2012, no water samples were significantly lethal to *C. dubia.* The acute toxicity TMDL/WQAS target (i.e., < 1.0 TU_a) for water has therefore been achieved.
- In contrast to diazinon, pyrethroid pesticides appear to remain a potential threat to Santa Clara Valley urban creeks at this time. Receiving water monitoring data indicate that concentrations observed in water during storm events and bedded creek sediments are likely high enough to adversely affect sensitive aquatic organisms (i.e., *Hyalella azteca*). Of particular concern are bifenthrin and cypermethrin, pyrethroid pesticides that are highly toxic to aquatic invertebrates and detected at concentrations above adverse effects thresholds.
- Sediment toxicity remains a potential concern in Santa Clara Valley urban creeks, specifically to aquatic invertebrates like *H. azteca* that are highly sensitive to pyrethroids. Of the 52 sediment toxicity tests conducted on *H. azteca* since 2002, 26 (50%) indicated that a significant toxic response was measured.

Overall, significant improvements in water quality and toxicity associated with organophosphate pesticides have been observed in Santa Clara Valley urban creeks. These improvements suggest that source controls targeting these types of pesticides, including regulations that prompted the phase-out of diazinon, are effective in protecting beneficial uses. Additionally, decreases in the use of pesticides of concern on municipal properties have also been reported via Co-permittee annual reports. The successful implementation of IPM and associated training and outreach by Co-permittees is likely responsible for the reduction in pesticide use. Sediment toxicity and concentrations of pyrethroid pesticides observed in Santa Clara Valley urban creeks, however, remains a concern. Sediment quality monitoring results indicate that residents and professional pesticide applicators are continuing to use pesticides of concern at rates that affect water quality.

6.3. Recommendations

Considering the results of this pesticide source control effectiveness evaluation, it is recommended that the Program and Co-permittees continue to implement the following pesticide source control measures, in an effort to not only reduce the impacts of pyrethroid pesticides, but also eliminate the risk of future pesticides types from impacting Santa Clara Valley creeks and the San Francisco Bay estuary.

- **Continue Implementing Local IPM Programs** – As indicated by pesticide use data reported by Co-permittees, the number of Co-permittees using pesticides of concern has declined. Many Co-permittees are also showing a decline in use of pesticides of concern on municipal properties. Co-permittees should continue implementing their local IPM Programs to maintain, and possibly further reduce the use of pesticides of concern.

- **Continue Active Participation in the Regulatory Process** - Since municipal agencies do not have the authority to ban or place significant restrictions on pesticide sales or use within their jurisdiction, it is essential that the Program and Co-permittees continue to try to influence the pesticide approval and registration process. The Program should continue to communicate to the USEPA Office of Pesticide Programs and the California Department of Pesticide Regulation the need to fully consider the impact on water quality during the pesticide approval and registration process. The Program should continue to actively implement these source control activitiesin coordination with the CASQA Pesticide Subcommittee.

- **Continue Outreach to Residents** – The Program and Co-permittees should continue to conduct outreach to pesticide users (i.e., residents who either themselves apply pesticides, or hire professionals who provide pest control services). This includes conducting media outreach, outreach at events, and point of purchase outreach at local stores. Based on the estimated use of pesticides by varying users, professional Pesticide Control Operators (PCOs) are likely the largest contributors to the urban application of pyrethroids. To bring about a change in the manner that PCOs apply pesticides, it is important that residents who hire PCOs are aware of the water quality impacts of specific types of pesticides and the ability to hire PCOs that effectively practice IPM.

- **Continue Implementing the Santa Clara Valley Green Gardener Program** – The Program should continue implementing the bilingual Santa Clara Valley Green Gardener Program to educate landscape maintenance professionals on sustainable landscaping techniques. Continuing this program is important to ensure that landscape workers are aware of IPM practices.

- **Continue Providing Disposal Locations for HHW, including Pesticides –** Co-permittees should continue to work with the County HHW Program to provide free pesticide disposal locations to residents.

- **Continue Requiring New Development and Redevelopment Projects to Implement "Beneficial Landscaping" Techniques** – The Program and Co-permittees should continue to encourage the inclusion of "beneficial landscaping" techniques in new and redevelopment projects. As indicated by data, the number of projects including beneficial techniques is increasing due to efforts made by the Program and Co-permittee staff that review projects.

In addition to the above, it is recommended that the Program and Co-permittees implement the following improvements to pesticide source control measures:

- **Outreach to Commercial Establishments** – The Program and Co-permittees should consider methods of conducting targeted outreach to commercial establishment to promote the hiring of IPM-certified pest control professionals. For example, targeted outreach may be conducted during industrial and commercial facility inspections, and though organizations such as the Building Owners and Managers Association (BOMA) and IFMA (International Facility Management Association).

- **Outreach to Structural Pest Control Operators** – Since pesticides used for outdoor structural pest control are of significant concern to stormwater quality, the Program and Co-permittees should consider methods for enhancing targeted outreach to structural pest control operators to encourage them to use IPM techniques and obtain IPM certification.

A time schedule for implementation of current and recommended additional control measures is provided in Table 10.

Table 10. Time Schedule for Pesticide Source Control Measure Implementation

Source Control Measure	Implementation Date
Implement Local IPM Programs	Ongoing
Participate in the Regulatory Process	Ongoing
Conduct Outreach to Residents	Ongoing
Conduct the Santa Clara Valley Green Gardener Program	Ongoing
Provide Proper Pesticide Disposal Opportunities	Ongoing
Require New Development and Redevelopment Projects to Implement "Beneficial Landscaping" Techniques	Ongoing
Conduct Outreach to Commercial Establishments	Begin FY 13-14
Enhance Outreach to Structural Pest Control Operators	Ongoing - Enhance in FY 13-14

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