Water Quality Progress Report

Bay Area Urban Creeks – Diazinon and Pesticide-Related Toxicity

(*Approved 2007*)

WATER QUALITY STATUS

- TMDL targets achieved
- Conditions improving
- **Improvement needed**
- Data inconclusive

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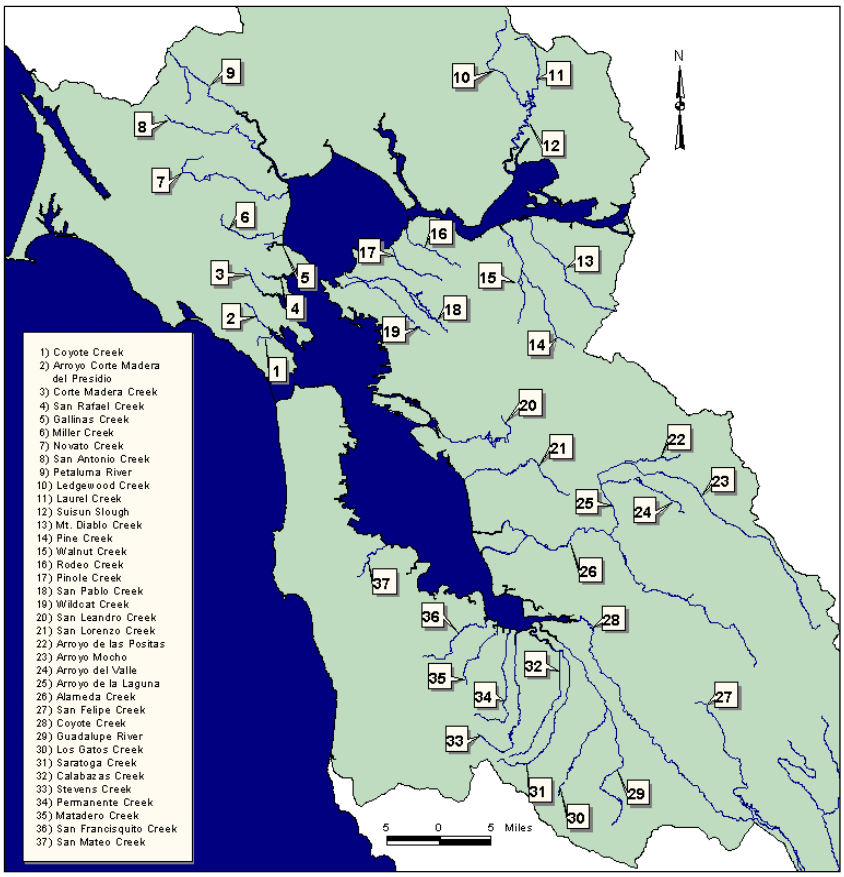
Total Maximum Daily Load (TMDL) Summary

Waterbody – 37 impaired urban creeks within seven counties in the San Francisco Bay region (see map below). In addition, the TMDL states that all Bay Area urban creeks likely receive pesticide discharges. Implementation actions will work best if applied throughout the region, so the TMDL strategy applies to all Bay Area urban creeks, including those not identified as impaired.



Urban Creeks Impaired due to Diazinon-Related Toxicity

Water Quality Goals

According to water quality objectives, all waters shall be maintained free of **toxic substances** in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms.

The TMDL includes numeric targets to interpret this narrative objective:

There shall be no pesticide-related acute or chronic **toxicity** in urban creek water and sediment in excess of 1.0 TU_a or 1.0 TU_c, where TU is a toxic unit.

This means that no acute or chronic toxic effects should be observed when compared to a control. This is determined through standard toxicity tests such as survival, growth, reproduction, and cell division.

Diazinon concentrations in urban creeks shall not exceed 100 nanograms per liter (ng/l) as a one-hour average.

This numeric target addresses both acute and chronic diazinon-related toxicity.

These targets must be met at all locations in each urban creek, including near storm drain outfalls where urban runoff enters the creeks.

Targeted Attainment Date – Not specified in the TMDL; however, the TMDL includes adaptive management which entails taking actions commensurate with available information, reviewing new information as it becomes available, and modifying actions as necessary based on the new information.

Water Quality Impairment –In the early 1990s, many Bay Area urban creek water samples were found to be toxic to aquatic organisms (causing mortality or impacting reproduction, among other responses). Studies were performed (toxicity identification evaluations) to identify the cause of toxicity. These studies found that pesticides, particularly diazinon, caused the toxicity. Diazinon is an insecticide, which is a specific category of pesticides, and has been found to be acutely toxic to aquatic life, wildlife, and humans. While pesticides are intended to eliminate insects and other pests, they can be harmful to living organisms that are not considered pests, particularly when rainwater or over-irrigation water carry the pesticide into a storm drain and creek. Aquatic invertebrates appear to be the aquatic organisms most sensitive to diazinon exposure.

Data collected by several agencies document diazinon concentrations high enough to cause aquatic toxicity in many urban creeks. Therefore, in 1998, a number of the Bay Area urban creeks were placed on the 303(d) list of impaired waters due to toxicity attributed to diazinon. The results of recent monitoring efforts suggest that toxicity occurs in urban creeks less frequently and diazinon concentrations are lower, when compared with conditions in the early 1990s. While improvements have been noted, toxicity indicators above the numeric targets do still occur. Urban creek waters that fail to meet these targets are not protective of cold and warm freshwater habitats. In 2004, the product registration for most urban (non-agricultural) uses of diazinon were cancelled; thereby phasing out urban diazinon use. Unfortunately, reducing diazinon use has increased reliance on other pesticides, which now post a threat to water and sediment quality. To ensure protection of water quality, the TMDL is focused on the attainment of pesticide-related toxicity targets (not just diazinon-related toxicity), regardless of which pesticide causes the toxicity, in all urban creeks in the Bay Area. Given what is known about pesticide use trends, the pyrethroid pesticide alternatives now pose the greatest concerns for water quality in urban creeks. For example, Kirker Creek was found to be impaired by pyrethroid-related toxicity in 2010. Because this TMDL is applicable to all urban creeks in the Bay Area, an additional TMDL was not necessary and the Kirker Creek impairment is being addressed through implementation of this TMDL.

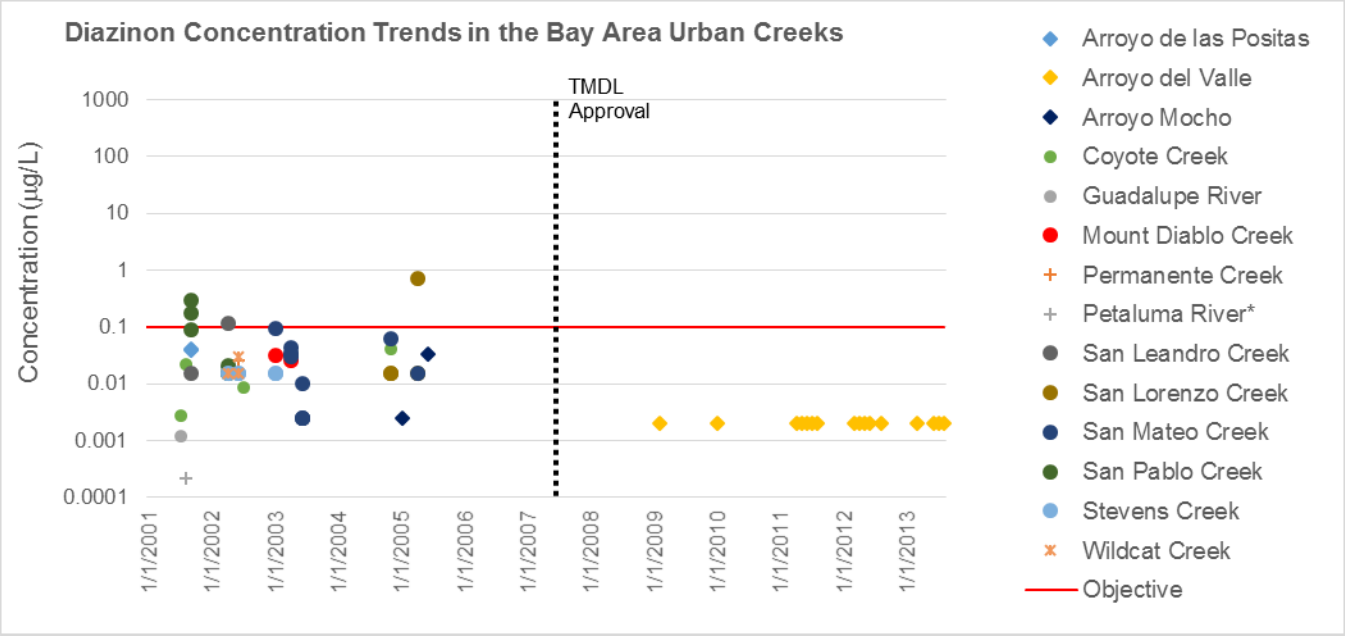
Pollutant Sources – Pesticides, including diazinon, enter urban creeks through urban storm water runoff and dry weather discharges from storm drains, with a much smaller contribution from direct discharges (e.g., dumping or riparian weed control). Storm drains are regulated and are owned and operated by municipalities, industrial and construction dischargers, large institutions, and the California Department of Transportation (Caltrans). Urban runoff contains pesticides that are purchased and applied by both businesses and individuals. Urban pesticides uses include applications by professional pest control personnel, municipal workers, and homeowners to control pests (aphids, spider mites, fleas, ants, roaches, and boring insects) on residential and commercial landscapes, around building foundations and roadways, and at commercial and industrial locations. Pesticide use by structural pest control professionals and use of products sold over-the-counter can be among the greatest contributors of pesticides in urban runoff. In the nine Bay Area counties, roughly 93% of pesticides by weight are applied in urban areas. Factors that affect pesticide concentrations in urban creeks include the amount used, the chemical and physical properties of the pesticide and its product formulation, the sites of use (e.g., landscaping, lawns/turf, or paved surfaces), and irrigation practices and precipitation.

Loading Capacity and Allocations – The loading capacity is the maximum amount of a contaminant or stressor that can be assimilated by the waterbody without exceeding the TMDL numeric targets (which in this case are interpretations of the narrative water quality objectives). The toxicity and diazinon loading capacity and source allocations in this TMDL are toxic unit- and concentration-based limits. These limits are measured in receiving waters and, for this TMDL, are equal to the numeric targets. Specifically, for urban creeks to assimilate diazinon

and other pesticide discharges, water quality measurements in urban creeks must be below the numeric targets. By expressing the loading capacity in terms of toxicity and diazinon concentrations, the TMDL automatically considers seasonal and other critical conditions. Wasteload allocations (point sources) for each source are also expressed in terms of toxic units and diazinon concentrations, and are the same as the numeric targets and the loading capacity. The wasteload allocations address all urban runoff, including urban runoff associated with municipal separate storm sewer systems, Caltrans facilities, and industrial, construction, and institutional sites.

Is Water Quality Improving?

Water quality is showing some improvement in the Bay Area urban creeks; however, additional effort is needed to fully protect the freshwater habitat designated uses. Management efforts to reduce diazinon contamination have been successful, including the cancellation of non-agricultural uses of diazinon and the subsequent reduction in its application. There have been no diazinon measurements above the numeric target since the TMDL has been approved (however, the California Environmental Data Exchange Network [CEDEN] dataset only included data for Arroyo del Valle in the past five years, so exceedances may still be observed in other creeks).



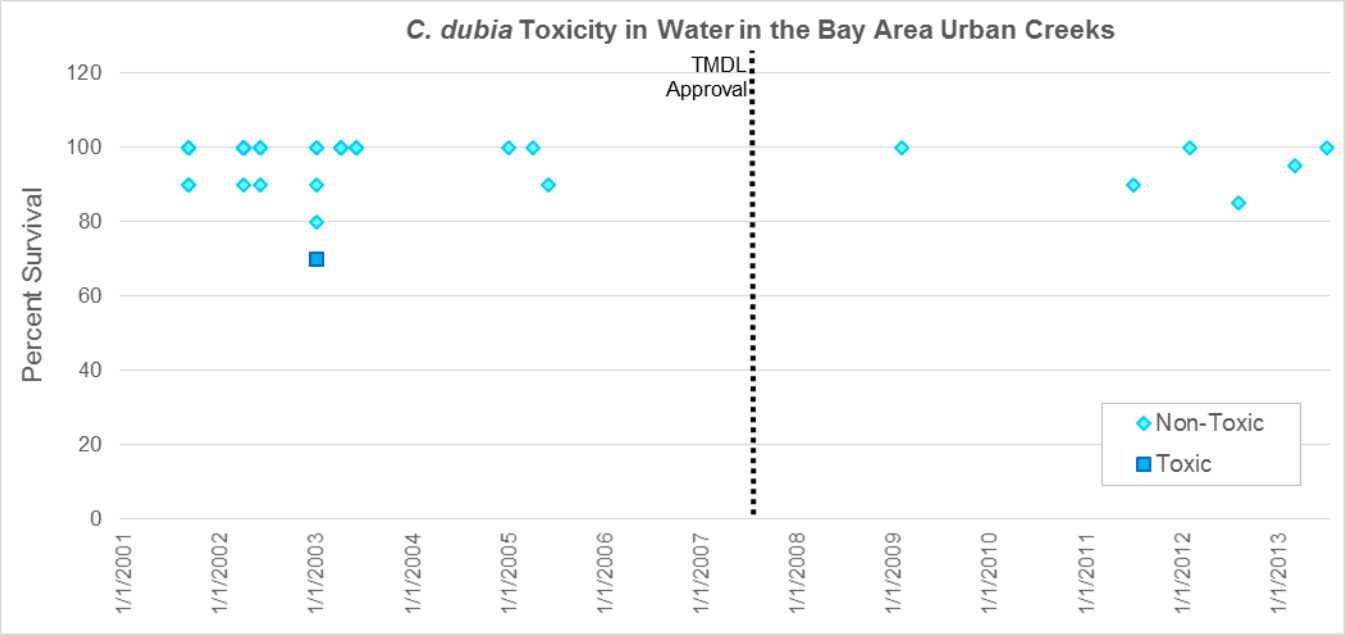
In addition to diazinon concentrations, it is important to evaluate toxicity over time in the Bay Area urban creeks to determine attainment of the water quality goals. Toxicity data can be difficult to interpret. Survival tests are one metric that can be used to evaluate toxicity. For all percent survival data available at Bay Area urban creek stations, the average value for each sampling date was calculated. Specifically, for each location-date combination, there were multiple measurements – on different samples as well as survival tests on different organisms. The average values were calculated and are graphed below over time for *Ceriodaphnia dubia* (*C. dubia*) and *Hyalella azteca* (*H. azteca*).

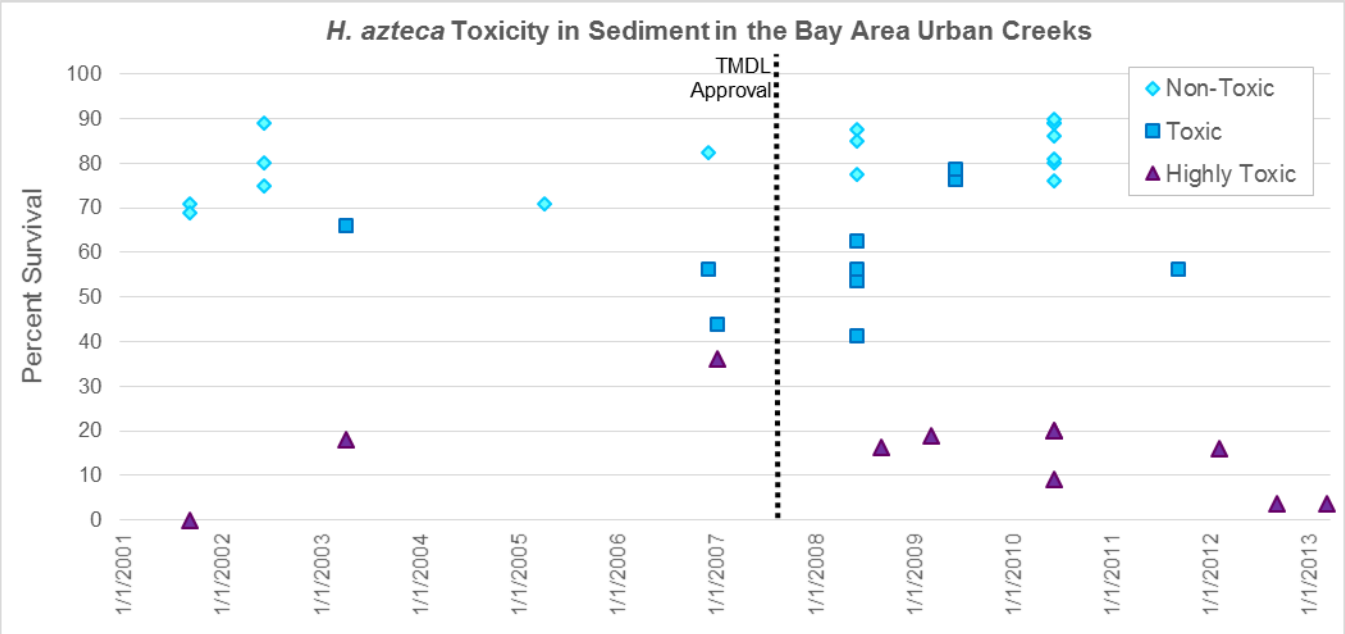
C. dubia is sensitive to organophosphate pesticides, such as diazinon. The graph below illustrates that *C. dubia* survival is not statistically different from the control, indicating that the samples are not toxic for that test organism (using the 4-, 7-, or 8-day survival test). Since diazinon is phased out, this lack of toxicity in *C. dubia* is expected.

Diazinon use has been replaced by pyrethroid pesticides in urban settings and these pesticides contribute to sediment toxicity as they bind to sediment particles and do not readily partition to water. Therefore, it is important to evaluate sediment toxicity associated with pyrethroid-sensitive test organisms, such as *H. azteca*. The percent

survival of *H. azteca* was analyzed (in both 10- and 28-day survival tests) and is illustrated in the bottom graph below. The non-toxic samples were not found to be statistically different than the control (based on the t test), while the toxic and highly toxic results displayed statistically significant toxicity when compared to the control. These toxic samples were then separated into toxic and highly toxic categories, where samples were identified as highly toxic if the average percent survival was lower than the high toxicity threshold for *H. azteca* of 38.6 percent survival.

Over time, the range of sediment toxicity has remained about the same. However, the number of samples characterized as highly toxic has increased in recent years. In addition, in the most recent three years of data, no samples were characterized as non-toxic to *H. azteca*, suggesting that the use of pyrethroid pesticides is resulting in sediment toxicity in urban creeks.





While conditions for diazinon impairment have improved considerably since implementation of the TMDL, additional practices are needed to address sediment toxicity in the urban creeks and to restore the freshwater habitat designated uses. Toxicity identification evaluations would be useful to identify the specific pollutants causing sediment toxicity. If those pollutants are pesticides, then they could be addressed through implementation of this TMDL.

TMDL Progress – Implementation activities and milestones

Implementation Activity	Target Date	Status	Progress Details
Summarize pesticide regulatory activities as they relate to water quality, and identify opportunities to advise pesticide regulatory oversight agencies regarding future actions	Annually	Complete/ Ongoing	Municipal stormwater Permittees' work collectively through the Bay Area Stormwater Management Agencies Association (BASMAA) to comment on, and participate in, pesticide regulatory actions. (summary table [link]; full report [link])
Summarize research and monitoring data for pesticide regulatory oversight agencies and others, and determine where to focus future monitoring efforts based on critical data needs	Annually	Complete/ Ongoing	Implementation activities include filling information gaps monitoring to measure implementation progress: • Summary of fipronil in San Francisco Bay (link) • Surface Water Ambient Monitoring Program (SWAMP) Toxicity Report (link) • Department of Pesticide Regulation (DPR) Surface Water Protection Program monitoring reports and related studies (link) • DPR webinars on monitoring surface water for pesticides (link)
Describe urban pesticide use trends and identify pesticides likely to affect water quality	Annually		California Stormwater Quality Association (CASQA) Pesticides Subcommittee developed a report entitled Preventing Urban Pesticide Pollution in Stormwater, including a Pesticide Watch List (link).
Notify pesticide regulatory oversight agencies if water quality standard violations exist or are likely to exist in the future due to pesticide discharges	At least annually		• As of 2009, diazinon and associated toxicity in urban creeks were no longer observed (link). • By 2011, toxicity found in urban creeks was related to pyrethroid pesticides, which have largely replaced urban uses of diazinon (link).
Identify waters impaired by pesticide-related toxicity and waters where there is a potential for impairment	Biannually	Complete/ Ongoing	• Kirker Creek exhibited pesticide-related impairments and was subsequently added to the 303(d) list and is being addressed by this TMDL (link).

Implementation Activity	Target Date	Status	Progress Details
Meet or correspond with pesticide regulatory oversight agencies regarding their roles in protecting water quality	At least annually	Complete/ Ongoing	• San Francisco Bay Regional Water Quality Control Board (Water Board) staff, as well as wastewater and stormwater discharger groups, work with DPR and the U.S. Environmental Protection Agency (EPA) to bring the potential threats to water quality to the forefront during pesticide evaluation and registration processes (see regulatory programs [link]).
Place required actions in National Pollutant Discharge Elimination System (NPDES) stormwater permits	No later than five years from effective date of strategy	Complete	• Incorporated into Municipal Separate Storm Sewer System (MS4) permit as per Order R2-2009-0074 (link). This permit will be reissued in 2015 with similar requirements for pesticide-related toxicity control.
Report implementation status to Water Board	Annually	Complete/ Ongoing	• Municipalities submit Annual Reports to document compliance with implementation requirements (link).

What Next?

Water quality goals are currently being achieved for diazinon but overall aquatic toxicity appears to be unchanged since the adoption of the TMDL. Cancellation of residential uses of diazinon has mitigated risks to aquatic life from this pesticide in urban areas but new pesticides, such as pyrethroids and fipronil, have emerged which also cause aquatic toxicity. Additional implementation activities for this TMDL associated with pyrethroid pesticides may be necessary to reduce sediment toxicity and achieve the toxicity water quality goals. Likely, new pesticides will emerge in the future and continued monitoring for aquatic toxicity will be the most efficient way to assess pesticide impacts over time. During pesticide registration and registration review, aquatic life risk mitigation strategies are developed into pesticide use instructions that must appear on product labels and must be followed by pesticide applicators. Increased coordination between State and Federal water quality and pesticide use regulators will help to achieve the long term goal of improved aquatic health.

Information Source Documents

- **San Francisco Bay RWQCB website for the Diazinon and Pesticide-Related Toxicity in Urban Creeks TMDL** (link)
- **Total Maximum Daily Load (TMDL) Report** for Diazinon and Pesticide-Related Toxicity in Urban Creeks (link)
- **San Francisco Bay RWQCB TMDL Resolution** – Amending the Water Quality Control Plan for the San Francisco Bay Region to Establish a Water Quality Attainment Strategy and Total Maximum Daily Load (TMDL) for Diazinon and Pesticide-Related Toxicity in Bay Area Urban Creeks (link)
- **California Department of Pesticide Regulation adopted regulations** (link) http://www.cdpr.ca.gov/docs/emon/surfwtr/reg_index.htm
- **NPDES MS4 Permit** – California Regional Water Quality Control Board San Francisco Bay Region, Municipal Regional Stormwater NPDES Permit, Order No. R2-2009-0074, NPDES No. CAS612008 (link)

  - Information on permit reissuance, including the draft permit is available on the San Francisco Bay Water Board website (link)

- **Annual Reports for Municipal Regional NPDES Permit (Bay Area Stormwater Management Agencies Association and Individual MRP Permittees)** (link)
- **EPA Aquatic Life Common Effects Methodology** (link)