

Memorandum



DATE: May 25, 2007

TO: Delia McGrath, City of Sacramento
Janet Parris, Sacramento County

Brian M. Laurenson, P.E.
707 4th Street
Suite 200
Davis, CA 95616
530.753.6400 ext.230
530.753.7030 fax
BrianL@lwa.com
e-mail transmittal only

SUBJECT: **EVALUATION OF ADDITIONAL PESTICIDE MONITORING DATA – 2007 UPDATE**

Overview

The purpose of this memorandum is to evaluate chlorpyrifos and diazinon monitoring data collected by the Permittees at six additional monitoring locations to determine if concentrations of these two constituents at these sites are adequately characterized by monitoring at any of the “long term” monitoring locations. If the additional pesticide locations can be shown to be “represented” by these other longer term monitoring locations, the additional monitoring would not be required based on § 2.E. of the Monitoring and Reporting Program (MRP) of the National Pollutant Elimination System (NPDES) discharge permit (Permit).

During the third Permit term, five dry weather and twenty-three wet weather samples were collected at the three urban tributary sites (Arcade Creek at Watt Ave – AC03, Morrison Creek at Brookfield Drive – MC01, and Willow Creek at Blue Ravine Road – WC01). Five dry weather and eight wet weather samples were collected at the following additional monitoring locations:

- Chicken Ranch Slough at Hurley Way (CRS01) – 2004-07 only
- Elk Grove Creek at Laguna (EGCK01)
- Elder Creek at Morrison Creek (ELDERCK01)
- Morrison Creek at Sunrise Blvd. (MC02) – upstream of urban development
- Natomas East Main Drain at Elkhorn Road (NEMD01)
- Natomas East Main Drain at San Juan Road (NEMD02) – upstream of urban development

The fifth dry weather even was recently collected (April 2007), however those data were not available for the purpose of this analysis. When possible, data were also synoptically collected at the urban runoff, urban tributary, and the Coordinated Monitoring Program (CMP) sites on the Sacramento and American Rivers. Long-term urban runoff (a.k.a. discharge characterization)

data and CMP data exist for approximately the last ten years for organophosphate (OP) pesticides, including diazinon and chlorpyrifos. Urban tributary data have been collected for the last five seasons at the three sites, however, at least two of these sites are considered long-term as it is anticipated that monitoring will be required in future permits.

DIAZINON AND CHLORPYRIFOS REGULATORY ACTIVITIES

The Central Valley Regional Water Quality Control Board (Water Board) adopted the Sacramento Urban Creek Pesticide TMDL¹ for those creeks listed as impaired due to diazinon or chlorpyrifos concentrations in the California 2002 303(d) list. The TMDL does not specifically require monitoring of the additional sites outside of the requirements in the Permit.

The Water Board has cited water quality criteria from California Department of Fish and Game (DFG) water quality objectives (WQOs) in both the MRP and the TMDL. The DFG diazinon criteria are 0.08 µg/L (acute, 1-hour) and 0.05 µg/L (chronic, 4-day). The DFG chlorpyrifos criteria are 0.02 µg/L (acute, 1-hour) and 0.014 µg/L (chronic, 4-day). However, based on a detailed review of the diazinon objective, USEPA has promulgated an adjusted a final WQO for diazinon of 0.17 µg/L for both chronic and acute averaging periods.

In January 2005, the Department of Pesticide registration changes banning (un-permitted) diazinon and chlorpyrifos residential use went into effect. Since this time concentrations of these constituents has decreased in Sacramento urban runoff and as shown in Figure 1 and Figure 2 for Sacramento urban tributaries.

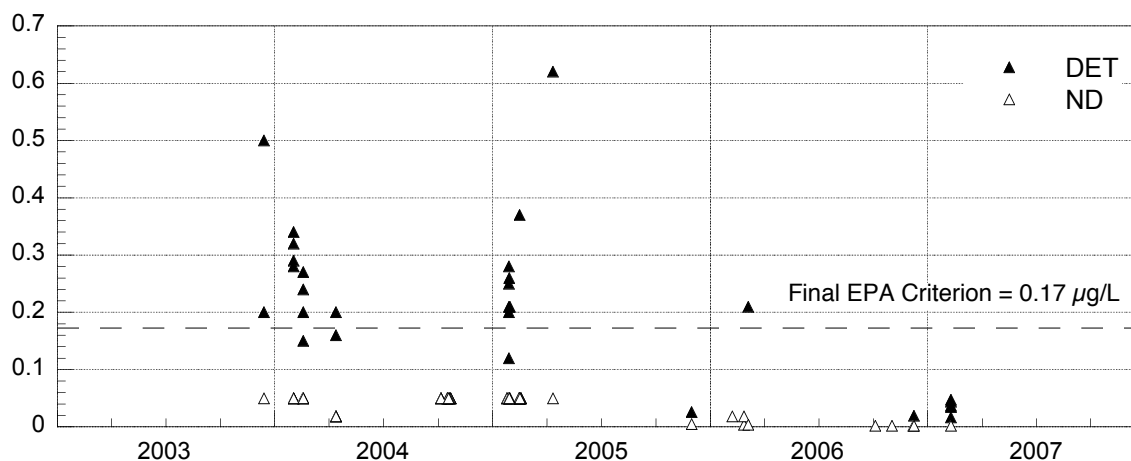


Figure 1. Diazinon in Sacramento Urban Tributaries 2003-2007

¹ Central Valley Regional Water Quality Control Board. Total Maximum Daily Load (TMDL) Report for the Pesticides Diazinon and Chlorpyrifos in: Arcade Creek, Elder Creek, Elk Grove Creek, Morrison Creek, Chicken Ranch Slough, and Strong Ranch Slough, July 2004

Table 1. 2003-05 Summary Statistics for Urban Creek OP Pesticides

Site Location	Site ID	Chlorpyrifos			Diazinon				
		n	Percent Detected	Max (µg/L)	Median (µg/L)	n	Percent Detected	Max (µg/L)	Median (µg/L)
Urban Tributary Monitoring									
Arcade Creek at Watt	AC03	26	3.8%	0.012	<0.05	26	34.6%	0.5	<0.05
Morrison Creek at Brookfield	MC01	26	7.7%	0.03	<0.05	26	23.1%	0.37	<0.05
Willow Creek at Blue Ravine	WC01	27	0.0%	<0.05	<0.05	27	0.0%	<0.05	<0.05
Additional Pesticide Monitoring									
Chicken Ranch Slough	CRS01	5	20.0%	0.017	<0.017	5	20.0%	0.21	<0.05
Elk Grove Creek at Laguna	EGCK01	11	9.1%	0.015	<0.012	11	54.5%	0.34	0.0437
Elder Creek at Morrison Creek	ELDERCK01	12	8.3%	0.023	<0.0175	12	50.0%	0.62	0.007985
Morrison Creek at Sunrise	MC02	11	0.0%	<0.05	<0.012	11	0.0%	<0.05	<0.018
Natomas East Main Drain at Elkhorn Road	NEMD01	12	0.0%	<0.05	<0.031	12	8.3%	0.0166	<0.034
Natomas East Main Drain at San Juan Road	NEMD02	12	0.0%	<0.05	<0.031	12	0.0%	<0.05	<0.034

Table 2. Chlorpyrifos Concentrations in Sacramento Urban Creeks

EVENT	DATE	Urban Tributary Monitoring Sites				Additional Pesticide Sites						
		AC03	MC01	WC01	EGCK01	ELDERCK01	MC02	NEMD01	NEMD02	CRS01		
DW01CRK	13-Apr-04	<0.012	0.03J	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	NS		
DW02CRK	6-Oct-04	<0.05	<0.05	<0.05	NS	<0.05	NS	<0.05	<0.05	NS		
DW04CRK	7-Feb-06	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	<0.012	NS		
DW03CRK	12-Apr-05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
WW02CRK	2-Feb-04	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NS		
WW03CRK	18-Feb-04	<0.05R	<0.05R	<0.05R	<0.05R	<0.05R	<0.05R	<0.05R	<0.05R	NS		
WW05CRK	28-Jan-05	0.012J	0.013J	<0.05	0.015J	0.023J	<0.05	<0.05	<0.05	0.017J		
WW06CRK	15-Feb-05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
WW08CRK	27-Feb-06	<0.00259	<0.012	<0.00259	<0.00259	<0.00259	<0.00259	<0.00259	<0.00259	NS		
WW09CRK	6-Mar-06	<0.00259	<0.003	<0.00259	<0.00259	<0.00259	<0.00259	<0.00259	<0.00259	NS		
WW12CRK	8-Dec-06	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
WW13CRK	9-Feb-07	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		

Note:

NS = not sampled

J = Detected, but not quantified (DNQ). Estimated value reported between MDL and RL.

R = Rejected. Reported as below reporting limit, but primary recovery spike failed.

Table 3. Diazinon Concentrations in Sacramento Urban Creeks

EVENT	DATE	Urban Tributary Monitoring Sites				Additional Pesticide Sites					
		AC03	MC01	WC01	EGCK01	ELDERCK01	MC02	NEMD01	NEMD02	CRS01	
DW01CRK	13-Apr-04	0.16	<0.018	<0.018	0.2	<0.018	<0.018	<0.018	<0.018	NS	
DW02CRK	6-Oct-04	<0.05	<0.05	<0.05	NS	<0.05	NS	<0.05	<0.05	NS	
DW03CRK	12-Apr-05	<0.05	<0.05	<0.05	<0.05	0.62	<0.05	<0.05	<0.05	<0.05	
DW04CRK	7-Feb-06	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	<0.018	NS	
WW02CRK	2-Feb-04	0.28	0.32	<0.05	0.34	0.29	<0.05	<0.05	<0.05	NS	
WW03CRK	18-Feb-04	0.24	0.2	<0.05R	0.27	0.15	<0.05R	<0.05R	<0.05R	NS	
WW05CRK	28-Jan-05	0.2	0.25	<0.05	0.12	0.28	<0.05	<0.05	<0.05	0.21	
WW06CRK	15-Feb-05	<0.05	0.37	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
WW08CRK	27-Feb-06	<0.00353	<0.018	<0.00353	<0.00353	<0.00353	<0.00353	<0.00353	<0.00353	NS	
WW09CRK	6-Mar-06	<0.00353	<0.004	<0.00353	0.21	<0.00353	<0.00353	<0.00353	<0.00353	NS	
WW12CRK	8-Dec-06	<0.002	<0.002	<0.002	<0.002	0.0195	<0.002	<0.002	<0.002	<0.002	
WW13CRK	9-Feb-07	0.0347	0.0478	<0.002	0.0437	0.0371	<0.002	0.0166	<0.002	<0.002	

Note:

NS = not sampled

J = Detected, but not quantified (DNQ). Estimated value reported between MDL and RL.

R = Rejected. Reported as below reporting limit, but primary recovery spike failed.

Site Comparisons

Several statistical and general inspection techniques are useful in determining if data and trends between sites are significantly different. Statistical “pair-wise” methods test whether the proposed hypothesis of “site data are the same” is false and generate a probability that differences between data are due to chance alone. Unpaired analyses perform a similar check using “mean” distributional data. This particular analysis is well suited for a pair-wise analysis because the data were collected synoptically at the sites. Finally, a general “inspection” of the data and summary statistics is useful in confirming results of the statistical comparison.

PAIRWISE DATA COMPARISON

Data from each additional pesticide monitoring site were compared against the long-term urban tributary monitoring locations using the paired sign test. This non-parametric test is similar to the distributionally based t-test, but does not rely on distributional (parametric) assumptions. The paired sign test also does not rely on the magnitude of the difference between results, which becomes difficult to accurately quantify when data are reported below the reporting limit. Table 4 presents the results of this analysis for the diazinon data. The chlorpyrifos analysis is more difficult to represent because it is less frequently reported and cannot be used for this evaluation.

Table 4. Paired Sign Test P-values for Diazinon Result Comparison

Site	AC03	MC01	WC01
AC03	NA	0.7539	0.0039*
MC01	0.7539	NA	0.0312*
WC01	0.0039*	0.0312*	NA
CRS01	>0.9999	0.25	[a]
EGCK01	0.2188	>0.9999	0.0312*
ELDERCK01	0.4531	>0.9999	0.0312*
MC02	0.0625**	0.0625**	[a]
NEMD01	0.0625**	0.0625**	[a]
NEMD02	0.0625**	0.0625**	[a]

Notes:

•p-values indicate the probability that differences between sites are related to something besides random chance. Stated differently, higher p-values indicate more similar sites. A p-value <0.05 is a typical threshold for determining that sites are not alike at a statistically significant level.

[a] Enough paired results are identical and reported as not detected to indicate that sites are similar. Sign test is not possible, but sites cannot be shown to be statistically different (i.e., both sites do not have reportable concentrations).

*Significant difference meeting 0.05 threshold.

The diazinon comparisons demonstrate that all of the additional pesticide sites are similar to at least one of the sites. The Arcade Creek and Morrison Creek (downstream) sites were generally

similar to the same additional pesticide locations (Elder Creek, Elk Grove Creek, and Chicken Ranch Slough). Those additional pesticide sites, which were not similar to the Arcade Creek or Morrison Creek (downstream) sites, did not have detected concentrations of diazinon and are more similar to the Willow Creek long-term urban tributary site.

No additional pesticide sites demonstrate a statistically significant (p -value < 0.05) difference from both Willow Creek and Arcade Creek. Based on the available data, Arcade Creek is statistically similar to Morrison Creek (downstream), Chicken Ranch Slough, Elder Creek, and Elk Grove Creek. The other three additional pesticide sites (NEMD at Elkhorn, NEMD at San Juan, and Morrison Creek at Sunrise) had only one detected concentrations of these two OP pesticides. The Willow Creek long term urban tributary site had no detected concentrations of these two OP pesticides during the monitoring period. No differences between sites can be determined, and additional monitoring will not likely not provide additional characterization information unless the watersheds change or reporting limits are significantly reduced.

VISUAL INSPECTION

Review of the data in Table 2 and Table 3 confirms the results of the paired comparison tests. For example, chlorpyrifos was detected at more than one site in only one event. (January 28, 2005). During this one event, chlorpyrifos was detected at similar concentrations at Arcade Creek, Morrison Creek (downstream), Elk Grove Creek, Elder Creek, and Chicken Ranch Slough. It was not detected during this event in Willow Creek, Natomas East Main Drain (upstream and downstream), or the upstream Morrison Creek site. This site grouping also follows the paired statistical comparisons for diazinon.

Conclusions

The Elder Creek, Elk Grove Creek, and Chicken Ranch Slough additional pesticide sites are likely sufficiently comparable, for the purpose of general urban watershed monitoring, to the Arcade Creek and Morrison Creek long-term urban tributary sites. The NEMD sites and the upstream Morrison Creek site had only one (collective) reported concentration of diazinon or chlorpyrifos, which compares well with the Willow Creek long-term urban tributary location. Moreover, the January 2005 change in chlorpyrifos and diazinon registration has significantly reduced both urban runoff and urban tributary concentrations in Sacramento; aside from regional assessment efforts, intensive monitoring of these constituents is no longer necessary.

Recommendations

Continued monitoring of the additional pesticide locations is only necessary if there are changes in (sub-) watershed-specific activities that are anticipated in the specific tributary watersheds that would affect OP pesticide concentrations differently from creek-to-creek. It may also be useful to occasionally monitor one urban tributary upstream monitoring location to characterize general upstream concentrations of pesticides. Based on this analysis, it is recommended that the Permittees formally request that the Water Board waive additional monitoring requirements at these six monitoring locations for the remaining years in the current Permit.