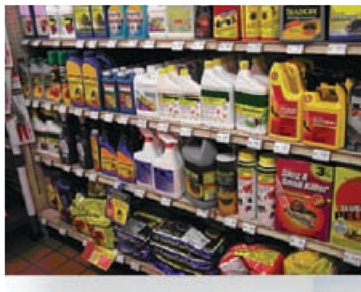
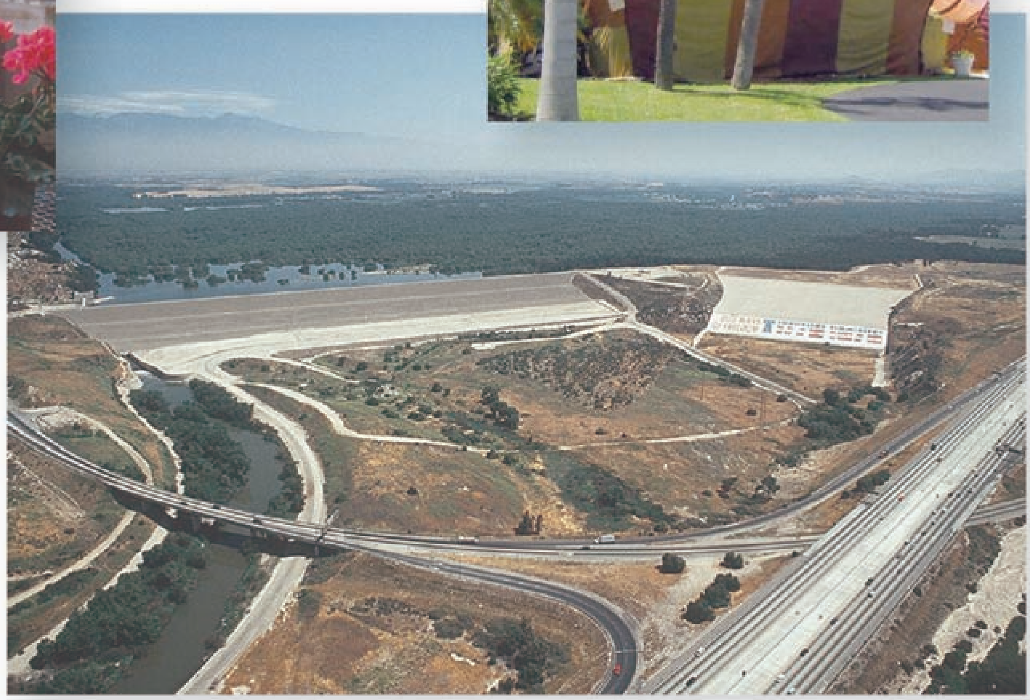
Occurrence and Distribution of Pesticides in Surface Water of the Santa Ana Basin, California, 1998–2001





NATIONAL WATER-QUALITY ASSESSMENT PROGRAM
Scientific Investigations Report 2005-5203

U.S. Department of the Interior
U.S. Geological Survey

Occurrence and Distribution of Pesticide Compounds in Surface Water of the Santa Ana Basin, California, 1998–2001

By Robert Kent, Kenneth Belitz, Andrea J. Altmann, Michael T. Wright, and Gregory O. Mendez

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Conversion Factors, Vertical Datum, Water-Quality Units, and Abbreviations and Acronyms

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
inch (in.)	25,400	micrometer (µm)
foot (ft)	0.3048	meter (m)
gallon (gal)	3.785	liter (L)
mile (mi)	1.609	kilometer (km)
pound (lb)	0.4536	kilogram (kg)
quart (qt)	0.9464	liter (L)
square mile (mi^2)	2.590	square kilometer (km^2)
acre-foot per year (acre-ft/yr)	0.001233	cubic hectometer per year (hm^3/yr)

Vertical coordinate information is referenced to the National Vertical Datum of 1929 (NGVD 29)

Altitude, as used in this report, refers to distance above the vertical datum.

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Abbreviations and Acronyms

DCPA	dimethyl 2,3,5,6-tetrachloro-1,4 benzenedicarboxylate (herbicide)
EWI	equal-width increment (sampling method)
GC/MS	gas chromatography and mass spectrometry
GUS	groundwater ubiquity score (Gustafson, 1989)
HAL	health advisory level (USEPA)
HIP	high intensity phase (NAWQA)
HPLC	high-performance liquid chromatography
Koc	organic carbon sorption coefficient
Kow	n-octanol water partition coefficient
LRL	Laboratory Reporting Level
MCL	maximum contaminant level (USEPA)
MRSD	mean relative standard deviation
MTBE	methyl-tert-butyl ether
MWD	Santa Ana River at MWD Crossing [site]
µm	micrometer
NAWQA	National Water-Quality Assessment Program (USGS)
NWQL	National Water Quality Laboratory (USGS)
PMR	pesticide movement rating (Vogue and others, 1994)
PVC	polyvinyl chloride
QC	quality control
RSD	relative standard deviation
SANA	Santa Ana NAWQA study unit
SPE	solid-phase extraction
Sw	water solubility
ULUG	urban land-use gradient synoptic study
VOC	volatile organic compound

Organizations

CDPR	California Department of Pesticide Regulation
EVMWD	Elsinore Valley Municipal Water District
OCWD	Orange County Water District
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

Occurrence and Distribution of Pesticide Compounds in Surface Water of the Santa Ana Basin, California, 1998–2001

By Robert Kent, Kenneth Belitz, Andrea J. Altmann, Michael T. Wright, and Gregory O. Mendez

Abstract

A study of the occurrence and distribution of pesticide compounds in surface water of the highly urbanized Santa Ana Basin, California, was done as part of the U.S. Geological Survey's National Water-Quality Assessment Program (NAWQA). One-hundred and forty-eight samples were collected from 23 sites, and analyzed for pesticide compounds during the study period from November 1998 to September 2001. Sixty-six different pesticide compounds were detected at varying frequencies and concentrations, and one or more pesticides were detected in 92 percent of the samples. All pesticide concentrations were below maximum levels permitted in drinking water. However, two compounds—diazinon and diuron—exceeded nonenforceable drinking water health-advisory levels in at least one stream sample, and five compounds exceeded guidelines to protect aquatic life—carbaryl, chlorpyrifos, diazinon, lindane, and malathion. Twenty-two pesticide compounds were detected in at least 25 percent of the samples collected from any one fixed site. These are identified as "major" pesticide compounds and are emphasized in this report.

The degree to which pesticides were used in the basin, as well as their physical-chemical properties, are important explanatory factors in stream pesticide occurrence, and most pesticides probably enter streams with urban runoff. Stormflow substantially increases urban runoff, and storm effects on stream pesticide concentrations sometimes persist for several days or weeks after the storm. Water sources other than urban runoff also deliver pesticide compounds to surface water in the basin. For example, atrazine may enter streams in gaining reaches where ground water carries high loads as a result of historical use in the basin. Also, the data suggest that lindane, and perhaps bromacil, are present in treated wastewater, the predominant source of water to streams in the Santa Ana Basin.

Introduction

A wide variety of pesticide compounds make their way into streams and rivers across the United States. Pesticide compounds include herbicides, insecticides, fungicides, and other compounds, along with their degradation products. A U.S. Geological Survey (USGS) study on about 8,000 streams in this country found at least one pesticide compound in 95 percent of the streams (U.S. Geological Survey, 1999). That study compiled pesticide findings for the first 20 study units of the USGS National Water Quality Assessment program (NAWQA). Data on stream pesticide occurrence has subsequently been collected by additional NAWQA study units, including a study unit located in the Santa Ana River Basin in Southern California. More than 5 million pounds of pesticides were used annually in the Santa Ana River Basin from 1999 to 2001 (California Department of Pesticide Regulation, accessed March 2, 2005 at *http://www.cdpr.ca.gov/*). The potential for these compounds to be transported to Santa Ana Basin streams represents a concern for human, as well as ecological health. The Santa Ana River is the largest river in Southern California, and is used to recharge aquifers that supply water to over 4 million people (Santa Ana Watershed Project Authority, 1998). In addition, the Santa Ana River and its tributaries provide habitat for sensitive aquatic species such as the Santa Ana sucker, the Arroyo Chub, the Red-legged Frog, the Western Toad, and the Pacific Tree Frog.

Study Unit Description

The Santa Ana NAWQA (SANA) study unit occupies about 2,700 mi^2 in the Transverse Range and Peninsular Range Provinces of Southern California (*fig. 1*). This drainage area makes the Santa Ana River the largest stream system in southern California. The Santa Ana River begins in the San Bernardino Mountains (which reach altitudes exceeding 10,000 ft) and flows more than 100 mi to the Pacific Ocean near Huntington Beach. The watershed is home to over 4 million people, and the population is expected to increase by more than 50 percent by the year 2020 (Santa Ana Watershed Project Authority, 1998). The water demand is expected to increase by somewhat less than 50 percent during the same period. The high degree of urbanization in the basin creates a disconnection between landscape and stream-water quality. Stream flow from the upper Santa Ana watershed is commonly diverted to detention basins, and seldom reaches the valley floor, even during storm events. The majority of flow in the lower basin originates from treated wastewater, with additional, but significant periodic inputs from storms. During these storms, natural hydrologic processes are short-circuited by the mostly concrete-lined urban flood control network, which is designed to rapidly transfer water downstream.

The climate is Mediterranean with hot, dry summers, and cooler, wetter winters. Average annual precipitation ranges from about 10 to 24 in. in the coastal plain and inland valleys, and from 24 to 48 in. in the San Gabriel and San Bernardino Mountains. Conditions during the study period (October 1998 to September 2001) were unusually dry, with rainfall only about a third of normal. As a result of this drought, the Santa Ana River, upstream from wastewater inputs, recorded its second lowest annual flow in recorded history in 2001 (City of Redlands, 2002).

The California Regional Water Quality Control Board (1995) divides the Santa Ana River into six reaches, numbered in ascending order from the mouth to the headwaters (*fig. 1*). For internal consistency in this report, these reaches are described from upstream to downstream. Reach 6 extends from the headwaters in the San Bernardino Mountains to just above the Seven Oaks Dam near Mentone. Flow in Reach 6 is perennial and consists of rising ground water, storm runoff, and, occasionally, snowmelt. Reach 5 extends from the Seven Oaks Dam to the Bunker Hill Dike in San Bernardino, and has intermittent flow due to upstream diversions. Reach 4 extends from Bunker Hill Dike to Mission Blvd. Bridge in Riverside. Reach 3 is located between Mission Blvd. Bridge and Prado Dam. In contrast to the intermittent flow found in Reach 5, discharges of treated wastewater enter the river along Reaches 4 and 3, resulting in perennial flow from near the beginning of Reach 4 to the recharge facilities at the downstream end of Reach 2. Reach 2 extends from Prado Dam to 17th Street in Santa Ana. Reach 1 extends from 17th Street to the river mouth near Huntington Beach. This reach usually is dry because nearly all the base flow of the Santa Ana River (about 140,000 acre-ft annually) is captured by ground-water recharge facilities operated by the Orange County Water District near the downstream end of Reach 2 (Orange County Water District, 1996). The recharge facility replenishes an aquifer used for public supply (Belitz and others, 2004).

Natural vegetation in the drainage area ranges from riparian habitat and coastal sage at lower altitudes, to chaparral and mixed deciduous and conifer forests at higher altitudes. Alpine tundra also is present at the mountain summits. Sycamore, cottonwood, and willow are common throughout the river flood plain, as are many aquatic plants. The San Gabriel, San Bernardino, and San Jacinto Mountains lie within the Southern California Mountains Ecoregion; the remainder of the study unit lies within the Southern and Central California Plains and Hills Ecoregion (Burton, 2002).

The study area can be subdivided into three primary subunits: the Coastal Basin, the Inland Basin, and the San Jacinto Basin (*fig. 1*). The undeveloped highlands are generally steep and relatively impervious. Water-bearing deposits are found in the alluvial-filled valleys and coastal plain, where land use primarily is urban and agricultural. However, local land use has little influence on surface-water quality in the basin under base-flow conditions because base flow in the Santa Ana River is maintained almost entirely by effluent from municipal wastewater treatment plants (Burton and others, 1998).

Ground water is the main source of water supply in the watershed, meeting about two-thirds of the total water demand (about 1.2 million acre-ft/yr) (Santa Ana Watershed Project Authority, 1998). Imported water from northern California and the Colorado River meet about one-quarter of the total consumptive demand. After delivery and domestic use, nearly all the water is tertiary-treated (Izbicki and others, 2000) to meet water-quality objectives established by the California Regional Water Quality Control Board (1995). Treated effluent is discharged to the Santa Ana River and several of its tributaries, and wastewater constitutes a major stream water source in the study area. Although treated effluent is known to contain numerous contaminants, including pharmaceuticals, health care products, pesticides and other compounds (Kolpin and others, 2001), effluent quality is highly variable, and its description is beyond the scope of this report.

Other surface-water inputs besides treated wastewater include rising ground water in various parts of the basin, mountain runoff, urban runoff (non-point source discharges not directly associated with storms), and stormflow. Base flow in the Santa Ana River also is supplemented by intermittent releases of water imported from northern California and the Colorado River to increase streamflow available for groundwater recharge (Burton and others, 1998). The California Regional Water Quality Control Board (1995) refers to these releases as “non-tributary flow.”

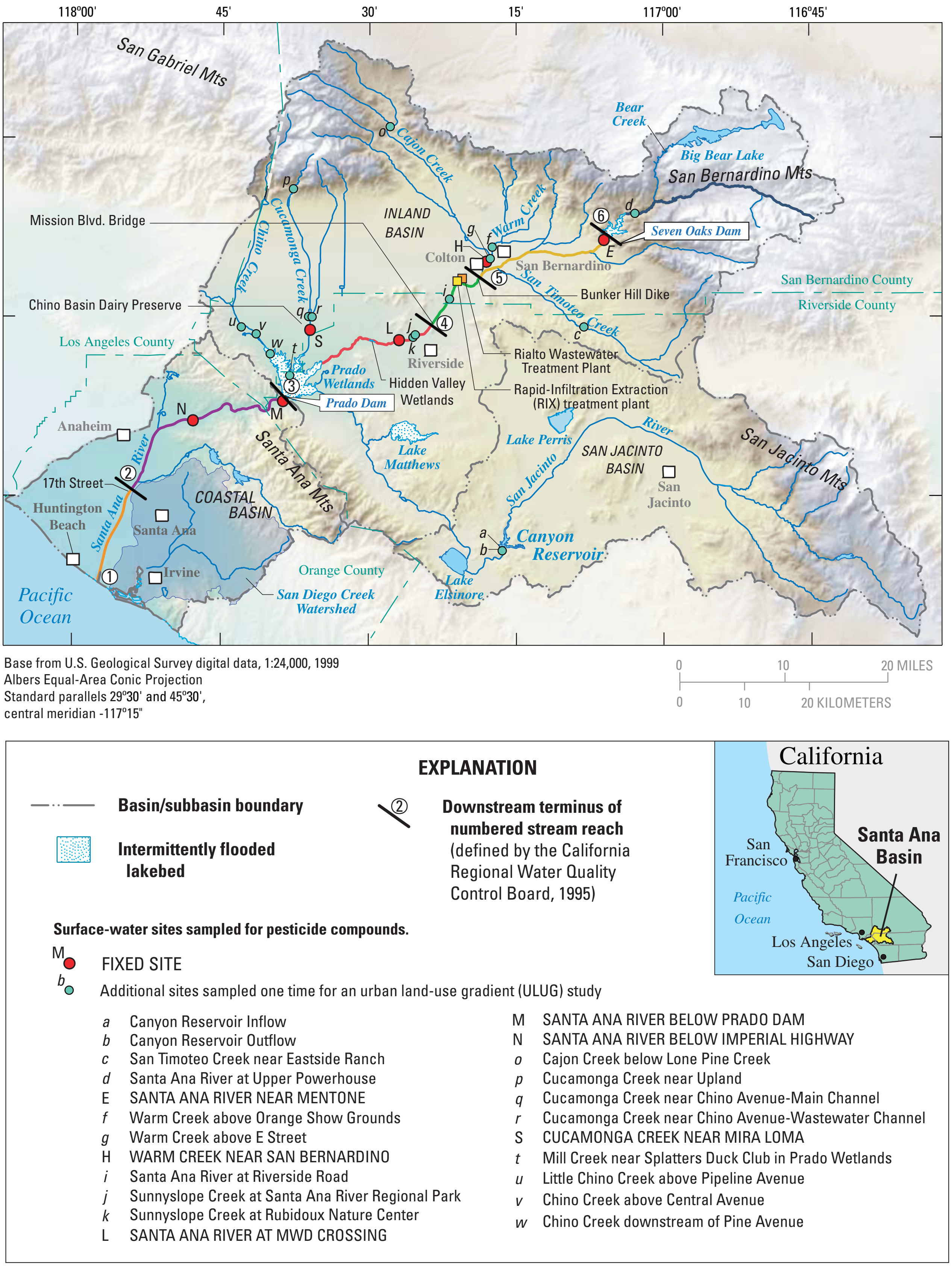


Figure 1. Location of study area and sampling sites in the Santa Ana Basin, California.

Purpose and Scope

The primary purpose of this report is to describe, and explain to the extent possible, the occurrence and distribution of pesticide compounds in surface water of the Santa Ana Basin. Fluxes or loads are not presented in this report. The Santa Ana Basin is the most densely populated of the NAWQA study areas and, therefore, particular emphasis is placed on understanding the influence of urbanization on stream concentrations of pesticides. The concentrations of selected pesticides that were detected in the present study also are placed in the context of water standards and concentrations detected in other NAWQA study areas.

Pesticides—herbicides, insecticides, and fungicides—are synthetic organic compounds used to control weeds, insects, and fungi. The California Department of Pesticide Regulation (CDPR) reported that 5.4 million pounds of pesticides were applied in the Santa Ana Basin during 2001 (California Department of Pesticide Regulation PDF listing California use by county in 2001, accessed on December 18, 2003, at URL: http://www.cdpr.ca.gov/docs/pur/pur01rep/lbsby_co.pdf). Samples collected for this study were analyzed for 189 different pesticide compounds and caffeine, using a combination of five different methods (*table 1*).

Study Design

Data for this study were collected from November 1998 to September 2001, corresponding to the "high intensity phase" (HIP) of the Santa Ana study unit (SANA) [Gilliom and others, 1995]. During this study period, pesticide data were collected from streams at six fixed sites at varying frequencies, and from several additional stream sites as part of an urban land-use gradient study (ULUG) that was operational in August 2000. Pesticide samples were also collected from the Elsinore Valley Municipal Water Treatment Plant at Canyon Reservoir, before and after treatment for domestic distribution. The locations of these various types of sampling sites are shown in *figure 1*, and their sampling dates are given in *table 2*.

Fixed Sites

In the NAWQA program, two types of fixed sampling sites are used to assess water-quality and biological conditions in streams and rivers. Indicator sites are chosen to represent stream water-quality conditions resulting from specific environmental factors of importance in the basin. In contrast, integrator sites are chosen to represent stream water-quality conditions affected by a combination of land uses, point sources, and natural influences. Fixed sites can be further divided into basic-fixed sites and intensive-fixed sites. Intensive-fixed sites were more frequently sampled for pesticides. The SANA fixed-site network included six sites from which samples were collected and analyzed for pesticides during all or part of the study period. Two of these were intensive-fixed sites, Warm Creek near San Bernardino, and the Santa Ana River below Imperial Highway (*fig. 1*). Therefore, these two sites were sampled for pesticides at least monthly during all of the study period. The other four sites were basic-fixed sites; the Santa Ana River near Mentone, the Santa Ana River at MWD Crossing, Cucamonga Creek near Mira Loma, and the Santa Ana River below Prado Dam. Pesticide samples were collected from these basic-fixed sites during only part of the study period.

The Warm Creek site is an urban indicator site, and it is concrete-lined. The drainage area is small (12 mi^2) and entirely urban. Therefore, a substantial portion of the discharge is urban runoff. Ground-water sources include a hot spring, which enters the stream upstream of the concrete lining, and seepage that enters the stream through cracks in the concrete bottom and through drainage holes perforated in the vertical concrete sides. Warm Creek joins the Santa Ana River near the downstream terminus of Reach 5 (*fig. 1*). Warm Creek was sampled monthly from October 1998 to June 1999, twice monthly from July 1999 to March 2000, and then monthly again from April 2000 to September 2001.

The Santa Ana River at Imperial Highway site is an integrator site, with a drainage area of more than 1,500 mi^2. It is located in Reach 2 about 11 mi downstream from Prado Dam, and upstream of the diversion structures and ground-water recharge facilities maintained by the Orange County Water District (OCWD). Under base-flow conditions, the discharge consists primarily of treated wastewater with minor amounts of urban runoff and ground water. Stormflows reaching this site have two sources: runoff from the Inland Basin that is released at Prado Dam, and runoff from urban areas located between the dam and the sampling site. The sampling schedule at the Imperial Highway site was the same as for Warm Creek until April 2001 when the last sample was collected there at Imperial Highway.

The routine monthly samples collected from each fixed site were typically collected during base-flow conditions. An additional six samples were collected at each of the two intensive-fixed sites and analyzed for pesticides specifically to assess water quality affected by storms. All of these were collected during the first 2 years of the study period. The other four fixed sites were sampled for pesticides on at least one occasion during the period of this study. However, no storm samples collected from these other sites were analyzed for pesticides.

The Santa Ana River at Mentone, a mountain reference site, is located a short distance upstream from where the Santa Ana River exits the San Bernardino Mountains (*fig. 1*). Owing to upstream diversions of the Santa Ana River, discharge at Mentone is primarily from Bear Creek, a major tributary of the Santa Ana River. Samples collected from the Mentone site were analyzed for pesticide compounds from February to September 2001.

Table 1. Pesticide target analytes categorized by use.

[Degradation products in italics; schedules and lab codes refer to collections of associated compounds analyzed by a common method at the USGS National Water-Quality Laboratory. GC/MS; gas chromatography/mass spectrometry; GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent; CAS, Chemical Abstract Services, a code used by the U.S. Environmental Protection Agency and other organizations to uniquely identify a specific constituent; MCL, maximum contaminant level; HAL, health advisory level; Aquatic Life, criterion for the protection of aquatic life; all units in micrograms per liter (µg/L); references for standards, guidelines and criteria: f, U.S. Environmental Protection Agency, 2004; g, U.S. Environmental Protection Agency, 2002a; h, Canadian Council of Ministers of the Environment, 2003; i, International Joint Commission Canada and United States, 1977]

Compound	Trade/common name	Methods	Laboratory reporting limit[1]	Parameter code	CAS No.	Parent compound of degradates	MCL (µg/L)f, HAL (µg/L)f, Aquatic Life (µg/L)g,h
Fungicides and fungicide degradates							
Benomyl	Benlate, Benomilosan	HPLC[d]	0.02	50300	17804-35-2		
Chlorothalonil	Brodan	HPLC[d, e]	0.05	49306	1897-45-6		*0.18*[h]
cis-Propiconazole		GC/MS[b]	0.005	79846	60207-90-1		
e-Dimethomorph		GC/MS[b]	0.03	79844	110488-70-5		
Iprodione	Kidan, Rovral	GC/MS[b]	0.03	61593	36734-19-7		
3,5-Dichloroaniline		GC/MS[b]	0.005	61627	626-43-7	Iprodione	
Metalaxyl	Apron	HPLC[d]	0.06	50359	57837-19-1		
		GC/MS[b]	0.02	61596			
Myclobutanil		GC/MS[b]	0.008	61599	88671-89-0		
Propiconazole		HPLC[d]	0.06	50471	60207-90-1		
trans-Propiconazole		GC/MS[b]	0.005	79847	60207-90-1		
z-Dimethomorph		GC/MS[b]	0.03	79845	110488-70-5		
Herbicides and herbicide degradates							
2-(2,4,5-Trichlorophenoxy) propionic acid	Silvex	HPLC[e]	0.03	39762	93-72-1		50[f]
2,4-D	Acme, Agricorn	HPLC[d, e]	0.08	39732	94-75-7		70f, *4h*
2,4-D methyl ester	ME	HPLC[d]	0.09	50470	1928-38-7		
2,4-DB		HPLC[d, e]	0.05	38746	94-82-6		
2,4,5-T		HPLC[e]	0.07	39742	93-76-5		70[f]
4,6-Dinitro-2-methylphenol	DNOC	HPLC[e]	0.42	49299	534-52-1		
Acetochlor	Guardian	GC/MS[a]	0.004	49260	34256-82-1		
Acifluorfen	Blazer	HPLC[d, e]	0.06	49315	50594-66-6		
Alachlor		GC/MS[a]	0.002	46342	15972-60-8		2[f]
2,6-Diethylaniline		GC/MS[a]	0.003	82660	579-66-8	Alachlor	
2-Chloro-2,6-diethyl acetanilide		GC/MS[b]	0.008	61618	6967-29-9	Alachlor	
Atrazine	Aatrex	GC/MS[a]	0.007	39632	1912-24-9		3[f], *1.8*[h]
		HPLC[d]	0.074				
2-Hydroxyatrazine	Hydroxy-atrazine	HPLC[d]	0.2	50355	2163-68-0	Atrazine	
Deethylatrazine	Desethyl atrazine	GC/MS[a]	0.006	04040	6190-65-4	Atrazine	
		HPLC[d]	0.087				
Deethyldeisopropylatrazine	Desdiethyl simazine	HPLC[d]	0.06	04039	3397-62-4	Atrazine	
Deisopropylatrazine	Desethyl simazine	HPLC[d]	0.07	04038	1007-28-9	Triazines	

Table 1. Pesticide target analytes categorized by use—Continued.

[Degradation products in italics; schedules and lab codes refer to collections of associated compounds analyzed by a common method at the USGS National Water-Quality Laboratory. GC/MS; gas chromatography/mass spectrometry; GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent; CAS, Chemical Abstract Services, a code used by the U.S. Environmental Protection Agency and other organizations to uniquely identify a specific constituent; MCL, maximum contaminant level; HAL, health advisory level; Aquatic Life, criterion for the protection of aquatic life; all units in micrograms per liter (µg/L); references for standards, guidelines and criteria: f, U.S. Environmental Protection Agency, 2004; g, U.S. Environmental Protection Agency, 2002a; h, Canadian Council of Ministers of the Environment, 2003; i, International Joint Commission Canada and United States, 1977]

Compound	Trade/common name	Methods	Laboratory reporting limit[1]	Parameter code	CAS No.	Parent compound of degradates	MCL (µg/L)f, HAL (µg/L)f, Aquatic Life (µg/L)g,h
Benfluralin	Benefin, Balan	GC/MS[a]	0.01	82673	1861-40-1		
Bensulfuron-methyl		HPLC[d]	0.05	61693	83055-99-6		
Bentazon	Basagran	HPLC[d, e]	0.02	38711	25057-89-0		200[f]
2-Amino-N-isopropylbenzamide		GC/MS[b]	0.005	61617	30391-89-0	Bentazon	
Bromacil	Borocil	HPLC[d, e]	0.08	04029	314-40-9		90[f], *5*[h]
Bromoxynil	Brominal	HPLC[d, e]	0.06	49311	1689-84-5		*5*[h]
Butylate		GC/MS[a]	0.002	04028	2008-41-5		400[f]
Chloramben		HPLC[e]	0.42	49307	7286-84-2		100[f]
2,5-Dichloroaniline	Scarlet base gg	GC/MS[b]	0.005	61614	95-82-9	Chloramben	
Chloramben, methyl ester		HPLC[d]	0.1	61188	7286-884-2		
Chlorimuron-ethyl		HPLC[d]	0.04	50306	90982-32-4		
Clopyralid	Confront	HPLC[d, e]	0.04	49305	1702-17-6		
Cyanazine	Bladex	GC/MS[a]	0.018	04041	21725-45-2		1[f], *2*[h]
Cycloate	Ro-Neet	HPLC[d]	0.02	04031	1134-23-2		
		GC/MS[b]	0.16				
DCPA	Dacthal	GC/MS[a]	0.003	82682	1861-32-1		70[f]
Dacthal monoacid		HPLC[d, e]	0.07	49304	887-54-7	Dacthal	
Dicamba	Banvel	HPLC[d, e]	0.10	38442	1918-00-9		200[f], 10[h]
Dichlobenil		HPLC[e]	1.2	49303	1194-65-6		
Dichlorprop		HPLC[d, e]	0.05	49302	120-36-5		
Dinoseb	Caldon, F-ISO	HPLC[d, e]	0.04	49301	88-85-7		7[f], *0.05*[h]
Diphenamid	Rideon, Dymid	HPLC[d]	0.06	04033	957-51-7		200[f]
Diuron	Karmex, Direx 80 DF	HPLC[d, e]	0.08	49300	330-54-1		10[f]
3(4-chlorophenyl)-1-methyl urea		HPLC[d]	0.09	61692	5352-88-5	Diuron	
3,4-Dichloroaniline	3,4-DCA	GC/MS[b]	0.008	61625	95-76-1	Urea herbicides	
EPTC	Eptam, Eradicane	GC/MS[a]	0.002	82668	759-94-4		
Ethalfluralin		GC/MS[a]	0.009	82663	55283-68-6		
Fenuron	Beet-Klean	HPLC[d, e]	0.07	49297	101-42-8		
Flumetralin		GC/MS[b]	0.02	61592	62924-70-3		
Flumetsulam		HPLC[d]	0.09	61694	98967-40-9		
Fluometuron	Flo-Met, Cotoran	HPLC[d, e]	0.06	38811	2164-17-2		90[f]

Table 1. Pesticide target analytes categorized by use—Continued.

[Degradation products in italics; schedules and lab codes refer to collections of associated compounds analyzed by a common method at the USGS National Water-Quality Laboratory. GC/MS; gas chromatography/mass spectrometry; GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent; CAS, Chemical Abstract Services, a code used by the U.S. Environmental Protection Agency and other organizations to uniquely identify a specific constituent; MCL, maximum contaminant level; HAL, health advisory level; Aquatic Life, criterion for the protection of aquatic life; all units in micrograms per liter (μg/L); references for standards, guidelines and criteria: f, U.S. Environmental Protection Agency, 2004; g, U.S. Environmental Protection Agency, 2002a; h, Canadian Council of Ministers of the Environment, 2003; i, International Joint Commission Canada and United States, 1977]

Compound	Trade/common name	Methods	Laboratory reporting limit[1]	Para-meter code	CAS No.	Parent compound of degradates	MCL (μg/L)f, HAL (μg/L)f, Aquatic Life (μg/L)g,h
3-Trifluoromethylaniline		GC/MS[b]	0.005	61630	98-16-8	Fluometuron	
Hexazinone	Brush-off, Velpar	GC/MS[b]	0.008	04025	51235-04-2		400[f]
Imazaquin	Detail	HPLC[d]	0.1	50356	81335-37-7		
Imazethapyr	Contour, Hammer	HPLC[d]	0.09	50407	81335-77-5		
Linuron	Lorox, Premalin	GC/MS[a]	0.035	82666	330-55-2		*7*[h]
		HPLC[d, e]	0.07	38478			
MCPA	Metaxon, Kilsem	HPLC[d, e]	0.06	38482	94-74-6		4[f], *2.6*[h]
4-Chloro-2-methylphenol	4-chloro-o-cresol	GC/MS[b]	0.005	61633	1570-64-5	MCPA, MCPB	
MCPB		HPLC[d, e]	0.06	38487	94-81-5		
Metolachlor	Dual, Pennant	GC/MS[a]	0.013	39415	51218-45-2		100[f], *7.8*[h]
2-[2-Ethyl-6-methylphenyl)amino]-1-propanol		GC/MS[b]	0.02	61615	61520-53-4	Metolachlor	
2-Ethyl-6-methylaniline		GC/MS[b]	0.005	61620	24549-06-2	Metolachlor	
Metribuzin		GC/MS[a]	0.006	82630	21087-64-9		200[f], *1*[h]
Metsulfuron methyl		HPLC[d]	0.1	61697	74223-64-6		
Molinate	Hydram	GC/MS[a]	0.004	82671	2212-67-1		
Napropamide	Devrinol	GC/MS[a]	0.007	82684	15299-99-7		
1,4-Napthaquinone		GC/MS[b]	0.008	61611	130-15-4	Napropamide, Carbaryl	
Neburon		HPLC[d, e]	0.07	49294	555-37-3		
Nicosulfuron	Accent, Challenger	HPLC[d]	0.07	50364	111991-09-4		
Norflurazon	Evital, Solicam	HPLC[d, e]	0.08	49293	27314-13-2		
Oryzalin	Surflan	HPLC[d, e]	0.31	49292	19044-88-3		
Oxyflurofen		GC/MS[b]	0.02	61600	42874-03-3		
Pebulate		GC/MS[a]	0.004	82669	1114-71-2		
Pendimethalin	Prowl, Stomp	GC/MS[a]	0.01	82683	40487-42-1		
4-(Hydroxymethyl)pendimethalin		GC/MS[b]	0.03	61665	56750-76-6	Pendimethalin	
Picloram	Tordon	HPLC[d, e]	0.07	49291	1918-02-1		500[f], *29*[h]
Prometon	Pramitol	GC/MS[a]	0.02	04037	1610-18-0		100[f]
Prometryn	Caparol, Gesagard	GC/MS[b]	0.005	04036	7287-19-6		
Propachlor		GC/MS[a]	0.01	04024	1918-16-7		90[f]
Propanil		GC/MS[a]	0.011	82679	709-98-8		
Propham	Chem-Hoe, IPC	HPLC[d, e]	0.07	49236	122-42-9		100[f]
Propyzamide	Pronamide, Kerb	GC/MS[a]	0.004	82676	23950-58-5		50[f]

Table 1. Pesticide target analytes categorized by use—Continued.

[Degradation products in italics; schedules and lab codes refer to collections of associated compounds analyzed by a common method at the USGS National Water-Quality Laboratory. GC/MS; gas chromatography/mass spectrometry; GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent; CAS, Chemical Abstract Services, a code used by the U.S. Environmental Protection Agency and other organizations to uniquely identify a specific constituent; MCL, maximum contaminant level; HAL, health advisory level; Aquatic Life, criterion for the protection of aquatic life; all units in micrograms per liter (µg/L); references for standards, guidelines and criteria: f, U.S. Environmental Protection Agency, 2004; g, U.S. Environmental Protection Agency, 2002a; h, Canadian Council of Ministers of the Environment, 2003; i, International Joint Commission Canada and United States, 1977]

Compound	Trade/common name	Methods	Laboratory reporting limit[1]	Parameter code	CAS No.	Parent compound of degradates	MCL (µg/L)f, HAL (µg/L)f, Aquatic Life (µg/L)g,h
Siduron	Tupersan	HPLC[d]	0.09	38548	1982-49-6		
Simazine	Aquazine, Framed, Princep	GC/MS[a]	0.011	04035	122-34-9		4[f], *10*[h]
Sulfometuron-methyl	Oust	HPLC[d]	0.04	50337	74222-97-2		
Tebuthiuron	Brush, Spike	GC/MS[a]	0.02	82670	34014-18-1		500[f], *1.6*[h]
		HPLC[d]	0.07				
Terbacil	Sinbar	GC/MS[a]	0.034	82665	5902-51-2		90[f]
		HPLC[d]	0.095	04032			
Terbuthylazine		GC/MS[a, b]	0.005	04022	5915-41-3		
Thiobencarb		GC/MS[a]	0.005	82681	28249-77-6		
4-Chlorobenzylmethyl sulfone		GC/MS[b]	0.008	61634	98-57-7	Thiobencarb	
Triallate	Far-Go	GC/MS[a]	0.002	82678	2303-17-5		*0.24*[h]
Trichloropropene sulfonic acid	TCPSA	GC/MS[b]	0.005	61670		Triallate	
Tribenuron-methyl		HPLC[d]	0.07	61159	101200-48-0		
Tribuphos		GC/MS[b]	0.02	61610	78-78-8		
Triclopyr	Access, ET	HPLC[d, e]	0.1	49235	55335-06-3		
Trifluralin	Treflan, turflon, Team	GC/MS[a]	0.009	82661	1582-09-8		5[f], *0.2*[h]
Insecticides and insecticide degradates							
1,2-Dibromoethane	Ethylene dibromide	GCMS[c]	0.04	77651	106-93-4		0.05[f]
1,2-Dibromo-3-chloropropane		GCMS[c]	0.2	82625	96-12-8		0.2[f]
1,2,3-Trichlorobenzene		GCMS[c]	0.3	77613	87-61-6		*8*[h]
cis-1,3-Dichloropropene		GCMS[c]	0.09	34704	10061-01-5		
trans-1,3-Dichloropropene		GCMS[c]	0.13	34699	10061-02-6		
1,4-Dichlorobenzene	p-Dichloro-benzene	GCMS[c]	0.05	34571	106-46-7		75[f], *26*[h]
Aldicarb	Temik	HPLC[d, e]	0.08	49312	116-06-3		7[f(2)],1h
Aldicarb sulfone	Aldoxycarb	HPLC[d, e]	0.2	49313	1646-88-4	Aldicarb	7[f(2)]
Aldicarb sulfoxide		HPLC[d, e]	0.03	49314	1646-87-3	Aldicarb	7[f(2)]
alpha-Endosulfan		GC/MS[b]	0.02	34362	959-98-8		*0.056*[g], *0.02*[h]
Endosulfan ether		GC/MS[b]	0.02	61642	3369-52-6	alpha and beta-Endo-sulfan	
Endosulfan sulfate		GC/MS[b]	0.008	61590	1031-07-8	alpha-Endo-sulfan	
alpha-HCH		GC/MS[a]	0.005	34253	319-84-6		
Azinphos-methyl		GC/MS[a]	0.05	82686	86-50-0		

Table 1. Pesticide target analytes categorized by use—Continued.

[Degradation products in italics; schedules and lab codes refer to collections of associated compounds analyzed by a common method at the USGS National Water-Quality Laboratory. GC/MS; gas chromatography/mass spectrometry; GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent; CAS, Chemical Abstract Services, a code used by the U.S. Environmental Protection Agency and other organizations to uniquely identify a specific constituent; MCL, maximum contaminant level; HAL, health advisory level; Aquatic Life, criterion for the protection of aquatic life; all units in micrograms per liter (µg/L); references for standards, guidelines and criteria: f, U.S. Environmental Protection Agency, 2004; g, U.S. Environmental Protection Agency, 2002a; h, Canadian Council of Ministers of the Environment, 2003; i, International Joint Commission Canada and United States, 1977]

Compound	Trade/common name	Methods	Laboratory reporting limit[1]	Parameter code	CAS No.	Parent compound of degradates	MCL (µg/L)f, HAL (µg/L)f, Aquatic Life (µg/L)g,h
Azinphos-methyl-oxon		GC/MS[b]	0.03	61635	961-22-8	Azinphos-methyl	
Bendiocarb	Dycarb	HPLC[d]	0.06	50299	22781-23-3		
beta-Endosulfan		GC/MS[b]	0.02	34357	33213-65-9		*0.056*[g], *0.02*[h]
Bifenthrin	Talstar	GC/MS[b]	0.002	61580	82657-04-3		
Bromomethane		GCMS[c]	0.3	34413	74-83-9		10[f]
Carbaryl	Sevin, Savit	GC/MS[a]	0.041	82680,	63-25-2		700[f], *0.2*[h]
		HPLC[d, e]	0.063	49310			
1-Naphthol	Durafur, Basf Urosol	GC/MS[b]	0.005	49295	90-15-3	Carbaryl/ Naprop-amide	
Carbofuran	Furadan	GC/MS[a]	0.02	82674,	1563-66-2		40[f], *1.8*[h]
		HPLC[d, e]		49309			
Carbon disulfide	Dithiocarbonic anhydride, carbon bisulfide	GCMS[c]	0.37	77041	75-15-0		
3-Hydroxycarbofuran		HPLC[d, e]	0.06	49308	16655-82-6	Carbofuran	
3-Ketocarbofuran		HPLC[d]	0.07	50295	16709-30-1	Carbofuran	
4,4'-Dichlorobenzophenone	Dicofol	GC/MS[b]	0.008	61631	90-98-2	Chlorobenzilate	
Chlorpyrifos	Dursban	GC/MS[a]	0.005	38933	2921-88-2		20[f], *0.041g, 0.0035*[h]
Chlorpyrifos, oxygen analog		GC/MS[b]	0.02	61636	5598-15-2	Chlorpyrifos	
cis-Permethrin	Pounce, Ambush	GC/MS[a]	0.006	82687	52341-33-0		
Cyfluthrin	Cy-kick	GC/MS[b]	0.03	61585	68359-37-5		
cis-Methyl-3-(2,2-dichlorovinyl)-2,2-dimethyl-(1-cyclopropane)-carboxylate		GC/MS[b]	0.02	79842	61898-95-1	Cyfluthrin, Cypermethrin, Permethrin	
trans-Methyl-3-(2,2-dichlorovinyl)-2,2-dimethyl-(1-cyclopropane)-carboxylate		GC/MS[b]	0.02	79843	61898-95-1	Cyfluthrin, Cypermethrin, Permethrin	
Cypermethrin	Ammo	GC/MS[b]	0.03	61586	52315-07-8		
p,p'-DDE	DDE	GC/MS[a]	0.003	34653	72-55-9	DDT	
Diazinon	Knox Out, Kayazol	GC/MS[a]	0.005	39572	333-41-5		0.6[f], *0.08*[i]
Dichlorvos	Apavap	GC/MS[b]	0.005	38775	62-73-7		
Dicrotophos	Bidrin, Carbricron	GC/MS[b]	0.02	38454	141-66-2		

Table 1. Pesticide target analytes categorized by use—Continued.

[Degradation products in italics; schedules and lab codes refer to collections of associated compounds analyzed by a common method at the USGS National Water-Quality Laboratory. GC/MS; gas chromatography/mass spectrometry; GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent; CAS, Chemical Abstract Services, a code used by the U.S. Environmental Protection Agency and other organizations to uniquely identify a specific constituent; MCL, maximum contaminant level; HAL, health advisory level; Aquatic Life, criterion for the protection of aquatic life; all units in micrograms per liter (µg/L); references for standards, guidelines and criteria: f, U.S. Environmental Protection Agency, 2004; g, U.S. Environmental Protection Agency, 2002a; h, Canadian Council of Ministers of the Environment, 2003; i, International Joint Commission Canada and United States, 1977]

Compound	Trade/common name	Methods	Laboratory reporting limit[1]	Parameter code	CAS No.	Parent compound of degradates	MCL (µg/L)f, HAL (µg/L)f, Aquatic Life (µg/L)g,h
Dieldrin		GC/MS[a]	0.005	39381	60-57-1		*0.056*[g]
Dimethoate	Cygon	GC/MS[b]	0.005	82662	60-51-5		
Disulfoton	Disyston, Bay S376	GC/MS[a]	0.02	82677	298-04-4		0.3[f]
Disulfoton sulfone	Disulfoton dioxide	GC/MS[b]	0.005	61640	2497-06-5	Disulfoton	
Disulfoton sulfoxide	Oxydisulfoton	GC/MS[b]	0.02	61641	2497-07-6	Disulfoton	
Ethion	Acithion, Ethanox	GC/MS[b]	0.005	82346	563-12-2		
Ethion monoxon		GC/MS[b]	0.008	61644	17356-42-2	Ethion	
Ethoprophos		GC/MS[a]	0.005	82672	13194-48-4		
O-ethyl-O-methyl-S-propylphophorothioate		GC/MS[b]	0.005	61660	76960-87-7	Ethoprophos	
Fenamiphos	Bay 68138	GC/MS[b]	0.02	61591	22224-92-6		2[f]
Fenamiphos sulfone		GC/MS[b]	0.008	61645	31972-44-8	Fenamiphos	
Fenamiphos sulfoxide		GC/MS[b]	0.03	61646	31972-43-7	Fenamiphos	
Fenthion		GC/MS[b]	0.005	38801	55-38-9		
Fenthion sulfoxide		GC/MS[b]	0.008	61647	3761-41-9	Fenthion	
Fonofos	Capfos, Cudgel	GC/MS[a]	0.003	04095	944-22-9		10[f]
Fonofos, oxygen analog	Capfos	GC/MS[b]	0.02	61649	944-21-8	Fonofos	
Imidacloprid	Admire, Imicide, Merit, Pre-empt, Provado	HPLC[d]	0.1	61695	138261-41-3		
Isofenphos	Amaze	GC/MS[b]	0.008	61594	25311-71-1		
Lambdacyhalothrin		GC/MS[b]	0.008	61595	91465-08-6		
Lindane (gamma HCH)	Acitox	GC/MS[a]	0.004	39341	58-89-9		0.2[f], *0.01*[h]
Malathion	Mercaptothion, Malcarbophos, Maldison	GC/MS[a]	0.027	39532	121-75-5		100[f], *0.1*[b]
Malaoxon	Liromat, Oxycarbophos	GC/MS[b]	0.02	61652	1634-78-2	Malathion	
Methidathion	Somonic	GC/MS[b]	0.02	61598	950-37-8		
Methiocarb		HPLC[d, e]	0.08	38501	2032-65-7		
Methomyl	Nudrin, Lannate	HPLC[d, e]	0.08	49296	16752-77-5		200[f]
Oxamyl		HPLC[d, e]	0.02	38866	23135-22-0		200[f]
Parathion		GC/MS[a]	0.004	39542	56-38-2		*0.013***g**
Paraoxon-ethyl		GC/MSb	0.03	61663	311-45-5	Parathion	
Parathion-methyl		GC/MS[a]	0.006	82667	2998-00-0		2[f]

Table 1. Pesticide target analytes categorized by use—Continued.

[Degradation products in italics; schedules and lab codes refer to collections of associated compounds analyzed by a common method at the USGS National Water-Quality Laboratory. GC/MS; gas chromatography/mass spectrometry; GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent; CAS, Chemical Abstract Services, a code used by the U.S. Environmental Protection Agency and other organizations to uniquely identify a specific constituent; MCL, maximum contaminant level; HAL, health advisory level; Aquatic Life, criterion for the protection of aquatic life; all units in micrograms per liter (µg/L); references for standards, guidelines and criteria: f, U.S. Environmental Protection Agency, 2004; g, U.S. Environmental Protection Agency, 2002a; h, Canadian Council of Ministers of the Environment, 2003; i, International Joint Commission Canada and United States, 1977]

Compound	Trade/common name	Methods	Laboratory reporting limit[1]	Parameter code	CAS No.	Parent compound of degradates	MCL (µg/L)f, HAL (µg/L)f, Aquatic Life (µg/L)g,h
Paraoxon-methyl		GC/MS[b]	0.03	61664	950-35-6	Parathion-methyl	
3-Phenoxybenzyl alcohol	MPBA	GC/MS[b]	0.03	61629	13826-35-2	Permethrin	
Phorate	Agrimet, Geomet	GC/MS[a]	0.002 0.011	82664	289-02-2		
Phorate oxon		GC/MS[b]	0.031	61666	2600-69-3	Phorate	
Phosmet	Imidan	GC/MS[b]	0.008	61601	732-11-6		
Phosmet oxon		GC/MS[b]	0.06	61668	3735-33-9	Phosmet	
Profenofos		GC/MS[b]	0.008	61603	41198-08-7		
Propargite		GC/MS[a]	0.02	82685	2312-35-8		
2-(4-tert-butylphenoxy)-cyclohexanol		GC/MS[b]	0.02	61637	1942-71-8	Propargite	
Propetamphos	Blotic	GC/MS[b]	0.02	61604	31218-83-4		
Propoxur	Baygon	HPLC[d, e]	0.06	38538	114-26-1		3[f]
Sulfotepp		GC/MS[b]	0.005	61605	3689-24-5		
Sulprofos		GC/MS[b]	0.005	38716	35400-43-2		
Tebupirimphos		GC/MS[b]	0.008	61602	96182-53-5		
Tebupirimphos oxygen analog		GC/MS[b]	0.02	61669		Tebupirimphos	
Tefluthrin		GC/MS[b]	0.008	61606	79538-32-2		
Tefluthrin metabolite [R1193642]		GC/MS[b]	0.005	61671		Tefluthrin	
Tefluthrin metabolite [R152912]		GC/MS[b]	0.008	61672		Tefluthrin	
Temephos	Abate	GC/MS[b]	0.03	61607	3383-96-8		
Terbufos		GC/MS[a]	0.02	82675	13071-79-9		0.9[f]
Terbufos -O-analogue sulfone		GC/MS[b]	0.02	61674	56070-15-6	Terbufos	
Stimulant							
Caffeine		HPLC[d]	0.08	50305	58-08-2		

[1]Laboratory reporting limit (LRL) for some compounds changed during the study; in these cases the highest LRL is shown.

[2]Aldicarb, aldicarb sulfone, and aldicarb sulfoxide—the MCL for any combination of two or more of these three chemicals should not exceed 7 µg/L because of similar mode of action.

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

[d]Furlong and others, 2001.

[e]Werner and others, 1996.

Table 2. Surface-water sites sampled for pesticide compounds in the Santa Ana Basin, California, 1998–2001.

[GC/MS, gas chromatography/mass spectrometry; GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; ULUG, urban land-use gradient synoptic study]

Site type	Site name	USGS site identification No.	Sample dates	Methods	No. samples
Fixed	Santa Ana River near Mentone	11051500	02/20/2001–09/13/2001	GC/MS[a, c]	8
Fixed and ULUG	Warm Creek near San Bernardino	11060400	11/16/1998–09/13/2001	GC/MS[a, c]	49
			03/09/1999–04/13/2000	HPLC[d]	27
			11/16/1998–02/12/1999	HPLC[e]	6
Fixed and ULUG	Santa Ana River below Prado Dam	11074000	07/13/2000–09/12/2001	GC/MS[a, c]	14
Fixed	Santa Ana River below Imperial Hwy	11075610	11/20/1998–04/19/2001	GC/MS[a, c]	43
			03/09/1999–04/13/2000	GC/MS[b], HPLC[d]	27
			11/16/1998–02/12/1999	HPLC[e]	6
Special Study	Canyon Reservoir Inflow	334032117162201	07/15/1999–12/13/1999	GC/MS[a, b] HPLC[d]	8
Special Study	Canyon Reservoir Outflow	334031117162301	07/15/1999–12/13/1999	GC/MS[a, b] HPLC[d]	8
Fixed and ULUG	Cucamonga Creek near Mira Loma*	11073495	04/19/1999 and 08/16/2000	GC/MS[a]	2
ULUG	Chino Creek above Central Avenue	335835117412701	08/07/2000	GC/MS[a, c]	1
ULUG	Cucamonga Creek near Upland	11073470	08/08/2000	GC/MS[a, c]	1
ULUG	Mill Creek near Splatters Duck Club	335506117381201	08/08/2000	GC/MS[a]	1
ULUG	Cucamonga Creek near Chino Ave-Main Channel	340042117355901	08/09/2000	GC/MS[a, c]	1
ULUG	Cucamonga Creek near Chino Ave-Wastewater Channel	340041117355901	08/09/2000	GC/MS[a, c]	1
ULUG	Chino Creek downstream of Pine Avenue	335655117395601	08/10/2000	GC/MS[a]	1
ULUG	Little Chino Creek Pipeline Road	335910117425801	08/11/2000	GC/MS[a, c]	1
ULUG	Cajon Creek below Lone Pine Creek	11063510	08/14/2000	GC/MS[a]	1
ULUG	Warm Creek above E Street	340455117173801	08/15/2000	GC/MS[a]	1
Fixed and ULUG	Santa Ana River at MWD Crossing	11066460	08/15/2000	GC/MS[a]	1
ULUG	Warm Creek above Orange Show Grounds	340552117172701	08/15/2000	GC/MS[a]	1
ULUG	Santa Ana River at Riverside Road	340132117214401	08/16/2000	GC/MS[a, c]	1
ULUG	San Timoteo Creek near Eastside Ranch	335913117080701	08/16/2000	GC/MS[a, c]	1
ULUG	Sunnyslope Creek at Santa Ana River Regional Park	335827117253801	08/17/2000	GC/MS[a]	1
ULUG	Sunnyslope Creek at Rubidoux Nature Center	335835117253401	08/17/2000	GC/MS[a]	1
ULUG	Santa Ana River at Upper Powerhouse	340843117032501	08/18/2000	GC/MS[a, c]	1

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

[d]Furlong and others, 2001.

[e]Werner and others, 1996. [d]Furlong and others, 2001.

[e]Werner and others, 1996.

The Santa Ana River below Prado Dam site is an integrator in space and time for the Inland Basin (*fig. 1*). Water quality at this site is affected by a number of factors including wastewater discharges, wetland processes in the Prado Wetlands, urban runoff, dairy runoff, and impoundment of stormflows. Fourteen pesticide samples were collected monthly from this site from July 2000 until the end of the study period in September 2001.

On seven dates between August 2000 and April 2001, paired samples were collected at the Prado and the Imperial Highway sites 5 hours apart in order to observe water-quality changes between the two sites. Five hours is the approximate travel time between the two sites on the basis of typical stream velocities and the distance between the two sites (approximately 11 mi) (Izbicki and others, 2000).

The other two fixed sites, the Santa Ana River at MWD Crossing (MWD) and Cucamonga Creek near Mira Loma, were sampled for pesticides only once and twice, respectively. MWD is an integrator site along Reach 3 (*fig. 1*), base flow primarily being treated wastewater plus minor contributions from ground water. MWD was sampled for pesticides only once, as part of the urban land-use gradient study in August 2000.

Cucamonga Creek near Mira Loma is located in the Chino Basin Dairy Preserve (*fig. 1*). However, discharge in Cucamonga Creek generally does not reflect land use in the adjacent area; the channel is concrete-lined and base flow consists primarily of treated wastewater with a small component of urban runoff. Under stormflow conditions, the discharge includes runoff from urban areas and undeveloped mountains. Runoff from dairies may also contribute discharge during extreme rain events. Cucamonga Creek joins Mill Creek, and their combined flows enter the Prado Wetlands near the downstream terminus of Reach 3 (*fig. 1*). Two pesticide samples were collected from Cucamonga Creek near Mira Loma during the period of this study.

One exception to the sampling strategy described above is that no samples were collected in November 2000. In general, during that time, monthly samples were being collected at Warm Creek, the Santa Ana River below Prado Dam, and the Santa Ana River below Imperial Highway.

Additional Studies

Urban Land-Use Gradient (ULUG) Study

The August 2000 urban land-use gradient study (ULUG) (Burton and others, 2005) contributed to increased understanding of the role of spatial variability in controlling pesticide occurrence in the basin. Sites were selected along a “gradient of urbanization” of 0 to 94 percent urbanized, largely characterized by water source and stream channel type (natural, concrete-lined, channelized) (*table 2*). Four of the nineteen ULUG sites—Warm Creek, MWD, Cucamonga Creek near Mira Loma, and the Santa Ana River below Prado Dam—were also fixed sites.

Pesticides in Reservoirs

In 1999, NAWQA and the Environmental Protection Agency (USEPA) initiated a 2-year pilot monitoring program to assess human exposure to pesticides in drinking water derived from surface-water reservoirs (Blomquist and others, 2001). Reservoirs were sampled because they are important sources of drinking water and because they integrate pesticide loadings within their watersheds. One of the twelve reservoirs sampled in the national assessment was Canyon Reservoir, in the Santa Ana Basin (*table 2*, *fig. 1*). The Elsinore Valley Municipal Water Treatment Plant treats the reservoir water before distribution. From July to December 1999, eight water samples were collected from the drinking-water treatment facility before and after treatment, and analyzed for 177 different pesticide compounds (*table 1*).

Methods and Data Analysis

Sample Collection and Processing

Water samples for pesticide analyses were collected by equal-width-increment [EWI] (Wilde and others, 1999), multiple-vertical, grab, or point (automatic) sampling methods, as site conditions dictated. The preferred method was EWI, because a discharge-weighted and isokinetic water-quality sample is collected along the sampling cross section. The multiple-vertical sampling method also strives to represent water quality in a cross section by integrating several verticals across a stream; multiple-vertical samples are usually not depth-integrated because shallow stream depths prohibit the use of isokinetic sampling equipment (Lane and others, 2003; Wilde and others, 1999). Grab samples, the least preferred method, are collected near midstream, and approximately mid-depth, when streams are too narrow for the EWI or multiple-vertical methods. Most samples collected for this study were obtained using the EWI method. Storm samples were usually collected near the stream bank by grab or an automatic sampler (which also represented a grab sample). Samples for the drinking-water monitoring program at Canyon Reservoir were collected directly from raw-water (reservoir intake) and treated-water faucets inside the Elsinore Valley Municipal Water District (EVMWD) treatment plant.

A cone splitter (Capel and Larson, 1996) was used to divide the composited pesticide samples into subsamples, which theoretically contain equal concentrations of suspended and dissolved analytes (Lane and others, 2003). The subsamples to be analyzed for pesticides were filtered, using a 0.7 µm glass fiber filter, into a 1-quart glass amber bottle. All pesticide samples were processed inside a clean mobile laboratory dedicated for this purpose. Sample filtration was performed inside a processing chamber— a clear plastic bag on a PVC frame— to further avoid contamination from the atmosphere (Wilde and others, 2004).

Cleaning procedures for equipment used to collect, split, and filter pesticide samples followed USGS protocols (Wilde, 2004). These include a thorough cleaning with a 0.2-percent solution of Liqui-Nox™ detergent, followed by rinsing with tap and deionized water, and a final rinse with laboratory-grade methanol.

Analytical Methods

Pesticide analyses were performed at the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado. Of the pesticide compounds analyzed for in this study, eight (all insecticide fumigants) were volatile organic compounds (VOCs). These, and other VOCs, were identified using purge and trap capillary-column gas chromatography and mass spectrometry (GC/MS) as described in Rose and Schroeder (1995) and Connor and others (1998). Samples were analyzed for the other pesticides, and pesticide degradation products, by one or more of four different analytical methods: schedules 2001 and 2050 and laboratory codes 9060 and 9002 (*table 1*). Methods referred to here as "schedules" are approved analytical procedures, whereas methods referred to here as "lab codes" were still in the developmental or provisional phase at the time that data were collected for this study. Both schedules and lab codes consist of laboratory methods that analyze for a specific group of associated analytes (Timme, 1995). The methods referred to here as "lab code 9060" and "lab code 9002" were subsequently approved as schedules 2060 and 2002, respectively (Furlong and others, 2001; Sandstrom and others, 2001)

Schedule 2001 utilizes a C-18 solid-phase extraction (SPE) in conjunction with GC/MS to determine the concentration of 48 pesticides, and pesticide degradation products, in water samples (Zaugg and others, 1995; Lindley and others, 1996). Schedule 2050 utilizes high-performance liquid chromatography (HPLC) to determine sample concentrations of 39 pesticides, and pesticide degradation products (Werner and others, 1996). Lab code 9002, which utilized essentially the same analytical procedure as schedule 2001, was used to determine the concentrations of 76 pesticide and pesticide degradation products not included in schedule 2001 (Sandstrom and others, 2001). Lab code 9060 utilized SPE in conjunction with HPLC to determine the concentration of 65 pesticides and pesticide degradation products in water samples. In addition, lab code 9060 determined the concentration of the environmental tracer caffeine in water samples (Furlong and others, 2001). Two compounds, methomyl oxime and oxamyl oxime, were subsequently removed from this method owing to poor method recoveries (for a total for this method of 63 compounds).

Many of the pesticide compounds were analyzed by more than one of the methods. A total of 190 different compounds (including caffeine) were analyzed for using the five different analytical methods. When samples were analyzed by more than one method, only the result of the preferred analytical method, as determined by the NWQL (Timme, 1995), was reported.

The analytical methods described above provided low detection limits for many of the pesticide analytes, and the NWQL has specific procedures for reporting low-concentration data in water-quality samples (Childress and others, 1999). Analytes that were detected above the Laboratory Reporting Level (LRL) were reported without qualification. In addition, the NWQL often reports analyte detections at estimated concentrations that are less than the LRL. In these cases, conclusive identification criteria are met, providing a high level of confidence that the compound was present in the sample despite its low concentration (Martin, 2002). The uncertainty associated with the magnitude (but not the presence) of estimated concentrations is greater than the uncertainty associated with the magnitude of unqualified values. Detection frequencies presented in this report include all detections, whether or not they are estimated values. When an analyte was not detected in a sample, its concentration was reported as less than the LRL (<LRL). Graphs are produced in this report that, in some cases, plot all of the pertinent sample values for selected compounds. For these graphs, values for non-detected analytes are plotted as one-fourth of the LRL.

Statistical Methods

Statistical methods were used to interpret some of the data results from this study. Stream pesticide occurrence was correlated with use in the basin using Kendall's Tau (τ), a nonparametric test of correlation (Helsel and Hirsch, 1992). The statistical significance of differences between groups was assessed using the Wilcoxon Rank-Sum test (Helsel and Hirsch, 1992). The variability observed in replicate samples (two samples collected and processed to be as identical in composition as possible) was evaluated using the relative standard deviation (RSD) of concentrations detected. The RSD is calculated as the standard deviation of the two quality-control (QC) sample concentrations, divided by their mean concentration, and expressed as a percentage.

Method of Evaluating Physical-Chemical Properties of Pesticides

Physical and chemical properties of pesticides can help explain their occurrence in water. Properties, such as organic carbon sorption coefficient (Koc), water solubility (Sw), and n-octanol water partition coefficient (Kow), measure the tendency of a compound to exist preferentially in the water or in the sediment-bound phase. There are strong correlations among Koc, Kow, and Sw (Tremolada and others, 2003). Therefore, any of these may be used with approximately equal success in measuring the tendency of a compound to exist preferentially in the water phase. Such a measure, along with a measure of the chemical persistence of a compound, can help predict the likelihood that the compound will occur in a water sample. One commonly used measure of chemical persistence is the aerobic soil half-life, the amount of time required to degrade the parent to one-half its initial concentration.

A pesticide movement rating (PMR) was developed by the Oregon State University Extension (Vogue and others, 1994), derived from a method for assessing pesticide leachability called the Groundwater Ubiquity Score (GUS) (Gustafson, 1989),
where

$$GUS = [4-\log (Koc)] \times [\log (\text{aerobic soil half-life})].$$

The GUS is generally used to predict the potential of a pesticide compound to move into ground water, but PMR categories that result from GUS intervals have also been used in surface-water studies (Carpenter, 2004). Six PMR categories are generally used as defined by the following GUS intervals: GUS less than 0.1, extremely low PMR; GUS = 0.1-1, very low PMR; 1-2, low PMR; 2-3, moderate PMR; 3-4, high PMR; greater than 4, very high PMR. PMR values of “low,” “very low,” or “extremely low” suggest that the compound is less likely to be found in the water phase, and “moderate,” “high,” or “very high” values indicate that it is more likely to be found in the water phase. GUS and the resulting PMR values for each of the target compounds detected were examined to determine whether physical-chemical properties could help explain the level of correlation between detection frequencies and use-intensity data for target pesticides in the Santa Ana Basin.

Quality-Control Samples

Quality-control (QC) samples are collected to provide estimates of the bias and variability that may be introduced during sample collection, processing, and analysis. Three kinds of QC samples—blanks, field matrix spikes, and replicates—were collected by study unit personnel at frequencies determined by NAWQA guidelines (Mueller and others, 1997).

Field blanks are collected and processed just like environmental samples, but using specially prepared analyte-free water instead of stream water samples. Field blanks are used to identify potential sources of sample contamination that could lead to a positive bias in the data. Equipment blanks are exposed to the same potential contamination as are field blanks except that related to the field site, because equipment blanks are performed away from stream sample collection sites.

Field matrix spikes are environmental samples to which known concentrations of the target analytes are injected during sample processing in the field. Spikes provide a measure of positive or negative bias resulting from analyte degradation, matrix interference, or analytical methods. Spikes were performed at a variety of sites because the extent of matrix interferences will vary, depending on the nature of the sample matrix (Zaugg and others, 1995). Matrix field spikes mixtures were obtained from the NWQL. Spiked samples were associated with unspiked environmental samples so that calculation of analytical recoveries could be corrected for background concentrations.

Replicates are two or more samples collected and processed to be as identical in composition as possible to provide a measure of data variability introduced during sample processing and analysis. Variability is the degree of random error in independent measurements of the same quantity (Mueller and others, 1997). The variability observed in replicate samples collected for this study is assumed to be representative of the variability in the environmental samples. Information on variability can be used to estimate result precision, concentration levels that are needed in order to be confident that a water-quality standard has been exceeded, and the statistical significance of result differences (Martin, 2002). Replicates collected for this study were “split” replicates; the composited samples were divided into two sets of containers as they were poured through the cone splitter (Lane and others, 2003). A limitation of this type of replicate is that it does not measure data variability introduced during sample collection.

Fourteen field blank samples were collected for pesticide compounds during the study period. In addition, five equipment blanks were collected.

Results

A variety of pesticide compounds commonly occur in surface water of the Santa Ana Basin. One-hundred and forty-eight samples were collected and analyzed for pesticide compounds during the study period from November 1998 until September 2001. Pesticides were detected in 136 of these samples (92 percent). The results for all compounds detected at least once during this study are presented in *Appendix A*.

Pesticide Compounds Detected in the Santa Ana Basin

Sixty-six pesticides, including pesticide degradation products, were detected at the sites sampled for this study (*Appendix A*). The pesticides detected were grouped into three classes: herbicides and their degradates, insecticides and their degradates, and fungicides. Forty-five of the detected pesticides (67 percent) were herbicides or herbicide degradates. Eighteen (27 percent) were insecticides or insecticide degradates. Three detected compounds (4 percent) were fungicides. No fungicide degradates were detected. One other compound, caffeine (a stimulant) also was detected by one of the analytical methods used to detect pesticides and pesticide degradates; thus a total of 67 different compounds were detected using pesticide analytical methods in this study.

Five of the sixty-seven detected compounds were detected only in samples collected for studies outside of the fixed-site sampling (Gilliom and others, 1995). Two herbicides (triallate and dicamba) and one herbicide degradate [3(4-chlorophenyl methyl urea)—a degradate of diuron] were detected only in raw-water (pre-treatment) samples collected for the drinking-water monitoring program. One herbicide (cyanazine) and one insecticide (alpha HCH) were detected only in a few samples collected for the urban land-use gradient study. Discounting these 5 pesticides and caffeine, which will be discussed separately, 61 different pesticide compounds were detected in samples collected from the fixed sampling sites (*fig. 2*). As is apparent in *figure 2*, many of these compounds (for example, the fungicides) were detected only infrequently at these sites.

Twenty-two pesticide compounds were detected in at least 25 percent of the samples collected from any one fixed site; these are identified as “major” compounds in this report (*table 3*). By virtue of their high detection frequency, results on these 22 major compounds will be emphasized in this report. The criterion of 25 percent is subjective, but it appears to include the most important target pesticides applied in the Santa Ana Basin that occur in surface water. Had the criterion been set at 10-percent occurrence at any fixed site instead of 25 percent, an additional eight compounds would have been included in the list of “major” compounds (2,4-D, MCPA, DNOC, 2,5-dichloroaniline, hydroxyatrazine, 4-chloro-2-methylphenol, 1-naphthol, and metalaxyl) (*fig. 2*). Conversely, had the criterion been increased to 50-percent occurrence at any fixed site, eight compounds would have been excluded from the list (sulfometuron methyl, oryzalin, bromacil, norflurazon, deisopropylatrazine, carbon disulfide, chlorpyrifos, and malathion).

The proportions of pesticide classes for the 22 major compounds were approximately the same as the proportions for all of the detected compounds. Fifteen of these major compounds (68 percent) were herbicides or herbicide degradates, and three of the major herbicides—atrazine, metolachlor, and simazine—have been shown to commonly co-occur in water samples (Barbash and others, 1999). Seven (32 percent) of the major compounds were insecticides. Although caffeine fits the criterion for the status of a major compound (*fig. 2*), it is not considered as such because it is not a pesticide, and its occurrence will be discussed separately.

Major Pesticides

As stated previously, pesticide compounds that were detected in at least 25 percent of the samples collected from any one fixed site were considered to be “major pesticides.” It is important to understand the use of each of these compounds and any standard or guideline associated with them.

Atrazine is a restricted-use herbicide used primarily for selective control of broadleaf and grassy weeds in agricultural settings, and as a nonselective herbicide on industrial and fallow lands (Hamlin and others, 2002). It occurs commonly in streams and ground water throughout the Nation (U.S. Geological Survey, 1999). Atrazine is a potential carcinogen and the USEPA (2004) has established a maximum contaminant level (MCL) of 3 µg/L in drinking water. The Canadian Council of Ministers of the Environment (2003) has also set a guideline (1.8 µg/L) for atrazine concentrations in surface water for the protection of aquatic life, and there is evidence that atrazine interferes with sexual differentiation in frogs (Hayes and others, 2002).

Bromacil is an herbicide registered for use on pineapple, citrus, and non-crop areas (Pfeuffer, 1999). Bromacil has a drinking water health-advisory level (HAL) of 90 µg/L (U.S. Environmental Protection Agency, 2004), and a Canadian guideline for the protection of aquatic life of 5 µg/L (Canadian Council of Ministers of the Environment, 2003).

Carbaryl is a broad-spectrum insecticide registered for general use. It is primarily used to control insects on lawns, forests, and fruit crops (King, 2003). It has a HAL of 700 µg/L (U.S. Environmental Protection Agency, 2004), and a Canadian guideline for the protection of aquatic life of 0.2 µg/L (Canadian Council of Ministers of the Environment, 2003).

Carbon disulfide is used industrially in the manufacture of regenerated cellulose rayon, and agriculturally as a fumigant to control insects (National Safety Council—accessed April 29, 2004 at: http://www.nsc.org/library/chemical/carbondi.htm).

Chlorpyrifos is an insecticide that is used to treat animals such as sheep and turkey for a variety of pests such as cutworms, fleas, fire ants, and lice (King, 2003). It is also used on lawns, ornamental plants, and commercial establishments. Chlorpyrifos has a HAL of 20 µg/L (U.S. Environmental Protection Agency, 2004), and an aquatic life criterion of 0.041 µg/L (U.S. Environmental Protection Agency, 2002a). The guideline from the Canadian Council of Ministers of the Environment (2003) is far more stringent (0.0035 ug/L).

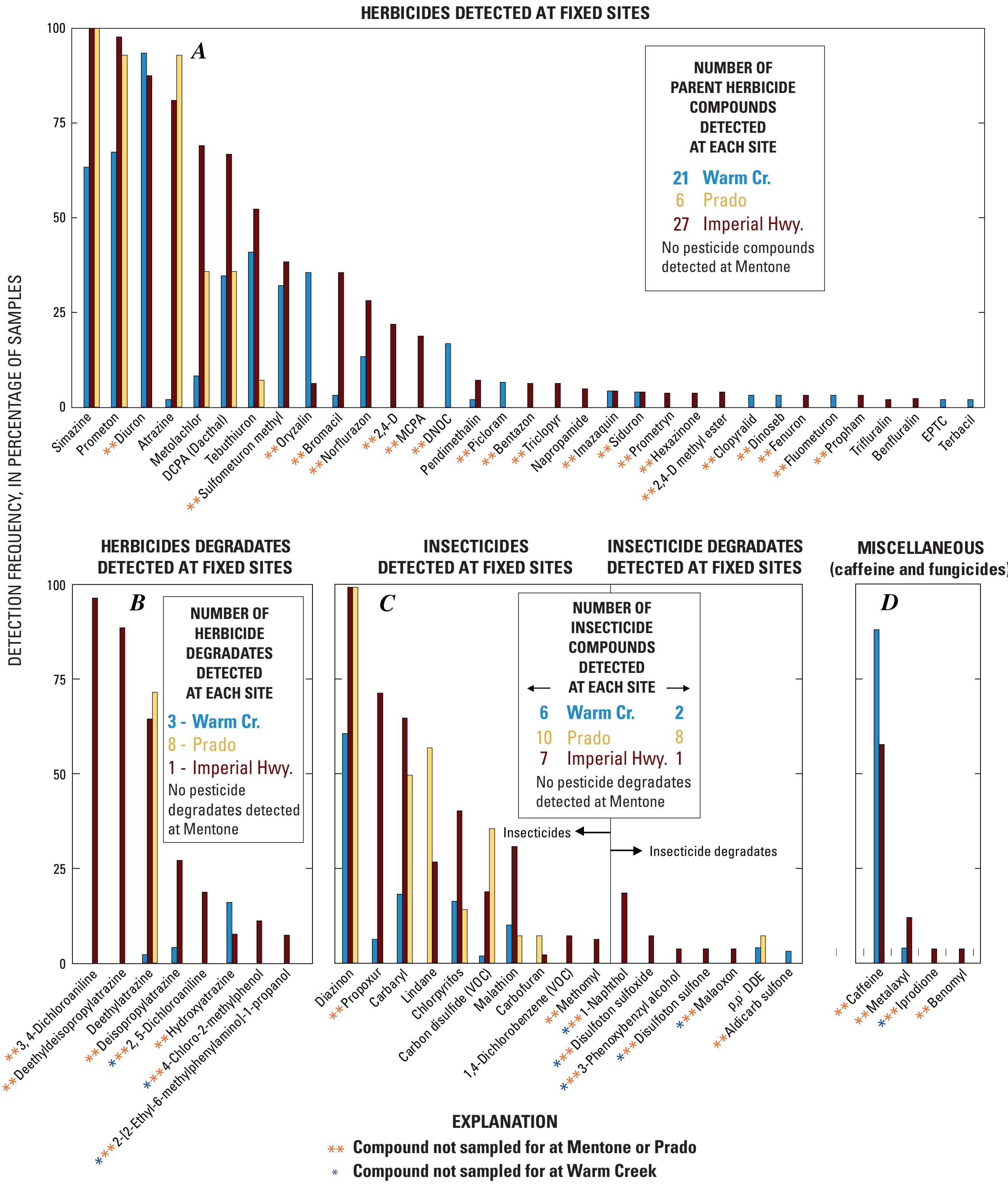


Figure 2. Pesticide compound detection frequencies at fixed sites in the Santa Ana Basin, California: *A*, herbicides; *B*, herbicide degradates; *C*, insecticides and insecticide degradates; and *D*, caffeine and fungicides.

Table 3. Detection frequency of the 22 major (as defined in the text) pesticide compounds detected in surface water of the Santa Ana Basin, California, during the period of this study, 1998–2001.

[Mentone, Santa Ana River near Mentone; Prado, Santa Ana River below Prado Dam; Imperial, Santa Ana River below Imperial Hwy; ULUG, urban land-use gradient synoptic study; Res, Canyon Reservoir-Elsinore Valley Municipal Water District Treatment Plant; —, samples not analyzed for this constituent]

		Detection frequency (percent)							
		Fixed sites in downstream order							
Compound	Chemical class	Mentone	Warm Creek	Prado	Imperial	ULUG	Res inflow	Res outflow	Total (all samples)
Herbicides									
Diuron	Urea	—	94	—	88	—	88	0	81
Simazine	Triazine	0	63	100	100	53	100	100	77
Prometon	Triazine	0	67	93	98	47	100	100	76
Atrazine	Triazine	0	2	93	81	41	50	50	43
DCPA	Chlorobenzoic acid	0	35	36	67	29	50	25	42
Sulfometuron methyl	Urea	—	32	—	38	—	100	0	39
Tebuthiuron	Urea	0	41	7	52	24	75	38	38
Metolachlor	Acetanilide	0	8	36	69	29	38	13	32
Norflurazon	Amine	—	13	—	28	—	13	0	18
Bromacil	Uracil	—	3	—	35	—	13	0	17
Oryzalin	Dinitroaniline	—	35	—	6	—	0	0	16
Herbicide degradates									
3,4-Dichloroaniline	Urea	—	—	—	96	—	100	0	79
Deethyldeisopropyl atrazine	Triazine	—	0	—	88	—	63	25	45
Deethylatrazine	Triazine	0	2	71	64	47	0	0	32
Deisopropylatrazine	Triazine	—	4	—	27	—	25	0	15
Insecticides									
Diazinon	Organophosphate	0	61	100	100	71	88	0	72
Carbaryl	Carbamate	0	18	50	65	18	0	0	33
Propoxur	Carbamate	—	6	—	72	—	0	0	32
Chlorpyrifos	Organophosphate	0	16	14	40	6	0	0	19
Lindane	Organochlorine	0	0	57	27	35	0	0	17
Malathion	Organophosphate	0	10	7	31	0	0	0	13
Carbon disulfide	Volatile organic compound	0	2	36	21	13	—	—	11

DCPA (dimethyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate) is a general-use herbicide. It is primarily used as a pre-emergent on annual grasses, and 20 percent of its use is in homes and gardens (King, 2003). The USEPA (2004) has established a HAL of 70 µg/L for DCPA.

Four major pesticide degradates: 3,4-Dichloroaniline is a degradate of diuron. Deethylatrazine, deethyldeisopropylatrazine, and deisopropylatrazine are all degradates of atrazine. Deethylatrazine is the dominant initial atrazine metabolite (Pfeuffer, 1999). Deisopropylatrazine can also be a degradate of cyanazine and simazine.

Diazinon is a restricted-use insecticide that was banned for use on golf courses and sod farms in 1988 owing to its toxic effects on birds (EXTOXNET, 1996). From 1994 to 1998, diazinon was responsible for most of the bird deaths in the United States attributed to pesticides (U.S. Environmental Protection Agency, 2001). Today it is used on citrus, bananas, vegetables, potatoes, sugarcane, rice, and ornamentals (Pfeuffer, 1999). In the United States, diazinon is the most frequently used home and garden insecticide, and, as a result, it is commonly found in urban streams (Cox, 2000). Diazinon has a HAL of 0.6 µg/L (U.S. Environmental Protection Agency, 2004), and a recommended maximum concentration for the protection of aquatic life of 0.08 µg/L (International Joint Commission Canada and United States, 1977). Owing to the high toxicity of diazinon and its degradates (U.S. Environmental Protection Agency, 2001), this pesticide was banned for all residential use in December 31, 2004 (*http://www.epa.gov/pesticides/factsheets/chemicals/diazinon-factsheet.htm*, accessed March 17, 2005).

Diuron is a general-use herbicide, used to control weeds on crops such as fruits, alfalfa, and wheat (King, 2003). It has a HAL of 10 µg/L (U.S. Environmental Protection Agency, 2004).

Lindane is an insecticide registered for general use. It was first introduced in the 1940s for use on fruit and vegetable crops, farm animal premises, and livestock dips, and for the treatment of lice and scabies on humans. Today its use is restricted to seed treatment on barley, corn, oats, rye, sorghum, and wheat, and for lice, scabies, flea, and tick control (U.S. Environmental Protection Agency, 2002b). This reduction in use comes as a result of serious health and environmental concerns, as lindane use can potentially have acute neurotoxic effects. Because of these concerns, the U.S. Food and Drug Administration issued a public health advisory updating labeling guidelines for products containing this compound in 2003 (FDA Talk Paper accessed March 29, 2005 at http://dermatology.about.com/gi/dynamic/offsite.htm?zi=1/XJ&sdn=dermatology&zu=http%3A%2F%2Fwww.fda.gov%2Fbbs%2Ftopics%2FANSWERS%2F2003%2FANS01205.html). In the past (including the study period for this report) this use contributed to lindane entering surface water through the discharge of treated wastewater (U.S. Environmental Protection Agency, 1998). A single lindane human treatment dose can pollute as much as 6 million gallons of water (INFORM, 2003). Lindane has an MCL of 0.2 µg/L (U.S. Environmental Protection Agency, 2004) and a guideline for the protection of aquatic life of 0.01 µg/L (Canadian Council of Ministers of the Environment, 2003).

Malathion is a broad spectrum insecticide that was first introduced in 1950 (King, 2003). It is registered for general use to control mosquitoes, flies, and animal parasites, and insects on fruit and vegetable crops. Malathion has a HAL of 100 µg/L (U.S. Environmental Protection Agency, 2004) and an aquatic life criterion for chronic concentrations in surface water of 0.1 µg/L (U.S. Environmental Protection Agency, 2002a).

Metolachlor is a general-use herbicide (King, 2003). It is used on potato, sugarcane, and vegetable crops (Pfeuffer, 1999), as well as on public rights-of-way (King, 2003). The Canadian Council of Ministers of the Environment (2003), has a guideline for the protection of aquatic life of 7.8 µg/L for metolachlor. Metolachlor has been linked to a reduction in human semen quality in the Midwest (Swan and others, 2003) and has a HAL of 100 µg/L (U.S. Environmental Protection Agency, 2004). Metolachlor often co-occurs with atrazine and simazine in water (Barbash and others, 1999).

Norflurazon is an herbicide used to control annual grasses and weeds in cotton, soybeans, and other crops (Ware, 2000). Norflurazon is the third most popular herbicide used on California roadsides (Californians for Alternatives to Toxics—accessed April 30, 2004 at *http://www.alternatives2toxics.org/pathways.htm*).

Oryzalin is an herbicide that is used heavily in agriculture to control annual grasses and weeds in fruit and nut trees, vineyards, and ornamentals (Ware, 2000).

Prometon is an herbicide registered for general use. Its use is primarily urban-related and, therefore, much goes unreported because pesticide-use reporting does not include use in homes and gardens unless applications are performed by a licensed pest-control applicator (Pesticide Action Network website, accessed on January 23, 2004, at URL: http://www.pesticideinfo.org/Index.html). It is used for weed control on rights-of-way, industrial lands, and non-cropland areas (King, 2003). The U.S. Environmental Protection Agency (2004) has established a HAL of 100 µg/L for prometon.

Propoxur is an insecticide sold and regulated under the trade name Baygon. It is used to control cockroaches, flies, mosquitoes, and insects on lawns, and is a common active ingredient in flea collars (US Environmental Protection Agency—accessed April 30, 2004 at: *http://www.epa.gov/ttn/atw/hlthef/propoxur.html*). Propoxur, or Baygon, has a HAL of 3 µg/L.

Simazine is an herbicide registered for general use. It is used to control weeds and annual grasses in fruit, vegetable, and ornamental crops. The U.S. Environmental Protection Agency (2004) has established an MCL of 4 µg/L, and the Canadian Council of Ministers of the Environment (2003) has established a guideline for the protection of aquatic life of 10 µg/L for simazine.

Sulfometuron methyl is an herbicide registered for general use. It is used to control grasses and weeds on non-crop lands, as well as woody species in forests.

Tebuthiuron is an herbicide registered for general use. It is used to control weeds on rights-of-way, industrial sites, and rangelands, as well as to control woody and herbaceous plants in sugarcane and grasslands (EXTOXNET, 1996). Tebuthiuron is potent and non-selective, killing both desirable and undesirable plants (Robberson, 1998). The U.S. Environmental Protection Agency (2004) has established a HAL of 500 µg/L, and the Canadian Council of Ministers of the Environment (2003) has established an aquatic life guideline of 1.6 µg/L for tebuthiuron.

Factors Contributing to the Occurrence of Selected Pesticides

Pesticide occurrence in surface waters is determined by use and tendency to be transported from application areas. This tendency of a compound to be transported is a function of various physical and chemical properties, such as water solubility, vapor pressure, soil adsorption coefficient, and persistence. In addition, the proximity of a stream to pesticide application areas, and the timing of applications within the basin, will determine the likelihood that a particular compound will occur in surface water. In-stream processes can also affect pesticide occurrence in streams. For example, some compounds may be released from the sediments to the water column through bacterial degradation and photo-oxidation. The physical setting of a drainage basin, its geomorphology, and soil types may also determine the fate of pesticides in the basin. Finally, point sources of water, such as treated wastewater outfalls in the Santa Ana Basin, may contain pesticides and carry them to streams.

Pesticide Use

The California Department of Pesticide Regulation (CDPR) provides data summaries on commercial use (or applications) for each county in California (California Department of Pesticide Regulation, accessed on December 18, 2003, at URL: http://www.cdpr.ca.gov/). More in-depth information may be purchased from the CDPR. However, the description and use of such detailed information is beyond the scope of this report.

The CDPR summaries listed use for 75 of the 189 pesticide compounds targeted for analysis in this study during the study period. These compounds included 17 of the 22 major pesticide compounds (there were no data on the 4 major pesticide degradates nor on the major volatile insecticide, carbon disulfide) (*table 4*). In general, only use data from the year 2001 were used in this report because some noncommercial use data were also available for that year (Wilen, 2001). Those data were on noncommercial pesticide use in the San Diego Creek watershed in Orange County (*fig. 1*). They were used to extrapolate noncommercial use for the rest of the Santa Ana Basin using the relative populations of each county (San Bernardino, Riverside, and Orange) in 2001 in comparison with the estimated 2001 population of the San Diego Creek Watershed. These extrapolated noncommercial use data were summed with the commercial use data in 2001 for each of the three counties to estimate total use of each target compound for which use data were available.

The 75 pesticides for which use data were available included 6 fungicides, 38 herbicides, and 31 insecticides (*table 4*). However, in 2001, zero usage was reported for six of the herbicides (fluometuron, MCPA, molinate, nicosulfuron, propanil, and thiobencarb) and two of the insecticides (fenthion and fonofos). The amounts used in 2001 for each of these pesticide classes indicate that median and total applications (in lbs) for target insecticides were more than twice the amounts for target herbicides. The median application for target fungicides was higher than the medians for herbicides and insecticides. However, only six target fungicides had available use data in the CDPR database. Therefore, the fungicide contribution to total target pesticide use reported here may not reflect all fungicide use in the basin (*table 4*).

It should be noted that the active ingredients of many of the most highly used pesticides in California were not target analytes for this study—including inorganic pesticides such as copper and sulfur, and the herbicide glyphosate (the active ingredient in Roundup™ and Rodeo™). Glyphosate use in 2001 was reported as 6,130 lbs in the Santa Ana Basin. Total pesticide use represented in *table 4* includes only compounds that were target analytes for this study. Therefore, the use shown there (about 918,000 pounds) represents only about 17 percent of the 5.4 million pounds of pesticide use in the Santa Ana Basin reported by the California Department of Pesticide Regulation for the year 2001 (California Department of Pesticide Regulation, accessed on December 18, 2003, at URL: http://www.cdpr.ca.gov/).

Table 4. Estimated commercial and noncommercial use of pesticides targeted for this study during 2001, Santa Ana Basin, California.

[California Department of Pesticide Regulation, accessed on December 18, 2003, at URL: http://www.cdpr.ca.gov/; Wilen, 2001]

	Use in pounds		Use in pounds
Target fungicides		Target herbicides	
Target fungicide total	**47,439**	**Target herbicide total**	**267,905**
Benomyl	3,421	2,4-D	557
Chlorothalonil	34,111	Alachlor	103
Iprodione	5,972	Atrazine	237
Metalaxyl	356	Benfluralin	364
Myclobutanil	2,859	Bromacil	10,040
Propiconazole	720	Butylate	97
Target insecticides		Cyanazine	120
Target insecticide total	**602,581**	Cycloate	1,638
1,3 Dichloropropene	33,815	DCPA	12,488
Aldicarb	1,460	Dicamba	51
Azinphos methyl	6	Dichlobenil	13
Bendiocarb	9	Diuron	103,013
Bifenthrin	8,792	EPTC	4,882
Carbaryl	52,009	Ethalfluralin	283
Carbofuran	6,000	Fluometuron	0
Chlorpyrifos	87,181	Hexazinone	299
Cyfluthrin	6,185	Imazethapyr	503
Cypermethrin	27,027	Linuron	2,014
Diazinon	197,013	MCPA	0
Dimethoate	15,177	Metolachlor	2,200
Disulfoton	10,679	Metribuzin	772
Fenamiphos	243	Molinate	0
Fenthion	0	Napropamide	351
Fonofos	0	Nicosulfuron	0
Imidacloprid	9,158	Norflurazon	18,636
Lambda Cyhalothrin	1,808	Oryzalin	12,342
Lindane	18	Oxyfluorfen	2,482
Malathion	118,570	Pebulate	18
Methiocarb	651	Pendimethalin	20,999
Methomyl	12,749	Prometon	468
Methyl parathion	3	Prometryn	1,331
Parathion	47	Propanil	0
Phorate	7,030	Siduron	3,250
Phosmet	279	Simazine	14,820
Profenofos	228	Sulfometuron methyl	2,124
Propargite	4,639	Tebuthiuron	2,886
Propetamphos	926	Thiobencarb	0
Propoxur	877	Trifluralin	48,524
Sulfotep	2		

Regressions were performed on the detection frequency of pesticide compounds at the Warm Creek and Imperial Highway sites as a function of their use in the contributing drainages to these sites. Samples collected from the Imperial Highway site were analyzed for all 75 of the target compounds having use data for at least part of the study period. Samples collected from Warm Creek were analyzed for 59 of the 75 compounds having use data. The estimated use of these pesticides in San Bernardino County for the year 2001 was regressed against their detection frequency in samples collected from Warm Creek during the HIP (*fig. 3A*). Of the three counties in the Santa Ana Basin, only drainages in San Bernardino County can contribute runoff to Warm Creek. The linear correlation, using Kendall's Tau (τ) [Helsel and Hirsch, 1992], was somewhat weak ($\tau = 0.33$), but statistically significant ($p < 0.0002$). The estimated total use of 75 target pesticides in all three counties of the Santa Ana Basin in 2001 was regressed against their detection frequency in samples collected from the Imperial Highway site during the HIP (*fig. 3B*). Similar to the Warm Creek analysis, there was a weak ($\tau = 0.27$), but highly statistically significant ($p = 0.0002$) correlation between use of all 75 target pesticides and their detection frequency in samples collected from the Imperial Highway site.

The accuracy of the use estimates depends on at least two assumptions: (1) target compounds not listed by the CDPR (2003) or in the residential survey published by Wilen (2001) had insignificant use in the basin during the study period, and (2) noncommercial pesticide use in the basin corresponds to population, and noncommercial use patterns in the San Diego Creek Watershed in Orange County are representative of use throughout the Santa Ana Basin. Additionally, in order to correlate 2001 use data to occurrence in basin streams during the study period, it must be assumed that the estimates in 2001 are representative of use over the 3-year study period and that the pesticides were transported to the streams the same year that they were applied. On the basis of commercial-use data from 1999 and 2000, this last assumption appears to have been met for most compounds. The assumption appears not to have been met for 10 of the compounds (trifluralin, propargite, benomyl, bifenthrin, lambdacyhalothrin, oxyfluorfen, cyfluthrin, cypermethrin, myclobutanil, and chlorpyrifos). These compounds had no listed commercial use during 1999–2000, but did have use in 2001. It is important to note that only one of these (chlorpyrifos) was a major compound (detected more than 25 percent of the time in samples collected from any of the fixed sites).

Pesticide Chemical Properties

The detection frequency for most of the major pesticides at the Warm Creek and Imperial Highway sites correlated reasonably well with use data for the respective drainages of these sites, with use explaining roughly 30 percent of the variance in detection rates. Much of the variation, however, may be explained by certain physical or chemical properties of the individual compounds, including their soil adsorption coefficients (Koc) and their aerobic soil half-lives. A pesticide movement rating (PMR), an index, derived from a compound's Groundwater Ubiquity Score (GUS) [Vogue and others, 1994] can indicate the likelihood that a pesticide will be found in water. A low PMR means that a compound is less likely to be found in water, and a high PMR means that it is more likely to be found in water.

Six pesticides had notably low detection frequencies, relative to their use, in samples collected from both the Warm Creek and Imperial Highway sites (*figs. 3A, B*). Two of these pesticides—malathion and norflurazon—were major compounds. The four other compounds—disulfoton, pendimethalin, chlorothalonil, and trifluralin—were never, or almost never, detected in stream samples collected from either of these two sites despite substantial use in their respective drainages. The PMRs for each of these four compounds is low or very low (*fig. 4*). The decision as to what constitutes substantial use in a drainage basin can be subjective, and should take into account the area of the basin. For the 1,500-mi^2 Imperial Highway drainage, substantial use is defined as more than 10,000 pounds used annually (2001) in all three counties of the Santa Ana Basin. For the 12-mi^2 Warm Creek drainage, substantial use is defined as more than 100 pounds used annually (2001) in San Bernardino County—the only county contributing runoff to this site. In each case the value for our criterion for substantial use (in pounds) is set one order of magnitude higher than the drainage area (in square miles).

In contrast to the six compounds with notably low or zero detection frequencies at both sites relative to use intensity, the detection frequencies of nine major compounds generally increased with use at both sites(lindane, propoxur, metolachlor, sulfometuron methyl, DCPA, tebuthiuron, simazine, diazinon, and diuron) (*fig. 4*).

Groundwater Ubiquity Scores for these nine major compounds were compared with scores for the six compounds with notably low relative detection frequencies (*fig. 4*). The difference between the two groups was highly statistically significant ($p < 0.009$) using the Wilcoxon Rank-Sum test (Helsel and Hirsch, 1992).

Correlation results for 10 compounds with substantial use in both basins were ambiguous, correlating well with use-intensity at one of the sites, and having relatively low detection frequencies at the other site (*fig. 4*). Four of these were major pesticide compounds: bromacil, carbaryl, chlorpyrifos, and oryzalin. An additional compound, the insecticide dimethoate, had substantial (>15,000 lbs) use in the Santa Ana Basin in 2001, and a moderate PMR (GUS=2.28). Dimethoate was not detected in samples collected from the Santa Ana River below Imperial Highway and, based on spike results, this may be due to poor analytical performance for this compound (table 7c, fig. 13A, later in this report). Samples collected from Warm Creek were not analyzed for this compound).

This figure contains interactive elements to help you better view and understand the data. You must have Adobe Acrobat Reader 6.0 or higher to use these features. You may download the reader for free by clicking here: http://www.adobe.com/products/acrobat/readstep2_allversions.html

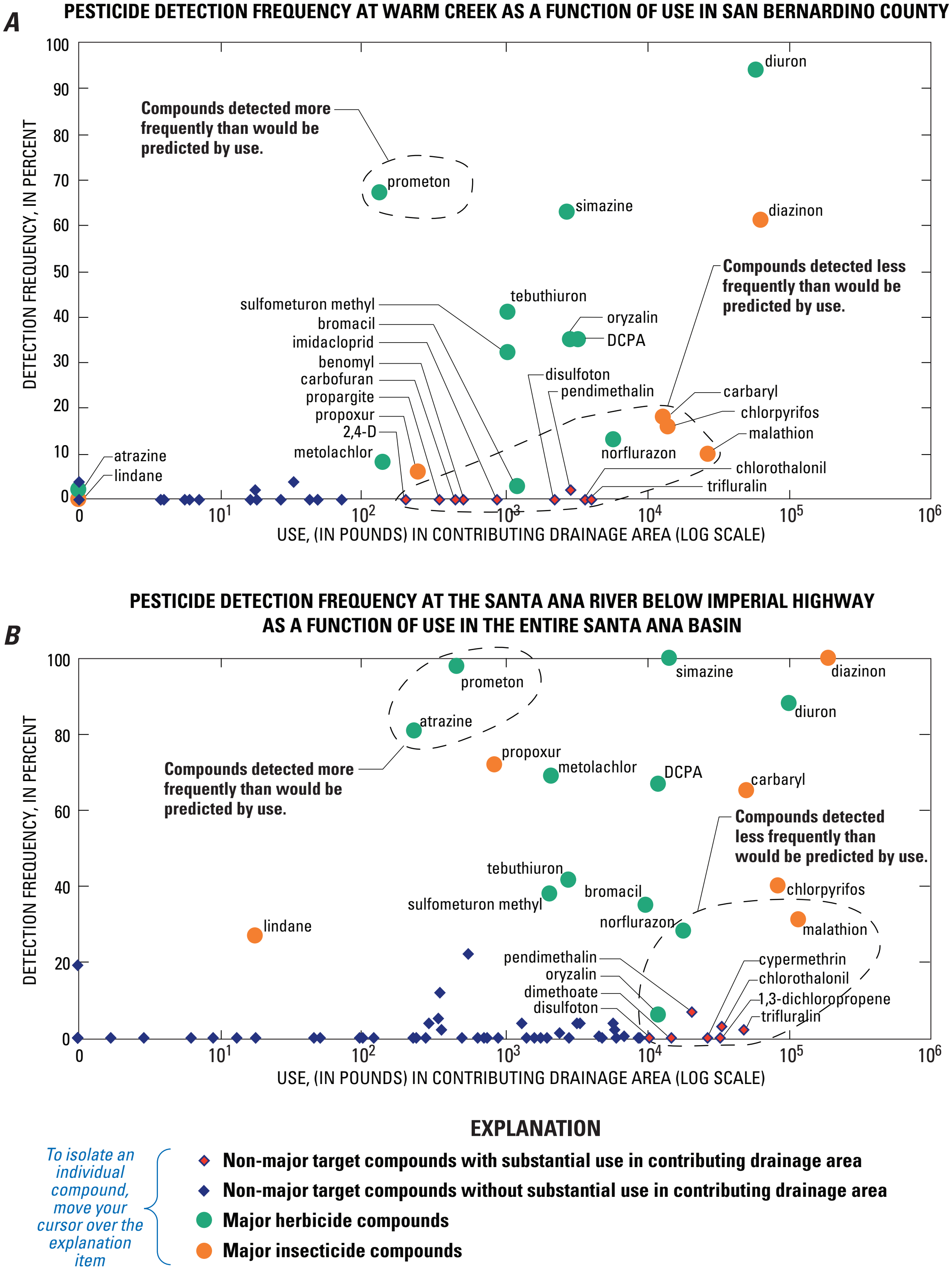


Figure 3. Detection frequency of selected compounds as a function of use: *A*, Warm Creek occurrence as a function of 2001 use in San Bernardino County; and *B*, Imperial Highway occurrence as a function of use basin-wide in 2001.

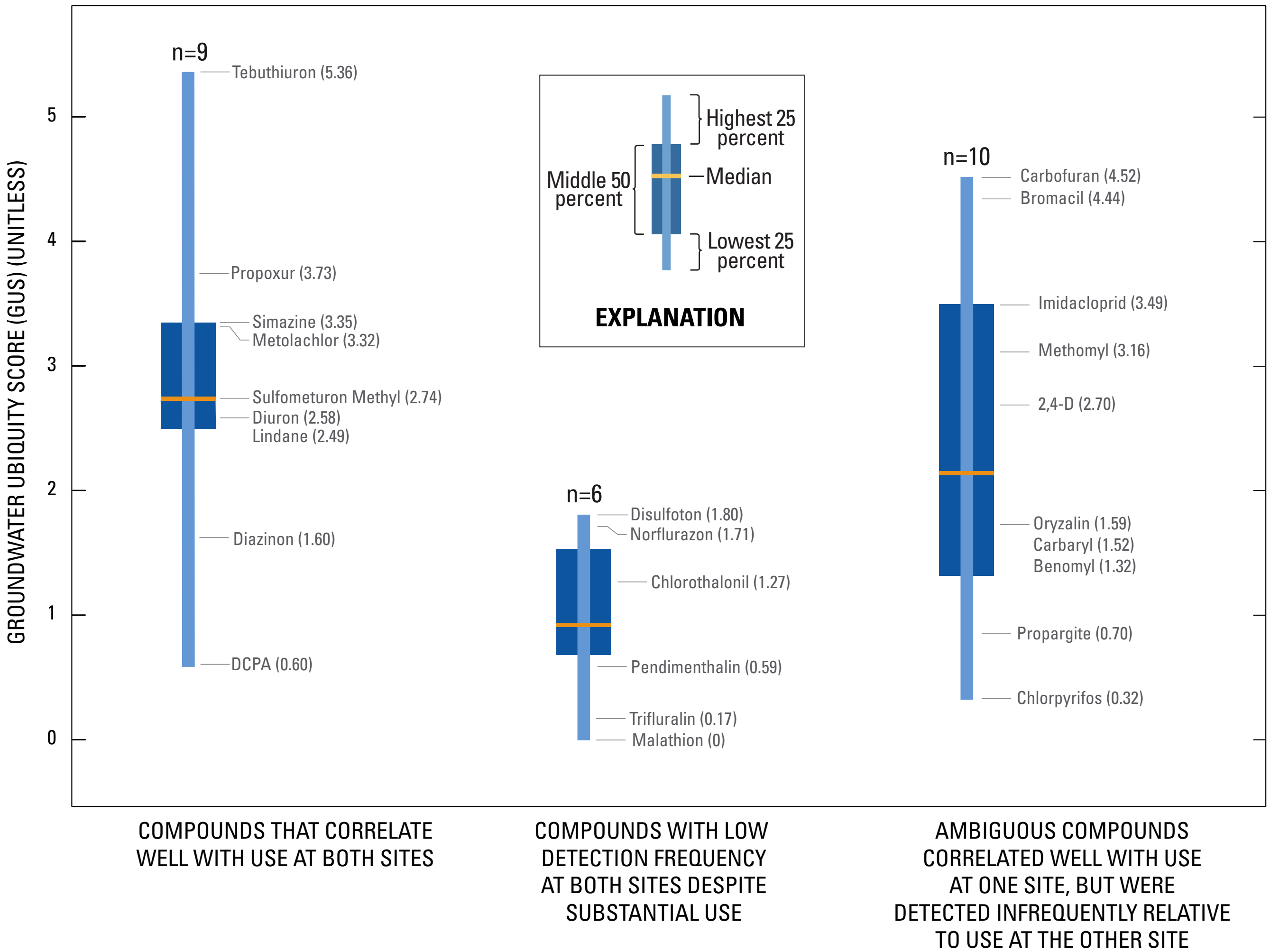


Figure 4. Groundwater Ubiquity Scores of compounds in three groups: compounds for which occurrence correlated reasonably well with use at both Warm Creek and the Santa Ana River below Imperial Highway; compounds for which occurrence was infrequent relative to use; ambiguous compounds for which occurrence correlated well with use in the corresponding drainage area at one site, but were detected infrequently relative to use in the corresponding drainage area at the other site.

Two major compounds, prometon and atrazine (both triazine herbicides) were detected in Imperial Highway samples far more frequently than would be predicted by their basin-wide use (*fig. 3B*). Prometon also occurred in samples collected from Warm Creek more frequently than would be predicted by its use in San Bernardino County (*fig. 3A*). Prometon use is primarily urban related and, therefore, much goes unreported (Izbicki and others, 2000). The PMR for prometon is “very high,” and the PMR for atrazine is “high.” However, the relatively frequent occurrence of atrazine in samples collected from the Imperial Highway site probably is due to a source of atrazine entering surface water upstream from this integrator site.

Historical Atrazine Use

Although atrazine use in the Santa Ana Basin became restricted before the present study period (U.S. Environmental Protection Agency, 2003), there was much higher reported use of this herbicide in the basin during the 1970s and 1980s (Beverly Martin, California Department of Pesticide Regulation, written commun., 2004) (*fig. 5*). It appears likely that, in certain places, ground water delivers atrazine, deethylatrazine, and other chemicals to the Santa Ana River. In a USGS survey of ground water in the Inland Santa Ana Basin, atrazine was detected in 66 percent of the wells sampled, at concentrations up to 0.05 µg/L (Hamlin and others, 2002). In that study-unit survey, only deethylatrazine (the dominant initial metabolite of atrazine) had a higher detection frequency among pesticide compounds. Certain reaches of the Santa Ana River in the Inland Basin receive substantial ground-water discharges (Mendez and Belitz, 2002). The high ground-water concentrations of atrazine are probably the result of legacy agricultural application in the Inland Basin.

Stream Site Location and Water Source

In addition to current and historical use patterns of pesticides, and their physical-chemical properties, stream location also helped to explain the occurrence of certain pesticides. For example, lindane enters surface water with wastewater discharge, and was only detected in samples collected from sites located downstream from wastewater inputs. The fixed sites that were sampled for pesticide compounds include a mountain reference site—Mentone, an urban indicator with ground-water inputs, Warm Creek, and two basin integrator sites—the Santa Ana River below Prado Dam and below Imperial Highway. As would be expected, more pesticide compounds were detected at the integrator sites (55) than at the indicator site, Warm Creek (34) (*fig. 2*). In addition, most compounds detected at all three sites were detected more frequently at the integrator sites than at Warm Creek. With eight exceptions—aldicarb sulfone, clopyralid, dinoseb, DNOC, EPTC, fluometuron, picloram, and terbacil—the pesticide compounds detected at Warm Creek were a subset of the compounds detected in the Santa Ana River at Imperial Highway (*fig. 2*). Seven of these eight compounds were detected in only one sample collected from Warm Creek; the eighth—picloram—was detected in two samples collected from Warm Creek.

No pesticide compounds were detected in samples collected from the mountain reference site. Similarly, three additional mountain sites sampled for pesticides during the urban land-use gradient (ULUG) synoptic study (August 2000) showed no pesticide detections— with the exception of atrazine and deethylatrazine at the Cajon Creek site. It is interesting to note that these also were the only pesticide compounds detected at forested reference sites in another basin (Clackamas) in the western United States (Carpenter, 2004). Land use at these sites is similar to that of the reference sites of the present study.

Treated wastewater is the most important source of water to the Santa Ana River and several of its tributaries. However, only one major pesticide compound—lindane—appears to be clearly associated with treated wastewater. A common use of lindane is to control external parasites on humans and pets. The USEPA (1998) reported that such use contributed to lindane entering surface water through the discharge of treated wastewater. Lindane was detected at all sites sampled for the present study where treated wastewater is the predominant source of water. In addition, treated wastewater is nearly the sole source of water to the three sites that had the highest lindane concentrations, which ranged from 0.024 to 0.072 µg/L. These three sites—Cucamonga Creek near Chino Avenue, Cucamonga Creek near Mira Loma, and San Timoteo Creek—were sampled during the ULUG study. Finally, lindane did not occur in samples that were associated with storms. This observation provides additional evidence that lindane entered Santa Ana Basin streams with wastewater effluent because it would be expected that the increased discharge associated with stormflow would dilute a point source such as treated wastewater (Mueller and others, 1995).

Lindane occurrence in Santa Ana Basin streams is currently decreasing, possibly the result of a public health advisory concerning lindane formulations issued in April 2003 by the Federal Food and Drug Administration (FDA public health advisory accessed March 29, 2005 at http://www.fda.gov/cder/drug/infopage/lindane/lindanePHA.htm). While half of the samples collected from the Santa Ana River below Prado Dam during 2000 and 2001 had detectable concentrations of lindane, 22 samples collected from January 2002 through August 2004 showed no detectable lindane (U.S. Geological Survey, 2001).

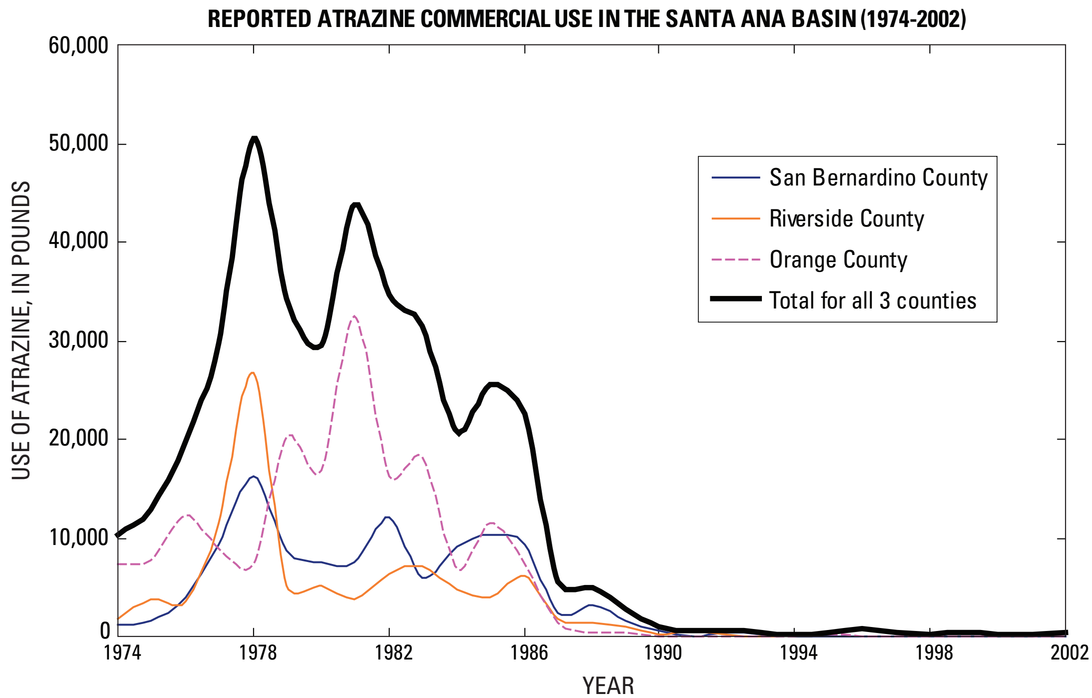


Figure 5. Historical reported use of atrazine in the Santa Ana Basin, California, 1974–2002. (Beverly Martin, California Department of Pesticide Regulation, unpub. data, 2004)

Several of the other pesticide compounds targeted for analysis in this study, including bromacil, carbaryl, chlorpyrifos, diazinon, metalaxyl, metolachlor, and prometon, have been associated with domestic wastewater (Zaugg and others, 2002, after Paxéus and others, 1992). All of these, with the exception of metalaxyl, were major compounds in this study. Bromacil may enter the basin in wastewater, as suggested by its higher detection frequency in the Santa Ana River below Imperial Highway integrator site compared to the urban indicator site, Warm Creek (*fig. 2*). However, the other five major compounds that Zaugg and others (2002) consider as potential wastewater indicators appear to be associated with urban runoff in the Santa Ana Basin, and their occurrence tends to increase with stormflow.

Stormflow

The occurrence of many pesticide compounds in surface water is affected by storms. Some of these compounds, such as chlorpyrifos and diazinon, have previously been detected in California rainwater (Zamora and others, 2003). Izbicki and others (2000) found that concentrations of 8 of the 10 most commonly detected compounds in the Santa Ana River increased during stormflow. That study examined storm effects on pesticide concentrations during and shortly after storms (1 to 48 hours). In the present study it was observed that storm effects on stream pesticide concentrations may persist for several days or weeks after the storm event. These effects often are observed even after the stream discharge has returned to base-flow conditions.

Because it rains more during the winter than during the other seasons in the Santa Ana Basin, storm effects occur more frequently during the winter. However, extended dry periods are common throughout the year, and rainfall occurred during this study in each of the four seasons. It is therefore more appropriate to characterize samples on the basis of how long it has been since the last event that resulted in increases in streamflow rather than by the season. The influence of storms was evaluated by grouping samples into four categories: samples collected during or less than 24 hours after a storm (or peak flow); samples collected more than 24 hours, but less than 7 days after a storm; 8 to 14 days after a storm; and more than 14 days after a storm. The period within 1 day of storms can be defined as wet conditions, and the period more than 14 days after can be defined as dry conditions. The other two categories are intermediate to these extremes. The frequency of detection for each of the major compounds is grouped by the four categories and shown in *figure 6* for the Warm Creek and Imperial Highway sites.

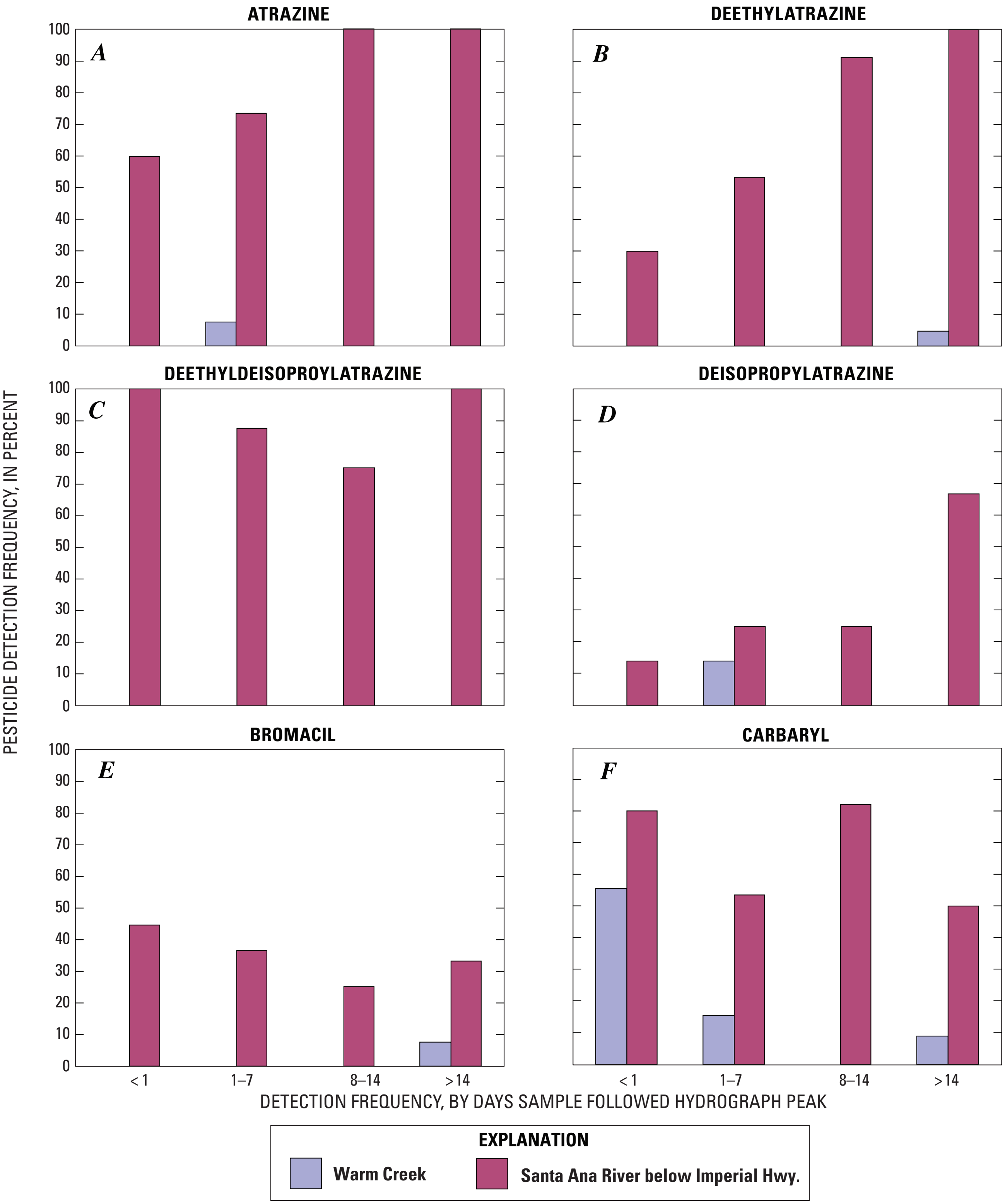
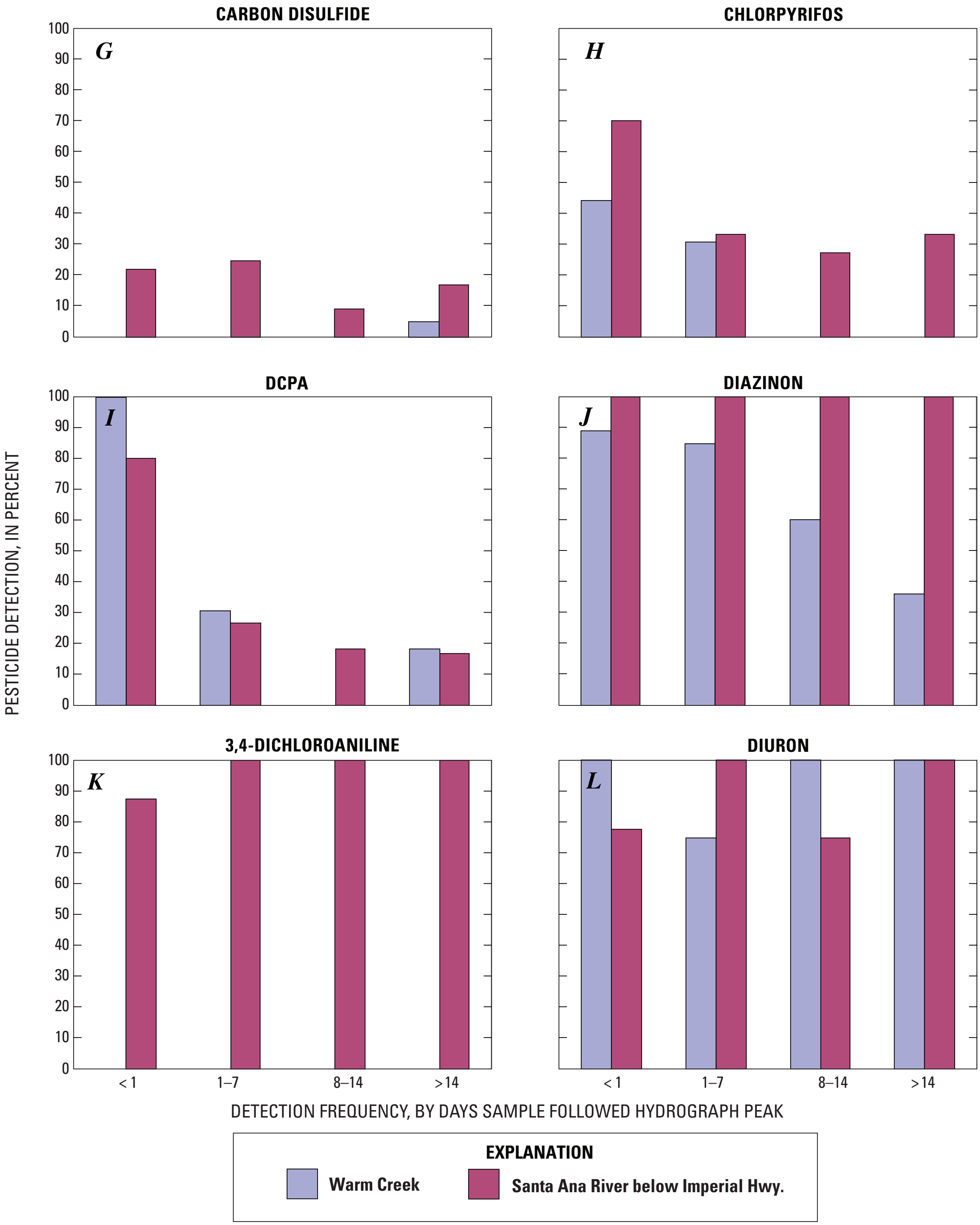


Figure 6. Detection frequency of major pesticide compounds as a function of days that sample was collected after a hydrograph peak for samples collected from Warm Creek and the Santa Ana River below Imperial Highway: *A*, atrazine; *B*, deethylatrazine; *C*, deethyldeisopropylatrazine; *D*, deisopropylatrazine; *E*, bromacil; *F*, carbaryl; *G*, carbon disulfide; *H*, chlorpyrifos; *I*, DCPA; *J*, diazinon; *K*, 3,4-dichloroaniline; *L*, diuron; *M*, lindane; *N*, malathion; *O*, metolachlor; *P*, norflurazon; *Q*, oryzalin; *R*, prometon; *S*, propoxur; *T*, simazine; *U*, sulfometuron methyl; and *V*, tebuthiuron.



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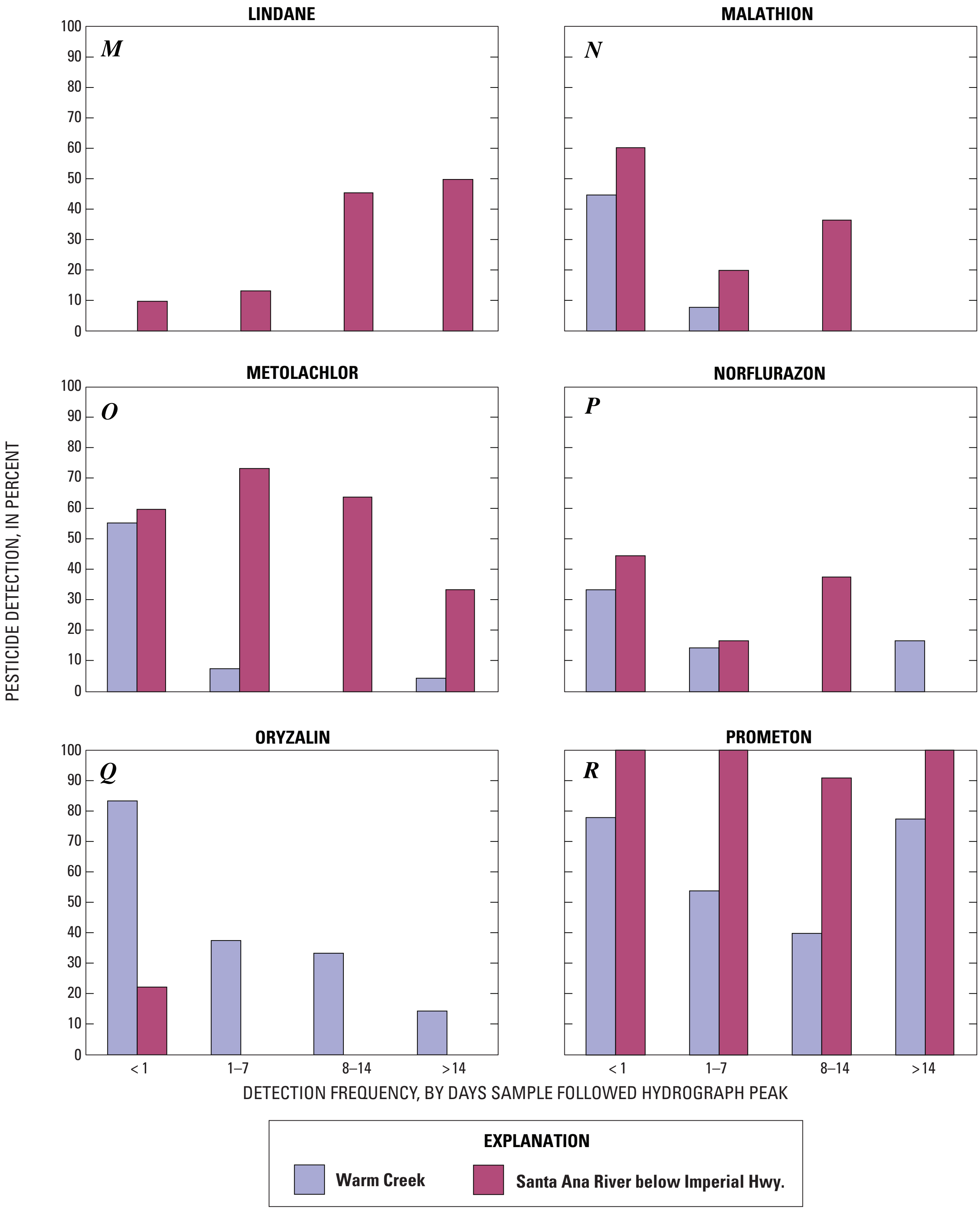

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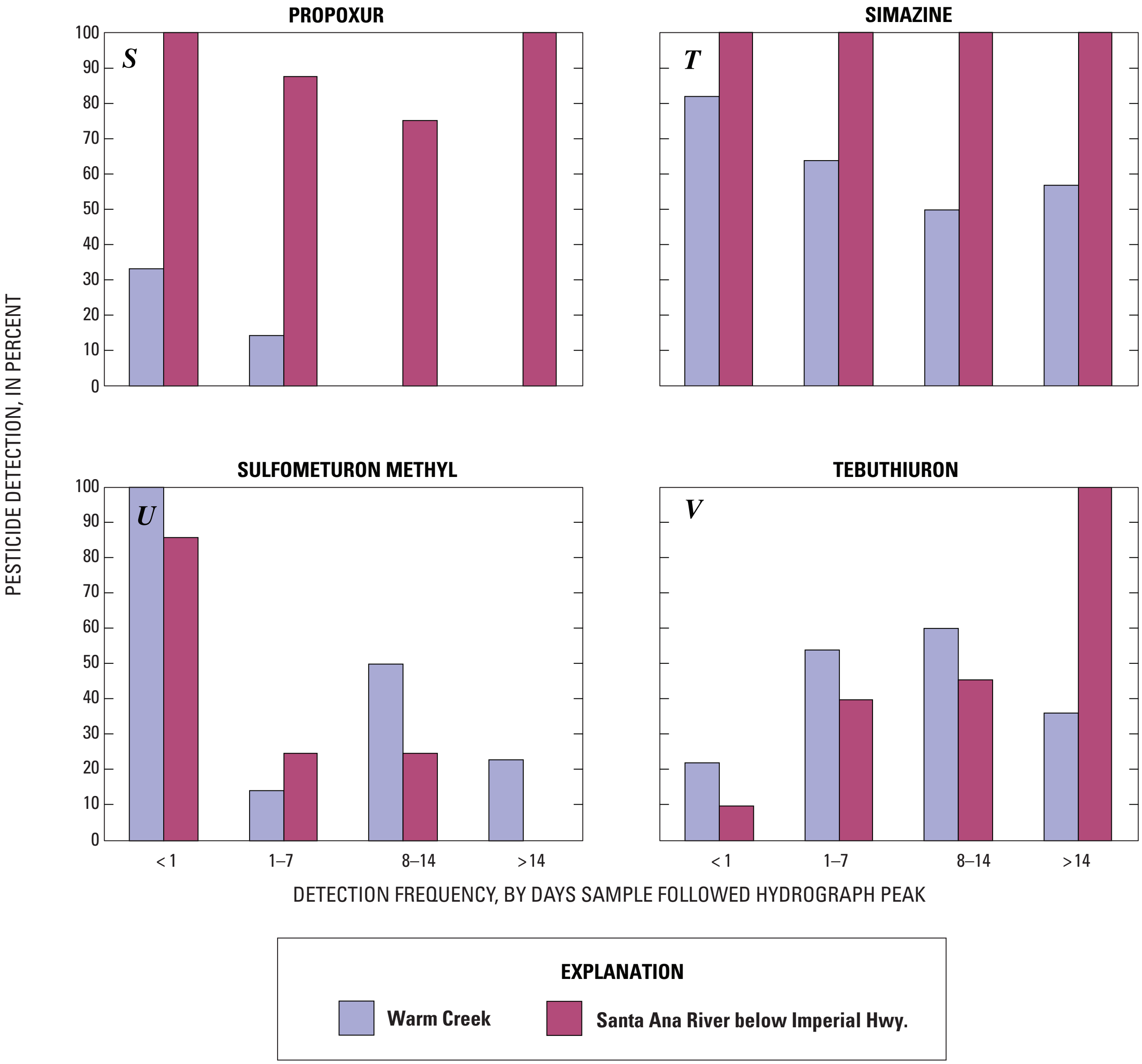

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Discharge in Warm Creek, a concrete-lined channel that drains a small urban area, increases rapidly in response to storms, and decreases rapidly after the storms pass. During the period of this study, few storms lasted more than a few hours, and the discharge at Warm Creek usually returned to pre-storm conditions within a few hours after the rain stopped (Kent and Belitz, 2004). However, storm effects on the detection frequencies persisted for as long as 2 weeks after the storm (*fig. 6*). For example, the insecticide diazinon (*fig. 6J*) was detected in nearly 90 percent of Warm Creek samples collected within 1 day of storms (wet conditions), and less than 40 percent of samples collected more than 14 days after storms (dry conditions); detection frequencies for samples in the two intermediate time categories are transitional between wet and dry conditions. Several other compounds, such as carbaryl, DCPA, metolachlor, oryzalin, and simazine behaved similarly (*figs. 6F*, *I*, *O*, *Q*, and *T*). This systematic decrease in detection frequency suggests that these pesticides are washed off the landscape by storms, and that storm effects can persist for several days afterwards.

The Santa Ana River below Imperial Highway drains a large watershed with mixed land use. Many pesticides are present at this site during both non-storm and storm conditions. For example, diazinon and simazine were detected in all samples collected at this site (*figs. 6J* and *T*). However, the concentrations of these and several other compounds are higher during wet conditions than during dry conditions (*fig. 7*), as was also observed by Izbicki and others (2000) at this site. In the present study, half of the major compounds (11 of 22) generally were observed at their highest concentrations in samples collected within 1 day of storms from the Imperial Highway site. These compounds were carbaryl, chlorpyrifos, DCPA, deethyldeisopropylatrazine, diazinon, malathion, norflurazon, oryzalin, prometon, simazine, and sulfometuron methyl (*figs. 7C*, *E*, *F*, *H*, *J*, *N*, *P*, *Q*, *R*, *T*, and *U*). The concentrations of 8 of these 11 compounds (all but carbaryl, chlorpyrifos, and oryzalin) generally remained elevated for several days after storm events (*figs. 7F*, *H*, *J*, *N*, *P*, *R*, *T*, and *U*).

Caffeine concentrations generally were highest in samples associated with storms (*fig. 8*). The presence of caffeine in streams may be an indicator of wastewater (Kolpin and others, 2001). Most of the discharge in the Santa Ana River is treated wastewater, so the presence of caffeine is expected. However, it is surprising that caffeine concentrations were generally higher in stormflow samples compared to base-flow samples collected from the Santa Ana River below Imperial Highway (the integrator site for which the predominant flow is treated wastewater) (*fig. 8B*). It would be expected that the increased discharge associated with stormflow would dilute a point source such as treated wastewater (Mueller and others, 1995). In addition, the detection frequency (*fig. 2D*) and concentrations of caffeine were higher for samples collected from Warm Creek (the urban indicator site upstream from the wastewater inputs) than for samples collected from the Imperial Highway site (*figs. 8A* and *B*). These observations suggest that urban runoff is a significant source of caffeine in the Santa Ana Basin. Caffeine in urban runoff may come from motorists and coffee-vending cart operators that dump waste coffee directly into storm drains. Evidence of such dumping forced water-quality researchers in the state of Washington to abandon plans to use caffeine as a wastewater tracer for a study on Puget Sound (Perry, 2000).

Not all pesticide compounds showed concentration increases under the influence of stormflow. The concentrations of a few pesticide compounds were observed to decrease with stormflow. Izbicki and others (2000) found significant decreases in concentrations associated with urban storm runoff for atrazine. In addition to atrazine (*fig. 7A*), stormflow concentrations of deethylatrazine, lindane, and tebuthiuron in the Santa Ana River below Imperial Highway were generally lowest during and after storms (*figs. 7G*, *M*, and *V*).

Stream Pesticide Concentrations Compared to Drinking-Water Standards and Aquatic Life Guidelines

Most detections of pesticides during this study were at low concentrations relative to drinking-water standards and guidelines established to protect aquatic life (*fig. 9*). For example, the maximum sample concentration of atrazine, an herbicide that was often detected in streams of the Santa Ana Basin, was 0.025 µg/L. This is far below the enforceable maximum contaminant level (MCL) established by the USEPA (2004) for drinking water (3 µg/L), as well as a guideline established to protect aquatic life (1.8 µg/L) [Canadian Council of Ministers of the Environment, 2003]. It is also well below the level (approximately 250 µg/L) considered potentially toxic to stream algal communities by Guasch and Sabater (1998).

Although all detections of pesticides during this study were at concentrations less than USEPA (2004) enforceable drinking-water MCLs, two pesticide compounds—diazinon and diuron—were detected in stream samples at concentrations exceeding nonenforceable drinking-water health-advisory levels (HALs) (U.S. Environmental Protection Agency, 2004). In addition to diazinon, four other insecticides—carbaryl, chlorpyrifos, lindane, and malathion—were detected at concentrations that exceeded guidelines established to protect aquatic life (U.S. Environmental Protection Agency, 2002a; Canadian Council of Ministers of the Environment, 2003; International Joint Commission Canada and United States, 1977).

Concentrations of the herbicide diuron exceeded its HAL (10 µg/L) in four storm samples collected from Warm Creek. In one of these storm samples, the diuron concentration (23.3 µg/L) was more than twice the HAL. Diazinon, an insecticide, was detected at a concentration above its HAL (0.6 µg/L) in two base-flow samples collected from urban sites for the ULUG synoptic study, and in one storm sample collected from the Santa Ana River below Imperial Highway.

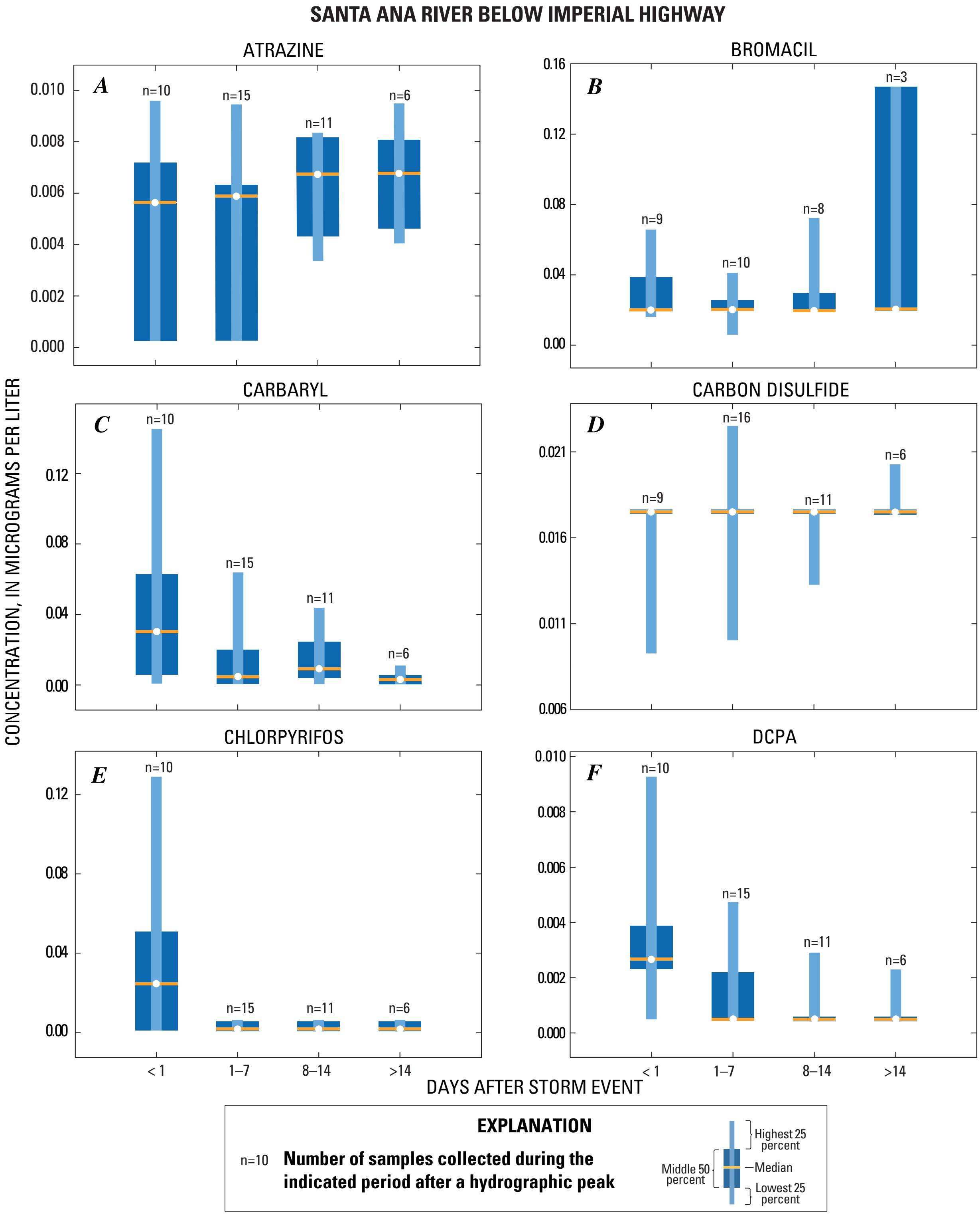
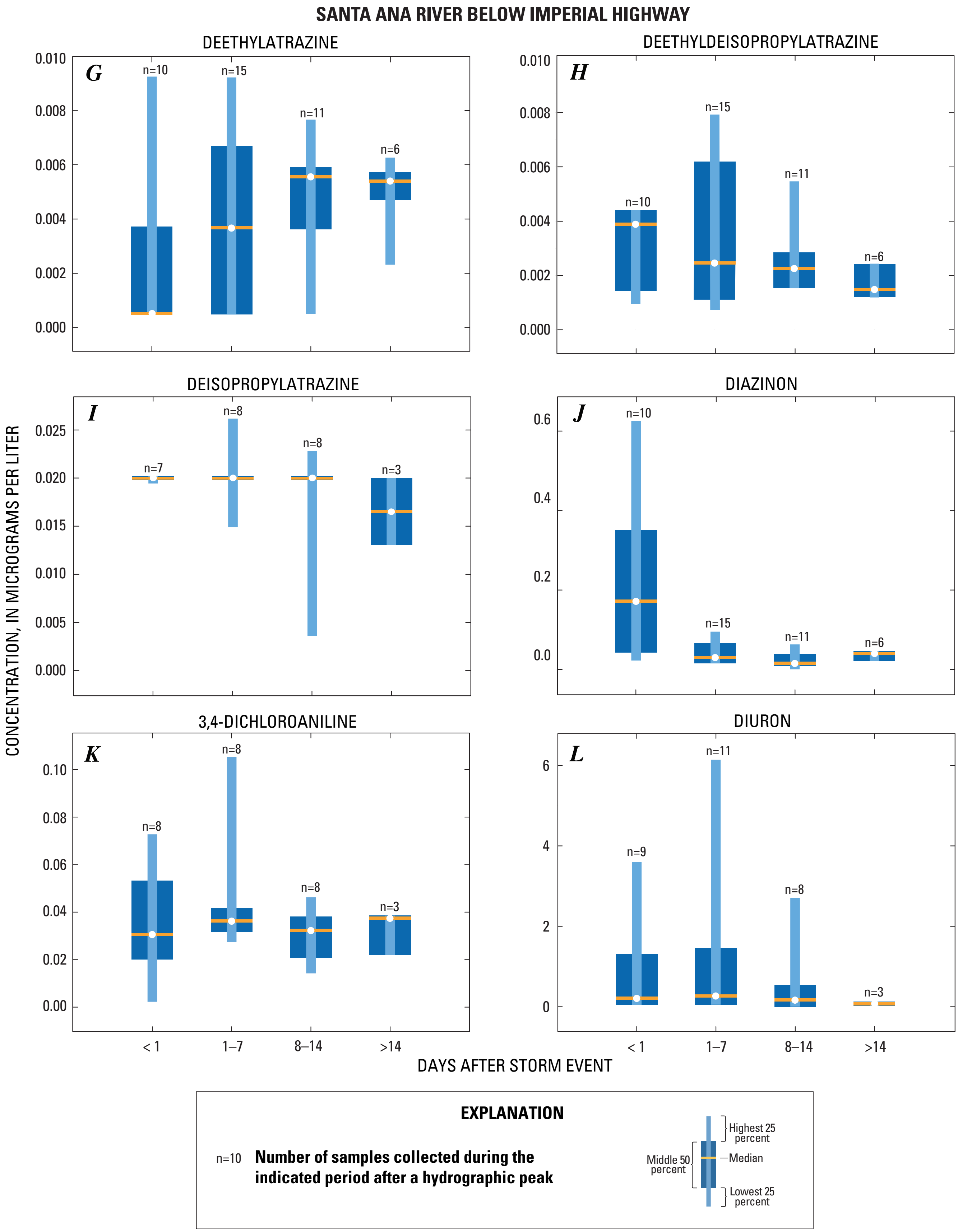


Figure 7. Concentrations of major pesticide compounds as a function of days that sample was collected after a hydrograph peak in samples collected from the Santa Ana River below Imperial Highway: *A*, atrazine; *B*, bromacil; *C*, carbaryl; *D*, carbon disulfide; *E*, chlorpyrifos; *F*, DCPA; *G*, deethylatrazine; *H*, deethyldesopropylatrazine; *I*, deisopropylatrazine; *J*, diazinon; *K*, 3,4-dichloroaniline; *L*, diuron; *M*, lindane; *N*, malathion; *O*, metolachlor; *P*, norflurazon; *Q*, oryzalin; *R*, prometon; *S*, propoxur; *T*, simazine; *U*, sulfometuron methyl; and *V*, tebuthiuron. Results <LRL are plotted as ¼ LRL.



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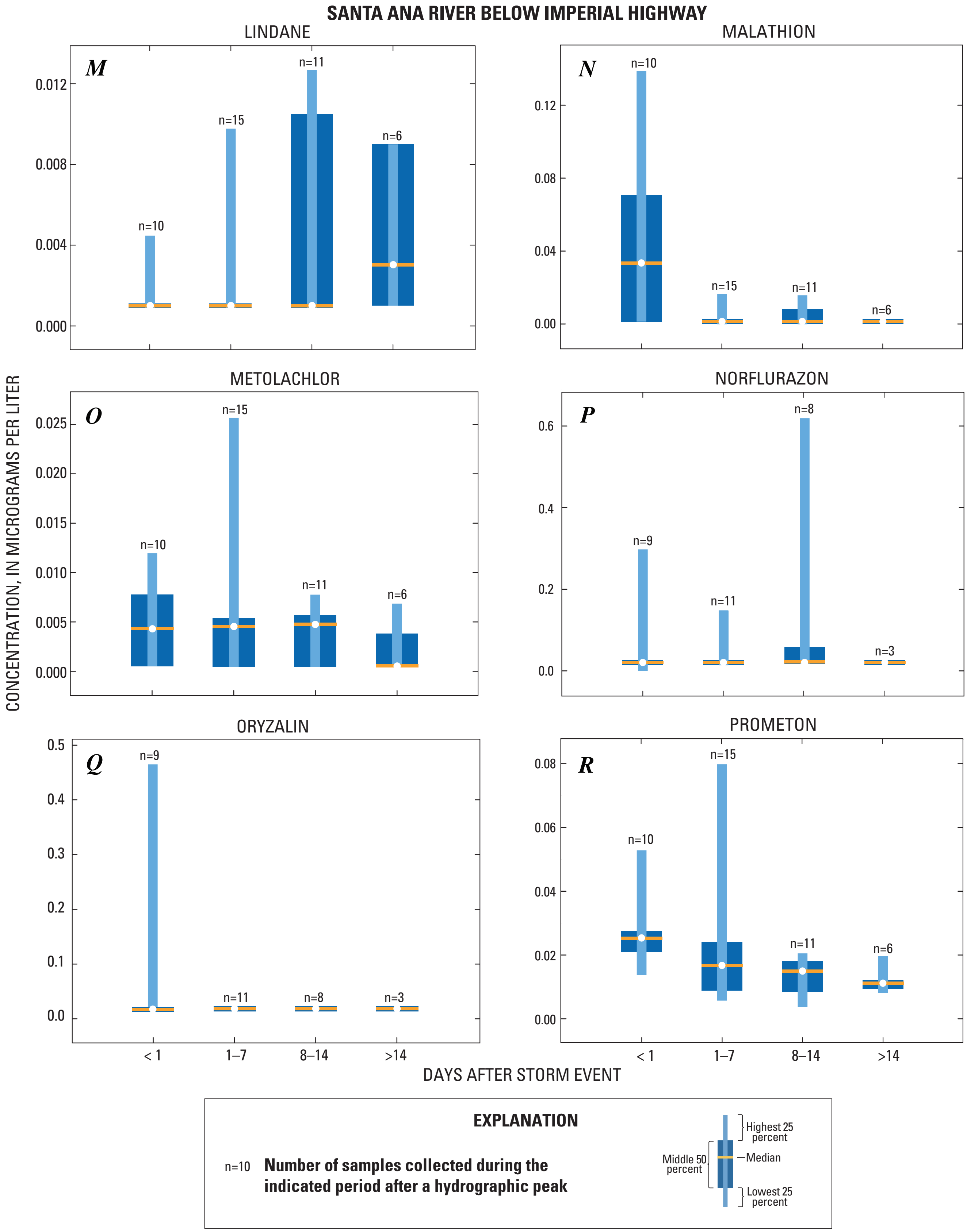

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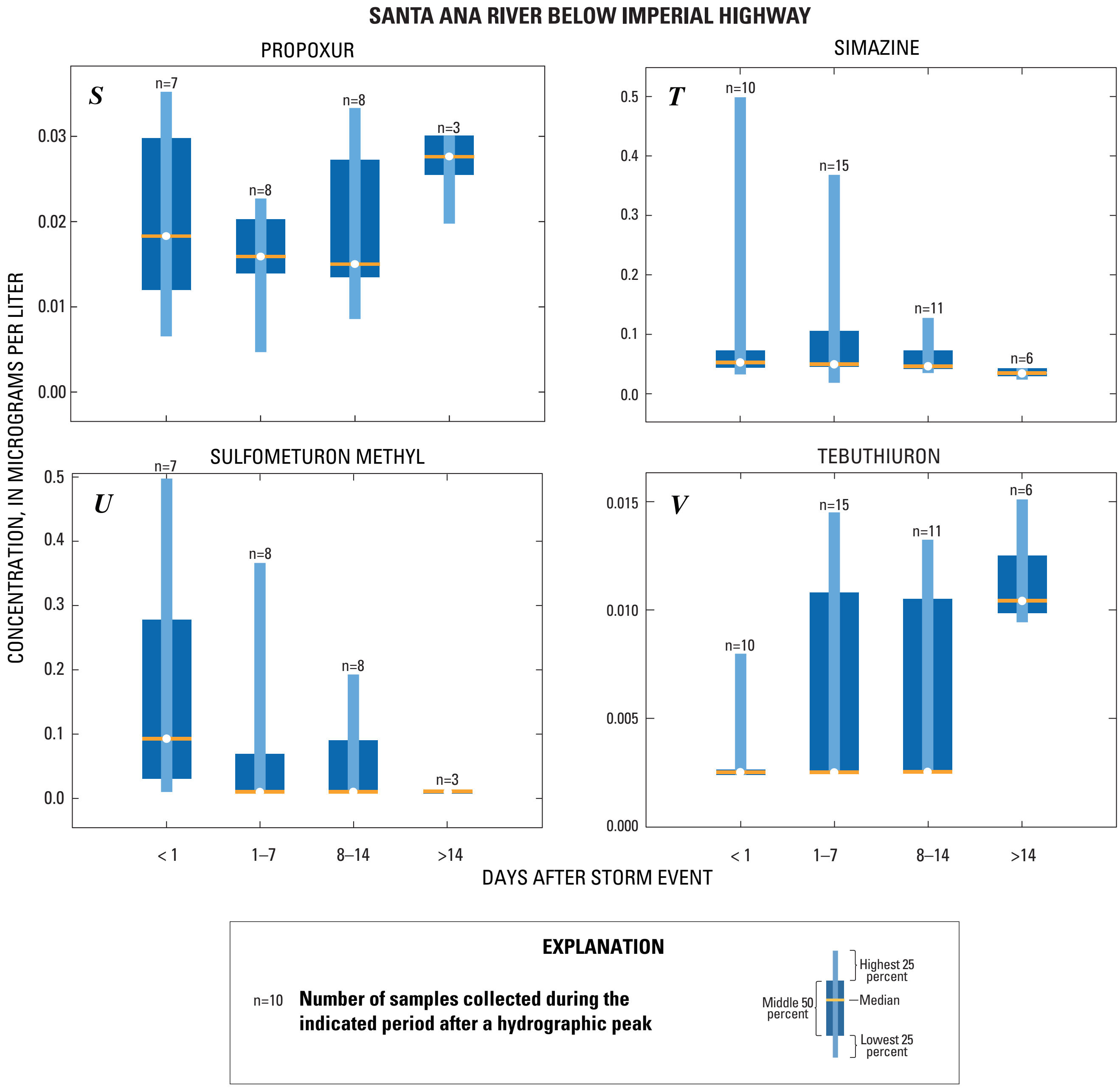

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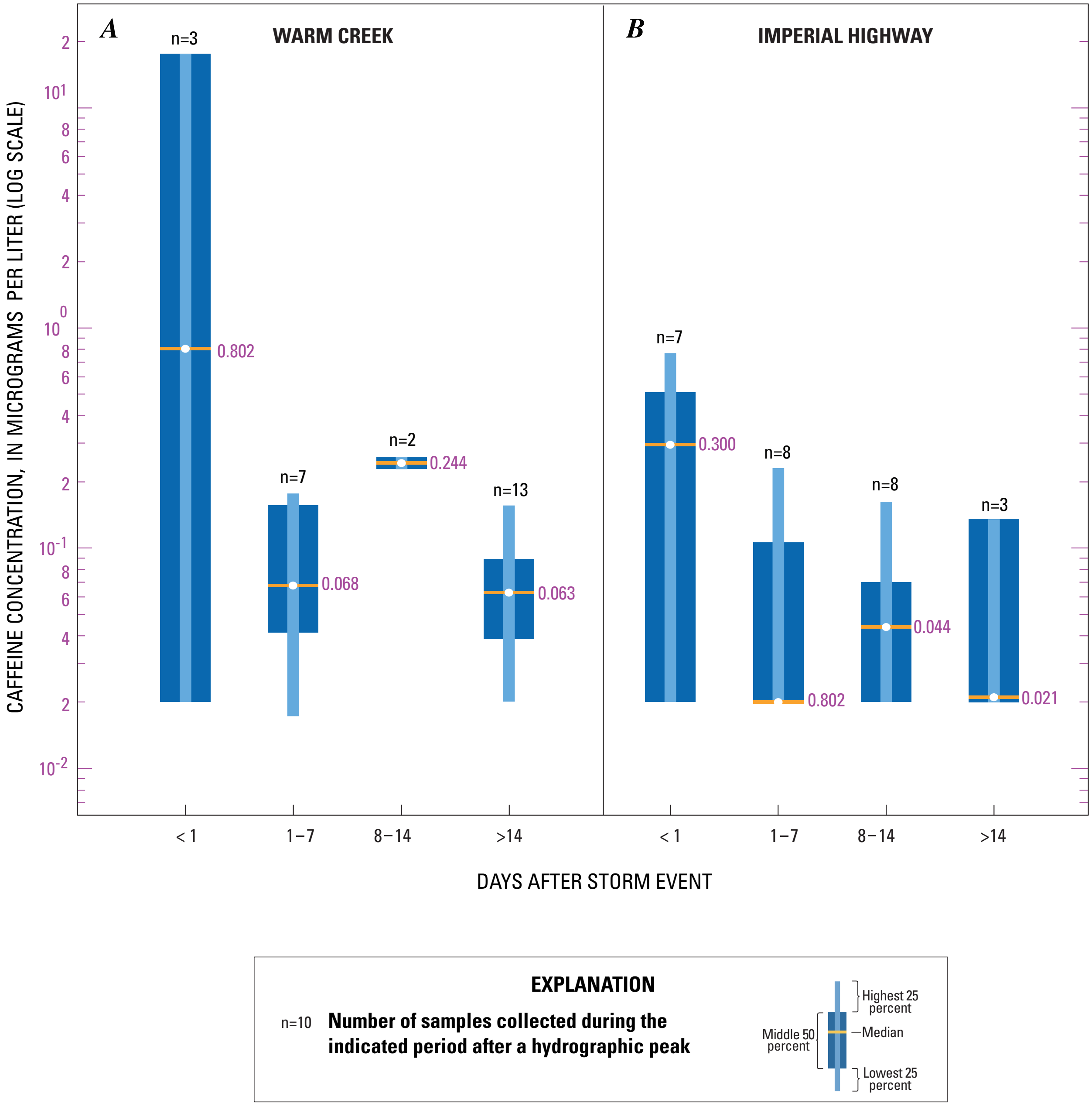

Figure 8. Concentrations of caffeine as a function of days that sample was collected after a hydrograph peak: *A*, Warm Creek; and *B*, Santa Ana River below Imperial Highway. Results <LRL are plotted as ¼ LRL.

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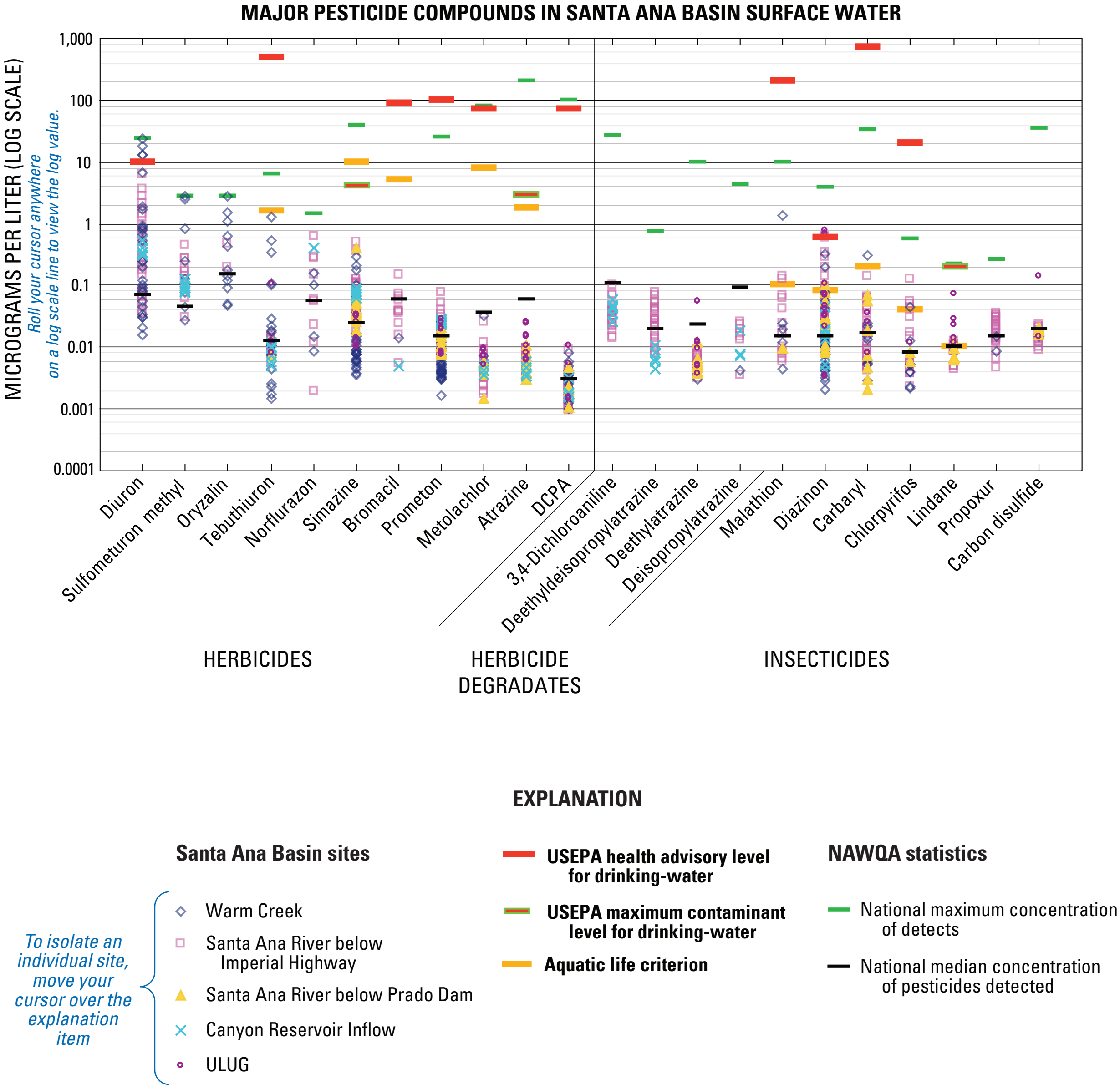

Figure 9. Concentrations of major pesticide compounds detected in Santa Ana Basin surface-water samples compared to standards, guidelines, and national data.

The concentration of diazinon exceeded its aquatic life criteria (0.08 µg/L) in 14 samples collected from 5 different sites for this study (*fig. 9*) [International Joint Commission Canada and United States, 1977]. Most of these high diazinon concentrations occurred in storm samples. However, the two highest diazinon concentrations observed in this study occurred in base-flow samples collected for the ULUG study from Little Chino Creek above Pipeline Road (0.77 µg/L) and Cucamonga Creek near Chino Avenue Main Channel (0.68 µg/L) (*table 2*). Diazinon is the most frequently-used garden insecticide, and is commonly found in urban streams (Cox, 2000). The main source of base flow to both of these sites is urban runoff.

Other insecticides also were detected at concentrations that exceeded guidelines established for the protection of aquatic life (U.S. Environmental Protection Agency, 2002a; Canadian Council of Ministers of the Environment, 2003). The highest concentrations of these also usually occurred in storm samples. Concentrations of malathion exceeded the aquatic life criterion for chronic concentration (0.1 µg/L) [U.S. Environmental Protection Agency, 2002a] in two storm samples collected from the Santa Ana River below Imperial Highway, and in one storm sample collected from Warm Creek. The malathion concentration in the Warm Creek sample (1.35 µg/L) was more than 10 times its aquatic-life criterion. Malathion residues on urban landscapes often result in increases in concentration of this insecticide in storm-water runoff that drains to urban streams (U.S. Environmental Protection Agency, 2000). In addition, registered use of malathion far exceeded the criteria for substantial use (defined above) in both San Bernardino County and the entire Santa Ana Basin.

Carbaryl was detected in one storm sample from Warm Creek at a concentration of 0.3 µg/L, exceeding its aquatic-life guideline of 0.2 µg/L (Canadian Council of Ministers of the Environment, 2003). It should be mentioned that quality-control samples indicated a positive analytical bias for carbaryl (see Quality Control Results below).

Chlorpyrifos was detected at concentrations that exceeded the aquatic life criterion of 0.041 µg/L (U.S. Environmental Protection Agency, 2002a) in four storm samples from the Imperial Highway site and in one storm sample collected from Warm Creek. Some of the chlorpyrifos in storm samples likely comes from the rainwater. Zamora and others (2003) found some concentrations of chlorpyrifos in California precipitation that exceeded 1 µg/L. The Canadian aquatic-life criterion for chlorpyrifos (0.0035 µg/L) [Canadian Council of Ministers of the Environment, 2003] is much lower than the criterion recommended by the USEPA (0.041 µg/L) [2002a]. Twenty-five of the twenty-eight detections of chlorpyrifos in this study exceeded the Canadian guideline, under both base-flow and stormflow conditions (*fig. 9*).

In contrast to these insecticides, for which concentrations were usually highest in storm samples, concentrations of the insecticide lindane were highest in dry-weather samples. In 10 samples these concentrations exceeded a guideline for the protection of aquatic life (0.01µg/L) [Canadian Council of Ministers of the Environment, 2003], ranging from barely above this guideline to 0.07 µg/L. Three of these samples were collected from the Santa Ana River below Imperial Highway, and seven of them were collected during the ULUG in August 2000. The data are consistent with the hypothesis that lindane enters basin streams with wastewater treatment plant effluent. Treated wastewater is the predominant source of water to all sites where lindane was detected during this study. In addition, treated wastewater is nearly the sole source of water to the three sites that had the highest lindane concentrations (samples collected during the ULUG).

A comprehensive analysis of possible risks to human health or aquatic life in the Santa Ana River Basin is not possible because many of the compounds do not have established standards or criteria. Only 32 of the 68 pesticides that were detected during this study, have regulatory standards in the form of maximum contaminant levels (MCL) or health advisory levels (HAL) relevant to drinking water (*table 1*). Only 21 of the 68 compounds have standards or guidelines for the protection of aquatic life. Many of the compounds lacking standards or guidelines are pesticide degradates, and analyses are generally only performed for a few of the thousands of possible pesticide breakdown products (U.S. Geological Survey, 1999). Studies on whether pesticide degradates are as toxic as their corresponding parent compounds are inconclusive (Kolpin and others, 2000).

It should also be noted that existing standards and criteria do not address exposure to mixtures of compounds. For example, Hernando and others (2003) found that the presence of methyl-tert-butyl ether (MTBE) increases the toxicity of some pesticides, including diuron, an herbicide whose toxicity can increase by more than 50 percent in the presence of MTBE. MTBE had a detection frequency of 91 percent of samples collected during the present study (U.S. Geological Survey, 2001). Diuron had a detection frequency of 81 percent and was one of the two pesticides detected above its drinking-water HAL during this study. Ongoing studies are examining the combined toxic effects of multiple pesticides in water. For example, the USEPA is carrying out a cumulative risk assessment of the triazine herbicides, which share a common mode or mechanism of toxicity (U.S. Environmental Protection Agency, 2003). This class of pesticides includes atrazine, prometon, simazine, and their degradates—major compounds in this study (*table 3*).

Pesticide Concentrations in the Santa Ana Basin Compared with Concentrations Nationwide

Stream pesticide concentrations of the major pesticide compounds in the present study were compared with data for these compounds from the other 50 NAWQA study units that participated in the first 10-year cycle of data collection (*table 5*, *fig. 9*) (values were obtained from the NAWQA Data Warehouse internal page in June 2004; public access to these data can be found at URL: http://water.usgs.gov/nawqa/data.). All the major compounds of the present study were detected in streams sampled in other study units (*table 5*). Major compounds that were frequently detected in samples from NAWQA study units nationwide include atrazine, simazine, prometon, chlorpyrifos, metolachlor, diazinon, carbaryl, DCPA, and diuron. The median and the maximum concentrations of the major pesticide compounds among study units nationwide are shown in *figure 9*, along with the standards, guidelines, and all SANA detections of these compounds.

Some pesticide compounds were detected in samples collected from Santa Ana Basin streams at relatively high concentrations in comparison with national data (*table 5*, *fig. 9*). NAWQA categorizes stream sites by the dominant land use, such as urban, agriculture, or reference, in the stream drainage area. Maximum concentrations of three herbicides detected in Warm Creek storm samples were the highest detected in any NAWQA study unit during the first 10-year cycle of NAWQA regardless of land-use type. These herbicides were diuron (23 µg/L), oryzalin (2.8 µg/L), and sulfometuron methyl (2.8 µg/L). With the partial exception of sulfometuron methyl, there was substantial registered use in the Santa Ana drainage basins in 2001 for these three compounds by the criteria defined previously. In addition, Wilen (2001) estimated that about 300 lbs of oryzalin were used residentially in the San Diego Creek Watershed of Orange County in 2001.

Sulfometuron methyl had substantial use in San Bernardino County (defined as >100 lbs), but had somewhat less than substantial use relative to the entire Santa Ana Basin (defined as >10,000 lbs). There may have been positive analytical bias for this compound. Quality-control samples in the form of spikes collected for this study showed sulfometuron methyl concentrations that were about double the expected concentrations in the samples. Such a positive bias would be expected to affect samples from other NAWQA study units because the NWQL analyzed all the samples and, therefore, this compound probably did occur at relatively high concentrations in the urban stormflow of the Santa Ana Basin.

With regard to concentrations related to specific land uses, a base-flow sample collected from the Imperial Highway site had the highest diuron concentration (6.17 µg/L) in a sample collected from a mixed land-use (integrator) site nationwide, and a storm sample collected from the Imperial Highway site had a concentration of chlorpyrifos (0.13 µg/L) that was ranked fourth nationwide for a mixed land-use site. Samples collected from the Warm Creek and Imperial Highway sites had the highest and second-highest concentrations of norflurazon for urban and mixed land-use sites, respectively. By the criteria previously defined, there was substantial registered use in the Santa Ana drainage basins in 2001 for chlorpyrifos, norflurazon, and, as mentioned above, diuron.

The Santa Ana Basin is intensely urban. A previous study on urban streams (Hoffman and others, 2000) identified chlorpyrifos as one of the most frequently detected insecticides in urban streams. Interestingly, none of the herbicides that were detected during the present study at relatively high concentrations in comparison with national data—diuron, oryzalin, sulfometuron methyl, and norflurazon—were among the herbicides identified as most frequently detected in urban streams by Hoffman and others (2000).

In-Stream Changes in Pesticide Concentrations

Between August 2000 and April 2001, seven sets of paired samples were collected at the Santa Ana River below Prado Dam and the Santa Ana River below Imperial Highway sites 5 hours apart in order to observe water-quality changes between the two sites. Five hours is the approximate travel time between the two sites on the basis of typical stream velocities and the distance between the two sites (Izbicki and others, 2000). The chloride concentrations for these paired samples are shown in *figure 10*. Chloride is a conservative tracer used in surface-water and ground-water studies to track water sources, and thus the similarity in chloride concentrations in the sample pairs (*fig. 10*) provides evidence that approximately the same parcels of water were compared in each sampling date.

Results from the seven paired samples indicate that stream concentrations of some pesticides—atrazine, carbaryl, diazinon, prometon, and simazine-like chloride—did not change much in the 11-mi reach between these two sites (*fig. 11*). This is especially true for the compounds atrazine, carbaryl, prometon, and simazine. Lindane concentrations decreased between the two sites on three of the four sampling dates when it was detected at the Prado Dam site (*fig. 11H*), which, because the lower site has less wastewater, is consistent with wastewater being the primary source of lindane in the Santa Ana River Basin. Tebuthiuron is the only pesticide that appears to have a consistent source between the two sites, where the adjacent land use includes residences and a golf course. Tebuthiuron was not detected in the samples collected from the Prado Dam site, but it was detected in five of the seven samples collected from the Imperial Highway site (*fig. 11M*).

Table 5. Major (as defined in the text) pesticides detected in the Santa Ana Basin, 1998–2001, and a comparison with other NAWQA study units nationwide during the first 10-year cycle of the National Water-Quality Assessment (NAWQA) program, 1991–2001.

[SANA, Santa Ana Basin; SANA concentrations that were the highest detected in streams nationwide are in bold]

Compound	No. of NAWQA study units that detected compound	Total No. detections (NAWQA study units nationwide)	Number of SANA detections	Highest concentration detected nationwide (NAWQA site land-use group) [µg/L]	Highest SANA concentration (NAWQA site land-use group) [µg/L]	Nationwide median concentration [µg/L]	SANA median concentration [µg/L]
Herbicides							
Simazine	45	9,998	203	38.8 (agriculture)	0.498 (mixed)	0.025	0.041
Prometon	46	8,073	102	25 (urban)	0.080 (mixed)	0.02	0.01
Diuron	42	1,542	62	23 (urban)	**23 (urban)**	0.07	0.32
DCPA	45	2,274	58	100 (urban)	0.019 (urban)	0.003	0.002
Atrazine	46	13,146	57	201 (agriculture)	0.007 (mixed)	0.058	0.006
Tebuthiuron	43	4,085	51	6.4 (urban)	1.3 (urban)	0.01	0.01
Metolachlor	43	11,436	47	77.6 (agriculture)	0.032 (urban)	0.036	0.005
Sulfometuron methyl	14	125	25	2.8 (urban)	**2.8 (urban)**	0.05	0.13
Oryzalin	19	71	20	2.8 (urban)	**2.8 (urban)**	0.15	0.20
Norflurazon	13	283	13	1.4 (agriculture)	0.62 (mixed)	0.06	0.10
Bromacil	22	262	12	5.0 (urban)	0.15 (mixed)	0.06	0.04
Insecticides							
Diazinon	46	5,444	99	3.80 (agriculture)	0.774 (urban)	0.015	0.027
Carbaryl	47	3,984	56	34 (agriculture)	0.31 (urban)	0.02	0.02
Chlorpyrifos	45	2,864	29	0.570 (urban)	0.129 (mixed)	0.008	0.006
Lindane	35	332	24	0.219 (agriculture)	0.072 (other*)	0.010	0.010
Propoxur	13	57	24	0.26 (urban)	0.04 (mixed)	0.02	0.02
Malathion	44	1,181	20	9.58 (urban)	1.35 (urban)	0.015	0.018
Carbon disulfide	22	299	15	34 (agriculture)	0.14 (urban)	0.02	0.02
Degradates							
Deethylatrazine	45	11,799	42	>10 (mixed)	0.056 (urban)	0.023	0.005
3,4-Dichloraniline	12	415	32	26.3 (agriculture)	0.105 (mixed)	0.110	0.035
Deethyldeisopropylatrazine	21	618	26	0.76 (agriculture)	0.04 (mixed)	0.02	0.02
Deisopropylatrazine	21	1,237	10	4.4 (agriculture)	0.03 (mixed)	0.09	0.01

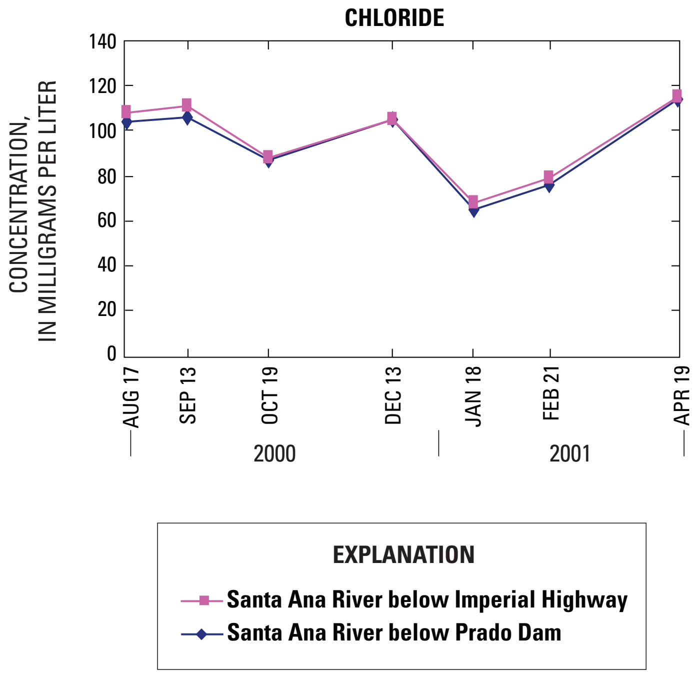

Figure 10. Chloride results for the paired sample study between the Santa Ana River below Prado Dam and the Santa Ana River below Imperial Highway.

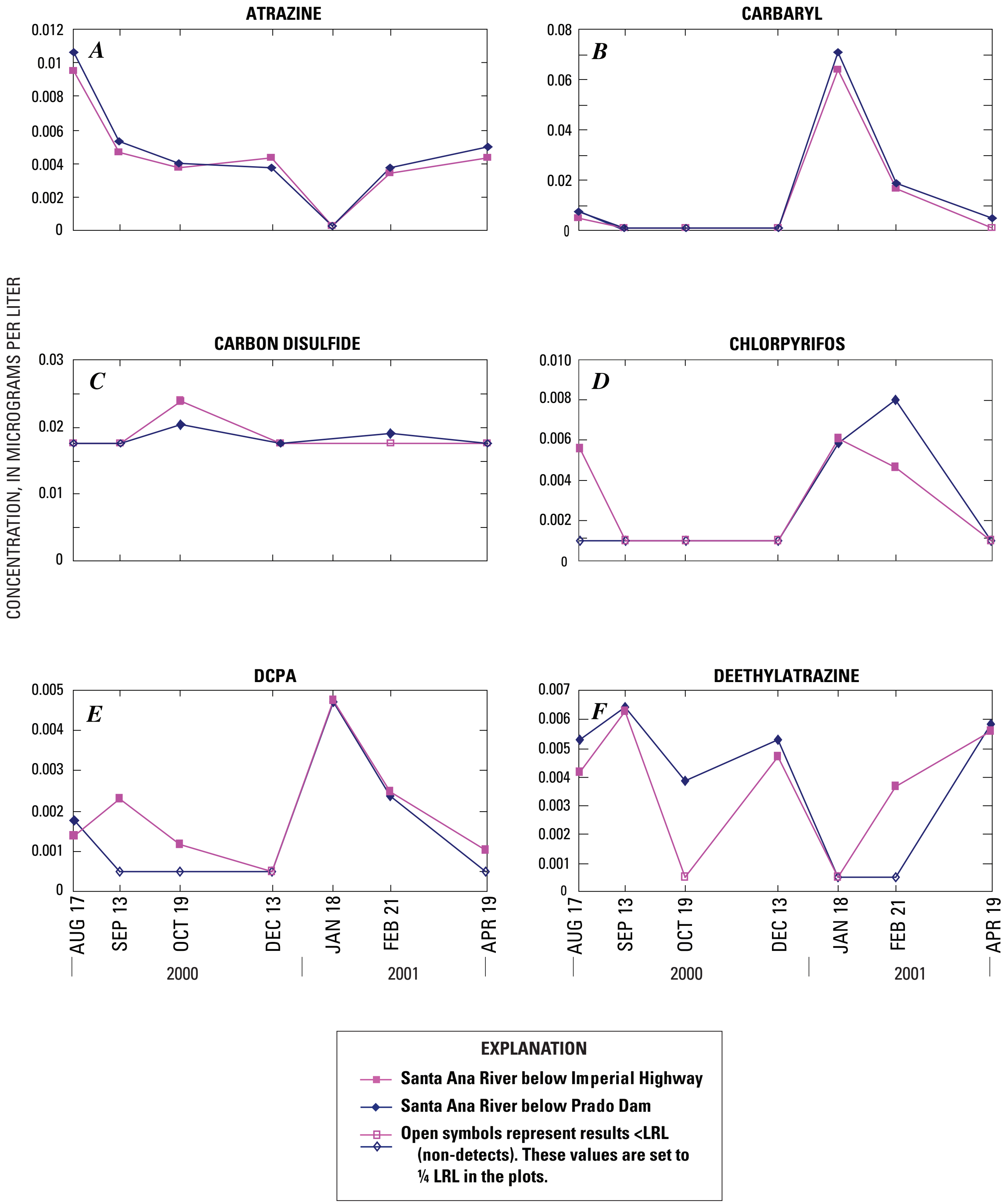

Figure 11. Major pesticide compound results for the paired sample study between the Santa Ana River below Prado Dam and the Santa Ana River below Imperial Highway: A, atrazine; B, carbaryl; C, carbon disulfide; D, chlorpyrifos; E, DCPA; F, deethylatrazine; G, diazinon; H, lindane; I, malathion; J, metolachlor; K, prometon; L, simazine; and M, tebuthiuron.

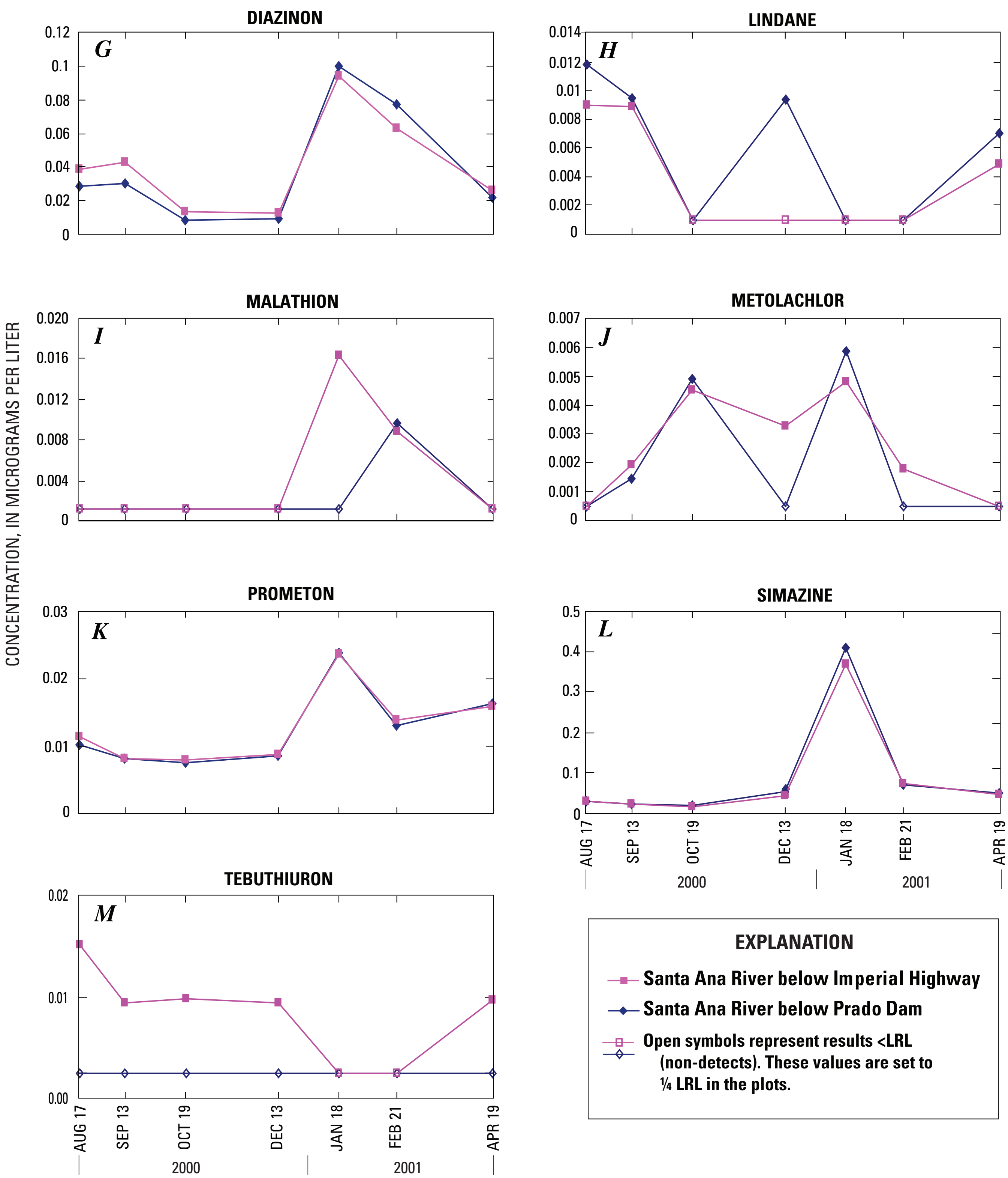

Figure 11.—Continued.

Pesticides in a Water-Supply Reservoir

In 1999, NAWQA and USEPA initiated a 2-year pilot monitoring program to assess human exposure to pesticides in drinking water derived from surface-water reservoirs, including Canyon Reservoir in the upper Santa Ana Basin (Blomquist and others, 2001). Water from Canyon Reservoir is treated at the Elsinore Valley Municipal Water District drinking-water treatment facility. From July to December 1999, water samples were collected from the drinking-water treatment facility both prior to (eight samples) and after treatment (eight samples). These samples were analyzed for 176 pesticide compounds plus caffeine.

Twenty pesticides were detected in the untreated water. All but one (diazinon) were herbicides or degradates of herbicides. Of these 20 compounds, drinking-water standards or guidelines (MCLs or HALs) have been established for 12. Concentrations of these 12 compounds were less than the applicable standards or guidelines for all samples. Eight of the compounds detected in the untreated water were also detected in the treated water, and no additional compounds were detected in the treated water. Five of these eight compounds were detected less frequently in the treated water than in the untreated water. Three compounds—prometon, simazine, and atrazine—were detected just as frequently in the treated water as in the untreated water (*fig. 12*). These were the only triazine parent compounds detected in the reservoir samples, suggesting that the treatment process was not effective on triazine herbicides. Interestingly, the three triazine degradate compounds detected in the untreated water were detected less frequently (deethyldeisopropylatrazine and hydroxyatrazine) or not at all (deisoproplatrazine) in treated water samples.

In contrast to what was observed with the triazine parent compounds, the treatment process appeared to be effective on urea compounds. Five urea compounds were frequently detected in untreated water samples: 3,(4a-chlorophenyl) methyl urea, 3,4-dichloroaniline, diuron, sulfometuron methyl, and tebuthiuron. Only one of these, tebuthiuron, was detected in any of the treated water samples, and tebuthiuron was detected less frequently in the treated than in the untreated water samples.

The one nonherbicide pesticide detected in reservoir samples was diazinon, which was only detected in untreated samples. Water treatment at the Elsinore Valley Municipal Water District plant includes dual media filtration, rapid mix with a cationic polymer, and chlorination. Chlorination has been shown to oxidize organophosphate insecticides, such as diazinon, into toxic by-products, such as diaoxon (Blomquist and others, 2001). Unfortunately, diaoxon was not a target analyte in this study and, therefore, it cannot be determined whether the absence of diazinon in treated samples was due to its removal during the treatment process, or to its degradation to the metabolite.

Quality-Control Results

Quality-control results generally showed good data integrity. Out of 190 pesticide analytes only 4 compounds were ever detected in field and equipment blank samples performed in the study. The relative percent differences in replicates generally showed little variability. Analyzed recoveries of surrogates and spikes were generally within acceptable ranges.

Blanks

Blanks are used to identify potential sources of sample contamination that could lead to a positive bias in the data. Blank data for compounds detected at least once in this study are presented in *Appendix B*. No compounds on lab code 9002 were detected in six field blanks performed on this lab code. Similarly, four equipment blanks that were analyzed for schedule 2050 compounds were free of detections, and none of the eight insecticide fumigants analyzed for on schedule 2020 (VOCs) were detected in the 11 field blanks performed for this schedule. Out of nine blanks analyzed for lab code 9060 compounds, only diuron was detected on one occasion at an estimated concentration of 0.01 µg/L. Concentrations of diuron detected in environmental samples were typically at several factors higher than 0.01 µg/L. However, estimated concentrations detected in two environmental samples collected at Warm Creek in October 1999 were similar to the concentration in the blank.

Three compounds on schedule 2001 were detected in blanks: DCPA, metolachlor, and p,p'-DDE. Each was detected in only 1 of 16 blanks analyzed for this schedule. DCPA was detected at an estimated concentration of 0.002 µg/L. Half of all the detections of this compound in environmental samples collected for this study were at concentrations at or less than this concentration. In addition, DCPA was often not detected at all in environmental samples. Therefore, those detections of DCPA at concentrations less than 0.002 µg/L should be viewed as suspect because concentrations at such low levels may be partly or entirely due to contamination introduced during sample collection or analysis. Metolachlor was detected at an estimated concentration of 0.002 µg/L. In contrast to DCPA, most detections of metolachlor in environmental samples (41 of 47 detections) were at concentrations above the one detection in a blank. Therefore, reported concentrations of metolachlor can be used without qualification. p,p'-DDE was detected in one blank collected at Prado Dam and two blanks collected at Warm Creek. All three detections in environmental samples were similar to the concentration found in the blank (E0.001), and therefore should be considered suspect.

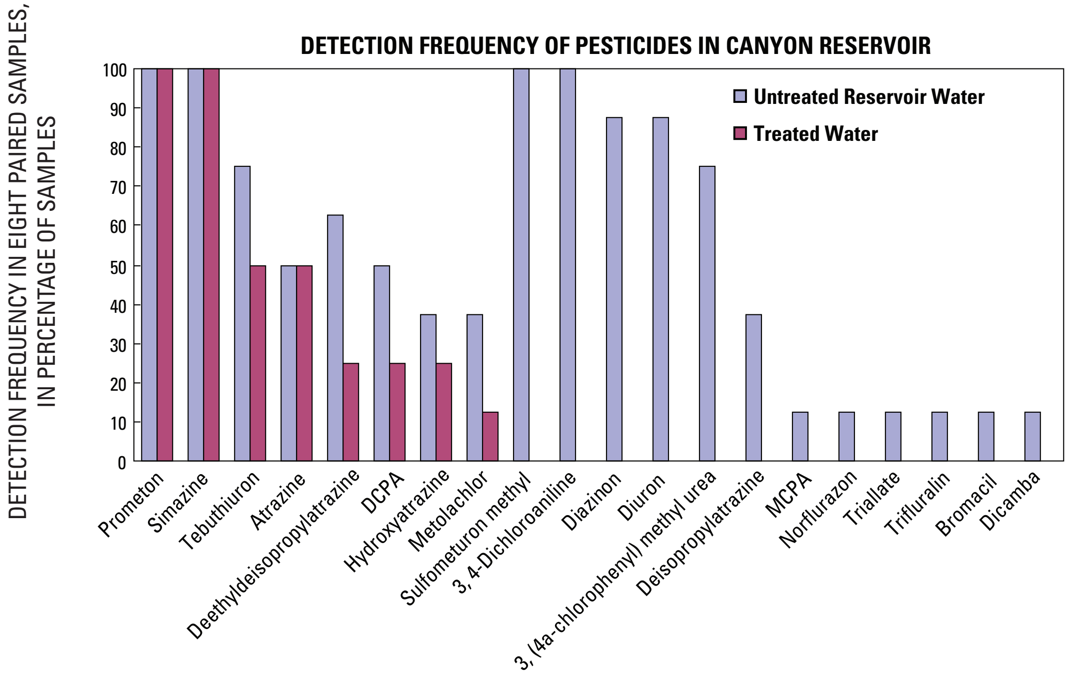

Figure 12. Detection frequency of pesticide compounds detected in water samples from Canyon Reservoir collected before and after treatment at the Elsinore Valley Municipal Water Treatment Plant.

Replicate Samples

Replicates are used to provide a measure of data variability. Replicate data for compounds detected at least once in this study are presented in *Appendix C*. The variability observed in replicate samples was evaluated using the relative standard deviation (RSD) of concentrations detected. Presented in *table 6* is the mean relative standard deviation (MRSD) for each major compound. Replicate sets consisting of nondetections were excluded from MRSD analyses because the resulting zero-value MRSDs would provide little useful information on sample-concentration variability (Martin, 2002). Replicate sets with inconsistent detections are those wherein an analyte was detected in one, but not both primary and duplicate samples in the set. Inconsistent detections were also excluded from MRSD analysis because MRSD values cannot be calculated when one of the values is a non-detect. Nevertheless, the number of detections in either a primary or duplicate sample is given in *table 6* for each analyte, because it provides information on detection variability.

The MRSDs for all pesticide compounds were less than 20 percent, the statistically acceptable value (Hamlin and others, 2002), except for deethyldeisopropylatrazine (38 percent), and most were less than 10 percent. Therefore, with the exception of deethyldeisopropylatrazine, replicate results from this study indicate acceptable analytical precision. MRSDs were calculated for all "major" compounds, except for chlorpyrifos, malathion, bromacil, deisopropylatrazine, and oryzalin. These compounds were not detected in samples for which replicates were performed. Inconsistent detections were observed on at least one occasion for only five compounds (four major compounds: lindane, prometon, simazine, tebuthiuron; and the non-major compound, metalaxyl), suggesting that their occurrence in the environment may have been more frequent, or less frequent than indicated by environmental sample results alone.

Spikes

Field matrix spikes are environmental samples to which known concentrations of target analytes are injected to provide a measure of positive or negative analytical bias. Matrix spikes were performed for all pesticide and VOC analytes, with the exception of schedule 2050 pesticides. Matrix spikes were performed at varying degrees of frequency depending on the analyte group. Field matrix pesticide spikes were performed at the fixed sites: Mentone, Warm Creek, Prado Dam, and Imperial Highway; as well as on untreated water samples collected from theElsinore Valley Municipal Water Treatment Plant at Canyon Reservoir. Matrix spikes for schedule 2001 pesticides were performed by study unit personnel in the field. Matrix spikes for lab codes 9002 and 9060 pesticides were performed by the laboratory on samples collected in the study unit. Most matrix spikes were performed as replicates, and thus there were two results for each spike-sampling episode. Matrix pesticide spikes performed on samples collected from the reservoir inflow samples were not performed as replicates. Pesticide replicate matrix spikes were collected as split replicates. Matrix spike recoveries between 70 and 130 percent were considered acceptable.

Table 6. Mean Relative Standard Deviation (MRSD) for major (as defined in the text) pesticide compounds in replicates performed for surface-water samples in the Santa Ana Basin, California, November 1998 to September 2001.

[Parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent; GC/MS, gas chromatography/mass spectrometry; HPLC, high-performance liquid chromatography. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC[d], lab code 9060; HPLC[e], schedule 2050]

Compound	Parameter code	Mean Relative Standard Deviation (MRSD) (in percent)	Replicates with detections in both primary and duplicate	Replicates with a detection in only primary or duplicate	Replicates without a detection in either primary or duplicate
GC/MS[a]—11 replicates performed for pesticides and pesticide degradates in this group					
Atrazine	39632	2.28	4	0	7
Carbaryl	82680	1.91	3	0	8
Chlorpyrifos	38933	—	0	0	11
DCPA	82682	1.94	3	0	8
Deethylatrazine	04040	3.30	3	0	8
Diazinon	39572	5.85	8	0	8
Lindane	39341	4.33	1	1	9
Malathion	39532	—	0	0	11
Metolachlor	39415	1.80	2	0	9
Prometon	04037	6.54	8	1	1
Simazine	04035	1.43	6	2	3
Tebuthiuron	82670	7.18	4	1	6
GC/MS[b]—4 replicates performed for pesticides and pesticide degradates in this group					
3,4-Dichloroaniline	61625	5.94	4	0	0
GC/MS[c]—6 replicates performed for volatile organic compounds (VOCs)					
Carbon disulfide	77041	—	0	1	5
HPLC[d]—6 replicates performed for pesticides and pesticide degradates in this group					
Bromacil	04029	—	0	0	6
Deisopropylatrazine	04038	—	0	0	6
Deethyldeisopropylatrazine	04039	37.81	2	0	4
Diuron	49300	6.41	4	0	2
Norflurazon	49293	0.29	2	0	4
Oryzalin	49292	—	0	0	6
Propoxur	38538	6.49	2	0	4
Sulfometuron-methyl	50337	5.69	3	0	3

Field matrix spikes were performed for schedule 2001 pesticides on nine occasions during the study period. Spike recoveries indicated acceptable laboratory analytical performance for most schedule 2001 analytes (*table 7B*, *fig. 13A*). However, low median recoveries for three compounds (disulfoton, cis-permethrin, and phorate), which were never detected in 138 environmental samples, indicate that the absence of these compounds in environmental samples may be due to a negative analytical bias. Disulfoton was one of six pesticides that had notably low detection frequencies, relative to their use, in samples collected from both the Warm Creek and Imperial Highway sites.

In contrast, two compounds, carbaryl and carbofuran, that were detected in environmental samples had median recoveries greater than 130 percent in field matrix spikes, and maximum recoveries of 691 and 442 percent, respectively. Such high recoveries could indicate a positive analytical bias. Carbaryl was frequently detected in environmental samples (48 of 138), and its concentration exceeded the aquatic life guideline (0.2 µg/L) in one storm sample collected from Warm Creek (0.307 µg/L). However, carbofuran was detected in only 2 of 138 samples analyzed for schedule 2001 analytes, suggesting that any positive analytical bias for this compound was of little importance to this study.

Laboratory matrix spikes were performed for lab code 9060 compounds on three occasions during the study period. A sample backlog at the NWQL in 1999 caused many lab code 9060 samples to exceed the recommended holding time of 4 days prior to extraction (Furlong and others, 2003). The spike sample collected from the reservoir inflow was one of the affected samples with a holding time interval of 97 days. The replicate spikes collected from the Warm Creek and Imperial Highway sites were not affected by the backlog. Spike recoveries indicated acceptable laboratory analytical performance for most lab code 9060 analytes (*table 7B*, *fig. 13B*). However, low median recoveries for seven compounds (2,4 DB; acifluorfen; aldicarb; cycloate; MCPB; neburon; and tribenuron methyl) never detected in 69 environmental samples indicate that the absence of these compounds in environmental samples may be due to a negative analytical bias. In contrast, four compounds that were commonly detected in environmental samples (hydroxyatrazine, deethyldeisopropylatrazine, imazaquin, and sulfometuron methyl) had median spike recoveries greater than 130 percent, indicating a positive bias for these compounds.

Two laboratory matrix spikes were performed for lab code 9002 samples; one of these was a replicate sample. As with the other methods of pesticide analyses, spike recoveries for most lab code 9002 analytes indicated acceptable laboratory analytical performance. Low median recoveries for 16 compounds never detected in 35 environmental samples indicate that the absence of these compounds in environmental samples may be due to a negative analytical bias (*table 7C*, *fig. 13C*). These compounds were 3-trifluoromethylaniline, bifenthrin, cis-propiconazole, cyfluthrin, dichlorvos, dicrotophos, dimethoate, e-dimethomorph, fenamiphos sulfoxide, cyhalothrin, phosmet oxon, phosmet, tefluthrin metabolite, tefluthrin, trans-propiconazole, and z-dimethomorph. In contrast, two lab code 9002 compounds that were detected in at least one environmental sample had median spike recoveries greater than 130 percent (malaoxon and 2-[(2-Ethyl-6-methylphenyl)amino]-1-propanol), possibly indicating a positive analytical bias for these compounds.

Eight field matrix spikes were performed for VOCs; all were performed as replicates. Spike recoveries for the eight pesticide VOCs indicated acceptable laboratory analytical performance (*table 7D*, *fig. 13D*).

Surrogates are compounds that behave similarly to pesticide analytes, but are not usually present in streams. Surrogates were added to all pesticide samples at the NWQL before sample analysis to evaluate the accuracy of laboratory analytical methods. With the exception of one pesticide surrogate (barban-54 percent), the median recoveries of these surrogates in the environmental samples were between 70 and 130 percent, which is considered acceptable (Hamlin and others, 2002).

Implications of Extended Holding Times for Lab Code 9060 Samples

During the early stages of implementing lab code 9060, a backlog of samples occurred at the NWQL, and consequently samples were held beyond their maximum recommended holding time of 4 days (Furlong and others, 2003). Holding time refers here to the period between sample collection and transfer to solid phase extraction columns. Samples collected at Warm Creek, Imperial Highway, and the Elsinore Municipal Water Treatment Plant at Canyon Reservoir were among the backlog of samples that exceeded the recommended holding time. The holding times for these samples ranged from 1 to 114 days with a median of 68 days. Therefore, pesticides detected by lab code 9060 may be biased low in comparison with actual concentrations in surface water owing to possible compound degradation during the extended holding times. In addition, pesticides not detected by lab code 9060 (reported as <LRL) may have actually been present in surface water at the time the sample was collected. Finally, it is possible that certain pesticides may have been transformed during the extended holding period. Therefore, although parent compounds could be biased low, their degradation products could be biased high (Blomquist and others, 2001).

Table 7A. Field matrix spike recovery data for pesticides targeted in this study. A. GC/MS[a].

[GC/MS, gas chromatography/mass spectrometry; GC/MS[a], lab schedule 2001 (Lindley and others, 1996; Zaugg and others, 1995); nine spikes were performed for this analyte group; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent]

Compound	Parameter code	No. of environmental detects out of 138 samples	Spike recovery (in percent)			
			Minimum	Maximum	Median	Mean
2,6-Diethylaniline	82660	0	78	134	91	96
Acetochlor	49260	0	104	141	111	114
Alachlor	46342	0	98	132	112	114
alpha-HCH	34253	1	71	121	91	88
Atrazine	39632	63	88	130	105	105
Azinphos-methyl	82686	0	93	194	134	149
Benfluralin	82673	2	68	97	86	85
Butylate	04028	0	95	163	106	109
Carbaryl	82680	47	57	691	142	192
Carbofuran	82674	2	77	442	155	168
Chlorpyrifos	38933	28	51	123	93	90
cis-Permethrin	82687	0	38	61	49	48
Cyanazine	04041	3	102	185	117	122
DCPA	82682	61	84	116	108	105
Deethylatrazine	04040	45	38	84	60	58
Diazinon	39572	105	72	115	99	97
Dieldrin	39381	0	90	147	101	103
Disulfoton	82677	0	18	96	58	60
EPTC	82668	2	79	117	95	96
Ethalfluralin	82663	0	82	157	98	102
Ethoprophos	82672	0	84	122	97	101
Fonofos	04095	0	76	124	97	99
Lindane	39341	25	81	121	100	100
Linuron	82666	0	75	165	110	118
Malathion	39532	19	43	119	90	89
Metolachlor	39415	48	99	143	109	115
Metribuzin	82630	0	85	124	102	101
Molinate	82671	0	86	144	97	103
Napropamide	82684	2	100	183	113	118
p,p’-DDE	34653	3	49	71	59	59
Parathion	39542	0	83	198	109	113
Parathion-methyl	82667	0	87	179	110	114
Pebulate	82669	0	84	123	95	100
Pendimethalin	82683	4	73	190	102	106
Phorate	82664	0	45	92	63	66
Prometon	04037	111	89	143	108	110
Propachlor	04024	0	102	150	115	118
Propanil	82679	0	101	150	120	120

Table 7A. Field matrix spike recovery data for pesticides targeted in this study. A. GC/MS[a]—Continued.

[GC/MS, gas chromatography/mass spectrometry; GC/MS[a], lab schedule 2001 (Lindley and others, 1996; Zaugg and others, 1995); nine spikes were performed for this analyte group; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent]

Compound	Parameter code	No. of environmental detects out of 138 samples	Spike recovery (in percent)			
			Minimum	Maximum	Median	Mean
Propargite	82685	0	57	126	98	98
Propyzamide	82676	0	88	130	108	107
Simazine	04035	112	82	132	108	108
Tebuthiuron	82670	57	98	141	112	116
Terbacil	82665	1	80	210	133	132
Terbufos	82675	0	65	88	80	80
Thiobencarb	82681	0	83	131	105	105
Tri-allate	82678	1	81	127	98	100
Trifluralin	82661	4	68	143	90	93

Table 7B. Field matrix spike recovery data for pesticides targeted in this study. B, HPLC[d].

[HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060 (Furlong and others, 2001); three spikes were performed for this analyte group; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent]

Compound	Parameter code	No. of environmental detects out of 69 samples	Spike recovery (in percent)			
			Minimum	Maximum	Median	Mean
2-Hydroxyatrazine	50355	11	154	252	192	196
2,4-D	39732	7	29	119	99	83
2,4-DB	38746	0	14	88	65	62
2,4-D methyl ester	50470	1	62	84	77	73
3-Hydroxycarbofuran	49308	0	78	135	106	104
3-Ketocarbofuran	50295	0	59	91	71	72
3(4-Chlorophenyl)-1-methyl urea	61692	5	72	106	88	87
Acifluorfen	49315	0	2	59	31	32
Aldicarb	49312	0	7	33	29	25
Aldicarb sulfone	49313	1	8	40	27	27
Aldicarb sulfoxide	49314	0	22	87	73	64
Atrazine	39632	29	42	91	52	65
Bendiocarb	50299	0	75	112	97	93
Benomyl	50300	1	44	170	84	101
Bensulfuron-methyl	61693	0	169	261	200	206
Bentazon	38711	2	18	86	66	56
Bromacil	04029	13	50	79	66	66
Bromoxynil	49311	0	25	106	86	74
Caffeine	50305	38	83	133	102	106
Carbaryl	49310	8	79	123	108	104
Carbofuran	49309	0	80	159	112	111
Chloramben, methyl ester	61188	0	53	179	73	102
Chlorimuron-ethyl	50306	0	55	172	108	120
Chlorothalonil	49306	1	16	121	64	71
Clopyralid	49305	1	33	114	61	63
Cycloate	04031	0	31	81	47	55
Dacthal monoacid	49304	0	24	165	89	98
Deethylatrazine	04040	17	23	74	31	46
Deethyldeisopropylatrazine	04039	30	67	155	134	123
Deisopropylatrazine	04038	11	25	86	70	63
Dicamba	38442	1	30	108	77	70
Dichlorprop	49302	0	27	111	96	81
Dinoseb	49301	1	1	76	49	40
Diphenamid	04033	1	81	104	89	93
Diuron	49300	53	24	165	89	83
Fenuron	49297	1	67	113	96	92
Flumetsulam	61694	0	146	275	253	231
Fluometuron	38811	1	82	123	105	102

Table 7B. Field matrix spike recovery data for pesticides targeted in this study. B, HPLC[d]—Continued.

[HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060 (Furlong and others, 2001); three spikes were performed for this analyte group; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent]

Compound	Parameter code	No. of environmental detects out of 69 samples	Spike recovery (in percent)			
			Minimum	Maximum	Median	Mean
Imazaquin	50356	2	122	291	272	238
Imazethapyr	50407	0	0	480	113	207
Imidacloprid	61695	0	119	230	186	186
Linuron	38478	0	77	145	95	108
MCPA	38482	7	29	93	85	69
MCPB	38487	0	10	70	55	51
Metalaxyl	50359	3	92	131	112	111
Methiocarb	38501	0	76	100	92	89
Methomyl	49296	2	68	147	106	108
Metsulfuron-methyl	61697	0	41	110	87	83
Neburon	49294	0	21	81	50	49
Nicosulfuron	50364	0	227	414	275	295
Norflurazon	49293	14	-54	125	114	81
Oryzalin	49292	8	25	70	63	54
Oxamyl Oxime	50410	0	—	—	—	—
Oxamyl	38866	0	54	112	96	88
Picloram	49291	2	44	191	130	119
Propham	49236	1	84	113	95	96
Propiconazole	50471	0	42	111	72	73
Propoxur	38538	25	70	121	102	96
Siduron	38548	2	93	119	95	102
Sulfometuron-methyl	50337	26	156	225	188	192
Tebuthiuron	82670	35	41	130	53	79
Terbacil	04032	0	57	97	80	80
Tribenuron-methyl	61159	0	24	53	45	41
Triclopyr	49235	2	34	147	90	91

Table 7C. Field matrix spike recovery data for pesticides targeted in this study. C, GC/MS[b].

[GC/MS, Gas chromatography/mass spectrometry; GC/MS[b], lab code 9002 (Sandstrom and others, 2001); two spikes were performed for this analyte group; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent]

Compound	Parameter code	Number of environmental detects out of 43 samples	Spike recovery (in percent)			
			Minimum	Maximum	Median	Mean
1-Naphthol	49295	5	4	66	58	43
1,4-Napthoquinone	61611	0	70	82	82	78
2-Amino-N-Isopropylbenzamide	61617	0	44	85	84	71
2-Chloro-2,6-diethylacetanilide	61618	0	111	114	111	112
2-Ethyl-6-methylaniline	61620	0	82	89	88	86
2-[(2-Ethyl-6-methylphenyl)amino]-1-propanol	61615	2	95	138	134	122
2-(4-tert-butylphenoxy)-cyclohexanol	61637	0	129	138	135	134
2,5-Dichloroaniline	61614	5	83	85	84	84
3-Phenoxybenzyl alcohol	61629	1	102	105	104	104
3-Trifluoromethylaniline	61630	0	33	46	42	40
3,4-Dichloroaniline	61625	34	70	90	83	81
3,5-Dichloroaniline	61627	0	90	93	93	92
4-Chlorobenzylmethylsulfone	61634	0	65	76	70	70
4-Chloro-2-methylphenol	61633	3	63	69	68	67
4,4’-Dichlorobenzophenone	61631	0	114	130	128	124
alpha-Endosulfan	34362	0	79	96	95	90
Azinphos-methyl-oxon	61635	0	106	125	123	118
beta-Endosulfan	34357	0	89	102	92	94
Bifenthrin	61580	0	26	29	27	28
Chlorpyrofos oxygen analog	61636	0	39	119	115	91
cis-Carboxylate	79842	0	49	65	49	55
cis-Propiconazole	79846	0	32	65	57	51
Cycloate	4031	0	112	199	114	142
Cyfluthrin	61585	0	62	88	64	71
Cypermethrin	61586	0	70	79	77	75
Dichlorvos	38775	0	27	54	49	43
Dicrotophos	38454	0	40	48	46	45
Dimethoate	82662	0	38	70	58	55
Disulfoton sulfone	61640	1	106	135	128	123
Disulfotone sulfoxide	61641	2	114	131	129	125
e-Dimethomorph	79844	0	55	59	55	56
Endosulfan-ether	61642	0	104	118	111	111
Endosulfan sulfate	61590	0	91	117	113	107
Ethion	82346	0	87	118	108	104
Ethion monoxon	61644	0	71	178	171	140
Fenamiphos	61591	0	106	136	129	124
Fenamiphos sulfone	61645	0	109	115	110	111
Fenamiphos sulfoxide	61646	0	34	56	37	42
Fenthion sulfone	61648	0	—	—	—	—
Fenthion sulfoxide	61647	0	101	129	123	117

Table 7C. Field matrix spike recovery data for pesticides targeted in this study. C, GC/MS[b]—Continued.

[GC/MS, Gas chromatography/mass spectrometry; GC/MS[b], lab code 9002 (Sandstrom and others, 2001); two spikes were performed for this analyte group; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent]

Compound	Parameter code	Number of environmental detects out of 43 samples	Spike recovery (in percent)			
			Minimum	Maximum	Median	Mean
Fenthion	38801	0	70	108	106	95
Flumetralin	61592	0	100	128	123	117
Fonofos oxygen analog	61649	0	103	123	113	113
Hexazinone	4025	1	81	99	94	91
Iprodione	61593	1	69	107	76	84
Isofenphos	61594	0	117	131	130	126
Lambdacyhalothrin	61595	0	33	45	34	38
Malaoxon	61652	1	119	155	143	139
Metalaxyl	61596	2	122	134	129	128
Methidathion	61598	0	86	118	111	105
Myclobutanil	61599	0	87	111	106	101
O-Ethyl-O-methyl-S-propylphosphoro-thioate	61660	0	103	116	106	108
Oxyfluorofen	61600	0	103	115	106	108
Paraoxon-ethyl	61663	0	133	142	135	137
Paraoxon-methyl	61664	0	92	113	109	105
Pendimethlion metabolite	61665	0	136	142	141	140
Phorate oxon	61666	0	126	146	136	136
Phosmet	61601	0	35	65	36	45
Phosmet oxon	61668	0	47	60	51	53
Phostebupirm	61602	0	107	111	107	108
Phostebupirim oxygen analogue	61669	0	114	127	116	119
Profenofos	61603	0	86	110	101	99
Prometryn	4036	1	113	123	114	117
Propetamphos	61604	0	105	139	138	127
Sulfotepp	61605	0	34	104	98	79
Sulprofos	38716	0	59	98	91	83
TCPSA, ethyl ester	61670	0	74	98	93	88
Tefluthrin	61606	0	54	55	54	54
Tefluthrin metabolite [R 119364]	61671	0	54	67	65	62
Tefluthrin metabolite [R 152912]	61672	0	80	86	82	83
Temephos	61607	0	27	79	73	60
Terbufos-O-analogue sulfone	61674	0	100	158	145	134
Terbuthylazine	4022	0	—	—	—	—
trans-Carboxylate	79843	0	48	53	51	51
trans-Propiconazole	79847	0	52	60	56	56
Tribufos	61610	0	88	228	205	174
z-Dimethomorph	79845	0	52	56	53	54

Table 7D. Field matrix spike recovery data for pesticides targeted in this study. D, VOCs-CG/MS[c].

[GC/MS, gas chromatography/mass spectrometry; GC/MS[c], lab schedule 2020 (volatile organic compounds) [Rose and Schroeder, 1995; Connor and others, 1998]; eight spikes were performed for this analyte group; parameter code, a 5-digit code used by the U.S. Geological Survey to uniquely identify a specific constituent]

Compound	Parameter code	Number of environmental detects out of 121 samples	Spike recovery (in percent)			
			Minimum	Maximum	Median	Mean
1,2-Dibromoethane	77651	0	71	101	80	84
1,2-Dibromo-3-chloropropane	82625	0	59	98	90	84
1,2,3-Trichlorobenzene	77613	0	57	96	69	74
1,4-Dichlorobenzene	34571	8	48	99	66	72
Carbon disulfide	77041	16	35	104	76	71
cis-1,3-Dichloropropene	34704	0	45	97	75	73
trans-1,3-Dichloropropene	34699	0	49	95	75	74

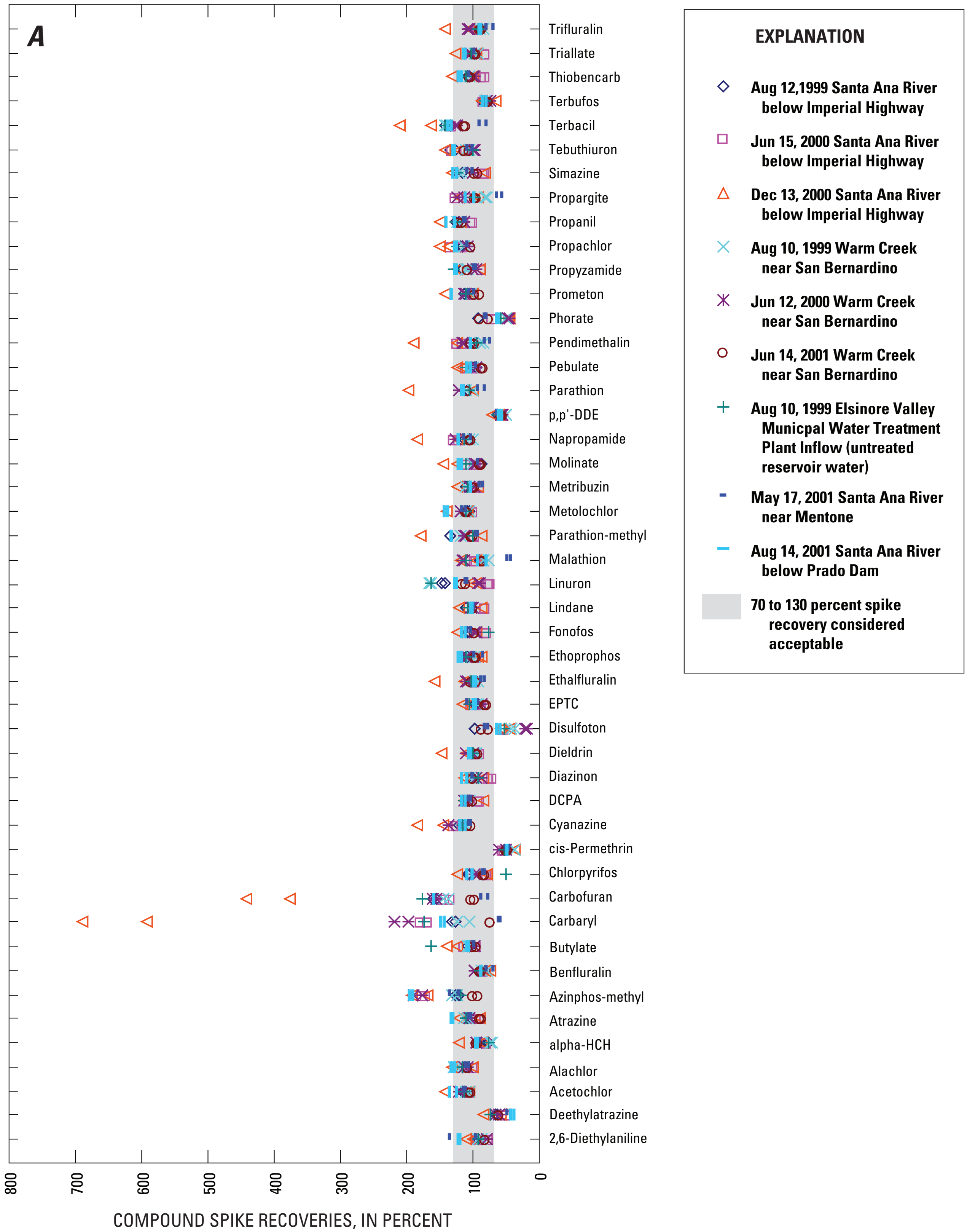

Figure 13. Percentage of recoveries for pesticide compounds in field matrix-spiked surface-water samples in the Santa Ana Basin: *A*, spike recoveries for Lab Schedule 2001 (GC/MS[a]); *B*, spike recoveries for Lab Code 9060 (HPLC[d]); *C*, spike recoveries for Lab Code 9002 (GC/MS[b]); and *D*, spike recoveries for Lab Schedule 2020 (GC/MS[c]). Recoveries between 70 and 130 percent (gray areas of plots) are considered acceptable.

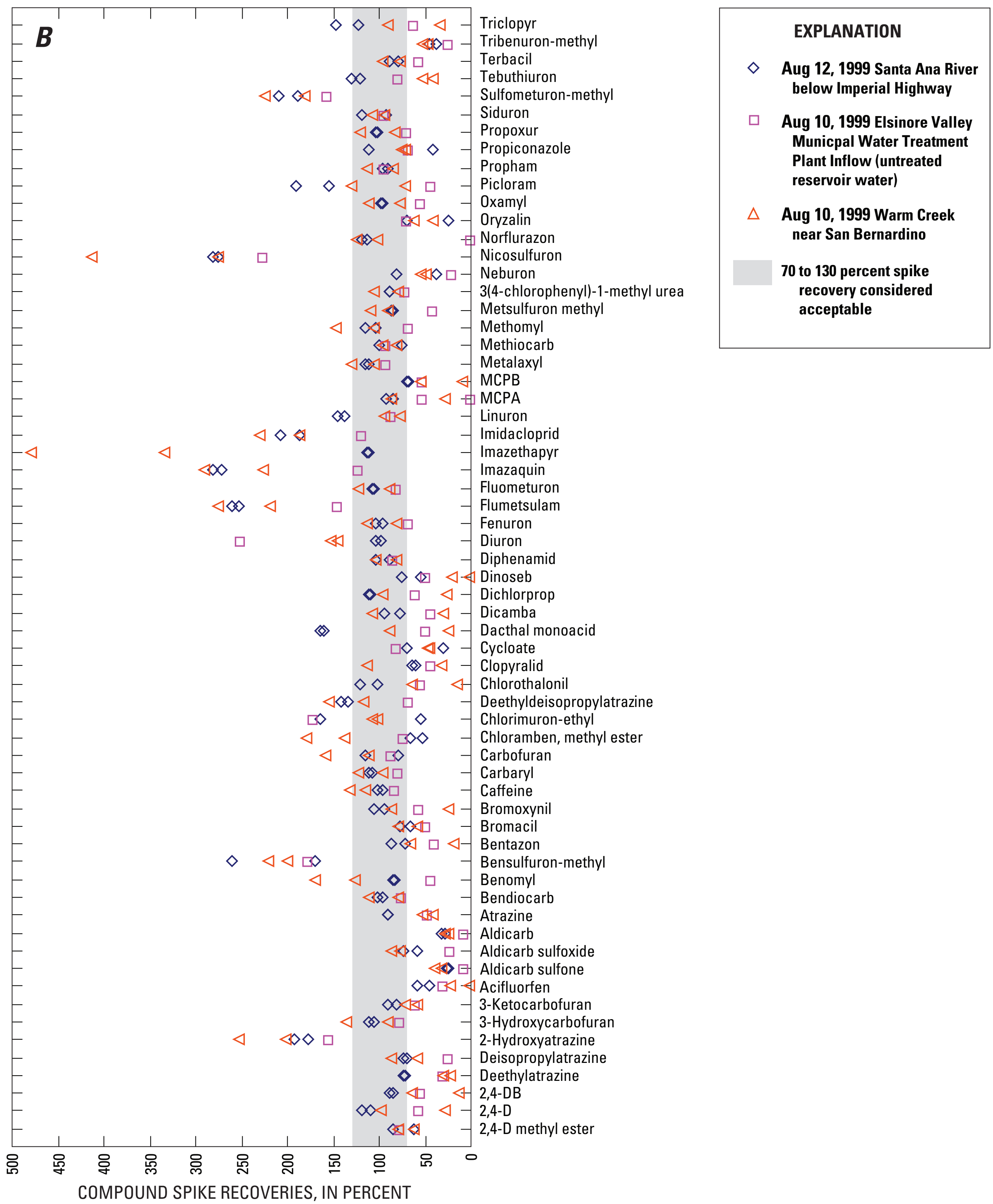

Figure 13.—Continued.

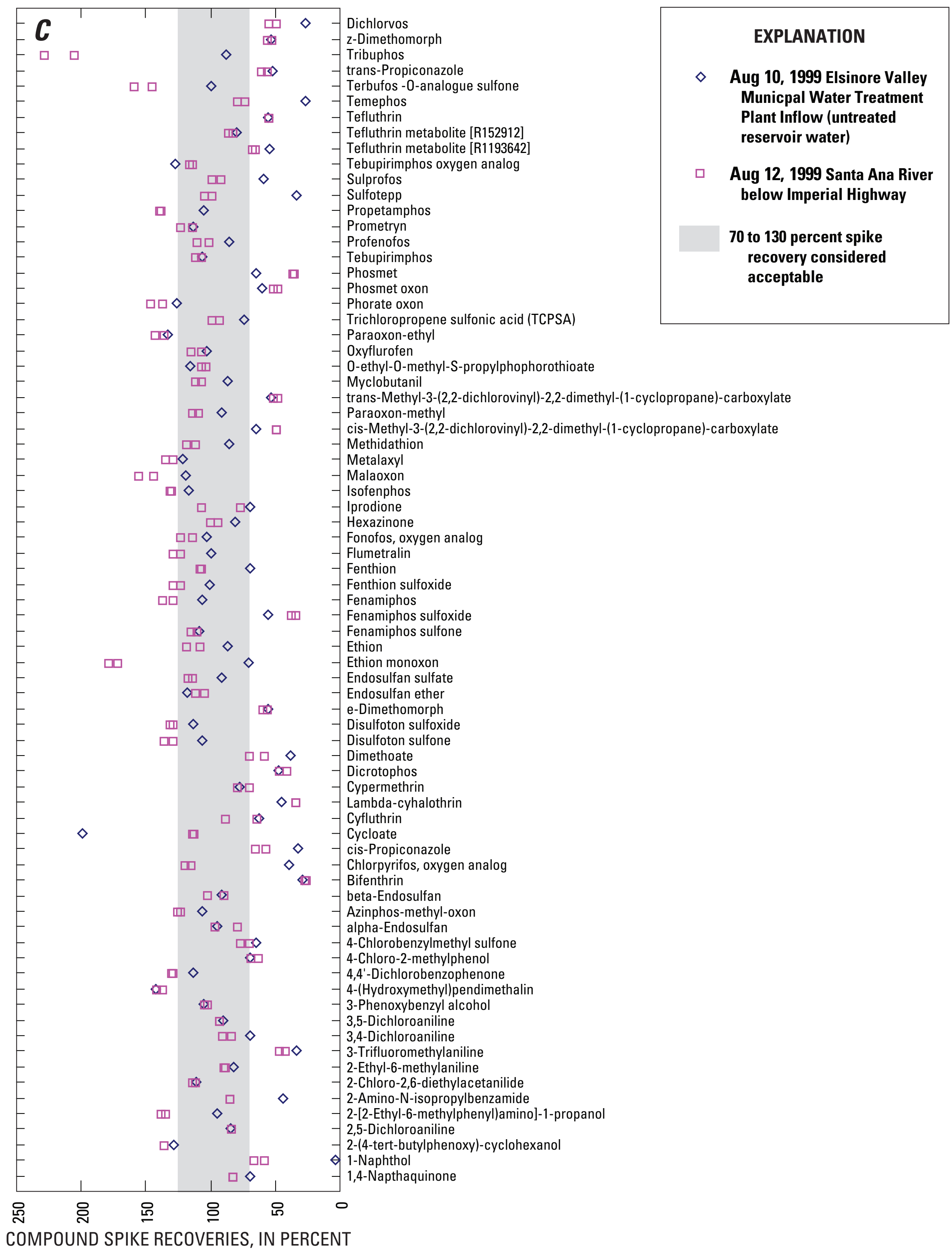

Figure 13.—Continued.

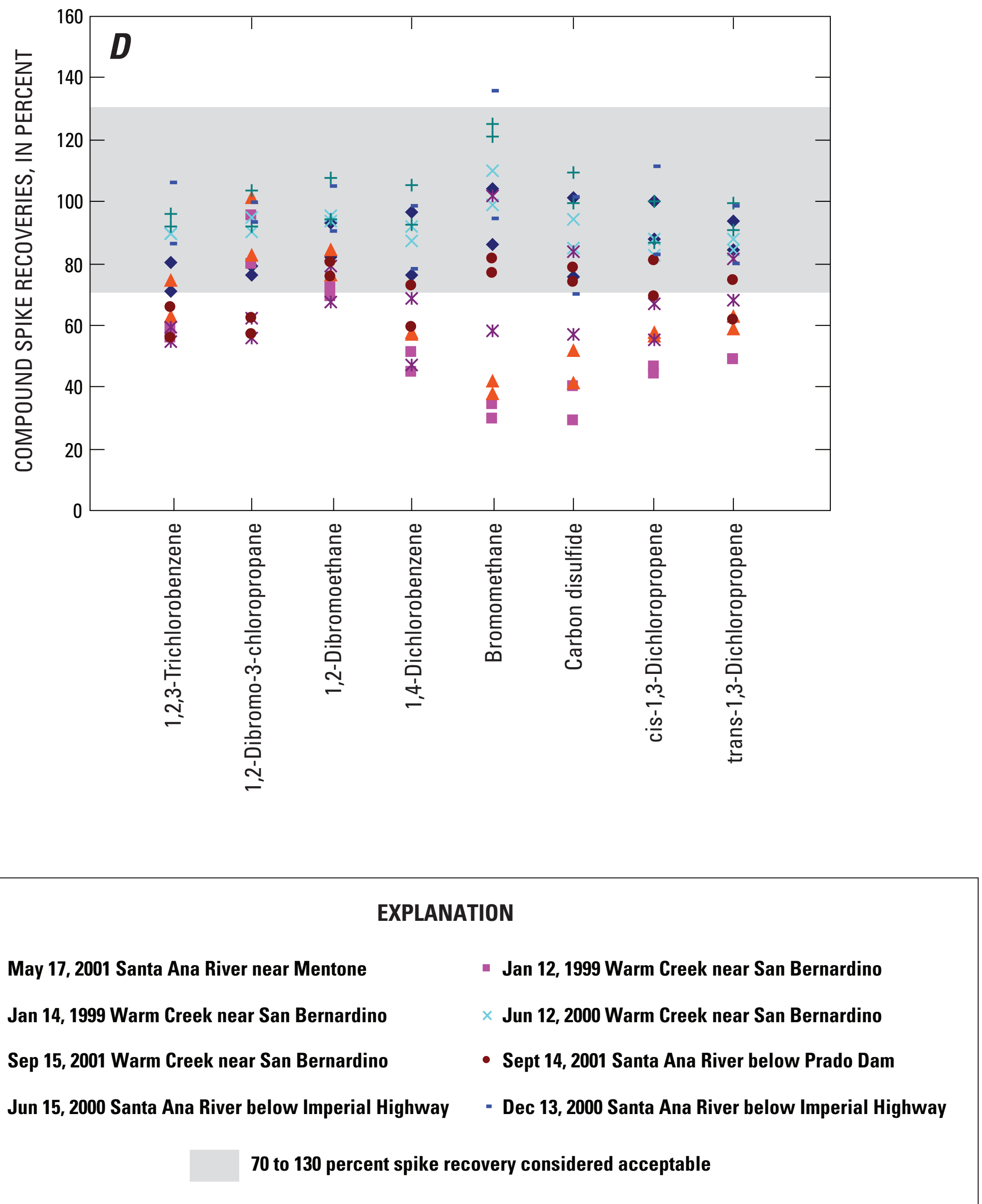

Figure 13.—Continued.

Summary and Conclusions

Pesticide compounds were detected in most water samples collected from November 1998 to September 2001 for a study of the occurrence and distribution of such compounds in surface water of the Santa Ana Basin. Sixty-six different pesticide compounds were present in at least one of the 148 samples collected for the study. One-third (22) of these compounds were detected frequently (in at least 25 percent of the samples) at any of the fixed sampling sites. These 22 "major" pesticide compounds included 15 herbicide compounds: atrazine and 3 of its degradates (deethylatrazine, deethyldeisopropylatrazine, and deisopropylatrazine), bromacil, DCPA, diuron, 3,4-dichloroaniline (a degradate of diuron), metolachlor, norflurazon, oryzalin, prometon, simazine, sulfometuron methyl, and tebuthiuron; and 7 insecticide compounds: carbaryl, carbon disulfide, chlorpyrifos, diazinon, lindane, malathion, and propoxur.

Stream concentrations of these major compounds mostly were within typical ranges observed in NAWQA studies nationwide. However, the maximum concentrations observed for three herbicides in this study—diuron, oryzalin, and sulfometuron methyl—were among the highest detected in streams studied by NAWQA nationwide. With the partial exception of sulfometuron methyl, there was substantial registered use in the Santa Ana drainage basins in 2001 for these three compounds. Most of the detections of pesticide compounds were at low concentrations relative to drinking-water standards and criteria established to protect aquatic life. However, the concentrations of two compounds, the insecticide diazinon and the herbicide diuron, exceeded non-enforceable drinking-water health-advisory levels in a few samples. Four additional insecticides—carbaryl, chlorpyrifos, lindane, and malathion—exceeded guidelines established to protect aquatic life in a few samples. Most pesticide concentrations that exceeded advisory levels or guidelines were observed following rainstorms. Storms had substantial and persistent effects on the stream concentrations of several pesticide compounds, along with caffeine. Caffeine is considered a wastewater indicator. Therefore, the observation that caffeine concentrations were highest in samples associated with storms was unexpected, since most base flow in the Santa Ana River consists of treated wastewater, and stormwater usually dilutes concentrations of base flow constituents.

Storms increased runoff and increased the detection frequency and concentrations of compounds associated with urban runoff. Compounds with sources other than urban runoff were detected less frequently, and at lower concentrations, following storms. For example, ground water in some areas is probably the source of most of the atrazine in the Santa Ana River. Treated wastewater is the likely source of much of the lindane and bromacil in study-area streams. The occurrence of several compounds showed correlation with their reported use in the basin. However, physical-chemical properties, such as those that affect the tendency of a compound to exist and persist in water, were also important factors for stream pesticide occurrence.

On seven dates, paired samples were collected from two Santa Ana River sites located approximately 11 mi apart on the highly urbanized basin floor. Sample-collection times were separated by the approximate travel time of a parcel of water between the two sites to evaluate in-stream changes in the concentrations of water-quality analytes. Results from the seven paired samples indicate that stream concentrations of most of the major pesticide compounds targeted for analysis in these samples tended to be conservative in the river. However, lindane concentrations tended to decrease, and there appeared to be a source of tebuthiuron entering the river between the two sites.

The present study collaborated with a USEPA nationwide monitoring program initiated to assess human exposure to pesticides in drinking water derived from surface-water reservoirs. Water from Canyon Reservoir in the Santa Ana Basin was sampled before and after treatment at a drinking-water treatment facility to determine the occurrence of pesticide compounds in the source reservoir, and to evaluate the effectiveness of the treatment process on reducing concentrations of these compounds. The samples were analyzed for 176 compounds. Twenty compounds were detected in at least one of the untreated reservoir samples. Eight of these twenty were also detected in at least one of the treated samples. But most of these were detected less frequently, and at lower concentrations, in the treated samples than in the untreated samples. It appears that the treatment process may be particularly effective on urea herbicides, and not effective on triazine herbicides.

The high degree of urbanization in the Santa Ana Basin creates a disconnection between landscape and streams. The disconnection is expressed in the forms of water diversions, stream channelization, and high volumes of point source discharges to the streams. Effluents from wastewater treatment plants comprise most of the baseflow of the Santa Ana River, and runoff from the landscape is only significant after rain events. Therefore, it is somewhat unexpected that pesticide occurrence in the basin generally correlates with patterns of outside pesticide use and physical-chemical characteristics of the compounds.

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Appendixes

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Atrazine, GC/MS[a] (39632)	Benfluralin, GC/MS[a] (82673)	Cyanazine, GC/MS[a] (04041)	DCPA (dacthal), GC/MS[a] (82682)	EPTC, GC/MS[a] (82668)	Metolachlor, GC/MS[a] (39415)	Napropamide, GC/MS[a] (82684)	Pendimethal-in, GC/MS[a] (82683)
EVMWTP-IN-01	07/15/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
EVMWTP-IN-02	08/10/1999	<0.001	<0.002	<0.004	<0.002	<0.002	**0.004**	<0.003	<0.004
EVMWTP-IN-03	08/23/1999	<0.001	<0.002	<0.004	<0.002	<0.002	**E0.004**	<0.003	<0.004
EVMWTP-IN-04	09/13/1999	**0.005**	<0.002	<0.004	**E0.002**	<0.002	<0.002	<0.003	<0.004
EVMWTP-IN-05	09/28/1999	<0.005	<0.002	<0.004	**E0.003**	<0.002	**0.005**	<0.003	<0.004
EVMWTP-IN-06	10/28/1999	**E0.004**	<0.002	<0.004	**E0.002**	<0.002	<0.002	<0.003	<0.004
EVMWTP-IN-07	11/29/1999	**0.006**	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
EVMWTP-IN-08	12/13/1999	**E0.003**	<0.002	<0.004	**E0.002**	<0.002	<0.002	<0.003	<0.004
EVMWTP-FI-01	07/15/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
EVMWTP-FI-02	08/10/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
EVMWTP-FI-03	08/23/1999	<0.001	<0.002	<0.004	<0.002	<0.002	0.003	<0.003	<0.004
EVMWTP-FI-04	09/13/1999	**E0.003**	<0.002	<0.004	**E0.002**	<0.002	<0.002	<0.003	<0.004
EVMWTP-FI-05	09/28/1999	<0.006	<0.002	<0.004	<0.002	<0.002	<0.006	<0.003	<0.004
EVMWTP-FI-06	10/28/1999	**E0.004**	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
EVMWTP-FI-07	11/29/1999	0.005	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
EVMWTP-FI-08	12/13/1999	**E0.003**	<0.002	<0.004	**E0.002**	<0.002	<0.002	<0.003	<0.004
IMP-01	11/20/1998	Ruined	Ruined	Ruined	Ruined	Ruined	Ruined	Ruined	Ruined
IMP-02	12/10/1998	**E0.006**	<0.002	<0.004	**E0.001**	<0.002	**E0.002**	<0.003	<0.004
IMP-03	01/14/1999	**0.006**	<0.002	<0.004	**E0.001**	<0.002	<0.002	<0.003	<0.004
IMP-04	01/25/1999	**0.006**	<0.002	<0.004	**0.009**	<0.002	**0.004**	**0.014**	<0.004
IMP-05	02/09/1999	**0.007**	<0.002	<0.004	**E0.004**	<0.002	<0.002	**0.008**	<0.004
IMP-06	02/12/1999	**0.006**	<0.002	<0.004	**E0.002**	<0.002	**0.026**	<0.003	<0.004

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Prometon, GC/MS[a] (04037)	Simazine, GC/MS[a] (04035)	Tebuthiuron, GC/MS[a] (82670)	Terbacil,* GC/MS[a] (82665)	Triallate, GC/MS[a] (82678)	Trifluralin, GC/MS[a] (82661)	Hexazinone, GC/MS[b] (04025)	Prometryn, GC/MS[b] (04036)
EVMWTP-IN-01	07/15/1999	**0.03**	**0.084**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-IN-02	08/10/1999	**0.02**	**0.081**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-IN-03	08/23/1999	**0.02**	**0.075**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-IN-04	09/13/1999	**0.03**	**0.091**	**E0.01**	<0.007	**E0.002**	**E0.002**	<0.008	<0.005
EVMWTP-IN-05	09/28/1999	**0.03**	**0.084**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-IN-06	10/28/1999	**0.03**	**0.070**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-IN-07	11/29/1999	**0.02**	**0.073**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-IN-08	12/13/1999	**E0.02**	**0.062**	**E0.01**	—	<0.001	<0.002	<0.008	<0.005
EVMWTP-FI-01	07/15/1999	**0.03**	**0.076**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-FI-02	08/10/1999	**E0.02**	**0.056**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-FI-03	08/23/1999	**0.02**	**0.061**	**0.02**	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-FI-04	09/13/1999	**E0.02**	**0.064**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-FI-05	09/28/1999	**0.02**	**0.073**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-FI-06	10/28/1999	**0.03**	**0.078**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-FI-07	11/29/1999	**0.02**	**0.059**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-FI-08	12/13/1999	**E0.02**	**0.059**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-01	11/20/1998	Ruined	Ruined	Ruined	Ruined	Ruined	Ruined	—	—
IMP-02	12/10/1998	**E0.01**	**E0.106**	<0.01	<0.007	<0.001	<0.002	—	—
IMP-03	01/14/1999	**0.08**	**0.050**	<0.01	<0.007	<0.001	<0.002	—	—
IMP-04	01/25/1999	**0.04**	**0.045**	<0.01	<0.007	<0.001	<0.002	—	—
IMP-05	02/09/1999	**0.03**	**0.067**	<0.01	<0.007	<0.001	<0.002	—	—
IMP-06	02/12/1999	**0.03**	**0.113**	<0.01	<0.007	<0.001	<0.002	—	—

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
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IMP-07	03/11/1999	**0.007**	<0.002	<0.004	**E0.001**	<0.002	**0.007**	<0.003	<0.004
IMP-08	03/15/1999	**0.006**	<0.002	<0.004	**E0.002**	<0.002	<0.002	<0.003	**0.05**
IMP-09	04/16/1999	**0.009**	<0.002	<0.004	**E0.003**	<0.002	**0.005**	<0.003	<0.004
IMP-10	05/20/1999	**0.007**	<0.002	<0.004	<0.002	<0.002	**0.004**	<0.003	<0.004
IMP-11	06/18/1999	**0.007**	<0.002	<0.004	**E0.001**	<0.002	**0.005**	<0.003	<0.004
IMP-12	07/15/1999	<0.010	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
IMP-13	07/26/1999	**0.008**	<0.002	<0.004	**E0.001**	<0.002	<0.010	<0.003	<0.004
IMP-14	08/12/1999	**0.006**	<0.002	<0.004	<0.002	<0.002	**E0.004**	<0.003	<0.004
IMP-15	08/25/1999	**0.008**	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
IMP-16	09/16/1999	**0.008**	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
IMP-17	09/29/1999	<0.008	<0.002	<0.004	<0.002	<0.002	<0.006	<0.003	<0.004
IMP-18	10/15/1999	**0.009**	<0.002	<0.004	**E0.003**	<0.002	**0.012**	<0.003	<0.004
IMP-19	10/29/1999	**0.006**	<0.002	<0.004	**E0.002**	<0.002	**0.005**	<0.003	<0.004
IMP-20	11/18/1999	**0.007**	<0.002	<0.004	<0.002	<0.002	**0.005**	<0.003	<0.004
IMP-21	11/30/1999	**0.010**	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
IMP-22	12/16/1999	**0.008**	<0.002	<0.004	<0.002	<0.002	**0.008**	<0.003	<0.004
IMP-23	12/28/1999	**0.006**	<0.002	<0.004	**E0.002**	<0.002	**E0.002**	<0.003	<0.004
IMP-24	01/13/2000	**0.007**	<0.002	<0.004	<0.002	<0.002	**0.006**	<0.003	<0.004
IMP-25	01/25/2000	<0.010	<0.002	<0.004	**E0.003**	<0.002	<0.002	<0.003	<0.004
IMP-26	02/01/2000	<0.007	<0.002	<0.004	**E0.002**	<0.002	**0.006**	<0.003	<0.004
IMP-27	02/12/2000	<0.001	**0.006**	<0.004	**E0.003**	<0.002	**0.008**	<0.003	**0.078**
IMP-28	02/18/2000	<0.010	<0.002	<0.004	**E0.004**	<0.002	**0.006**	<0.003	**0.008**

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Prometon, GC/MS[a] (04037)	Simazine, GC/MS[a] (04035)	Tebuthiuron, GC/MS[a] (82670)	Terbacil,* GC/MS[a] (82665)	Triallate, GC/MS[a] (82678)	Trifluralin, GC/MS[a] (82661)	Hexazinone, GC/MS[b] (04025)	Prometryn, GC/MS[b] (04036)
IMP-07	03/11/1999	**E0.01**	**0.043**	0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-08	03/15/1999	**0.05**	**0.056**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-09	04/16/1999	**0.02**	**0.100**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-10	05/20/1999	**E0.02**	**0.049**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-11	06/18/1999	**0.02**	**0.043**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-12	07/15/1999	**E0.01**	**0.059**	<0.02	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-13	07/26/1999	**0.02**	**0.045**	**0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-14	08/12/1999	**E0.01**	**0.035**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-15	08/25/1999	**E0.01**	**0.042**	**0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-16	09/16/1999	**E0.01**	**0.035**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-17	09/29/1999	**E0.01**	**0.036**	**0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-18	10/15/1999	**0.02**	**0.033**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-19	10/29/1999	**0.04**	**0.044**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-20	11/18/1999	<0.02	**0.096**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-21	11/30/1999	**E0.01**	**0.073**	**0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-22	12/16/1999	**E0.01**	**0.042**	**E0.01**	<0.007	<0.001	<0.002	<0.008	**E0.004**
IMP-23	12/28/1999	**E0.01**	**0.043**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-24	01/13/2000	**E0.01**	**0.041**	**E0.01**	<0.007	<0.001	<0.002	**0.01**	<0.005
IMP-25	01/25/2000	**0.02**	**0.038**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-26	02/01/2000	**E0.02**	**0.050**	**0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-27	02/12/2000	**0.03**	**0.044**	<0.01	<0.007	<0.001	**0.007**	<0.008	<0.005
IMP-28	02/18/2000	**E0.03**	**0.107**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Atrazine, GC/MS[a] (39632)	Benfluralin, GC/MS[a] (82673)	Cyanazine, GC/MS[a] (04041)	DCPA (dacthal), GC/MS[a] (82682)	EPTC, GC/MS[a] (82668)	Metolachlor, GC/MS[a] (39415)	Napropamide, GC/MS[a] (82684)	Pendimethal-in, GC/MS[a] (82683)
IMP-29	02/23/2000	<0.001	<0.002	<0.004	**E0.004**	<0.002	**0.009**	<0.003	<0.004
IMP-30	02/29/2000	**0.006**	<0.002	<0.004	**E0.004**	<0.002	**0.006**	<0.003	<0.004
IMP-31	03/17/2000	**0.006**	<0.002	<0.004	**E0.003**	<0.002	**0.007**	<0.003	<0.010
IMP-32	03/31/2000	**E0.003**	<0.002	<0.004	**E0.002**	<0.002	**0.004**	<0.003	<0.004
IMP-33	04/13/2000	**0.008**	<0.002	<0.004	<0.002	<0.002	**0.005**	<0.003	<0.004
IMP-34	05/12/2000	**0.008**	<0.002	<0.008	<0.002	<0.002	**0.005**	<0.003	<0.004
IMP-35	06/15/2000	**0.005**	<0.002	<0.004	**E0.001**	<0.002	<0.002	<0.003	<0.004
IMP-36	07/14/2000	**0.004**	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
IMP-37	08/17/2000	**0.009**	<0.002	<0.004	**E0.001**	<0.002	<0.002	<0.003	<0.004
IMP-38	09/13/2000	**0.005**	<0.002	<0.004	**E0.002**	<0.002	**E0.002**	<0.003	<0.004
IMP-39	10/19/2000	**E0.004**	<0.010	<0.018	**E0.001**	<0.002	**E0.005**	<0.007	<0.010
IMP-40	12/13/2000	**E0.004**	<0.010	<0.018	<0.003	<0.002	**E0.003**	<0.007	<0.010
IMP-41	01/18/2001	<0.007	<0.010	<0.018	**0.005**	<0.002	**E0.005**	<0.007	<0.010
IMP-42	02/21/2001	**E0.003**	<0.010	<0.018	**E0.002**	<0.002	**E0.002**	<0.007	<0.010
IMP-43	04/19/2001	**E0.004**	<0.010	<0.018	**E0.001**	<0.002	<0.013	<0.007	<.011
MEN-01	02/20/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
MEN-02	03/22/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
MEN-03	04/16/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
MEN-04	05/17/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
MEN-05	06/14/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
MEN-06	07/10/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
MEN-07	08/13/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Prometon, GC/MS[a] (04037)	Simazine, GC/MS[a] (04035)	Tebuthiuron, GC/MS[a] (82670)	Terbacil,* GC/MS[a] (82665)	Triallate, GC/MS[a] (82678)	Trifluralin, GC/MS[a] (82661)	Hexazinone, GC/MS[b] (04025)	Prometryn, GC/MS[b] (04036)
IMP-29	02/23/2000	**0.02**	**0.498**	<0.01	<0.007	<0.001	**E0.002**	<0.008	<0.005
IMP-30	02/29/2000	**E0.02**	**0.125**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-31	03/17/2000	**E0.01**	**0.127**	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-32	03/31/2000	**0.02**	**0.064**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-33	04/13/2000	**E0.02**	**0.045**	**0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-34	05/12/2000	**E0.02**	**0.068**	**0.01**	<0.007	<0.001	<0.002	—	—
IMP-35	06/15/2000	**0.02**	**0.043**	**0.01**	<0.030	<0.001	**E0.002**	—	—
IMP-36	07/14/2000	**0.02**	**0.034**	**E0.01**	<0.007	<0.001	<0.002	—	—
IMP-37	08/17/2000	**E0.01**	**0.030**	**E0.02**	<0.007	<0.001	<0.002	—	—
IMP-38	09/13/2000	**E0.01**	**0.024**	**E0.01**	<0.007	<0.001	<0.002	—	—
IMP-39	10/19/2000	**E0.01**	**0.018**	**E0.01**	<0.034	<0.002	<0.009	—	—
IMP-40	12/13/2000	**E0.01**	**0.044**	**E0.01**	<0.034	<0.002	<0.009	—	—
IMP-41	01/18/2001	**0.02**	**0.368**	<0.02	<0.034	<0.002	<0.009	—	—
IMP-42	02/21/2001	**E0.01**	**0.073**	<0.02	<0.034	<0.002	<0.009	—	—
IMP-43	04/19/2001	**0.02**	**0.046**	**E0.01**	<0.034	<0.002	<0.009	—	—
MEN-01	02/20/2001	<0.01	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
MEN-02	03/22/2001	<0.01	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
MEN-03	04/16/2001	<0.01	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
MEN-04	05/17/2001	<0.01	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
MEN-05	06/14/2001	<0.01	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
MEN-06	07/10/2001	<0.01	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
MEN-07	08/13/2001	<0.01	<0.011	<0.02	<0.034	<0.002	<0.009	—	—

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Atrazine, GC/MS[a] (39632)	Benfluralin, GC/MS[a] (82673)	Cyanazine, GC/MS[a] (04041)	DCPA (dacthal), GC/MS[a] (82682)	EPTC, GC/MS[a] (82668)	Metolachlor, GC/MS[a] (39415)	Napropamide, GC/MS[a] (82684)	Pendimethal-in, GC/MS[a] (82683)
MEN-08	09/13/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
PRADO-01	07/13/2000	**E0.003**	<0.002	<0.004	**E0.001**	<0.002	**E0.004**	<0.003	<0.004
PRADO-02	08/17/2000	**0.011**	<0.002	<0.004	**E0.002**	<0.002	<0.002	<0.003	<0.004
PRADO-03	09/13/2000	**0.005**	<0.002	<0.004	<0.002	<0.002	**E0.001**	<0.003	<0.004
PRADO-04	10/19/2000	**E0.004**	<0.010	<0.018	<0.003	<0.002	**E0.005**	<0.007	<0.010
PRADO-05	12/13/2000	**E0.004**	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
PRADO-06	01/18/2001	<0.007	<0.010	<0.018	**0.005**	<0.002	**E0.006**	<0.007	<0.010
PRADO-07	02/21/2001	**E0.004**	<0.010	<0.018	**E0.002**	<0.002	<0.013	<0.007	<0.010
PRADO-08	03/21/2001	**E0.003**	<0.010	<0.018	**E0.002**	<0.002	<0.013	<0.007	<0.010
PRADO-09	04/19/2001	**E0.005**	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
PRADO-10	05/16/2001	**E0.004**	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
PRADO-11	06/13/2001	**0.008**	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
PRADO-12	07/12/2001	**E0.006**	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
PRADO-13	08/14/2001	**E0.003**	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
PRADO-14	09/12/2001	**0.007**	<0.010	<0.018	<0.003	<0.002	**E0.006**	<0.007	<0.010
ULUG-01	08/07/2000	<0.005	<0.002	<0.004	**0.006**	<0.002	<0.002	<0.003	<0.004
ULUG-02	08/08/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
ULUG-03	08/08/2000	<0.005	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
ULUG-04	08/09/2000	<0.001	<0.002	**0.01**	**E0.002**	<0.002	**0.009**	<0.003	<0.004
ULUG-05	08/09/2000	<0.004	<0.002	**0.023**	<0.002	<0.002	**0.007**	<0.003	<0.004
ULUG-06	08/10/2000	**0.016**	**0.004**	**0.008**	**0.011**	<0.002	**0.009**	<0.003	<0.004
ULUG-07	08/11/2000	<0.001	<0.002	<0.004	**E0.001**	<0.002	**0.007**	<0.003	<0.004

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Prometon, GC/MS[a] (04037)	Simazine, GC/MS[a] (04035)	Tebuthiuron, GC/MS[a] (82670)	Terbacil,* GC/MS[a] (82665)	Triallate, GC/MS[a] (82678)	Trifluralin, GC/MS[a] (82661)	Hexazinone, GC/MS[b] (04025)	Prometryn, GC/MS[b] (04036)
MEN-08	09/13/2001	<0.01	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
PRADO-01	07/13/2000	**0.02**	**0.036**	<0.01	<0.020	<0.001	<0.002	—	—
PRADO-02	08/17/2000	**E0.01**	**0.032**	<0.01	<0.007	<0.001	<0.002	—	—
PRADO-03	09/13/2000	**E0.01**	**0.025**	<0.01	<0.007	<0.001	<0.002	—	—
PRADO-04	10/19/2000	**E0.01**	**0.019**	<0.02	<0.034	<0.002	<0.009	—	—
PRADO-05	12/13/2000	**E0.01**	**0.053**	<0.02	<0.034	<0.002	<0.009	—	—
PRADO-06	01/18/2001	**0.02**	**0.409**	<0.02	<0.034	<0.002	<0.009	—	—
PRADO-07	02/21/2001	**E0.01**	**0.071**	<0.02	<0.034	<0.002	<0.009	—	—
PRADO-08	03/21/2001	**E0.01**	**0.061**	<0.02	<0.034	<0.002	<0.009	—	—
PRADO-09	04/19/2001	**0.02**	**0.049**	<0.02	<0.034	<0.002	<0.009	—	—
PRADO-10	05/16/2001	**E0.01**	**0.039**	**E0.01**	<0.034	<0.002	<0.009	—	—
PRADO-11	06/13/2001	**0.02**	**0.035**	<0.02	<0.034	<0.002	<0.009	—	—
PRADO-12	07/12/2001	**0.02**	**0.035**	<0.02	<0.034	<0.002	<0.009	—	—
PRADO-13	08/14/2001	<0.01	**0.039**	<0.02	<0.034	<0.002	<0.009	—	—
PRADO-14	09/12/2001	**0.02**	**0.030**	<0.02	<0.034	<0.002	<0.009	—	—
ULUG-01	08/07/2000	**0.02**	<0.020	<0.01	<0.007	<0.001	<0.002	—	—
ULUG-02	08/08/2000	<0.02	<0.005	<0.01	<0.007	<0.001	<0.002	—	—
ULUG-03	08/08/2000	<0.02	<0.010	<0.01	<0.007	<0.001	<0.002	—	—
ULUG-04	08/09/2000	**0.03**	**0.034**	**E0.11**	<0.100	<0.001	<0.002	—	—
ULUG-05	08/09/2000	<0.02	<0.010	<0.01	<0.100	<0.001	<0.002	—	—
ULUG-06	08/10/2000	**0.03**	**0.026**	<0.01	<0.100	<0.001	<0.004	—	—
ULUG-07	08/11/2000	**0.02**	**0.011**	<0.01	<0.100	<0.001	<0.002	—	—

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Atrazine, GC/MS[a] (39632)	Benfluralin, GC/MS[a] (82673)	Cyanazine, GC/MS[a] (04041)	DCPA (dacthal), GC/MS[a] (82682)	EPTC, GC/MS[a] (82668)	Metolachlor, GC/MS[a] (39415)	Napropamide, GC/MS[a] (82684)	Pendimethal-in, GC/MS[a] (82683)
ULUG-08	08/14/2000	**0.006**	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
ULUG-09	08/15/2000	<0.005	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
ULUG-10	08/15/2000	**0.008**	<0.002	<0.004	<0.002	**E0.008**	<0.002	<0.003	<0.004
ULUG-11	08/15/2000	**0.015**	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
ULUG-12	08/16/2000	**0.007**	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
ULUG-13	08/16/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
ULUG-14	08/16/2000	<0.006	<0.002	<0.010	**E0.002**	<0.002	**0.005**	<0.003	<0.004
ULUG-15	08/17/2000	**0.025**	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
ULUG-16	08/17/2000	**0.025**	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
ULUG-17	08/18/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-01	11/16/1998	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-02	12/08/1998	<0.001	<0.002	<0.004	**E0.001**	<0.002	<0.002	<0.003	<0.004
WARM-03	01/12/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-04	01/27/1999	<0.001	<0.002	<0.004	**0.004**	<0.002	**0.005**	<0.003	<0.010
WARM-05	02/09/1999	<0.001	<0.002	<0.004	**0.006**	<0.002	**0.007**	<0.003	<0.004
WARM-06	02/10/1999	<0.001	<0.002	<0.004	**E0.001**	<0.002	<0.002	<0.003	<0.004
WARM-07	03/09/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-08	03/15/1999	<0.010	<0.002	<0.004	**0.008**	<0.002	**0.032**	<0.003	<0.040
WARM-09	04/14/1999	<0.001	<0.002	<0.004	**E0.002**	<0.002	**0.005**	<0.003	<0.004
WARM-10	05/18/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-11	06/16/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Prometon, GC/MS[a] (04037)	Simazine, GC/MS[a] (04035)	Tebuthiuron, GC/MS[a] (82670)	Terbacil,* GC/MS[a] (82665)	Triallate, GC/MS[a] (82678)	Trifluralin, GC/MS[a] (82661)	Hexazinone, GC/MS[b] (04025)	Prometryn, GC/MS[b] (04036)
ULUG-08	08/14/2000	<0.02	<0.005	<0.01	<0.007	<0.001	<0.002	—	—
ULUG-09	08/15/2000	<0.02	<0.010	<0.01	<0.007	<0.001	<0.002	—	—
ULUG-10	08/15/2000	**E0.01**	**0.033**	**E0.01**	<0.007	<0.001	<0.002	—	—
ULUG-11	08/15/2000	<0.02	<0.005	<0.01	<0.007	<0.001	<0.002	—	—
ULUG-12	08/16/2000	<0.02	<0.020	<0.01	<0.007	<0.001	<0.002	—	—
ULUG-13	08/16/2000	**E0.01**	**0.010**	<0.01	<0.007	<0.001	<0.002	—	—
ULUG-14	08/16/2000	<0.02	**0.012**	<0.01	<0.007	<0.001	<0.002	—	—
ULUG-15	08/17/2000	**E0.01**	**0.033**	**0.01**	<0.007	<0.001	<0.002	—	—
ULUG-16	08/17/2000	**E0.01**	**0.035**	**0.01**	<0.007	<0.001	<0.002	—	—
ULUG-17	08/18/2000	<0.02	<0.005	<0.01	<0.007	<0.001	<0.002	—	—
WARM-01	11/16/1998	<0.02	<0.005	**M**	<0.007	<0.001	<0.002	—	—
WARM-02	12/08/1998	<0.02	**0.011**	**M**	<0.007	<0.001	<0.002	—	—
WARM-03	01/12/1999	**M**	**0.008**	**M**	<0.007	<0.001	<0.002	—	—
WARM-04	01/27/1999	**E0.01**	**0.100**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-05	02/09/1999	**E0.02**	**0.033**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-06	02/10/1999	**M**	**0.012**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-07	03/09/1999	<0.02	**0.006**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-08	03/15/1999	**0.03**	**0.177**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-09	04/14/1999	<0.02	**0.017**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-10	05/18/1999	**M**	**0.009**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-11	06/16/1999	<0.02	**0.008**	<0.01	<0.007	<0.001	<0.002	—	—

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Atrazine, GC/MS[a] (39632)	Benfluralin, GC/MS[a] (82673)	Cyanazine, GC/MS[a] (04041)	DCPA (dacthal), GC/MS[a] (82682)	EPTC, GC/MS[a] (82668)	Metolachlor, GC/MS[a] (39415)	Napropamide, GC/MS[a] (82684)	Pendimethal-in, GC/MS[a] (82683)
WARM-12	07/13/1999	<0.010	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-13	07/27/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-14	08/10/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-15	08/24/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-16	09/14/1999	<0.004	<0.002	<0.004	**E0.003**	<0.002	<0.002	<0.003	<0.004
WARM-17	09/28/1999	<0.005	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-18	10/13/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-19	10/28/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-20	11/15/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-21	11/29/1999	<0.001	<0.002	<0.004	**E0.002**	<0.002	<0.002	<0.003	<0.004
WARM-22	12/13/1999	**E0.003**	<0.002	<0.004	**E0.002**	<0.002	<0.002	<0.003	<0.004
WARM-23	12/27/1999	<0.001	<0.002	<0.004	**E0.001**	<0.002	<0.002	<0.003	<0.004
WARM-24	01/11/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-25	01/25/2000	<0.001	<0.002	<0.004	**0.005**	<0.002	<0.002	<0.003	<0.004
WARM-26	02/01/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	**0.008**
WARM-27	02/12/2000	<0.001	<0.002	<0.004	**E0.004**	<0.002	**E0.004**	<0.003	<0.030
WARM-28	02/15/2000	<0.005	<0.002	<0.004	**E0.002**	<0.002	<0.002	<0.003	<0.004
WARM-29	02/21/2000	<0.001	<0.002	<0.004	**E0.003**	<0.002	0.006	<0.003	<0.004
WARM-30	02/28/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-31	03/14/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-32	03/30/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-33	04/10/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Prometon, GC/MS[a] (04037)	Simazine, GC/MS[a] (04035)	Tebuthiuron, GC/MS[a] (82670)	Terbacil,* GC/MS[a] (82665)	Triallate, GC/MS[a] (82678)	Trifluralin, GC/MS[a] (82661)	Hexazinone, GC/MS[b] (04025)	Prometryn, GC/MS[b] (04036)
WARM-12	07/13/1999	**E0.01**	**0.006**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-13	07/27/1999	**E0.01**	**0.036**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-14	08/10/1999	**E0.01**	<0.008	<0.01	<0.007	<0.001	<0.002	—	—
WARM-15	08/24/1999	**M**	<0.005	<0.01	<0.007	<0.001	<0.002	—	—
WARM-16	09/14/1999	**M**	**0.215**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-17	09/28/1999	**E0.01**	**0.009**	**0.55**	<0.030	<0.001	<0.002	—	—
WARM-18	10/13/1999	<0.02	**0.012**	**0.11**	<0.007	<0.001	<0.002	—	—
WARM-19	10/28/1999	<0.02	<0.005	**E1.26**	<0.007	<0.001	<0.002	—	—
WARM-20	11/15/1999	<0.02	<0.005	**0.02**	<0.007	<0.001	<0.002	—	—
WARM-21	11/29/1999	<0.02	<0.020	<0.01	<0.007	<0.001	<0.002	—	—
WARM-22	12/13/1999	**M**	**0.006**	**0.02**	<0.007	<0.001	<0.002	—	—
WARM-23	12/27/1999	**M**	**0.008**	**0.35**	<0.007	<0.001	<0.002	—	—
WARM-24	01/11/2000	<0.02	**0.008**	**E0.01**	<0.007	<0.001	<0.002	—	—
WARM-25	01/25/2000	<0.02	<0.005	<0.01	<0.007	<0.001	<0.002	—	—
WARM-26	02/01/2000	**E0.01**	**0.013**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-27	02/12/2000	**0.03**	**0.296**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-28	02/15/2000	**E0.01**	**0.015**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-29	02/21/2000	**E0.01**	**0.066**	**0.1**	<0.007	<0.001	<0.002	—	—
WARM-30	02/28/2000	<0.02	**0.009**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-31	03/14/2000	**E0.01**	<0.005	**0.01**	<0.007	<0.001	<0.002	—	—
WARM-32	03/30/2000	**M**	**E0.004**	**E0.01**	<0.007	<0.001	<0.002	—	—
WARM-33	04/10/2000	**E0.01**	<0.005	**0.02**	<0.007	<0.001	<0.002	—	—

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Atrazine, GC/MS[a] (39632)	Benfluralin, GC/MS[a] (82673)	Cyanazine, GC/MS[a] (04041)	DCPA (dacthal), GC/MS[a] (82682)	EPTC, GC/MS[a] (82668)	Metolachlor, GC/MS[a] (39415)	Napropamide, GC/MS[a] (82684)	Pendimethal-in, GC/MS[a] (82683)
WARM-34	05/09/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-35	06/12/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-36	07/11/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-37	08/14/2000	<0.001	<0.002	<0.004	**E0.003**	**E0.019**	**E0.002**	<0.003	<0.004
WARM-38	09/11/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-39	10/16/2000	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
WARM-40	12/12/2000	<0.013	<0.010	<0.018	**E0.004**	<0.002	<0.013	<0.007	<0.010
WARM-41	01/16/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
WARM-42	02/22/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
WARM-43	03/22/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
WARM-44	04/17/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
WARM-45	05/17/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
WARM-46	06/14/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
WARM-47	07/10/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
WARM-48	08/15/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
WARM-49	09/13/2001	<0.007	<0.010	<0.018	**E0.002**	<0.002	<0.013	<0.007	<0.010
CUCA-01	04/01/1999	**0.005**	<0.002	<0.004	**0.019**	<0.002	0.018	<0.003	<0.021

See footnotes at end of table.

Appendix A-1. Analytical results for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry. GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides anayzed by gas chromatography/mass spectrometry							
		Prometon, GC/MS[a] (04037)	Simazine, GC/MS[a] (04035)	Tebuthiuron, GC/MS[a] (82670)	Terbacil,* GC/MS[a] (82665)	Triallate, GC/MS[a] (82678)	Trifluralin, GC/MS[a] (82661)	Hexazinone, GC/MS[b] (04025)	Prometryn, GC/MS[b] (04036)
WARM-34	05/09/2000	**M**	<0.005	<0.01	<0.007	<0.001	<0.002	—	—
WARM-35	06/12/2000	**M**	**0.005**	**M**	<0.070	<0.001	<0.002	—	—
WARM-36	07/11/2000	**E0.01**	**E0.004**	**M**	<0.007	<0.001	<0.002	—	—
WARM-37	08/14/2000	**M**	**E0.004**	<0.01	**E0.031**	<0.001	<0.002	—	—
WARM-38	09/11/2000	**M**	<0.005	<0.01	<0.007	<0.001	<0.002	—	—
WARM-39	10/16/2000	**M**	<0.011	**E0.01**	<0.034	<0.002	<0.009	—	—
WARM-40	12/12/2000	<0.01	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
WARM-41	01/16/2001	<0.01	**E0.008**	**0.03**	<0.034	<0.002	<0.009	—	—
WARM-42	02/22/2001	**M**	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
WARM-43	03/22/2001	**M**	**E0.006**	**E0.01**	<0.034	<0.002	<0.009	—	—
WARM-44	04/17/2001	**M**	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
WARM-45	05/17/2001	**M**	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
WARM-46	06/14/2001	<0.01	**E0.007**	<0.02	<0.034	<0.002	<0.009	—	—
WARM-47	07/10/2001	**E0.01**	**E0.005**	**E0.01**	<0.034	<0.002	<0.009	—	—
WARM-48	08/15/2001	<0.01	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
WARM-49	09/13/2001	**E0.01**	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
CUCA-01	04/01/1999	**0.04**	**0.069**	<0.01	<0.007	<0.001	<0.002	—	—

*Terbacil as parameter code 04032 on lab code 9060 (HPLC[d]) was never detected in enviromental samples.
[a]Lindley and others, 1996. Zaugg and others, 1995.
[b]Sandstrom and others, 2001.
[c]Rose and Schroeder, 1995. Connor and others, 1998.
[d]Furlong and others, 2001.
[e]Werner and others, 1996.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

		Herbicides analyzed by high-performance liquid chromatography									
Sample identification No.	Sample date	2,4-D,* HPLC[d,e] (39732)	2,4-D Methyl ester, HPLC[d] (50470)	Bentazon,* HPLC[d,e] (38711)	Bromacil,* HPLC[d,e] (04029)	Clopyralid,* HPLC[d,e] (49305)	Dicamba,* HPLC[d,e] (38442)	Dinoseb,* HPLC[d,e] (49301)	Diuron,* HPLC[d,e] (49300)	4,6-Dinitro-2-methyl-phenol (DNOC), HPLC[e] (49299)	Fenuron,* HPLC[d,e] (49297)
EVMWTP-IN-01	07/15/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.54**	—	<0.07
EVMWTP-IN-02	08/10/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
EVMWTP-IN-03	08/23/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.41**	—	<0.07
EVMWTP-IN-04	09/13/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.35**	—	<0.07
EVMWTP-IN-05	09/28/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.33**	—	<0.07
EVMWTP-IN-06	10/28/1999	<0.08	<0.09	<0.02	**E0.01**	<0.04	**E0.09**	<0.04	**E0.35**	—	<0.07
EVMWTP-IN-07	11/29/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.31**	—	<0.07
EVMWTP-IN-08	12/13/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.31**	—	<0.07
EVMWTP-FI-01	07/15/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
EVMWTP-FI-02	08/10/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
EVMWTP-FI-03	08/23/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
EVMWTP-FI-04	09/13/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
EVMWTP-FI-05	09/28/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
EVMWTP-FI-06	10/28/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
EVMWTP-FI-07	11/29/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
EVMWTP-FI-08	12/13/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
IMP-01	11/20/1998	<0.15	—	<0.01	<1.24	<0.23	<0.04	<0.04	**0.91**	<0.42	<0.01
IMP-02	12/10/1998	<0.15	—	<0.01	<0.04	<0.23	<0.04	<0.04	**6.17**	<0.42	<0.01
IMP-03	01/14/1999	<0.15	—	<0.01	<1.67	<0.23	<0.04	<0.04	**0.68**	<0.42	<0.65
IMP-04	01/25/1999	<0.15	—	<0.01	<0.95	<0.23	<0.04	<0.04	**1.31**	<0.42	<0.01

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		Fluometuron,* HPLC[d,e] (38811)	Imazaquin, HPLC[d] (50356)	Metaxon* (MCPA), HPLC[d,e] (38482)	Norflurazon,* HPLC[d,e] (49293)	Oryzalin,* HPLC[d,e] (49292)	Picloram,* HPLC[d,e] (49291)	Propham,* HPLC[d,e] (49236)	Siduron, HPLC[d] (38548)	Sulfometuron-methyl, HPLC[d] (50337)	Triclopyr,* HPLC[d,e] (49235)
EVMWTP-IN-01	07/15/1999	<0.06	<0.1	**E0.01**	<0.08	<0.07	<0.07	<0.07	<0.09	**E0.13**	<0.1
EVMWTP-IN-02	08/10/1999	<0.06	<0.1	<0.06	**E0.41**	<0.07	<0.07	<0.07	<0.09	**E0.11**	<0.1
EVMWTP-IN-03	08/23/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**E0.13**	<0.1
EVMWTP-IN-04	09/13/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**E0.09**	<0.1
EVMWTP-IN-05	09/28/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**E0.10**	<0.1
EVMWTP-IN-06	10/28/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**E0.08**	<0.1
EVMWTP-IN-07	11/29/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**E0.10**	<0.1
EVMWTP-IN-08	12/13/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**E0.08**	<0.1
EVMWTP-FI-01	07/15/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
EVMWTP-FI-02	08/10/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
EVMWTP-FI-03	08/23/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
EVMWTP-FI-04	09/13/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
EVMWTP-FI-05	09/28/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
EVMWTP-FI-06	10/28/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
EVMWTP-FI-07	11/29/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
EVMWTP-FI-08	12/13/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-01	11/20/1998	<0.04	—	<0.17	<0.02	<0.31	<0.05	<0.04	—	—	<0.25
IMP-02	12/10/1998	<0.04	—	<0.17	<0.02	<0.31	<0.05	<0.04	—	—	<0.25
IMP-03	01/14/1999	<0.04	—	<0.17	<0.02	<0.31	<0.05	<0.04	—	—	<0.25
IMP-04	01/25/1999	<0.04	—	<0.17	<0.02	<0.31	<0.05	<0.04	—	—	<0.25

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		2,4-D,* HPLC[d,e] (39732)	2,4-D Methyl ester, HPLC[d] (50470)	Bentazon,* HPLC[d,e] (38711)	Bromacil,* HPLC[d,e] (04029)	Clopyralid,* HPLC[d,e] (49305)	Dicamba,* HPLC[d,e] (38442)	Dinoseb,* HPLC[d,e] (49301)	Diuron,* HPLC[d,e] (49300)	4,6-Dinitro-2-methyl-phenol (DNOC), HPLC[e] (49299)	Fenuron,* HPLC[d,e] (49297)
IMP-05	02/09/1999	<0.15	—	<0.03	<1.20	<0.23	<0.04	<0.04	<1.25	<0.42	<0.09
IMP-06	02/12/1999	<0.27	—	<0.01	<1.54	<0.23	<0.04	<0.05	**1.68**	<0.42	<0.18
IMP-07	03/11/1999	<0.08	<0.09	<0.02	**E0.15**	<0.04	<0.10	<0.04	**E0.08**	—	<0.07
IMP-08	03/15/1999	**E0.42**	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.23**	—	<0.07
IMP-09	04/16/1999	<0.08	<0.09	<0.02	**E0.01**	<0.04	<0.10	<0.04	**E0.27**	—	**E0.02**
IMP-10	05/20/1999	<0.08	<0.09	<0.02	**E0.02**	<0.04	<0.10	<0.04	**E0.08**	—	<0.07
IMP-11	06/18/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.18	—	<0.07
IMP-12	07/15/1999	**E0.06**	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.07**	—	<0.07
IMP-13	07/26/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.05**	—	<0.07
IMP-14	08/12/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.06**	—	<0.07
IMP-15	08/25/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.08**	—	<0.07
IMP-16	09/16/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.05**	—	<0.07
IMP-17	09/29/1999	<0.08	<0.09	<0.02	—	<0.04	<0.10	<0.04	**E0.04**	—	<0.07
IMP-18	10/15/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
IMP-19	10/29/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.03**	—	<0.07
IMP-20	11/18/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.52**	—	<0.07
IMP-21	11/30/1999	<0.08	<0.09	<0.02	**E0.07**	<0.04	<0.10	<0.04	**E0.21**	—	<0.07
IMP-22	12/16/1999	<0.08	<0.09	<0.02	**E0.07**	<0.04	<0.10	<0.04	**E0.28**	—	<0.07
IMP-23	12/28/1999	<0.08	<0.09	<0.02	**E0.04**	<0.04	<0.10	<0.04	**0.15**	—	<0.07
IMP-24	01/13/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		Fluometuron,* HPLC[d,e] (38811)	Imazaquin, HPLC[d] (50356)	Metaxon* (MCPA), HPLC[d,e] (38482)	Norflurazon,* HPLC[d,e] (49293)	Oryzalin,* HPLC[d,e] (49292)	Picloram,* HPLC[d,e] (49291)	Propham,* HPLC[d,e] (49236)	Siduron, HPLC[d] (38548)	Sulfometuron-methyl, HPLC[d] (50337)	Triclopyr,* HPLC[d,e] (49235)
IMP-05	02/09/1999	<0.04	—	<0.17	<0.02	<0.31	<0.05	<0.04	—	—	<0.25
IMP-06	02/12/1999	<0.04	—	<0.17	<0.02	<0.31	<0.05	<0.34	—	—	<0.68
IMP-07	03/11/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-08	03/15/1999	<0.06	<0.1	**E0.54**	<0.08	**E0.47**	<0.07	<0.07	<0.09	**E0.28**	**E1.1**
IMP-09	04/16/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-10	05/20/1999	<0.06	<0.1	<0.06	**E0.01**	<0.07	<0.07	<0.07	<0.09	**E0.03**	<0.1
IMP-11	06/18/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	**E0.18**	<0.09	<0.04	<0.1
IMP-12	07/15/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-13	07/26/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-14	08/12/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-15	08/25/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-16	09/16/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-17	09/29/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-18	10/15/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-19	10/29/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-20	11/18/1999	<0.06	<0.1	<0.06	**E0.06**	<0.07	<0.07	<0.07	<0.09	**E0.17**	<0.1
IMP-21	11/30/1999	<0.06	<0.1	<0.06	**E0.01**	<0.07	<0.07	<0.07	<0.09	**E0.06**	<0.1
IMP-22	12/16/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-23	12/28/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-24	01/13/2000	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		2,4-D,* HPLC[d,e] (39732)	2,4-D Methyl ester, HPLC[d] (50470)	Bentazon,* HPLC[d,e] (38711)	Bromacil,* HPLC[d,e] (04029)	Clopyralid,* HPLC[d,e] (49305)	Dicamba,* HPLC[d,e] (38442)	Dinoseb,* HPLC[d,e] (49301)	Diuron,* HPLC[d,e] (49300)	4,6-Dinitro-2-methyl-phenol (DNOC), HPLC[e] (49299)	Fenuron,* HPLC[d,e] (49297)
IMP-25	01/25/2000	**0.08**	<0.09	**M**	<0.08	<0.04	<0.10	<0.04	**0.07**	—	<0.07
IMP-26	02/01/2000	<0.08	<0.09	**M**	<0.08	<0.04	<0.10	<0.04	**0.73**	—	<0.07
IMP-27	02/12/2000	**0.26**	<0.09	<0.02	*E0.04*	<0.04	<0.10	<0.04	**2.08**	—	<0.07
IMP-28	02/18/2000	—	—	—	—	—	—	—	—	—	—
IMP-29	02/23/2000	**0.26**	<0.09	<0.02	**E0.06**	<0.04	<0.10	<0.04	**3.61**	—	<0.07
IMP-30	02/29/2000	**0.14**	<0.09	<0.02	**E0.04**	<0.04	<0.10	<0.04	**1.46**	—	<0.07
IMP-31	03/17/2000	**0.11**	<0.09	<0.02	**E0.04**	<0.04	<0.10	<0.04	**2.71**	—	<0.07
IMP-32	03/31/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**0.39**	—	<0.07
IMP-33	04/13/2000	<0.08	**0.02**	<0.02	**E0.03**	<0.04	<0.10	<0.04	**0.18**	—	<0.07
IMP-34	05/12/2000	—	—	—	—	—	—	—	—	—	—
IMP-35	06/15/2000	—	—	—	—	—	—	—	—	—	—
IMP-36	07/14/2000	—	—	—	—	—	—	—	—	—	—
IMP-37	08/17/2000	—	—	—	—	—	—	—	—	—	—
IMP-38	09/13/2000	—	—	—	—	—	—	—	—	—	—
IMP-39	10/19/2000	—	—	—	—	—	—	—	—	—	—
IMP-40	12/13/2000	—	—	—	—	—	—	—	—	—	—
IMP-41	01/18/2001	—	—	—	—	—	—	—	—	—	—
IMP-42	02/21/2001	—	—	—	—	—	—	—	—	—	—
IMP-43	04/19/2001	—	—	—	—	—	—	—	—	—	—
MEN-01	02/20/2001	—	—	—	—	—	—	—	—	—	—

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		Fluometuron,* HPLC[d,e] (38811)	Imazaquin, HPLC[d] (50356)	Metaxon* (MCPA), HPLC[d,e] (38482)	Norflurazon,* HPLC[d,e] (49293)	Oryzalin,* HPLC[d,e] (49292)	Picloram,* HPLC[d,e] (49291)	Propham,* HPLC[d,e] (49236)	Siduron, HPLC[d] (38548)	Sulfometuron-methyl, HPLC[d] (50337)	Triclopyr,* HPLC[d,e] (49235)
IMP-25	01/25/2000	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	**0.02**	**0.09**	<0.1
IMP-26	02/01/2000	<0.06	<0.1	**0.03**	**E0.02**	<0.07	<0.07	<0.07	<0.09	**0.13**	<0.1
IMP-27	02/12/2000	<0.06	**E0.2**	**0.07**	**E0.28**	**0.2**	<0.07	<0.07	<0.09	**0.46**	**0.2**
IMP-28	02/18/2000	—	—	—	—	—	—	—	—	—	—
IMP-29	02/23/2000	<0.06	<0.1	**0.06**	**E0.30**	<0.07	<0.07	<0.07	<0.09	**0.27**	<0.1
IMP-30	02/29/2000	<0.06	<0.1	**0.04**	**E0.15**	<0.07	<0.07	<0.07	<0.09	**0.14**	<0.1
IMP-31	03/17/2000	<0.06	—	**0.03**	**E0.62**	<0.07	<0.07	<0.07	<0.09	**0.19**	<0.1
IMP-32	03/31/2000	<0.06	—	<0.06	**E0.06**	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-33	04/13/2000	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-34	05/12/2000	—	—	—	—	—	—	—	—	—	—
IMP-35	06/15/2000	—	—	—	—	—	—	—	—	—	—
IMP-36	07/14/2000	—	—	—	—	—	—	—	—	—	—
IMP-37	08/17/2000	—	—	—	—	—	—	—	—	—	—
IMP-38	09/13/2000	—	—	—	—	—	—	—	—	—	—
IMP-39	10/19/2000	—	—	—	—	—	—	—	—	—	—
IMP-40	12/13/2000	—	—	—	—	—	—	—	—	—	—
IMP-41	01/18/2001	—	—	—	—	—	—	—	—	—	—
IMP-42	02/21/2001	—	—	—	—	—	—	—	—	—	—
IMP-43	04/19/2001	—	—	—	—	—	—	—	—	—	—
MEN-01	02/20/2001	—	—	—	—	—	—	—	—	—	—

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		2,4-D,* HPLC[d,e] (39732)	2,4-D Methyl ester, HPLC[d] (50470)	Bentazon,* HPLC[d,e] (38711)	Bromacil,* HPLC[d,e] (04029)	Clopyralid,* HPLC[d,e] (49305)	Dicamba,* HPLC[d,e] (38442)	Dinoseb,* HPLC[d,e] (49301)	Diuron,* HPLC[d,e] (49300)	4,6-Dinitro-2-methyl-phenol (DNOC), HPLC[e] (49299)	Fenuron,* HPLC[d,e] (49297)
MEN-02	03/22/2001	—	—	—	—	—	—	—	—	—	—
MEN-03	04/16/2001	—	—	—	—	—	—	—	—	—	—
MEN-04	05/17/2001	—	—	—	—	—	—	—	—	—	—
MEN-05	06/14/2001	—	—	—	—	—	—	—	—	—	—
MEN-06	07/10/2001	—	—	—	—	—	—	—	—	—	—
MEN-07	08/13/2001	—	—	—	—	—	—	—	—	—	—
MEN-08	09/13/2001	—	—	—	—	—	—	—	—	—	—
PRADO-01	07/13/2000	—	—	—	—	—	—	—	—	—	—
PRADO-02	08/17/2000	—	—	—	—	—	—	—	—	—	—
PRADO-03	09/13/2000	—	—	—	—	—	—	—	—	—	—
PRADO-04	10/19/2000	—	—	—	—	—	—	—	—	—	—
PRADO-05	12/13/2000	—	—	—	—	—	—	—	—	—	—
PRADO-06	01/18/2001	—	—	—	—	—	—	—	—	—	—
PRADO-07	02/21/2001	—	—	—	—	—	—	—	—	—	—
PRADO-08	03/21/2001	—	—	—	—	—	—	—	—	—	—
PRADO-09	04/19/2001	—	—	—	—	—	—	—	—	—	—
PRADO-10	05/16/2001	—	—	—	—	—	—	—	—	—	—
PRADO-11	06/13/2001	—	—	—	—	—	—	—	—	—	—
PRADO-12	07/12/2001	—	—	—	—	—	—	—	—	—	—

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		Fluome-turon,* HPLC[d,e] (38811)	Imazaquin, HPLC[d] (50356)	Metaxon* (MCPA), HPLC[d,e] (38482)	Nor-flurazon,* HPLC[d,e] (49293)	Oryzalin,* HPLC[d,e] (49292)	Picloram,* HPLC[d,e] (49291)	Propham,* HPLC[d,e] (49236)	Siduron, HPLC[d] (38548)	Sulfo-meturon-methyl, HPLC[d] (50337)	Triclopyr,* HPLC[d,e] (49235)
MEN-02	03/22/2001	—	—	—	—	—	—	—	—	—	—
MEN-03	04/16/2001	—	—	—	—	—	—	—	—	—	—
MEN-04	05/17/2001	—	—	—	—	—	—	—	—	—	—
MEN-05	06/14/2001	—	—	—	—	—	—	—	—	—	—
MEN-06	07/10/2001	—	—	—	—	—	—	—	—	—	—
MEN-07	08/13/2001	—	—	—	—	—	—	—	—	—	—
MEN-08	09/13/2001	—	—	—	—	—	—	—	—	—	—
PRADO-01	07/13/2000	—	—	—	—	—	—	—	—	—	—
PRADO-02	08/17/2000	—	—	—	—	—	—	—	—	—	—
PRADO-03	09/13/2000	—	—	—	—	—	—	—	—	—	—
PRADO-04	10/19/2000	—	—	—	—	—	—	—	—	—	—
PRADO-05	12/13/2000	—	—	—	—	—	—	—	—	—	—
PRADO-06	01/18/2001	—	—	—	—	—	—	—	—	—	—
PRADO-07	02/21/2001	—	—	—	—	—	—	—	—	—	—
PRADO-08	03/21/2001	—	—	—	—	—	—	—	—	—	—
PRADO-09	04/19/2001	—	—	—	—	—	—	—	—	—	—
PRADO-10	05/16/2001	—	—	—	—	—	—	—	—	—	—
PRADO-11	06/13/2001	—	—	—	—	—	—	—	—	—	—
PRADO-12	07/12/2001	—	—	—	—	—	—	—	—	—	—

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		2,4-D,* HPLC[d,e] (39732)	2,4-D Methyl ester, HPLC[d] (50470)	Bentazon,* HPLC[d,e] (38711)	Bromacil,* HPLC[d,e] (04029)	Clopyralid,* HPLC[d,e] (49305)	Dicamba,* HPLC[d,e] (38442)	Dinoseb,* HPLC[d,e] (49301)	Diuron,* HPLC[d,e] (49300)	4,6-Dinitro-2-methyl-phenol (DNOC), HPLC[e] (49299)	Fenuron,* HPLC[d,e] (49297)
PRADO-13	08/14/2001	—	—	—	—	—	—	—	—	—	—
PRADO-14	09/12/2001	—	—	—	—	—	—	—	—	—	—
ULUG-01	08/07/2000	—	—	—	—	—	—	—	—	—	—
ULUG-02	08/08/2000	—	—	—	—	—	—	—	—	—	—
ULUG-03	08/08/2000	—	—	—	—	—	—	—	—	—	—
ULUG-04	08/09/2000	—	—	—	—	—	—	—	—	—	—
ULUG-05	08/09/2000	—	—	—	—	—	—	—	—	—	—
ULUG-06	08/10/2000	—	—	—	—	—	—	—	—	—	—
ULUG-07	08/11/2000	—	—	—	—	—	—	—	—	—	—
ULUG-08	08/14/2000	—	—	—	—	—	—	—	—	—	—
ULUG-09	08/15/2000	—	—	—	—	—	—	—	—	—	—
ULUG-10	08/15/2000	—	—	—	—	—	—	—	—	—	—
ULUG-11	08/15/2000	—	—	—	—	—	—	—	—	—	—
ULUG-12	08/16/2000	—	—	—	—	—	—	—	—	—	—
ULUG-13	08/16/2000	—	—	—	—	—	—	—	—	—	—
ULUG-14	08/16/2000	—	—	—	—	—	—	—	—	—	—
ULUG-15	08/17/2000	—	—	—	—	—	—	—	—	—	—
ULUG-16	08/17/2000	—	—	—	—	—	—	—	—	—	—
ULUG-17	08/18/2000	—	—	—	—	—	—	—	—	—	—

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		Fluometuron,* HPLC[d,e] (38811)	Imazaquin, HPLC[d] (50356)	Metaxon* (MCPA), HPLC[d,e] (38482)	Norflurazon,* HPLC[d,e] (49293)	Oryzalin,* HPLC[d,e] (49292)	Picloram,* HPLC[d,e] (49291)	Propham,* HPLC[d,e] (49236)	Siduron, HPLC[d] (38548)	Sulfometuron-methyl, HPLC[d] (50337)	Triclopyr,* HPLC[d,e] (49235)
PRADO-13	08/14/2001	—	—	—	—	—	—	—	—	—	—
PRADO-14	09/12/2001	—	—	—	—	—	—	—	—	—	—
ULUG-01	08/07/2000	—	—	—	—	—	—	—	—	—	—
ULUG-02	08/08/2000	—	—	—	—	—	—	—	—	—	—
ULUG-03	08/08/2000	—	—	—	—	—	—	—	—	—	—
ULUG-04	08/09/2000	—	—	—	—	—	—	—	—	—	—
ULUG-05	08/09/2000	—	—	—	—	—	—	—	—	—	—
ULUG-06	08/10/2000	—	—	—	—	—	—	—	—	—	—
ULUG-07	08/11/2000	—	—	—	—	—	—	—	—	—	—
ULUG-08	08/14/2000	—	—	—	—	—	—	—	—	—	—
ULUG-09	08/15/2000	—	—	—	—	—	—	—	—	—	—
ULUG-10	08/15/2000	—	—	—	—	—	—	—	—	—	—
ULUG-11	08/15/2000	—	—	—	—	—	—	—	—	—	—
ULUG-12	08/16/2000	—	—	—	—	—	—	—	—	—	—
ULUG-13	08/16/2000	—	—	—	—	—	—	—	—	—	—
ULUG-14	08/16/2000	—	—	—	—	—	—	—	—	—	—
ULUG-15	08/17/2000	—	—	—	—	—	—	—	—	—	—
ULUG-16	08/17/2000	—	—	—	—	—	—	—	—	—	—
ULUG-17	08/18/2000	—	—	—	—	—	—	—	—	—	—

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		2,4-D,* HPLC[d,e] (39732)	2,4-D Methyl ester, HPLC[d] (50470)	Bentazon,* HPLC[d,e] (38711)	Bromacil,* HPLC[d,e] (04029)	Clopyralid,* HPLC[d,e] (49305)	Dicamba,* HPLC[d,e] (38442)	Dinoseb,* HPLC[d,e] (49301)	Diuron,* HPLC[d,e] (49300)	4,6-Dinitro-2-methyl-phenol (DNOC), HPLC[e] (49299)	Fenuron,* HPLC[d,e] (49297)
WARM-01	11/16/1998	<0.15	—	<0.01	<0.04	<0.23	<0.04	<0.04	**E.03**	<0.42	<0.01
WARM-02	12/08/1998	<0.15	—	<0.01	<0.04	<0.23	<0.04	<0.04	**0.1**	<0.42	<0.01
WARM-03	01/12/1999	<0.15	—	<0.01	<0.04	<0.23	<0.04	<0.04	**E0.03**	<0.42	<0.01
WARM-04	01/27/1999	<0.15	—	<0.15	<1.43	<0.23	<0.04	<0.04	**6.88**	<0.42	<0.33
WARM-05	02/09/1999	<0.15	—	<0.08	<1.15	<0.23	<0.27	<0.04	**23.3**	**E0.20**	<0.31
WARM-06	02/10/1999	<0.15	—	<0.01	<0.13	<0.23	<0.04	<0.04	**0.53**	<0.42	<0.01
WARM-07	03/09/1999	<0.08	<0.09	<0.02	**E0.01**	<0.04	<0.10	<0.04	**E0.47**	—	<0.07
WARM-08	03/15/1999	<0.08	<0.09	<0.02	<0.08	**E0.40**	<0.10	<0.04	**E12.7**	—	<0.07
WARM-09	04/14/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.84**	—	<0.07
WARM-10	05/18/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.03**	—	<0.07
WARM-11	06/16/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.12**	—	<0.07
WARM-12	07/13/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.91**	—	<0.07
WARM-13	07/27/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.04**	—	<0.07
WARM-14	08/10/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**0.25**	—	<0.07
WARM-15	08/24/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.08**	—	<0.07
WARM-16	09/14/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.68**	—	<0.07
WARM-17	09/28/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.08**	—	<0.07
WARM-18	10/13/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.02**	—	<0.07
WARM-19	10/28/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.02**	—	<0.07
WARM-20	11/15/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		Fluometuron,* HPLC[d,e] (38811)	Imazaquin, HPLC[d] (50356)	Metaxon* (MCPA), HPLC[d,e] (38482)	Norflurazon,* HPLC[d,e] (49293)	Oryzalin,* HPLC[d,e] (49292)	Picloram,* HPLC[d,e] (49291)	Propham,* HPLC[d,e] (49236)	Siduron, HPLC[d] (38548)	Sulfometuron-methyl, HPLC[d] (50337)	Triclopyr,* HPLC[d,e] (49235)
WARM-01	11/16/1998	<0.04	—	<0.17	<0.02	**0.09**	<0.05	<0.04	—	—	<0.25
WARM-02	12/08/1998	<0.04	—	<0.17	<0.02	**0.05**	<0.05	<0.04	—	—	<0.25
WARM-03	01/12/1999	<0.04	—	<0.17	<0.02	<0.31	<0.05	<0.04	—	—	<0.25
WARM-04	01/27/1999	<0.42	—	<0.17	<0.02	**1.51**	<0.05	<0.04	—	—	<0.25
WARM-05	02/09/1999	<0.12	—	<0.17	<0.02	**1.12**	<0.05	<0.04	—	—	<0.25
WARM-06	02/10/1999	<0.04	—	<0.17	<0.02	**0.62**	<0.05	<0.04	—	—	<0.25
WARM-07	03/09/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**E0.03**	<0.1
WARM-08	03/15/1999	<0.06	<0.1	<0.06	<0.08	**E2.81**	**E0.73**	<0.07	<0.09	**E0.82**	<0.1
WARM-09	04/14/1999	<0.06	<0.1	<0.06	<0.08	<0.07	—	<0.07	<0.09	**E0.05**	<0.1
WARM-10	05/18/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-11	06/16/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-12	07/13/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**E0.25**	<0.1
WARM-13	07/27/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	**E0.01**	<0.04	<0.1
WARM-14	08/10/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-15	08/24/1999	<0.06	<0.1	<0.06	—	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-16	09/14/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-17	09/28/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-18	10/13/1999	<0.06	<0.1	<0.06	<0.08	<0.07	**E0.12**	<0.07	<0.09	<0.04	<0.1
WARM-19	10/28/1999	<0.06	<0.1	<0.06	<0.08	**E0.18**	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-20	11/15/1999	<0.06	<0.1	<0.06	<0.08	**E0.14**	<0.07	<0.07	<0.09	<0.04	<0.1

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		2,4-D,* HPLC[d,e] (39732)	2,4-D Methyl ester, HPLC[d] (50470)	Bentazon,* HPLC[d,e] (38711)	Bromacil,* HPLC[d,e] (04029)	Clopyralid,* HPLC[d,e] (49305)	Dicamba,* HPLC[d,e] (38442)	Dinoseb,* HPLC[d,e] (49301)	Diuron,* HPLC[d,e] (49300)	4,6-Dinitro-2-methyl-phenol (DNOC), HPLC[e] (49299)	Fenuron,* HPLC[d,e] (49297)
WARM-21	11/29/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.09**	—	<0.07
WARM-22	12/13/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
WARM-23	12/27/1999	—	—	—	—	—	—	—	—	—	—
WARM-24	01/11/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**1.67**	—	<0.07
WARM-25	01/25/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**17.6**	—	<0.07
WARM-26	02/01/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**0.86**	—	<0.07
WARM-27	02/12/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	0.02	**12.8**	—	<0.07
WARM-28	02/15/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**0.77**	—	<0.07
WARM-29	02/21/2000	—	—	—	—	—	—	—	—	—	—
WARM-30	02/28/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**0.19**	—	<0.07
WARM-31	03/14/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**0.06**	—	<0.07
WARM-32	03/30/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**1.92**	—	<0.07
WARM-33	04/10/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**0.25**	—	<0.07
WARM-34	05/09/2000	—	—	—	—	—	—	—	—	—	—
WARM-35	06/12/2000	—	—	—	—	—	—	—	—	—	—
WARM-36	07/11/2000	—	—	—	—	—	—	—	—	—	—
WARM-37	08/14/2000	—	—	—	—	—	—	—	—	—	—
WARM-38	09/11/2000	—	—	—	—	—	—	—	—	—	—
WARM-39	10/16/2000	—	—	—	—	—	—	—	—	—	—
WARM-40	12/12/2000	—	—	—	—	—	—	—	—	—	—

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		Fluometuron,* HPLC[d,e] (38811)	Imazaquin, HPLC[d] (50356)	Metaxon* (MCPA), HPLC[d,e] (38482)	Norflurazon,* HPLC[d,e] (49293)	Oryzalin,* HPLC[d,e] (49292)	Picloram,* HPLC[d,e] (49291)	Propham,* HPLC[d,e] (49236)	Siduron, HPLC[d] (38548)	Sulfometuron-methyl, HPLC[d] (50337)	Triclopyr,* HPLC[d,e] (49235)
WARM-21	11/29/1999	<0.06	<0.1	<0.06	<0.08	**E0.12**	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-22	12/13/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-23	12/27/1999	—	—	—	—	—	—	—	—	—	—
WARM-24	01/11/2000	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**0.13**	<0.1
WARM-25	01/25/2000	0.13	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**2.82**	<0.1
WARM-26	02/01/2000	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-27	02/12/2000	<0.06	**E0.7**	<0.06	**E0.16**	**0.42**	<0.07	<0.07	<0.09	**2.44**	<0.1
WARM-28	02/15/2000	<0.06	<0.1	<0.06	<0.08	**0.05**	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-29	02/21/2000	—	—	—	—	—	—	—	—	—	—
WARM-30	02/28/2000	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-31	03/14/2000	<0.06	—	<0.06	**E0.01**	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-32	03/30/2000	<0.06	<0.1	<0.06	**E0.10**	<0.07	<0.07	<0.07	<0.09	**0.08**	<0.1
WARM-33	04/10/2000	<0.06	<0.1	<0.06	**E0.01**	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-34	05/09/2000	—	—	—	—	—	—	—	—	—	—
WARM-35	06/12/2000	—	—	—	—	—	—	—	—	—	—
WARM-36	07/11/2000	—	—	—	—	—	—	—	—	—	—
WARM-37	08/14/2000	—	—	—	—	—	—	—	—	—	—
WARM-38	09/11/2000	—	—	—	—	—	—	—	—	—	—
WARM-39	10/16/2000	—	—	—	—	—	—	—	—	—	—
WARM-40	12/12/2000	—	—	—	—	—	—	—	—	—	—

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		2,4-D,* HPLC[d,e] (39732)	2,4-D Methyl ester, HPLC[d] (50470)	Bentazon,* HPLC[d,e] (38711)	Bromacil,* HPLC[d,e] (04029)	Clopyralid,* HPLC[d,e] (49305)	Dicamba,* HPLC[d,e] (38442)	Dinoseb,* HPLC[d,e] (49301)	Diuron,* HPLC[d,e] (49300)	4,6-Dinitro-2-methyl-phenol (DNOC), HPLC[e] (49299)	Fenuron,* HPLC[d,e] (49297)
WARM-41	01/16/2001	—	—	—	—	—	—	—	—	—	—
WARM-42	02/22/2001	—	—	—	—	—	—	—	—	—	—
WARM-43	03/22/2001	—	—	—	—	—	—	—	—	—	—
WARM-44	04/17/2001	—	—	—	—	—	—	—	—	—	—
WARM-45	05/17/2001	—	—	—	—	—	—	—	—	—	—
WARM-46	06/14/2001	—	—	—	—	—	—	—	—	—	—
WARM-47	07/10/2001	—	—	—	—	—	—	—	—	—	—
WARM-48	08/15/2001	—	—	—	—	—	—	—	—	—	—
WARM-49	09/13/2001	—	—	—	—	—	—	—	—	—	—
CUCA-01	04/01/1999	—	—	—	—	—	—	—	—	—	—

See footnotes at end of table.

Appendix A-2. Analytical results for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone: all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		Fluome-turon,* HPLC[d,e] (38811)	Imazaquin, HPLC[d] (50356)	Metaxon* (MCPA), HPLC[d,e] (38482)	Nor-flurazon,* HPLC[d,e] (49293)	Oryzalin,* HPLC[d,e] (49292)	Picloram,* HPLC[d,e] (49291)	Propham,* HPLC[d,e] (49236)	Siduron, HPLC[d] (38548)	Sulfo-meturon-methyl, HPLC[d] (50337)	Triclopyr,* HPLC[d,e] (49235)
WARM-41	01/16/2001	—	—	—	—	—	—	—	—	—	—
WARM-42	02/22/2001	—	—	—	—	—	—	—	—	—	—
WARM-43	03/22/2001	—	—	—	—	—	—	—	—	—	—
WARM-44	04/17/2001	—	—	—	—	—	—	—	—	—	—
WARM-45	05/17/2001	—	—	—	—	—	—	—	—	—	—
WARM-46	06/14/2001	—	—	—	—	—	—	—	—	—	—
WARM-47	07/10/2001	—	—	—	—	—	—	—	—	—	—
WARM-48	08/15/2001	—	—	—	—	—	—	—	—	—	—
WARM-49	09/13/2001	—	—	—	—	—	—	—	—	—	—
CUCA-01	04/01/1999	—	—	—	—	—	—	—	—	—	—

*Samples collected from November 1998 through February 1999 were analyzed by analytical schedule 2050 (HPLC[2]).

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

[d]Furlong and others, 2001.

[e]Werner and others, 1996.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides								
		Alpha HCH, GC/MS[a] (34253)	**Carbaryl,* HPLC[d,e] (49310)**	**Carbaryl, GC/MS[a] (82680)**	**Carbo-furan,** GC/MS[a] (82674)**	**Chlor-pyrifos, GC/MS[a] (38933)**	**Diazinon, GC/MS[a] (39572)**	**Lindane, GC/MS[a] (39341)**	**Malathion, GC/MS[a] (39532)**	**Methomyl,* HPLC[d,e] (49296)**
EVMWTP-IN-01	07/15/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.045**	<0.004	<0.005	<0.08
EVMWTP-IN-02	08/10/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.016**	<0.004	<0.005	<0.08
EVMWTP-IN-03	08/23/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.019**	<0.004	<0.005	<0.08
EVMWTP-IN-04	09/13/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.013**	<0.004	<0.005	<0.08
EVMWTP-IN-05	09/28/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.019**	<0.004	<0.005	<0.08
EVMWTP-IN-06	10/28/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.005**	<0.004	<0.005	<0.08
EVMWTP-IN-07	11/29/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
EVMWTP-IN-08	12/13/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.004**	<0.004	<0.005	<0.08
EVMWTP-FI-01	07/15/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
EVMWTP-FI-02	08/10/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
EVMWTP-FI-03	08/23/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
EVMWTP-FI-04	09/13/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
EVMWTP-FI-05	09/28/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
EVMWTP-FI-06	10/28/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
EVMWTP-FI-07	11/29/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
EVMWTP-FI-08	12/13/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
IMP-01	11/20/1998	—	<0.008	—	—	—	—	—	—	<0.30
IMP-02	12/10/1998	<0.002	<0.008	<0.003	<0.003	**E0.002**	**E0.020**	<0.004	<0.005	<0.02
IMP-03	01/14/1999	<0.002	<0.008	**E0.005**	<0.003	<0.004	**0.015**	**E0.010**	<0.005	<0.02
IMP-04	01/25/1999	<0.002	<0.008	**E0.020**	<0.003	**0.031**	**0.351**	<0.004	**0.043**	<0.02
IMP-05	02/09/1999	<0.002	<0.008	**E0.016**	<0.003	**0.051**	**0.296**	<0.004	**0.071**	<0.02

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides			Fungicides				Stimulant
		Propoxur,* HPLC[d,e] (38538)	1,4-Dichloro-benzene, GC/MS[c] (34571)	Carbon disulfide, GC/MS[c] (77041)	Benomyl, HPLC[d] (50300)	Iprodione, GC/MS[b] (61593)	Metalaxyl, GC/MS[b] (61596)	Metalaxyl, HPLC[d] (50359)	Caffeine, HPLC[d] (50305)
EVMWTP-IN-01	07/15/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-IN-02	08/10/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-IN-03	08/23/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-IN-04	09/13/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	**E0.03**
EVMWTP-IN-05	09/28/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-IN-06	10/28/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-IN-07	11/29/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-IN-08	12/13/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-FI-01	07/15/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-FI-02	08/10/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-FI-03	08/23/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-FI-04	09/13/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-FI-05	09/28/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-FI-06	10/28/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-FI-07	11/29/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-FI-08	12/13/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
IMP-01	11/20/1998	<0.04	<0.10	<0.74	—	—	—	—	—
IMP-02	12/10/1998	<0.04	<0.10	<0.74	—	—	—	—	—
IMP-03	01/14/1999	<0.38	<0.05	**E.01**	—	—	—	—	—
IMP-04	01/25/1999	<0.10	—	—	—	—	—	—	—
IMP-05	02/09/1999	<0.37	<0.10	<0.74	—	—	—	—	—

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides								
		Alpha HCH, GC/MS[a] (34253)	Carbaryl,* HPLC[d,e] (49310)	Carbaryl, GC/MS[a] (82680)	Carbo-furan,** GC/MS[a] (82674)	Chlor-pyrifos, GC/MS[a] (38933)	Diazinon, GC/MS[a] (39572)	Lindane, GC/MS[a] (39341)	Malathion, GC/MS[a] (39532)	Methomyl,* HPLC[d,e] (49296)
IMP-06	02/12/1999	<0.002	<0.008	**E0.007**	<0.003	**0.006**	**0.071**	<0.004	<0.005	<0.34
IMP-07	03/11/1999	<0.002	<0.06	**E0.011**	<0.003	**E0.004**	**0.043**	**0.007**	<0.005	<0.08
IMP-08	03/15/1999	<0.002	<0.06	**E0.145**	<0.003	**0.057**	**0.626**	**0.004**	**0.131**	<0.08
IMP-09	04/16/1999	<0.002	<0.06	**E0.020**	<0.003	**0.005**	**0.066**	<0.004	0.006	<0.08
IMP-10	05/20/1999	<0.002	<0.06	**E0.006**	<0.003	<0.004	**0.038**	<0.004	<0.005	<0.08
IMP-11	06/18/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.039**	<0.004	<0.005	<0.08
IMP-12	07/15/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.069**	<0.004	<0.005	<0.08
IMP-13	07/26/1999	<0.002	<0.06	**E0.044**	<0.003	<0.004	**0.031**	<0.020	<0.005	<0.08
IMP-14	08/12/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.029**	<0.004	<0.005	<0.08
IMP-15	08/25/1999	<0.002	<0.06	**E0.005**	<0.003	<0.004	**0.045**	<0.004	<0.005	<0.08
IMP-16	09/16/1999	<0.002	<0.06	**E0.004**	<0.003	<0.004	**0.029**	**0.011**	<0.005	<0.08
IMP-17	09/29/1999	<0.002	<0.06	**E0.007**	<0.003	<0.004	**0.036**	**0.009**	<0.005	<0.08
IMP-18	10/15/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.027**	<0.004	<0.005	<0.08
IMP-19	10/29/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.027**	<0.004	<0.005	<0.08
IMP-20	11/18/1999	<0.002	**E0.01**	**E0.035**	<0.003	**E0.004**	**0.027**	**0.009**	<0.005	<0.08
IMP-21	11/30/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.024**	<0.004	<0.005	<0.08
IMP-22	12/16/1999	<0.002	<0.06	**E0.009**	<0.003	<0.004	**0.015**	<0.010	<0.005	**E0.01**
IMP-23	12/28/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.03**	<0.004	<0.005	<0.08
IMP-24	01/13/2000	<0.002	<0.06	**E0.009**	<0.003	<0.004	**0.012**	**0.011**	<0.005	<0.08
IMP-25	01/25/2000	<0.002	<0.06	**E0.041**	<0.003	**0.045**	**0.202**	—	**0.061**	**E0.01**

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides			Fungicides				Stimulant
		Propoxur,* HPLC[d,e] (38538)	1,4-Dichloro-benzene, GC/MS[c] (34571)	Carbon disulfide, GC/MS[c] (77041)	Benomyl, HPLC[d] (50300)	Iprodione, GC/MS[b] (61593)	Metalaxyl, GC/MS[b] (61596)	Metalaxyl, HPLC[d] (50359)	Caffeine, HPLC[d] (50305)
IMP-06	02/12/1999	<0.25	<0.10	<0.74	—	—	—	—	—
IMP-07	03/11/1999	**E0.03**	<0.05	<0.37	<0.02	<0.03	<0.02	<0.06	**E0.14**
IMP-08	03/15/1999	**E0.03**	<0.10	<0.74	<0.02	<0.03	<0.02	<0.06	**E0.30**
IMP-09	04/16/1999	**M**	<0.10	<0.74	<0.02	<0.03	<0.02	<0.06	<0.08
IMP-10	05/20/1999	**E0.01**	<0.05	<0.37	Lost	<0.12	<0.02	<0.06	**E0.03**
IMP-11	06/18/1999	<0.06	<0.05	**E0.01**	<0.02	<0.03	<0.02	<0.06	**E0.08**
IMP-12	07/15/1999	**E0.02**	<0.05	**E0.02**	<0.02	<0.03	<0.02	<0.06	<0.08
IMP-13	07/26/1999	**E0.03**	<0.05	<0.37	<0.02	<0.03	<0.02	<0.06	<0.08
IMP-14	08/12/1999	**E0.03**	<0.05	<0.37	<0.02	<0.03	<0.02	<0.06	**E0.02**
IMP-15	08/25/1999	**E0.03**	<0.05	<0.37	<0.02	<0.03	<0.02	<0.06	<0.08
IMP-16	09/16/1999	**E0.01**	<0.05	<0.37	<0.02	<0.03	<0.02	<0.06	<0.08
IMP-17	09/29/1999	**E0.01**	<0.05	**E0.01**	<0.02	<0.03	<0.02	<0.06	<0.08
IMP-18	10/15/1999	**E0.01**	<0.10	<0.14	<0.02	<0.03	<0.02	<0.06	<0.08
IMP-19	10/29/1999	<0.06	<0.05	<0.07	<0.02	<0.03	<0.02	<0.06	<0.08
IMP-20	11/18/1999	**E0.03**	<0.05	<0.07	<0.02	<0.03	0.05	**E0.03**	<0.08
IMP-21	11/30/1999	**E0.04**	**E0.01**	<0.07	<0.02	<0.03	**E0.01**	<0.06	<0.08
IMP-22	12/16/1999	**E0.02**	<0.05	<0.07	<0.02	<0.03	<0.02	<0.06	**E0.06**
IMP-23	12/28/1999	**E0.02**	<0.05	<0.07	<0.02	<0.03	<0.02	<0.06	<0.08
IMP-24	01/13/2000	<0.06	<0.05	<0.07	<0.02	<0.03	<0.02	<0.06	**0.05**
IMP-25	01/25/2000	**0.02**	**E0.01**	**E0.01**	<0.02	**0.04**	<0.02	<0.06	**0.51**

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides								
		Alpha HCH, GC/MS[a] (34253)	Carbaryl,* HPLC[d,e] (49310)	Carbaryl, GC/MS[a] (82680)	Carbo-furan,** GC/MS[a] (82674)	Chlor-pyrifos, GC/MS[a] (38933)	Diazinon, GC/MS[a] (39572)	Lindane, GC/MS[a] (39341)	Malathion, GC/MS[a] (39532)	Methomyl,* HPLC[d,e] (49296)
IMP-26	02/01/2000	<0.002	**M**	**E0.025**	<0.003	<0.010	**0.042**	<0.004	<0.005	<0.08
IMP-27	02/12/2000	<0.002	**0.02**	**E0.067**	<0.003	**0.129**	**0.584**	<0.004	**0.139**	<0.08
IMP-28	02/18/2000	<0.002	—	**E0.062**	<0.003	**0.018**	**0.086**	<0.004	<0.025	—
IMP-29	02/23/2000	<0.002	**0.02**	**E0.054**	<0.003	**0.015**	**0.142**	<0.004	**0.024**	<0.08
IMP-30	02/29/2000	<0.002	**M**	**E0.020**	<0.003	**0.006**	**0.054**	<0.004	0.01	<0.08
IMP-31	03/17/2000	<0.002	<0.06	**E0.009**	<0.003	**0.006**	**0.06**	<0.004	**0.008**	<0.08
IMP-32	03/31/2000	<0.002	<0.06	**E0.018**	<0.003	<0.004	**0.017**	**0.013**	**0.016**	<0.08
IMP-33	04/13/2000	<0.002	<0.06	**E0.018**	<0.003	<0.004	**0.024**	<0.020	<0.005	<0.08
IMP-34	05/12/2000	<0.002	—	**E0.010**	<0.003	<0.004	**0.02**	<0.005	**0.007**	—
IMP-35	06/15/2000	<0.002	—	<0.003	<0.003	<0.004	**0.029**	<0.004	<0.005	—
IMP-36	07/14/2000	<0.002	—	<0.003	<0.003	<0.004	**0.022**	**0.005**	<0.005	—
IMP-37	08/17/2000	<0.002	—	**E0.005**	**E0.006**	**0.006**	**0.038**	**0.009**	<0.005	—
IMP-38	09/13/2000	<0.002	—	<0.003	<0.003	<0.004	**0.043**	**0.009**	<0.005	—
IMP-39	10/19/2000	<0.005	—	<0.041	<0.020	<0.005	**0.013**	<0.004	<0.027	—
IMP-40	12/13/2000	<0.005	—	<0.041	<0.020	<0.010	**0.013**	<0.007	<0.027	—
IMP-41	01/18/2001	<0.005	—	**E0.064**	<0.020	**0.006**	**0.094**	<0.004	**E0.016**	—
IMP-42	02/21/2001	<0.005	—	**E0.016**	<0.020	**E0.005**	**0.063**	<0.004	**E0.009**	—
IMP-43	04/19/2001	<0.005	—	<0.041	<0.020	<0.005	**0.026**	**0.005**	<0.027	—
MEN-01	02/20/2001	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—
MEN-02	03/22/2001	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides			Fungicides				Stimulant
		Propoxur,* HPLC[d,e] (38538)	1,4-Dichloro-benzene, GC/MS[c] (34571)	Carbon disulfide, GC/MS[c] (77041)	Benomyl, HPLC[d] (50300)	Iprodione, GC/MS[b] (61593)	Metalaxyl, GC/MS[b] (61596)	Metalaxyl, HPLC[d] (50359)	Caffeine, HPLC[d] (50305)
IMP-26	02/01/2000	0.02	**E0.01**	<0.07	<0.02	<0.03	<0.02	<0.06	**0.23**
IMP-27	02/12/2000	0.02	—	—	**0.03**	<0.03	<0.02	<0.06	**0.77**
IMP-28	02/18/2000	—	<0.10	<0.14	—	<0.03	<0.02	—	—
IMP-29	02/23/2000	**0.01**	<0.05	**E0.01**	<0.02	<0.03	<0.02	<0.06	**0.34**
IMP-30	02/29/2000	**0.02**	<0.05	<0.07	<0.02	<0.03	<0.02	<0.06	**0.19**
IMP-31	03/17/2000	**0.01**	<0.05	<0.07	<0.02	<0.03	<0.02	<0.06	**0.16**
IMP-32	03/31/2000	**0.01**	<0.05	<0.07	<0.02	<0.03	<0.02	<0.06	**0.04**
IMP-33	04/13/2000	**0.01**	<0.05	<0.07	<0.02	<0.03	<0.02	<0.06	**0.02**
IMP-34	05/12/2000	—	<0.05	<0.07	—	—	—	—	—
IMP-35	06/15/2000	—	<0.05	<0.07	—	—	—	—	—
IMP-36	07/14/2000	—	<0.05	**E0.02**	—	—	—	—	—
IMP-37	08/17/2000	—	<0.05	<0.07	—	—	—	—	—
IMP-38	09/13/2000	—	<0.05	<0.07	—	—	—	—	—
IMP-39	10/19/2000	—	<0.05	**E0.02**	—	—	—	—	—
IMP-40	12/13/2000	—	<0.05	<0.07	—	—	—	—	—
IMP-41	01/18/2001	—	<0.05	<0.07	—	—	—	—	—
IMP-42	02/21/2001	—	<0.05	<0.07	—	—	—	—	—
IMP-43	04/19/2001	—	<0.05	<0.07	—	—	—	—	—
MEN-01	02/20/2001	—	<0.05	<0.07	—	—	—	—	—
MEN-02	03/22/2001	—	<0.05	<0.07	—	—	—	—	—

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides								
		Alpha HCH, GC/MS[a] (34253)	Carbaryl,* HPLC[d,e] (49310)	Carbaryl, GC/MS[a] (82680)	Carbo-furan,** GC/MS[a] (82674)	Chlor-pyrifos, GC/MS[a] (38933)	Diazinon, GC/MS[a] (39572)	Lindane, GC/MS[a] (39341)	Malathion, GC/MS[a] (39532)	Methomyl,* HPLC[d,e] (49296)
MEN-03	04/16/2001	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—
MEN-04	05/17/2001	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—
MEN-05	06/14/2001	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—
MEN-06	07/10/2001	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—
MEN-07	08/13/2001	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—
MEN-08	09/13/2001	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—
PRADO-01	07/13/2000	<0.002	—	<0.003	<0.003	<0.004	**0.018**	**0.006**	<0.005	—
PRADO-02	08/17/2000	<0.002	—	**E0.007**	**E0.008**	<0.004	**0.029**	**0.012**	<0.005	—
PRADO-03	09/13/2000	<0.002	—	<0.003	<0.003	<0.004	**0.03**	**0.009**	<0.005	—
PRADO-04	10/19/2000	<0.005	—	<0.041	<0.020	<0.005	**0.008**	<0.004	<0.027	—
PRADO-05	12/13/2000	<0.005	—	<0.041	<0.020	<0.005	**0.009**	**0.009**	<0.027	—
PRADO-06	01/18/2001	<0.005	—	**E0.071**	<0.020	**0.006**	**0.1**	<0.004	<0.027	—
PRADO-07	02/21/2001	<0.005	—	**E0.018**	<0.020	**0.008**	**0.077**	<0.004	**E.010**	—
PRADO-08	03/21/2001	<0.005	—	**E0.055**	<0.020	<0.005	**0.024**	**0.007**	<0.027	—
PRADO-09	04/19/2001	<0.005	—	**E0.005**	<0.020	<0.005	**0.022**	**0.007**	<0.027	—
PRADO-10	05/16/2001	<0.005	—	<0.041	<0.020	<0.005	**0.011**	**0.007**	<0.027	—
PRADO-11	06/13/2001	<0.005	—	**E0.002**	<0.020	<0.005	**0.026**	**0.006**	<0.027	—
PRADO-12	07/12/2001	<0.005	—	<0.041	<0.020	<0.005	**0.029**	<0.004	<0.027	—
PRADO-13	08/14/2001	<0.005	—	<0.041	<0.020	<0.005	**0.026**	<0.004	<0.027	—
PRADO-14	09/12/2001	<0.005	—	**E0.003**	<0.020	<0.005	**0.056**	<0.005	<0.027	—

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides			Fungicides				Stimulant
		Propoxur,* HPLC[d,e] (38538)	1,4-Dichloro-benzene, GC/MS[c] (34571)	Carbon disulfide, GC/MS[c] (77041)	Benomyl, HPLC[d] (50300)	Iprodione, GC/MS[b] (61593)	Metalaxyl, GC/MS[b] (61596)	Metalaxyl, HPLC[d] (50359)	Caffeine, HPLC[d] (50305)
MEN-03	04/16/2001	—	<0.05	<0.07	—	—	—	—	—
MEN-04	05/17/2001	—	<0.05	<0.07	—	—	—	—	—
MEN-05	06/14/2001	—	<0.05	<0.07	—	—	—	—	—
MEN-06	07/10/2001	—	<0.05	<0.07	—	—	—	—	—
MEN-07	08/13/2001	—	<0.05	<0.07	—	—	—	—	—
MEN-08	09/13/2001	—	<0.05	<0.07	—	—	—	—	—
PRADO-01	07/13/2000	—	<0.05	<0.07	—	—	—	—	—
PRADO-02	08/17/2000	—	<0.05	<0.07	—	—	—	—	—
PRADO-03	09/13/2000	—	<0.05	<0.07	—	—	—	—	—
PRADO-04	10/19/2000	—	<0.05	**E0.02**	—	—	—	—	—
PRADO-05	12/13/2000	—	<0.05	<0.07	—	—	—	—	—
PRADO-06	01/18/2001	—	<0.05	<0.07	—	—	—	—	—
PRADO-07	02/21/2001	—	<0.05	**E0.02**	—	—	—	—	—
PRADO-08	03/21/2001	—	<0.05	<0.07	—	—	—	—	—
PRADO-09	04/19/2001	—	<0.05	<0.07	—	—	—	—	—
PRADO-10	05/16/2001	—	<0.05	<0.07	—	—	—	—	—
PRADO-11	06/13/2001	—	<0.05	**E0.02**	—	—	—	—	—
PRADO-12	07/12/2001	—	<0.05	**E0.02**	—	—	—	—	—
PRADO-13	08/14/2001	—	<0.05	**E0.01**	—	—	—	—	—
PRADO-14	09/12/2001	—	<0.05	<0.07	—	—	—	—	—

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides								
		Alpha HCH, GC/MS[a] (34253)	Carbaryl,* HPLC[d,e] (49310)	Carbaryl, GC/MS[a] (82680)	Carbo-furan,** GC/MS[a] (82674)	Chlor-pyrifos, GC/MS[a] (38933)	Diazinon, GC/MS[a] (39572)	Lindane, GC/MS[a] (39341)	Malathion, GC/MS[a] (39532)	Methomyl,* HPLC[d,e] (49296)
ULUG-01	08/07/2000	<0.002	—	<0.003	<0.003	<0.004	**0.043**	**0.012**	<0.005	—
ULUG-02	08/08/2000	<0.002	—	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	—
ULUG-03	08/08/2000	<0.002	—	<0.003	<0.003	<0.004	**0.022**	**0.015**	<0.005	—
ULUG-04	08/09/2000	<0.002	—	<0.003	<0.020	<0.004	**0.685**	<0.004	<0.005	—
ULUG-05	08/09/2000	<0.002	—	<0.003	<0.003	<0.004	**0.069**	**0.024**	<0.005	—
ULUG-06	08/10/2000	<0.002	—	**E0.037**	<0.003	<0.004	**0.111**	**0.012**	<0.005	—
ULUG-07	08/11/2000	<0.002	—	**E0.008**	<0.003	**0.012**	**0.774**	<0.004	<0.005	—
ULUG-08	08/14/2000	<0.002	—	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	—
ULUG-09	08/15/2000	<0.002	—	<0.003	<0.003	<0.004	<0.010	<0.010	<0.005	—
ULUG-10	08/15/2000	<0.002	—	<0.003	<0.003	<0.004	**0.032**	<0.004	<0.005	—
ULUG-11	08/15/2000	<0.002	—	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	—
ULUG-12	08/16/2000	<0.002	—	<0.003	<0.003	<0.004	**0.048**	<0.004	<0.005	—
ULUG-13	08/16/2000	<0.002	—	**E0.026**	<0.003	<0.004	**0.073**	**0.072**	<0.005	—
ULUG-14	08/16/2000	**E0.003**	—	<0.003	<0.007	<0.004	**0.034**	**0.029**	<0.005	—
ULUG-15	08/17/2000	<0.002	—	<0.003	<0.003	<0.004	**E0.003**	<0.004	<0.005	—
ULUG-16	08/17/2000	<0.002	—	<0.003	<0.003	<0.004	**E0.004**	<0.004	<0.005	—
ULUG-17	08/18/2000	<0.002	—	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	—
WARM-01	11/16/1998	<0.002	<0.008	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.23
WARM-02	12/08/1998	<0.002	<0.008	<0.003	<0.003	**E0.002**	**E0.003**	<0.004	<0.005	<0.02
WARM-03	01/12/1999	<0.002	<0.008	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.02

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides			Fungicides				Stimulant
		Propoxur,* HPLC[d,e] (38538)	1,4-Dichloro-benzene, GC/MS[c] (34571)	Carbon disulfide, GC/MS[c] (77041)	Benomyl, HPLC[d] (50300)	Iprodione, GC/MS[b] (61593)	Metalaxyl, GC/MS[b] (61596)	Metalaxyl, HPLC[d] (50359)	Caffeine, HPLC[d] (50305)
ULUG-01	08/07/2000	—	**0.13**	<0.07	—	—	—	—	—
ULUG-02	08/08/2000	—	<0.05	<0.07	—	—	—	—	—
ULUG-03	08/08/2000	—	—	—	—	—	—	—	—
ULUG-04	08/09/2000	—	**E0.01**	<0.07	—	—	—	—	—
ULUG-05	08/09/2000	—	**0.15**	<0.07	—	—	—	—	—
ULUG-06	08/10/2000	—	—	—	—	—	—	—	—
ULUG-07	08/11/2000	—	<0.05	**0.14**	—	—	—	—	—
ULUG-08	08/14/2000	—	—	—	—	—	—	—	—
ULUG-09	08/15/2000	—	—	—	—	—	—	—	—
ULUG-10	08/15/2000	—	—	—	—	—	—	—	—
ULUG-11	08/15/2000	—	—	—	—	—	—	—	—
ULUG-12	08/16/2000	—	**E0.03**	<0.07	—	—	—	—	—
ULUG-13	08/16/2000	—	**E0.04**	<0.07	—	—	—	—	—
ULUG-14	08/16/2000	—	—	—	—	—	—	—	—
ULUG-15	08/17/2000	—	—	—	—	—	—	—	—
ULUG-16	08/17/2000	—	—	—	—	—	—	—	—
ULUG-17	08/18/2000	—	<0.05	<0.07	—	—	—	—	—
WARM-01	11/16/1998	<0.04	<0.10	<0.74	—	—	—	—	—
WARM-02	12/08/1998	<0.04	<0.05	<0.37	—	—	—	—	—
WARM-03	01/12/1999	<0.04	<0.05	<0.37	—	—	—	—	—

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides								
		Alpha HCH, GC/MS[a] (34253)	Carbaryl,* HPLC[d,e] (49310)	Carbaryl, GC/MS[a] (82680)	Carbo-furan,** GC/MS[a] (82674)	Chlor-pyrifos, GC/MS[a] (38933)	Diazinon, GC/MS[a] (39572)	Lindane, GC/MS[a] (39341)	Malathion, GC/MS[a] (39532)	Methomyl,* HPLC[d,e] (49296)
WARM-04	01/27/1999	<0.002	<0.008	**E0.013**	<0.003	**0.013**	**0.057**	<0.004	**0.012**	<0.02
WARM-05	02/09/1999	<0.002	<0.008	**E0.025**	<0.003	**0.046**	**0.07**	<0.004	<0.005	<1.22
WARM-06	02/10/1999	<0.002	<0.008	<0.003	<0.003	**E0.002**	**0.016**	<0.004	<0.005	<0.02
WARM-07	03/09/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-08	03/15/1999	<0.002	**M**	**E0.307**	<0.003	<0.080	**0.198**	<0.004	<0.070	<0.08
WARM-09	04/14/1999	<0.002	<0.06	<0.003	<0.003	**E0.004**	**0.021**	<0.004	<0.005	<0.08
WARM-10	05/18/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-11	06/16/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-12	07/13/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-13	07/27/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-14	08/10/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-15	08/24/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.004	<0.004	<0.005	<0.08
WARM-16	09/14/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.005**	<0.004	<0.005	<0.08
WARM-17	09/28/1999	<0.002	<0.06	<0.006	<0.003	<0.004	**0.014**	<0.004	<0.005	<0.08
WARM-18	10/13/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-19	10/28/1999	<0.002	<0.06	**E.005**	<0.003	<0.004	**E0.002**	<0.004	<0.005	<0.08
WARM-20	11/15/1999	<0.002	<0.06	<0.003	<0.003	<0.004	0.008	<0.004	<0.005	<0.08
WARM-21	11/29/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-22	12/13/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**E0.003**	<0.004	<0.005	<0.08
WARM-23	12/27/1999	<0.002	—	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	—

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides			Fungicides				Stimulant
		Propoxur,* HPLC[d,e] (38538)	**1,4-Dichloro-benzene, GC/MS[c] (34571)**	**Carbon disulfide, GC/MS[c] (77041)**	**Benomyl, HPLC[d] (50300)**	**Iprodione, GC/MS[b] (61593)**	**Metalaxyl, GC/MS[b] (61596)**	**Metalaxyl, HPLC[d] (50359)**	**Caffeine, HPLC[d] (50305)**
WARM-04	01/27/1999	<0.42	<0.05	<0.37	—	—	—	—	—
WARM-05	02/09/1999	<0.04	—	—	—	—	—	—	—
WARM-06	02/10/1999	<0.04	<0.05	<0.37	—	—	—	—	—
WARM-07	03/09/1999	<0.06	<0.05	<0.37	<0.02	—	—	<0.06	<0.08
WARM-08	03/15/1999	<0.06	<0.25	<1.85	<0.02	—	—	<0.06	<0.08
WARM-09	04/14/1999	<0.06	<0.05	<0.37	<0.02	—	—	<0.06	**E0.04**
WARM-10	05/18/1999	<0.06	<0.05	<0.37	<0.02	—	—	<0.06	**E0.06**
WARM-11	06/16/1999	<0.06	<0.05	<0.37	<0.02	—	—	<0.06	**E0.26**
WARM-12	07/13/1999	<0.06	<0.05	<0.37	<0.02	—	—	<0.06	**E0.07**
WARM-13	07/27/1999	<0.06	<0.05	<0.37	<0.02	—	—	<0.06	**E0.04**
WARM-14	08/10/1999	<0.06	<0.05	<0.37	<0.02	—	—	**E0.01**	**E0.06**
WARM-15	08/24/1999	—	<0.05	<0.37	<0.02	—	—	<0.06	**E0.12**
WARM-16	09/14/1999	<0.06	<0.05	<0.37	<0.02	—	—	<0.06	**E0.08**
WARM-17	09/28/1999	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	**E0.14**
WARM-18	10/13/1999	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	**E0.03**
WARM-19	10/28/1999	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	**E0.04**
WARM-20	11/15/1999	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	**E0.06**
WARM-21	11/29/1999	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	**E0.16**
WARM-22	12/13/1999	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	**E0.07**
WARM-23	12/27/1999	—	<0.05	<0.07	—	—	—	—	—

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides								
		Alpha HCH, GC/MS[a] (34253)	Carbaryl,* HPLC[d,e] (49310)	Carbaryl, GC/MS[a] (82680)	Carbo-furan,** GC/MS[a] (82674)	Chlor-pyrifos, GC/MS[a] (38933)	Diazinon, GC/MS[a] (39572)	Lindane, GC/MS[a] (39341)	Malathion, GC/MS[a] (39532)	Methomyl,* HPLC[d,e] (49296)
WARM-24	01/11/2000	<0.002	<0.06	<0.003	<0.003	<0.004	**0.004**	<0.004	<0.005	<0.08
WARM-25	01/25/2000	<0.002	**0.02**	<0.003	<0.150	<0.004	**0.043**	—	<0.005	<0.08
WARM-26	02/01/2000	<0.002	<0.06	**E0.006**	<0.003	**0.004**	**0.013**	<0.004	<0.005	<0.08
WARM-27	02/12/2000	<0.002	**M**	**E0.021**	<0.003	**0.005**	**0.078**	<0.004	**0.024**	<0.08
WARM-28	02/15/2000	<0.002	<0.06	<0.003	<0.003	**0.005**	**0.012**	<0.004	<0.005	<0.08
WARM-29	02/21/2000	<0.002	—	**E0.015**	<0.003	<0.004	**0.028**	<0.004	**0.02**	—
WARM-30	02/28/2000	<0.002	<0.06	<0.003	<0.003	<0.004	**0.01**	<0.004	<0.005	<0.08
WARM-31	03/14/2000	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-32	03/30/2000	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-33	04/10/2000	<0.002	<0.06	<0.003	<0.003	<0.004	**0.006**	<0.004	<0.005	<0.08
WARM-34	05/09/2000	<0.002	—	<0.003	<0.003	<0.004	**0.008**	<0.004	<0.005	—
WARM-35	06/12/2000	<0.002	—	<0.003	<0.003	<0.004	**0.004**	<0.004	<0.005	—
WARM-36	07/11/2000	<0.002	—	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	—
WARM-37	08/14/2000	<0.002	—	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	—
WARM-38	09/11/2000	<0.002	—	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	—
WARM-39	10/16/2000	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—
WARM-40	12/12/2000	<0.005	—	<0.041	<0.020	<0.050	**0.32**	<0.004	**1.35**	—
WARM-41	01/16/2001	<0.005	—	<0.041	<0.020	<0.005	**0.01**	<0.004	<0.027	—
WARM-42	02/22/2001	<0.005	—	<0.041	<0.020	<0.005	**0.008**	<0.004	<0.027	—
WARM-43	03/22/2001	<0.005	—	<0.041	<0.020	<0.005	**0.014**	<0.004	<0.027	—

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides			Fungicides				Stimulant
		Propoxur,* HPLC[d,e] (38538)	1,4-Dichloro-benzene, GC/MS[c] (34571)	Carbon disulfide, GC/MS[c] (77041)	Benomyl, HPLC[d] (50300)	Iprodione, GC/MS[b] (61593)	Metalaxyl, GC/MS[b] (61596)	Metalaxyl, HPLC[d] (50359)	Caffeine, HPLC[d] (50305)
WARM-24	01/11/2000	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	**0.23**
WARM-25	01/25/2000	<0.06	—	—	<0.02	—	—	<0.06	**17.7**
WARM-26	02/01/2000	**0.01**	<0.05	<0.07	<0.02	—	—	<0.06	**0.14**
WARM-27	02/12/2000	**0.01**	—	—	<0.02	—	—	<0.06	**0.8**
WARM-28	02/15/2000	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	**0.18**
WARM-29	02/21/2000	—	<0.05	<0.07	—	—	—	—	—
WARM-30	02/28/2000	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	**0.16**
WARM-31	03/14/2000	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	**0.02**
WARM-32	03/30/2000	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	<0.08
WARM-33	04/10/2000	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	**0.09**
WARM-34	05/09/2000	—	<0.05	<0.07	—	—	—	—	—
WARM-35	06/12/2000	—	<0.05	<0.07	—	—	—	—	—
WARM-36	07/11/2000	—	<0.05	<0.07	—	—	—	—	—
WARM-37	08/14/2000	—	<0.05	**E0.01**	—	—	—	—	—
WARM-38	09/11/2000	—	<0.05	<0.07	—	—	—	—	—
WARM-39	10/16/2000	—	<0.05	<0.07	—	—	—	—	—
WARM-40	12/12/2000	—	<0.25	<0.35	—	—	—	—	—
WARM-41	01/16/2001	—	<0.05	<0.07	—	—	—	—	—
WARM-42	02/22/2001	—	<0.05	<0.07	—	—	—	—	—
WARM-43	03/22/2001	—	<0.05	<0.07	—	—	—	—	—

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides								
		Alpha HCH, GC/MS[a] (34253)	Carbaryl,* HPLC[d,e] (49310)	Carbaryl, GC/MS[a] (82680)	Carbo-furan,** GC/MS[a] (82674)	Chlor-pyrifos, GC/MS[a] (38933)	Diazinon, GC/MS[a] (39572)	Lindane, GC/MS[a] (39341)	Malathion, GC/MS[a] (39532)	Methomyl,* HPLC[d,e] (49296)
WARM-44	04/17/2001	<0.005	—	<0.041	<0.020	<0.005	**0.008**	<0.004	<0.027	—
WARM-45	05/17/2001	<0.005	—	**E0.006**	<0.020	<0.005	**0.005**	<0.004	<0.027	—
WARM-46	06/14/2001	<0.005	—	**E0.003**	<0.020	<0.005	**E0.005**	<0.004	**E0.004**	—
WARM-47	07/10/2001	<0.005	—	<0.041	<0.020	<0.005	**0.01**	<0.004	<0.027	—
WARM-48	08/15/2001	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—
WARM-49	09/13/2001	<0.005	—	<0.041	<0.020	<0.005	**0.01**	<0.004	<0.027	—
CUCA-01	04/01/1999	<0.002	—	**E0.090**	<0.003	**0.036**	**0.095**	<0.004	**0.044**	—

See footnotes at end of table.

Appendix A-3. Analytical results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	Sample date	Insecticides			Fungicides				Stimulant
		Propoxur,* HPLC[d,e] (38538)	1,4-Dichloro-benzene, GC/MS[c] (34571)	Carbon disulfide, GC/MS[c] (77041)	Benomyl, HPLC[d] (50300)	Iprodione, GC/MS[b] (61593)	Metalaxyl, GC/MS[b] (61596)	Metalaxyl, HPLC[d] (50359)	Caffeine, HPLC[d] (50305)
WARM-44	04/17/2001	—	<0.05	<0.07	—	—	—	—	—
WARM-45	05/17/2001	—	<0.05	<0.07	—	—	—	—	—
WARM-46	06/14/2001	—	<0.05	<0.07	—	—	—	—	—
WARM-47	07/10/2001	—	<0.05	<0.07	—	—	—	—	—
WARM-48	08/15/2001	—	<0.05	<0.07	—	—	—	—	—
WARM-49	09/13/2001	—	<0.05	<0.07	—	—	—	—	—
CUCA-01	04/01/1999	—	—	—	—	—	—	—	—

*Samples collected from November 1998 through February 1999 were analyzed by analytical schedule 2050 (HPLC[e]).

**Carbofuran as parameter code 49309 on schedule 2050 and lab code 9060 was never detected.

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

[d]Furlong and others, 2001.

[e]Werner and others, 1996.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		1-Naphthol, GC/MS[b] (49295)	2,5-Dichloro-aniline, GC/MS[b] (61614)	2-[2-Ethyl-6-methyl phenyl) amino]-1 propanol, GC/MS[b] (61615)	4-Chloro-2-methyl-phenol, GC/MS[b] (61633)	Aldicarb sulfone, HPLC[d,e] (49313)	3,4-Di-chloro-aniline, GC/MS[b] (61625)	3-Phenox-ybenzyl alcohol, GC/MS[b] (61629)	Deethyl-atrazine, GC/MS[a], HPLC[d] (04040)
EVMWTP-IN-01	07/15/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.048**	<0.03	<0.002
EVMWTP-IN-02	08/10/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.045**	<0.03	<0.002
EVMWTP-IN-03	08/23/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.043**	<0.03	<0.002
EVMWTP-IN-04	09/13/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.026**	<0.03	<0.002
EVMWTP-IN-05	09/28/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.035**	<0.03	<0.004
EVMWTP-IN-06	10/28/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.061**	<0.03	<0.002
EVMWTP-IN-07	11/29/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.044**	<0.03	<0.002
EVMWTP-IN-08	12/13/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.026**	<0.03	<0.002
EVMWTP-FI-01	07/15/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
EVMWTP-FI-02	08/10/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
EVMWTP-FI-03	08/23/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
EVMWTP-FI-04	09/13/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
EVMWTP-FI-05	09/28/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.004
EVMWTP-FI-06	10/28/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
EVMWTP-FI-07	11/29/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
EVMWTP-FI-08	12/13/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
IMP-01	11/20/1998	—	—	—	—	<0.10	—	—	—
IMP-02	12/10/1998	—	—	—	—	<0.10	—	—	<0.002
IMP-03	01/14/1999	—	—	—	—	<0.10	—	—	<0.002
IMP-04	01/25/1999	—	—	—	—	<0.10	—	—	**E0.004**

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		Deethylde-isopropyl-atrazine, HPLC[d] (04039)	Deisopropyl-atrazine, HPLC[d] (04038)	Disulfoton sulfone, GC/MS[b] (61640)	Disulfotone sulfoxide, GC/MS[b] (61641)	2-Hydroxy-atrazine, HPLC[d] (50355)	Malaoxon, GC/MS[b] (61652)	p,p′-DDE, GC/MS[a] (34653)	3(4-chloro-phenyl)-1-methyl urea, HPLC[d] (61692)
EVMWTP-IN-01	07/15/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	**E0.01**
EVMWTP-IN-02	08/10/1999	**E0.01**	**E0.01**	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
EVMWTP-IN-03	08/23/1999	<0.06	<0.07	<0.005	<0.02	**M**	<0.02	<0.006	**E0.01**
EVMWTP-IN-04	09/13/1999	**E0.01**	**E0.01**	<0.005	<0.02	**M**	<0.02	<0.006	<0.09
EVMWTP-IN-05	09/28/1999	**E0.01**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
EVMWTP-IN-06	10/28/1999	**M**	<0.07	<0.005	<0.02	**M**	<0.02	<0.006	**E0.01**
EVMWTP-IN-07	11/29/1999	<0.06	**E0.02**	<0.005	<0.02	<0.2	<0.02	<0.006	**E0.02**
EVMWTP-IN-08	12/13/1999	**E0.01**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	**E0.03**
EVMWTP-FI-01	07/15/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
EVMWTP-FI-02	08/10/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
EVMWTP-FI-03	08/23/1999	**E0.01**	<0.07	<0.005	<0.02	**M**	<0.02	<0.006	<0.09
EVMWTP-FI-04	09/13/1999	**E0.01**	<0.07	<0.005	<0.02	**M**	<0.02	<0.006	<0.09
EVMWTP-FI-05	09/28/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
EVMWTP-FI-06	10/28/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
EVMWTP-FI-07	11/29/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
EVMWTP-FI-08	12/13/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-01	11/20/1998	—	—	—	—	—	—	—	—
IMP-02	12/10/1998	—	—	—	—	—	—	<0.006	—
IMP-03	01/14/1999	—	—	—	—	—	—	<0.006	—
IMP-04	01/25/1999	—	—	—	—	—	—	<0.006	—

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		1-Naphthol, GC/MS[b] (49295)	2,5-Dichloro-aniline, GC/MS[b] (61614)	2-[2-Ethyl-6-methyl phenyl) amino]-1 propanol, GC/MS[b] (61615)	4-Chloro-2-methyl-phenol, GC/MS[b] (61633)	Aldicarb sulfone, HPLC[d,e] (49313)	3,4-Di-chloro-aniline, GC/MS[b] (61625)	3-Phenox-ybenzyl alcohol, GC/MS[b] (61629)	Deethyl-atrazine, GC/MS[a], HPLC[d] (04040)
IMP-05	02/09/1999	—	—	—	—	<0.10	—	—	**E0.004**
IMP-06	02/12/1999	—	—	—	—	<0.94	—	—	<0.002
IMP-07	03/11/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.022**	<0.03	**E0.005**
IMP-08	03/15/1999	**0.016**	<0.005	<0.02	**0.018**	<0.2	<0.008	<0.03	<0.002
IMP-09	04/16/1999	**E0.020**	<0.005	**0.13**	<0.005	<0.2	**0.105**	<0.03	**E0.004**
IMP-10	05/20/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.037**	<0.03	**E0.006**
IMP-11	06/18/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.038**	<0.03	**E0.003**
IMP-12	07/15/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.037**	<0.03	<0.002
IMP-13	07/26/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.039**	<0.03	**E0.008**
IMP-14	08/12/1999	<0.005	**0.009**	<0.02	<0.005	<0.2	**0.037**	<0.03	**E0.006**
IMP-15	08/25/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.038**	<0.03	**E0.006**
IMP-16	09/16/1999	<0.005	**E0.005**	<0.02	<0.005	<0.2	**0.032**	<0.03	**E0.005**
IMP-17	09/29/1999	<0.005	**E0.006**	<0.02	<0.005	<0.2	**0.032**	<0.03	**E0.008**
IMP-18	10/15/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.028**	<0.03	<0.002
IMP-19	10/29/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.031**	<0.03	**E0.007**
IMP-20	11/18/1999	**E0.006**	**E0.006**	<0.02	<0.005	<0.2	**0.033**	<0.03	**E0.006**
IMP-21	11/30/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.038**	<0.03	<0.007
IMP-22	12/16/1999	**E0.003**	<0.005	<0.02	<0.005	<0.2	**0.014**	<0.03	**E0.005**
IMP-23	12/28/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.036**	<0.03	**E0.007**
IMP-24	01/13/2000	<0.005	<0.005	**0.02**	<0.005	<0.2	**0.023**	**E0.01**	**E0.006**

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		Deethylde-isopropyl-atrazine, HPLC[d] (04039)	Deisopropyl-atrazine, HPLC[d] (04038)	Disulfoton sulfone, GC/MS[b] (61640)	Disulfotone sulfoxide, GC/MS[b] (61641)	2-Hydroxy-atrazine, HPLC[d] (50355)	Malaoxon, GC/MS[b] (61652)	p,p′-DDE, GC/MS[a] (34653)	3(4-chloro-phenyl)-1-methyl urea, HPLC[d] (61692)
IMP-05	02/09/1999	—	—	—	—	—	—	<0.006	—
IMP-06	02/12/1999	—	—	—	—	—	—	<0.006	—
IMP-07	03/11/1999	**E0.01**	<0.07	<0.005	<0.02	—	<0.02	<0.006	<0.09
IMP-08	03/15/1999	**E0.01**	<0.07	<0.005	<0.02	—	<0.02	<0.006	<0.09
IMP-09	04/16/1999	**E0.01**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-10	05/20/1999	**E0.01**	**E0.02**	<0.005	<0.02	**M**	<0.02	<0.006	<0.09
IMP-11	06/18/1999	**E0.02**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-12	07/15/1999	**E0.02**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-13	07/26/1999	**E0.02**	<0.07	<0.005	<0.02	**M**	<0.02	<0.006	<0.09
IMP-14	08/12/1999	**E0.02**	**E0.02**	<0.005	**E0.01**	<0.2	<0.02	<0.006	<0.09
IMP-15	08/25/1999	**E0.01**	**E0.01**	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-16	09/16/1999	**E0.02**	**M**	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-17	09/29/1999	**E0.03**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-18	10/15/1999	**E0.04**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-19	10/29/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-20	11/18/1999	**E0.03**	**E0.02**	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-21	11/30/1999	**E0.03**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-22	12/16/1999	**E0.05**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-23	12/28/1999	**E0.01**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-24	01/13/2000	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		1-Naphthol, GC/MS[b] (49295)	2,5-Dichloro-aniline, GC/MS[b] (61614)	2-[2-Ethyl-6-methyl phenyl) amino]-1 propanol, GC/MS[b] (61615)	4-Chloro-2-methyl-phenol, GC/MS[b] (61633)	Aldicarb sulfone, HPLC[d,e] (49313)	3,4-Di-chloro-aniline, GC/MS[b] (61625)	3-Phenox-ybenzyl alcohol, GC/MS[b] (61629)	Deethyl-atrazine, GC/MS[a], HPLC[d] (04040)
IMP-25	01/25/2000	<0.005	<0.005	<0.02	<0.005	<0.2	**0.015**	<0.03	<0.002
IMP-26	02/01/2000	<0.005	<0.005	<0.02	E0.003	<0.2	**0.027**	<0.03	<0.006
IMP-27	02/12/2000	<0.005	<0.005	<0.02	E0.003	<0.2	**0.024**	<0.03	<0.002
IMP-28	02/18/2000	<0.005	<0.005	<0.02	<0.005	—	**0.068**	<0.03	<0.010
IMP-29	02/23/2000	<0.005	<0.005	<0.02	<0.005	<0.2	**0.072**	<0.03	<0.002
IMP-30	02/29/2000	<0.005	<0.005	<0.02	<0.005	<0.2	**0.039**	<0.03	**E0.005**
IMP-31	03/17/2000	<0.005	<0.005	<0.02	<0.005	<0.2	**0.046**	<0.03	**E0.006**
IMP-32	03/31/2000	<0.005	<0.005	<0.02	<0.005	<0.2	**0.019**	<0.03	<0.007
IMP-33	04/13/2000	**E0.001**	**E0.005**	<0.02	<0.005	<0.2	**0.044**	<0.03	**E0.009**
IMP-34	05/12/2000	—	—	—	—	—	—	—	**E0.007**
IMP-35	06/15/2000	—	—	—	—	—	—	—	**E0.005**
IMP-36	07/14/2000	—	—	—	—	—	—	—	**E0.005**
IMP-37	08/17/2000	—	—	—	—	—	—	—	**E0.004**
IMP-38	09/13/2000	—	—	—	—	—	—	—	**E0.006**
IMP-39	10/19/2000	—	—	—	—	—	—	—	<0.006
IMP-40	12/13/2000	—	—	—	—	—	—	—	**E0.005**
IMP-41	01/18/2001	—	—	—	—	—	—	—	<0.006
IMP-42	02/21/2001	—	—	—	—	—	—	—	**E0.004**
IMP-43	04/19/2001	—	—	—	—	—	—	—	**E0.006**
MEN-01	02/20/2001	—	—	—	—	—	—	—	<0.006
MEN-02	03/22/2001	—	—	—	—	—	—	—	<0.006

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		Deethylde-isopropyl-atrazine, HPLC[d] (04039)	Deisopropyl-atrazine, HPLC[d] (04038)	Disulfoton sulfone, GC/MS[b] (61640)	Disulfotone sulfoxide, GC/MS[b] (61641)	2-Hydroxy-atrazine, HPLC[d] (50355)	Malaoxon, GC/MS[b] (61652)	p,p′-DDE, GC/MS[a] (34653)	3(4-chloro-phenyl)-1-methyl urea, HPLC[d] (61692)
IMP-25	01/25/2000	**E0.04**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-26	02/01/2000	**E0.08**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-27	02/12/2000	**E0.04**	<0.07	**0.02**	**0.03**	<0.2	**0.04**	<0.006	<0.09
IMP-28	02/18/2000	—	—	<0.005	<0.02	—	<0.02	<0.006	—
IMP-29	02/23/2000	**E0.04**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-30	02/29/2000	**E0.07**	**E0.01**	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-31	03/17/2000	**E0.03**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-32	03/31/2000	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-33	04/13/2000	**E0.05**	**E0.03**	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-34	05/12/2000	—	—	—	—	—	—	<0.006	—
IMP-35	06/15/2000	—	—	—	—	—	—	<0.006	—
IMP-36	07/14/2000	—	—	—	—	—	—	<0.006	—
IMP-37	08/17/2000	—	—	—	—	—	—	<0.006	—
IMP-38	09/13/2000	—	—	—	—	—	—	<0.006	—
IMP-39	10/19/2000	—	—	—	—	—	—	<0.003	—
IMP-40	12/13/2000	—	—	—	—	—	—	<0.003	—
IMP-41	01/18/2001	—	—	—	—	—	—	<0.003	—
IMP-42	02/21/2001	—	—	—	—	—	—	<0.003	—
IMP-43	04/19/2001	—	—	—	—	—	—	<0.003	—
MEN-01	02/20/2001	—	—	—	—	—	—	<0.003	—
MEN-02	03/22/2001	—	—	—	—	—	—	<0.003	—

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		1-Naphthol, GC/MS[b] (49295)	2,5-Dichloro-aniline, GC/MS[b] (61614)	2-[2-Ethyl-6-methyl phenyl) amino]-1 propanol, GC/MS[b] (61615)	4-Chloro-2-methyl-phenol, GC/MS[b] (61633)	Aldicarb sulfone, HPLC[d,e] (49313)	3,4-Di-chloro-aniline, GC/MS[b] (61625)	3-Phenox-ybenzyl alcohol, GC/MS[b] (61629)	Deethyl-atrazine, GC/MS[a], HPLC[d] (04040)
MEN-03	04/16/2001	—	—	—	—	—	—	—	<0.006
MEN-04	05/17/2001	—	—	—	—	—	—	—	<0.006
MEN-05	06/14/2001	—	—	—	—	—	—	—	<0.006
MEN-06	07/10/2001	—	—	—	—	—	—	—	<0.006
MEN-07	08/13/2001	—	—	—	—	—	—	—	<0.006
MEN-08	09/13/2001	—	—	—	—	—	—	—	<0.006
PRADO-01	07/13/2000	—	—	—	—	—	—	—	**E0.005**
PRADO-02	08/17/2000	—	—	—	—	—	—	—	**E0.005**
PRADO-03	09/13/2000	—	—	—	—	—	—	—	**E0.006**
PRADO-04	10/19/2000	—	—	—	—	—	—	—	**E0.004**
PRADO-05	12/13/2000	—	—	—	—	—	—	—	**E0.005**
PRADO-06	01/18/2001	—	—	—	—	—	—	—	<0.006
PRADO-07	02/21/2001	—	—	—	—	—	—	—	<0.006
PRADO-08	03/21/2001	—	—	—	—	—	—	—	<0.006
PRADO-09	04/19/2001	—	—	—	—	—	—	—	**E0.006**
PRADO-10	05/16/2001	—	—	—	—	—	—	—	<0.006
PRADO-11	06/13/2001	—	—	—	—	—	—	—	**E0.005**
PRADO-12	07/12/2001	—	—	—	—	—	—	—	**E0.012**
PRADO-13	08/14/2001	—	—	—	—	—	—	—	**E0.004**
PRADO-14	09/12/2001	—	—	—	—	—	—	—	**E0.005**

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		Deethylde-isopropyl-atrazine, HPLC[d] (04039)	Deisopropyl-atrazine, HPLC[d] (04038)	Disulfoton sulfone, GC/MS[b] (61640)	Disulfotone sulfoxide, GC/MS[b] (61641)	2-Hydroxy-atrazine, HPLC[d] (50355)	Malaoxon, GC/MS[b] (61652)	p,p′-DDE, GC/MS[a] (34653)	3(4-chloro-phenyl)-1-methyl urea, HPLC[d] (61692)
MEN-03	04/16/2001	—	—	—	—	—	—	<0.003	—
MEN-04	05/17/2001	—	—	—	—	—	—	<0.003	—
MEN-05	06/14/2001	—	—	—	—	—	—	<0.003	—
MEN-06	07/10/2001	—	—	—	—	—	—	<0.003	—
MEN-07	08/13/2001	—	—	—	—	—	—	<0.003	—
MEN-08	09/13/2001	—	—	—	—	—	—	<0.003	—
PRADO-01	07/13/2000	—	—	—	—	—	—	**E0.002**	—
PRADO-02	08/17/2000	—	—	—	—	—	—	<0.006	—
PRADO-03	09/13/2000	—	—	—	—	—	—	<0.006	—
PRADO-04	10/19/2000	—	—	—	—	—	—	<0.003	—
PRADO-05	12/13/2000	—	—	—	—	—	—	<0.003	—
PRADO-06	01/18/2001	—	—	—	—	—	—	<0.003	—
PRADO-07	02/21/2001	—	—	—	—	—	—	<0.003	—
PRADO-08	03/21/2001	—	—	—	—	—	—	<0.003	—
PRADO-09	04/19/2001	—	—	—	—	—	—	<0.003	—
PRADO-10	05/16/2001	—	—	—	—	—	—	<0.003	—
PRADO-11	06/13/2001	—	—	—	—	—	—	<0.003	—
PRADO-12	07/12/2001	—	—	—	—	—	—	<0.003	—
PRADO-13	08/14/2001	—	—	—	—	—	—	<0.003	—
PRADO-14	09/12/2001	—	—	—	—	—	—	<0.003	—

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		1-Naphthol, GC/MS[b] (49295)	2,5-Dichloro-aniline, GC/MS[b] (61614)	2-[2-Ethyl-6-methyl phenyl) amino]-1 propanol, GC/MS[b] (61615)	4-Chloro-2-methyl-phenol, GC/MS[b] (61633)	Aldicarb sulfone, HPLC[d,e] (49313)	3,4-Di-chloro-aniline, GC/MS[b] (61625)	3-Phenox-ybenzyl alcohol, GC/MS[b] (61629)	Deethyl-atrazine, GC/MS[a], HPLC[d] (04040)
ULUG-01	08/07/2000	—	—	—	—	—	—	—	**E0.005**
ULUG-02	08/08/2000	—	—	—	—	—	—	—	<0.002
ULUG-03	08/09/2000	—	—	—	—	—	—	—	<0.002
ULUG-04	08/09/2000	—	—	—	—	—	—	—	<0.002
ULUG-05	08/09/2000	—	—	—	—	—	—	—	<0.002
ULUG-06	08/10/2000	—	—	—	—	—	—	—	<0.002
ULUG-07	08/11/2000	—	—	—	—	—	—	—	<0.002
ULUG-08	08/14/2000	—	—	—	—	—	—	—	**E0.013**
ULUG-09	08/15/2000	—	—	—	—	—	—	—	<0.002
ULUG-10	08/15/2000	—	—	—	—	—	—	—	**E0.012**
ULUG-11	08/15/2000	—	—	—	—	—	—	—	**E0.004**
ULUG-12	08/16/2000	—	—	—	—	—	—	—	**E0.010**
ULUG-13	08/16/2000	—	—	—	—	—	—	—	<0.002
ULUG-14	08/16/2000	—	—	—	—	—	—	—	<0.002
ULUG-15	08/17/2000	—	—	—	—	—	—	—	**E0.055**
ULUG-16	08/17/2000	—	—	—	—	—	—	—	**E0.056**
ULUG-17	08/18/2000	—	—	—	—	—	—	—	<0.002
WARM-01	11/16/1998	—	—	—	—	<0.10	—	—	<0.002
WARM-02	12/08/1998	—	—	—	—	<0.10	—	—	<0.002
WARM-03	01/12/1999	—	—	—	—	<0.10	—	—	<0.002

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		Deethylde-isopropyl-atrazine, HPLC[d] (04039)	Deisopropyl-atrazine, HPLC[d] (04038)	Disulfoton sulfone, GC/MS[b] (61640)	Disulfotone sulfoxide, GC/MS[b] (61641)	2-Hydroxy-atrazine, HPLC[d] (50355)	Malaoxon, GC/MS[b] (61652)	p,p′-DDE, GC/MS[a] (34653)	3(4-chloro-phenyl)-1-methyl urea, HPLC[d] (61692)
ULUG-01	08/07/2000	—	—	—	—	—	—	<0.006	—
ULUG-02	08/08/2000	—	—	—	—	—	—	<0.006	—
ULUG-03	08/09/2000	—	—	—	—	—	—	<0.006	—
ULUG-04	08/09/2000	—	—	—	—	—	—	<0.006	—
ULUG-05	08/09/2000	—	—	—	—	—	—	<0.006	—
ULUG-06	08/10/2000	—	—	—	—	—	—	<0.006	—
ULUG-07	08/11/2000	—	—	—	—	—	—	<0.006	—
ULUG-08	08/14/2000	—	—	—	—	—	—	<0.006	—
ULUG-09	08/15/2000	—	—	—	—	—	—	<0.006	—
ULUG-10	08/15/2000	—	—	—	—	—	—	<0.006	—
ULUG-11	08/15/2000	—	—	—	—	—	—	<0.006	—
ULUG-12	08/16/2000	—	—	—	—	—	—	<0.006	—
ULUG-13	08/16/2000	—	—	—	—	—	—	<0.006	—
ULUG-14	08/16/2000	—	—	—	—	—	—	<0.006	—
ULUG-15	08/17/2000	—	—	—	—	—	—	<0.006	—
ULUG-16	08/17/2000	—	—	—	—	—	—	<0.006	—
ULUG-17	08/18/2000	—	—	—	—	—	—	<0.006	—
WARM-01	11/16/1998	—	—	—	—	—	—	<0.006	—
WARM-02	12/08/1998	—	—	—	—	—	—	**E0.001**	—
WARM-03	01/12/1999	—	—	—	—	—	—	<0.006	—

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		1-Naphthol, GC/MS[b] (49295)	2,5-Dichloro-aniline, GC/MS[b] (61614)	2-[2-Ethyl-6-methyl phenyl) amino]-1 propanol, GC/MS[b] (61615)	4-Chloro-2-methyl-phenol, GC/MS[b] (61633)	Aldicarb sulfone, HPLC[d,e] (49313)	3,4-Di-chloro-aniline, GC/MS[b] (61625)	3-Phenox-ybenzyl alcohol, GC/MS[b] (61629)	Deethyl-atrazine, GC/MS[a], HPLC[d] (04040)
WARM-04	01/27/1999	—	—	—	—	<0.56	—	—	<0.002
WARM-05	02/09/1999	—	—	—	—	<0.21	—	—	<0.002
WARM-06	02/10/1999	—	—	—	—	<0.10	—	—	<0.002
WARM-07	03/09/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-08	03/15/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-09	04/14/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-10	05/18/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-11	06/16/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-12	07/13/1999	—	—	—	—	**M**	—	—	<0.002
WARM-13	07/27/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-14	08/10/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-15	08/24/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-16	09/14/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-17	09/28/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-18	10/13/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-19	10/28/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-20	11/15/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-21	11/29/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-22	12/13/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-23	12/27/1999	—	—	—	—	—	—	—	<0.002
WARM-24	01/11/2000	—	—	—	—	<0.2	—	—	<0.002

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		Deethylde-isopropyl-atrazine, HPLC[d] (04039)	Deisopropyl-atrazine, HPLC[d] (04038)	Disulfoton sulfone, GC/MS[b] (61640)	Disulfotone sulfoxide, GC/MS[b] (61641)	2-Hydroxy-atrazine, HPLC[d] (50355)	Malaoxon, GC/MS[b] (61652)	p,p′-DDE, GC/MS[a] (34653)	3(4-chloro-phenyl)-1-methyl urea, HPLC[d] (61692)
WARM-04	01/27/1999	—	—	—	—	—	—	<0.006	—
WARM-05	02/09/1999	—	—	—	—	—	—	<0.006	—
WARM-06	02/10/1999	—	—	—	—	—	—	<0.006	—
WARM-07	03/09/1999	<0.06	<0.07	—	—	—	—	<0.006	<0.09
WARM-08	03/15/1999	<0.06	<0.07	—	—	—	—	<0.006	<0.09
WARM-09	04/14/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-10	05/18/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-11	06/16/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-12	07/13/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-13	07/27/1999	<0.06	<0.07	—	—	**M**	—	<0.006	<0.09
WARM-14	08/10/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-15	08/24/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-16	09/14/1999	<0.06	<0.07	—	—	**M**	—	<0.006	<0.09
WARM-17	09/28/1999	<0.06	<0.07	—	—	**M**	—	<0.006	<0.09
WARM-18	10/13/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-19	10/28/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-20	11/15/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-21	11/29/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-22	12/13/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-23	12/27/1999	—	—	—	—	—	—	<0.006	—
WARM-24	01/11/2000	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		1-Naphthol, GC/MS[b] (49295)	2,5-Dichloro-aniline, GC/MS[b] (61614)	2-[2-Ethyl-6-methyl phenyl) amino]-1 propanol, GC/MS[b] (61615)	4-Chloro-2-methyl-phenol, GC/MS[b] (61633)	Aldicarb sulfone, HPLC[d,e] (49313)	3,4-Di-chloro-aniline, GC/MS[b] (61625)	3-Phenox-ybenzyl alcohol, GC/MS[b] (61629)	Deethyl-atrazine, GC/MS[a], HPLC[d] (04040)
WARM-25	01/25/2000	—	—	—	—	<0.2	—	—	<0.002
WARM-26	02/01/2000	—	—	—	—	<0.2	—	—	<0.002
WARM-27	02/12/2000	—	—	—	—	<0.2	—	—	<0.002
WARM-28	02/15/2000	—	—	—	—	<0.2	—	—	<0.002
WARM-29	02/21/2000	—	—	—	—	—	—	—	<0.002
WARM-30	02/28/2000	—	—	—	—	<0.2	—	—	<0.002
WARM-31	03/14/2000	—	—	—	—	<0.2	—	—	<0.002
WARM-32	03/30/2000	—	—	—	—	<0.2	—	—	<0.002
WARM-33	04/10/2000	—	—	—	—	<0.2	—	—	<0.002
WARM-34	05/09/2000	—	—	—	—	—	—	—	<0.002
WARM-35	06/12/2000	—	—	—	—	—	—	—	<0.002
WARM-36	07/11/2000	—	—	—	—	—	—	—	<0.002
WARM-37	08/14/2000	—	—	—	—	—	—	—	<0.002
WARM-38	09/11/2000	—	—	—	—	—	—	—	<0.002
WARM-39	10/16/2000	—	—	—	—	—	—	—	<0.006
WARM-40	12/12/2000	—	—	—	—	—	—	—	<0.006
WARM-41	01/16/2001	—	—	—	—	—	—	—	<0.006
WARM-42	02/22/2001	—	—	—	—	—	—	—	<0.006
WARM-43	03/22/2001	—	—	—	—	—	—	—	<0.006
WARM-44	04/17/2001	—	—	—	—	—	—	—	<0.006

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		Deethylde-isopropyl-atrazine, HPLC[d] (04039)	Deisopropyl-atrazine, HPLC[d] (04038)	Disulfoton sulfone, GC/MS[b] (61640)	Disulfotone sulfoxide, GC/MS[b] (61641)	2-Hydroxy-atrazine, HPLC[d] (50355)	Malaoxon, GC/MS[b] (61652)	p,p′-DDE, GC/MS[a] (34653)	3(4-chloro-phenyl)-1-methyl urea, HPLC[d] (61692)
WARM-25	01/25/2000	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-26	02/01/2000	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-27	02/12/2000	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-28	02/15/2000	<0.06	**M**	—	—	<0.2	—	<0.006	<0.09
WARM-29	02/21/2000	—	—	—	—		—	<0.006	—
WARM-30	02/28/2000	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-31	03/14/2000	<0.06	<0.07	—	—	<0.2	—	**E0.001**	<0.09
WARM-32	03/30/2000	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-33	04/10/2000	<0.06	<0.07	—	—	**M**	—	<0.006	<0.09
WARM-34	05/09/2000	—	—	—	—	—	—	<0.006	—
WARM-35	06/12/2000	—	—	—	—	—	—	<0.006	—
WARM-36	07/11/2000	—	—	—	—	—	—	<0.006	—
WARM-37	08/14/2000	—	—	—	—	—	—	<0.006	—
WARM-38	09/11/2000	—	—	—	—	—	—	<0.006	—
WARM-39	10/16/2000	—	—	—	—	—	—	<0.003	—
WARM-40	12/12/2000	—	—	—	—	—	—	<0.003	—
WARM-41	01/16/2001	—	—	—	—	—	—	<0.003	—
WARM-42	02/22/2001	—	—	—	—	—	—	<0.003	—
WARM-43	03/22/2001	—	—	—	—	—	—	<0.003	—
WARM-44	04/17/2001	—	—	—	—	—	—	<0.003	—

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		1-Naphthol, GC/MS[b] (49295)	2,5-Dichloro-aniline, GC/MS[b] (61614)	2-[2-Ethyl-6-methyl phenyl) amino]-1 propanol, GC/MS[b] (61615)	4-Chloro-2-methyl-phenol, GC/MS[b] (61633)	Aldicarb sulfone, HPLC[d,e] (49313)	3,4-Di-chloro-aniline, GC/MS[b] (61625)	3-Phenox-ybenzyl alcohol, GC/MS[b] (61629)	Deethyl-atrazine, GC/MS[a], HPLC[d] (04040)
WARM-45	05/17/2001	—	—	—	—	—	—	—	<0.006
WARM-46	06/14/2001	—	—	—	—	—	—	—	<0.006
WARM-47	07/10/2001	—	—	—	—	—	—	—	<0.006
WARM-48	08/15/2001	—	—	—	—	—	—	—	<0.006
WARM-49	09/13/2001	—	—	—	—	—	—	—	**E0.003**
CUCA-01	04/01/1999	—	—	—	—	—	—	—	<0.002

See footnotes at end of table.

Appendix A-4. Analytical results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; ULUG, Urban Land-Use Gradient Synoptic Study; WARM, Warm Creek near San Bernardino; CUCA, Cucamonga Creek near Mira Loma; MEN, Santa Ana River near Mentone; all values are reported as micrograms per liter (µg/L); bold values were detected by NWQL]

		Pesticide degradation products							
Sample identification No.	NAWQA sample date	Deethylde-isopropyl-atrazine, HPLC[d] (04039)	Deisopropyl-atrazine, HPLC[d] (04038)	Disulfoton sulfone, GC/MS[b] (61640)	Disulfotone sulfoxide, GC/MS[b] (61641)	2-Hydroxy-atrazine, HPLC[d] (50355)	Malaoxon, GC/MS[b] (61652)	p,p′-DDE, GC/MS[a] (34653)	3(4-chloro-phenyl)-1-methyl urea, HPLC[d] (61692)
WARM-45	05/17/2001	—	—	—	—	—	—	<0.003	—
WARM-46	06/14/2001	—	—	—	—	—	—	<0.003	—
WARM-47	07/10/2001	—	—	—	—	—	—	<0.003	—
WARM-48	08/15/2001	—	—	—	—	—	—	<0.003	—
WARM-49	09/13/2001	—	—	—	—	—	—	<0.003	—
CUCA-01	04/01/1999	—	—	—	—	—	—	<0.006	—

[a]Lindley and others, 1996; Zaugg and others, 1995.
[b]Sandstrom and others, 2001.
[c]Rose and Schroeder, 1995; Connor and others, 1998.
[d]Furlong and others, 2001.
[e]Werner and others, 1996.

Appendix B-1. Analytical results on blank samples for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; SDLAB, Equipment blank performed in the USGS San Diego Projects Office; CAJON, Cajon Creek below Lone Pine Creek; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Site where blank was performed	Sample date	Herbicides analyzed by gas chromatography/mass spectrometry							
		Atrazine, GC/MS[a] (39632)	Benfluralin, GC/MS[a] (82673)	Cyanazine, GC/MS[a] (04041)	DCPA (dacthal), GC/MS[a] (82682)	EPTC, GC/MS[a] (82668)	Metolachlor, GC/MS[a] (39415)	Napropamide, GC/MS[a] (82684)	Pendimethalin, GC/MS[a] (82683)
SDLAB	10/16/1998	—	—	—	—	—	—	—	—
SDLAB	12/01/1998	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
SDLAB	12/08/1998	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
SDLAB	12/17/1998	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM	03/09/1999	—	—	—	—	—	—	—	—
IMP	05/20/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM	06/16/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
EVMWTP-IN	07/15/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
IMP	08/12/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
IMP	11/30/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
EVMWTP-FI	12/13/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM	12/27/1999	<0.001	<0.002	<0.004	**E0.002**	<0.002	E0.002	<0.003	<0.004
WARM	12/27/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM	02/20/2000	—	—	—	—	—	—	—	—
IMP	02/29/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM	06/12/2000	—	—	—	—	—	—	—	—
CAJON	08/14/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM	12/12/2000	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.020	<0.010
IMP	02/21/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
PRADO	06/13/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010

See footnotes at end of table.

Appendix B-1. Analytical results on blank samples for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; SDLAB, Equipment blank performed in the USGS San Diego Projects Office; CAJON, Cajon Creek below Lone Pine Creek; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Site where blank was performed	Sample date	Herbicides analyzed by gas chromatography/mass spectrometry							
		Prometon, GC/MS[a] (04037)	Simazine, GC/MS[a] (04035)	Tebuthiuron,GC/MS[a] (82670)	Terbacil* GC/MS[a] (82665)	Triallate, GC/MS[a] (82678)	Trifluralin, GC/MS[a] (82661)	Hexazinone, GC/MS[b] (04025)	Prometryn, GC/MS[b] (04036)
SDLAB	10/16/1998	—	—	—	—	—	—	—	—
SDLAB	12/01/1998	<0.02	<0.005	<0.01	<0.007	<0.001	<0.002	—	—
SDLAB	12/08/1998	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	—	—
SDLAB	12/17/1998	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	—	—
WARM	03/09/1999	—	—	—	—	—	—	—	—
IMP	05/20/1999	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
WARM	06/16/1999	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	—	—
EVMWTP-IN	07/15/1999	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP	08/12/1999	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
IMP	11/30/1999	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
EVMWTP-FI	12/13/1999	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
WARM	12/27/1999	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	—	—
WARM	12/27/1999	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	—	—
WARM	02/20/2000	—	—	—	—	—	—	—	—
IMP	02/29/2000	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	<0.008	<0.005
WARM	06/12/2000	—	—	—	—	—	—	—	—
CAJON	08/14/2000	<0.02	<.005	<0.01	<0.007	<0.001	<0.002	—	—
WARM	12/12/2000	<0.01	<.011	<0.02	<0.034	<0.002	<0.009	—	—
IMP	02/21/2001	<0.01	<.011	<0.02	<0.034	<0.002	<0.009	—	—
PRADO	06/13/2001	<0.01	<.011	<0.02	<0.034	<0.002	<0.009	—	—

*Terbacil as parameter code 04032 on lab code 9060 (HPLC[d]) was never detected in enviromental samples.

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

[d]Furlong and others, 2001.

[e]Werner and others, 1996.

Appendix B-2. Analytical results on blank samples for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; SDLAB, Equipment blank performed in the USGS San Diego Projects Office; CAJON, Cajon Creek below Lone Pine Creek; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Site where blank was performed	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		2,4-D,* HPLC[d,e] (39732)	2,4-D Methyl ester, HPLC[d] (50470)	Bentazon,* HPLC[d,e] (38711)	Bromacil,* HPLC[d,e] (04029)	Clopyralid,* HPLC[d,e] (49305)	Dicamba,* HPLC[d,e] (38442)	Dinoseb,* HPLC[d,e] (49301)	Diuron,* HPLC[d,e] (49300)	4,6-Dinitro-2-methyl-phenol (DNOC), HPLC[e] (49299)	Fenuron,* HPLC[d,e] (49297)
SDLAB	10/16/1998	<0.15	—	<0.01	<0.04	<0.23	<0.04	<0.04	<0.02	<0.42	<0.01
SDLAB	12/01/1998	<0.15	—	<0.01	<0.04	<0.23	<0.04	<0.04	<0.02	<0.42	<0.01
SDLAB	12/08/1998	<0.15	—	<0.01	<0.04	<0.23	<0.04	<0.04	<0.02	<0.42	<0.01
SDLAB	12/17/1998	<0.15	—	<0.01	<0.04	<0.23	<0.04	<0.04	<0.02	<0.42	<0.01
WARM	03/09/1999	—	—	—	—	—	—	—	—	—	—
IMP	05/20/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
WARM	06/16/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
EVMWTP-IN	07/15/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.01**	—	<0.07
IMP	08/12/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
IMP	11/30/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
EVMWTP-FI	12/13/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
WARM	12/27/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
WARM	12/27/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
WARM	02/20/2000	—	—	—	—	—	—	—	—	—	—
IMP	02/29/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	<0.08	—	<0.07
WARM	06/12/2000	—	—	—	—	—	—	—	—	—	—
CAJON	08/14/2000	—	—	—	—	—	—	—	—	—	—
WARM	12/12/2000	—	—	—	—	—	—	—	—	—	—
IMP	02/21/2001	—	—	—	—	—	—	—	—	—	—
PRADO	06/13/2001	—	—	—	—	—	—	—	—	—	—

See footnotes at end of table.

Appendix B-2. Analytical results on blank samples for herbicides analyzed by high-performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; SDLAB, Equipment blank performed in the USGS San Diego Projects Office; CAJON, Cajon Creek below Lone Pine Creek; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Site where blank was performed	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		Fluometuron,* HPLC[d,e] (38811)	Imazaquin, HPLC[d] (50356)	Metaxon* (MCPA), HPLC[d,e] (38482)	Norflurazon,* HPLC[d,e] (49293)	Oryzalin,* HPLC[d,e] (49292)	Picloram,* HPLC[d,e] (49291)	Propham,* HPLC[d,e] (49236)	Siduron, HPLC[d] (38548)	Sulfometuron-methyl, HPLC[d] (50337)	Triclopyr,* HPLC[d,e] (49235)
SDLAB	10/16/1998	<0.04	—	<0.17	<0.02	<0.31	<0.05	<0.04	—	—	<0.25
SDLAB	12/01/1998	<0.48	—	<0.17	<0.02	<0.31	<0.05	<0.04	—	—	<0.25
SDLAB	12/08/1998	<0.04	—	<0.17	<0.02	<0.31	<0.05	<0.04	—	—	<0.25
SDLAB	12/17/1998	<0.04	—	<0.17	<0.02	<0.31	<0.05	<0.04	—	—	<0.25
WARM	03/09/1999	—	—	—	—	—	—	—	—	—	—
IMP	05/20/1999	<0.06	<0.1	<0.06		<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM	06/16/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
EVMWTP-IN	07/15/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP	08/12/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP	11/30/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
EVMWTP-FI	12/13/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM	12/27/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM	12/27/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM	02/20/2000	—	—	—	—	—	—	—	—	—	—
IMP	02/29/2000	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM	06/12/2000	—	—	—	—	—	—	—	—	—	—
CAJON	08/14/2000	—	—	—	—	—	—	—	—	—	—
WARM	12/12/2000	—	—	—	—	—	—	—	—	—	—
IMP	02/21/2001	—	—	—	—	—	—	—	—	—	—
PRADO	06/13/2001	—	—	—	—	—	—	—	—	—	—

*Samples collected from November 1998 through February 1999 were analyzed by analytical schedule 2050 (HPLC[e]).

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

[d]Furlong and others, 2001.

[e]Werner and others, 1996.

Appendix B-3. Analytical results on blank samples for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory: GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; SDLAB, Equipment blank performed in the USGS San Diego Projects Office; CAJON, Cajon Creek below Lone Pine Creek ; WARM, Warm Creek near San Bernardino]

Site where blank was performed	Sample date	Insecticides								
		Alpha HCH, GC/MS[a] (34253)	Carbaryl,* HPLC[d,e] (49310)	Carbaryl, GC/MS[a] (82680)	Carbofuran,** GC/MS[a] (82674)	Chlorpyrifos, GC/MS[a] (38933)	Diazinon, GC/MS[a] (39572)	Lindane, GC/MS[a] (39341)	Malathion, GC/MS[a] (39532)	Methomyl,* HPLC[d,e] (49296)
SDLAB	10/16/1998	—	<0.008	—	—	—	—	—	—	<0.02
SDLAB	12/01/1998	<0.002	<0.008	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.27
SDLAB	12/08/1998	<0.002	<0.008	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.27
SDLAB	12/17/1998	<0.002	<0.008	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.02
WARM	03/09/1999	—	—	—	—	—	—	—	—	—
IMP	05/20/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM	06/16/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
EVMWTP-IN	07/15/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
IMP	08/12/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
IMP	11/30/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
EVMWTP-FI	12/13/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM	12/27/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM	12/27/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM	02/20/2000	—	—	—	—	—	—	—	—	—
IMP	02/29/2000	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM	06/12/2000	—	—	—	—	—	—	—	—	—
CAJON	08/14/2000	<0.002	—	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	—
WARM	12/12/2000	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—
IMP	02/21/2001	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—
PRADO	06/13/2001	<0.005	—	<0.041	<0.020	<0.005	<0.005	<0.004	<0.027	—

See footnotes at end of table.

Appendix B-3. Analytical results on blank samples for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory: GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; SDLAB, Equipment blank performed in the USGS San Diego Projects Office; CAJON, Cajon Creek below Lone Pine Creek; WARM, Warm Creek near San Bernardino]

Site where blank was performed	Sample date	Insecticides			Fungicides				Stimulant
		Propoxur,* HPLC[d,e] (38538)	1,4-Dichlorobenzene, GC/MS[c] (34571)	Carbon disulfide, GC/MS[c] (77041)	Benomyl, HPLC[d] (50300)	Iprodione, GC/MS[b] (61593)	Metalaxyl, GC/MS[b] (61596)	Metalaxyl HPLC[d] (50359)	Caffeine, HPLC[d] (50305)
SDLAB	10/16/1998	<0.04	—	—	—	—	—	—	—
SDLAB	12/01/1998	<0.04	—	—	—	—	—	—	—
SDLAB	12/08/1998	<0.04	—	—	—	—	—	—	—
SDLAB	12/17/1998	<0.04	—	—	—	—	—	—	—
WARM	03/09/1999	—	<0.05	<0.37	—	—	—	—	—
IMP	05/20/1999	—	<0.05	<0.37	<0.02	<0.03	<0.02	<0.06	<0.08
WARM	06/16/1999	<0.06	<0.05	<0.37	<0.02			<0.06	<0.08
EVMWTP-IN	07/15/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
IMP	08/12/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
IMP	11/30/1999	<0.06	<0.05	<0.07	<0.02	<0.03	<0.02	<0.06	<0.08
EVMWTP-FI	12/13/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
WARM	12/27/1999	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	<0.08
WARM	12/27/1999	<0.06	—	—	<0.02	—	—	<0.06	<0.08
WARM	02/20/2000	—	<0.05	<0.07	—	—	—	—	—
IMP	02/29/2000	<0.06	<0.05	<0.07	<0.02	<0.03	<0.02	<0.06	<0.08
WARM	06/12/2000	—	<0.05	<0.07	—	—	—	—	—
CAJON	08/14/2000	—	—	—	—	—	—	—	—
WARM	12/12/2000	—	<0.05	<0.07	—	—	—	—	—
IMP	02/21/2001	—	<0.05	<0.07	—	—	—	—	—
PRADO	06/13/2001	—	<0.05	<0.07	—	—	—	—	—

*Samples collected from November 1998 through February 1999 were analyzed by analytical schedule 2050 (HPLC[e]).

**Carbofuran as parameter code 49309 on schedule 2050 and lab code 9060 was never detected in enviromental samples.

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

[d]Furlong and others, 2001.

[e]Werner and others, 1996.

Appendix B-4. Analytical results on blank samples for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River SDLAB, Equipment blank performed in the USGS San Diego Projects Office; CAJON, Cajon Creek below Lone Pine Creek ; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Site where blank was performed	NAWQA sample date	Pesticide degradation products							
		1-Naphthol, GC/MS[b] (49295)	2,5-Dichloro-aniline, GC/MS[b] (61614)	2-[2-Ethyl-6-methyl-phenyl)a-mino]-1-propanol, GC/MS[b] (61615)	4-Chloro-2-methylphenol, GC/MS[b] (61633)	Aldicarb sulfone, HPLC[d,e] (49313)	3,4-Di-chloro-aniline, GC/MS[b] (61625)	3-Phenoxy benzyl alcohol, GC/MS[b] (61629)	Deethyl-atra-zine, GC/MS[1], HPLC[d] (04040)
SDLAB	10/16/1998	—	—	—	—	<0.10	—	—	—
SDLAB	12/01/1998	—	—	—	—	<0.10	—	—	<0.002
SDLAB	12/08/1998	—	—	—	—	<0.10	—	—	<0.002
SDLAB	12/17/1998	—	—	—	—	<0.10	—	—	<0.002
WARM	03/09/1999	—	—	—	—	—	—	—	—
IMP	05/20/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
WARM	06/16/1999	—	—	—	—	<0.2	—	—	<0.002
EVMWTP-IN	07/15/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
IMP	08/12/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
IMP	11/30/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
EVMWTP-FI	12/13/1999	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
WARM	12/27/1999	—	—	—	—	<0.2	—	—	<0.002
WARM	12/27/1999	—	—	—	—	<0.2	—	—	<0.002
WARM	02/20/2000	—	—	—	—	—	—	—	—
IMP	02/29/2000	<0.005	<0.005	<0.02	<0.005	<0.2	<0.008	<0.03	<0.002
WARM	06/12/2000	—	—	—	—	—	—	—	—
CAJON	08/14/2000	—	—	—	—	—	—	—	<0.002
WARM	12/12/2000	—	—	—	—	—	—	—	<0.006
IMP	02/21/2001	—	—	—	—	—	—	—	<0.006
PRADO	06/13/2001	—	—	—	—	—	—	—	<0.006

See footnotes at end of table.

Appendix B-4. Analytical results on blank samples for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit code in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated reservoir water); EVMWTP-FI, Elsinore Valley Municipal Water Treatment Plant Finished (treated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River SDLAB, Equipment blank performed in the USGS San Diego Projects Office; CAJON, Cajon Creek below Lone Pine Creek ; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Site where blank was performed	NAWQA sample date	Pesticide degradation products							
		Deethylde-iso-propylatrazine, HPLC[d] (04039)	Deisopropyl-atrazine, HPLC[d] (04038)	Disulfoton sulfone, GC/MS[b] (61640)	Disulfotone sulfoxide, GC/MS[b] (61641)	2-Hydroxy-atrazine, HPLC[d] (50355)	Malaoxon, GC/MS[b] (61652)	p,p′-DDE, GC/MS[a] (34653)	3(4-chloro-phenyl)-1-methyl urea, HPLC[d] (61692)
SDLAB	10/16/1998	—	—	—	—	—	—	—	—
SDLAB	12/01/1998	—	—	—	—	—	—	**E0.001**	—
SDLAB	12/08/1998	—	—	—	—	—	—	<0.006	—
SDLAB	12/17/1998	—	—	—	—	—	—	<0.006	—
WARM	03/09/1999	—	—	—	—	—	—	—	—
IMP	05/20/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
WARM	06/16/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
EVMWTP-IN	07/15/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP	08/12/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP	11/30/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
EVMWTP-FI	12/13/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
WARM	12/27/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM	12/27/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM	02/20/2000	—	—	—	—	—	—	—	—
IMP	02/29/2000	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
WARM	06/12/2000	—	—	—	—	—	—	—	—
CAJON	08/14/2000	—	—	—	—	—	—	<0.006	—
WARM	12/12/2000	—	—	—	—	—	—	<0.003	—
IMP	02/21/2001	—	—	—	—	—	—	<0.003	—
PRADO	06/13/2001	—	—	—	—	—	—	<0.003	—

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

[d]Furlong and others, 2001.

[e]Werner and others, 1996.

Appendix C-1. Replicate results for for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL); GC/MS; gas chromatography/mass spectrometry; GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by gas chromatography/mass spectrometry							
		Atrazine, GC/MS[a] (39632)	Benfluralin, GC/MS[a] (82673)	Cyanazine, GC/MS[a] (04041)	DCPA, GC/MS[a] (82682)	EPTC, GC/MS[a] (82668)	Metolachlor, GC/MS[a] (39415)	Napropamide, GC/MS[a] (82684)	Pendimethalin, GC/MS[a] (82683)
WARM-11	06/16/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
replicate	06/16/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-14	08/10/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
replicate	08/10/1999	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-32	03/30/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
replicate	03/30/2000	<0.001	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
WARM-44	04/17/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
replicate	04/17/2001	<0.007	<0.010	<0.018	<0.003	<0.002	<0.013	<0.007	<0.010
IMP-10	05/20/1099	**0.007**	<0.002	<0.011	<0.002	<0.002	**0.004**	<0.003	<0.004
replicate	05/20/1099	**0.007**	<0.002	<0.004	<0.002	<0.002	**0.004**	<0.003	<0.004
IMP-12	07/15/1099	<0.010	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
replicate	07/15/1099	<0.010	<0.002	<0.004	<0.002	<0.002	<0.002	<0.003	<0.004
IMP-26	02/01/2000	<0.007	<0.002	<0.004	**E0.002**	<0.002	**0.006**	<0.003	<0.004
replicate	02/01/2000	<0.007	<0.002	<0.004	**E0.002**	<0.002	**0.006**	<0.003	<0.004
IMP-43	04/19/2001	**E0.004**	<0.010	<0.018	**E0.001**	<0.002	<0.013	<0.007	<0.011
replicate	04/19/2001	**E0.005**	<0.010	<0.018	**E0.001**	<0.002	<0.013	<0.007	<0.012
PRADO-08	03/21/2001	**E0.003**	<0.010	<0.018	**E0.002**	<0.002	<0.013	<0.007	<0.010
replicate	03/21/2001	**E0.003**	<0.010	<0.018	**E0.002**	<0.002	<0.013	<0.007	<0.010
EVMWTP-IN-03	08/23/1099	<0.001	<0.002	<0.004	<0.002	<0.002	**0.003**	<0.003	<0.004
replicate	08/23/1099	<0.001	<0.002	<0.004	<0.002	<0.002	**E0.003**	<0.003	<0.004

See footnotes at end of table.

Appendix C-1. Replicate results for for herbicides analyzed by gas chromatography/mass spectrometry that were detected at least once in surface water of the Santa Ana Basin, California, November 1998-September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL); GC/MS; gas chromatography/mass spectrometry; GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by gas chromatography/mass spectrometry							
		Prometon GC/MS[a] (04037)	Simazine GC/MS[a] (04035)	Tebuthiuron GC/MS[a] (82670)	Terbacil,* GC/MS[a] (82665)	Triallate, GC/MS[a] (82678)	Trifluralin, GC/MS[a] (82661)	Hexazinone, GC/MS[b] (04025)	Prometryn, GC/MS[b] (04036)
WARM-11	06/16/1999	<0.02	**0.008**	<0.01	<0.007	<0.001	<0.002	—	—
replicate	06/16/1999	<0.02	**0.007**	<0.01	<0.007	<0.001	<0.002	—	—
WARM-14	08/10/1999	**E0.01**	<0.008	<0.01	<0.007	<0.001	<0.002	—	—
replicate	08/10/1999	**E0.01**	<0.005	<0.01	<0.007	<0.001	<0.002	—	—
WARM-32	03/30/2000	**M**	**E0.004**	**E0.01**	<0.007	<0.001	<0.002	—	—
replicate	03/30/2000	**M**	<0.005	**E0.01**	<0.007	<0.001	<0.002	—	—
WARM-44	04/17/2001	**M**	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
replicate	04/17/2001	**M**	<0.011	<0.02	<0.034	<0.002	<0.009	—	—
IMP-10	05/20/1999	**E0.02**	**0.049**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
replicate	05/20/1999	**E0.01**	**0.049**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-12	07/15/1999	**E0.01**	**0.059**	<0.02	<0.007	<0.001	<0.002	<0.008	<0.005
replicate	07/15/1999	**E0.01**	**0.062**	**0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-26	02/01/2000	**E0.02**	**0.05**	**0.01**	<0.007	<0.001	<0.002	<0.008	<0.005
replicate	02/01/2000	**E0.02**	**0.048**	**0.02**	<0.007	<0.001	<0.002	<0.008	<0.005
IMP-43	04/19/2001	**0.02**	**0.046**	**E0.01**	<0.034	<0.002	<0.009	—	—
replicate	04/19/2001	**0.02**	**0.049**	**E0.01**	<0.034	<0.002	<0.009	—	—
PRADO-08	03/21/2001	**E0.01**	**0.061**	<0.02	<0.034	<0.002	<0.009	—	—
replicate	03/21/2001	**E0.01**	**0.06**	<0.02	<0.034	<0.002	<0.009	—	—
EVMWTP-IN-03	08/23/1999	**0.02**	**0.061**	**0.02**	<0.007	<0.001	<0.002	<0.008	<0.005
replicate	08/23/1999	**0.02**	**0.07**	**E0.01**	<0.007	<0.001	<0.002	<0.008	<0.005

*Terbacil as parameter code 04032 on lab code 9060 (HPLC[d]) was never detected in enviromental samples.

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

[d]Furlong and others, 2001.

[e]Werner and others, 1996.

Appendix C-2. Replicate results for herbicides analyzed by high performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		2,4-D,* HPLC[d,e] (39732)	2,4-D Methyl ester, HPLC[d] (50470)	Bentazon,* HPLC[d,e] (38711)	Bromacil,* HPLC[d,e] (04029)	Clopyralid,* HPLC[d,e] (49305)	Dicamba,* HPLC[d,e] (38442)	Dinoseb,* HPLC[d,e] (49301)	Diuron,* HPLC[d,e] (49300)	4,6-Dinitro-2-methyl-phenol (DNOC), HPLC[e] (49299)	Fenuron,* HPLC[d,e] (49297)
WARM-11	06/16/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.12**	—	<0.07
replicate	06/16/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.12**		<0.07
WARM-14	08/10/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**0.25**	—	<0.07
replicate	08/10/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**0.15**		<0.07
WARM-32	03/30/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**1.92**	—	<0.07
replicate	03/30/2000	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**1.87**		<0.07
WARM-44	04/17/2001	—	—	—	—	—	—	—	—	—	—
replicate	04/17/2001	—	—	—	—	—	—	—	—	—	—
IMP-10	05/20/1999	<0.08	<0.09	<0.02	**E0.02**	<0.04	<0.10	<0.04	**E0.08**		<0.07
replicate	05/20/1999	Lost	Lost	Lost	Lost	Lost	Lost	Lost	Lost	—	Lost
IMP-12	07/15/1999	**E0.06**	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.07**	—	<0.07
replicate	07/15/1999	**E0.04**	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.08**		<0.07
IMP-26	02/01/2000	<0.08	<0.09	**M**	<0.08	<0.04	<0.10	<0.04	**0.73**	—	<0.07
replicate	02/01/2000	<0.08	<0.09	**E0.01**	<0.08	<0.04	<0.10	<0.04	**0.76**		<0.07
IMP-43	04/19/2001	—	—	—	—	—	—	—	—	—	—
replicate	04/19/2001	—	—	—	—	—	—	—	—	—	—
PRADO-08	03/21/2001	—	—	—	—	—	—	—	—	—	—
replicate	03/21/2001	—	—	—	—	—	—	—	—	—	—
EVMWTP-IN-03	08/23/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.41**	—	<0.07
replicate	08/23/1999	<0.08	<0.09	<0.02	<0.08	<0.04	<0.10	<0.04	**E0.45**	—	<0.07

See footnotes at end of table.

Appendix C-2. Replicate results for herbicides analyzed by high performance liquid chromatography that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is a code used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Sample identification No.	Sample date	Herbicides analyzed by high-performance liquid chromatography									
		Fluometuron,* HPLC[d,e] (38811)	Imazaquin, HPLC[d] (50356)	MCPA,* HPLC[d,e] (38482)	Norflurazon,* HPLC[d,e] (49293)	Oryzalin,* HPLC[d,e] (49292)	Picloram,* HPLC[d,e] (49291)	Propham,* HPLC[d,e] (49236)	Siduron, HPLC[d] (38548)	Sulfometuron-methyl, HPLC[d] (50337)	Triclopyr,* HPLC[d,e] (49235)
WARM-11	06/16/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
replicate	06/16/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-14	08/10/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
replicate	08/10/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
WARM-32	03/30/2000	<0.06	<0.1	<0.06	**E0.10**	<0.07	<0.07	<0.07	<0.09	**0.08**	<0.1
replicate	03/30/2000	<0.06		<0.06	**E0.10**	<0.07	<0.07	<0.07	<0.09	**0.08**	<0.1
WARM-44	04/17/2001	—	—	—	—	—	—	—	—	—	—
replicate	04/17/2001	—	—	—	—	—	—	—	—	—	—
IMP-10	05/20/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**E0.03**	<0.1
replicate	05/20/1999	Lost	Lost	Lost	Lost	Lost	Lost	Lost	Lost	Lost	**Lost**
IMP-12	07/15/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
replicate	07/15/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	<0.04	<0.1
IMP-26	02/01/2000	<0.06	<0.1	**0.03**	**E0.02**	<0.07	<0.07	<0.07	<0.09	**0.13**	<0.1
replicate	02/01/2000	<0.06	<0.1	**0.03**	**E0.02**	<0.07	<0.07	<0.07	<0.09	**0.14**	<0.1
IMP-43	04/19/2001	—	—	—	—	—	—	—	—	—	—
replicate	04/19/2001	—	—	—	—	—	—	—	—	—	—
PRADO-08	03/21/2001	—	—	—	—	—	—	—	—	—	—
replicate	03/21/2001	—	—	—	—	—	—	—	—	—	—
EVMWTP-IN-03	08/23/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	**E0.13**	<0.1
replicate	08/23/1999	<0.06	<0.1	<0.06	<0.08	<0.07	<0.07	<0.07	<0.09	E0.16	<0.1

*Samples collected from November 1998 through February 1999 were analyzed by analytical schedule 2050 (HPLC[e]).

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

[d]Furlong and others, 2001.

[e]Werner and others, 1996.

Appendix C-3. Replicate results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; WARM, Warm Creek near San Bernardino; bold values detected by NWQL]

Sample identification No.	Sample date	Insecticides								
		Alpha, HCH, GC/MS[a] (34253)	Carbaryl,* HPLC[d,e] (49310)	Carbaryl, GC/MS[a] (82680)	Carbofuran,** GC/MS[a] (82674)	Chlorpyrifos (38933) GC/MS[a]	Diazinon (39572) GC/MS[a]	Lindane, GC/MS[a] (39341)	Malathion, GC/MS[a] (39532)	Methomyl,* HPLC[d,e] (49296)
WARM-11	06/16/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
replicate	06/16/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-14	08/10/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
replicate	08/10/1999	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-32	03/30/2000	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
replicate	03/30/2000	<0.002	<0.06	<0.003	<0.003	<0.004	<0.002	<0.004	<0.005	<0.08
WARM-44	04/17/2001	<0.002	—	<0.041	<0.020	<0.005	**0.008**	<0.004	<0.027	—
replicate	04/17/2001	<0.002	—	<0.041	<0.020	<0.005	**0.006**	<0.004	<0.027	—
IMP-10	05/20/1999	<0.002	<0.06	**E0.006**	<0.003	<0.004	**0.038**	<0.004	<0.005	<0.08
replicate	05/20/1999	<0.002	Lost	**E0.006**	<0.003	<0.004	**0.042**	<0.004	<0.005	Lost
IMP-12	07/15/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.069**	<0.004	<0.005	<0.08
replicate	07/15/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.065**	<0.004	<0.005	<0.08
IMP-26	02/01/2000	<0.002	**M**	**E0.025**	<0.003	<0.010	**0.042**	<0.004	<0.005	<0.08
replicate	02/01/2000	<0.002	**M**	**E0.026**	<0.003	<0.009	**0.054**	<0.004	<0.005	<0.08
IMP-43	04/19/2001	<0.005	—	<0.041	<0.020	<0.005	**0.026**	**0.005**	<0.027	—
replicate	04/19/2001	<0.005	—	<0.041	<0.020	<0.005	**0.028**	**0.005**	<0.027	—
PRADO-08	03/21/2001	<0.005	—	**E0.055**	<0.020	<0.005	**0.024**	**0.007**	<0.027	—
replicate	03/21/2001	<0.005	—	**E0.055**	<0.020	<0.005	**0.024**	<0.010	<0.027	—
EVMWTP-IN-03	08/23/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.019**	<0.004	<0.005	<0.08
replicate	08/23/1999	<0.002	<0.06	<0.003	<0.003	<0.004	**0.017**	<0.004	<0.005	<0.08

See footnotes at end of table.

Appendix C-3. Replicate results for insecticides, fungicides, and caffeine that were detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050; the 5-digit number in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; WARM, Warm Creek near San Bernardino; bold values detected by NWQL]

Sample identification No.	Sample date	Insecticides			Fungicides				Stimulant
		Propoxur,* HPLC[d,e] (38538)	1,4-Dichloro-benzene, GC/MS[c] (34571)	Carbon disulfide, GC/MS[c] (77041)	Benomyl, HPLC[d] (50300)	Iprodione, GC/MS[b] (61593)	Metalaxyl, GC/MS[b] (61596)	Metalaxyl, HPLC[d] (50359)	Caffeine, HPLC[d] (50305)
WARM-11	06/16/1999	<0.06	<0.05	<0.37	<0.02	—	—	<0.06	**E0.26**
replicate	06/16/1999	<0.06	<0.05	<0.37	<0.02			<0.06	**E0.26**
WARM-14	08/10/1999	<0.06	<0.05	<0.37	<0.02	—	—	**E0.01**	**E0.06**
replicate	08/10/1999	<0.06	—	—	<0.02	—	—	<0.06	**E0.07**
WARM-32	03/30/2000	<0.06	<0.05	<0.07	<0.02	—	—	<0.06	<0.08
replicate	03/30/2000	<0.06	—	—	<0.02			<0.06	<0.08
WARM-44	04/17/2001	—	<0.05	<0.07	—	—	—	—	—
replicate	04/17/2001	—	<0.05	<0.07	—	—	—	—	—
IMP-10	05/20/1999	**E0.01**	<0.05	<0.37	<0.02	<0.12	<0.02	<0.06	**E0.03**
replicate	05/20/1999	Lost	<0.05	<0.37	Lost	<0.03	<0.02	Lost	Lost
IMP-12	07/15/1999	**E0.02**	<0.05	**E0.02**	<0.02	<0.03	<0.02	<0.06	<0.08
replicate	07/15/1999	**E0.01**	<0.05	<0.37	<0.02	<0.03	<0.02	<0.06	**E0.05**
IMP-26	02/01/2000	0.02	**E0.01**	<0.37	<0.02	<0.03	<0.02	<0.06	**0.23**
replicate	02/01/2000	**0.02**	**E0.01**	<0.37	<0.02	<0.03	<0.02	<0.06	**0.24**
IMP-43	04/19/2001	—	<0.05	<0.37	—	—	—	—	—
replicate	04/19/2001	—	—	—	—	—	—	—	—
PRADO-08	03/21/2001	—	<0.05	<0.07	—	—	—	—	—
replicate	03/21/2001	—	<0.05	<0.07	—	—	—	—	—
EVMWTP-IN-03	08/23/1999	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	<0.08
replicate	08/2319/99	<0.06	—	—	<0.02	<0.03	<0.02	<0.06	**E0.03**

*Samples collected from November 1998 through February 1999 were analyzed by analytical schedule 2050 (HPLC[e]).

*Carbofuran as parameter code 49309 on schedule 2050 and lab code 9060 was never detected.

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

Appendix C-4. Replicate results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050); the 5-digit number in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		1-Naphthol, GC/MS[b] (49295)	2,5-Dichloro-aniline, GC/MS[b] (61614)	2-[2-Ethyl-6-methyl-phenyl) amino]-1-propanol, GC/MS[b] (61615)	4-Chloro-2-methyl-phenol, GC/MS[b] (61633)	Aldicarb sulfone, HPLC[d,e] (49313)	3,4-Dichloro-aniline, GC/MS[b] (61625)	3-Phenox-ybenzyl alcohol, GC/MS[b] (61629)	Deethyl-atrazine, GC/MS[1], HPLC[d] (04040)
WARM-11	06/16/1999	—	—	—	—	<0.2	—	—	<0.002
replicate	06/16/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-14	08/10/1999	—	—	—	—	<0.2	—	—	<0.002
replicate	08/10/1999	—	—	—	—	<0.2	—	—	<0.002
WARM-32	03/30/2000	—	—	—	—	<0.2	—	—	<0.002
replicate	03/30/2000	—	—	—	—	<0.2	—	—	<0.002
WARM-44	04/17/2001	—	—	—	—	—	—	—	<0.006
replicate	04/1720/01	—	—	—	—	—	—	—	<0.006
IMP-10	05/20/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.037**	<0.03	**E0.006**
replicate	05/20/1999	<0.005	<0.005	<0.02	<0.005	Lost	**0.033**	<0.03	**E0.006**
IMP-12	07/15/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.037**	<0.03	<0.002
replicate	07/15/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.033**	<0.03	<0.002
IMP-26	02/01/2000	<0.005	<0.005	<0.02	**E0.003**	<0.2	**0.027**	<0.03	<0.006
replicate	02/01/2000	<0.005	<0.005	<0.02	**E0.003**	<0.2	**0.028**	<0.03	<0.006
IMP-43	04/19/2001	—	—	—	—	—	—	—	**E0.006**
replicate	04/19/2001	—	—	—	—	—	—	—	**E0.005**
PRADO-08	03/21/2001	—	—	—	—	—	—	—	<0.006
replicate	03/21/2001	—	—	—	—	—	—	—	<0.006
EVMWTP-IN-03	08/23/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.043**	<0.03	<0.002
replicate	08/23/1999	<0.005	<0.005	<0.02	<0.005	<0.2	**0.053**	<0.03	<0.002

See footnotes at end of table.

Appendix C-4. Replicate results for pesticide degradation products detected at least once in surface water of the Santa Ana Basin, California, November 1998–September 2001—Continued.

[Compounds are grouped by analytical method employed by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL): GC/MS; gas chromatography/mass spectrometry, GC/MS[a], schedule 2001; GC/MS[b], lab code 9002; GC/MS[c], schedule 2020; HPLC, high-performance liquid chromatography; HPLC[d], lab code 9060; HPLC[e], schedule 2050); the 5-digit number in parentheses is used by the USGS to uniquely identify a specific constituent; <, actual value is known to be less than the value shown; —, not analyzed for this constituent; E, estimated; M, presence of material verified but not quantified; sample identification acronyms: EVMWTP-IN, Elsinore Valley Municipal Water Treatment Plant Inflow (untreated water); IMP, Santa Ana River below Imperial Highway; PRADO, Santa Ana River below Prado Dam; WARM, Warm Creek near San Bernardino; bold values were detected by NWQL]

Sample identification No.	NAWQA sample date	Pesticide degradation products							
		Deethylde-isopropyl-atrazine, HPLC[d] (04039)	Deisopropyl-atrazine, HPLC[d] (04038)	Disulfoton sulfone, GC/MS[b] (61640)	Disulfotone sulfoxide, GC/MS[b] (61641)	2-Hydrox-yatrazine, HPLC[d] (50355)	Malaoxon, GC/MS[b] (61652)	p,p′-DDE, GC/MS[a] (34653)	3(4-chlorophenyl)-1-methyl urea, HPLC[d] (61692)
WARM-11	06/16/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
replicate	06/16/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-14	08/10/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
replicate	08/10/1999	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-32	03/30/2000	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
replicate	03/30/2000	<0.06	<0.07	—	—	<0.2	—	<0.006	<0.09
WARM-44	04/17/2001	—	—	—	—	—	—	<0.003	—
replicate	04/1720/01	—	—	—	—	—	—	<0.003	—
IMP-10	05/20/1999	**E0.01**	**E0.02**	<0.005	<0.02	**M**	<0.02	<0.006	<0.09
replicate	05/20/1999	Lost	Lost	<0.005	<0.02	Lost	<0.02	<0.006	Lost
IMP-12	07/15/1999	**E0.02**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
replicate	07/15/1999	**M**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-26	02/01/2000	**E0.08**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
replicate	02/01/2000	**E0.08**	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09
IMP-43	04/19/2001	—	—	—	—	—	—	<0.003	—
replicate	04/19/2001	—	—	—	—	—	—	<0.003	—
PRADO-08	03/21/2001	—	—	—	—	—	—	<0.003	—
replicate	03/21/2001	—	—	—	—	—	—	<0.003	—
EVMWTP-IN-03	08/23/1999	<0.06	<0.07	<0.005	<0.02	**M**	<0.02	<0.006	**E0.01**
replicate	08/23/1999	<0.06	<0.07	<0.005	<0.02	<0.2	<0.02	<0.006	<0.09

[a]Lindley and others, 1996; Zaugg and others, 1995.

[b]Sandstrom and others, 2001.

[c]Rose and Schroeder, 1995; Connor and others, 1998.

[d]Furlong and others, 2001.

[e]Werner and others, 1996.