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SUBJECT: STUDY 182/228-PRELIMINARY SUMMARY OF RESULTS FOR WELL SAMPLING FROM 1999 THROUGH 2011

SCOPE OF THE MEMORANDUM

This memorandum summarizes results of a monitoring program that documents pesticide concentrations in domestic wells located in the San Joaquin Valley of California. The wells were sampled annually from 1999 through 2011. Included here are the results of each annual sampling with respect to number of wells sampled, the number of wells with detections of residues, and the mean concentration of detected residues. A subsequent report will present in depth statistical analysis and discussion of measured trends.

BACKGROUND

In 1982, the Department of Pesticide Regulation (DPR) reported the first incidence of simazine in groundwater in California (Weaver et al., 1983). In 1983, DPR found simazine in soil to a depth of 28 feet at concentrations of 2 to 55ug/L (ppb) (Zalkin et al., 1984). In 1985, California Assembly Bill AB2021, called the Pesticide Contamination Prevention Act, was passed in an attempt to prevent further contamination of California groundwater by pesticides (Food and Agriculture Code, section 13141-13152). DPR first developed regulations for use of pesticides detected in groundwater in the late 1980's. Use was regulated in areas denoted as Pesticide Management Zones (PMZs), which were sections of land where pesticide residues were detected in well water. The groundwater regulations were revised in May of 2004. The revisions expanded the definition of a vulnerable area to include all the former existing and draft PMZs as well as sections of land with no reported detections but with soil types and depths-to-ground water that are characteristic of contaminated areas. The term PMZ was dropped and replaced by the term Groundwater Protection Area (GWPA). Based on the pathway of pesticide movement to ground water, GWPAs are designated as either leaching or runoff and property operators must obtain a permit from the County Agricultural Commissioner before they may use a regulated pesticide in a GWPA. The permit specifies the pesticide use modifications, tailored to the specific vulnerability of the intended treatment site.

This monitoring well network was developed as a means to measure the success of regulations enacted to protect groundwater from further contamination by pesticide residues. In anticipation of the passage of revised regulations, well water sampling was initiated in the fall of 1999.

A DPR study in 1997 (Spurlock et al., 2000) used chlorofluorocarbon tracers in well water in Fresno and Tulare counties to estimate the amount of time it took for an herbicide to reach groundwater from the time it was applied to the soil. More than half of the detections in the study were determined to have been from applications that occurred seven to nine years previously. Keeping that in mind this study will attempt to collect samples from the same wells over many years to ensure having enough data to document any trends that may occur. Given this consideration, all results collected to date, including sampling conducted during the spring of 2011, are considered as a background indication of effects occurring prior to the onset of the 2004 revised regulations. Potential effects on well water concentration due to the revisions are not expected until at least one to four more years.

MATERIALS AND METHODS

A protocol was written for this study in 1999 (Garretson, 1999) and wells were chosen that had been sampled previously by DPR and that were found to have positive detections for simazine, bromacil, or diuron (Troiano and Segawa, 1987). DPR's Ground Water Protection Program obtains samples primarily from domestic wells because they are more susceptible to contamination than municipal wells due to their location in agricultural areas and because they generally draw water from shallower aquifers. The wells in this study are located in Tulare and Fresno Counties in areas that have been identified as being susceptible to the movement of pesticides to groundwater based on soil type and average depth to ground water (Teso et al., 1988; Troiano et al., 1998). Sections of land determined to be the most susceptible are those containing coarse soils because pesticides may leach to groundwater, and those containing a hardpan layer because pesticides may move off site in runoff water to areas or structures that provide fast movement to groundwater. Permission to sample each well was obtained from 75 well owners: 33 in Fresno County coarse soil sections, 18 in Fresno County hardpan, 3 in Tulare County coarse soil sections, and 21 in Tulare County hardpan soil sections.

Sampling began in the fall of 1999 following procedures in DPR SOP FSWA001.00 (Nordmark and Herrig, 2011). A chain of custody record was completed and accompanied each sample. Collection and transport of samples followed DPR SOP QAQC004.01 (Jones, 1999). The California Department of Food and Agriculture, Center for Analytical Chemistry analyzed all samples according to analytical method EMON-SM-62.9 (CDFA, 2009), Determination of

Atrazine, Bromacil, Cyanazine, Diuron, Hexazinone, Metribuzin, Norflurazon, Prometon, Prometryn, Simazine, Deethyl Atrazine (DEA), Deisopropyl Atrazine (ACET), and Diamino Chlorotraizine (DACT) in Well Water and River Water By Liquid Chromatography-Atmospheric Pressure Chemical Ionization Mass Spectrometry. The reporting limit for each analyte is 0.05ug/L. Over time, the method was streamlined to exclude chemicals that were not detected and that had little to no use in the sampled areas or to include new chemicals of concern. These changes are documented in the Results section. Quality control samples were collected in accordance with the well water study procedures described in DPR SOP QAQC001.00 with the following deviation (Segawa, 1995). The SOP requires study staff to collect one field blank sample per well and to have that sample analyzed for each positive well sample. As this is an ongoing study of wells that have been sampled and shown to be positive for one or more of the target analytes, field blank samples are analyzed for approximately 10% of the study wells at each sampling interval. No field blanks have had a positive result during the course of the study.

RESULTS

Table 1 summarizes chemicals analyzed during each sampling interval.
Yearly Summary of Number of Wells Sampled and Pesticide Residues Monitored:

1999

- Fall–75 wells were sampled in August and September.

The samples were analyzed for: atrazine, simazine, diuron, bromacil, prometon, prometryn, hexazinone, cyanazine, metribuzin, norflurazon, DEA (a metabolite of atrazine), ACET, and DACT (metabolites of atrazine and simazine).

2000

- Spring–74 wells were sampled in March and April.

- Fall–70 wells were sampled in November and December.

2001

- Spring–71 wells were sampled in March, April and May.

Nitrate was added at the request of the owners in the spring of 2001, and was included in all future sampling.

- Fall–71 wells were sampled in August and September.

Prometryn, cyanazine and metribuzin were not detected in the four previous samplings so they were excluded from the analysis beginning in the fall of 2001.

2002

- Spring–70 wells were sampled in March, April and May.

Three degradation products of hexazinone (A1-G3453, B-A3928, IN-G3710) were added to the analysis when the laboratory had the capability to include them in the screen. The ratio of a degradation product to its parent compound may be one factor that can help to determine if positive results are due to new pesticide application. None of the hexazinone degradation products were found during the spring 2002 sampling interval and they were not included in the analysis for any future sampling.

- Fall–69 wells were sampled in October.

2003

- Spring–72 wells were sampled in April and May.

The second sampling interval conducted during the fall was dropped from the schedule due to personnel and budget limitations. Sampling was initially scheduled for twice a year, once in the spring and then again in the fall for each well. The concern was that aquifer levels normally drop between the spring and fall due to pumping for crop irrigations. This drop in water level could have caused variation in concentrations. An analysis of the paired spring and fall data indicated that for wells where concentrations remained similar throughout the years, the spring and fall concentrations were also similar. For wells where trends were noted the fall concentrations followed the trend line. The conclusion was that a single spring sampling was adequate to track changes and that a long term commitment was the more important factor in measuring potential trends in concentration.

2004

- Spring–68 wells were sampled in May and June.

Desmethyl norflurazon (DMN), a metabolite of norflurazon, was added to the analysis when the laboratory was able to add it to the screen. It was found in almost half of the wells and was included in all future sampling.

2005

- Spring–68 wells were sampled in May and June.

2006

- Spring–66 wells were sampled in May and June.

2007

- Spring–69 wells were sampled in April and May.

2008

- Spring–68 wells were sampled in March, April and May.

2009

- Spring–68 wells were sampled in March, April and May.

Tebuthiuron was added to the analysis when the laboratory was able to add it to the screen. There were no detections of tebuthiuron.

2010

- Spring–68 wells were sampled in February, March, and April.

Four degradation products of tebuthiuron (M-104, M-106, M-107, and M-108) were added to the analysis when the laboratory was able to add them to the screen. No tebuthiuron and none of its' degradates were detected. Oryzalin, an herbicide that has been identified by DPR as a potential groundwater contaminant, was analyzed in twenty-three of the study wells where its use in the sections around the wells was the highest (as determined by pesticide use reports). No oryzalin was detected in any of the samples. Tebuthiuron, its degradation products, and oryzalin were all excluded from future analysis.

2011

- Spring–68 wells were sampled in March and April.

Summary of Detection Frequency and Concentration of Residues

Appendix 1 presents raw sampling results for 2011 for each well. A summary of detection frequency is presented in Table 2 and Figure 1 where the specific number of wells with detections is given in Table 2 and a visual representation of the annual fluctuations of the percentage of wells with detections is graphed in Figure 1. Table 3 and Figure 2 present the average concentrations detected during each sampling interval.

Simazine and its degradation products, ACET and DACT, were present in nearly all the wells at one or more sampling interval (Table 2). Simazine is a pre-emergence herbicide with use on a wide variety of crops in Fresno and Tulare counties. The detection frequency is a reflection of the intense use of simazine in this area and high potential for the parent and degradation products to move to ground water. Diuron was found in at least half the wells except in the last few years where detection frequency dropped below 50% and bromacil was present in at least a third of them. Like simazine, diuron and bromacil are also pre-emergence herbicides. Diuron is used on a diversity of crops throughout this area, whereas the use of bromacil is restricted to citrus crops and it is in the citrus belt along the Eastern foothills in Fresno and Tulare counties where the detections were concentrated. Norflurazon, another pre-emergence herbicide, was typically present in over 20% of the wells, whereas, its degradation product was found in almost 50% of the wells. Atrazine, prometon and hexazinone are pre-emergence herbicides with lower use rates in this area and the residues were found at a lower frequency, in 4 wells or less, during the course of the study.

For the 2011 sampling, results indicate that fewer wells are positive for several of the study analytes. Simazine and diuron have had the biggest decrease in positive results since the beginning of the study (Figure 1). Diuron went from being detected in 60% of study wells in1999 to 32% of them in 2011. Frequency of simazine detections declined from 87% to 56% of the wells during the same period. Bromacil and ACET results also show a decrease in the percent of positive wells since the study inception. The percent of wells positive for atrazine, prometon, hexazinone, DACT, and DEA are nearly the same in 2011 as in 1999. The only two analytes with a higher percentage of wells testing positive in 2011 are norflurazon and its' degradation product, DMN.

It appears that the trend is similar for the average concentration of each pesticide or pesticide degradation product for wells with detections in 2011 (Table 3 and Figure 2). Diuron had the greatest decrease in mean concentration, going from 0.35ug/L in 1999 to 0.12ug/L now. Simazine, bromacil, ACET, and DACT also had lower mean concentrations in 2011. Statistical analyses will be conducted to confirm whether these decreases are significant. Bromacil concentration was the highest for a single residue with the 13-year average close to 1 ug/L. The triazine breakdown products, DACT and ACET had the next highest levels and were generally found at higher levels than their parent, simazine; ACET is formed first and then DACT is formed next during degradation (Troiano and Nordmark, 2002). The levels of DACT are the highest, perhaps reflecting long-life and stability in ground water.

Summary of Pesticide Use Patterns

Figure 3 shows use of these pesticides in study sections with wells that have positive results for pesticide residues from 1990-2010 (CDPR, 2010). Atrazine, hexazinone, and prometon are not included in the table since their use in these sections was negligible (50lbs or less in just 4 or fewer years). A decrease in use is evident between 1998 and 2000. This coincides with the enactment of the bulk of PMZ management areas in 1999 when 702 of the total 973 PMZs were identified in regulation. This pattern indicates that decrease in use was one reason for decreases in load of the pesticide residues to sub-surface aquifers.

CONCLUSIONS

Based on frequency alone, detections for several of the regulated pesticide active ingredients, namely simazine, diuron, and bromacil, are decreasing in regulated areas. Average concentrations also showed some decline over the 13-year period. These decreases were evident in 2004, the same year new regulations were implemented indicating prior regulations facilitated these declines. In addition, these regulations may have influenced the decline in use of these regulated pesticides in the areas of this well network. Additional analyses will establish a statistical basis for potential trends in the data. Continued monitoring is needed to determine if the changes enacted in 2004 are sufficient to continue the apparent downward trends in frequency and concentration of residues in well water.

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Table 1. Chemicals Analyzed in Each Sampling Interval.

	Fall 1999	Spring 2000	Fall 2000	Spring 2001	Fall 2001	Spring 2002	Fall 2002	Spring 2003	Spring 2004	Spring 2005	Spring 2006	Spring 2007	Spring 2008	Spring 2009	Spring 2010	Spring 2011
Atrazine	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Simazine	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Diuron	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Prometon	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bromacil	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Hexazinone	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Norflurazon	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
DEA[a]	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ACET[b]	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
DACT[c]	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Prometryn	x	x	x	x												
Cyanazine	x	x	x	x												
Metribuzin	x	x	x	x												
Hex A1(G3453)[d]						x										
Hex B(A3928)[d]						x										
Hex IN(G3710)[d]						x										
DMN[e]									x	x	x	x	x	x	x	x
Tebuthiuron														x	x	
Teb M-104[f]															x	
Teb M-106[f]															x	
Teb M-107[f]															x	
Teb M-108[f]															x	

[a] DEA (deethyl atrazine) a degradation product of atrazine
[b] ACET (2-amino-4-chlor-6-ethylamino-s-triazine) a degradation product of atrazine and/or simazine
[c] DACT (2-amino-4-chlor-6-isopropylamino-s-triazine) a degradation product of atrazine and/or simazine
[d] Degradation product of hexazinone
[e] DMN (desmethyl norflurazon) a degradation product of norflurazon
[f] Degradation product of tebuthiuron

Table 2. Number of wells sampled annually that contained pesticides and/or pesticide degradation products.

	# Sampled	ACET	DACT	Simazine	Diuron	DMN	Bromacil	Norflurazon	DEA	Atrazine	Prometon	Hexazinone
Fall 1999	75	71	64	65	45		30	13	6	4	1	0
Spring 2000	74	66	66	61	37		28	13	3	3	1	1
Fall 2000	70	69	60	63	43		26	14	5	3	1	0
Spring 2001	71	67	61	61	42		28	16	6	3	1	1
Fall 2001	71	63	60	57	42		26	13	5	3	2	1
Spring 2002	70	66	62	65	45		27	11	9	3	1	0
Fall 2002	69	60	59	60	42		28	14	8	3	1	1
Spring 2003	72	64	62	62	44		29	15	7	3	1	0
Spring 2004	68	59	58	55	39	30	23	17	6	3	1	0
Spring 2005	68	60	51	48	37	31	23	16	4	3	1	0
Spring 2006	66	55	55	48	34	29	25	15	5	3	1	0
Spring 2007	69	59	59	53	32	31	22	20	4	2	1	0
Spring 2008	68	58	58	47	34	30	23	14	4	3	1	0
Spring 2009	68	60	58	41	31	32	21	14	3	2	1	0
Spring 2010	68	55	58	43	26	34	20	19	3	2	1	1
Spring 2011	68	52	54	38	22	36	21	19	4	3	0	1
	MEAN	62	59	54	37	32	25	15	5	3	1	0
	SD	5	4	9	7	2	3	3	2	1	0	1

Table 3. Average annual concentration in ug/L(ppb) for wells sampled that contained pesticide residues.

	Bromacil	DACT	ACET	Diuron	DMN	Norflurazon	DEA	Simazine	Atrazine	Prometon	Hexazinone
Fall 1999	0.96	0.82	0.48	0.35		0.16	0.11	0.13	0.08	0.07	
Spring 2000	1.31	0.75	0.47	0.35		0.14	0.13	0.11	0.08	0.06	0.07
Fall 2000	1.16	0.91	0.47	0.28		0.09	0.15	0.10	0.10	0.09	
Spring 2001	1.12	0.97	0.50	0.33		0.11	0.13	0.12	0.10	0.10	0.05
Fall 2001	0.92	0.91	0.51	0.28		0.16	0.10	0.11	0.08	0.10	0.06
Spring 2002	0.85	1.08	0.58	0.31		0.28	0.09	0.13	0.08	0.09	
Fall 2002	0.75	0.90	0.51	0.30		0.20	0.12	0.12	0.11	0.09	0.06
Spring 2003	0.99	0.89	0.55	0.31		0.18	0.12	0.14	0.11	0.08	
Spring 2004	1.12	0.85	0.50	0.28	0.22	0.21	0.15	0.10	0.12	0.09	
Spring 2005	0.95	0.66	0.38	0.25	0.25	0.24	0.17	0.10	0.10	0.09	
Spring 2006	0.88	0.82	0.42	0.28	0.27	0.23	0.13	0.10	0.09	0.06	
Spring 2007	0.85	0.80	0.40	0.26	0.26	0.13	0.10	0.10	0.07	0.06	
Spring 2008	0.81	0.68	0.38	0.21	0.25	0.24	0.10	0.09	0.07	0.07	
Spring 2009	0.79	0.67	0.39	0.20	0.23	0.21	0.12	0.09	0.07	0.06	
Spring 2010	0.83	0.70	0.41	0.17	0.27	0.19	0.15	0.10	0.11	0.09	0.05
Spring 2011	0.82	0.71	0.40	0.12	0.23	0.19	0.15	0.09	0.09		0.07
MEAN	0.94	0.82	0.46	0.27	0.25	0.18	0.13	0.11	0.09	0.08	0.06
SD	0.16	0.12	0.06	0.06	0.02	0.05	0.02	0.02	0.02	0.01	0.01

Figure 1. Plot of the annual percentage of wells sampled that contained pesticide residues.

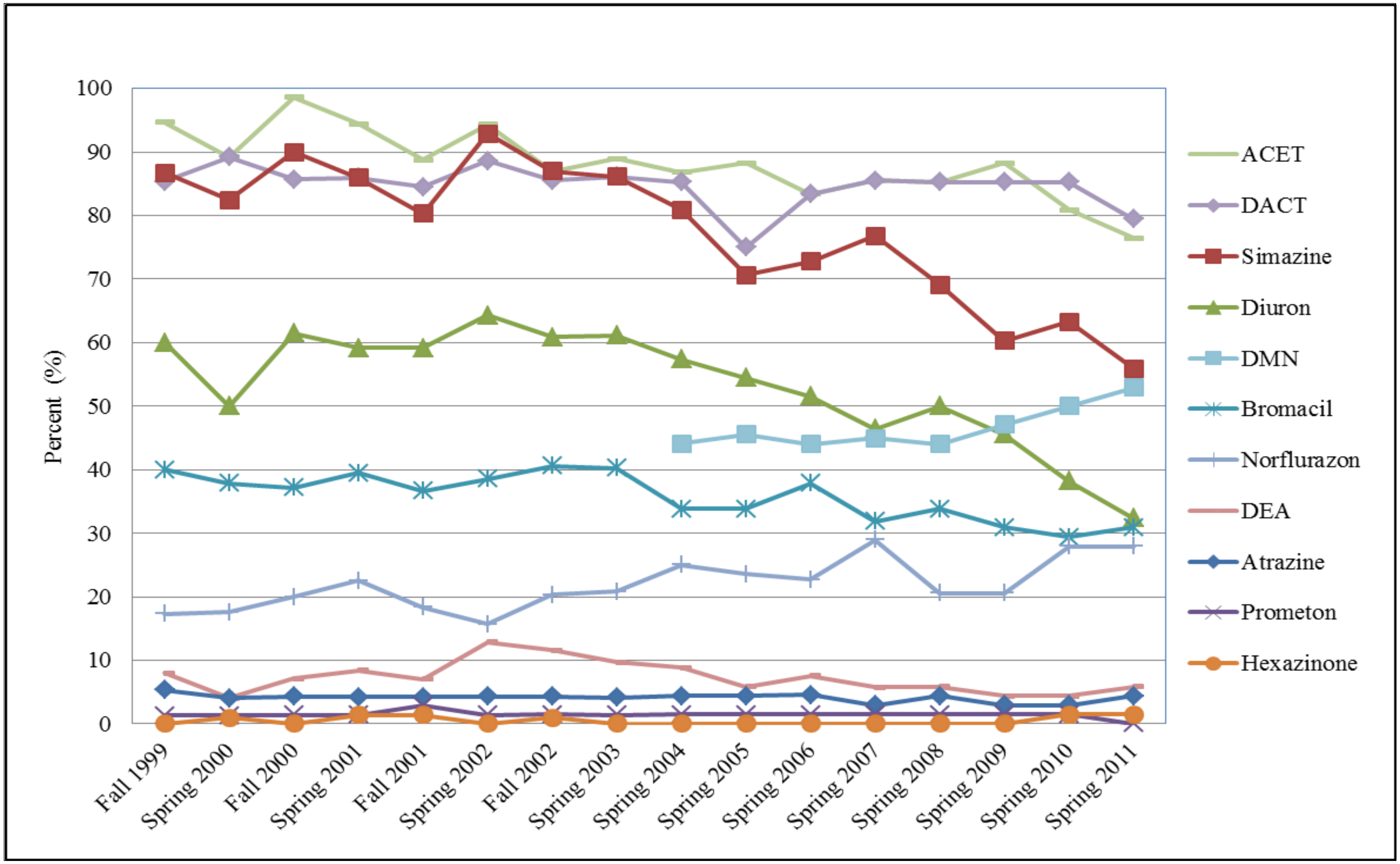


Figure 2. Plot of the annual mean concentration for each pesticide residue for wells with detections.

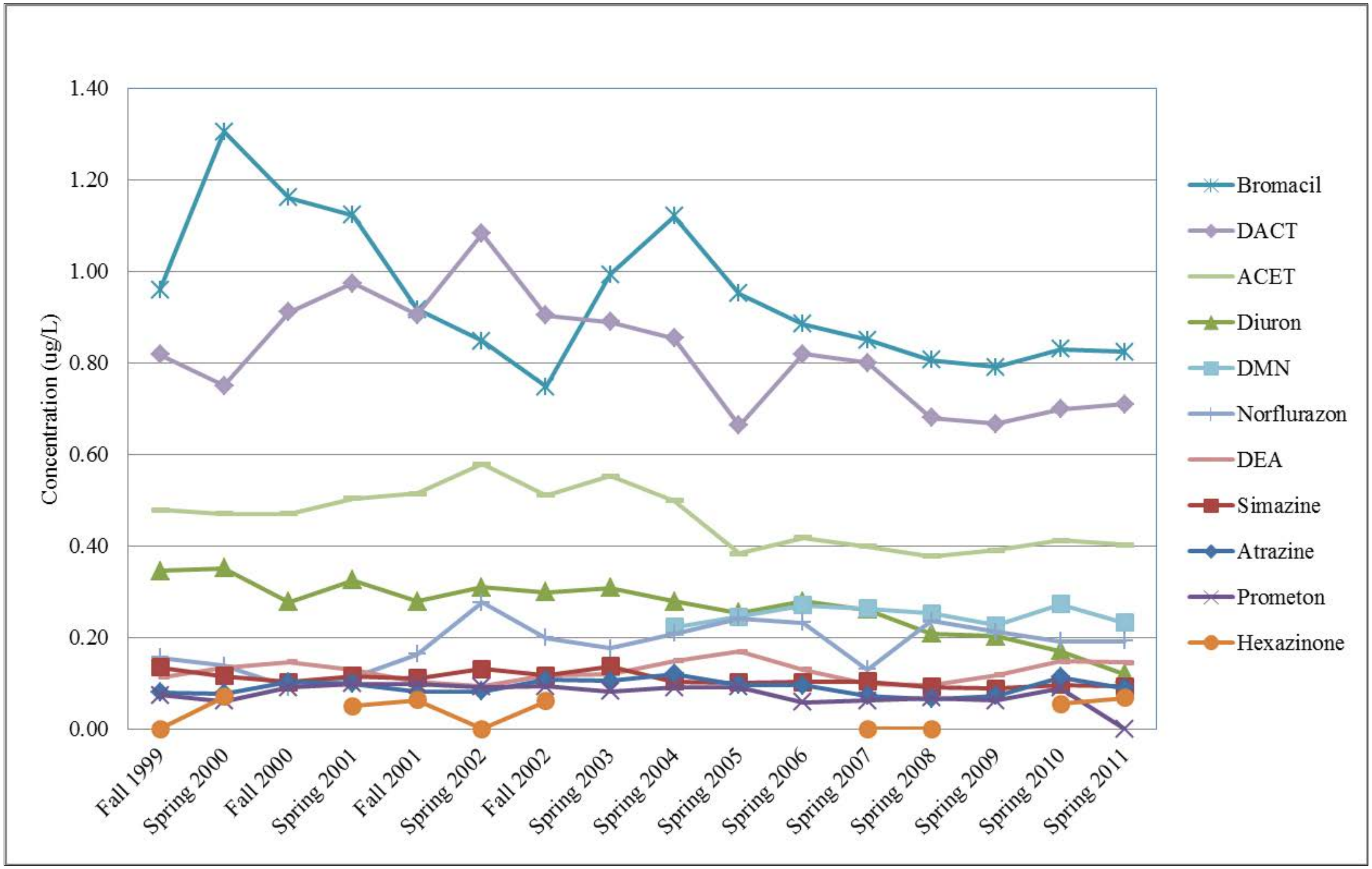
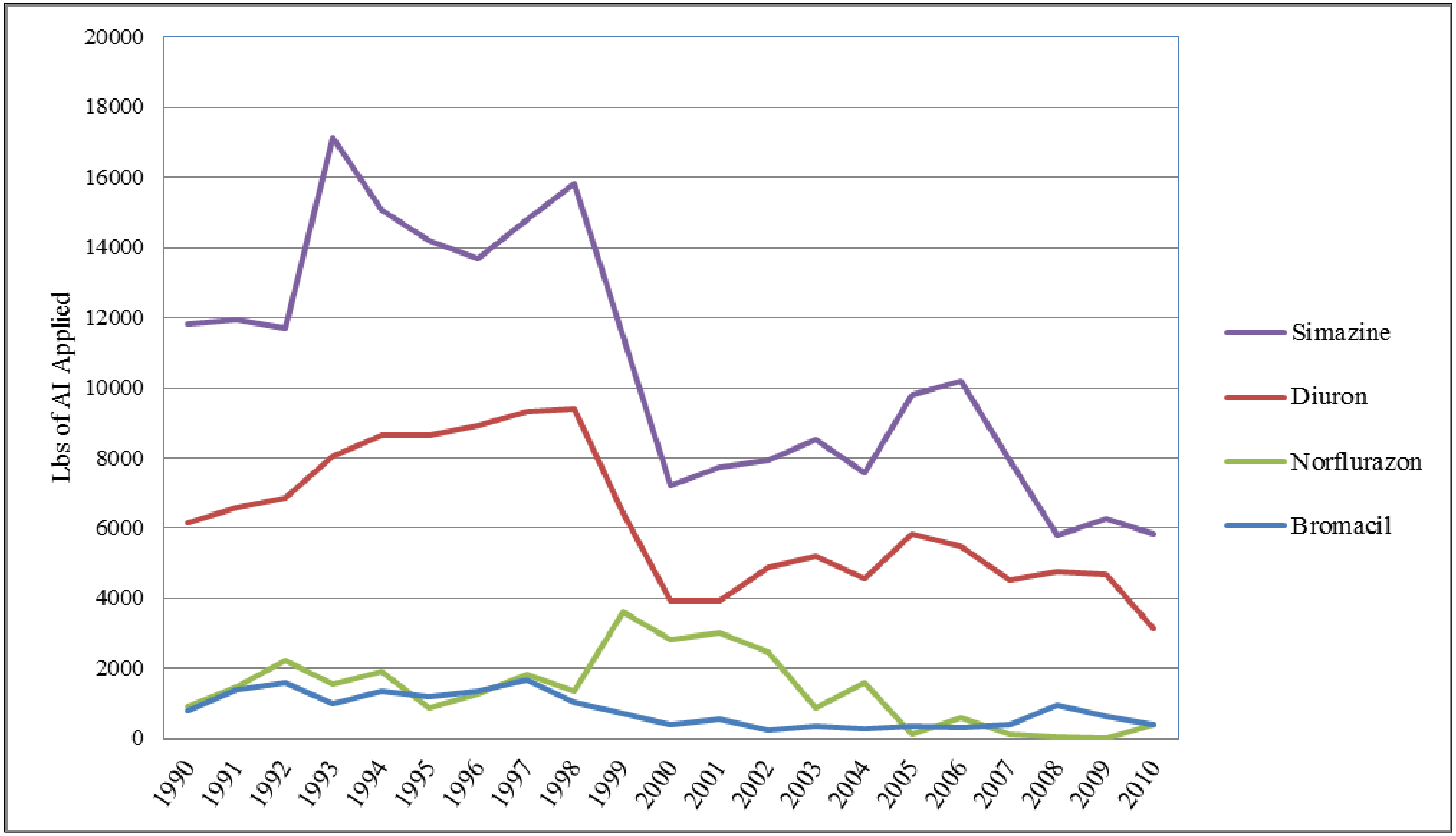


Figure 3. Use of pesticides in sections with wells that contained pesticide residues 1990-2010 (CDPR, 2010).



APPENDIX 1. Spring 2011 Sampling Results in ug/L(ppb).

Well Number	Date Sampled	Atrazine	Simazine	Diuron	Prometon	Bromacil	Hexazinone	Norflurazon	DEA	ACET	DACT	DMN	Reporting Limit
1	3/7/11	ND[1]	ND	ND	ND	ND	ND	ND	ND	0.252	0.189	ND	0.05
2	3/7/11	ND	0.088	0.156	ND	ND	ND	ND	ND	0.236	0.112	0.079	0.05
3	3/7/11	ND	0.085	ND	ND	ND	ND	0.078	ND	0.253	0.128	0.350	0.05
4	3/7/11	0.077	0.086	0.123	ND	6.690	ND	0.204	0.160	0.743	2.050	0.300	0.05
5	3/21/11	ND	0.120	ND	ND	ND	ND	ND	ND	0.562	0.858	0.485	0.05
6	3/21/11	ND	0.079	0.067	ND	ND	ND	ND	ND	0.590	0.872	ND	0.05
7	3/28/11	ND	ND	ND	ND	ND	ND	ND	ND	0.203	0.462	ND	0.05
8	3/21/11	ND	0.122	0.112	ND	0.174	ND	ND	ND	0.296	0.332	ND	0.05
11	3/14/11	ND	0.056	0.052	ND	0.073	ND	ND	ND	0.305	0.526	0.161	0.05
12	3/7/11	ND	ND	0.571	ND	0.429	ND	ND	ND	0.448	0.273	ND	0.05
13	3/14/11	ND	ND	0.088	ND	0.288	ND	0.184	ND	0.161	0.200	0.155	0.05
14	3/21/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
15	3/21/11	ND	0.088	0.082	ND	ND	ND	0.162	ND	0.121	0.126	0.202	0.05
16	3/21/11	ND	0.076	0.111	ND	ND	ND	0.205	ND	0.214	0.563	0.633	0.05
18	4/5/11	ND	0.059	ND	ND	ND	ND	ND	ND	0.128	0.246	0.099	0.05
19	4/12/11	ND	0.069	ND	ND	ND	ND	0.076	ND	0.256	0.405	0.281	0.05
20	4/11/11	ND	ND	ND	ND	ND	ND	ND	ND	0.139	0.188	ND	0.05
21	4/11/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.126	0.278	0.05
22	4/12/11	ND	0.100	ND	ND	ND	ND	ND	ND	0.156	0.331	0.059	0.05
23	4/12/11	ND	ND	ND	ND	0.096	ND	ND	ND	0.179	0.180	0.103	0.05
24	3/28/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.097	0.05
25	3/28/11	ND	0.069	ND	ND	ND	ND	ND	ND	0.131	0.050	ND	0.05
26	3/28/11	ND	0.089	ND	ND	ND	ND	ND	ND	0.356	0.326	ND	0.05
27	3/29/11	ND	0.069	ND	ND	ND	ND	ND	ND	0.204	0.193	ND	0.05
28	3/29/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
29	4/5/11	ND	0.053	0.059	ND	ND	ND	0.211	ND	0.143	0.230	0.820	0.05
30	4/5/11	ND	0.086	ND	ND	ND	ND	0.102	ND	0.269	0.453	0.535	0.05
32	4/5/11	ND	0.104	ND	ND	ND	ND	0.305	ND	0.310	0.291	0.513	0.05
34	4/5/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.092	0.05
35	4/4/11	ND	0.106	0.070	ND	ND	ND	ND	ND	0.161	0.125	0.058	0.05
36	4/4/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
37	4/4/11	ND	0.124	0.061	ND	ND	ND	0.305	ND	0.273	0.334	0.291	0.05
43	4/12/11	ND	0.110	0.141	ND	ND	ND	0.177	ND	0.240	0.165	0.103	0.05

ND[1] = none detected (<0.05ug/L)

APPENDIX 1. cont'd. Spring 2011 Sampling Results in ug/L(ppb).

Well Number	Date Sampled	Atrazine	Simazine	Diuron	Prometon	Bromacil	Hexazinone	Norflurazon	DEA	ACET	DACT	DMN	Reporting Limit
44	4/12/11	ND[1]	0.057	0.080	ND	0.065	ND	ND	ND	0.143	0.168	ND	0.05
45	4/12/11	ND	ND	0.076	ND	ND	ND	ND	ND	ND	ND	ND	0.05
47	3/9/11	ND	0.066	ND	ND	ND	ND	ND	0.082	0.871	1.120	ND	0.05
48	3/22/11	ND	0.062	0.052	ND	0.536	ND	ND	ND	0.934	1.280	ND	0.05
49	3/9/11	ND	ND	ND	ND	ND	ND	ND	ND	0.322	2.150	0.055	0.05
50	3/29/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
51	3/29/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
52	3/29/11	ND	0.128	ND	ND	ND	ND	ND	ND	0.186	0.226	0.051	0.05
53	3/29/11	ND	ND	ND	ND	ND	ND	ND	ND	0.060	0.133	ND	0.05
54	3/29/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
56	3/29/11	ND	0.114	ND	ND	ND	ND	ND	ND	0.514	1.130	ND	0.05
57	3/29/11	ND	ND	ND	ND	ND	ND	ND	ND	0.122	0.279	ND	0.05
58	3/22/11	ND	0.108	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
59	3/22/11	0.095	ND	0.056	ND	0.065	ND	0.069	0.126	0.342	0.268	0.314	0.05
61	3/22/11	ND	0.064	ND	ND	0.680	ND	ND	ND	0.236	0.614	0.053	0.05
63	3/22/11	ND	0.087	ND	ND	ND	ND	ND	ND	0.215	0.178	0.119	0.05
65	3/15/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
68	3/15/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05
69	3/22/11	ND	ND	ND	ND	1.700	ND	ND	ND	0.973	2.210	ND	0.05
70	3/15/11	ND	0.133	ND	ND	ND	ND	0.302	ND	0.334	0.638	0.620	0.05
71	3/15/11	ND	ND	ND	ND	0.353	ND	0.499	ND	0.777	1.110	0.372	0.05
72	3/15/11	ND	0.108	ND	ND	ND	ND	ND	ND	0.689	1.210	ND	0.05
73	3/15/11	ND	ND	ND	ND	0.524	ND	ND	ND	0.242	0.773	0.074	0.05
74	3/15/11	ND	0.108	ND	ND	0.650	ND	0.096	ND	0.708	0.848	ND	0.05
75	3/8/11	ND	0.089	ND	ND	0.662	ND	ND	ND	1.070	0.748	ND	0.05
79	3/8/11	ND	0.202	0.286	ND	ND	ND	ND	ND	ND	0.057	0.080	0.05
80	3/8/11	ND	ND	0.061	ND	1.750	ND	0.085	ND	0.916	3.420	0.091	0.05
84	3/8/11	ND	ND	ND	ND	0.050	ND	ND	ND	ND	ND	ND	0.05
85	3/8/11	ND	0.147	ND	ND	2.110	ND	0.430	ND	1.090	0.964	0.234	0.05
86	3/8/11	ND	0.075	ND	ND	ND	ND	ND	ND	1.490	5.220	0.085	0.05
89	3/14/11	ND	ND	ND	ND	0.059	ND	ND	ND	0.094	0.127	0.058	0.05
90	4/5/11	0.093	0.087	0.106	ND	0.111	0.067	ND	0.212	0.170	0.199	ND	0.05
92	4/12/11	ND	0.054	0.173	ND	ND	ND	0.070	ND	0.382	0.342	0.179	0.05
94	3/22/11	ND	ND	0.055	ND	0.235	ND	0.072	ND	0.692	2.600	0.280	0.05
95	4/5/11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05

ND[1] = none detected (<0.05ug/L)