

# AMBIENT AIR MONITORING FOR PESTICIDES IN LOMPOC, CALIFORNIA

## VOLUME 3: MULTIPLE PESTICIDES

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## ABSTRACT

Lompoc is a small city located in a coastal valley of Santa Barbara County, California, with agricultural fields located in the area between Lompoc and the coast. As with most California coastal valleys, the area is cool with frequent fog or low cloudiness, and winds are predominantly from the west or northwest; Lompoc is downwind from the agricultural area. The Department of Pesticide Regulation (DPR) conducted air monitoring in Lompoc to determine whether, and in what amounts, pesticides occur in air in residential areas of the city. DPR monitored 22 pesticides and five oxygen analog breakdown products simultaneously during the peak use period for most of the pesticides, between May 31 and August 3, 2000. During this 10-week period, DPR collected 24-hour samples, four consecutive days per week at each of four monitoring locations. DPR collected additional samples for a single pesticide, oxydemeton-methyl for a two-week period.

Of the 28 pesticides or breakdown products monitored, DPR detected 25 of them in one or more of the 159 samples collected and analyzed. The highest concentration detected for any chemical in any sample was PCNB with  $47.7 \text{ ng/m}^3$  at the west site. The highest 14-day average concentration measured for any site was PCNB with  $17.9 \text{ ng/m}^3$ . The highest 10-week average (study duration) concentration measured for any site was PCNB at  $8.5 \text{ ng/m}^3$ . Chlorthal-dimethyl was detected most frequently, in 91 percent of the samples.

While many pesticides were detected, and some quite frequently, air concentrations were low compared to health screening levels. DPR estimated the risk for individual pesticides by determining the hazard quotients (air concentration detected divided by the screening level). DPR estimated the cumulative risk by determining the hazard index (adding the hazard quotients of all pesticides detected). DPR considers hazard quotients and hazard indices less than one protective of health. For individual pesticides, chlorpyrifos had the highest hazard quotient of 0.04 ( $1.9 \text{ ng/m}^3$  detected and an acute screening level of  $510 \text{ ng/m}^3$ ). For all monitored pesticides combined, the highest hazard index was 0.22 for acute exposure, indicating low risk from the individual pesticides and multiple pesticides monitored.

The weather and pesticide use at the time of the monitoring are consistent with historical patterns in the Lompoc area. The predominant wind direction was from the northwest-west and the majority of the pesticides were applied in the agricultural area to the west of the city. The northwest and west monitoring sites had the highest risk, consistent with the meteorological and pesticide use patterns for the area. Monitoring occurred for 10 weeks during the highest use period for most pesticides. A few pesticides monitored may have higher air concentrations because other days or months had two to four times higher use than the monitoring period. However, it is unlikely that these or any of the other pesticides monitored exceeded their health screening levels during periods not monitored.

The monitoring data as well as the pesticide use data for periods not monitored all indicate that the inhalation risk from pesticides monitored in the Lompoc area is low. This study and monitoring from other areas in the state indicate that pesticide air concentrations in Lompoc are less than other areas. DPR manages pesticides statewide based on the areas or populations at greatest risk. Monitoring and control of pesticides in the higher risk areas will provide adequate protection for Lompoc. No further pesticide monitoring or investigation in the Lompoc area is warranted.

## **PREFACE**

This report is the second of two volumes describing air monitoring for pesticides in Lompoc, California. Volume 1 describes air monitoring for individual fumigant pesticides. Volume 2 describes air monitoring for multiple pesticides simultaneously.

## **ACKNOWLEDGMENTS**

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## GLOSSARY

**Acute:** Short term exposure. Acute toxicity can be defined as the toxicity manifested within a relatively short time interval. Acute exposure can be as short as a few minutes or as long as a few days, but is generally not longer than one day. In toxicity testing, exposure is usually for 24 hours or less.

**APCD:** Air Pollution Control District

**ARB:** California Air Resources Board

**Breakthrough:** The desorption and loss of an analyte trapped on sampling media due to too large of a volume of air moving over the sampling media.

**Cholinesterase:** Short for acetylcholinesterase, (AChE). An enzyme that breaks down the neurotransmitter acetylcholine. It is found in the nervous system and in other tissues. When this enzyme is inhibited, acetylcholine can build up, often leading to overstimulation of nerves and subsequent toxicity.

**Chronic:** Long term exposure. Chronic exposure is generally for a significant portion of an animal's or human's lifetime. Exposure may be through repeated single doses or may be continuous (e.g., food, air, or drinking water).

**Concentration:** The amount of a chemical (weight) in a given volume of air. Concentrations in air can be expressed in units of volume or weight. In this report, pesticide concentrations are expressed as nanograms per cubic meter (ng/m<sup>3</sup>).

**Confirmation sample:** Same as a duplicate sample, but is sent to a different lab for confirmation.

**Detection limit:** see MDL (method detection limit)

**DPR:** California Department of Pesticide Regulation

**DQO:** Data Quality Objectives

**Duplicate sample:** Same as a primary sample, but is run on a collocated sampler as a replicate.

**EQL:** Estimated quantitation limit. Similar to detection limit (MDL), the EQL is the smallest amount of the chemical that can be measured. Samples with concentrations less than the EQL, but more than the MDL can be identified as containing a *trace* amount of the analyte, but the concentration cannot be measured reliably with the method employed. When calculating average concentrations or other statistics, DPR assumes that samples with a trace concentration have a concentration of the midpoint between the MDL and the EQL. As with the MDL, the EQL is a characteristic of both the method and the chemical. Different methods



can have different EQLs limits for the same chemical. The same method can have different EQLs limits for different chemicals.

Field Blank: A sample cartridge, capped, and left out beside sampler for a single sampling interval, and stored on dry ice with the rest of the samples. The purpose of the field blank is to determine if the field or sample transporting procedures may have contaminated the sample

Exposure: Contact with a chemical. Some common routes of exposure are dermal (skin), oral (by mouth) and inhalation (breathing).

FedEx: Federal Express

Field Blank: A sample cartridge capped, covered with foil and left out beside sampler for a single sampling interval, and stored on dry ice with the rest of the samples.

FFDCA: Federal Food, Drug, and Cosmetic Act

FIFRA: Federal Insecticide, Fungicide, and Rodenticide Act

Fortified sample: A sample with a known amount of analyte spiked onto the sample media which is placed next to primary sample and treated to same flow and run time. The fortified spike, in comparison with trip spikes and the respective field sample, provides some information about any change in the ability to recover the analyte during air sampling.

FQPA: Food Quality Protection Act

Hazard Index (HI). The sum of all hazard quotients (HQ) (see below). Used to estimate the potential health risk for non-cancer effects from exposure to several chemicals for a given time period (acute, subchronic, chronic).

$$HI = HQ_1 + HQ_2 + HQ_3$$

HQ: Hazard Quotient (HQ). The ratio of an exposure level for a chemical (measured air concentration of a pesticide) to a reference concentration for the chemical (screening level for that pesticide) over the same time period. An  $HQ < 1$  is generally considered to be health-protective

$$\text{Hazard Quotient} = \frac{\text{Air Concentration Detected (ng/m}^3\text{)}}{\text{Screening Level (ng/m}^3\text{)}}$$

LIWG: Lompoc Interagency Work Group

LOAEL: Lowest Observed Adverse Effect Level. In a toxicity study, the LOAEL is the lowest dose level that still produces an observable adverse effect.

MDL: Method Detection Limit. The MDL is the smallest amount of the chemical that can be identified in a sample with the method employed. If the sample contains no analyte, or may

have a concentration less than the MDL, the sample is designated as containing no detectable amount. When calculating average concentrations or other statistics, DPR assumes that samples with no detectable amount have a concentration of one-half the MDL. The MDL is a characteristic of both the method and the chemical. Different methods can have different MDLs for the same chemical. The same method can have different MDLs for different chemicals.

NCDC: National Climatic Data Center

NOAEL: No Observed Adverse Effect Level. In a toxicity study, the NOAEL is the highest dose level that does not produce an observable adverse effect.

NOI: Notice of Intent. Document submitted to the County Department of Agriculture with information regarding a proposed pesticide application.

ND: None detected. Concentration is below the method detection limit (MDL).

OA: Oxygen Analog. Breakdown product from certain organophosphates (ie. oxon), which is generally more toxic than the parent compound.

OEHHA: California Office of Environmental Health Hazard Assessment

Primary sample: Sample collected in field to measure pesticide air concentrations.

Public Land Survey System (PLSS)

Section - Basic unit of the system, a square tract of land one mile by one mile containing 640 acres.

Township - 36 sections arranged in a 6 by 6 array, measuring 6 miles by 6 miles. Sections are numbered beginning with the northeast-most section, proceeding west to 6, then south along the west edge of the township and to the east.

Range - Assigned to a township by measuring east or west of a Meridian

Range Lines - North to south lines that mark township boundaries

Township Lines - East to west lines that mark township boundaries

Meridian - Reference or beginning point for measuring east or west ranges. All townships in Lompoc use the San Bernardino Meridian.

Baseline - Reference or beginning point for measuring north or south townships. All townships in Lompoc use the San Bernardino Baseline.

A specific township and section are identified as being north or south of a particular baseline and east or west of a particular principal meridian. For example, township S07N35W is the seventh township north of the San Bernardino baseline in the thirty-fifth

range west of the San Bernardino meridian. This particular 36 square-mile area is located west of Lompoc. S07N35W36 is section 36 in this township, a one by one mile area in the southeast corner of the township.

PUR: Pesticide Use Report. California's reporting system that records all agricultural pesticide use in the state.

Range: see Public Land Survey System.

RCD: Risk Characterization Document. DPR's human health risk assessment for a pesticide is presented in the RCD.

RED: Re-registration Eligibility Document. U.S. EPA's human health risk assessment for a pesticide is presented as part of their RED.

RfD: Reference Dose. The RfD is an estimate of the daily exposure of the human population to a chemical, usually by the oral route, that is likely to be without adverse effects. Initially the term was only used to address chronic exposures, but it is now often used for other exposure durations. When it is used for other than chronic exposure, that exposure is specified (e.g. "subchronic RfD").

RfC: Reference concentration. The RfC is an estimate of the daily air concentration of a chemical that is likely to be without adverse effects to the exposed human population. Initially the term was only used to address chronic exposures, but it is now often used for other exposure durations. When it is used for exposure durations other than chronic, that exposure is specified (e.g. "subchronic RfC").

Risk: Risk is the probability that a toxic effect (adverse health effect) will result from a given exposure to a chemical. It is a function of both the inherent toxicity of the chemical as well as the exposure to the chemical.

Screening Level: The calculated air concentration based on a chemical's toxicity that is used to evaluate the possible health effects of exposure to the chemical. Although not a regulatory standard, screening levels can be used in the process of evaluating the air monitoring results. A measured air level that is below the screening level for a given pesticide would not generally undergo further evaluation, should not automatically be considered "safe" and could undergo further evaluation. By the same token, a measured level that is above the screening level would not necessarily indicate a health concern, but would indicate the need for a further and more refined evaluation. Different screening levels are determined for different exposure periods (i.e., acute, subchronic, and chronic)

Section: see Public Land Survey System.

SOP: Standard Operating Procedure. A document describing the materials and methods used for various monitoring tasks.

Sorbent cartridge: A Teflon® cartridge filled with a measured amount of trapping media and sealed. The tube is attached to an air pump and ambient air is drawn through the trapping media in the tube.

Subchronic: Exposure may be through repeated single doses or may be continuous (e.g., food, air, or drinking water).

TAG: Technical Advisory Group. A subcommittee of the Lompoc Interagency Work Group responsible for planning and evaluating pesticide monitoring.

Township: see Public Land Survey System.

Trace: see EQL (estimated quantitation limit)

Trip Blank sample: A sample cartridge capped and stored on dry ice with the rest of the samples. The purpose of the trip blank is to determine if the field or sample transporting or storage procedures may have contaminated the sample.

Trip Spike sample: A sample with a known amount of analyte spiked onto the sample media which is sent with the field technician but stays in an ice chest on dry ice for the duration of the monitoring period. The trip spikes gives some information about any loss or change in the ability to recover the analyte during sample transport or storage.

UCD: University of California at Davis

Units of measurement:

g:	Gram. 1 g = 1,000 mg
Kg:	Kilogram. 1 Kg = 1,000 grams
L:	Liter
lbs:	Pounds
m:	Meter
m <sup>3</sup> :	Cubic meter. 1 m <sup>3</sup> = 1,000 L
mg:	Milligram. 1 mg = 1,000 ug
ng:	Nanogram. 1 ug = 1000 ng
ppb:	Parts per billion.
ppm:	Parts per million.
ug:	Microgram. 1 ug = 1,000 ng
%:	Percent

Units of measurement of air concentration: The amount of a chemical (weight) in a given volume of air. Concentrations in air can be expressed in units of volume or weight. In this report, pesticide concentrations are expressed as nanograms per cubic meter (ng/m<sup>3</sup>).

U.S. EPA: United States Environmental Protection Agency

## INTRODUCTION

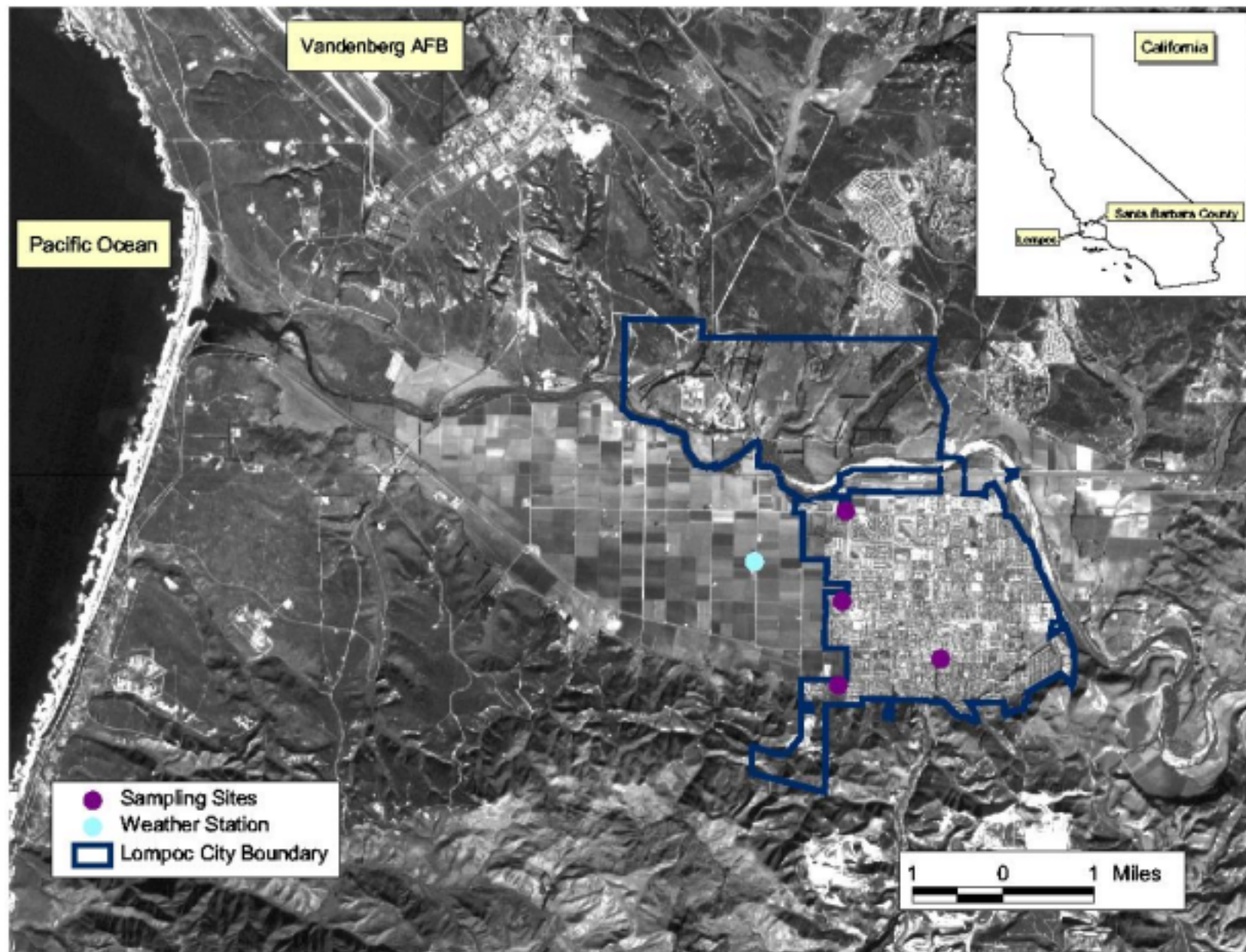
Lompoc is a small city located in a coastal valley of Santa Barbara County, California (Figure 1). The population has been estimated at 41,103 in a U.S. Census conducted in 2000. The city is located approximately seven to eight miles east of the coastline. The valley is oriented roughly northwest to southeast and the surrounding hills form a V shape fanning out towards the ocean. Hills to the east of Lompoc tend to stall air movement as it passes the city, while the air is funneled eastward through the Santa Ynez River basin. Vandenberg Air Force Base (a rocket launch facility) and agricultural fields dominate the area between Lompoc and the coast. Five major crops or crop groups are grown in this area: cole crops (broccoli, cabbage, and cauliflower), lettuce, dried beans, celery, and flowers.

In 1997, the Department of Pesticide Regulation (DPR) formed the Lompoc Interagency Work Group (LIWG) to help investigate Lompoc residents' concerns (first voiced in 1992) about pesticide use as it relates to community health. The LIWG is composed of staff from federal, state, county, and city agencies as well as community representatives. The LIWG formed several subgroups to develop recommendations to address health concerns, to conduct a pesticide air monitoring program, and to consider potential exposures from other environmental factors, such as crystalline silica and radon.

The health subgroup of the LIWG was requested to analyze hospital discharge data to determine if there was an increased incidence of specific illnesses in Lompoc compared to other areas. The data from 1991-1994 evaluated by the State's Office of Environmental Health Hazard Assessment (OEHHA) suggested that certain respiratory illnesses occurred in Lompoc at higher rates than in other comparison areas. (Wisniewski et al., 1998; Ames and Wisniewski, 1999). The evaluation indicated that the proportion of hospitalizations due to respiratory illnesses, in particular bronchitis and asthma, were elevated in Lompoc relative to the proportion of hospitalizations in the comparison areas, with some differences by age. The incidence of lung and bronchus cancers also was increased above the expected numbers based on regional rates. The purpose of the report was not to speculate on the cause of the illnesses; but rather, to evaluate the incidence of specific illnesses. A later evaluation of hospital discharge data from 1995 through 1997 (Fan, 2000) by OEHHA found that the occurrence of asthma hospitalizations were not elevated statistically in Lompoc compared to the comparison areas during the 1995 through 1997 period. The data did indicate that the occurrence of hospitalizations for bronchitis were statistically elevated for both males and females during 1995-1997, similar to the 1991-1994 data. In both time periods, the elevations were, by observation, slightly higher for females than males. A comparison of Lompoc hospitalizations by month during the agricultural season, March through October, with the comparison areas did not provide any evidence that either asthma or bronchitis in Lompoc was related to the pesticide application season.

The pesticide exposure subgroup (now called the Technical Advisory Group) developed a work plan that recommended comprehensive air monitoring in Lompoc during various seasons to determine whether, and in what amounts, pesticides occurred in air in residential areas within the city of Lompoc. This Technical Advisory Group (TAG, Appendix A)

Figure 1. Lompoc study area and location of sampling sites and weather station.



prioritized 46 pesticides based on their toxicity, amount used, and volatility (Appendix B). The TAG recommended a comprehensive monitoring program to span peak use periods for the top 23 chemicals in a two-phase program. The TAG did not recommend monitoring for the remaining 23 pesticides from the original list of 46, realizing fiscal resources were limited. The first phase of monitoring was recommended for the summer of 1998 (if only partial funding was available), and the second phase for early summer of 1999 (Appendix B). The monitoring recommendation was designed to measure maximum daily pesticide concentrations in air that could be compared to human health endpoints. The LIWG accepted the TAG recommendations and forwarded them to DPR in April 1998.

In August 1998, the Legislature passed Senate Bill 661, which provided funding to DPR to conduct the first phase of pesticide air monitoring. The first phase of monitoring was completed in September 1998. The Phase One study was intended to test pesticide sampling and analysis methods and to determine if a subset of the total pesticides in use in the area could be measured in air. With some exceptions, these goals were achieved. The study was most successful in developing and demonstrating the multiple-pesticide sampling and analysis method. Due to the limited nature of the Phase One sampling, these results were not considered appropriate for risk assessment.

Over 50 pesticides were used in or near Lompoc during the August-September 1998 monitoring period. Air monitoring was conducted for twelve pesticides with recorded use in those months in prior years. Of the 12, five were not applied during the 1998 monitoring period, and were not detected in air samples. The remaining seven were detected in air samples. Many of these detected concentrations were between the sample detection limit (MDL) and quantitation limit (EQL) meaning that the existence of the pesticide in a sample, while likely, was too low to be assigned a numerical value. Results are described in the Results and Discussion section.

In May 1999, DPR received a grant from the U.S. Environmental Protection Agency (U.S. EPA) to monitor pesticide applications in the Lompoc area during the fall and winter months. This monitoring began in January 2000. The Governor's 1999 - 2000 budget allocated \$345,000 to DPR for monitoring pesticide air concentrations in the spring, summer, and fall 2000 in Lompoc. This document describes the monitoring conducted for pesticides (other than fumigants) applied during the months of late May through early August 2000 using multiple-pesticide analysis of single samples in accordance with the Multiple Pesticide Sampling and Analysis Plan (MPSAP, Appendix C).

The list of pesticides, although based partially on the list the TAG prioritized in 1998 (see Appendix B), was based on the TAG's more recent ranking of compounds in three categories using the most current information: (1) toxicity, (2) vapor pressure (volatility), and (3) use. The measured ambient air concentrations were compared to human health screening levels (acute and subchronic) to determine if any of the pesticides occurred at concentrations which exceed the screening levels. To evaluate chronic health risk, the DPR estimated chronic exposure by extrapolating from the several weeks of monitoring data collected in this study. The estimated chronic exposures were compared to the chronic screening levels to determine

if the Lompoc residents may be exposed long-term to concentrations of these pesticides that would have adverse health effects.

## **PESTICIDES AND AREA MONITORED**

### **Pesticides Monitored**

In 1999, the TAG reviewed the pesticides used in Lompoc (Appendix D) and developed a ranking scheme based on equal weighting of the most current use that was available, toxicity, and vapor pressure information. They selected the top 17 from each of these three lists, combined them and removed replicate entries to produce a list of active ingredients and additional breakdown products (Table 1). Then DPR submitted this list to at least 12 analytical laboratories to determine their interest and ability to develop methods and analyze air samples for multiple pesticides. The TAG requested the two laboratories that sent proposals to develop two methods for a candidate list of up to 32 pesticides and 7 breakdown products (Tables 2-3).

Table 2 contains the list of candidate compounds whose physicochemical properties made them compatible with a single sample multiresidue air sampling/analysis scheme using XAD-4 resin as a trapping medium and analyzed by gas chromatography (Group 1). Since oxydemeton-methyl required a different extraction procedure it could not be analyzed as part of the single multiresidue sample, but required separate samples. Method development was performed by the University of California Davis' (UCD) Trace Analytical Laboratory.

Table 3 contains the second list of candidate compounds whose physical and chemical properties made them compatible with a single sample multiresidue air sampling/analysis scheme using XAD-4 resin as a trapping medium, and liquid chromatography/mass spectroscopy analysis. Method development was performed by Battelle Atmospheric Science and Applied Technology Department (Battelle) Laboratory (Group 2). Unfortunately, Battelle was unable to develop the method for the study, so the chemicals in Group 2 were not monitored. The problems encountered in the method development are discussed in the Laboratory Methods section.

Analytical methods were developed for 23 of the pesticides plus five breakdown products of the pesticides chlorpyrifos, diazinon, dimethoate, fonofos, and malathion. The physical and chemical properties of the pesticides monitored are presented in Table 4. Consistent with the crops and climate, insecticides and fungicides are the most heavily used pesticides in the Lompoc area. Table 5 lists the use and chemical class of each of the pesticides monitored.



Table 1. List of pesticides and breakdown products the TAG reprioritized in 1999-2000 and targeted for air monitoring in Lompoc.

Pesticide	Breakdown Product	Why not on candidate lists?
Acephate	Methamidophos <sup>a</sup>	
Anilazine		
Benomyl	<b>Methyl 2-benzimidazole carbamate (MBC)</b> <sup>b</sup>	Difficult method, single method
Chlorothalonil		
Chlorpyrifos	Oxygen analog(OA)	
Chlorthal-dimethyl	<b>Monomethyl and tetrachloroterephthalic acid (TPA, MTP)</b>	Single method
Cycloate		
Diazinon	OA	
Dicloran		
Dicofol		
Dimethoate	OA	
<b>Disulfoton</b>	<b>Disulfoton oxygen analog</b>	Single method
EPTC		
Ethalfuralin		
Ethephon		
Fonofos	OA	
<b>Fosetyl-Al</b>		Difficult method, low toxicity
<b>Glyphosate</b>		Single method, low toxicity
Iprodione		
Malathion	OA	
<b>Mancozeb</b>	<b>Ethylene thiourea</b>	Difficult method
Maneb	<b>Ethylene thiourea</b>	Difficult method
Mefenoxam		
Methomyl		
Metolachlor		
Naled	DDVP (dichlorvos)	
Oxamyl		
Oxydemeton-methyl		
PCNB		
Permethrin		
Propyzamide		
Simazine	<b>Deethyl simazine, diaminochlorotriazine</b>	Single method
<b>Sulfur</b>		Single method, low toxicity
<b>Sulfuryl fluoride</b>		Single method, study design does not include its residential structural uses
Thiodicarb		
Thiophanate-methyl	<b>Methyl 2-benzimidazole carbamate (MBC)</b>	Difficult method, single method
Trifluralin		
Vinclozolin		

a. Methamidophos is also a pesticide active ingredient that is applied in the Lompoc area.

b. The compounds shown in bold are those not included as candidate pesticides for which to develop methods. See the reason shown in the last column.

Table 2. Group 1 - List of Candidate Compounds for a Multiresidue Air Sampling Scheme (analysis by gas chromatography, UCD).

<b>Pesticide</b>	<b>Breakdown Product</b>
Chlorothalonil	
Chlorpyrifos	Chlorpyrifos OA
Chlorthal-dimethyl	
Cycloate	
Diazinon	Diazinon OA
Dicloran	
Dicofol	
Dimethoate	Dimethoate OA
EPTC	
Ethalfuralin	
Fonofos	Fonofos OA
Iprodione	
Malathion	Malathion OA
Mefenoxam	
Metolachlor	
Naled	
Oxydemeton-methyl	
PCNB	
Permethrin	
Propyzamide	
Simazine	
Trifluralin	
Vinclozolin	

Table 3. Group 2 - List of Candidate Compounds for Multiresidue Air Sampling Scheme (analysis by liquid chromatography/mass spectroscopy, Battelle).

<b>Pesticide (Active Ingredient)</b>	<b>Breakdown product</b>
Acephate	Methamidophos <sup>a</sup>
Anilazine	
Benomyl	
	DDVP (from Naled)
Ethephon	
Maneb	
Methomyl	
Oxamyl	
Thiodicarb	
Thiophanate-methyl	

a. Methamidophos is also a pesticide active ingredient that is applied in the Lompoc area

Table 4. Some physical and chemical properties of the pesticides monitored in Lompoc May 31, 2000 – August 3, 2000\*.

Analyte	Molecular Weight (g/mole)	Water Solubility <sup>a</sup> (ppm)	Vapor Pressure <sup>b</sup> (mmHg)	Hydrolysis Half-life <sup>c</sup> (days)	Aerobic Soil Half-life <sup>d</sup> (days)	Photolysis Half-life <sup>e</sup> (days)
Chlorothalonil	265.9	1.2	2.40E-04	49 <sup>f</sup>	35	74
Chlorpyrifos	350.6	1.39	2.21E-05	72.1	NA	10
Chlorthal-dimethyl	303.9	0.5	2.50E-04	36 <sup>f</sup>	0.26	168 <sup>f</sup>
Cycloate	215.4	95	1.60E-03	30	43	36.5
Diazinon	304.3	60	8.98E-05	138	40	2.55
Dicloran	207.0	6	1.97E-06	72 <sup>f</sup>	549	4.38
Dicofol	370.5	NA	3.90E-06	2.74	66.4	60.2
Dimethoate	229.2	39,800	1.85E-06	68	2	66.7
EPTC	189.3	345	2.64E-02	30 <sup>f</sup>	42	NA
Ethalfuralin	333.3	2.93	8.80E-05	33	45	21.1
Fonofos	246.3	17	3.04E-04	432	80	25.8
Iprodione	330.2	12	1.00E-07	5	64	13.7
Malathion	330.3	125	2.30E-05	6	2	174
Mefenoxam	279.3	26000	2.48E-05	1000	60.2	30 <sup>f</sup>
Metolachlor	283.8	492	3.14E-05	200 <sup>f</sup>	26	37
Naled	380.8	2,000	2.00E-04	0.68	3	5
Oxydemeton-methyl	246.3	NA	3.83E-05	40	6	73.7
PCNB	295.3	0.39	7.74E-05	180 <sup>f</sup>	80.2	28.5
Permethrin	391.3	0.07	2.15E-08	42	10.5	289
Propyzamide	256.1	13	4.35E-07	42 <sup>f</sup>	392	113
Simazine	201.7	6	2.21E-08	28 <sup>f</sup>	110	11.1
Trifluralin	335.3	0.3	1.04E-04	30	169	41
Vinclozolin	286.1	3	2.55E-06	1 <sup>f</sup>	28	NA

\*Source: DPR Pesticide Chemistry Database

NA = Not Available

a. 9 - 25 °C

b. 20 - 25 °C

c. 19 - 25 °C; pH 6 - 7.5

d. Averaged over different soil types

e. Soil photolysis

f. No reaction occurred during the study. The half-life is greater than the value listed which represents the length of the study.

Table 5. The use and chemical class for each of the pesticides monitored.

<b>Pesticide (Active Ingredient)</b>	<b>Common Trade Names</b>	<b>Use</b>	<b>Chemical Class</b>
Chlorothalonil	Bravo, Daconil	Fungicide	Chloronitrile
Chlorpyrifos	Dursban, Lorsban	Insecticide	Organophosphate
Chlorthal-dimethyl	Dacthal, DCPA	Herbicide	Benzoic acid
Cycloate	Ro-Neet	Herbicide	Thiocarbamate
Diazinon		Insecticide	Organophosphate
Dicloran	Botran, DCNA	Fungicide	Dinitroaniline
Dicofol	Kelthane	Insecticide	Organochlorine
Dimethoate	Cygon	Insecticide	Organophosphate
EPTC	Eptam	Herbicide	Carbamate
Ethalfuralin	Sonalan	Herbicide	Dinitroaniline
Fonofos	Dyfonate	Insecticide	Organophosphate
Iprodione	Roval	Fungicide	Dicarboximide
Malathion		Insecticide	Organophosphate
Mefenoxam	Apron, Dividend, Maxim, Subdue	Fungicide	Phenylamide
Metolachlor	Dual	Herbicide	Chloracetanilide
Naled	Dibrom	Insecticide	Organophosphate ester
Oxydemeton-methyl	Metasystox-R	Insecticide	Organophosphate
PCNB	Terrachlor	Fungicide	Organochlorine
Permethrin	Ambush, Pounce	Insecticide	Pyrethroid
Propyzamide	Pronamide, Kerb	Herbicide	Amide
Simazine	Princep	Herbicide	Triazine
Trifluralin	Treflan	Herbicide	Dinitroaniline
Vinclozolin	Curalan, Ronilan, Vorlan	Fungicide	Dicarboximide

### Pesticide Use

The information given in this section was extracted from DPR's pesticide use report database (PUR). The pesticide use report database is a system to collect information on pesticide use in California that has been in operation in some form for over 50 years. The current system started in 1990. The PUR contains information on nearly all production agricultural pesticide use and some nonagricultural use in California. The data collected include the pesticide product used, the application date, the application amount, and application location to a square-mile section. A complete description of the pesticide use report database is given in DPR, 1995.

Between 1996 and 1999, approximately 137 pesticides were used for agricultural production in the Lompoc Valley area, with an average of approximately 137,000 pounds used per year. The chemicals selected for monitoring and the timing of the monitoring was dependant on the use information from the PUR. The Township, Range, and square-mile sections that make up the Lompoc Valley are displayed in Figure 2. The summary of monthly use for the pesticides monitored (Table 6) indicates that the highest use period for a majority of the pesticides was during the months of May through August. Therefore, monitoring was conducted from late May to early August.

Figure 2 Township, range, and sections of the Lompoc Valley.

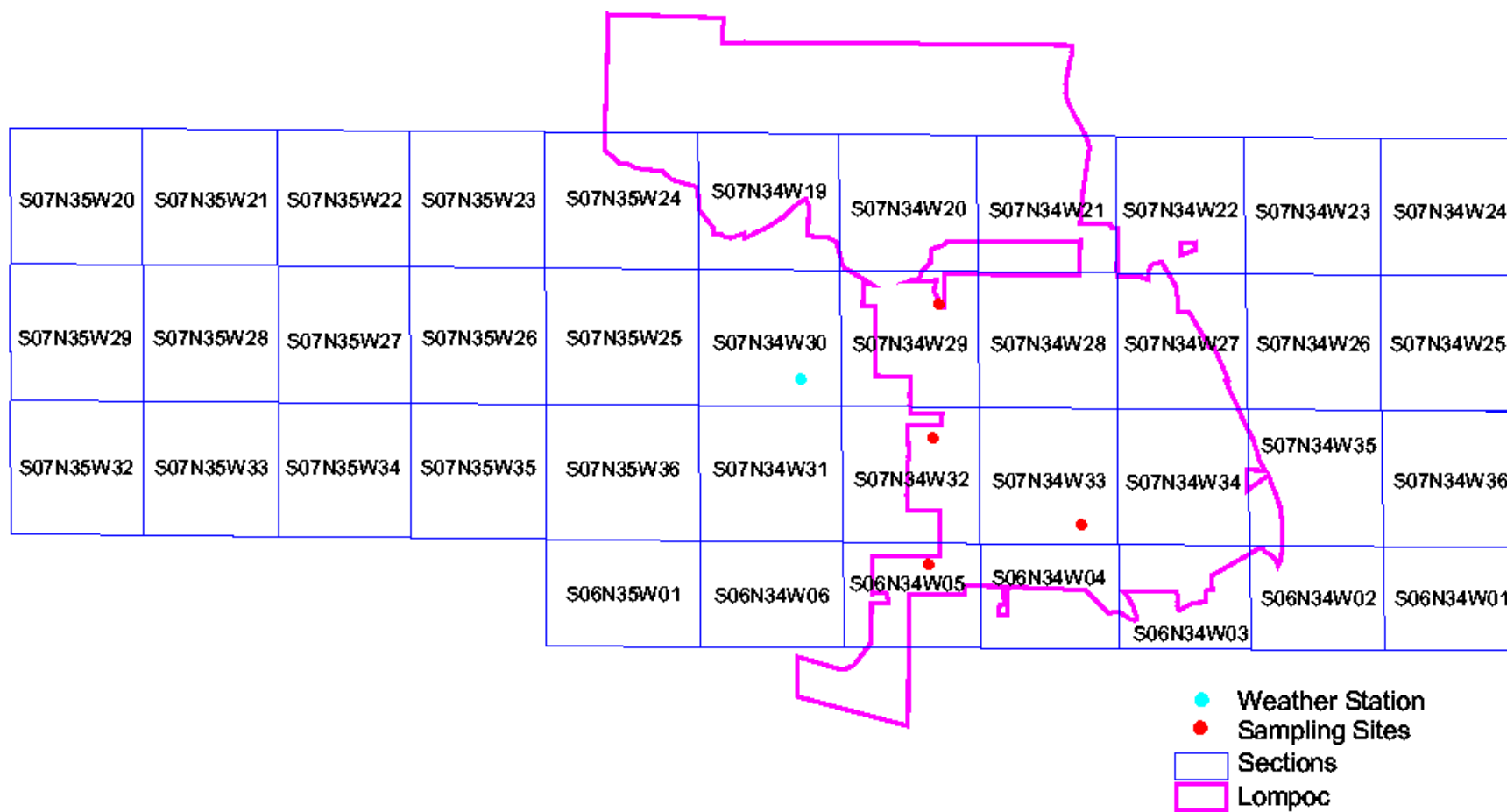


Table 6. Monthly pesticide use summary (1996 - 1998) for the list of compounds for analysis by gas chromatography. Three highest months are in bold.

Pesticide	January	February	March	April	May	June	July	August	September	October	November	December	Total
Chlorothalonil	138	105	126	266	510	802	613	<b>902</b>	<b>921</b>	<b>1132</b>	784	380	6,679
Chlorpyrifos	705	462	881	1,068	1,048	1,166	<b>1,525</b>	<b>1,597</b>	<b>1,658</b>	749	610	670	12,139
Chlorthal-Dimethyl	1,576	1,824	<b>1,974</b>	1,751	<b>1,895</b>	<b>2,285</b>	1,866	1,638	578	470	455	620	16,932
Cycloate	21	56	39	<b>95</b>	30	41	73	<b>128</b>	<b>129</b>	78	56	52	798
Diazinon	3	8	105	108	259	<b>418</b>	<b>445</b>	<b>310</b>	35	133	305	0	2,128
Dicloran	41	84	101	221	618	852	847	<b>1,326</b>	<b>1,188</b>	<b>962</b>	8	2	6,251
Dicofol	0	0	0	0	6	0	<b>105</b>	<b>197</b>	<b>20</b>	0	0	0	329
Dimethoate	28	31	85	159	<b>232</b>	148	<b>211</b>	<b>195</b>	95	100	2	51	1,337
EPTC	0	0	0	0	<b>186</b>	0	0	0	0	0	0	0	186
Ethalfuralin	0	0	<b>74</b>	29	<b>1,270</b>	<b>31</b>	0	0	0	0	0	0	1,404
Fonofos	0	<b>172</b>	<b>130</b>	116	<b>320</b>	114	90	0	0	64	66	0	1,072
Iprodione	299	677	1,263	1,423	1,751	<b>1,829</b>	<b>2,010</b>	<b>1,900</b>	1,750	604	514	163	14,181
Malathion	0	42	0	77	4	35	<b>876</b>	<b>935</b>	<b>121</b>	42	9	0	2,140
Mefenoxam	35	11	0	0	0	<b>122</b>	<b>382</b>	5	5	5	2	<b>191</b>	758
Metolachlor	0	0	0	0	<b>891</b>	<b>698</b>	0	0	0	0	0	0	1,589
Naled	26	35	49	9	50	<b>150</b>	<b>104</b>	77	<b>184</b>	74	16	0	773
Oxydemeton-Methyl	63	108	182	283	<b>332</b>	287	298	<b>418</b>	<b>348</b>	158	57	68	2,601
PCNB	156	245	448	<b>461</b>	392	437	<b>576</b>	<b>550</b>	80	66	29	0	3,439
Permethrin	44	102	374	423	702	744	<b>867</b>	<b>924</b>	<b>956</b>	634	182	50	6,002
Propyzamide	<b>925</b>	636	<b>911</b>	608	751	663	781	<b>818</b>	117	8	173	615	7,005
Simazine	41	0	0	0	0	<b>380</b>	<b>390</b>	<b>89</b>	0	0	0	0	900
Trifluralin	0	0	0	<b>25</b>	<b>459</b>	<b>73</b>	0	0	0	0	0	0	557
Vinclozolin	<b>410</b>	152	86	51	126	36	101	223	269	205	<b>414</b>	<b>601</b>	2,674
Total	4,512	4,752	6,827	7,173	<b>11,833</b>	11,311	<b>12,158</b>	<b>12,231</b>	8,452	5,484	3,681	3,462	91,876

## Study Area

The study area encompasses the City of Lompoc and the surrounding agricultural areas west and just east of the city. For the purpose of this study, the pesticide use report data will reflect only applications made in the Lompoc Valley in the sections listed in Table 7 and Figure 2.

## Sampling Site Locations

During Phase One sampling in 1998, five sites were used to monitor air concentrations in Lompoc. In a discussion of the fumigant monitoring on October 26, 1999, the TAG decided to sample these original five sites. However, the TAG modified the number of sites to include only four of the original five sites (Figure 1), due to monetary constraints. The sites of primary concern were those along the western edge of the city due to proximity to the majority of the agriculture in the valley and the predominance of wind directions from the west and northwest. Historically, during the months of May through October, the winds were from a western direction over 75% of the time (Figure 3). The sites were selected based on siting criteria, access and security. The sites may not be representative of the areas of maximum concentrations in the community. All sample sites met the U.S. EPA siting criteria for ambient air monitoring sites (Appendix E). Samplers at all locations were on rooftops to ensure the security of the samples.

Figure 3. The percentage of time the wind blows from various directions during the months of May through October. Compiled from weather data collected during 1992-1994 at the H Street weather station located in downtown Lompoc.

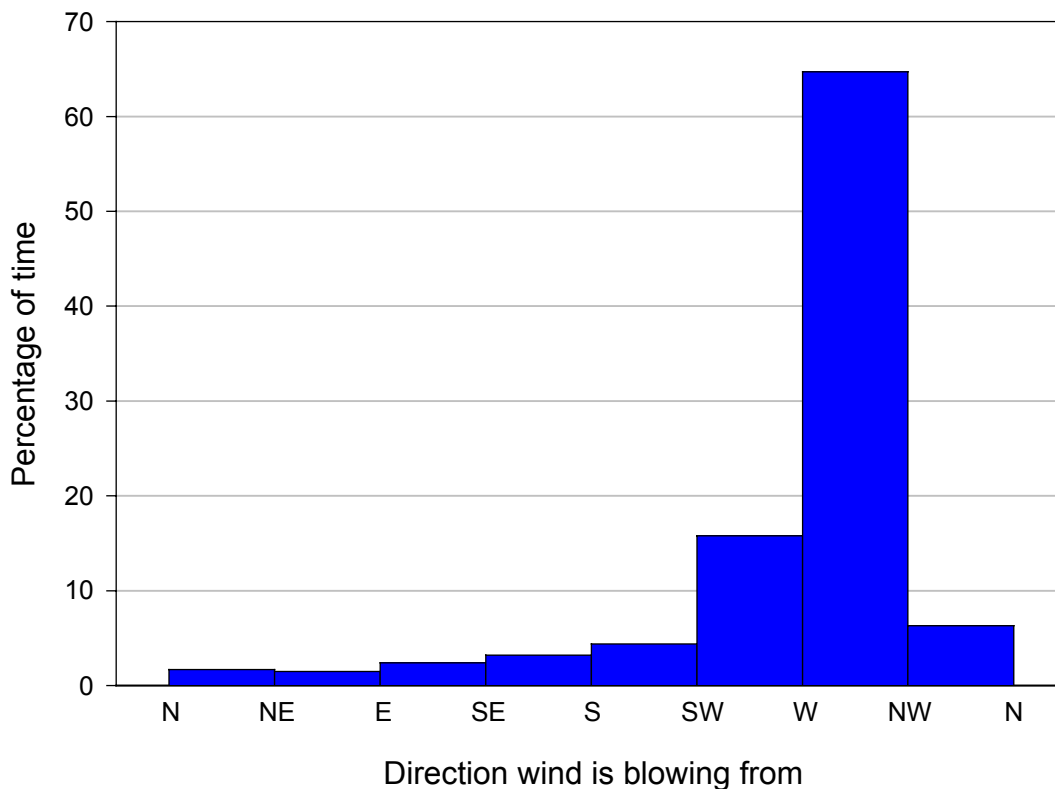


Table 7. Township, range and sections used to define the agricultural boundary for the Lompoc air monitoring studies. <sup>a</sup>

Meridian	Township	Range	Section
S	06N	34W	1
S	06N	34W	2
S	06N	34W	3
S	06N	34W	4
S	06N	34W	5
S	06N	34W	6
S	06N	35W	1
S	07N	34W	19
S	07N	34W	20
S	07N	34W	21
S	07N	34W	22
S	07N	34W	23
S	07N	34W	24
S	07N	34W	25
S	07N	34W	26
S	07N	34W	27
S	07N	34W	28
S	07N	34W	29
S	07N	34W	30
S	07N	34W	31
S	07N	34W	32
S	07N	34W	33
S	07N	34W	34
S	07N	34W	35
S	07N	34W	36
S	07N	35W	20
S	07N	35W	21
S	07N	35W	22
S	07N	35W	23
S	07N	35W	24
S	07N	35W	25
S	07N	35W	26
S	07N	35W	27
S	07N	35W	28
S	07N	35W	29
S	07N	35W	32
S	07N	35W	33
S	07N	35W	34
S	07N	35W	35
S	07N	35W	36

<sup>a</sup> See Figure 2 for agricultural boundaries defined by the above Township-Range-Sections



Four sampling sites were located within the city limits of Lompoc, one each in the northwest, central-west, southwest, and near the center of Lompoc (Figures 1 and 2). These sites plus an additional site on the northeast side of Lompoc were used for Phase One and the fumigant monitoring study.

#### Locations:

- Northwest - Santa Barbara County Animal Control Shelter  
1501 W. Central Ave. at V St.
- West- Clarence Ruth School  
501 N. W St. at College Ave.
- Southwest- Miguelito School  
1600 W. Olive St. at V St.
- Central- Santa Barbara County APCD monitoring trailer  
Between G and H Streets, ½ block south of Ocean Ave.

## **MATERIAL AND METHODS**

The design for sample collection is a product of the data quality objectives (DQOs) process as well as a result of community and technical input from the TAG and LIWG. This section describes the types of samples collected, sample measurement, sampling materials used, numbers of sampling sites and their general location.

### **Sampling Methods**

The method uses sorbent cartridges to trap the pesticides and sampling and chemical analytical methods that have been established for all pesticides. The most widely used procedure for atmospheric measurement of pesticides is to pass 2 to 100 liters of air per minute through a solid sorbent material onto which the pesticide is adsorbed (Keith, 1988). Sorbent media typically used to trap pesticides include XAD resins and carbon sorbents such as charcoal (Majewski and Capel, 1995; Keith, 1988; Baker *et al.*, 1996). For this study each sampling cartridge contained 30 mL of XAD-4 for the field samples. The flow rate was set at 15 L/min.

Following applications, pesticides (other than those applied as dusts) move away from the target field by drift and post-application volatilization in two forms: gaseous and adsorbed onto airborne particulates. Collocated samples were collected during the last week of sampling to determine if any percentage of the chemical concentrations are being missed in the analysis of the primary samples as particulates. Particulate samples contained a filter placed into the cartridge prior to the resin.

The samples were sent to a chemical laboratory for extraction and analysis. The field sampling protocol is located in Appendix F.

The XAD-4 sorbent material used in the sample container was washed and rinsed by UCD Trace Analytical Laboratory according to method in Appendix I. The sample cartridges and XAD-4 were also assembled by the UCD laboratory personnel. Prior to monitoring, sample labels with the study number and sample identification numbers were attached to the cartridges. Chain of custody forms, log book forms, and sample analysis request forms were supplied to field sampling personnel. The sampling equipment was calibrated to a flow rate of 15 liters/minute in the laboratory prior to delivery to the field. The samples were collected with Andersen Series 110 Constant Flow Air Sampler Model 114 pumps. The use, operation, calibration and maintenance of air sampling pumps are described in DPR's SOP EQAI001.00 (Appendix G).

The flow rate for each sampler was measured and recorded before and after each sampling period. Flows were measured with rotameter which had been calibrated against a referenced measuring device. All equipment was checked and initially calibrated in the laboratory.

All sampling equipment and forms were placed in a rental storage locker in Lompoc for easy access for the duration of the study.

### **Sampling Procedure**

Sampling for the Group 1 chemicals began May 31, 2000 and continued for 10 weeks through August 3, 2000. Four 24-hour sequential samples were collected each week at each of the 4 sites for a total of 160 samples. In addition, 12 separate samples were collected the last two weeks of the sampling period at random sites and analyzed only for oxydemeton-methyl. The County Agricultural Commissioner confirmed use during that time. Six collocated particulate samples were collected during the last week of sampling.

Air samples were collected for a continuous 24-hour period. For safety reasons, the change of air sampling cartridges occurred in daylight hours. The samples were started at the same time each day at the first site. This sequence of air sampling cartridge changes continued throughout the four days of sampling (96 hours of sampling). The starting date for each week of sequential samples was randomly selected. The site and time of duplicate sampling, fortified sampling, and confirmation sampling was randomly assigned. The schedule for such sampling, as well as field sampling is located in Appendix F.

### **Sample Handling**

Samples were shipped via FedEx overnight or delivered to the laboratories by the field personnel. The samples were packaged and shipped according to procedures in DPR's SOP QAQC004.1 (Appendix H). Each shipment of samples was accompanied by a temperature data-logger that recorded sample temperatures from collection to delivery to the lab. Samples were shipped or delivered as soon as possible after final sample collection for each weekly monitoring period as described in DPR's SOP EQOT001.01 (Appendix G). Each sample was accompanied by chain of custody record that was signed by the field personnel and laboratory personnel handling the sample. All samples followed sample receipt log-in and verification procedures described in Appendix H.

## **Quality Control Methods**

In addition to field samples collected during monitoring, two fortified field spikes, one trip spike, one trip blank, one (collocated) duplicate, and two (collocated) confirmation samples were collected each 4-day sampling event.

A fortified spike (also called a sample spike) was a laboratory spike, which was sent to the field and placed on an air sampler with air flowing through the sorbent cartridge. Shipped overnight on dry ice to the field, it was treated just like a field sample, including storage and shipping conditions. The fortified spike, in comparison with trip spikes and the respective field sample, gives us some information about any change in our ability to recover the analyte during air sampling.

The trip spikes were generated in the primary laboratory, at a concentration within the range of concentrations anticipated. The trip spike was shipped overnight to the field technician and stored on dry ice until all samples for the 4-day sampling event were collected. The trip spike was sent back to the laboratory with the field samples for analysis.

The cartridges used for trip blanks were sent with the spikes from the laboratory. The trip blank was stored on ice until all samples were collected. The trip blank was shipped overnight with the field samples to the primary laboratory for analysis.

The primary laboratory analyzed the duplicate samples. A duplicate sample is a sample that is collocated with a field sample. These samples serve to evaluate overall precision in sample measurement and analysis.

A confirmation sample is a sample that is collocated with a field sample, yet analyzed by the confirmation laboratory (CDFA). The confirmation samples were shipped to the confirmation laboratory for analysis.

The site and time of duplicate sampling, fortified sampling, and confirmation sampling was randomly assigned.

### Laboratory Audits

Based on the recommendations of the TAG, DPR formed a multi-agency quality assurance team to audit each of the laboratories analyzing samples for this study. The quality assurance team was led by a representative from the ARB, and included members from the U.S. EPA, the Pesticide Action Network (an environmental advocate group), and a DPR representative, employed in a separate division from the personnel directing the study. The quality assurance team performed informal audits prior to the start of the study, as well as formal audits while the study was in progress.

## **Laboratory Methods for the Group 1 Chemicals Analyzed by Gas Chromatography**

Chemical extraction methods for the gas chromatography pesticides from sorbent cartridges are referenced below for the primary and confirmation laboratories. The primary laboratory

for all Group 1 analytes (Table 3) was the Trace Analytical Laboratory, Department of Environmental Toxicology, University of California, Davis, California 95616. Its confirmation laboratory was the California Department of Food and Agriculture, Center for Analytical Chemistry located at 3292 Meadowview Road, Sacramento, California 95832.

The chemical analytical methods for pesticides extracted from sorbent cartridges analyzed by Gas Chromatograph (GC) by the primary laboratory was performed in accordance with the SOP in Appendix I.

The chemical analytical methods for pesticides extracted from sorbent cartridges analyzed by the confirmation laboratory was performed in accordance with the SOP in Appendix J.

The chemical analytical methods for pesticides on particulates extracted from filters in cartridges analyzed by GC by the primary laboratory was performed in accordance with the SOP in Appendix I.

#### Method calibration

Each laboratory used certified standards. New standards are prepared at least every six months. New standards were compared with old standards for verification. Standards for pesticides have shown no degradation over a six-month period in prior studies. The primary (UCD) and quality control (CDFA) laboratories exchanged standards for chlorpyrifos, diazinon, diazinon OA, dimethoate, malathion, and malathion OA for verification. The results of both laboratories' analysis of the other laboratory's standards were provided to both laboratories and to the Quality Assurance team (see Appendix S).

Both the primary and quality control laboratories verified calibration by analyzing a series of standards (samples containing known amounts of analyte dissolved in a solvent for the sorbent samples). The linear range of calibration is determined by analyzing standards of increasing concentration. Within the linear range, the calibration is determined by regressing the standard concentration on the response of the instrument (peak height or peak area of the chromatogram) using at least five concentrations. The minimum acceptable correlation coefficient of the calibration is given in the SOP for each method, but in general is at least 0.95. The calibration is verified with each set of samples analyzed as described in the continuing quality control section.

#### Method Detection Limit and Estimated Quantitation Limit

Each laboratory determined the MDL for each analyte by analyzing a standard at a concentration with a signal to noise ratio of 2.5 to 5. The spiked matrix was analyzed at least seven times, and the MDL was determined by calculating the 99% confidence interval of the mean. This procedure is described in detail in U.S. EPA (1990). The MDL analyte and method is given in the SOP.

The EQL is set a certain factor above the MDL. The level of interference found in the samples determines this factor: the more interference, the higher the factor. The MDL and EQL for each analyte are listed in table 8. The EQLs are at least 25 times less than the health

screening levels for all of the chemicals. The screening levels are discussed later in the Health Evaluation Methods section.

Table 8. Method Detection Limit (MDL) and Estimated Quantitation Limit (EQL) for the Group 1 analytes (Trace Analytical Laboratory, UC Davis).

Pesticide (Active Ingredient)	Breakdown Product	Method Detection Limit <sup>a</sup> (ng/m <sup>3</sup> )	Estimated Quantitation Limit <sup>a</sup> (ng/m <sup>3</sup> )	Chronic Screening Level (ng/m <sup>3</sup> )
Chlorothalonil		1.4	7.1	8,500
Chlorpyrifos		0.77	3.8	510
	Chlorpyrifos OA	0.55	2.7	510
Chlorthal-dimethyl		0.29	1.5	17,000
Cycloate		1.8	9.0	340
Diazinon		0.72	3.6	83
	Diazinon OA	0.52	2.6	83
Dicloran		1.3	6.4	42,500
Dicofol		1.3	6.6	2,040
Dimethoate		0.55	2.8	850
	Dimethoate OA	0.48	2.4	850
EPTC		0.61	3.1	8,500
Ethalfuralin		0.60	3.0	68,000
Fonofos		0.66	3.3	3,400
	Fonofos OA	0.53	2.7	3,400
Iprodione		1.5	7.5	102,000
Malathion		0.82	4.1	29,000
	Malathion OA	0.40	2.0	29,000
Mefenoxam		0.59	3.0	136,000
Metolachlor		0.58	2.9	170,000
Naled		0.96	4.8	648
Oxydemeton-methyl <sup>b</sup>		0.92	4.6	87,000
PCNB		0.85	4.2	5,100
Permethrin		1.4	7.2	20,230
Propyzamide		1.7	8.4	85,000
Simazine		0.61	3.0	8,500
Trifluralin		1.5	7.6	40,800
Vinclozolin		0.38	1.9	20,400

<sup>a</sup> Based on a flow rate = 15 L/min

<sup>b</sup> This data was developed as part of the Phase One project (Okumura, 1999).

#### Calculation of air concentrations

For the sorbent cartridge samples the air concentrations were calculated as a concentration removed from a volume of air moving through the sampling media. Analytical results are presented in ug/sample. The concentrations are converted from ug/sample to ng/m<sup>3</sup> with the following calculations:

$$\frac{\text{sample results (ug)} \times 1000 \ell / m^3}{\text{flow rate of sampler } (\ell / \text{min}) \times \text{run time (min)}} \times 1000 \text{ ng/ug} = \text{ng/m}^3$$

$$\text{ng/m}^3 \div \text{molecular weight of analyte} \div 40.7 (\text{moles/m}^3 \text{ air}) = \text{ppb}$$

#### Holding times

Storage stability data and trapping efficiencies for the pesticides can be found in Table 9. All sample cartridges were extracted within 8 days of collection.

Table 9. Storage stability and trapping efficiency data from UCD for pesticides and breakdown products.

Compound	Detector	Storage Stability (% recovery)		Trapping (% recovery)			Notes
		Day 0	Day 31	Wool	Resin	Total	
Chlorothalonil	MSD <sup>d</sup>	107 <sup>a</sup>	100 <sup>a</sup>	<sup>a</sup>	<sup>a</sup>	78 <sup>a</sup>	1
Chlorpyrifos	FPD <sup>e</sup>	105 <sup>a</sup>	93 <sup>a</sup>	<sup>a</sup>	<sup>a</sup>	105 <sup>a, b</sup>	1, 7
Chlorpyrifos OA	FPD	86	98	7.9	50	58	2
Chlorthal-dimethyl	MSD	97	92	25	79	104	4
Cycloate	MSD	89	113	0	37	37	4
Diazinon	FPD	102 <sup>a</sup>	92 <sup>a</sup>	<sup>a</sup>	<sup>a</sup>	117 <sup>a</sup>	1
Diazinon OA	FPD	88	98	0	89	89	2
Dichloran	MSD	88	85	26	67	93	4
Dicofol	MSD	78	74	61	41	103	3
Dimethoate	FPD	105 <sup>a</sup>	95 <sup>a</sup>	<sup>a</sup>	<sup>a</sup>	133 <sup>a</sup>	1
Dimethoate OA	FPD	89	96	21	69	90	2
EPTC	MSD	91	107	0	53	53	3
Ethalfuralin	MSD	83	96	0	60	60	4
Fonofos	FPD	97 <sup>a</sup>	89 <sup>a</sup>	<sup>a</sup>	<sup>a</sup>	102 <sup>a</sup>	1
Fonofos OA	FPD	87	95	0	87	87	2
Iprodione	MSD	88	89	77	5	82	5
Malathion	FPD	90	99	27	58	86	2
Malathion OA	FPD	88	105	34	71	104	2
Mefenoxam	MSD	91	91	7.8	83	91	3
Metolachlor	MSD	93	90	15	77	93	4
Naled	FPD	N/A <sup>c</sup>	108	2.4	69.2	74	6
Oxydemeton-methyl	FPD	112 <sup>a</sup>	99 <sup>a</sup>	<sup>a</sup>	<sup>a</sup>	102 <sup>a</sup>	1
PCNB	MSD	87	83	0	93	93	4
Permethrin	MSD	107 <sup>a</sup>	98 <sup>a</sup>	<sup>a</sup>	<sup>a</sup>	110 <sup>a</sup>	1
Propyzamide	MSD	85	87	0	77	77	3
Simazine	MSD	95	92	69	21	90	7
Trifluralin	MSD	85	95	0	77	77	3
Vinclozolin	MSD	93	92	6.8	82	89	3

<sup>a</sup> Indicates Storage Stability (for days 0 and 30) and Trapping were completed during Phase One for that compound (Okumura, 1999).

<sup>b</sup> Indicates that chlorpyrifos and its oxygen analog detected in the control sample, cannot determine relative proportions

<sup>c</sup> Mourer, C.R., G. Hall, T. Shibamoto. 1994. Method Development for Naled and Dichlorovos in Air Samples Using XAD-4<sup>®</sup> as a Trapping Medium. Report to the California Air Resources Board, April 1995. Storage stability tests were run for 21 days; no data were available for day 0.

<sup>d</sup> MSD = Mass Spectrometry Detector

<sup>e</sup> FPD = Flame Photometric Detector

## **Laboratory Methods for the Group 2 Chemicals Analyzed by Liquid Chromatography/Mass Spectroscopy**

The method development for analysis of the Group 2 chemicals was conducted by Battelle Atmospheric Science and Applied Technology Department, 505 King Avenue, Columbus, Ohio 43201-6424. Methods for mass spectroscopy/mass spectroscopy analysis or liquid chromatography/mass spectroscopy/ mass spectroscopy analysis were developed for most of the target analytes. Problems arose with the methods for extraction of the analytes off of the XAD-4 resin. Recoveries ranged from 5% to 173%. Further work on trapping and extraction efficiency experiments resulted in recoveries ranging from not detectable to 26%. In addition, interferences were observed for four of the nine Group 2 analytes. When it became apparent that we could not be assured of adequate methods of analysis before the period of use for the target chemicals had passed, the TAG agreed to instruct the laboratory to stop work on the analytical methods. The method development and discussion of work by Batelle Laboratory is located in Appendix K.

## **Meteorological Measurements**

In addition to air samples, a MetOne® meteorological station was located approximately 0.75 miles west of the city of Lompoc (Figures 1 and 2) near the agricultural areas on the west side of the city of Lompoc in a fenced maintenance yard. The station was set up according to DPR's SOP EQWE001.00 (Appendix G) in November 1999 prior to the start of sampling. The MetOne® meteorological sensors were placed on a trailer mast at a height of 10 meters. The sensors recorded wind direction, horizontal wind speed, temperature, and relative humidity. The MetOne® sensors were calibrated by the manufacturer on October 5, 1999 to fit within the specifications of the manufacturer. The meteorological data was recorded on a Campbell Scientific CR 21X Datalogger every 5 minutes. In addition, the Santa Barbara County Air Pollution Control District maintains a weather station at the H Street air monitor station in central Lompoc. Data from this station can be compared with the meteorological data collected by DPR.

The MetOne® meteorological station was checked periodically (at least once a month) against hand-held sensors (Appendix G). Storage modules were downloaded and batteries were exchanged approximately once a month.

## **DATA ANALYSIS METHODS**

### **Health Evaluation Methods**

No state or federal agency has established health standards for pesticides in air. Therefore, DPR and a subcommittee of the LIWG's TAG developed health screening levels for these pesticides to place the results in a health-based context. Although not regulatory standards, these screening levels can be used in the process of evaluating the air monitoring results. A measured air level that is below the screening level for a given pesticide would not be considered to represent a significant health concern and would not generally undergo further



evaluation, but also should not automatically be considered “safe” and could undergo further evaluation. By the same token, a measured level that is above the screening level would not necessarily indicate a significant health concern, but would indicate the need for a further and more refined evaluation. Significant exceedances of the screening levels could be of health concern and would indicate the need to explore the imposition of mitigation measures.

To the extent possible, the screening levels were based on toxicology values taken from existing documents. The two primary sources were risk assessments, in the form of Risk Characterization Documents (RCDs), completed by DPR and risk assessments, included in Reregistration Eligibility Documents (REDs), completed by U.S. EPA. Only RCDs that were finalized were used in this effort. Likewise, only REDs that were publicly available on U.S. EPA’s web site ([www.epa.gov/pesticides/reregistration](http://www.epa.gov/pesticides/reregistration)) were used. These documents specified the studies and toxicity values to be used for various exposure scenarios (e.g. acute inhalation, chronic exposure, etc.). When REDs or RCDs were not available or appropriate values were not available, the primary sources were the U.S. EPA Integrated Risk Integration System (IRIS), ([www.epa.gov/iris/](http://www.epa.gov/iris/)) or the U.S. EPA RfD (reference Dose) Tracking Report for chronic toxicity or cancer values, or DPR Toxicology Summaries ([www.cdpr.ca.gov/docs/toxsums/toxsumlist.htm](http://www.cdpr.ca.gov/docs/toxsums/toxsumlist.htm)) for acute values. These acute values were generally taken from developmental toxicity (teratology) studies involving multi-day exposures, resulting in health protective acute values. In the absence of established subchronic values, chronic values were used as health protective surrogates.

In 1996, Congress passed major pesticide food safety legislation. This legislation, titled the Food Quality Protection Act of 1996 (FQPA) made significant changes to the federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA). Among other provisions, FQPA requires U.S. EPA to review existing pesticide food tolerances (legal limits for pesticides in food) and to include an additional safety factor of up to ten-fold, if necessary, to account for uncertainty in data relative to children. This additional factor has become known as the “FQPA factor” or “FQPA safety factor.” U.S. EPA establishes an FQPA factor for a pesticide in the course of preparing the RED for that chemical. Depending on the data, the factor is set at 1X, 3X, or 10X. In a number of cases, U.S. EPA may not have established an FQPA factor for a given pesticide. In this document, the FQPA factor, or lack thereof, is noted for each pesticide.

### **Calculations and Physiologic Values Used in Deriving the Screening Levels**

Children less than one year of age have the highest inhalation rate relative to body weight (see U.S. EPA Child-Specific Exposure Factors Handbook, ([www.epa.gov/ncea/sefh2.htm](http://www.epa.gov/ncea/sefh2.htm))). Therefore, they would inhale the highest amount of airborne material relative to their body weight. Since the screening levels are being used to evaluate ambient air levels, it is appropriate that health protective values are used, and the screening levels will be based on children less than one year of age. Per the Handbook:

- The inhalation rate for a child less than one year of age is 4.5 m<sup>3</sup>/day.
- The body weight for this child is 7.6kg.

The respiratory rate is then calculated as  $(4.5 \text{ m}^3/\text{day}) / (7.6\text{kg}) = 0.59 \text{ m}^3/\text{kg}/\text{day}$

Inhalation No Observed Adverse Effect Levels (NOAELs) are generally derived from studies using laboratory animals, frequently the rat and are usually expressed in terms of an air concentration. Since the experimental animals have different respiratory rates than humans, it is DPR's practice to convert an inhalation NOAEL (expressed as an air concentration) from an animal study to a human equivalent level (again expressed as an air concentration) in order to account for the differences in respiratory rates. It should be noted that this adjustment does not factor in potential differences in toxicologic sensitivity. This potential differential toxicologic sensitivity is taken into account in the application of uncertainty factors.

*To convert an animal inhalation NOAEL to the human equivalent inhalation NOAEL, DPR uses the equation:*

Animal NOAEL x (animal resp. rate/human resp. rate) = human equivalent NOAEL

For the rat, the DPR default respiratory rate is  $0.96 \text{ m}^3/\text{kg}/\text{day}$ , and the above equation becomes:

$\text{Rat NOAEL} \times (0.96 \text{ m}^3/\text{kg}/\text{day}) / (0.59 \text{ m}^3/\text{kg}/\text{day}) = \text{human equivalent NOAEL}$

**Rat NOAEL x 1.6 = human equivalent NOAEL**

In general, for logistical reasons, the rat inhalation NOAELs are derived from studies using exposures of either 4 or 6 hours out of 24 hours. In cases where an inhalation NOAEL is derived from such a study, it is the accepted practice to normalize the NOAEL to a 24-hour period by multiplying the experimental NOAEL by either **(4/24)** or **(6/24)** to calculate an equivalent 24-hour NOAEL.

Sub-chronic or chronic inhalation studies, again for logistical reasons, are generally conducted for 5 out of 7 days per week. When an inhalation NOAEL is derived from such a study, it is the accepted practice to normalize the NOAEL to a 7-day week by multiplying the NOAEL by **(5/7)** to calculate an equivalent NOAEL for exposure throughout the 7-day week.

In some cases inhalation studies may not be available for a particular chemical. In these cases, the results from oral studies are used. However, the oral RfD (often expressed as mg of chemical/kg of body weight) must be converted to an inhalation Reference Concentration (RfC) (usually expressed as an air concentration). This conversion calculates the air concentration that would result in the subject taking in the same amount of chemical as would be taken in orally at the RfD. The screening level is calculated in the same manner as the RfC.

*To convert an oral RfD (mg/kg/day) to a screening level or an inhalation RfC (mg/m<sup>3</sup>), DPR uses the equation:*

$\text{RfC or screening level (mg/m}^3\text{)} = \text{RfD (oral)} \times \text{body weight of subject} / \text{inhalation rate}$

For the above child, the screening level ( $\text{mg/m}^3$ ) =  $\text{RfD (mg/kg/day)} \times (7.6 \text{ kg}) / (4.5 \text{ m}^3/\text{day})$ , or:

$$\text{Screening level (mg/m}^3\text{)} = 1.7 \text{ oral RfD}$$

In deriving a RfD or a RfC from a NOAEL from an animal study, the standard practice is to apply a default uncertainty factor of 100 (to extrapolate from the results of an animal study to an estimated safe level for humans). This factor of 100 is derived from a factor of 10 to account for the uncertainty in extrapolating for animals to humans and an uncertainty factor of 10 to account for variability in the human population. The presence of additional data or information may support the use of alternate factors.

## Screening Levels

### Benomyl

The original sampling plan included monitoring for this chemical. Unfortunately the lab was unable to develop the method for the study, so the chemical was not monitored. DPR has completed a Risk Characterization Document (RCD) on benomyl. The critical studies were all oral. For acute toxicity, the critical NOAEL of 15 mg/kg was taken from a rabbit developmental toxicity study showing postimplantation loss (miscarriage). This oral NOAEL converts to an acute oral RfD of 0.15 mg/kg, using the standard default uncertainty factor of 100. This acute oral RfD then converts to a screening level of  $0.255 \text{ mg/m}^3$  or  $255,000 \text{ ng/m}^3$ . The chronic oral NOAEL is also 15 mg/kg and is taken from a chronic dog study showing hepatotoxicity (liver damage). This also leads to a chronic screening level of  $0.255 \text{ mg/m}^3$  or  $255,000 \text{ ng/m}^3$ . This chronic screening level is also used for subchronic exposure. U.S. EPA classifies benomyl as a C carcinogen (possible human cancer agent) with a cancer slope factor of  $4.3 \text{ E-3}$ . An FQPA factor has not been established by U.S. EPA.

It should be noted that IRIS lists a RfD of 0.05 mg/kg based on the results of a 1968 rat reproduction study showing a NOAEL of 5 mg/kg. DPR reviewed this study and found it unacceptable for several reasons. A more recent rat reproduction study was conducted in 1991, following current guidelines, and was found to be acceptable. This study had a NOEL of 28.2 mg/kg. Thus, the lowest appropriate NOEL for chronic exposure is the 15 mg/kg selected by DPR.

### Chlorothalonil

DPR has completed an RCD on chlorothalonil. The RCD used an acute inhalation NOAEL from an acute inhalation study in rats using chlorothalonil dust in a 4-hour exposure. The lowest dose in this study was 0.00208 mg/L and was a LOEL for clinical signs (decreased activity, piloerection, and respiratory sounds). The standard default factor of 10 was used to derive a NOAEL of 0.000208 mg/L from the LOEL. The human equivalent NOAEL is  $0.0555 \text{ mg/m}^3$ , and the resulting acute screening level is  $560 \text{ ng/m}^3$ . For subchronic toxicity, the RCD used a 13-week oral rat study with an adjusted (to compensate for 30% oral absorption) NOAEL of 0.51 mg/kg. This converted to a subchronic screening level of 8,500

ng/m<sup>3</sup>. For chronic toxicity, the RCD used a chronic oral rat study with a NOAEL of 1.8 mg/kg. This converted to a chronic screening level of 30,600 ng/m<sup>3</sup>. U.S. EPA classifies chlorothalonil as a likely carcinogen with a cancer slope factor of 7.66 E-3. The U.S. EPA established an FQPA factor of 1X.

It should be noted that IRIS lists an RfD of 0.015 mg/kg based on a 1970 chronic dog study. However, the more recent U.S. EPA RED uses a chronic RfD of 0.02 mg/kg based on a NOEL of 2.0 mg/kg from the same chronic study as was used by DPR. The difference in values between the RCD and the RED is probably due to rounding by U.S. EPA.

#### Chlorpyrifos

The values for these screening levels were derived from the U.S. EPA Reregistration Eligibility Document (RED) on chlorpyrifos. The RED addressed short term and intermediate term inhalation using the same subchronic rat inhalation study. Rats were exposed 6 hours per day, 5 days per week. The highest dose level was 297 ug/m<sup>3</sup>, and no effects were seen at any dose level, making 297 ug/m<sup>3</sup> a health protective NOAEL, especially for acute exposure. For an acute screening level, the 297 ug/m<sup>3</sup> is adjusted by 6/24 to give a 24-hour NOAEL of 74 ug/m<sup>3</sup>. This leads to screening level of 1,200 ng/m<sup>3</sup>. For the subchronic screening level, the value is further adjusted by 5/7 to compensate for the 5 day out of 7-day exposure, leading to a screening level of 850 ng/m<sup>3</sup>. For chronic exposure, the RED used a chronic dog study with a NOAEL of 0.03 mg/kg for cholinesterase inhibition (nerve damage). This leads to a RfD of 0.0003 mg/kg and a screening level of 510 ng/m<sup>3</sup>. U.S. EPA classifies the chlorpyrifos as an E, not likely to be a carcinogen. U.S. EPA established an FQPA factor of 10X. The values for chlorpyrifos are used to evaluate air levels of chlorpyrifos OA.

Note: Subsequent to the development of these screening levels, DPR completed an RCD for chlorpyrifos and concluded that NOAELs higher than those used by U.S. EPA are more appropriate for calculating the screening levels. However, it was felt that for clarity, the screening levels should remain unchanged.

#### Chlorthal-dimethyl

(Dacthal, DCPA) The chronic screening level was derived from the values in a 1995 U.S. EPA RED. This document did not designate acute reference values or a critical acute study; therefore, the acute screening level was derived from toxicology studies on file at DPR. In the absence of a single dose acute toxicity study, it is DPR practice to take the value from a developmental toxicity study, since these studies involve a limited number of repeated doses. The lowest NOAEL for a developmental toxicity study was 200 mg/kg in a pilot rabbit study that demonstrated maternal toxicity (weight loss and mortality after several days). Since the period of exposure was 13 days, this is a health protective value for an acute exposure. This NOAEL results in an acute oral RfD of 2.0 mg/kg that converts to a screening level of 3,400,000 ng/m<sup>3</sup>. The RED established a chronic RfD of 0.01 mg/kg, based on liver, thyroid, and lung effects in a chronic oral rat study. This converts to a screening level of 17,000 ng/m<sup>3</sup>. The chronic screening level was also used for subchronic exposure. U.S. EPA classifies chlorthal-dimethyl as a C carcinogen (possible human cancer agent) with a cancer slope factor of 1.49 E-3. U.S. EPA has not established a FQPA factor.

### Cycloate

DPR completed a RCD on cycloate. The RCD used an acute NOAEL of 20 mg/kg from an oral study in rats. The NOAEL was estimated from a LOEL of 200 mg/kg for neurotoxicity (nerve damage). This results in an acute RfD of 0.2 mg/kg and a screening level of 340,000 ng/m<sup>3</sup>. For subchronic toxicity, the RCD used a NOAEL of 0.02 for neurotoxicity, estimated from the LOEL of 0.2 mg/kg in a 15-day subchronic rat inhalation study. This NOAEL results in a screening level of 340 ng/m<sup>3</sup>. For chronic toxicity, the RCD used an oral NOAEL of 0.5 mg/kg for neurotoxic and reproductive effects from chronic oral studies in rats and dogs. This NOAEL results in a RfD of 0.005 mg/kg and a screening level of 8,500 ng/m<sup>3</sup>. Therefore, the screening level of 340 ng/m<sup>3</sup> for the subchronic will also be used for the chronic screening level. U.S. EPA has not classified this chemical for carcinogenic potential. The studies on file at DPR showed no evidence of carcinogenicity. U.S. EPA has not established a FQPA factor.

### Diazinon

The values for these screening levels were taken from a U.S. EPA RED released in 2000. In this document, U.S. EPA determined that inhalation for all time periods should be evaluated using a 21-day rat inhalation study. This study used inhalation exposure 6 hour per day, 7 days a week for 21 days. The LOEL in this study 0.1 ug/L for cholinesterase inhibition. U.S. EPA used a factor of 3 to derive a NOAEL from the LOEL. Therefore the NOAEL would be 0.0333 ug/L. This results in an acute, chronic and subchronic screening level of 83 ng/m<sup>3</sup>. U.S. EPA established a FQPA factor of 1X. The values for diazinon are used to evaluate air levels of diazinon OA.

### Dicloran

(DCNA, Botran) U.S. EPA and DPR risk assessments are not available for this chemical. The acute screening level was derived from the results of an oral developmental toxicity study in rabbits. No effects were seen at any dose level, so the highest dose, 50 mg/kg was set as the NOAEL. This would lead to an acute RfD of 0.5 mg/kg and an acute screening level of 850,000 ng/m<sup>3</sup>. The chronic screening level was set using the U.S. EPA RfD of 0.025 mg/kg, based on liver effects in a chronic dog study. This RfD of 0.025 mg/kg leads to a chronic screening level of 42,500 ng/m<sup>3</sup>. This value was also used as the subchronic screening level. A FQPA factor has not been established.

### Dicofol

U.S. EPA has completed a RED on dicofol. To evaluate short-term inhalation exposure, the RED uses a NOAEL of 4 mg/kg for increased abortions from an oral rabbit developmental toxicity study. This NOAEL results in an acute screening level of 68,000 ng/m<sup>3</sup>. To evaluate intermediate-term inhalation exposure, the RED uses a NOAEL of 0.29 mg/kg for inhibition of ACTH release from a 90-day oral dog study. This NOAEL results in a subchronic screening level of 4,930 ng/m<sup>3</sup>. To evaluate long-term inhalation, the RED uses a NOAEL of 0.12 mg/kg for inhibition of ACTH release from a chronic dog study. This NOAEL results in a chronic screening level of 2,040 ng/m<sup>3</sup>. U.S. EPA classifies dicofol as a C carcinogen (possible human cancer agent), but recommends a RfD approach for assessing risk. U.S. EPA established a FQPA factor of 3X.

### Dimethoate

U.S. EPA has released a RED on dimethoate. To evaluate short-term inhalation, the RED uses a NOAEL of 2.0 mg/kg for neurotoxic effects (nerve damage) from an acute oral neurotoxicity study. This NOAEL results in an acute screening level of 34,000 ng/m<sup>3</sup>. To evaluate intermediate-term inhalation, the RED uses a LOEL of 3.2 mg/kg for cholinesterase inhibition (nerve damage) from a 90-day oral rat study, which is reduced by a factor of three to arrive at the NOAEL of 1.07 mg/kg. This NOAEL results in a subchronic screening level of 17,000 ng/m<sup>3</sup>. To evaluate long-term inhalation, the RED uses a NOAEL of 0.05 mg/kg for cholinesterase inhibition in a chronic rat study. This NOAEL results in a chronic screening level of 850 ng/m<sup>3</sup>. U.S. EPA classifies dimethoate as a C carcinogen, but recommends a RfD approach for assessing risk. U.S. EPA established a FQPA factor of 1X. The values for dimethoate are used to evaluate air levels of dimethoate OA.

### EPTC

U.S. EPA has completed a RED on EPTC. DPR has completed a RCD on EPTC. To evaluate short-term exposure, the RED used a NOAEL of 58 ug/L for myocardial degeneration (heart damage) from a 90-day rat inhalation study with exposure 6 hours per day, 5 days per week. This NOAEL results in an acute screening level of 230,000 ng/m<sup>3</sup>. To evaluate intermediate-term exposure, the RED used the same study. For exposures of less than 21 days, the RED used the above NOAEL, which results in a subchronic screening level of 170,000 ng/m<sup>3</sup> (lower screening level since incorporates compensation for exposure of 5 days per week). For intermediate-term exposures of greater than 21 days, the RED uses the same study, but a NOAEL of 8.3 ug/L for clinical signs. This NOAEL results in a screening level of 24,000 ng/m<sup>3</sup>. The RED did not select a value for evaluating long term inhalation. The DPR RCD used an estimated NOAEL of 0.5 mg/kg/day for neuromuscular degeneration from a two-year oral rat study. This NOAEL converts to a chronic screening level of 8,500 ng/m<sup>3</sup>. Both the RED and RCD concluded that no oncogenic effects were demonstrated in any of the studies. U.S. EPA established a FQPA factor of 10X.

### Ethalfuralin

U.S. EPA completed a RED on ethalfuralin in 1995. However, the document did not designate acute reference values; therefore, the acute screening level was derived from toxicology studies on file at DPR. The NOAEL used was 75 mg/kg from an oral rabbit developmental toxicity study showing increased abortions and decreased food consumption. This NOAEL results in an acute screening level of 1,275,000 ng/m<sup>3</sup>. The RED set a chronic RfD of 0.04 mg/kg, based on a NOAEL of 4 mg/kg for clinical chemistry changes in a one-year dog study. The RfD of 0.04 mg/kg results in a chronic screening level of 68,000 ng/m<sup>3</sup>. The chronic screening level was also used for the subchronic screening level. U.S. EPA classifies ethalfuralin as a class C carcinogen (possible human cancer agent) with a slope factor of 8.9E-2. U.S. EPA has not established a FQPA factor.

### Fonofos

U.S. EPA initiated a RED on fonofos; however, the registrations were cancelled before the RED was completed. U.S. EPA assessed acute dietary exposure using a NOAEL of 2 mg/kg from rabbit oral developmental toxicity study. This NOAEL results in an acute screening level of 34,000 ng/m<sup>3</sup>. U.S. EPA recommended a RfD of 0.002 mg/kg from a NOAEL of 0.2

mg/kg for cholinesterase inhibition (nerve damage) in an oral chronic dog study. This RfD results in a chronic screening level of 3,400 ng/m<sup>3</sup>. The chronic screening level was also used for the subchronic screening level. U.S. EPA assigned a cancer classification of E, evidence of noncarcinogenicity. A FQPA factor was not established. The values for fonofos are used to evaluate air levels of fonofos OA.

#### Iprodione

U.S. EPA released a RED on iprodione in 1998. To evaluate short-term inhalation exposure, the RED used a NOAEL of 20 mg/kg for decreased anogenital distance in male pups (sex organ damage) in an oral rat developmental toxicity study. This NOAEL results in an acute screening level of 340,000 ng/m<sup>3</sup>. For intermediate-term inhalation, the RED used a NOAEL of 6.1 mg/kg for histopathological lesions in the reproductive system from a chronic rat study. This NOAEL results in a subchronic screening level of 102,000 ng/m<sup>3</sup>. The RED did not assess chronic inhalation exposure. Since the subchronic screening level was taken from a chronic study, the same value is used for a chronic screening level. U.S. EPA classifies iprodione as a likely human carcinogen with a slope factor of 4.39E-2. U.S. EPA established a FQPA factor of 3X.

#### Malathion

U.S. EPA released a RED on malathion in 2000. U.S. EPA addressed short-term, intermediate-term, and long-term inhalation using a LOEL of 0.1 mg/L for cholinesterase inhibition (nerve damage) in a 90-day rat inhalation study in which the rats were exposed 6 hours per day, 5 days per week. U.S. EPA used a factor of 10 was used to derive a NOAEL of 0.01 mg/L from the LOEL. Using the NOAEL and adjusting for the 6 hour per day exposure results in an acute screening level of 40,000 ng/m<sup>3</sup>. Using the NOAEL and also adjusting for the 5 day per week exposure results in subchronic and chronic screening levels of 29,000 ng/m<sup>3</sup>. In the RED, U.S. EPA classified malathion as “suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential by all routes of exposure” and indicated that a low-dose linear extrapolation model is not indicated. Earlier U.S. EPA documents have quoted a cancer slope factor of 1.52E-3. U.S. EPA established a FQPA factor of 1X. The values for malathion are used to evaluate air levels of malathion OA.

#### Mefenoxam

Mefenoxam is an optical isomer of metalaxyl. Both U.S. EPA and DPR considered the two chemicals to be toxicologically the same and used the toxicology studies on metalaxyl to evaluate mefenoxam. U.S. EPA completed a RED on metalaxyl in 1994; however, the RED did not set an acute reference value. Therefore, the acute screening level was set based on toxicology studies on file at DPR. The NOAEL used was 50 mg/kg for maternal toxicity from a rat developmental toxicity study. This NOAEL results in an acute screening level of 850,000 ng/m<sup>3</sup>. The RED set a chronic RfD of 0.08 mg/kg based on a NOAEL of 7.8 mg/kg for serum chemistry effects (abnormal levels of essential chemicals in the blood) in a 6-month dog study. This RfD results in a chronic screening level of 136,000 ng/m<sup>3</sup>. This chronic screening level was also used for the subchronic screening level. U.S. EPA assigned a cancer classification of E, evidence of noncarcinogenicity. U.S. EPA has not established a FQPA factor.

### Methomyl

The original sampling plan included monitoring for this chemical. Unfortunately the lab was unable to develop the method for the study, so the chemical was not monitored. U.S. EPA released a RED on methomyl. In this document, U.S. EPA used a NOAEL of 0.137 mg/L for neurotoxicity for a 4-hour acute nose-only rat inhalation study to evaluate short, intermediate, and long-term inhalation exposure. This NOAEL leads to a screening level of 370,000 ng/m<sup>3</sup> for all time periods. U.S. EPA assigned a cancer classification of E, evidence of noncarcinogenicity. U.S. EPA established a FQPA factor of 3X.

### Metolachlor

U.S. EPA completed a RED on metolachlor in 1995; however, the RED did not set an acute reference value. Therefore, the acute screening level was set based on toxicology studies on file at DPR. The NOAEL used was 36 mg/kg for maternal toxicity from a rabbit developmental toxicity study. This NOAEL results in an acute screening level of 612,000 ng/m<sup>3</sup>. The RED set a chronic RfD of 0.1 mg/kg based on a NOAEL of 9.7 mg/kg for decreased body weight gain in a 1-year dog study. This RfD results in a chronic screening level of 170,000 ng/m<sup>3</sup>. This chronic screening level was also used for the subchronic screening level. U.S. EPA assigned a cancer classification of C, possible human carcinogen, but also recommended an MOE approach to assessing risk. U.S. EPA has not established a FQPA factor.

### Naled

U.S. EPA released a RED on naled. In this document, U.S. EPA used a NOAEL of 0.00023 mg/L for cholinesterase inhibition (nerve damage) from a 13-week rat inhalation study to evaluate inhalation exposure of any duration. In this study, exposure took place 6 hours per day, 5 days per week. After adjusting for the 6-hour per day exposure, this NOAEL results in an acute screening level of 900 ng/m<sup>3</sup>. After also adjusting for exposure of 5 days per week, this NOAEL results in subchronic and chronic screening levels of 648 ng/m<sup>3</sup>. U.S. EPA assigned a cancer classification of E, evidence of noncarcinogenicity. U.S. EPA established a FQPA factor of 1X.

Note: Subsequent to the development of these screening levels, DPR completed an RCD for Naled looking at all routes of exposure. The NOAELs selected in the RCD are based on oral studies, rather than inhalation studies, and would not have resulted in lower screening levels. Therefore, the original screening levels were retained.

### Oxamyl

The original sampling plan included monitoring for this chemical. Unfortunately the lab was unable to develop the method for the study, so the chemical was not monitored. The final draft U.S. EPA RED on oxamyl uses an acute rat inhalation study for calculating short and intermediate term inhalation risks. The LOAEL is 0.0049 mg/L (4-hour exposure). U.S. EPA applied an uncertainty factor of 3 to extrapolate from a LOAEL to a NOAEL, yielding a NOAEL of 0.0016mg/L (approximately 0.85 mg/kg over 4 hours as compared to an oral NOAEL of 0.01 mg/kg-day used in earlier drafts). This NOAEL results in a screening level of 4,267 ng/m<sup>3</sup>. U.S. EPA stated that an evaluation of chronic inhalation risk was not required. This screening level is used for all time periods. U.S. EPA assigned a cancer



classification of E, evidence of noncarcinogenicity. U.S. EPA established a FQPA factor of 1X. .

#### Oxydemeton-methyl

U.S. EPA has released a RED on oxydemeton-methyl. U.S. EPA used the results of an acute rat inhalation study to evaluate inhalation exposures of all durations. In this study, rats were exposed for 4 hours, resulting in a LOEL of 0.177 mg/L for neurotoxic effects. U.S. EPA adjusted this dose by a factor of .553 to account for the concentration of the active ingredient in the carrier to arrive at an adjusted LOEL of 0.098 mg/L. A factor of 3X was used to arrive at an estimated NOAEL of 0.0327 mg/L. Adjusting for the 4-hour exposure results in a daily NOAEL of 0.0054 mg/l. This NOAEL results in a screening level of 87,000 ng/m<sup>3</sup> for exposures of all duration. U.S. EPA classified oxydemeton-methyl as “not likely” human carcinogen. U.S. EPA established a FQPA factor of 1X.

#### PCNB

(Pentachloronitrobenzene) U.S. EPA has not completed a RED nor has DPR completed a RCD on PCNB. The acute screening level was derived from developmental toxicity studies on file at DPR. The lowest value is a LOEL of 30 mg/kg for a marginal increase in resorptions in a rat developmental toxicity study. Using a default value of 10 results in a derived NOAEL of 3.0 mg/kg. A rabbit developmental toxicity study had a NOAEL of 125 mg/kg for this same effect. A rat 2-generation reproduction study had a NOAEL of 10 mg/kg. Therefore, the derived NOAEL of 3.0 mg/kg is very health protective. This NOAEL results in an acute screening level of 51,000 ng/m<sup>3</sup>. The chronic screening level was derived from a U.S. EPA RfD of 0.003 mg/kg listed in IRIS, which was the only available U.S. EPA value. This RfD is based on a NOAEL of 0.75 mg/kg for liver toxicity in a chronic dog study, and results in a chronic screening level of 5,100 ng/m<sup>3</sup>. The chronic screening value was used for subchronic exposure. U.S. EPA classifies PCNB as a C carcinogen (possible human cancer agent), but in their most recent classification recommends an MOE approach for assessing cancer risk.

#### Permethrin

U.S. EPA has not completed a RED on permethrin. DPR has completed a RCD on permethrin. In this document, acute inhalation exposure was evaluated using a 4-hour rat acute inhalation study. In this study the LOEL was 240 ug/L for neurotoxicity. A factor of 10 was used to derive a NOAEL of 24 ug/L. This NOAEL results in an acute screening level of 64,000 ng/m<sup>3</sup>. The RCD assessed subchronic toxicity using the results of a 90-day rat feeding study resulting in a NOAEL of 1.7 mg/kg for liver hypertrophy. This NOAEL results in a subchronic screening level of 28,900 ng/m<sup>3</sup>. The RCD assessed chronic toxicity using the results chronic oral mouse study resulting in a NOAEL of 3 mg/kg for liver hypertrophy and alveolar cell proliferation (lung damage). This NOAEL results in a chronic screening level of 51,000 ng/m<sup>3</sup>. The RCD used an oral absorption rate of 70%. If this is applied to screening levels based on oral NOAELs, the subchronic and chronic screening levels would be reduced to 20,230 ng/m<sup>3</sup> and 35,700 ng/m<sup>3</sup>, respectively. U.S. EPA has classified permethrin as a C carcinogen (possible human carcinogen) with a slope factor of 1.84E-2. In the RCD, DPR used a slope factor of 7.8E-3. U.S. EPA has not established a FQPA factor.

### Propyzamide

(Pronamide) U.S. EPA completed a RED in 1994. This document did not set an acute reference value; therefore, this value was set based on developmental toxicology studies on file at DPR. The lowest NOAEL was 5 mg/kg for maternal toxicity (weight loss, liver histopathology), in a rabbit developmental toxicity study. This NOAEL results in an acute screening level of 85,000 ng/m<sup>3</sup>. The RED set a RfD of 0.08 mg/kg based on decreased body weight, liver hypertrophy, and thyroid cell hypertrophy in a chronic rat study. This RfD results in a chronic screening level of 136,000 ng/m<sup>3</sup>. This chronic screening level was also used for subchronic exposure. U.S. EPA has classified propyzamide as a B carcinogen (probable human carcinogen) and assigned a slope factor of 1.54E-2. U.S. EPA established a FQPA factor of 3X.

### Simazine

U.S. EPA has not completed a RED nor has DPR completed a RCD on simazine. The acute screening level was derived from developmental toxicity studies on file at DPR. The lowest NOAEL was 5 mg/kg for decreased maternal weight gain in a rabbit developmental toxicity study. This NOAEL results in an acute screening level of 85,000 ng/m<sup>3</sup>. The chronic screening level was derived from a U.S. EPA RfD of 0.005 mg/kg as listed in IRIS. This RfD is based on a NOAEL of 0.5 mg/kg for hematological changes (damage to blood) in a 2-year rat feeding study. This RfD results in a chronic screening level of 8,500 ng/m<sup>3</sup>. The chronic screening level was used to assess subchronic air levels. U.S. EPA has classified simazine as a C carcinogen (possible human carcinogen) and has assigned a slope factor of 1.2E-1. U.S. EPA has not established a FQPA factor.

### Thiodicarb

The original sampling plan included monitoring for this chemical. Unfortunately the lab was unable to develop the method for the study, so the chemical was not monitored. U.S. EPA released a RED on thiodicarb. In this document, U.S. EPA used a LOEL of 0.0048 mg/L for neurotoxic effects in a 9-day rat dust inhalation study to evaluate inhalation exposure of any duration. In this study, exposure took place 6 hours per day for 9 days. U.S. EPA used an uncertainty factor of 3X to derive a NOAEL from the LOEL. After adjusting for the 6-hour per day exposure and the default 100X uncertainty factor, this NOAEL results in a screening level of 6,400 ng/m<sup>3</sup>. U.S. EPA assigned a cancer classification of B, probable human carcinogen, with a slope factor of 1.88E-2. U.S. EPA established a FQPA factor of 3X.

### Thiophanate-methyl

The original sampling plan included monitoring for this chemical. Unfortunately the lab was unable to develop the method for the study, so the chemical was not monitored. U.S. EPA has not completed a RED nor has DPR completed a RCD on thiophanate-methyl. The acute screening level was derived from developmental toxicity studies on file at DPR. The lowest NOAEL was 2 mg/kg for skeletal abnormalities in a 1986 rabbit developmental toxicity study. This NOAEL results in an acute screening level of 34,000 ng/m<sup>3</sup>. The chronic screening level was derived from a U.S. EPA RfD of 0.08 mg/kg as listed in IRIS. This RfD is based on a NOAEL of 8 mg/kg for decreased body weight, decreased spermatogenesis, and hyperthyroidism in a 2-year rat feeding study. This RfD results in a chronic screening level of 136,000 ng/m<sup>3</sup>. The chronic screening level was used to assess subchronic air levels. U.S.

EPA has classified thiophanate-methyl as a “likely” human carcinogen and has assigned a slope factor of 1.38E-2. U.S. EPA has not established a FQPA factor.

Subsequent to the initial development of these screening levels, U.S. EPA released a risk assessment on thiophanate-methyl (U.S.EPA, 2001). In this document, U.S. EPA uses a NOAEL of 10 mg/kg from a 1997 repeat rabbit developmental toxicity study to evaluate short-term and intermediate-term inhalation exposure. This would result in a screening level of 170,000 ng/m<sup>3</sup>. In the RED, U.S. EPA uses the same chronic RfD that was listed in IRIS, so the chronic screening level would remain the same. The cancer slope factor also did not change. U.S. EPA did establish a FQPA factor of 3X.

#### Trifluralin

U.S. EPA completed a RED on trifluralin in 1995. This document did not set an acute reference value; therefore, this value was set based on developmental toxicology studies on file at DPR. The lowest NOAEL was 100 mg/kg for maternal toxicity (decreased weight gain, abortions), in a rabbit developmental toxicity study. This NOAEL results in an acute screening level of 1,700,000 ng/m<sup>3</sup>. The RED set a RfD of 0.024 mg/kg based on decreased body weight and hematological effects (damage to blood) in a chronic dog study. This RfD results in a chronic screening level of 40,800 ng/m<sup>3</sup>. This chronic screening level was also used for subchronic exposure. In a 1989 review cited on IRIS, U.S. EPA set an RfD of 0.0075 mg/kg based on a dog study; however, this is superceded by the newer U.S. EPA review in the RED. U.S. EPA has classified trifluralin as a C carcinogen (possible human carcinogen) and assigned a slope factor of 7.7E-3. U.S. EPA has not established a FQPA factor.

#### Vinclozolin

U.S. EPA has released a RED on vinclozolin. U.S. EPA used the results of a rat developmental toxicity study to evaluate short-term and intermediate-term inhalation exposure. The NOAEL in this study was 3 mg/kg, for decreased fetal prostate weights, and results in acute and subchronic screening levels of 51,000 ng/m<sup>3</sup>. U.S. EPA used the results of a rat chronic feeding study to evaluate long-term inhalation exposure. This study had a NOAEL of 1.2 mg/kg for histopathological lesions in the lung, liver, ovaries, and eyes, resulting in a chronic screening level of 20,400 ng/m<sup>3</sup>. U.S. EPA has classified vinclozolin as a C (possible human) carcinogen, but recommended an MOE approach using antiandrogenic activity (is used in the chronic evaluation). U.S. EPA has established a FQPA factor of 10X.

### **Methods for Estimating Health Risk**

The potential health risk of a chemical(s) in air is a function of both the inherent toxicity of the chemical(s) as well as the level of exposure to the chemical(s). The potential health risk to Lompoc residents from exposure to pesticides in the air can be evaluated by comparing the air concentration measured over a specified time (e.g. 24 hours, 14 days, 10 weeks) with the screening level derived for a similar time (acute, subchronic, chronic). In these calculations, the screening level is used in the same manner as the RfC.

The ratio of an exposure level for a chemical (measured air concentration of a pesticide) to a RfC for the chemical (screening level for that pesticide) over the same time period is called the Hazard Quotient (HQ). In this case,

$$HQ = C / SL$$

*Where HQ = Hazard Quotient*

*C = air concentration of monitored pesticide over specified time period*

*SL = screening level of pesticide for same time period*

A measured air level that is well below a screening level for a given pesticide is not considered to represent be a public health concern and will not generally undergo further evaluation; however, that air level will not be automatically considered “safe.” By the same token, a measured air level that is above a screening level will not necessarily be a public health concern, but will indicate the need for a further and more refined evaluation. Put in terms of the Hazard Quotient, if the HQ exceeds one, there may be concern for the occurrence of toxic effects, while HQs below one are generally not considered to be represent a health concern. The lower the value of HQ below one, the greater the health protection. Likewise, the greater the value of the HQ above one, the greater the level of concern.

The preceding approach is used to evaluate individual chemicals. However, exposures may occur to more than one chemical at a time, as in the current situation. The Food Quality Protection Act (FQPA) mandates that U.S. EPA, when reviewing the existing food tolerances for a given pesticide, consider the cumulative exposure to pesticides sharing a common mechanism of toxicity. U.S. EPA is in the process of developing new and refined risk assessment methods to meet this mandate. These methods, which incorporate both the grouping of pesticides having a common mechanism of toxicity (e.g., cholinesterase inhibition) as well as distributional analysis of exposure, are data and resource intensive. Another method, the Hazard Index (HI) approach, is currently in use, primarily for assessing hazardous waste sites. The HI approach is less refined both in terms of toxicity and exposure estimation. The HI approach is generally considered more health-conservative than the methods under development for FQPA. As with the approach for individual pesticides, if the results for multiple pesticide exposure suggest possible health concerns, more refined methods for estimating potential health risk could always be employed.

The HI approach is an extension of the HQ approach, and assumes that simultaneous exposure to several chemicals may result in an adverse health effect, even if the level of each individual chemical would not. The magnitude of the cumulative adverse effect would be proportional to the sum of the ratios of the individual exposures (pesticide air concentration) to the individual acceptable concentrations (RfC or SL). Thus, the HI would be equal to the sum of the individual HQs for a given time period (acute, subchronic, chronic).

$$HI = HQ_1 + HQ_2 + HQ_3 + \dots HQ_I$$

As with the HQs, a HI less than one indicates low risk, while an HI greater than one could be cause for health concern.

The assumption of dose additivity implicit in the HI approach is most properly applied to compounds that induce the same toxic effect (e.g., neurotoxicity) by the same mechanism of action (e.g., cholinesterase inhibition). The application of the HI equation to a number of compounds that are not expected to induce the same type of effect or that do not act by the same mechanism of toxicity could overestimate the potential for adverse effects. However, this approach is appropriate as the first tier in a screening approach such as is being employed here. If an HI were greater than one, then the next step would be to segregate the pesticides into groups by toxic effect and mechanism of action and derive HIs for each group.

This discussion on the HQ approach was excerpted from portions of documents listed in Appendix L, all of which are available online.

#### Acute Exposure

To evaluate the potential health risk of acute exposure to the individual monitored pesticides, the highest 24-hour concentration at any site at any time was used. If a pesticide was not detected at any time, a default value of one-half the MDL was used. If only a trace detection was measured, the value used was the concentration halfway between the MDL and the EQL.

#### Subchronic Exposure

To evaluate the potential health risk of subchronic exposure to the individual monitored chemicals, the highest 14-day average concentration measured at any site was used. Similar to the previous calculations, if a pesticide was not detected at any time, a default value of one-half the MDL was used. If only a trace detection was measured, the value used was the concentration halfway between the MDL and the EQL.

#### Chronic Exposure

Chronic exposure is considered to be long term, generally for a significant portion of an lifetime. To evaluate the potential health risk of chronic exposure to the individual monitored pesticides, the highest 10-week average concentration (study duration) at any site was used. Similar to the previous calculations, if a pesticide was not detected at any time, a default value of one-half the MDL concentration was used. If only a trace detection was measured, the value used was the concentration halfway between the MDL and the EQL.

### **Methods for Estimating Air Concentrations for Locations, Time Periods, and Pesticides Not Monitored**

In some studies, computer modeling can be attempted to estimate ambient air concentrations from pesticide applications made during monitoring, provided meteorological measurements and application/sampling site information are available. Thus, modeling can be used to supplement measured air concentrations to determine potential concentrations at places and time periods other than the ones monitored, or in the event a large application, or one close to the city limits occurs. The strength of this approach is the flexibility afforded by modeling. It can provide air concentration estimates within city limits given application scenarios that occur outside of the monitoring period.

DPR used the Industrial Source Complex-Short Term, version 3 (ISCST) computer model to estimate air concentration (U.S. EPA 1995). This is Gaussian plume dispersion model developed by U.S. EPA and has been used successfully to estimate pesticide air concentrations (Ross, et al. 1995). DPR compared the ISCST model predictions to the measured air concentrations to determine if the values agree. Where the model predictions for a pesticide agreed with air concentration, DPR estimated air concentrations for locations, time periods, and pesticides that were not monitored. DPR will also use statistical analyses to correlate pesticide use patterns with air concentrations.

## RESULTS AND DISCUSSION

### Air Monitoring Data

DPR collected and analyzed 159 of the 160 samples described in the monitoring plan. One primary sample was mistakenly analyzed for oxydemeton-methyl only. Another primary result was removed due to flow deviation in excess of 25%. In addition, 12 samples were collected for oxydemeton-methyl analysis during the last two weeks of monitoring. Five additional samples were collocated for particulate collection. Logbook Sampling data is located in Appendix M and all sample raw data are contained in Appendix N. None of the results have been adjusted for recovery results.

Ten of the 28 chemicals were detected at quantifiable concentrations, 15 were detected at trace amounts and three were below any detectable concentrations (Table 10).

Table 10. Detection status of each of the pesticides monitored.

Not Detected	Trace Detection Only	Quantifiable Detection
Fonofos OA	Chlorothalonil	Chlorpyrifos
Oxydemeton-methyl	Diazinon	Chlorpyrifos OA
Simazine	Diazinon OA	Clorthal-dimethyl
	Dicofol	Cycloate
	Dimethoate	Dicloran
	Demethoate OA	EPTC
	Ethalfuralin	Malathion
	Fonofos	Malathion OA
	Iprodione	PCNB
	Mefenoxam	Vinclozolin
	Metolachlor	
	Naled	
	Permethrin	
	Propyzamide	
	Trifluralin	

The highest one-day concentration at any site for each chemical is presented in Table 11 and Figures 4 and 5. The highest concentration detected for any chemical in any sample was PCNB at 47.7 ng/m<sup>3</sup> at the west site. The second highest was dicloran at 17.6 ng/m<sup>3</sup>, also at the west site. The highest 14-day average concentration measured for any site was PCNB at 17.9 ng/m<sup>3</sup> (Table 12). The highest 10-week average (study duration) concentration measured for any site was PCNB at 8.5 ng/m<sup>3</sup> (Table 13). The 14-day and 10-week concentrations were calculated using one-half the MDL for samples with no detectable amount and value halfway between the MDL and the EQL for samples with trace concentrations. For any sample with a collocated duplicate sample which has a higher reported concentration for any chemical, the higher concentration was reported with a notation. A total of six values were higher in the duplicate samples. The higher values were used in all calculations of 14-day and 10-week exposure concentrations. All concentrations of individual chemicals were below the screening levels for all exposure levels.

Table 11. Highest 1-day concentration for chemicals with quantifiable concentrations.

Pesticide	Concentration (ng/m <sup>3</sup> )	Acute Screening Level (ng/m <sup>3</sup> )
PCNB	47.7 <sup>a</sup>	51,000
Dicloran	17.6	850,000
Vinclozolin	16.2	5,100
Chlorpyrifos	15.1	1,200
Chlorthal-dimethyl	14.2	3,400,000
Cycloate	12.4	340,000
Malathion	7.6	40,000
EPTC	6.5	230,000
Chlorpyrifos OA	2.9	1,200
Malathion OA	2.2	40,000

<sup>a</sup> Duplicate concentration.

Figure 4. Highest concentration for each monitored chemical.

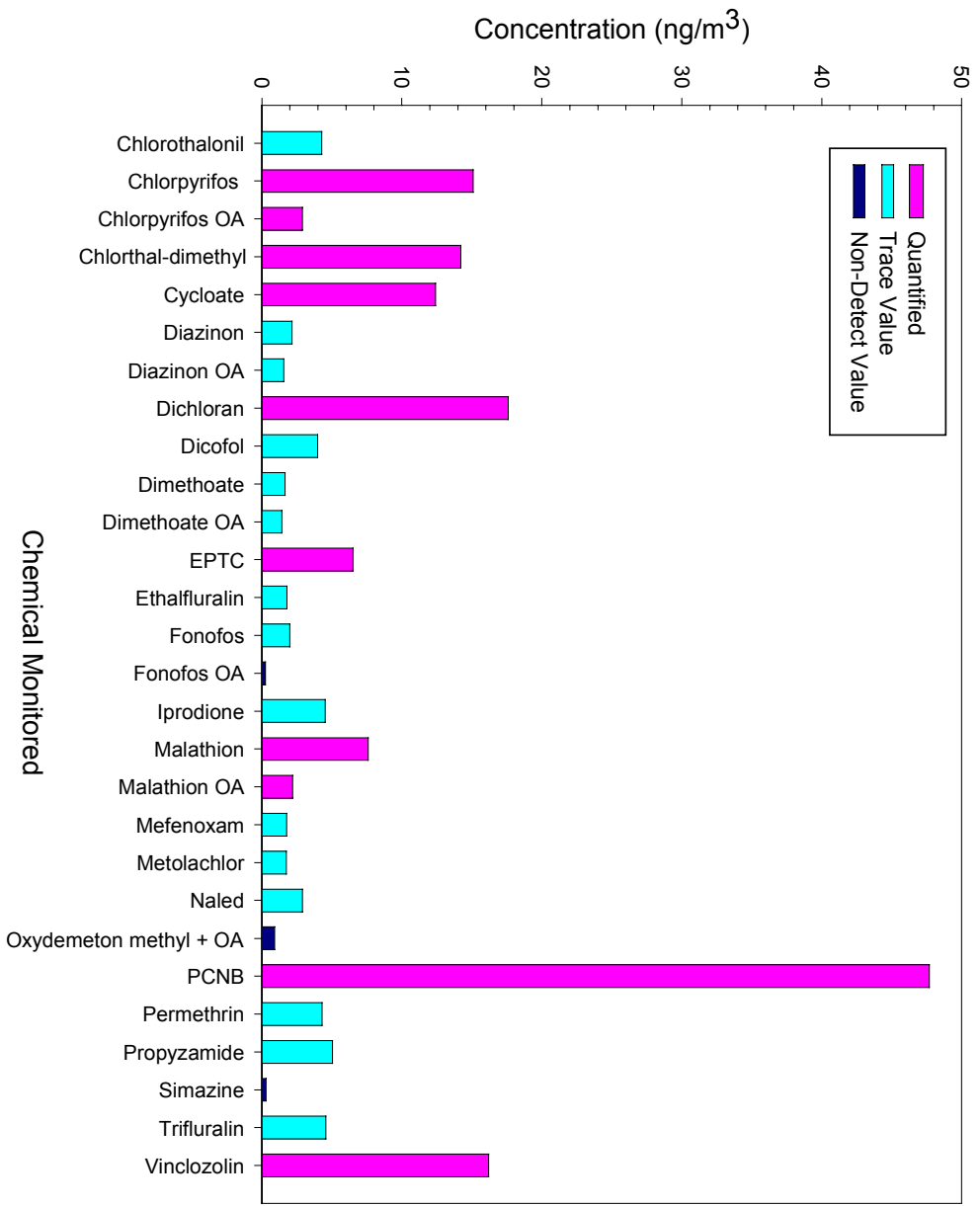




Figure 5. The highest concentration at all sites for each sampling date

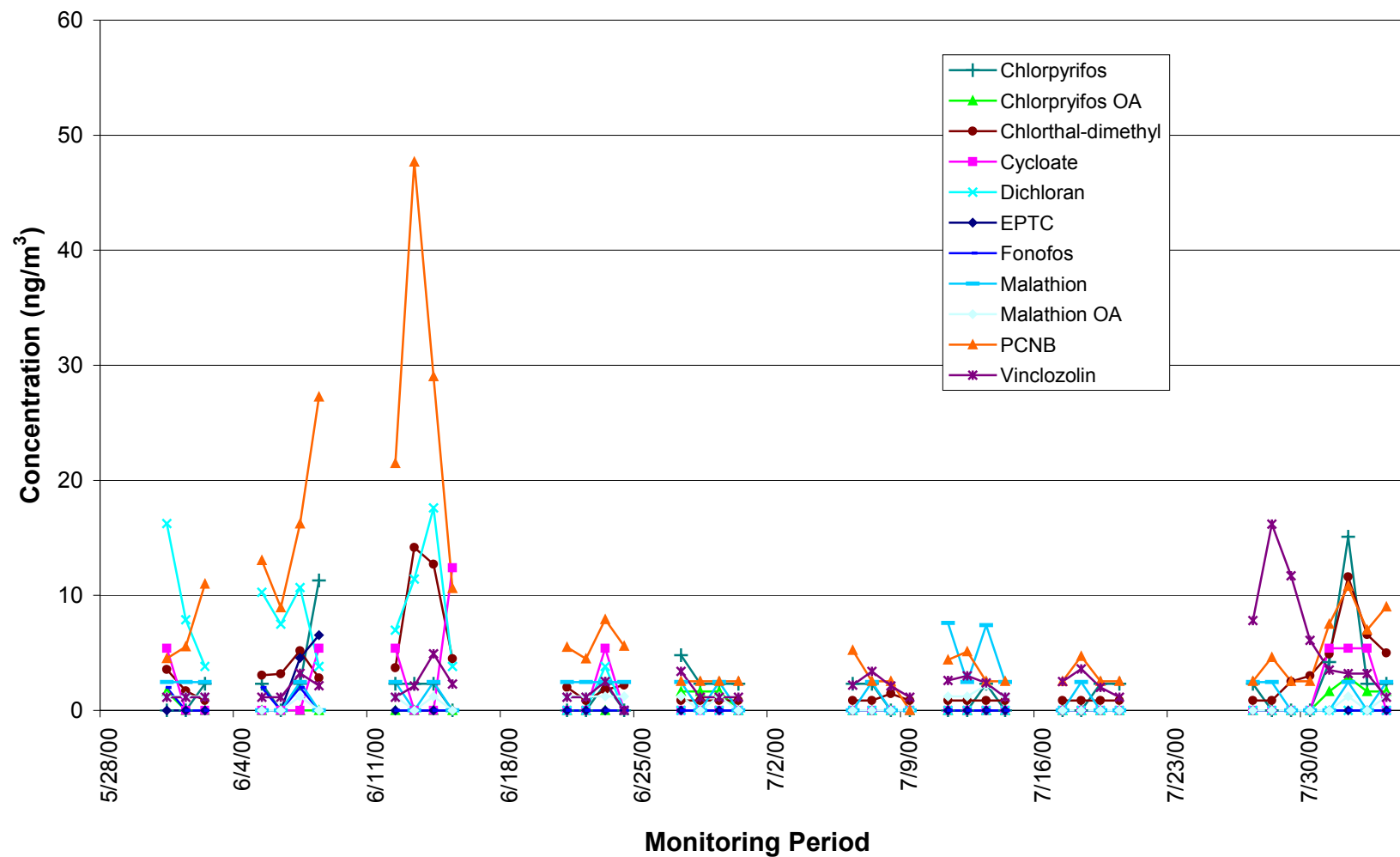


Table 12. The highest 14-day average concentration for chemicals with detectable concentrations.

Pesticide	Concentration (ng/m <sup>3</sup> )	Subchronic Screening Level (ng/m <sup>3</sup> )
PCNB	17.9	5,100
Dicloran	7.7	42,500
Vinclozolin	4.9	51,000
Chlorthal-dimethyl	4.4	17,000
Chlorpyrifos	4.0	850
Trifluralin <sup>a</sup>	4.0	40,800
Chlorothalonil <sup>a</sup>	3.3	8,500
Cycloate	3.0	340
Propyzamide <sup>a</sup>	2.6	85,000
Malathion	2.5	29,000
Naled <sup>a</sup>	2.2	648
Dicofol <sup>a</sup>	1.6	4,930
Permethrin <sup>a</sup>	1.5	20,230
Iprodione <sup>a</sup>	1.3	102,000
Diazinon <sup>a</sup>	1.3	93
Ethalfuralin <sup>a</sup>	1.2	68,000
EPTC	1.1	240,000
Metolachlor <sup>a</sup>	1.0	170,000
Chlorpyrifos OA	1.0	850
Malathion OA	0.9	29,000
Dimethoate OA <sup>a</sup>	0.7	17,000
Fonofos <sup>a</sup>	0.6	3,400
Dimethoate <sup>a</sup>	0.5	17,000
Diazinon OA <sup>a</sup>	0.4	83
Mefenoxam <sup>a</sup>	0.4	136,000
Fonofos OA	not detected (MDL 0.52)	34,000
Simazine	not detected (MDL 0.60)	85,000

<sup>a</sup> There were no quantifiable concentrations of chemical detected.

Table 13. The highest 10-week (study duration) average concentration for chemicals with detectable concentrations.

Pesticide	Concentration (ng/m <sup>3</sup> )	Chronic or Cancer Screening Level (ng/m <sup>3</sup> )
PCNB	8.5	5,100
Dicloran	3.1	42,500
Chlorthal-dimethyl	2.1	17,000
Vinclozolin	2.1	20,400
Trifluralin <sup>a</sup>	1.9	40,800
Chlorpyrifos	1.9	510
Cycloate	1.6	340
Chlorothalonil <sup>a</sup>	1.6	8,500
Propyzamide <sup>a</sup>	1.5	85,000
Malathion	1.2	29,000
Naled <sup>a</sup>	1.1	648
Dicofol <sup>a</sup>	1.0	2,040
Permethrin <sup>a</sup>	1.0	20,230
Iprodione <sup>a</sup>	0.9	102,000
Diazinon <sup>a</sup>	0.7	93
Ethalfuralin <sup>a</sup>	0.6	68,000
EPTC	0.6	8,500
Metolachlor <sup>a</sup>	0.5	170,000
Chlorpyrifos OA	0.5	510
Fonofos <sup>a</sup>	0.4	3,400
Malathion OA	0.4	29,000
Dimethoate OA <sup>a</sup>	0.4	850
Dimethoate <sup>a</sup>	0.3	850
Mefenoxam <sup>a</sup>	0.3	136,000
Diazinon OA <sup>a</sup>	0.3	83
Fonofos OA	not detected (MDL 0.52)	3,400
Simazine	not detected (MDL 0.60)	8,500

<sup>a</sup> There were no quantifiable concentrations of chemical detected.

Table 14 lists the percentage of samples that had detections for each separate chemical. Chlorthal-dimethyl was the most detected chemical, occurring in 91% of the samples. Fonofos OA, oxydemeton-methyl, and simazine were not detected in any samples. The most common number of multiple detections of chemicals in a sample was six (Figure 6). One sample had positive detections for 12 different chemicals, while 18.4% of the samples had positive detections of six different chemicals. Ninety-eight percent of the primary samples contained some detectable amount of at least one of the pesticides analyzed. Ninety percent of the samples had detections of two or more chemicals.

Table 14. The percent of samples with detectable concentrations.

Pesticide	Percent of Samples with Detection <sup>a</sup>
Chlorthal-dimethyl	90.5
PCNB	71.5
Vinclozolin	65.8
Chlorpyrifos	34.2
Dicloran	27.2
Trifluralin	24.1
Malathion	22.8
Naled	19.6
Malation OA	19.6
Chlorthalonil	17.1
Metolachlor	15.2
Chlorpyrifos OA	11.4
Propyzamide	9.5
Ethalfuralin	8.2
Diazinon	7.6
Dimethoate OA	7.6
Dicofol	5.7
Cycloate	5.1
EPTC	5.1
Permethrin	4.4
Diazinon OA	2.5
Fonofos	1.9
Dimethoate	1.9
Iprodione	1.3
Mefenoxam	0.6
Fonofos OA	0.0
Simazine	0.0

<sup>a</sup> Includes quantified detections and trace detections.

Table 15 indicates the number of detections of any chemical at each individual site. The table does not include the results for the 12 oxydemeton-methyl samples that were all non-detects. The west site had the highest number of detections with 23.2% of the possible detections above the MDL. Out of all possible detections (158 samples x 27 chemicals), 17.8% of the concentrations were above the MDL for the chemicals. Conversely, 82.2% of the possible detections were below the MDL. The detections of each individual chemical at each site are detailed in Table 16. The number of detections above the EQL (quantifiable) is listed in parentheses. The northwest site had the smallest number of detections.

Figure 6. The percentage of samples with multiple chemical detections.

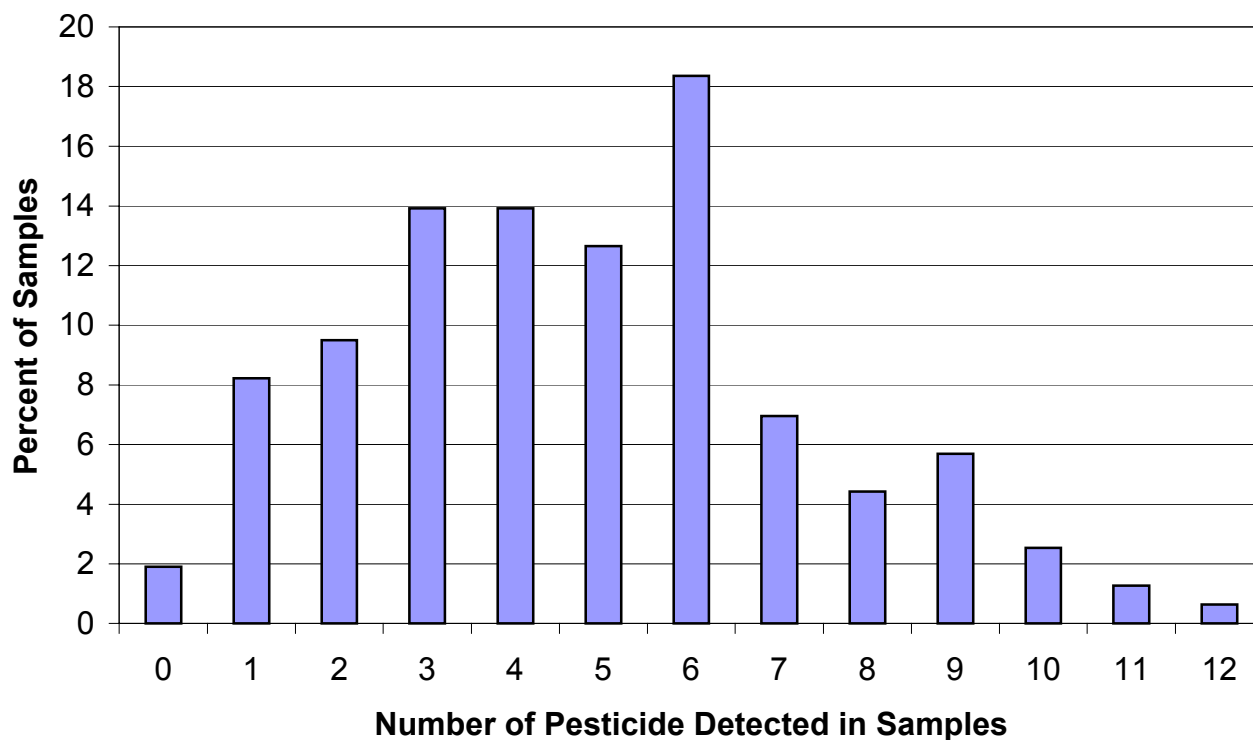


Table 15. Pesticide detections by location.

Location	Number of Possible Detections <sup>a</sup>	Number of Detections <sup>b</sup>	Percent of Possible Detections
Central	1053	185	17.6
Northwest	1080	149	13.8
Southwest	1053	175	16.6
West	1080	250	23.1
Total	4266	759	17.8

<sup>a</sup> Does not include oxydemeton-methyl samples.

<sup>b</sup> Includes quantified detections and trace detections.

Table 16. Number of confirmed pesticide detections at each monitoring site.  
(number in parenthesis is number of positives above EQL).

Chemical	Central	Northwest	Southwest	West
Chlorothalonil	6(0)	4(0)	7(0)	10(0)
Chlorpyrifos	12(1)	13(1)	10(2)	19(3)
Chlorpyrifos OA	6(1)	2(0)	3(0)	7(0)
Chlorthal-dimethyl	38(6)	32(8)	33(4)	40(14)
Cycloate	0	5(1)	2(0)	1(0)
Diazinon	1(0)	7(0)	0	4(0)
Diazinon OA	1(0)	2(0)	0	1(0)
Dichloran	12(0)	7(0)	12(0)	12(9)
Dicofol	2(0)	0	4(0)	3(0)
Dimethoate	0	1(0)	2(0)	0
Dimethoate OA	2(0)	0	4(0)	6(0)
EPTC	2(1)	2(0)	2(2)	2(1)
Ethalfuralin	1(0)	8(0)	0	4(0)
Fonofos	0	0	2(0)	1(0)
Fonofos OA	0	0	0	0
Iprodione	0	0	2(0)	0
Malathion	7(1)	7(2)	6(0)	16(0)
Malathion OA	9(0)	8(1)	5(0)	9(0)
Mefenoxam	0	0	0	1(0)
Metolachlor	6(0)	6(0)	5(0)	7(0)
Naled	7(0)	8(0)	6(0)	10(0)
Oxydemeton-methyl	0	0	0	0
PCNB	29(13)	17(6)	28(10)	39(24)
Permethrin	1(0)	1(0)	3(0)	2(0)
Propyzamide	2(0)	2(0)	6(0)	5(0)
Simazine	0	0	0	0
Trifluralin	12(0)	6(0)	8(0)	12(0)
Vinclozolin	29(4)	11(0)	25(11)	39(19)
Total	185(27)	149(19)	175(29)	251(71)

### Particulate Sample Results

As noted earlier in the report, collocated samples were collected during the last week of sampling to determine if any percentage of the chemical concentrations were being missed in the analysis of the primary samples as particulates. Particulate samples contained a filter

placed into the cartridge prior to the resin. None of the filters showed a positive detection, although some of the sample resins contained measurable amounts or trace amounts of the five chemicals analyzed (Table 17).

Table 17. Results of particulate sample compared to primary sample (concentrations in ng/m<sup>3</sup>).

Site	Start Date	PCNB		Vinclozolin		Chlorthal-dimethyl		Dicofol		Permethrin	
		resin	filter	resin	filter	resin	filter	resin	filter	resin	filter
West	7/29/00	trace		2.9		trace		nd		nd	
		<i>trace</i>	<i>nd</i>	<i>3.1</i>	<i>nd</i>	<i>trace</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>
Central	7/30/00	trace		trace		trace		nd		nd	
		<i>trace</i>	<i>nd</i>	<i>trace</i>	<i>nd</i>	<i>trace</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>
West	8/1/00	10.8		3.2		trace		nd		trace	
		<i>11.5</i>	<i>nd</i>	<i>3.1</i>	<i>nd</i>	<i>trace</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>
Southwest	8/2/00	trace		trace		trace		nd		nd	
		<i>trace</i>	<i>nd</i>	<i>trace</i>	<i>nd</i>	<i>trace</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>
Central	8/2/00	sample was analyzed for oxydemeton-methyl instead of as a primary sample									
		<i>trace</i>	<i>nd</i>	<i>trace</i>	<i>nd</i>	<i>trace</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>
West	8/3/00	9.0		trace		trace		nd		nd	
		<i>4.4</i>	<i>nd</i>	<i>trace</i>	<i>nd</i>	<i>trace</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>

nd = None detected

trace = Pesticide detection confirmed, but less than the quantitation limit

*Particulate sample in Italics*

## Oxydemeton-methyl

During the last three weeks of sampling, 12 separate samples were collected at random sites and analyzed for oxydemeton-methyl. None of the samples contained any measurable amount of the chemical.

## Weather Data

The region is dominated in summer months by a Pacific high-pressure area. This high-pressure area tends to produce northwesterly winds in the Lompoc area. Aiding this tendency, the Central Valley of California heats up during the summer and creates a large pressure and temperature differential between inland and ocean surfaces. The air aloft from the Pacific high is generally warming and descending as it approaches the coastline near Vandenberg Air Force Base. Consequently, the cool moist marine area below tends to form a subsidence inversion accompanied by frequent fog or low cloudiness. The northwesterly winds exert pressure on the ocean surface that causes up-welling of cool water. This cools the

air near the surface and contributes to fog formation. During winter, the Pacific high weakens, the jet stream shifts southward, and heating of the Central Valley is weaker or absent. Winds tend to be more westerly and frontal systems move through the area, changing the wind direction more frequently than in summer months. This summary and a complete description of weather patterns for Lompoc are given in Johnson (1998).

A summary of the weather data is presented in Table 18. The only rainfall during the monitoring period occurred during the 24-hour period before 16:00 on June 8, 2000. A total of 0.06 inches was measured at a weather station located at the Lompoc water treatment plant (National Climatic Data Center [NCDC] #5064, Lompoc). Figure 6 is a wind rose that indicates the wind speed and direction the wind was blowing “to” for the entire monitoring study period (May 31 – August 4, 2000). For 85% of the monitoring study the wind blew towards due east to south-southeast.

Table 18. Summary of weather data measured at DPR meteorological station.

	Minimum	Maximum	Average
Wind Speed (m/s)	<0.2	13.2	4.5 ± 2.0
Wind Speed (mph)	<0.5	29.6	10.1 ± 5.7
Percent Relative Humidity <sup>a</sup>	58.0	94.6	83.2 ± 7.2
Temperature ( °F)	41.8	79.9	58.8 ± 4.6
Temperature ( °C)	5.4	26.6	14.9 ± 2.6

<sup>a</sup> Only data after 6/22 used. Sensor fault was detected and adjusted.

As a quality control check on the meteorological data collected by the MetOne® station, weather data were compared to data collected by the Santa Barbara County Air Pollution Control District (APCD) station at the H Street sampling site. On average the H Street wind speed was 59% of the DPR wind speed. A summary of the weather data measured at the APCD station for the monitoring period is located in Table 19. The APCD station is located in a central business district of Lompoc and is surrounded by trees and buildings that could alter wind speeds measured at the site, while the DPR weather station is located west of the city in an open agricultural area. It was difficult to compare the wind directions measured by the two weather stations because different methods were used by the systems to average measurements. The APCD station calculated a scalar hourly average wind direction with crossover correction. DPR calculated a vector average wind direction, which weights the individual direction measurement by wind speed. A regression of corresponding hourly wind directions from the APCD and DPR was not statistically significant. Lack of statistical significance was probably due to differences in the computational algorithms, as well as the siting differences mentioned above. As with differences in wind speed, the presence of buildings and trees at the H Street station may cause local variations in wind direction, not observed in the more open site of the DPR station. Another factor contributing to the differences in wind direction may have been the localized topography. The DPR site was more in the center of the valley. The H Street site was two miles east of the DPR site, closer to the southeastern end of the valley that terminates in hilly terrain.



Figure 7. A summary of the direction the wind was blowing “to” for the entire 10-week study period.

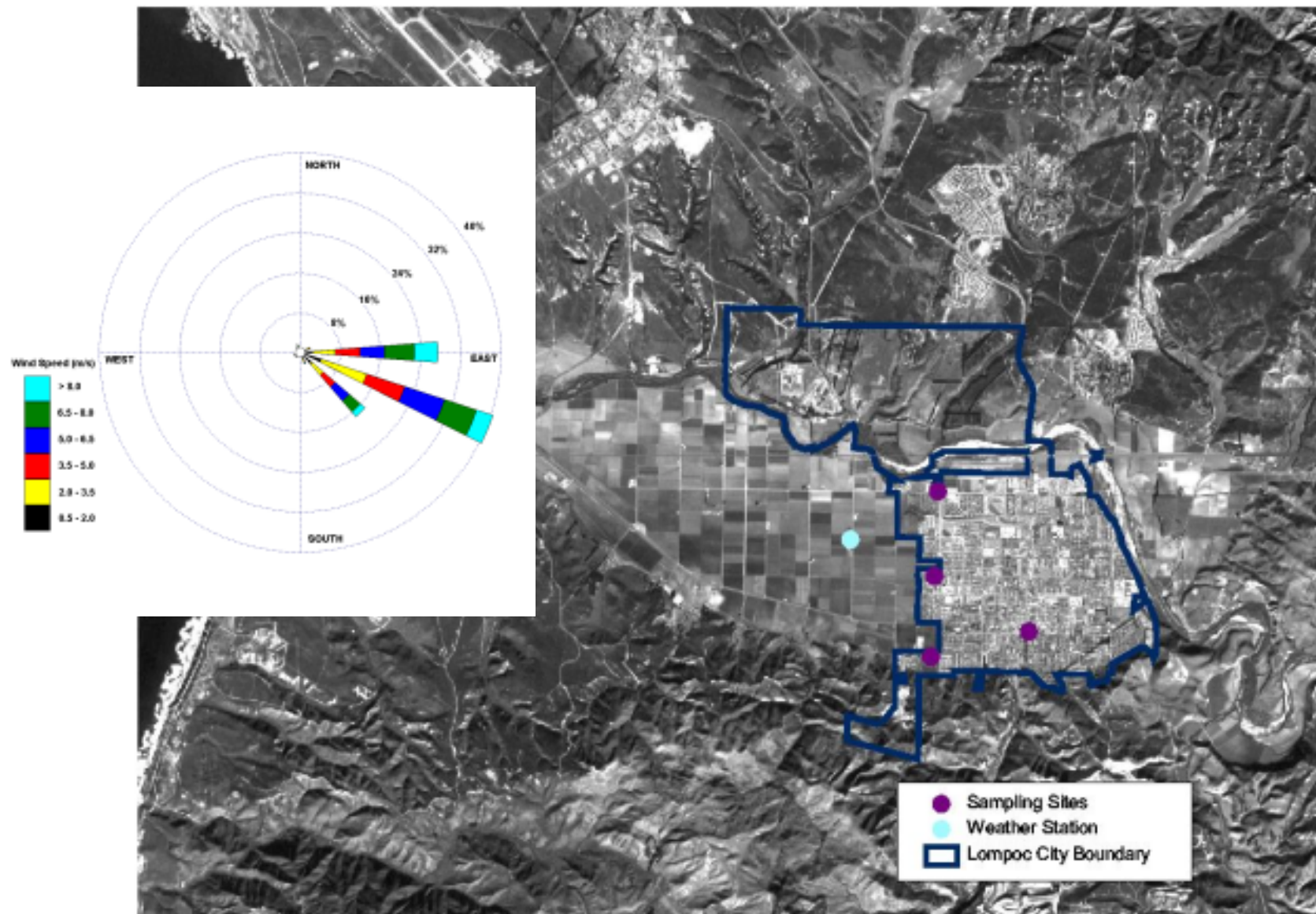


Table 19. Summary of weather data measured at the APCD meteorological station.

	Minimum	Maximum	Average
Wind Speed (m/s)	0.4	6.6	$2.6 \pm 1.3$
Wind Speed (mph)	0.9	14.8	$5.9 \pm 2.9$
Percent Relative Humidity	NA	NA	NA
Temperature ( °F)	46.0	84.6	$60.0 \pm 5.5$
Temperature ( °C)	7.8	29.2	$15.6 \pm 2.9$

NA = Not available

## Comparisons to Other Air Concentrations Measured in Lompoc

### Phase One of Monitoring Study

Of the 12 pesticides that were monitored in Phase One, eight were monitored in this sampling and analysis plan: chlorpyrifos and chlorpyrifos OA, chlorothalonil, cycloate, diazinon and diazinon OA, dimethoate, fonofos, oxydemeton-methyl, and permethrin. A summary of the results from Phase One and Phase Two monitoring is located in Table 20. All pesticide concentrations measured during both the Phase One and Phase Two studies were highest during Phase One. Due to the limited nature of the Phase One sampling, these results were not considered appropriate for risk assessment.

Chlorpyrifos, the most frequently detected pesticide, was detected in 55 of 119 samples above the quantitation limit of  $4 \text{ ng/m}^3$ , and in an additional 60 of 119 samples between the quantitation limit and the detection limit of  $1 \text{ ng/m}^3$ . The maximum concentration of chlorpyrifos that was detected was  $83 \text{ ng/m}^3$ . In addition, chlorpyrifos OA was detected in 4/119 samples above the quantitation limit of  $5 \text{ ng/m}^3$ . The maximum concentration of chlorpyrifos OA was  $8.5 \text{ ng/m}^3$ . Chlorpyrifos OA was not detected above the detection limit of  $5 \text{ ng/m}^3$  in 115/119 samples.

Chlorothalonil was detected in 28/119 samples between the quantitation limit of  $8 \text{ ng/m}^3$  and the detection limit of  $2 \text{ ng/m}^3$ . Chlorothalonil was detected in 91/119 samples below the detection limit; no samples were detected above the quantitation limit.

Cycloate was not one of the 12 pesticides on the monitoring list, but was detected during laboratory screening. Concentrations of cycloate are considered to be estimates because of limited laboratory quality assurance. Cycloate was detected in 7/119 samples above the quantitation limit of  $9 \text{ ng/m}^3$ . Its maximum concentration was  $760 \text{ ng/m}^3$ . The rest of the samples were below the detection limit of  $2 \text{ ng/m}^3$ .

Diazinon was detected in 3/119 samples. Its maximum concentration was  $18 \text{ ng/m}^3$ . The remaining 116/119 samples were below the detection limit of  $1 \text{ ng/m}^3$ . Diazinon OA was detected in 1/119 samples above the quantitation limit of  $5 \text{ ng/m}^3$ ; its concentration was  $5.3 \text{ ng/m}^3$ . Diazinon OA was detected below the detection limit of  $5 \text{ ng/m}^3$  in 118/119 samples.

All 119 dimethoate samples were below the detection limit of  $1 \text{ ng/m}^3$ .

Fonofos was not applied during the Phase one monitoring period, nor was it detected.

Oxydemeton-methyl was detected in 2/119 samples, but not quantified or confirmed. The detection limit was 1 ng/m<sup>3</sup> and the quantitation limit was 5 ng/m<sup>3</sup>.

Permethrin was detected in 1/119 samples between the quantitation limit of 9 ng/m<sup>3</sup> and the detection limit of 2 ng/m<sup>3</sup>. The rest of the samples were below the detection limit. The metal analyses were originally intended as surrogates for pesticides containing metals (aluminum in fosetyl-Al, and manganese in maneb and mancozeb). In retrospect, these analyses are not capable of discriminating between pesticide-applied sources and natural background sources, e.g., soils. Results should not be interpreted as indicative of the presence or absence of these metal-containing pesticides in air.

#### Phase Two - Fumigant Sampling and Analysis

The ambient air monitoring targeted four fumigants: 1,3-dichloropropene (Telone), chloropicrin, metam sodium, and methyl bromide. Air sampling of each of these fumigants was coordinated with an application of the respective fumigant so that ambient air samples are collected during an application of a particular fumigant. During the 2000 fumigant air monitoring study six applications of metam sodium (or metam potassium) and two applications of methyl bromide/chloropicrin were monitored. There were no applications of 1,3-dichloropropene made during 2000.

Of the 293 samples collected and analyzed, 103 had detectable concentrations, 100 for MITC, two for methyl bromide, and none for chloropicrin. The highest concentration detected in any sample for MITC was 920 ng/m<sup>3</sup> using charcoal tubes and 1885 ng/m<sup>3</sup> using canisters. The highest 3-day average concentration measured was 616 ng/m<sup>3</sup>, using canister samples. All MITC concentrations were less than the acute health screening level of 66,000 ng/m<sup>3</sup> and the subchronic health screening level of 3,000 ng/m<sup>3</sup>. Only trace levels were detected for methyl bromide, and chloropicrin had no detectable concentrations.

Table 20. Summary of 24-hour concentrations measured in Lompoc in Phase One and Phase Two.

Chemical	Phase One		Phase Two	
	Highest Concentration (ng/m <sup>3</sup> )	Percent of Samples with Detection <sup>a</sup>	Highest Concentration (ng/m <sup>3</sup> )	Percent of Samples with Detection <sup>a</sup>
Chlorpyrifos	83	97	15.1	34
Chlorpyrifos OA	8.5	3.4	2.9	11
Chlorothalonil	Trace	23.5	Trace	17
Cycloate	760 <sup>b</sup>	5.9	12.4	5.1
Diazinon	18	2.5	Trace	7.6
Diazinon OA	5.3	0.8	Trace	2.5
Dimethoate	Not detected	0	Trace	1.9
Fonofos	Not detected <sup>c</sup>	0	Trace	1.9
Oxydemeton-methyl	Trace <sup>d</sup>	1.7	Not detected	0
Permethrin	Trace	0.8	Trace	4.4

<sup>a</sup> Includes quantified and trace detections.

<sup>b</sup> Not on monitoring list, but detected during screening. Considered to be an estimate.

<sup>c</sup> Not applied during monitoring period.

<sup>d</sup> Not confirmed

## Comparison to Other Pesticide Monitoring in California

The Air Resources Board, in consultation with DPR, conducts ambient monitoring for a variety of pesticides in accordance with the Toxic Air Contaminant (TAC) monitoring program. Monitoring for pesticides is conducted in counties with the highest use for a particular pesticide to be monitored and during the season of highest use. Information is available from air sampling conducted under the TAC program for nine of the pesticides monitored in Phase Two: chlorothalonil, diazinon, EPTC, malathion, naled and its breakdown product DDVP, oxydemeton-methyl, permethrin, and simazine. Results of the monitoring are summarized below. A summary of the results from the monitoring studies is located in Table 21.

Chlorothalonil was measured in Ventura County in January and February 1990 using charcoal sorbent and analyzed by gas chromatography (Baker *et al.*, 1996). Three sites were measured over the course of 15 days and 7% of the sample concentrations were above the minimum quantitation level of  $3.9 \text{ ng/m}^3$ . The maximum concentration was  $4.6 \text{ ng/m}^3$ , the average was  $4.4 \text{ ng/m}^3$ , and the mean urban background concentration was  $<3.9 \text{ ng/m}^3$ .

Chlorpyrifos and its oxygen analog were measured in Tulare County during May and June 1996 using XAD-4 resin and gas chromatography (California Air Resources Board, 1998b). Four sites were measured over the course of 22 days and 74% of the sample concentrations were above the minimum quantitation level of  $9.4 \text{ ng/m}^3$ . The maximum concentration was  $815 \text{ ng/m}^3$ , and the mean urban background concentration was  $27 \text{ ng/m}^3$ . For chlorpyrifos OA, 70% of the sample concentrations were above the minimum quantitation level of  $9.4 \text{ ng/m}^3$ . The maximum concentration was  $230 \text{ ng/m}^3$ , and the mean urban background concentration was  $20 \text{ ng/m}^3$ .

Diazinon was measured in Fresno County during January and February 1997 using XAD-2 resin and gas chromatography (California Air Resources Board, 1998a). Four sites were measured over a six-week period and 22% of the sample concentrations were above the estimated quantitation limit of  $215 \text{ ng/sample}$ . The estimated quantitation limit, expressed in units of  $\text{ng/m}^3$ , is dependent on the volume of air sampled, which varies from sample to sample. For a 24-hour sampling period at  $2 \text{ L/min}$  the estimated limit of quantitation would be  $75 \text{ ng/m}^3$ . The maximum concentration was  $290 \text{ ng/m}^3$ , and all urban background sample concentrations were below the level of quantitation.

EPTC was measured in Imperial County during October and November 1996 using XAD-2 resin and gas chromatography (California Air Resources Board, 1998c). Four sites were measured over the course of 24 days and 23% of the sample concentrations were above the limit of quantitation of  $197 \text{ ng/sample}$ . The method limit of quantitation, expressed in units of  $\text{ng/m}^3$ , is dependent on the volume of air sampled, which varies from sample to sample. The method limit of quantitation for a 24-hour sampling period at  $1.9 \text{ L/min}$  would be  $72 \text{ ng/m}^3$ . The maximum EPTC concentration was  $240 \text{ ng/m}^3$ , and all of the urban background samples had concentrations below the limit of quantitation.

Malathion and its breakdown product malathion OA were measured in Imperial County during February and March 1998 using XAD-2 resin and gas chromatography (California Air Resources Board, 1999a). Four sites were measured over the course of 12 days and 78% of the sample malathion concentrations were above the estimated quantitation limit of 17.3 ng/sample. The estimated quantitation limit, expressed in units of  $\text{ng}/\text{m}^3$ , is dependent on the volume of air sampled, which varies from sample to sample. For a 24-hour sampling period at 3 L/min the air concentration would be  $4 \text{ ng}/\text{m}^3$  for malathion and  $7.9 \text{ ng}/\text{m}^3$  for malathion OA. The maximum malathion concentration was  $90 \text{ ng}/\text{m}^3$ , and the mean urban background concentration was  $5.7 \text{ ng}/\text{m}^3$ . For malathion OA, 37% of the sample concentrations were above the estimated quantitation limit. The maximum malathion OA concentration was  $28 \text{ ng}/\text{m}^3$ , and the mean urban background concentration was  $4.8 \text{ ng}/\text{m}^3$ .

Naled/dichlorvos (DDVP) were measured in Tulare County during May and June 1991 using XAD-2, and analyzed by gas chromatography (California Air Resources Board, 1993). Four sites were measured over the course of 16 days and 14% of the sample concentrations were above the minimum quantitation level of  $40 \text{ ng}/\text{m}^3$ . The maximum concentration was  $65 \text{ ng}/\text{m}^3$ , and the mean urban background concentration was  $68 \text{ ng}/\text{m}^3$ .

Oxydemeton-methyl was measured in Monterey County during August and September 1995 using XAD-4 resin, and analyzed by gas chromatography (California Air Resources Board, 1996). Five sites were measured over the course of 15 days and none of the sample concentrations were above the limit of quantitation. The limit of quantitation for oxydemeton-methyl and its breakdown product was 250 ng/samples ( $12 \text{ ng}/\text{m}^3$  for a 24-hour sample collected at 14.6 L/min).

Permethrin was measured in Monterey County during August and September 1997 using XAD-4 resin and gas chromatography (California Air Resources Board, 1998d). Four sites were measured over the course of 24 days and 5% of the sample concentrations were above the limit of detection, but were below the limit of quantitation; the remaining sample concentrations were below the limit of detection. All urban background samples had concentrations below the limit of detection. The limit of quantitation for permethrin was 330 ng/sample. The air concentration, expressed in units of  $\mu\text{g}/\text{m}^3$ , associated with the limit of quantitation is dependent on the volume of air samples, which varies from sample to sample. For a 24-hour sampling period at 15 L/min the air concentration would be  $15 \text{ ng}/\text{m}^3$  as associated with the limit of quantitation.

Simazine was measured in Fresno County during February through April 1998 using XAD-2 resin and gas chromatography (California Air Resources Board, 1999b). Four sites were measured over the course of 24 days and 18% of the sample concentrations were above the estimated quantitation limit. The analytical estimated quantitation limit for simazine was 18.2 ng/sample. The air concentration, expressed in units of  $\text{ng}/\text{m}^3$ , with the associated estimated quantitation limit is dependent on the volume of air sampled, which varies from sample to sample. For a 24-hour sampling period at 3 L/min the air concentration would be  $4.2 \text{ ng}/\text{m}^3$  for simazine as associated with the estimated quantitation limit. The maximum concentration was  $18 \text{ ng}/\text{m}^3$ ; all background sample concentrations were below the estimated quantitation limit.

Table 21. Highest 24-hour concentrations measured in Lompoc and previous monitoring studies.

Chemical	Year	County	Maximum 24-hour Concentration (ng/m <sup>3</sup> )	Percent of Samples with Measurable Concentrations	EQL <sup>a</sup> (ng/m <sup>3</sup> )	Lompoc Maximum 24-hour Concentration (ng/m <sup>3</sup> )	EQL (ng/m <sup>3</sup> )
Chlorothalonil	1990	Ventura	4.6	7	3.9	trace	7.1
Chlorpyrifos	1996	Tulare	815	74	9.4	15	3.8
Chlorpyrifos OA	1996	Tulare	230	70	9.4	trace	2.7
Diazinon	1997	Fresno	290	22	75	2.2	3.6
EPTC	1996	Imperial	240	23	72	6.5	3.1
Malathion	1998	Imperial	90	78	4	7.6	4.1
Malathion OA	1998	Imperial	28	37	7.9	2.2	2
Naled/dichlorvos	1991	Tulare	65	14	40	trace	4.8
Oxydemeton-methyl	1995	Monterey	nd	0	12	nd	2.1
Permethrin	1997	Monterey	Trace	5	15	trace	7.2
Simazine	1998	Fresno	18	18	4.2	nd	3

<sup>a</sup> EQL = Estimated Quantitation Limit

## Health Evaluation of Measured Air Levels

As mentioned earlier in this report, the potential health risk of a chemical(s) in air is a function of both the inherent toxicity of the chemical(s) as well as the level of exposure to the chemical(s). The potential risk of the measured levels of pesticides in Lompoc air can be evaluated by comparing the air concentration measured over a specified time (e.g. 24 hours, 14 days, 10-weeks) with the screening level derived for a similar time (acute, subchronic, chronic).

### Acute Exposure

To evaluate the potential health risk of acute exposure to the individual monitored pesticides, the highest 24-hour concentration at any site at any time was used. As can be seen from the “Acute Hazard Quotient” column in Table 22, the HQs for chlorpyrifos, diazinon, and diazinon OA are nearly 100 times less than one, while the HQs for the rest of the pesticides are more than 100 times below one.

To evaluate the acute multi-pesticide exposures, the acute HQs (Table 22) were used. Inherent in this first tier is the use of the highest air concentration at any time, at any site for each pesticide. A more realistic approach would be to evaluate the multiple pesticide exposure at a single site at a series of time points, and then take the highest HI. This approach

would produce lower estimates of total exposure. In addition, as discussed previously, all pesticides were grouped together, rather than by mechanism and site of toxicity. The acute HI, which is the sum of the individual pesticide HQs, is 0.073, more than ten times less than one (Table 22). Therefore, there is no need to further refine the calculations in terms of mechanism of toxicity grouping or time of multi-pesticide measurement, since these refinements, while more realistic, would only decrease the hazard estimate.

It is interesting to note that the main contributors to the acute cumulative HI are chlorpyrifos and diazinon. No agricultural use was reported for diazinon during the monitoring period, suggesting that the trace levels were due to residential, industrial, or unreported agricultural use. During the monitoring period, chlorpyrifos was still available for residential use; however, these uses are being or already have been phased out. Thus, the acute HI, may have been influenced by residential use of diazinon and chlorpyrifos.

#### Subchronic Exposure

To evaluate the potential health effects from subchronic exposure to the individual monitored pesticides, the air levels from the West Site were used, since the West Site almost always had the highest measured air levels. As a first tier, the subchronic exposure was estimated by taking the average of the highest 14 daily air levels at any time during the 10-week monitoring period. Since the highest average of 14 consecutive days is a more realistic estimate of subchronic exposure, this is an overestimate of exposure.

As can be seen from the “Subchronic Hazard Quotient” column in Table 23, the HQs for all of the pesticides are almost more than 100 times less than one. Therefore, no further refinement of the estimate of the 14-day exposure period is necessary. To evaluate subchronic multi-pesticide exposure, these individual HQs were added together. As with acute, all pesticides were grouped together, regardless of site or mechanism of toxicity. The 14-day subchronic HI is 0.033, nearly 30-fold less than one. If the 14-day subchronic HI is calculated using the highest individual HQ from any of the sampling sites (instead of the west site only) the HI would be 0.044, still more than ten times less than one. Therefore, there is no need to further refine the calculations in terms of toxicity grouping or time of multi-pesticide measurement, since these refinements, while more realistic would only decrease the hazard estimate. The main contributors to the subchronic HI (cumulative risk) are chlorpyrifos, diazinon (as with the acute), as well as cycloate, naled, and PCNB.

#### Chronic Exposure

To evaluate the potential health effects from chronic exposure to the individual monitored pesticides, the air levels from the West Site were used, since the West Site almost always had the highest average air levels over the ten-week monitoring period. As a first tier estimate of chronic exposure, the ten-week average exposure was used as the chronic exposure with no adjustments for use or averaging over the rest of the year. Put another way, although the monitoring took place during the high use period, it is assumed that the use and corresponding air levels remained the same through the rest of the year, even when there may have been no applications. Since use was lower during some or many of the other months for all the pesticides, this approach overestimates chronic exposure, but is used as a first tier evaluation.

As can be seen from the “Chronic Hazard Quotient” column in Table 24, the HQs for all of the pesticides are more than 100-fold below one. Therefore, no further refinement of the estimate of the chronic exposure is necessary. To evaluate chronic multi-pesticide exposure, the individual HQs were added together regardless of site or mechanism of toxicity, the same as with the acute and subchronic calculations. The chronic HI is 0.023, nearly 50-fold less than one. If the ten -week chronic HI is calculated using the highest individual HQ from any of the sampling sites (instead of the west site only) the HI would be 0.027, still more than ten times less than one. Therefore, there is no need to further refine the calculations in terms of toxicity grouping or time of multi-pesticide measurement, since these more realistic refinements would only decrease the hazard estimate. As is the case for subchronic exposure, the main contributors for the chronic HI (cumulative risk) are chlorpyrifos, diazinon (as with the acute), as well as cycloate, naled, and PCNB.

#### FQPA Safety Factor

The FQPA safety factor is discussed in the section on the Health Evaluation Methods section. In Tables 22-24 and Figure 7, the FQPA safety factors are applied to the individual hazard quotients for acute, subchronic, and chronic exposure. In cases where U.S. EPA has not yet assigned a FQPA safety factor, a default factor of 10 is used. The HQs are then summed for each exposure period to yield the HIs. The same conservative first tier assumptions discussed above apply to these calculations. In all cases, the individual HQs and the HIs are less than one, even with the assumptions and default safety factors. Therefore, no further refinement of toxicity assumptions (groupings) or exposures are necessary, since they would only serve to lower the estimates of hazard.

The pesticides with the highest relative risk remain the same. Chlorpyrifos (and its breakdown product), diazinon (and its breakdown product), cycloate, and PCNB account for approximately 90% of the total risk from the 28 chemicals monitored (Figure 8).

To determine the highest possible risk based on the monitoring data, DPR chose data from different monitoring sites and different time periods to calculate the hazard indices. Examining each monitoring site separately shows that the West and Northwest monitoring sites had the highest hazard indices (cumulative risk), relative to the Southwest and Central monitoring sites (Table 25).



Table 22. Highest one-day air concentrations, acute screening levels, and acute hazard quotients. The adjusted hazard quotient adds an uncertainty factor for some pesticides to address children's sensitivity. Pesticides with the highest risk are shown in bold.

Chemical	Screening Level (ng/m <sup>3</sup> )	Air Concentration (ng/m <sup>3</sup> )	Acute Hazard Quotient	FQPA Adjusted Hazard Quotient
Chlorothalonil	560	trace (4.3)**	0.007657	0.007657
<b>Chlorpyrifos</b>	<b>1,200</b>	<b>15.1</b>	<b>0.012615</b>	<b>0.126150</b>
Chlorpyrifos OA	1,200	2.9	0.002379	0.023790
Chlorthal-dimethyl	3,400,000	14.2	0.000004	0.000042
Cycloate	340,000	12.4	0.000036	0.000364
<b>Diazinon</b>	<b>83</b>	<b>trace (2.1)</b>	<b>0.025942</b>	<b>0.025942</b>
<b>Diazinon OA</b>	<b>83</b>	<b>trace (1.6)</b>	<b>0.018862</b>	<b>0.018862</b>
Dicloran	850,000	17.6	0.000021	0.000207
Dicofol	68,000	trace (4.0)	0.000058	0.000175
Dimethoate	34,000	trace (1.7)	0.000049	0.000049
Dimethoate OA	34,000	trace (1.4)	0.000042	0.000042
EPTC	230,000	6.5	0.000028	0.000284
Ethalfuralin	1,275,000	trace (1.8)	0.000001	0.000014
Fonofos	34,000	trace (2.0)	0.000058	0.000582
Fonofos OA	34,000	nd (0.3)	0.000008	0.000078
Iprodione	340,000	trace (4.5)	0.000013	0.000040
Malathion	40,000	7.6	0.000190	0.000190
Malathion OA	40,000	2.2	0.000055	0.000055
Mefenoxam	850,000	trace (1.8)	0.000002	0.000021
Metolachlor	312,000	trace (1.7)	0.000006	0.000056
Naled	900	trace (2.9)	0.003197	0.003197
Oxydemeton methyl + OA	87,000	nd (0.5)	0.000011	0.000011
PCNB	51,000	47.7	0.000935	0.009353
Permethrin	64,000	trace (4.3)	0.000067	0.000672
Propyzamide	85,000	trace (5.0)	0.000059	0.000593
Simazine	85,000	nd (0.3)	0.000004	0.000036
Trifluralin	1,700,000	trace (4.6)	0.000003	0.000027
Vinclozolin	51,000	16.2	0.000318	0.003179
TOTAL (Hazard Index)			0.072620	0.221664

\* nd - No detectable amount assumes a concentration one-half the method detection limit concentration, shown in parentheses.

\*\* A trace detection assumes a concentration halfway between the method detection limit and the estimated quantitation limit, shown in parentheses.

Table 23. Highest 14-day air concentrations, subchronic screening levels, and subchronic hazard quotients. The adjusted hazard quotient adds an uncertainty factor for some pesticides to address children's sensitivity. Pesticides with the highest risk are shown in bold.

Chemical	Screening Level (ng/m <sup>3</sup> )	Air Concentration (ng/m <sup>3</sup> )	Subchronic Hazard Quotient	FQPA Adjusted Hazard Quotient
Chlorothalonil	8,500	trace (3.27)**	0.000384	0.000384
<b>Chlorpyrifos</b>	<b>850</b>	<b>4.05</b>	<b>0.004760</b>	<b>0.047603</b>
<b>Chlorpyrifos OA</b>	<b>850</b>	<b>0.95</b>	<b>0.001123</b>	<b>0.011227</b>
Chlorthal-dimethyl	17,000	4.43	0.000261	0.002607
<b>Cycloate</b>	<b>340</b>	<b>1.22</b>	<b>0.003594</b>	<b>0.035937</b>
<b>Diazinon</b>	<b>83</b>	<b>trace (0.87)</b>	<b>0.010500</b>	<b>0.010500</b>
<b>Diazinon OA</b>	<b>83</b>	<b>trace (0.35)</b>	<b>0.004266</b>	<b>0.004266</b>
Dicloran	42,500	7.72	0.000182	0.001816
Dicofol	4,930	trace (1.37)	0.000278	0.000834
Dimethoate	17,000	trace (0.28)	0.000016	0.000016
Dimethoate OA	17,000	trace (0.75)	0.000044	0.000044
EPTC	240,000	0.66	0.000003	0.000027
Ethalfuralin	68,000	trace (0.72)	0.000011	0.000107
Fonofos	3,400	trace (0.45)	0.000132	0.001324
Fonofos OA	3,400	nd (0.3)*	0.000078	0.000778
Iprodione	102,000	0.75	0.000007	0.000022
Malathion	29,000	2.47	0.000085	0.000085
Malathion OA	29,000	0.85	0.000029	0.000029
Mefenoxam	136,000	trace (0.40)	0.000003	0.000030
Metolachlor	170,000	trace (1.01)	0.000006	0.000060
Naled	648	trace (2.19)	0.003383	0.003383
Oxydemeton methyl + OA	87,000	nd (0.5)	0.000011	0.000011
<b>PCNB</b>	<b>5,100</b>	<b>17.87</b>	<b>0.003504</b>	<b>0.035036</b>
Permethrin	20,230	trace (1.23)	0.000061	0.000607
Propyzamide	85,000	trace (2.34)	0.000028	0.000275
Simazine	8,500	nd (0.3)	0.000036	0.000358
Trifluralin	40,800	trace (4.03)	0.000099	0.000987
Vinclozolin	51,000	3.05	0.000060	0.000597
TOTAL (Hazard Index)			0.032943	0.158953

\* nd - No detectable amount assumes a concentration one-half the method detection limit concentration, shown in parentheses.

\*\* A trace detection assumes a concentration halfway between the method detection limit and the estimated quantitation limit, shown in parentheses.

Table 24. Highest 10-week air concentrations, chronic screening levels, and chronic hazard quotients. The adjusted hazard quotient adds an uncertainty factor for some pesticides to address children's sensitivity. Pesticides with the highest risk are shown in bold.

Chemical	Screening Level (ng/m <sup>3</sup> )	Air Concentration (ng/m <sup>3</sup> )	Chronic Hazard Quotient	FQPA Adjusted Hazard Quotient
Chlorothalonil	8,500	trace (1.61)**	0.000189	0.000189
<b>Chlorpyrifos</b>	<b>510</b>	<b>1.91</b>	<b>0.003738</b>	<b>0.037383</b>
<b>Chlorpyrifos OA</b>	<b>510</b>	<b>0.51</b>	<b>0.001002</b>	<b>0.010025</b>
Chlorthal-dimethyl	17,000	2.12	0.000125	0.001245
<b>Cycloate</b>	<b>340</b>	<b>1.01</b>	<b>0.002979</b>	<b>0.029790</b>
<b>Diazinon</b>	<b>83</b>	<b>trace (0.54)</b>	<b>0.006485</b>	<b>0.006485</b>
<b>Diazinon OA</b>	<b>83</b>	<b>trace (0.29)</b>	<b>0.003537</b>	<b>0.003537</b>
Dicloran	42,500	3.12	0.000073	0.000733
Dicofol	2,040	trace (0.91)	0.000447	0.001340
Dimethoate	850	trace (0.28)	0.000325	0.000325
Dimethoate OA	850	trace (0.42)	0.000489	0.000489
EPTC	8,500	0.43	0.000050	0.000502
Ethalfuralin	68,000	trace (0.45)	0.000007	0.000066
Fonofos	3,400	trace (0.37)	0.000109	0.001088
Fonofos OA	3,400	nd (0.3)*	0.000078	0.000778
Iprodione	102,000	trace (0.75)	0.000007	0.000022
Malathion	29,000	1.23	0.000043	0.000043
Malathion OA	29,000	0.43	0.000015	0.000015
Mefenoxam	136,000	trace (0.33)	0.000002	0.000024
Metolachlor	170,000	trace (0.54)	0.000003	0.000032
Naled	648	trace (1.08)	0.001665	0.001665
Oxydemeton methyl + OA	87,000	nd (0.5)	0.000011	0.000011
<b>PCNB</b>	<b>5,100</b>	<b>8.47</b>	<b>0.001661</b>	<b>0.016609</b>
Permethrin	20,230	trace (0.90)	0.000044	0.000443
Propyzamide	85,000	trace (1.37)	0.000016	0.000161
Simazine	8,500	nd (0.3)	0.000036	0.000358
Trifluralin	40,800	trace (1.90)	0.000047	0.000467
Vinclozolin	20,400	1.91	0.000094	0.000936
TOTAL (Hazard Index)			0.023277	0.114761

\* nd - No detectable amount assumes a concentration one-half the method detection limit concentration, shown in parentheses.

\*\* A trace detection assumes a concentration halfway between the method detection limit and the estimated quantitation limit, shown in parentheses.

Figure 8. Cumulative (combined) health risk of all monitored pesticides, expressed as the hazard index. Hazard index less than one indicates low risk.

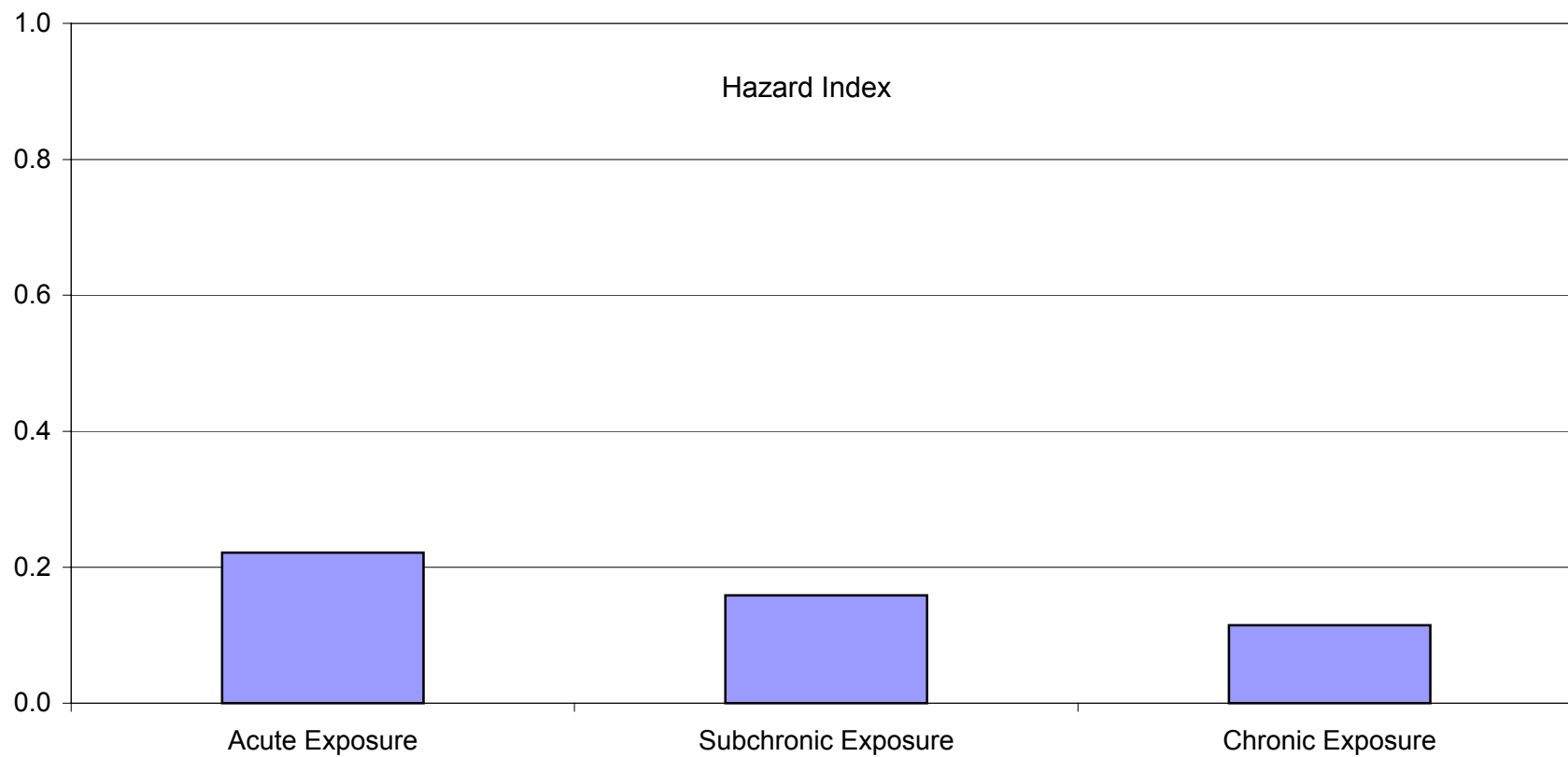


Figure 9. Relative health risk of all monitored pesticides.

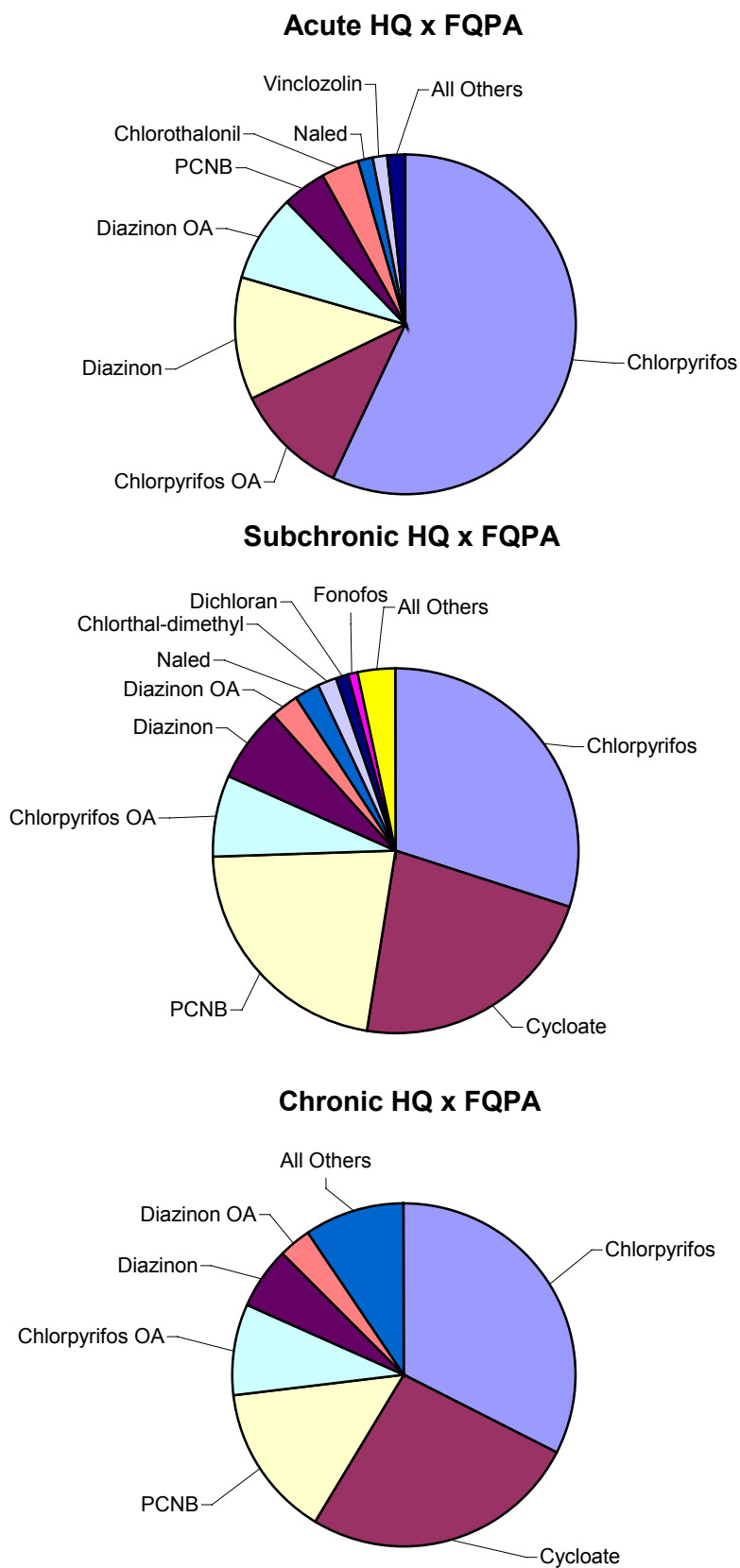


Table 25. Cumulative hazard indices for each monitoring site.<sup>a</sup>

Table 25: Cumulative hazard indices for each monitoring site.			
		Hazard Index	
Monitoring Site	Acute (1 Day)	Subchronic (14 Days)	Chronic (10 Weeks)
Central	0.047	0.021	0.017
Northwest	0.047	0.036	0.022
Southwest	0.022	0.019	0.017
West	0.055	0.031	0.022

<sup>a</sup> These hazard indices do not include the FQPA factor.

### Evaluation of Cancer Potential

In general, carcinogens are treated as having one of two broad mechanisms, threshold and nonthreshold. In a nonthreshold model or mechanism, it is assumed that even a single molecule interacting with the genetic material (DNA) of a single cell can result in a finite risk of cancer. Without sufficient information to the contrary for a given carcinogen, the default is to assume a nonthreshold mechanism and apply a low dose extrapolation model to assess risk. In a threshold model or mechanism, it is assumed that the cancer is secondary to some nongenotoxic effect of the chemical in question. For example, the chemical does not bind to DNA, but rather may affect a hormone level that in turn stimulates the cells to multiply. If that event does not take place, cancer will not result, and if the exposure is low enough, that event will not occur. That is, there is a *threshold*, or dose level at which this event would not likely occur. The carcinogenic potential of a threshold carcinogen is evaluated using a RfD/RfC approach, such as was used for evaluating acute, subchronic, and chronic toxicity in this report.

When USEPA classifies a chemical as a carcinogen, it generally indicates whether a low dose extrapolation or RfD approach should be used. If a low dose extrapolation model is appropriate, USEPA usually indicates the cancer potency factor (sometimes also referred to as the slope factor) that should be applied. This approach or process for carcinogens is also followed by other state and federal agencies in their regulatory programs, including DPR. As indicated in the section of this report on the derivation of screening levels, USEPA has stated that an RfD (threshold) approach should be used for assessing the carcinogenic potential of dicofol, dimethoate, metolachlor, PCNB, and vinclozolin. For these chemicals, the RfD/RfC evaluation used for chronic exposure would also address and protect against carcinogenic effects.

Also as indicated in the report, USEPA has stated that a nonthreshold or low dose extrapolation approach should be used for chlorothalonil, chlorthal-dimethyl, ethalfluralin, iprodione, permethrin, propyzamide, and trifluralin. In such a low dose extrapolation approach, the risk of cancer from exposure to a chemical is determined from the cancer potency of and the human exposure to the chemical. With airborne chemicals, the human exposure is determined from the air concentration of the chemical and the human respiratory rate.

$$Risk = (cancer\ potency) \times (exposure)$$

$$\text{Exposure} = (\text{air concentration}) \times (\text{respiratory rate})$$

$$\text{Risk} = (\text{cancer potency}) \times (\text{air concentration}) \times (\text{respiratory rate})$$

Risk is generally expressed as a probability for the occurrence of cancer (e.g., 1 in 1,000,000). Virtually all state and federal agencies consider a risk of less than 1 in 1,000,000 ( $1 \times 10^{-6}$ ), for the general public, to be extremely low and describe the risk as “negligible.”

Cancer potency is expressed with the units of  $1/(\text{mg/kg/day})$ . The air concentration is expressed as  $\text{mg/m}^3$ . Since the air concentrations in this report have been expressed as  $\text{ng/m}^3$ , and a ng (nanogram) is  $1/1,000,000$  milligram ( $10^{-6}$  mg), the units will be converted for use in these calculations. It is a standard default assumption that exposure to a carcinogen for the public can take place over an entire lifetime of 70 years, so the default respiratory rate for an adult is used --  $0.29 \text{ m}^3/\text{kg/day}$ . The air concentration that is used is the same that was used to assess the chronic exposure, that is, the 10-week average air concentration at the West site. To calculate the cancer risk for exposure to multiple carcinogens, it is standard practice to add the risks together, regardless of tumor site or type.

Since the combined cancer risk for the seven pesticides is more than 50 times less than the benchmark of negligible risk for the general public (Table 26), the risk levels for exposure to the measured levels of the above seven pesticides, both individually and together (multiple pesticide exposure) is negligible.

Table 26. Cancer risk calculations for monitored pesticides.

PESTICIDE	CANCER POTENCY $1/(\text{mg/kg/day})$	AIR CONCENTRATION $\text{mg/m}^3$	RESPIRATORY RATE $\text{m}^3/\text{kg}$	CANCER RISK
Chlorothalonil	$7.66 \times 10^{-3}$	$1.6 \times 10^{-6}$	0.29	<b><math>0.36 \times 10^{-8}</math></b>
Chlorthal-dimethyl	$1.5 \times 10^{-3}$	$1.5 \times 10^{-6}$	0.29	<b><math>0.09 \times 10^{-8}</math></b>
Ethalfuralin	$8.9 \times 10^{-2}$	$0.6 \times 10^{-6}$	0.29	<b><math>1.55 \times 10^{-8}</math></b>
Iprodione	$4.4 \times 10^{-2}$	$0.9 \times 10^{-6}$	0.29	<b><math>1.15 \times 10^{-8}</math></b>
Permethrin	$1.8 \times 10^{-2}$	$1.0 \times 10^{-6}$	0.29	<b><math>0.52 \times 10^{-8}</math></b>
Propyzamide	$1.5 \times 10^{-2}$	$1.5 \times 10^{-6}$	0.29	<b><math>0.65 \times 10^{-8}</math></b>
Trifluralin	$7.7 \times 10^{-3}$	$2.1 \times 10^{-6}$	0.29	<b><math>0.42 \times 10^{-8}</math></b>
			<b>TOTAL RISK</b>	<b><math>4.75 \times 10^{-8}</math></b>

#### Uncertainty Discussion for Multiple Pesticides

Almost all U.S. and international regulatory organizations use similar batteries of animal toxicity studies to evaluate the potential toxicity of chemicals (pesticides, pharmaceutical agents, industrial releases, etc.). The studies are conducted over different periods of time, measure specific types of effects, and are evaluated to screen for potential health effects in infants, children, and adults. In the case of pesticides in the U.S., the required toxicity studies may include (depending on the type and proposed use):

**Acute studies:** oral, dermal, and inhalation exposure; eye irritation; dermal irritation; dermal sensitization; and neurotoxicity.

**Subchronic studies:** oral, dermal, and inhalation exposure; neurotoxicity.

**Chronic studies:** chronic toxicity, carcinogenicity, two-generation reproductive toxicity, developmental toxicity, and genotoxicity. The latter two study areas, while not chronic in nature are generally placed in this grouping.

These studies do not specifically examine hormone or immune response disruption. Many of the studies can reveal some, but not all, end effects of disruption in these areas. Studies are currently under development at the federal level to more specifically evaluate effects in these areas. The existing battery of studies might also miss more subtle manifestations of toxic effects, such as diminished learning ability or increased incidence of neurological diseases such as Parkinson's disease.

Since the above studies are used by regulatory agencies to evaluate toxicity and, thus, estimate risk, gaps in knowledge regarding toxicity could lead to gaps in the resulting risk estimates. Thus, if a chemical could adversely impact human immunological, endocrinological, or other toxicological responses in a manner that was too subtle or sufficiently different in nature to be picked up by the current battery of studies, the adversity of these impacts could be missed. This is inherent to any testing or safety program.

As discussed in other sections, exposures may occur to more than one pesticide at a time. Evaluating chemicals only on an individual basis could overlook the possibility of interactions in multiple chemical exposures. The possible interactions could be no interaction (e.g., additive), antagonistic interaction (one chemical would diminish the toxic effects of the other), and synergistic interaction (one chemical would increase the toxicity of the other).

Studies have indicated all of these interactions are possible for pesticide mixtures. An increase in of the toxicity (synergism) of some mixtures of insecticidal organophosphates has been described, as has a lack of interaction (Dubois 1959, WHO 1980). Porter et al. (1999) describe endocrine, immune, and behavioral effects in mice of pesticides individually and in mixtures at groundwater concentrations. This laboratory also reported thyroid effects in rats from other groundwater pesticide mixtures (Porter et al. 1993). Thiruchelvam et al. (2000a,b) suggest that the synergistic effects of paraquat and maneb, shown in the nervous system in mice, are risk factors in the etiology of Parkinson's disease. Several studies, primarily showing no interaction among pesticide mixtures, are summarized by Carpy et al. (2000). Eroschenko et al. (2000) report that estradiol and methoxychlor did not exhibit additivity or synergism in the reproductive tracts of mice, and Ramamoorthy et al. (1997) report no apparent synergism in the estrogenic activity of a dieldrin/toxaphene mixture. On the other hand, Soto et al. (1994) report that the pesticides endosulfan, toxaphene, and dieldrin had estrogenic effects on human estrogen-sensitive cells in culture. However, from the information presented, the combined effects appear to be less than fully additive.



The National Institute of Environmental Health Sciences (NIEHS)/National Toxicology Program (NTP) undertook an extended series of animal studies on the toxicology of chemical mixtures of environmental concern, including groundwater contaminants from hazardous waste sites and agricultural chemicals. The few positive findings in these studies included subtle effects on the immune system from hazardous waste contaminants and DNA effects from a mixture of common agrochemical contaminants in California groundwater. The lead scientist for this project summarized the findings: “For most of the [health] end points examined, the results have been ‘negative’... Thus, these results provide good news from the public health perspective because these mixtures were tested at concentrations 10- to 100-fold or even several orders of magnitude higher than the potential human exposure level.” (Yang, 1994). The NIEH scientist drew the following conclusions about long-term, low-level exposure to chemical mixtures at environmental levels: 1) toxicological interactions are possible at environmental levels; 2) however, effects are likely to be subtle and marginal; acute toxic responses are unlikely; and 3) effects may not be initially detectable, but may become identifiable as a result of other stresses (chemical, biological, or physical). Uncertainties limiting conclusions from such studies include: 1) effects may be unconventional in the context of current bioassays and thus difficult to detect; 2) humans, particularly sensitive individuals such as children, elderly and ill people, may be more susceptible to exposure than animals; and 3) little or no toxicology information is available on most environmental chemical mixtures. [Note: When extrapolating from animal studies to humans, safety factors are included in health-based exposure limits to buffer against these uncertainties.]

U.S. EPA Office of Pesticide Programs (OPP) assumes additivity for chemicals with the same mode of action in their methods for evaluating multiple chemical exposures. The interaction of chemicals with different modes of action or different target organs is less clear, and OPP does not assume additivity for these cases. In the present report, because of the screening nature of the evaluation, we assumed that all the pesticides could interact in an additive manner.

#### Other Adjustments/Uncertainties

As discussed in the Data Validation/Quality Assurance Section, concentrations of chlorpyrifos OA, cycloate, EPTC, and ethalfluralin may be underestimated due to low trapping efficiency of the method for these chemicals. Concentrations of these four chemicals may be two to three times higher than shown in the results. Due to the high number of trace and no detectable samples, the exact adjustment to the air concentrations is problematic. Even if the maximum adjustment is applied to the concentrations, the hazard indices are still less than one, indicating no further refinement of the risk estimates is necessary.

#### **Pesticide Use**

Overall, pesticide use has increased over the last several years (Figure 9), with the fumigants accounting for the increase. Use of most other pesticides has decreased over the last several years. In 2000, fumigants (monitoring described in Volume 1) accounted for 68% of total pesticide use, the monitored pesticides accounted for 10% of total use, with the unmonitored pesticides accounting for 22% of total use (Figure 9). During the monitoring period from May

31, 2000 to August 3, 2000, 76 pesticides were used in the study area for a total of 53,736 lbs of active ingredient (Appendix O), or 24% of the 228,542 lbs used in 2000. Of the 23 pesticides monitored, three (diazinon, ethalfluralin, and trifluralin) had no reported use during the 10-week monitoring period, and three additional pesticides (dicofol, fonofos, and simazine) had no reported use during 2000 (Table 27). Reported applications for each chemical monitored during the study period are located in Appendix P. A comparison of the use during the monitoring period and the total use for the year is presented in Table 27, Figure 10, and Appendix Q.

As in previous years, peak use in 2000 for most of the monitored pesticides occurred in May – August (Table 28, Figure 11). Use for May – August was less than previous years, with the 2000 use 25% less than the 1996 – 1998 averages (Table 28). Three of the monitored pesticides had months of highest use during June or July: EPTC, malathion, and metolachlor. June or July were one of the three highest use months for 15 of the 23 monitored pesticides. Cycloate had a monthly use 2.3 times higher in November than June/July, the highest relative monthly use for the monitored pesticides. Plus, there were three pesticides (diazinon, ethalfluralin, and trifluralin) that were used during 2000, but their use was not reported during the monitoring period. Figure 12 presents the monthly use for each individual monitored pesticide that had reported use during 2000.

The total number of detections for each sampling date and the daily reported pesticide use are presented in Figure 13. The data are broken down further in Figure 14 so each chemical is individually represented. The daily reported pesticide use for each chemical monitored and detected is presented with the daily highest concentration detected. Although six of the pesticides were not applied during the study, five of them were detected at trace levels (diazinon, dicofol, ethalfluralin, fonofos, trifluralin). The detections may be due to unreported use or use not required to be reported (home, industrial, institutional, etc.).

Table 29 compares the highest daily use amounts during the monitoring period to the highest daily use amounts for all of 2000 within the study area. The highest amount of the monitored pesticides applied for any individual day during the monitoring period was 352 lbs (all of malathion), the second highest day during the monitoring period was 294 lbs (12 pesticides), and the highest day for all of 2000 was 361 lbs (seven pesticides). Of the 17 pesticides monitored and applied during the monitoring period, four had the highest daily amount during the monitoring period, including the 352 lbs of malathion applied in a single day. Thirteen of the monitored pesticides had higher daily amounts during periods not monitored, although nine pesticides were within a factor of two. Cycloate had approximately four times higher amount during a day not monitored, the largest relative day not included during the monitoring period. Three other pesticides (diazinon, ethalfluralin, and trifluralin) were not reported during the monitoring period, but were used during periods not monitored.

Most non-fumigant pesticide use occurred in the agricultural area west of Lompoc, for all pesticides in 2000 (Figure 15) and for the 23 pesticides during the 10-week monitoring period (Figure 16). The locations of all of the applications made during the monitoring study are shown in Figures 17 – 33 for each individual pesticide with use reported during the study.

Figure 10. A summary of the yearly pesticide use (pounds active ingredient) for 1991 – 2000.

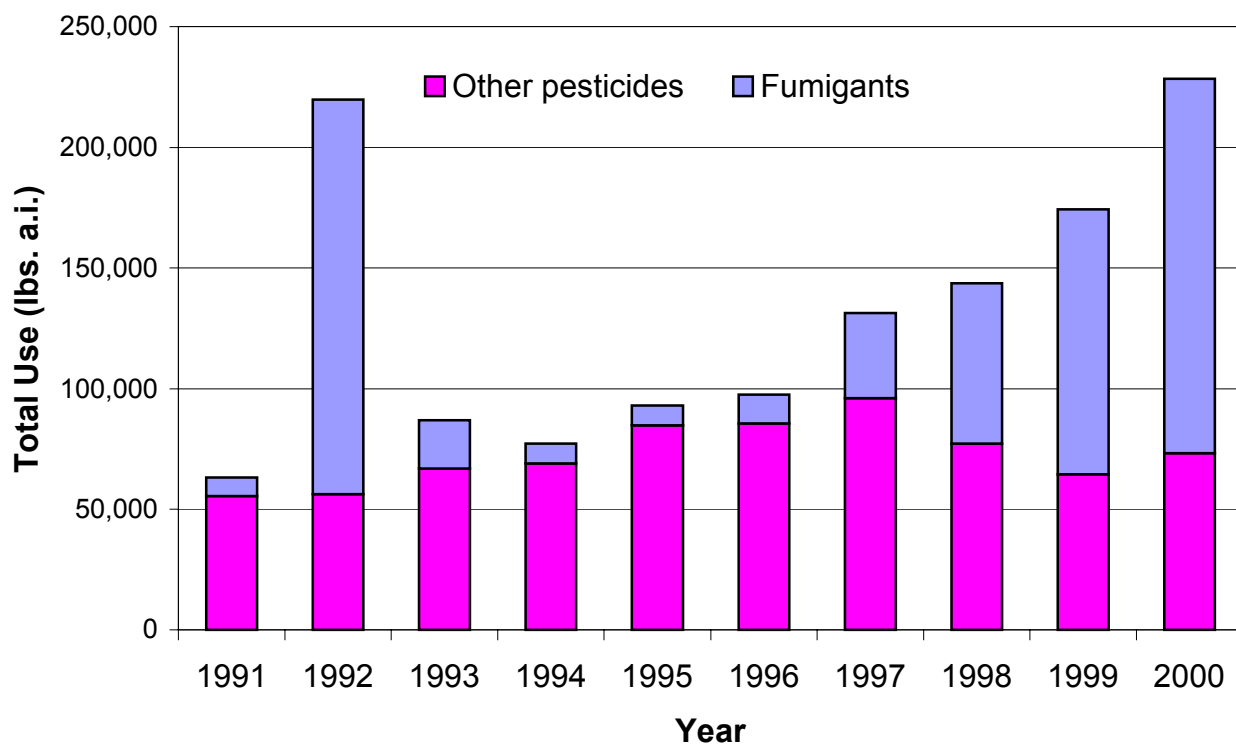


Table 27. Comparison of pounds of active ingredient used for each monitored chemical during the study period to the rest of the year.

Pesticide <sup>a</sup>	Reported Use During Monitoring (lbs. a.i.)	Total Reported Use During Year (lbs. a.i.)	Percent Use During Monitoring Period (percent of total)
Chlorothalonil	190.5	929.2	20.5
Chlorpyrifos	551.1	2201.3	25.0
Chlorthal-dimethyl	172.9	667.6	25.9
Cycloate	45.1	307.3	14.7
Diazinon	0.0	26.1	0.0
Dicloran	706.3	2366.0	29.9
Dicofol	0.0	0.0	0.0
Dimethoate	423.1	1644.0	25.7
EPTC	149.1	149.1	100.0
Ethalfuralin	0.0	267.3	0.0
Fonofos	0.0	0.0	0.0
Iprodione	627.6	2998.3	20.9
Malathion	953.6	2533.1	37.6
Mefenoxam	57.7	255.7	22.6
Metolachlor	138.5	138.5	100.0
Naled	112.2	353.8	31.7
Oxydemeton-methyl	329.2	1559.9	21.1
PCNB	259.8	1067.4	24.3
Permethrin	265.0	1095.1	24.2
Propyzamide	758.9	2839.2	26.7
Simazine	0.0	0.0	0.0
Trifluralin	0.0	119.6	0.0
Vinclozolin	436.7	1835.2	23.8
Total	6177.4	23353.6	26.5

Figure 11. Comparison of pesticide use during the monitoring period (May 31 – August 3) to the rest of 2000 for the pesticides monitored.

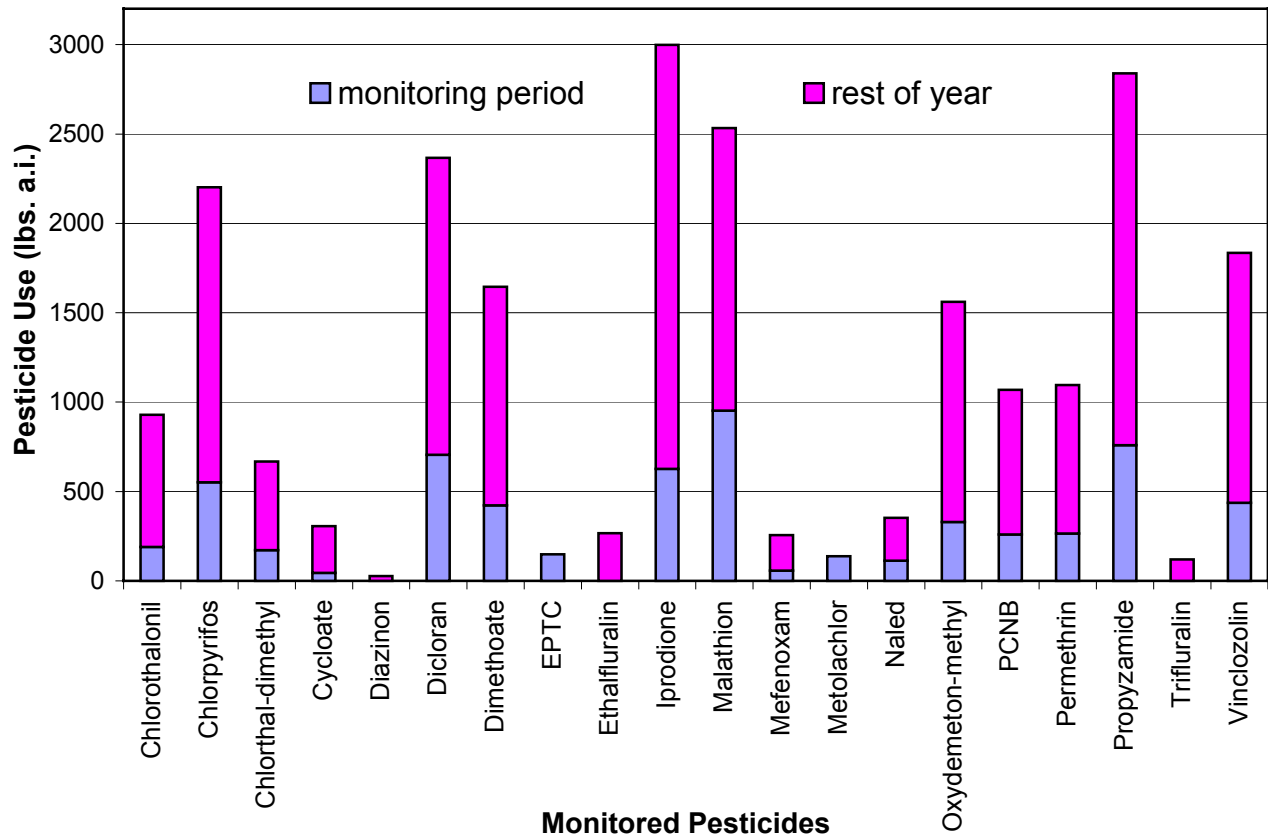


Table 28. Monthly use of the monitored pesticides for 2000.

Pesticide	January	February	March	April	May	June	July	August	September	October	November	December	Total
Chlorothalonil	8.5	3.6	21.4	38.9	37.0	54.8	135.7	66.1	168.7	164.8	206.3	23.2	929.2
Chlorpyrifos	74.8	80.0	165.3	237.4	228.4	267.5	190.3	370.3	243.8	113.6	99.1	71.7	2142.1
Chlorthal-Dimethyl	90.0		135.9	119.4	138.9	106.9	66.0				10.5		667.6
Cycloate	18.8	10.9	20.3	13.5	12.8	25.2	19.9	20.1	43.2	49.2	57.9	15.4	307.3
Diazinon	1.0								9.5		15.6		26.1
Dicloran		6.5	45.0	195.7	246.8	302.7	330.6	482.6	611.2	87.5		57.4	2366.0
Dicofol													0.0
Dimethoate	10.9	47.2	111.0	66.2	151.1	230.1	156.4	291.7	309.5	171.0	50.4	48.5	1644.0
EPTC						149.1							149.1
Ethalfuralin					259.7								259.7
Fonofos													0.0
Iprodione	50.5	283.2	509.9	164.4	302.7	328.1	287.5	335.8	444.4	229.0	39.9	22.8	2998.3
Malathion	34.8	180.7	202.1	203.8	379.4	353.1	600.4	98.5	258.6	204.4	6.0	11.3	2533.1
Mefenoxam	33.8		18.0	11.3	6.5	23.5	34.3	54.7	35.5	0.5	3.1	34.5	255.7
Metolachlor						138.5							138.5
Naled	5.4		12.7	25.5	20.1	46.7	65.5	37.1	115.3	25.4			353.8
Oxydemeton-Methyl	4.2	32.6	199.2	232.7	222.6	179.8	132.6	134.2	212.0	123.8	53.2	32.8	1559.9
PCNB	94.3		192.2	29.3	78.4	195.3	64.6	359.2	20.8				1034.0
Permethrin	4.1	22.3	45.8	85.5	93.8	141.6	101.2	146.8	229.0	167.7	51.9	5.2	1094.9
Propyzamide	234.9	130.0	175.5	330.8	436.5	309.8	399.4	361.5	37.1	54.2	155.2	251.2	2876.1
Simazine													0.0
Trifluralin				66.9	52.7								119.6
Vinclozolin	185.0	10.8	28.0	119.5	258.3	199.1	237.6	277.0	217.0	167.4	122.6	13.0	1835.2
Total	851.0	807.8	1882.3	1940.9	2925.7	3051.8	2822.0	3035.7	2955.7	1558.7	871.7	587.1	23290.3
1996 – 1998 Average	1504	1584	2276	2391	3944	3770	4053	4077	2817	1828	1227	1154	30625

Figure 12. Monthly pesticide use (pounds active ingredient) of the monitored pesticides, fumigants and all others.

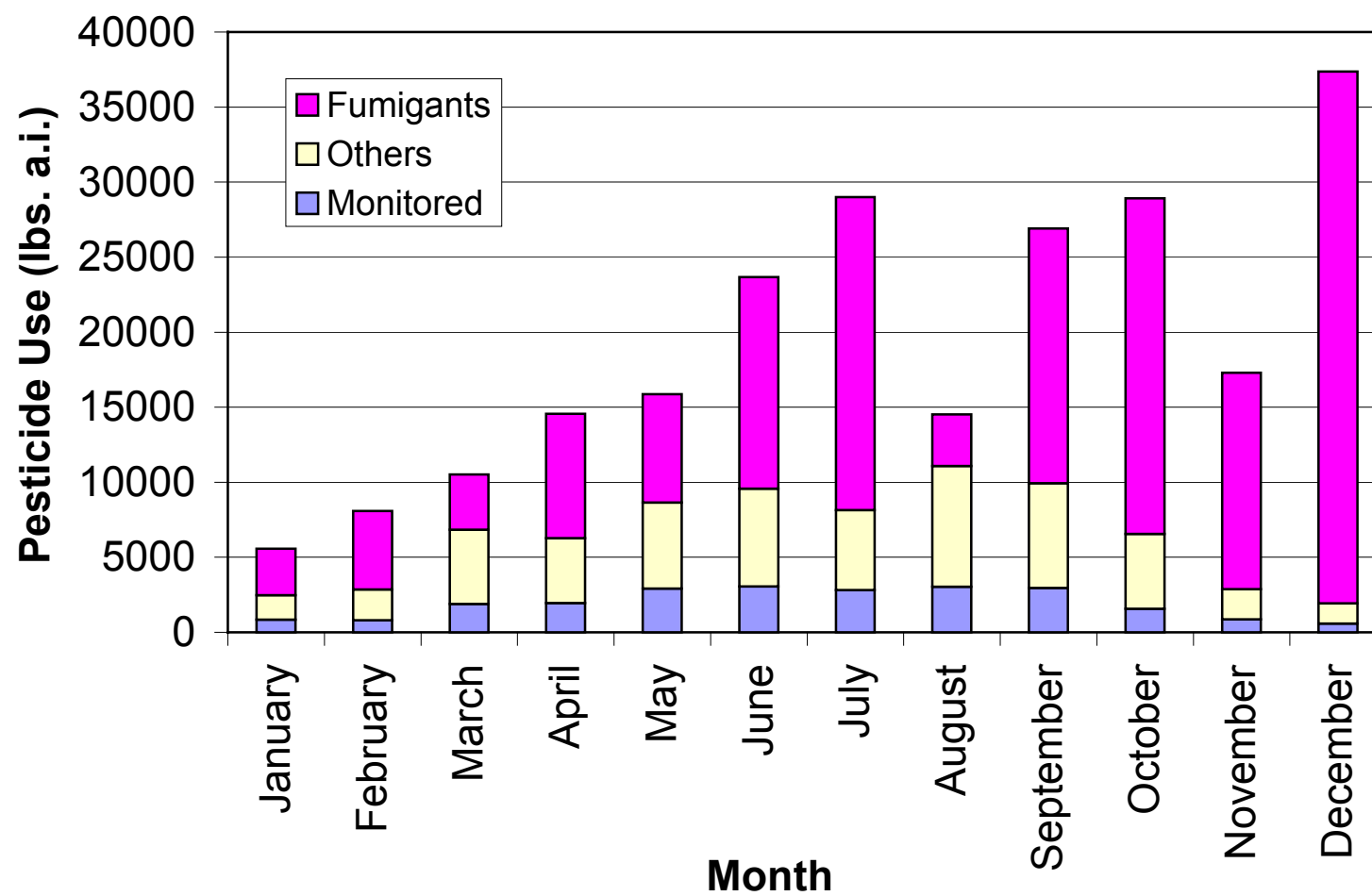


Figure 13a. Monthly pesticide use for monitored chemicals.

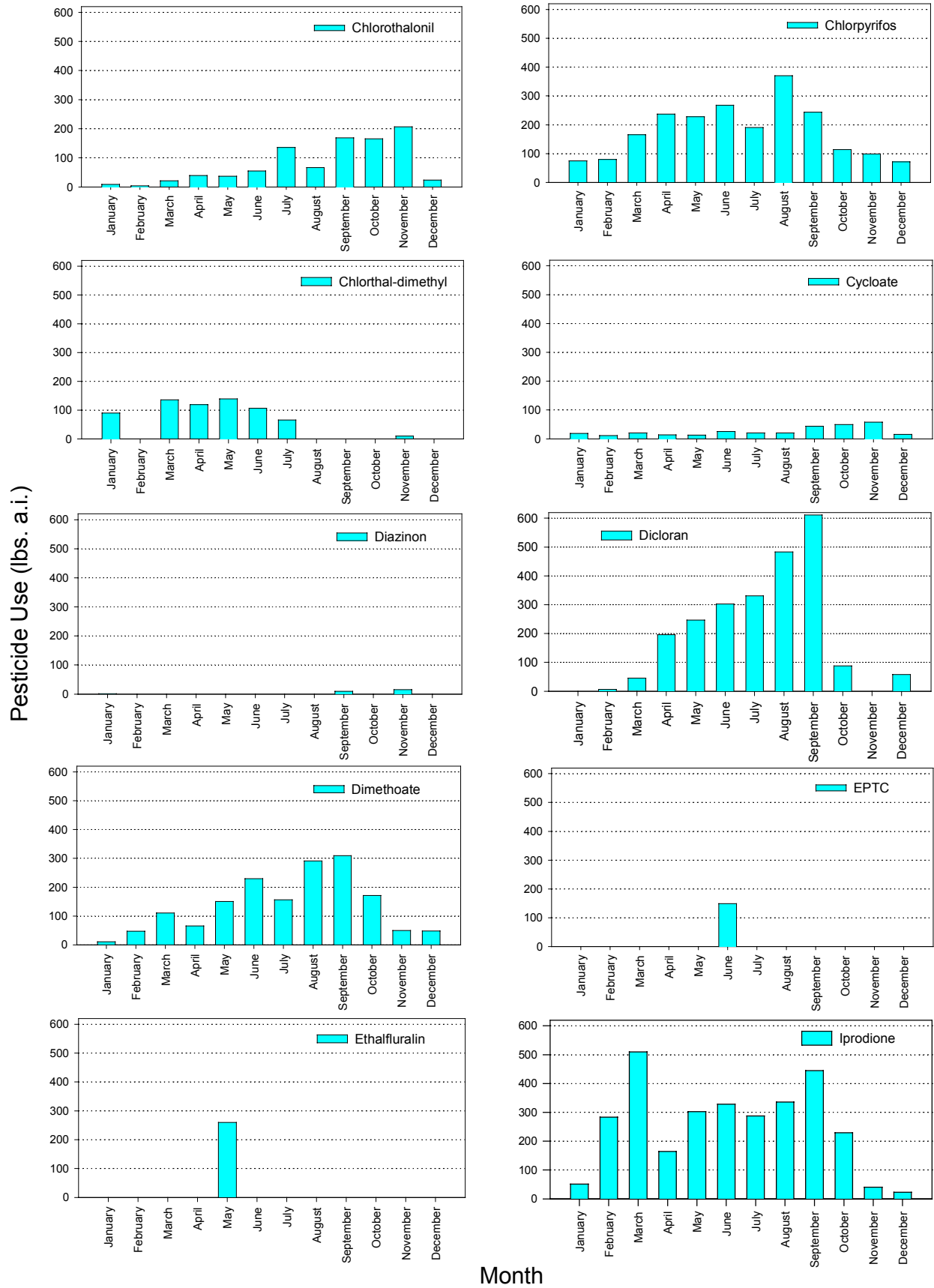




Figure 13b. Monthly pesticide use for monitored chemicals. (cont.)

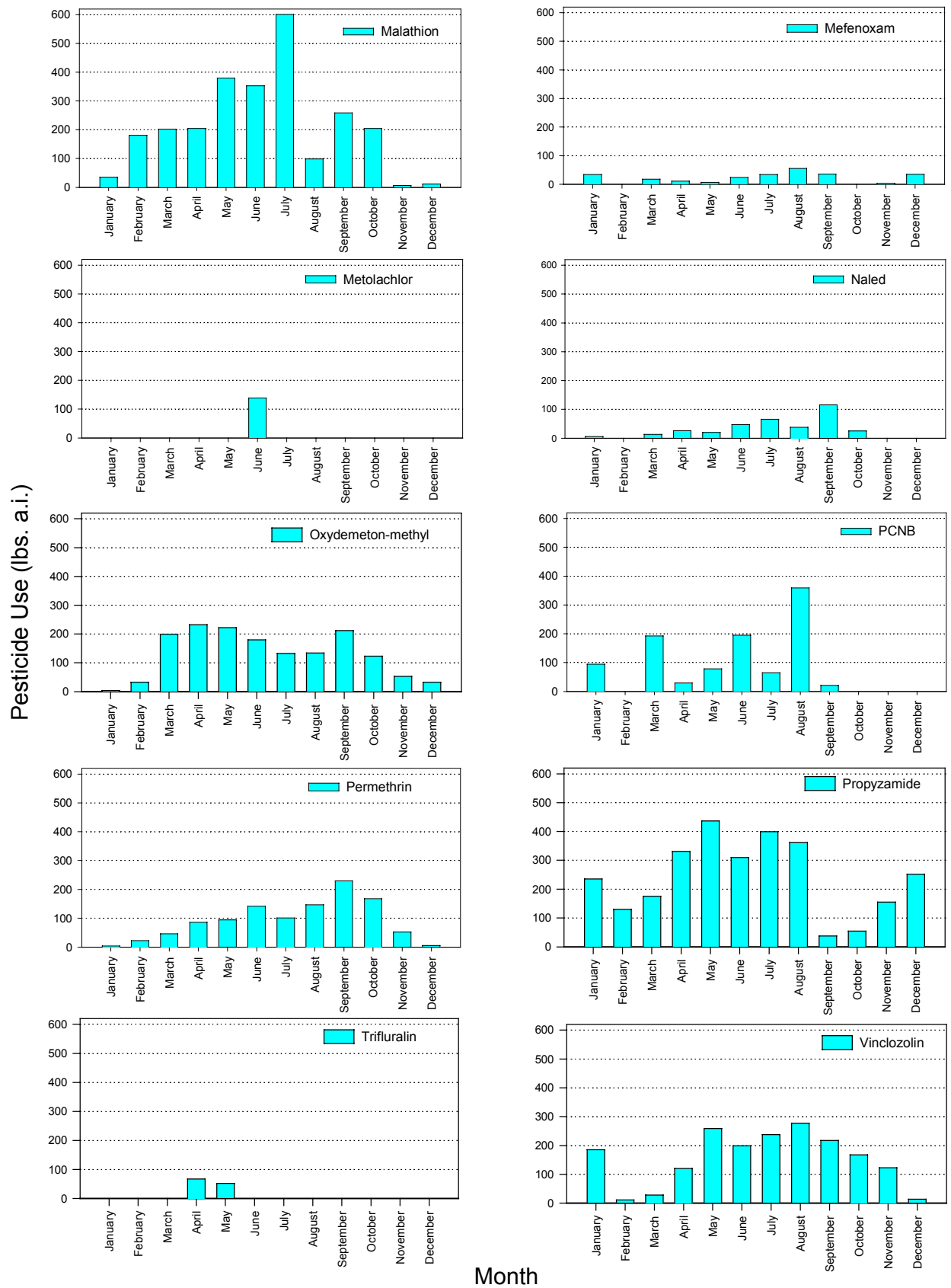


Figure 14. Number of detections for each sampling day and total pesticide use.

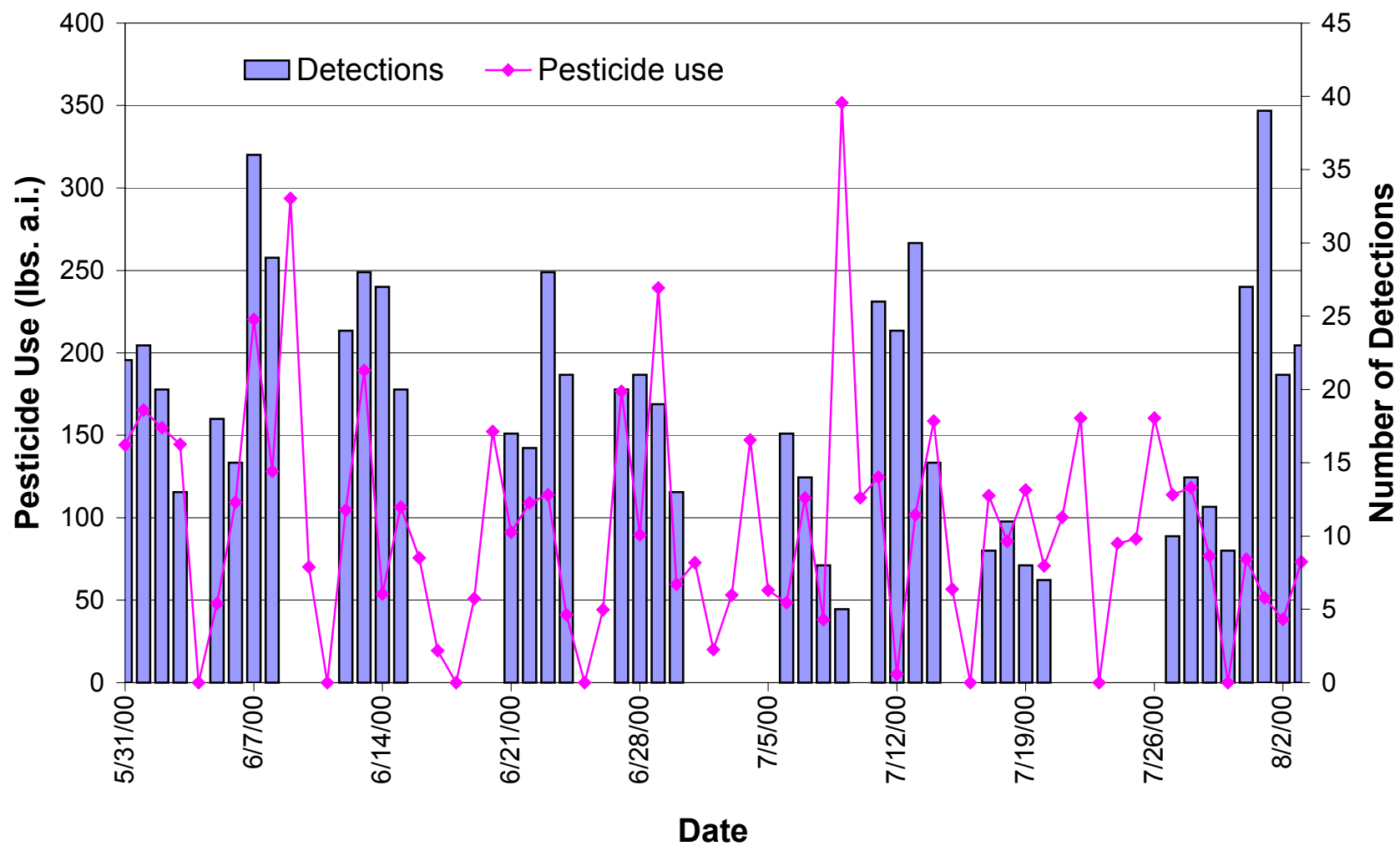


Figure 15a. Reported daily pesticide use and highest concentrations detected for each sampling day.

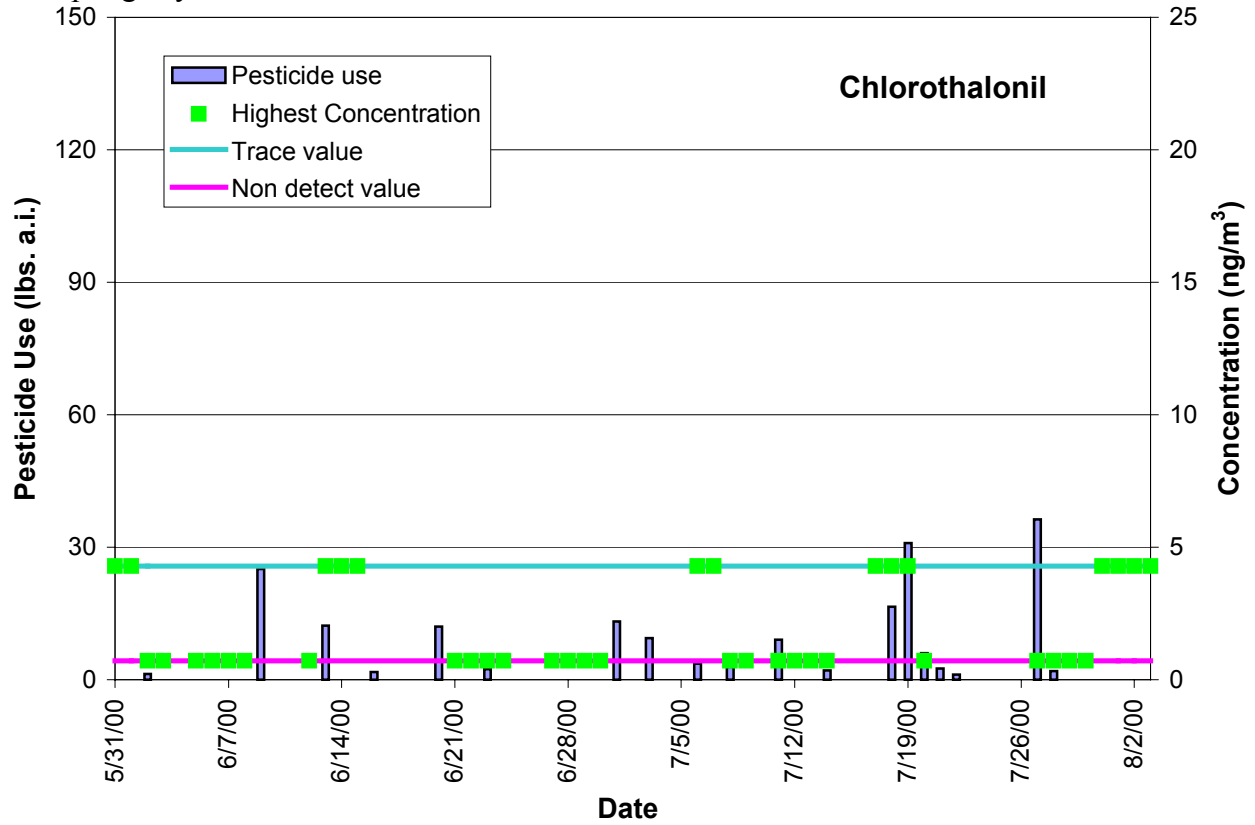


Figure 15b.

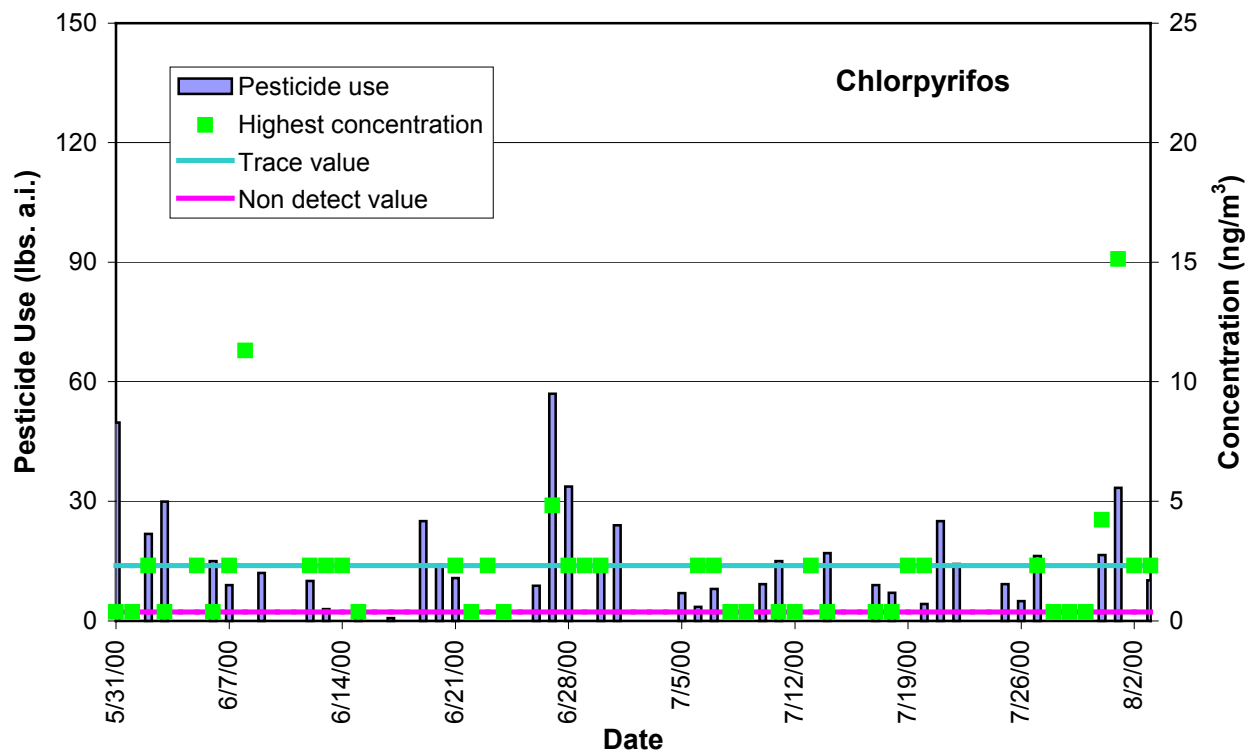


Figure 15c. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.).

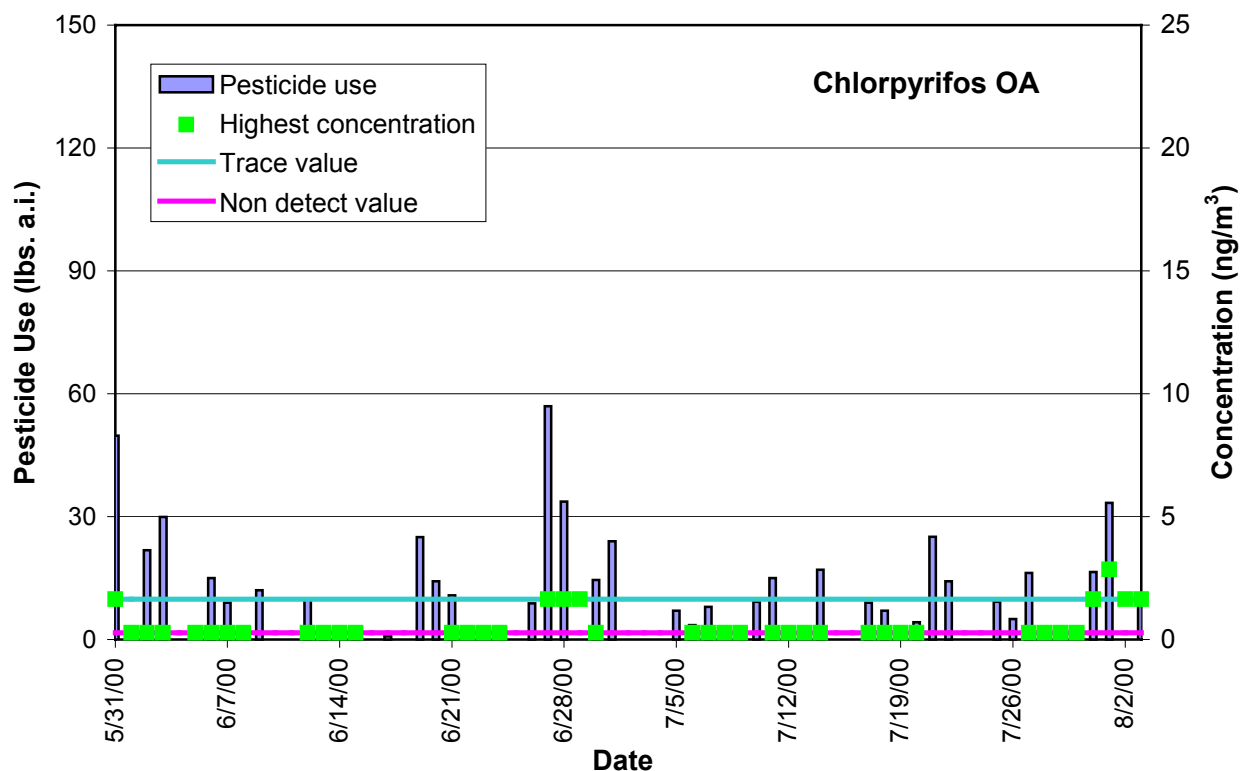


Figure 15d.

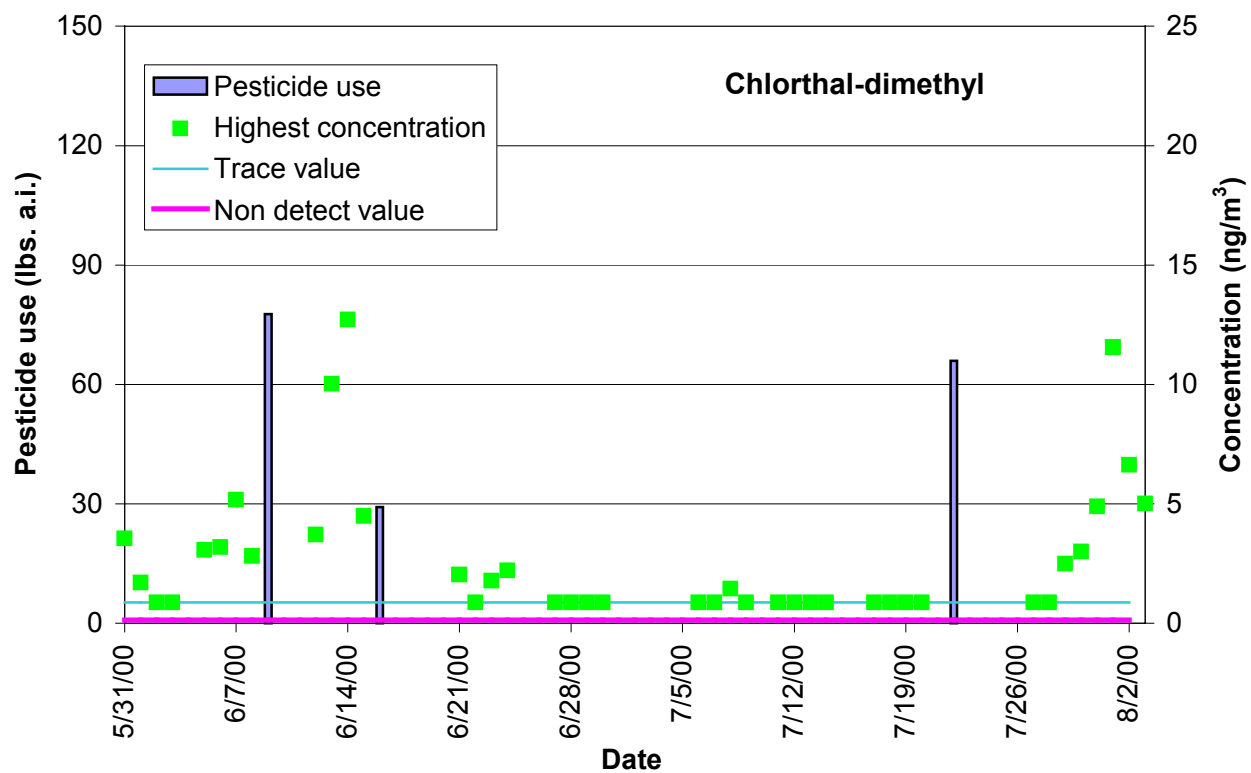


Figure 15e. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.).

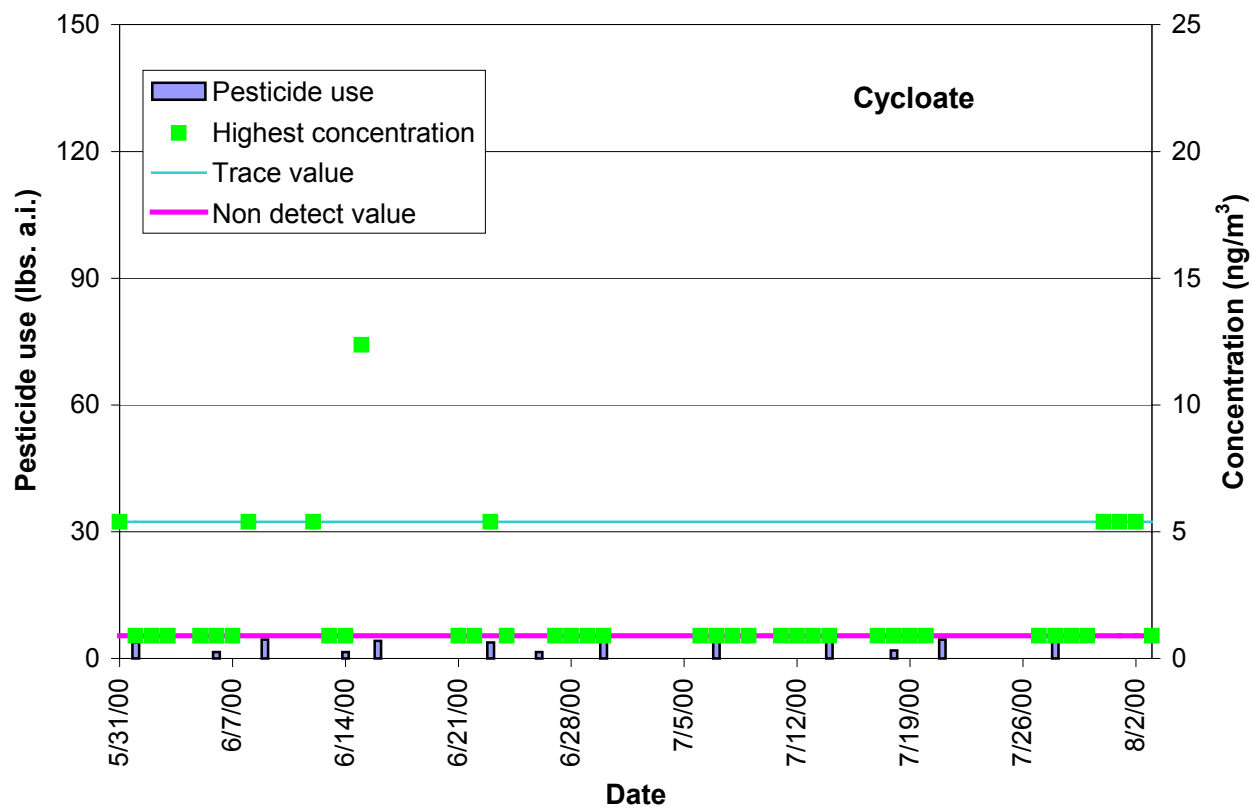


Figure 15f.

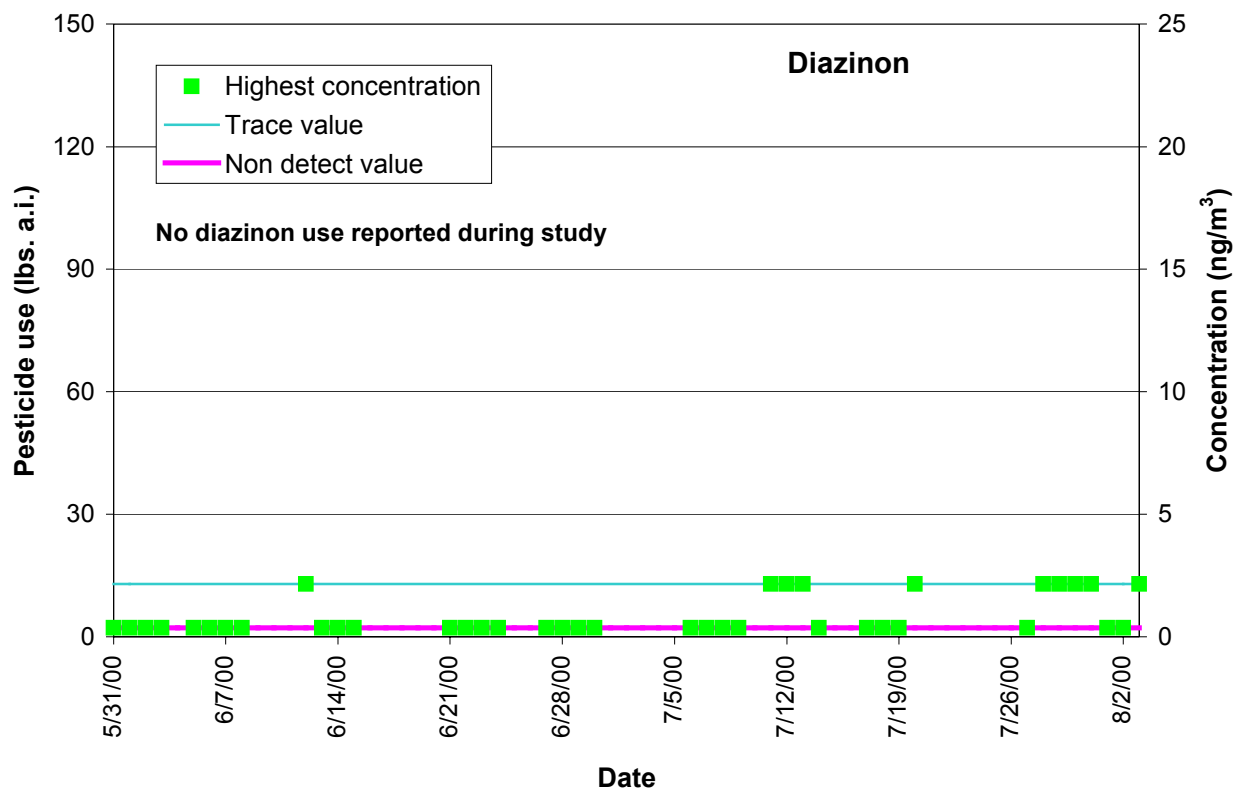


Figure 15g. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.).

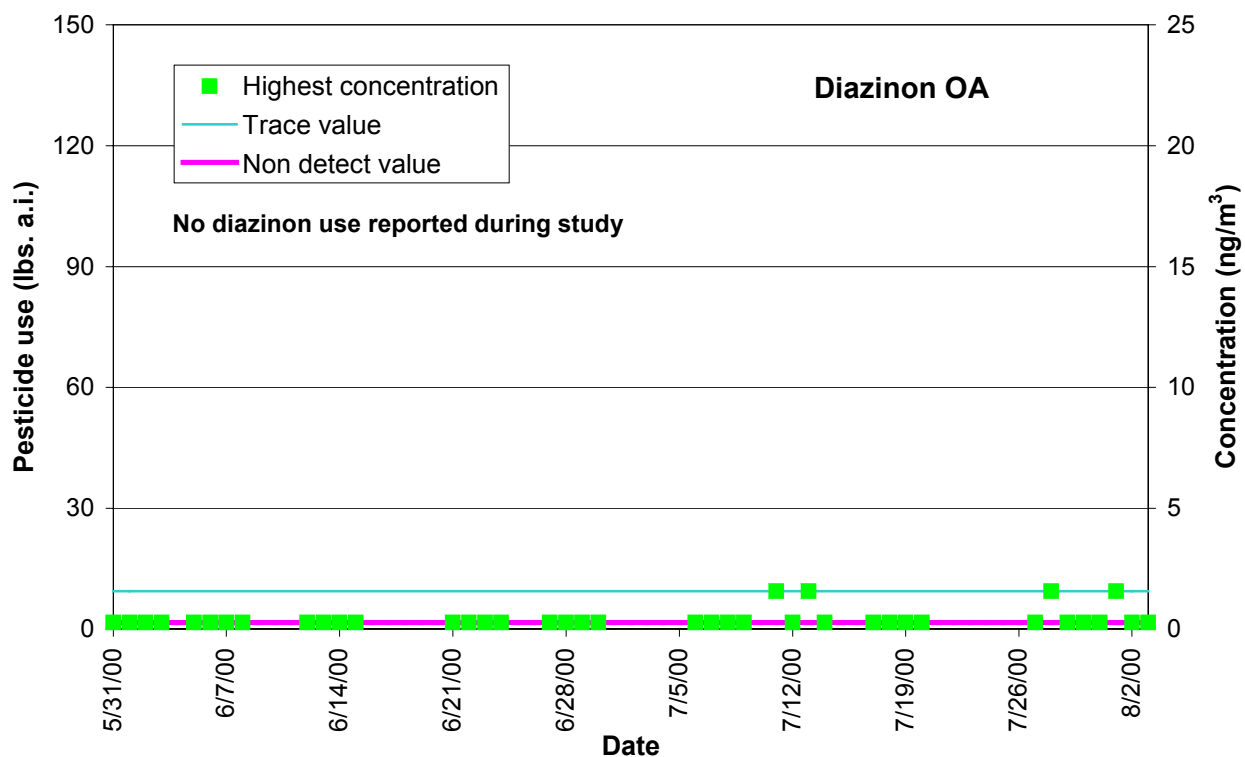


Figure 15h.

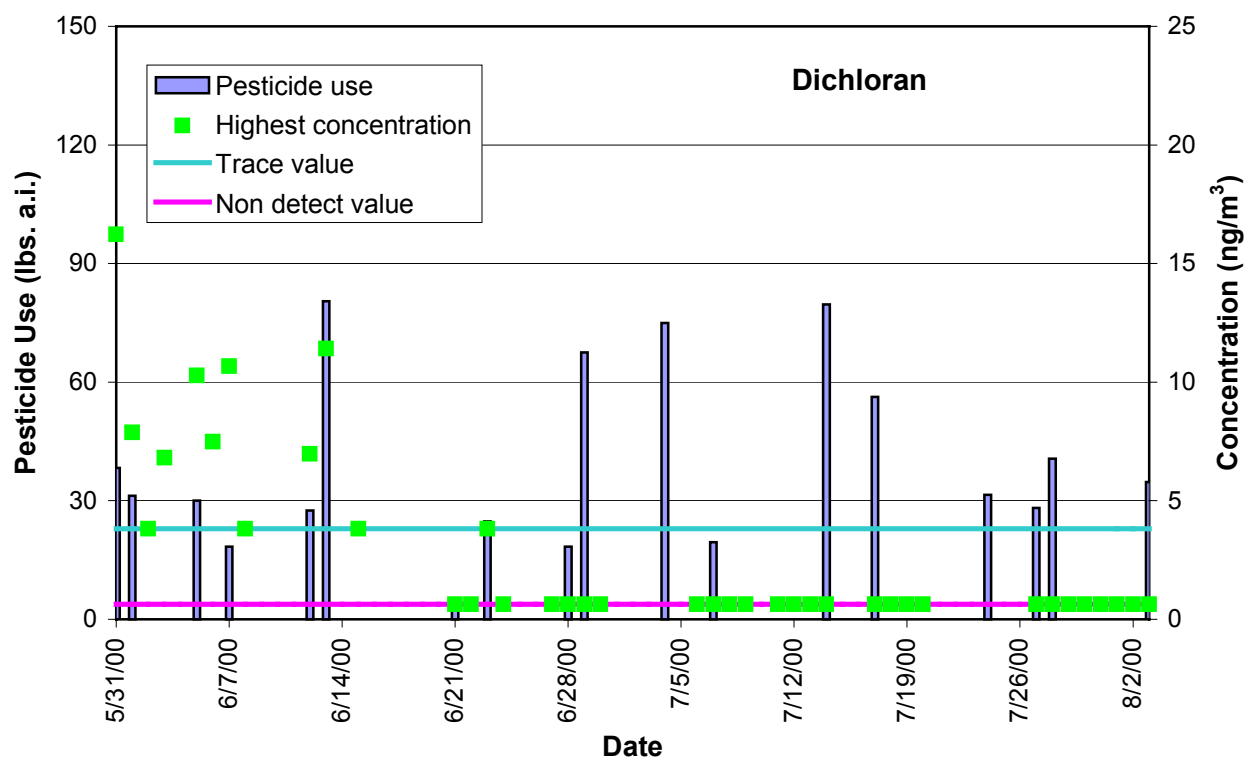


Figure 15i. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.).

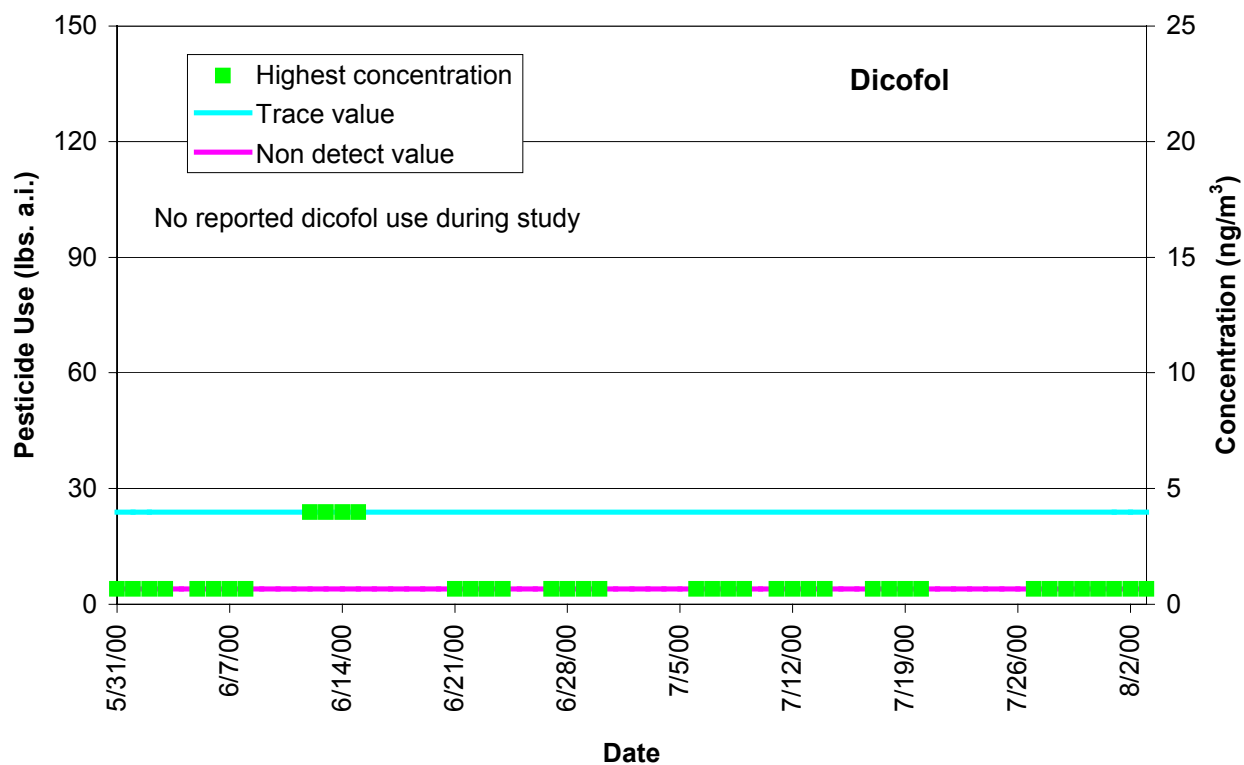


Figure 15j.

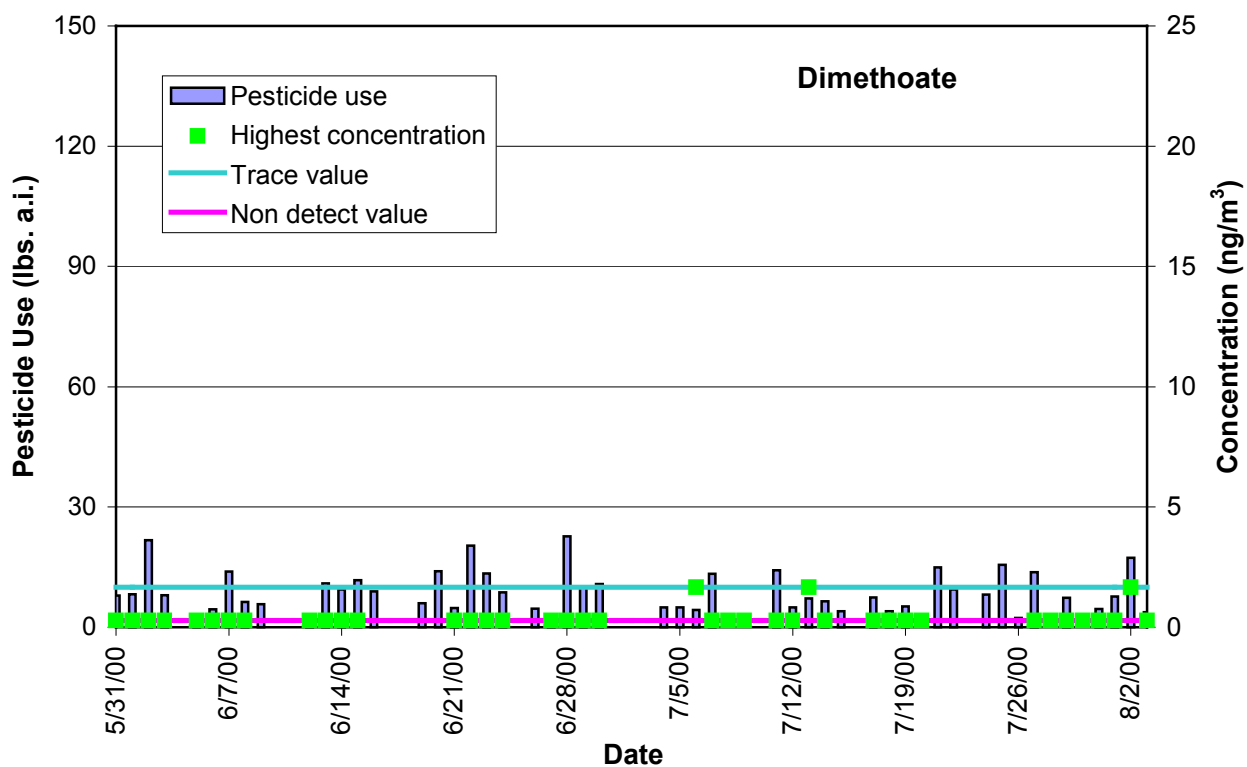


Figure 15k. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.).

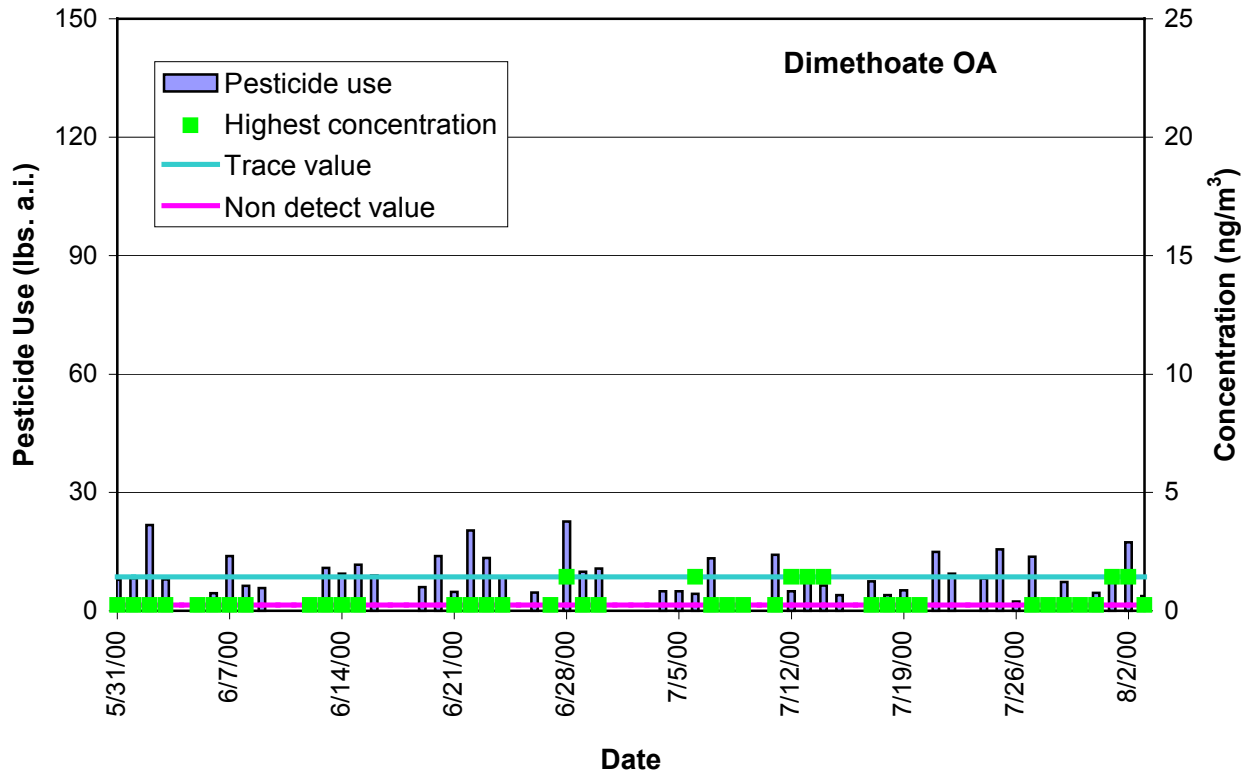


Figure 15l.

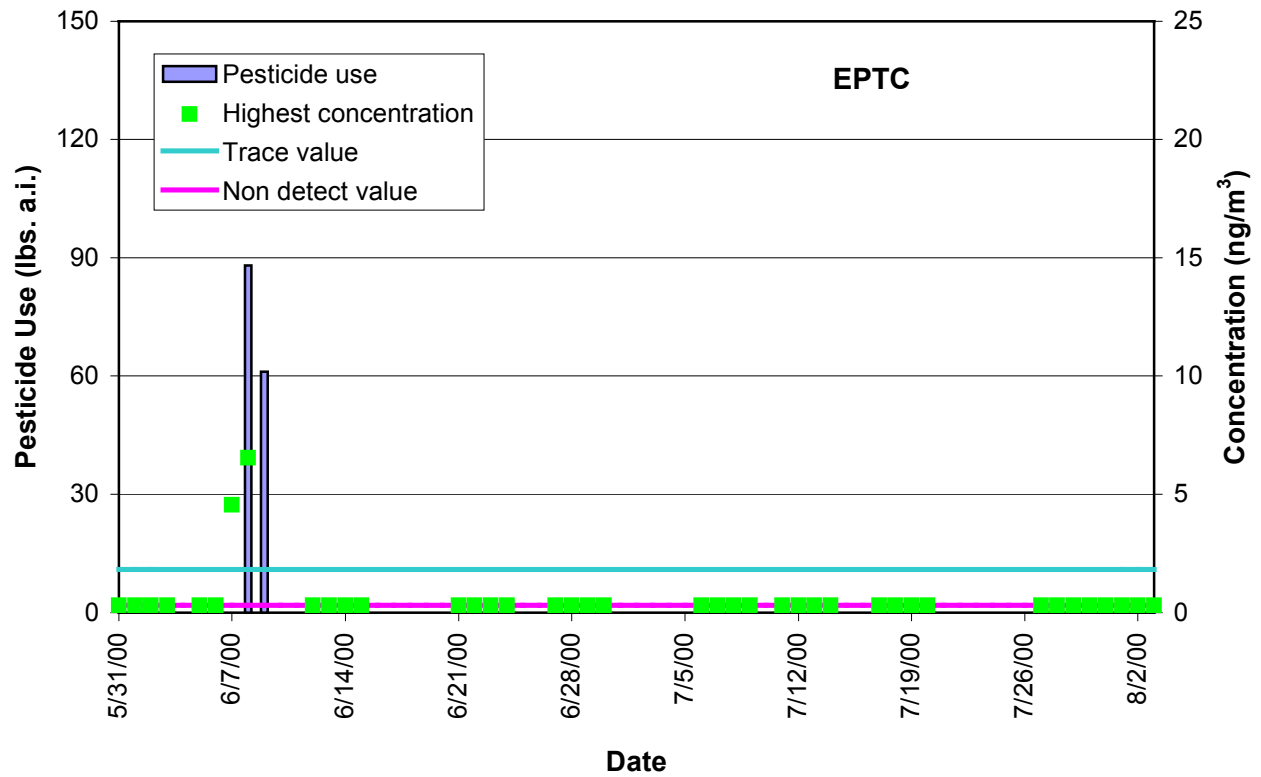




Figure 15m. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.).

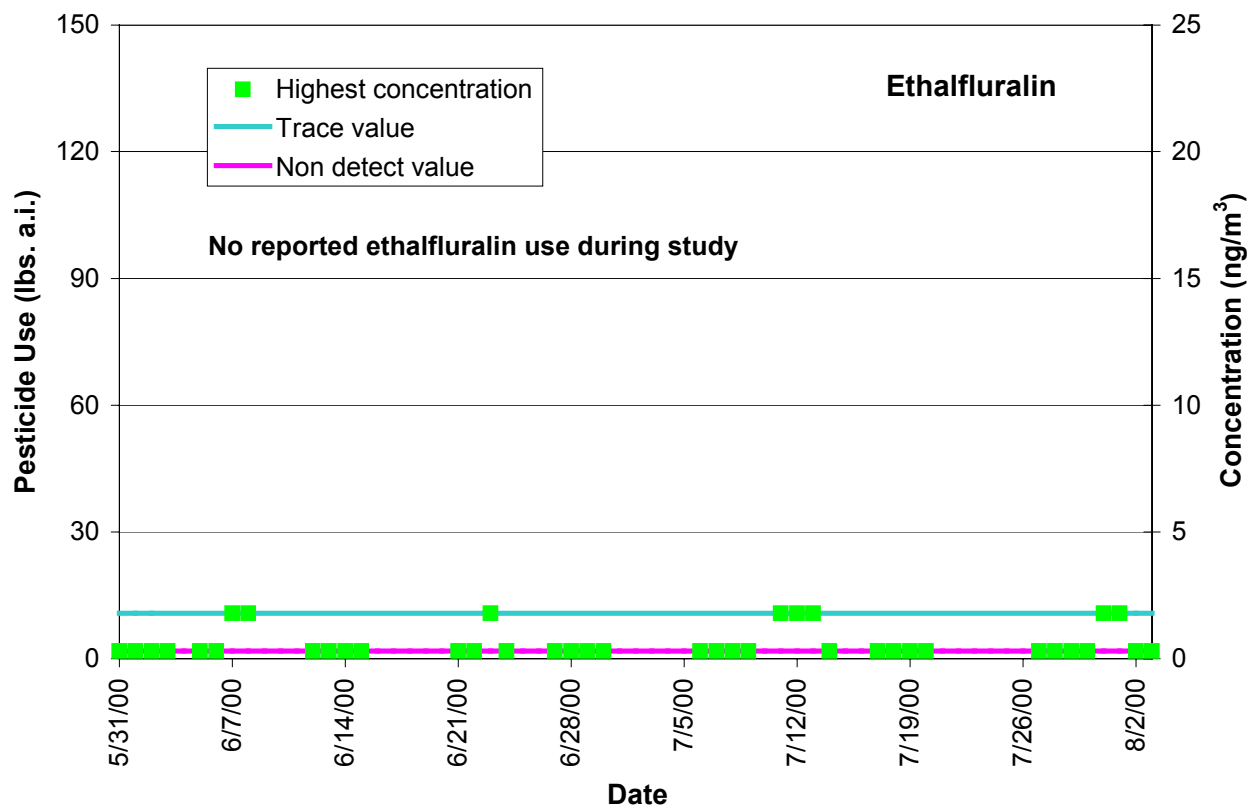


Figure 15n.

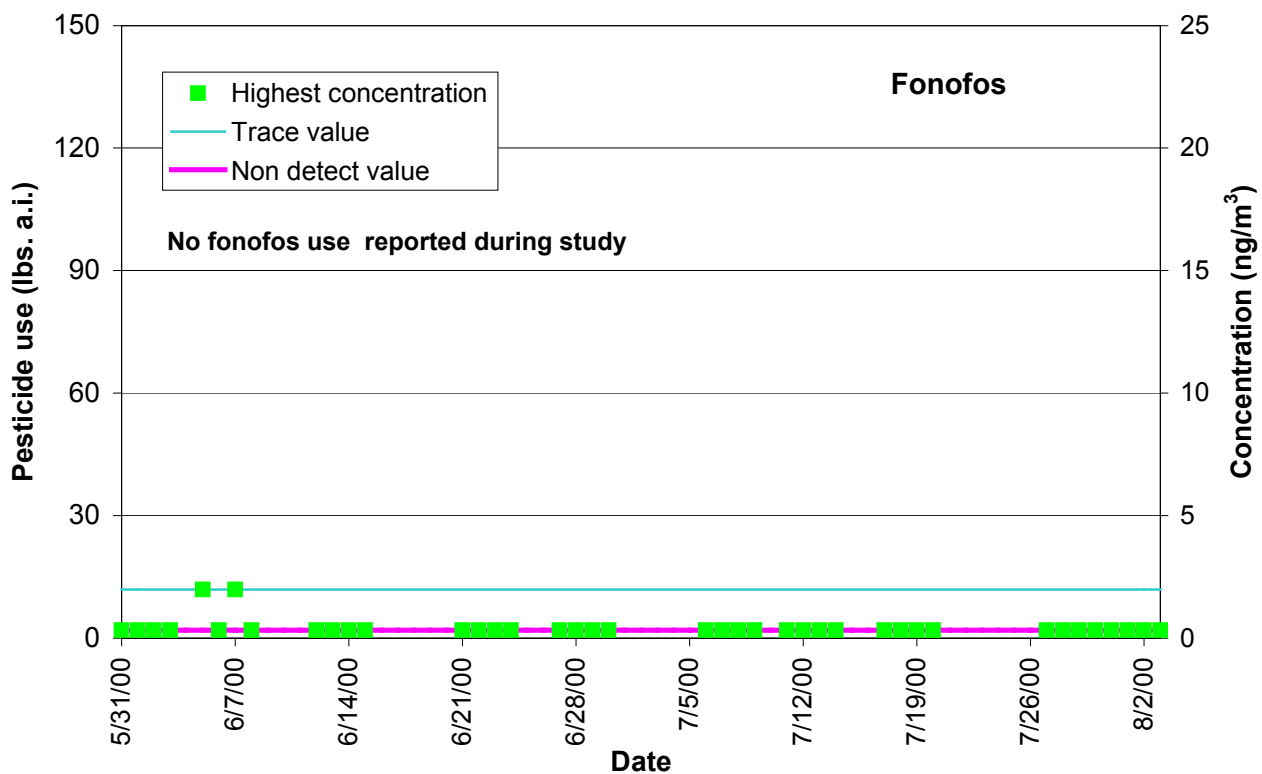


Figure 15o. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.).

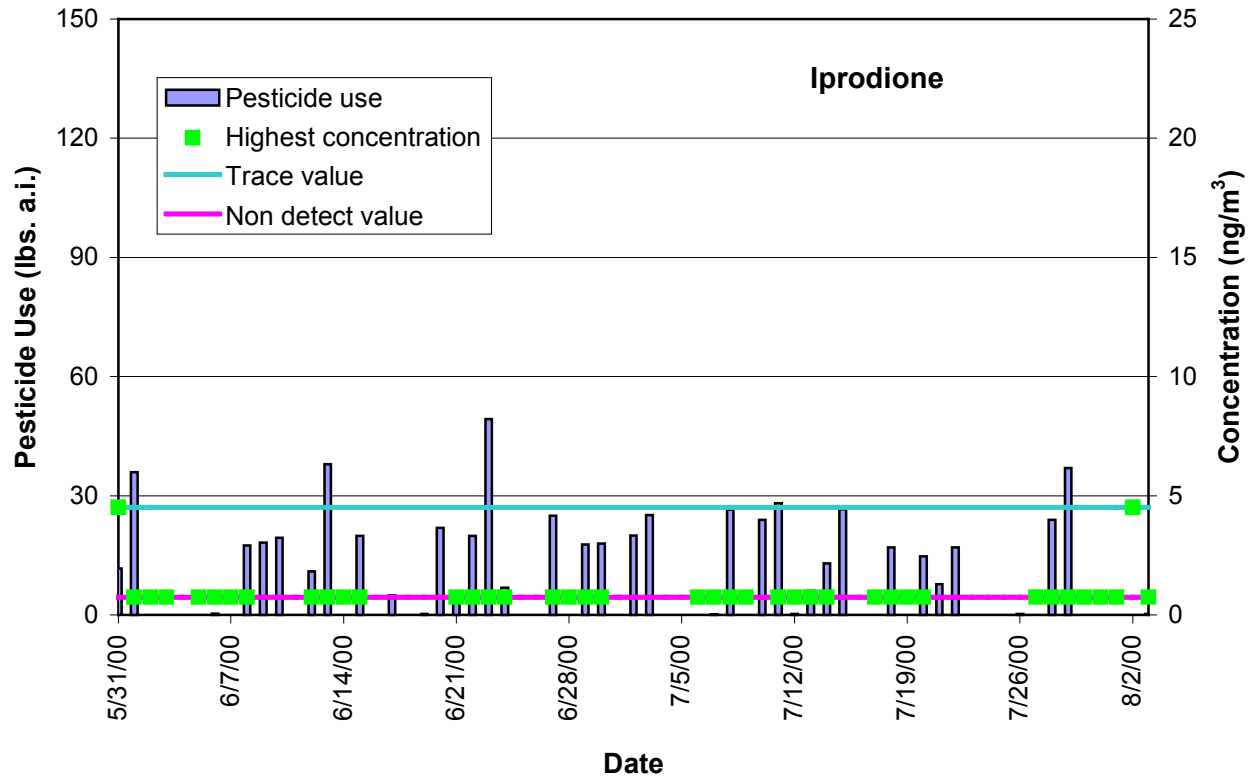


Figure 15p. (scale for malathion pesticide use is larger)

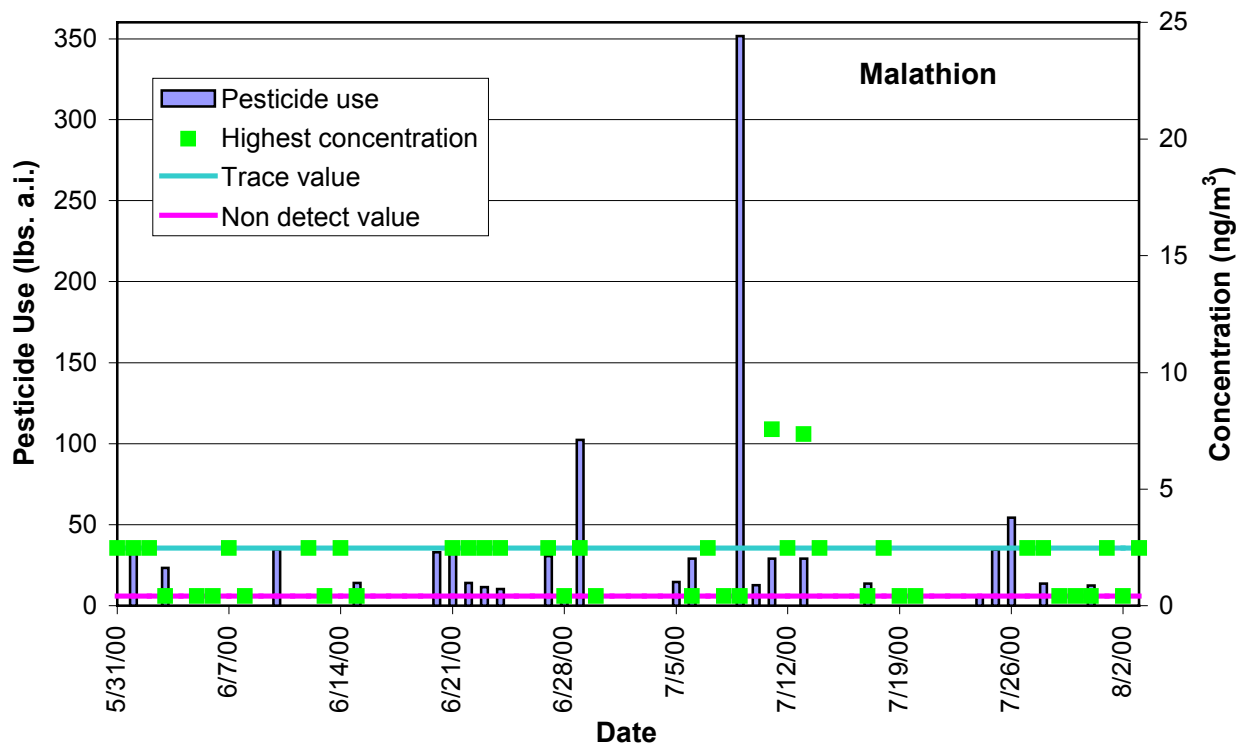


Figure 15q. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.). (scale for malathion pesticide use is larger)

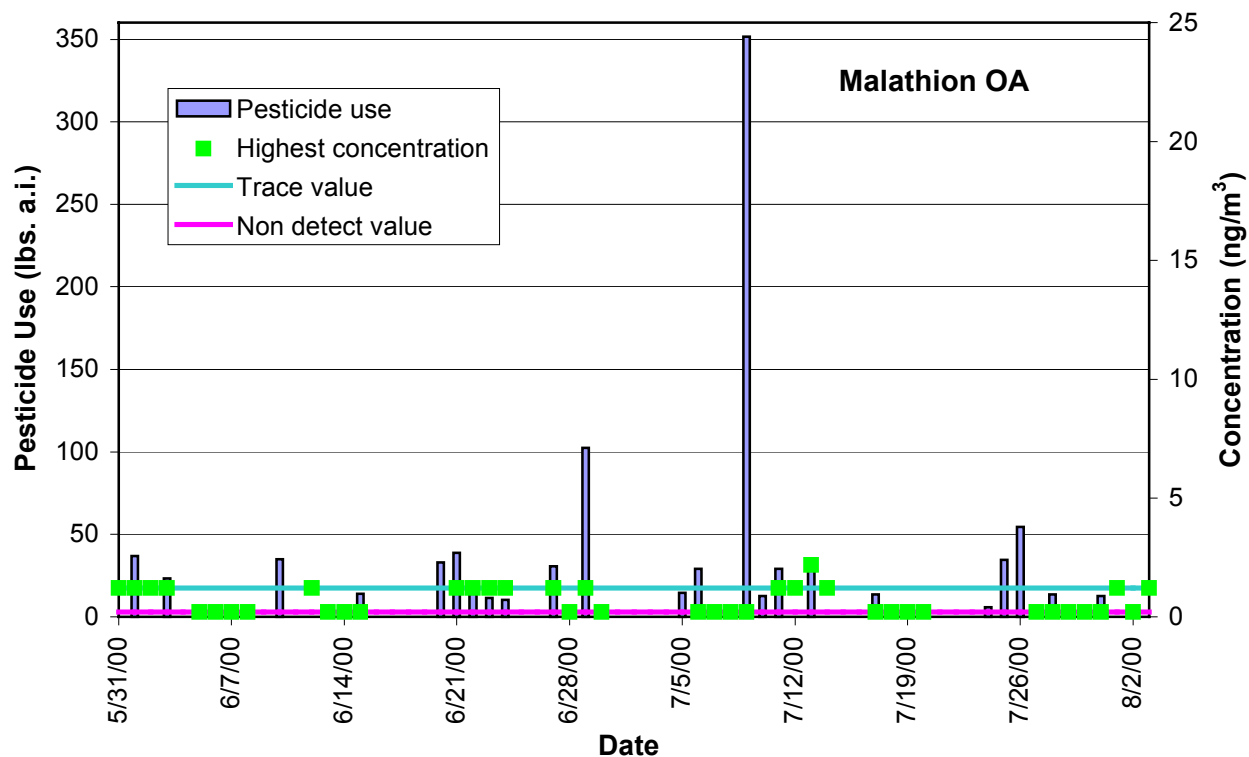


Figure 15r.

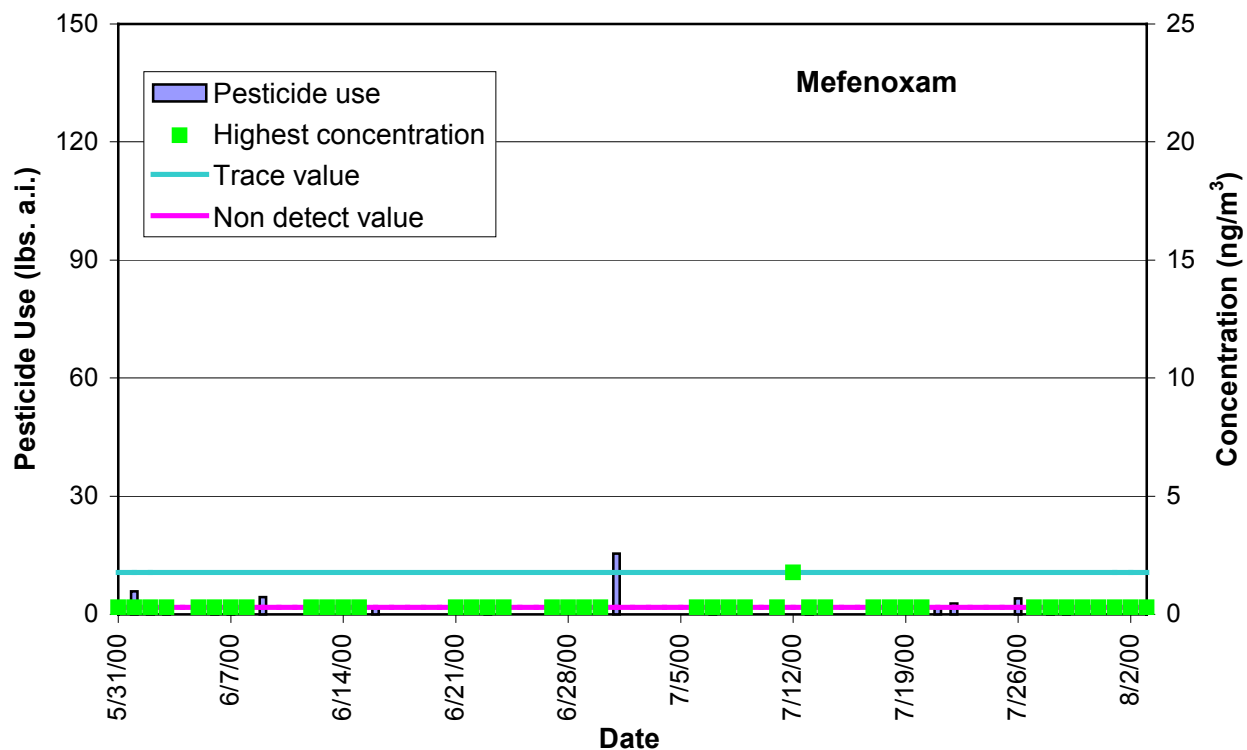


Figure 15s. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.).

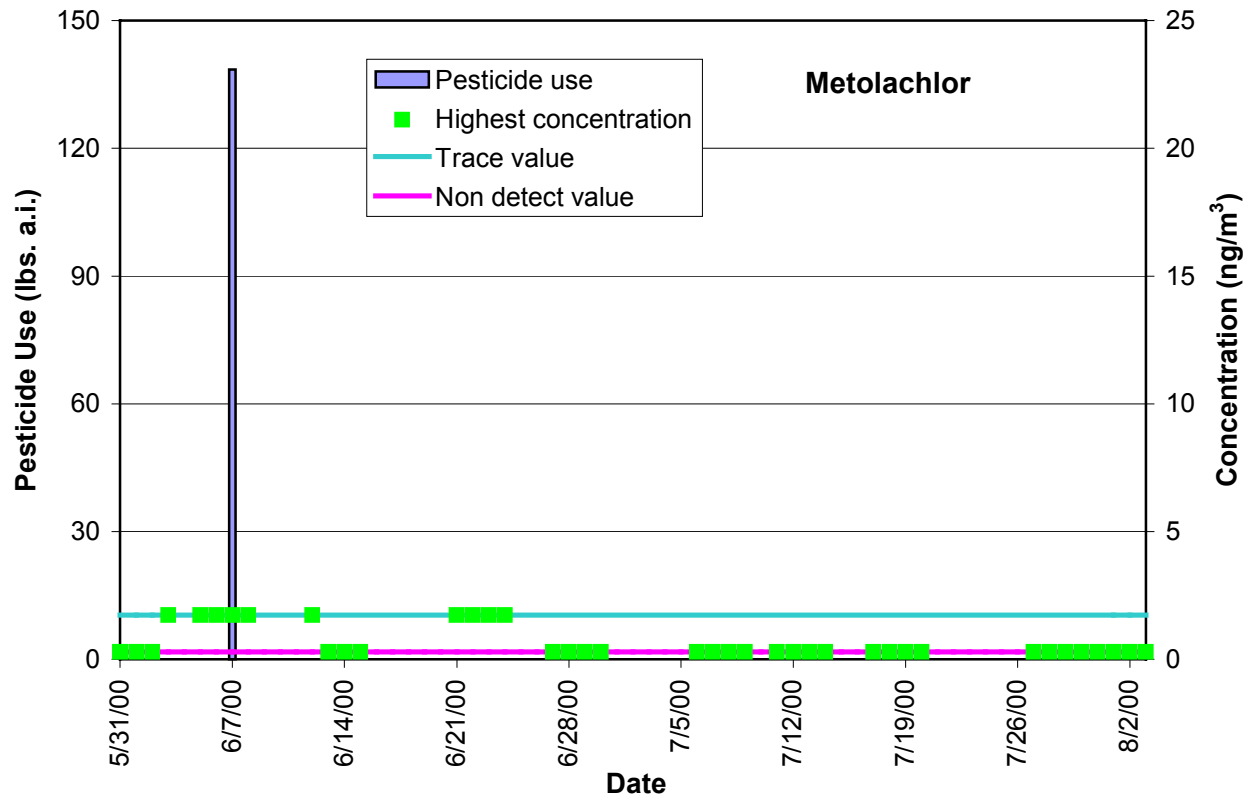


Figure 15t.

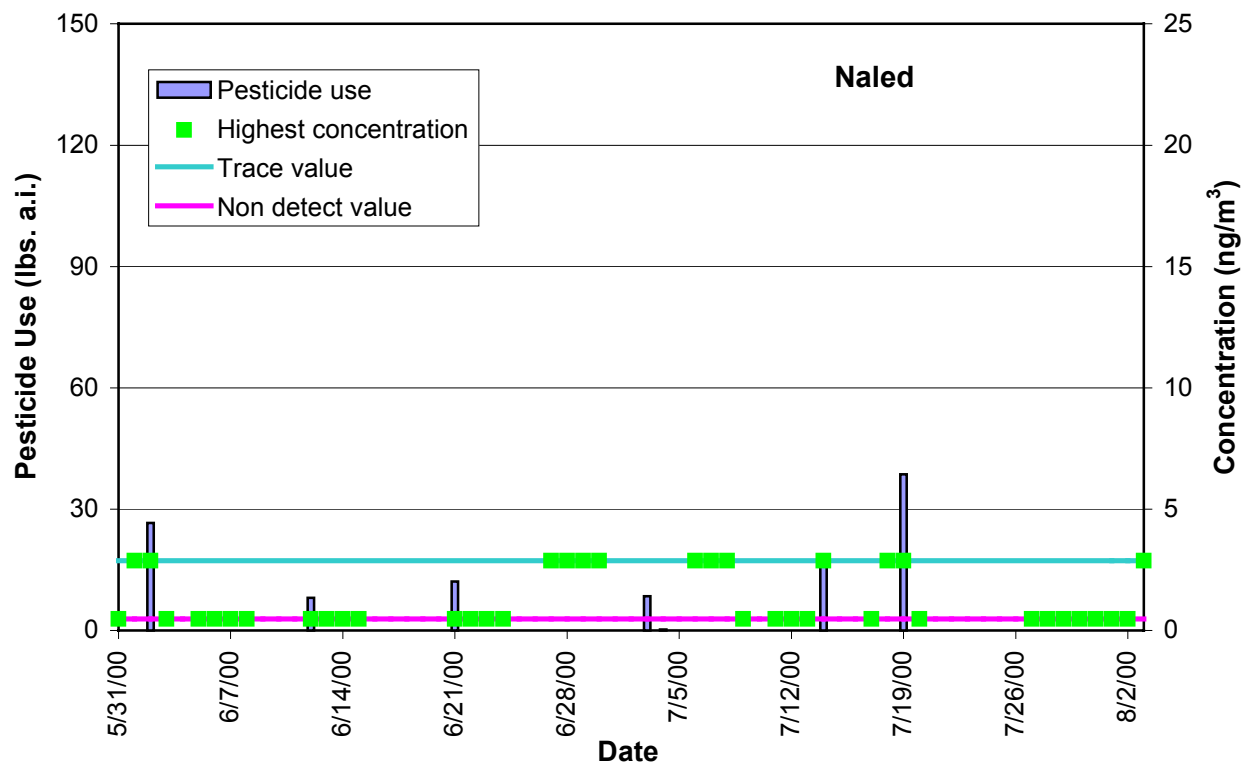


Figure 15u. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.).

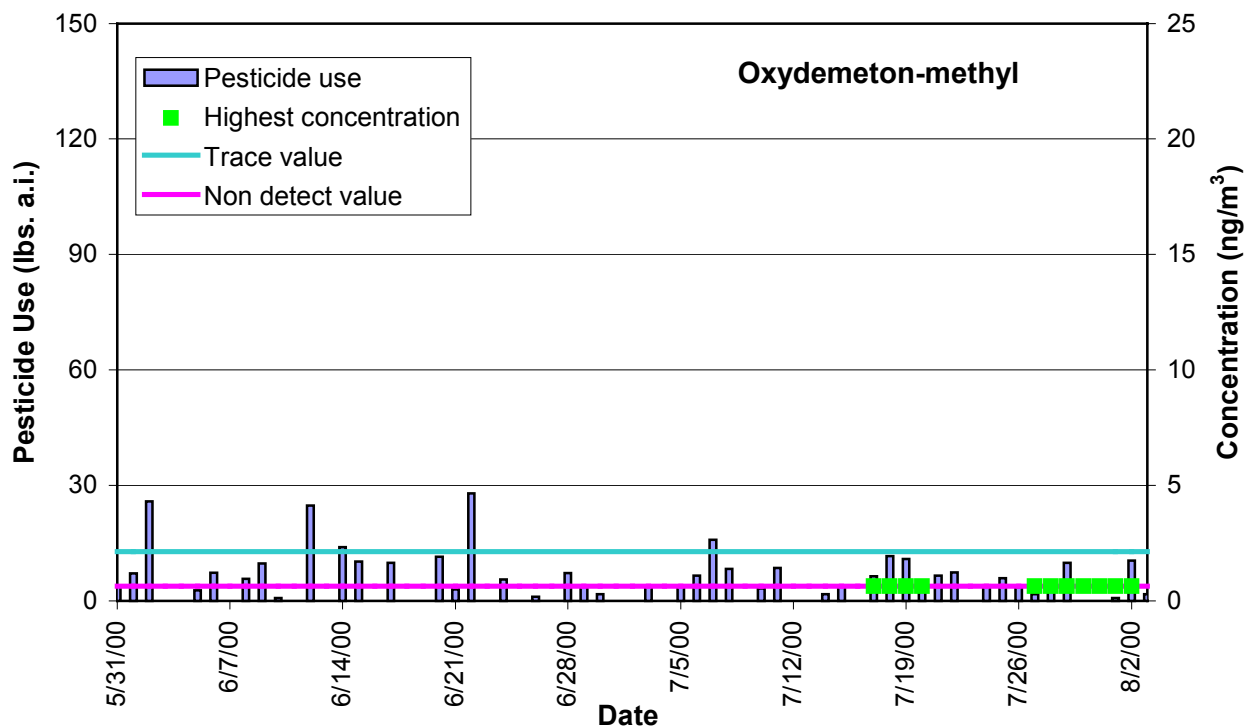


Figure 15v.

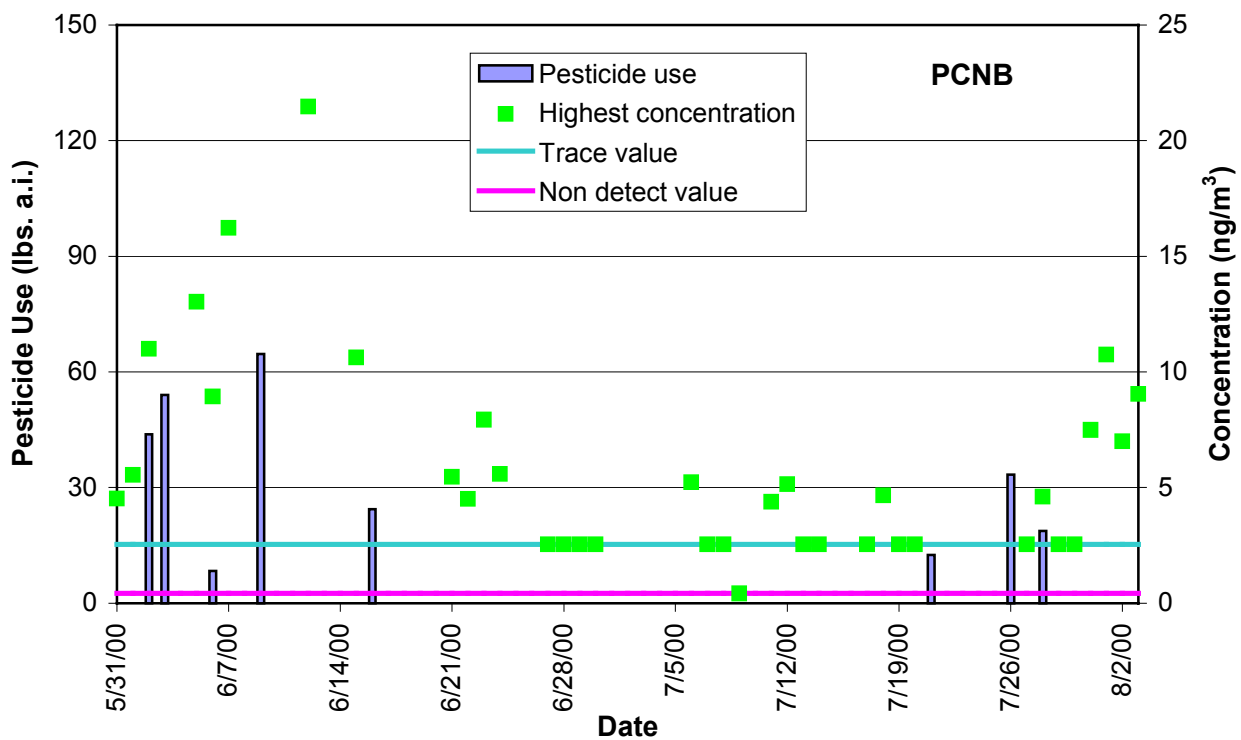


Figure 15w. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.).

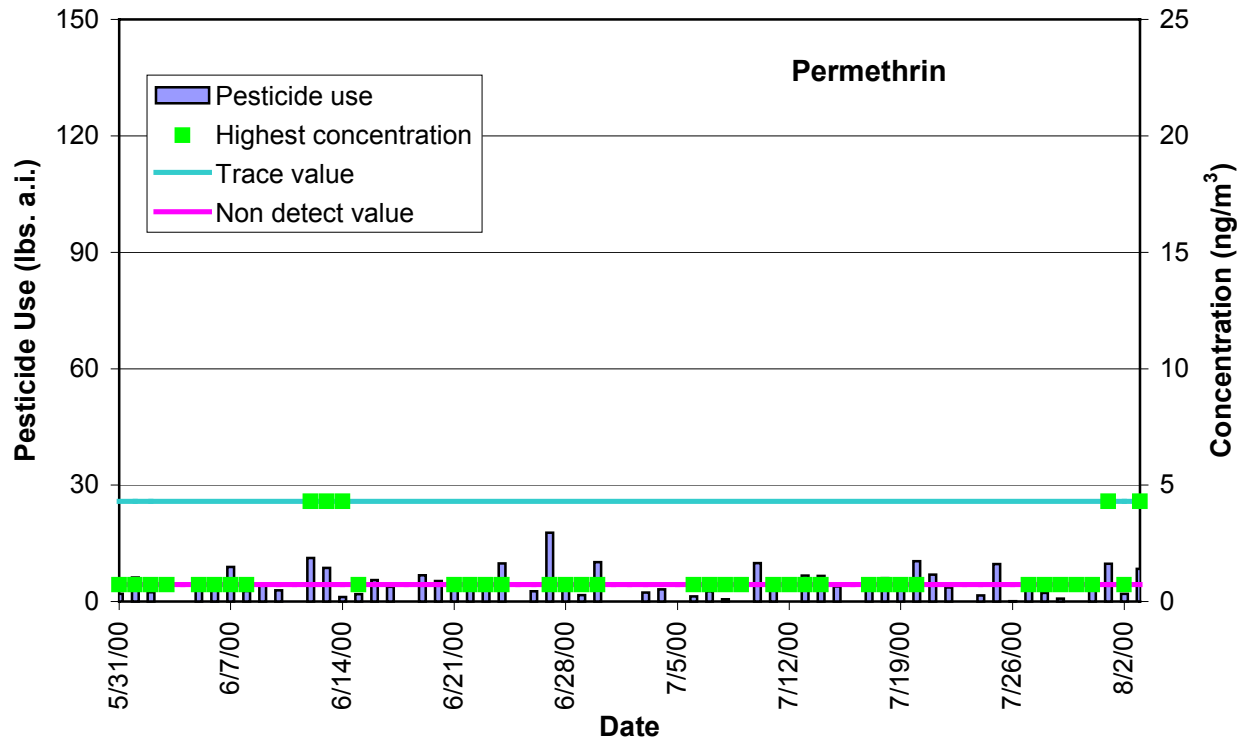


Figure 15x.

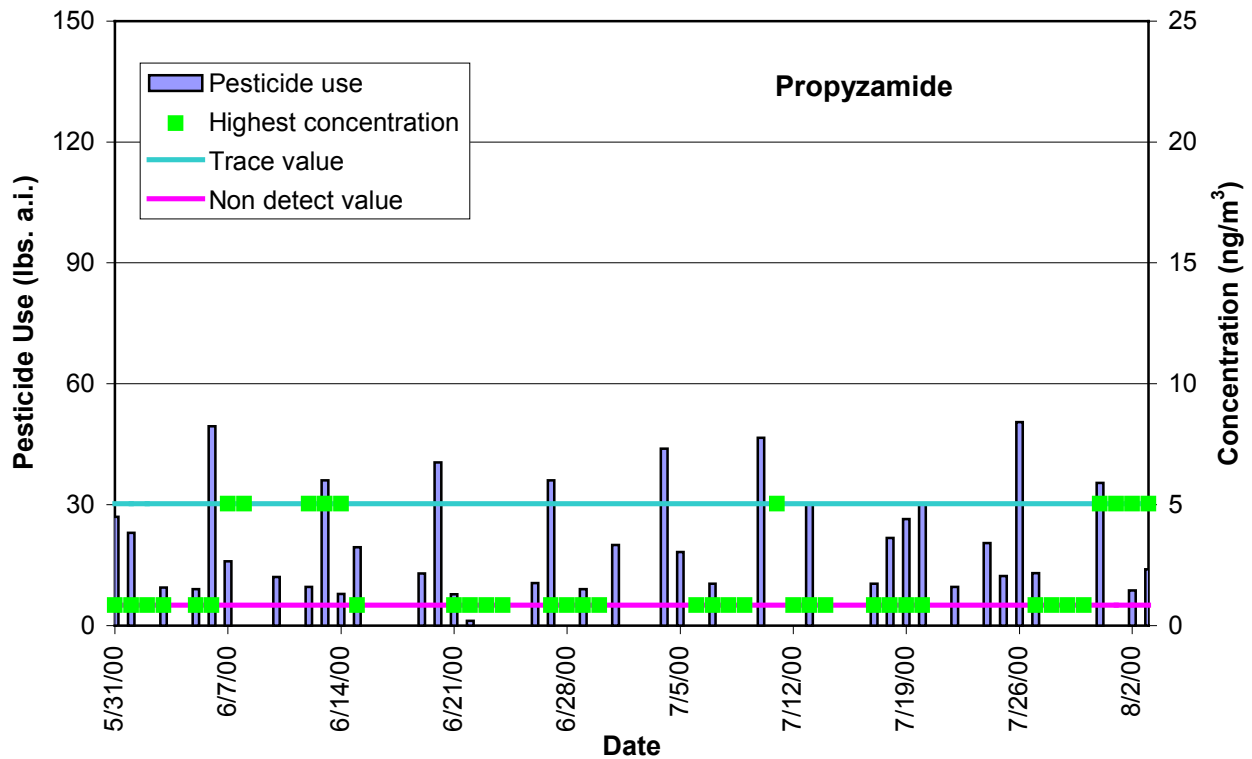


Figure 15y. Reported daily pesticide use and highest concentrations detected for each sampling day (cont.).

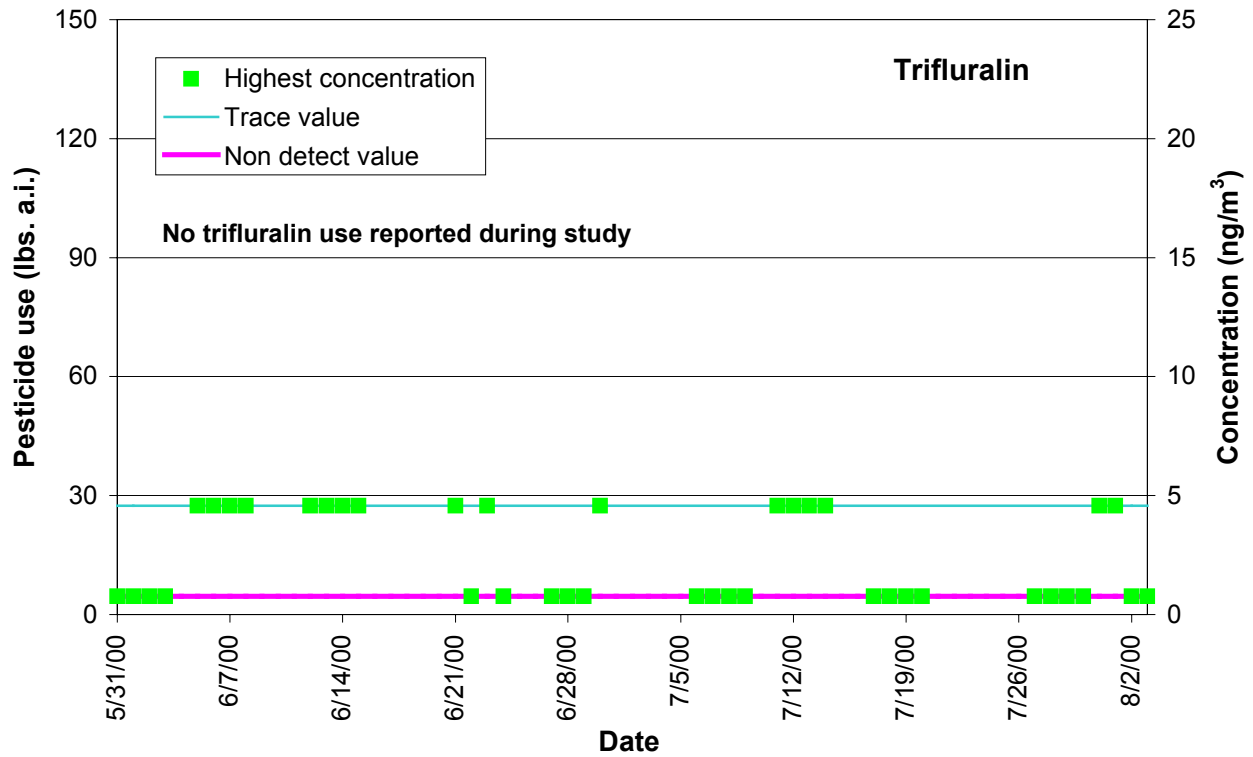


Figure 15z.

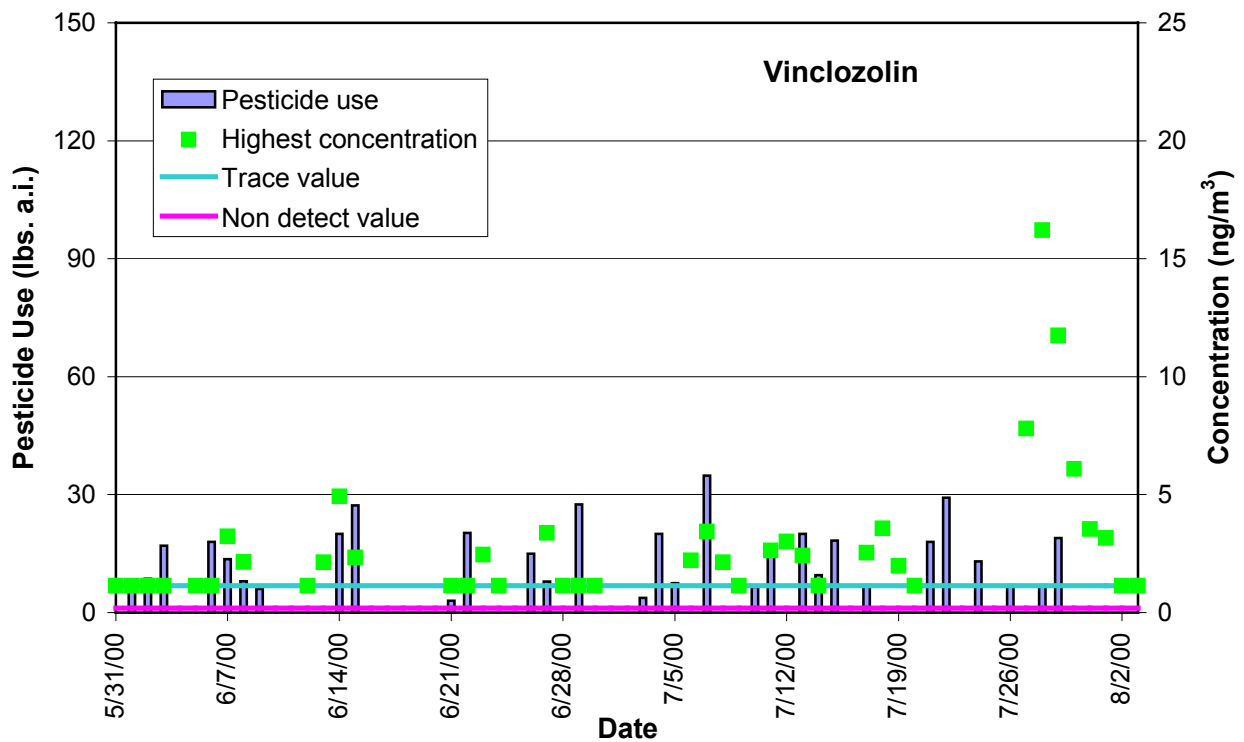


Table 29. Highest daily amount applied within the Lompoc study area.

Pesticide	Highest Daily Amount (lbs a.i.)		Ratio of Highest Days (2000/Monitoring Period)
	Monitoring Period	2000	
Chlorothalonil	36.3	89.1	2.4
Chlorpyrifos	57.0	60.0	1.1
Chlorthal-dimethyl	77.6	77.6	1.0
Cycloate	4.5	16.7	3.7
Diazinon	0.0	15.6	None monitored
Dicloran	80.5	127.8	1.6
Dicofol	0.0	0.0	No applications
Dimethoate	22.6	38.6	1.7
EPTC	88.0	88.0	1.0
Ethalfuralin	0.0	72.6	None monitored
Fonofos	0.0	0.0	No applications
Iprodione	49.3	119.2	2.4
Malathion	351.6	351.6	1.0
Mefenoxam	15.5	25.0	1.6
Metolachlor	138.5	138.5	1.0
Naled	38.7	65.5	1.7
Oxydemeton-methyl	27.9	44.5	1.6
PCNB	64.7	79.1	1.2
Permethrin	17.8	35.0	2.0
Propyzamide	50.5	80.5	1.6
Simazine	0.0	0.0	No applications
Trifluralin	0.0	37.6	None monitored
Vinclozolin	34.8	75.0	2.1



Figure 16. Locations and amount of all pesticide use reported in 2000.

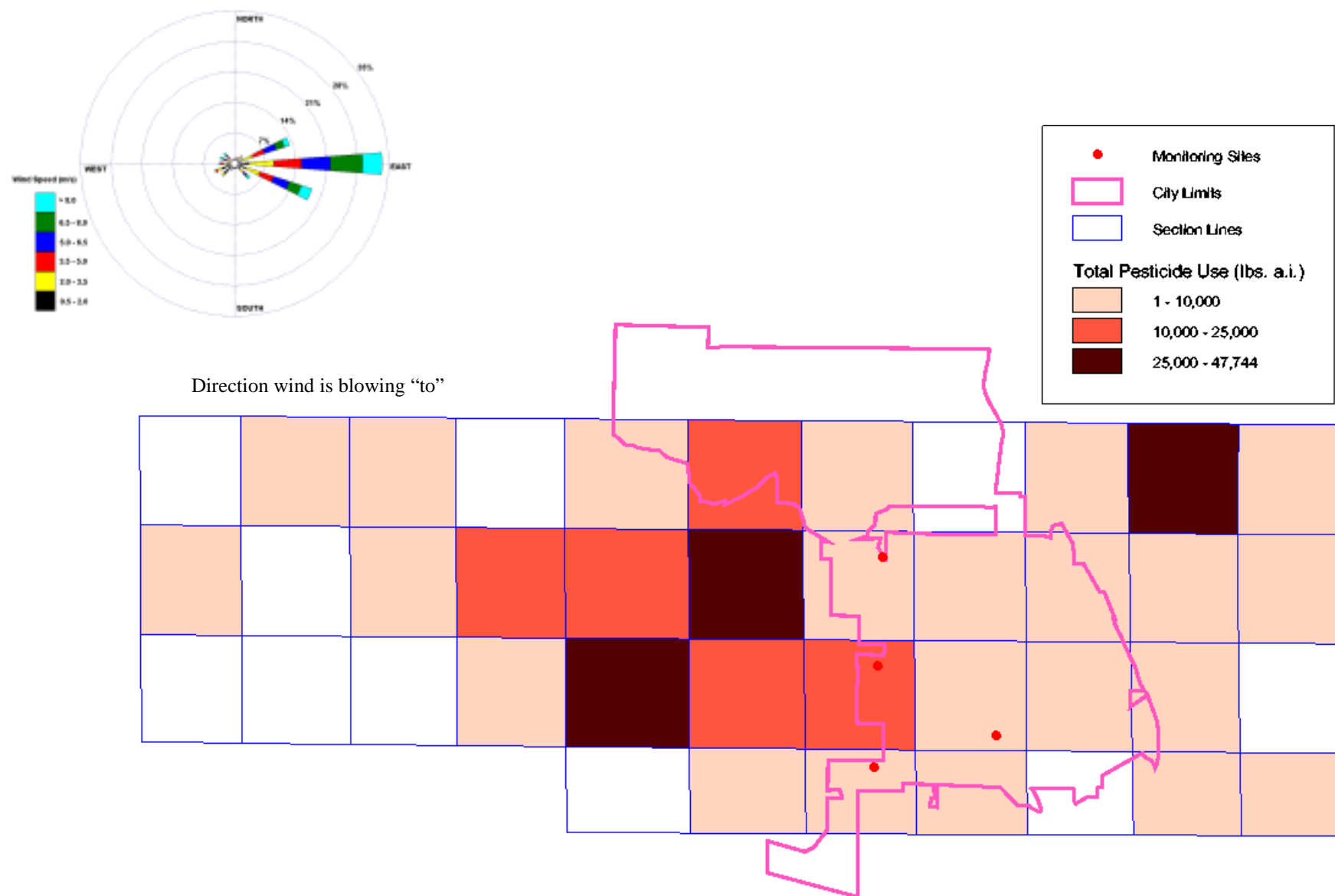


Figure 17. Locations and amount of monitored pesticide use reported during monitoring period.

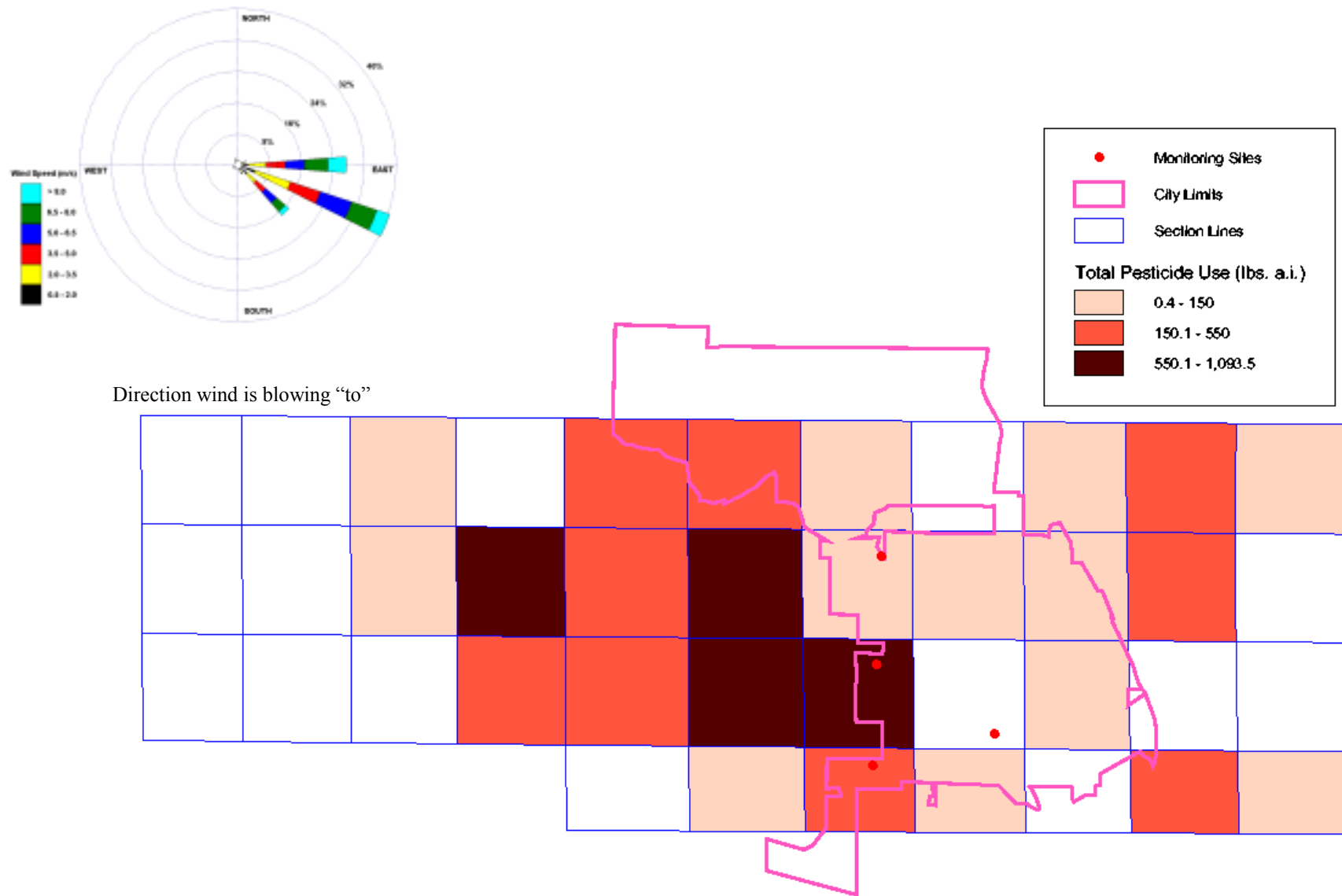


Figure 18. Chlorothalonil applications during monitoring period.

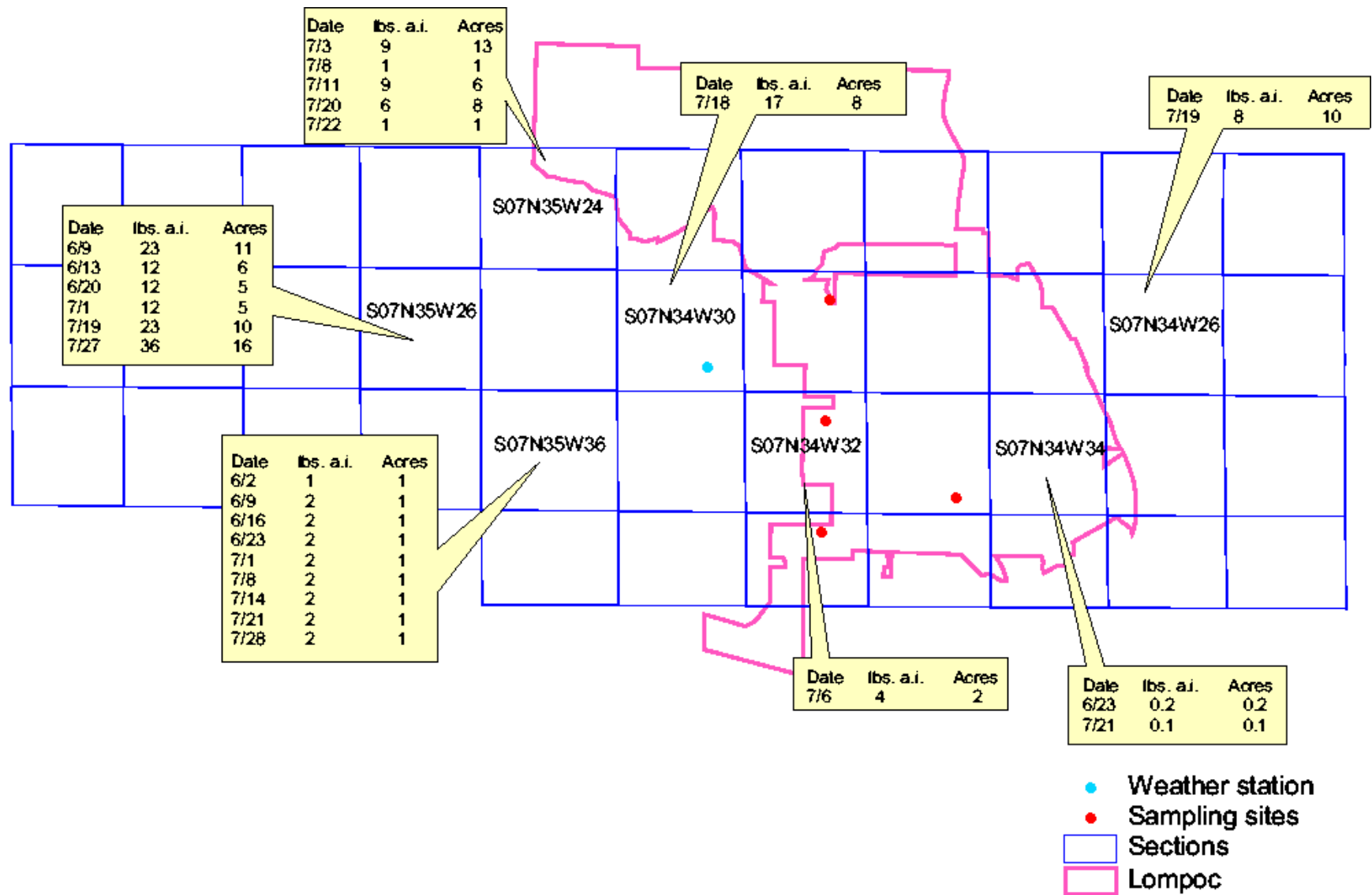


Figure 19. Chlorpyrifos applications during monitoring period.

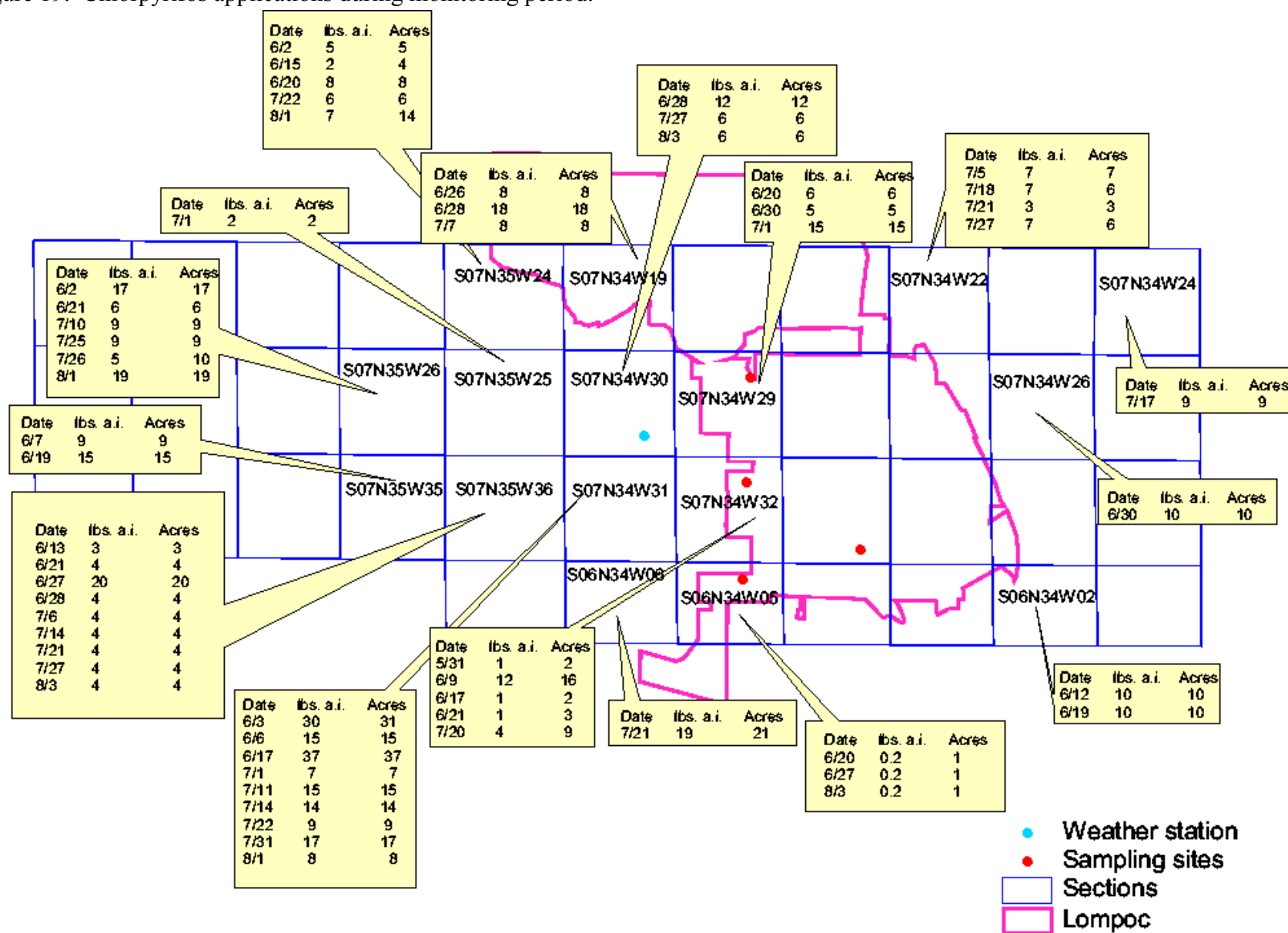


Figure 20. Clorthal-dimethyl applications during monitoring period

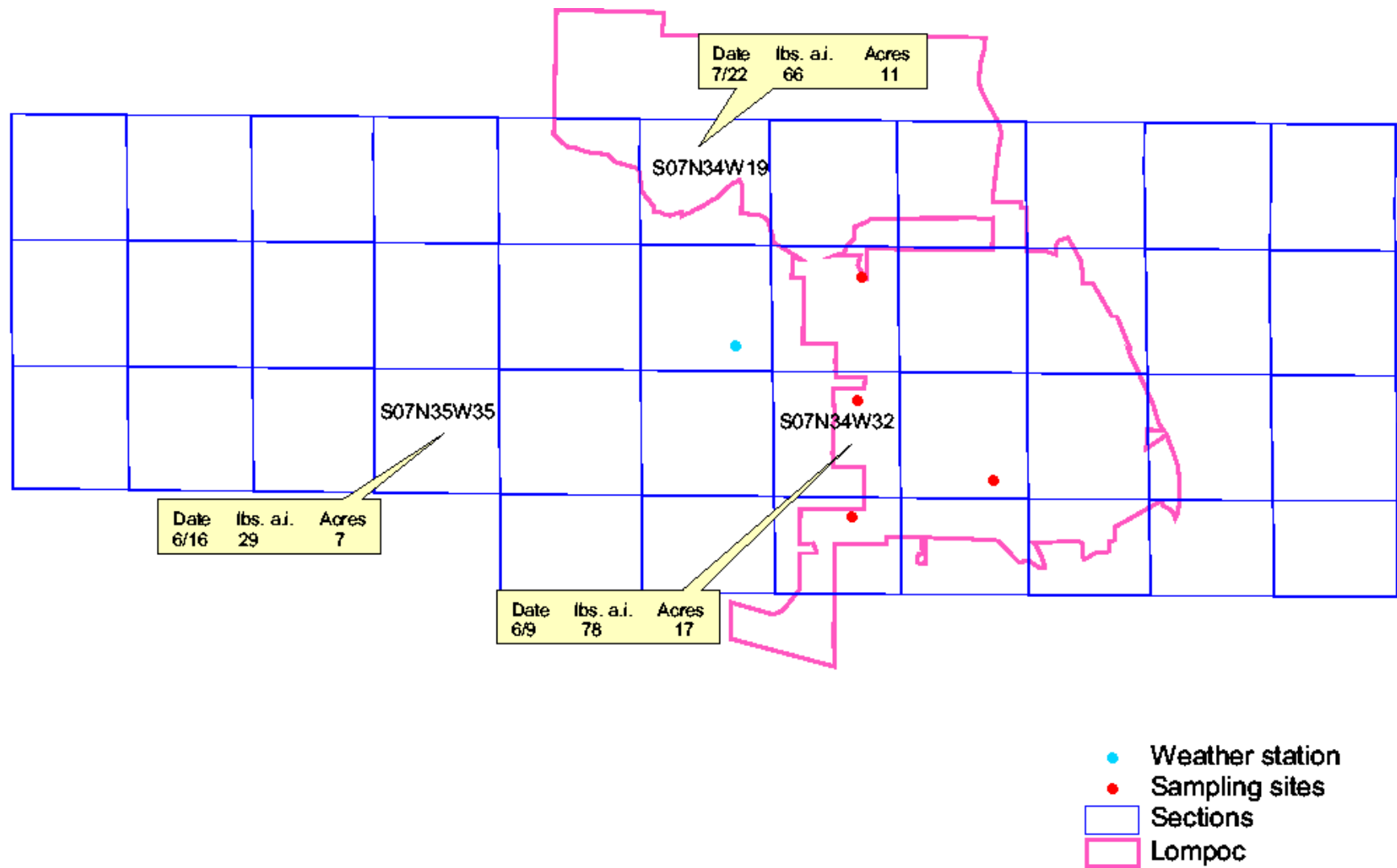


Figure 21. Cycloate applications during monitoring period.

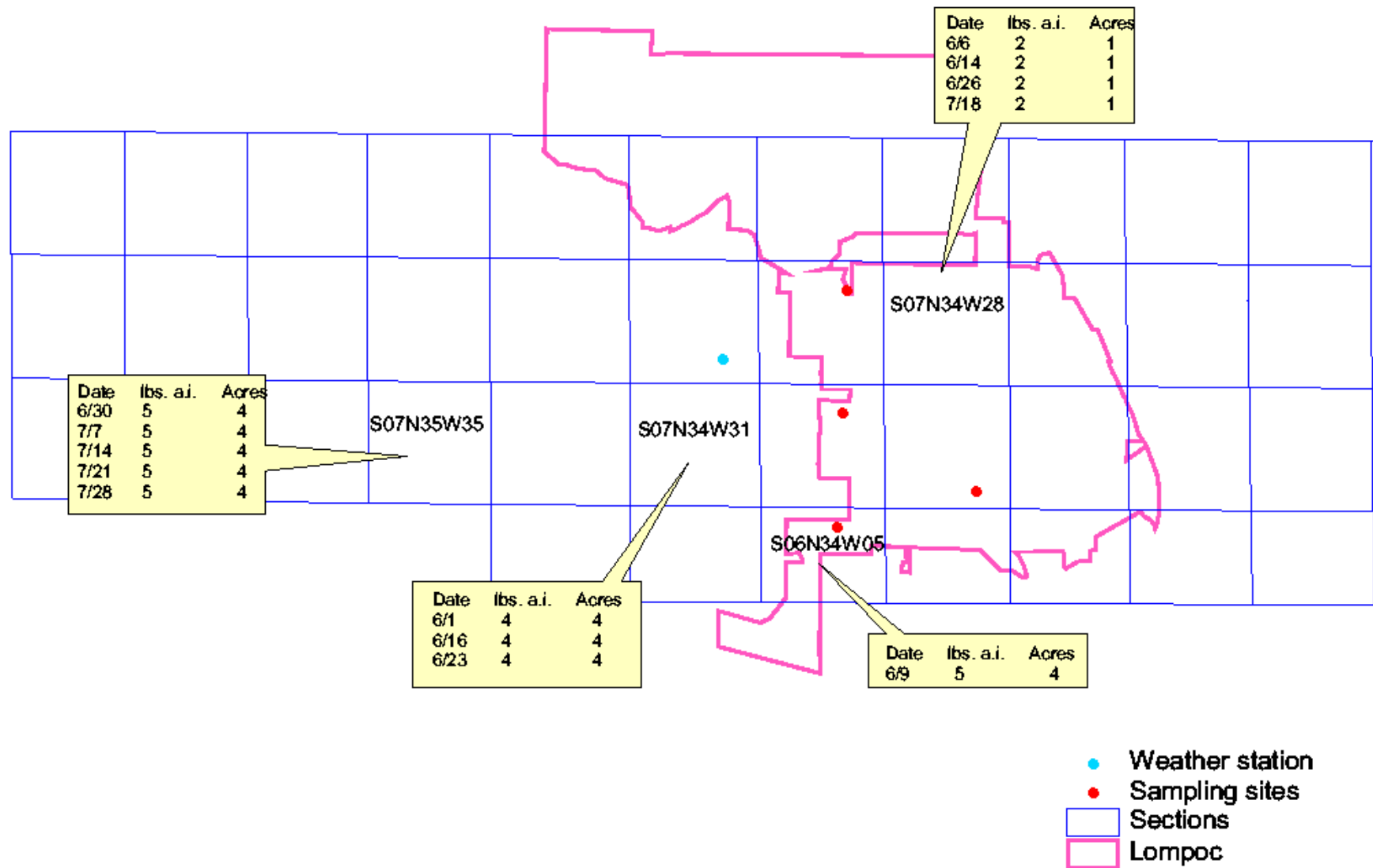


Figure 22. Dichloran applications during monitoring period.

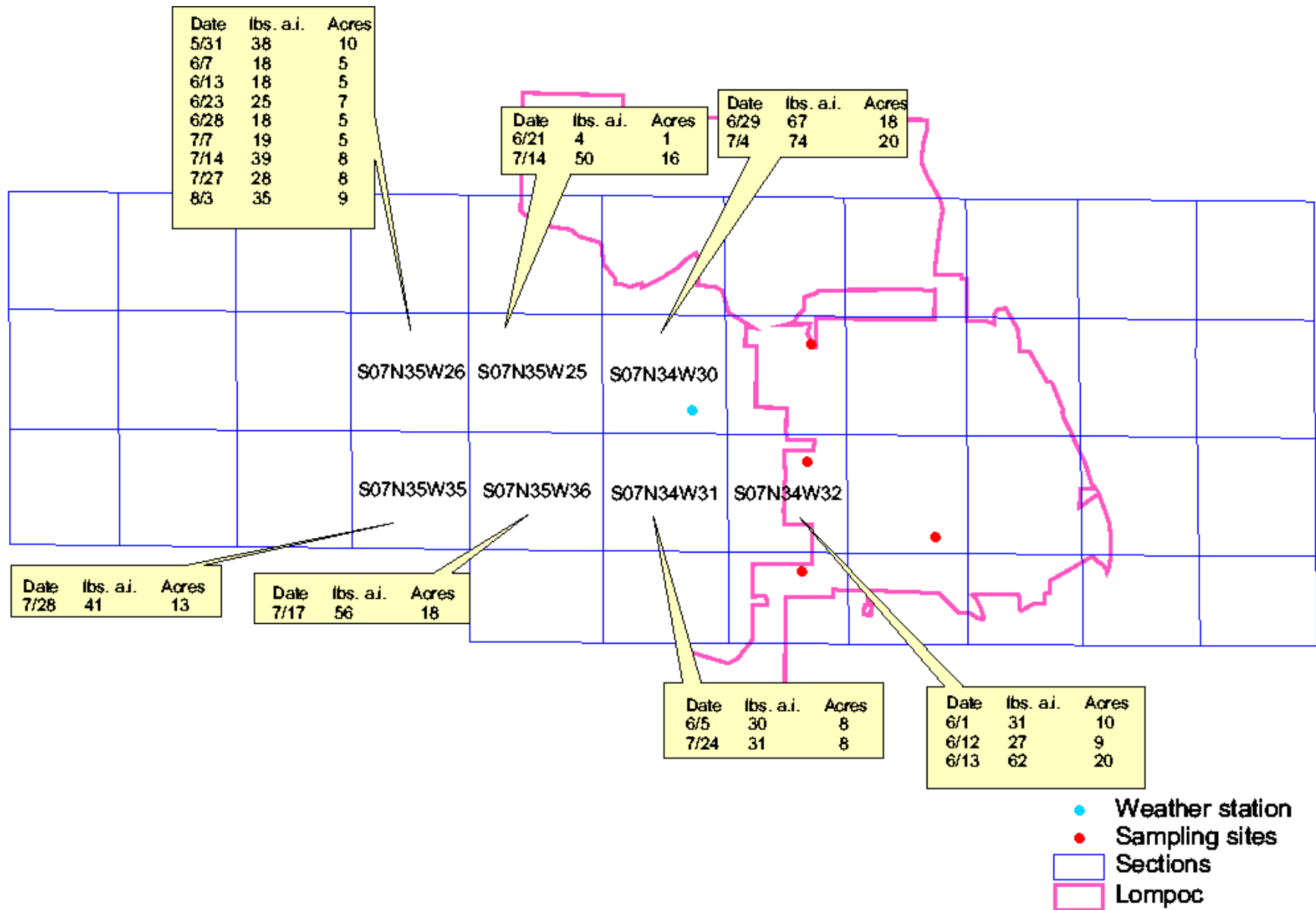


Figure 23. Dimethoate applications during monitoring period.

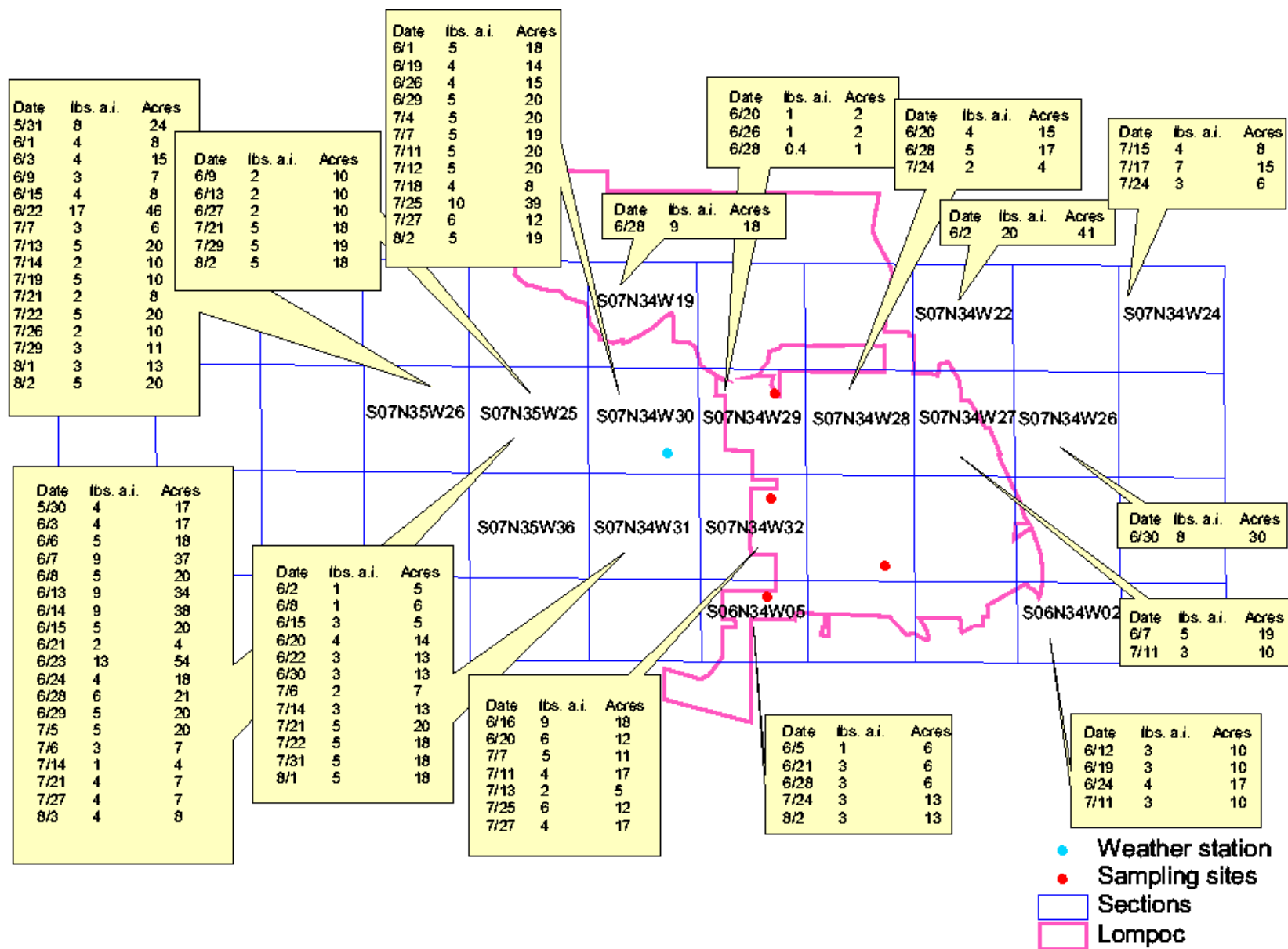




Figure 24. EPTC applications during monitoring period.

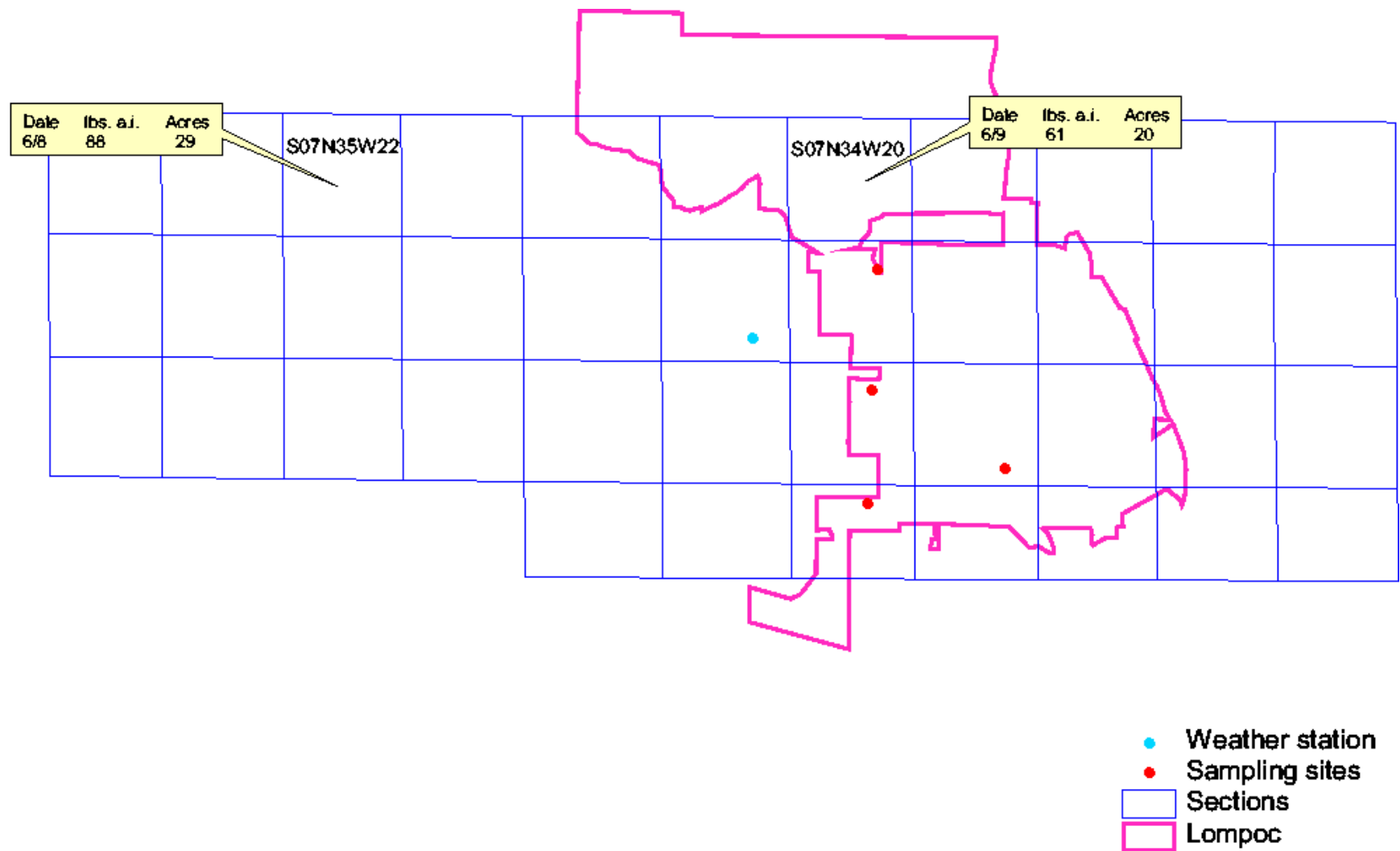


Figure 25. Iprodione applications during monitoring period.

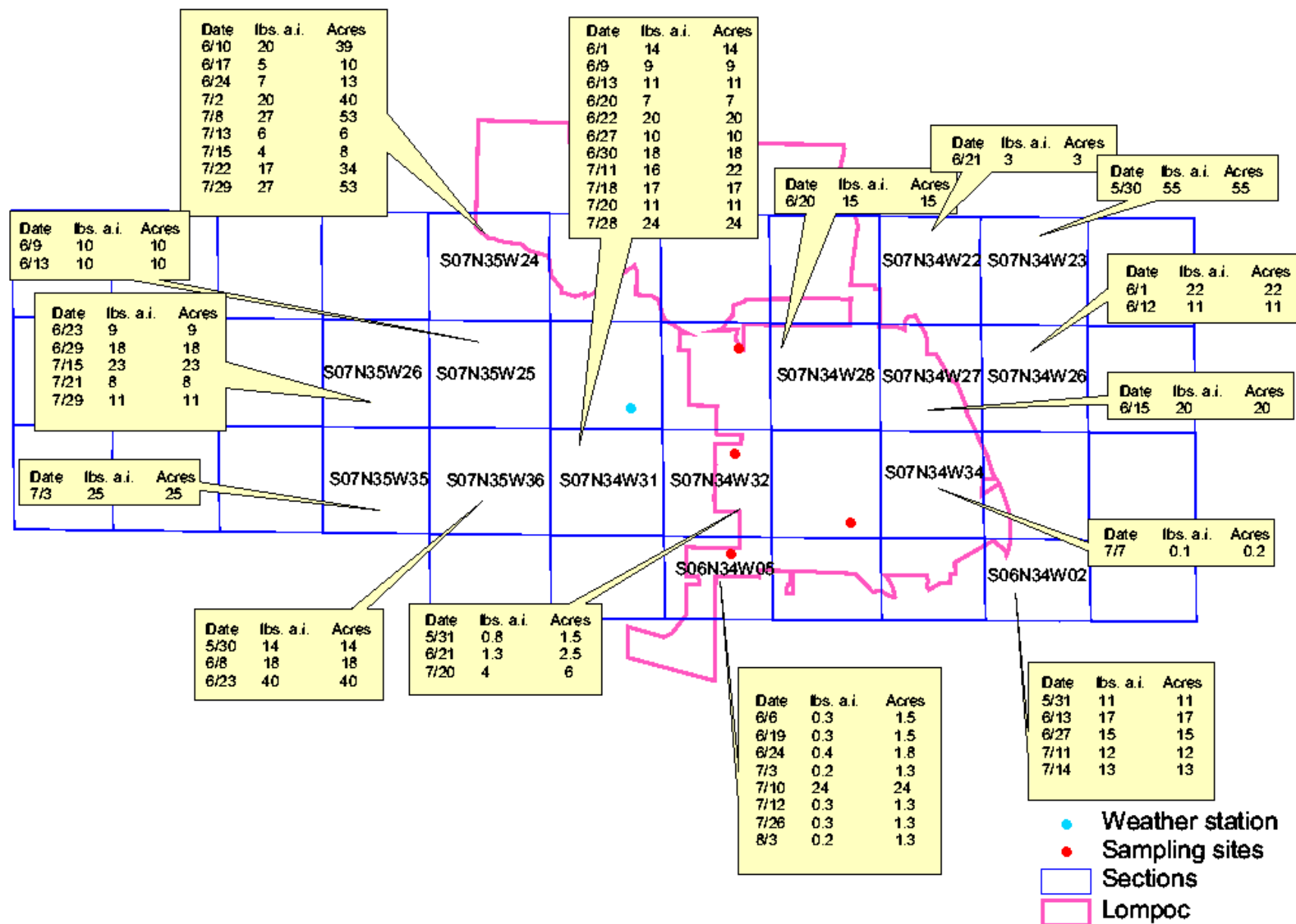


Figure 26. Malathion applications during monitoring period.

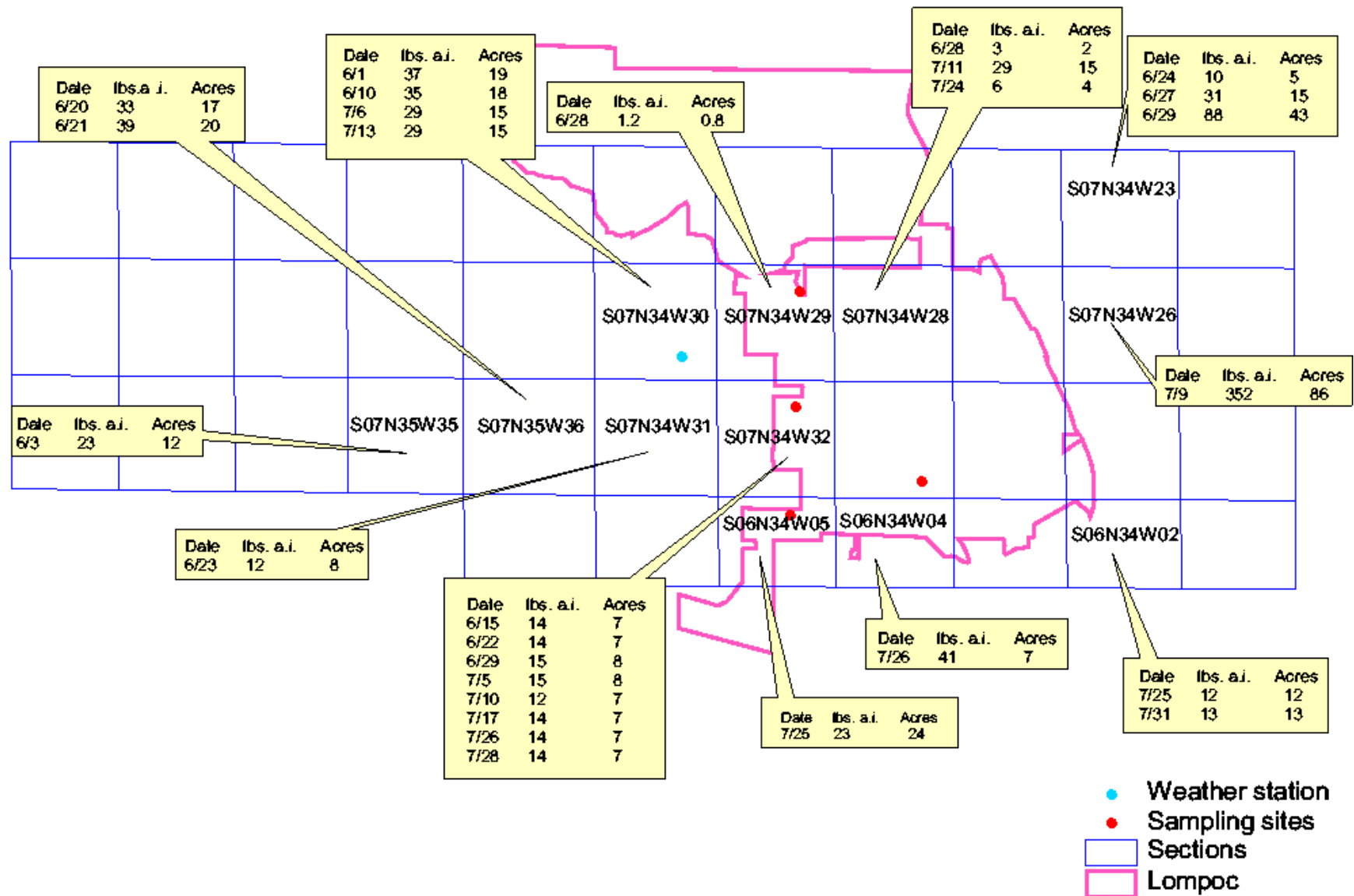


Figure 27. Mefenoxam applications during monitoring period.

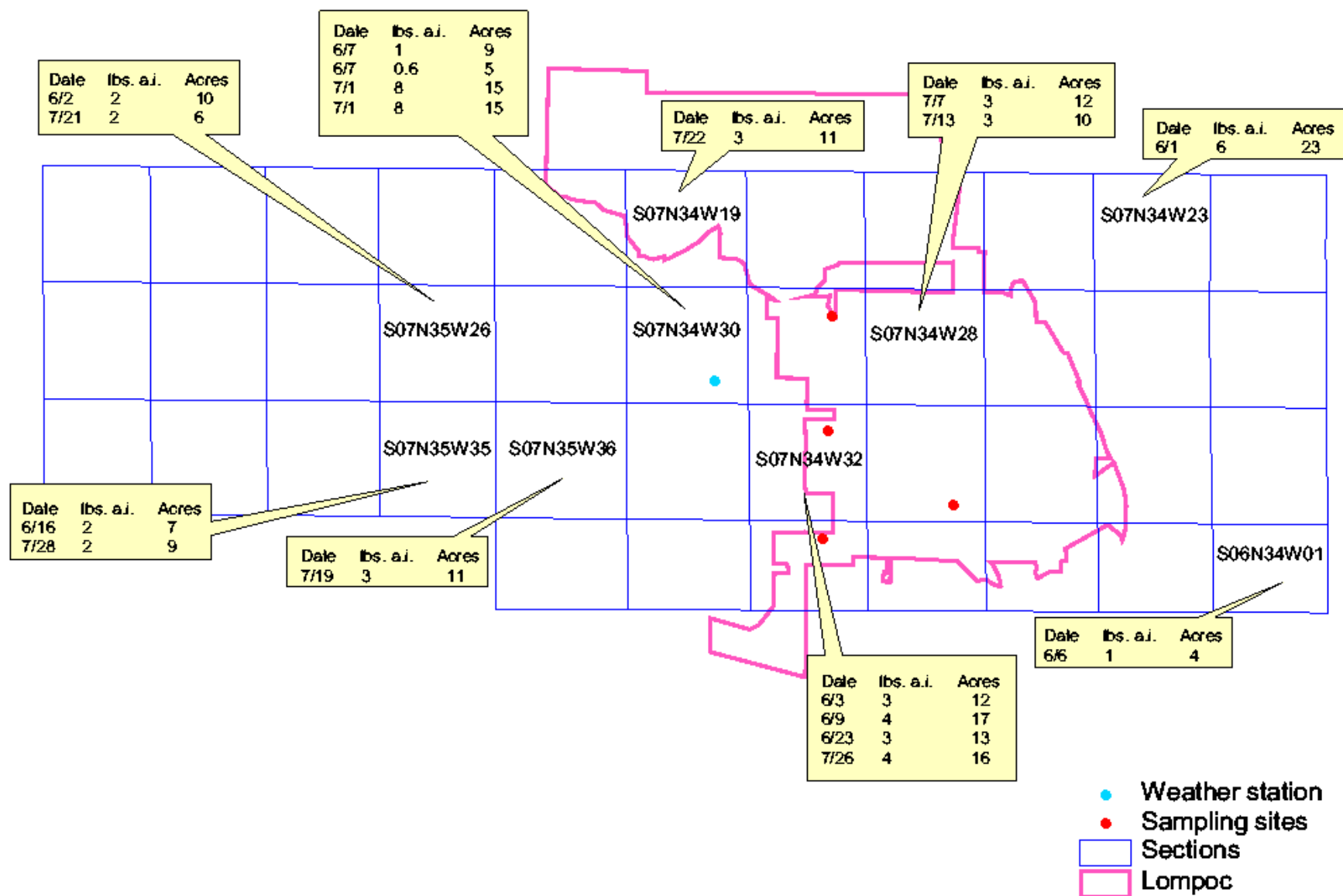


Figure 28. Metolachlor applications during monitoring period.

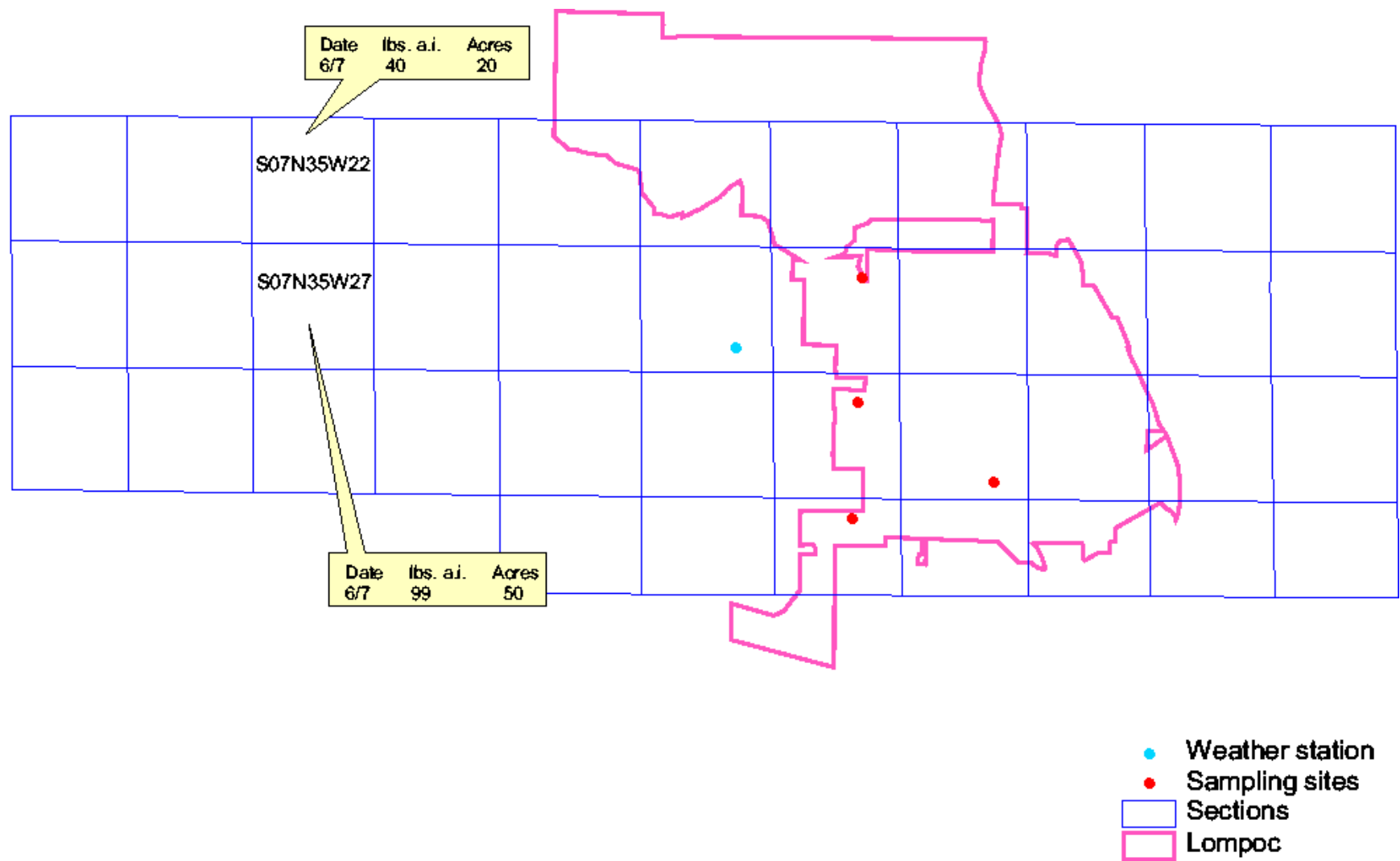


Figure 29. Naled applications during monitoring period.

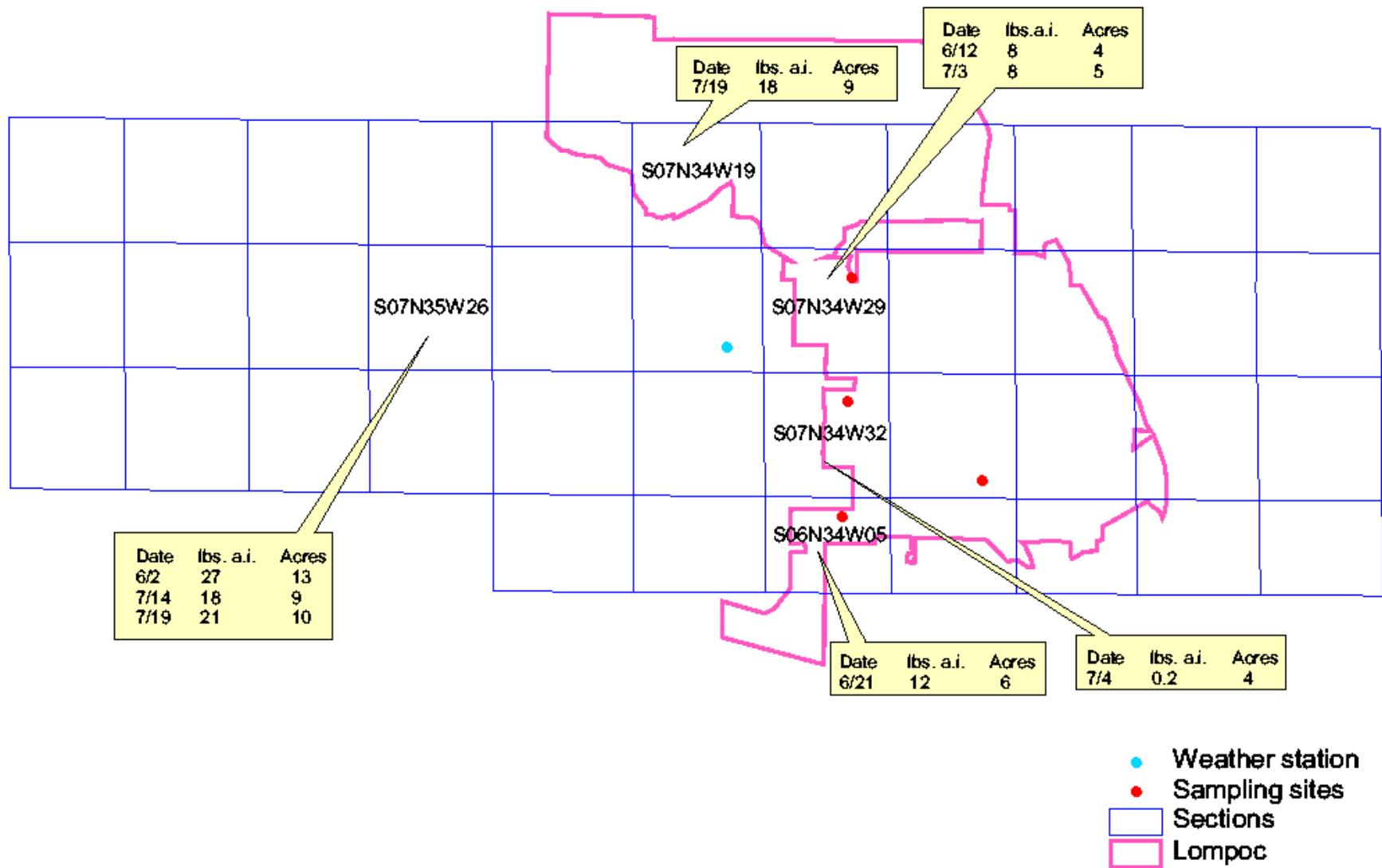


Figure 30. Oxydemeton-methyl applications during monitoring periods.

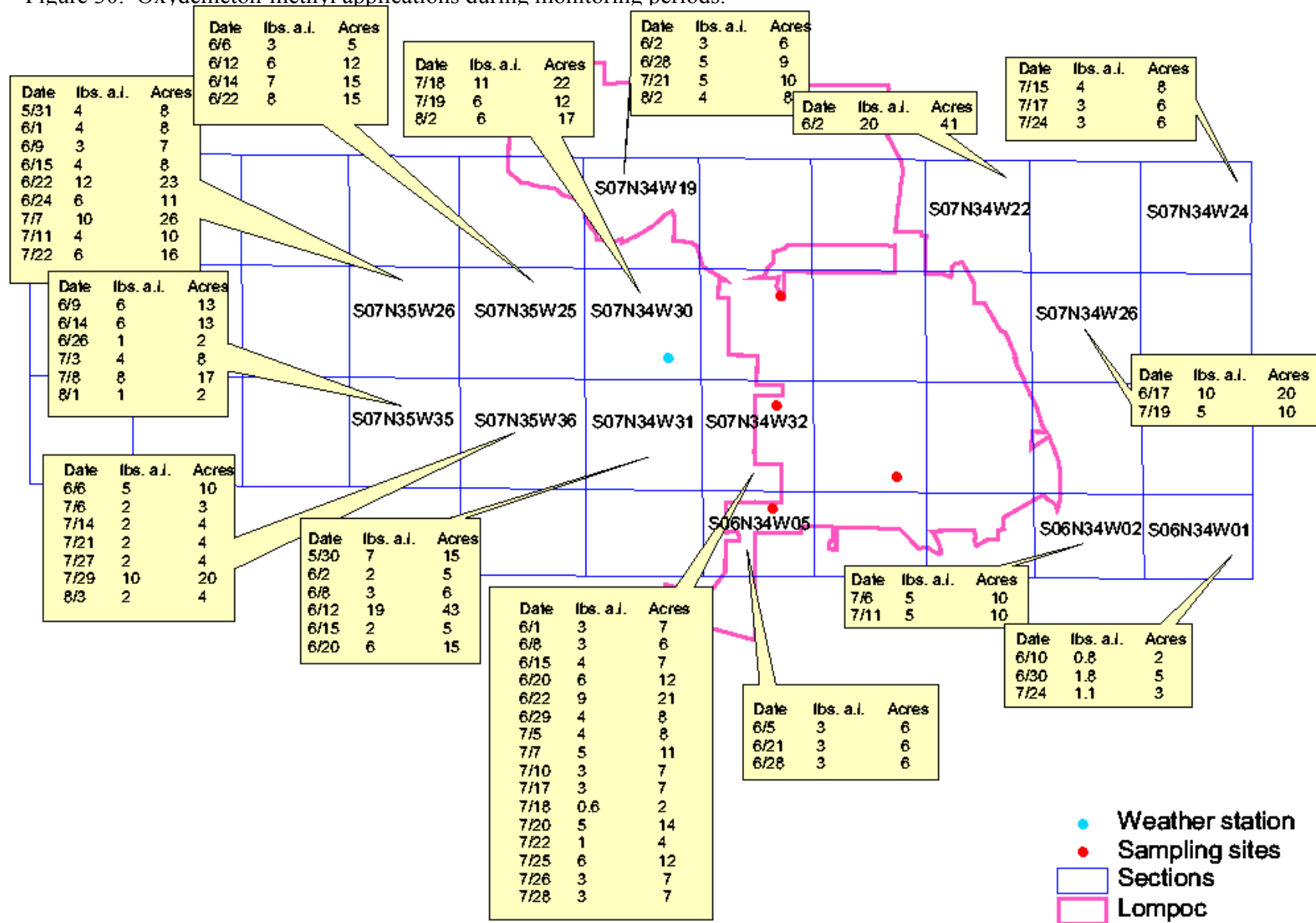


Figure 31. PCNB applications during monitoring periods.

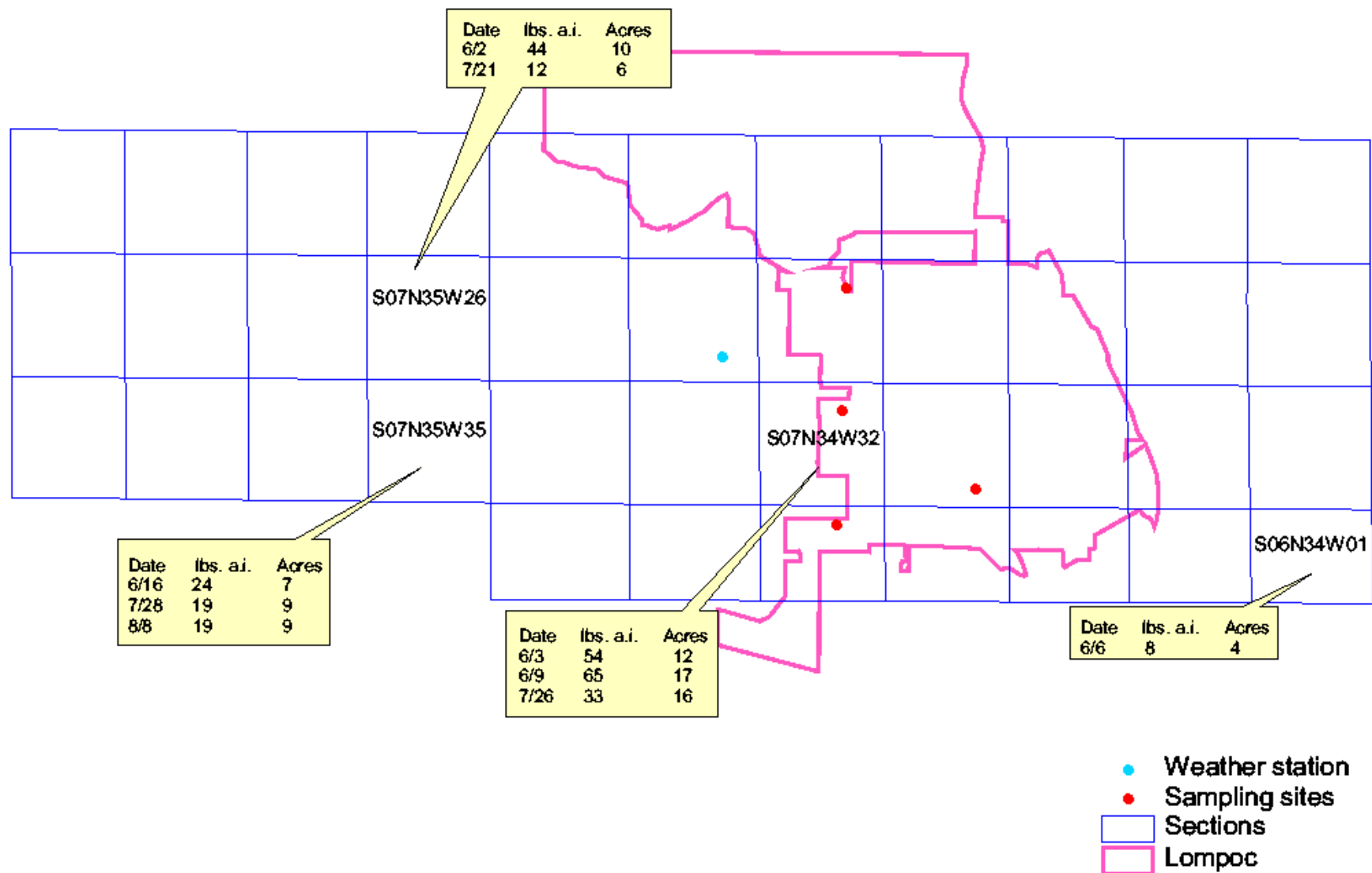




Figure 32. Permethrin applications during monitoring period.

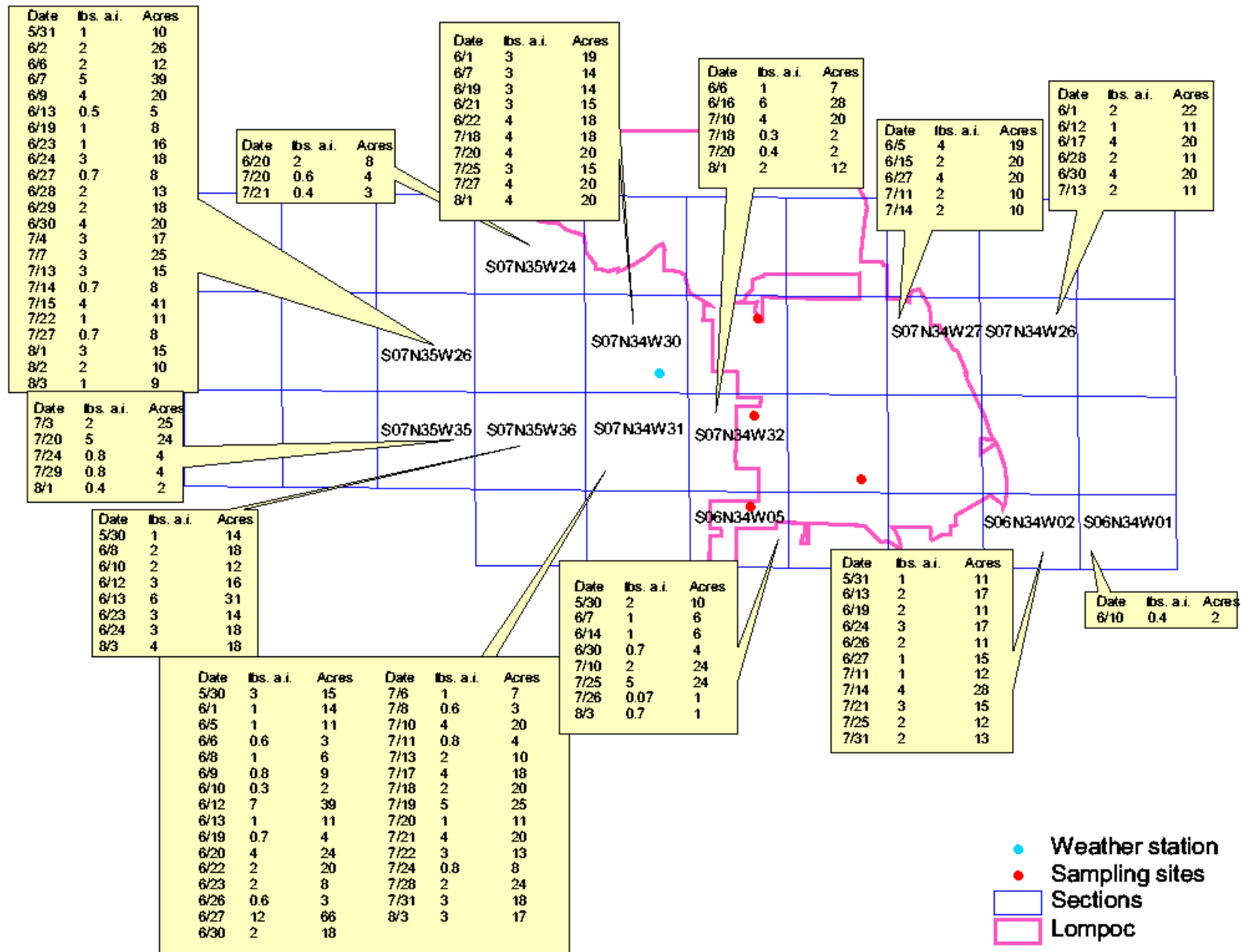


Figure 33. Propyzamide applications during monitoring period.

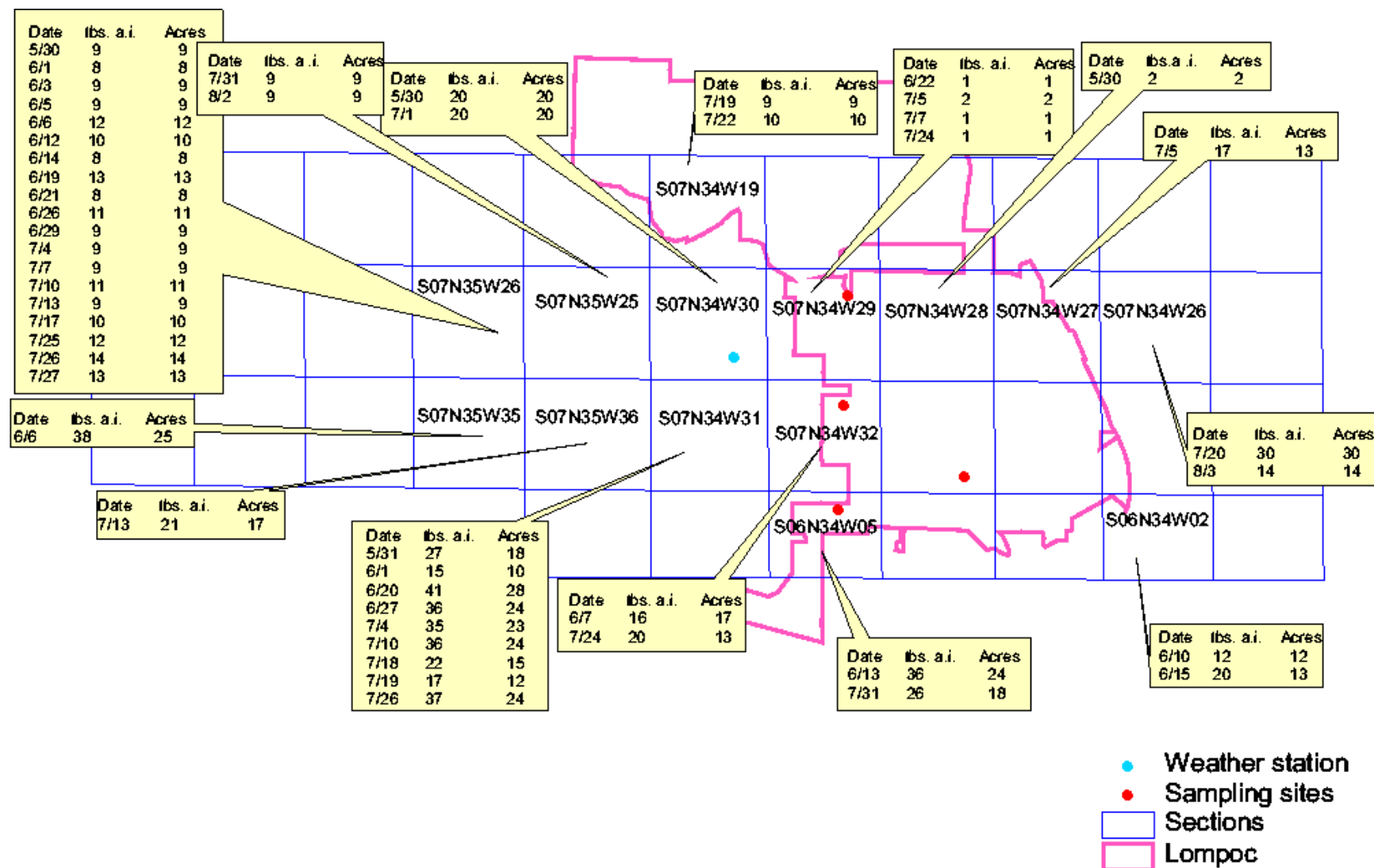
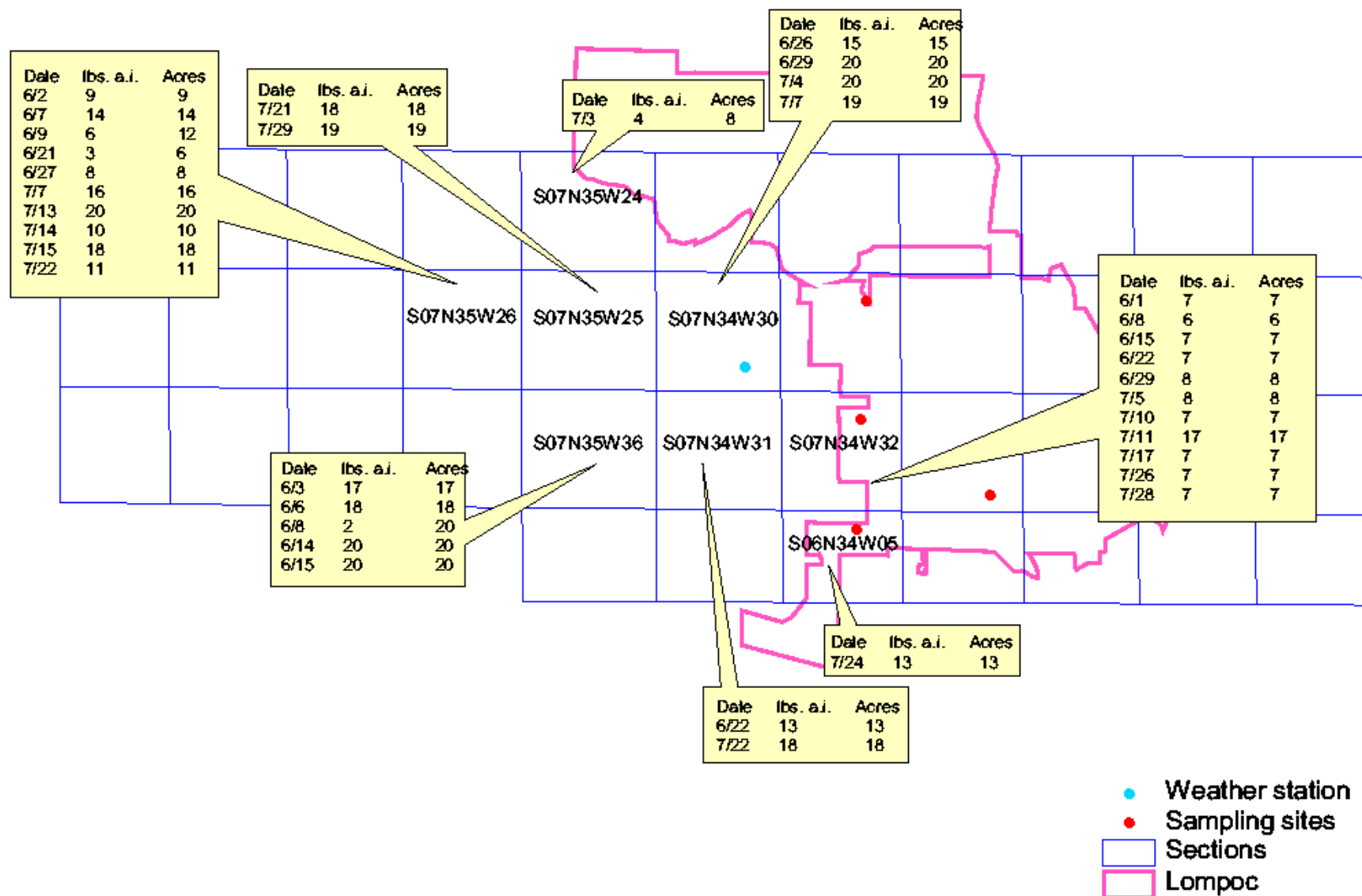


Figure 34. Vinclozolin applications during monitoring period.



## **Estimates of Concentrations for Locations, Time Periods, and Pesticides Not Monitored**

In some studies, computer modeling can be attempted to estimate ambient air concentrations from pesticide applications made during monitoring, providing that meteorological measurements and application/sampling site information are available. Thus, modeling can be used to supplement measured air concentrations to determine potential concentrations at places and time periods other than the ones monitored. Unfortunately, analysis of the data showed several occasions when air concentrations were detected, but no applications occurred, and vice versa. Computer modeling with this type of data is futile. In addition, modeling attempted during the fumigation monitoring section of this study indicated that the ISCST model used by DPR could not adequately model the measured concentrations. Attempts to statistically correlate pesticide use patterns to air concentrations were also unsuccessful due to the inconsistency between detections and use.

## **DATA VALIDATION/QUALITY ASSURANCE**

### **Data Review**

Before any statistical or other evaluation of the data took place, the entire set of field logbook sheets and laboratory quality assurance data was reviewed to determine the strength of the data for final assessment. The field logbook records were checked for any notations of flow faults or stoppage in sample collection, or any changes in the flow over the sampling interval greater than 25%. Any problems encountered during sampling are noted in the log book data (Appendix M). The primary sample collected on June 3<sup>rd</sup> at the southwest site had a 250% increase in flow during the sampling period so it was removed from the data analysis. In addition, a duplicate sample collected on June 24<sup>th</sup> had a flow fault during the sampling interval.

### Sample Shipment Quality Assurance

Measurements collected by the temperature recorders located in the sample shipment containers were reviewed for any occurrence of temperature changes during shipment that would adversely affect the samples. Most samples arrived as expected with dry ice in sample shipment and measured temperatures in an acceptable range. During the shipment of the samples collected the eighth week of monitoring, samples were misrouted and were received two days later at both laboratories. Temperatures recorded by the Hobo® indicate the samples reached temperatures near 100 °F. The trip spike was analyzed and all recoveries were acceptable except chlorothalonil (47%) and naled (62%). In addition, confirmation samples from the forth, sixth and seventh weeks of sampling arrived at the CDFA laboratory with little or no dry ice. The samples for the sixth and seventh week were still below zero at arrival, whereas the samples for week four were at approximately 60 °F.

### Pesticide Use Report validation

The methods used in the validation of the DPR's pesticide use reporting database are located in the DPR report PM 01-02 entitled "Final Report to the California Department of Food and Agriculture for Contract Agreement No. 98-0241 Data Quality of California's Pesticide Use Report" (Wilhoit et al, 2001).

## **Audit Results**

The quality assurance team performed informal audits prior to the start of the study, as well as a formal audit while the study was in progress. The quality assurance team performed the pre-study audits on May 12, 2000. The pre-study audit recommended several minor procedural changes, which were implemented (Appendix R).

The quality assurance team performed the first study audits at the UCD Trace Analytical Laboratory and the CDFA Center for Analytical Chemistry on July 24. The quality assurance team found that both laboratories were following accepted and agreed-upon procedures for analysis and quality assurance. Some problems were found with sample shipment, as discussed above. UCD used an expired fonofos OA standard because a new standard could not be obtained. UCD verified that the fonofos OA standard had not degraded and the quality assurance team agreed that the standard should continue to be used. The audit team did not review the particulate analysis. The quality assurance audit team's complete report is presented in Appendix R.

## **Quality Control Results**

The averages for the quality assurance samples for the monitoring period for each chemical are listed in Table 30. Lab personnel explained that the high recoveries in some chemicals, especially ethalfluralin, are due to enhancement of recovery by the matrix (resin material). The amount of matrix was chosen to minimize the amount of resin material on column, while providing enough matrix to reduce the enhancement of recoveries on the majority of the compounds. Some compounds are more sensitive to enhancement. The recoveries of the replicated concurrent recoveries are similar indicating that although the recoveries are high, the method is consistent. The full explanation is included in the Chemical Analytical Method Appendix I. While these recoveries look reasonable, the recoveries from the trapping efficiency tests (Table 9) are low for some chemicals (chlorpyrifos OA, cycloate, EPTC, and ethalfluralin) may indicate a need to adjust the detected air concentrations.

All quantifiable concentrations of any organophosphate (see Table 5) was confirmed with mass spectrometry. In addition, 22 "trace" detections of various organophosphates were also confirmed.

Table 30. Average results for quality control/quality assurance samples.

Chemical	Lab Spikes (% recovery)	Trip Spikes (% recovery)	Field Spikes (% recovery) <sup>a</sup>	Lab Blanks (ng/m <sup>3</sup> )	Trip Blanks (ng/m <sup>3</sup> )
Chlorothalonil	81	82	80 - 77	nd	nd
Chlorpyrifos	95	91	99 - 92	nd	nd
Chlorpyrifos OA	99	93	101	nd	nd
Chlorthal-dimethyl	98	96	106 - 87	nd	nd
Cycloate	90	90	86 - 85	nd	nd
Diazinon	91	87	88 - 87	nd	nd
Diazinon OA	95	90	99	nd	nd
Dichloran	93	97	85 - 81	nd	nd
Dicofol	95	107	107 - 105	nd	nd
Dimethoate	94	89	77	nd	nd
Dimethoate OA	103	99	113	nd	nd
EPTC	85	87	80 - 77	nd	nd
Ethalfuralin	148	160	140 - 135	nd	nd
Fonofos	89	80	66	nd	nd
Fonofos OA	94	92	108	nd	nd
Iprodione	88	97	100	nd	nd
Malathion	93	89	94 - 86	nd	nd
Malathion OA	104	99	109 - 102	nd	nd
Mefenoxam	100	98	101	nd	nd
Metolachlor	109	109	116 - 112	nd	nd
Naled	89	86	91 - 82	nd	nd
PCNB	98	99	100 - 93	nd	nd
Permethrin	91	96	103 - 102	nd	nd
Propyzamide	93	102	111	nd	nd
Simazine	103	98	101	nd	nd
Trifluralin	87	95	85 - 78	nd	nd
Vinclozolin	103	103	114 - 105	nd	nd

nd = None detected

trace = Pesticide detection confirmed, but less than the quantitation limit

<sup>a</sup> recovery of the field spike minus any concentrations in the colocated primary sample. Average of two field spikes per week. If the primary contained a "trace" amount of chemical a range of recovery for (spike - MDL) and (spike - EQL) was determined.

### Spike recoveries

The range of recovery for each chemical in the laboratory spikes are presented in Table 31.

Table 31. Laboratory spike recoveries.

Chemical	Minimum Recovery (%)	Maximum Recovery (%)	Average Recovery (%)
Chlorothalonil	30.3	91.0	80.7
Chlorpyrifos	89.4	101.8	95.0
Chlorpyrifos OA	84.9	116.1	99.2
Chlorthal-dimethyl	82.4	115.5	97.5
Cycloate	81.5	104.6	89.7
Diazinon	80.9	99.6	91.5
Diazinon OA	88.0	100.5	94.7
Dichloran	74.2	126.0	92.8
Dicofol	77.0	117.8	94.8
Dimethoate	84.8	101.7	94.4
Dimethoate OA	90.0	112.9	103.0
EPTC	77.1	91.6	84.8
Ethalfuralin	113.3	176.7	147.5
Fonofos	76.4	98.9	88.9
Fonofos OA	88.3	99.0	94.4
Iprodione	71.9	104.9	88.0
Malathion	82.9	96.9	93.0
Malathion OA	92.6	113.6	103.7
Mefenoxam	85.1	121.7	99.7
Metolachlor	86.2	143.6	109.1
Naled	74.8	108.3	88.9
PCNB	77.7	128.2	98.5
Permethrin	74.4	101.5	91.3
Propyzamide	77.6	106.5	93.5
Simazine	84.2	110.5	97.9
Trifluralin	67.0	116.3	87.1
Vinclozolin	89.1	122.9	103.4

#### Primary versus duplicate samples

The data for the primary and collocated duplicate samples is located in Appendix S. Eleven collocated duplicate samples were collected. The duplicates were analyzed for all 27 chemicals which would allow for 297 possible matches (Table 32). The 13 pairs of quantifiable results were not significantly different ( $P = <0.001$ ).

Table 32. Summary of results in the collocated samples.

Primary/duplicate results	Number of matches
nd/nd	240
trace/trace	36
nd/trace	5
nd/>EQL	1
trace/>EQL	2
>EQL/>EQL	13

#### Primary versus confirmation samples

The confirmation samples are collocated with primary samples and analyzed at a different laboratory. The CDFA Center for Analytical Chemistry was the confirmation laboratory for the multipesticide study. Although the EQL's for the two laboratories were different the results are very similar (Table 33).



Table 33. Results of collocated primary and confirmation samples.

Start Date	Sample Type	Chlorpyrifos (ng/m <sup>3</sup> )	Diazinon (ng/m <sup>3</sup> )	Diazinon OA (ng/m <sup>3</sup> )	Dimethoate (ng/m <sup>3</sup> )	Malathion (ng/m <sup>3</sup> )	Malathion OA (ng/m <sup>3</sup> )
6/1/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	trace <i>nd</i>	trace <i>nd</i>
6/3/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	trace <i>nd</i>
6/6/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
6/7/00	Primary <i>Confirmation</i>	trace <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
6/12/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
6/15/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
6/23/00	Primary <i>Confirmation</i>	trace <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	trace <i>nd</i>	trace <i>nd</i>
6/24/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	trace <i>nd</i>	trace <i>nd</i>
6/27/00	Primary <i>Confirmation</i>	4.8 <i>trace</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	trace <i>trace</i>	trace <i>nd</i>
6/27/00	Primary <i>Confirmation</i>	trace <i>trace</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
7/8/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
7/9/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
7/11/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	trace <i>nd</i>	trace <i>nd</i>
7/12/00	Primary <i>Confirmation</i>	nd <i>nd</i>	trace <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	trace <i>trace</i>	trace <i>nd</i>
7/18/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
7/20/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
7/28/00	Primary <i>Confirmation</i>	nd <i>nd</i>	trace <i>trace</i>	trace <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
7/29/00	Primary <i>Confirmation</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
7/31/00	Primary <i>Confirmation</i>	trace <i>trace</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
8/3/00	Primary <i>Confirmation</i>	trace <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>	nd <i>nd</i>
Primary	EQL	3.85	3.59	2.61	2.77	4.12	2.02
	MDL	0.77	0.72	0.52	0.55	0.82	0.40
Confirmation	EQL	9.25	9.25	9.25	9.25	9.25	9.25
	MDL	4.63	5.56	5.09	5.09	5.56	7.41

### Blank samples

All blank samples were non-detects.

### **Confirmation Laboratory Quality Control**

The confirmation laboratory spike recovery results are listed in Table 34. There were no detections in any of the blank laboratory spikes.

Table 34. Laboratory spike recovery results for the confirmation laboratory.

Chemical	Minimum Recovery (%)	Maximum Recovery (%)	Average Recovery (%)
Chlorpyrifos	93	114	101.8
Diazinon	85	108	97.8
Diazinon OA	93	113	101.3
Dimethoate	90	115	99.6
Malathion	88	109	98.6
Malathion OA	95	119	106.6

### **CONCLUSIONS**

Multiple pesticides were monitored for ten weeks during late spring and summer of 2000 at four locations in Lompoc. Monitoring results were evaluated with a series of conservative or health-protective assumptions regarding exposure. All acute, subchronic, and chronic Hazard Quotient values for individual pesticide air levels and Hazard Indices for all monitored pesticides combined are below one, the value that DPR, DHS and OEHHA consider protective of health. In relative terms, chlorpyrifos (and its OA breakdown product), diazinon (and its OA breakdown product), cycloate, and PCNB accounted for 90% of the risk for all exposure periods (acute, subchronic, and chronic). The highest risk was associated with acute exposure, relative to subchronic and chronic exposure. The difference is probably larger than indicated here because several health-protective assumptions are included in the subchronic and chronic risk estimates, but not in the acute risk estimate.

Chlorpyrifos OA, cycloate, EPTC, and ethalfluralin had trapping efficiencies less than 70%, and as low as 37%. Air concentrations for these pesticides may be underestimated. Even if an adjustment is made for the low trapping efficiency, the effect on the risk estimates is negligible since the highest hazard quotient for any of these four pesticides is 0.02.

The weather and pesticide use at the time of the monitoring are consistent with historical patterns in the Lompoc area. The predominant wind direction was from the northwest-west and the majority of the pesticides were applied in the agricultural area to the west of the city. The Northwest and West monitoring sites had the highest hazard indices, consistent with the meteorological and pesticide use patterns for the area. Monitoring occurred for 10 weeks during the highest use period for most pesticides.

While concentrations for other locations and time periods cannot be quantified, some qualitative conclusions are possible. This study was designed to monitor potentially higher-risk pesticides, in higher-risk areas, during a higher-risk period. This study monitored pesticides that are among the highest in volatility, toxicity, and use for the Lompoc area, the factors most critical to determining inhalation risk. Most other pesticides used in the Lompoc area will have lower risk. The monitored pesticides also account for most of the pesticide use in the Lompoc area. For 2000, fumigants (monitoring described in Volume 1) account for 68% of total pesticide use, the monitored pesticides account for 10% of total use, with the unmonitored pesticides accounting for 22% of total use.

Few other areas within the city of Lompoc should have higher risk than documented here. The monitoring sites encompass an area approximately 1.1 square miles, approximately 17% of the area of the city south of the airport. Approximately 0.15 square miles, or two percent of the city south of the airport is located to the west of the monitoring sites and may have higher air concentrations than those documented here due to closer proximity of the agricultural area. However, air concentrations within this area may only be slightly higher. There was less than 50% difference in hazard indices between the Central and other monitoring sites, with approximately one mile separation.

Daily pesticide use may indicate the acute risk. For individual pesticides monitored, a few may have higher air concentrations on individual days because a few pesticides had other days with higher amounts applied. The acute risk for chlorothalonil, cycloate, iprodione, permethrin, and vinclozolin is likely higher than documented here since some days not monitored had two to four times more use. However, since the highest acute hazard quotient for any of these five pesticides was 0.0008, it is unlikely that these or any of the other pesticides monitored with reported applications exceed an acute hazard quotient of one. The acute risk for diazinon, dicofol, ethalfluralin, fonofos, and trifluralin during other periods cannot be estimated since they were detected, but no applications were reported during the monitoring period.

Monthly pesticide use may indicate the subchronic and chronic risk. A few pesticides monitored may have higher average monthly air concentrations because other months had higher use than the monitored months. The subchronic and chronic risk for cycloate, dicloran, and PCNB is likely higher than documented here because they had months with approximately twice as much use as the monitored months. However, since the highest subchronic or chronic hazard quotient for any of these pesticides is 0.04, it is unlikely that these or any of the other pesticides monitored with reported applications exceed a hazard quotient of one. The subchronic and chronic risk for diazinon, dicofol, ethalfluralin, fonofos, and trifluralin cannot be estimated during other periods since they were detected, but no applications were reported during the monitoring period.

It is likely that this monitoring represents the upper end of the cumulative or combined risk of all monitored pesticides for 2000. Other days, weeks, or months (acute, subchronic, and chronic exposure) in 2000 should have comparable or lower cumulative risk than documented here. As an indication of cumulative acute exposure, the monitoring period included the second and third highest daily use (352 lbs and 294 lbs) for all monitored pesticides combined, and are within three percent of the highest daily use (361 lbs) during 2000. Most of the monitoring occurred

during June and July. As an indication of subchronic exposure, June was the highest use month in 2000 for the monitored pesticides, 3,052 lbs. May and July through September had slightly lower use (2,822 lbs – 3,036 lbs), and the remaining seven months had less than 2,000 lbs each. Assuming the meteorology remains comparable throughout the year, the relative risk should be proportional to pesticide use. While individual pesticides may have higher concentrations and risk during periods not monitored, the cumulative risk is probably lower. The chronic risk estimates assume the 10-week concentrations during the monitoring period occur throughout the year, another health-protective assumption incorporated in the hazard index. While overall pesticide use has increased over the last several years, the fumigants account for most of the increase. Use of other pesticides has decreased over the last several years. If this trend continues, the cumulative risk from non-fumigant pesticides should also decrease.

The monitoring data as well as the pesticide use data for periods not monitored all indicate that the inhalation risk from pesticides monitored in the Lompoc area is low. However, as with all scientific studies, these risk estimates have uncertainties. Key uncertainties in the toxicological data include the absence of information for some potential toxic effects such as hormone or immune response disruption. Several of the pesticides may also interact in an unexpected manner. The key uncertainty in the monitoring data is the absence of information for pesticides not monitored. In addition, the risk from other routes of exposure such as ingestion or absorption through the skin is outside the scope of this study. More stagnant meteorological conditions may occur during the winter and may lead to comparable air concentrations with lower pesticide use. These uncertainties cannot be quantified. Therefore, the effect of these uncertainties on the risk estimates cannot be determined.

This study and monitoring from other areas in the state indicate that pesticide air concentrations in Lompoc are less than other areas. DPR manages pesticides statewide based on the areas or populations at greatest risk. Monitoring and control of pesticides in the higher-risk areas will provide adequate protection for Lompoc. No further pesticide monitoring or investigation in the Lompoc area is warranted.

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