Department of Pesticide Regulation
Environmental Monitoring Branch
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AIR MONITORING NETWORK STUDY DURING 2017 - 2018: AMBIENT AIR MONITORING FOR PESTICIDES IN MULTIPLE CALIFORNIA COMMUNITIES
Study # 257

January 2017

I. INTRODUCTION

The Department of Pesticide Regulation (DPR) is the public agency responsible for protecting California and its residents from adverse health effects caused by the use of pesticides. In February 2011, as part of DPR's legal requirements for "continuous evaluation" of currently registered pesticides, DPR implemented the Air Monitoring Network (AMN) for measuring pesticides in three agricultural communities every week. The AMN monitors many pesticides and breakdown products of the greatest health concern in communities of highest use. The AMN results supply data needed to accurately determine chronic exposures to various pesticides. These data gaps exist because past studies by the California Air Resources Board (ARB) and DPR usually consisted of two types of sampling better designed to estimate acute and subchronic exposures: application-site and seasonal ambient air monitoring, respectively. For application-site monitoring, air is monitored next to applications of a specific pesticide for several days to estimate acute exposures. For seasonal ambient monitoring, air samples are collected for a specific pesticide or two for several weeks in communities near high pesticide-use regions and during high pesticide-use periods to estimate seasonal exposures. With these data, DPR estimates subchronic pesticide exposures. Since long-term data were not available prior to the AMN, DPR extrapolated the short-term concentrations detected in these studies to estimate concentrations associated with annual (or chronic) and lifetime exposures. The AMN results provide the data necessary for DPR to:

- More accurately estimate subchronic, chronic, and lifetime pesticide exposures,
- Assist in assessing potential health risks,
- Develop measures to mitigate these risks, and
- Evaluate the effectiveness of regulatory requirements.

Additionally, previous application-site and seasonal ambient air monitoring studies were usually designed to sample for single pesticides while the AMN is designed to sample for 31 pesticides and 5 pesticide breakdown products over a longer period of time.

In June 2016, the California legislature increased DPR's funding to enhance the current AMN in two ways. First, the increased funding allows DPR to increase the number of communities it monitors from three to eight until June 30, 2018. Both DPR and ARB will monitor the eight AMN sites: DPR will operate the monitoring stations in three communities, while ARB will be responsible for monitoring at five communities.

Second, since children may be more susceptible to the effects of pesticide exposure, DPR will give selection preference to school locations, which will enable DPR to monitor the potential exposure to children in areas of high pesticide use. In addition, when regional use is similar, communities with more economic and environmental pollution burdens will be selected over communities with lower based on their environmental justice rating (as described below).

II. OBJECTIVES

The primary objectives of the AMN include:

1. Identify common pesticides in air and determine seasonal, annual, and multiple year concentrations.
2. Compare air concentrations to sub-chronic and chronic human health screening levels.
3. Estimate cumulative exposure to multiple pesticides with common modes of action.
4. Evaluate air concentrations with pesticide use and local weather patterns.

III. PERSONNEL

DPR's standard project organization and responsibilities are described in Segawa (2003). This project is under the overall management of Pam Wofford, Environmental Program Manager I, (916) 324-4297, pam.wofford@cdpr.ca.gov. Other key personnel assigned to this project include:

Project Supervisor:	Edgar Vidrio
Project lead:	Kenneth D. King
Field Coordinator:	Christopher Collins
Statistician:	Jing Tao
Laboratory Liaison:	Sue Peoples
Analytical Laboratories:	California Department of Food and Agriculture (CDFA), Center for Analytical Chemistry
	California Air Resources Board (ARB) Monitoring and Laboratory Division Organic Laboratory Section

IV. STUDY PLAN

A. General Overview

The eight AMN sampling sites will be operated by either DPR (three communities) or ARB (five communities). At each monitoring site, one 24-hour sample will be collected by ARB or DPR personnel each week. The starting day will vary each week with the actual start dates being randomly selected. Sampling start times will most likely vary by week and by site as the site operator will dictate actual sampling start time, but sampling time will normally begin between the hours of 9:00 a.m. to 2:00 p.m.

Monitoring sites must meet the following minimum criteria:

- The location of sample collection meets all U.S. EPA ambient air siting criteria
    - 2 to 15 meters above ground
    - At least 1 meter horizontal and vertical distance from supporting structure
    - At least 20 meters from trees
    - Distance from obstacles should be at least twice the obstacle height
    - Unobstructed air flow for 270°
- Accessible to sampling personnel during time of sampling
- Accessible to electrical outlets
- Secure from equipment loss or tampering
- Permission of site operator/owner

Preference will be given to monitoring sites that also meet the following criteria:

- School, day care center, or other "sensitive site"
- Located on the edge of the community and/or adjacent to agricultural fields

B. Communities Selected for Monitoring

DPR evaluated 1,267 communities for selection and ranked them based on objective data, using criteria that can be quantified, validated, and verified. DPR ranked the monitored communities based on the following criteria and selected eight for the AMN:

- Two sets of communities were selected (four communities per set):
    - One set was based on 2012-2014 use of 4 fumigants – 1,3-dichloropropene, chloropicrin, methyl bromide and MITC-generators
    - One set was based on 2012-2014 use of 11 organophosphates – acephate, bensulide, chlorpyrifos, DDVP, diazinon, dimethoate, malathion, methidation, naled, oxydemeton-methyl, phosmet and S,S,S-tributyl phosphorotrithioate.
- For all communities considered, reported pesticide use was calculated for 3 zones:
    - Use within the community boundary (community zone)
    - Use between the community boundary and 1 mile of community boundary (local zone)

    - Use between 1 mile of community boundary and 5 miles of community boundary (regional zone)
- The use density (lbs/sq mi) was determined by pesticide, year, and zone - for each community.
- Using data from the nearest California Irrigation Management Information System (CIMIS) station, the average wind speed was used as a weighting factor.
- Each community was ranked from highest to lowest community (1 to 1,267) for each zone and assigned a final ranking based on the average rank of the three zones.

DPR also considered environmental justice factors when selecting the eight communities to be included in the AMN. DPR used the Office of Environmental Health Hazards Assessment (OEHHA) Environmental Health Screening Tool: CalEnviroScreen Version 2.0 (CES 2.0) Population Characteristics (PC) percentile to identify communities that may have more vulnerable inhabitants. The CES 2.0 PC percentile for any California census tract provides the following parameters: percent of children and elderly in the population, percent of low birth-weight births, and the rates of asthma emergency department visits, educational attainment, linguistic isolation, poverty, and unemployment (OEHHA, 2014). For DPR's AMN community selection rankings, an average of all PC percentiles from all census tracts bisecting a community was utilized.

The top 30 communities for fumigant use and organophosphate use for 2012-2014 are listed in Table 1.

Table 1. Communities with the highest adjusted use rankings for four fumigants and 11 organophosphates (2012-2014 data) grouped by region (use ranking was adjusted for wind speed and use density factors). In parentheses, average CalEnviroscreen 2.0 Population Characteristics percentiles are also given for each community.

Communities (CES 2.0 PC Percentile)	County	Adjusted Use Ranking
Fumigants		
El Rio (42.6), Camarillo (26.3), Oxnard* (68.7)	Ventura	2,5,19
Watsonville Area (10 communities, including Watsonville* (62.8))	Monterey, Santa Cruz	4 - 29
Santa Maria* (54.1), Guadalupe (73.3), Woodlands (30.0), Nipomo (37.7), Callander (30.0), Orcutt (22.4)	Santa Barbara, San Luis Obispo	9, 13, 17, 22, 23, 28
Mettler (37.1), Edmundson Acres (83.0), Weedpatch (92.1), Arvin (82.6), Rosedale (6.0), Lamont (83.1)	Kern	1, 3, 6, 18, 24, 30
Macdoel (54.7), Mount Hebron (54.7)	Siskiyou	7, 9
Cuyama (51.7), New Cuyama (51.7)	Santa Barbara	12, 21
Organophosphates		
Guadalupe (73.3), Woodlands (30.0), Santa Maria* (54.1), Callendar (30.0), Garey (23.4)	Santa Barbara, San Luis Obispo	1, 2, 15, 26, 28
Chualar (69.7), Gonzalez (67.7)	Monterey	3, 12
Tulare–Kingsburg area (20 communities)	Tulare	4-30
San Joaquin (82.4), Tranquility (82.4), Cantua Creek (82.4)	Fresno	10,15,19
Hamilton City (73.4)	Glenn	11
Lost Hills (78.2), Shafter* (69.8)	Kern	17, 27
Seeley (83.4)	Imperial	23

Based on the criteria above, DPR selected the following eight communities for the air monitoring network:

Communities selected based on statewide fumigant use rankings for selected geographic regions:

1. Santa Maria (Santa Barbara County)
2. Cuyama/New Cuyama (Santa Barbara County)
3. Watsonville Area (Monterey County)
4. El Rio/Oxnard (Ventura County)

Communities selected based on statewide organophosphate use ranking for selected geographic regions:

1. Chualar (Monterey County)
2. Lindsay (Tulare County)
3. San Joaquin (Fresno County)
4. Shafter (Kern County)

Santa Maria is located in Santa Barbara County, approximately 12 miles east of the Pacific Ocean. Of the 99,553 residents in 2010, 31% were below 18 years old and 9.4% were above 65. The average CES 2.0 PC percentile for Santa Maria was 54.
The major crops in the area are strawberries and cole crops.

The monitoring site is located in a private building at an ARB air quality monitoring station. The address is 906 S. Broadway, Santa Maria.

Cuyama (or New Cuyama) is a census-designated place (CDP) (0.46 m^2 in area) (or 0.71 m^2 in area) located about 45 miles east of Santa Maria in a valley. The 2010 population was 57 (517), of which 25% were below 18 and 9% were above 65 (31% were below 18 and 12 % were above 65). The average CES 2.0 PC percentile for Cuyama was 51. The major crops in the area are carrots and leafy greens.

The monitoring site is located at Cuyama Elementary School. The address is 2300 CA-166, Cuyama.

The Watsonville area site is located near the City of Watsonville and Las Lomas CPD. Watsonville (6.8 m^2 in area) is located in Santa Cruz County and had a 2010 population of 51,199 of which 31% was below 18 and 8% was above 65 and has a CES 2.0 PCP of 63. Las Lomas is a CDP (1 m^2) located in Monterey County which had a 2010 population of 3,024 of which 33% were below 18 and 6% were above 65 and has a CES 2.0 PCP of 72. The major crops in the area are vegetables, leafy greens and strawberries.

The monitoring site is located at the Ohlone Elementary School approximately 2 miles south of the Watsonville City boundary and 1 mile west of Las Lomas and is located in Monterey County. The address is 24 Green Valley Road, Watsonville.

El Rio is a CDP (2 m^2 in area) just northeast of Oxnard with a 2010 population of 7,198 of which 30% was below 18 and 9% was above 65. Oxnard is a city (39.2 m^2 in area) located on the southern coast just south of the city of Ventura in Ventura County. The 2010 population was 197,899 of which 30% was below 18 and 8% was above 65.The average CES 2.0 PC percentile for Oxnard is 69. The average CES 2.0 PC percentile for El Rio is 45. The major crops in the area are vegetables, greenhouse flowers and plants and strawberries.

The monitoring site is located at Rio Mesa High School within the El Rio CDP boundary. The address is 545 Central Ave, Oxnard.

Chualar is a CDP (0.63 m^2 in area) in the Salinas Valley in Monterey County about 10 miles southeast of Salinas. Elevation is 115 feet above sea level. The population in 2010 was 1,190, of which 36% was below 18 and 5% was above 65. The average CES 2.0 PC percentile for Chualar is 70. The major crops in the immediate area around Chualar are cole crops, leafy greens, and other vegetables.

The monitoring site is located near a water district well on Lincoln Street (eastern edge of the city) that is about 0.1 miles from Chualar Union Elementary School.

Lindsay is a city in Tulare County (2.6 m^2 in area) with a 2010 population of 11,768, of which 38% was below 18 years old and 7.5% was above 65. The average CES 2.0 PC percentile for Lindsay is 85. It is located on the eastern side of the San Joaquin Valley about 10 miles east of Tulare. The elevation is 387 feet. The major crops in the immediate area are citrus orchards.

The monitoring site is located at Jefferson Elementary School. The address is 333 North Westwood Ave, Lindsay.

San Joaquin is a city (1.15 m^2) located in Fresno County approximately 25 miles southwest of the city of Fresno. The population in 2010 was 4001, of which 41% was below 18 and 4% was above 65 years. The average CES 2.0 PC percentile for San Joaquin is 82. It is at an elevation of 174 feet and the major crops in the area are alfalfa, almonds and cotton.

The monitoring site is located at San Joaquin Elementary School. The address is 8535 9th Street, San Joaquin.

Shafter is a city (18 m^2 in area) located approximately 18 miles west-northwest of Bakersfield in Kern County. The elevation is 351 feet, with approximately 7 inches of precipitation annually. In 2000, the population was 12,736 of which 25.7% was below 18 and 12.4% was above 65 years of age. The average CES 2.0 PC percentile for Shafter is 70. The major crops in the immediate area around Shafter are almonds, grapes, and alfalfa.

The monitoring site is located near a city well next to Shafter High School. The address is 526 Mannel Ave, Shafter.

See Appendix A for maps of the monitoring locations and reported pesticide use within 5 miles of each community selected for monitoring. The maps present the reported use of fumigants or organophosphates around each community.

C. Air Sampling Equipment and Method

The monitoring equipment will be located at a site at least 65 ft from trees, have a distance from obstacles at least twice the obstacle height, and have unobstructed air flow for 270° around the air sampling equipment.

Air samples will be collected via three different sampling methods. The first method (sampling method #1), which samples for target analytes in the multi-pesticide residue analysis, will use a Met One Instrument® 3-channel pesticide sampler pulling air through channel 1 at a rate of 15 liters per minute (L/min) attached to a hand-packed Teflon cartridge containing 30 milliliters (mL) of XAD-4 sorbent resin material. The second method (sampling method #2), will sample for MITC and will use manufactured pre-packed 200/1800 milligram (mg) coconut charcoal tubes with sealed glass end tips attached to channel 2 of the Met One Instruments® 3-channel pesticide sampler set to a flow rate of 1.5 L/min. The third method (sampling method #3), will sample for chloropicrin and use a manufactured pre-packed 400/200 mg XAD-4 tubes with sealed glass end tips attached to channel 3 of the Met Instruments® 3-channel pesticide sampler set to a flow rate 50 milliliters per minute (mL/min). The forth method (sampling method #4), will sample for target analytes in the volatile

organic compound (VOC) analysis, and will use a vacuumed 6-L SilcoCan® canister connected to a Xonteck® Model 901 Canister Sampler set at an air flow rate of 7.5 mL/min for a 24-hour period.

An equipment enclosure will house the Xonteck® Model 901 Canister Sampler and SilcoCan® canisters (Restek cat. no. 24142-65). The enclosure will prevent damage to air sampling equipment from sunlight, rainfall, and fog during the long-term monitoring study. Due to its size and durability, the Met One Instruments® 3-channel pesticide sampler will be placed outside of, but in close proximity to, the equipment enclosure.

Sample labels printed with the study number and a sample tracking number will be secured to the outside of all sample tubes and canisters. When air sampling commences at each monitoring site, the sample tracking number, date, time, staff initials, weather conditions, and air sampler flow rate will be documented on a chain of custody (COC) form as described by Ganapathy (2004). At the end of each sampling period staff will record the date, time, staff initials, and ending flow rate on the COC form. Weather conditions and other pertinent information that may affect sample results will be recorded on the COC or in a field note book.

Once samples are collected, open tube or cartridge ends will be tightly capped with appropriate end caps and the canister's flow will be closed. Canisters will be transported at ambient conditions. All sample tubes or cartridges will be placed into an insulated storage container containing dry ice and remain frozen until transported to the West Sacramento facility where they will be checked-in and placed into a freezer until delivered to the appropriate laboratory for analysis. Sample handling-shipping and tracking procedures will be followed as defined by Jones (1999) and Ganapathy (2005), respectively.

D. Field Sampling Quality Control

Three types of quality control samples will be routinely collected in the field over the course of the air monitoring study: trip blanks, fortified field spikes, and co-located duplicate samples. A trip blank sample is a "blank" sample tube or canister containing no pesticide residue. Upon collection of all field samples for that week, the end caps of a trip "blank" are momentarily removed or broken and the tube is then immediately re-capped. The canisters remain unopened. Air is not pulled through any of the trip blank samples. The "blank" samples are placed with the study samples and transported together until receipt at the West Sacramento facility. If pesticide residue is detected in any of the blank samples, action will take place to reassess field and laboratory procedures.

Fortified field spikes are sample tubes that have an added known quantity of pesticides prepared and added by the laboratory. Following laboratory preparation, field spikes are transported at the beginning of the week's sampling period where they are stored on dry ice until needed. Fortified field spike tubes are then placed on the second set of air sampling pumps housed in the portable shelter and operated under the same conditions and time-frame as the primary air sampler pumps.

Comparison of the fortified sample and field sample pesticide recovery at the same monitoring location from the same type of air sampling pump will provide information on any change in the ability to recover the pesticides under field conditions. Should fortified field spike pesticide

recoveries fall outside the preset recovery control limits then a reassessment of the field and laboratory procedures would be conducted.
Duplicate samples are collected adjacent to the study samples under the same conditions and time-frame as the primary air sampler. Pesticide recovery from the duplicate and primary samples is used to evaluate laboratory analytical precision; samples with greater than 50% difference in pesticide residue concentration will result in reassessment of the field and laboratory procedures.

DPR considers data to be valid if it originates from an air sampler pump that displays less than a 20% difference from the observed starting and ending flow rate. A canister sample is considered to be valid if the pressure remaining in the canister after sampling is below -5 mmHg.

One of the three types of quality control sample will be collected at two sites every month. At the end of the sampling year this will result in at least twelve of each type of quality control sample, or equal to 12 percent of the number of samples collected.

An ARB quality assurance team will conduct a field audit of the sampler air flow rates.

E. Meteorological Monitoring

When available, meteorological data can be electronically downloaded from the National Weather Service, California Irrigation Management Information Systems (CIMIS) stations or from Air Resources Board (ARB) weather stations located adjacent to monitored communities. All weather stations collect hourly data on wind speed and direction, air temperature, and relative humidity. The CIMIS stations collect additional weather and environmental information including precipitation, solar radiation, barometric pressure, dew point, and soil temperature.

F. Pesticide Use Reporting

Pesticide use information within a 5-mile distance of each monitored community will be gathered on a township, range, and section basis to define the agricultural boundary for detected pesticide residues within a community. Universal use reporting required by DPR directs all agricultural pesticide applicators to submit detailed pesticide application information to the County Agricultural Commissioner's office in the county where the application occurs. Reported pesticide use information includes operator identification, date of application, county of application, pesticide product applied, amount of pesticide product applied, area/unit treated, site/commodity treated, field identification number, and locations using meridian, township, range, and section data. Detailed pesticide information is not required for applicators applying pesticides for rights-of-way, home, industrial, or commercial use.

V. ANALYTICAL METHODS

Multi-Pesticide Residue Analysis (Sampling method #1)
Table 2 lists the pesticides that are included in the California Department of Food and Agriculture Center for Analytical Chemistry (CDFA laboratory) multi-pesticide residue analysis using XAD-4 resin as the solid phase trapping medium. Analytes include a variety of fungicides, insecticides,

herbicides, and defoliants. The breakdown products of chlorpyrifos, diazinon, dimethoate, endosulfan and malathion are also included in the multi-residue analysis method. The XAD-4 resin samples will be extracted using ethyl acetate and extracts will be analyzed for pesticide residues using gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-mass spectrometry (LC-MS) methods as described in method EMON-SM-05-0021 (CDFA, 2012)

MITC Chemical Analysis (Sampling method #2)

SKC Inc® coconut charcoal sample tubes will be analyzed for residues of MITC as described in analytical method EMON-SM41.9 (CDFA, 2004). MITC extraction from the sorbent medium involves using carbon disulfide in ethyl acetate with subsequent analysis using GC with a nitrogen/phosphorous detector.

Chloropicrin Chemical Analysis (Sampling method #3)

SKC Inc® XAD-4 sample tubes will be analyzed for residues of chloropicrin as described in CDFA Method: EM16.0 (CDFA, 1999). Each tube will be desorbed in hexane and analyzed by gas chromatograph equipped with an electron capture detector (GC/ECD) as described in the laboratory analysis section.

Volatile Organic Compound Analysis (Sampling method #4)

ARB's Organic Laboratory Section will analyze the canisters for volatile organic compounds using a method similar to United States Environmental Protection Agency's (U.S. EPA) method TO-15 (U.S. EPA, 1999). Table 3 lists the pesticides that are included in the volatile organic compound analysis.

Table 2. Target analytes in multi-pesticide residue analysis with XAD-4 or charcoal resin.

Pesticide	Product Name	Pesticide Group	Chemical Class
Sampling method #1			
Acephate	Orthene	Insecticide	Organophosphate
Bensulide	Prefar	Herbicide	Organophosphate
Chlorothalonil	Bravo	Fungicide	Chloronitrile
Chlorpyrifos	Dursban	Insecticide	Organophosphate
Chlorpyrifos Oxygen Analog	-		
Chlorthal-dimethyl	Dacthal	Herbicide	Phthalate
Cypermethrin	Demon	Insecticide	Pyrethroid
Diazinon	Various names	Insecticide	Organophosphate
Diazinon Oxygen Analog	-		
Dicofol	Kelthan	Insecticide	Organochlorine
Dimethoate	Cygon	Insecticide	Organophosphate
Dimethoate Oxygen Analog	-		
Diuron	Karmex	Herbicide	Urea
Endosulfan	Thiodan	Insecticide	Organochlorine
Endosulfan Sulfate	-		
EPTC	Eptam	Herbicide	Carbamate
Iprodione	Rovral	Fungicide	Dicarboximide
Malathion	Various names	Insecticide	Organophosphate
Malathion Oxygen Analog	-		
Methidathion	Supracide	Insecticide	Organophosphate
Metolachlor (S-metolachlor)	Dual	Herbicide	Chloracetanilide
Naled as dichlorvos (DDVP)	Dibrom, Vapona	Insecticide	Organophosphate
Norflurazon	Solicam	Herbicide	Pyridazinone
Oryzalin	Surflan	Herbicide	Dinitroaniline
Oxydemeton-methyl	Metasystox-R	Insecticide	Organophosphate
Oxyfluorfen	Goal	Herbicide	Diphenyl ether
Permethrin	Ambush	Insecticide	Pyrethroid
Phosmet	Imidan	Insecticide	Organophosphate
Propargite	Omite	Insecticide	Organosulfite
Simazine	Princep	Herbicide	Triazine
SSS-tributylphosphorotrithioate	DEF	Defoliant	Organophosphate
Trifluralin	Treflan	Herbicide	Dinitroaniline
Sampling method #2			
MITC	Vapam, K-Pam, Dazomet	Fumigant	
Sampling method #3			
Chloropicrin		Fumigant	Halogenated organic

Table 3. Target analytes in canister residue analysis (Sampling method #4).

Pesticide	Product Name	Pesticide Group	Chemical Class
1,3-dichloropropene	Telone, Inline	Fumigant	Halogenated organic
Methyl Bromide		Fumigant	Halogenated organic

C. Method Detection Limit and Reporting Limit

The method detection limit (MDL) is the lowest concentration of a pesticide (analyte) that a chemical method can reliably detect. The laboratory determines 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 is analyzed at least seven times, and the MDL is determined by calculating the 99% confidence interval of the mean. This procedure is described in detail in U.S. EPA (1990). The limit of quantitation is set at 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 MDLs and limits of quantitation for each pesticide are given in Table 4.

Table 4. Detection limits and quantitation limits for the monitored pesticides. Detection and quantitation limits are approximate for a 24-hour sample and will vary with the amount of air sampled and interferences present.

Pesticide or Breakdown product	Method Detection Limit (ng/m^3)	Quantitation Limit (ng/m^3)
Acephate	1.02	9.3
Bensulide	1.39	9.3
Chlorothalonil	13.7	23.1
Chloropicrin	222	2,780
Chlorpyrifos	5.05	23.1
Chlorpyrifos oxygen analog	2.92	9.3
Chlorthal-dimethyl	1.67	23.1
Cypermethrin	4.68	23.1
Diazinon	1.16	9.3
Diazinon oxygen analog	2.08	9.3
Dichlorvos (DDVP)	3.24	23.1
1,3-Dichloropropene	45.4*	136.2*
Dicofol	2.13	23.1
Dimethoate	2.31	9.3
Dimethoate oxygen analog	1.94	9.3
Diuron	5.14	9.3
Endosulfan	3.24	23.1
Endosulfan sulfate	4.63	23.1
EPTC	1.67	23.1
Iprodione	1.06	23.1
Malathion	2.18	23.1
Malathion oxygen analog	1.30	9.3
Metam-sodium (MITC)	5.56	23.1
Methidathion	1.44	9.3
Methyl bromide	38.8*	116.4*
Metolachlor	2.73	9.3
Norflurazon	3.75	9.3
Oryzalin	1.39	23.1
Oxydemeton-methyl	2.31	9.3
Oxyfluorfen	6.39	23.1
Permethrin	7.22	23.1
Phosmet	7.96	9.3
Propargite	3.80	23.1
SSS-tributyltriphosphorotrithioate (DEF)	1.76	9.3
Simazine	1.20	9.3
Trifluralin	1.67	23.1

*The ARB laboratory is currently working on methods to reduce detection limits.

D. Quality Assurance

Prior to the analysis of field samples, the laboratory will validate the method by analyzing a series of spikes (samples containing known amounts of pesticides) to document the precision and accuracy of the methods. Trapping efficiency tests will be performed to ensure breakthrough (pesticides not adsorbed to the sorbent tube) does not occur and to check for chemical transformation of the adsorbed pesticides. Storage stability tests will be performed to document the degradation of samples between the time of sample collection and the time of sample analysis. The laboratory will include quality control samples with each batch of field samples analyzed, including blank samples (samples containing no pesticides) to check for contamination, and spikes to check the precision and accuracy.

For each analyte, upper and lower warning and control limits are set at ± 2 and ± 3 standard deviations derived from the average percent recovery, respectively, of the above mentioned replicates. During analyses of field samples quality control samples will also be submitted for analyses. Corrective action will take place if spiked quality control recovery levels fall outside the established preset limits.

VI. DATA ANALYSIS

A. Air Concentration Calculations

Pesticide concentrations in air will be calculated as 24-hr air concentrations by taking the weight of the pesticide analyte per sample medium (result from chemical analysis) and dividing this value by the volume of air pulled through the sample medium over the 24-hr sampling period. Concentrations will be reported in nanograms per cubic meter (ng/m^3). Samples below the limit of detection will be treated as having one-half the detection limit, except in cases where a specific pesticide is not detected and was not applied in the 5-mile pesticide use boundary. In this case this concentration will be assumed to be zero. Samples with concentrations less than the limit of quantitation (reporting limit), but greater than limit of detection will be reported as having a “trace” concentration detected. For calculation purposes, DPR will assume that trace detections contain a concentration that is the average of the quantitation limit and the detection limit.

Estimates for pesticide exposure at the seasonal and chronic levels will be made by staff toxicologists. Seasonal exposure will be estimated for each monitored community from individual 24-hr sample results by calculating the average concentration during peak use season for each pesticide. Chronic exposure will be estimated for each community from individual 24-hr sample results by calculating the average concentration of all sample results for 1 year for each pesticide.

B. Health Evaluation Methods

Pesticides can cause a variety of health effects when present at concentrations above health-protective levels. The pesticides included in the AMN were selected in part because (1) risk

assessments indicate the potential for high exposure or (2) they are high priority for risk assessment due to toxicity and/or exposure concerns. Some of the pesticides in the AMN can cause a variety of adverse effects, including respiratory illnesses, damage to the nervous system, cancer, and birth defects. No state or federal agency has established health standards for pesticides in air. Therefore, DPR in consultation with the Office of Environmental Health Hazard Assessment (OEHHA) and others has developed health screening levels for monitored pesticides to place the results in a health-based context (Table 5). A description of how the screening levels were calculated and the data used to determine the levels for each monitored chemical are presented in Appendix B.

DPR will compare the measured ambient air concentrations to human health screening levels to determine what, if any, action to take. Health screening levels are based on a preliminary assessment of possible health effects, and are used as triggers for DPR to conduct a more detailed evaluation. A measured air concentration below the screening level for a given pesticide would not be considered a significant health concern and the pesticide would not undergo further evaluation at that time. A measured concentration above the screening level would not necessarily indicate a significant health concern, but would indicate the need for a further, more refined evaluation.

Once a complete assessment of possible health risks is completed, regulatory target concentrations are established and supersede the screening levels. DPR puts measures in place based on the regulatory target concentration to limit exposures so that adverse effects can be avoided. Exceeding a regulatory target concentration does not necessarily mean an adverse health effect occurs, but it does indicate that the restrictions on the pesticide use may need to be modified. DPR normally establishes a regulatory target concentration after completing a formal risk assessment of a chemical's toxicity and potential exposures. DPR management determines a regulatory target concentration based on the risk assessment, as well as risk assessments from other agencies, pesticide use patterns, potential effects on use of alternative pesticides, and other factors. A regulatory target concentration is based on a more comprehensive evaluation than a health screening level. Therefore, a regulatory target concentration supersedes a health screening level (i.e. a specific pesticide and exposure duration will have either a regulatory target or a health screening level, but not both). Four of the pesticides monitored in the AMN (chloropicrin, methyl bromide, MITC, and 1,3-dichloropropene) have regulatory targets for one or more exposure periods.

The cumulative exposure and risk will be estimated using a hazard quotient and hazard index approach for pesticides that have a common mode of action (such as cholinesterase inhibitors). The potential risk of the measured concentrations of a pesticide in air was evaluated by comparing the air concentration measured over a specified time (e.g., 24 hours, 4 weeks, 1 year) with the screening level derived for a similar exposure (i.e., acute, subchronic, chronic). The ratio of measured air concentration of a pesticide to a reference concentration or screening level for that pesticide is called the hazard quotient (HQ). In this case,

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

If the HQ is greater than 1, then the air concentration exceeds the screening level and would indicate the need for further and more refined evaluation. Similarly, the risk from multiple pesticides (cumulative risk) is evaluated using the hazard index (HI) approach, which sums all of the HQs for the pesticides monitored.

$$HI = HQ_1 \text{ (pesticide 1)} + HQ_2 \text{ (pesticide 2)} + HQ_3 \text{ (pesticide 3)} + \ldots \text{ (and so forth)}$$

If the HI is greater than 1, this indicates that the cumulative toxicity of the multiple pesticides should be further evaluated and that potential health impacts may have been missed by only considering the pesticides individually.

This approach assumes that toxicity and risk of all monitored pesticides are additive, although only a subset of the monitored pesticides (including organophosphate insecticides and oxygen analog breakdown products toxic to the nervous system) are known to act in an additive manner.

The AMN collects samples for eight pesticides that have been designated as potential carcinogens by Proposition 65 (the Safe Drinking Water and Toxic Enforcement Act of 1986) or by the U.S. Environmental Protection Agency's (EPA) B2 list. Chemicals designated as potential carcinogens by Proposition 65 are: oxydemeton methyl, and propargite while chemicals designated as potential carcinogens by EPA's B2 list are: 1,3-dichloropropene, chlorothalonil, DDVP, diuron, Iprodione, and propargite. Cancer risk is expressed as a probability for the occurrence of cancer (e.g., 1 in 1,000,000 or 10^{-6}, 1 in 100,000 or 10^{-5}, etc.), and was estimated based on the following calculation for each pesticide.

Risk of single pesticide = (cancer potency) X (exposure)

Exposure for single pesticide = (air concentration) X (respiratory rate)

Risk of single pesticide = (cancer potency) X (air concentration) X (respiratory rate)

Total risk for AMN pesticides = (risk of pesticide 1) + (risk of pesticide 2)…

It is a standard default assumption that exposure to a carcinogen takes place over a lifetime, so DPR uses a default respiratory rate for an adult of 0.28 m^3/kg-day. The cancer potency (also called cancer slope factor) is used to estimate the risk of cancer associated with exposure to a carcinogenic substance and expressed in units of proportion (of a population) affected per mg of substance/kg body weight-day.

DPR has issued risk management directives for some pesticides that specify air concentration levels as regulatory targets, and these targets have been footnoted in the appropriate tables. DPR will use the data from this monitoring, in part, to determine the effectiveness of its mitigation measures in meeting these targets.

VII. EVALUATION OF RESULTS

The monitoring results will be evaluated to determine the exposure and risk from individual as well as multiple pesticides. The data will be compared to historical monitoring results from other areas in the state. DPR will also evaluate the results and pesticide use patterns at the time of monitoring to determine possible mitigation measures, as well as other potential areas and time periods for future monitoring.

Table 5. Health screening levels and regulatory targets for pesticides included in the monitoring.

Pesticide	24-hour acute screening level (ng/m^3)	Subchronic Screening Level (ng/m3)	Chronic screening level (ng/m3)
1,3-Dichloropropene	505,000*	14,000	9,000
Acephate	12,000	8,500	8,500
Bensulide	259,000	24,000	24,000
Chloropicrin	491,000*	2,300	1,800
Chlorothalonil	34,000	34,000	34,000
Chlorpyrifos	1,200	850	510
Chlorpyrifos OA	1,200	850	510
Chlorthal-dimethyl (DCPA)	23,500,000	470,000	47,000
Cypermethrin	113,000	81,000	27,000
DDVP	11,000	2,200	770
Diazinon	130	130	130
Diazinon OA	130	130	130
Dimethoate	4,300	3,000	300
Dimethoate OA	4,300	3,000	300
Diuron	170,000	17,000	5,700
Endosulfan	3,300	3,300	330
Endosulfan Sulfate	3,300	3,300	330
EPTC	230,000	24,000	8,500
Iprodione	939,000	286,000	286,000
Malathion	112,500	80,600	8,100
Malathion OA	112,500	80,600	8,100
Methidathion	3,100	3,100	2,500
Methyl Bromide	820,000*	19,400*	3,900
Metolachlor	85,000	15,000	15,000
MITC	66,000*	3,000	300
Norflurazon	170,000	26,000	26,000
Oryzalin	420,000	230,000	232,000
Oxydemeton methyl	39,200	610	610
Oxyfluorfen	510,000	180,000	51,000
Permethrin	168,000	90,000	90,000
Phosmet	77,000	26,000	18,000
pp-Dicofol	68,000	49,000	20,000
Propargite	14,000	14,000	14,000
Simazine	110,000	31,000	31,000
SSS-tributyltriphosphorotrithioate (DEF)	8,800	8,800	**
Trifluralin	1,200,000	170,000	41,000

*Regulatory target

**Pesticides have seasonal use only, so there is no chronic exposure.

VII. REFERENCES

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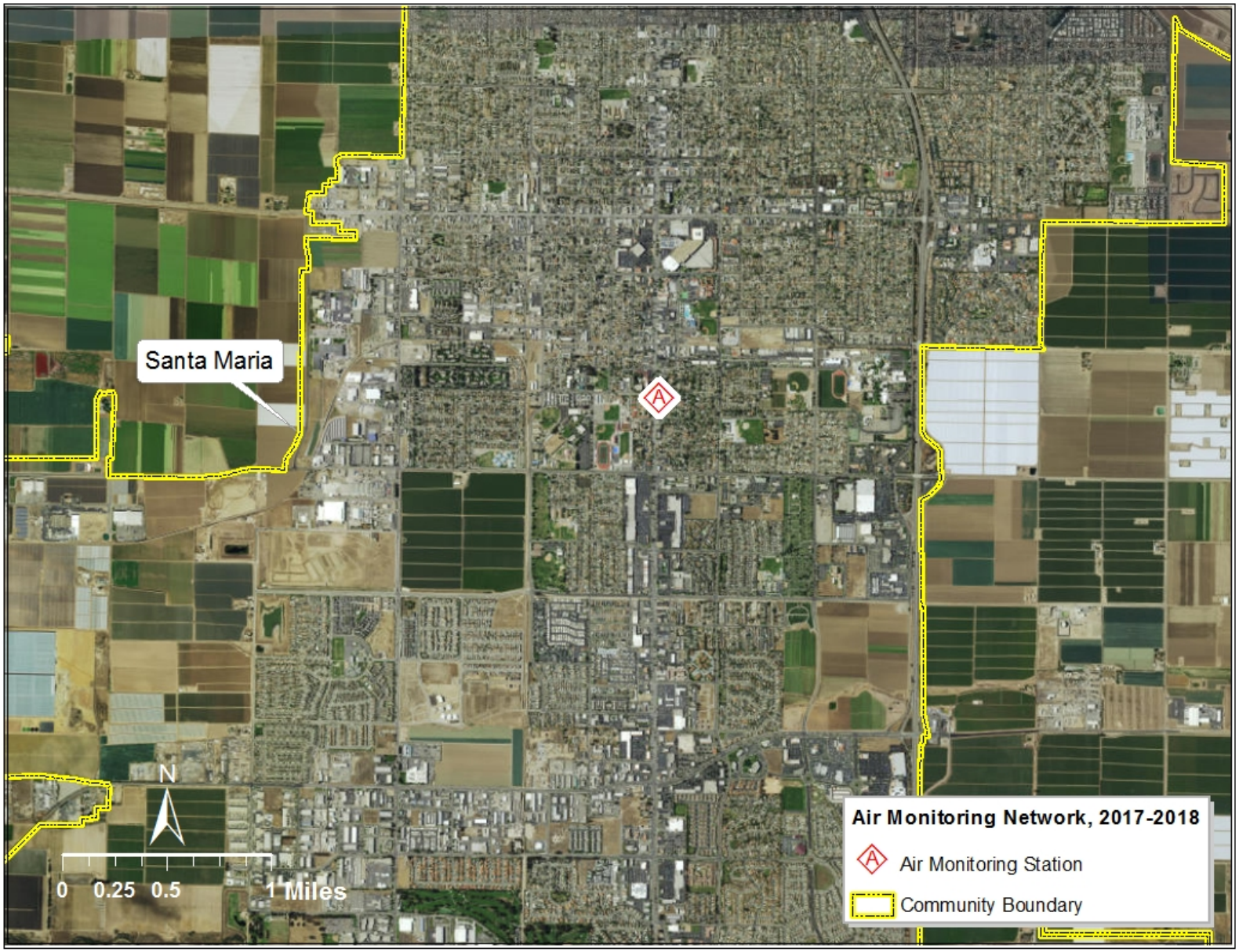
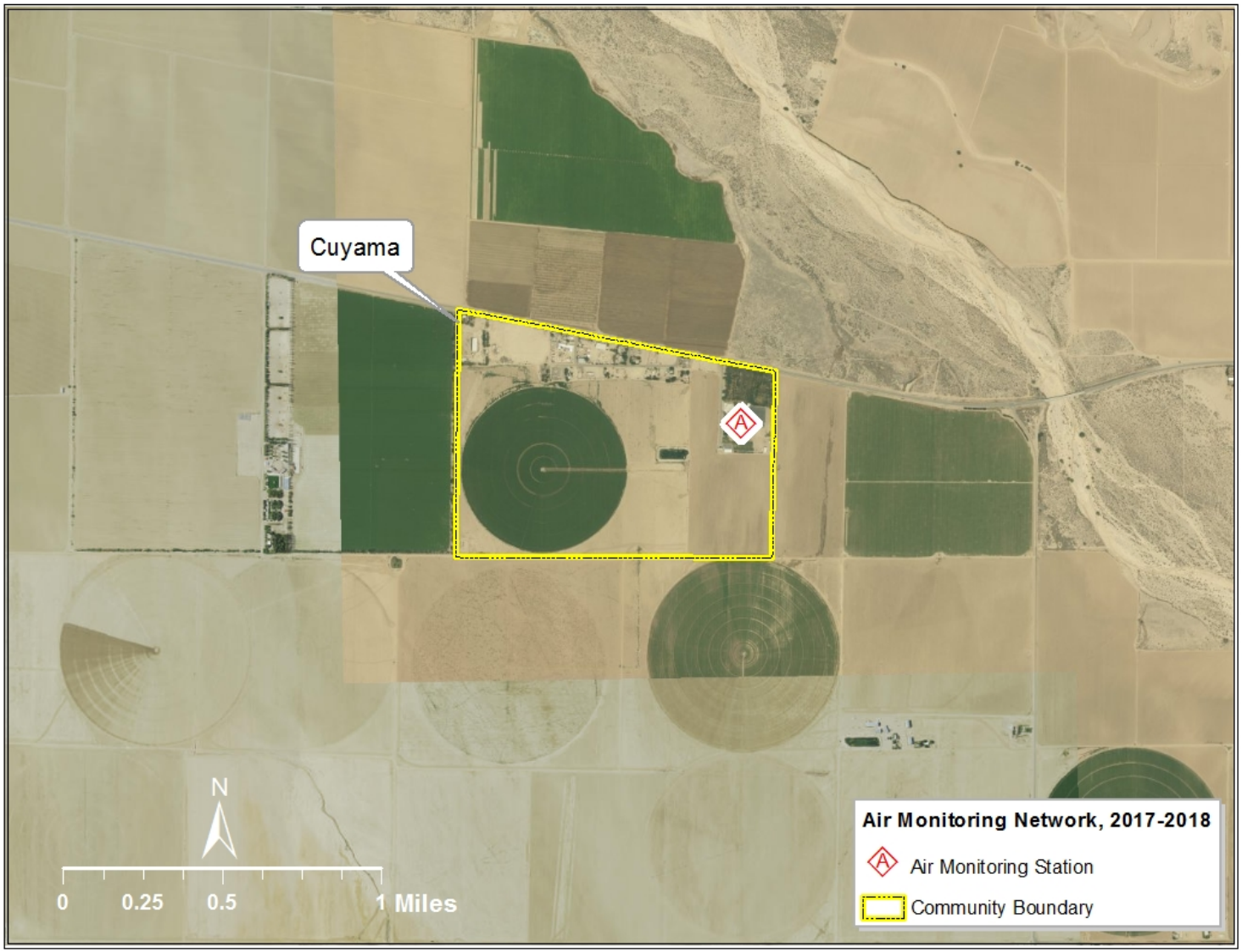
APPENDIX A

MAPS OF SELECTED COMMUNITIES TO MONITOR

Monitoring site location in the City of Santa Maria (Santa Barbara County)



Monitoring site location in Cuyama/New Cuyama (Santa Barbara County)

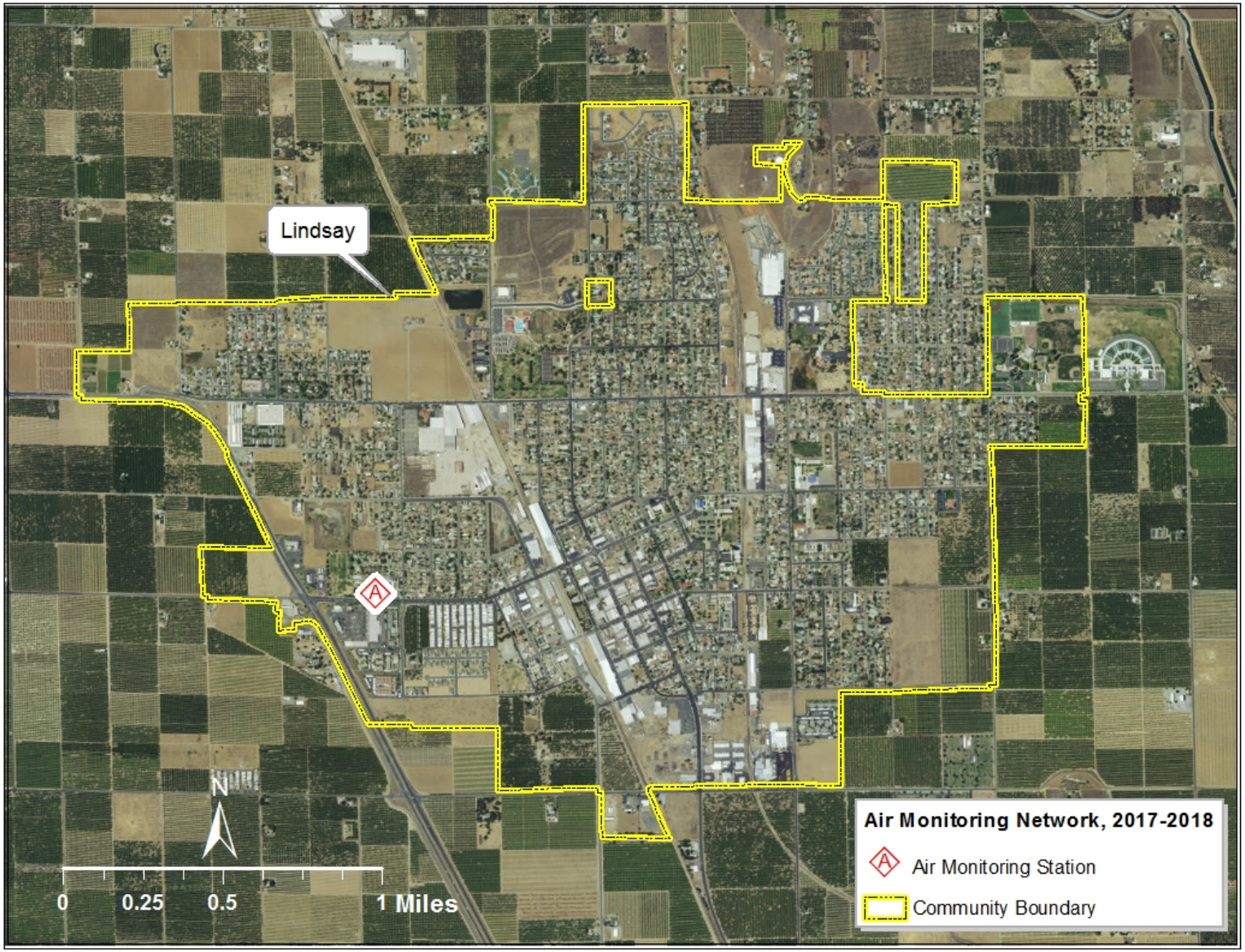


Monitoring site location in Watsonville Area (Monterey County)

Monitoring site location in El Rio/Oxnard (Ventura County)

Monitoring site location in Chualar CDP (Monterey County)

Monitoring site location in the City of Lindsay (Tulare County)



Monitoring site location in the City of San Joaquin (Fresno County)

Monitoring site location in the City of Shafter (Kern County)

APPENDIX B

DERIVATION OF SCREENING LEVELS

Health Evaluation Methods

No state or federal agency has established health standards for pesticides in air. Therefore, DPR 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.

In 1996, Congress passed major pesticide food safety legislation. This legislation, 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, the 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 10-fold to account for uncertainty in data relative to children. U.S. EPA generally sets the factor at 1-fold, 3-fold, or 10-fold, depending on the completeness and reliability of the data available to assess pre- or post-natal toxicity and depending on the potential for pre- or post-natal effects of concern .This additional factor has become known as the "FQPA factor" or "FQPA safety factor." Although the U.S. EPA uses this factor for evaluating pesticide food tolerances and dietary risk, the factor is applied to all potential sources of exposure to children. They have also established the FQPA factors for pesticides in the course of preparing the RED for specific chemicals. DPR evaluated the results of this project by considering the "FQPA factor" in addition to the screening levels following discussions with the LAG and TAG. These recommendations were also available for public comment.

The uncertainty factor approach used in generating the screening levels implicitly assumes that there is a threshold below which the toxic effect will not occur. This approach is not appropriate for carcinogenic chemicals that have a non-threshold mechanism of action. For these chemicals, the chronic screening level does not include carcinogenic effects, and a cancer potency value is derived for that chemical. The carcinogenic risk of these compounds is evaluated using a low dose extrapolation (non-threshold mechanism). In such an approach, the risk of cancer from exposure to a chemical is determined from the cancer potency of the chemical and the human exposure to the chemical. For each monitored chemical that ahs carcinogenic effects, the cancer potency is presented along with the screening levels. Cancer potency is expressed in the units of $(mg/kg\text{-}day)^{-1}$. Cancer risk is expressed as a probability for the occurrence of cancer (e.g., 1 in 1,000,000 or 10^{-6}, 1 in 100,000 or 10^{-5}, etc). It is a standard default assumption that exposure to a carcinogen takes place over a lifetime, so the default respiratory rate for an adult is used (0.28 $m^3/kg/day$).

Screening Levels
Acephate

DPR completed a RCD in 2008, but air exposure was not a significant part of the overall exposure and reference concentrations were not set. U.S.EPA released an RED in 2006. In that document, the results of a 4-week rat inhalation study were specified to evaluate inhalation exposures of any duration. Rats were exposed 6 hours per day, and it is assumed they were exposed 5 days per week. The NOAEL was 1.064 mg/m^3 for brain cholinesterase inhibition. U.S.EPA assigned an FQPA value of 1X. These values lead to the calculation of acute, subchronic, and chronic NOAELs of 0.266, 0.19, and 0.19 mg/m^3, and human equivalent NOAELs of 1.20, 0.85, and 0.85 mg/m^3, respectively. Applying the uncertainty factor of 100X leads to the calculation of acute, subchronic, and chronic screening levels of 12.0, 8.5, and 8.5 ug/m^3, respectively.

Bensulide

U.SEPA released an RED in 2006. The RED specified the use of a NOAEL of 5.5 mg/kg for maternal plasma cholinesterase inhibition in a rat oral developmental toxicity study as the basis for assessing short-term inhalation. The RED specified the use of a NOAEL of 0.5 mg/kg for plasma cholinesterase inhibition in a chronic oral dog study as the basis for assessing intermediate-term inhalation. The RED did not address chronic or long-term inhalation; however, since the dog study was chronic, it would be appropriate for chronic inhalation. The RED specified an FQPA factor of 1X and an overall uncertainty factor of 100X. Applying uncertainty factor of 100 and the RfD to RfC conversion factor of 4.7 results in acute, subchronic, and chronic screening levels of 259, 24, and 24 ug/m^3 respectively.

Chloropicrin

In 2010, DPR completed an evaluation of chloropicrin as part of the Toxic Air Contaminant process. The risk assessment was peer reviewed by the Scientific Review Panel. The assessment set RfCs for acute, subchronic, and chronic timeframes. These values will be used as the corresponding acute, subchronic, and chronic screening levels. A NOEL of 670 ug/m^3 for maternal effects (mortality, nasal discharge, decreased body weight, discolored lungs) in a rabbit inhalation developmental toxicity study was used as the basis for a 24-hour acute RfC of 6.1 ug/m^3 for children. A NOEL of 807 ug/m^3 for rhinitis in a 90-day rat inhalation toxicity study was used as the basis for a subchronic RfC of 2.3 ug/m^3 for children. A NOEL of 289 ug/m^3 for bronchietasis (chronic dilation of the bronchi with violent coughing) in a chronic mouse inhalation toxicity study was used as the basis for a chronic RfC of 1.8 ug/m^3 for children. The document also assessed cancer risk based on lung tumors in mice.

Chlorothalonil

U.S. EPA completed an RED on chlorothalonil in 1999. The RED addressed inhalation for all time periods with a NOAEL of 2 mg/kg (kidney toxicity, forestomach ulcers) in a two-year oral rat study, assuming 100% absorption. Using this NOAEL and a combined uncertainty factor of 100 (a factor of 10 to address interspecies variability and a factor of 10 to address intraspecies variability) results in a screening level of 34 ug/m^3 for all time periods. U.S. EPA assigned a FQPA safety factor of 1X. U.S. EPA classified chlorothalonil as likely to be a human carcinogen by all routes of exposure (based on

rat kidney tumors) and calculated a potency factor of 0.00766 $(mg/kg/day)^{-1}$. The RED uses both a potency factor and RfD approach for assessing carcinogenicity.

DPR completed a dietary RCD on chlorothalonil in 2004, which calculated a potency factor of 0.011 $(mg/kg/day)^{-1}$ for kidney tumors. This slightly higher potency factor was used in this analysis. Since the RCD is limited to dietary exposure, inhalation was not included. Inhalation exposure was evaluated in a comprehensive risk assessment (evaluates all routes of exposure and exposure scenarios) whose completion is pending completion of the non-dietary exposure analysis. The completion of this risk assessment could result in changes to the above screening levels.

Chlorpyrifos

U.S. EPA released a finalized RED in 2006. 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^3, and no effects were seen at any dose level, making 297 ug/m^3 a health protective NOAEL. For an acute screening level, the 297 ug/m^3 is adjusted by 6/24 to give a 24 hour NOAEL of 74 ug/m^3 and a screening level of 1.2 ug/m^3 (employs uncertainty factors of 10 each for inter and intraspecies uncertainty and corrects for differences in breathing rates). For the subchronic screening level, the value is adjusted by 5/7 to compensate for the 5 day out of 7-day exposure, leading to a screening level of 0.85 ug/m3. For chronic exposure, the IRED used a chronic oral dog study with a NOAEL 0.03 mg/kg for cholinesterase inhibition. This leads to an RfD of 0.0003 mg/kg and a screening level of 0.51 ug/m^3. U.S. EPA retained the FQPA safety factor of 10X.

U.S. EPA has assigned chlorpyrifos an "E" carcinogenicity classification, evidence of non-carcinogenicity.

Chlorthal dimethyl (Dacthal, DCPA)

U.S.EPA completed an RED on chlorthal dimethyl in 1998. Acute and subchronic toxicity were not addressed because they were not a concern (due to low toxicity). The RED used a NOAEL of 1.0 mg/kg for thyroid effects in a chronic oral rat study to assess chronic dietary exposure. An oral rabbit developmental toxicity study had a NOEL of 500 mg/kg (highest dose tested). This value will be used to assess acute exposure. A 90-day rat oral subchronic toxicity study had a NOEL of 10 mg/kg for liver effects, and this will be used to assess subchronic toxicity. The RED used an FQPA value of 1X and an overall uncertainty factor of 100X. Therefore, the acute, subchronic, and chronic NOELs to be used are 500, 10, and 1.0 mg/kg respectively. Applying the uncertainty factor of 100X and the RfD to RfC conversion factor of 4.7 results in acute, subchronic, and chronic screening levels of 23,500, 470, and 47 ug/m^3 respectively.

Cypermethrin

U.S. EPA released a revised RED in 2008. The RED stated that the NOAEL of 0.01 mg/L (10 mg/m^3) for body weight loss and salivation in a 21-day subchronic inhalation study in rats should be used to assess inhalation exposure scenarios of all durations. The RED also stated that an uncertainty factor of 3X should be applied to the above NOAEL to estimate a chronic NOAEL. In the study, exposure

occurred 6 hours a day, 5 days a week. To estimate an acute 24-hour NOAEL, 10 mg/m^3 is adjusted by 6/24, resulting in a NOAEL of 2.5 mg/m^3. An adjustment of 5/7 results in a subchronic NOAEL of 1.8 mg/m^3 for exposure 7 days a week. The application of the 3X factor results in a chronic NOAEL of 0.6 mg/m^3. Applying a correction factor of 4.5 to the NOAELs will result in human equivalent acute, subchronic, and chronic NOAELs of 11.3, 8.1, and 2.7 mg/m^3, respectively. Applying an uncertainty factor of 10 for interspecies variation and 10 for intraspecies variation results in acute, subchronic, and chronic screening levels of 113, 81, and 27 ug/m^3, respectively. U.S.EPA applied a FQPA safety factor of 1X.

U.S. EPA has designated cypermethrin as a "C" carcinogenicity classification (possible human carcinogen) but did not derive a cancer potency value.

Diazinon

The values for these screening levels were taken from a U.S. EPA IRED released in 2004. In this document, U.S. EPA determined that inhalation for all time periods should be evaluated using a 21-day rat inhalation study. The study used inhalation exposures of 6 hours per day, 7 days a week for 21 days. The LOAEL in this study is 0.1 ug/L (100 ug/m^3) for cholinesterase inhibition. U.S. EPA used a factor of 3 to derive a NOAEL from a LOAEL. Therefore, the NOAEL would be 33 ug/m^3. Normalizing to a 24-hour exposure results in a NOAEL of 8.33 ug/m^3 and a human equivalent NOAEL of 13.3 ug/m^3. This results in an acute, subchronic, and chronic screening level of 0.13 ug/m^3. U.S. EPA assigned a FQPA safety factor of 1X.

U.S. EPA has classified diazinon as "not likely to be carcinogenic to humans."

1,3-dichloropropene (1,3-D)

DPR has set RfCs for 1,3-D to support its ongoing control measures. The acute RfC of 505 ug/m^3 was calculated from nine inhalation subchronic, chronic and developmental toxicity studies that reported effects occurring at early time points. A critical endpoint value of 49 ppm was selected based on weight decrements first measured in male rats at 3 days. Applying the appropriate Regional Gas Dose Ratio (RGDR) scalar and adjusting for a 24-hr exposure day resulted in an HEC of 11 ppm and an RfC of 110 ppb (505,000 ng/m^3) for non-occupational exposure scenarios. This value was used as the acute screening level.

The critical inhalation endpoint for the evaluation of seasonal exposure risks was 16 ppm. This was based on the appearance of hyperplasia of the nasal respiratory epithelium in rats after 13 weeks of daily exposure (5 days/week, 6 hr/day). Application of the RGDR scalar resulted in a non-occupational HEC of 0.30 ppm and a RfC of 3 ppb (14,000 ng/m^3). This value was used as the seasonal screening level.

The critical inhalation endpoint for the evaluation of chronic exposure risks was 6 ppm. This was based on a 2-year inhalation mouse study that led to hyperplasia and hypertrophy of the respiratory epithelium and hyperplasia of the urinary bladder mucosa in mice. Application of the RGDR scalar resulted in a non-occupational HEC of 0.20 ppm and an RfC of 2 ppb (9,000 ng/m^3). This value was used as the chronic screening level.

1,3-D is classified as a probable human carcinogen by U.S. EPA and is listed as a carcinogen under Proposition 65. DPR has calculated a cancer potency of 0.014 $(mg/kg/day)^{-1}$, which assumed a portal of entry mode of action.

Dichlorvos (DDVP)

At the time DPR developed the dichlorvos screening level for the Parlier project, the U.S. EPA had scheduled an RED for release. In 2001, U.S. EPA U.S. released a risk assessment for the RED. The RED has since been released. The risk assessment specified the use of a NOAEL of 0.1 mg/kg from an oral rabbit developmental toxicity study (maternal mortality, decreased weight gain, and cholinergic signs) to evaluate short-term inhalation. This NOAEL would result in an acute screening level of 1.7 ug/m^3. (U.S. EPA used an uncertainty factor of 100 X, excluding the FQPA factor, for all exposure periods.) The risk assessment specified the use of a NOAEL of 0.05 mg/kg from an oral dog chronic toxicity study (cholinesterase inhibition) to evaluate intermediate-term inhalation. This NOAEL would results in a subchronic screening level of 0.85 ug/m^3. The risk assessment specified the use of a NOAEL of 50 ug/m3 (inhibition of brain cholinesterase) in a chronic rat inhalation study. Exposure took place 23 hours a day, 7 days a week. The amortized NOAEL is 48 ug/mg^3, and the resulting screening level would be 0.77 ug/m^3. U.S. EPA assigned a FQPA factor of 3X and classified DDVP as having suggestive evidence of carcinogenicity.

DPR completed a RCD for DDVP in 1996, with two subsequent addenda. In the RCD, DPR evaluated acute inhalation exposure using the NOAEL of 1250 ug/m^3 (cholinergic signs) in a rabbit inhalation developmental toxicity study. Exposure took place 23 hours a day, 7 days a week. Amortizing the exposure to 24 hours results in a NOAEL of 1200 ug/m^3. Using this NOAEL and a rabbit breathing rate of 0.54 $m^3/kg/day$ and a 100 X uncertainty factor results in an acute screening level of 11 ug/m^3. The same study, but with the lower NOAEL 250 ug/m3, was used to evaluate subchronic inhalation. This NOAEL would result in a subchronic screening level of 2.2 ug/m^3. The RCD used the same chronic inhalation study as was described for the U.S. EPA risk assessment, resulting in the chronic screening level of 0.77 ug/m^3. The DPR also developed a potency factor of 0.35 $(mg/kg/day)^{-1}$ based on leukemia in the rat. Since they were based on inhalation studies, the screening levels from the DPR RCD were used.

Dicofol (pp-Dicofol)

U.S. EPA completed a RED on dicofol in 1998. 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 ug/m^3. 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 49 ug/m^3. To evaluate long-term inhalation, the RED uses a NOAEL of 0.12 mg/kg for release of ACTH release from a chronic oral dog study. This NOAEL results in a chronic screening level of 20 ug/m^3. U.S. EPA assigned dicofol a carcinogen classification of C, possible human carcinogen, but recommended an RfD approach for assessing risk. U.S. EPA assigned an FQPA factor of 3X.

Dimethoate

U.S. EPA completed an RED for Dimethoate in 2006. The RED specified that the results of a 21-day rat inhalation study on omethoate should be used to evaluate acute and subchronic inhalation exposure to Dimethoate. Omethoate is the more toxic oxygen metabolic of dimethoate, so its use would be health protective. In the study, rats were exposed by nose 6 hours per day, 5 days per week, for 3 weeks. U.S. EPA used a benchmark dose extrapolation to determine a point of departure. The $BMCL_{10}$ for inhibition of brain cholinesterase calculated as 0.38 mg/m^3. This value is adjusted by 6/24 resulting in a 24 hour value of 0.095 mg/m^3. A further adjustment of 5/7 yields a subchronic value of 0.068 mg/m^3. An uncertainty factor of 10X can be used to estimate a chronic value of 0.0068 mg/m^3. Applying a correction factor of 4.5 to the $BMCL_{10}$s will result in human equivalent acute, subchronic, and chronic values of 0.43, 0.30, and 0.030 mg/m^3, respectively. Applying the conventional total uncertainty factor of 100 will result in acute, subchronic, and chronic screening levels of 4.3, 3.0, and 0.30 ug/m^3, respectively.

Diuron

U.S. EPA completed an RED on diuron in 1993. To evaluate short-term inhalation, the assessment uses a NOAEL 10 mg/kg for maternal toxicity in a rabbit developmental toxicity study. Applying this NOAEL, an uncertainty factor of 10 to address interspecies uncertainty, and a factor of 10 to address intraspecies uncertainty results in an acute screening level of 170 ug/m^3. To evaluate intermediate-term inhalation, the assessment uses a NOAEL 1.0 mg/kg for altered hematological values in the first 6 months of a chronic oral rat study. Applying this NOAEL, an uncertainty factor of 10 to address interspecies uncertainty, and a factor of 10 to address intraspecies uncertainty results in a subchronic screening level of 17 ug/m^3. To evaluate long-term inhalation, the assessment uses a LOAEL 1.0 mg/kg for altered hematological values in the same chronic oral rat study. U.S. EPA applied an uncertainty factor of 3 to estimate a NOAEL of 0.33 mg/kg. Applying this NOAEL, an uncertainty factor of 10 to address interspecies uncertainty, and a factor of 10 to address intraspecies uncertainty results in a subchronic screening level of 5.7 ug/m^3. U.S. EPA classified diuron as a likely human carcinogen (based on bladder and kidney tumors in rats and mammary tumors in mice) and derived a potency value of 0.0191 $(mg/kg/day)^{-1}$. U.S. EPA assigned an FQPA factor of 1X.

Endosulfan

DPR completed a risk assessment on endosulfan in 2008 under the Toxic Air Contaminant program. A 21-day rat inhalation study (nose only, 6 hours per day) was used as the basis for evaluating acute, subchronic, and chronic inhalation. Toxic effects in this study included various clinical signs of neurotoxicity and other signs of ill health (e.g. decreased body weight and food consumption). Using this study, the risk assessment established acute, subchronic, and chronic RfCs of 3.3, 3.3, and 0.33 ug/m^3, respectively. These values will be used as the corresponding screening levels.

EPTC

U.S. EPA completed an RED on EPTC in 1998. DPR has completed a RCD on EPTC. To evaluate short-term exposures, the RED used a NOAEL of 58 mg/m^3 for myocardial degeneration (heart muscle

damage) from a 90-day rat inhalation study with exposure 6 hours per day, 5 days peer week. This NOAEL results in an acute screening level of 230 ug/m^3. To evaluate intermediate-term exposures, 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 ug/m3. For intermediate-term exposures greater than 21 days, the RED used the same study, but a NOAEL of 8.3 mg/m^3 for clinical signs. This NOAEL results in a subchronic screening level of 24 ug/m^3. 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 8.5 ug/m^3. U.S. EPA has classified EPTC as not likely to be carcinogenic to humans. U.S. EPA assigned a FQPA factor of 10X.

Iprodione

An RED was completed on iprodione in 1998. The RED specified the use of a NOAEL of 20 mg/kg for developmental effects in a rat oral developmental toxicity study as the basis for assessing short-term inhalation. The RED specified the use of a NOAEL of 6.1 mg/kg for histopathological lesions in the male reproductive system and adrenal effects in males and females in a chronic oral rat study as the basis for assessing intermediate-term inhalation. The RED did not address chronic or long-term inhalation; however, since the rat study was chronic, it would be appropriate also for chronic inhalation. The RED specified an FQPA factor of 3X and an overall uncertainty factor of 100X. Applying uncertainty factor of 300X (does not include the FQPA factor) and the RfD to RfC conversion factor of 4.7 results in acute, subchronic, and chronic screening levels of 939, 286, and 286 ug/m^3 respectively. U.S.EPA has classified iprodione as a likely human carcinogen with a potency factor of 4.39 x 10^{-2} $(mg/kg/day)^{-1}$.

Malathion

U.S. EPA released a revised RED on Malathion in 2009. Inhalation exposure was evaluated based on the results of a 90-day rat inhalation study in which rats were exposed 6 hours per day, 5 days per week. The lowest dose in the study, 100 mg/m^3, was a LOAEL based on histopathological effects in the respiratory epithelium, and a NOEL for plasma and RBC cholinesterase inhibition. U.S. EPA recommended the use of this study to evaluate short term and intermediate term inhalation exposure and used a factor of 10 to derive an estimated NOAEL of 10 mg/m^3 for the histopathological effects. Using this derived NOAEL, adjusting for the 6-hour per day exposure results in an acute NOEL of 2.5 mg/m^3. Adjusting for exposure 5 days per week will result in a subchronic NOEL of 1.79 mg/m^3. The RED did not have an evaluation of chronic inhalation. One approach would be to apply an additional uncertainty factor of 10X to the subchronic NOEL for a chronic NOEL of 0.179 mg/m^3. Applying the correction factor of 4.5 to the NOAELs will result in human equivalent acute, subchronic, and chronic NOAELs of 11.25, 8.06, and 0.81 mg/m^3, respectively. Applying an uncertainty factor of 10 for interspecies variation and 10 for intraspecies variation results in acute, subchronic, and chronic screening levels of 112.5, 80.6, and 8.1 ug/m^3, respectively. U.S.EPA applied a FQPA safety factor of 1X.

Metam Sodium/MITC

While metam sodium is the active ingredient that is applied in agricultural settings, it converts to fumigant methyl isothiocyanate (MITC), which moves into the ambient air. Therefore, screening levels are set for MITC. DPR has completed a RCD on metam sodium and MITC. The RCD has undergone scientific peer review and has been accepted by the SRP. RELs were set in the RCD and reviewed by the SRP. DPR calculated an acute REL of 22 ppb (66 ug/m^3) based on eye irritation in a study of human volunteers. DPR set a subchronic REL of 1 ppb (3 ug/m^3) based on nasal epithelial atrophy in rat subchronic inhalation study. DPR set a chronic REL of 0.1 ppb (0.3 ug/m^3) based on the same subchronic rat study, but employing an uncertainty factor of 10X to address the uncertainty of using a subchronic value for chronic exposure. While metam sodium is classified by U.S. EPA as a probable human carcinogen, U.S. EPA has categorized MITC as having insufficient data for carcinogenicity classification. In the RCD, DPR concluded that the data were not sufficient to support a quantitative assessment of carcinogenicity. U.S. EPA did not assign a FQPA factor to MITC. The above RELs were used as the screening levels.

Methidathion

DPR completed a risk assessment of methidathion in 2007 as part of the Toxic Air Contaminant process. The assessment set RfCs for the acute, subchronic, and chronic timeframes. A NOEL of 0.18 mg/kg in a 90-day oral rat study for brain cholinesterase inhibition after 2 weeks was used as the basis for an acute RfC of 3.1 ug/m^3. This same value was used for the subchronic RfC. A NOEL of 0.15 mg/kg for liver effects in a 1-year oral dog study was used as the basis for a chronic RfC of 2.5 ug/m^3. U.S.EPA assigned an FQPA value of 1X and classified methidathion as a possible human carcinogen.

Methyl Bromide

DPR has completed an RCD for methyl bromide, which has undergone formal external peer review. RELs were set in the RCD. DPR calculated an acute REL of 210 ppb (820 ug/m^3) based on developmental effects (NOAEL of 40 ppm) in a rabbit developmental toxicity study. DPR calculated an REL of 9 ppb (35 ug/m^3) based on neurotoxic effects in a subchronic dog inhalation study designed to evaluate neurotoxicity. DPR calculated a chronic REL of 1 ppb (3.9 ug/m^3) based on nasal epithelial hyperplasia and degeneration in a chronic rat inhalation study. U.S. EPA has classified methyl bromide as not likely to be carcinogenic to humans. U.S. EPA assigned a FQPA factor of 1X.

Metolachlor

U.S. EPA issued a Tolerance Reassessment Decision (TRED) on metolachlor and s-metolachlor in 2002. The TRED was based on a report of the U.S. EPA Hazard Identification Assessment Review Committee (HIARC) released in 2001. In this report, U.S. EPA specified the use of the NOAEL of 50 mg/kg (for clinical signs, decreased body weight gain, and decreased food consumption) in an oral rat developmental toxicity study with s-metolachlor, for assessing short-term inhalation exposure. U.S. EPA specified the use of the NOAEL of 8.8 mg/kg (for decreased body weight gain) in an oral dog subchronic toxicity study, for assessing intermediate-term inhalation exposure. U.S. EPA

specified the use of the NOAEL of 9.7 mg/kg (for decreased body weight gain) in an oral chronic dog study with metolachlor for assessing long-term inhalation exposure. In all cases, U.S. EPA specified the use of a total uncertainty factor of 100X. This would result in acute, subchronic, and chronic screening levels of 85 ug/m^3, 15 ug/m^3, and 15 ug/m^3, respectively. Since the subchronic screening level is slightly lower than the chronic screening level, it was used for both subchronic and chronic. U.S. EPA has classified metolachlor as a C, possible human, carcinogen, but has specified a non-linear MOE approach. U.S. EPA assigned a FQPA factor of 1X.

Naled (Dichlorvos/DDVP)

DPR completed a RCD on Naled in 1999 and an addendum in 2001. In the RCD, acute exposure, including inhalation, was evaluated using an estimated NOAEL of 2.5 mg/kg, based on neurotoxic effects in an oral rat Functional Observational Battery study. Subchronic exposure was evaluated using a NOAEL of 2.5 mg/kg (in terms of absorbed dose and amortized for daily exposure) for cholinesterase inhibition in a subchronic dermal rat study. Chronic exposure was evaluated using a NOAEL of 0.2 mg/kg for brain cholinesterase inhibition in a chronic rat study. This would result in acute, subchronic, and chronic screening levels of 43 ug/m^3, 43 ug/m^3, and 3.4 ug/m^3, respectively.

In 2002, U.S. EPA released an RED on naled. In the RED, U.S. EPA used a NOAEL of 0.23 mg/m^3 for cholinesterase inhibition 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. Adjusting for the 6-hour exposure and breathing rate differences results in a human equivalent NOAEL of 92 ug/m^3. Applying an uncertainty factor of 100 results in an acute screening level of 0.92 ug/m^3. Adjusting for exposures 5 days per week results in subchronic and chronic screening levels of 0.65 ug/m^3. U.S. EPA assigned a cancer classification of E, evidence of non-carcinogenicity and assigned a FQPA factor of 1X. Since the screening levels based on the RED are derived from an inhalation study, they were used here.

Norflurazon

U.S. EPA completed an RED in 1996 and a TRED in 2002. Neither document addressed inhalation exposure; therefore, the screening levels are set based on oral toxicity values. The TRED evaluated acute dietary exposure using the NOAEL of 10 mg/kg/day for increased skeletal variations in an oral rabbit developmental toxicity study. Using this NOAEL and a combined uncertainty factor of 100 results in an acute screening level of 170 ug/m^3. The TRED evaluated chronic dietary exposure using the NOAEL of 1.5 mg/kg/day for liver toxicity in a 6-month oral dog study. Using this NOAEL and a combined uncertainty factor of 100 results in chronic screening level of 26 ug/m^3. The TRED did not evaluate intermediate-term or subchronic exposure; therefore, the chronic screening level of 26 ug/m^3 was also used as the subchronic screening level. U.S. EPA has classified norflurazon as a possible human carcinogen based on liver tumors, but did not recommend a quantitative risk assessment. U.S. EPA assigned an FQPA factor of 3X only for acute exposure of females 13-50 years of age, while assigning an FQPA factor of 1X for all other acute exposures and all chronic exposures.

Oryzalin

U.S. EPA completed an RED in 1994 and published a risk assessment in 2003, which will form the basis for a TRED. In the risk assessment, U.S. EPA specified evaluating short-term inhalation using the NOAEL of 25 mg/kg (maternal toxicity in an oral rabbit developmental toxicity study) and applying an uncertainty factor of 100X. This would result in an acute screening level of 420 ug/m^3. U.S. EPA specified evaluating intermediate-term and long-term inhalation using the NOAEL of 13.82 mg/kg (decreased weight gain, hematological effects, and thyroid effects in a chronic rat feeding study) and applying an uncertainty factor of 100X. This would result in a subchronic and chronic screening level of 230 ug/m^3. U.S. EPA classified oryzalin as likely to be carcinogenic to humans and assigned a slope factor of 0.00779 $(mg/kg/day)^{-1}$. U.S. EPA assigned an FQPA factor of 1X.

Oxydemeton-methyl

An RED was completed on oxydemeton-methyl in 2006. The RED and the supporting risk assessment specified the use of the results of a 4-hour acute inhalation study (with no NOEL) as the basis for assessing inhalation exposures of all durations. This could be viewed as an over-extrapolation. Therefore, the studies used by the RED to assess acute and chronic dietary exposure will be used as the basis for evaluating inhalation exposures of differing duration. A LOAEL of 2.5 for cholinesterase inhibition in a rat oral acute neurotoxicity study was used as the basis for assessing acute dietary exposure. The RED used an uncertainty factor of 3X to account for the use of a LOEL, for a total uncertainty factor of 300X. A NOAEL of 0.013 mg/kg for decreased brain cholinesterase in a 1-year oral dog study was used, along with an uncertainty factor of 100X, as the basis for assessing and chronic exposure. This value will also be used to assess subchronic exposure. The RED specified an FQPA factor of 1X. Applying the uncertainty factors and the RfD to RfC conversion factor of 4.7 results in acute, subchronic, and chronic screening levels of 39.2, 0.61, and 0.61 ug/m^3 respectively.

Oxyfluorfen

U.S. EPA completed an RED in 2002. In the RED, U.S. EPA specified evaluating short-term inhalation using the NOAEL of 30 mg/kg (maternal toxicity in an oral rabbit developmental toxicity study) and applying an uncertainty factor of 100X. This would result in an acute screening level of 510 ug/m^3. U.S. EPA specified evaluating intermediate-term inhalation using the LOAEL of 32 mg/kg (liver toxicity a subchronic mouse feeding study), and applied an uncertainty factor of 3X to derive a NOAEL of 10.67 mg/kg. Applying an uncertainty factor of 100X results in a subchronic screening level of 180 ug/m^3. U.S. EPA specified evaluating long-term inhalation using the NOAEL of 3.0 mg/kg (liver toxicity in chronic dog and mouse studies). Applying an uncertainty factor of 100X would result in a chronic screening level of 51 ug/m^3. U.S. EPA classified oxyfluorfen as a possible human carcinogen based on liver tumors in mice and assigned a slope factor of 0.0732 $(mg/kg/day)^{-1}$. U.S. EPA assigned an FQPA factor of 1X.

Permethrin

U.S. EPA completed an RED on permethrin in 2005. In the RED, U.S. EPA specified using the NOAEL of 42 mg/m^3 (neurotoxicity in a 15 day rat inhalation study) to evaluate short-term, intermediate-

term, and long term-inhalation exposure. U.S. EPA applied an uncertainty factor of 100X. The study exposed animals 6 hours a day for an average of 3.75 days a week. Adjusting for exposure for 24 hours and differences in breathing rates results in a human equivalent acute NOAEL of 16.8 mg/m^3. Applying the uncertainty factor of 100X results in an acute screening level of 168 ug/m^3. Adjusting this value for exposure 3.75 days per week results in subchronic and chronic screening levels of 90 ug/m^3. U.S. EPA classified permethrin as likely to be carcinogenic to humans based on lung tumors in mice and derived a slope factor of 0.00957 $(mg/kg/day)^{-1}$. U.S. EPA assigned an FQPA factor of 1X.

Phosmet

U.S. EPA completed an IRED for Phosmet in 2001. In the IRED and supporting risk assessment, U.S. EPA specified evaluating short-term inhalation using the NOAEL of 4.5 mg/kg (cholinesterase inhibition an acute rat oral neurotoxicity study) and applying an uncertainty factor of 100X. This would result in an acute screening level of 77 ug/m^3. U.S. EPA specified evaluating intermediate-term inhalation using the NOAEL of 1.5 mg/kg (cholinesterase inhibition in an oral subchronic rat neurotoxicity study) and applying an uncertainty factor of 100X. This would result in a subchronic screening level of 26 ug/m^3. U.S. EPA specified evaluating long-term inhalation using the NOAEL of 1.1 mg/kg (cholinesterase inhibition in an oral rat chronic toxicity study) and applying an uncertainty factor of 100X. This would result in a chronic screening level of 18 ug/m^3. U.S. EPA classified phosmet as having suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential. U.S. EPA assigned an FQPA factor of 1X.

Propargite

U.S. EPA completed an RED on propargite in 2001. In the RED, U.S. EPA used a LOAEL of 310 mg/m^3 (mortality in a 4-hour rat inhalation study) to evaluate short-term, intermediate term, and long-term inhalation. The RED specified a total uncertainty factor of 1000X. This included a 10X factor due to the lack of a NOAEL, the severity of effects at the lowest dose tested, and the 4-hour exposure duration. Adjusting for differences in human and rat breathing rates and using this 1000X uncertainty factor would result in a screening level of 496 ug/m^3 for all timeframes. U.S. EPA has classified propargite as a probable human carcinogen based on intestinal tumors in rats. The RED specified a cancer potency factor of 0.0033 $(mg/kg/day)^{-1}$. U.S. EPA assigned an FQPA factor of 1X.

DPR completed an RCD on propargite in 2004. In the RCD, DPR derived an acute RfC of 14 ug/m^3 based on maternal toxicity at 2 mg/kg in a rabbit developmental, an oral absorption rate of 40%, and an uncertainty factor of 100. DPR derived a chronic RfC of 26 ug/m3 based decreased body weights and decreased food consumption at 3.8 mg/kg in a chronic rat study, an oral absorption rate of 40%, and an uncertainty factor of 100. The seeming incongruity of a chronic NOAEL higher than the acute NOAEL is probably the result of dose selection. Since the current process is intended to develop screening levels, a conservative approach would be to use the lower acute value to examine all time periods. For propargite, the screening level of 14 ug/m^3, derived from the acute RfC was used for evaluating acute, subchronic, and chronic exposures. In the RCD, DPR calculated cancer potency values in a range of 0.0059 to 0.026 $(mg/kg/day)^{-1}$.

SSS-tributyltriphosphorotrithioate (DEF)

In 1999, DPR completed an RCD on DEF that was peer reviewed by the SRP. The RCD derived an acute and subchronic REL of 8.8 ug/m^3 based on cholinesterase inhibition and clinical signs in a 90-day rat inhalation study. Since DEF is not used year round, chronic inhalation exposure was not evaluated. DPR derived a carcinogenicity potency factor of 0.084 $(mg/kg/day)^{-1}$. In a 1999 IRED, U.S. EPA specified the use of the same study to evaluate short-term and intermediate term exposure. The RED also did not evaluate long-term inhalation exposure. U.S. EPA classified DEF as a likely high dose/not likely low dose carcinogen and recommended that a potency factor not be calculated. U.S. EPA retained the FQPA factor of 10X.

Simazine

U.S. EPA released an RED on simazine in 2006. The RED evaluated short-term inhalation using a NOAEL of 6.25 mg/kg from a 28-day oral pubertal study in rats. This NOAEL results in an acute screening level of 110 ug/m^3. The RED recommended evaluating intermediate-term and long-term inhalation exposure using a NOAEL of 1.8 mg/kg from an oral 6-month luteinizing hormone surge study in rats. This NOAEL results in both subchronic and chronic screening levels of 31 ug/m^3. U.S.EPA classified simazine as not likely to be carcinogenic to humans and assigned an FQPA factor of 3X.

Trifluralin

U.S. EPA completed an IRED on trifluralin in 2004. The IRED assessed short-term inhalation was assessed using a NOAEL of 300 mg/m^3 for methemoglobinemia and clinical signs in a 30-day rat inhalation study in which exposure took place 6 hours a day, 5 days a week. The amortized 24-hour NOAEL would be 75 mg/m^3. Adjusting for differences in rat and human breathing rats and applying a total uncertainty factor of 100X results in an acute screening level of 1,200 ug/m^3. Intermediate-term inhalation was assessed using a NOAEL of 10 mg/kg for kidney and urine chemistry effects in an oral rat urinalysis study. This would convert to a subchronic screening level of 170 ug/m^3. Long-term inhalation was assessed using a NOAEL of 2.4 mg/kg for decreased body weight, decreased red blood cells, and other hematological effects in an oral chronic dog study. This would convert to a chronic screening level of 41 ug/m^3. U.S. EPA classified trifluralin as a C, possible human carcinogen and derived a cancer potency value of 0.0058 $(mg/kg/day)^{-1}$. U.S. EPA assigned an FQPA factor of 1X.