AIR MONITORING NETWORK RESULTS FOR 2018

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EXECUTIVE SUMMARY

In February 2011, the California Department of Pesticide Regulation (DPR) implemented a multi-year statewide air monitoring network to measure pesticides in various agricultural communities. This pesticide Air Monitoring Network (AMN) is the first multi-year air monitoring study conducted by DPR. The goals of the AMN are to provide data that assists in assessing potential health risks, developing measures to mitigate risks, and measuring the effectiveness of regulatory requirements. This annual report is the eighth volume of this study and contains AMN results from January 1, 2018, to December 31, 2018.

In 2018, DPR, with the assistance of staff from the California Air Resources Board (CARB) and the Santa Barbara County Agricultural Commissioner's Office, monitored a total of 31 pesticides and 5 pesticide breakdown products in eight communities. Pesticides monitored in the AMN were selected based primarily on potential risk to human health. Higher-risk pesticides were prioritized and selected for inclusion in the AMN based on higher use, higher volatility, and higher toxicity.

The AMN originally provided monitoring for three communities, but with the passing of the Budget Act of 2016, it was temporarily expanded to include eight sites for a two-year period. Not all eight sites were operational at the start of 2018; however, all eight sites were in operation by the end of 2018. Monitoring for the communities of Cuyama, Lindsay, Oxnard, and San Joaquin began at different dates partway through 2018. Therefore, monitoring data from these locations were not sufficient to determine 2018 annual air concentrations.

One 24-hour sample was collected each week at each monitoring location. Sampling start dates were randomly selected each week to produce variation in the sampling day while sampling start times ranged between 9:00 a.m. to 2:00 p.m.

Of the 12,058 analyses[1] conducted, 93.8% (11,316) did not return a detectable concentration. Seven hundred forty-two (6.2%) of the analyses returned a detectable (trace or quantifiable) concentration, while 152 (1.3%) of all analyses had quantifiable concentrations. A quantifiable concentration refers to a concentration above the analytical limit of quantitation.

Eight of the 36 chemicals monitored were not detected; of the remaining pesticides, 17 were only detected at trace levels. Eleven compounds were detected at quantifiable levels. These were 1,3-dichloropropene (1,3-D), chloropicrin, chlorothalonil, chlorpyrifos, chlorpyrifos oxygen analog (OA), chlorthal-dimethyl, dimethoate OA, malathion, methyl bromide, MITC, and trifluralin. The chemicals with the highest number of quantifiable detections from all eight sites were MITC, 1,3-D, and chloropicrin, respectively.

No state or federal agency has established health standards for pesticides in ambient air. Therefore, DPR estimates the potential for adverse health effects by comparing the measured air concentrations of a pesticide to its health screening levels or regulatory targets for 1- or 3-day (depending on the pesticide), 4- or 13-week (depending on the pesticide), 1-year, and lifetime exposure periods. DPR devised health screening levels based on a preliminary assessment of possible health effects; they are used as triggers

[1] Number of analyses = Number of samples multiplied by number of chemicals analyzed in each sample.

for DPR to conduct a more detailed evaluation. Regulatory targets are established based on a complete assessment of possible health risks and supersede the screening levels. DPR puts measures in place based on the regulatory target to limit exposures so that adverse effects can be avoided. Exceeding a regulatory target 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.

Results from the monitoring performed during the 2018 calendar year showed that the highest 13-week rolling average concentration of 1,3-D (5.6 ppb) exceeded the established subchronic screening level of 3.0 ppb at the Shafter sampling location. This 13-week rolling average was largely influenced by a single 24-hr 1,3-D air concentration of 50.5 ppb measured in Shafter on January 21, 2018. DPR is in the process of developing regulations to reduce exposures to 1,3-D in ambient air. None of the 30 other pesticides or five breakdown products exceeded any of their health screening levels or regulatory targets.

PERSONNEL

DPR personnel assigned to this project include:

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INTRODUCTION

Background

In February 2011, as part of DPR's mandate for "continuous evaluation" of currently registered pesticides, the California Department of Pesticide Regulation (DPR) implemented its first multi-year statewide Air Monitoring Network (AMN) for measuring pesticides in various agricultural communities. AMN data is used to estimate subchronic and chronic pesticide exposures. The goals of the AMN are to provide data that assists in assessing potential health risks, developing measures to mitigate risks, and measuring the effectiveness of regulatory requirements.

The AMN consists of the following scientific objectives:

- Identify pesticides in air and determine seasonal, annual, and multiple-year concentrations.
- Compare concentrations to subchronic and chronic health screening levels.
- Track trends in air concentrations over time.
- Estimate cumulative exposure to multiple pesticides with common physiological modes of action in humans (e.g., cholinesterase inhibitors).
- Attempt to correlate concentrations with use and weather patterns.

As part of the community selection process for the AMN, DPR evaluated a total of 1,267 communities and ranked them based on pesticide use (both local and regional), demographic data[2], and availability of other exposure and health data. DPR ranked all 1,267 communities and a total of eight communities were selected for the AMN. In 2017, four sampling sites were operational; four others were added to the AMN in 2018.

At each sampling site location, one 24-hour (h) air sample set was collected on a weekly basis. The air samples were analyzed for 31 pesticides and 5 pesticide breakdown products. This report is the eighth volume of this study and contains AMN results from January 1, 2018, to December 31, 2018.

Changes to the Air Monitoring Network in 2017

The Budget Act of 2016 temporarily increased funding of the AMN, enabling DPR to expand from three original sampling sites to a total of eight sites for a period of two years (Vidrio, et al., 2017). During the temporary expansion of the AMN, DPR is responsible for operation of three sites while the California Air Resources Board (CARB) is responsible for operating five sampling sites. Due to sampling equipment and site procurement delays, the site expansion took place in various phases starting on January 1, 2017, and concluding in August 2018 when the last of the eight monitoring sites was added to the AMN.

Number of Communities Monitored

Four communities were selected based on nearby use of the fumigants 1,3-dichloropropene (1,3-D), chloropicrin, and MITC-generators, while the other four communities were selected based on the use of selected organophosphates (Vidrio et al., 2017). However, all eight sites were monitored for all 36 compounds. Complete details on community selection can be found at:

[2] Communities with similar pesticide-use rankings were prioritized based on the number of children, number of persons over 65, and number of persons living in close proximity to farms and agricultural areas with high pesticide use.

https://www.cdpr.ca.gov/docs/emon/airinit/community_monitoring.htm. Table 1 lists the eight communities selected for monitoring.

Table 1. List of communities in the 2017 AMN monitoring plan.

Community	County	Date of first sample collection	Agency Responsible for Site Operation
Chualar	Monterey	1/1/2017	DPR
Cuyama	Santa Barbara	5/10/2018	CARB
Lindsay	Tulare	4/26/2018	CARB
Oxnard	Ventura	8/14/2018 ‡	CARB
San Joaquin	Fresno	4/26/2018	CARB
Santa Maria	Santa Barbara	1/1/2017	DPR
Shafter	Kern	1/1/2017 | 4/2/2018 *	DPR → CARB*
Watsonville	Monterey	1/1/2017	DPR

* Monitoring responsibilities of site was transitioned from DPR to CARB. Samples collected by CARB staff began to be processed as primary samples on 4/2/18.

‡ The Oxnard sampling site transitioned from a Toxic Air Contaminant (TAC) monitoring site to an AMN site in 2018. Additional information on TAC monitoring including annual monitoring reports can be accessed at the following site: https://www.cdpr.ca.gov/docs/emon/airinit/air_monitoring_reports.htm

CARB began monitoring at their five assigned sites on various dates throughout 2018. The dates at which monitoring began at each of those sites are detailed in Table 1. Monitoring at Shafter was performed by DPR staff until CARB was able to take over the monitoring at the site. Additionally, Oxnard began the year as a Toxic Air Contaminant (TAC) network site in which 1,3-D and methyl bromide were monitored using 6-day intervals until it was transitioned to a full AMN site in August. After the transition, weekly monitoring for all 36 compounds was conducted at the Oxnard AMN site.

Equipment Upgrades

The increase in temporary funding allowed for DPR and CARB to purchase upgraded sampling equipment custom built for pesticide ambient air monitoring. A key advantage of the new system is greater accuracy and precision in sample collection.

Pesticides Monitored

As part of the AMN, DPR and CARB monitored for 31 pesticides and 5 breakdown products. Chemicals included in the AMN were selected based primarily on potential health risk (Vidrio et al., 2013a). Four analytical methods were used to analyze the collected air samples as part of the AMN[3]:

(1) Multi-pesticide Residue;
(2) Volatile Organic Compounds (VOC);
(3) Methyl Isothiocyanate (MITC); and
(4) Chloropicrin.

[3] Greater detail on each of these analytical methods is provided in Appendices I and J.

AIR MONITORING NETWORK RESULTS

Results for all Pesticides and Communities Combined[4]

Pesticide Detections

A total of 12,058 analyses were conducted on the air samples collected from the 8 AMN sites operating from January 1, 2018, to December 31, 2018. Of the 12,058 analyses 6.2% (742) resulted in a detectable concentration, which includes both quantifiable and trace detections[5]. Samples that resulted in a quantifiable detection accounted for 1.3% (152) of all analyses conducted.

Of the 36 pesticides and breakdown products monitored; 11 were detected at quantifiable levels, 17 were detected at trace levels, and 8 were not detected. Table 2 lists the number of detections by type for each pesticide and pesticide breakdown product at all sites included in the AMN for this year. The chemicals with the highest number of quantifiable detections were MITC (21.7%), 1,3-D (11.1%), and chloropicrin (3.6%).

Table 2. Number and percentage of positive samples per chemical for all AMN sites during 2018.

Chemical	Number of possible detections	Total number of detections*	Number of quantified detections	Percent of possible detections	Percent of quantifiable detections
1,3-dichloropropene	333	37	37	11.1%	11.1%
Acephate	335	5	0	1.5%	0%
Bensulide	335	3	0	0.9%	0%
Chloropicrin	336	34	12	10.1%	3.6%
Chlorothalonil	335	96	5	28.7%	1.5%
Chlorpyrifos	335	31	2	9.3%	0.6%
Chlorpyrifos OA	335	35	2	10.4%	0.6%
Chlorthal-dimethyl	335	84	6	25.1%	1.8%
Cypermethrin	335	1	0	0.3%	0%
DDVP	335	32	0	9.6%	0%
DEF	335	0	0	0%	0%
Diazinon	335	0	0	0%	0%
Diazinon OA	335	2	0	0.6%	0%
Dimethoate	335	1	0	0.3%	0%
Dimethoate OA	335	5	1	1.5%	0.3%
Diuron	335	6	0	1.8%	0%
Endosulfan	335	3	0	0.9%	0%
Endosulfan Sulfate	335	0	0	0%	0%
EPTC	335	3	0	0.9%	0%
Iprodione	335	3	0	0.9%	0%

[4] See Appendices A-H for detailed Air Monitoring Network Results for each sampling location.

[5] Quantifiable detections refer to concentrations above the Limit of Quantitation (LOQ) for the respective pesticide.

Trace detections are measured concentrations between the LOQ and the Method Detection Limit (MDL).

Non-detections refer to all samples with measured concentrations below the MDL.

Malathion	335	40	2	11.9%	0.6%
Malathion OA	335	48	0	14.3%	0%
Methidathion	335	0	0	0%	0%
Methyl bromide	333	10	10	3.0%	3.0%
Metolachlor	335	1	0	0.3%	0%
MITC	336	207	73	61.6%	21.7%
Norflurazon	335	0	0	0%	0%
Oryzalin	335	1	0	0.3%	0%
Oxydemeton methyl	335	0	0	0.0%	0%
Oxyfluorfen	335	6	0	1.8%	0%
Permethrin	335	2	0	0.6%	0%
Phosmet	335	0	0	0%	0%
pp-Dicofol	335	0	0	0%	0%
Propargite	335	5	0	1.5%	0%
Simazine	335	5	0	1.5%	0%
Trifluralin	335	36	2	10.7%	0.6%
Total	**12,058**	**742**	**152**	**6.2%**	**1.3%**

* Includes both quantified and trace detections.

Table 3 summarizes the total number of detections of the monitored chemicals by community. The percentages of detections for monitored chemicals in each community ranged from 2.9% to 8.4% of all collected samples. These detections included quantifiable detections (above the Limit of Quantitation (LOQ)) and trace detections (above the Method Detection Limit (MDL) but below the LOQ). Shafter had the highest percentage of samples with detections (8.4%), as well as the highest percentage of samples with quantifiable detections (3.0%).

A sample set is the collective term for all samples recovered from one site in one week (each sample set includes four chemical analyses methods). A total of 336 sample sets were taken from all eight (8) communities (53 sets from Shafter; 52 sets each from Santa Maria, Watsonville, and Chualar; 36 sets each from Lindsay and San Joaquin; 35 sets from Cuyama, and 20 sets from Oxnard). Two hundred eighty-eight (86%) of these sample sets contained at least one detection (Table 4).

There were a total of four lost samples in 2018. Three of these were summa canisters, used to sample for the VOCs 1,3-D and methyl bromide; they arrived at the California Air Resources Board – Organic Laboratory Section (CARB-OLS) lab with pressure that was outside the acceptable range for analysis. This was most likely due a mechanical valve failure or leak during storage or transit. The sorbent media from one multi-residue cartridge was lost during analysis by the California Department of Food and Agriculture (CDFA) laboratory, thereby making this sample invalid. Appendix I lists the details of these samples.

Table 3. Detections of monitored chemicals by location, as individual samples during 2018.

Community	Number of possible detections	Total number of detections*	Number of quantifiable detections	Percent of possible detections	Percent of quantifiable detections
Shafter	1,908	161	58	8.4%	3.0%
Santa Maria	1,840	151	16	8.2%	0.9%

Watsonville	1,870	54	13	2.9%	0.7%
Chualar	1,870	114	23	6.1%	1.2%
Oxnard	720	42	6	5.8%	0.8%
Cuyama	1,260	48	10	3.8%	0.8%
Lindsay	1,294	68	7	5.3%	0.5%
San Joaquin	1,296	104	19	8.0%	1.5%
Total	**12,058**	**742**	**152**	**6.2%**	**1.3%**

* Includes both quantifiable and trace detections.

Table 4. Detections of monitored chemicals by location, as weekly sample sets during 2018.

Community	Number of sample sets	Number of sets with at least one detection *	Percent of sample sets with at least one detection
Shafter	53	51	96%
Santa Maria	52	45	87%
Watsonville	52	29	56%
Chualar	52	51	98%
Oxnard	20	18	90%
Cuyama	35	33	94%
Lindsay	36	28	78%
San Joaquin	36	33	92%
Total	**336**	**288**	**86%**

* Includes both quantifiable and trace detections.

Pesticide Concentrations

Acute Exposure: Highest 24-hour Concentrations Among All Sites

While the results of the 24-h samples and acute exposures are discussed in this report, estimating acute exposures is not one of the AMN objectives as the AMN is designed to best measure subchronic and chronic exposures. DPR and CARB routinely conduct application-site monitoring studies that are designed to assess acute exposures to pesticides as monitoring is conducted in the immediate vicinity (100 feet or less) of a treated field. Application site monitoring studies for individual pesticides and all monitoring reports can be found at:

https://www.cdpr.ca.gov/docs/emon/airinit/air_monitoring_reports.htm.

Table 5 lists the highest 24-h concentrations at any site for the pesticides detected at a quantifiable concentration in 2018. None of the pesticides or breakdown products exceeded their respective acute (24-h or 72-h) screening levels or regulatory targets during 2018 monitoring. Of all monitored pesticides, the pesticide with the highest percentage of 24-h air concentration compared to its acute screening level (45.3%) was 1,3-D, followed chlorpyrifos (4.2%), chlorpyrifos OA (1.2%), and chloropicrin (1.1%). All other compounds were less than 1% of their acute screening level or regulatory target during monitoring in 2018 (Table 5). The following chemicals were only detected at trace levels at any monitoring location:

- Acephate
- Bensulide
- Cypermethrin

- DDVP
- Diazinon OA
- Dimethoate
- Diuron
- Endosulfan
- EPTC
- Iprodione
- Malathion OA
- Metolachlor
- Oryzalin
- Oxyfluorfen
- Permethrin
- Propargite
- Simazine

The following chemicals were not detected at any monitoring location:

- DEF
- Diazinon
- Endosulfan sulfate
- Methidathion
- Norflurazon
- Oxydemeton methyl
- Phosmet
- pp-dicofol

Table 5. Highest 24-h air concentrations, acute screening levels, and percent of screening level of any pesticide detected at a quantifiable concentration in 2018 among all eight sites.

Chemical	Highest 24-h concentration	24-h acute screening level	% of screening level
1,3-dichloropropene	50.5 ppb (228,936 ng/m³)	110 ppb (505,000 ng/m³)	45.3%
Chloropicrin	0.8 ppb (5,367 ng/m³)	73.0 ppb (491,000 ng/m³) **	1.1%
Chlorothalonil	0.005 ppb (50 ng/m³)	3 ppb (34,000 ng/m³)	0.1%
Chlorpyrifos	0.004 ppb (50 ng/m³)	0.1 ppb (1,200 ng/m³) ***	4.2%
Chlorpyrifos OA	0.001 ppb (14 ng/m³)	0.1 ppb (1,200 ng/m³) ***	1.2%
Chlorthal-dimethyl	0.003 ppb (39 ng/m³)	1,700 ppb (23,500,000 ng/m³)	0.00%
Dimethoate OA	0.002 ppb (17 ng/m³)	0.5 ppb (4,300 ng/m³)	0.4%

Malathion	0.0007 ppb (9.8 ng/m³)	8.5 ppb (113,000 ng/m³)	0.01%
Methyl bromide	0.097 ppb (376 ng/m³)	210 ppb (820,000 ng/m³) *	0.05%
MITC	1.2 ppb (3,726 ng/m³)	220 ppb (660,000 ng/m³) *	0.56%
Trifluralin	0.03 ppb (405 ng/m³)	90 ppb (1,200,000 ng/m³)	0.03%

* This value is a regulatory target rather than a screening level.
** This value is an 8-h time-weighted-average (TWA) used to compare against the 24-h measured concentration.
*** DPR's May 28, 2019, risk management directive for chlorpyrifos established an acute regulatory target of 0.28 ppb (4,050 ng/m³), 1-hr TWA. However, the current sample duration does not allow for a direct comparison between the acute regulatory target concentration and the measured sample values.

Subchronic Exposure: Highest Rolling 4-Week or 13-Week Average Concentrations Among All Sites

Table 6 lists the highest observed rolling 4-week or 13-week average concentrations for any chemical detected at a quantifiable concentration in 2018 among all sites. 1,3-D was the pesticide with the highest rolling 13-week average concentration with an estimated concentration of 5.6 ppb. This concentration was determined to be 182% of the subchronic screening level. This exceedance was primarily driven by one abnormally high 24-h concentration detected at Shafter on 1/22/18. After a DPR investigation, it was determined that the probable cause that led to this detection was a result of a 25 acre 1,3-D application that took place about 0.15 miles upwind of the monitoring site location. No other pesticides or breakdown products were observed to exceed their respective subchronic screening levels or regulatory targets. Among those, the highest percentage of screening level reached was that of MITC (50.1%), followed by chloropicrin (32.5%), then chlorpyrifos (2.5%).

Table 6. Highest rolling 4-week average air concentrations, subchronic screening levels, and percent of screening level of any pesticide detected at a quantifiable concentration in 2018 among all eight sites.

Chemical	Highest rolling 4-week average concentration†	Subchronic screening level	% of screening level
1,3-dichloropropene	5.6 ppb (25,422 ng/m³)	3.0 ppb (14,000 ng/m³)	182%
Chloropicrin	0.11 ppb (748 ng/m³)	0.35 ppb (2,300 ng/m³)	32.5%
Chlorothalonil	0.003 ppb (35 ng/m³)	3 ppb (34,000 ng/m³)	0.1%
Chlorpyrifos	0.002 ppb (22 ng/m³)	0.06 ppb (850 ng/m³)	2.5%
Chlorpyrifos OA	0.0005 ppb (7.3 ng/m³)	0.06 ppb (850 ng/m³)	0.9%
Chlorthal-dimethyl	0.002 ppb (25 ng/m³)	35 ppb (470,000 ng/m³)	0.01%
Dimethoate OA	0.0008 ppb	0.3 ppb	0.2%

	(6.9 ng/m³)	(3,000 ng/m³)	
Malathion	0.0005 ppb (6.4 ng/m³)	6 ppb (80,600 ng/m³)	0.01%
Methyl bromide	0.04 ppb (155 ng/m³)	5.0 ppb (19,400 ng/m³) *	0.8%
MITC	0.5 ppb (1,502 ng/m³)	1.00 ppb (3,000 ng/m³)	50.1%
Trifluralin	0.012 ppb (167 ng/m³)	12 ppb (170,000 ng/m³)	0.1%

† Concentrations are presented as rolling or moving averages (i.e., average of weeks 1, 2, 3, and 4; average of weeks 2, 3, 4, and 5; etc.).

* This value is a regulatory target rather than a screening level.

** These concentrations represent the highest 13-week rolling average, rather than the default 4-week rolling average.

Chronic Exposure: Highest One Year Average Concentrations Among All Sites

Table 7 presents the highest observed annual average concentrations for each chemical detected at a quantifiable concentration in 2018 at any AMN site with one full year of monitoring data available alongside its respective chronic screening levels. The highest annual average concentration relative to its chronic screening level was that of 1,3-D (76.9%), followed by MITC (58.3%), then chloropicrin (15.4%).

Table 7. Highest annual average air concentrations, chronic screening levels, and percent of screening level of any pesticide detected at a quantifiable concentration in 2018 among all eight sites.

Chemical	Highest annual average concentration	Chronic screening level	% of screening level
1,3-dichloropropene	1.5 ppb (6,920 ng/m³)	2.00 ppb (9,000 ng/m³)	76.9%
Chloropicrin	0.041 ppb (277 ng/m³)	0.27 ppb (1,800 ng/m³)	15.4%
Chlorothalonil	0.0009 ppb (10 ng/m³)	3 ppb (34,000 ng/m³)	0.03%
Chlorpyrifos	0.0004 ppb (5.3 ng/m³)	0.04 ppb (510 ng/m³)	1.0%
Chlorthal-dimethyl	0.0005 ppb (7.1 ng/m³)	3.5 ppb (47,000 ng/m³)	0.02%
Malathion	0.0003 ppb (3.5 ng/m³)	0.6 ppb (8,100 ng/m³)	0.04%
Methyl bromide	0.018 ppb (71 ng/m³)	1.00 ppb (3,900 ng/m³)	1.8%
MITC	0.058 ppb (175 ng/m³)	0.10 ppb (300 ng/m³)	58.3%

Lifetime Exposure: Cancer Risk Estimates

The AMN monitors for seven pesticides that have been designated as probable carcinogens by Proposition 65 or by U.S. EPA's B2 list: 1,3-D, chlorothalonil, DDVP, diuron, iprodione, oxydemeton methyl, and propargite. Of these, only 1,3-D and chlorothalonil had any quantifiable concentrations during 2018 AMN sampling. Annual average concentrations and cancer risk estimates for 1,3-D and chlorothalonil are shown in Table 8 and Table 9. These calculations use the average concentration using all data available from the specified site. This data was limited to communities with at least one full year of monitoring as part of the AMN. It is important to note that these shorter timeframes are less suitable for comparison to a 70-year target and are shown for illustrative purposes only. These values differ from those presented in the calculated annual concentrations above because those are a simple mean (average) while a TWA is used for the cancer risk estimates.

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.). Risk in the range of 10^{-5} to 10^{-6} or less is generally considered to be at the limit of what is considered to be negligible. Cancer risk is estimated based on the following calculation:

$$\text{Cancer Risk} = CPFH * LAC * nBR$$

where:

Cancer Risk = probability of an additional case of cancer over a 70-year period.
CPFH = estimated cancer potency factor in humans $(mg/kg/day)^{-1}$.
LAC = mean lifetime (70-year) air concentration ($mg\ m^{-3}$).
nBR = normalized breathing rate of a human adult ($m^3\ kg^{-1}\ day^{-1}$).

DPR assumes nBR to be 0.28 $m^3\ kg^{-1}\ day^{-1}$ (DPR, 2015). Based on the available monitoring data, LAC is taken as the mean annual concentration of the pesticide for all available monitoring years. DPR has estimated the following CPF_H values for three of the seven AMN-monitored pesticides, two of which were detected in 2018:

- For 1,3-D: CPF_H= 0.014 $(mg/kg\text{-}day)^{-1}$ (DPR, 2015).
- For chlorothalonil: CPF_H= 0.016 $(mg/kg\text{-}day)^{-1}$ (DPR, 2018).

Table 8. Average 1,3-dichloropropene concentrations, regulatory target, cancer risk estimates, cancer risk target, and proportion of cancer risk target for each AMN sampling location during 2018.

Community	Average concentration (ng/m^3)	Lifetime regulatory target (ng/m^3)	Cancer risk estimate	Target	Percent of target (%)
Chualar	180	2,600	7.06E-07	1.00E-05	7
Santa Maria	593	2,600	2.32E-06	1.00E-05	23
Shafter	2,115	2,600	8.29E-06	1.00E-05	83
Watsonville	455	2,600	1.78E-06	1.00E-05	18

Table 9. Average chlorothalonil concentrations, cancer risk estimates, cancer risk target, and proportion of cancer risk target for each AMN sampling location during 2018.

Community	Average concentration (ng/m³)	Cancer risk estimate	Target	Percent of target (%)
Chualar	5.53	2.48E-08	1.00E-05	0.25
Santa Maria	4.52	2.03E-08	1.00E-05	0.20
Shafter	14.1	6.33E-08	1.00E-05	0.63
Watsonville	3.87	1.73E-08	1.00E-05	0.17

Cumulative Exposure Estimates for Organophosphates

Cumulative exposures were calculated for organophosphates because these are the only pesticides included in the AMN that have a common mode of action (cholinesterase inhibition) and that were detected at quantifiable concentrations. The 14 organophosphates included in the AMN monitoring are:

- Acephate
- Bensulide
- Chlorpyrifos and its oxygen analog
- DDVP
- DEF
- Diazinon and its oxygen analog
- Dimethoate and its oxygen analog
- Malathion and its oxygen analog
- Oxydemeton methyl
- Phosmet

As described in Appendix K, the cumulative exposure was estimated using a hazard quotient (HQ) and hazard index (HI) approach that relies on the ratio between the detected air concentration and the screening level. The organophosphate cumulative exposures were estimated for each community and exposure period.

Table 10 summarizes the highest calculated HI's for each community and time period during monitoring in 2018. Both the acute and subchronic HI values were calculated for each individual sample set, from which the maximum observed HI was reported. None of the HI's exceeded a value of 1.0 at any of the sampling locations during this year. This indicates that even for the combined 14 organophosphate compounds, a summed screening level was not exceeded.

Table 10. Summary of organophosphate cumulative exposure.

Community	Acute Hazard Index	Subchronic Hazard Index	Chronic Hazard Index
Chualar	0.005	0.010	0.010
Cuyama	0.005	0.007	0.009
Lindsay	0.025	0.024	0.018
Oxnard	0.008	0.007	0.009
San Joaquin	0.025	0.025	0.021
Santa Maria	0.040	0.015	0.013
Shafter	0.053	0.036	0.022
Watsonville	0.005	0.008	0.010

DISCUSSION

Fumigants accounted for four of the eleven pesticides detected at quantifiable concentrations by the AMN in 2018. These fumigants were 1,3-D, chloropicrin, methyl bromide, and MITC. Quantifiable detections of 1,3-D were observed at Chualar, Oxnard, San Joaquin, Santa Maria, and Shafter; quantifiable detections of chloropicrin were observed at Chualar, Oxnard, Santa Maria, and Watsonville; and quantifiable detections of methyl bromide were observed at San Joaquin and Shafter. MITC was quantifiably detected at all currently active AMN sites. Organophosphates and their breakdown products accounted for another four of the eleven pesticides detected at quantifiable concentrations. These were chlorpyrifos and its OA, dimethoate OA, and malathion. The remaining three pesticides detected at quantifiable concentrations in 2018 were chlorothalonil, chlorthal-dimethyl, and trifluralin.

An HI was calculated for the included organophosphates that have a common mode of action (cholinesterase inhibition) and that were detected at quantifiable concentrations. The maximum HI calculated for any site at any exposure period was 0.053, indicating a low risk from cumulative exposure.

Overall, concentrations representing subchronic exposure were higher than acute or chronic exposures relative to their respective screening levels. Acute exposures were generally higher than chronic exposures relative to their respective screening levels. As previously discussed, while acute exposure is discussed in this report, the AMN best measures subchronic and chronic exposures.

The only concentration to exceed its respective screening level was that of 1,3-D in Shafter for the subchronic timeframe. The 13-week average concentration was mainly driven by a single elevated air concentration of 50.5 ppb observed on 1/22/18. This unusual result was immediately investigated by DPR and CDFA-CAC laboratory to validate the detection value. The Kern County Agricultural Commissioner's Office was informed of the preliminary result, compliant with our standard practice. DPR is in the process of updating existing regulations to reduce exposures to 1,3-D in ambient air.

Appendix A: Detailed Result Information for Chualar

Chualar is a census-designated place (0.6 square miles in area) located approximately 10 miles south-southeast of Salinas in Monterey County. The elevation is 115 feet; it receives on average 16 inches of precipitation annually. Average temperatures range from 53 to 72° F in the summer and 41 to 63° F in the winter. Based on the 2010 census, the population of Chualar was 1,190, of which 36.1% were below 18 years of age and 5.0% were above 65 years of age. The major crops in the immediate area around Chualar are strawberries, lettuce, and tomatoes. The monitoring site is located at a privately-owned water well situated on the eastern side of the community.

Pesticide Detections

Table 1 lists the number and percentage of analyses resulting in detections at the Chualar sampling site. The highest percentage of detections were for chlorthal-dimethyl (98%, n = 51), followed by MITC (42%, n = 22), and then 1,3-dichloropropene (18%, n = 9). The highest percentages of quantifiable detections were observed for 1,3-dichloropropene (18%, n = 9), followed by chlorthal-dimethyl (12%, n = 6), and then MITC (8%, n = 4).

Table 1. Number and percentage of positive samples per chemical in Chualar, California.

Chemical	Number of possible detections	Total number of detections*	Number of quantifiable detections	Percent of possible detections	Percent of quantifiable detections
1,3-dichloropropene	51	9	9	18%	18%
Acephate	52	1	0	2%	0%
Bensulide	52	1	0	2%	0%
Chloropicrin	52	8	3	15%	6%
Chlorothalonil	52	4	0	8%	0%
Chlorpyrifos	52	0	0	0%	0%
Chlorpyrifos OA	52	0	0	0%	0%
Chlorthal-dimethyl	52	51	6	98%	12%
Cypermethrin	52	0	0	0%	0%
DDVP	52	6	0	12%	0%
DEF	52	0	0	0%	0%
Diazinon	52	0	0	0%	0%
Diazinon OA	52	0	0	0%	0%
Dimethoate	52	0	0	0%	0%
Dimethoate OA	52	0	0	0%	0%
Diuron	52	0	0	0%	0%
Endosulfan	52	1	0	2%	0%
Endosulfan Sulfate	52	0	0	0%	0%
EPTC	52	0	0	0%	0%
Iprodione	52	0	0	0%	0%
Malathion	52	5	1	10%	2%

Malathion OA	52	4	0	8%	0%
Methidathion	52	0	0	0%	0%
Methyl bromide	51	0	0	0%	0%
Metolachlor	52	0	0	0%	0%
MITC	52	22	4	42%	8%
Norflurazon	52	0	0	0%	0%
Oryzalin	52	0	0	0%	0%
Oxydemeton methyl	52	0	0	0%	0%
Oxyfluorfen	52	0	0	0%	0%
Permethrin	52	2	0	4%	0%
Phosmet	52	0	0	0%	0%
pp-Dicofol	52	0	0	0%	0%
Propargite	52	0	0	0%	0%
Simazine	52	0	0	0%	0%
Trifluralin	52	0	0	0%	0%
Total	**1,870**	**114**	**23**	**6%**	**1%**

* Includes both quantifiable and trace detections.

Pesticide Concentrations

Acute (24-h) Concentrations

Table 2 shows the highest observed 24-h concentrations observed for all chemicals monitored at the Chualar Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chloropicrin at 0.2%, followed by 1,3-dichloropropene at 0.1%. The remaining chemicals for which there were quantifiable detections at Chualar in 2018 were chlorthal-dimethyl and malathion.

As noted in Appendix I, the MDL for 1,3-dichloropropene and methyl bromide analyzed by the California Air Resources Board's Organic Laboratory Section (CARB OLS) laboratory is 10-fold higher than that of samples analyzed by California Department of Food and Agriculture's Center for Analytical Chemistry (CDFA CAC) laboratory. Incorporating these analytical limits into the estimated values for non-detections produced the observed variation between sites for these chemicals, particularly for annual averages where large periods of non-detections have a larger effect on the calculated concentration.

Table 2. Highest 24-h air concentrations, acute screening levels, and percent of the acute screening level for chemicals monitored at the Chualar Air Monitoring Network sampling location.

Chemical	Highest 24-h concentration in ppb (ng/m^3)	24-h acute screening level in ppb (ng/m^3)	% of screening level
1,3-dichloropropene	0.1 ppb (460 ng/m^3)	110 ppb (505,000 ng/m^3)	0.1%
Chloropicrin	0.12 ppb (780 ng/m^3)	73.0 ppb (491,000 ng/m^3) *	0.2%
Chlorthal-dimethyl	0.003 ppb (39 ng/m^3)	1,730 ppb (23,500,000 ng/m^3)	0.0002%
Malathion	0.0007 ppb (9.5 ng/m^3)	8.33 ppb (113,000 ng/m^3)	0.01%

MITC	0.11 ppb (340 ng/m³)	220 ppb (660,000 ng/m³) *	0.05%
Acephate	Trace	1.60 ppb (12,000 ng/m³)	
Bensulide	Trace	15.9 ppb (259,000 ng/m³)	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	ND	0.08 ppb (1,200 ng/m³) **	
Chlorpyrifos OA	ND	0.09 ppb (1,200 ng/m³) **	
Cypermethrin	ND	6.64 ppb (113,000 ng/m³)	
DDVP	Trace	1.22 ppb (11,000 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.46 ppb (4,300 ng/m³)	
Dimethoate OA	ND	0.49 ppb (4,300 ng/m³)	
Diuron	ND	17.8 ppb (170,000 ng/m³)	
Endosulfan	Trace	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	29.7 ppb (230,000 ng/m³)	
Iprodione	ND	69.6 ppb (939,000 ng/m³)	
Malathion OA	Trace	8.76 ppb (113,000 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	210 ppb (820,000 ng/m³) *	
Metolachlor	ND	7.33 ppb (85,000 ng/m³)	
Norflurazon	ND	12.6 ppb (170,000 ng/m³)	
Oryzalin	ND	29.7 ppb (420,000 ng/m³)	
Oxydemeton methyl	ND	3.74 ppb (39,200 ng/m³)	
Oxyfluorfen	ND	34.5 ppb	

		(510,000 ng/m³)	
Permethrin	Trace	10.5 ppb (168,000 ng/m³)	
Phosmet	ND	5.94 ppb (77,000 ng/m³)	
pp-Dicofol	ND	4.49 ppb (68,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	ND	13.3 ppb (110,000 ng/m³)	
Trifluralin	ND	87.5 ppb (1,200,000 ng/m³)	

* This value is a regulatory target rather than a screening level.
** DPR's May 28, 2019, risk management directive for chlorpyrifos established an acute regulatory target of 0.28 ppb (4,050 ng/m³), 1-hr TWA. However, the current sample duration does not allow for a direct comparison between the acute regulatory target concentration and the measured sample values.

Subchronic (4- or 13-wk) Concentrations

Table 3 shows the highest observed rolling 4-week or 13-week average concentrations for all chemicals monitored at the Chualar Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chloropicrin at 15.8%. This was followed by MITC at 3.4%, and then 1,3-dichloropropene at 2.7%. Quantifiable detections for chlorthal-dimethyl and malathion resulted in calculated subchronic concentrations reaching 0.01% of their respective screening levels.

Table 3. Highest 4- or 13-wk air concentrations, subchronic screening levels, and percent of the subchronic screening level for chemicals monitored at the Chualar Air Monitoring Network sampling location.

Chemical	Highest 4-week rolling average concentration in ppb (ng/m³)	Subchronic screening level in ppb (ng/m³)	% of screening level
1,3-dichloropropene *	0.081 ppb (370 ng/m³)	3.0 ppb (14,000 ng/m³)	2.7%
Chloropicrin *	0.055 ppb (370 ng/m³)	0.35 ppb (2,300 ng/m³)	15.8%
Chlorthal-dimethyl	0.002 ppb (25 ng/m³)	34.6 ppb (470,000 ng/m³)	0.01%
Malathion	0.0004 ppb (5.2 ng/m³)	5.97 ppb (80,600 ng/m³)	0.01%
MITC	0.034 ppb (100 ng/m³)	1.00 ppb (3,000 ng/m³)	3.4%
Acephate	Trace	1.13 ppb (8,500 ng/m³)	
Bensulide	Trace	1.47 ppb (24,000 ng/m³)	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	ND	0.06 ppb (850 ng/m³)	
Chlorpyrifos OA	ND	0.06 ppb (850 ng/m³)	

Cypermethrin	ND	4.76 ppb (81,000 ng/m³)	
DDVP	Trace	0.24 ppb (2,200 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.32 ppb (3,000 ng/m³)	
Dimethoate OA	ND	0.34 ppb (3,000 ng/m³)	
Diuron	ND	1.78 ppb (17,000 ng/m³)	
Endosulfan	Trace	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	3.10 ppb (24,000 ng/m³)	
Iprodione	ND	21.2 ppb (286,000 ng/m³)	
Malathion OA	Trace	6.27 ppb (80,600 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	5.0 ppb (19,400 ng/m³)	
Metolachlor	ND	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	ND	16.2 ppb (230,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	
Oxyfluorfen	ND	12.2 ppb (180,000 ng/m³)	
Permethrin	Trace	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	2.00 ppb (26,000 ng/m³)	
pp-Dicofol	ND	3.24 ppb (49,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	ND	3.76 ppb (31,000 ng/m³)	
Trifluralin	ND	12.4 ppb	

		(170,000 ng/m³)	

* These concentrations represent the highest 13-week rolling average, rather than the default 4-week rolling average.

Chronic (2018) Concentrations

Table 4 shows the annual average concentration for all chemicals monitored at the Chualar Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chloropicrin at 9.6%. This was followed by MITC at 5.0%, and then 1,3-dichloropropene at 1.4%. All other monitored chemicals were less than 1% of their chronic screening level or regulatory target in Chualar during monitoring in 2018.

Table 4. Annual average air concentrations, chronic screening levels, and percent of the chronic screening level for chemicals monitored at the Chualar Air Monitoring Network sampling location.

Chemical	Overall average concentration (ng/m³)	Chronic screening level (ng/m³)	% of screening level
1,3-dichloropropene	0.027 ppb (120 ng/m³)	2.00 ppb (9,000 ng/m³)	1.4%
Chloropicrin	0.026 ppb (180 ng/m³)	0.27 ppb (1,800 ng/m³)	9.6%
Chlorthal-dimethyl	0.0005 ppb (7.1 ng/m³)	3.46 ppb (47,000 ng/m³)	0.01%
Malathion	0.00009 ppb (1.2 ng/m³)	0.60 ppb (8,100 ng/m³)	0.02%
MITC	0.005 ppb (15 ng/m³)	0.10 ppb (300 ng/m³)	5.0%
Acephate	Trace	1.13 ppb (8,500 ng/m³)	
Bensulide	Trace	1.48 ppb (24,000 ng/m³)	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	ND	0.04 ppb (510 ng/m³)	
Chlorpyrifos OA	ND	0.04 ppb (510 ng/m³)	
Cypermethrin	ND	1.59 ppb (27,000 ng/m³)	
DDVP	Trace	0.09 ppb (770 ng/m³)	
DEF	ND	NA - Seasonal	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.03 ppb (300 ng/m³)	
Dimethoate OA	ND	0.03 ppb (300 ng/m³)	
Diuron	ND	0.60 ppb (5,700 ng/m³)	
Endosulfan	Trace	0.02 ppb	

		(330 ng/m³)	
Endosulfan Sulfate	ND	0.02 ppb (330 ng/m³)	
EPTC	ND	1.10 ppb (8,500 ng/m³)	
Iprodione	ND	21.2 ppb (286,000 ng/m³)	
Malathion OA	Trace	0.63 ppb (8,100 ng/m³)	
Methidathion	ND	0.20 ppb (2,500 ng/m³)	
Methyl bromide	ND	1.00 ppb (3,900 ng/m³)	
Metolachlor	ND	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	ND	16.4 ppb (232,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	
Oxyfluorfen	ND	3.45 ppb (51,000 ng/m³)	
Permethrin	Trace	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	1.39 ppb (18,000 ng/m³)	
pp-Dicofol	ND	1.32 ppb (20,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	ND	3.76 ppb (31,000 ng/m³)	
Trifluralin	ND	2.99 ppb (41,000 ng/m³)	

Temporal trends in detected concentrations

Figures 1 – 5 present the concentrations over time for monitoring results in 2018 for any chemical detected at a quantifiable concentration in Chualar. Screening levels, as defined in Appendix K, are abbreviated as SL in the following graphs. Regulatory targets, also defined in Appendix K, are abbreviated as RT. For graphs where both a pesticide and its degradate are shown, the detected concentrations of both the parent chemical and its degradate have been summed for each sampling date.

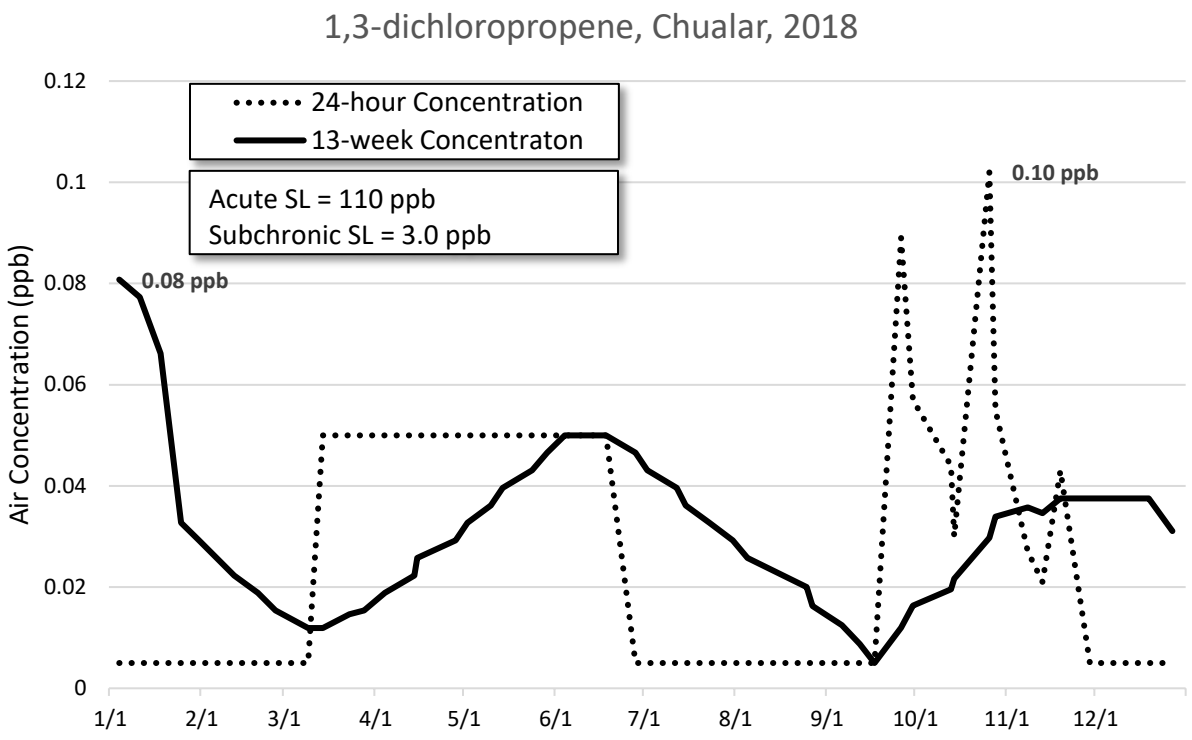

Figure 1. Temporal trend in 1,3-dichloropropene concentrations in Chualar in 2018.

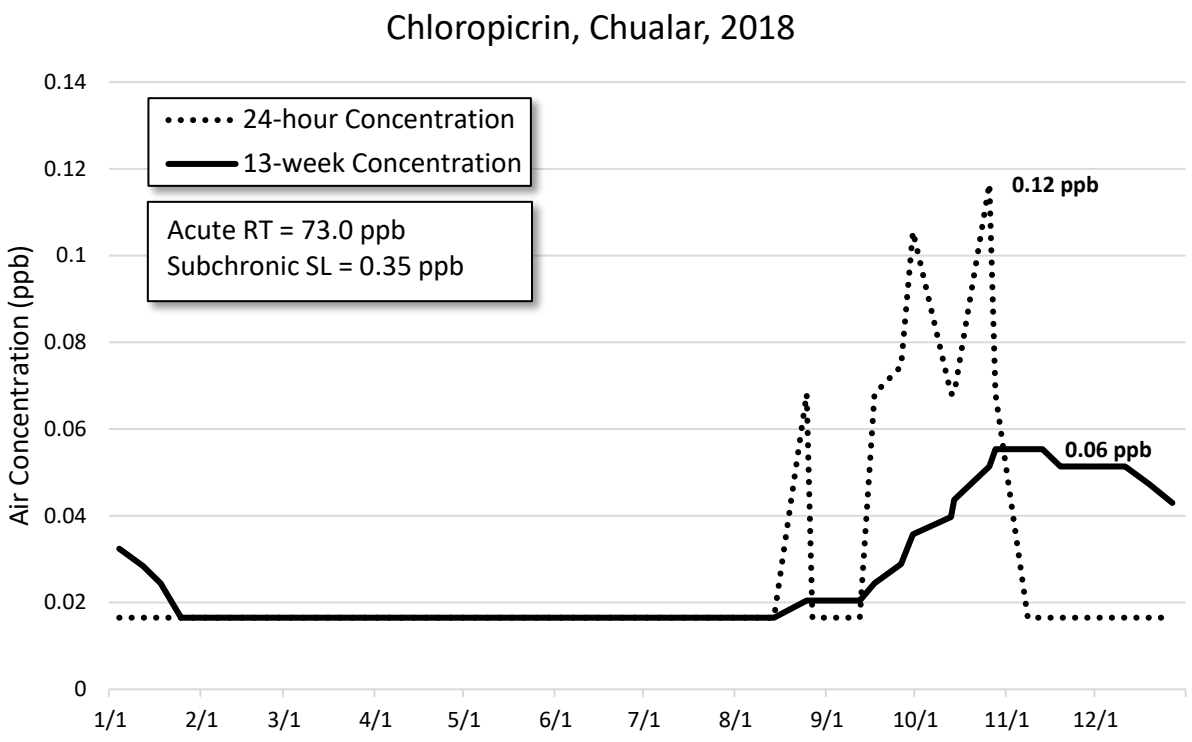

Figure 2. Temporal trend in chloropicrin concentrations in Chualar in 2018.

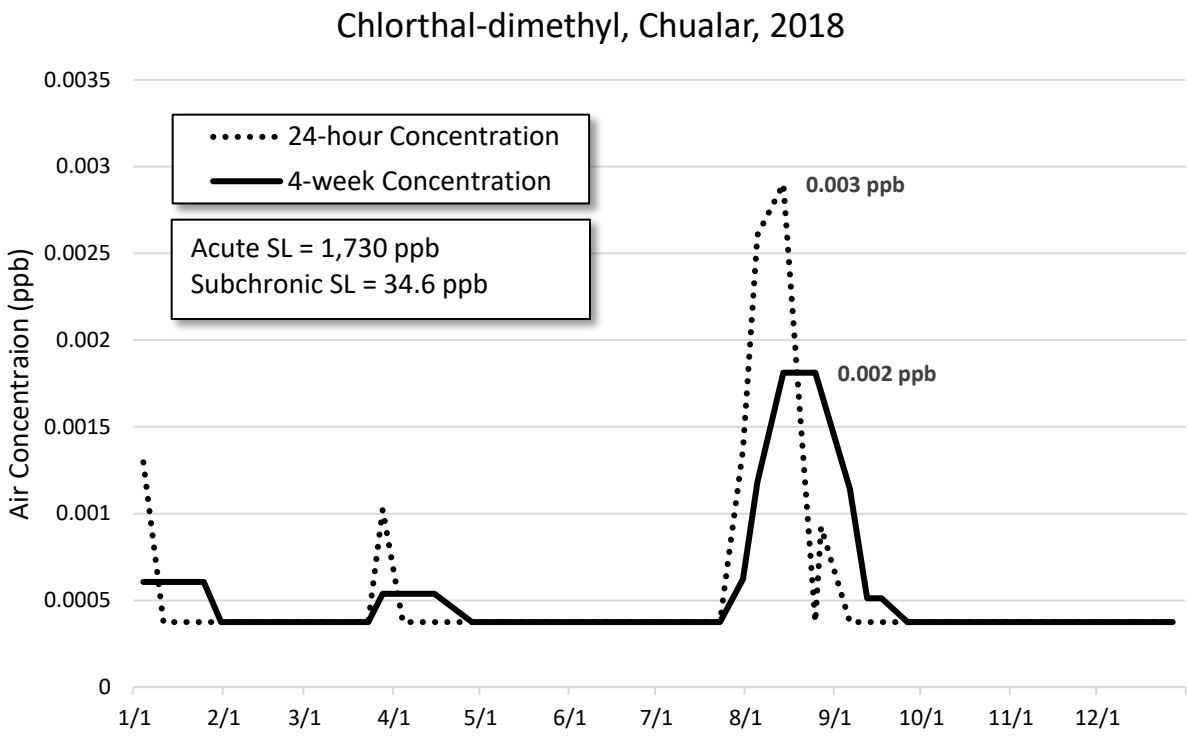

Figure 3. Temporal trend in chlorthal-dimethyl concentrations in Chualar in 2018.

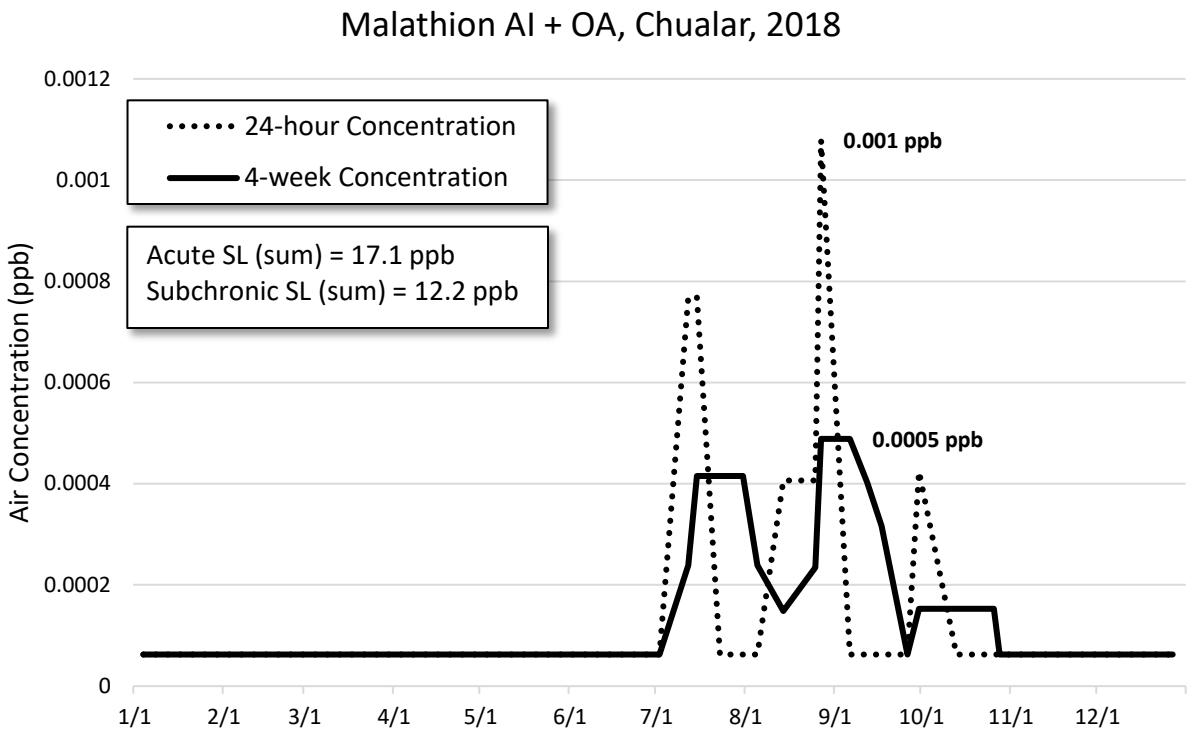

Figure 4. Temporal trend in summed malathion AI + OA concentrations in Chualar in 2018.

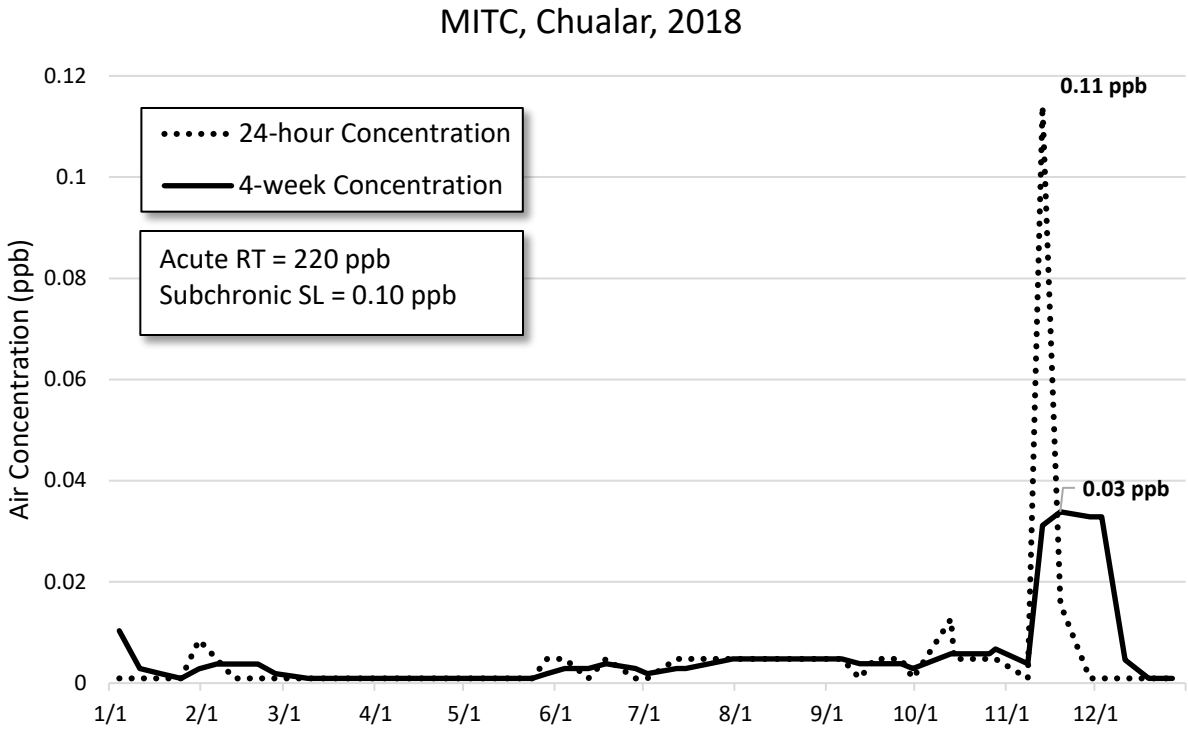

Figure 5. Temporal trend in MITC concentrations in Chualar in 2018.

Appendix B: Detailed Result Information for Cuyama

Cuyama

Cuyama is a census-designated place located in Santa Barbara County, and is 0.46 square miles in area. The average elevation is 2,293 feet; it receives an average of 13.3 inches of precipitation annually. Average temperatures range from 59° to 81° F in the summer and 46° to 69° F in the winter. Based on the 2010 census, the population of Cuyama was 57, of which 24.6% were under 18 years of age and 8.8% were over 65 years of age. The major crops in the immediate area around Cuyama are carrots, apricots, peaches, and plums. The monitoring site is located at Cuyama Elementary School. Monitoring at this site is conducted by the California Air Resources Board (CARB) and commenced on May 10, 2018 resulting in less than a full year of analytical results for this site.

Pesticide Detections

Table 1 lists the number and percentage of analyses resulting in detections at the Cuyama sampling site. The highest percentage of detections were for MITC (89%, n = 31), followed by trifluralin (31%, n = 11), and then chlorothalonil (9%, n = 3). The highest percentage of quantifiable detections were observed for MITC (23%, n = 8) and trifluralin (6%, n = 2). No additional chemicals were detected at quantifiable concentrations by the AMN in Cuyama in 2018.

Table 1. Number and percentage of positive samples per chemical in Cuyama, California.

Chemical	Number of possible detections	Total number of detections*	Number of quantifiable detections	Percent of possible detections	Percent of quantifiable detections
1,3-dichloropropene	35	0	0	0%	0%
Acephate	35	0	0	0%	0%
Bensulide	35	0	0	0%	0%
Chloropicrin	35	0	0	0%	0%
Chlorothalonil	35	3	0	9%	0%
Chlorpyrifos	35	0	0	0%	0%
Chlorpyrifos OA	35	0	0	0%	0%
Chlorthal-dimethyl	35	0	0	0%	0%
Cypermethrin	35	0	0	0%	0%
DDVP	35	1	0	3%	0%
DEF	35	0	0	0%	0%
Diazinon	35	0	0	0%	0%
Diazinon OA	35	0	0	0%	0%
Dimethoate	35	0	0	0%	0%
Dimethoate OA	35	0	0	0%	0%
Diuron	35	0	0	0%	0%
Endosulfan	35	0	0	0%	0%
Endosulfan Sulfate	35	0	0	0%	0%

EPTC	35	0	0	0%	0%
Iprodione	35	1	0	3%	0%
Malathion	35	0	0	0%	0%
Malathion OA	35	1	0	3%	0%
Methidathion	35	0	0	0%	0%
Methyl bromide	35	0	0	0%	0%
Metolachlor	35	0	0	0%	0%
MITC	35	31	8	89%	23%
Norflurazon	35	0	0	0%	0%
Oryzalin	35	0	0	0%	0%
Oxydemeton methyl	35	0	0	0%	0%
Oxyfluorfen	35	0	0	0%	0%
Permethrin	35	0	0	0%	0%
Phosmet	35	0	0	0%	0%
pp-Dicofol	35	0	0	0%	0%
Propargite	35	0	0	0%	0%
Simazine	35	0	0	0%	0%
Trifluralin	35	11	2	31%	6%
Total	**1,260**	**48**	**10**	**4%**	**1%**

* Includes both quantifiable and trace detections.

Pesticide Concentrations

Acute (24-h) Concentrations

Table 2 shows the highest observed 24-h concentrations observed for all chemicals monitored at the Cuyama Air Monitoring Network sampling location in 2018. Only MITC and trifluralin were detected at quantifiable concentrations in Cuyama during monitoring in 2018. The highest concentration relative to its screening level was that trifluralin at 0.03%.

Table 2. Highest 24-h air concentrations, acute screening levels, and percent of the acute screening level for all chemicals monitored at the Cuyama Air Monitoring Network sampling location in 2018.

Chemical	Highest 24-h concentration in ppb (ng/m³)	24-h acute screening level in ppb (ng/m³)	% of screening level
Trifluralin	0.03 ppb (410 ng/m³)	87.5 ppb (1,200,000 ng/m³)	0.03%
MITC	0.02 ppb (60 ng/m³)	220 ppb (660,000 ng/m³) *	0.01%
1,3-dichloropropene	ND	110 ppb (505,000 ng/m³)	
Acephate	ND	1.60 ppb (12,000 ng/m³)	
Bensulide	ND	15.9 ppb (259,000 ng/m³)	
Chloropicrin	ND	73.0 ppb (491,000 ng/m³) *	
Chlorothalonil	Trace	3.13 ppb	

		(34,000 ng/m³)	
Chlorpyrifos	ND	0.08 ppb (1,200 ng/m³) **	
Chlorpyrifos OA	ND	0.09 ppb (1,200 ng/m³) **	
Chlorthal-dimethyl	ND	1,730 ppb (23,500,000 ng/m³)	
Cypermethrin	ND	6.64 ppb (113,000 ng/m³)	
DDVP	Trace	1.22 ppb (11,000 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.46 ppb (4,300 ng/m³)	
Dimethoate OA	ND	0.49 ppb (4,300 ng/m³)	
Diuron	ND	17.8 ppb (170,000 ng/m³)	
Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	29.7 ppb (230,000 ng/m³)	
Iprodione	Trace	69.6 ppb (939,000 ng/m³)	
Malathion	ND	8.33 ppb (113,000 ng/m³)	
Malathion OA	Trace	8.76 ppb (113,000 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	210 ppb (820,000 ng/m³) *	
Metolachlor	ND	7.33 ppb (85,000 ng/m³)	
Norflurazon	ND	12.6 ppb (170,000 ng/m³)	
Oryzalin	ND	29.7 ppb (420,000 ng/m³)	
Oxydemeton methyl	ND	3.74 ppb (39,200 ng/m³)	
Oxyfluorfen	ND	34.5 ppb (510,000 ng/m³)	
Permethrin	ND	10.5 ppb (168,000 ng/m³)	

Phosmet	ND	5.94 ppb (77,000 ng/m³)	
pp-Dicofol	ND	4.49 ppb (68,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	ND	13.3 ppb (110,000 ng/m³)	

* This value is a regulatory target rather than a screening level.
** DPR's May 28, 2019, risk management directive for chlorpyrifos established an acute regulatory target of 0.28 ppb (4,050 ng/m³), 1-hr TWA. However, the current sample duration does not allow for a direct comparison between the acute regulatory target concentration and the measured sample values.

Subchronic (4- or 13-wk) Concentrations

Table 3 shows the highest observed rolling 4-week or 13-week average concentrations for all chemicals monitored at the Cuyama Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of MITC at 1.1%. This was followed by trifluralin at 0.1%.

Table 3. Highest 4- or 13-week air concentrations, subchronic screening levels, and percent of the subchronic screening level for all chemicals monitored at the Cuyama Air Monitoring Network sampling location in 2018.

Chemical	Highest 4-week rolling average concentration in ppb (ng/m³)	Subchronic screening level in ppb (ng/m³)	% of screening level
MITC	0.011 ppb (32 ng/m³)	1.00 ppb (3,000 ng/m³)	1.1%
Trifluralin	0.012 ppb (170 ng/m³)	12.4 ppb (170,000 ng/m³)	0.1%
1,3-dichloropropene *	ND	3.0 ppb (14,000 ng/m³)	
Acephate	ND	1.13 ppb (8,500 ng/m³)	
Bensulide	ND	1.47 ppb (24,000 ng/m³)	
Chloropicrin *	ND	0.35 ppb (2,300 ng/m³)	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	ND	0.06 ppb (850 ng/m³)	
Chlorpyrifos OA	ND	0.06 ppb (850 ng/m³)	
Chlorthal-dimethyl	ND	34.6 ppb (470,000 ng/m³)	
Cypermethrin	ND	4.76 ppb (81,000 ng/m³)	
DDVP	Trace	0.24 ppb (2,200 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb	

		(130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.32 ppb (3,000 ng/m³)	
Dimethoate OA	ND	0.34 ppb (3,000 ng/m³)	
Diuron	ND	1.78 ppb (17,000 ng/m³)	
Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	3.10 ppb (24,000 ng/m³)	
Iprodione	Trace	21.2 ppb (286,000 ng/m³)	
Malathion	ND	5.97 ppb (80,600 ng/m³)	
Malathion OA	Trace	6.27 ppb (80,600 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	5.0 ppb (19,400 ng/m³)	
Metolachlor	ND	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	ND	16.2 ppb (230,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	
Oxyfluorfen	ND	12.2 ppb (180,000 ng/m³)	
Permethrin	ND	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	2.00 ppb (26,000 ng/m³)	
pp-Dicofol	ND	3.24 ppb (49,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	ND	3.76 ppb (31,000 ng/m³)	

* These concentrations represent the highest 13-week rolling average, rather than the default 4-week rolling average.

Chronic (2018) Concentrations

Annual 2018 average concentrations were not able to be determined for Cuyama since monitoring at this site is conducted by CARB and commenced on May 10, 2018 resulting in less than a full year of analytical results for this site.

Temporal trends in detected concentrations

Figures 1 and 2 present the concentrations over time for monitoring results in 2018 for any chemical detected at a quantifiable concentration in Cuyama. MITC and trifluralin were the only two analytes detected during AMN monitoring in 2018, which began on 5/10/18. Screening levels, as defined in Appendix K, are abbreviated as SL in the following graphs. For graphs where both a pesticide and its degradate are shown, the detected concentrations of both the parent chemical and its degradate have been summed for each sampling date.

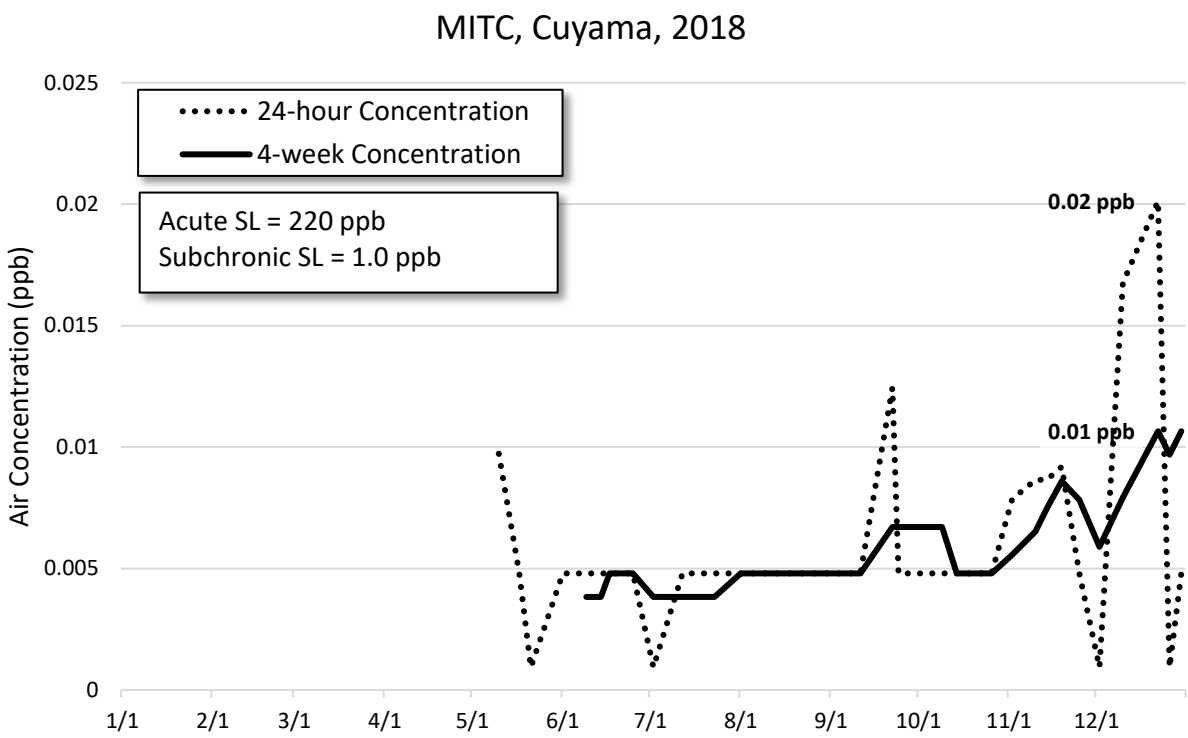

Figure 1. Temporal trend in MITC concentrations in Cuyama in 2018.

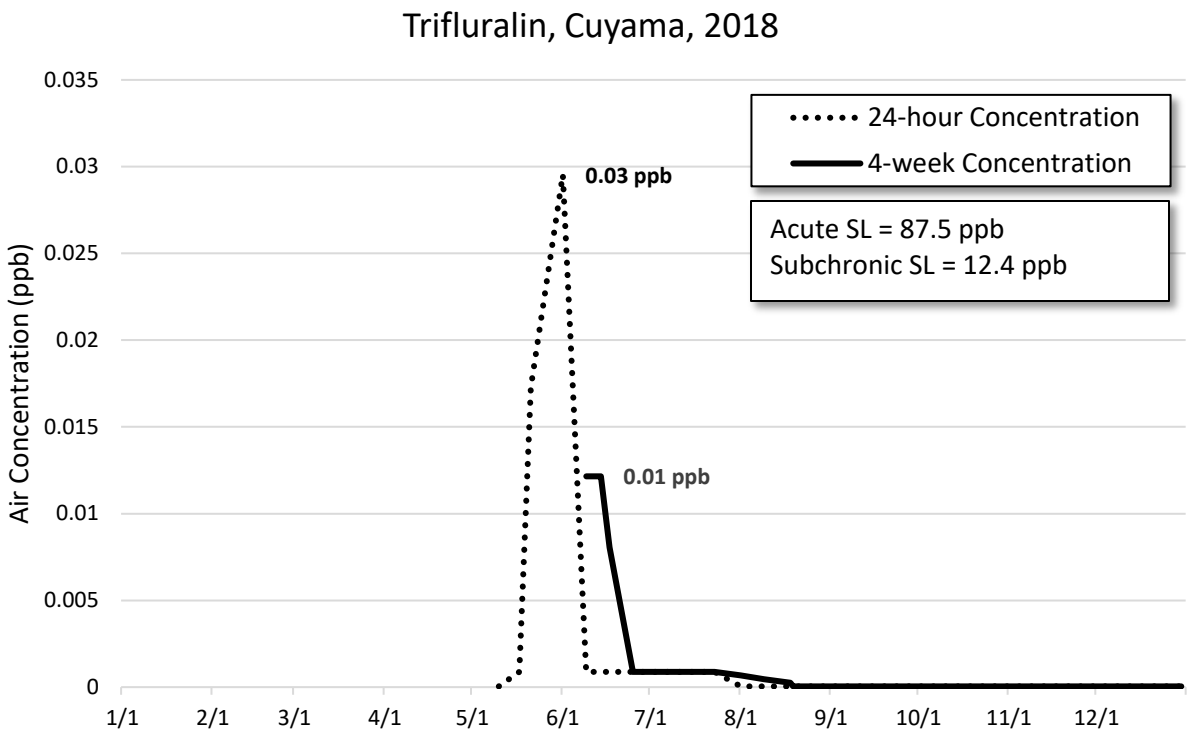

Figure 2. Temporal trend in trifluralin concentrations in Cuyama in 2018.

Appendix C: Detailed Result Information for Lindsay

Lindsay

Lindsay is located in Tulare County, and is 2.73 square miles in area. The average elevation is 387 feet; it receives about 11.6 inches of precipitation annually. Average temperatures range from 56° to 80°F in the summer and 35° to 64°F in the winter. Based on the 2010 census, the population of Lindsay was 11,768 of which 38.4% were under 18 years of and 7.5% were above 65 years of age. The major crops around Lindsay are oranges and grapes. The monitoring site is at Reagan Elementary School. Monitoring at this site is conducted by the California Air Resources Board (CARB) and commenced on April 26, 2018 resulting in less than a full year of analytical results for this site.

Pesticide Detections

Table 1 lists the number and percentage of analyses resulting in detections at the Lindsay sampling site. The highest percentage of detections were for MITC (61%, n = 22), followed by chlorothalonil (50%, n = 18), and then chlorpyrifos (22%, n = 8). This highest percentage of quantifiable detections were observed for MITC (14%, n = 5), followed by chlorpyrifos OA and dimethoate OA, both with 3% (n = 1).

Table 1. Number and percentage of positive samples per chemical in Cuyama, California.

Chemical	Number of possible detections	Total number of detections*	Number of quantifiable detections	Percent of possible detections	Percent of quantifiable detections
1,3-dichloropropene	35	0	0	0%	0%
Acephate	36	1	0	3%	0%
Bensulide	36	0	0	0%	0%
Chloropicrin	36	0	0	0%	0%
Chlorothalonil	36	18	0	50%	0%
Chlorpyrifos	36	6	0	17%	0%
Chlorpyrifos OA	36	8	1	22%	3%
Chlorthal-dimethyl	36	0	0	0%	0%
Cypermethrin	36	0	0	0%	0%
DDVP	36	1	0	3%	0%
DEF	36	0	0	0%	0%
Diazinon	36	0	0	0%	0%
Diazinon OA	36	0	0	0%	0%
Dimethoate	36	1	0	3%	0%
Dimethoate OA	36	3	1	8%	3%
Diuron	36	2	0	6%	0%
Endosulfan	36	0	0	0%	0%
Endosulfan Sulfate	36	0	0	0%	0%
EPTC	36	0	0	0%	0%
Iprodione	36	0	0	0%	0%
Malathion	36	1	0	3%	0%
Malathion OA	36	3	0	8%	0%
Methidathion	36	0	0	0%	0%

Methyl bromide	35	0	0	0%	0%
Metolachlor	36	0	0	0%	0%
MITC	36	22	5	61%	14%
Norflurazon	36	0	0	0%	0%
Oryzalin	36	0	0	0%	0%
Oxydemeton methyl	36	0	0	0%	0%
Oxyfluorfen	36	0	0	0%	0%
Permethrin	36	0	0	0%	0%
Phosmet	36	0	0	0%	0%
pp-Dicofol	36	0	0	0%	0%
Propargite	36	1	0	3%	0%
Simazine	36	1	0	3%	0%
Trifluralin	36	0	0	0%	0%
Total	**1,294**	**68**	**7**	**5%**	**1%**

* Includes both quantifiable and trace detections.

Pesticide Concentrations

Acute (24-h) Concentrations

Table 2 shows the highest observed 24-h concentrations observed for all chemicals monitored at the Lindsay Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chlorpyrifos oxygen analog (OA) at 1.2%. This was followed by dimethoate OA at 0.4%.

Table 2. Highest 24-h air concentrations, acute screening levels, and percent of the acute screening level for all chemicals monitored at the Lindsay Air Monitoring Network sampling location in 2018.

Chemical	Highest 24-h concentration in ppb (ng/m³)	24-h acute screening level in ppb (ng/m³)	% of screening level
Chlorpyrifos OA	0.001 ppb (14 ng/m³)	0.09 ppb (1,200 ng/m³) *	1.2%
Dimethoate OA	0.002 ppb (17 ng/m³)	0.49 ppb (4,300 ng/m³)	0.4%
MITC	0.028 ppb (84 ng/m³)	220 ppb (660,000 ng/m³) **	0.01%
1,3-dichloropropene	ND	110 ppb (505,000 ng/m³)	
Acephate	Trace	1.60 ppb (12,000 ng/m³)	
Bensulide	ND	15.9 ppb (259,000 ng/m³)	
Chloropicrin	ND	73.0 ppb (491,000 ng/m³) **	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	Trace	0.08 ppb (1,200 ng/m³) *	
Chlorthal-dimethyl	ND	1,730 ppb (23,500,000 ng/m³)	
Cypermethrin	ND	6.64 ppb	

		(113,000 ng/m³)	
DDVP	Trace	1.22 ppb (11,000 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	Trace	0.46 ppb (4,300 ng/m³)	
Diuron	Trace	17.8 ppb (170,000 ng/m³)	
Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	29.7 ppb (230,000 ng/m³)	
Iprodione	ND	69.6 ppb (939,000 ng/m³)	
Malathion	Trace	8.33 ppb (113,000 ng/m³)	
Malathion OA	Trace	8.76 ppb (113,000 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	210 ppb (820,000 ng/m³) **	
Metolachlor	ND	7.33 ppb (85,000 ng/m³)	
Norflurazon	ND	12.6 ppb (170,000 ng/m³)	
Oryzalin	ND	29.7 ppb (420,000 ng/m³)	
Oxydemeton methyl	ND	3.74 ppb (39,200 ng/m³)	
Oxyfluorfen	ND	34.5 ppb (510,000 ng/m³)	
Permethrin	ND	10.5 ppb (168,000 ng/m³)	
Phosmet	ND	5.94 ppb (77,000 ng/m³)	
pp-Dicofol	ND	4.49 ppb (68,000 ng/m³)	
Propargite	Trace	0.98 ppb (14,000 ng/m³)	
Simazine	Trace	13.3 ppb (110,000 ng/m³)	
Trifluralin	ND	87.5 ppb (1,200,000 ng/m³)	

* DPR's May 28, 2019, risk management directive for chlorpyrifos established an acute regulatory target of 0.28 ppb (4,050 ng/m³), 1-hr TWA. However, the current sample duration does not allow for a direct comparison between the acute regulatory target concentration and the measured sample values.
** This value is a regulatory target rather than a screening level.

Subchronic (4- or 13-wk) Concentrations

Table 3 shows the highest observed rolling 4-week or 13-week average concentrations for all chemicals monitored at the Lindsay Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of MITC at 1.7%. This was followed by chlorpyrifos OA at 0.9%, and then dimethoate OA at 0.2%.

Table 3. Highest 4- or 13-wk air concentrations, subchronic screening levels, and percent of the subchronic screening level for all chemicals monitored at the Lindsay Air Monitoring Network sampling location in 2018.

Chemical	Highest 4-week rolling average concentration in ppb (ng/m³)	Subchronic screening level in ppb (ng/m³)	% of screening level
Chlorpyrifos OA	0.0005 ppb (7.3 ng/m³)	0.06 ppb (850 ng/m³)	0.9%
Dimethoate OA	0.0008 ppb (6.9 ng/m³)	0.34 ppb (3,000 ng/m³)	0.2%
MITC	0.017 ppb (51 ng/m³)	1.00 ppb (3,000 ng/m³)	1.7%
1,3-dichloropropene **	ND	3.0 ppb (14,000 ng/m³)	
Acephate	Trace	1.13 ppb (8,500 ng/m³)	
Bensulide	ND	1.47 ppb (24,000 ng/m³)	
Chloropicrin **	ND	0.35 ppb (2,300 ng/m³)	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	Trace	0.06 ppb (850 ng/m³)	
Chlorthal-dimethyl	ND	34.6 ppb (470,000 ng/m³)	
Cypermethrin	ND	4.76 ppb (81,000 ng/m³)	
DDVP	Trace	0.24 ppb (2,200 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	Trace	0.32 ppb (3,000 ng/m³)	
Diuron	Trace	1.78 ppb (17,000 ng/m³)	

Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	3.10 ppb (24,000 ng/m³)	
Iprodione	ND	21.2 ppb (286,000 ng/m³)	
Malathion	Trace	5.97 ppb (80,600 ng/m³)	
Malathion OA	Trace	6.27 ppb (80,600 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	5.0 ppb (19,400 ng/m³) *	
Metolachlor	ND	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	ND	16.2 ppb (230,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	
Oxyfluorfen	ND	12.2 ppb (180,000 ng/m³)	
Permethrin	ND	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	2.00 ppb (26,000 ng/m³)	
pp-Dicofol	ND	3.24 ppb (49,000 ng/m³)	
Propargite	Trace	0.98 ppb (14,000 ng/m³)	
Simazine	Trace	3.76 ppb (31,000 ng/m³)	
Trifluralin	ND	12.4 ppb (170,000 ng/m³)	

* This value is a regulatory target rather than a screening level.
** These concentrations represent the highest 13-week rolling average, rather than the default 4-week rolling average.

Chronic (2018) Concentrations

Annual 2018 average concentrations were not able to be determined for Lindsay since monitoring at this site is conducted by CARB and commenced on April 26, 2018 resulting in less than a full year of analytical results for this site.

Temporal trends in detected concentrations

Figures 1 – 3 present the concentrations over time for monitoring results in 2018 for any chemical detected at a quantifiable concentration in Lindsay. Screening levels, as defined in Appendix K are abbreviated as SL in the following graphs. Regulatory targets, also defined in Appendix K, are

abbreviated as RT. For graphs where both a pesticide and its degradate are shown, the detected concentrations of both the parent chemical and its degradate have been summed for each sampling date.

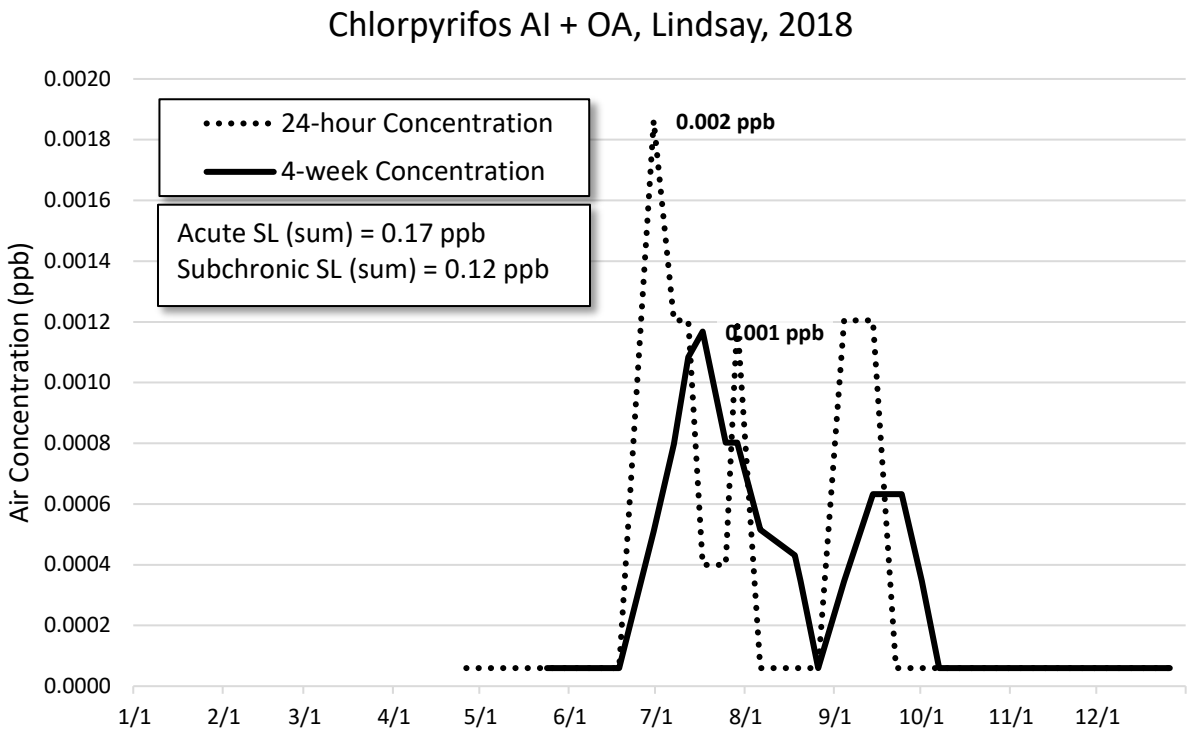

Figure 1. Temporal trend in summed chlorpyrifos AI + OA concentrations in Lindsay in 2018.

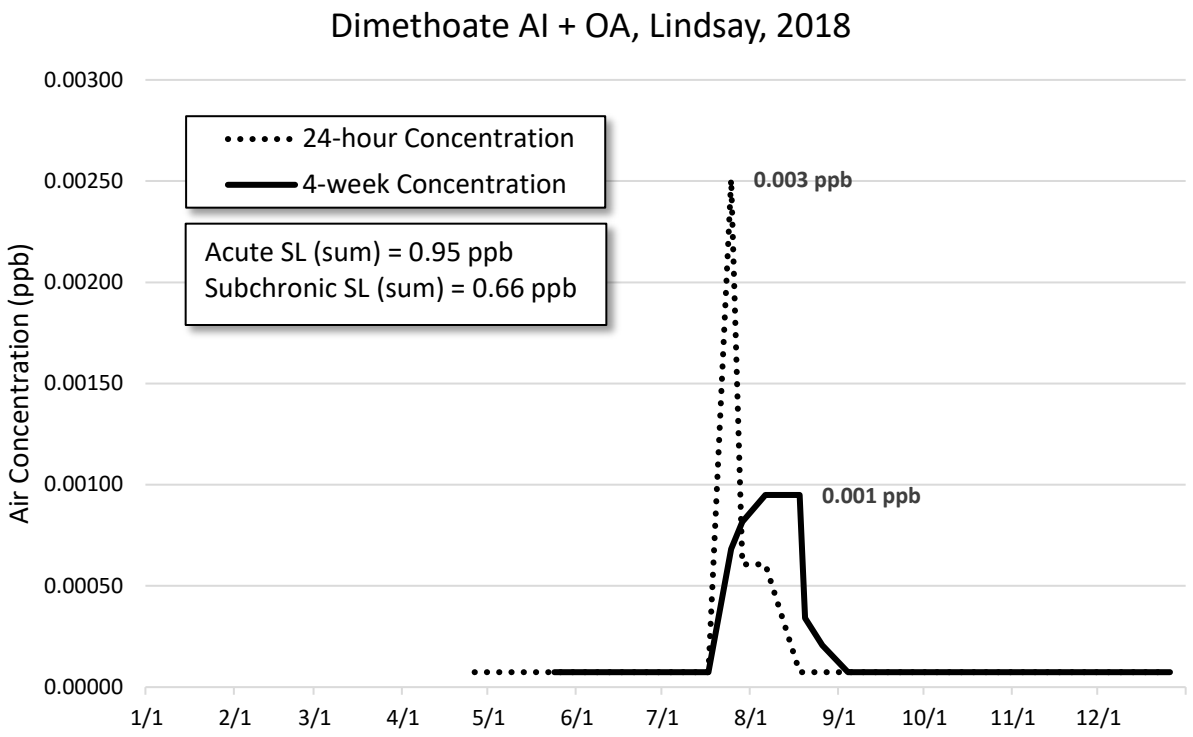

Figure 2. Temporal trend in summed dimethoate AI + OA concentrations in Lindsay in 2018.

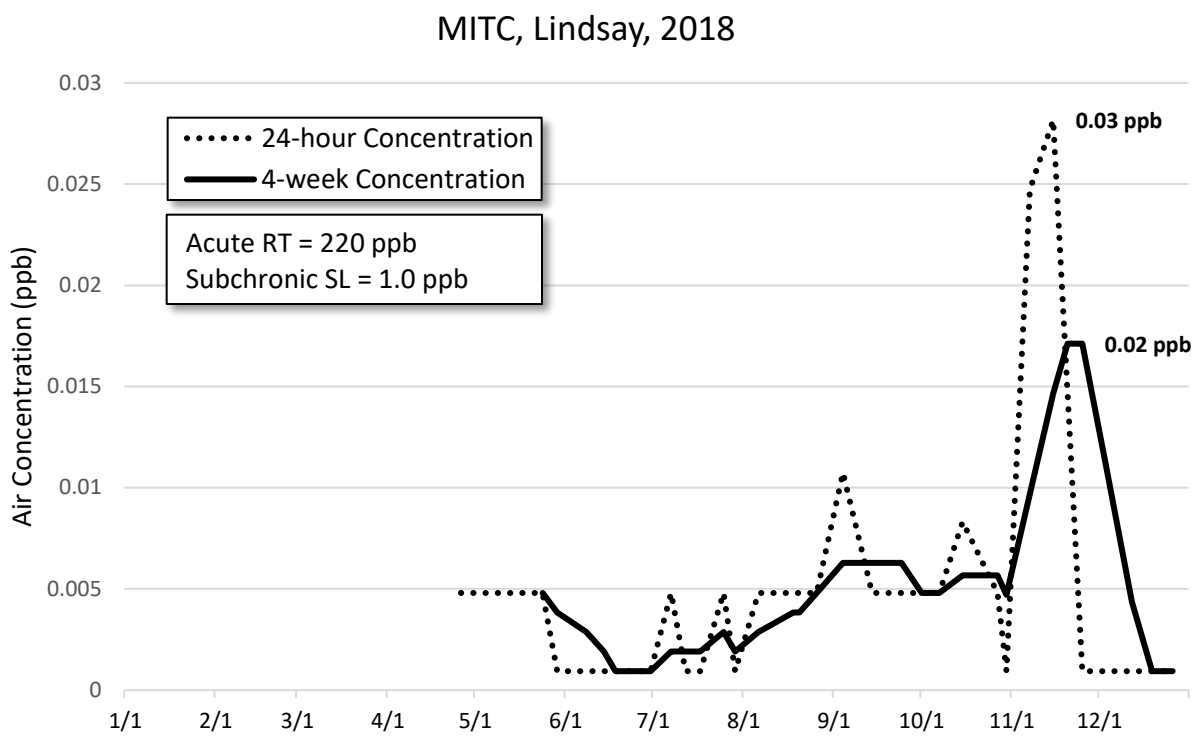

Figure 3. Temporal trend in MITC concentrations in Lindsay in 2018.

Appendix D: Detailed Result Information for Oxnard

Oxnard

Oxnard is located in Ventura County and is 39.21 square miles in area. The average elevation is 52 feet; it receives an average of 15.62 inches of precipitation annually. Average temperatures range from 56° to 76° F in the summer and 42° to 66° F in the winter. Based on the 2010 census, the population of Oxnard was 197,899, of which 29.8% were under 18 years of age and 8.3% were above 65 years of age. The Oxnard Plain is primarily known for strawberry production. The monitoring site is located at Rio Mesa High School and transitioned from a Toxic Air Contaminant (TAC) Network site to an Air Monitoring Network (AMN) site. Monitoring is conducted by the California Air Resources Board (CARB). Sampling as part of the Air Monitoring Network began on August 14, 2018 resulting in less than a full year of analytical results for this site.

Pesticide Detections

Table 1 lists the number and percentage of analyses resulting in detections at the Oxnard sampling site. The highest percentage of detections were for chlorothalonil (65%, n = 13), followed by MITC (55%, n = 11), and then chlorthal-dimethyl (40%, n = 8). The highest percentage of quantifiable detections were observed for MITC (15%, n = 3), followed by chloropicrin (10%, n = 2), and then 1,3-dichloropropene (5%, n = 1).

Table 1. Number and percentage of positive samples per chemical in Oxnard, California.

Chemical	Number of possible detections	Total number of detections*	Number of quantifiable detections	Percent of possible detections	Percent of quantifiable detections
1,3-dichloropropene	20	1	1	5%	5%
Acephate	20	0	0	0%	0%
Bensulide	20	0	0	0%	0%
Chloropicrin	20	4	2	20%	10%
Chlorothalonil	20	13	0	65%	0%
Chlorpyrifos	20	0	0	0%	0%
Chlorpyrifos OA	20	1	0	5%	0%
Chlorthal-dimethyl	20	8	0	40%	0%
Cypermethrin	20	0	0	0%	0%
DDVP	20	0	0	0%	0%
DEF	20	0	0	0%	0%
Diazinon	20	0	0	0%	0%
Diazinon OA	20	0	0	0%	0%
Dimethoate	20	0	0	0%	0%
Dimethoate OA	20	0	0	0%	0%
Diuron	20	0	0	0%	0%
Endosulfan	20	0	0	0%	0%
Endosulfan Sulfate	20	0	0	0%	0%
EPTC	20	0	0	0%	0%
Iprodione	20	0	0	0%	0%
Malathion	20	1	0	5%	0%

Malathion OA	20	3	0	15%	0%
Methidathion	20	0	0	0%	0%
Methyl bromide	20	0	0	0%	0%
Metolachlor	20	0	0	0%	0%
MITC	20	11	3	55%	15%
Norflurazon	20	0	0	0%	0%
Oryzalin	20	0	0	0%	0%
Oxydemeton methyl	20	0	0	0%	0%
Oxyfluorfen	20	0	0	0%	0%
Permethrin	20	0	0	0%	0%
Phosmet	20	0	0	0%	0%
pp-Dicofol	20	0	0	0%	0%
Propargite	20	0	0	0%	0%
Simazine	20	0	0	0%	0%
Trifluralin	20	0	0	0%	0%
Total	720	42	6	6%	1%

* Includes both quantifiable and trace detections.

Pesticide Concentrations

Acute (24-h) Concentrations

Table 2 shows the highest observed 24-h concentrations observed for all chemicals monitored at the Oxnard Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chloropicrin at 1.1%. This was followed by 1,3-dichloropropene at 0.1% of its acute screening level.

Table 2. Highest 24-h air concentrations, acute screening levels, and percent of the acute screening level for all chemicals monitored at the Oxnard Air Monitoring Network sampling location in 2018.

Chemical	Highest 24-h concentration in ppb (ng/m³)	24-h acute screening level in ppb (ng/m³)	% of screening level
1,3-dichloropropene	0.1 ppb (450 ng/m³)	110 ppb (505,000 ng/m³)	0.1%
Chloropicrin	0.8 ppb (5400 ng/m³)	73.0 ppb (491,000 ng/m³) *	1.1%
MITC	0.016 ppb (48 ng/m³)	220 ppb (660,000 ng/m³) *	0.01%
Acephate	ND	1.60 ppb (12,000 ng/m³)	
Bensulide	ND	15.9 ppb (259,000 ng/m³)	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	ND	0.08 ppb (1,200 ng/m³)**	
Chlorpyrifos OA	Trace	0.09 ppb (1,200 ng/m³) **	
Chlorthal-dimethyl	Trace	1,730 ppb (23,500,000 ng/m³)	
Cypermethrin	ND	6.64 ppb (113,000 ng/m³)	

DDVP	ND	1.22 ppb (11,000 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.46 ppb (4,300 ng/m³)	
Dimethoate OA	ND	0.49 ppb (4,300 ng/m³)	
Diuron	ND	17.8 ppb (170,000 ng/m³)	
Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	29.7 ppb (230,000 ng/m³)	
Iprodione	ND	69.6 ppb (939,000 ng/m³)	
Malathion	Trace	8.33 ppb (113,000 ng/m³)	
Malathion OA	Trace	8.76 ppb (113,000 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	210 ppb (820,000 ng/m³) *	
Metolachlor	ND	7.33 ppb (85,000 ng/m³)	
Norflurazon	ND	12.6 ppb (170,000 ng/m³)	
Oryzalin	ND	29.7 ppb (420,000 ng/m³)	
Oxydemeton methyl	ND	3.74 ppb (39,200 ng/m³)	
Oxyfluorfen	ND	34.5 ppb (510,000 ng/m³)	
Permethrin	ND	10.5 ppb (168,000 ng/m³)	
Phosmet	ND	5.94 ppb (77,000 ng/m³)	
pp-Dicofol	ND	4.49 ppb (68,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	ND	13.3 ppb (110,000 ng/m³)	
Trifluralin	ND	87.5 ppb	

		(1,200,000 ng/m³)	

* This value is a regulatory target rather than a screening level.
** DPR's May 28, 2019, risk management directive for chlorpyrifos established an acute regulatory target of 0.28 ppb (4,050 ng/m³), 1-hr TWA. However, the current sample duration does not allow for a direct comparison between the acute regulatory target concentration and the measured sample values.

Subchronic (4- or 13-wk) Concentrations

Table 3 shows the highest observed rolling 4-week or 13-week average concentrations for all chemicals monitored at the Oxnard Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chloropicrin at 10.0%. This was followed by 1,3-dichloropropene at 1.8%, and then MITC at 1.1%.

Table 3. Highest 4- or 13-wk air concentrations, subchronic screening levels, and percent of the subchronic screening level for all chemicals monitored at the Oxnard Air Monitoring Network sampling location in 2018.

Chemical	Highest 4-week rolling average concentration in ppb (ng/m³)	Subchronic screening level in ppb (ng/m³)	% of screening level
1,3-dichloropropene *	0.054 ppb (240 ng/m³)	3.0 ppb (14,000 ng/m³)	1.8%
Chloropicrin *	0.035 ppb (240 ng/m³)	0.35 ppb (2,300 ng/m³)	10.0%
MITC	0.011 ppb (32 ng/m³)	1.00 ppb (3,000 ng/m³)	1.1%
Acephate	ND	1.13 ppb (8,500 ng/m³)	
Bensulide	ND	1.47 ppb (24,000 ng/m³)	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	ND	0.06 ppb (850 ng/m³)	
Chlorpyrifos OA	Trace	0.06 ppb (850 ng/m³)	
Chlorthal-dimethyl	Trace	34.6 ppb (470,000 ng/m³)	
Cypermethrin	ND	4.76 ppb (81,000 ng/m³)	
DDVP	ND	0.24 ppb (2,200 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.32 ppb (3,000 ng/m³)	
Dimethoate OA	ND	0.34 ppb (3,000 ng/m³)	
Diuron	ND	1.78 ppb	

		(17,000 ng/m³)	
Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	3.10 ppb (24,000 ng/m³)	
Iprodione	ND	21.2 ppb (286,000 ng/m³)	
Malathion	Trace	5.97 ppb (80,600 ng/m³)	
Malathion OA	Trace	6.27 ppb (80,600 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	5.0 ppb (19,400 ng/m³) *	
Metolachlor	ND	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	ND	16.2 ppb (230,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	
Oxyfluorfen	ND	12.2 ppb (180,000 ng/m³)	
Permethrin	ND	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	2.00 ppb (26,000 ng/m³)	
pp-Dicofol	ND	3.24 ppb (49,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	ND	3.76 ppb (31,000 ng/m³)	
Trifluralin	ND	12.4 ppb (170,000 ng/m³)	

* These concentrations represent the highest 13-week rolling average, rather than the default 4-week rolling average.

Chronic (2018) Concentrations

Annual 2018 average concentrations were not able to be determined for Oxnard since monitoring at this site is conducted by CARB and commenced on August 14, 2018 resulting in less than a full year of analytical results for this site.

Temporal trends in detected concentrations

Figures 1 – 3 present the concentrations over time for monitoring results in 2018 for any chemical detected at a quantifiable concentration in Oxnard. The results for 1,3-dichloropropene in Oxnard have

been supplemented with available data from the TAC network. Slight differences exist in data collection methods between the studies, so this is of limited value for quantitative comparisons. Screening levels, as defined in Appendix K are abbreviated as SL in the following graphs. Regulatory targets, also defined in Appendix K, are abbreviated as RT. For graphs where both a pesticide and its degradate are shown, the detected concentrations of both the parent chemical and its degradate have been summed for each sampling date.

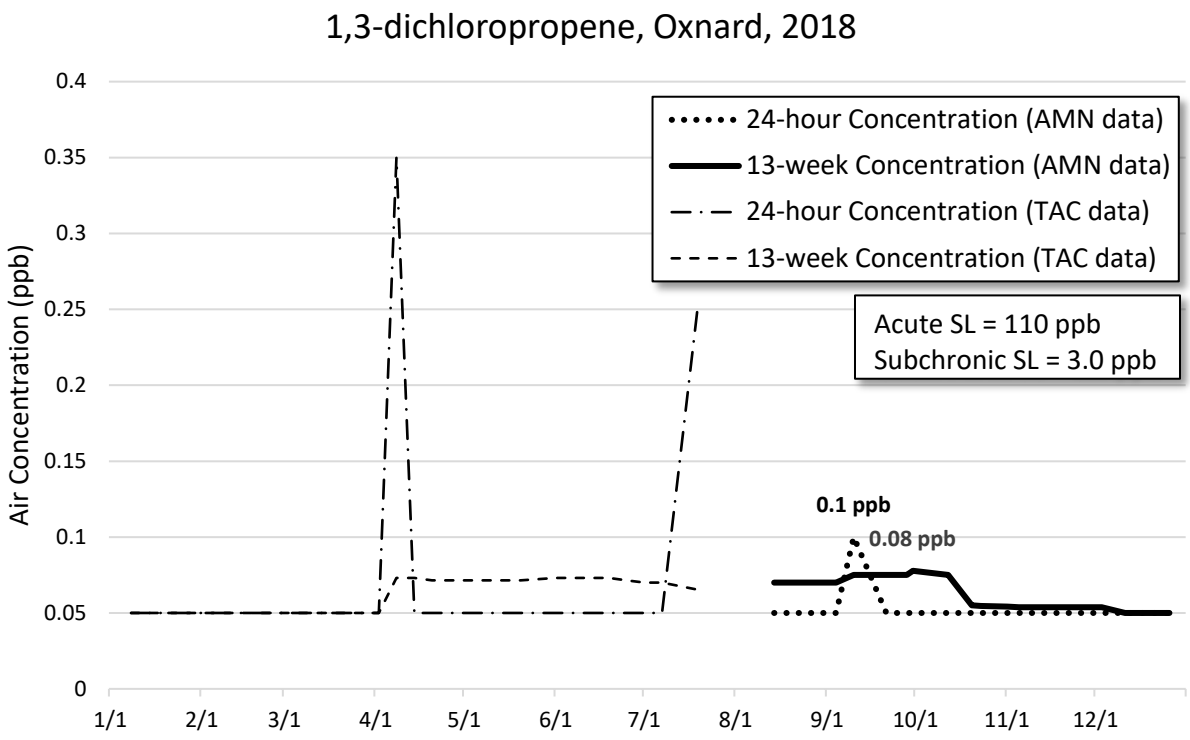

Figure 1. Temporal trend in 1,3-dichloropropene concentrations in Oxnard in 2018.

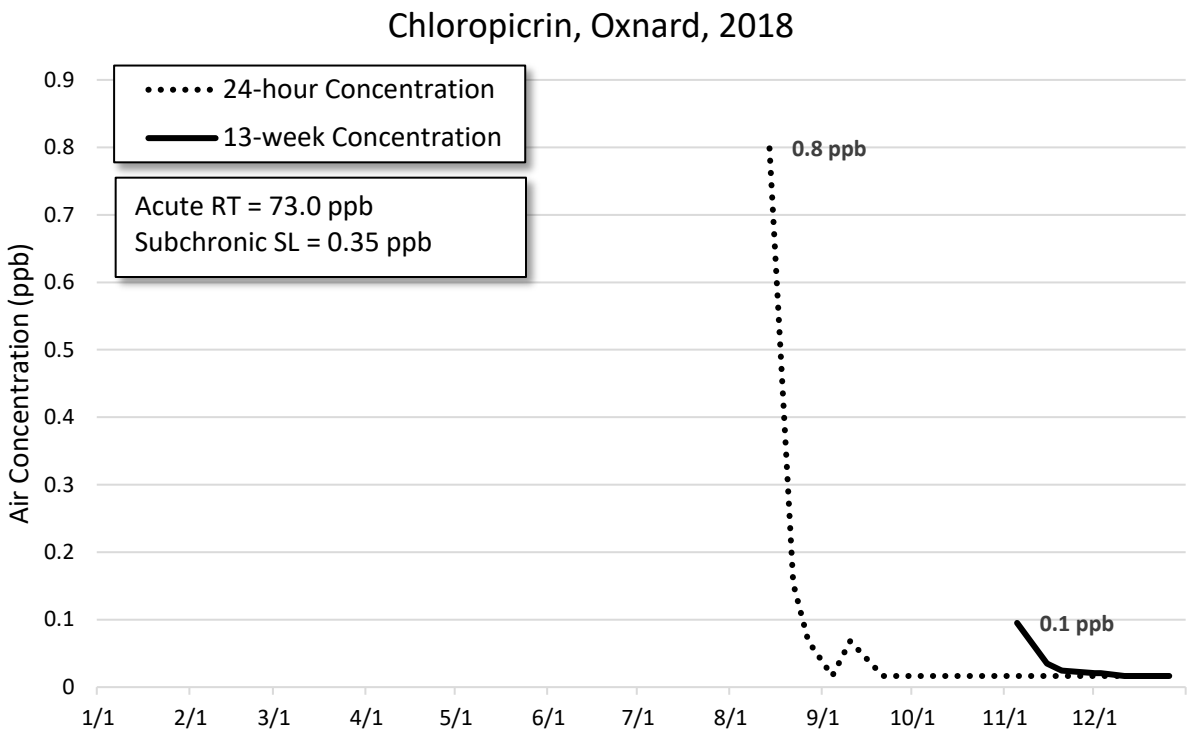

Figure 2. Temporal trend in chloropicrin concentrations in Oxnard in 2018.

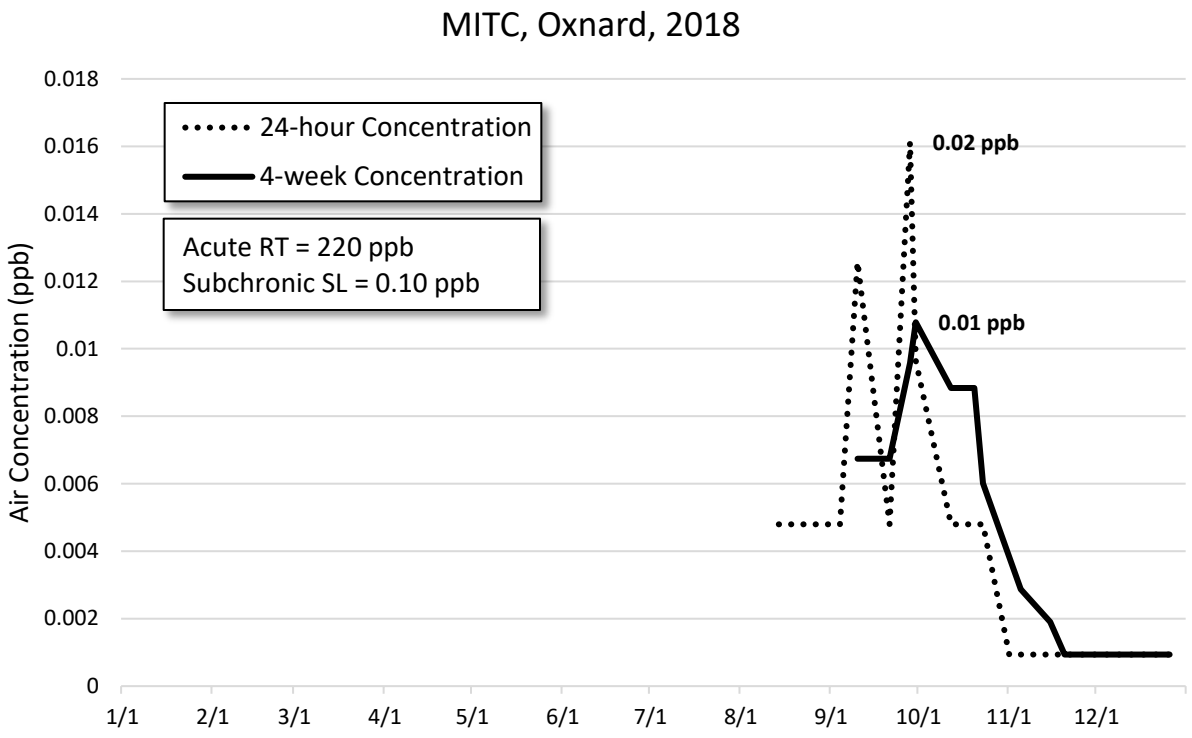

Figure 3. Temporal trend in MITC concentrations in Oxnard in 2018.

Appendix E: Detailed Result Information for San Joaquin

San Joaquin

The city of San Joaquin is located in Fresno County and is 1.20 square miles in area. The average elevation is 174 feet; it receives an average of 12.5 inches of precipitation annually. Average temperatures range from 56° to 97° F in the summer and 36° to 63° F in the winter. Based on the 2010 census, the population of the city of San Joaquin was 4,001, of which 41.3% were under 18 years of age and 4.4% were above 65 years of age. Agriculture in the area include grapes, oranges, and nectarines. The monitoring site is located at San Joaquin Elementary School. Monitoring is conducted by the California Air Resources Board (CARB) and commenced on April 26, 2018 resulting in less than a full year of analytical results for this site.

Pesticide Detections

Table 1 lists the number and percentage of analyses resulting in detections at the San Joaquin sampling site. The highest percentage of detections were for MITC (72%, n = 26), followed by chlorothalonil (56%, n = 20), and then chlorpyrifos oxygen analog (OA) (36%, n = 13). The highest percentage of quantifiable detections were observed for MITC (39%, n = 14), followed by methyl bromide (8%, n = 3), and then chlorpyrifos OA (3%, n = 1).

Table 1. Number and percentage of positive samples per chemical in San Joaquin, California.

Chemical	Number of possible detections	Total number of detections*	Number of quantifiable detections	Percent of possible detections	Percent of quantifiable detections
1,3-dichloropropene	36	1	1	3%	3%
Acephate	36	3	0	8%	0%
Bensulide	36	0	0	0%	0%
Chloropicrin	36	0	0	0%	0%
Chlorothalonil	36	20	0	56%	0%
Chlorpyrifos	36	7	0	19%	0%
Chlorpyrifos OA	36	13	1	36%	3%
Chlorthal-dimethyl	36	2	0	6%	0%
Cypermethrin	36	0	0	0%	0%
DDVP	36	7	0	19%	0%
DEF	36	0	0	0%	0%
Diazinon	36	0	0	0%	0%
Diazinon OA	36	0	0	0%	0%
Dimethoate	36	0	0	0%	0%
Dimethoate OA	36	2	0	6%	0%
Diuron	36	1	0	3%	0%
Endosulfan	36	0	0	0%	0%
Endosulfan Sulfate	36	0	0	0%	0%
EPTC	36	0	0	0%	0%
Iprodione	36	0	0	0%	0%
Malathion	36	0	0	0%	0%
Malathion OA	36	1	0	3%	0%

Methidathion	36	0	0	0%	0%
Methyl bromide	36	3	3	8%	8%
Metolachlor	36	1	0	3%	0%
MITC	36	26	14	72%	39%
Norflurazon	36	0	0	0%	0%
Oryzalin	36	0	0	0%	0%
Oxydemeton methyl	36	0	0	0%	0%
Oxyfluorfen	36	1	0	3%	0%
Permethrin	36	0	0	0%	0%
Phosmet	36	0	0	0%	0%
pp-Dicofol	36	0	0	0%	0%
Propargite	36	4	0	11%	0%
Simazine	36	0	0	0%	0%
Trifluralin	36	12	0	33%	0%
Total	**1,296**	**104**	**19**	**8%**	**1%**

* Includes both quantifiable and trace detections.

Pesticide Concentrations

Acute (24-h) Concentrations

Table 2 shows the highest observed 24-h concentrations observed for all chemicals monitored at the San Joaquin Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chlorpyrifos OA at 1.2%, followed by 1,3-dichloropropene at 0.7%.

Table 2. Highest 24-h air concentrations, acute screening levels, and percent of the acute screening level for all chemicals monitored at the San Joaquin Air Monitoring Network sampling location in 2018.

Chemical	Highest 24-h concentration in ppb (ng/m³)	24-h acute screening level in ppb (ng/m³)	% of screening level
1,3-dichloropropene	0.74 ppb (3,359 ng/m³)	110 ppb (505,000 ng/m³)	0.7%
Chlorpyrifos OA	0.001 ppb (14 ng/m³)	0.1 ppb (1,200 ng/m³) *	1.2%
Methyl bromide	0.038 ppb (147 ng/m³)	210 ppb (820,000 ng/m³) **	0.02%
MITC	0.32 ppb (949 ng/m³)	220 ppb (660,000 ng/m³) **	0.14%
Acephate	Trace	1.60 ppb (12,000 ng/m³)	
Bensulide	ND	15.9 ppb (259,000 ng/m³)	
Chloropicrin	ND	73.0 ppb (491,000 ng/m³) **	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	Trace	0.08 ppb (1,200 ng/m³) *	
Chlorthal-dimethyl	Trace	1,730 ppb (23,500,000 ng/m³)	
Cypermethrin	ND	6.64 ppb	

		(113,000 ng/m³)	
DDVP	Trace	1.22 ppb (11,000 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.46 ppb (4,300 ng/m³)	
Dimethoate OA	Trace	0.49 ppb (4,300 ng/m³)	
Diuron	Trace	17.8 ppb (170,000 ng/m³)	
Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	29.7 ppb (230,000 ng/m³)	
Iprodione	ND	69.6 ppb (939,000 ng/m³)	
Malathion	ND	8.33 ppb (113,000 ng/m³)	
Malathion OA	Trace	8.76 ppb (113,000 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Metolachlor	Trace	7.33 ppb (85,000 ng/m³)	
Norflurazon	ND	12.6 ppb (170,000 ng/m³)	
Oryzalin	ND	29.7 ppb (420,000 ng/m³)	
Oxydemeton methyl	ND	3.74 ppb (39,200 ng/m³)	
Oxyfluorfen	Trace	34.5 ppb (510,000 ng/m³)	
Permethrin	ND	10.5 ppb (168,000 ng/m³)	
Phosmet	ND	5.94 ppb (77,000 ng/m³)	
pp-Dicofol	ND	4.49 ppb (68,000 ng/m³)	
Propargite	Trace	0.98 ppb (14,000 ng/m³)	
Simazine	ND	13.3 ppb (110,000 ng/m³)	
Trifluralin	Trace	87.5 ppb (1,200,000 ng/m³)	

* DPR's May 28, 2019, risk management directive for chlorpyrifos established an acute regulatory target of 0.28 ppb (4,050 ng/m^3), 1-hr TWA. However, the current sample duration does not allow for a direct comparison between the acute regulatory target concentration and the measured sample values.
** This value is a regulatory target rather than a screening level.

Subchronic (4- or 13-wk) Concentrations

Table 3 shows the highest observed rolling 4-week or 13-week average concentrations for all chemicals monitored at the San Joaquin Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of MITC at 14.1%. This was followed by 1,3-dichloropropene at 3.3%, and then chlorpyrifos OA at 0.9%.

Table 3. Highest 4- or 13-wk air concentrations, subchronic screening levels, and percent of the subchronic screening level for all chemicals monitored at the San Joaquin Air Monitoring Network sampling location in 2018.

Chemical	Highest 4-week rolling average concentration in ppb (ng/m^3)	Subchronic screening level in ppb (ng/m^3)	% of screening level
1,3-dichloropropene **	0.10 ppb (468 ng/m^3)	3.0 ppb (14,000 ng/m^3)	3.3%
Chlorpyrifos OA	0.0005 ppb (7.2 ng/m^3)	0.06 ppb (850 ng/m^3)	0.9%
Methyl bromide	0.024 ppb (93 ng/m^3)	5.0 ppb (19,400 ng/m^3) *	0.5%
MITC	0.14 ppb (422 ng/m^3)	1.00 ppb (3,000 ng/m^3)	14.1%
Acephate	Trace	1.13 ppb (8,500 ng/m^3)	
Bensulide	ND	1.47 ppb (24,000 ng/m^3)	
Chloropicrin *	ND	0.35 ppb (2,300 ng/m^3)	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m^3)	
Chlorpyrifos	Trace	0.06 ppb (850 ng/m^3)	
Chlorthal-dimethyl	Trace	34.6 ppb (470,000 ng/m^3)	
Cypermethrin	ND	4.76 ppb (81,000 ng/m^3)	
DDVP	Trace	0.24 ppb (2,200 ng/m^3)	
DEF	ND	0.68 ppb (8,800 ng/m^3)	
Diazinon	ND	0.01 ppb (130 ng/m^3)	
Diazinon OA	ND	0.01 ppb (130 ng/m^3)	
Dimethoate	ND	0.32 ppb (3,000 ng/m^3)	
Dimethoate OA	Trace	0.34 ppb	

		(3,000 ng/m³)	
Diuron	Trace	1.78 ppb (17,000 ng/m³)	
Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	3.10 ppb (24,000 ng/m³)	
Iprodione	ND	21.2 ppb (286,000 ng/m³)	
Malathion	ND	5.97 ppb (80,600 ng/m³)	
Malathion OA	Trace	6.27 ppb (80,600 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Metolachlor	Trace	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	ND	16.2 ppb (230,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	
Oxyfluorfen	Trace	12.2 ppb (180,000 ng/m³)	
Permethrin	ND	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	2.00 ppb (26,000 ng/m³)	
pp-Dicofol	ND	3.24 ppb (49,000 ng/m³)	
Propargite	Trace	0.98 ppb (14,000 ng/m³)	
Simazine	ND	3.76 ppb (31,000 ng/m³)	
Trifluralin	Trace	12.4 ppb (170,000 ng/m³)	

* This value is a regulatory target rather than a screening level.
** These concentrations represent the highest 13-week rolling average, rather than the default 4-week rolling average.

Chronic (2018) Concentrations

Annual 2018 average concentrations were not able to be determined for San Joaquin since monitoring at this site is conducted by CARB and commenced on April 26, 2018 resulting in less than a full year of analytical results for this site.

Temporal trends in detected concentrations

Figures 1 – 4 present the concentrations over time for monitoring results in 2018 for any chemical detected at a quantifiable concentration in San Joaquin. Screening levels, as defined in Appendix K are

abbreviated as SL in the following graphs. Regulatory targets, also defined in Appendix K, are abbreviated as RT. For graphs where both a pesticide and its degradate are shown, the detected concentrations of both the parent chemical and its degradate have been summed for each sampling date.

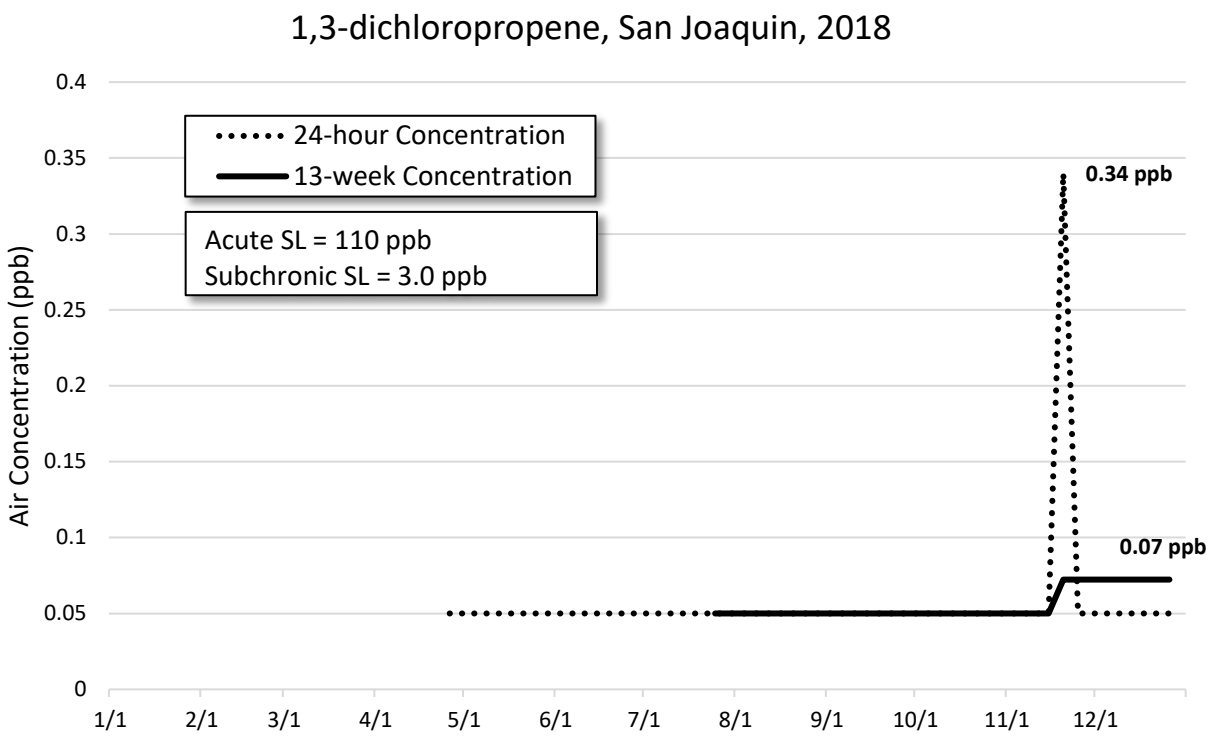

Figure 1. Temporal trend in 1,3-dichloropropene concentrations in San Joaquin in 2018.

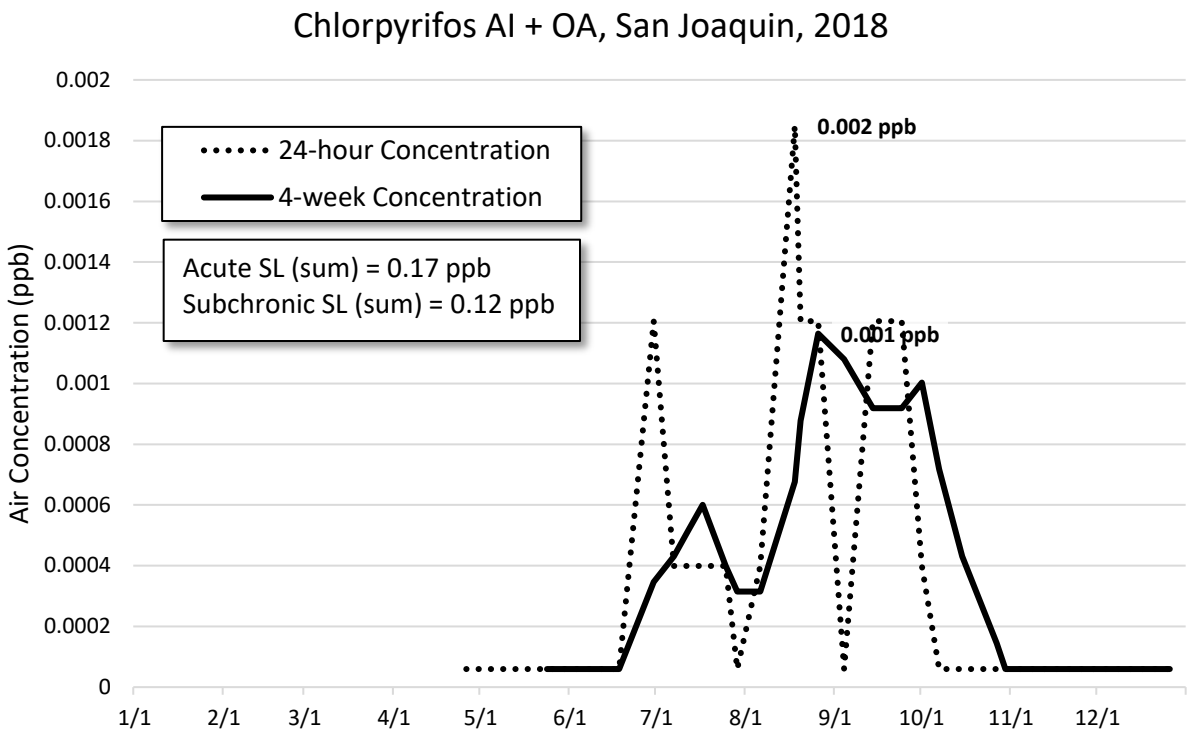

Figure 2. Temporal trend in summed chlorpyrifos AI + OA concentrations in San Joaquin in 2018.

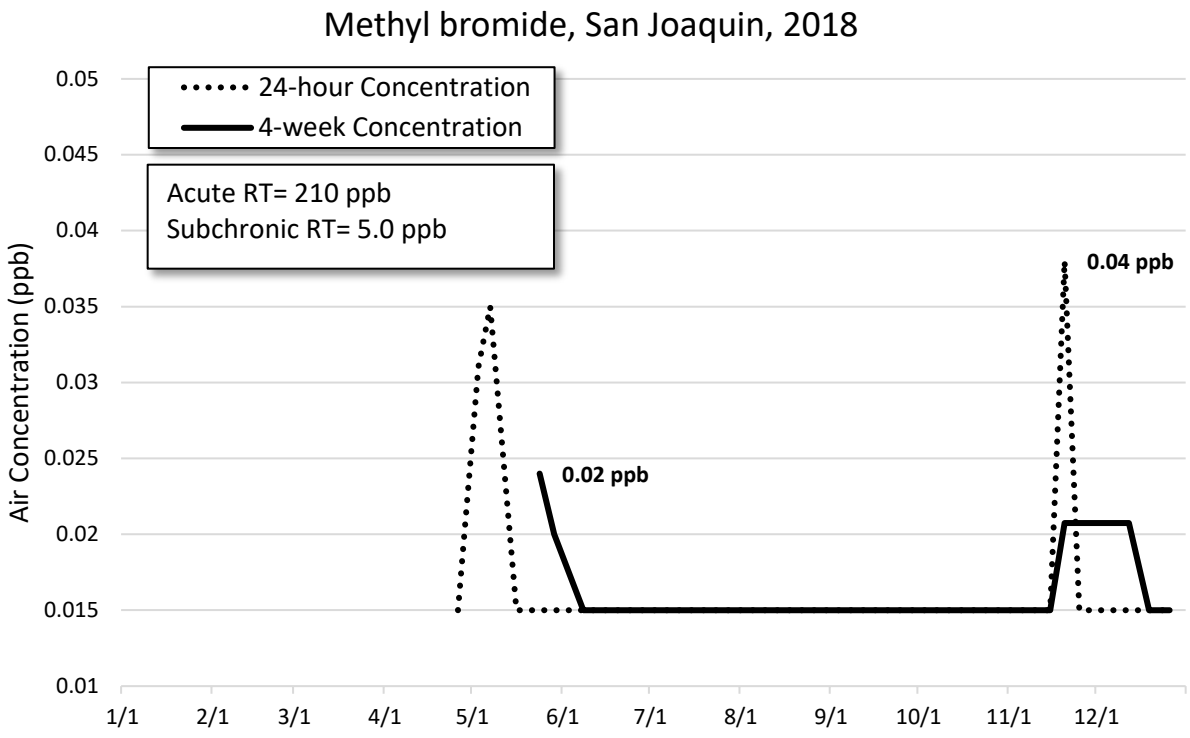

Figure 3. Temporal trend in methyl bromide concentrations in San Joaquin in 2018.

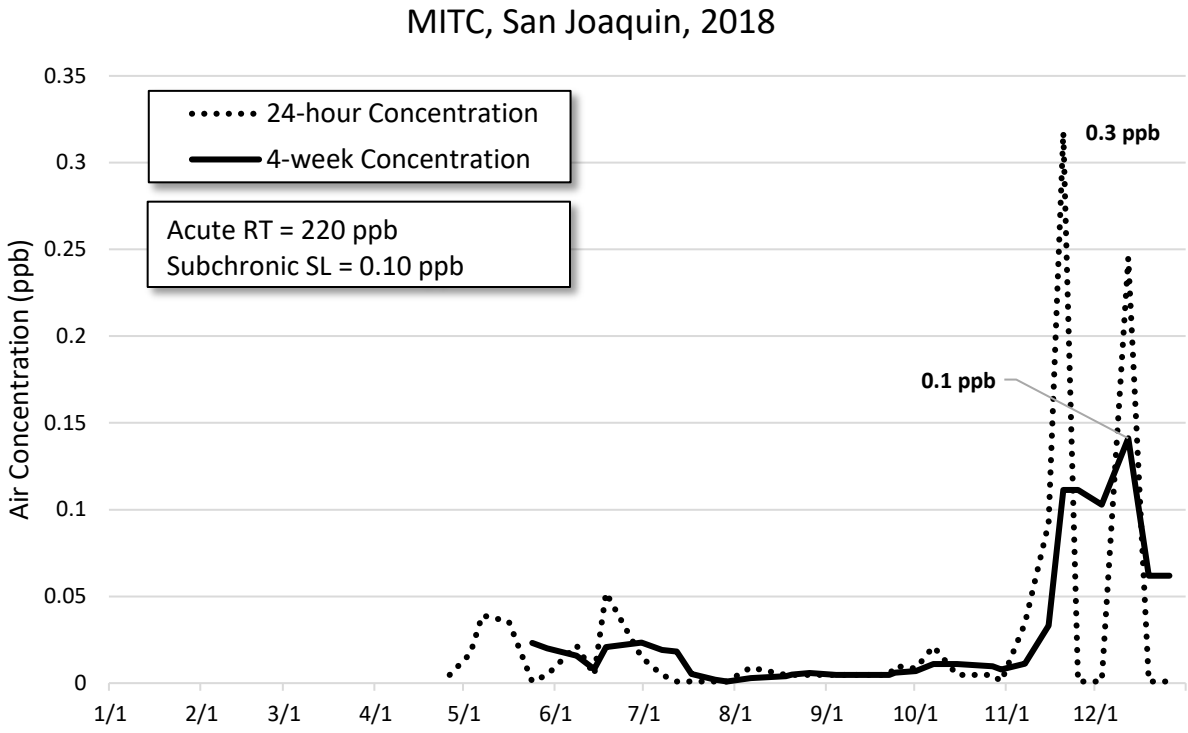

Figure 4. Temporal trend in MITC concentrations in San Joaquin in 2018

Appendix F: Detailed Result Information for Santa Maria

Santa Maria

Santa Maria is located in Santa Barbara County, and is 23.42 square miles in area. The average elevation is 217 feet; it receives an average of 14 inches of precipitation annually. Average temperatures range from 47° to 73° F in the summer and 39° to 64° F in winter. Santa Maria is the most populous city in Santa Barbara County, with a population of 99,553 based on the 2010 census. Of this population, 31.45% were below 18 years of age and 9.43% were above 65 years of age. The major crops in the immediate area around Santa Maria are strawberries, wine grapes, and broccoli. The monitoring site is located at a California Air Resources Board (CARB) monitoring location adjacent to Santa Maria High School. Monitoring at this site is conducted through a DPR contract with the Santa Barbara County Agricultural Commissioner's (SB CAC) office. SB CAC staff follow strict standard operating procedures established by the Department of Pesticide Regulation (DPR) Air Program for this study, ensuring that samples are collected, handled, and transported in the appropriate manner to maintain consistency and integrity of the samples. DPR Air Program staff provides annual training and continuous support to SB CAC for operation and monitoring at this sampling location.

Pesticide Detections

Table 1 lists the number and percentage of analyses resulting in detections at the Santa Maria sampling site. The highest percentage of detections were for malathion oxygen analog (OA) (63%, n = 32), followed by malathion (59%, n = 30), and then MITC (50%, n = 26). This highest percentage of quantifiable detections were observed for MITC (13%, n = 7), followed by chloropicrin (10%, n = 5), and then 1,3-dichloropropene (6%, n = 3).

Table 1. Number and percentage of positive samples per chemical in Santa Maria, California.

Chemical	Number of possible detections	Total number of detections*	Number of quantifiable detections	Percent of possible detections	Percent of quantifiable detections
1,3-dichloropropene	52	3	3	6%	6%
Acephate	51	0	0	0%	0%
Bensulide	51	0	0	0%	0%
Chloropicrin	52	9	5	17%	10%
Chlorothalonil	51	4	0	8%	0%
Chlorpyrifos	51	2	0	4%	0%
Chlorpyrifos OA	51	0	0	0%	0%
Chlorthal-dimethyl	51	20	0	39%	0%
Cypermethrin	51	0	0	0%	0%
DDVP	51	8	0	16%	0%
DEF	51	0	0	0%	0%
Diazinon	51	0	0	0%	0%
Diazinon OA	51	1	0	2%	0%
Dimethoate	51	0	0	0%	0%
Dimethoate OA	51	0	0	0%	0%
Diuron	51	1	0	2%	0%

Endosulfan	51	2	0	4%	0%
Endosulfan Sulfate	51	0	0	0%	0%
EPTC	51	0	0	0%	0%
Iprodione	51	1	0	2%	0%
Malathion	51	30	1	59%	2%
Malathion OA	51	32	0	63%	0%
Methidathion	51	0	0	0%	0%
Methyl bromide	52	0	0	0%	0%
Metolachlor	51	0	0	0%	0%
MITC	52	26	7	50%	13%
Norflurazon	51	0	0	0%	0%
Oryzalin	51	0	0	0%	0%
Oxydemeton methyl	51	0	0	0%	0%
Oxyfluorfen	51	0	0	0%	0%
Permethrin	51	0	0	0%	0%
Phosmet	51	0	0	0%	0%
pp-Dicofol	51	0	0	0%	0%
Propargite	51	0	0	0%	0%
Simazine	51	1	0	2%	0%
Trifluralin	51	11	0	22%	0%
Total	**1,840**	**151**	**16**	**8%**	**1%**

* Includes both quantifiable and trace detections.

Pesticide Concentrations

Acute (24-h) Concentrations

Table 2 shows the highest observed 24-h concentrations observed for all chemicals monitored at the Santa Maria Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chloropicrin at 0.6%, followed by 1,3-dichloropropene at 0.4%.

Table 2. Highest 24-h air concentrations, acute screening levels, and percent of the acute screening level for all chemicals monitored at the Santa Maria Air Monitoring Network sampling location in 2018.

Chemical	Highest 24-h concentration in ppb (ng/m³)	24-h acute screening level in ppb (ng/m³)	% of screening level
1,3-dichloropropene	0.48 ppb (2,200 ng/m³)	110 ppb (505,000 ng/m³)	0.4%
Chloropicrin	0.46 ppb (3,100 ng/m³)	73.0 ppb (491,000 ng/m³) *	0.6%
Malathion	0.0007 ppb (9.8 ng/m³)	8.33 ppb (113,000 ng/m³)	0.01%
MITC	0.42 ppb (1,300 ng/m³)	220 ppb (660,000 ng/m³) *	0.19%
Acephate	ND	1.60 ppb (12,000 ng/m³)	
Bensulide	ND	15.9 ppb (259,000 ng/m³)	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	

Chlorpyrifos	Trace	0.08 ppb (1,200 ng/m³) **	
Chlorpyrifos OA	ND	0.09 ppb (1,200 ng/m³) **	
Chlorthal-dimethyl	Trace	1,730 ppb (23,500,000 ng/m³)	
Cypermethrin	ND	6.64 ppb (113,000 ng/m³)	
DDVP	Trace	1.22 ppb (11,000 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	Trace	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.46 ppb (4,300 ng/m³)	
Dimethoate OA	ND	0.49 ppb (4,300 ng/m³)	
Diuron	Trace	17.8 ppb (170,000 ng/m³)	
Endosulfan	Trace	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	29.7 ppb (230,000 ng/m³)	
Iprodione	Trace	69.6 ppb (939,000 ng/m³)	
Malathion OA	Trace	8.76 ppb (113,000 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	210 ppb (820,000 ng/m³) *	
Metolachlor	ND	7.33 ppb (85,000 ng/m³)	
Norflurazon	ND	12.6 ppb (170,000 ng/m³)	
Oryzalin	ND	29.7 ppb (420,000 ng/m³)	
Oxydemeton methyl	ND	3.74 ppb (39,200 ng/m³)	
Oxyfluorfen	ND	34.5 ppb (510,000 ng/m³)	
Permethrin	ND	10.5 ppb (168,000 ng/m³)	
Phosmet	ND	5.94 ppb (77,000 ng/m³)	
pp-Dicofol	ND	4.49 ppb	

		(68,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	Trace	13.3 ppb (110,000 ng/m³)	
Trifluralin	Trace	87.5 ppb (1,200,000 ng/m³)	

* This value is a regulatory target rather than a screening level.
** DPR's May 28, 2019, risk management directive for chlorpyrifos established an acute regulatory target of 0.28 ppb (4,050 ng/m³), 1-hr TWA. However, the current sample duration does not allow for a direct comparison between the acute regulatory target concentration and the measured sample values.

Subchronic (4- or 13-wk) Concentrations

Table 3 shows the highest observed rolling 4-week or 13-week average concentrations for all chemicals monitored at the Santa Maria Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chloropicrin at 31.8%. This was followed by MITC at 10.7%, and then 1,3-dichloropropene at 3.2%.

Table 3. Highest 4- or 13-wk air concentrations, subchronic screening levels, and percent of the subchronic screening level for all chemicals monitored at the Santa Maria Air Monitoring Network sampling location in 2018.

Chemical	Highest 4-week rolling average concentration in ppb (ng/m³)	Subchronic screening level in ppb (ng/m³)	% of screening level
1,3-dichloropropene *	0.097 ppb (440 ng/m³)	3.0 ppb (14,000 ng/m³)	3.2%
Chloropicrin *	0.11 ppb (750 ng/m³)	0.35 ppb (2,300 ng/m³)	31.8%
Malathion	0.0005 ppb (6.4 ng/m³)	5.97 ppb (80,600 ng/m³)	0.01%
MITC	0.11 ppb (320 ng/m³)	1.00 ppb (3,000 ng/m³)	10.7%
Acephate	ND	1.13 ppb (8,500 ng/m³)	
Bensulide	ND	1.47 ppb (24,000 ng/m³)	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	Trace	0.06 ppb (850 ng/m³)	
Chlorpyrifos OA	ND	0.06 ppb (850 ng/m³)	
Chlorthal-dimethyl	Trace	34.6 ppb (470,000 ng/m³)	
Cypermethrin	ND	4.76 ppb (81,000 ng/m³)	
DDVP	Trace	0.24 ppb (2,200 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb	

		(130 ng/m³)	
Diazinon OA	Trace	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.32 ppb (3,000 ng/m³)	
Dimethoate OA	ND	0.34 ppb (3,000 ng/m³)	
Diuron	Trace	1.78 ppb (17,000 ng/m³)	
Endosulfan	Trace	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	3.10 ppb (24,000 ng/m³)	
Iprodione	Trace	21.2 ppb (286,000 ng/m³)	
Malathion OA	Trace	6.27 ppb (80,600 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	5.0 ppb (19,400 ng/m³) *	
Metolachlor	ND	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	ND	16.2 ppb (230,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	
Oxyfluorfen	ND	12.2 ppb (180,000 ng/m³)	
Permethrin	ND	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	2.00 ppb (26,000 ng/m³)	
pp-Dicofol	ND	3.24 ppb (49,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	Trace	3.76 ppb (31,000 ng/m³)	
Trifluralin	Trace	12.4 ppb (170,000 ng/m³)	

* These concentrations represent the highest 13-week rolling average, rather than the default 4-week rolling average.

Chronic (2018) Concentrations

Table 4 shows the annual average concentration for all chemicals monitored at the Santa Maria Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chloropicrin at 15.2%. This was followed by MITC at 12.0%, and then 1,3-dichloropropene at 3.1%.

Table 4. Annual average air concentrations, chronic screening levels, and percent of the chronic screening level for all chemicals monitored at the Santa Maria Air Monitoring Network site in 2018.

Chemical	Overall average concentration (ng/m³)	Chronic screening level (ng/m³)	% of screening level
1,3-dichloropropene	0.062 ppb (280 ng/m³)	2.00 ppb (9,000 ng/m³)	3.1%
Chloropicrin	0.041 ppb (280 ng/m³)	0.27 ppb (1,800 ng/m³)	15.2%
Malathion	0.0003 ppb (3.5 ng/m³)	0.60 ppb (8,100 ng/m³)	0.1%
MITC	0.012 ppb (37 ng/m³)	0.10 ppb (300 ng/m³)	12.0%
Acephate	ND	1.13 ppb (8,500 ng/m³)	
Bensulide	ND	1.48 ppb (24,000 ng/m³)	
Chlorothalonil	Trace	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	Trace	0.04 ppb (510 ng/m³)	
Chlorpyrifos OA	ND	0.04 ppb (510 ng/m³)	
Chlorthal-dimethyl	Trace	3.46 ppb (47,000 ng/m³)	
Cypermethrin	ND	1.59 ppb (27,000 ng/m³)	
DDVP	Trace	0.09 ppb (770 ng/m³)	
DEF	ND	NA - Seasonal	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	Trace	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.03 ppb (300 ng/m³)	
Dimethoate OA	ND	0.03 ppb (300 ng/m³)	
Diuron	Trace	0.60 ppb (5,700 ng/m³)	
Endosulfan	Trace	0.02 ppb (330 ng/m³)	
Endosulfan Sulfate	ND	0.02 ppb (330 ng/m³)	
EPTC	ND	1.10 ppb	

		(8,500 ng/m³)	
Iprodione	Trace	21.2 ppb (286,000 ng/m³)	
Malathion OA	Trace	0.63 ppb (8,100 ng/m³)	
Methidathion	ND	0.20 ppb (2,500 ng/m³)	
Methyl bromide	ND	1.00 ppb (3,900 ng/m³)	
Metolachlor	ND	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	ND	16.4 ppb (232,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	
Oxyfluorfen	ND	3.45 ppb (51,000 ng/m³)	
Permethrin	ND	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	1.39 ppb (18,000 ng/m³)	
pp-Dicofol	ND	1.32 ppb (20,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	Trace	3.76 ppb (31,000 ng/m³)	
Trifluralin	Trace	2.99 ppb (41,000 ng/m³)	

Temporal trends in detected concentrations

Figures 1 – 4 present the concentrations over time for monitoring results in 2018 for any chemical detected at a quantifiable concentration in Santa Maria. Screening levels, as defined in Appendix K are abbreviated as SL in the following graphs. Regulatory targets, also defined in Appendix K, are abbreviated as RT. For graphs where both a pesticide and its degradate are shown, the detected concentrations of both the parent chemical and its degradate have been summed for each sampling date.

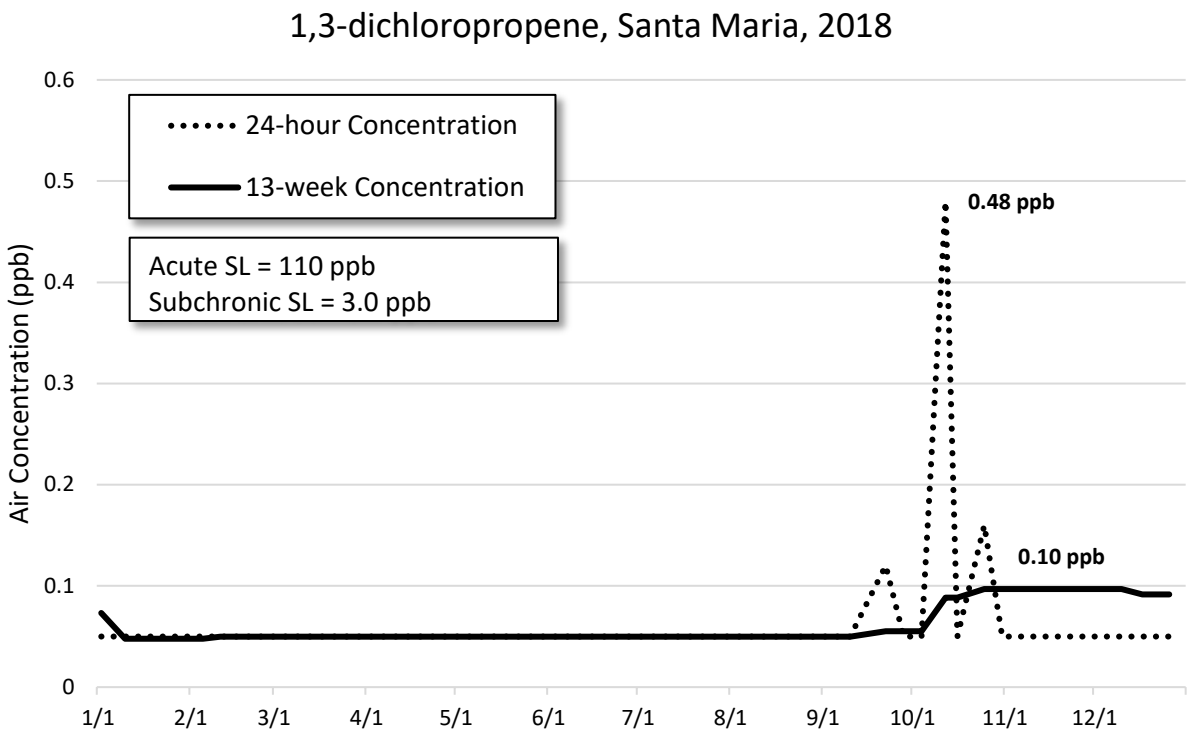

Figure 1. Temporal trend in 1,3-dichloropropene concentrations in Santa Maria in 2018.

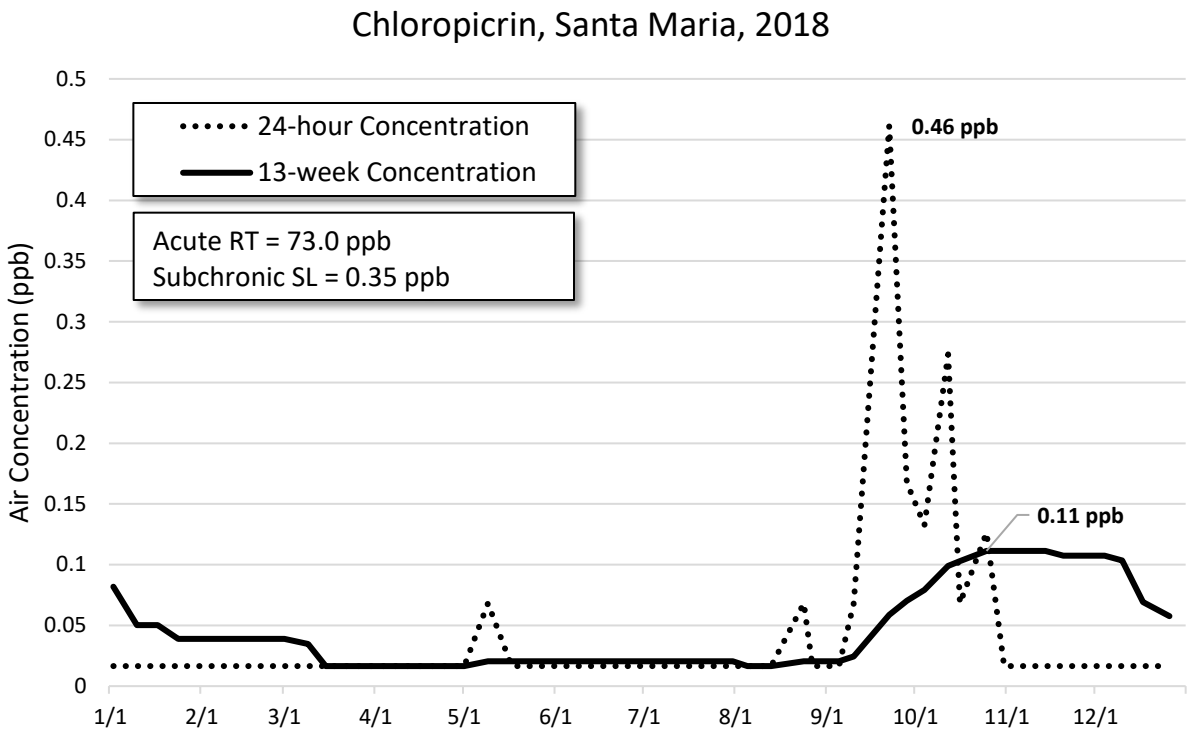

Figure 2. Temporal trend in chloropicrin concentrations in Santa Maria in 2018.

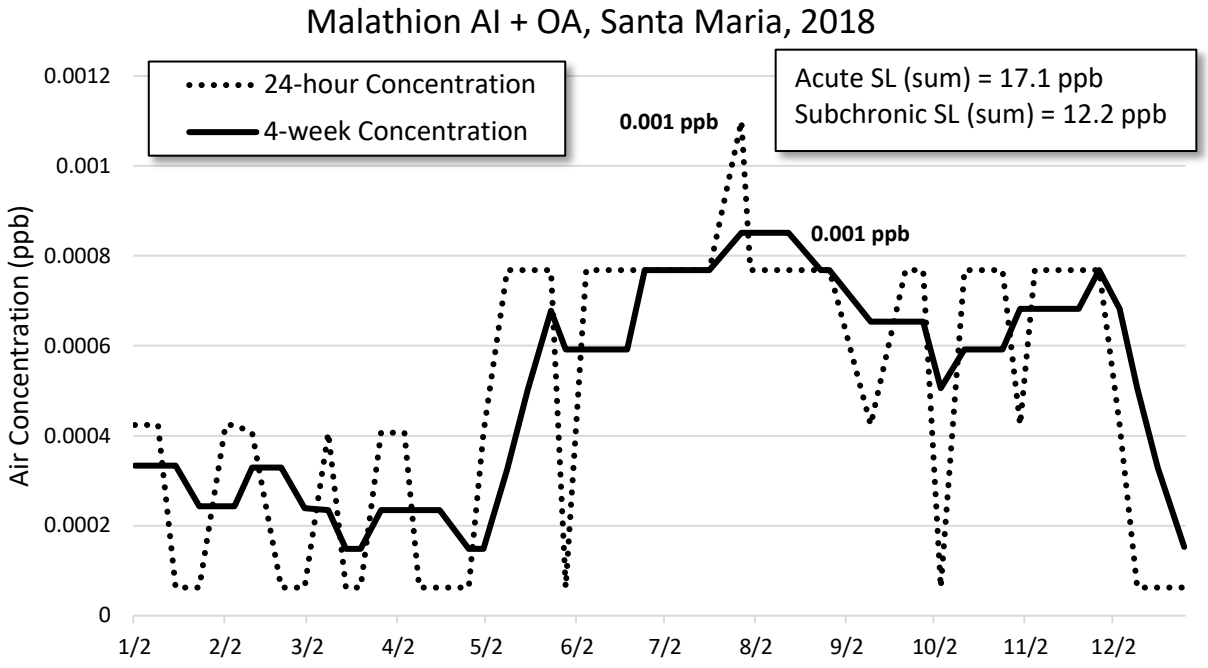

Figure 3. Temporal trend in summed Malathion AI + OA concentrations in Santa Maria in 2018.

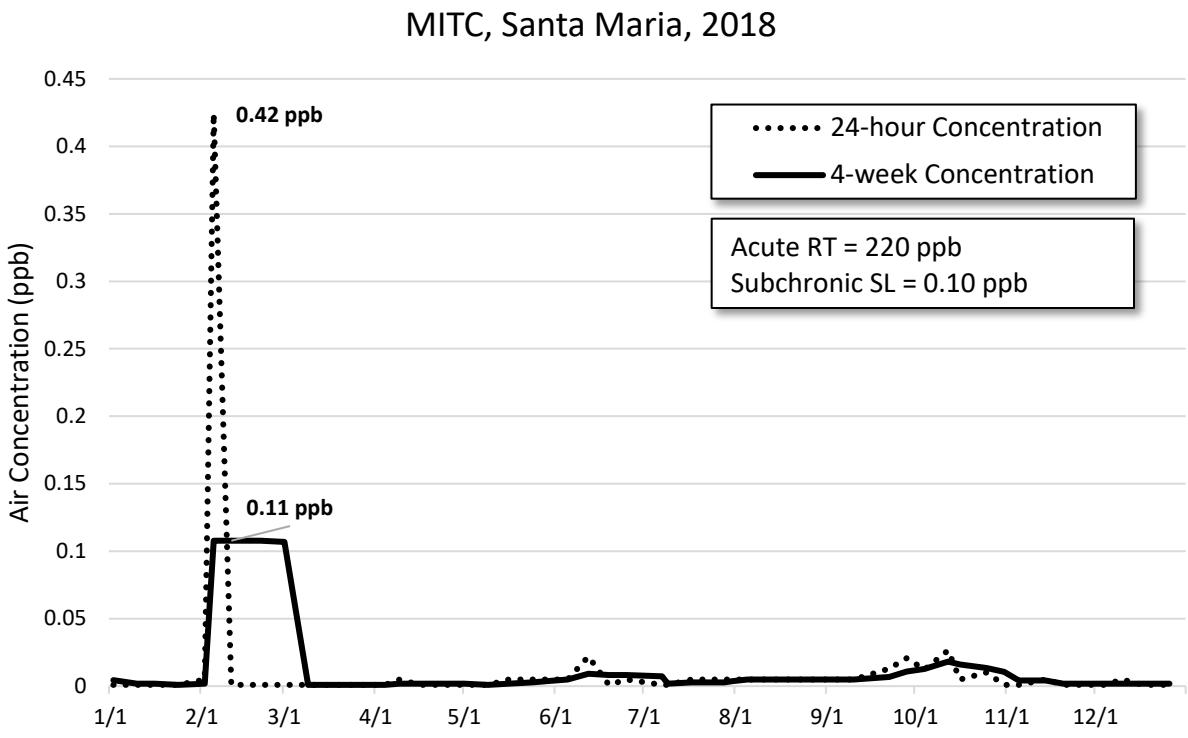

Figure 4. Temporal trend in MITC concentrations in Santa Maria in 2018.

Appendix G: Detailed Results Information for Shafter

Shafter

The Shafter sampling site has continued as a monitoring site from the original three communities in the 2011-2016 AMN monitoring period. Shafter is a small city (18 square miles in area) located approximately 18 miles west-northwest of Bakersfield in Kern County. The elevation is 351 feet; it receives an average of 7 inches of precipitation annually. Average temperatures range from 59° to 99° F in the summer and 35° to 64° F in winter. Based on the 2010 census, the population of Shafter was 16,988, of which 36.0% were below 18 years of age and 6.6% were above 65 years of age. The major crops in the immediate area around Shafter are almonds, grapes, carrots, and alfalfa. The monitoring site is situated at a city well location adjacent to Shafter High School in the northeastern edge of the city. Monitoring at this sampling location has continued uninterrupted since February 1, 2011 operated by Department of Pesticide Regulation (DPR). The California Air Resources Board (CARB) assumed responsibility for the monitoring of this site from DPR on April 2, 2018.

Pesticide Detections

Table 1 lists the number and percentage of analyses resulting in detections at the Shafter sampling site. The highest percentage of detections were for MITC (83%, n = 44), followed by chlorothalonil (64%, n = 34), and then 1,3-dichloropropene (38%, n = 20). This highest percentage of quantifiable detections were observed for MITC (45%, n = 24), followed by 1,3-dichloropropene (38%, n = 20), and then methyl bromide (13%, n = 7).

Table 1. Number and percentage of positive samples per chemicals in Shafter, California.

Chemical	Number of possible detections	Total number of detections*	Number of quantifiable detections	Percent of possible detections	Percent of quantifiable detections
1,3-dichloropropene	53	20	20	38%	38%
Acephate	53	0	0	0%	0%
Bensulide	53	2	0	4%	0%
Chloropicrin	53	0	0	0%	0%
Chlorothalonil	53	34	5	64%	9%
Chlorpyrifos	53	16	2	30%	4%
Chlorpyrifos OA	53	13	0	25%	0%
Chlorthal-dimethyl	53	2	0	4%	0%
Cypermethrin	53	1	0	2%	0%
DDVP	53	4	0	8%	0%
DEF	53	0	0	0%	0%
Diazinon	53	0	0	0%	0%
Diazinon OA	53	1	0	2%	0%
Dimethoate	53	0	0	0%	0%
Dimethoate OA	53	0	0	0%	0%
Diuron	53	2	0	4%	0%
Endosulfan	53	0	0	0%	0%

Endosulfan Sulfate	53	0	0	0%	0%
EPTC	53	3	0	6%	0%
Iprodione	53	1	0	2%	0%
Malathion	53	0	0	0%	0%
Malathion OA	53	1	0	2%	0%
Methidathion	53	0	0	0%	0%
Methyl bromide	53	7	7	13%	13%
Metolachlor	53	0	0	0%	0%
MITC	53	44	24	83%	45%
Norflurazon	53	0	0	0%	0%
Oryzalin	53	1	0	2%	0%
Oxydemeton methyl	53	0	0	0%	0%
Oxyfluorfen	53	5	0	9%	0%
Permethrin	53	0	0	0%	0%
Phosmet	53	0	0	0%	0%
pp-Dicofol	53	0	0	0%	0%
Propargite	53	0	0	0%	0%
Simazine	53	3	0	6%	0%
Trifluralin	53	1	0	2%	0%
Total	**1,908**	**161**	**58**	**8%**	**3%**

* Includes both quantifiable and trace detections.

Pesticide Concentrations

Acute (24-h) Concentrations

Table 2 shows the highest observed 24-h concentrations observed for all chemicals monitored at the Shafter Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of 1,3-dichloropropene at 45.9%. This was followed by chlorpyrifos at 4.2%.

Table 2. Highest 24-h air concentrations, acute screening levels, and percent of the acute screening level for all chemicals monitored at the Shafter Air Monitoring Network sampling location in 2018.

Chemical	Highest 24-h concentration in ppb (ng/m³)	24-h acute screening level in ppb (ng/m³)	% of screening level
1,3-dichloropropene	50 ppb (230,000 ng/m³)	110 ppb (505,000 ng/m³)	45.9%
Chlorothalonil	0.005 ppb (50 ng/m³)	3.13 ppb (34,000 ng/m³)	0.1%
Chlorpyrifos	0.004 ppb (50 ng/m³)	0.08 ppb (1,200 ng/m³) *	4.2%
Methyl bromide	0.097 ppb (380 ng/m³)	210 ppb (820,000 ng/m³) **	0.05%
MITC	1.2 ppb (3,700 ng/m³)	220 ppb (660,000 ng/m³) **	0.56%
Acephate	ND	1.60 ppb (12,000 ng/m³)	
Bensulide	Trace	15.9 ppb (259,000 ng/m³)	
Chloropicrin	ND	73.0 ppb	

		(491,000 ng/m³) **	
Chlorpyrifos OA	Trace	0.09 ppb (1,200 ng/m³) *	
Chlorthal-dimethyl	Trace	1,730 ppb (23,500,000 ng/m³)	
Cypermethrin	Trace	6.64 ppb (113,000 ng/m³)	
DDVP	Trace	1.22 ppb (11,000 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	Trace	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.46 ppb (4,300 ng/m³)	
Dimethoate OA	ND	0.49 ppb (4,300 ng/m³)	
Diuron	Trace	17.8 ppb (170,000 ng/m³)	
Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	Trace	29.7 ppb (230,000 ng/m³)	
Iprodione	Trace	69.6 ppb (939,000 ng/m³)	
Malathion	ND	8.33 ppb (113,000 ng/m³)	
Malathion OA	Trace	8.76 ppb (113,000 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Metolachlor	ND	7.33 ppb (85,000 ng/m³)	
Norflurazon	ND	12.6 ppb (170,000 ng/m³)	
Oryzalin	Trace	29.7 ppb (420,000 ng/m³)	
Oxydemeton methyl	ND	3.74 ppb (39,200 ng/m³)	
Oxyfluorfen	Trace	34.5 ppb (510,000 ng/m³)	
Permethrin	ND	10.5 ppb (168,000 ng/m³)	
Phosmet	ND	5.94 ppb (77,000 ng/m³)	
pp-Dicofol	ND	4.49 ppb (68,000 ng/m³)	

Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	Trace	13.3 ppb (110,000 ng/m³)	
Trifluralin	Trace	87.5 ppb (1,200,000 ng/m³)	

* DPR's May 28, 2019, risk management directive for chlorpyrifos established an acute regulatory target of 0.28 ppb (4,050 ng/m³), 1-hr TWA. However, the current sample duration does not allow for a direct comparison between the acute regulatory target concentration and the measured sample values.
** This value is a regulatory target rather than a screening level.

Subchronic (4- or 13-wk) Concentrations

Table 3 shows the highest observed rolling 4-week or 13-week average concentrations for all chemicals monitored at the Shafter Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of 1,3-dichloropropene at 186.8%. This was the only exceedance of a screening level or regulatory target observed in 2018. This was followed by MITC at 50.1%, and then chlorpyrifos at 2.5%.

Table 3. Highest 4- or 13-wk air concentrations, subchronic screening levels, and percent of the subchronic screening level for all chemicals monitored at the Shafter Air Monitoring Network sampling location in 2018.

Chemical	Highest 4-week rolling average concentration in ppb (ng/m³)	Subchronic screening level in ppb (ng/m³)	% of screening level
1,3-dichloropropene **	5.6 ppb (25,000 ng/m³)	3.0 ppb (14,000 ng/m³)	186.8%
Chlorothalonil	0.003 ppb (35 ng/m³)	3.13 ppb (34,000 ng/m³)	0.1%
Chlorpyrifos	0.002 ppb (22 ng/m³)	0.06 ppb (850 ng/m³)	2.5%
Methyl bromide	0.04 ppb (160 ng/m³)	5.0 ppb (19,400 ng/m³) *	0.8%
MITC	0.5 ppb (1,500 ng/m³)	1.00 ppb (3,000 ng/m³)	50.1%
Acephate	ND	1.13 ppb (8,500 ng/m³)	
Bensulide	Trace	1.47 ppb (24,000 ng/m³)	
Chloropicrin **	ND	0.35 ppb (2,300 ng/m³)	
Chlorpyrifos OA	Trace	0.06 ppb (850 ng/m³)	
Chlorthal-dimethyl	Trace	34.6 ppb (470,000 ng/m³)	
Cypermethrin	Trace	4.76 ppb (81,000 ng/m³)	
DDVP	Trace	0.24 ppb (2,200 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	

Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	Trace	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.32 ppb (3,000 ng/m³)	
Dimethoate OA	ND	0.34 ppb (3,000 ng/m³)	
Diuron	Trace	1.78 ppb (17,000 ng/m³)	
Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	Trace	3.10 ppb (24,000 ng/m³)	
Iprodione	Trace	21.2 ppb (286,000 ng/m³)	
Malathion	ND	5.97 ppb (80,600 ng/m³)	
Malathion OA	Trace	6.27 ppb (80,600 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Metolachlor	ND	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	Trace	16.2 ppb (230,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	
Oxyfluorfen	Trace	12.2 ppb (180,000 ng/m³)	
Permethrin	ND	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	2.00 ppb (26,000 ng/m³)	
pp-Dicofol	ND	3.24 ppb (49,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	Trace	3.76 ppb (31,000 ng/m³)	
Trifluralin	Trace	12.4 ppb (170,000 ng/m³)	

* This value is a regulatory target rather than a screening level.
** These concentrations represent the highest 13-week rolling average, rather than the default 4-week rolling average.

Chronic (2018) Concentrations

Table 4 shows the annual average concentration for all chemicals monitored at the Shafter Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of 1,3-dichloropropene at 75.0%. This was followed by MITC at 57.8%, and then methyl bromide at 1.8%.

Table 4. Annual average air concentrations, chronic screening levels, and percent of the chronic screening level for all chemicals monitored at the Shafter Air Monitoring Network sampling location in 2018.

Chemical	Overall average concentration (ng/m³)	Chronic screening level (ng/m³)	% of screening level
1,3-dichloropropene	1.5 ppb (6,900 ng/m³)	2.00 ppb (9,000 ng/m³)	75.0%
Chlorothalonil	0.0009 ppb (10 ng/m³)	3.13 ppb (34,000 ng/m³)	0.03%
Chlorpyrifos	0.0004 ppb (5.3 ng/m³)	0.04 ppb (510 ng/m³)	1.1%
Methyl bromide	0.018 ppb (71 ng/m³)	1.00 ppb (3,900 ng/m³)	1.8%
MITC	0.058 ppb (170 ng/m³)	0.10 ppb (300 ng/m³)	57.8%
Acephate	ND	1.13 ppb (8,500 ng/m³)	
Bensulide	Trace	1.48 ppb (24,000 ng/m³)	
Chloropicrin	ND	0.27 ppb (1,800 ng/m³)	
Chlorpyrifos OA	Trace	0.04 ppb (510 ng/m³)	
Chlorthal-dimethyl	Trace	3.46 ppb (47,000 ng/m³)	
Cypermethrin	Trace	1.59 ppb (27,000 ng/m³)	
DDVP	Trace	0.09 ppb (770 ng/m³)	
DEF	ND	NA - Seasonal	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	Trace	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.03 ppb (300 ng/m³)	
Dimethoate OA	ND	0.03 ppb (300 ng/m³)	
Diuron	Trace	0.60 ppb (5,700 ng/m³)	
Endosulfan	ND	0.02 ppb (330 ng/m³)	
Endosulfan Sulfate	ND	0.02 ppb (330 ng/m³)	
EPTC	Trace	1.10 ppb	

		(8,500 ng/m³)	
Iprodione	Trace	21.2 ppb (286,000 ng/m³)	
Malathion	ND	0.60 ppb (8,100 ng/m³)	
Malathion OA	Trace	0.63 ppb (8,100 ng/m³)	
Methidathion	ND	0.20 ppb (2,500 ng/m³)	
Metolachlor	ND	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	Trace	16.4 ppb (232,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	
Oxyfluorfen	Trace	3.45 ppb (51,000 ng/m³)	
Permethrin	ND	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	1.39 ppb (18,000 ng/m³)	
pp-Dicofol	ND	1.32 ppb (20,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	Trace	3.76 ppb (31,000 ng/m³)	
Trifluralin	Trace	2.99 ppb (41,000 ng/m³)	

Temporal trends in detected concentrations

Figures 1 – 5 present the concentrations over time for monitoring results in 2018 for any chemical detected at a quantifiable concentration in Shafter. Screening levels, as defined in Appendix K are abbreviated as SL in the following graphs. Regulatory targets, also defined in Appendix K, are abbreviated as RT. For graphs where both a pesticide and its degradate are shown, the detected concentrations of both the parent chemical and its degradate have been summed for each sampling date.

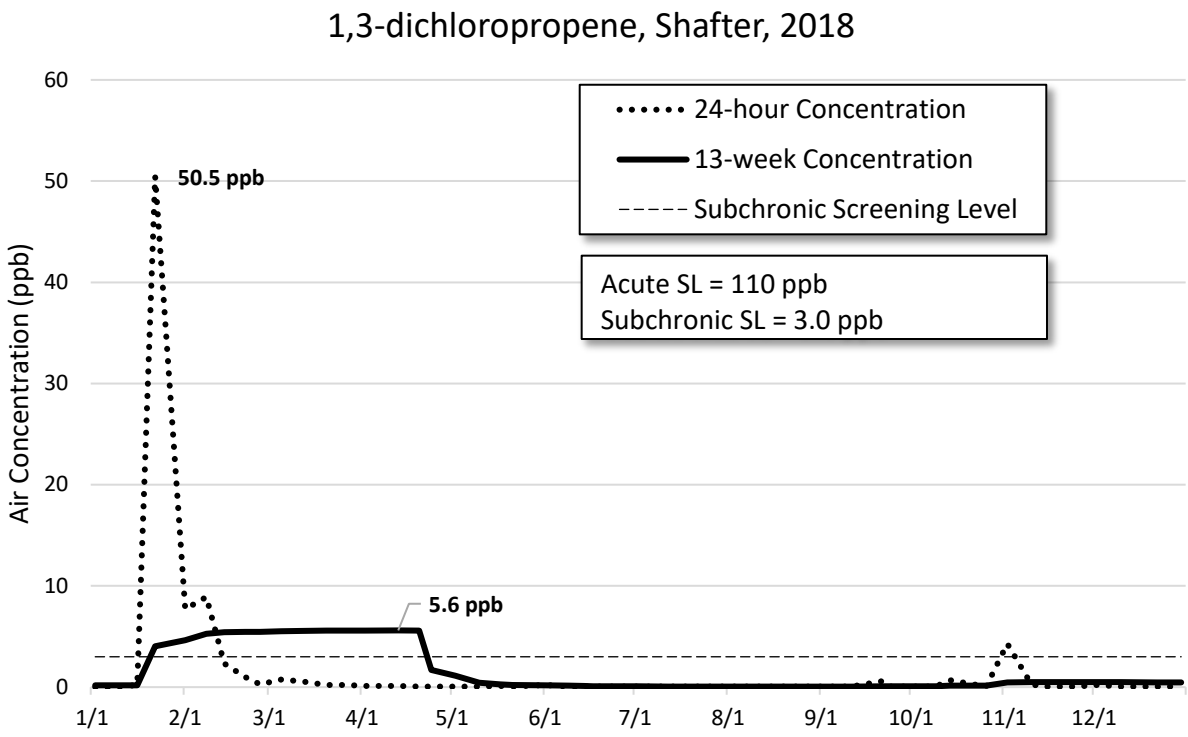

Figure 1. Temporal trend in 1,3-dichloropropene concentrations in Shafter in 2018.

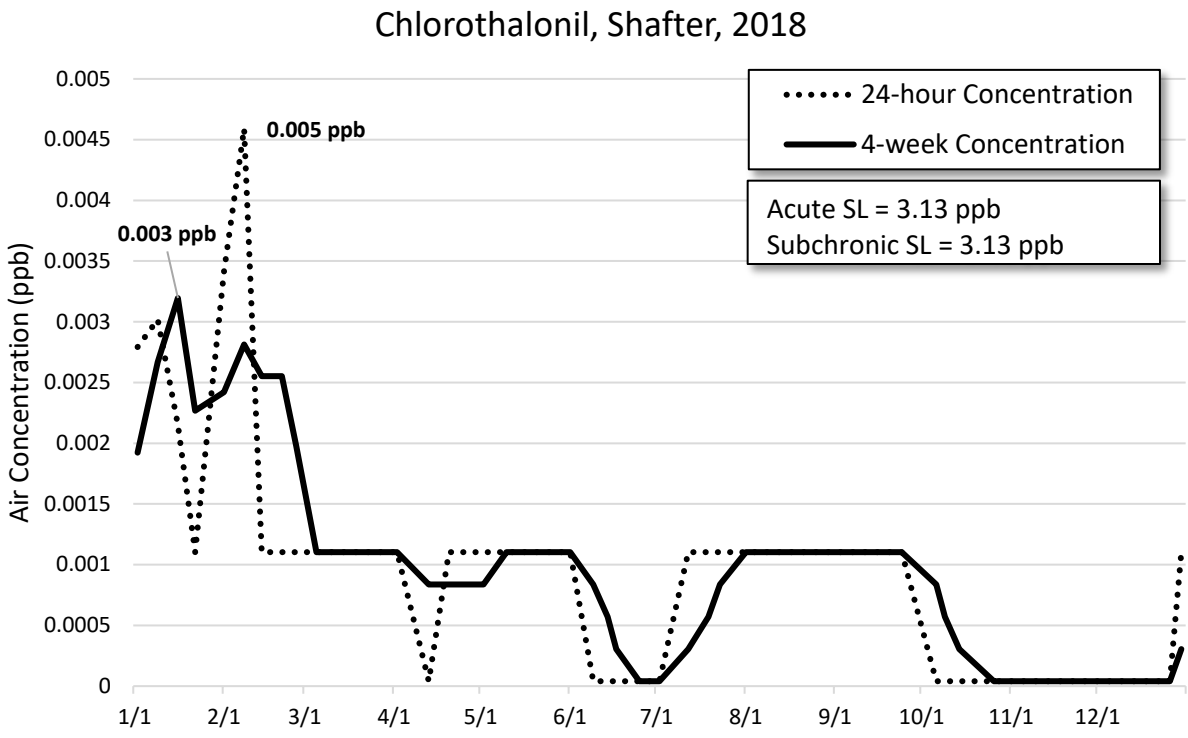

Figure 2. Temporal trend in chlorothalonil concentrations in Shafter in 2018.

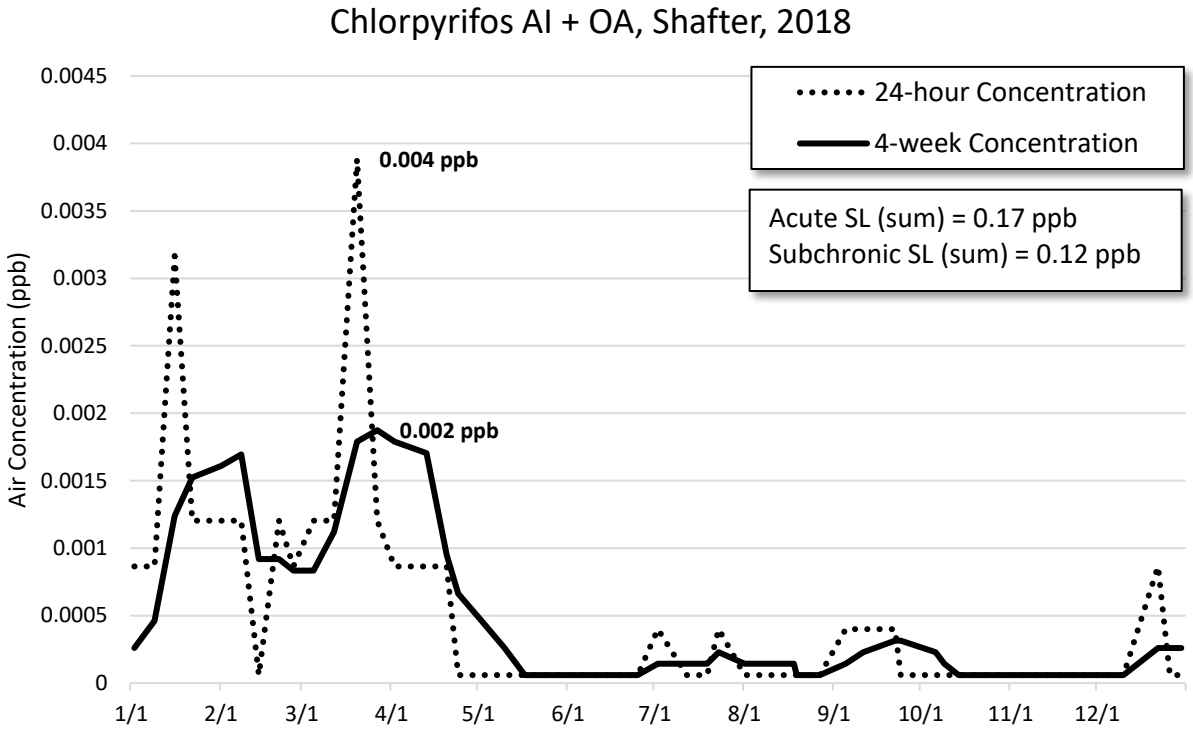

Figure 3. Temporal trend in summed chlorpyrifos AI + OA concentrations in Shafter in 2018.

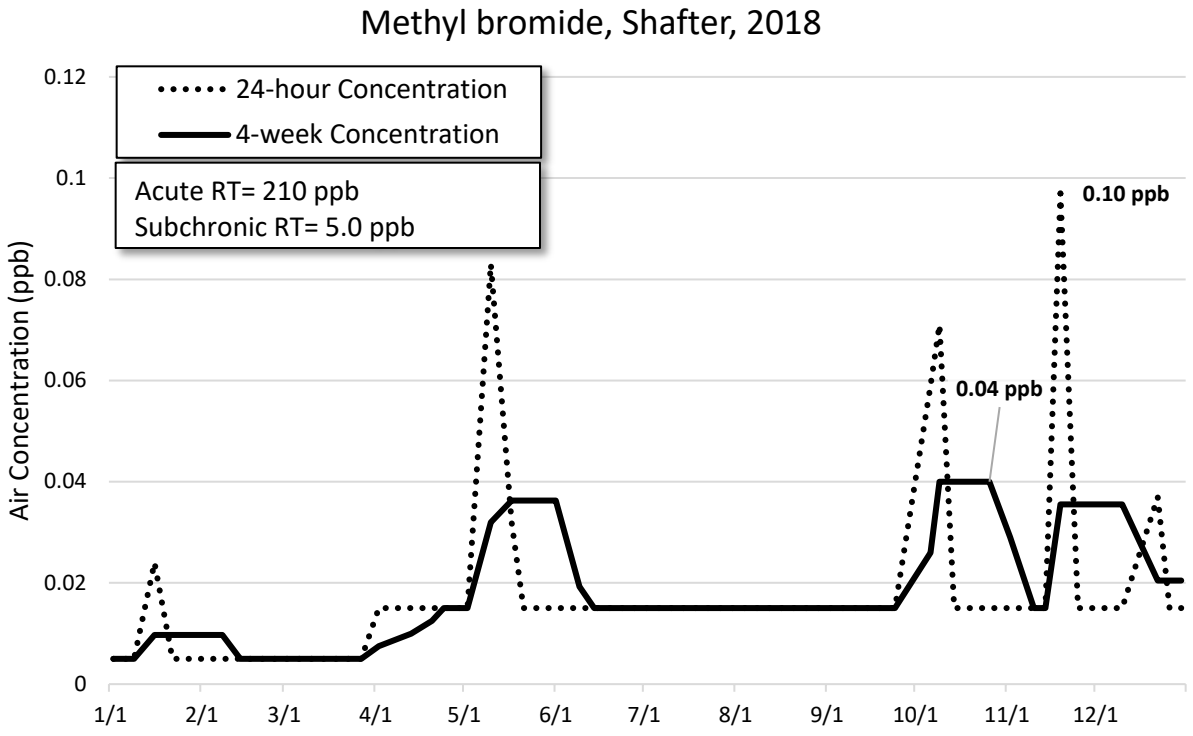

Figure 4. Temporal trend in methyl bromide concentrations in Shafter in 2018.

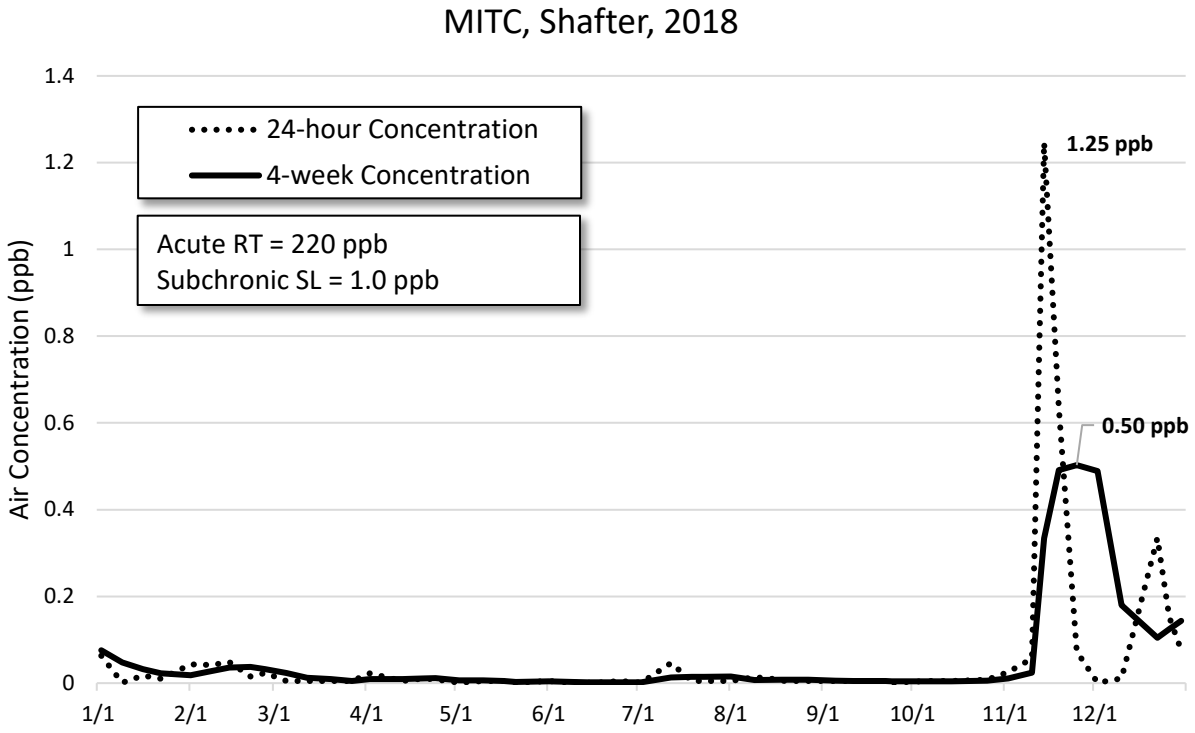

Figure 5. Temporal trend in MITC concentrations in Shafter in 2018.

Appendix H: Detailed Result Information for Watsonville

Watsonville

Watsonville is a small city (7 square miles in area) located on the southern edge of Santa Cruz County. The elevation is 29 feet; it receives on average 22 inches of precipitation annually. Average temperatures range from 50° to 72° F in the summer to 38° to 63° F in winter. Based on the 2010 census, the population of Watsonville was 51,199, of which 31.5% were below 18 years of age and 8.3% were above 65 years of age. The major crops in the immediate area around Watsonville are strawberries, apples, and lettuce. The monitoring site is located approximately 2 miles south of Watsonville at Ohlone Elementary School.

Pesticide Detections

Table 1 lists the number and percentage of analyses resulting in detections at the Watsonville sampling site. The highest percentage of detections were for MITC (48%, n = 25), followed by chloropicrin (25%, n = 13), and then DDVP (10%, n = 5). This highest percentage of quantifiable detections were observed for MITC (15%, n = 8), followed by 1,3-dichloropropene (6%, n = 3), and then chloropicrin (4%, n = 2).

Table 1. Number and percentage of positive samples per chemical in Watsonville, California.

Chemical	Number of possible detections	Total number of detections*	Number of quantifiable detections	Percent of possible detections	Percent of quantifiable detections
1,3-dichloropropene	51	3	3	6%	6%
Acephate	52	0	0	0%	0%
Bensulide	52	0	0	0%	0%
Chloropicrin	52	13	2	25%	4%
Chlorothalonil	52	0	0	0%	0%
Chlorpyrifos	52	0	0	0%	0%
Chlorpyrifos OA	52	0	0	0%	0%
Chlorthal-dimethyl	52	1	0	2%	0%
Cypermethrin	52	0	0	0%	0%
DDVP	52	5	0	10%	0%
DEF	52	0	0	0%	0%
Diazinon	52	0	0	0%	0%
Diazinon OA	52	0	0	0%	0%
Dimethoate	52	0	0	0%	0%
Dimethoate OA	52	0	0	0%	0%
Diuron	52	0	0	0%	0%
Endosulfan	52	0	0	0%	0%
Endosulfan Sulfate	52	0	0	0%	0%
EPTC	52	0	0	0%	0%
Iprodione	52	0	0	0%	0%
Malathion	52	3	0	6%	0%
Malathion OA	52	3	0	6%	0%
Methidathion	52	0	0	0%	0%
Methyl bromide	51	0	0	0%	0%
Metolachlor	52	0	0	0%	0%
MITC	52	25	8	48%	15%
Norflurazon	52	0	0	0%	0%
Oryzalin	52	0	0	0%	0%

Oxydemeton methyl	52	0	0	0%	0%
Oxyfluorfen	52	0	0	0%	0%
Permethrin	52	0	0	0%	0%
Phosmet	52	0	0	0%	0%
pp-Dicofol	52	0	0	0%	0%
Propargite	52	0	0	0%	0%
Simazine	52	0	0	0%	0%
Trifluralin	52	1	0	2%	0%
Total	**1,870**	**54**	**13**	**3%**	**1%**

* Includes both quantifiable and trace detections.

Pesticide Concentrations

Acute (24-h) Concentrations

Table 2 shows the highest observed 24-h concentrations for all chemicals monitored at the Watsonville Air Monitoring Network sampling location in 2018. 1,3-dichloropropene and chloropicrin were each detected at 24-h concentrations equal to 0.2% of their respective acute screening levels or regulatory targets. No other chemicals were detected at quantifiable concentrations at Watsonville in 2018.

Table 2. Highest 24-h air concentrations, acute screening levels, and percent of the acute screening level for chemicals monitored at the Watsonville Air Monitoring Network sampling location.

Chemical	Highest 24-h concentration in ppb (ng/m³)	24-h acute screening level in ppb (ng/m³)	% of screening level
1,3-dichloropropene	0.27 ppb (1,200 ng/m³)	110 ppb (505,000 ng/m³)	0.2%
Chloropicrin	0.12 ppb (780 ng/m³)	73.0 ppb (491,000 ng/m³) *	0.2%
MITC	0.042 ppb (120 ng/m³)	220 ppb (66,000 ng/m³) *	0.02%
Acephate	ND	1.60 ppb (12,000 ng/m³)	
Bensulide	ND	15.9 ppb (259,000 ng/m³)	
Chlorothalonil	ND	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	ND	0.08 ppb (1,200 ng/m³) **	
Chlorpyrifos OA	ND	0.09 ppb (1,200 ng/m³) **	
Chlorthal-dimethyl	Trace	1,730 ppb (23,500,000 ng/m³)	
Cypermethrin	ND	6.64 ppb (113,000 ng/m³)	
DDVP	Trace	1.22 ppb (11,000 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb	

		(130 ng/m³)	
Dimethoate	ND	0.46 ppb (4,300 ng/m³)	
Dimethoate OA	ND	0.49 ppb (4,300 ng/m³)	
Diuron	ND	17.8 ppb (170,000 ng/m³)	
Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	29.7 ppb (230,000 ng/m³)	
Iprodione	ND	69.6 ppb (939,000 ng/m³)	
Malathion	Trace	8.33 ppb (113,000 ng/m³)	
Malathion OA	Trace	8.76 ppb (113,000 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	210 ppb (820,000 ng/m³) *	
Metolachlor	ND	7.33 ppb (85,000 ng/m³)	
Norflurazon	ND	12.6 ppb (170,000 ng/m³)	
Oryzalin	ND	29.7 ppb (420,000 ng/m³)	
Oxydemeton methyl	ND	3.74 ppb (39,200 ng/m³)	
Oxyfluorfen	ND	34.5 ppb (510,000 ng/m³)	
Permethrin	ND	10.5 ppb (168,000 ng/m³)	
Phosmet	ND	5.94 ppb (77,000 ng/m³)	
pp-Dicofol	ND	4.49 ppb (68,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	ND	13.3 ppb (110,000 ng/m³)	
Trifluralin	Trace	87.5 ppb (1,200,000 ng/m³)	

* DPR's May 28, 2019, risk management directive for chlorpyrifos established an acute regulatory target of 0.28 ppb (4,050 ng/m^3), 1-hr TWA. However, the current sample duration does not allow for a direct comparison between the acute regulatory target concentration and the measured sample values.
** This value is a regulatory target rather than a screening level.

Subchronic (4- or 13-wk) Concentrations

Table 3 shows the highest observed rolling 4-week or 13-week average concentrations for all chemicals monitored at the Watsonville Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chloropicrin at 20.3%. This was followed by 1,3-dichloropropene at 3.1%, and then MITC at 1.5%.

Table 3. Highest 4- or 13-wk air concentrations, subchronic screening levels, and percent of the subchronic screening level for chemicals monitored at the Watsonville Air Monitoring Network sampling location.

Chemical	Highest 4-week rolling average concentration in ppb (ng/m³)	Subchronic screening level in ppb (ng/m³)	% of screening level
1,3-dichloropropene *	0.094 ppb (430 ng/m³)	3.0 ppb (14,000 ng/m³)	3.1%
Chloropicrin *	0.071 ppb (480 ng/m³)	0.35 ppb (2,300 ng/m³)	20.3%
MITC	0.015 ppb (44 ng/m³)	1.00 ppb (3,000 ng/m³)	1.5%
Acephate	ND	1.13 ppb (8,500 ng/m³)	
Bensulide	ND	1.47 ppb (24,000 ng/m³)	
Chlorothalonil	ND	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	ND	0.06 ppb (850 ng/m³)	
Chlorpyrifos OA	ND	0.06 ppb (850 ng/m³)	
Chlorthal-dimethyl	Trace	34.6 ppb (470,000 ng/m³)	
Cypermethrin	ND	4.76 ppb (81,000 ng/m³)	
DDVP	Trace	0.24 ppb (2,200 ng/m³)	
DEF	ND	0.68 ppb (8,800 ng/m³)	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.32 ppb (3,000 ng/m³)	
Dimethoate OA	ND	0.34 ppb (3,000 ng/m³)	
Diuron	ND	1.78 ppb (17,000 ng/m³)	
Endosulfan	ND	0.20 ppb (3,300 ng/m³)	
Endosulfan Sulfate	ND	0.19 ppb (3,300 ng/m³)	
EPTC	ND	3.10 ppb (24,000 ng/m³)	

Iprodione	ND	21.2 ppb (286,000 ng/m³)	
Malathion	Trace	5.97 ppb (80,600 ng/m³)	
Malathion OA	Trace	6.27 ppb (80,600 ng/m³)	
Methidathion	ND	0.25 ppb (3,100 ng/m³)	
Methyl bromide	ND	5.0 ppb (19,400 ng/m³) *	
Metolachlor	ND	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	ND	16.2 ppb (230,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	
Oxyfluorfen	ND	12.2 ppb (180,000 ng/m³)	
Permethrin	ND	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	2.00 ppb (26,000 ng/m³)	
pp-Dicofol	ND	3.24 ppb (49,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	ND	3.76 ppb (31,000 ng/m³)	
Trifluralin	Trace	12.4 ppb (170,000 ng/m³)	

* These concentrations represent the highest 13-week rolling average, rather than the default 4-week rolling average.

Chronic (2018) Concentrations

Table 4 shows the annual average concentration for all chemicals monitored at the Watsonville Air Monitoring Network sampling location in 2018. The highest concentration relative to its screening level was that of chloropicrin at 11.1%. This was followed by MITC at 5.0%, and then 1,3-dichloropropene at 2.3%.

Table 4. Annual average air concentrations, chronic screening levels, and percent of the chronic screening level for chemicals monitored at the Watsonville Air Monitoring Network sampling location.

Chemical	Overall average concentration in ppb (ng/m³)	Chronic screening level in ppb (ng/m³)	% of screening level
1,3-dichloropropene	0.046 ppb (210 ng/m³)	2.00 ppb (9,000 ng/m³)	2.3%
Chloropicrin	0.03 ppb (200 ng/m³)	0.27 ppb (1,800 ng/m³)	11.1%
MITC	0.005 ppb (15 ng/m³)	0.10 ppb (300 ng/m³)	5.0%

Acephate	ND	1.13 ppb (8,500 ng/m³)	
Bensulide	ND	1.48 ppb (24,000 ng/m³)	
Chlorothalonil	ND	3.13 ppb (34,000 ng/m³)	
Chlorpyrifos	ND	0.04 ppb (510 ng/m³)	
Chlorpyrifos OA	ND	0.04 ppb (510 ng/m³)	
Chlorthal-dimethyl	Trace	3.46 ppb (47,000 ng/m³)	
Cypermethrin	ND	1.59 ppb (27,000 ng/m³)	
DDVP	Trace	0.09 ppb (770 ng/m³)	
DEF	ND	NA - Seasonal	
Diazinon	ND	0.01 ppb (130 ng/m³)	
Diazinon OA	ND	0.01 ppb (130 ng/m³)	
Dimethoate	ND	0.03 ppb (300 ng/m³)	
Dimethoate OA	ND	0.03 ppb (300 ng/m³)	
Diuron	ND	0.60 ppb (5,700 ng/m³)	
Endosulfan	ND	0.02 ppb (330 ng/m³)	
Endosulfan Sulfate	ND	0.02 ppb (330 ng/m³)	
EPTC	ND	1.10 ppb (8,500 ng/m³)	
Iprodione	ND	21.2 ppb (286,000 ng/m³)	
Malathion	Trace	0.60 ppb (8,100 ng/m³)	
Malathion OA	Trace	0.63 ppb (8,100 ng/m³)	
Methidathion	ND	0.20 ppb (2,500 ng/m³)	
Methyl bromide	ND	1.00 ppb (3,900 ng/m³)	
Metolachlor	ND	1.29 ppb (15,000 ng/m³)	
Norflurazon	ND	1.92 ppb (26,000 ng/m³)	
Oryzalin	ND	16.4 ppb (232,000 ng/m³)	
Oxydemeton methyl	ND	0.06 ppb (610 ng/m³)	

Oxyfluorfen	ND	3.45 ppb (51,000 ng/m³)	
Permethrin	ND	5.63 ppb (90,000 ng/m³)	
Phosmet	ND	1.39 ppb (18,000 ng/m³)	
pp-Dicofol	ND	1.32 ppb (20,000 ng/m³)	
Propargite	ND	0.98 ppb (14,000 ng/m³)	
Simazine	ND	3.76 ppb (31,000 ng/m³)	
Trifluralin	Trace	2.99 ppb (41,000 ng/m³)	

Temporal trends in detected concentrations

Figures 1 – 3 present the concentrations over time for monitoring results in 2018 for any chemical detected at a quantifiable concentration in Watsonville. Screening levels, as defined in Appendix K are abbreviated as SL in the following graphs. Regulatory targets, also defined in Appendix K, are abbreviated as RT. For graphs where both a pesticide and its degradate are shown, the detected concentrations of both the parent chemical and its degradate have been summed for each sampling date.

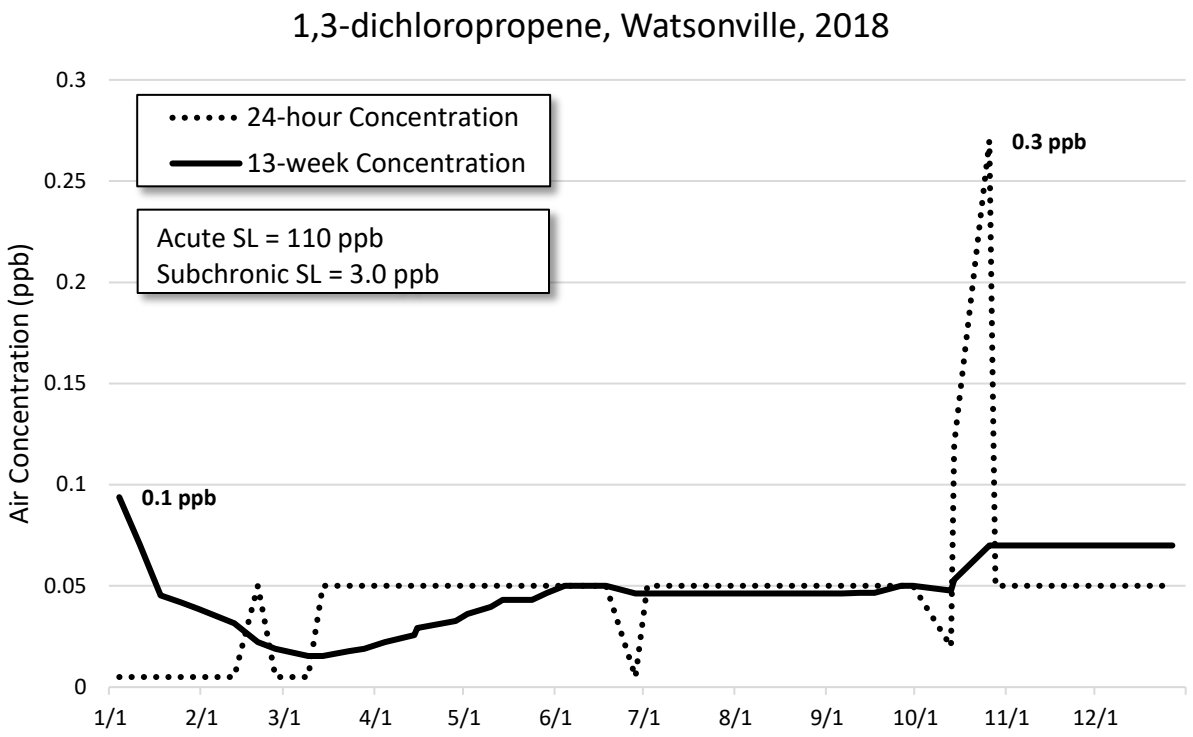

Figure 1. Temporal trend in 1,3-dichloropropene concentrations in Watsonville in 2018.

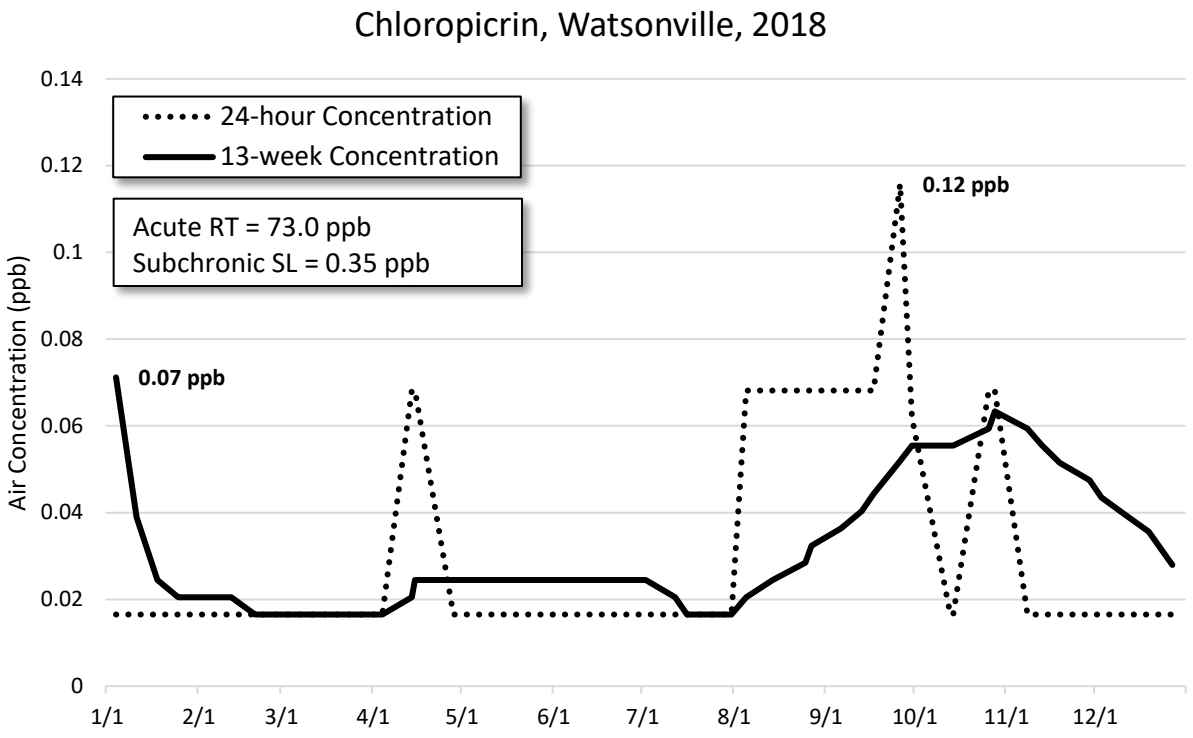

Figure 2. Temporal trend in chloropicrin concentrations in Chualar in 2018.

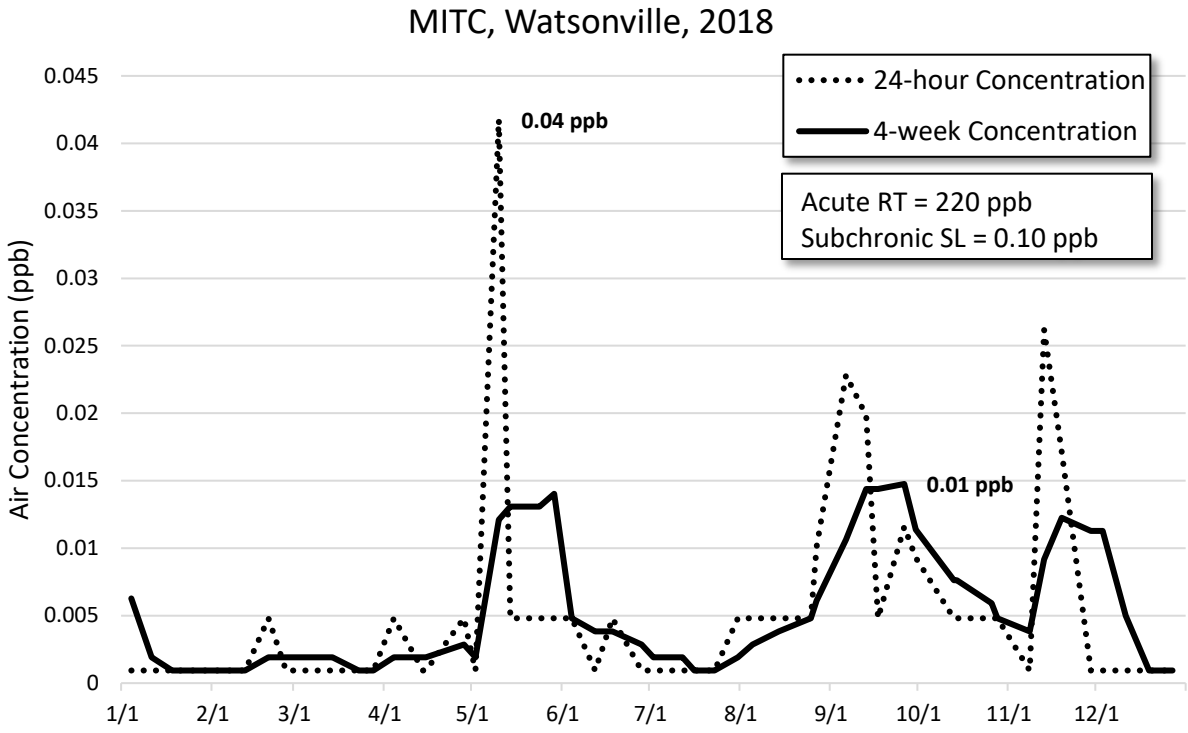

Figure 3. Temporal trend in MITC concentrations in Watsonville in 2018.

Appendix I: Laboratory Analysis

Pesticides Monitored

As part of the Air Monitoring Network (AMN), DPR monitors for 31 pesticides and 5 breakdown products. Chemicals included in the AMN were selected based primarily on potential health risk (Vidrio et al., 2013a). A total of four analytical methods were used to analyze the collected air samples as part of the AMN:

1. Multi-pesticide residue analysis
2. Volatile organic compounds (VOC) analysis
3. MITC analysis
4. Chloropicrin analysis

Multi-Pesticide Residue Analysis

Prior to sampling, personnel from the California Department of Food and Agriculture Center for Analytical Chemistry laboratory (CDFA CAC laboratory) washed, rinsed, and packed 30 mL of XAD-4 sorbent material into a custom-built Teflon® cartridge to be used for the collection of 32 analytes via multi-pesticide residue analysis.

Multi-pesticide residue analysis using XAD-4 resin was performed by laboratory staff using gas chromatography – mass spectrometry (GC-MS) and liquid chromatography – mass spectrometry (LC-MS) methods as described elsewhere (CDFA, 2018a). This analysis can detect a variety of fungicides, insecticides, herbicides, and defoliants. The breakdown products of chlorpyrifos, diazinon, dimethoate, endosulfan and malathion were also included in the multi-pesticide residue analysis method. Table 1 lists the 32 analytes included in the multi-pesticide residue analysis.

Table 1. Target analytes in multi-pesticide residue analysis with XAD-4 resin.

Chemical	Chemical Class	Pesticide Group
Acephate	Organophosphate	Insecticide
Bensulide	Organophosphate	Herbicide
Chlorothalonil	Chloronitrile	Fungicide
Chlorpyrifos	Organophosphate	Insecticide
Chlorpyrifos Oxygen Analog	Organophosphate	Degradate
Chlorthal-dimethyl (DCPA, Dacthal)	Phthalate	Herbicide
Cypermethrin	Pyrethroid	Insecticide
DDVP	Organophosphate	Insecticide
DEF (SSS-tributyl phosphorotrithioate)	Organophosphate	Defoliant
Diazinon	Organophosphate	Insecticide
Diazinon Oxygen Analog	Organophosphate	Degradate
Dicofol	Organochlorine	Insecticide
Dimethoate	Organophosphate	Insecticide
Dimethoate Oxygen Analog	Organophosphate	Degradate
Diuron	Urea	Herbicide
Endosulfan	Organochlorine	Insecticide
Endosulfan Sulfate	Organochlorine	Degradate

EPTC	Carbamate	Herbicide
Iprodione	Dicarboximide	Fungicide
Malathion	Organophosphate	Insecticide
Malathion Oxygen Analog	Organophosphate	Degradate
Methidathion	Organophosphate	Insecticide
Metolachlor	Chloracetanilide	Herbicide
Norflurazon	Pyridazinone	Herbicide
Oryzalin	Dinitroaniline	Herbicide
Oxydemeton-methyl	Organophosphate	Insecticide
Oxyfluorfen	Diphenyl ether	Herbicide
Permethrin	Pyrethroid	Insecticide
Phosmet	Organophosphate	Insecticide
Propargite	Organosulfite	Insecticide
Simazine	Triazine	Herbicide
Trifluralin	Dinitroaniline	Herbicide

Volatile Organic Compound Analysis

Collected air canisters were analyzed for the presence of two analytes (Table 2) using a volatile organic compound (VOC) GC-MS method similar to the United States Environmental Protection Agency's (US EPA) Method TO-15. The standard operating procedure for this analysis is described in detail elsewhere (CDFA, 2010). Analysis of 1,3-D, includes results for both *cis*- and *trans*- isomers, which are then consolidated and reported as a total 1,3-D concentration for use in this report.

Table 2. Target analytes in volatile organic compound analysis.

Pesticide	Pesticide Group	Chemical Class
1,3-dichloropropene	Fumigant	Halogenated organic
Methyl bromide	Fumigant	Halogenated organic

MITC

Samples collected on Anasorb coconut charcoal sorbent tubes were analyzed by CDFA CAC laboratory for the presence of MITC by GC-MS as described by CDFA (2018b). MITC extraction from the sorbent medium involves using carbon disulfide in ethyl acetate. The proportion of carbon disulfide used was recently increased to 1.0% (CDFA, 2018b). This is followed by analysis using a gas chromatography-nitrogen phosphorous detector (GC-NPD) (Table 3).

Chloropicrin

Samples collected on XAD-4 sorbent tubes were analyzed by CDFA CAC laboratory for the presence of chloropicrin by gas chromatography-electron capture detector (GC-ECD) as described by CDFA (1999). Each tube was desorbed in hexane and analyzed by a GC equipped with an ECD (Table 3).

Table 3. Target analytes in individual analyte residue analysis.

Pesticide	Pesticide Group	Chemical Class
MITC	Fumigant	-
Chloropicrin	Fumigant	Halogenated organic

Laboratory Methods

Method Calibration

The laboratory established method calibration by analyzing a series of standard samples (samples containing known amounts of analyte dissolved in a solvent). The linear range of calibration was determined by analyzing standards of increasing concentration. Within the linear range, the calibration was determined by conducting a regression analysis of standard concentrations measured by the instrument (peak height or peak area of the chromatogram) using at least five concentrations. The minimum acceptable correlation coefficient of the calibration was given in the standard operating procedure for each method, but in general was at least 0.95.

Method Detection Limits and Limits of Quantitation

The method detection limit (MDL) is the lowest concentration of a pesticide (analyte) that a chemical method can reliably detect. The 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. This standard is analyzed at least 7 times, and the MDL is determined by calculating the 99 % confidence interval of the mean.

The limit of quantitation (LOQ) is the level at which concentrations may be reliably measured and is set at a certain factor above the MDL. The level of interference determines the magnitude of this factor; the more interference, the higher the factor. Tables 4 and 5 list all the quantitation and detection limits for AMN analytes.

Table 4. Quantitation and detection limits for Air Monitoring Network samples collected on sorbent media analyzed by the CDFA CAC laboratory.

Chemical	MDL (ppb)	LOQ (ppb)	MDL (ng/m^3)	LOQ (ng/m^3)
Acephate	0.000087	0.0012	0.65	9.3
Bensulide	0.000054	0.00057	0.88	9.3
Chloropicrin	0.033	0.10	222	694
Chlorothalonil	0.000081	0.0021	0.88	23.1
Chlorpyrifos	0.000061	0.0016	0.88	23.1
Chlorpyrifos OA	0.000058	0.00068	0.79	9.3
Cypermethrin	0.00014	0.0014	2.31	23.1
Chlorthal-dimethyl	0.000065	0.00068	0.88	9.3
DDVP	0.000082	0.0026	0.74	23.1
DEF	0.000022	0.00072	0.28	9.3
Diazinon	0.000030	0.00075	0.37	9.3
Diazinon OA	0.000031	0.00079	0.37	9.3

Dimethoate	0.000079	0.00099	0.74	9.3
Dimethoate OA	0.000069	0.0011	0.6	9.3
Diuron	0.000039	0.00098	0.37	9.3
Endosulfan	0.00011	0.0014	1.76	23.1
Endosulfan Sulfate	0.000051	0.0013	0.88	23.1
EPTC	0.00019	0.0030	1.44	23.1
Iprodione	0.000076	0.0017	1.02	23.1
Malathion	0.000096	0.00069	1.3	9.3
Malathion OA	0.000029	0.00072	0.37	9.3
Methidathion	0.000071	0.00075	0.88	9.3
Metolachlor	0.000091	0.00080	1.06	9.3
MITC	0.0019	0.0077	5.44	23.1
Norflurazon	0.000044	0.00069	0.6	9.3
Oryzalin	0.00012	0.0016	1.67	23.1
Oxydemeton methyl	0.00014	0.00089	1.44	9.3
Oxyfluorfen	0.000088	0.0016	1.3	23.1
Permethrin	0.00010	0.0014	1.62	23.1
Phosmet	0.00029	0.00072	3.7	9.3
pp-Dicofol	0.00030	0.0015	4.49	23.1
Propargite	0.000071	0.0016	1.02	23.1
Simazine	0.000039	0.0011	0.32	9.3
Trifluralin	0.000085	0.0017	1.16	23.1

Table 5. Method detection limits for Air Monitoring Network volatile organic compound (VOC) samples, by laboratory.

Chemical	MDL (CARB-OLS) (ppb)	MDL (CARB-OLS) (ng/m^3)	MDL (CDFA CAC) (ppb)	MDL (CDFA CAC) (ng/m^3)
1,3-dichloropropene	0.1	454	0.01	45.4
Methyl bromide	0.1	396	0.01	39.6

Air Concentration Calculations

For the sorbent tube and cartridge samples, air concentrations are calculated as an amount of pesticide captured from a volume of air moving through the sampling media. Analytical results are presented in micrograms per sample (µg/sample). The concentrations are converted from µg/sample to nanograms per cubic meter (ng/m^3) of sample air using the following calculation:

$$\frac{Sample\ results\ (ug) x\ 1000\ L/m^3}{Flow\ rate\ \left(\frac{L}{\min}\right) x\ run\ time\ (\min)} \text{ x } 1000\ ng/\mu g = ng/m^3$$

The VOC concentrations were reported as parts per billion by volume (ppb) and converted to ng/m^3 using the following calculations:

$$\frac{Sample\ results\ (ppb) x\ Molecular\ weight\ (g/mol)}{24.45} \text{ x } 1000 = ng/m^3$$

The calculation above assumes 1 atmosphere of pressure at 25°C and 24.45 is obtained from multiplication of the Universal Gas Constant (R) (82.06 atm.cm^3/(mol·K)) and temperature in Kelvin (298 K) with appropriate unit conversions based on the ideal gas law[1].

Per standard DPR practice, when calculating average concentrations from multiple samples, samples with no detectable amounts were assumed to contain one-half the MDL (ND=0.5*MDL), and samples with trace amounts were assumed to contain the value halfway between the MDL and the LOQ (Trace= 0.5*(MDL+LOQ)).

Data Validation/Quality Assurance

Method Validation

An acceptable range of spike recoveries was established by analyzing laboratory spike samples in five replicate analyses at five different spike levels. The mean percent recovery and standard deviation were determined based on these 25 data points. The control limits were established as the mean percent recovery ± 3 SDs. In addition, a method trapping efficiency was determined by collecting 2-stage air samples that were analyzed to determine the proportion of the spike trapped in the bottom stage to assess for possible sample breakthrough.

General Continuing Quality Control

Samples were stored at the DPR facility in West Sacramento under the care of the laboratory liaison until scheduled delivery to the CDFA CAC laboratory or the California Air Resources Board – Organic Laboratory Section (CARB-OLS) laboratory. Storage stability was evaluated for the longest anticipated holding period with at least four sampling intervals and two replicate samples at each sampling interval. All analytes have storage stability data for a minimum of 28 days. Each extraction set consisted of 1 to 20 actual samples and QC samples which include a reagent blank, a matrix blank, and a matrix spiked sample. Any subsequent matrix spiked samples outside the control limits required the set of samples associated with that spike to be reanalyzed.

Quality Control Results

Laboratory matrix spikes and matrix blanks were included with every set of samples extracted and analyzed at the CDFA CAC laboratory and are part of the laboratory QC program. The matrix spikes are conducted to assess accuracy and precision; the blanks are to check for contamination at the laboratory or contamination of the media packed in the sorption tubes or cartridges. The blank matrix materials were not fortified, but were extracted and analyzed along with the matrix spikes and field samples. Table 6 lists the average for the QC samples that were extracted and analyzed with the air samples for the entire monitoring period. Average laboratory matrix spike recoveries ranged from 81% to 99% for all chemicals analyzed.

Field blanks, blind field spikes, and duplicate samples are part of DPR's field and laboratory QC program. The field spikes were fortified by a CDFA chemist not associated with the analysis. The field spikes were given to DPR staff, relabeled, and then intermingled and delivered with field samples to the laboratory for analysis. Table 6 lists the average percent recovery results which ranged from 72% to 138%.

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[1] Ideal gas law: pV = nRT
where p = pressure, V = volume, n = number of moles, R = universal gas constant, and T = temperature

The trip blanks were blank matrix samples that were transported to and from the field locations, but were not placed on air pumps. These samples were a control to check for contamination during transportation. All field blanks resulted in non-detections. These results are shown in Table 6.

Table 7 summarizes the results of duplicate samples. A duplicate sample is a sample that is collocated with another sample in the field. These samples serve to evaluate the overall precision in sample measurement and analysis. Consistent with previous reports, there were a large number of non-detection pairs among co-located samples. For sample pairs in which both samples produced a quantifiable detection these concentrations were compared to find the relative difference, expressed as a percentage. This was possible for a total of eight sample pairs, and range from 3% to 16%.

Table 6. Average results for quality control/quality assurance samples from the 2018 AMN.

Chemical	Lab spikes (% recovery)	Field spikes (% recovery)	Lab blanks (ng/m^3)	Field blanks (ng/m^3)
1,3-dichloropropene	99%	94%	ND	None Taken
Acephate	91%	87%	ND	ND
Bensulide	84%	91%	ND	ND
Chloropicrin	94%	99%	ND	ND
Chlorothalonil	94%	73%	ND	ND
Chlorpyrifos	95%	77%	ND	ND
Chlorpyrifos OA	88%	None Taken	ND	ND
Chlorthal-dimethyl	91%	107%	ND	ND
Cypermethrin	95%	76%	ND	ND
DDVP	91%	98%	ND	ND
DEF	81%	75%	ND	ND
Diazinon	88%	92%	ND	ND
Diazinon OA	94%	98%	ND	ND
Dimethoate	94%	84%	ND	ND
Dimethoate OA	94%	95%	ND	ND
Diuron	92%	108%	ND	ND
Endosulfan	94%	87%	ND	ND
Endosulfan Sulfate	96%	80%	ND	ND
EPTC	88%	83%	ND	ND
Iprodione	97%	91%	ND	ND
Malathion	97%	72%	ND	ND
Malathion OA	91%	138%	ND	ND
Methidathion	89%	97%	ND	ND
Methyl bromide	99%	94%	ND	None Taken
Metolachlor	87%	92%	ND	ND
MITC	88%	78%	ND	ND
Norflurazon	94%	94%	ND	ND
Oryzalin	91%	None Taken	ND	ND
Oxydemeton methyl	93%	123%	ND	ND

Oxyfluorfen	99%	None Taken	ND	ND
Permethrin	95%	93%	ND	ND
Phosmet	86%	None Taken	ND	ND
pp-Dicofol	98%	100%	ND	ND
Propargite	97%	103%	ND	ND
Simazine	94%	92%	ND	ND
Trifluralin	96%	97%	ND	ND

Table 7. Results for duplicate (collocated) sample pairs in 2018.

Primary/duplicate paired results category	Chloropicrin	MITC	Multi-residue	VOC
ND †/ND	11	3	336	28
Trace ‡/Trace	1	3	12	N/A
ND/Trace	0	0	2	N/A
ND/ > LOQ	0	0	0	0
Trace/ > LOQ	0	0	1	N/A
> LOQ/ > LOQ	0	5	1	2
Relative Difference *	N/A	3%	16%	12%

† ND = Not Detected.
‡ Trace = Pesticide detection confirmed, but less than the quantitation limit.
* For pairs with both concentrations >LOQ.

Lost and Invalid Samples

As previously stated on page 8 of the report, four samples were lost or invalidated during the year of sampling. Table 8 lists the location, date, and type of samples.

Table 8. Lost or invalid samples in 2018.

Location	Date	Type
Ohlone	6/12/2018	VOC
Chualar	8/14/2018	VOC
Santa Maria	9/5/2018	Multi-pesticide Residue
Lindsay	11/25/2018	VOC

Appendix J – Field Methods

MATERIALS AND METHODS

Air Sampling Equipment and Methods

There were a total of four methods used for the collection of air samples as part of the AMN. Each of these methods required specific equipment as described below.

Multi-Pesticide Residue Sampling

Original AMN Equipment:

For all samples taken in Shafter during the months of January through March: as part of sample collection, ambient air was drawn through the XAD-4 media with an SKC® AirChek HV30 air pump, calibrated at a flow rate of 15 L/min (± 10%) for a continuous 24-h period. The cartridge was connected to the pump using a combination of threaded ABS plastic fittings, nitrile o-rings, and approximately 8 feet of Tygon® tubing which were all downstream of the sample media. The Teflon® tube containing the sample media was kept sealed prior to sampling at which time the inlet of the cartridge itself was open to the ambient air. Bios Defender 530® or DC-Lite® flow meters were used to obtain flow rates at the start and finish of the sampling period.

New Equipment:

For samples collected at Shafter starting in April, as well as all other samples collected as part of the AMN: as part of sample collection, ambient air was drawn through the XAD-4 media using channel 1 of a custom-built 3-channel pesticide sampling version of a Speciation Air Sampling System (SASS) manufactured by Met One Instruments, hereafter referred to as Met One® pesticide sampler. Channel 1 provided a sustained flow of 15.0 L/min ± 5%. The average of flow measurements collected at 5-minute intervals was used to directly calculate the volume sampled which was reported by the instrument. This allowed for more certainty than that of the previous method of calculation which used the mean from only two data points (measurements at the start and finish of sample collection). The Met One® pesticide sampler includes a solar shield of a sufficient size to shield the multi-pesticide cartridges from direct sunlight exposure during the sampling period.

Volatile Organic Compounds

Original AMN Equipment:

For all samples taken in Shafter during the months of January through March: as part of sample collection, ambient air was drawn into a 6-L SilcoCan canister (cat. # 24142) pre-evacuated to a pressure of -30” Hg for VOC analysis. A Restek flow controller (cat. # 24160) was attached to the canister inlet to achieve a flow rate of 3.0 mL/min (± 10%) for a continuous 24-h sampling period. The air sampling inlet of the flow controller was placed at a sampling height of 3-10 meters, depending on the sampling site location, with a sufficient amount of 1/16” internal diameter PTFE (Teflon®) tubing to reach the canister. Bios Defender 530® or DC-Lite® flow meters were used to check the flow rate at the start and finish of the sampling period.

New Equipment:

For Samples collected at Shafter starting in April, as well as all other samples collected as part of the AMN: as part of sample collection, ambient air was drawn through 1/16" internal diameter PTFE (Teflon®) tubing into a Xonteck model 901 ambient air sampler into a 6-L SilcoCan canister. The flow rate using this method was 7.5 mL/min (± 10%) and was sustained for a 24-h period. The sampler itself included an automatically initiated 60-second purge period to clear the sampling lines immediately prior to sample collection.

MITC

Original AMN Equipment:

For all samples taken in Shafter during the months of January through March: as part of sample collection, Anasorb sorbent sample tubes containing activated charcoal as the sampling media (cat. # 226-16-02) were used for the collection of MITC. These tubes measured 10mm in diameter by 160mm in length and contained 1,800 mg of sorbent in the primary sample region. Ambient air was drawn through the media by an SKC® XR series pump (PCXR8 or PCXR4) at a flow rate of 1.5 L/min (± 10%) for a continuous 24-h sampling period. The glass tube containing the sample media was connected to the pump with approximately 8 feet of Tygon® tubing, downstream of the sample media. The glass tips sealing the sampling media were broken open immediately prior to sampling. Bios Defender 530® or DC-Lite® flow meters were used to obtain flow rates at the start and finish of the sampling period.

New Equipment:

For samples collected in Shafter starting in April, as well as all other samples collected as part of the AMN: as part of sample collection, ambient air was drawn through the SKC® Anasorb® CSC sorbent sample tubes containing activated coconut charcoal media using channel 2 of the Met One pesticide sampler. Channel 2 provided a sustained flow of 1.5 L/min ± 5%. The average of flow measurements collected at 5-minute intervals was used to directly calculate the volume sampled which was reported by the sampler. This allowed for more certainty than that of the previous method of calculation, which used the mean from only two data points (measurements at the start and end of sample collection). The glass sorption tubes containing the sampling media and any collected analyte were shielded from sunlight by the sampler's radiation shield.

Chloropicrin

Original AMN Equipment:

For all samples taken in Shafter during the months of January through March: as part of sample collection, SKC® XAD-4 sorbent sample tubes (cat. # 226-175) were used for the collection of the analyte chloropicrin. These tubes measured 8mm in diameter and 150 mm in length, and contained 400 mg of sorbent material in the primary sample region. Ambient air was drawn through the media by an SKC® XR series pump (PCXR8 or PCXR4) at a flow rate of 50 mL/min (± 10%) for a continuous 24-h sampling period. The glass tube containing the sample media was connected to an adjustable low-flow single tube holder (SKC cat. # 224-26-01) which was in turn connected to the pump with approximately 8 feet of Tygon® tubing, all of which were downstream of the sample media. The glass tips sealing the sampling media were broken to allow airflow immediately prior to sampling and the inlet was open directly to the ambient air. Bios Defender 530® or DC-Lite® flow meters were used to obtain flow rates at the start and finish of the sampling period.

New Equipment:

For all samples collected in Shafter starting in April, as well as all other samples collected as part of the AMN: as part of sample collection, ambient air was drawn through the SKC® XAD-4 sorbent sample tubes using channel 3 of the Met One pesticide sampler. Channel 3 provided a sustained flow of 50 mL/min ± 5%. The average of flow measurements collected at 5-minute intervals was used to directly calculate the volume sampled which was reported by the machine. This allowed for more certainty than from the previous method of calculation which used the mean from only two data points (measurements at the start and finish of sample collection). The glass sorption tubes containing the sampling media and any collected analyte were shielded from sunlight by the sampler's radiation shield.

Field Sampling Procedure

One 24-h sample was collected each week at each of the eight sites, once they were active. The starting day varied each week with the actual dates being randomly selected as much as possible. Actual sampling start times were left to the discretion of the field sampling personnel.

Chain of custody (COC) forms, sample analysis request forms, and sample labels including the study number and unique sample identification numbers were supplied to field sampling personnel to be attached to sample tubes, cartridges, and canister tags prior to sampling.

Each of the four sample types detailed above were set up and started as closely as possible to the same time, except for the occasional make-up sample needed to replace an invalid sample. These make-up samples were typically run on the day following an invalidation event. Reasons why samples might be deemed invalid include, but are not limited to, the following: sampling period out of range, ending flow or pressure out of acceptable range, power interruptions, glass tube breakage during removal (i.e., damaged sampling media), and inoperative sampling equipment. The starting flow rates were measured prior to air sample collection and if any were determined to be out of the acceptable range (± 5% for the new equipment, ± 10% for the old equipment) that sampling equipment was recalibrated to within an acceptable tolerance. As the air sampling commenced at each monitoring site, the sample tracking number, date, time, staff initials, weather conditions, and air sampler flow rate were documented on a COC form.

Quality Control Methods

In addition to the primary samples, DPR collected quality control (QC) samples including trip blanks, field spikes, and co-located duplicate samples at a rate of 10% of primary samples. The QC results section located at the end of this report summarizes the results of these QC procedures.

A trip blank sample provides information on possible contamination of field collected samples. For the manufactured pre-packed XAD-4 and charcoal sample tubes, trip blank sample ends were broken open, capped and placed on dry ice with the field samples. The multi-pesticide residue XAD cartridges were opened in the field, capped, and placed on dry ice to be stored and shipped with the field samples. No air canister trip blanks were collected. Trip blanks were collected from the monitoring station in Watsonville (designated DPR's QC sampling site) at least once every month of sampling. Trip blank samples containing detectable amounts of any of the pesticides would indicate a problem with contamination during transport or during laboratory extraction.

A field spike is a sample with a known amount of chemical spiked onto the sample media, which is placed next to a primary sample that undergoes the same air flow and run time conditions. The field spike is stored under dry ice (-78.5° C) during transport for sorbent tubes and cartridges, and at ambient temperature for canisters. It is treated like a field sample, undergoing the same storage and shipping conditions. The field spiked sample, when compared to the primary sample, provides some information about any changes in the ability to recover the analyte during air sampling. DPR collected one field spike sample per month for each sample type. The multi-pesticide residue XAD cartridge was spiked with two different analytes every month at various concentrations. For chloropicrin- and MITC-spiked samples, concentrations varied every month. VOC canister spike samples were scheduled for collection once per month at the monitoring station in Watsonville.

An acceptable range of spike recoveries for the AMN was established by analyzing blank-matrix spike samples at five replicate analyses at five different spike levels. The mean percent recovery and standard deviation (SD) were determined based on these 25 data points. The control limits are then established at the mean percent recovery ± 3 SDs. Spike samples outside the control limits established for each pesticide do not necessarily indicate that the obtained results are deemed invalid or unusable, however, it would indicate the need for a further and more refined assessment of the field and laboratory procedures to determine the root issue. Depending on the results of this assessment, changes to field and laboratory procedures may be necessary.

Additionally, to look for sample analyte breakthrough in the sampling media, a method trapping efficiency was conducted for AMN sample collection media with the exception of air canisters (DPR, 1995). Two-stage air samples were collected and analyzed to determine the proportion of the spike trapped in the bottom stage to assess for possible sample breakthrough.

A duplicate sample is a sample that is co-located with a regular field sample. These samples evaluate overall precision in sample measurement and analysis.

The site at Watsonville was designated as DPR's QC site for the DPR-operated portion of the AMN. A second set of sampling equipment dedicated to the collection of QC samples was installed at this location

Appendix K: Health Evaluation and Calculations

Calculation of Subchronic Rolling Averages

13-week Rolling Averages

In 2016, DPR eliminated the practice of using a 4-week rolling average concentration to represent a subchronic time period for 1,3-Dichloropropene (1,3-D) and chloropicrin for comparisons to subchronic screening levels and regulatory targets. This determination was based on an evaluation conducted by DPR's Human Health Assessment Branch that looked at seasonal reference concentrations for these two chemicals. Greater details are provided elsewhere (DPR, 2016b)

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 high potential for 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 adverse effects such as respiratory illnesses, damage to the nervous system, cancer, and birth defects. Vidrio et al. (2013a) summarizes the potential health effects of each pesticide. 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) developed health screening levels or regulatory targets to place the results in a health-based context.

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 this 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. Vidrio et al. (2013a) summarizes more information on DPR-determined screening levels including information on deriving screening levels for each pesticide.

DPR puts measures in place based on the regulatory target to limit exposures so that adverse effects can be avoided. Exceeding a regulatory target 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 after completing a formal risk assessment of a chemical's toxicity and potential exposures. DPR management determines a regulatory target using its 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 is based on a more comprehensive evaluation than a health screening level. Therefore, a regulatory target 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, MeBr, MITC, and 1,3-D) have regulatory targets for one or more exposure periods.

Cumulative Exposures

Cumulative exposure and risk were 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. Such a results 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 of the HQs for the pesticides monitored.

HI = HQ1 (pesticide 1) + HQ2 (pesticide 2) + HQ3 (pesticide 3) + … (and so forth)

An HI greater than 1 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.

Appendix L: Comparison to previous years of AMN data

Comparison of 2018 to Previous Years of AMN Results

All AMN Sites

This report covers results from the eighth year of monitoring by the AMN, which has been collecting samples since 2011. While there were significant changes to the AMN commencing in 2017, as detailed in the main body of this report, a few comparisons to the overall results from previous years are possible. Among individual sites, Shafter has remained in operation since 2011 and comparisons of the historic data for that site are shown below. Additionally, comparisons between 2018 and 2017 data have been made for the three sites which became operational in 2017 (Chualar, Santa Maria, and Watsonville).

Table 1 shows the number of individual pesticides and breakdown products monitored by the AMN each year, as well as whether that pesticide was detected in a given year. This is further broken down into whether that pesticide was detected at a quantifiable level during monitoring in that year. The initial number of pesticides monitored by the AMN was 39 in 2011 (34 pesticides and 5 breakdown products). On January 1, 2012, acrolein was removed from AMN monitoring because acrolein is mainly produced as a byproduct of automobile emissions and other combustion sources not related to pesticidal uses (ATSDR, 2007), and uncertainties about the laboratory methodology. On March 21, 2012, DPR cancelled the registration of all products containing methyl iodide at the request of the registrant. Therefore, monitoring for methyl iodide as part of the AMN was stopped on June 20, 2012. In December 2016, carbon disulfide was removed from the list of monitored chemicals due to detections originating from non-pesticidal sources, and the voluntary withdrawal of registration of pesticide products that produce carbon disulfide.

The results presented in terms of individual analyses are shown as raw counts in Table 2, which are then summarized into the percentages of possible detections in Table 3. Inspection of these results reveals that the highest number of detections as a percentage of analyses occurred in 2015 (10.3%), and that the highest percentage of quantifiable detections occurred in both 2015 and 2016 (5.2%, each). The lowest percentage of detections occurred in 2012 (5.5%). 2018 and 2012 shared the lowest percentage of quantifiable detections (1.3%, each).

Table 1. Summary of pesticide detection trends in the Air Monitoring Network, aggregated by chemical (2011-2018).

Year	Total monitored chemicals*	Total non-detected chemicals	Total detected chemicals †	Total quantifiable chemicals
2011	39	10	29	9
2012	38	14	24	11
2013	37	13	24	14
2014	37	14	23	11
2015	37	11	26	14
2016	37	12	25	11
2017	36	9	27	10
2018	36	8	28	11

* Includes all pesticides that were monitored as part of the AMN for that year.
† Includes both quantified and trace detections.

Table 2. Summary of pesticide detection trends in the Air Monitoring Network, as individual analyses (2011-2018).

Year	Total analyses	Total non-detected analyses	Total detected analyses †	Total quantifiable analyses
2011	5,676	5,251	425	173
2012	6,002	5,671	331	81
2013	6,033	5,607	426	159
2014	5,966	5,468	498	225
2015	5,892	5,286	606	306
2016	5,928	5,393	535	307
2017	7,396	6,868	528	122
2018	12,058	11,316	742	152

† Includes both quantified and trace detections.

Table 3. Summary of pesticide detection trends in the Air Monitoring Network, as a percentage of possible detections (2011-2018)

Year	Percent of non-detected analyses	Percent of detected analyses †	Percent of quantifiable analyses
2011	92.5%	7.5%	3.0%
2012	94.5%	5.5%	1.3%
2013	92.9%	7.1%	2.6%
2014	91.7%	8.3%	3.8%
2015	89.7%	10.3%	5.2%
2016	91.0%	9.0%	5.2%
2017	92.9%	7.1%	1.6%
2018	93.8%	6.2%	1.3%

† Includes both quantified and trace detections.

Historic Air Concentrations in Chualar

Monitoring began in Chualar on January 1, 2017. Summarized results for the two years of monitoring are shown in Tables 4, 5, 6, and 7.

Table 4 shows the percentage of analyses during that year which resulted in either a trace or quantifiable detection. Changes between these two years include an increase in the number of detections for the fumigants 1,3-D and MITC and a decrease in the number of detections of the organophosphate malathion and its oxon.

Table 5 shows the highest observed 24-h concentration for any chemical with a positive detection during any year of monitoring at Chualar. The highest observed 24-h concentration of 1,3-D decreased from 1,996 ng/m^3 (0.4 ppb) in 2017 to 460 ng/m^3 (0.1 ppb) in 2018. The highest observed 24-h concentration of MITC increased from 92 ng/m^3 (0.0 ppb) in 2017 to 340 ng/m^3 (0.11 ppb) in 2018.

Table 6 shows the highest observed rolling 4- or 13- week average concentrations for any chemical with a positive detection during any year of monitoring at Chualar. The highest observed rolling 13-week average of 1,3-D and chloropicrin in 2018 were relatively close to those seen in 2017. The highest

observed rolling 4-week average concentration of MITC increased from 31 ng/m³ (0.0 ppb) in 2017 to 101 ng/m³ (0.034 ppb) in 2018.

Table 7 shows the annual average concentrations for any chemical with a positive detection during any year of monitoring at Chualar. The annual average concentration of 1,3-D in Chualar decreased from 252 ng/m³ (0.1 ppb) in 2017 to 120 ng/m³ (0.027 ppb) in 2018. The annual average concentration of chloropicrin showed a very slight increase from 164 ng/m³ (0.0 ppb) in 2017 to 180 ng/m³ (0.026 ppb) in 2018. The annual average concentration of MITC increased from 7 ng/m³ (0.0 ppb) in 2017 to 15 ng/m³ (0.005 ppb) in 2018.

Table 4. Percentage of analyses performed resulting in a detection at Chualar, by year.

Chemical	2017	2018
1,3-dichloropropene	4%	18%
Acephate	0%	2%
Bensulide	4%	2%
Chloropicrin	12%	15%
Chlorothalonil	25%	8%
Chlorthal-dimethyl	100%	98%
DDVP	6%	12%
Diuron	4%	0%
Endosulfan	0%	2%
Malathion	18%	10%
Malathion OA	16%	8%
MITC	25%	42%
Norflurazon	4%	0%
Oryzalin	4%	0%
Permethrin	2%	4%
Simazine	2%	0%

* These values include both trace and quantifiable detections.

Table 5. Highest 24-hour concentrations for pesticides with at least one detectable concentration by year (2017-2018) in Chualar, California.

Chemical	2017	2018
1,3-dichloropropene	0.4 ppb (1,996 ng/m³)	0.1 ppb (460 ng/m³)
Acephate	ND	Trace
Bensulide	Trace	Trace
Chloropicrin	0.1 ppb (805 ng/m³)	0.1 ppb (780 ng/m³)
Chlorothalonil	Trace	Trace
Chlorthal-dimethyl	0.0 ppb (22 ng/m³)	0.003 ppb (39 ng/m³)
DDVP	Trace	Trace
Diuron	Trace	ND

Endosulfan	ND	Trace
Malathion	Trace	0.0007 ppb (9.5 ng/m³)
Malathion OA	Trace	Trace
MITC	0.0 ppb (92 ng/m³)	0.11 ppb (340 ng/m³)
Norflurazon	Trace	ND
Oryzalin	Trace	ND
Permethrin	Trace	Trace
Simazine	Trace	ND

Table 6. Highest rolling 4-week average concentrations for pesticides with at least one detectable concentration by year (2017-2018) in Chualar, California.

Chemical	2017	2018
1,3-dichloropropene (13-wk)	0.1 ppb (398 ng/m³)	0.081 ppb (370 ng/m³)
Acephate	ND	Trace
Bensulide	Trace	Trace
Chloropicrin (13-wk)	0.0 ppb (322 ng/m³)	0.055 ppb (370 ng/m³)
Chlorothalonil	Trace	Trace
Chlorthal-dimethyl	0.0 ppb (16 ng/m³)	0.002 ppb (25 ng/m³)
DDVP	Trace	Trace
Diuron	Trace	ND
Endosulfan	ND	Trace
Malathion	Trace	0.0004 ppb (5.2 ng/m³)
Malathion OA	Trace	Trace
MITC	0.0 ppb (31 ng/m³)	0.034 ppb (101 ng/m³)
Norflurazon	Trace	ND
Oryzalin	Trace	ND
Permethrin	Trace	Trace
Simazine	Trace	ND

Table 7. Comparison of the 1-year average concentration for pesticides with at least one detectable concentration by year (2017-2018) in Chualar, California.

Chemical	2017	2018
1,3-dichloropropene	0.1 ppb (252 ng/m³)	0.027 ppb (120 ng/m³)

Acephate	ND	Trace
Bensulide	Trace	Trace
Chloropicrin	0.0 ppb (164 ng/m³)	0.026 ppb (180 ng/m³)
Chlorothalonil	Trace	Trace
Chlorthal-dimethyl	0.0 ppb (8 ng/m³)	0.0005 ppb (7.1 ng/m³)
DDVP	Trace	Trace
Diuron	Trace	ND
Endosulfan	ND	Trace
Malathion	Trace	0.00009 ppb (1.2 ng/m³)
Malathion OA	Trace	Trace
MITC	0.0 ppb (7 ng/m³)	0.005 ppb (15 ng/m³)
Norflurazon	Trace	ND
Oryzalin	Trace	ND
Permethrin	Trace	Trace
Simazine	Trace	ND

Historic Air Concentrations in Santa Maria

Summarized results for the two years of AMN monitoring are shown in Tables 8, 9, 10, and 11.

Table 8 shows that percentage of analyses during that year which resulted in either a trace or quantifiable detection. Changes between these two years include an increase in the number of detections of MITC, while detections of other analytes were generally observed to have decreased from 2017 to 2018.

Table 9 shows the highest observed 24-h concentration for any chemical with a positive detection during any year of monitoring at Santa Maria. The highest observed 24-h concentration of MITC increased from 457 ng/m³ (0.2 ppb) in 2017 to 1,300 ng/m³ (0.42 ppb) in 2018. Other 24-h concentrations at Santa Maria were relatively consistent between 2017 and 2018.

Table 10 shows the highest observed rolling 4- or 13- week average concentrations for any chemical with a positive detection at Santa Maria. The highest observed rolling 13-wk average concentration of 1,3-D decreased from 1,152 ng/m³ (0.3 ppb) in 2017 to 440 ng/m³ (0.097 ppb) in 2018. The highest observed rolling 4-wk average concentration of MITC increased from 140 ng/m³ (0.0 ppb) in 2017 to 320 ng/m³ (0.11 ppb) in 2018.

Table 11 shows the annual average concentrations for any chemical with a positive detection during any year of monitoring at Santa Maria. The annual average concentration of 1,3-D decreased from 366 ng/m³ (0.1 ppb) in 2017 o 280 ng/m³ (0.062 ppb) in 2018. The annual average concentration of MITC increased from 23 ng/m³ (0.0 ppb) in 2017 to 37 ng/m³ (0.012 ppb) in 2018.

Table 8. Percentage of analyses performed resulting in a detection at Santa Maria, by year.

Chemical	2017	2018
1,3-dichloropropene	13%	6%
Chloropicrin	21%	17%
Chlorothalonil	10%	8%
Chlorpyrifos	0%	4%
Chlorthal-dimethyl	40%	39%
DDVP	23%	16%
Diazinon OA	0%	2%
Diuron	0%	2%
Endosulfan	0%	4%
Iprodione	0%	2%
Malathion	60%	59%
Malathion OA	69%	63%
MITC	33%	50%
Simazine	0%	2%
Trifluralin	33%	22%

* These values include both trace and quantifiable detections.

Table 9. Highest 24-hour concentrations for pesticides with at least one detectable concentration by year (2017-2018) in Santa Maria, California.

Chemical	2017	2018
1,3-dichloropropene	0.5 ppb (2,450 ng/m^3)	0.48 ppb (2,200 ng/m^3)
Chloropicrin	0.5 ppb (3,095 ng/m^3)	0.46 ppb (3,100 ng/m^3)
Chlorothalonil	Trace	Trace
Chlorpyrifos	ND	Trace
Chlorthal-dimethyl	Trace	Trace
DDVP	Trace	Trace
Diazinon OA	ND	Trace
Diuron	ND	Trace
Endosulfan	ND	Trace
Malathion	0.0 ppb (15 ng/m^3)	0.0007 ppb (9.8 ng/m^3)
Malathion OA	Trace	Trace
MITC	0.2 ppb (457 ng/m^3)	0.42 ppb (1,300 ng/m^3)
Simazine	ND	Trace
Trifluralin	Trace	Trace

Table 10. Highest rolling 4-week average concentrations for pesticides with at least one detectable concentration by year (2017-2018) in Santa Maria, California.

Chemical	2017	2018
1,3-dichloropropene (13-wk)	0.3 ppb (1,152 ng/m³)	0.097 ppb (440 ng/m³)
Chloropicrin (13-wk)	0.1 ppb (849 ng/m³)	0.11 ppb (750 ng/m³)
Chlorothalonil	Trace	Trace
Chlorpyrifos	ND	Trace
Chlorthal-dimethyl	Trace	Trace
DDVP	Trace	Trace
Diazinon OA	ND	Trace
Diuron	ND	Trace
Endosulfan	ND	Trace
Malathion	0.0 ppb (12 ng/m³)	0.0005 ppb (6.4 ng/m³)
Malathion OA	Trace	Trace
MITC	0.0 ppb (140 ng/m³)	0.11 ppb (320 ng/m³)
Simazine	ND	Trace
Trifluralin	Trace	Trace

Table 11. Comparison of the 1-year average concentration for pesticides with at least one detectable concentration by year (2017-2018) in Santa Maria, California.

Chemical	2017	2018
1,3-dichloropropene	0.1 ppb (366 ng/m³)	0.062 ppb (280 ng/m³)
Chloropicrin	0.0 ppb (317 ng/m³)	0.041 ppb (280 ng/m³)
Chlorothalonil	Trace	Trace
Chlorpyrifos	ND	Trace
Chlorthal-dimethyl	Trace	Trace
DDVP	Trace	Trace
Diazinon OA	ND	Trace
Diuron	ND	Trace
Endosulfan	ND	Trace
Malathion	0.0 ppb (5 ng/m³)	0.0003 ppb (3.5 ng/m³)
Malathion OA	Trace	Trace
MITC	0.0 ppb (23 ng/m³)	0.012 ppb (37 ng/m³)
Simazine	ND	Trace
Trifluralin	Trace	Trace

Historic Air Concentrations in Shafter

Shafter is one of the original AMN monitoring locations with available pesticide concentration air monitoring data going back to February of 2011. Summarized results for monitoring data from Shafter are presented in Tables 12, 13, 14, and 15.

Table 12 shows the percentage of analyses during that year which resulted in either a trace or quantifiable detection. Patterns in the percentage of positive detections generally held across all chemicals monitored for the duration of monitoring at Shafter. Chlorpyrifos and its oxon produced a slightly lower number of positive detections than the average of previous years while MITC was detected more often in 2018 than in any previous year. Chloropicrin has not been detected at Shafter during any year of AMN monitoring.

Table 13 shows the highest observed 24-h concentration for any chemical with a positive detection during any year of monitoring at Shafter. The highest observed 24-h concentration (230,000 ng/m³, 50 ppb) of 1,3-D in 2018 was larger than that observed in any previous year of monitoring at that location. The highest observed 24-h concentration of MITC in 2018 (3,700 ng/m³, 1.2 ppb) was also the highest observed in any year of monitoring at that location.

Table 14 shows the highest observed rolling 4- or 13-week average concentrations for any chemical with a positive detection during any year of monitoring at Shafter. The highest observed rolling 13-wk average concentration (25,000 ng/m³, 5.6 ppb) of 1,3-D in 2018 was larger than that observed in any previous year of monitoring at that location. The highest observed rolling 4-wk average concentration of MITC in 2018 (1,500 ng/m³, 0.5 ppb) was also the highest observed in any year of monitoring at that location.

Table 15 shows the annual average concentrations for any chemical with a positive detection during any year of monitoring at Shafter. The annual average concentration (6,900 ng/m³, 1.5 ppb) of 1,3-D in 2018 was larger than that observed in any previous year of monitoring at Shafter. The annual average concentration (170 ng/m³, 0.058 ppb) of MITC was also the highest observed in any year of monitoring at that location.

Table 12. Percentage of analyses performed resulting in a detection at Shafter, by year.

Chemical	2011	2012	2013	2014	2015	2016	2017	2018
1,3-dichloropropene	ND	6%	26%	37%	42%	50%	48%	38%
Acephate	ND	2%	ND	ND	ND	ND	2%	ND
Acrolein †	60%	--	--	--	--	--	--	--
Bensulide	2%	ND	ND	ND	ND	ND	ND	4%
Carbon Disulfide †	ND	ND	15%	50%	90%	92%	--	--
Chlorothalonil	13%	23%	60%	13%	75%	62%	69%	64%
Chlorpyrifos	53%	48%	75%	56%	61%	29%	48%	30%
Chlorpyrifos OA	45%	48%	55%	62%	53%	50%	58%	25%
Chlorthal-dimethyl	15%	ND	8%	ND	2%	15%	10%	4%
DDVP	2%	ND	6%	2%	8%	2%	2%	8%
Diazinon	11%	4%	6%	ND	ND	ND	4%	ND
Diazinon OA	4%	8%	8%	ND	ND	2%	2%	2%
Diuron	6%	12%	2%	10%	10%	ND	4%	4%

EPTC	17%	4%	9%	12%	10%	6%	10%	6%
Iprodione	2%	4%	4%	6%	8%	8%	6%	2%
Malathion	ND	2%	4%	2%	ND	ND	6%	ND
Malathion OA	6%	10%	9%	6%	6%	ND	4%	2%
Methyl bromide	9%	4%	4%	15%	13%	8%	ND	13%
Metolachlor	ND	ND	ND	ND	ND	ND	10%	ND
MITC	40%	56%	57%	42%	35%	42%	62%	83%
Norflurazon	2%	ND	ND	ND	2%	ND	2%	ND
Oryzalin	2%	2%	2%	2%	6%	ND	8%	2%
Oxyfluorfen	ND	ND	ND	ND	ND	ND	6%	9%
Permethrin	2%	ND	2%	ND	ND	ND	ND	ND
Propargite	2%	ND	11%	ND	ND	ND	2%	ND
Simazine	4%	12%	ND	4%	4%	6%	6%	6%
Trifluralin	9%	6%	4%	4%	8%	ND	2%	2%

* These values include both trace and quantifiable detections.

† Monitoring for acrolein was discontinued on January 1, 2012. Monitoring for carbon disulfide was discontinued on January 1, 2017.

Table 13. Highest 24-hour concentrations for pesticides with at least one detectable concentration by year (2011-2018) in Shafter, California.

Chemical	2011	2012	2013	2014	2015	2016	2017	2018
1,3-dichloropropene	ND	0.8 ppb (3,643 ng/m³)	8.8 ppb (39,969 ng/m³)	2 ppb (9,251 ng/m³)	2.1 ppb (9,713 ng/m³)	10.0 ppb (45,323 ng/m³)	0.7 ppb (3,394 ng/m³)	50 ppb (230,000 ng/m³)
Acephate	ND	Trace	ND	ND	ND	ND	Trace	ND
Acrolein†	1.2 ppb (2,796 ng/m³)	-	-	-	-	-	-	-
Bensulide	Trace	ND	ND	ND	ND	ND	ND	Trace
Carbon Disulfide†	ND	ND	0.3 ppb (897 ng/m³)	0.2 ppb (548 ng/m³)	0.3 ppb (812 ng/m³)	0.3 ppb (946 ng/m³)	-	-
Chlorothalonil	Trace	Trace	0.0 ppb (80 ng/m³)	0.0 ppb (118 ng/m³)	0.0 ppb (39 ng/m³)	0.0 ppb (58 ng/m³)	0.0 ppb (55 ng/m³)	0.005 ppb (50 ng/m³)
Chlorpyrifos	0.0 ppb (27 ng/m³)	0.0 ppb (131 ng/m³)	0.0 ppb (423 ng/m³)	0.0 ppb (338 ng/m³)	0.0 ppb (78 ng/m³)	0.0 ppb (52 ng/m³)	0.0 ppb (138 ng/m³)	0.004 ppb (50 ng/m³)
Chlorpyrifos OA	0.0 ppb (9 ng/m³)	0.0 ppb (17 ng/m³)	0.0 ppb (143 ng/m³)	0.0 ppb (110 ng/m³)	0.0 ppb (13 ng/m³)	Trace	0.0 ppb (59 ng/m³)	Trace
Chlorthal-dimethyl	Trace	ND	Trace	ND	Trace	Trace	Trace	Trace

DDVP	Trace	ND	Trace	Trace	Trace	0.0 ppb (49 ng/m³)	0.0 ppb (65 ng/m³)	Trace
Diazinon	0.0 ppb (60 ng/m³)	Trace	0.0 ppb (29 ng/m³)	ND	ND	ND	Trace	ND
Diazinon OA	0.0 ppb (36 ng/m³)	0.0 ppb (10 ng/m³)	Trace	ND	ND	Trace	Trace	Trace
Diuron	Trace	Trace	Trace	Trace	Trace	ND	Trace	Trace
EPTC	0.0 ppb (187 ng/m³)	0.0 ppb (18 ng/m³)	0.0 ppb (250 ng/m³)	0.0 ppb (216 ng/m³)	0.0 ppb (29 ng/m³)	0.0 ppb (27 ng/m³)	0.0 ppb (12 ng/m³)	Trace
Iprodione	Trace	Trace	Trace	Trace	Trace	0.0 ppb (17 ng/m³)	Trace	Trace
Malathion	ND	Trace	Trace	Trace	ND	ND	0.0 ppb (15 ng/m³)	ND
Malathion OA	Trace	0.0 ppb (11 ng/m³)	Trace	Trace	Trace	ND	Trace	Trace
Methyl bromide	0.8 ppb (2,934 ng/m³)	0.6 ppb (2,135 ng/m³)	0.1 ppb (209 ng/m³)	0.2 ppb (963 ng/m³)	0.1 ppb (283 ng/m³)	0.0 ppb (113 ng/m³)	ND	0.097 ppb (380 ng/m³)
Metolachlor	ND	ND	ND	ND	ND	ND	Trace	ND
MITC	0.3 ppb (930 ng/m³)	0.1 ppb (347 ng/m³)	0.3 ppb (762 ng/m³)	0.0 ppb (113 ng/m³)	0.1 ppb (232 ng/m³)	0.0 ppb (109 ng/m³)	0.1 ppb (382 ng/m³)	1.2 ppb (3,700 ng/m³)
Norflurazon	Trace	ND	ND	ND	Trace	ND	Trace	ND
Oryzalin	Trace	Trace	Trace	Trace	0.0 ppb (62 ng/m³)	ND	Trace	Trace
Oxyfluorfen	ND	ND	ND	ND	ND	ND	Trace	Trace
Permethrin	Trace	ND	Trace	ND	ND	ND	ND	ND
Propargite	Trace	ND	Trace	ND	ND	ND	Trace	ND
Simazine	Trace	Trace	ND	Trace	Trace	Trace	Trace	Trace
Trifluralin	Trace	Trace	Trace	Trace	Trace	ND	Trace	Trace

† Monitoring for acrolein was discontinued on January 1, 2012. Monitoring for carbon disulfide was discontinued on January 1, 2017.

Table 14. Highest rolling 4-week average concentrations for pesticides with at least one detectable concentration by year (2011-2018) in Shafter, California.

Chemical	2011	2012	2013	2014	2015	2016	2017	2018

1,3-dichloropropene (13-wk)	ND	0.1 ppb (594 ng/m³)	2 ppb (9,190 ng/m³)	2.2 ppb (10,119 ng/m³)	0.5 ppb (2,176 ng/m³)	1 ppb (4,678 ng/m³)	1.1 ppb (4,812 ng/m³)	5.6 ppb (25,000 ng/m³)
Acephate	ND	Trace	ND	ND	ND	ND	Trace	Trace
Bensulide	Trace	ND	ND	ND	ND	ND	ND	ND
Chlorothalonil	Trace	Trace	0.0 ppb (38 ng/m³)	Trace	0.0 ppb (25 ng/m³)	0.0 ppb (24 ng/m³)	0.0 ppb (38 ng/m³)	0.003 ppb (35 ng/m³)
Chlorpyrifos	0.0 ppb (15 ng/m³)	0.0 ppb (46 ng/m³)	0.0 ppb (113 ng/m³)	0.0 ppb (92 ng/m³)	0.0 ppb (60 ng/m³)	0.0 ppb (39 ng/m³)	0.0 ppb (51 ng/m³)	0.002 ppb (22 ng/m³)
Chlorpyrifos OA	0.0 ppb (7 ng/m³)	0.0 ppb (13 ng/m³)	0.0 ppb (44 ng/m³)	0.0 ppb (32 ng/m³)	0.0 ppb (9 ng/m³)	Trace	0.0 ppb (19 ng/m³)	Trace
Chlorthal-dimethyl	Trace	ND	Trace	ND	Trace	Trace	Trace	Trace
DDVP	Trace	ND	Trace	Trace	Trace	0.0 ppb (13 ng/m³)	0.0 ppb (17 ng/m³)	Trace
Diazinon	0.0 ppb (18 ng/m³)	Trace	0.0 ppb (10 ng/m³)	ND	ND	ND	Trace	ND
Diazinon OA	0.0 ppb (11 ng/m³)	Trace	ND	ND	ND	Trace	Trace	Trace
Diuron	Trace	Trace	Trace	Trace	Trace	ND	Trace	Trace
EPTC	0.0 ppb (76 ng/m³)	Trace	0.0 ppb (139 ng/m³)	0.0 ppb (86 ng/m³)	0.0 ppb (19 ng/m³)	0.0 ppb (10 ng/m³)	0.0 ppb (9 ng/m³)	Trace
Iprodione	Trace	Trace	Trace	Trace	Trace	0.0 ppb (10 ng/m³)	Trace	Trace
Malathion	ND	Trace	Trace	Trace	ND	ND	0.0 ppb (5 ng/m³)	ND
Malathion OA	Trace	Trace	Trace	Trace	Trace	ND	Trace	Trace
Methyl bromide	0.4 ppb (1,403 ng/m³)	0.2 ppb (683 ng/m³)	0.1 ppb (198 ng/m³)	0.1 ppb (389 ng/m³)	0.0 ppb (186 ng/m³)	0.0 ppb (81 ng/m³)	ND	0.004 ppb (160 ng/m³)
Metolachlor	ND	ND	ND	ND	ND	ND	Trace	ND
MITC	0.2 ppb (564 ng/m³)	0.1 ppb (177 ng/m³)	0.1 ppb (319 ng/m³)	0.0 ppb (74 ng/m³)	0.1 ppb (156 ng/m³)	0.0 ppb (51 ng/m³)	0.1 ppb (236 ng/m³)	0.5 ppb (1,500 ng/m³)
Norflurazon	Trace	ND	ND	ND	Trace	ND	Trace	ND

Oryzalin	Trace	Trace	Trace	Trace	0.0 ppb (16 ng/m³)	ND	Trace	Trace
Oxyfluorfen	ND	ND	ND	ND	ND	ND	Trace	Trace
Permethrin	Trace	ND	Trace	ND	ND	ND	ND	ND
Propargite	Trace	ND	Trace	ND	ND	ND	Trace	ND
Simazine	Trace	Trace	ND	Trace	Trace	Trace	Trace	Trace
Trifluralin	ND	ND	ND	ND	ND	ND	Trace	Trace

Table 15. Comparison of the 1-year average concentration for pesticides with at least one detectable concentration by year (2011-2018) in Shafter, California.

Chemical	2011	2012	2013	2014	2015	2016	2017	2018
1,3-dichloropropene	ND	0.1 ppb (453 ng/m³)	0.6 ppb (2,589 ng/m³)	0.2 ppb (909 ng/m³)	0.2 ppb (800 ng/m³)	0.3 ppb (1,559 ng/m³)	0.1 ppb (486 ng/m³)	1.5 ppb (6,900 ng/m³)
Acephate	ND	Trace	ND	ND	ND	ND	Trace	Trace
Bensulide	Trace	ND	ND	ND	ND	ND	ND	ND
Chlorothalonil	Trace	Trace	0.0 ppb (16 ng/m³)	0.0 ppb (22 ng/m³)	Trace	0.0 ppb (15 ng/m³)	0.0 ppb (16 ng/m³)	0.0009 ppb (10 ng/m³)
Chlorpyrifos	Trace	Trace	0.0 ppb (20 ng/m³)	0.0 ppb (16 ng/m³)	Trace	0.0 ppb (8 ng/m³)	0.0 ppb (11 ng/m³)	0.0004 ppb (5.3 ng/m³)
Chlorpyrifos OA	Trace	Trace	0.0 ppb (8 ng/m³)	0.0 ppb (7 ng/m³)	Trace	Trace	0.0 ppb (6 ng/m³)	Trace
Chlorthal-dimethyl	Trace	ND	Trace	ND	Trace	Trace	Trace	Trace
DDVP	Trace	ND	Trace	Trace	Trace	0.0 ppb (3 ng/m³)	0.0 ppb (3 ng/m³)	Trace
Diazinon	Trace	Trace	Trace	ND	ND	ND	Trace	ND
Diazinon OA	Trace	Trace	ND	ND	ND	Trace	Trace	Trace
Diuron	Trace	Trace	Trace	Trace	Trace	ND	Trace	Trace
EPTC	Trace	Trace	Trace	Trace	Trace	0.0 ppb (2 ng/m³)	0.0 ppb (2 ng/m³)	Trace
Iprodione	Trace	Trace	Trace	Trace	Trace	0.0 ppb (2 ng/m³)	Trace	Trace

Malathion	ND	Trace	Trace	Trace	ND	ND	0.0 ppb (2 ng/m³)	ND
Malathion OA	Trace	Trace	Trace	Trace	Trace	ND	Trace	Trace
Methyl bromide	0.1 ppb (425 ng/m³)	0.1 ppb (247 ng/m³)	0.0 ppb (163 ng/m³)	0.0 ppb (70 ng/m³)	0.0 ppb (40 ng/m³)	0.0 ppb (26 ng/m³)	ND	0.018 ppb (71 ng/m³)
Metolachlor	ND	ND	ND	ND	ND	ND	Trace	ND
MITC	0.0 ppb (73 ng/m³)	0.0 ppb (51 ng/m³)	0.0 ppb (66 ng/m³)	0.0 ppb (21 ng/m³)	0.0 ppb (27 ng/m³)	0.0 ppb (17 ng/m³)	0.0 ppb (51 ng/m³)	0.058 ppb (170 ng/m³)
Norflurazon	Trace	ND	ND	ND	Trace	ND	Trace	ND
Oryzalin	Trace	Trace	Trace	Trace	Trace	ND	Trace	Trace
Oxyfluorfen	ND	ND	ND	ND	ND	ND	Trace	Trace
Permethrin	Trace	ND	Trace	ND	ND	ND	ND	ND
Propargite	Trace	ND	Trace	ND	ND	ND	Trace	ND
Simazine	Trace	Trace	ND	Trace	Trace	Trace	Trace	Trace
Trifluralin	ND	ND	ND	ND	ND	ND	Trace	Trace

Historic Air Concentrations in Watsonville

Summarized results for AMN monitoring at Watsonville are presented in Tables 16, 17, 18, and 19.

Table 16 shows the percentage of analyses during that year which resulted in either a trace or quantifiable detection. Changes between these two years include a decrease in the number of detections of 1,3-D and an increase in the number of detections of MITC.

Table 17 shows the highest observed 24-h concentration for any chemical with a positive detection during any year of monitoring at Watsonville. The highest observed 24-h concentration of 1,3-D decreased from 1,860 ng/m³ (0.4 ppb) in 2017 to 1,200 ng/m³ (0.27 ppb) in 2018. The highest observed 24-h concentration of chloropicrin decreased from 3,221 ng/m³ (0.5 ppb) in 2017 to 780 ng/m³ (0.12 ppb) in 2018. The highest observed 24-h concentration of MITC increased from 56 ng/m³ (0.0 ppb) in 2017 to 120 ng/m³ (0.042 ppb) in 2018.

Table 18 shows the highest observed rolling 4- or 13-wk average concentration for any chemical with a positive detection during any year of monitoring at Watsonville. The highest observed rolling 13-wk average concentration of 1,3-D decreased from 904 ng/m³ (0.2 ppb) in 2017 to 430 ng/m³ (0.094 ppb) in 2018. The highest observed rolling 13-wk average concentration of chloropicrin decreased from 974 ng/m³ (0.1 ppb) in 2017 to 480 ng/m³ (0.071 ppb) in 2018. The highest observed rolling 4-wk average concentration of MITC increased from 19 ng/m³ (0.0 ppb) in 2017 to 44 ng/m³ (0.015 ppb) in 2018.

Table 19 shows the annual average concentrations for any chemical with a positive detection during any year of monitoring at Watsonville. The annual average concentration of 1,3-D decreased from 397 ng/m³ (0.1 ppb) in 2017 to 210 ng/m³ (0.046 ppb) in 2018. The annual average concentration of

chloropicrin decreased from 347 ng/m³ (0.1 ppb) in 2017 to 200 ng/m³ (0.03 ppb) in 2018. The annual average concentration of MITC increased from 6 ng/m³ (0.0 ppb) in 2017 to 15 ng/m³ (0.005 ppb) in 2018.

Table 16. Percentage of analyses performed resulting in a detection at Watsonville, by year.

Chemical	2017	2018
1,3-dichloropropene	20%	6%
Chloropicrin	25%	25%
Chlorothalonil	4%	0%
Chlorpyrifos	2%	0%
Chlorthal-dimethyl	8%	2%
DDVP	2%	10%
Diuron	2%	0%
Endosulfan	2%	0%
Malathion	14%	6%
Malathion OA	10%	6%
Metolachlor	2%	0%
MITC	18%	48%
Norflurazon	2%	0%
Oryzalin	2%	0%
pp-Dicofol	2%	0%
Simazine	2%	0%
Trifluralin	14%	2%

* These values include both trace and quantifiable detections.

Table 17. Highest 24-hour concentrations for pesticides with at least one detectable concentration by year (2017-2018) in Watsonville, California.

Chemical	2017	2018
1,3-dichloropropene	0.4 ppb (1,860 ng/m³)	0.27 ppb (1,200 ng/m³)
Chloropicrin	0.5 ppb (3,221 ng/m³)	0.12 ppb (780 ng/m³)
Chlorothalonil	Trace	ND
Chlorpyrifos	Trace	ND
Chlorthal-dimethyl	Trace	Trace
DDVP	Trace	Trace
Diuron	Trace	ND
Endosulfan	Trace	ND
Malathion	Trace	Trace
Malathion OA	Trace	Trace
Metolachlor	Trace	ND
MITC	0.0 ppb (56 ng/m³)	0.042 ppb (120 ng/m³)

Norflurazon	Trace	ND
Oryzalin	Trace	ND
pp-Dicofol	Trace	ND
Simazine	Trace	ND
Trifluralin	Trace	Trace

Table 18. Highest rolling 4-week average concentrations for pesticides with at least one detectable concentration by year (2017-2018) in Watsonville, California.

Chemical	2017	2018
1,3-dichloropropene (13-wk)	0.2 ppb (904 ng/m³)	0.094 ppb (430 ng/m³)
Chloropicrin (13-wk)	0.1 ppb (974 ng/m³)	0.071 ppb (480 ng/m³)
Chlorothalonil	Trace	ND
Chlorpyrifos	Trace	ND
Chlorthal-dimethyl	Trace	Trace
DDVP	Trace	Trace
Diuron	Trace	ND
Endosulfan	Trace	ND
Malathion	Trace	Trace
Malathion OA	Trace	Trace
Metolachlor	Trace	ND
MITC	0.0 ppb (19 ng/m³)	0.015 ppb (44 ng/m³)
Norflurazon	Trace	ND
Oryzalin	Trace	ND
pp-Dicofol	Trace	ND
Simazine	Trace	ND
Trifluralin	Trace	Trace

Table 19. Comparison of the 1-year average concentration for pesticides with at least one detectable concentration by year (2017-2018) in Watsonville, California.

Chemical	2017	2018
1,3-dichloropropene	0.1 ppb (397 ng/m³)	0.046 ppb (210 ng/m³)
Chloropicrin	0.1 ppb (347 ng/m³)	0.03 ppb (200 ng/m³)
Chlorothalonil	Trace	ND
Chlorpyrifos	Trace	ND
Chlorthal-dimethyl	Trace	Trace
DDVP	Trace	Trace
Diuron	Trace	ND
Endosulfan	Trace	ND
Malathion	Trace	Trace

Malathion OA	Trace	Trace
Metolachlor	Trace	ND
MITC	0.0 ppb (6 ng/m³)	0.005 ppb (15 ng/m³)
Norflurazon	Trace	ND
Oryzalin	Trace	ND
pp-Dicofol	Trace	ND
Simazine	Trace	ND
Trifluralin	Trace	Trace

Appendix M: Comparison to Other Studies

Additional Monitoring of Toxic Air Contaminants

As part of DPR's TAC monitoring program, both DPR and CARB monitor ambient air for a variety of pesticides, specifically in counties with the highest reported use for that particular pesticide and during the season of its highest reported use. Previous TAC monitoring performed by CARB include results for 15 of the pesticides monitored in the AMN: 1,3-D, chlorpyrifos, chlorpyrifos OA, chlorothalonil, diazinon, endosulfan, EPTC, malathion, malathion OA, MITC, MeBr, permethrin, propargite, simazine, and DEF which are listed in Table 1. In general, the concentrations detected by the AMN in 2018 were lower than those of these previous studies. The exception to this is the concentration of 228,936 ng/m^3 detected in Shafter in 2018.

Table 1. Highest 24-h concentrations of pesticides monitored by the AMN in 2018 compared to previous DRP and CARB monitoring studies in California.

Chemical	County, Year (Other Study)	Concentration (ng/m^3) (Other Study)	Community (AMN, 2018)	Concentration (ng/m^3) (AMN, 2018)
1,3-dichloropropene	Kern, 2000	135,000	Shafter	228,936
Chlorothalonil	Fresno, 2002	14	Shafter	50
Chlorpyrifos	Tulare, 1996	815	Shafter	50
Chlorpyrifos OA	Tulare, 1996	230	Lindsay	14
Diazinon	Fresno, 1997	290	*all sites*	ND
Endosulfan	Fresno, 1996	140	*multiple*	Trace
EPTC	Imperial, 1996	240	Shafter	Trace
Malathion	Imperial, 1998	90	Santa Maria	10
Malathion OA	Imperial, 1998	28	*multiple*	Trace
Methyl bromide	Santa Cruz, 2001	142,000	Shafter	376
MITC	Kern, 1993	18,000	Shafter	3,726
Permethrin	Monterey, 1997	Trace	Chualar	Trace
Propargite	Fresno, 1999	1,300	*multiple*	Trace
Simazine	Fresno, 1998	18	*multiple*	Trace
DEF	Fresno, 1987	340	*all sites*	ND

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APPENDIX N

Responses to Comments on the AIR MONITORING NETWORK RESULTS FOR 2018 VOLUME 8

Number	Comment	Response	Action
1.	**From California Rural Legal Assistance Foundation (CRLAF), Natural Resources Defense Council (NRDC), Center for Environmental Health (CEH), Californians for Pesticide Reform (CPR), Pesticide Action Network (PAN):** **Executive Summary –** The description of Shafter air monitoring results in the Executive Summary should include two clarifying statements: 1) If the 2018 annual average 1,3-D air concentration of 1.53 ppb were to continue for 70 years it would exceed DPR's current regulatory target of 0.56 ppb for control of lifetime cancer risk; and 2) The 8 year average 1,3-D air concentration of 0.41 ppb already exceeds DPR's previous regulatory target of 0.14 ppb which OEHHA continues to support.	While DPR has used annual averages to compare to regulatory targets to assess lifetime exposures, in cases where longer term monitoring data is not available, shorter timeframes are less suitable for comparison to a 70-year target. Therefore if longer term monitoring data is available, use of a multi-year average value to approximate a lifetime cancer risk estimate is more accurate and the preferred DPR approach. All of the screening levels and regulatory targets for the various active ingredients and time periods were established by DPR in collaboration with OEHHA. The methodology used to compare measured air concentrations to DPR-established screening levels and regulatory targets in this report is consistent with previous DPR study publications.	No changes to report are needed.

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Number	Comment	Response	Action
2.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Combined results for all pesticides and communities –** We remain concerned that beginning the report by quoting statistics that aggregate all the data conveys a false sense of security that does not reflect the air levels documented by the actual monitoring data. The statements in the report that 93.8% of analyses did not return a detectable concentration that 6.2% of analyses had at least one detectable pesticide concentration and that 1.3% of analyses had quantifiable detections are highly misleading because they ignore the realities of pesticide use patterns. In order to reach 100% detections (a total of 12,058 positive analyses), every pesticide tested for would have to be found on each of the days monitored at each of the air monitoring sites. In reality, use of most pesticides is concentrated in certain months. As pesticide use varies between crops and regions, not all of the pesticides monitored for are used near all of the monitoring sites. Therefore, using the total number of analyses for all pesticides at all locations as the denominator does not provide a meaningful context. Detection frequency should either be calculated based on what pesticides were used in the vicinity of a specific site, shortly prior to the sampling date, or should not be highlighted. When these concerns were raised two years ago at the August 18, 2017 PREC meeting, then Branch Chief Pam Wofford stated that DPR was conducting an uncertainty analysis of frequency of detections. Is this analysis still in process and if so when will it be completed?	DPR makes every attempt to convey all data and results obtained as part of the AMN in a clear and unbiased manner. The manner in which pesticide air concentrations are stated in this report, are consistent with previous DPR study publications. Pesticide concentrations measured in all eight of the AMN's sampling locations are listed in various tables throughout the report, and described in the report's text, Discussion, and Executive Summary. DPR believes that the sampling results are clearly and effectively presented throughout the report and thus no changes are required at this time. DPR posts all completed air monitoring reports including raw monitoring data. This information can be accessed at the following site: http://www.cdpr.ca.gov/docs/emon/airinit/air_network_data_analysis.htm On June 2018, DPR released the report titled "Air Monitoring Network Report: A Comprehensive Evaluation of Results (2011-2016)". This report includes a section titled: "Analysis of Sampling Frequency". In this section, DPR used several non-parametric statistical methods to evaluate the AMN data. Results from the sampling frequency analysis showed that the sampling was not equally distributed among all seven days of the week during the 2011–2016 sampling period, which led DPR to increase the randomization of the sampling start days to include Fridays to Sundays more consistently for sampling in 2018 and on. Additionally, based on the 2011-2016 AMN data, a lack of significant difference between days of a week and measured concentrations was observed. A linear regression model was used to establish that the percentage of quantifiable detections increases on average by 3.8 for every 100 additional collected samples. As a result of the analysis, although a larger sample size could result in more detections, the effect was determined to be relatively weak and DPR determined that based on limited resources, no major change to current sampling procedures were needed at the time.	No changes to report are needed.

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Number	Comment	Response	Action
3.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Combined results for all pesticides and communities –** We note that Table 4 shows that there was an average of at least one pesticide detection in 86% of weekly sample sets collected at each monitoring site. This statistic should also be included in any discussion of aggregate findings in the report narrative.	DPR makes every attempt to convey all data and results obtained as part of the AMN in a clear and unbiased manner. The manner in which pesticide air concentrations are stated in this report, are consistent with previous DPR study publications. Additionally, DPR posts all AMN obtained results on the Pesticide Air Monitoring Results Database where all monitored results can be accessed. This information can be accessed at the following site: https://www.cdpr.ca.gov/docs/emon/airinit/pesticide_air_monitoring_database.htm.	No changes to report are needed.
4.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Combined results for all pesticides and communities –** The report states that there were 4 lost samples in 2018 including 3 summa canisters. The date and location of lost or otherwise invalidated samples should be provided in the report.	Comment acknowledged by DPR. 2018 AMN report was amended to include a detailed description of invalided air samples.	Changes to report were made
5.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Combined results for all pesticides and communities –** The tables in the Air Monitoring Study Results and 1,3-D Ambient Air Monitoring Results Presentations at the July 19th Pesticide Registration and Evaluation Committee (slides 13-15 and slides 26-27) that compile highest air concentrations and compare highest 1 day, 4 week or 13 week and annual average concentrations between sites for all pesticides with quantifiable detections are very helpful and informative. We strongly recommend including them in the report with 1,3-D results combined with other pesticide results.	Comment acknowledged by DPR. DPR will continue to evaluate changes to future air monitoring reports in an effort to improve transparency and help the reader better understand the air monitoring results.	No changes to report are needed.

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Number	Comment	Response	Action
6.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Chloropicrin Acute Screening Level –** The acute regulatory target for chloropicrin of 73 ppb used in this report as a 24 hour average exposure target level was set in a Risk Management Directive (RMD) as an 8 hour average so at the very least it should be adjusted to 24.3 ppb as a 24 hour level. Furthermore, this 73 ppb target level was set over the objection of OEHHA. The chloropicrin TAC report and risk assessment, which are also supported by OEHHA, include a 24 hour reference level of 0.92 ppb for protection of children. The highest 24 hour level measured in Oxnard (0.8 ppb) reached 87% of this reference level and the highest level measured in Santa Maria (0.46 ppb) reached 50% of this level.	DPR devised regulatory targets based on complete assessments of possible health risks. As mentioned in the report, exceeding a regulatory target does not necessarily mean an adverse health effect occurs, but it does trigger a detailed evaluation and it may indicate that the restrictions on the pesticide use may need to be modified. DPR, as part of the AMN procedures, collects 24-hr air samples, which are compared with established acute screening levels or regulatory targets for individual pesticides. If any 24-hr air concentration exceeds its acute target, DPR conducts a detailed evaluation to determine if any unacceptable exposure may have occurred and if any additional restrictions on the use of the pesticide are needed. Comparing a measured 24-hr air concentration to the established acute regulatory target (8-hr, 24-hrs, or 72-hrs) as a trigger for further evaluation in the case of any exceedances is consistent with previous DPR protocols and studies. No changes to the report are deemed necessary.	No changes to report are needed.
7.	**From CRLAF, NRDC, CEH, CPR, PAN:** **MITC Acute Screening Level –** The acute regulatory target for MITC of 220 ppb used in this report as a 24 hour average exposure target level was set in a Risk Management Directive as an 8 hour exposure level so at the very least it should be adjusted to 73 ppb as a 24 hour exposure target level. Furthermore, this level was set over OEHHA's objections because 220 ppb was the "no effects" level in a toxicology study, leaving no margin of error. The DPR TAC report and risk assessment established an 8 hour reference level of 22 ppb for protection against irritation to the eyes and respiratory system which should be adjusted to 7.3 ppb as a 24 hour target exposure level. The highest 24 hour air level measured in Shafter (1.2 ppb) reached 16.4% of 7.3ppb, the reference level of 22 ppb, adjusted for 24 hour exposure. As you know, in the seasonal monitoring study conducted in Arvin in the summer of 2017 a peak 24 hour level of 4 ppb was measured with a month-long average air level of 1.03 ppb, exceeding the sub-chronic screening level of 1 ppb, set to prevent damage to the nasal cavity.	See response for Comment #6 above.	No changes to report are needed.

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Number	Comment	Response	Action
8.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Use of 13-week Subchronic Screening Levels –** In 2017 DPR discontinued the practice of using a 4-week rolling average concentration to compare to chloropicrin and 1,3 D sub-chronic screening levels and began comparing to 90 day or 13 week rolling averages. This change was made after peak 4 week rolling averages were found to exceed the 4 week chloropicrin screening level at the Santa Maria air monitoring site in 2014 and 2015 and the peak 4-week 1,3-D air concentration for 2016 in Shafter reached 97.6% the 1,3-D sub-chronic screening level. DPR toxicologists claim these changes were justified because the toxicology studies used to set the sub-chronic screening levels were 90 days long for chloropicrin and 13 weeks long for 1,3-D. However, the revised averaging times have still not been reviewed by OEHHA and should be. We think it is more scientifically valid and health protective to continue to compare air levels of these fumigants to the peak 4-week rolling average concentration rather than a season long average concentration. While rhinitis was found in rats at the end of a 90-day chloropicrin inhalation study it may have developed earlier and humans may be more sensitive than rats. In addition, in reality people are exposed to varying levels of chloropicrin and 1,3-D over time and higher level short term exposures may cause more respiratory and nasal problems. If calculated as a 4 week rolling average, the highest sub-chronic chloropicrin air concentration in 2018 was 0.225 ppb at both the Oxnard and Santa Maria sites. This reaches 64% of the sub-chronic screening level of 0.35 ppb.	DPR disagrees with this comment. While, as a standard practice, we default to comparing calculated 4-week rolling average air concentrations against a 28-day time period as a Tier-I comparison for subchronic exposures for most pesticides included in the AMN. This practice is inappropriate for pesticides that have a specified subchronic time period established from available toxicological data. Therefore, in the absence of additional toxicological data, DPR will continue to use a 13-week time frame to estimate subchronic exposures to chloropicrin as stated in this report and consistent with previous DPR study publications.	No changes to report are needed.
9.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Contribution of Concentrations to Averages –** This report correctly reports that in 2018 the 1,3 D sub-chronic screening level averaged over 13 weeks was exceeded at the Shafter site. However, the statement that the exceedance of the sub-chronic 1,3 D screening level at the Shafter site was primarily driven by the 50.5 ppb level measured on January 22nd is misleading because levels in excess of 1 ppb were measured for several weeks after the January spike and a level of 4 ppb was measured in late October.	DPR makes every attempt to convey all data and results obtained as part of the AMN in a clear and unbiased manner. The detection of 50.5 ppb from the Shafter site was by far the largest observed value to date for that sampling site location. As such, it had the largest direct effect on the all average time frames for 2018 including sub-chronic and chronic average. While other smaller concentration peaks occurred throughout the year and they do contribute to the overall average concentration, they did not have the same statistical impact as the 50.5 ppb detection.	No changes to report are needed.

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Number	Comment	Response	Action
10.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Use of the Phrase "Potential Carcinogens" –** The phrase "potential carcinogens" is not appropriate. The pesticides 1,3 D, chlorothalonil, DDVP, diuron, iprodione and propargite are classified as known carcinogens under Proposition 65 and as probable carcinogens by USEPA. In addition, studies are in process evaluating potential carcinogenicity of MITC and chloropicrin.	While DPR believes the use of the work "potential" is appropriate when addressing the list of pesticides as a whole, to avoid any mischaracterization, the sentence on Page 13 of the Report has been amended to read as "probable carcinogens."	Changes to report were made.
11.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Cancer Risk Level –** DPR has selected a cancer risk level of 1 in 100,000 as the regulatory target for 1,3 D but this level is not generally considered negligible. A cancer risk of 1 in 1 million is used as the level of negligible risk by DPR in risk assessments and considered by OEHHA and most public health entities as the limit for adequate health protection.	DPR disagrees with this comment. DPR's language for the selected cancer risk level is consistent with language previously published by the department. The statement is included in the report to provide the necessary context to the risk estimate calculations. Additionally, the provided range is in line with the range considered by other agencies, including US EPA and World Health Organization, to be "negligible" or "low-risk" (i.e. 10^{-5} to 10^{-6}).	No changes to report are needed.
12.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Cancer Risk Level (continued) –** The report should also note that DPR's 1,3 D risk assessment includes both the portal of entry and systemic cancer potency risk factors and that OEHHA maintains that the systemic cancer potency risk factor should continue to be used for adequate health protection. We note, as shown in slide 32 of the Air Monitoring Network results July 19, 2019 PREC meeting presentation, that 1,3 D cancer risk levels exceed 10^{-6} at the Shafter, Santa Maria and Watsonville sites using the portal of entry cancer potency factor. Utilizing the systemic cancer potency risk factor, risk exceeds 10^{-5} at the Shafter and Santa Maria sites. Further, at the Watsonville site, the average air concentration reached 0.1 ppb, the threshold level OEHHA supports to protect children from cancer.	DPR disagrees with this comment. The cancer risk estimate and interpretations included in this report are consistent with previous DPR study publications and follow the latest 2016 1,3-D Risk Management Directive. No changes to the report are deemed necessary	No changes to report are needed.
13.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Chloropicrin carcinogenicity –** The average annual concentration of chloropicrin in Chualar and Watsonville was 0.03 ppb (30 ppt) and was 0.04 ppb (40 ppt) in Santa Maria. If sustained over time, these concentrations all greatly exceed the reference concentration of 0.24 ppt for controlling cancer risk to the 1 in a million level that was established in the DPR Chloropicrin TAC and Risk Characterization documents as the negligible risk level and supported in review by OEHHA and the TAC Scientific Review Panel. DPR subsequently made a unilateral decision that chloropicrin cancer data was equivocal and that an additional study was needed to assess cancer risk. That study is not due to be submitted until December 31, 2021 so in the meantime we are left with great uncertainty about cancer risk from chloropicrin exposure due to this huge data gap.	Comment acknowledged by DPR. As stated in the comment, DPR is awaiting additional data submission on chloropicrin. Until the Department updates any of the regulatory targets for chloropicrin, monitored air concentrations will continue to be compared to previously established values in a manner that is consistent with previous DPR publications.	No changes to report are needed.

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Number	Comment	Response	Action
14.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Results for Individual Communities –** We appreciate inclusion of a description of each community. An aerial view map of each monitoring site would also be helpful along with an assessment of proximity to agricultural fields. Carrots are an additional major crop in the Cuyama area. Carrot preplant fumigation may account for the high percentage (89%) of detections of MITC at the Cuyama site. The figures showing temporal trends in levels of individual pesticides detected at each monitoring site are very useful.	Comment acknowledged by DPR. The addition of carrots as a major crop in the Cuyama area has been included in the community description. While we agree that inclusion of pesticide use information will be greatly beneficial to frame a detailed picture of the typical use of pesticides near the monitored community, official PUR data for 2018 is not available as of this publication. We do intent on conducting relevant pesticide use and air concentration correlations in future analysis reports, but any such work is beyond the scope of this annual report.	Changes to report were made.

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Number	Comment	Response	Action
15.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Discontinuation of Field Spikes –** We are concerned to note fairly low field spike percent recoveries for chlorothalonil (73%); chlorpyrifos (77%); malathion (72%); and MITC (78%) which suggest that reported values for these pesticides may be underestimates. We also strongly disagree with the Department's decision to discontinue use of field spikes at the end of 2018. It would seem appropriate to devote more resources to figuring out why these field spikes were low instead of discontinuing field spike measurements. Field spikes provide reliable data about how field conditions may be affecting sample recovery. While the field spikes have their challenges and the data from them have their limitations (as cited by DPR in the 2018 AMN update), discontinuing the practice of collecting field spikes would mean that no information would be collected about how field samples might have been affected by important environmental conditions (e.g., humidity, temperature, other environmental factors affecting samples). For example, a 2018 memo from CDFA regarding MITC stated "The low recovery for the blind spikes would indicate that the sampling, extraction and analysis of the samples the lab analyzed during 2017 are reporting findings that are lower than what is actually in the air during the sampling." MITC air monitoring studies conducted by academics have included fortified field spikes, in order to collect data about field conditions while conducting air sampling. DPR could potentially use information from field spikes to help determine whether losses in the field are the result of laboratory methods (as CARB determined for 2017 methyl bromide samples), or for other reasons. In the 1990s, low field spike recovery rates for methyl bromide contributed to a study being conducted that showed that recoveries were greatly improved if steel canisters were used, rather than charcoal air tubes. As a result, sampling methodologies were improved for DPR field sampling. Therefore, field spikes can be useful and indeed may play an important role in helping DPR assess whether screening thresholds are potentially being exceeded.	DPR disagrees with this comment. DPR performed an assessment on the need and value of fortified field spikes detailed in a memorandum released on November 9, 2018. Although fortified field spike samples provide some additional information on recovery from the sampling matrix, the value of these samples, as currently prepared and handled, in assessing any quality control aspect of the air monitoring studies conducted by DPR's Air Program are debatable. DPR will continue to use results from trapping efficiency studies, storage stability studies, laboratory field blanks, laboratory fortified matrix spikes, field blanks, and co-located samples to provide greater verifiable information. These quality control measures provide DPR confidence in the analytical method and resulting air concentrations.	No changes to report are needed.
16.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Historic Air Concentrations –** It would be better to place the historical air concentration analyses, which provide very useful background, in the "Results from individual communities" section after 2018 data for each community site. In the historic analyses, some of the table entries show 0 ppb with a value in ng/m3. A non-zero value should also be provided in ppb. Tables 10 and 11 for Santa Maria appear to have ppb to ng/m3 conversion or rounding errors for chloropicrin and malathion.	The intent of this report is to focus on the observed ambient air concentrations during the 2018 calendar year. Historical data for all air monitoring studies are available through the Pesticide Air Monitoring Results Database where all monitored results can be access and/or reviewed. This information can be accessed at the following site: https://www.cdpr.ca.gov/docs/emon/airinit/pesticide_air_monitoring_database.htm.	No changes to report are needed.

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Number	Comment	Response	Action
17.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Historic Air Concentrations in Shafter –** The historical air concentration analysis shows that the Shafter annual air concentration for MITC (0.058 ppb) was higher in 2018 than any previous year. This should be mentioned earlier in the report.	DPR makes every attempt to convey all data and results obtained as part of the AMN in a clear and unbiased manner. As such, we attempt to follow a similar result reporting pattern for all sampling site locations. The manner in which the overall air concentrations for MITC in Shafter are stated are consistent with all other sampling locations.	No changes to report were made.
18.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Historic Air Concentrations from TAC Network Sites –** For Oxnard, Santa Maria and Watsonville more than 2 years of data are available for 1,3-D, methyl bromide and chloropicrin because these were previously TAC sites. That additional data should be included in historical analyses.	DPR disagrees with this comment. Although similar pesticides were sampled for, the TAC study and the AMN study differ in sampling protocol and sampling interval. The intent of this report is to focus on the observed ambient air concentrations during the 2018 calendar year. However, historical data for all air monitoring studies are available through the Pesticide Air Monitoring Results Database where all monitored results can be access and/or reviewed. This information can be accessed at the following site: https://www.cdpr.ca.gov/docs/emon/airinit/pesticide_air_monitoring_database.htm.	No changes to report are needed.
19.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Air Monitoring Database –** The Air Monitoring database is very well designed, user friendly and versatile. We greatly appreciate the inclusion of preliminary monitoring data and the ability to filter data by chemical, site and specific time periods and download filtered data into spreadsheets. It is unfortunate that Google will discontinue Google sheets at the end of the year, which means that the AMN data can no longer be organized using this system. We urge DPR to develop an alternative database that continues to be searchable and if possible is expanded to include mapping and graphing functions.	Comment acknowledged by DPR. DPR is currently working to provide a suitable alternative with similar functionality as the Google Fusion Tables interface. During this time, result from the Pesticide Air Monitoring Results Database will continue to be available for download as a .CSV file until a suitable Google Fusion Table replacement is determined.	No changes to report are needed.
20.	**From CRLAF, NRDC, CEH, CPR, PAN:** **Suggestions for Further Analysis –** Many of these monitoring sites are located at schools. We would recommend conducting an analysis to evaluate how the school buffer zone requirements may have impacted air levels measured at these sites. It also appears that 1,3- D and chloropicrin air levels have decreased at coastal sites in recent years. We recommend conducting an analysis that looks at whether there is any correlation between these fumigant air levels and the extent of use of TIF tarps surrounding the air monitoring sites.	This comment is beyond the scope of the "Air Monitoring Network Results for 2018 – Volume 8" draft document. Comment acknowledged by the Department. No response required.	No changes to report are needed.

21.	**From DAS:** 1,3-D Screening Levels and Regulatory Target – Alternative, refined derivations of 1,3-D acute, subchronic and chronic Human Equivalent Concentrations (HECs) and associated screening levels, and the "regulatory target" concentration (for lifetime exposure and risk evaluation) used for comparison to AMN measurements and modeled air concentrations, have been presented to DPR by DAS. Table 1 presents a comparison of screening level values currently recommended by DPR, versus those recommended by DAS. Detailed comments have been submitted to DPR. Further, an important consideration is the selection of an appropriate exposure metric (i.e., matching duration and time required for manifestation of the toxicological effect of interest), for comparison to alternative HECs and the resulting risk estimates (Margins of Exposure). In the case of the acute HEC recommended by DPR, while the values have been time-weighted to a 24 hour period based on Haber's Law (or Rule) (i.e., adjustment for concentration x time), the time to effect in the repeat dose study selected by DPR is 3 days (time and repeat dosing period required for statistically significant body weight decrement to be observed). Thus, the DPR acute screening level, should be compared to 72-hour time weighted average estimated exposure values (theoretical air concentrations assumed to be inhaled by bystanders for risk analysis). Further, an alternative to the repeat dose study used by DPR for the acute screening level derivation, is reliance on a 4-hour inhalation toxicology study and related benchmark response (BMR) of 10% body weight gain decrement, which reflects U.S. Environmental Protection Agency (U.S. EPA) and other guidance for selection of a biologically significant response. Differences in subchronic and chronic screening levels recommended by DAS, in comparison to DPR (see Table 1), relate to DAS's reliance on U.S. EPA's most recent guidance for derivation of inhalation reference concentrations (screening levels), and the use of a refined uncertainty factor that is consistent with that derived by the U.S. EPA. Detailed comments regarding DAS's recommendations have been submitted to DPR. <table 1> In the case of the acute screening level for 1,3-D, it is important to provide context to the point of departure, i.e., decrements in body weight gain. Body weight gain decrements have been used by multiple entities (DPR, U.S. EPA) as a point of departure and the basis for establishing permissible exposure limits to humans. However, upon closer examination of 1,3-D inhalation toxicology studies and the decrements in body weight observed in all of these studies, coupled with consideration of some key physiological and toxicokinetic measurements/indicators, it is clear that body weight, particularly after repeat dosing, e.g., 3 days, is not an optimal point of departure for use in acute (24 hrs or less) Human Equivalent Concentration (HEC) derivation. In fact, it appears body weight decrements resulting from inhalation exposure to 1,3-D are a secondary effect, resulting from primary effects on respiration rate, GSH depletion, and systemic over-exposure to the test material. A recent toxicokinetic study supports this reasoned conclusion and also raises significant questions about inhalation studies that are conducted above the kinetically-derived maximum dose and their use in risk assessment. As DPR considers risk mitigation measures for acute exposures to 1,3-D, it is imperative that a balanced discussion and reasoned conclusion, supported by the available science, be conducted. If a repeat dose study is used for the acute HEC (normalized to 24 hr exposure duration, i.e., per day exposure basis), as stated previously, it is imperative that it is compared to an appropriate exposure metric that matches the time to effects (3 days, or three 24 hr periods).	Development of the screening levels for 1,3-D, including information and justification of all data used to determine these levels, were detailed in the 2015 1,3-D Risk Assessment document. The use of human equivalent concentrations and uncertainty factors in establishing DPR screening levels is consistent with previous DPR study publications. No changes to the report are deemed necessary.	No changes to report are needed.

22.	**From DAS:** 1,3-D and Effects on Portal of Entry Tissues – Dichloropropene compounds, in general, have sensory irritation properties and this translates into portal of entry (in this case inhalation) effects involving the respiratory tract, which are considered a primary toxicological/irritancy effect in animals and humans. Body weight is typically a secondary effect from oral and inhalation exposures often resulting from an apical injury, stress, or other treatment-related factors that may directly affect food consumption or respirability (e.g., breathing rate). In fact, for 1,3-D, the U.S. EPA IRIS program/office used nasal histopathology for derivation of the BMD and while this was derived from a repeated dose and longer-term study, it shows the focus on portal of entry effects, which are a primary effect of exposure to 1,3-D. Consideration of body weight as the sentinel and appropriate endpoint of concern for establishing permissible exposure levels to humans, particularly from body weight decrements after 3 days of exposure (as used by DPR from Stott et al., 1984) is a toxicologically "blunt" and potentially irrelevant (relative to the toxicological profile and characteristics of 1,3-D) endpoint. If body weight is going to be used as a point of departure, particularly for acute exposures, available data for 4-hr exposures should be used, notably when body weight changes were reported. Finally, use of an acute exposure scenario such as 4-hours is far more appropriate when extrapolating to the human situation for protection of human health following acute exposures of this time duration. Humans are not continuously exposure to 1,3-D for 72 hours and therefore, there is no scientific or rational basis to use body weight decrements at 3 days for extrapolating to the acute (24 hrs or less) exposure scenario for humans.	Comment acknowledged by DPR. Comment is directed towards the established regulatory target concentration of 1,3-D and not specific to the Draft Air Monitoring Network Results For 2018 Report. No changes to the report are deemed necessary.	No changes to report are needed.

23.	**From DAS:** Review of Selected Inhalation Studies and Effects on Body Weight – Stott et al (1984) conducted a 13-week inhalation in rats and mice and at the two top concentrations (90 and 150 ppm) for both species, statistical decrements in body weight were recorded. In rats, the decrements for both sexes began on day 3 (first measurement) and continued for the duration of the study, while in male and female mice, statistically significant differences were not recorded at 90 ppm until day 59 and 45, respectively and at day 15 (males) and day 3 and 17 (females) for animals exposed to 150 ppm. In interpreting these effects for rats, Stott et al (1984) concluded that "As no histologically observable changes were noted in these tissues, the organ weight differences were not interpreted as being indicative of a specific target organ effect; but rather, represented an indirect, nonspecific result of TELONE II vapor exposure in these rats." For mice, Stott et al (2014) concluded that "The absence of any observable histological alterations in any of these organs indicated that the organ weight differences were a nonspecific result of exposure to TELONE II vapors (e.g. stress-induced atrophy of lymphoid elements)." For both species, there is a clear threshold for concentration dependent effects on body weight gain and for both, high concentrations of 1,3-D were required in order to elicit/manifest a decrement in weight gain. Additionally, it would appear that the absence of any histologically relevant changes in those organs/tissues evaluated support the interpretation that decrements in body weight gain are a result of non-specific secondary consequences to experimental stress or reduction in respiratory minute volume (discussed below), both of which could result in reduction in food consumption and hence declines in body weight gain. In the end, these results are consistent with exposure to excessive concentrations of 1,3-D and not the result of treatment-related target organ specificity and toxicity. A review of six different study types as noted by DPR in their 2015 Risk Characterization Document (RCD) for 1,3-D, Table IV, reveals a generally similar pattern in that body weight decrements, while recorded at various days (and again, multiple study types were involved), are concentration-dependent, but clearly threshold related. The studies ranged from a genotoxicity study to subchronic inhalation studies to 2-yr bioassays, and while we have not reviewed these studies for determination of the critical point of departure, it is likely that body weight decrements were not found to be the most sensitive driver in all cases for establishment of references values for permissible exposures to humans. In summary, a review of multiple studies shows body weight decrements to be a common occurrence resulting from repeated exposure to 1,3-D, a phenomenon which is concentration-dependent and for which a clear threshold exists. Table 2 presents Benchmark Concentrations (BMC10 for body weight decrement associated with a 10% response rate) and BMCL10 (lower confidence limit) based on body weight decrement for various 1,3 D repeat dose studies. In comparison, the BMCL10 derived by DAS for the Cracknell et al (1987) 4-hour inhalation exposure study (1,3 D at concentrations 0, 351, 572, 585, or 665 ppm) is 42 ppm. Moreover, the effects consistently resulted from exposure to high concentrations of 1,3-D, and certainly for animals from the repeat dose study conducted by Stott et al (1984), appear to be secondary effects owing to other experimental factors (e.g., stress, reduction in respiratory minute volume). If, as we believe, these effects are secondary to other experimental factors, then it is important to probe further for biological/physiological evidence as to why exposure to high concentrations of 1,3-D result in overall body weight declines, which is discussed next.	Comment acknowledged by DPR. Comment is directed towards the established regulatory target concentration of 1,3-D and not specific to the Draft Air Monitoring Network Results For 2018 Report. No changes to the report are deemed necessary.	No changes to report are needed.

24.	**From DAS:** **Drivers Behind Body Weight Decrements –** Several biological changes occur in animals upon repeated inhalation exposure to 1,3-D. These effects are physiological (respiration) as well as metabolic (glutathione depletion). Either or both of these effects could result in stress to rats or mice exposed to 1,3-D via inhalation. Changes in the respiratory patterns of rats or mice have been observed following 1,3-D exposures. Stott et al. report 26-47% decreases in respiratory minute volume (RMV) in rats acutely exposed for 3 hr to 1,3- D concentrations of 300 and 900 ppm (Stott and Kastl, 1986). Hotchkiss et al. also found a decrease in respiration of rats acutely exposed to 1,3-D for 6 hr, with 21 and 52% reductions in RMV at 60 and 150 ppm vs. 2.5 ppm (Hotchkiss et al., 2015). These up to two-fold decreases in total inhalation would impact normal physiology and as a result, food consumption and body weight. The metabolic fate of 1,3-D involves conjugation with glutathione (GSH) for all of the reported pathways observed in the rat and mouse (Bartels et al., 2004). These observations are consistent with the measured depletion of lung GSH levels upon repeated exposures, with decreases of ~40-50% at 1,3-D concentrations of 60 and 150 ppm (Stott et al., 2001). Depletion of GSH in the portal of-entry lung tissue is known to result in oxidative stress (Deneke et al., 1985; Rahman and MacNee, 2000) which could impact body weight gains (i.e., resulting in body weight decrements).	Comment acknowledged by DPR. Comment is directed towards the established regulatory target concentration of 1,3-D and not specific to the Draft Air Monitoring Network Results For 2018 Report. No changes to the report are deemed necessary.	No changes to report are needed.

25.	**From DAS:** **Toxicokinetic KMD –** The metabolic clearance of inhaled 1,3-D has been shown to saturate in the rat and mouse. Stott and Kastl found that 1,3-D blood levels became supralinear at or above 300 ppm (3 hr acute exposure) (Stott and Kastl, 1986). Similarly, blood levels of 1,3-D were shown to be supralinear in mice at or above 30 ppm (6 hr acute exposure) (Hackett, 2018). This nonlinearity in systemic exposure is consistent with test material-based GSH depletion (discussed above), and correlates with increases in 1,3-D blood levels following lung GSH depletion via diethylmaleate pretreatment in rats (Yang, 1989). Beyond saturation of metabolic clearance, the ratio of cis/trans 1,3-D isomers in mouse blood also changes substantially from ~0.13 to ~0.20 between the exposure concentrations of 40 and 60 ppm. These data indicate a substantial shift in one or more processes involved in metabolism of these two isomers at higher 1,3-D exposure levels. Several regulatory guidance documents describe a Kinetically-derived Maximum Dose (KMD) as a dose level or exposure concentration at which systemic exposures become non-dose proportional, due to saturation of one or more pharmacokinetic or metabolic processes (i.e., absorption, metabolism) (OECD, 2014; NRC, 2007). For example, as per OECD Guidance document 116: *"Although top dose selection based on identification of inflection points in toxicokinetic nonlinearity may result in study designs that fail to identify target organ or body weight effects, it must be appreciated that metabolic saturation in fact represents an equivalent indicator of biological stress. In this case, the stress is evidenced by appearance of non-linear toxicokinetics rather than appearance of histological damage, adverse changes in clinical chemistry, haematology parameters or decrease in body weight gain."* Based on this rationale, biological effects such as body weight gain decrements, seen only at or above the KMD, would be considered irrelevant for human health risk assessments.	Comment acknowledged by DPR. Comment is directed towards the established regulatory target concentration of 1,3-D and not specific to the "Air Monitoring Network Results for 2018 – Volume 8" draft document. No changes to the report are deemed necessary.	No changes to report are needed.

26.	**From DAS:** **Discussion and Recommendations –** Analysis of the scientific data presented above indicates that there is strong evidence that the body weight decrements that are often seen in toxicity studies in animals exposed to 1,3-D are not a direct result of treatment-related exposure (i.e., primary or apical effect), but rather an indirect effect resulting from key physiological and metabolic processes. This is supported by evidence that 1,3-D's primary effect following inhalation is on portal-of-entry effects (used by EPA's IRIS program for BMD calculations) and consistent evidence from numerous studies indicating that body weight decrements are a threshold-related phenomenon with decrements only occurring at higher doses/concentrations, ones at which systemic exposures become non-dose proportional owing to saturation of pharmacokinetic or metabolic processes. In fact, as discussed above, there is solid evidence that the higher concentrations associated with body weight decrements were associated with (a) reduced respiration which directly has relevance for reduced food consumption and body weight gain; (b) GSH depletion which in turn can be associated with oxidative stress and body weight decrements; and (c) test concentrations which exceeded the KMD for 1,3-D and therefore which are not relevant for human risk assessment. Body weight decrements resulting from high exposures to 1,3-D should not be used as the primary basis for HEC derivation and subsequent risk mitigation as it has clearly been shown that this effect is secondary to overexposure which has direct effects on physiological parameters such as respiration rate and resultant reduced body weight gain. If DPR decides to continue to use body weight decrease from the repeated exposure studies to derive an acute endpoint, several considerations should be recognized: 1) Body weight was evaluated following acute exposure in the Cracknell et al (1987) study, and the use of repeated exposure on the same endpoint and disregarding the existing acute exposure studies results in a more conservative acute screening level value. 2) DPR used the benchmark dose approach to generate BMCLs and used the 1 standard deviation (SD) as benchmark response (BMR). This is a default assumption / selection according to the Benchmark Dose Technical Guidance Document (External Review Draft): "for continuous data if no known biological significance, a change of 1SD may be applied as a default BMR." However, with respect to body weight change and to what degree or magnitude it is considered adverse, two guidance documents specifically point out that 10% decrease in body weight is generally recognized as biologically significant (USEPA 2003, and USEPA 2000). Consistent with this guidance, U.S. EPA's tier I risk assessment, Integrated Risk Information System (IRIS), and tier II risk assessment, Provisional Peer-viewed Toxicity Values (PPRTV) both utilize 10% body weight decrease as BMR. 3) Body weight decrease used to derive an acute reference concentration (RfC) is of minimal adversity when such effect is not accompanied with other toxicological correlates or toxicity indications from other endpoints including clinical chemistry, hematology, neurotoxicity, and histopathology in adult animals, or fetal and offspring effects in pre-, post-neonatal, or young animals. Thus, based on these considerations, reduced uncertainty factors may be warranted. Solecki et al (2005) in their publication on the establishment of acute reference doses for pesticides, specifically noted that "A reduced factor [safety] might be appropriate if the	Comment acknowledged by DPR. Comment is directed towards the established regulatory target concentration of 1,3-D and not specific to the "Air Monitoring Network Results for 2018 – Volume 8" draft document. No changes to the report are deemed necessary.	No changes to report are needed.

	endpoint used to derive an ARfD is of minimal adversity and the critical NOAEL is from a repeat dose study (e.g., reduced food consumption and body weight gain (i.e., observed in the first days) or increased organ weight with minimal pathological change. When considering body weight changes considerations need to be given to potential problems of palatability of the feed." This perspective is directly relevant to the case here in which inhalation of high concentrations of 1,3-D are affecting respiration and hence reduced food consumption. In conclusion, there is little support for the utilization of body weight decrement as an endpoint for establishing an acute HEC and if this practice continues, then there is strong recommendation for comparing the selected time domain of the acute HEC to a corresponding exposure period (i.e., 4 hr HEC compared to a 4 hr TWA inhalation exposure, or a 3-day HEC compared to a 3-day TWA inhalation exposure). For purposes of "acute" exposure, a more defensible and appropriate exposure period is 4- hours (or 24-hours), and not 3 days. The latter is clearly not acute and would be better described as short-term. Finally, there is sound scientific evidence that body weight decrements are secondary effects owing to a variety of 1,3-D-specific portal of entry effects, and related effects on physiology,), pharmacokinetics and metabolism, at sufficient doses (at and above the KMD).		

27.	**From DAS:** **AMN Program Overview –** Table 3 shows the years that monitoring was conducted and the total number of 24-h samples collected at each of the 17 locations that are currently, or were historically, in the AMN program. Extensive monitoring in areas of high 1,3-D use during 2018 showed that 88.9% of the samples had no detectable residues of 1,3-D (Report AIR 19-02). Targeted monitoring in the two high use areas (Delhi and Parlier) under Study 309 in 2018 showed that 1,3-D was detected in 68% and 84% of the samples, respectively (Report AIR 19-03). The highest 24-h concentration of 1,3-D in 2018 occurred in Shafter and although it did not exceed the acute screening level (110 ppb), it did result in exceedance of the 13 week rolling average (RA) concentration screening level (3 ppb). Dow AgroSciences (DAS) concurs with the Department's observation that the exceedance of the 13-week RA at the Shafter site was largely influenced by the single high 24-h 1,3-D concentration (50.5 ppb) that occurred at that site. The dominating effect of a single high concentration of 1,3-D on the 13-week RA and annual average concentration was also observed at the Parlier site in Study 309 (Report AIR 19-03) where a 1,3-D concentration of 111.3 ppb was measured in October 2018. Considering these exceedances of the subchronic screening level at the Shafter and Parlier locations, and the uncertainty associated with the 13- week RA concentration, DAS suggests some alternative approaches for determining annual average and RA concentrations, including the use of air dispersion modeling to account for missing and censored data, in subsequent sections of this document. The distribution of all the weekly 24-h 1,3-D concentrations measured in the AMN program to date (3,037 samples) are shown in Figure 1 and illustrate the highly skewed nature of the data, with the highest measured concentration (100th percentile) of 111.3 ppb, while the 99.9th percentile concentration falls to 10 ppb. This reflects the fact that most of the samples resulted in no detection of 1,3-D (ND) or low trace level detections, as was the case in the 2018, with 88.9% of samples containing no detectable level of 1,3-D. <table 3> <figure 1> The annual average 24-h 1,3-D concentration at each AMN location, for each year of monitoring, is shown in Table 4. Although 24-h 1,3-D concentrations have not exceeded the DAS-recommended acute screening level at any of the monitoring locations, the maximum value measured (see Figure 1, i.e., 111.3 ppb) slightly exceeds DPR's current acute screening level (110 ppb; see Table 4 below), and a small number of higher-level detections have resulted in an exceedance of the DPRs 13-week rolling average (RA) screening level (3 ppb) in Parlier and Shafter, and exceedance of the chronic screening level for 1,3-D (2 ppb) in Parlier in 2018. The DPR lifetime/cancer risk regulatory target of 0.56 ppb was exceeded in Parlier in 2017 and 2018, and Shafter in 2018. All other sites/years have annual average concentrations 10 to 20-fold below the chronic screening level (2 ppb). Table 4 also shows that when all weekly 24-h concentrations are averaged across the years sampled at a given location, the multi-year concentrations are also below the chronic screening level, ranging from 0.07-1.71 ppb. The average 24-h concentration at the Parlier site is based on just two years (2017/2018) of weekly 24-h 1,3-D data that contain a small number of exceptionally high 1,3-D concentrations that drive the rolling average and annual average 1,3-D concentration and is discussed in more detail below.	DPR disagrees with this comment. Every attempt is made by staff to convey the obtained results in clear and unbiased manner. The manner in which pesticide air concentrations are stated in this report, are consistent with previous DPR study publications. Pesticide concentrations measured in all AMN sampling locations are listed in various tables throughout the report, and described in the report's text, Discussion, and Executive Summary. DPR believes that the sampling results are clearly and effectively presented throughout the report and thus no changes are required at this time.	No changes to report are needed.

	Table 4 also shows that the average 24-h 1,3-D concentration across all AMN locations each year is less than the chronic screening level (2 ppb). The "Grand Mean" of 24-h concentrations from all sites/all years is 0.25 ppb, and suggests that on average, over the long-term California residents are not exposed to levels of 1,3-D exceeding the chronic screening level. It is appropriate to consider the "Grand Mean" concentration to infer potential long-term human exposure to CA residents, since it inherently considers population mobility. <table 4>		
28.	**From DAS:** **Parlier Site 2017-2018 –** Figure 2 is a time series plot of the weekly 24-h 1,3-D concentration at the Parlier AMN site for 2017 and 2018 and shows that a very small number of high concentrations control the 13-week RA concentrations (Figure 3), and the annual average concentration. The annual average concentration at the Parlier site in 2017 (0.62 ppb) was dominated by a single detection of 1,3-D (16 ppb) from a sample collected on Sept 19-20, 2017. Examination of the 1,3-D application records and weather conditions at the Parlier site during September 2017 showed that 1,3-D was applied at 33 gallons per acre (gpa), the tree and vine rate, to a 9-acre field within a few hundred feet of the AMN receptor. The weather data showed significant calm periods for several days following the application and during the sampling time. Calm conditions are known to cause elevated concentrations of ambient air concentrations of pesticides. The annual average concentration at the Parlier site in 2018 was dominated by a single detection of 1,3- D (111 ppb) occurring on October 9, 2018. Just prior to that sample event, 5 applications of 1,3-D had been made to fields ranging from 1.5 to 2 acres in size. All fields were within one mile of the AMN receptor, and two were within about 500 feet of the receptor. Averaging this single 24-h detection with the 51 other weekly 24-h samples resulted in an annual average concentration of 2.94 ppb, exceeding both the chronic screening level and lifetime/cancer risk regulatory target of 0.56 ppb. <figure 2>	Comment acknowledged by DPR. Comment is not directed toward the "Air Monitoring Network Results for 2018 – Volume 8" draft document. No changes to the report are deemed necessary.	No changes to report are needed.

29.	**From DAS:** **Shafter Site 2018 –** In contrast to previous years of AMN results for Shafter, where maximum measured concentrations were well below screening levels, in 2018 a single high 24-h concentration (50.5 ppb) was measured at the Shafter receptor, though not exceeding the acute screening level, which resulted in an exceedance of the 13-week RA and annual average screening levels when averaged with weekly 24-h 1,3-D concentrations for the rest of 2018. Figure 4 shows a time series plot of the 24-h 1,3-D concentrations at the Shafter AMN site plotted weekly for 2018. The single high concentration of 1,3-D (50.5 ppb) detected at the site on January 23-24, 2018 dominates the 13-week rolling average (RA) concentration which peaks at 5.6 ppb (Figure 5) and exceeds the subchronic screening level of 3 ppb. Examination of the 1,3-D application records and weather conditions at the Shafter site during January 2018 showed that 1,3-D was applied at 30 gpa to a 25-acre field within a few hundred feet of the AMN receptor, two days prior to the sample event. The weather data showed significant stable air (calm periods) for several days following the application and during the sampling event. Calm conditions are known to cause elevated concentrations of pesticides in ambient air. The SOFEA model was parameterized with product use data (from PUR database) and weather data from the area and which simulated 24-h 1,3-D concentrations of 50 ppb between the 95th and 99th percentile, suggesting a concentration of that magnitude is a low probability occurrence and is driven by the close proximity of the field to the receptor, and wind direction. It should be noted that 1,3-D applications to tree and vine crops occur only once every 20-30 years depending on the lifespan of the orchard. Furthermore, for a human to potentially be exposed at those sub-chronic and chronic levels of 1,3-D would require that they be co-located with that receptor for 13 weeks or 52 weeks, or in the case of the lifetime/cancer risk regulatory target, for 70 years. National and California specific population mobility surveys indicate that humans are very mobile and the assumption that they remain in a fixed location for 13 weeks, let alone a year, is extremely rare and adds significant conservatism to the risk assessment (Driver et al. 2016a, 2016b). Figure 5 shows that the 13-week RA 1,3-D concentration begins to rise in late January 2018 (after the 50.5 ppb 24-h detection on Jan 23), exceeding the 13-week RA screening level (3ppb) in February 2018, and reaching a maximum (5.6 ppb) approximately 13 weeks later (April 24, 2018). After the 13-week RA peaks on April 24, it drops precipitously, reflecting the low 24-h weekly concentrations occurring throughout the remainder of the year at the Shafter site. <figure 4> <figure 5>	Comment acknowledged by DPR. No response is required.	No changes to report are needed.

30.	**From DAS:** **Study 309 AMN Sites in Delhi and Parlier –** DPR initiated monitoring at two additional sites (Delhi and Parlier) in late 2016 as part of Study 309. The goal of that air monitoring study is to evaluate the effectiveness of the current 1,3-D township cap and permit conditions promulgated as a result of DPR's 2016 RCD that became effective in January 2017. The new permit conditions allow annual application of 136,000 pounds of 1,3-D per township, ban December applications, and eliminate the 'banking' system. To monitor the effect of these changes in 1,3-D product use, DPR selected two communities characterized by relatively high historical 1,3-D use which were not already included in monitoring conducted by DPR or the California Air Resources Board (ARB). DPR staff collected weekly 24-h air samples to monitor 1,3-D in the communities of Delhi (Merced County) and Parlier (Fresno County) beginning in November 2016. Weekly 24-h 1,3-D samples have been collected since then, and a complete weekly time series for these communities is available for January 1, 2017 through December 31, 2018. Since the measured concentration at a receptor is more greatly affected by the proximity and source strength of a 1,3-D application, and less by the total number of applications, or total mass applied in a 6x6 mile township, it is erroneous to assume that the observation of a single high 24-h 1,3-D concentration means that a particular mitigation is not effective. It could simply mean that a single application of 1,3-D was made very close to the receptor at a time when meteorological conditions favored movement to that receptor location. DPR has shown in multiple analyses with several active ingredients, that correlation between the AMN concentration at a receptor and the mass of chemical applied in the township(s) surrounding the receptor is very weak. This is because parameters such as weather and proximity to the AMN receptor have a major effect on the measured concentration causing it to vary significantly from year to year. Therefore, multiple years of monitoring are needed to visualize and quantify the effect of mitigations that reduce the mass of 1,3-D applied annually in a township. The weekly 24-h AMN data is perhaps more useful for assessing mitigations that reduce 1,3-D use during certain times of year (e.g. the December ban). The 1,3-D concentration data collected from the new site in Delhi for example show that the 2016 RCD mitigation banning December applications has been successful in reducing historically high 1,3-D concentrations resulting from calm conditions that are prevalent at that time of year, as is discussed in detail below.	Comment acknowledged by DPR. Comment is not directed toward the "Air Monitoring Network Results for 2018 – Volume 8" draft document. No response is required.	No changes to report are needed.

31.	**From DAS:** **Effectiveness of December Ban using Delhi AMN data –** The AMN receptor in Delhi is in the same township (Merced 06S11E) as the DAS receptor that was used to collect continuous 72-h 1,3-D concentrations from October 2010-January 2012. The AMN and DAS receptors were about 2 miles apart, located in section 8 and section 16 of Merced 06S11E, respectively. The close spatial proximity of the receptors allows comparison of 1,3-D concentrations observed in December both before and after the ban on December applications in 2016. Figure 6 (see subfigures A and B) show the 72-h 1,3-D concentrations at the DAS monitor near the Delhi site in 2011, prior to the ban on December applications, with a peak concentration of 61 ppb occurring in December of that year (highlighted in red). The annual average concentration at that receptor was 1.02 ppb in 2011. Removing the December 2011 data from the annual average calculation reduces the annual average concentration to 0.11 ppb (~ 10-fold reduction, Fig. 5B) and is similar to the annual average concentrations of 0.13 and 0.2 ppb observed at the AMN Delhi receptor in 2017 (Fig. 5C) and 2018 (Fig. 5D) respectively, measured after the ban on December applications. <figure 6> This comparison of monitoring data collected in Merced, one of the highest 1,3-D use areas in California, shows that historically high 1,3-D concentrations occurring in December have been significantly mitigated by the ban on applications in December.	Comment acknowledged by DPR. Comment is not directed toward the "Air Monitoring Network Results for 2018 – Volume 8" draft document. No response is required.	No changes to report are needed.
32.	**From DAS:** **Impact of Township Cap Set at 136,000 Pounds 1,3-D per Year –** The impact of setting the township allocation at 136,000 pounds 1,3-D per year could take more time to show up in the AMN monitoring results since the 1,3-D levels in air are primarily dependent on whether an application occurs close to and upwind of the receptor, or under stable air conditions. Changes in township allocation limits will likely be observed in the AMN dataset after the new township cap limit has been in place for several more years. Possibly the best way to assess the effect of the change in California-wide 1,3-D township allocation (cap) is to look at the trend in annual average concentration obtained at all AMN sites over time. DAS agrees with DPRs acknowledgement that a single high 24-h concentration can dominate the 13-week RA and the annual average concentration, which can result in an exceedance of a trigger. This suggests that additional years of monitoring are required before the full impact of mitigations are reflected in the ambient 1,3-D concentrations.	Comment acknowledged by DPR. Comment is not directed toward the "Air Monitoring Network Results for 2018 – Volume 8" draft document. No response is required.	No changes to report are needed.

33.	**From DAS:** **Calculation of Rolling Average (RA) Concentrations –** As shown earlier, a single 24-hour 1,3-D concentration can dominate the calculation of the 13-week RA concentration each year, and raises the question of the representativeness of that RA. This is further exacerbated by the uncertainty introduced by the 85% missing data in the dataset and suggests that the longest time series of weekly 24-h data available should be used to calculate moving averages and annual averages for the purpose of characterizing potential exposure and risk. Figure 7 shows the weekly 24-hour 1,3-D concentration for the Shafter AMN receptor from the start of monitoring in 2011 through the end of 2018, the last full year of data, resulting in an 8-year time series of weekly 24-h concentrations (416 values). The highest measured 24-h concentration (~50 ppb) at the Shafter AMN site occurred on Jan 21, 2018 and is highlighted in red in Figure 6. DAS recommends using all the available AMN data at each site to calculate all the potential 13-week RA concentrations for the eight year period that the AMN receptor at Shafter has been monitored (Figure 6A). This requires the same assumption discussed above, that each 'weekly' average concentration is characterized by the single 24-h sample collected during that week. The number of 13 week rolling average concentrations (n) that can be calculated from eight continuous years of weekly monitoring data is 403 (n=8*52-13) and are shown in Figure 6B. These 403 estimates form a probability distribution function (PDF) of 13-week RA concentrations at the Shafter AMN site (Figure 7) and allow the risk manager to select an appropriate percentile concentration to use in the risk assessment. Figure 8 shows that the 13-week RA concentration spanning the 50 ppb 24-h detection that occurred on January 21, 2018 is the highest RA concentration (5.6 ppb) ever measured at Shafter over eight years. This is not surprising since 50 ppb is the highest 24-h concentration of 1,3-D ever measured at the Shafter AMN location between 2011 and 2018, and clearly dominates the 13-week RA calculation in early 2018. For comparison, the 90th and 95th percentile 13-week RA concentrations are 1 ppb and 2 ppb, respectively when the entire 8-year time series of weekly 1,3-D concentrations is considered. <figure 7> <figure 8> Here again, the missing data come into play because a true 13-week rolling average would require averaging 91 consecutive days of concentration data, but since there is only a single 24-h sample collected each week, that concentration is necessarily assumed to represent exposure for that entire week (i.e.. the same concentration applies for all seven days of the week). Depending on the local weather and product use near the receptor, this could result in an over- or under- estimation of the weekly and rolling average concentrations and underscores the value of using an air dispersion model (e.g. SOFEA) to simulate 1,3-D concentrations in ambient air based on known mass of 1,3-D applied, location and timing of the applications, and local weather (wind speed, direction, etc.).	The manner in which pesticide air concentrations are stated in this report, are consistent with previous DPR study publications. The use of 13-week rolling averages for 1,3-D are clearly explained in the report. Furthermore, all tables in the report where the use of 13-week average concentrations are included contain a footnote that reads: "These concentrations represent the highest 13-week rolling average." DPR believes that the sampling results are clearly and effectively presented throughout the report and thus no changes are required at this time.	No changes to report are needed.

34.	**From DAS:** **General Discussion of AMN data utility –** The collection and analysis of air samples is very resource intensive and taking continuous measurements for an extended time period is typically not feasible. For this reason, only a single 24-h sample is collected from each AMN site each week. The weekly 24-hour 1,3-D concentrations are very useful for characterizing potential acute exposure to 1,3-D, however the utility of the AMN data for quantifying short-term, sub-chronic, and chronic (annual or lifetime) exposure and risk is not as straightforward for two reasons. First, only a single 24-h sample is collected each week and therefore 6 out of 7 days (>85%) have no data. This results in the need to assume a 1,3-D concentration on the non-sampled days. DPR assumes that the measured concentration persists for the entire week which they acknowledge could result in either an over- or under-prediction of the weekly average concentration. Secondly, the AMN dataset is typically highly censored due to many samples where the concentration is less than the analytical Limit of Detection (LOD) or Minimum Detection Limit (MDL). DPR assumes that samples that show no detection (ND) are equal to one-half of the MDL or LOD, which could also result in an over- or under-prediction of the weekly concentration. Both issues add uncertainty when monitoring data is used to assess potential sub-chronic, chronic and lifetime exposure and risk, and point to the value of air dispersion modeling to fill in gaps in the monitoring data.	Comment acknowledged by DPR. No response is required.	No changes to report are needed.
35.	**From DAS:** **Use of Air Dispersion Modeling to Supplement AMN Data –** A cost-effective and scientifically sound approach to supplementing monitoring data is to use a validated air dispersion model such as the SOil Fumigant Exposure Assessment (SOFEA) model. SOFEA can be parameterized with pesticide use data (volume applied; date applied etc.) obtained from DPR's Pesticide Use Reporting (PUR) database and when combined with local meteorological data, has been shown to accurately simulate the timing and magnitude of 1,3-D concentrations in ambient air (van Wesenbeeck et al., 2016) as well as the overall PDF of 1,3-D concentrations in air. SOFEA also simulates air concentrations on an hourly time step and can therefore be used to characterize acute, subchronic and chronic exposures ranging from 1 hour to several years, or a human lifetime. The use of a modeling tool such as SOFEA is a logical complement to monitoring datasets and can be used to fill in data gaps with reasonable certainty, especially when local product use information and weather data are available. Ultimately the use of a model significantly reduces the need for arbitrarily conservative assumptions to deal with missing and censored data, and decreases the uncertainty associated with many monitoring datasets.	Comment acknowledged by DPR. Comment is not directed toward the "Air Monitoring Network Results for 2018 – Volume 8" draft document. No response is required.	No changes to report are needed.
36.	**From CARB:** **Significance of undetected pesticides –** The executive summary and the body of the report note that of the 36 pesticides monitored, eight were not detected. This implies that those pesticides do not become airborne. We suggest noting that one reason for not detecting some of the pesticides is that they were not used in the vicinity of the monitoring sites.	DPR disagrees with this comment. Official 2018 pesticide use information has not been released by the Department as of this report's publication. Therefore, it would be inappropriate for DPR to make the claim that no pesticide use occurred in the vicinity of the monitoring sites as suggested without having use data for the time period in question.	No changes to report are needed.

Responses to Comments on the AIR MONITORING NETWORK RESULTS FOR 2018 - VOLUME 8

37.	**From CARB:** **Page numbers –** Although the table of contents lists page numbers, there are no page numbers in the body of the report.	Comment acknowledged by DPR. Page numbers have been added to the report.	Changes to report were made.
38.	**From CARB:** **References to CARB** – On page 5 and throughout the report, the California Air Resources Board is referenced as ARB. We officially now go by CARB, not ARB.	Comment acknowledged by DPR. All references to the California Air Resources Board throughout the report have been updated from ARB to CARB as requested.	Changes to report were made.
39.	**From CARB:** **Reason for community selection –** On page 5, the section titled "Number of Communities Monitored" states that four communities were selected based on nearby use of four soil fumigants. Fumigants listed include methyl isothiocyanate (MITC) and MITC-generators. MITC is not an applied fumigant; it breaks down from metam sodium and metam potassium. We suggest deleting MITC and just describing this as MITC-generators.	Comment acknowledged by DPR. The sentence on Page 5 has been updated to read as "MITC-generators" instead of "MITC" as suggested.	Changes to report were made.
40.	**From CARB:** **Pesticides monitored –** On page 6, the section titled "Pesticides Monitored" indicates that "DPR monitored 31 pesticides and 5 breakdown products." This should be DPR and CARB. In addition, it may be useful to include a description of which pesticides were analyzed by the CARB lab and which were analyzed by the CDFA lab.	Comment acknowledged by DPR. Page 6 has been edited to include "DPR and CARB" as requested.	Changes to report were made.
41.	**From CARB:** **Discussion –** On page 15, the last sentence states that "DPR is in the process of developing regulations to reduce exposures to 1,3-D in ambient air." This implies that there is no current mitigation for 1,3-D, which is incorrect. We suggest rewording this sentence to make it clear that the DPR effort will modify existing mitigation measures to further reduce exposures to 1,3-D.	Comment acknowledged by DPR. The sentence on Page 15 has been updated to read as follows: "DPR is in the process of developing additional regulations to further reduce exposures to 1,3-D in ambient air."	Changes to report were made.

Responses to Comments on the AIR MONITORING NETWORK RESULTS FOR 2018 - VOLUME 8

Attachments: Comments Correspondence

August 29, 2019

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RE: Comments on Draft Air Monitoring Report for 2018

Dear Dr. Pham:

Thank you for the opportunity to comment on this draft report. We appreciate all the hard work that went into conducting the air monitoring and compiling the report and the detailed presentation of air monitoring results. We offer the following recommendations to improve data presentation and correct a few errors we noted.

We commend the Department on improvements to the air monitoring program such as the development of the air monitoring database, which we find very well designed and useful. However, the presentation of air monitoring results in the annual report continues to be misleading, incomplete and, in some instances, inaccurate in its description of health threats from airborne pesticides. We strongly urge the Department to revise the draft report to provide a more comprehensive description of the air monitoring data

Comments on data presentation in the draft report

Executive Summary
The description of Shafter air monitoring results in the Executive Summary should include two clarifying statements:
1) If the 2018 annual average 1,3-D air concentration of 1.53 ppb were to continue for 70 years it would exceed DPR's current regulatory target of 0.56 ppb for control of lifetime cancer risk; and
2) The 8 year average 1,3-D air concentration of 0.41 ppb already exceeds DPR's previous regulatory target of 0.14 ppb which OEHHA continues to support.

Combined results for all pesticides and communities
We remain concerned that beginning the report by quoting statistics that aggregate all the data conveys a false sense of security that does not reflect the air levels documented by the actual monitoring data.

The statements in the report that 93.8% of analyses did not return a detectable concentration, that 6.2% of analyses had at least one detectable pesticide concentration and that 1.3% of analyses had quantifiable detections are highly misleading because they ignore the realities of pesticide use patterns. In order to reach 100% detections (a total of 12,058 positive analyses), every pesticide tested for would have to be found on each of the days monitored at each of the air monitoring sites. In reality, use of most pesticides is concentrated in certain months. As pesticide use varies between crops and regions, not all of the pesticides monitored for are used near all of the monitoring sites. Therefore, using the total number of analyses for all pesticides at all locations as the denominator does not provide a meaningful context.

Detection frequency should either be calculated based on what pesticides were used in the vicinity of a specific site, shortly prior to the sampling date, or should not be highlighted. When these concerns were raised two years ago at the August 18, 2017 PREC meeting, then Branch Chief Pam Wofford stated that DPR was conducting an uncertainty analysis of frequency of detections. Is this analysis still in process and if so when will it be completed?

We note that Table 4 shows that there was an average of at least one pesticide detection in 86% of weekly sample sets collected at each monitoring site. This statistic should also be included in any discussion of aggregate findings in the report narrative.

The report states that there were 4 lost samples in 2018 including 3 summa canisters. The date and location of lost or otherwise invalidated samples should be provided in the report.

The tables in the Air Monitoring Study Results and 1,3-D Ambient Air Monitoring Results Presentations at the July 19th Pesticide Registration and Evaluation Committee[1] (slides 13-15 and slides 26-27) that compile highest air concentrations and compare highest 1 day, 4 week or 13 week and annual average concentrations between sites for all pesticides with quantifiable detections are very helpful and informative. We strongly recommend including them in the report with 1,3-D results combined with other pesticide results.

Acute Screening Levels

Chloropicrin

The acute regulatory target for chloropicrin of 73 ppb used in this report as a 24 hour average exposure target level was set in a Risk Management Directive (RMD)[2] as an 8 hour average so at the very least it should be adjusted to 24.3 ppb as a 24 hour level. Furthermore, this 73 ppb target level was set over the objection of OEHHA.[3] The chloropicrin TAC report[4] and risk assessment[5], which are also supported by OEHHA[6], include a 24 hour reference level of 0.92 ppb for protection of children. The highest 24 hour level measured in Oxnard (0.8 ppb) reached 87% of this reference level and the highest level measured in Santa Maria (0.46 ppb) reached 50% of this level.

MITC

The acute regulatory target for MITC of 220 ppb used in this report as a 24 hour average exposure target level was set in a Risk Management Directive[7] as an 8 hour exposure level so at the very least it should be adjusted to 73 ppb as a 24 hour exposure target level. Furthermore, this level was set over OEHHA's objections [8] because 220 ppb was the "no effects" level in a toxicology study, leaving no margin of error. The DPR TAC report[9] and risk assessment[10] established an 8 hour reference level of 22 ppb for protection against irritation to the eyes and respiratory system which should be adjusted to 7.3 ppb as a 24 hour target exposure level.

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[1] DPR Pesticide Registration and Evaluation Committee Air Monitoring Results and 1,3-D Ambient Air Monitoring Results Presentation. July 19, 2019

[2] https://www.cdpr.ca.gov/docs/emon/pubs/chloropicrin/directive.pdf

[3] https://oehha.ca.gov/media/downloads/pesticides/report/chloropicrinmitigationmemooehha2013.pdf

[4] DPR Toxic Air contaminant Assessment for Chloropicrin. February 2010

[5] DPR Risk Characterization Document (For chloropicrin exposure of Workers and the General Public) November 2012

[6] https://www.cdpr.ca.gov/docs/risk/rcd/oehha_comments.pdf

[7] https://www.cdpr.ca.gov/docs/emon/pubs/mitc/dirctv120202.pdf

[8] OEHHA Memorandum to Charles Andrews of CDPR. Comments on DPR's Proposed Mitigation Strategy for MITC. May 5, 2006.

[9] DPR Toxic Air Contaminant Report for MITC. August 2002

[10] DPR Risk Characterization for MITC. July 2003

DPR Risk Characterization for Metam Sodium. July 21, 2004
https://www.cdpr.ca.gov/docs/risk/rcd/metam.pdf

The highest 24 hour air level measured in Shafter (1.2 ppb) reached 16.4% of 7,.3ppb, the reference level of 22 ppb, adjusted for 24 hour exposure. As you know, in the seasonal monitoring study conducted in Arvin in the summer of 2017 a peak 24 hour level of 4 ppb was measured with a month-long average air level of 1.03 ppb, exceeding the sub-chronic screening level of 1 ppb, set to prevent damage to the nasal cavity.

Sub-Chronic Screening Levels
Chloropicrin and 1,3-D

In 2017 DPR discontinued the practice of using a 4-week rolling average concentration to compare to chloropicrin and 1,3 D sub-chronic screening levels and began comparing to 90 day or 13 week rolling averages.[11] This change was made after peak 4 week rolling averages were found to exceed the 4 week chloropicrin screening level at the Santa Maria air monitoring site in 2014 and 2015[12] and the peak 4-week 1,3-D air concentration for 2016 in Shafter reached 97.6% the 1,3-D sub-chronic screening level.[13] DPR toxicologists claim these changes were justified because the toxicology studies used to set the sub-chronic screening levels were 90 days long for chloropicrin and 13 weeks long for 1,3-D. However, the revised averaging times have still not been reviewed by OEHHA and should be.

We think it is more scientifically valid and health protective to continue to compare air levels of these fumigants to the peak 4-week rolling average concentration rather than a season long average concentration. While rhinitis was found in rats at the end of a 90-day chloropicrin inhalation study it may have developed earlier and humans may be more sensitive than rats. In addition, in reality people are exposed to varying levels of chloropicrin and 1,3-D over time and higher level short term exposures may cause more respiratory and nasal problems.

If calculated as a 4 week rolling average, the highest sub-chronic chloropicrin air concentration in 2018 was 0.225 ppb at both the Oxnard and Santa Maria sites. This reaches 64% of the sub-chronic screening level of 0.35 ppb.

This report correctly reports that in 2018 the 1,3 D sub-chronic screening level averaged over 13 weeks was exceeded at the Shafter site. However, the statement that the exceedance of the sub-chronic 1,3 D screening level at the Shafter site was primarily driven by the 50.5 ppb level measured on January 22nd is misleading because levels in excess of 1 ppb were measured for several weeks after the January spike and a level of 4 ppb was measured in late October.

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[11] DPR Memorandum to Shelley DuTeaux. Calculation of Intermediate Term Residential Exposures Using Measured Air Concentrations from the Ambient Air Monitoring Network. August 9, 2016 https://www.cdpr.ca.gov/docs/hha/memos/intermediate_term_exposure_calculations.pdf
[12] DPR Report on Methyl bromide, 1,3-D and Chloropicrin Air Monitoring Results for 2010-2015. November 3, 2016
[13] DPR Air Monitoring Network Results for 2016. Volume 6. December 2017

Lifetime exposure: Cancer risk estimates
The phrase "potential carcinogens" is not appropriate. The pesticides 1,3 D, chlorothalonil, DDVP, diuron, iprodione and propargite are classified as known carcinogens under Proposition 65 and as probable carcinogens by USEPA. In addition, studies are in process evaluating potential carcinogenicity of MITC and chloropicrin.

DPR has selected a cancer risk level of 1 in 100,000 as the regulatory target for 1,3 D but this level is not generally considered negligible. A cancer risk of 1 in 1 million is used as the level of negligible risk by DPR in risk assessments and considered by OEHHA and most public health entities as the limit for adequate health protection.

The report should also note that DPR's 1,3 D risk assessment includes both the portal of entry and systemic cancer potency risk factors and that OEHHA maintains that the systemic cancer potency risk factor should continue to be used for adequate health protection. We note, as shown in slide 32 of the Air Monitoring Network results July 19, 2019 PREC meeting presentation, that 1,3 D cancer risk levels exceed 10^{-6} at the Shafter, Santa Maria and Watsonville sites using the portal of entry cancer potency factor. Utilizing the systemic cancer potency risk factor, risk exceeds 10^{-5} at the Shafter and Santa Maria sites. Further, at the Watsonville site, the average air concentration reached 0.1 ppb, the threshold level OEHHA supports to protect children from cancer.

Chloropicrin carcinogenicity
The average annual concentration of chloropicrin in Chualar and Watsonville was 0.03 ppb (30 ppt) and was 0.04 ppb (40 ppt) in Santa Maria. If sustained over time, these concentrations all greatly exceed the reference concentration of 0.24 ppt for controlling cancer risk to the 1 in a million level that was established in the DPR Chloropicrin TAC and Risk Characterization documents as the negligible risk level and supported in review by OEHHA and the TAC Scientific Review Panel. DPR subsequently made a unilateral decision that chloropicrin cancer data was equivocal and that an additional study was needed to assess cancer risk. That study is not due to be submitted until December 31, 2021[14] so in the meantime we are left with great uncertainty about cancer risk from chloropicrin exposure due to this huge data gap.

Results for individual communities
We appreciate inclusion of a description of each community. An aerial view map of each monitoring site would also be helpful along with an assessment of proximity to agricultural fields. Carrots are an additional major crop in the Cuyama area. Carrot preplant fumigation may account for the high percentage (89%) of detections of MITC at the Cuyama site.

The figures showing temporal trends in levels of individual pesticides detected at each monitoring site are very useful.

[14] Ann Prichard, communication by email

Field spike recoveries

We are concerned to note fairly low field spike percent recoveries for chlorothalonil (73%); chlorpyrifos (77%); malathion (72%); and MITC (78%) which suggest that reported values for these pesticides may be underestimates. We also strongly disagree with the Department's decision to discontinue use of field spikes at the end of 2018. It would seem appropriate to devote more resources to figuring out why these field spikes were low instead of discontinuing field spike measurements.

Field spikes provide reliable data about how field conditions may be affecting sample recovery. While the field spikes have their challenges and the data from them have their limitations (as cited by DPR in the 2018 AMN update)[15], discontinuing the practice of collecting field spikes would mean that *no* information would be collected about how field samples might have been affected by important environmental conditions (e.g., humidity, temperature, other environmental factors affecting samples). For example, a 2018 memo[16] from CDFA regarding MITC stated "The low recovery for the blind spikes would indicate that the sampling, extraction and analysis of the samples the lab analyzed during 2017 are reporting findings that are lower than what is actually in the air during the sampling."

MITC air monitoring studies conducted by academics[17] have included fortified field spikes, in order to collect data about field conditions while conducting air sampling. DPR could potentially use information from field spikes to help determine whether losses in the field are the result of laboratory methods (as CARB determined for 2017 methyl bromide samples), or for other reasons. In the 1990s, low field spike recovery rates for methyl bromide contributed to a study being conducted that showed that recoveries were greatly improved if steel canisters were used, rather than charcoal air tubes. As a result, sampling methodologies were improved for DPR field sampling. Therefore, field spikes can be useful and indeed may play an important role in helping DPR assess whether screening thresholds are potentially being exceeded.

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[15] DPR Air Program Updates and Quality Control Discussion (Edgar Vidrio).
Memo from CDFA to DPR. Field Spikes for Air Monitoring Studies. November 2, 2018.
[16] CDFA memo to DPR: Addressing the recovery of MITC from charcoal tubes, June 14, 2018.
https://www.cdpr.ca.gov/docs/emon/airinit/cdfa_memoranda_mitc_field_spike.pdf#page=4

[17] Woodrow, James E., et al. "Determination of Methyl Isocyanate in Outdoor Residential Air near Metam-Sodium Soil Fumigations." *Journal of Agricultural and Food Chemistry* 62, no. 36 (September 10, 2014): 8921–27. https://doi.org/10.1021/jf501696a.

Littke, Matt H, et al. "Comparison of Field Methyl Isothiocyanate Flux Following Pacific Northwest Surface-Applied and Ground-Incorporated Fumigation Practices: Comparison of Field Methyl Isothiocyanate Flux Following Different Fumigation Practices." *Pest Management Science* 69, no. 5 (May 2013): 620–26. https://doi.org/10.1002/ps.3414.

Historical air concentration analyses
It would be better to place the historical air concentration analyses, which provide very useful background, in the "Results from individual communities" section after 2018 data for each community site. In the historic analyses, some of the table entries show 0 ppb with a value in ng/m3. A non-zero value should also be provided in ppb. Tables 10 and 11 for Santa Maria appear to have ppb to ng/m3 conversion or rounding errors for chloropicrin and malathion.

The historical air concentration analysis shows that the Shafter annual air concentration for MITC (0.058 ppb) was higher in 2018 than any previous year. This should be mentioned earlier in the report.

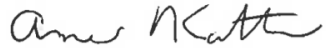
For Oxnard, Santa Maria and Watsonville more than 2 years of data are available for 1,3-D, methyl bromide and chloropicrin because these were previously TAC sites. That additional data should be included in historical analyses.

Air Monitoring Database
The Air Monitoring database is very well designed, user friendly and versatile. We greatly appreciate the inclusion of preliminary monitoring data and the ability to filter data by chemical, site and specific time periods and download filtered data into spreadsheets. It is unfortunate that Google will discontinue Google sheets at the end of the year, which means that the AMN data can no longer be organized using this system. We urge DPR to develop an alternative database that continues to be searchable and if possible is expanded to include mapping and graphing functions.

Suggestions for further analyses
Many of these monitoring sites are located at schools. We would recommend conducting an analysis to evaluate how the school buffer zone requirements may have impacted air levels measured at these sites. It also appears that 1,3- D and chloropicrin air levels have decreased at coastal sites in recent years. We recommend conducting an analysis that looks at whether there is any correlation between these fumigant air levels and the extent of use of TIF tarps surrounding the air monitoring sites.

Please contact us if you have any questions about these comments. Thank you again for your hard work maintaining the Air Monitoring Network and database and preparing these reports.

Sincerely,



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Dow AgroSciences Comments on
DPR's Draft Air Monitoring Network Results for 2018

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Introduction

The California Department of Pesticide Regulation's (DPR) Air Monitoring Network (AMN) has been in operation since 2010 and has developed a database of 24-h concentrations of 31 pesticide products, including 1,3-D, measured at receptors located in intensive agricultural areas in CA. A 24-h sample is collected on a randomly assigned day, once per week, at each AMN site for an entire year. Data exists for 17 sites, although since 2010, new sites have been added and some sites have been retired. Dow AgroSciences (DAS) recognizes that some of the sites are part of the Toxic Air Contaminant (TAC) or Study 309 programs, however the data are collectively referred to as "AMN" results in this review. A total of 3037 samples have been analyzed to date. Sites in Delhi and Parlier were introduced in 2016 under "Study 309" and are in townships with historically high 1,3-D demand and use (Merced and Fresno, respectively). The primary objective of monitoring at these sites under Study 309 is to evaluate the effectiveness of township use restrictions and a ban on December applications of 1,3-D.

DPR issued two draft reports, "AIR MONITORING NETWORK RESULTS FOR 2018 Volume 8- Report AIR 19-02" and "Monitoring of 1,3-Dicloropropene in Merced and Fresno Counties-Results for 2018: Volume 2-Report AIR 19-03" in July 2019. Results from both reports are reviewed in this document.

In addition, DAS has provided detailed comments to DPR regarding refined derivations of acute, subchronic and chronic screening levels and the regulatory target concentration value for 1,3-D. This is summarized further below. Finally, the regulatory target concentration derivation should be revised to address recent documentation of 1,3-D's Kinetically-derived Maximum Dose (KMD). Studies and related evaluations have been provided to DPR regarding the threshold-based KMD for 1,3-D and its role in refinement of chronic and lifetime exposure and risk estimation.

Evaluation of 1,3-D Screening-Levels and Regulatory Target

Alternative, refined derivations of 1,3-D acute, subchronic and chronic Human Equivalent Concentrations (HECs) and associated screening levels, and the "regulatory target" concentration (for lifetime exposure and risk evaluation) used for comparison to AMN measurements and modeled air concentrations, have been presented to DPR by DAS. Table 1 presents a comparison of screening level values currently recommended by DPR, versus those recommended by DAS. Detailed comments have been submitted to DPR. Further, an important consideration is the selection of an appropriate exposure metric (i.e., matching duration and time required for manifestation of the toxicological effect of interest), for comparison to alternative HECs and the resulting risk estimates (Margins of Exposure).

In the case of the acute HEC recommended by DPR, while the values have been time-weighted to a 24 hour period based on Haber's Law (or Rule)[1] (i.e., adjustment for concentration x time), the time to effect in the repeat dose study selected by DPR is 3 days (time and repeat dosing period required for statistically significant body weight decrement to be observed). Thus, the DPR acute screening level, should be compared to 72-hour time weighted average estimated exposure values (theoretical air concentrations assumed to be inhaled by bystanders for risk analysis). Further, an alternative to the repeat dose study used by DPR for the acute screening level derivation, is reliance on a 4-hour inhalation toxicology study

[1]F. J. Miller; P. M. Schlosser; D. B. Janszen (August 14, 2000). "Haber's rule: a special case in a family of curves relating concentration and duration of exposure to a fixed level of response for a given endpoint". *Toxicology*. **149** (1): 22–34.

and related benchmark response (BMR) of 10% body weight gain decrement, which reflects U.S. Environmental Protection Agency (U.S. EPA) and other guidance for selection of a biologically significant response. Differences in subchronic and chronic screening levels recommended by DAS, in comparison to DPR (see Table 1), relate to DAS's reliance on U.S. EPA's most recent guidance for derivation of inhalation reference concentrations (screening levels), and the use of a refined uncertainty factor that is consistent with that derived by the U.S. EPA. Detailed comments regarding DAS's recommendations have been submitted to DPR.

Table 1. Comparison of Alternative Screening Levels			**DPR Values**			**DAS Recommended Values**		
Exposure Duration	RGDR	HEC (ppm)	UFs	Screening Level (ng/m^3)	RGDR	HEC (ppm)	UFs	Screening Level (ng/m^3)
Acute	1	11	100	505, 000	1	42	30	6,342,000[c]
Sub-chronic	0.115	0.3	100	14,000[a]	1	2.6	30	394,110[b]
Chronic	0.198	0.2	100	9,000[a]	1	0.99	30	149,490[b]

[a] Based on EPA 1994: Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry Data.

[b] Based on EPA 2012: Advances in Inhalation Gas Dosimetry for Derivation of a Reference Concentration (RfC) and Use in Risk Assessment.

[c] Based on selection of 4-hr study and 10% BW gain decrement for the BMR.

In the case of the acute screening level for 1,3-D, it is important to provide context to the point of departure, i.e., decrements in body weight gain. Body weight gain decrements have been used by multiple entities (DPR, U.S. EPA) as a point of departure and the basis for establishing permissible exposure limits to humans. However, upon closer examination of 1,3-D inhalation toxicology studies and the decrements in body weight observed in all of these studies, coupled with consideration of some key physiological and toxicokinetic measurements/indicators, it is clear that body weight, particularly after repeat dosing, e.g., 3 days, is not an optimal point of departure for use in acute (24 hrs or less) Human Equivalent Concentration (HEC) derivation. In fact, it appears body weight decrements resulting from inhalation exposure to 1,3-D are a secondary effect, resulting from primary effects on respiration rate, GSH depletion, and systemic over-exposure to the test material. A recent toxicokinetic study supports this reasoned conclusion and also raises significant questions about inhalation studies that are conducted above the kinetically-derived maximum dose and their use in risk assessment. As DPR considers risk mitigation measures for acute exposures to 1,3-D, it is imperative that a balanced discussion and reasoned conclusion, supported by the available science, be conducted. If a repeat dose study is used for the acute

HEC (normalized to 24 hr exposure duration, i.e., per day exposure basis), as stated previously, it is imperative that it is compared to an appropriate exposure metric that matches the time to effects (3 days, or three 24 hr periods).

1,3-D and Effects on Portal of Entry Tissues

Dichloropropene compounds, in general, have sensory irritation properties and this translates into portal of entry (in this case inhalation) effects involving the respiratory tract, which are considered a primary toxicological/irritancy effect in animals and humans. Body weight is typically a secondary effect from oral and inhalation exposures often resulting from an apical injury, stress, or other treatment-related factors that may directly affect food consumption or respirability (e.g., breathing rate). In fact, for 1,3-D, the U.S. EPA IRIS program/office used nasal histopathology for derivation of the BMD and while this was derived from a repeated-dose and longer-term study, it shows the focus on portal of entry effects, which are a primary effect of exposure to 1,3-D. Consideration of body weight as the sentinel and appropriate endpoint of concern for establishing permissible exposure levels to humans, particularly from body weight decrements after 3 days of exposure (as used by DPR from Stott et al., 1984) is a toxicologically "blunt" and potentially irrelevant (relative to the toxicological profile and characteristics of 1,3-D) endpoint. If body weight is going to be used as a point of departure, particularly for acute exposures, available data for 4-hr exposures should be used, notably when body weight changes were reported. Finally, use of an acute exposure scenario such as 4-hours is far more appropriate when extrapolating to the human situation for protection of human health following acute exposures of this time duration. Humans are not continuously exposure to 1,3-D for 72 hours and therefore, there is no scientific or rational basis to use body weight decrements at 3 days for extrapolating to the acute (24 hrs or less) exposure scenario for humans.

Review of Selected Inhalation Studies and Effects on Body Weight

Stott et al (1984) conducted a 13-week inhalation in rats and mice and at the two top concentrations (90 and 150 ppm) for both species, statistical decrements in body weight were recorded. In rats, the decrements for both sexes began on day 3 (first measurement) and continued for the duration of the study, while in male and female mice, statistically significant differences were not recorded at 90 ppm until day 59 and 45, respectively and at day 15 (males) and day 3 and 17 (females) for animals exposed to 150 ppm. In interpreting these effects for rats, Stott et al (1984) concluded that "As no histologically observable changes were noted in these tissues, the organ weight differences were not interpreted as being indicative of a specific target organ effect; but rather, represented an indirect, nonspecific result of TELONE II vapor exposure in these rats." For mice, Stott et al (2014) concluded that "The absence of any observable histological alterations in any of these organs indicated that the organ weight differences were a nonspecific result of exposure to TELONE II vapors (e.g. stress-induced atrophy of lymphoid elements)." For both species, there is a clear threshold for concentration-dependent effects on body weight gain and for both, high concentrations of 1,3-D were required in order to elicit/manifest a decrement in weight gain. Additionally, it would appear that the absence of any histologically relevant changes in those organs/tissues evaluated support the interpretation that decrements in body weight gain are a result of

non-specific secondary consequences to experimental stress or reduction in respiratory minute volume (discussed below), both of which could result in reduction in food consumption and hence declines in body weight gain. In the end, these results are consistent with exposure to excessive concentrations of 1,3-D and not the result of treatment-related target organ specificity and toxicity.

A review of six different study types as noted by DPR in their 2015 Risk Characterization Document (RCD) for 1,3-D, Table IV, reveals a generally similar pattern in that body weight decrements, while recorded at various days (and again, multiple study types were involved), are concentration-dependent, but clearly threshold-related. The studies ranged from a genotoxicity study to subchronic inhalation studies to 2-yr bioassays, and while we have not reviewed these studies for determination of the critical point of departure, it is likely that body weight decrements were not found to be the most sensitive driver in all cases for establishment of references values for permissible exposures to humans.

In summary, a review of multiple studies shows body weight decrements to be a common occurrence resulting from repeated exposure to 1,3-D, a phenomenon which is concentration-dependent and for which a clear threshold exists. Table 2 presents Benchmark Concentrations (BMC10 for body weight decrement associated with a 10% response rate) and BMCL10 (lower confidence limit) based on body weight decrement for various 1,3-D repeat dose studies. In comparison, the BMCL10 derived by DAS for the Cracknell et al (1987) 4-hour inhalation exposure study (1,3-D at concentrations 0, 351, 572, 585, or 665 ppm) is 42 ppm.

Moreover, the effects consistently resulted from exposure to high concentrations of 1,3-D, and certainly for animals from the repeat dose study conducted by Stott et al (1984), appear to be secondary effects owing to other experimental factors (e.g., stress, reduction in respiratory minute volume). If, as we believe, these effects are secondary to other experimental factors, then it is important to probe further for biological/physiological evidence as to why exposure to high concentrations of 1,3-D result in overall body weight declines, which is discussed next.

Table 2. Summary of BMC10 and BMCL10 for eight repeat-toxicity studies

Study	Dose levels (ppm)	Exposure duration	BMC10	BMCL10
Rat dominant lethal	0, 10, 60, 150	7	167	137
Rat 2-year	0, 5, 20, 60	6	63 (M) 81 (F)	61 (M) 75 (F)
Rat 13-week	0, 10, 30, 90, 150	3	148 (M) 169 (F)	117 (M) 134 (F)
Rat developmental (full)	0, 20, 60, 120	4 (gestation day-9)	188	146
Mouse 2 year	0, 5, 20, 60	7	109 (M) 102 (F)	81 (M) 81 (F)
Rabbit developmental (full)	0, 20, 60, 120	3 (gestation day-9)	No dose response	
Rat developmental (probe)	0, 50, 150, 300	3 (gestation day-8)	274	165

Rabbit developmental (probe)	0, 50, 150, 300	3 (gestation day-8)	203	105

Drivers Behind Body Weight Decrements

Several biological changes occur in animals upon repeated inhalation exposure to 1,3-D. These effects are physiological (respiration) as well as metabolic (glutathione depletion). Either or both of these effects could result in stress to rats or mice exposed to 1,3-D via inhalation.

Changes in the respiratory patterns of rats or mice have been observed following 1,3-D exposures. Stott et al. report 26-47% decreases in respiratory minute volume (RMV) in rats acutely exposed for 3 hr to 1,3-D concentrations of 300 and 900 ppm (Stott and Kastl, 1986). Hotchkiss et al. also found a decrease in respiration of rats acutely exposed to 1,3-D for 6 hr, with 21 and 52% reductions in RMV at 60 and 150 ppm vs. 2.5 ppm (Hotchkiss et al., 2015). These up to two-fold decreases in total inhalation would impact normal physiology and as a result, food consumption and body weight.

The metabolic fate of 1,3-D involves conjugation with glutathione (GSH) for all of the reported pathways observed in the rat and mouse (Bartels et al., 2004). These observations are consistent with the measured depletion of lung GSH levels upon repeated exposures, with decreases of ~40-50% at 1,3-D concentrations of 60 and 150 ppm (Stott et al., 2001). Depletion of GSH in the portal-of-entry lung tissue is known to result in oxidative stress (Deneke et al., 1985; Rahman and MacNee, 2000) which could impact body weight gains (i.e., resulting in body weight decrements).

Toxicokinetic KMD

The metabolic clearance of inhaled 1,3-D has been shown to saturate in the rat and mouse. Stott and Kastl found that 1,3-D blood levels became supralinear at or above 300 ppm (3 hr acute exposure) (Stott and Kastl, 1986). Similarly, blood levels of 1,3-D were shown to be supralinear in mice at or above 30 ppm (6 hr acute exposure) (Hackett, 2018). This nonlinearity in systemic exposure is consistent with test material-based GSH depletion (discussed above), and correlates with increases in 1,3-D blood levels following lung GSH depletion via diethylmaleate pretreatment in rats (Yang, 1989).

Beyond saturation of metabolic clearance, the ratio of cis/trans 1,3-D isomers in mouse blood also changes substantially from ~0.13 to ~0.20 between the exposure concentrations of 40 and 60 ppm. These data indicate a substantial shift in one or more processes involved in metabolism of these two isomers at higher 1,3-D exposure levels.

Several regulatory guidance documents describe a Kinetically-derived Maximum Dose (KMD) as a dose level or exposure concentration at which systemic exposures become non-dose proportional, due to saturation of one or more pharmacokinetic or metabolic processes (i.e., absorption, metabolism) (OECD, 2014; NRC, 2007). For example, as per OECD Guidance document 116:

"Although top dose selection based on identification of inflection points in toxicokinetic nonlinearity may result in study designs that fail to identify target organ or body weight effects, it must be appreciated that

metabolic saturation in fact represents an equivalent indicator of biological stress. In this case, the stress is evidenced by appearance of non-linear toxicokinetics rather than appearance of histological damage, adverse changes in clinical chemistry, haematology parameters or decrease in body weight gain."

Based on this rationale, biological effects such as body weight gain decrements, seen only at or above the KMD, would be considered irrelevant for human health risk assessments.

Discussion and Recommendations

Analysis of the scientific data presented above indicates that there is strong evidence that the body weight decrements that are often seen in toxicity studies in animals exposed to 1,3-D are not a direct result of treatment-related exposure (i.e., primary or apical effect), but rather an indirect effect resulting from key physiological and metabolic processes. This is supported by evidence that 1,3-D's primary effect following inhalation is on portal-of-entry effects (used by EPA's IRIS program for BMD calculations) and consistent evidence from numerous studies indicating that body weight decrements are a threshold-related phenomenon with decrements only occurring at higher doses/concentrations, ones at which systemic exposures become non-dose proportional owing to saturation of pharmacokinetic or metabolic processes. In fact, as discussed above, there is solid evidence that the higher concentrations associated with body weight decrements were associated with (a) reduced respiration which directly has relevance for reduced food consumption and body weight gain; (b) GSH depletion which in turn can be associated with oxidative stress and body weight decrements; and (c) test concentrations which exceeded the KMD for 1,3-D and therefore which are not relevant for human risk assessment. Body weight decrements resulting from high exposures to 1,3-D should not be used as the primary basis for HEC derivation and subsequent risk mitigation as it has clearly been shown that this effect is secondary to overexposure which has direct effects on physiological parameters such as respiration rate and resultant reduced body weight gain.

If DPR decides to continue to use body weight decrease from the repeated exposure studies to derive an acute endpoint, several considerations should be recognized:

1) Body weight was evaluated following acute exposure in the Cracknell et al (1987) study, and the use of repeated exposure on the same endpoint and disregarding the existing acute exposure studies results in a more conservative acute screening level value.

2) DPR used the benchmark dose approach to generate BMCLs and used the 1 standard deviation (SD) as benchmark response (BMR). This is a default assumption / selection according to the Benchmark Dose Technical Guidance Document (External Review Draft): "for continuous data if no known biological significance, a change of 1SD may be applied as a default BMR." *However, with respect to body weight change and to what degree or magnitude it is considered adverse, two guidance documents specifically point out that 10% decrease in body weight is generally recognized as biologically significant (USEPA 2003, and USEPA 2000).* Consistent with this guidance, U.S. EPA's tier I risk assessment, Integrated Risk

Information System (IRIS), and tier II risk assessment, Provisional Peer-viewed Toxicity Values (PPRTV) both utilize 10% body weight decrease as BMR.

3) Body weight decrease used to derive an acute reference concentration (RfC) is of minimal adversity when such effect is not accompanied with other toxicological correlates or toxicity indications from other endpoints including clinical chemistry, hematology, neurotoxicity, and histopathology in adult animals, or fetal and offspring effects in pre-, post-neonatal, or young animals. Thus, based on these considerations, reduced uncertainty factors may be warranted. Solecki et al (2005) in their publication on the establishment of acute reference doses for pesticides, specifically noted that "A reduced factor [safety] might be appropriate if the endpoint used to derive an ARfD is of minimal adversity and the critical NOAEL is from a repeat dose study (e.g., reduced food consumption and body weight gain (i.e., observed in the first days) or increased organ weight with minimal pathological change. When considering body weight changes considerations need to be given to potential problems of palatability of the feed." This perspective is directly relevant to the case here in which inhalation of high concentrations of 1,3-D are affecting respiration and hence reduced food consumption.

In conclusion, there is little support for the utilization of body weight decrement as an endpoint for establishing an acute HEC and if this practice continues, then there is strong recommendation for comparing the selected time domain of the acute HEC to a corresponding exposure period (i.e., 4 hr HEC compared to a 4 hr TWA inhalation exposure, or a 3-day HEC compared to a 3-day TWA inhalation exposure). For purposes of "acute" exposure, a more defensible and appropriate exposure period is 4-hours (or 24-hours), and not 3 days. The latter is clearly not acute and would be better described as short-term. Finally, there is sound scientific evidence that body weight decrements are secondary effects owing to a variety of 1,3-D-specific portal of entry effects, and related effects on physiology,), pharmacokinetics and metabolism, at sufficient doses (at and above the KMD).

AMN Program Overview

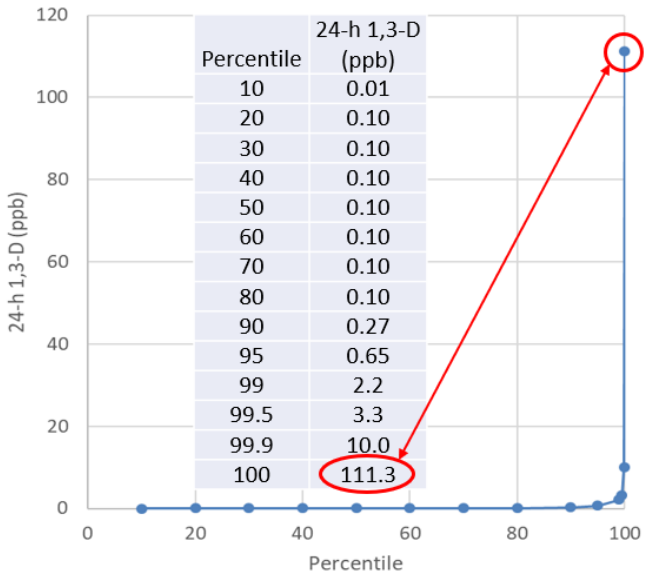
Table 3 shows the years that monitoring was conducted and the total number of 24-h samples collected at each of the 17 locations that are currently, or were historically, in the AMN program. Extensive monitoring in areas of high 1,3-D use during 2018 showed that 88.9% of the samples had no detectable residues of 1,3-D (Report AIR 19-02). Targeted monitoring in the two high use areas (Delhi and Parlier) under Study 309 in 2018 showed that 1,3-D was detected in 68% and 84% of the samples, respectively (Report AIR 19-03). The highest 24-h concentration of 1,3-D in 2018 occurred in Shafter and although it did not exceed the acute screening level (110 ppb), it did result in exceedance of the 13-week rolling average (RA) concentration screening level (3 ppb). Dow AgroSciences (DAS) concurs with the Department's observation that the exceedance of the 13-week RA at the Shafter site was largely influenced by the single high 24-h 1,3-D concentration (50.5 ppb) that occurred at that site. The dominating effect of a single high concentration of 1,3-D on the 13-week RA and annual average concentration was also observed at the Parlier site in Study 309 (Report AIR 19-03) where a 1,3-D concentration of 111.3 ppb was measured in October 2018. Considering these exceedances of the sub-chronic screening level at the Shafter and Parlier locations, and the uncertainty associated with the 13-week RA concentration, DAS suggests some alternative approaches for determining annual average and RA concentrations, including the use of air dispersion modeling to account for missing and censored data, in subsequent sections of this document.

The distribution of all the weekly 24-h 1,3-D concentrations measured in the AMN program to date (3,037 samples) are shown in Figure 1 and illustrate the highly skewed nature of the data, with the highest measured concentration (100th percentile) of 111.3 ppb, while the 99.9th percentile concentration falls to 10 ppb. This reflects the fact that most of the samples resulted in no detection of 1,3-D (ND) or low trace level detections, as was the case in the 2018, with 88.9% of samples containing no detectable level of 1,3-D.

Table 3. Monitoring years and number of 24-h 1,3-D samples collected at AMN each site.

Site	Years monitored	No. of Samples
Santa Maria	2010-2018	519
Shafter	2011-2018	413
Oxnard	2011-2018	450
Watsonville	2011-2019	428
Ripon	2011-2016	306
Salinas	2011-2016	306
Parlier	2017-2018	108
Delhi	2017-2018	109
Camarillo	2010-2011	65
Chualar	2017-2018	100
Tulelake	2017	25
San Joaquin	2018	36
Macdoel	2017	32
Dorris	2017	35
Lindsay	2018	35
Weed	2017	35
Cuyama	2018	35
TOTAL 1,3-D analyses		**3037**

Figure 1. Probability distribution of all 3,037 24-h 1,3-D concentrations measured in the AMN program since 2010.



The annual average 24-h 1,3-D concentration at each AMN location, for each year of monitoring, is shown in Table 4. Although 24-h 1,3-D concentrations have not exceeded the DAS-recommended acute screening level at any of the monitoring locations, the maximum value measured (see Figure 1, i.e., 111.3

ppb) slightly exceeds DPR's current acute screening level (110 ppb; see Table 4 below), and a small number of higher-level detections have resulted in an exceedance of the DPRs 13-week rolling average (RA) screening level (3 ppb) in Parlier and Shafter, and exceedance of the chronic screening level for 1,3-D (2 ppb) in Parlier in 2018. The DPR lifetime/cancer risk regulatory target of 0.56 ppb was exceeded in Parlier in 2017 and 2018, and Shafter in 2018. All other sites/years have annual average concentrations 10 to 20-fold below the chronic screening level (2 ppb).

Table 4 also shows that when all weekly 24-h concentrations are averaged across the years sampled at a given location, the multi-year concentrations are also below the chronic screening level, ranging from 0.07-1.71 ppb. The average 24-h concentration at the Parlier site is based on just two years (2017/2018) of weekly 24-h 1,3-D data that contain a small number of exceptionally high 1,3-D concentrations that drive the rolling average and annual average 1,3-D concentration and is discussed in more detail below.

Table 4 also shows that the average 24-h 1,3-D concentration across all AMN locations each year is less than the chronic screening level (2 ppb). The "Grand Mean" of 24-h concentrations from all sites/all years is 0.25 ppb, and suggests that on average, over the long-term California residents are not exposed to levels of 1,3-D exceeding the chronic screening level. It is appropriate to consider the "Grand Mean" concentration to infer potential long-term human exposure to CA residents, since it inherently considers population mobility.

Table 4. Average of all 24-h 1,3-D concentrations (ppb) collected at AMN sites from 2010-2018

Site	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Average (All years)**
Camarillo	0.359	0.255								**0.285**
Chualar								0.096	0.044	**0.069**
Cuyama									0.100	**0.100**
Delhi							0.277[a]	0.134	0.198	**0.170**
Dorris								0.100		**0.100**
Lindsay									0.100	**0.100**
Macdoel								0.100		**0.100**
Oxnard		0.100	0.236	0.209	0.136	0.254	0.156	0.159	0.108	**0.181**
Parlier							0.433[a]	0.617	2.945	**1.708**
Ripon		0.542	0.100	0.234	0.071	0.074	0.089			**0.178**
Salinas		0.532	0.113	0.176	0.012	0.048	0.045			**0.150**
San Joaquin									0.105	**0.105**
Santa Maria	0.270[a]	0.209	0.228	0.226	0.157	0.153	0.159	0.119	0.108	**0.179**
Shafter		0.464	0.132	0.607	0.204	0.179	0.346	0.110	1.554	**0.452**
Tulelake								0.100		**0.100**
Watsonville		0.118	0.205	0.171	0.134	0.157	0.117	0.117	0.084	**0.144**
Weed								0.100		**0.100**
AVERAGE (All Sites)	**0.314**	**0.317**	**0.169**	**0.271**	**0.119**	**0.144**	**0.203**	**0.159**	**0.535**	**0.248**

[a]Partial Year

Table 5. DPRs acute, subchronic, and chronic screening levels and lifetime cancer risk regulatory target.

Exposure	Exposure Period	Screening Level (ppb)	Potential Health Effect
Acute	72 hour	110	Change in body weight
Subchronic	90 day	3	Tissue damage in nose and lung
Chronic	1 year	2	Tissue damage in nose and lung
Lifetime/Cancer Risk*	70 years	0.56	Cancer

*Regulatory target rather than a screening level

Parlier Site 2017-2018

Figure 2 is a time series plot of the weekly 24-h 1,3-D concentration at the Parlier AMN site for 2017 and 2018 and shows that a very small number of high concentrations control the 13-week RA concentrations (Figure 3), and the annual average concentration.

The annual average concentration at the Parlier site in 2017 (0.62 ppb) was dominated by a single detection of 1,3-D (16 ppb) from a sample collected on Sept 19-20, 2017. Examination of the 1,3-D application records and weather conditions at the Parlier site during September 2017 showed that 1,3-D was applied at 33 gallons per acre (gpa), the tree and vine rate, to a 9-acre field within a few hundred feet of the AMN receptor. The weather data showed significant calm periods for several days following the application and during the sampling time. Calm conditions are known to cause elevated concentrations of ambient air concentrations of pesticides.

The annual average concentration at the Parlier site in 2018 was dominated by a single detection of 1,3-D (111 ppb) occurring on October 9, 2018. Just prior to that sample event, 5 applications of 1,3-D had been made to fields ranging from 1.5 to 2 acres in size. All fields were within one mile of the AMN receptor, and two were within about 500 feet of the receptor. Averaging this single 24-h detection with the 51 other weekly 24-h samples resulted in an annual average concentration of 2.94 ppb, exceeding both the chronic screening level and lifetime/cancer risk regulatory target of 0.56 ppb.

Figure 2. Weekly time series of 24-h 1,3-D concentration at the Parlier AMN site from 2017-2018

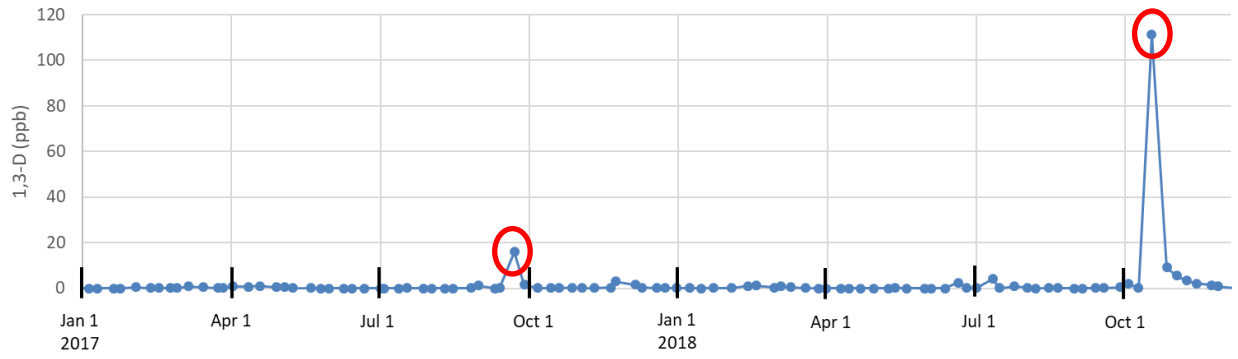
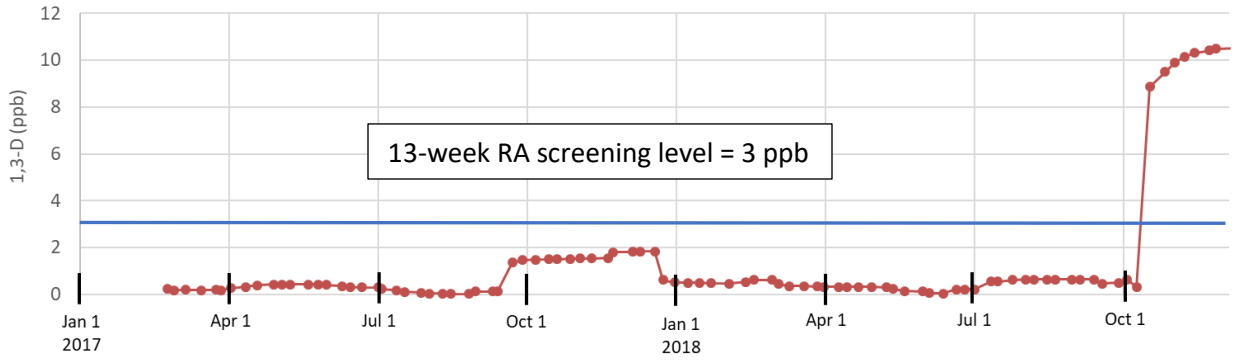


Figure 3. Weekly time series of 13-week RA 1,3-D concentration at the Parlier AMN site 2017-2018



Shafter Site 2018

In contrast to previous years of AMN results for Shafter, where maximum measured concentrations were well below screening levels, in 2018 a single high 24-h concentration (50.5 ppb) was measured at the Shafter receptor, though not exceeding the acute screening level, which resulted in an exceedance of the 13-week RA and annual average screening levels when averaged with weekly 24-h 1,3-D concentrations for the rest of 2018.

Figure 4 shows a time series plot of the 24-h 1,3-D concentrations at the Shafter AMN site plotted weekly for 2018. The single high concentration of 1,3-D (50.5 ppb) detected at the site on January 23-24, 2018 dominates the 13-week rolling average (RA) concentration which peaks at 5.6 ppb (Figure 5) and exceeds the subchronic screening level of 3 ppb.

Examination of the 1,3-D application records and weather conditions at the Shafter site during January 2018 showed that 1,3-D was applied at 30 gpa to a 25-acre field within a few hundred feet of the AMN receptor, two days prior to the sample event. The weather data showed significant stable air (calm periods) for several days following the application and during the sampling event. Calm conditions are known to cause elevated concentrations of pesticides in ambient air. The SOFEA model was parameterized with product use data (from PUR database) and weather data from the area and which simulated 24-h 1,3-D concentrations of 50 ppb between the 95th and 99th percentile, suggesting a concentration of that magnitude is a low probability occurrence and is driven by the close proximity of the field to the receptor, and wind direction.

It should be noted that 1,3-D applications to tree and vine crops occur only once every 20-30 years depending on the lifespan of the orchard. Furthermore, for a human to potentially be exposed at those sub-chronic and chronic levels of 1,3-D would require that they be co-located with that receptor for 13 weeks or 52 weeks, or in the case of the lifetime/cancer risk regulatory target, for 70 years. National and California specific population mobility surveys indicate that humans are very mobile and the assumption that they remain in a fixed location for 13 weeks, let alone a year, is extremely rare and adds significant conservatism to the risk assessment (Driver et al. 2016a, 2016b).

Figure 5 shows that the 13-week RA 1,3-D concentration begins to rise in late January 2018 (after the 50.5 ppb 24-h detection on Jan 23), exceeding the 13-week RA screening level (3ppb) in February 2018, and

reaching a maximum (5.6 ppb) approximately 13 weeks later (April 24, 2018). After the 13-week RA peaks on April 24, it drops precipitously, reflecting the low 24-h weekly concentrations occurring throughout the remainder of the year at the Shafter site.

Figure 4. Weekly time series of 24-h 1,3-D concentration at the Shafter AMN site in 2018

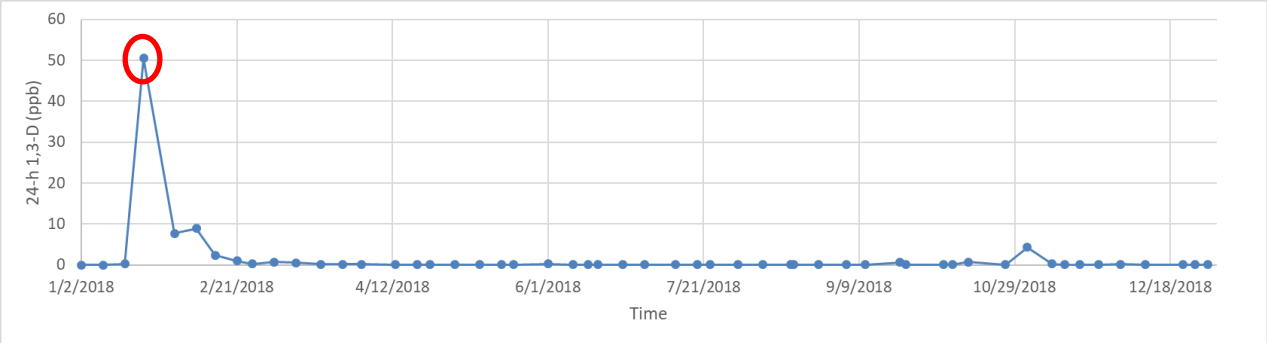
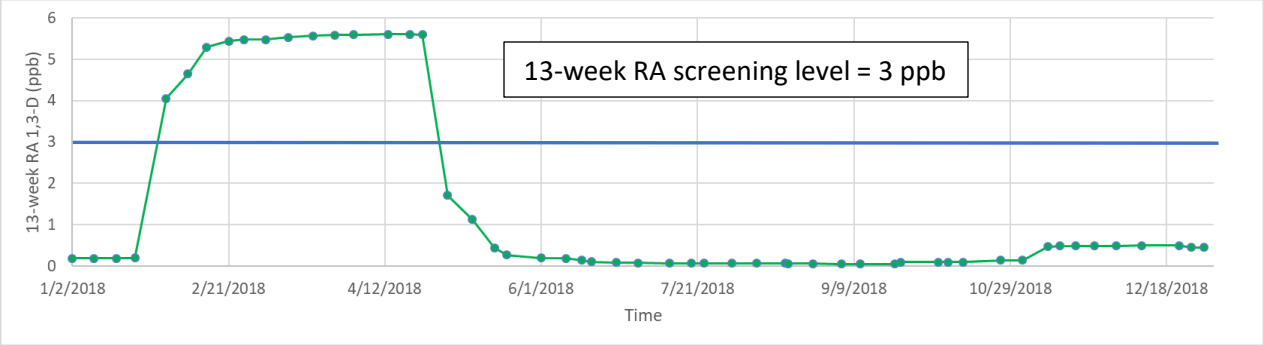


Figure 5. Weekly time series of 13-week RA 1,3-D concentration at the Shafter AMN site in 2018.



Figures 2-5 clearly show the impact that a single high 24-h concentration has on RA and annual average concentrations. Additional discussion of calculation of RA's, and potential ways to refine these values using all the available AMN data is given in a later section of this document.

Study 309 AMN Sites in Delhi and Parlier

DPR initiated monitoring at two additional sites (Delhi and Parlier) in late 2016 as part of Study 309. The goal of that air monitoring study is to evaluate the effectiveness of the current 1,3-D township cap and permit conditions promulgated as a result of DPR's 2016 RCD that became effective in January 2017. The new permit conditions allow annual application of 136,000 pounds of 1,3-D per township, ban December applications, and eliminate the 'banking' system.

To monitor the effect of these changes in 1,3-D product use, DPR selected two communities characterized by relatively high levels of historical 1,3-D use which were not already included in monitoring conducted by DPR or the California Air Resources Board (ARB). DPR staff collected weekly 24-h air samples to monitor 1,3-D in the communities of Delhi (Merced County) and Parlier (Fresno County) beginning in November 2016. Weekly 24-h 1,3-D samples have been collected since then, and a complete weekly time series for these communities is available from January 1, 2017 through December 31, 2018.

Since the measured concentration at a receptor is more greatly affected by the proximity and source strength of a 1,3-D application, and less by the total number of applications, or total mass applied in a 6x6 mile township, it is erroneous to assume that the observation of a single high 24-h 1,3-D concentration means that a particular mitigation is not effective. It could simply mean that a single application of 1,3-D was made very close to the receptor at a time when meteorological conditions favored movement to that receptor location. DPR has shown in multiple analyses with several active ingredients, that correlation between the AMN concentration at a receptor and the mass of chemical applied in the township(s) surrounding the receptor is very weak. This is because parameters such as weather and proximity to the AMN receptor have a major effect on the measured concentration causing it to vary significantly from year to year. Therefore, multiple years of monitoring are needed to visualize and quantify the effect of mitigations that reduce the mass of 1,3-D applied annually in a township.

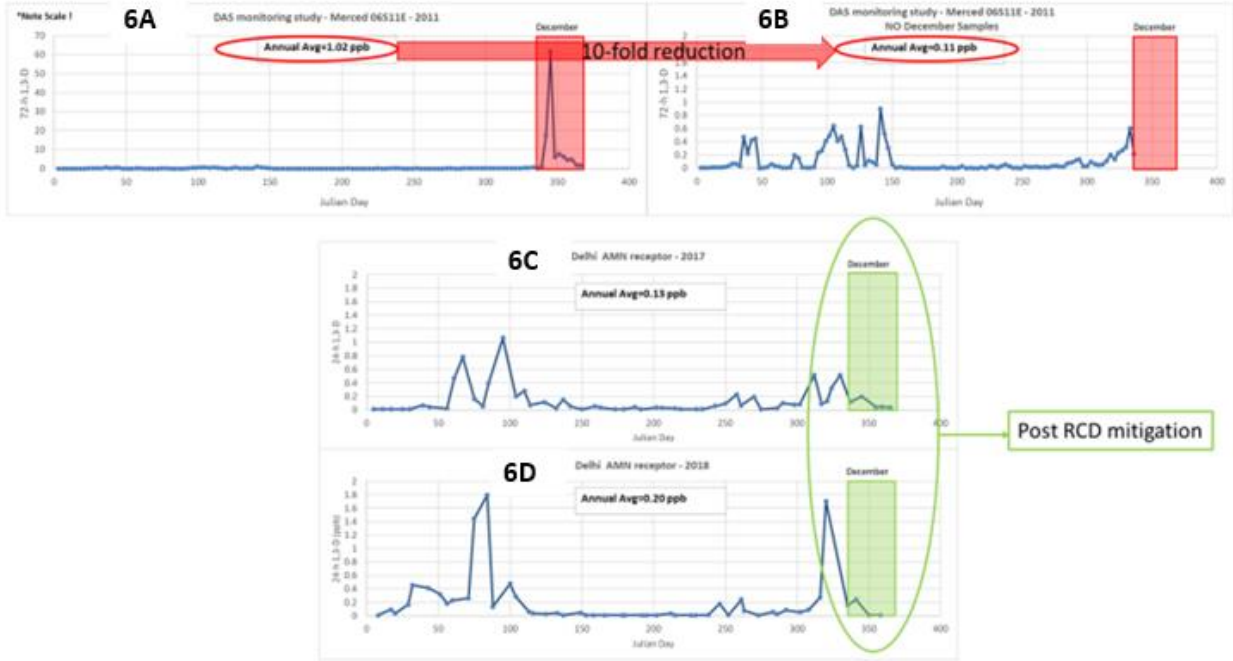
The weekly 24-h AMN data is perhaps more useful for assessing mitigations that reduce 1,3-D use during certain times of year (e.g. the December ban). The 1,3-D concentration data collected from the new site in Delhi for example show that the 2016 RCD mitigation banning December applications has been successful in reducing historically high 1,3-D concentrations resulting from calm conditions that are prevalent at that time of year, as is discussed in detail below.

Effectiveness of December Ban using Delhi AMN data

The AMN receptor in Delhi is in the same township (Merced 06S11E) as the DAS receptor that was used to collect continuous 72-h 1,3-D concentrations from October 2010-January 2012. The AMN and DAS receptors were about 2 miles apart, located in section 8 and section 16 of Merced 06S11E, respectively. The close spatial proximity of the receptors allows comparison of 1,3-D concentrations observed in December both before and after the ban on December applications in 2016.

Figure 6 (see subfigures A and B) show the 72-h 1,3-D concentrations at the DAS monitor near the Delhi site in 2011, prior to the ban on December applications, with a peak concentration of 61 ppb occurring in December of that year (highlighted in red). The annual average concentration at that receptor was 1.02 ppb in 2011. Removing the December 2011 data from the annual average calculation reduces the annual average concentration to 0.11 ppb (~ 10-fold reduction, Fig. 5B) and is similar to the annual average concentrations of 0.13 and 0.2 ppb observed at the AMN Delhi receptor in 2017 (Fig. 5C) and 2018 (Fig. 5D) respectively, measured after the ban on December applications.

Figure 6. Impact of 2016 ban on December applications in Merced township 06S11E (Delhi).



This comparison of monitoring data collected in Merced, one of the highest 1,3-D use areas in California, shows that historically high 1,3-D concentrations occurring in December have been significantly mitigated by the ban on applications in December.

Impact of Township Cap Set at 136,000 Pounds 1,3-D per Year

The impact of setting the township allocation at 136,000 pounds 1,3-D per year could take more time to show up in the AMN monitoring results since the 1,3-D levels in air are primarily dependent on whether an application occurs close to and upwind of the receptor, or under stable air conditions. Changes in township allocation limits will likely be observed in the AMN dataset after the new township cap limit has been in place for several more years.

Possibly the best way to assess the effect of the change in California-wide 1,3-D township allocation (cap) is to look at the trend in annual average concentration obtained at all AMN sites over time. DAS agrees with DPRs acknowledgement that a single high 24-h concentration can dominate the 13-week RA and the annual average concentration, which can result in an exceedance of a trigger. This suggests that additional years of monitoring are required before the full impact of mitigations are reflected in the ambient 1,3-D concentrations.

Calculation of Rolling Average (RA) Concentrations

As shown earlier, a single 24-hour 1,3-D concentration can dominate the calculation of the 13-week RA concentration each year, and raises the question of the representativeness of that RA. This is further exacerbated by the uncertainty introduced by the 85% missing data in the dataset and suggests that the

longest time series of weekly 24-h data available should be used to calculate moving averages and annual averages for the purpose of characterizing potential exposure and risk.

Figure 7 shows the weekly 24-hour 1,3-D concentration for the Shafter AMN receptor from the start of monitoring in 2011 through the end of 2018, the last full year of data, resulting in an 8-year time series of weekly 24-h concentrations (416 values). The highest measured 24-h concentration (~50 ppb) at the Shafter AMN site occurred on Jan 21, 2018 and is highlighted in red in Figure 6.

DAS recommends using all the available AMN data at each site to calculate all the potential 13-week RA concentrations for the eight-year period that the AMN receptor at Shafter has been monitored (Figure 6A). This requires the same assumption discussed above, that each 'weekly' average concentration is characterized by the single 24-h sample collected during that week. The number of 13-week rolling average concentrations (n) that can be calculated from eight continuous years of weekly monitoring data is 403 (n=8*52-13) and are shown in Figure 6B. These 403 estimates form a probability distribution function (PDF) of 13-week RA concentrations at the Shafter AMN site (Figure 7) and allow the risk manager to select an appropriate percentile concentration to use in the risk assessment.

Figure 8 shows that the 13-week RA concentration spanning the 50 ppb 24-h detection that occurred on January 21, 2018 is the highest RA concentration (5.6 ppb) ever measured at Shafter over eight years. This is not surprising since 50 ppb is the highest 24-h concentration of 1,3-D ever measured at the Shafter AMN location between 2011 and 2018, and clearly dominates the 13-week RA calculation in early 2018. For comparison, the 90th and 95th percentile 13-week RA concentrations are 1 ppb and 2 ppb, respectively when the entire 8-year time series of weekly 1,3-D concentrations is considered.

Figure 7. Weekly time series of 24-h 1,3-D concentration (A) and 13-week RA (B) from 2011-2018 at the Shafter AMN receptor

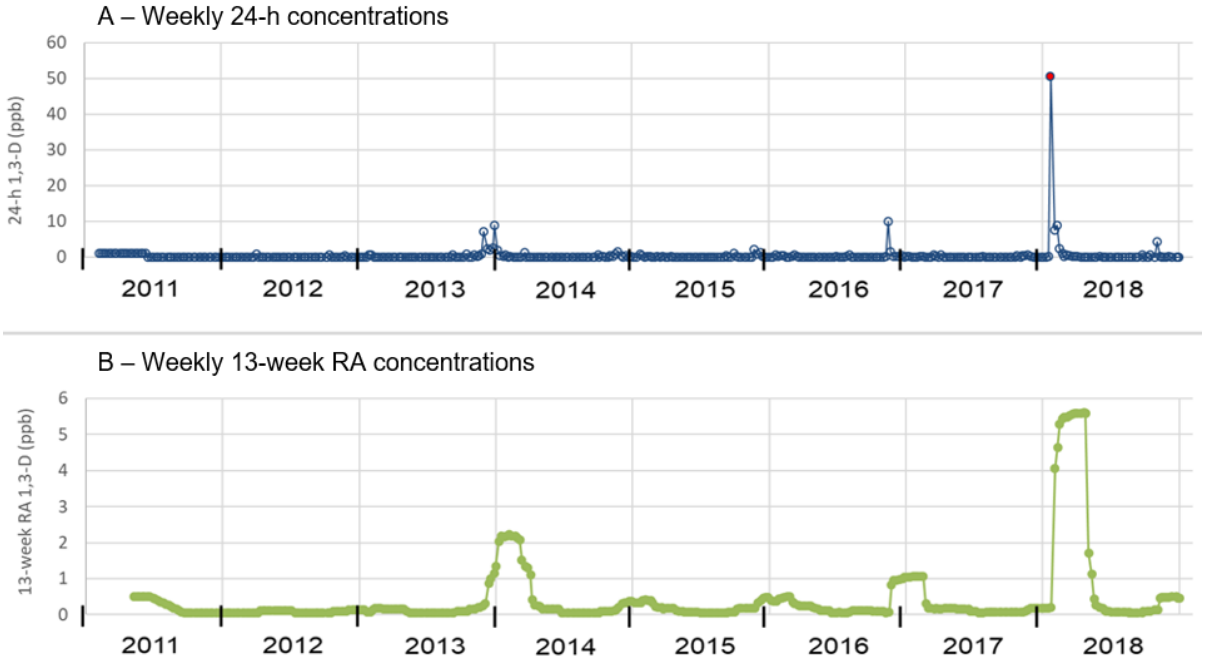
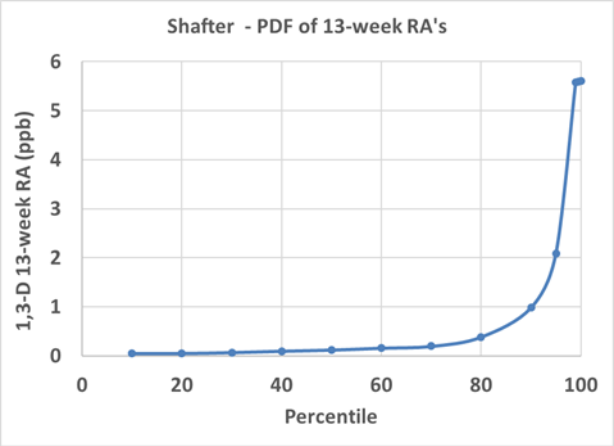


Figure 8. Shafter PDF of 13-week RA from 8-year dataset.



Here again, the missing data come into play because a true 13-week rolling average would require averaging 91 consecutive days of concentration data, but since there is only a single 24-h sample collected each week, that concentration is necessarily assumed to represent exposure for that entire week (i.e.. the same concentration applies for all seven days of the week). Depending on the local weather and product use near the receptor, this could result in an over- or under- estimation of the weekly and rolling average concentrations and underscores the value of using an air dispersion model (e.g. SOFEA) to simulate 1,3-D concentrations in ambient air based on known mass of 1,3-D applied, location and timing of the applications, and local weather (wind speed, direction, etc.).

General Discussion of AMN data utility

The collection and analysis of air samples is very resource intensive and taking continuous measurements for an extended time period is typically not feasible. For this reason, only a single 24-h sample is collected from each AMN site each week. The weekly 24-hour 1,3-D concentrations are very useful for characterizing potential acute exposure to 1,3-D, however the utility of the AMN data for quantifying short-term, sub-chronic, and chronic (annual or lifetime) exposure and risk is not as straightforward for two reasons. First, only a single 24-h sample is collected each week and therefore 6 out of 7 days (>85%) have no data. This results in the need to assume a 1,3-D concentration on the non-sampled days. DPR assumes that the measured concentration persists for the entire week which they acknowledge could result in either an over- or under-prediction of the weekly average concentration. Secondly, the AMN dataset is typically highly censored due to many samples where the concentration is less than the analytical Limit of Detection (LOD) or Minimum Detection Limit (MDL). DPR assumes that samples that show no detection (ND) are equal to one-half of the MDL or LOD, which could also result in an over- or under-prediction of the weekly concentration. Both issues add uncertainty when monitoring data is used to assess potential sub-chronic, chronic and lifetime exposure and risk, and point to the value of air dispersion modeling to fill in gaps in the monitoring data.

Use of Air Dispersion Modeling to Supplement AMN Data

A cost-effective and scientifically sound approach to supplementing monitoring data is to use a validated air dispersion model such as the SOil Fumigant Exposure Assessment (SOFEA) model. SOFEA can be parameterized with pesticide use data (volume applied; date applied etc.) obtained from DPR's Pesticide Use Reporting (PUR) database and when combined with local meteorological data, has been shown to accurately simulate the timing and magnitude of 1,3-D concentrations in ambient air (van Wesenbeeck et al., 2016) as well as the overall PDF of 1,3-D concentrations in air. SOFEA also simulates air concentrations on an hourly time step and can therefore be used to characterize acute, subchronic and chronic exposures ranging from 1 hour to several years, or a human lifetime.

The use of a modeling tool such as SOFEA is a logical complement to monitoring datasets and can be used to fill in data gaps with reasonable certainty, especially when local product use information and weather data are available. Ultimately the use of a model significantly reduces the need for arbitrarily conservative assumptions to deal with missing and censored data, and decreases the uncertainty associated with many monitoring datasets.

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From: Baker, Lynn@ARB <lynn.baker@arb.ca.gov>
Sent: Tuesday, August 13, 2019 10:45 AM
To: Pham, Minh@CDPR <Minh.Pham@cdpr.ca.gov>
Cc: Guerrero, Joe@ARB <joe.guerrero@arb.ca.gov>
Subject: Comments on 2018 air monitoring network report

Minh,

Following the July 2019 presentation at DPR's PREC meeting regarding your air monitoring network report for 2018, I reviewed the draft report and have the following comments.

1. Significance of undetected pesticides – The executive summary and the body of the report note that of the 36 pesticides monitored, eight were not detected. This implies that those pesticides do not become airborne. We suggest noting that one reason for not detecting some of the pesticides is that they were not used in the vicinity of the monitoring sites.
2. Page numbers – Although the table of contents lists page numbers, there are no page numbers in the body of the report.
3. References to CARB – On page 5 and throughout the report, the California Air Resources Board is referenced as ARB. We officially now go by CARB, not ARB.
4. Reason for community selection – On page 5, the section titled "Number of Communities Monitored" states that four communities were selected based on nearby use of four soil fumigants. Fumigants listed include methyl isothiocyanate (MITC) and MITC-generators. MITC is not an applied fumigant; it breaks down from metam sodium and metam potassium. We suggest deleting MITC and just describing this as MITC-generators.
5. Pesticides monitored – On page 6, the section titled "Pesticides Monitored" indicates that "DPR monitored 31 pesticides and 5 breakdown products." This should be DPR and CARB. In addition, it may be useful to include a description of which pesticides were analyzed by the CARB lab and which were analyzed by the CDFA lab.
6. Discussion – On page 15, the last sentence states that "DPR is in the process of developing regulations to reduce exposures to 1,3-D in ambient air." This implies that there is no current mitigation for 1,3-D, which is incorrect. We suggest rewording this sentence to make it clear that the DPR effort will modify existing mitigation measures to further reduce exposures to 1,3-D.

Please contact me if you have any questions about these comments.

Lynn

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