Department of Pesticide Regulation
Environmental Monitoring Branch
1001 I Street, P.O. Box 4015
Sacramento, CA 95812-4015

Addendum: Modeling for mitigation measures to reduce acute exposure from 1,3-Dichloropropene, Revised setback tables

Yuzhou Luo, Ph.D.

Research Scientist IV

4/3/2023

1 Introduction

The report is an addendum to the initial modeling report for the mitigation measures to reduce acute exposure from 1,3-Dichloropropene (1,3-D) (Luo, 2022). To mitigate acute exposure from 1,3-D applications, Department of Pesticide Regulation (DPR) proposed setbacks from occupied structures and associated limits on application rates and block sizes (DPR, 2023). In the previous study (Luo, 2022), air dispersion modeling approach was used to generate the setback tables. This study will update and extend the existing setback tables with additional application methods and more options for model inputs and outputs (Table 1).

Table 1. Modeling configurations in this study and the previous study

	Presented in the previous study	Proposed in this study
Field fumigation methods (FFMs)	8 FFM groups including 23 methods	Same groups with 24 methods. Change 50% TIF methods to 40% TIF (Totally Impermeable Film). Add 24-in GPS method
Setback distances (ft)	100, 200, and 500	100, 200, 300, 400, and 500
Application rates	8 rates from 100 to 332 lb/ac	26 rates from 80 to 332 lb/ac with an interval of 10 lb/ac
Meteorological conditions	Representing the inland region	Inland and coastal regions

2 Methods and materials

2.1 Field fumigation methods and flux time series

In total 24 field fumigation methods (FFMs) are considered in this study (Appendix I). Changes to the previous study include:

[1] Change the 50% TIF methods to 40% TIF methods, which conservatively represent the proposed 40 to 60% TIF strips.

[2] Add the 24-in GPS method (FFM 1227) and group it with the standard 24-in methods (Group 4, Table 2)

The FFMs are categorized into 8 groups according to injection depth, tarpaulin type, and emission ratio (Table 2). For each group of FFMs, a representative FFM (highlighted in Table 2) is selected by considering the associated uses and 72-hour peak fluxes. For the representative FFMs, their flux time series with hourly flux rates ($\mu g/m^2/s$) were generated by HYDRUS model (Brown, 2022, 2023). There are 21 flux time series for each FFM, representing the 21 distinct sets of soil conditions sampled in previous fumigant field studies. Model simulations are conducted for each flux time series, and the median value of the modeling results over the 21 soils is reported for the corresponding FFM.

Table 2. Groups of field fumigation methods (FFMs) and the representative method

Group of FFMs	FFMs in the group
1-Standard nontarped and non-TIF tarp shallow (12 inch) methods	**1201**, 1202, 1203, 1204, 1205
2-Standard nontarped and non-TIF tarp deep (18 inch) methods	**1206**, 1207, 1208, 1210, 1211
3-Chemigation (drip)/non-TIF tarp method	**1209**
4-24-inch injection methods	**1224**, 1225, 1226, 1227
5-TIF methods – broadcast and strip	**1242**, 1247, 1249
6-TIF methods – bed and drip	**1243**, 1245, 1248, 1259
7-40% TIF with 18-inch injection depth method	**1250**
8-40% TIF with 24-inch injection depth method	**1264**

Notes: TIF = Totally Impermeable Film. Highlighted is the representative FFM for the group.

2.2 Meteorological data analysis

Setback distances and application block sizes are separately developed for the inland or coastal regions in California. Inland and coastal county designations follow the definition used for the buffer zones of chloropicrin (DPR, 2017) (Table 3).

Table 3. County designations for inland and coastal regions in California

Inland	Coastal
Alameda, Amador, Alpine, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Imperial, Inyo, Kern, Kings, Lake, Lassen, Madera, Mariposa, Merced, Modoc, Mono, Napa, Nevada, Placer, Plumas, Riverside, Sacramento, San Benito, San Bernardino, San Joaquin, Santa Clara, Shasta, Sierra, Siskiyou, Solano, Stanislaus, Sutter, Tehama, Trinity, Tulare, Tuolumne, Yolo, Yuba	Del Norte, Humboldt, Los Angeles, Marin, Mendocino, Monterey, Orange, San Diego, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Santa Cruz, Sonoma, Ventura

In order to select the representative meteorological input data for air dispersion modeling in each region, the high-use areas of 1,3-D are first determined at a county scale. Counties are ranked based on the total reported 1,3-D uses during the 5-year simulation period of 2013-2017. Top 13 counties are selected to include at least 5 inland and 5 coastal counties (Table 4). These counties

explained about 90% of the total uses of 1,3-D in California during the same period. For comparison, the data analysis is also conducted with the 1,3-D use data during a more recent 5-year period of 2017-2021. The same top 13 counties are identified, although some of their ranks are slightly different. This suggests that the spatial pattern of high-use areas of 1,3-D in California is generally invariant during the past years.

Meteorological data are retrieved from the NWS (National Weather Service) weather stations with the ASOS (Automated Surface Observing System) program. Each station is indexed by a 5-digit WBAN (Weather-Bureau-Army-Navy) identifier. In the selected counties, the spatial distributions of the reported use data are also considered to determine the weather stations most relevant to 1,3-D uses. For example, there are two candidate weather stations (Santa Maria Public Airport and Santa Barbara Municipal Airport) in the Santa Barbara County, but most of the 1,3-D uses in this county were reported in the Santa Maria area. Therefore, the meteorological data collected at Santa Maria (WBAN 23273) is selected for Santa Barbara County. In total 12 stations are selected in this study for further data analysis (Table 4).

Table 4. Top counties ranked by 1,3-D uses during 2013-2017 and associated weather stations

Rank	County	Region	Surface station (by WBAN)	Represented high-use area of 1,3-D	LWS fraction
1	Fresno	Inland	**93193**	**Parlier**	**0.355**
2	Kern	Inland	23155	Shafter	0.320
3	Merced	Inland	23257	Merced (city)	0.290
4	Tulare	Inland	-	-	-
5	Stanislaus	Inland	23258	Modesto	0.269
6	Monterey	Coastal	23233	Salinas	0.255
7	San Joaquin	Inland	23237	Stockton	0.262
8	Madera	Inland	93242	Madera (city)	0.272
9	Santa Barbara	Coastal	23273	Santa Maria	0.400
10	Imperial	Inland	03144	Imperial (city)	0.255
11	Santa Cruz	Coastal	**23277**	**Watsonville**	**0.467**
12	Ventura	Coastal	93110	Oxnard	0.299
13	San Luis Obispo	Coastal	93206	San Luis Obispo (city)	0.370

Notes: WBAN = Weather-Bureau-Army-Navy, a five-digit identifier for weather stations operated by National Weather Service. There is no ASOS station in Tulare County. High-use areas in this county are close to Parlier and Shafter which have been considered in the table. Highlighted (Parlier and Watsonville) are the stations with the highest LWS fractions in the inland and coastal areas, respectively.

The MetProc program (Luo, 2017) is utilized to retrieve and process hourly meteorological input data for the simulation period. The processed data are analyzed for the fraction of low wind speed (LWS), i.e., the number of hours with low wind speed ($0.5<WS\leq2$ m/s) normalized by the total number of hours in the meteorological data. The value of LWS fraction indicates the potential to generate higher ambient concentrations from air dispersion modeling. In a previous

study by DPR (Tao and Vidrio, 2019), the same approach was used to rank weather stations and select the metrological inputs to represent the worst-case scenario for air dispersion modeling.

The calculated LWS fractions (Table 4) are generally consistent with the previous results based on the meteorological data during 2011-2015 (Tao and Vidrio, 2019). Among the selected stations in the high-use areas of 1,3-D, meteorological data at Watsonville is associated with the highest LWS fraction (0.467). For the inland counties, the highest LWS fraction is calculated at Parlier (0.355). Note that there are even higher LWS fractions derived from other weather stations which are not located in the high-use areas of 1,3-D, and thus not used in this study. For example, the LWS fraction of 0.714 was calculated at the Los Angeles downtown station (WBAN 93134).

In summary, the meteorological data at Parlier and Watsonville are used for setback modeling in the inland and coastal regions, respectively. Note that the same Parlier data have been used in the previous study (Luo, 2022).

2.3 Air dispersion modeling and post-processing of modeling results

The air concentrations of 1,3-D are predicted by AERFUM, an integrated air dispersion modeling system for soil fumigants developed by DPR (Luo, 2019). The modeling approach and simulation design for determining setbacks has been documented in the previous study (Luo, 2022). As summarized in Table 1, this study only updates the model inputs (flux time series and meteorological data) and introduces more options (setback distances and application rates) for reporting the application block sizes.

To be consistent with the definition of seasons in the modeling of application factors of 1,3-D (Luo and Brown, 2022), modeling results are summarized for the two seasons of March to October and November to February. Specifically, the model predictions from Match to October are used to calculate setbacks for the season of March to October. For the season of November to February, only the results in December and January are used in the setback calculation, representing a conservative estimation over the season (November to February).

A three-season designation is also evaluated by considering a separate season of November and February. Modeling results are demonstrated in Appendix II.

3 Modeling results for single applications

3.1 Setback settings under the worst-case condition

Required setback distances and durations are first modeled for the worst-case applications with the maximum application rate of 332 lb/ac and the maximum application block size of 80 ac (Table 5).

Table 5. Setback settings required for 1,3-D application under the worst-case applications (application rate of 332lb/ac and application block size of 80ac)

Inland counties:

FFM	Applications during March to October		Applications during November to February	
	Distance (ft)	Duration (day)	Distance (ft)	Duration (day)
1201	3583	2	5262	2
1206	1272	3	2457	4
1209	2273	1	4222	1
1224	400	4	1011	5
1242	0	0	78	2
1243	254	2	881	3
1250	642	3	1507	4
1264	68	3	455	5

Coastal counties:

FFM	Applications during March to October		Applications during November to February	
	Distance (ft)	Duration (day)	Distance (ft)	Duration (day)
1201	5377	2	6036	2
1206	2406	3	3566	3
1209	4043	1	5269	1
1224	746	4	1385	4
1242	0	0	187	2
1243	531	3	1172	3
1250	1302	3	2151	3
1264	248	4	671	4

The predicted setback durations are less than 7 days for all FFMs even with the worst-case applications. Therefore, the label requirement for a setback duration of 7 days is adequate. The following modeling efforts will only focus on setback distances.

A three-season designation is also evaluated by considering a separate season of November and February. Modeling results are demonstrated in Appendix II and compared with the results in Table 5. Results show that setback distances predicted for November and February are only slightly lower than those for December and January, and the separation of November and February from the 4-month winter season (November to February) would not significantly reduce the required setback distances.

3.2 Restrictions on application rate and block size

At a given set of setback distance (one of the 5 predefined distances of 100, 200, 300, 400 or 500 ft) and application rate (80 to 332 lb/ac with an interval of 10), the maximum application block sizes are tabulated for each group of FFMs (Table 6). The results are rounded down to the nearest 5 (or down to the nearest integer if the prediction is less than 5). For example, a predicted value of 7.5 ac is reported as 5 ac in the table. Two special conditions are considered:

1) If the estimated application block size is less than 1 ac, the corresponding application (by FFM, application rate, month of application, and setback distance) is “Not Allowed” (NA).

2) If the estimated application block size is larger than 80 ac, "no restriction" (NR) is required for the corresponding application in addition to the minimum requirements (i.e., setback distance = 100 ft).

Table 6. Maximum application block sizes (ac)

(a) Standard nontarped and non-TIF tarp shallow (12-inch) methods

Inland counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	10	20	35	50	65	4	5	10	10	15
90 lbs/ac	5	15	25	40	50	3	5	5	10	15
100 lbs/ac	5	10	20	30	40	3	4	5	5	10
110 lbs/ac	5	10	15	25	35	3	4	5	5	10
120 lbs/ac	4	5	15	20	30	2	4	4	5	5
130 lbs/ac	4	5	10	15	25	2	3	4	5	5
140 lbs/ac	4	5	10	15	20	1	3	4	5	5
150 lbs/ac	3	5	10	10	15	1	3	4	4	5
160 lbs/ac	3	5	5	10	15	NA	2	3	4	5
170 lbs/ac	3	4	5	10	15	NA	2	3	4	5
180 lbs/ac	3	4	5	10	10	NA	2	3	4	4
190 lbs/ac	2	4	5	5	10	NA	2	3	4	4
200 lbs/ac	2	4	5	5	10	NA	1	3	4	4
210 lbs/ac	2	4	5	5	10	NA	1	3	3	4
220 lbs/ac	2	3	4	5	5	NA	1	2	3	4
230 lbs/ac	1	3	4	5	5	NA	1	2	3	4
240 lbs/ac	1	3	4	5	5	NA	1	2	3	4
250 lbs/ac	1	3	4	5	5	NA	NA	2	3	3
260 lbs/ac	1	3	4	5	5	NA	NA	2	3	3
270 lbs/ac	1	3	4	5	5	NA	NA	2	3	3
280 lbs/ac	NA	2	4	4	5	NA	NA	1	2	3
290 lbs/ac	NA	2	3	4	5	NA	NA	1	2	3
300 lbs/ac	NA	2	3	4	5	NA	NA	1	2	3
310 lbs/ac	NA	2	3	4	5	NA	NA	1	2	3
320 lbs/ac	NA	2	3	4	5	NA	NA	1	2	3
332 lbs/ac	NA	2	3	4	4	NA	NA	1	2	3

Coastal counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	5	10	10	20	25	3	5	5	10	10
90 lbs/ac	4	5	10	15	20	3	4	5	5	10
100 lbs/ac	4	5	5	10	15	3	4	4	5	5
110 lbs/ac	3	4	5	10	10	2	3	4	5	5
120 lbs/ac	3	4	5	5	10	2	3	4	4	5
130 lbs/ac	3	4	5	5	5	1	3	3	4	5
140 lbs/ac	2	3	4	5	5	1	2	3	4	4
150 lbs/ac	2	3	4	5	5	NA	2	3	4	4
160 lbs/ac	2	3	4	5	5	NA	2	3	3	4
170 lbs/ac	1	3	4	4	5	NA	1	2	3	4
180 lbs/ac	1	2	3	4	5	NA	1	2	3	4
190 lbs/ac	1	2	3	4	4	NA	1	2	3	3
200 lbs/ac	NA	2	3	4	4	NA	NA	2	3	3
210 lbs/ac	NA	2	3	4	4	NA	NA	2	2	3
220 lbs/ac	NA	1	3	3	4	NA	NA	1	2	3
230 lbs/ac	NA	1	2	3	4	NA	NA	1	2	3
240 lbs/ac	NA	1	2	3	4	NA	NA	1	2	3
250 lbs/ac	NA	1	2	3	4	NA	NA	1	2	3
260 lbs/ac	NA	NA	2	3	3	NA	NA	NA	2	2
270 lbs/ac	NA	NA	2	3	3	NA	NA	NA	1	2
280 lbs/ac	NA	NA	2	2	3	NA	NA	NA	1	2
290 lbs/ac	NA	NA	1	2	3	NA	NA	NA	1	2
300 lbs/ac	NA	NA	1	2	3	NA	NA	NA	1	2
310 lbs/ac	NA	NA	1	2	3	NA	NA	NA	1	2
320 lbs/ac	NA	NA	1	2	3	NA	NA	NA	1	2
332 lbs/ac	NA	NA	1	2	3	NA	NA	NA	NA	1

(b) Standard nontarped and non-TIF tarp deep (18 inch) methods

Inland counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	40	65	NR	NR	NR
90 lbs/ac	NR	NR	NR	NR	NR	30	45	65	NR	NR
100 lbs/ac	NR	NR	NR	NR	NR	20	35	50	65	NR
110 lbs/ac	NR	NR	NR	NR	NR	15	25	40	50	70
120 lbs/ac	60	NR	NR	NR	NR	10	20	30	40	55
130 lbs/ac	45	NR	NR	NR	NR	10	15	25	35	45
140 lbs/ac	35	65	NR	NR	NR	5	10	20	30	40
150 lbs/ac	30	50	75	NR	NR	5	10	15	25	35
160 lbs/ac	25	45	65	NR	NR	5	10	15	20	30
170 lbs/ac	20	35	55	75	NR	5	5	10	20	25
180 lbs/ac	15	30	45	65	NR	4	5	10	15	20
190 lbs/ac	15	25	40	55	75	4	5	10	15	20
200 lbs/ac	10	25	35	50	65	4	5	10	10	20
210 lbs/ac	10	20	30	45	60	4	5	5	10	15
220 lbs/ac	10	15	30	40	50	3	5	5	10	15
230 lbs/ac	5	15	25	35	45	3	5	5	10	15
240 lbs/ac	5	15	20	35	45	3	4	5	10	10
250 lbs/ac	5	10	20	30	40	3	4	5	10	10
260 lbs/ac	5	10	20	30	35	3	4	5	5	10
270 lbs/ac	5	10	15	25	35	3	4	5	5	10
280 lbs/ac	5	10	15	25	30	2	4	5	5	10
290 lbs/ac	5	10	15	20	30	2	4	5	5	10
300 lbs/ac	5	5	10	20	25	2	4	5	5	5
310 lbs/ac	4	5	10	20	25	2	3	4	5	5
320 lbs/ac	4	5	10	15	25	2	3	4	5	5
332 lbs/ac	4	5	10	15	20	2	3	4	5	5

Coastal counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	25	35	55	75	NR
90 lbs/ac	55	NR	NR	NR	NR	15	30	40	55	65
100 lbs/ac	40	65	NR	NR	NR	15	20	30	40	55
110 lbs/ac	30	50	75	NR	NR	10	15	25	35	40
120 lbs/ac	25	40	60	75	NR	10	10	20	30	35
130 lbs/ac	20	30	45	60	75	5	10	15	25	30
140 lbs/ac	15	25	35	50	65	5	10	15	20	25
150 lbs/ac	10	20	30	40	55	5	5	10	15	20
160 lbs/ac	10	15	25	35	45	5	5	10	15	20
170 lbs/ac	10	15	20	30	40	4	5	10	10	15
180 lbs/ac	5	10	20	25	35	4	5	5	10	15
190 lbs/ac	5	10	15	25	30	4	5	5	10	10
200 lbs/ac	5	10	15	20	25	4	5	5	10	10
210 lbs/ac	5	10	10	15	25	3	4	5	5	10
220 lbs/ac	5	5	10	15	20	3	4	5	5	10
230 lbs/ac	5	5	10	15	20	3	4	5	5	5
240 lbs/ac	4	5	10	10	15	3	4	5	5	5
250 lbs/ac	4	5	5	10	15	3	4	4	5	5
260 lbs/ac	4	5	5	10	15	2	3	4	5	5
270 lbs/ac	4	5	5	10	10	2	3	4	5	5
280 lbs/ac	3	5	5	10	10	2	3	4	5	5
290 lbs/ac	3	4	5	5	10	2	3	4	4	5
300 lbs/ac	3	4	5	5	10	2	3	4	4	5
310 lbs/ac	3	4	5	5	10	2	3	4	4	5
320 lbs/ac	3	4	5	5	10	1	3	3	4	5
332 lbs/ac	3	4	5	5	5	1	2	3	4	5

(c) Chemigation (drip)/non-TIF tarp method

Inland counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	40	75	NR	NR	NR	5	15	20	30	40
90 lbs/ac	30	50	NR	NR	NR	5	10	15	25	30
100 lbs/ac	20	40	60	NR	NR	5	5	10	20	25
110 lbs/ac	15	30	45	65	NR	4	5	10	15	20
120 lbs/ac	10	25	40	55	70	4	5	10	10	15
130 lbs/ac	10	20	30	45	60	3	5	5	10	15
140 lbs/ac	5	15	25	35	50	3	4	5	10	10
150 lbs/ac	5	15	20	30	40	3	4	5	5	10
160 lbs/ac	5	10	20	25	35	2	4	5	5	10
170 lbs/ac	5	10	15	25	30	2	4	5	5	10
180 lbs/ac	4	10	15	20	30	2	3	4	5	5
190 lbs/ac	4	5	10	20	25	2	3	4	5	5
200 lbs/ac	4	5	10	15	20	1	3	4	5	5
210 lbs/ac	4	5	10	15	20	1	3	4	5	5
220 lbs/ac	3	5	10	10	15	1	3	4	5	5
230 lbs/ac	3	5	5	10	15	NA	2	4	4	5
240 lbs/ac	3	5	5	10	15	NA	2	3	4	5
250 lbs/ac	3	4	5	10	15	NA	2	3	4	5
260 lbs/ac	3	4	5	10	10	NA	2	3	4	5
270 lbs/ac	2	4	5	10	10	NA	2	3	4	4
280 lbs/ac	2	4	5	5	10	NA	2	3	4	4
290 lbs/ac	2	4	5	5	10	NA	2	3	4	4
300 lbs/ac	2	4	5	5	10	NA	1	3	3	4
310 lbs/ac	2	4	5	5	10	NA	1	3	3	4
320 lbs/ac	2	3	5	5	10	NA	1	2	3	4
332 lbs/ac	1	3	4	5	5	NA	1	2	3	4

Coastal counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	20	30	45	60	75	5	10	15	20	25
90 lbs/ac	10	20	35	40	55	5	5	10	15	20
100 lbs/ac	10	15	25	35	40	4	5	5	10	15
110 lbs/ac	5	10	20	25	35	4	5	5	10	10
120 lbs/ac	5	10	15	20	30	3	4	5	5	10
130 lbs/ac	5	5	10	15	20	3	4	5	5	10
140 lbs/ac	4	5	10	15	20	3	4	5	5	5
150 lbs/ac	4	5	10	10	15	2	3	4	5	5
160 lbs/ac	4	5	5	10	15	2	3	4	5	5
170 lbs/ac	3	5	5	10	10	2	3	4	4	5
180 lbs/ac	3	4	5	5	10	1	3	4	4	5
190 lbs/ac	3	4	5	5	10	1	2	3	4	5
200 lbs/ac	3	4	5	5	10	1	2	3	4	4
210 lbs/ac	2	4	5	5	5	NA	2	3	4	4
220 lbs/ac	2	3	4	5	5	NA	2	3	4	4
230 lbs/ac	2	3	4	5	5	NA	2	3	3	4
240 lbs/ac	2	3	4	5	5	NA	1	3	3	4
250 lbs/ac	2	3	4	5	5	NA	1	2	3	4
260 lbs/ac	1	3	4	4	5	NA	1	2	3	4
270 lbs/ac	1	3	3	4	5	NA	1	2	3	3
280 lbs/ac	1	2	3	4	5	NA	NA	2	3	3
290 lbs/ac	1	2	3	4	5	NA	NA	2	3	3
300 lbs/ac	NA	2	3	4	4	NA	NA	2	2	3
310 lbs/ac	NA	2	3	4	4	NA	NA	1	2	3
320 lbs/ac	NA	2	3	4	4	NA	NA	1	2	3
332 lbs/ac	NA	2	3	3	4	NA	NA	1	2	3

(d) 24-inch injection methods

Inland counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
90 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
100 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
110 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
120 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
130 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
140 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
150 lbs/ac	NR	NR	NR	NR	NR	65	NR	NR	NR	NR
160 lbs/ac	NR	NR	NR	NR	NR	50	75	NR	NR	NR
170 lbs/ac	NR	NR	NR	NR	NR	40	60	NR	NR	NR
180 lbs/ac	NR	NR	NR	NR	NR	35	55	75	NR	NR
190 lbs/ac	NR	NR	NR	NR	NR	30	45	65	NR	NR
200 lbs/ac	NR	NR	NR	NR	NR	25	40	55	75	NR
210 lbs/ac	NR	NR	NR	NR	NR	20	35	50	65	NR
220 lbs/ac	NR	NR	NR	NR	NR	20	30	45	60	75
230 lbs/ac	70	NR	NR	NR	NR	15	25	40	55	70
240 lbs/ac	60	NR	NR	NR	NR	15	25	35	45	60
250 lbs/ac	55	NR	NR	NR	NR	10	20	30	40	55
260 lbs/ac	45	NR	NR	NR	NR	10	20	30	40	50
270 lbs/ac	40	70	NR	NR	NR	10	15	25	35	45
280 lbs/ac	35	60	NR	NR	NR	10	15	25	35	40
290 lbs/ac	35	55	NR	NR	NR	5	15	20	30	40
300 lbs/ac	30	50	75	NR	NR	5	10	20	30	35
310 lbs/ac	25	45	70	NR	NR	5	10	20	25	35
320 lbs/ac	25	40	65	NR	NR	5	10	15	25	35
332 lbs/ac	20	40	55	75	NR	5	10	15	20	30

Coastal counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
90 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
100 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
110 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
120 lbs/ac	NR	NR	NR	NR	NR	75	NR	NR	NR	NR
130 lbs/ac	NR	NR	NR	NR	NR	55	NR	NR	NR	NR
140 lbs/ac	NR	NR	NR	NR	NR	45	70	NR	NR	NR
150 lbs/ac	NR	NR	NR	NR	NR	35	55	NR	NR	NR
160 lbs/ac	NR	NR	NR	NR	NR	30	45	70	NR	NR
170 lbs/ac	NR	NR	NR	NR	NR	25	40	60	NR	NR
180 lbs/ac	70	NR	NR	NR	NR	20	35	50	65	NR
190 lbs/ac	60	NR	NR	NR	NR	20	30	45	60	75
200 lbs/ac	50	NR	NR	NR	NR	15	25	40	50	65
210 lbs/ac	45	70	NR	NR	NR	15	25	35	45	60
220 lbs/ac	35	60	NR	NR	NR	10	20	30	40	50
230 lbs/ac	35	50	75	NR	NR	10	20	30	35	45
240 lbs/ac	30	45	70	NR	NR	10	15	25	35	40
250 lbs/ac	25	40	60	NR	NR	10	15	20	30	40
260 lbs/ac	25	35	55	70	NR	10	15	20	30	35
270 lbs/ac	20	35	50	65	NR	5	10	20	25	35
280 lbs/ac	20	30	45	60	75	5	10	15	25	30
290 lbs/ac	15	30	40	55	65	5	10	15	20	30
300 lbs/ac	15	25	35	50	60	5	10	15	20	25
310 lbs/ac	15	25	35	45	55	5	10	15	20	25
320 lbs/ac	10	20	30	40	55	5	5	10	15	25
332 lbs/ac	10	20	30	40	50	5	5	10	15	20

(e) Totally Impermeable Film (TIF) methods – broadcast and strip

Inland counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
90 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
100 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
110 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
120 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
130 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
140 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
150 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
160 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
170 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
180 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
190 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
200 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
210 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
220 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
230 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
240 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
250 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
260 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
270 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
280 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
290 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
300 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
310 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
320 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
332 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

Coastal counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
90 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
100 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
110 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
120 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
130 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
140 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
150 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
160 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
170 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
180 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
190 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
200 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
210 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
220 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
230 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
240 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
250 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
260 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
270 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
280 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
290 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
300 lbs/ac	NR	NR	NR	NR	NR	75	NR	NR	NR	NR
310 lbs/ac	NR	NR	NR	NR	NR	65	NR	NR	NR	NR
320 lbs/ac	NR	NR	NR	NR	NR	60	NR	NR	NR	NR
332 lbs/ac	NR	NR	NR	NR	NR	55	NR	NR	NR	NR

(f) Totally Impermeable Film (TIF) methods – bed and drip

Inland counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
90 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
100 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
110 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
120 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
130 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
140 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
150 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
160 lbs/ac	NR	NR	NR	NR	NR	65	NR	NR	NR	NR
170 lbs/ac	NR	NR	NR	NR	NR	50	NR	NR	NR	NR
180 lbs/ac	NR	NR	NR	NR	NR	45	70	NR	NR	NR
190 lbs/ac	NR	NR	NR	NR	NR	35	60	NR	NR	NR
200 lbs/ac	NR	NR	NR	NR	NR	30	50	75	NR	NR
210 lbs/ac	NR	NR	NR	NR	NR	25	45	65	NR	NR
220 lbs/ac	NR	NR	NR	NR	NR	25	40	60	NR	NR
230 lbs/ac	NR	NR	NR	NR	NR	20	35	50	70	NR
240 lbs/ac	NR	NR	NR	NR	NR	15	30	45	60	NR
250 lbs/ac	NR	NR	NR	NR	NR	15	30	40	55	70
260 lbs/ac	NR	NR	NR	NR	NR	15	25	35	50	65
270 lbs/ac	70	NR	NR	NR	NR	10	20	35	45	60
280 lbs/ac	60	NR	NR	NR	NR	10	20	30	40	55
290 lbs/ac	55	NR	NR	NR	NR	10	20	30	40	50
300 lbs/ac	50	NR	NR	NR	NR	10	15	25	35	45
310 lbs/ac	45	NR	NR	NR	NR	10	15	25	35	45
320 lbs/ac	40	70	NR	NR	NR	5	15	20	30	40
332 lbs/ac	35	65	NR	NR	NR	5	10	20	30	35

Coastal counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
90 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
100 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
110 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
120 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
130 lbs/ac	NR	NR	NR	NR	NR	75	NR	NR	NR	NR
140 lbs/ac	NR	NR	NR	NR	NR	60	NR	NR	NR	NR
150 lbs/ac	NR	NR	NR	NR	NR	50	75	NR	NR	NR
160 lbs/ac	NR	NR	NR	NR	NR	40	60	NR	NR	NR
170 lbs/ac	NR	NR	NR	NR	NR	35	50	70	NR	NR
180 lbs/ac	NR	NR	NR	NR	NR	30	45	60	NR	NR
190 lbs/ac	NR	NR	NR	NR	NR	25	40	55	70	NR
200 lbs/ac	NR	NR	NR	NR	NR	20	35	45	60	NR
210 lbs/ac	75	NR	NR	NR	NR	20	30	40	55	70
220 lbs/ac	60	NR	NR	NR	NR	15	25	35	50	65
230 lbs/ac	55	NR	NR	NR	NR	15	25	35	45	55
240 lbs/ac	45	75	NR	NR	NR	10	20	30	40	50
250 lbs/ac	40	65	NR	NR	NR	10	20	30	35	45
260 lbs/ac	35	60	NR	NR	NR	10	15	25	35	45
270 lbs/ac	35	55	75	NR	NR	10	15	25	30	40
280 lbs/ac	30	45	70	NR	NR	10	15	20	30	35
290 lbs/ac	25	40	60	NR	NR	5	10	20	25	35
300 lbs/ac	25	40	55	75	NR	5	10	15	25	35
310 lbs/ac	20	35	50	70	NR	5	10	15	25	30
320 lbs/ac	20	30	45	65	NR	5	10	15	20	30
332 lbs/ac	15	30	40	55	75	5	10	15	20	25

(g) 40% TIF with 18-inch injection depth method

Inland counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
90 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
100 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
110 lbs/ac	NR	NR	NR	NR	NR	60	NR	NR	NR	NR
120 lbs/ac	NR	NR	NR	NR	NR	45	75	NR	NR	NR
130 lbs/ac	NR	NR	NR	NR	NR	35	55	NR	NR	NR
140 lbs/ac	NR	NR	NR	NR	NR	30	45	65	NR	NR
150 lbs/ac	NR	NR	NR	NR	NR	20	35	55	75	NR
160 lbs/ac	NR	NR	NR	NR	NR	20	30	45	65	NR
170 lbs/ac	NR	NR	NR	NR	NR	15	25	40	55	70
180 lbs/ac	65	NR	NR	NR	NR	10	20	35	45	60
190 lbs/ac	55	NR	NR	NR	NR	10	20	30	40	55
200 lbs/ac	45	NR	NR	NR	NR	10	15	25	35	45
210 lbs/ac	40	70	NR	NR	NR	5	15	25	35	40
220 lbs/ac	35	60	NR	NR	NR	5	10	20	30	40
230 lbs/ac	30	50	NR	NR	NR	5	10	20	25	35
240 lbs/ac	25	45	70	NR	NR	5	10	15	25	30
250 lbs/ac	25	40	65	NR	NR	5	10	15	20	30
260 lbs/ac	20	35	60	NR	NR	5	10	15	20	25
270 lbs/ac	15	35	50	70	NR	5	5	10	20	25
280 lbs/ac	15	30	45	65	NR	4	5	10	15	25
290 lbs/ac	15	30	40	60	NR	4	5	10	15	20
300 lbs/ac	10	25	40	55	75	4	5	10	15	20
310 lbs/ac	10	25	35	50	65	4	5	10	15	20
320 lbs/ac	10	20	35	45	60	4	5	10	10	15
332 lbs/ac	10	20	30	40	55	4	5	5	10	15

Coastal counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
90 lbs/ac	NR	NR	NR	NR	NR	65	NR	NR	NR	NR
100 lbs/ac	NR	NR	NR	NR	NR	45	75	NR	NR	NR
110 lbs/ac	NR	NR	NR	NR	NR	35	55	NR	NR	NR
120 lbs/ac	NR	NR	NR	NR	NR	30	45	60	NR	NR
130 lbs/ac	75	NR	NR	NR	NR	25	35	50	65	NR
140 lbs/ac	60	NR	NR	NR	NR	20	30	40	55	70
150 lbs/ac	45	75	NR	NR	NR	15	25	35	45	60
160 lbs/ac	40	65	NR	NR	NR	10	20	30	40	50
170 lbs/ac	35	55	75	NR	NR	10	15	25	35	45
180 lbs/ac	30	45	65	NR	NR	10	15	20	30	40
190 lbs/ac	25	40	55	75	NR	5	10	20	25	35
200 lbs/ac	20	35	50	65	NR	5	10	15	25	30
210 lbs/ac	15	30	40	55	70	5	10	15	20	30
220 lbs/ac	15	25	35	50	60	5	10	15	20	25
230 lbs/ac	15	25	35	45	55	5	5	10	15	25
240 lbs/ac	10	20	30	40	50	5	5	10	15	20
250 lbs/ac	10	15	25	35	45	5	5	10	15	20
260 lbs/ac	10	15	25	30	40	4	5	10	15	15
270 lbs/ac	10	15	20	30	35	4	5	10	10	15
280 lbs/ac	5	10	20	25	35	4	5	5	10	15
290 lbs/ac	5	10	15	25	30	4	5	5	10	15
300 lbs/ac	5	10	15	20	30	4	5	5	10	10
310 lbs/ac	5	10	15	20	25	4	5	5	10	10
320 lbs/ac	5	10	15	20	25	3	5	5	5	10
332 lbs/ac	5	5	10	15	25	3	4	5	5	10

(h) 40% TIF with 24-inch injection depth method

Inland counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
90 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
100 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
110 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
120 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
130 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
140 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
150 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
160 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
170 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
180 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
190 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
200 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
210 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
220 lbs/ac	NR	NR	NR	NR	NR	75	NR	NR	NR	NR
230 lbs/ac	NR	NR	NR	NR	NR	65	NR	NR	NR	NR
240 lbs/ac	NR	NR	NR	NR	NR	55	NR	NR	NR	NR
250 lbs/ac	NR	NR	NR	NR	NR	45	75	NR	NR	NR
260 lbs/ac	NR	NR	NR	NR	NR	40	70	NR	NR	NR
270 lbs/ac	NR	NR	NR	NR	NR	35	60	NR	NR	NR
280 lbs/ac	NR	NR	NR	NR	NR	35	55	NR	NR	NR
290 lbs/ac	NR	NR	NR	NR	NR	30	50	70	NR	NR
300 lbs/ac	NR	NR	NR	NR	NR	25	45	65	NR	NR
310 lbs/ac	NR	NR	NR	NR	NR	25	40	60	NR	NR
320 lbs/ac	NR	NR	NR	NR	NR	20	35	55	75	NR
332 lbs/ac	NR	NR	NR	NR	NR	20	35	50	65	NR

Coastal counties:

Broadcast Equivalent a.i. App Rate	Maximum Application Block Size (ac), Month of Application, and Setback Distance (ft)									
	March to October					November to February				
	100 ft	200 ft	300 ft	400 ft	500 ft	100 ft	200 ft	300 ft	400 ft	500 ft
80 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
90 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
100 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
110 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
120 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
130 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
140 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
150 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
160 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
170 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
180 lbs/ac	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
190 lbs/ac	NR	NR	NR	NR	NR	70	NR	NR	NR	NR
200 lbs/ac	NR	NR	NR	NR	NR	60	NR	NR	NR	NR
210 lbs/ac	NR	NR	NR	NR	NR	50	NR	NR	NR	NR
220 lbs/ac	NR	NR	NR	NR	NR	45	70	NR	NR	NR
230 lbs/ac	NR	NR	NR	NR	NR	40	60	NR	NR	NR
240 lbs/ac	NR	NR	NR	NR	NR	35	55	75	NR	NR
250 lbs/ac	NR	NR	NR	NR	NR	30	50	70	NR	NR
260 lbs/ac	NR	NR	NR	NR	NR	30	45	60	NR	NR
270 lbs/ac	NR	NR	NR	NR	NR	25	40	55	75	NR
280 lbs/ac	75	NR	NR	NR	NR	25	35	50	65	NR
290 lbs/ac	65	NR	NR	NR	NR	20	35	45	60	75
300 lbs/ac	55	NR	NR	NR	NR	20	30	40	55	70
310 lbs/ac	50	NR	NR	NR	NR	15	30	40	50	65
320 lbs/ac	45	75	NR	NR	NR	15	25	35	45	60
332 lbs/ac	40	65	NR	NR	NR	15	25	30	45	55

4 Modeling results for multiple applications

4.1 Predicted concentrations from multiple applications with setbacks overlapping

According to the previously developed approach for multiple applications (Luo, 2022), two fields are conservatively modeled with application block size of 80 ac, setback distance of 100 ft, and corresponding maximum application rate determined from the setback modeling for single applications. The distance between the two fields is 200 ft (ΔL=200 ft), so their setback perimeters are adjacent to each other. AERFUM continuously models all days and months during the 5-year simulation period, while the maximum application rates vary with the month of modeled applications (Table 6). The modeling results are presented as the exposure concentrations, i.e., the 95th percentile (over the simulation period) of the maximum 72-hour concentrations predicted along the setback perimeter.

The modeling results are presented in Table 7 and compared to the target concentration of 55 ppb for exposure analysis. There is a general decreasing trend for the predicted concentrations with the interval between the two applications (ΔT). With $\Delta T \leq 48$ hours, most of the application methods are associated with concentrations above the regulatory target. With the interval

increased to 72 hours, only one FFM group (24-in methods) is predicted in the inland counties with exposure concentration above 55 ppb. With ΔT>72 hours (modeled as 96 hours, the last columns in Table 7), the predictions for all methods and seasons are equal to or less than 55 ppb.

Table 7. Predicted exposure concentrations (ppb) from two applications of 1,3-D with adjacent setbacks (ΔL=200 ft) with an application interval (ΔT) from 0 to 96 hours

Inland counties:

FFM	ΔT=0	ΔT=24 hr	ΔT=48 hr	ΔT=72 hr	ΔT=96 hr
1201	58.6	57.7	55.5	≤55	≤55
1206	58.9	58.0	56.6	≤55	≤55
1209	57.8	57.9	55.9	≤55	≤55
1224	59.0	58.6	56.9	55.3	≤55
1242	≤55	≤55	≤55	≤55	≤55
1243	59.2	58.3	56.9	≤55	≤55
1250	58.5	58.2	56.8	≤55	≤55
1264	55.3	≤55	≤55	≤55	≤55

Coastal counties:

FFM	ΔT=0	ΔT=24 hr	ΔT=48 hr	ΔT=72 hr	ΔT=96 hr
1201	57.0	56.2	≤55	≤55	≤55
1206	57.0	56.4	55.1	≤55	≤55
1209	57.4	56.8	55.6	≤55	≤55
1224	57.0	26.7	55.4	≤55	≤55
1242	≤55	≤55	≤55	≤55	≤55
1243	57.2	56.2	≤55	≤55	≤55
1250	56.7	56.3	≤55	≤55	≤55
1264	57.1	57.0	56.0	≤55	≤55

4.2 Predicted protection levels with an application interval of 48 hours

To be consistent with the 36-hour separation required for overlapping buffer zones of chloropicrin applications (DPR, 2017), the application interval of 48 hours modeled for 1,3-D is further investigated. For most of the application methods and seasons, the predicted concentrations at ΔT=48 hours exceed the target concentration of 55 ppb (Table 7), suggesting a protection level below 95%. Additional model simulations are conducted to estimate the acute protection level with the given application interval of 48 hours (Table 8). Modeling results show that multiple applications with a 48-hour interval could provide at least 93.7% protection over the 5-year simulation period.

Table 8. Predicted protection levels with a 48-hour interval (i.e., 36-hour separation) between applications

FFM	Inland	Coastal
1201	94.8%	≥95%
1206	94.2%	94.9%
1209	94.7%	94.2%
1224	93.7%	94.5%
1242	≥95%	≥95%
1243	94.0%	≥95%
1250	93.9%	≥95%
1264	≥95%	93.9%

Acknowledgments

The author acknowledges Colin Brown, Randy Segawa, Jazmin Gonzalez, Aniela Burant, Maziar Kandelous, and Minh Pham for valuable discussions and critical reviews in the initialization and development of this study.

References

Brown, C. (2022). Updates to HYDRUS-simulated flux estimates of 1,3-dichloropropene maximum period-averaged flux and emission ratios. California Department of Pesticide Regulation, Sacramento, CA.

Brown, C. (2023). Modeling broadcast-strip TIF applications with 40% tarp coverage. California Department of Pesticide Regulation.

DPR (2017). Additional Labeling Requirements for Use of All Products Containing Chloropicrin as an Active Ingredient in California. California Department of Pesticide Regulation, Sacramento, CA.

DPR (2023). DPR 22-005 Health Risk Mitigation and Volatile Organic Compound Emission Reduction for 1,3-Dichloropropene. California Department of Pesticide Regulation.

Luo, Y. (2017). Meteorological data processing for ISCST3 and AERMOD. California Department of Pesticide Regulation, Sacramento, CA.

Luo, Y. (2019). AERFUM: an integrated air dispersion modeling system for soil fumigants. California Department of Pesticide Regulation, Sacramento, CA.

Luo, Y. (2022). Modeling for mitigation measures to reduce acute exposure from 1,3-Dichloropropene, modeling approach #2. California Department of Pesticide Regulation, Sacramento, CA.

Luo, Y. and C. Brown (2022). Modeling for application factors of 1,3-Dichloropropene, modeling approach #2. California Department of Pesticide Regulation, Sacramento, CA.

Tao, J. and E. Vidrio (2019). A Procedure to Select Meteorological Data for Air Dispersion Modeling of Pesticide Applications in California. Integrated Environmental Assessment and Management 15(4): 648-658.

Appendix I. 1,3-Dichloropropene field fumigation methods

Table 9. 1,3-Dichloropropene field fumigation methods in California

Method Group	Method Name	Field Fumigation Method (FFM) Code
1	Nontarp/shallow/broadcast or bed	1201
1	Tarp/shallow/broadcast	1202
1	Tarp/shallow/bed	1203
1	Nontarp/shallow/broadcast or bed/3 water treatments	1204
1	Tarp/shallow/bed/3 water treatments	1205
2	Nontarp/18 inches deep/broadcast or bed	1206
2	Tarp/18 inches deep/broadcast	1207
2	Tarp/18 inches deep/bed	1208
3	Chemigation (drip system)/tarp	1209
2	Nontarp/18 inches deep/strip	1210
2	Nontarp/18 inches deep/GPS targeted	1211
4	Nontarp/24 inches deep/broadcast	1224
4	Tarp/24 inches deep/broadcast	1225
4	Nontarp/24 inches deep/strip	1226
4	Nontarp/24 inches deep/GPS targeted	1227
5	Totally Impermeable Film (TIF) tarp/shallow/broadcast	1242
6	TIF tarp/shallow/bed	1243
6	TIF tarp/shallow/bed/3 water treatments	1245
5	TIF tarp/deep/broadcast	1247
6	TIF tarp/deep/bed	1248
5	TIF tarp/deep/strip	1249
7	40% TIF tarp/18 inches deep/broadcast	1250
6	Chemigation (drip)/ TIF tarp	1259
8	40% TIF tarp/24 inches deep/broadcast	1264

Appendix II. Setback distances for November and February

Additional modeling is conducted for setback distances in November and February. In the main text of the report, setback distances are determined for December and January and applied to the four months of November to February (as described in Section 2.3). In this appendix, modeling simulations for November and February are demonstrated for the setback determination under the worst-case applications (application rate of 332lb/ac and application block size of 80ac), and the results are compared to those for December and January (Table 10). The predicted setback distances during November and February are generally lower than those during December and January. Except for FFM1242, the relative differences range from 0 to 16.1% with a median of about 7%. Only for FFM1242 under the coastal meteorological conditions, the predicted setback distances significantly reduced by 46.5% from 187 (December and January) to <100 ft (November and February).

Table 10. Setback settings required for 1,3-D application under the worst-case applications (application rate of 332lb/ac and application block size of 80ac)

FFM	Inland counties			Coastal counties		
	Nov & Feb	Dec & Jan	Difference	Nov & Feb	Dec & Jan	Difference
1201	5260	5262	0.0%	5925	6036	1.8%
1206	2312	2457	6.3%	3299	3566	7.5%
1209	3932	4222	7.4%	4987	5269	5.4%
1224	930	1011	8.7%	1288	1385	7.0%
1242	0	78	0	74	187	46.5%
1243	788	881	11.8%	1087	1172	7.3%
1250	1417	1507	6.4%	2013	2151	6.4%
1264	407	455	11.8%	563	671	16.1%

Note: the relative difference for FFM1242 is calculated by considering a minimum setback of a 100ft according to the 1,3-D field fumigation requirements.

Note that the reported differences in Table 10 are based on the worst-case condition of 1,3-D applications with a rate of 332 lb/ac over an 80-ac field. In the field conditions, the actual application rates and treated areas, and thus the differences of required setback distances between the two seasons, could be much smaller. For example, in the coastal region during 2013-2017 (based on the top-5 counties in Table 4: Monterey, Santa Barbara, Santa Cruz, and San Luis Obispo), the median rate and median acre of reported 1,3-D applications with the FFM group represented by FFM1242 (1242, 1247, and 1249, Table 2) were 131.1 lb/ac and 16.2 ac, respectively. Even with the 95th percentiles of the reported rates (187.0 lb/ac) and acres (44.5 ac), the model-predicted setback distances are both <100 ft for November and February and for December and January. Therefore, the modeling results indicate that the separation of November and February from the 4-month winter season (November to February) would not significantly reduce the required setback distances.