Addendum to the June 2022 Economic and Pest Management Evaluation of Proposed 1,3-Dichloropropene Regulation

Prepared for the Department of Pesticide Regulation by the California Department of Food and Agriculture's Office of Pesticide Consultation and Analysis, and the University of California, Davis

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Background

While California Department of Food and Agriculture's Office of Pesticide Consultation and Analysis (OPCA) and University of California, Davis were finalizing the June 21, 2022, report "Economic and Pest Management Evaluation of Proposed 1,3-Dichloropropene," DPR informed CDFA OPCA of a significant potential change in the proposed regulation on May 31, 2022. In the original proposal given to OPCA, there was one set of application tables and applications were prohibited in December. In the alternative proposed regulation, there are two sets of application tables, one for March-October (non-winter) and another for November-February (winter). Applications in December would no longer be prohibited. This following addendum includes the number of fields and estimated costs of the alternative proposed regulation but does not include detailed discussions of methods or other information that did not change from the June 21, 2022, report. The original report is quoted as needed to provide context. However, this addendum is not an independent, comprehensive document and should be read in conjunction with the June 21, 2022, report.

Summary

As in the June 21, 2022, report, this addendum examines the mitigations for acute exposure by evaluating how growers could comply with the proposed regulations regarding the relationships between the allowable application method, setbacks to occupied structures, and block size. It estimates the economic impacts associated with these proposed changes. DPR's proposed regulation regarding these three factors is reported in tables for each mitigation option showing the maximum allowed daily acres treated (block size), which are based on distance from the field to an occupied structure (100 ft, 200 ft, or 500 ft) and the application rate. As stated in the June 21, 2022, report:

> In general, the higher the application rate and shorter the distance to an occupied structure the lower the maximum application block size for each application method. The maximum permitted block size can range from 0 acres (application not permitted) to as much as 80 acres for some application methods and rates. But for untarped applications the proposed maximum block size has been reduced to achieve the minimum 100 ft setback from occupied structures even with new application methods. Current restrictions allow a block size of up to 80 acres in an application while maintaining a 100 ft setback from occupied structures.
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> We examine the cost of complying with the proposed regulation for acute exposure in two ways. First, we evaluate the cost for all 1,3-D applications to comply with the proposed changes by adopting, if needed, a new application method and/or reducing block size to retain a 100 ft setback and current application rate, regardless of whether or not the applications are in fact near an occupied structure. This approach identifies how costly the proposed changes would be if all

applications had to comply with the combinations of application rate, application method, and maximum block size permitted under the proposed regulation. This analysis uses data on applications from 2017-2020 (Method 1). Second, for three focal counties in 2017-2018, Fresno, Kern, and Stanislaus, we integrate GIS data with application data and isolate only those applications within certain distances of occupied structures. We then identify how much acreage would have been impacted directly for all crops and the associated mitigation cost (Method 2). However, we cannot know with certainty that all of the applications examined using Method 2 are ones that would have been impacted by the occupied distance restriction because fields, not applications, are mapped. If not all of a field was fumigated with 1,3-D it is conceivable that the proposed setback distance for that application would not be binding.

Under the newly proposed changes estimated costs range from $1,020,278 (2019) to $1,546,033 (2018) (Table 1). Comparable annual cost results from the June 21, 2022 report are presented in Table 2, a reproduction of ES-Table 1 in that report. Each year the cost of the original proposed regulation would have been higher than the proposed regulation considered in this addendum.

Table 1: Updated Annual Cost of Compliance with Occupied Structure Setback for Statewide 1,3-D Applications Assuming a 100 ft Setback and Current Application Rate

Year	Total Cost
2017	$1,425,081
2018	$1,546,033
2019	$1,020,278
2020	$1,471,936

Table 2: Original Annual Cost of Compliance with Occupied Structure Setback for Statewide 1,3-D Applications Assuming a 100 ft Setback and Current Application Rate

Year	Total Cost
2017	$1,897,283
2018	$1,996,093
2019	$1,278,772
2020	$1,729,988

Methods and Data

Detailed methods can be found in the June 21, 2022, report. Changes in the application of Method 1 relative to its application in the June 21, 2022, report are presented here. The differences that characterize the application of Method 2 from the June 21, 2022, report are the same as the differences for Method 1. The data are the same as in the June 21, 2022, report.

Changes in the application of Method 1: Changes in application methods to retain 100-foot distance to occupied structures

The updated proposed regulation introduces seasonal differences in the fumigation tables for 1,3-D. For each season there are new maximum block sizes if occupied structures are near the application site for all non-tarped and some tarped fumigation methods. As in the June 21, 2022, report, this analysis assumes that all applications would have to choose an application method and/or split applications into multiple blocks in order to comply with the maximum block size specified in the proposed regulation for the observed application rate and a 100-ft setback. The new setbacks and maximum acres for 12-in, 18-in, 24-in, and TIF tarp application methods proposed by DPR are presented by time period in Table 3, Table 4, Table 5, Table 6 and Table 7, respectively. Methods with codes 1203, 1204, and 1205 are no longer allowed under the season-differentiated proposed regulation. No changes from current regulations are proposed for TIF methods using deeper injection (FFMs 1242, 1247, 1249). These tables were provided to CDFA by DPR on 5/31/2022.

Table 3: Maximum Block Size (Acres) for Application Rate-Occupied Structure Distance Pairs for Untarped Application Methods Using 12-in Injection (FFMs 1201, 1202)

a) March-October

Application Rate (lbs/acre)	**Maximum Application Block Size (ac) and Occupied Structure Distance**		
	100 ft	200 ft	500 ft
100	5 ac	15 ac	40 ac
110	5 ac	10 ac	35 ac
125	4 ac	5 ac	25 ac
150	3 ac	5 ac	15 ac
200	2 ac	3 ac	10 ac
250	1 ac	2 ac	5 ac
300	Not allowed	2 ac	5 ac
332	Not allowed	1 ac	4 ac

b) November-February

Application Rate (lbs/acre)	**Maximum Application Block Size (ac) and Occupied Structure Distance**		
	100 ft	200 ft	500 ft
100	2 ac	4 ac	10 ac
110	2 ac	3 ac	10 ac
125	1 ac	3 ac	5 ac
150	1 ac	2 ac	5 ac
200	Not allowed	1 ac	4 ac
250	Not allowed	Not allowed	3 ac
300	Not allowed	Not allowed	2 ac
332	Not allowed	Not allowed	2 ac

Table 4: Maximum Block Size (Acres) for Application Rate-Occupied Structure Distance Pairs for Application Methods Using 18-in Injection (FFMs 1206, 1207, 1210, and 1211)

a) March-October

Application Rate	**Maximum Application Block Size (ac) and Occupied Structure Distance**		
	100 ft	200 ft	500 ft
100 lbs/ac	80 ac	80 ac	80 ac
110 lbs/ac	80 ac	80 ac	80 ac
125 lbs/ac	50 ac	80 ac	80 ac
150 lbs/ac	25 ac	50 ac	80 ac
200 lbs/ac	15 ac	20 ac	65 ac
250 lbs/ac	5 ac	15 ac	40 ac
300 lbs/ac	5 ac	10 ac	25 ac
332 lbs/ac	4 ac	5 ac	20 ac

b) November-February

Application Rate	**Maximum Application Block Size (ac) and Occupied Structure Distance**		
	100 ft	200 ft	500 ft
100 lbs/ac	20 ac	35 ac	80 ac
110 lbs/ac	15 ac	25 ac	65 ac
125 lbs/ac	10 ac	15 ac	50 ac
150 lbs/ac	5 ac	10 ac	30 ac
200 lbs/ac	3 ac	5 ac	15 ac
250 lbs/ac	2 ac	4 ac	10 ac
300 lbs/ac	2 ac	3 ac	10 ac
332 lbs/ac	1 ac	2 ac	5 ac

Table 5: Maximum Block Size (Acres) for Application Rate- Occupied Structure Distance Pairs for Untarped Application Methods Using 24-in Injection (FFMs 1224, 1225, 1226)

a) March-October

Application Rate	**Maximum Application Block Size (ac) and Occupied Structure Setback Distance**		
	100 ft	200 ft	500 ft
100 lbs/ac	80 ac	80 ac	80 ac
110 lbs/ac	80 ac	80 ac	80 ac
125 lbs/ac	80 ac	80 ac	80 ac
150 lbs/ac	80 ac	80 ac	80 ac
200 lbs/ac	80 ac	80 ac	80 ac
250 lbs/ac	55 ac	80 ac	80 ac
300 lbs/ac	30 ac	50 ac	80 ac
332 lbs/ac	20 ac	40 ac	80 ac

b) November-February

Application Rate	**Maximum Application Block Size (ac) and Occupied Structure Setback Distance**		
	100 ft	200 ft	500 ft
100 lbs/ac	80 ac	80 ac	80 ac
110 lbs/ac	80 ac	80 ac	80 ac
125 lbs/ac	80 ac	80 ac	80 ac
150 lbs/ac	60 ac	80 ac	80 ac
200 lbs/ac	25 ac	40 ac	80 ac
250 lbs/ac	15 ac	20 ac	55 ac
300 lbs/ac	5 ac	15 ac	35 ac
332 lbs/ac	5 ac	10 ac	30 ac

Table 6: Maximum Block Size (Acres) for Application Rate-Occupied Structure Distance Pairs for TIF Application Methods Using Shallow Injection (FFMs 1243, 1245, and 1259)

a) March-October

Application Rate	**Maximum Application Block Size (ac) and Occupied Structure Distance**		
	100 ft	200 ft	500 ft
100 lbs/ac	80 ac	80 ac	80 ac
110 lbs/ac	80 ac	80 ac	80 ac
125 lbs/ac	80 ac	80 ac	80 ac
150 lbs/ac	80 ac	80 ac	80 ac
200 lbs/ac	80 ac	80 ac	80 ac
250 lbs/ac	80 ac	80 ac	80 ac
300 lbs/ac	50 ac	80 ac	80 ac
332 lbs/ac	35 ac	65 ac	80 ac

b) November- February

Application Rate	**Maximum Application Block Size (ac) and Occupied Structure Distance**		
	100 ft	200 ft	500 ft
100 lbs/ac	80 ac	80 ac	80 ac
110 lbs/ac	80 ac	80 ac	80 ac
125 lbs/ac	80 ac	80 ac	80 ac
150 lbs/ac	80 ac	80 ac	80 ac
200 lbs/ac	30 ac	50 ac	80 ac
250 lbs/ac	15 ac	25 ac	70 ac
300 lbs/ac	10 ac	15 ac	45 ac
332 lbs/ac	5 ac	15 ac	35 ac

Table 7: Maximum Block Size (Acres) for Application Rate-Occupied Structure Distance Pairs for Drip Application (FFM 1209)

a) March-October

Application Rate	**Maximum Application Block Size (ac) and Occupied Structure Distance**		
	100 ft	200 ft	500 ft
100 lbs/ac	20 ac	40 ac	80 ac
110 lbs/ac	15 ac	30 ac	80 ac
125 lbs/ac	10 ac	20 ac	65 ac
150 lbs/ac	5 ac	15 ac	40 ac
200 lbs/ac	3 ac	5 ac	20 ac
250 lbs/ac	2 ac	4 ac	15 ac
300 lbs/ac	2 ac	3 ac	10 ac
332 lbs/ac	1 ac	3 ac	10 ac

b) November-February

Application Rate	**Maximum Application Block Size (ac) and Occupied Structure Distance**		
	100 ft	200 ft	500 ft
100 lbs/ac	5 ac	10 ac	25 ac
110 lbs/ac	4 ac	5 ac	20 ac
125 lbs/ac	3 ac	5 ac	15 ac
150 lbs/ac	2 ac	4 ac	10 ac
200 lbs/ac	1 ac	2 ac	5 ac
250 lbs/ac	Not allowed	2 ac	5 ac
300 lbs/ac	Not allowed	1 ac	4 ac
332 lbs/ac	Not allowed	1 ac	3 ac

As stated in the June 21, 2022, report,

> When choosing an application method, growers balance multiple factors; ideally, they want to minimize setbacks to occupied structures and costs while maximizing block size and maintaining pest control efficacy. Season, application rate, application method, occupied structure distance, and block size can all be adjusted to get the most cost-effective result. We make a series of assumptions about grower actions to estimate the cost. We assume that:
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> - Growers will not change application rates; application rates are determined by what is effective for pest control for that crop so applying at a lower rate for any given method is largely not an option. Appendix B presents more detailed information on pest management. Growers will not switch to TIF tarp application methods due to cost. Adding TIF tarp is currently estimated to cost around $1,150 an acre, including tarp removal. Additionally, currently there is not a sufficient supply of TIF tarp to allow all crops to use it. If there were a substantial shift to increased TIF, the price could increase.

- Growers using shallow injection and TIF tarp will switch to deep injection and TIF tarp when shallow injection applications would lead to greater setbacks.
- Growers will not increase the setback to occupied structures because in many cases that would lead to leaving a section of the field untreated. These sections would have to planted to nematode-resistant plants or left fallow. Nematodes are mobile in the soil and can infect a field from one untreated section. For perennial crops like almonds, having an untreated section would risk significant long-term yield loss. For annual crops like sweet potato the margins are too small to absorb a loss of acreage or yield for the year. We look at the potential lost acreage in the Method 2 analysis. Appendix B presents more detailed information on pest management.
- Growers will choose the least costly application method that maximizes block size. Blocks that exceed the maximum size based on application method, application rate, and occupied structure setback are split into smaller blocks that are within the size requirements. In other words, growers will not shift to an alternative application method or rate in order to increase the maximum block size, even if that would be sufficient for an existing application to meet the proposed requirements. Using TIF tarps would allow growers to maintain 80-acre blocks but comes at a cost. In comparison to the $1,150 per acre cost of TIF, the maximum estimated cost to split an 80-acre block (derived below) is $1,480, which amounts to $18.50 per acre on average. There is likely heterogeneity in the cost to split a block across fields and growers.
- Growers using chemigation (FFM 1209) will add TIF tarps at the cost of $1,150/ac and keep using chemigation. This is more expensive than switching to deeper injection. However, if a field is set up to use chemigation, it would likely require significant time and effort to re-do that field to instead use deep injection.

The updated seasonal regulation added additional considerations.

- When planting time is flexible, growers will choose to apply in the March-October timeframe instead of splitting blocks if their desired application does not meet the November-February restrictions. We assume that planting time for annual crops is not flexible, and that they will comply with the new restrictions for the season in which the application was made, including splitting a field into smaller blocks. For tree and vine crops, there is more flexibility in when they can plant. For this analysis, we assume that applications to tree and vine crops that violate the November-February restrictions would move to March-October.

It is worth noting that particularly hot weather in March would be problematic in the current scenario. A grower waiting until March to plant an orchard, which is the assumption in this report, could end up having to wait until the fall or even following March if the desired planting time was during a severe heat wave. This serves as a caveat that applies to this addendum but not to the June 21, 2022, report.

As stated in the June 21, 2022, report,

> We first identified any application statewide in our study period that would not have been in compliance under the proposed regulation, assuming they had to comply with the combinations of application rate, application method and maximum block size required in order to maintain a

100 ft setback from an occupied structure, regardless of whether or not one is present. Use rates are rounded up to the next level (i.e., an application with a use rate of 101 lbs/ac would be bound by the 110 lbs/ac rules). Given the assumptions above and DPR's updated fumigations tables, applications were separated into three sets: already compliant with the proposed regulation, able to comply by changing application method, and requiring splitting to comply.

We estimate two types of costs: application method costs and costs associated with splitting fields into smaller blocks. Based on stakeholder input, we set the cost of converting from 12-in or 18-in injection to 24-in injection depth at $10 per acre due to increased fuel costs[1]. At the time of this report, adding TIF tarp cost around $1,150 an acre including tarp removal, as noted above. Any costs that could be associated with additional soil preparation operations such as deep tillage, if required under some conditions, are not considered. Given that, and due to the small magnitude of the increase in fuel cost, 24-in injection depth is the lowest-cost application method for untarped and tarped applications if the method must be altered for compliance with the proposed regulations.

As described in the June 21, 2022, report, growers incur a time cost when fields must be split in order to not exceed the maximum block size for a given rate and the lowest-cost application method. We obtained an estimated cost per split of $185.92. Accordingly, the change in cost for a field requiring splitting will be the change in application method cost ($10 per acre for 24-in injection) plus the splitting cost ($185.92 per split).

Results for Alternative Proposed Regulation

Discussion of the results is separated by method.

Method 1: Economic analysis of changes in application methods to comply with 100 ft setback distance for all 1,3-D applications

Table 8 summarizes the number of violations when the proposed requirements are applied to historical data.

The number of acres that would have been affected annually by the regulation ranged from 15,045 to 18,066 for low-rate applications, 1,970 to 3,583 for medium-rate applications, and 20,862 to 24,632 for high-rate applications. A total of 38,391-43,528 acres per year would have been affected. The number of fields out of compliance with the new proposed regulations ranged from 337 to 432 for low-rate applications, 70 to 133 for medium-rate applications, and 902 to 1,036 for high-rate applications. A total of 1,312 to 1,536 fields per year would have been out of compliance.

[1] These fuel cost estimates were obtained prior to the 2022 increases in the cost of fuel.

Table 8: Incremental Cost Due to 1,3-D Restrictions, 2017-2020

Use Rate Category	Year	# of Violations	Affected Acres	# of Splits	Split Cost ($)	Deep Injection Cost ($)	TIF Cost	Total Cost ($)	Share of cost due to splits (%)	Share of cost due to deep-injection (%)	Share of cost due to TIF 1209 Injection (%)
Low	2017	432	18,066	42	7,809	173,708	799,020	980,536	1	18	81
Low	2018	388	16,271	31	5,764	155,827	791,131	952,721	1	16	83
Low	2019	380	15,784	30	5,578	155,194	304,405	465,177	1	33	65
Low	2020	337	15,045	39	7,251	144,317	705,238	856,805	1	17	82
Medium	2017	133	3,583	55	10,226	35,833	0	46,059	22	78	0
Medium	2018	112	2,626	28	5,206	25,341	105,800	136,347	4	19	78
Medium	2019	103	2,508	23	4,276	23,585	171,925	199,786	2	12	86
Medium	2020	70	1,970	28	5,206	18,003	195,776	218,984	2	8	89
High	2017	902	21,852	968	179,971	218,516	0	398,486	45	55	0
High	2018	1,036	24,632	1,133	210,647	246,318	0	456,965	46	54	0
High	2019	914	20,862	789	146,691	208,625	0	355,315	41	59	0
High	2020	905	21,376	981	182,388	213,759	0	396,147	46	54	0
Total	2017	1,467	43,500	1,065	198,005	428,057	799,020	1,425,081	14	30	56
Total	2018	1,536	43,528	1,192	221,617	427,485	896,931	1,546,033	14	28	58
Total	2019	1,397	39,155	842	156,545	387,403	476,330	1,020,278	15	38	47
Total	2020	1,312	38,391	1,048	194,844	376,078	901,014	1,471,936	13	26	61

Under the proposed seasonal tables, the addition of TIF tarp for chemigation is a big driver of cost increases, particularly in the low and medium rate categories. The number of splits required varied across application rate categories. Low-rate applications required 30-42 splits with a cost of $5,578 to $$7,809 (Table 8). Medium-rate blocks require 23-55 splits and high-rate blocks 789 to 1,133 splits annually to bring them into compliance. For the high-rate fields, the vast majority of which are tree and vine crops, around 45% of the estimated change in cost is due to the logistical costs of splitting fields into smaller blocks. Applications requiring splits could incur higher costs if applicators decide to charge more per acre for smaller blocks and/or charge for mileage. As stated in the June 21, 2022, report:

> Additionally, it is possible that some new maximum block sizes are so small that if all applications were divided into such blocks applicators simply wouldn't have the time or resources to treat all of them in time for planting, particularly if the affected fields are geographically dispersed. That scenario could likely be resolved by increased hiring and investment in equipment by applicators but does present a potentially very damaging situation in the short term if growers struggle to meet planting times and must leave fields fallow.

In total, annual compliance costs ranged from $465,177 to $980,536 for low-rate applications, from $46,059 to $218,984 for medium-rate applications, and from $355,315 to $456,965 for high-rate applications (Table 8). The $46,059 for medium-rate applications was from 2017 and is lower than the other years because no applications had to switch to TIF. For all crops, annual compliance costs are estimated at $1,020,278-1,546,033 (Table 8).

Costs disaggregated by crop and year are available in Appendix A.

Method 2: Spatial analysis of fields impacted by 100 ft, 200 ft, and 500 ft occupied structure setback distances in three counties

There were 1,711 1,3-D applications in the three focal counties in total for the years 2017 and 2018. For these counties in total, the estimated costs obtained using Method 1 were $435,257 in 2017 and $240,067 for 2018 (Table 9). Limiting the analysis to the actual fields and acreage affected by the regulations reduces costs by 66% in 2018 and 76% in 2017 (Table 9).

Table 9 compares costs from the first analysis (Method 1) and the spatial analysis (Method 2), disaggregated into costs from splitting blocks, using deeper injection, and using TIF. It also reports the spatial costs as a share of the first analysis by cost component. Notably, across years and counties the cost of 24 in-injection under Method 2 is a significantly higher percentage of its cost under Method 1 than is the case for the cost of block splitting. Limiting the analysis to the actual fields and acreage affected by the regulations gave estimated costs that were 66% in 2018 and 76% in 2017 (Table 9).

Table 9. Comparison across Methods of Estimated Cost of Complying with Proposed Regulations on Occupied Structure Setbacks, Application Methods and Rates, and Maximum Block Size

	Year	**Method 1 Costs ($)**				**Method 2 Costs ($)**				**Method 2 Cost as a Share of Method 1 Cost (%)**			
		Split	**Deep Inj.**	**TIF**	**Total**	**Split**	**Deep Inj.**	**TIF**	**Total**	**Split**	**Deep Inj.**	**TIF**	**Total**
Fresno	2017	29,189	62,332	0	91,521	18,220	55,454	0	73,674	62	89		80
Kern	2017	28,818	62,947	202,400	294,165	9,668	46,910	158,700	215,277	34	75	78	73
Stanislaus	2017	14,130	35,441	0	49,571	8,366	32,623	0	40,989	59	92		83
Total	**2017**	**72,137**	**160,720**	**202,400**	**435,257**	**36,254**	**134,986**	**158,700**	**329,940**	**50**	**84**	**78**	**76**
Fresno	2018	22,310	60,100	0	82,410	12,643	51,540	0	64,182	57	86	0	78
Kern	2018	31,792	63,890	0	95,683	6,135	45,518	0	51,653	19	71	0	54
Stanislaus	2018	20,451	41,523	0	61,974	10,226	32,600	0	42,826	50	79	0	69
Total	2018	**74,554**	**165,513**	0	**240,067**	**29,004**	**129,658**	0	**158,661**	**39**	**78**	**0**	**66**

Table 10, reproduced from the June 21, 2022, report, shows the number of fields with occupied structures within 100 ft, 200 ft, and 500 ft. There were 268 fields in 2017 and 353 in 2018 with no occupied structures within 500 ft. This is 33% and 39% of fields, respectively.

Table 10: Number of Fields in 2017 and 2018 with Occupied Structures within 100 ft, 200 ft, and 500 ft Setbacks

Year	**Setback (ft)**	**Fields with structures within setback**
2017	100	147
	200	223
	500	179
2018	100	155
	200	226
	500	160

Fields with occupied structures within 200 ft would have to use the 100 ft setback rules in Table 5. This was estimated to cost $90,955 in 2017 and $87,053 in 2018, which is 28 and 54% of the total cost in each year (Table 11).

Applications that did not comply with the proposed regulations on fields with occupied structures between 200 and 500 ft would need to use deeper injection applications to comply with the proposed regulations but would be able to use the 200 ft setback rules (Table 5). This was estimated to cost $33,543 in 2017 and $23,592 in 2018, which is 10% and 15% of the total cost in each year, respectively (Table 11).

Applications that did not comply with the proposed regulations on fields with no occupied structures within 500 ft would switch to deeper injection but would be able to use the 500 ft setback rules in the proposed regulations (Table 5). This was estimated to cost $205,442 in 2017 and $50,974 in 2018, which is 62% and 32% of the total cost in each year, respectively (Table 11). The higher cost of compliance in 2017 was due to some fields having to add TIF tarp. There was no TIF added in 2018 in these three counties. This made the estimated compliance cost higher in 2018 using Method 1 but higher in 2017 using Method 2.

Table 11: Estimated Costs by Year and Occupied Structure Setback Distance in Focal Counties

Setback (ft)	Year	# of Violations	Affected Acres	# of Splits	Split Cost ($)	Deep Injection Cost ($)	TIF 1209	Total Cost ($)	% of Total Cost
100	2017	276	6,325	149	27,702	63,253	0	90,955	28
100	2018	294	6,326	128	23,798	63,255	0	87,053	54
200	2017	91	2,797	30	5,578	27,965	0	33,543	10
200	2018	95	2,118	13	2,417	21,176	0	23,592	15
500	2017	89	4,515	16	2,975	43,767	158,700	205,442	62
500	2018	100	4,726	20	3,718	47,256	0	50,974	32
Total	2017	456	13,637	195	36,254	134,986	158,700	329,940	100
Total	2018	489	13,169	161	29,933	131,687	0	161,620	100

The total estimated cost for the three focal counties to comply with the proposed regulation using the spatially explicit approach was 76% (2017) and 66% (2018) of the total estimated cost using the assumption that all fields had a structure within 100 ft. Most of the reduction in estimated costs is due to fewer splits being required with the larger setback distances. As stated in the June 21, 2022, report:

> Note that these three counties and two years may or may not be representative for all counties in all years. In particular, none of these are coastal counties where there are more fields using application methods that would require TIF to be added. However, it does indicate that it is appropriate to treat our estimates from the first analysis as an upper bound. For growers with blocks farther than 200 ft from an occupied structure, splitting costs will be lower than what is estimated for all counties on average.

Appendix A: Estimated Costs by Crop and Year

Commodity	Year	Fields not in compliance	Acres not in compliance	Splits needed	Split costs	Deeper injection costs	TIF 1209	Total cost
ALMOND	2017	384	9,155	659	122,521	91,552	-	214,073
ALMOND	2018	501	11,198	780	145,018	111,980	-	256,997
ALMOND	2019	407	8,917	616	114,527	89,166	-	203,693
ALMOND	2020	421	9,363	680	126,426	93,628	-	220,053
APPLE	2018	2	19	1	186	190	-	376
APPLE	2019	2	23	1	186	225	-	411
APRICOT	2017	5	64	4	744	639	-	1,383
APRICOT	2018	1	4	-	-	40	-	40
APRICOT	2020	3	65	5	930	650	-	1,580
ASIAN PEAR	2019	1	7	-	-	65	-	65
BEAN DRIED	2017	1	48	-	-	480	-	480
BEET	2017	2	15	-	-	150	-	150
BEET	2019	-	-	-	-	-	-	-
BLACKBERRY	2017	-	-	-	-	-	-	-
BLACKBERRY	2018	-	-	-	-	-	-	-
BLACKBERRY	2019	-	-	-	-	-	-	-
BLACKBERRY	2020	-	-	-	-	-	-	-
BLUEBERRY	2017	2	111	10	1,859	1,107	-	2,966
BLUEBERRY	2018	2	178	16	2,975	1,780	-	4,755
BLUEBERRY	2019	1	40	3	558	400	-	958
BROCCOLI	2017	4	113	-	-	1,130	-	1,130
BROCCOLI	2018	-	-	-	-	-	-	-
BROCCOLI	2019	2	60	-	-	602	-	602
BROCCOLI	2020	1	33	-	-	333	-	333
BRUSSEL SPROUT	2017	90	1,807	5	930	18,071	-	19,000
BRUSSEL SPROUT	2018	65	1,294	4	744	12,941	-	13,684
BRUSSEL SPROUT	2019	82	1,491	3	558	14,909	-	15,467

BRUSSEL SPROUT	2020	35	793	2	372	7,930	-	8,302
BRUSSEL SPROUT SEED	2020	1	17	-	-	170	-	170
CABBAGE	2017	5	56	-	-	557	-	557
CABBAGE	2018	1	10	-	-	95	-	95
CABBAGE	2019	1	11	-	-	110	-	110
CABBAGE	2020	1	14	-	-	140	-	140
CANTALOUPE	2017	3	336	3	558	3,360	-	3,918
CANTALOUPE	2018	4	372	2	372	3,720	-	4,092
CANTALOUPE	2019	7	635	2	372	6,350	-	6,722
CANTALOUPE	2020	5	401	2	372	4,010	-	4,382
CARROT	2017	141	8,020	24	4,462	80,197	-	84,659
CARROT	2018	123	6,945	15	2,789	69,452	-	72,241
CARROT	2019	142	7,393	13	2,417	73,926	-	76,343
CARROT	2020	119	6,973	20	3,718	69,734	-	73,452
CAULIFLOWER	2017	-	-	-	-	-	-	-
CAULIFLOWER	2018	-	-	-	-	-	-	-
CAULIFLOWER	2020	10	152	-	-	1,523	-	1,523
CHERRY	2017	16	341	27	5,020	3,407	-	8,426
CHERRY	2018	16	340	27	5,020	3,402	-	8,421
CHERRY	2019	10	222	16	2,975	2,223	-	5,198
CHERRY	2020	13	183	11	2,045	1,826	-	3,871
CITRUS	2017	-	-	-	-	-	-	-
CORN FOR/FOD	2017	1	27	2	372	270	-	642
EGGPLANT	2017	1	40	-	-	400	-	400
EGGPLANT	2018	-	-	-	-	-	-	-
EGGPLANT	2019	3	85	-	-	849	-	849
EGGPLANT	2020	-	-	-	-	-	-	-
FALLOW OR IDLE LAND	2018	1	37	-	-	370	-	370

GF-GROUND COVER	2019	1	43	4	744	432	-	1,176
GP-VINE	2018	1	78	7	1,301	778	-	2,079
GRAPE	2017	67	2,226	172	31,978	22,259	-	54,237
GRAPE	2018	51	1,858	133	24,727	18,581	-	43,309
GRAPE	2019	47	1,749	118	21,939	17,487	-	39,425
GRAPE	2020	75	1,997	128	23,798	19,966	-	43,764
GRAPE, RAISIN	2017	14	351	24	4,462	3,514	-	7,976
GRAPE, RAISIN	2018	20	343	24	4,462	3,429	-	7,891
GRAPE, RAISIN	2019	17	349	26	4,834	3,486	-	8,320
GRAPE, RAISIN	2020	17	436	35	6,507	4,355	-	10,862
GRAPE, WINE	2017	37	1,127	85	15,803	11,268	-	27,072
GRAPE, WINE	2018	40	1,845	162	30,119	18,453	-	48,572
GRAPE, WINE	2019	35	990	79	14,688	9,897	-	24,585
GRAPE, WINE	2020	31	1,582	128	23,798	15,823	-	39,620
GRAPEFRUIT	2018	1	3	-	-	25	-	25
GRAPEFRUIT	2019	1	14	1	186	135	-	321
HONEYDEW MELON	2017	4	380	3	558	3,800	-	4,358
HONEYDEW MELON	2018	4	345	1	186	3,450	-	3,636
HONEYDEW MELON	2019	5	556	3	558	5,560	-	6,118
HONEYDEW MELON	2020	6	510	2	372	5,100	-	5,472
KIWI	2018	1	12	1	186	118	-	304
KIWI	2020	1	3	-	-	33	-	33
LEMON	2017	2	50	3	558	500	-	1,058
LEMON	2018	11	108	5	930	1,080	-	2,010
LEMON	2019	5	162	13	2,417	1,618	-	4,035
LEMON	2020	2	55	4	744	549	-	1,292

LETTUCE HEAD	2017	1	15	-	-	150	-	150
LETTUCE HEAD	2018	3	193	-	-	1,930	-	1,930
LETTUCE HEAD	2020	2	54	-	-	540	-	540
LETTUCE HEAD SEED	2017	1	55	-	-	550	-	550
LETTUCE LEAF	2017	2	148	-	-	1,481	-	1,481
LETTUCE LEAF	2018	1	150	1	186	1,500	-	1,686
LETTUCE LEAF	2020	1	34	-	-	343	-	343
LETTUCE ROMAINE	2019	2	144	-	-	1,443	-	1,443
MELON	2019	1	76	-	-	760	-	760
N-OUTDOOR FLOWER	2017	1	5	-	-	-	5,463	5,463
N-OUTDOOR FLOWER	2018	-	-	-	-	-	-	-
N-OUTDOOR FLOWER	2019	-	-	-	-	-	-	-
N-OUTDOOR FLOWER	2020	-	-	-	-	-	-	-
N-OUTDOOR PLANT	2018	2	10	-	-	99	-	99
N-OUTDOOR PLANT	2019	1	5	-	-	45	-	45
N-OUTDOOR PLANT	2020	-	-	-	-	-	-	-
N-OUTDOOR TRANSPL	2018	-	-	-	-	-	-	-
N-OUTDOOR TRANSPL	2019	1	2	-	-	21	-	21
NAPA CAB(TGHT HD)	2017	61	604	-	-	6,038	-	6,038

NAPA CAB(TGHT HD)	2018	35	379	-	-	3,790	-	3,790
NAPA CAB(TGHT HD)	2019	47	453	-	-	4,534	-	4,534
NAPA CAB(TGHT HD)	2020	44	538	-	-	5,384	-	5,384
NECTARINE	2017	27	204	6	1,116	2,035	-	3,151
NECTARINE	2018	25	225	9	1,673	2,254	-	3,927
NECTARINE	2019	23	179	6	1,116	1,792	-	2,908
NECTARINE	2020	15	186	11	2,045	1,860	-	3,905
OF-BULB	2017	-	-	-	-	-	-	-
OF-BULB	2019	1	6	-	-	62	-	62
OLIVE	2017	3	92	8	1,487	922	-	2,409
OLIVE	2018	9	272	19	3,532	2,724	-	6,256
OLIVE	2020	1	22	2	372	219	-	591
ONION DRY	2019	1	4	-	-	40	-	40
OP-BULB	2017	14	121	2	372	1,212	-	1,584
OP-FLOWERING PLANT	2017	5	57	1	186	572	-	758
OP-VINE	2017	7	329	12	2,231	3,289	-	5,520
OP-VINE	2018	8	476	13	2,417	4,760	-	7,177
OP-VINE	2019	4	306	14	2,603	3,064	-	5,667
ORANGE	2017	5	87	6	1,116	869	-	1,985
ORANGE	2018	7	200	15	2,789	1,998	-	4,786
ORANGE	2019	2	33	2	372	325	-	697
ORANGE	2020	4	62	4	744	618	-	1,361
ORANGE NAVEL	2019	1	10	-	-	100	-	100
ORANGE NAVEL	2020	3	54	3	558	536	-	1,094
OT-DEC. TREE	2017	1	15	1	186	145	-	331
OT-DEC. TREE	2018	1	9	-	-	88	-	88
OT-DEC. TREE	2019	2	14	-	-	140	-	140

OT-DEC. TREE	2020	1	3	-	-	25	-	25
PARSLEY	2017	-	-	-	-	-	-	-
PEACH	2017	71	743	33	6,135	7,428	-	13,563
PEACH	2018	56	496	21	3,904	4,957	-	8,861
PEACH	2019	45	444	22	4,090	4,438	-	8,528
PEACH	2020	39	432	21	3,904	4,322	-	8,226
PEACH PROCESSING	2017	14	143	5	930	1,427	-	2,357
PEACH PROCESSING	2018	8	92	5	930	921	-	1,851
PEACH PROCESSING	2019	5	35	1	186	353	-	539
PEACH PROCESSING	2020	2	13	-	-	132	-	132
PEAR	2019	1	7	-	-	68	-	68
PEAR, ASIAN	2017	1	13	1	186	127	-	313
PEAS	2019	-	-	-	-	-	-	-
PECAN	2017	-	-	-	-	-	-	-
PEPPER FRUITING	2017	23	745	-	-	3,798	420,440	424,238
PEPPER FRUITING	2018	19	643	-	-	3,832	299,184	303,016
PEPPER FRUITING	2019	30	981	3	558	7,235	295,665	303,458
PEPPER FRUITING	2020	31	717	-	-	1,000	709,320	710,320
PEPPER FRUITING SD	2017	-	-	-	-	-	-	-
PEPPER FRUITING SD	2018	-	-	-	-	-	-	-
Pepper, Bell	2020	6	360	1	186	3,600	-	3,786
PERSIMMON	2018	1	8	-	-	80	-	80
PISTACHIO	2017	1	13	1	186	130	-	316
PISTACHIO	2020	4	69	5	930	691	-	1,620
PLUM	2017	10	74	2	372	743	-	1,115

PLUM	2018	16	100	1	186	1,001	-	1,186
PLUM	2019	15	159	7	1,301	1,589	-	2,890
PLUM	2020	6	35	1	186	354	-	540
POTATO	2017	22	1,049	5	930	10,485	-	11,415
POTATO	2018	24	1,028	5	930	10,276	-	11,206
POTATO	2019	29	1,308	3	558	13,078	-	13,635
POTATO	2020	13	830	2	372	8,299	-	8,670
POTATO SEED	2017	-	-	-	-	-	-	-
POTATO SEED	2018	1	85	1	186	850	-	1,036
PREPLANT/SOIL FUM	2017	267	5,564	376	69,906	55,635	-	125,541
PREPLANT/SOIL FUM	2018	280	4,951	321	59,680	49,507	-	109,187
PREPLANT/SOIL FUM	2019	313	5,720	381	70,836	57,195	-	128,031
PREPLANT/SOIL FUM	2020	281	5,482	368	68,419	54,815	-	123,234
PRUNE	2017	9	363	31	5,764	3,634	-	9,398
PRUNE	2018	14	341	26	4,834	3,413	-	8,247
PRUNE	2019	8	106	6	1,116	1,063	-	2,179
PRUNE	2020	3	133	11	2,045	1,335	-	3,380
RASPBERRY	2017	1	12	-	-	-	13,800	13,800
RASPBERRY	2018	-	-	-	-	-	-	-
RASPBERRY	2019	1	11	-	-	-	13,202	13,202
RASPBERRY	2020	2	25	-	-	-	28,888	28,888
RESEARCH COMMODITY	2017	-	-	-	-	-	-	-
RESEARCH COMMODITY	2019	1	5	-	-	50	-	50
RESEARCH COMMODITY	2020	1	3	-	-	26	-	26

RUTABAGA	2019	-	-	-	-	-	-	-
SOIL FUMI/PREPLANT	2017	6	124	6	1,116	1,239	-	2,355
SOIL FUMI/PREPLANT	2018	3	33	1	186	332	-	518
SOIL FUMI/PREPLANT	2019	4	30	-	-	297	-	297
SOIL FUMI/PREPLANT	2020	6	212	18	3,347	2,124	-	5,471
SQUASH, SUMMER	2018	4	74	-	-	740	-	740
SQUASH, SUMMER	2019	1	18	-	-	180	-	180
SQUASH, WINTER	2019	1	34	-	-	340	-	340
STONE FRUIT	2020	1	7	-	-	70	-	70
STRAWBERRY	2017	31	1,586	-	-	11,636	485,737	497,373
STRAWBERRY	2018	36	1,993	-	-	16,284	419,267	435,551
STRAWBERRY	2019	19	1,462	-	-	12,807	208,150	220,957
STRAWBERRY	2020	17	1,487	1	186	12,915	224,526	237,626
SWEET POTATO	2017	114	5,220	9	1,673	52,198	-	53,871
SWEET POTATO	2018	103	5,009	9	1,673	50,092	-	51,765
SWEET POTATO	2019	92	4,315	10	1,859	43,153	-	45,012
SWEET POTATO	2020	96	4,437	7	1,301	44,369	-	45,671
TANGELO	2017	1	19	1	186	191	-	377
TANGELO	2019	1	25	2	372	246	-	617
TANGERINE	2017	7	133	9	1,673	1,329	-	3,002
TANGERINE	2018	18	200	6	1,116	1,998	-	3,113
TANGERINE	2019	20	341	18	3,347	3,409	-	6,755
TANGERINE	2020	9	196	13	2,417	1,961	-	4,377
TANGERINE, SEEDLESS	2017	7	264	20	3,718	2,643	-	6,361
TANGERINE, SEEDLESS	2018	8	254	21	3,904	2,544	-	6,448

TANGERINE, SEEDLESS	2019	18	654	54	10,040	6,537	-	16,576
TANGERINE, SEEDLESS	2020	9	343	27	5,020	3,431	-	8,451
TOMATO	2017	22	1,781	10	1,859	17,809	-	19,668
TOMATO	2019	5	215	-	-	2,149	-	2,149
TOMATO	2020	3	333	3	558	3,326	-	3,884
TOMATO PROCESSING	2017	2	194	2	372	1,938	-	2,310
TOMATO PROCESSING	2020	3	224	1	186	2,240	-	2,426
UNCULTIVATED AG	2017	40	910	61	11,341	9,097	-	20,438
UNCULTIVATED AG	2018	37	1,096	86	15,989	10,959	-	26,948
UNCULTIVATED AG	2019	34	1,094	91	16,919	10,938	-	27,856
UNCULTIVATED AG	2020	42	1,233	99	18,406	12,326	-	30,732
UNDECLARED COMM	2020	1	56	-	-	564	-	564
WALNUT	2017	66	1,794	141	26,215	17,937	-	44,152
WALNUT	2018	84	2,502	202	37,556	25,023	-	62,579
WALNUT	2019	57	1,386	104	19,336	13,859	-	33,194
WALNUT	2020	43	1,191	97	18,034	11,906	-	29,941
WATERMELON	2017	6	159	-	-	-	182,402	182,402
WATERMELON	2018	14	403	-	-	-	463,036	463,036
WATERMELON	2019	2	41	-	-	47	41,400	41,447
WATERMELON	2020	1	37	-	-	-	42,412	42,412
WHEAT	2017	1	83	1	186	830	-	1,016
WHEAT	2018	3	79	7	1,301	786	-	2,087
WHEAT FOR/FOD	2020	1	52	5	930	520	-	1,450