



2022

# STATEWIDE AVOCADO

## ACREAGE & CONDITION ANALYSIS

Prepared for  
California Avocado Commission

Prepared by



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## EXECUTIVE SUMMARY

Spatial land use information is essential for the California Avocado Commission to make informed decisions for budgeting and marketing of crops. Accurate and timely land use information is the foundation of these analyses and is vital to the decision-making process.

Increased availability of digital satellite imagery, aerial photography and new analytical tools make remote sensing land use surveys possible at the grove scale. These technologies allow accurate, large-scale crop and land use identification to be performed at time increments as desired and make highly accurate and comprehensive statewide avocado mapping possible.

Growers, industry, regulators, government agencies, and commodity groups also benefit from spatial data related to crop type, location, condition, and density. These data are key components for management of environmental resources and proximity to sensitive areas including water quality, air quality, and disease or pest vectors.

For 2022, the total planted avocado acreage in California was 52,204 acres.





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## INTRODUCTION

Accurate acreage information is critically important to the work of the California Avocado Commission (CAC). Acreage drives a multitude of activities that range from yield forecasting, to member data tracking, and budgeting. In response to this need for information, Land IQ was contracted by CAC to develop a comprehensive and accurate statewide spatial land use database of avocado groves and condition on a grove scale using remote sensing, statistical, and temporal analysis methods.





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**FORECASTING METHODS**

Land IQ integrated crop production knowledge with multiple satellite and aerial image resources to conduct remote sensing land use analysis at the grove scale. The mapping approach employs advanced spatial statistical analysis to determine prediction probabilities and inform QA/QC efforts. A rigorous QA/QC and photo interpretive analysis is employed to improve predictions on all lower probability groves. In addition, these groves are also back-checked with the CAC industry representatives.

Individual avocado polygon boundaries (areas of homogeneous crop types representing true cropped area, rather than legal parcel boundaries) are used so that each independent avocado polygon could be analyzed independently and assigned a condition class. The results represent the true cropped area and not legal or other less detailed boundaries that may be available elsewhere.

The condition legend was developed by CAC and is summarized in Table 1.

**Table 1. Avocado Condition Description**

| Condition      | Description   |
|----------------|---|
| Producing      | Groves that are greater than 4 years old.   |
| Topped/Stumped | Groves that have been topped and/or stumped and not producing.  |
| New/Young      | Groves that are 4 years old or younger.   |
| Abandoned      | Groves previously identified as avocados that do not return to healthy growth statistics as represented by spectral data. |





## Data Collection

Both aerial and satellite data resources were used for the classification. Avocado boundaries from 2021 avocado mapping were used as a base layer for 2022. Multiple Landsat 8 images were used for the initial crop classification. Imagery from the Landsat 8 satellite is free, available every 16 days, and used for temporal analysis throughout the growing season. Following analysis with Landsat 8 images, various sources of localized high resolution imagery were used to further evaluate groves for condition, age, density, and boundary updates. Data provided by Maxar is higher resolution but requires a paid subscription.



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## Analysis

The Land IQ avocado mapping unit is a grove-scale layer focused on avocado polygons equal to or greater than 0.5 acres across the state. 16,631 delineated polygons were classified using multiple image sources and dates. The images are used as the base layer data, in which classification algorithms are applied for crop identification.

Classified groves with a lower confidence level are carefully reviewed by assessing image resources using photo interpretation methods. Results are also cross-validated with ancillary data sources such as the coinciding USDA Crop Data Layer, county agricultural surveys and county crop reports to assess and evaluate significant differences.

The geospatial database is attributed with avocado polygon size in acres, relevant county, and the appropriate condition category per the CAC legend (Table 1). Table 2 summarizes the database attributes (columns) associated with the final mapping product and their definitions.

**Table 2. Definition of Database Fields**

| Avocado Polygon Attribute | Description   |
|---------------------------|---|
| Acres                     | Area of the avocado polygon   |
| County                    | Indicates the county that the centroid of each avocado polygon resides in |
| Crop 2022                 | Crop classification type for the year 2022                                |
| Modified By               | Name of person who last modified the record                               |
| Date Data Refers To       | Date the data refers to   |
| Last Modified Date        | Date record was last modified   |
| Condition                 | Describes condition of the avocado polygon                                |
| Year Planted              | Year the grove was planted or stumped                                     |
| Density                   | Describes the planting density of the grove                               |
| Comments                  | Any user-provided comments  |
| Source                    | Original source of the boundary and attribute information                 |



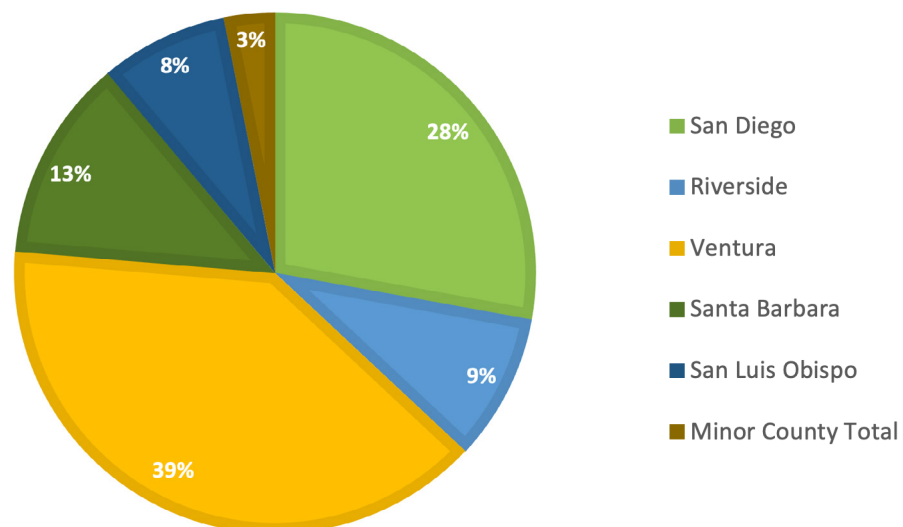
## Numeric Results

The avocado acreage classification for the 2022 year totaled 16,631 avocado fields and 52,204 planted acres. The five main avocado growing counties are Ventura, San Diego, Santa Barbara, Riverside, and San Luis Obispo. Small acreages were also present in Orange, San Bernardino, Monterey, Tulare, Los Angeles, Fresno, and Kern Counties. Statewide avocado acreages by county are summarized in Table 3 and Figure 1.

Table 3. Summary of 2022 Statewide Avocado Acreage by County

| Five County   | Acres         | Number of Fields | Minor County              | Acres        | Number of Fields |
|---|---------------|------------------|---------------------------|--------------|------------------|
| San Diego   | 14,547        | 5,507            | Orange                    | 906          | 341              |
| Riverside   | 4,754         | 2,150            | San Bernardino            | 418          | 114              |
| Ventura   | 20,542        | 6,016            | Monterey                  | 227          | 36               |
| Santa Barbara   | 6,576         | 1,560            | Tulare                    | 83           | 24               |
| San Luis Obispo   | 4,136         | 868              | Los Angeles               | 12           | 13               |
|   |               |                  | Fresno                    | 3            | 2                |
|   |               |                  | Kern                      |              |                  |
| <b>Five County Total</b>                                      | <b>50,555</b> | <b>16,101</b>    | <b>Minor County Total</b> | <b>1,648</b> | <b>530</b>       |
| <b>Overall Total: 52,204 Classified Acres / 16,631 Fields</b> |               |                  |                           |              |                  |

Figure 1. Summary of 2022 Statewide Avocado Acreage by County



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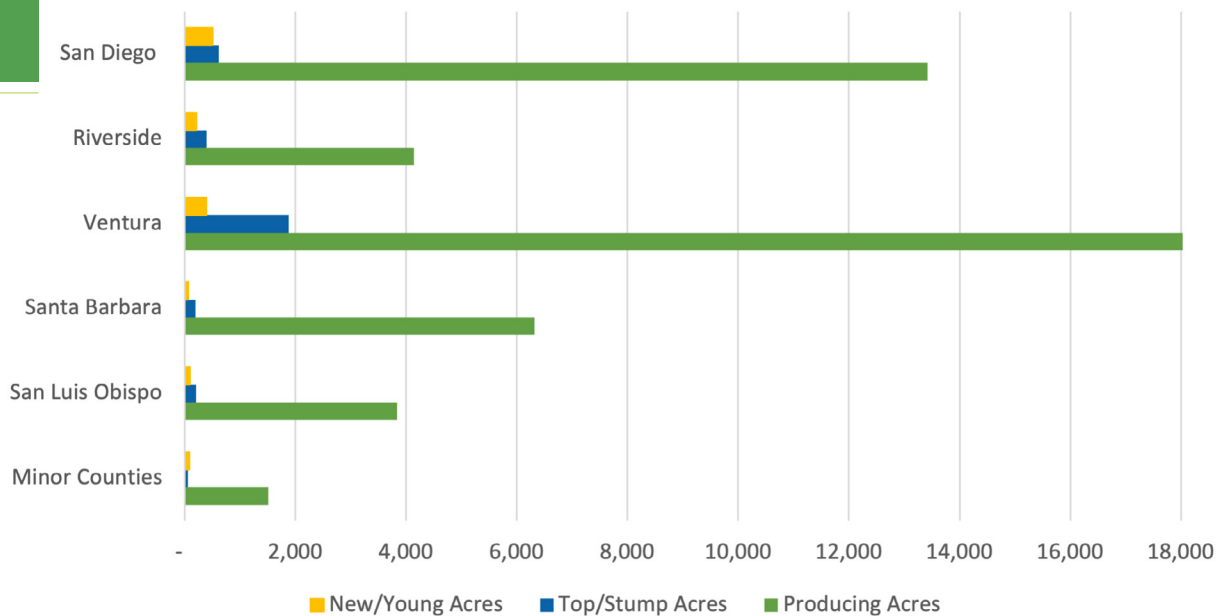
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Acres by county and condition for the five main growing areas are summarized in Table 4 and Figures 2 and 3.

Table 4. Summary of 2022 Statewide Avocado Acreage by Condition

| County                   | Producing Acres | Top/Stump Acres | New/Young Acres | Planted Acres |
|--------------------------|-----------------|-----------------|-----------------|---------------|
| San Diego                | 13,425          | 509             | 613             | 14,547        |
| Riverside                | 4,139           | 217             | 398             | 4,754         |
| Ventura                  | 18,278          | 386             | 1,878           | 20,542        |
| Santa Barbara            | 6,315           | 65              | 196             | 6,576         |
| San Luis Obispo          | 3,839           | 93              | 204             | 4,136         |
| <b>Five County Total</b> | <b>45,996</b>   | <b>1,269</b>    | <b>3,290</b>    | <b>50,555</b> |
| Minor Counties           | 1,509           | 83              | 57              | 1,648         |
| <b>Total</b>             | <b>47,505</b>   | <b>1,352</b>    | <b>3,347</b>    | <b>52,204</b> |

Figure 2. 2022 Avocado Acreage by Condition and County







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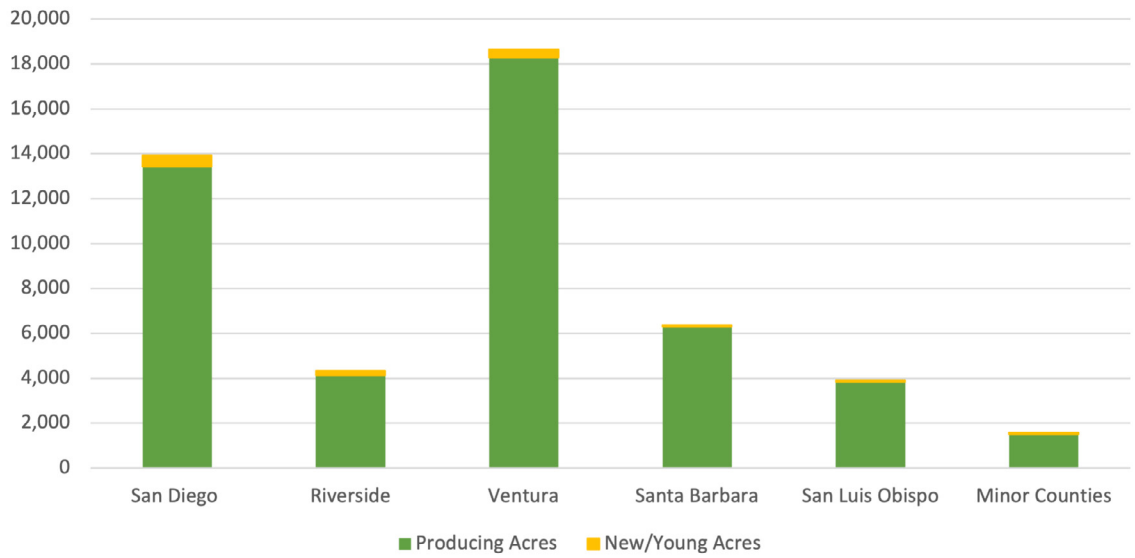
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Figure 3. 2022 Avocado Acreage of Producing and New/Young Acreage by County





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In addition to acreage and condition summaries, a spatial analysis was completed to determine acreage by other jurisdictional boundaries including zip code. Acreage by zip code is summarized in Table 5.

Table 5. Summary of 2022 Statewide Avocado Acreage by Zip Code

| San Diego |           | Riverside |           | Ventura  |           |
|-----------|-----------|-----------|-----------|----------|-----------|
| Zip Code  | Producing | Zip Code  | Producing | Zip Code | Producing |
| 91935     | 0         | 92028     | 44        | 90265    | 3         |
| 92003     | 684       | 92503     | 27        | 91320    | 1         |
| 92019     | 3         | 92504     | 43        | 91360    | 25        |
| 92021     | 276       | 92506     | 4         | 91361    | 6         |
| 92025     | 326       | 92507     | 16        | 93001    | 1,310     |
| 92026     | 927       | 92508     | 0         | 93003    | 218       |
| 92027     | 1,261     | 92521     | 11        | 93004    | 118       |
| 92028     | 3,359     | 92544     | 7         | 93010    | 252       |
| 92029     | 32        | 92557     | 12        | 93012    | 1,253     |
| 92040     | 5         | 92562     | 168       | 93013    | 32        |
| 92055     | 0         | 92570     | 6         | 93015    | 2,996     |
| 92057     | 262       | 92583     | 9         | 93021    | 2,273     |
| 92059     | 145       | 92590     | 3,703     | 93022    | 2         |
| 92061     | 1,314     | 92592     | 20        | 93023    | 781       |
| 92064     | 271       | 92595     | 30        | 93030    | 0         |
| 92065     | 169       | 92881     | 6         | 93033    | 224       |
| 92069     | 220       | 92882     | 24        | 93036    | 102       |
| 92078     | 53        | 92883     | 11        | 93040    | 481       |
| 92082     | 3,578     |           |           | 93060    | 4,341     |
| 92084     | 540       |           |           | 93065    | 119       |
|           |           |           |           | 93066    | 3,740     |



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### Santa Barbara

| Zip Code | Producing |
|----------|-----------|
| 93013    | 1,937     |
| 93103    | 36        |
| 93105    | 246       |
| 93108    | 145       |
| 93109    | 11        |
| 93110    | 14        |
| 93111    | 499       |
| 93117    | 3,061     |
| 93436    | 39        |
| 93454    | 29        |
| 93455    | 296       |

### Los Angeles

| Zip Code | Producing |
|----------|-----------|
| 90265    | 4         |
| 90631    | 4         |
| 91301    | 2         |
| 91711    | 1         |
| 91768    | 3         |

### San Luis Obispo

| Zip Code | Producing |
|----------|-----------|
| 93401    | 241       |
| 93402    | 15        |
| 93405    | 147       |
| 93420    | 499       |
| 93422    | 2         |
| 93428    | 178       |
| 93430    | 337       |
| 93442    | 586       |
| 93444    | 504       |
| 93452    | 29        |
| 93454    | 1,253     |
| 93465    | 47        |

### Monterey

| Zip Code | Producing |
|----------|-----------|
| 93960    | 199       |
| 95076    | 8         |

### Orange

| Zip Code | Producing |
|----------|-----------|
| 92602    | 560       |
| 92610    | 57        |
| 92618    | 56        |
| 92620    | 12        |
| 92675    | 107       |
| 92694    | 0         |
| 92705    | 4         |
| 92782    | 7         |
| 92887    | 1         |

### Fresno

| Zip Code | Producing |
|----------|-----------|
| 93654    | 0         |
| 93662    | 1         |

### Kern

| Zip Code | Producing |
|----------|-----------|
| 93308    | 0         |

### San Bernardino

| Zip Code | Producing |
|----------|-----------|
| 91709    | 39        |
| 91784    | 7         |
| 92313    | 12        |
| 92359    | 115       |
| 92373    | 42        |
| 92374    | 181       |
| 92407    | 4         |

### Tulare

| Zip Code | Producing |
|----------|-----------|
| 11502    | 3         |
| 93221    | 2         |
| 93247    | 4         |
| 93257    | 9         |
| 93286    | 16        |
| 93292    | 33        |
| 93647    | 15        |





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In 2022, a separate algorithm was applied to the mapping to determine the year the grove was either planted or stumped. Table 6 shows the acreage that was either planted or stumped within that year. Table 7 and Figure 4 show the age as a percentage of planted acreage.

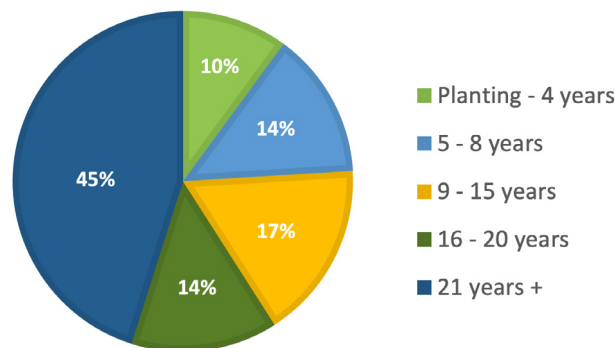
**Table 6. 2022 Planted Avocado Acreage by Year Planted or Stumped**

| Year Planted | Planted Acres | Year Planted | Planted Acres | Year Planted | Planted Acres | Year Planted | Planted Acres |
|--------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|
| 1984         | 16,155        | 1994         | 505           | 2004         | 2,195         | 2014         | 1,516         |
| 1985         | 5             | 1995         | 78            | 2005         | 1,271         | 2015         | 1,491         |
| 1986         | 48            | 1996         | 152           | 2006         | 806           | 2016         | 3,128         |
| 1987         | 177           | 1997         | 168           | 2007         | 1,586         | 2017         | 1,100         |
| 1988         | 23            | 1998         | 191           | 2008         | 944           | 2018         | 1,565         |
| 1989         | 34            | 1999         | 882           | 2009         | 1,140         | 2019         | 1,413         |
| 1990         | 562           | 2000         | 343           | 2010         | 862           | 2020         | 1,399         |
| 1991         | 197           | 2001         | 1,043         | 2011         | 1,009         | 2021         | 1,833         |
| 1992         | 153           | 2002         | 2,680         | 2012         | 913           | 2022         | 617           |
| 1993         | 148           | 2003         | 1,423         | 2013         | 2,448         |              |               |

**Table 7. 2022 Age as a Percentage of Planted Acreage**

| Age                 | Acreage | Percentage of Planted Acres |
|---------------------|---------|-----------------------------|
| Planting to 4 years | 5,261   | 10%                         |
| 5 - 8 years         | 7,285   | 14%                         |
| 9 - 15 years        | 8,832   | 17%                         |
| 16 - 20 years       | 7,281   | 14%                         |
| 21 years +          | 23,544  | 45%                         |

**Figure 4. Age as a Percentage of Planted Acres**





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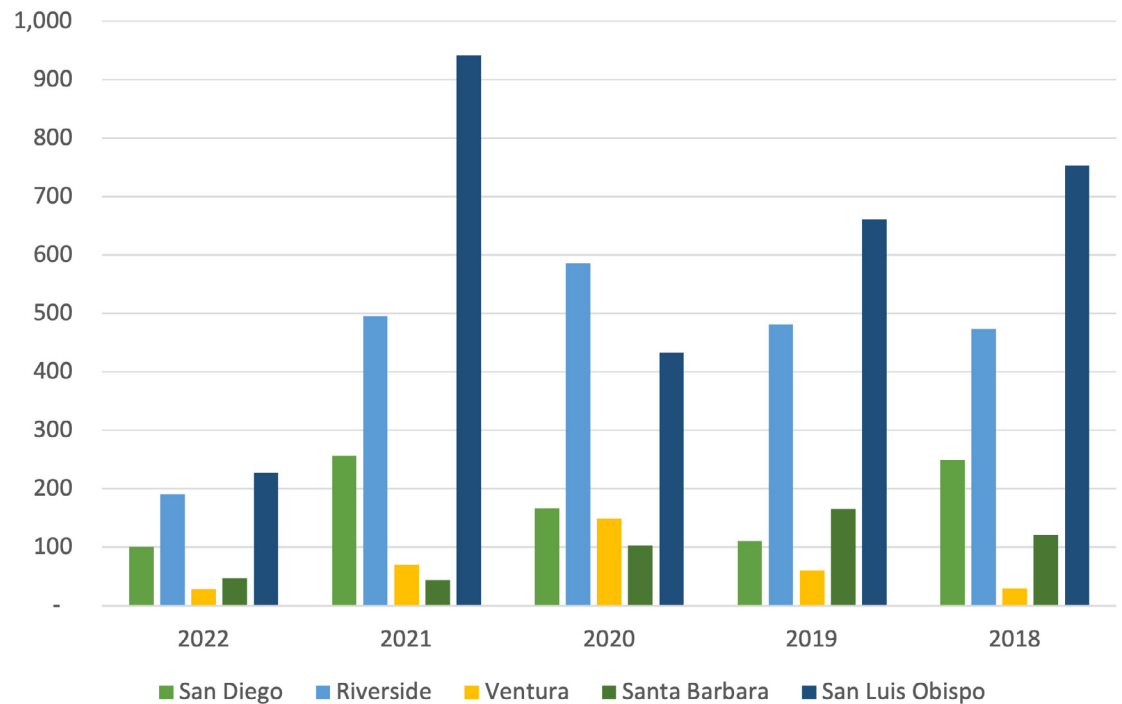
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Table 8 and Figure 5 show the amount of new plantings that have occurred over the last five years. The spatial analysis can only be performed once new groves have reached a certain canopy size. Thus, the acres reported for 2021 and 2022 are only those that have been visually confirmed through ground truthing efforts.

**Table 8. New Acres by County and Planting Year**

| County          | 2022 | 2021 | 2020 | 2019 | 2018 |
|-----------------|------|------|------|------|------|
| San Diego       | 101  | 257  | 167  | 111  | 249  |
| Riverside       | 190  | 495  | 586  | 481  | 473  |
| Ventura         | 29   | 69   | 149  | 60   | 30   |
| Santa Barbara   | 47   | 44   | 102  | 166  | 121  |
| San Luis Obispo | 227  | 942  | 433  | 661  | 753  |

**Figure 5. Young Avocado Acreage by Planting Year**





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In addition to age, a density analysis was conducted. Table 9 shows the number of acres by condition and density. Groves were classified according to the following standards:

**High Density:** 15x15 or closer and 20x10

**Standard Density:** 15x20 or greater

Table 9. 2022 Avocado Acreage by Planting Density

| County          | Condition | High Density | Standard | County         | Condition | High Density | Standard |
|-----------------|-----------|--------------|----------|----------------|-----------|--------------|----------|
| San Diego       | Producing | 2,166        | 11,259   | San Bernardino | Producing | 55           | 347      |
|                 | Stumped   | 86           | 423      |                | Stumped   |              |          |
|                 | Young*    | 251          | 363      |                | Young     |              | 16       |
|                 | Abandon   | 585          | 3,261    |                | Abandon   | 0            |          |
| Riverside       | Producing | 1,122        | 3,017    | Monterey       | Producing | 3            | 204      |
|                 | Stumped   | 75           | 141      |                | Stumped   |              | 19       |
|                 | Young     | 244          | 154      |                | Young     |              |          |
|                 | Abandon   | 203          | 530      |                | Abandon   |              |          |
| Ventura         | Producing | 3,621        | 14,656   | Tulare         | Producing | 11           | 72       |
|                 | Stumped   | 55           | 331      |                | Stumped   |              | 1        |
|                 | Young*    | 1,126        | 752      |                | Young     | 0            |          |
|                 | Abandon   | 185          | 440      |                | Abandon   | 7            | 31       |
| Santa Barbara   | Producing | 1,135        | 5,180    | Los Angeles    | Producing | 0            | 12       |
|                 | Stumped   | 14           | 51       |                | Stumped   |              |          |
|                 | Young     | 135          | 61       |                | Young     |              | 0        |
|                 | Abandon   | 99           | 557      |                | Abandon   | 11           | 23       |
| San Luis Obispo | Producing | 412          | 3,427    | Fresno         | Producing |              | 1        |
|                 | Stumped   | 5            | 88       |                | Stumped   |              |          |
|                 | Young     | 54           | 149      |                | Young     | 2            |          |
|                 | Abandon   |              | 5        |                | Abandon   |              |          |
| Orange          | Producing | 67           | 738      | Kern           | Producing |              |          |
|                 | Stumped   | 0            | 63       |                | Stumped   |              |          |
|                 | Young     | 12           | 27       |                | Young     |              |          |
|                 | Abandon   | 1            | 27       |                | Abandon   |              | 3        |

Table 10 demonstrates the percentage of planted acres that are considered high density.

Table 10. Percentage of High Density Plantings by Condition

| County          | Producing | Young* | Stumped |
|-----------------|-----------|--------|---------|
| San Diego       | 16%       | 41%    | 17%     |
| Riverside       | 27%       | 61%    | 35%     |
| Ventura         | 20%       | 60%    | 14%     |
| Santa Barbara   | 18%       | 69%    | 21%     |
| San Luis Obispo | 11%       | 27%    | 5%      |
| Other           | 9%        | 25%    | 0%      |

\* A small amount of young acreage could not be analyzed for density due to being so young they did not appear on imagery. These groves were physically confirmed during ground truthing.

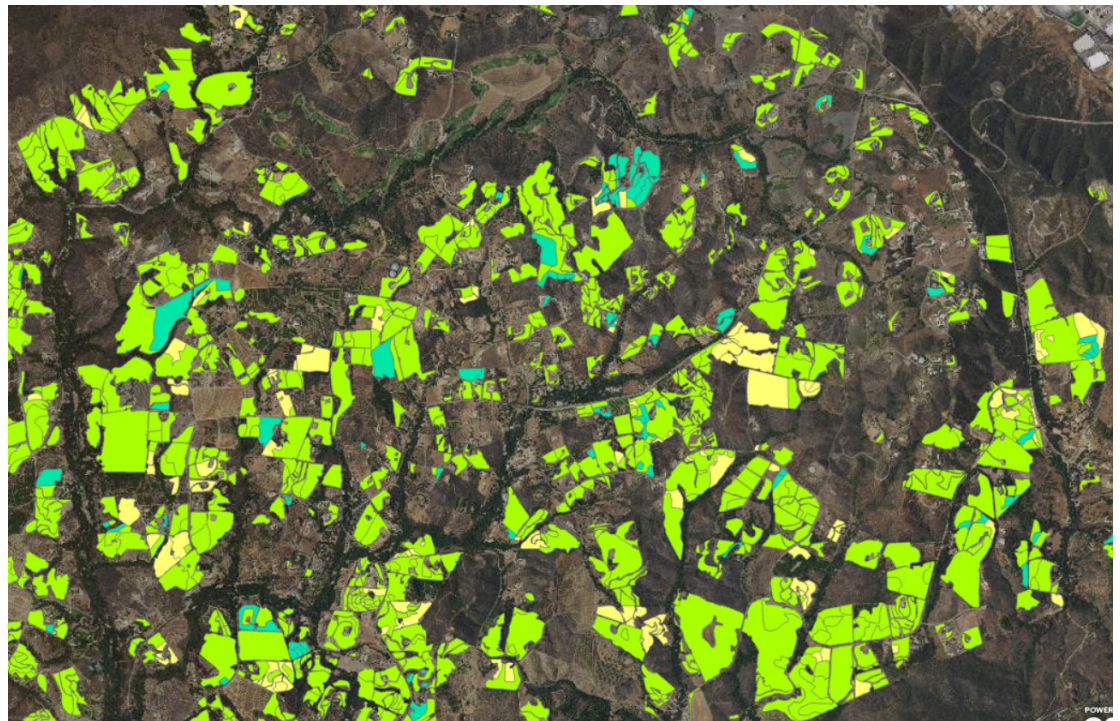




# Mapping Results

A series of maps are provided to demonstrate the avocado classification results. Figures 6 through 11 show the avocado acreage and condition classification example as well as maps of the five CAC districts.

Figure 6. Example of 2022 Avocado Classification Conditions



**Legend**

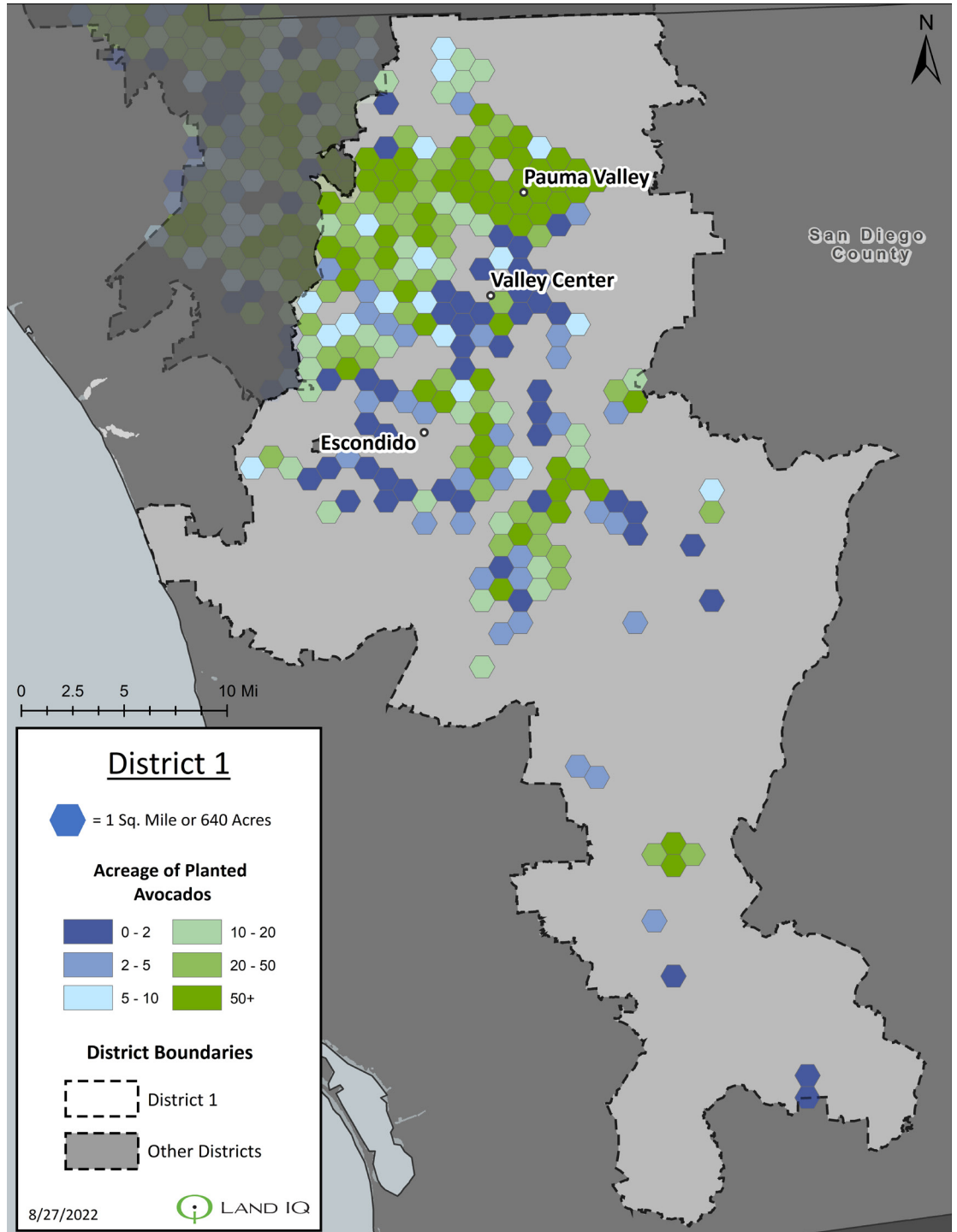
**CAC Webmap Inventory**  
Avocado Field Boundaries 2022

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Figure 7. 2022 Avocado Planted Polygons in CAC District 1



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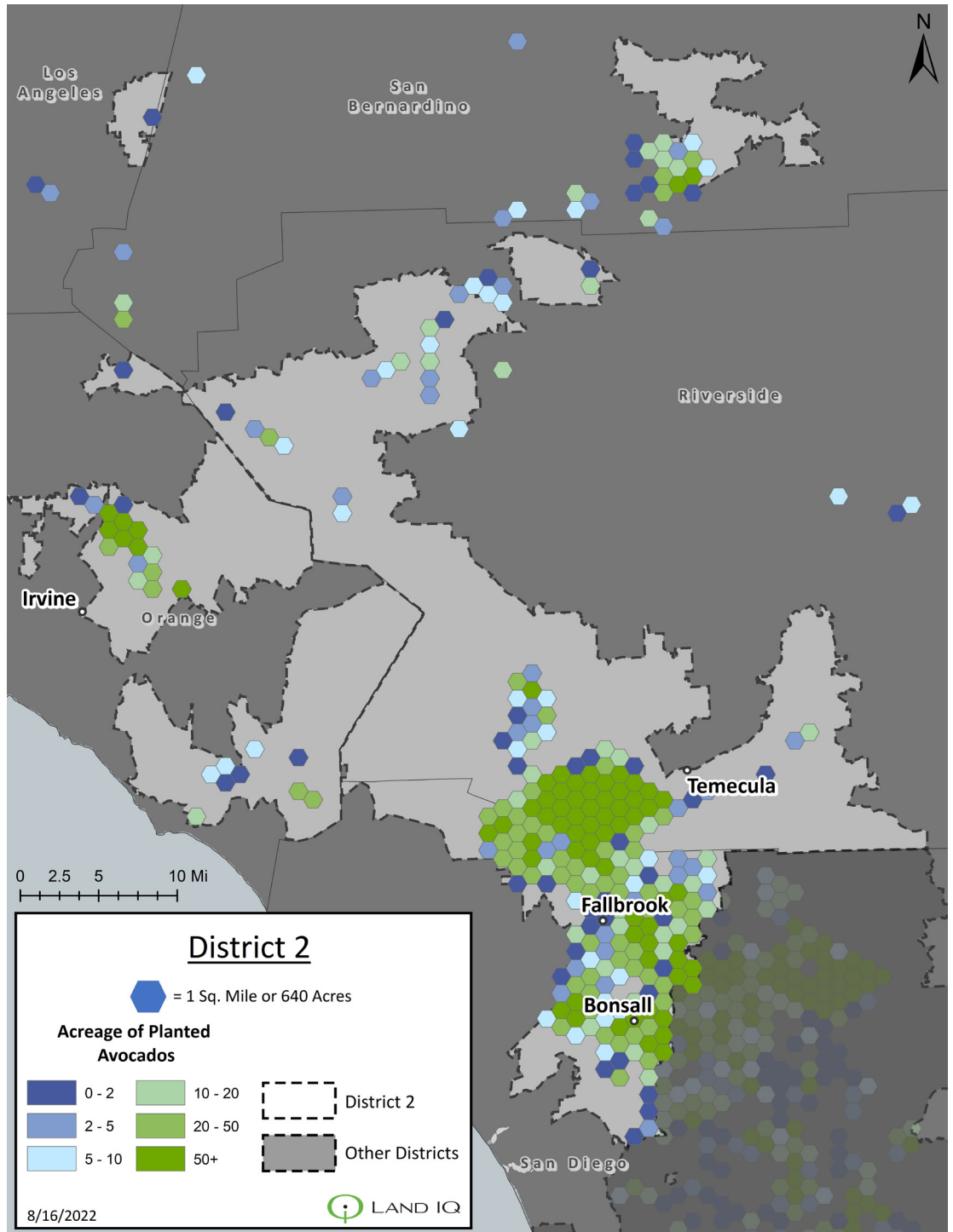
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Figure 8. 2022 Avocado Planted Polygons in CAC District 2



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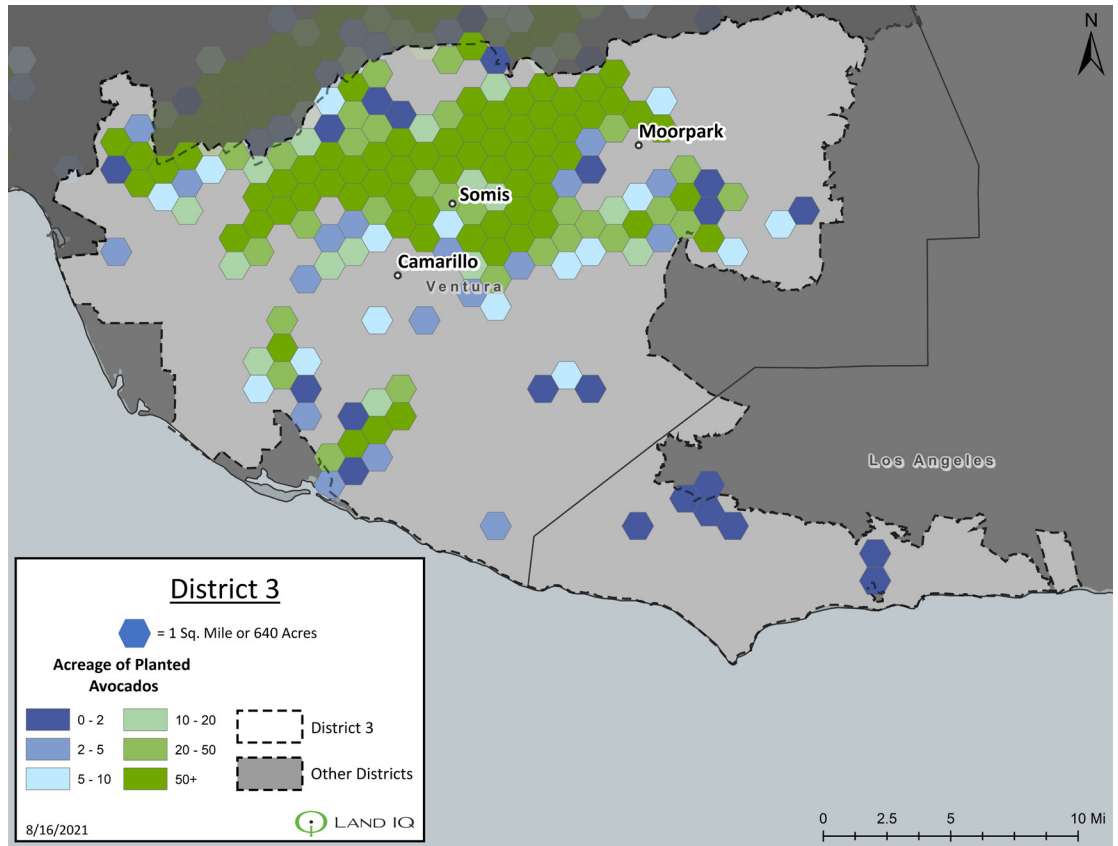
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Figure 9. 2022 Avocado Planted Polygons in CAC District 3



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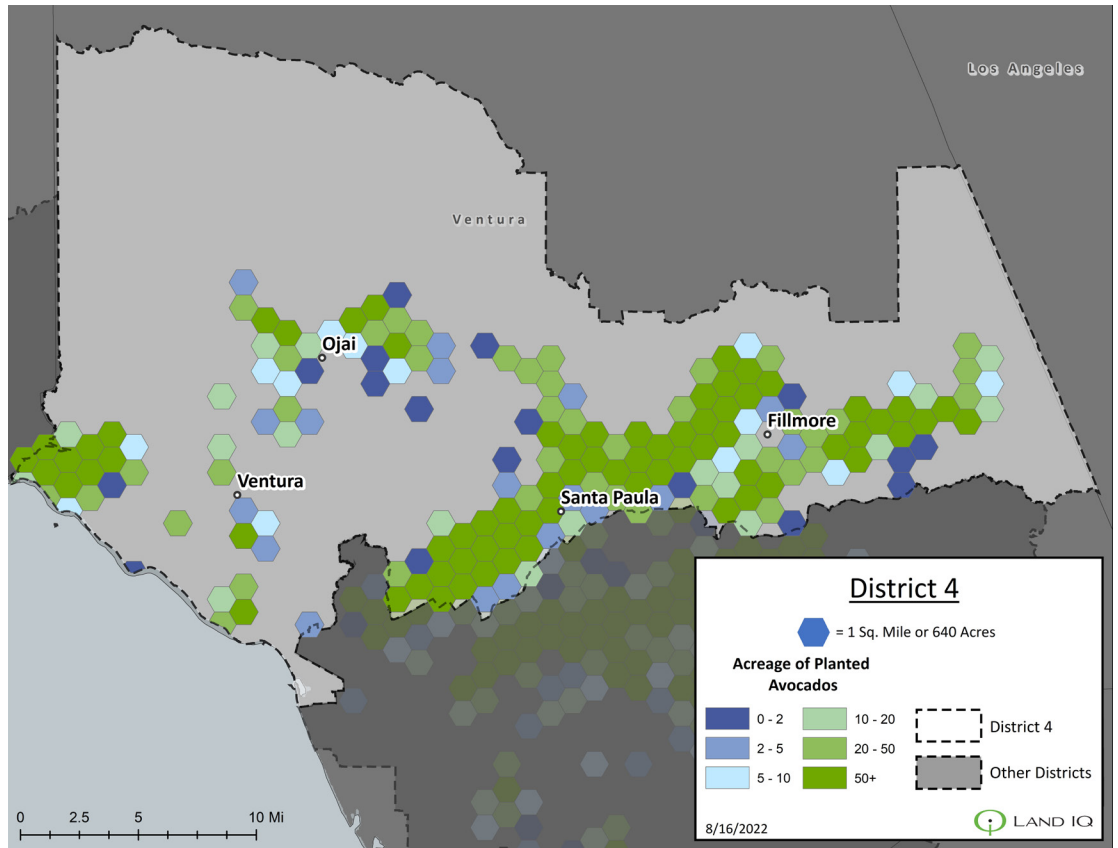
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Figure 10. 2022 Avocado Planted Polygons in CAC District 4



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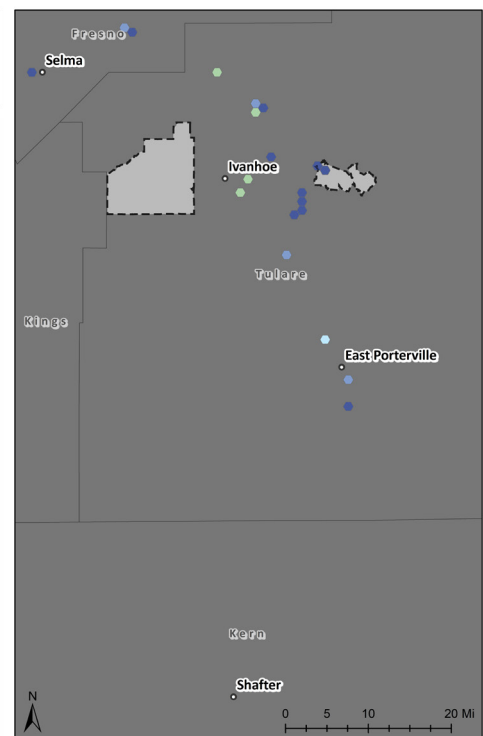
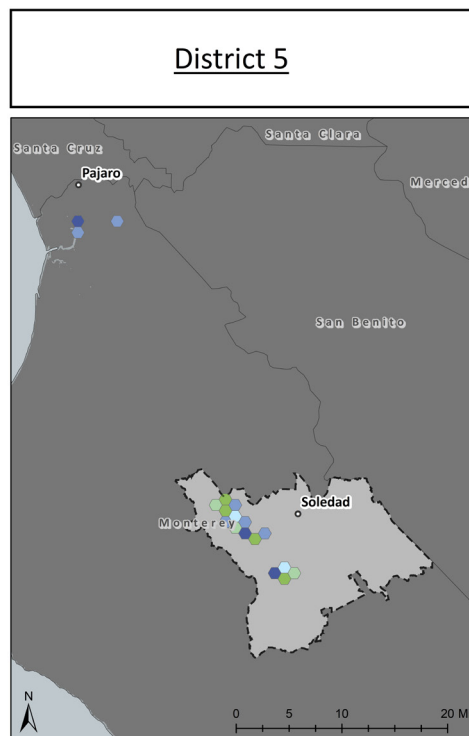
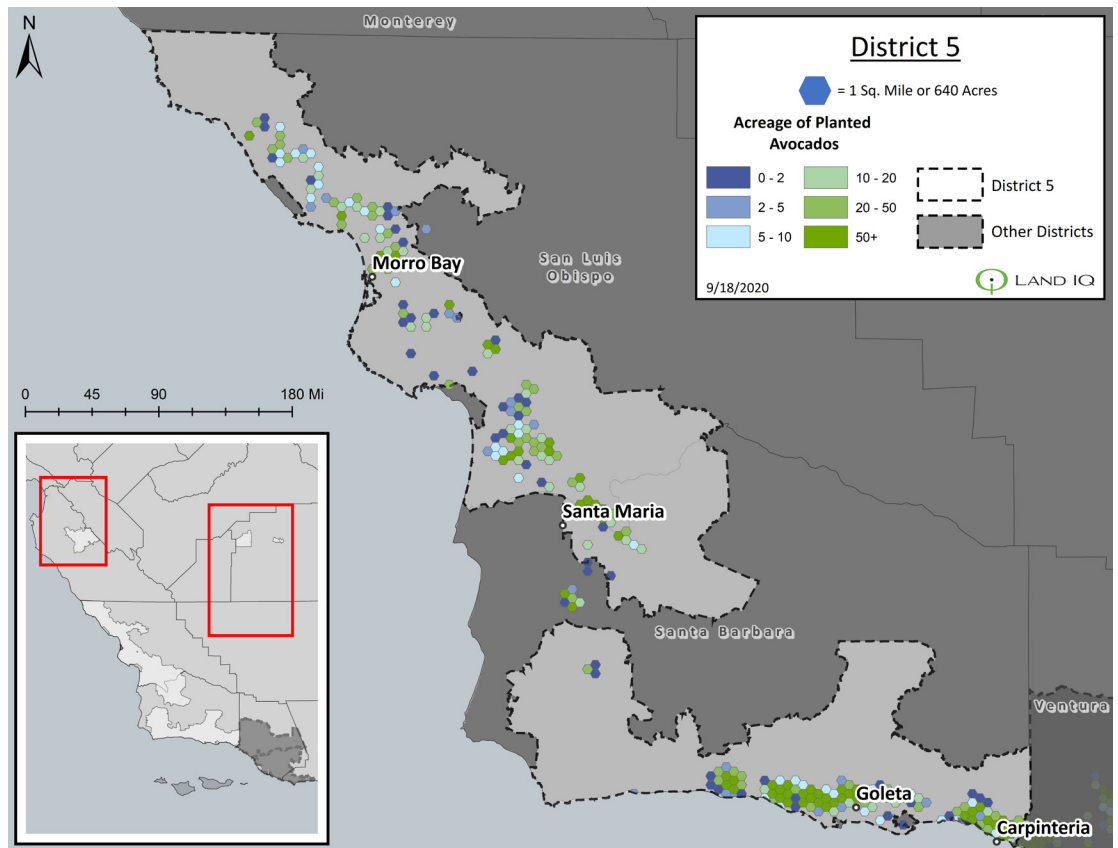
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Figure 11. 2022 Avocado Planted Polygons in CAC District 5







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## DATA DELIVERABLES

Data delivered to CAC as a part of the 2022 avocado mapping effort are listed and described in Table 11.

Table 11. Summary of 2022 Avocado Acreage Deliverables

| File Name                        | Description   |
|----------------------------------|---|
| CAC_2022_Avocados_Districts_Zips | Spatial file of statewide avocado acreage with condition, age, density, zipcode and CAC district. |
| CAC_2022_Avocado_Acreage_Tables  | Tabular data summarizing acreage by county, condition, age, density, zip code and CAC district.   |
| 2022_Statewide_Avocado_Mapping   | Report  |

The net change in acreage from 2021 to 2022 is summarized in Table 12.

Table 12. Net Acreage Change from 2021 to 2022 by County

| County          | Producing  | Young      | Stumped        | Abandoned    | Total        |
|-----------------|------------|------------|----------------|--------------|--------------|
| San Diego       | 111        | 170        | (612)          | (200)        | (531)        |
| Riverside       | (276)      | 190        | 6              | (347)        | (427)        |
| Ventura         | 951        | 245        | (506)          | (14)         | 676          |
| Santa Barbara   | 176        | (23)       | (160)          | 88           | 81           |
| San Luis Obispo | 50         | 125        | 33             | (64)         | 144          |
| Orange          | (133)      | (63)       | (72)           | 113          | (156)        |
| San Bernardino  | (63)       | 17         | 60             | (86)         | (73)         |
| Monterey        | (14)       | 16         | (7)            | 3            | (2)          |
| Tulare          | (22)       | (1)        | 18             | 20           | 14           |
| Los Angeles     | 2          | 0          | 1              | 10           | 13           |
| Fresno          | 0          | 0          | 0              | 2            | 2            |
| Kern            | (3)        | 2          | 0              | 1            | 0            |
| <b>Total</b>    | <b>777</b> | <b>678</b> | <b>(1,240)</b> | <b>(475)</b> | <b>(259)</b> |



The change in avocado classification from 2021 to 2022 is summarized in Table 13.

**Table 13. Change in California Avocado Acreage Classification from 2021 to 2022**

| County          | 2021 Classification | 2022 Classification |           |           |         |
|-----------------|---------------------|---------------------|-----------|-----------|---------|
|                 |                     | Producing           | Top/Stump | New/Young | Abandon |
| San Diego       | Producing           | 12,151              | 359       | 102       | 417     |
|                 | Top/Stump           | 836                 | 93        | 53        | 69      |
|                 | New/Young           | 86                  |           | 306       | 1       |
|                 | Abandon             | 260                 | 46        | 63        | 3,340   |
|                 | Not Classified      | 92                  | 11        | 90        | 19      |
| Riverside       | Producing           | 3,867               | 180       | 58        | 126     |
|                 | Top/Stump           | 114                 | 9         | 28        | 52      |
|                 | New/Young           | 32                  | 0         | 162       | 1       |
|                 | Abandon             | 46                  | 22        | 24        | 535     |
|                 | Not Classified      | 81                  | 5         | 127       | 19      |
| Ventura         | Producing           | 16,851              | 254       | 67        | 67      |
|                 | Top/Stump           | 762                 | 107       | 7         | 8       |
|                 | New/Young           | 233                 |           | 1,236     | 23      |
|                 | Abandon             | 20                  | 5         | 19        | 486     |
|                 | Not Classified      | 411                 | 20        | 549       | 41      |
| Santa Barbara   | Producing           | 5,968               | 56        | 13        | 95      |
|                 | Top/Stump           | 211                 | 8         | 3         |         |
|                 | New/Young           | 72                  |           | 145       |         |
|                 | Abandon             | 2                   |           |           | 559     |
|                 | Not Classified      | 62                  | 1         | 36        | 2       |
| San Luis Obispo | Producing           | 3,656               | 80        | 5         | 4       |
|                 | Top/Stump           | 51                  | 8         | 1         |         |
|                 | New/Young           | 15                  |           | 63        |         |
|                 | Abandon             | 2                   | 3         |           | 2       |
|                 | Not Classified      | 114                 | 3         | 134       |         |

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