



Air Monitoring Network Site Selection: Standard Operating Procedure

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Air Program
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1. Introduction

As part of the Department of Pesticide Regulation's (DPR) mandate for continuous evaluation of currently registered pesticides, DPR implemented a multi-year statewide Air Monitoring Network (AMN) to measure pesticide concentrations in the ambient air in various agricultural California communities in 2011. The AMN aims to collect ambient air data to support the assessment of potential health risks, the development of mitigation measures, and the evaluation of the effectiveness of current regulatory requirements. Currently, the AMN monitors weekly for 35 pesticides and 5 breakdown products in the ambient air at Oxnard (Rio Mesa-Ventura County), Santa Maria (Santa Barbara County), Shafter (Kern County), and Pajaro Valley (unincorporated Monterey County).

In 2025, DPR was given additional permanent funding, which allows for the expansion of the AMN. When considering the placement of a new long-term air monitoring station, DPR follows a site selection procedure to evaluate communities across the state. This process is updated with new data every 3-6 years and informs decisions on potential stations to be added to the monitoring network. The process was last updated in 2020 (DPR 2020).

This report describes updated methods for use in prioritizing communities for placement of new AMN monitoring stations. Through this process, communities in the state are ranked from highest to lowest based on their proximity to fumigant and organophosphate applications, with consideration also given to community disease burden and socioeconomic factors. Similar to the previous approach, the updated process expands the analysis to include additional communities, refines emission estimates for fumigants, prioritizes communities containing schools, and prioritizes clusters of high-priority sites over isolated ones.

2. Methods

2.1. Pesticide Data

Reported fumigant and organophosphate (OP) use data is retrieved from DPR's PUR database. Pesticide use records include the following information: date of application, product name, percent of active ingredient (AI) in product, pounds of active ingredient used, fumigation code, chemical name, county name, township, and section. Townships and sections are a component of the Public Lands Survey System (PLSS), a system of land classification that divides land into grids of 6-by-6-mile townships and 1-by-1-mile sections. Only pesticide applications used for agriculture are considered. Non-agricultural pesticide applications, such as those used in right-of-way, commodity, and structural

fumigations, have different PUR reporting requirements. These applications are reported at the county level rather than at a specific section.

The four fumigants included in this analysis are: 1,3-D, chloropicrin, methyl bromide, and methyl isothiocyanate (MITC) generators (dazomet, metam-sodium, and metam-potassium). The 11 OPs selected in this analysis are: acephate, bensulide, DDVP, diazinon, dimethoate, malathion, methidathion, naled, oxydemeton-methyl, phosmet, and S-S-S-tributyl phosphorotrithioate. Fumigants are prioritized because they are used in relatively large amounts statewide, enter the gas phase more readily than non-fumigant pesticides, and are known to emit into ambient air in relatively high amounts, creating a pathway for off-site transport and potential exposure. Organophosphates are a widely used class of pesticides that share a common biological mechanism, acting on the enzyme acetylcholinesterase; therefore, when assessing exposure, this group of many pesticides may be treated as one. While the individual chemicals in this category may be used in low amounts relative to certain non-fumigant, non-OP pesticides, their combined usage can be an important public health consideration and is therefore including in this analysis.

Total pesticide use within either fumigant or OP categories was aggregated and grouped by section (each uniquely represented by the PLSS identifiers Meridian, Township, Range, and Section, or MTRS) and by the year it was applied. In each category, the pounds of AI were equally weighted. A 5-year average (years with no data were replaced with zeros) was calculated for each section and used for this analysis. The results were transferred into an ArcGIS readable file for further analysis.

2.2. Geospatial Data and Analysis

The geographic boundaries of California communities, which include cities and census-designated places (CDP), are downloaded from the U.S. Census Bureau's Place 2020 TIGER/Line shapefile (U.S. Census 2020). DPR uses ArcGIS Pro to calculate the area of the communities in square miles (ESRI 2025). A statewide section boundary shapefile is then overlaid and spatially joined to the community boundary dataset.

The ArcGIS buffer tool is used to generate template shapefiles for all California communities, consisting of three non-overlapping ring-shaped zones. Distances begin at the edge of each community's boundary and were analyzed at a radius of 0 (within a community boundary) 1, 5, and 10 miles. The four zones are: within community boundaries (community zone), between the edge of the community boundary and 1 mile beyond the community boundary (local zone), between 1 and 5 miles outside the community boundary (regional zone), and between 5 and 10 miles outside the community boundary (greater regional zone). This template is used with the PUR data to calculate the use density (lbs/sq

mi). Fumigant use is analyzed at all four zones, while OPs use is analyzed at the community, local, and regional zones. DPR has adopted the practice of evaluating all fumigant use within a 10-mile radius to ensure a comprehensive assessment, even though applications at greater distances are expected to have no to minimal impact on elevated levels (Luo, 2019, Luo, 2022, Luo and Uyeda 2023). Figure 1 illustrates a community and its four zones.

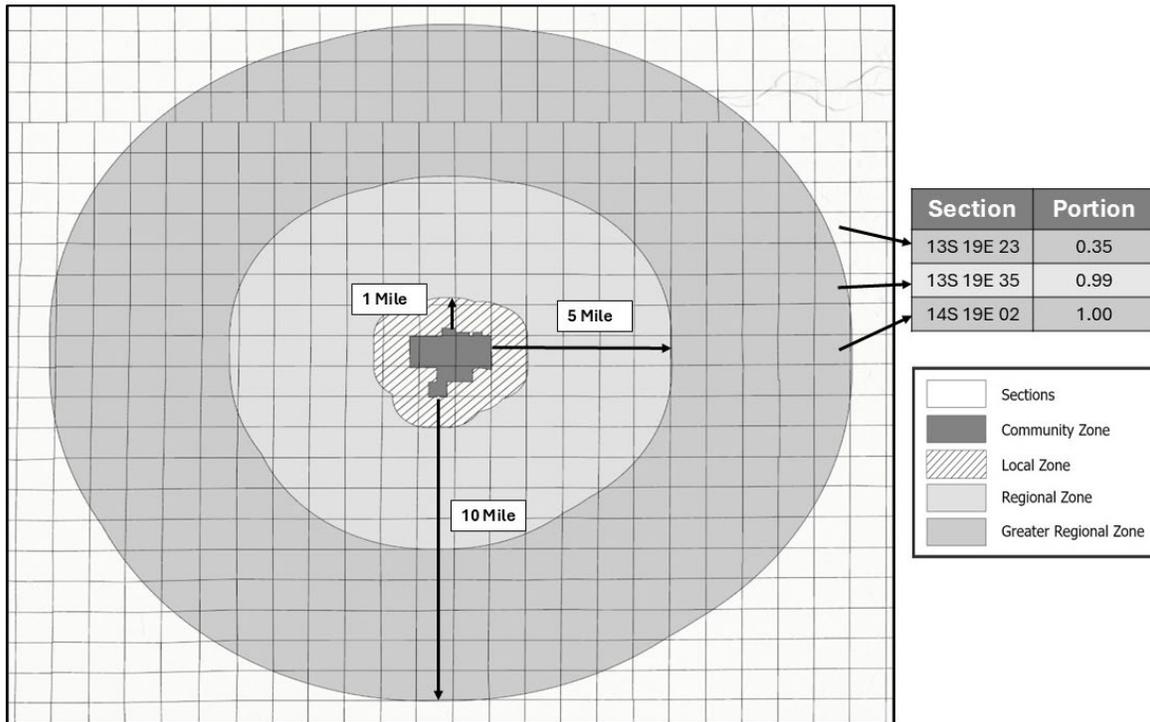


Figure 1: Community, local, regional, and greater regional zone from a community

For cases where sections are partially included within a zone, the amount of pesticide use reported for that section could be overestimated. To account for this overestimation, DPR uses a scaling method in which the proportion of each section within a zone is calculated, and the amount of pesticide used is scaled to the section's area within the zone. Sections with proportions below 0.01 are excluded from this analysis, as such small proportions are unlikely to significantly affect overall pesticide use. A multiplication factor is generated for partial sections. To simplify the data, sections with a multiplication factor greater than 0.99 are rounded to 1.

Once the four zones are determined for each community, the total area (sq mi) of each community's zone is tabulated. The readable ArcGIS files with pesticide use data for fumigants and OPs are processed and spatially joined. Pesticide use data and section

boundaries are matched by linking MTRS field. A similar process is performed for each of the four zones.

This exercise quantifies the geospatial distribution of fumigant and OP use relative to California communities. DPR determines use density (lbs/sq mi) by the amount of pesticide applied within each of those four zones divided by the area of each zone (sq mi). The use density for fumigants is calculated for all four zones in each community, while the OPs use density for each community is calculated based on the community, local, and regional zones.

2.3. Meteorological Data

Local environmental conditions, such as weather (wind speed and direction) during and after a pesticide application, can impact the dispersion of any emissions from the field. DPR uses meteorological data from the California Irrigation Management Information System (CIMIS), a network of 145 automated stations across California (DWR 2025). This network is managed by the California Department of Water Resources, and stations collect data at a 2-meter height.

Annual weather data for the most recent 5-year period are downloaded from the CIMIS FTP site and processed in the statistical programming language R (Posit team, 2025). The average wind speeds over the 5-year period are calculated for each active station. Stations with less than three years of data are excluded from the analysis. Coordinate information was extracted and formatted into a readable ArcGIS file. Geospatial analysis is used to identify the nearest CIMIS station for each community.

The use density for each community is divided by the average wind speed from the corresponding weather station. Using this method, for a given use density, the community with a higher average wind speed would have a lower use density because higher average wind speed increases turbulence and mixing, diluting pesticide concentrations and potentially reducing exposure. The average adjusted use density of the zones is calculated for each community.

2.4. Environmental Justice Factors

CES version 4.0, developed by OEHHA, is used in this analysis to provide DPR with the most up-to-date screening tool to assist in prioritizing DPR's site selection (OEHHA 2021). CES 4.0 is designed to identify California communities more susceptible to a pollution burden. DPR used the Population Characteristics (PC) percentile field, which rates sensitive population indicators as well as socio-economic factors. The higher the PC

percentile, the higher the degree to which the population of a community is burdened. To account for the difference in the CES spatial scale among census tracts and community boundaries, DPR uses ArcGIS to process these indicators by overlaying the community boundaries and PC census tract data to create PC score for each community. In cases where multiple census tracts bisected a community boundary, the average PC score was taken.

2.5. Updates to Site Selection Procedures

2.5.1. Emission Rating

The previous site selection procedure assumed that all fumigant use is equal in producing emissions. However, several field studies have shown that emissions vary by application method. To account for the effect of application method on emissions, DPR developed the Emission Fraction (EF), also known as the Application Method Adjustment Factor (AMAF). EF is the proportion of applied fumigant mass that contributes to Volatile Organic Compound (VOC) emissions under field conditions (Aguirre and Kroes 2023). EFs are determined from modeling and field studies and are AI- and application-method-specific, thus they are more refined estimates of emissions.

Fumigant use is multiplied by the associated EF value to determine the emissions of the fumigant. This adjustment enables a more refined technical analysis of communities with higher potential exposure risk. OP pesticide use was not adjusted since there is no EF associated with non-fumigants to support such adjustments.

2.5.2. Additional Considerations

DPR will evaluate all counties as part of this process, including the urban counties of Los Angeles, Orange, San Diego, and San Francisco (DPR 2014, 2017, 2020).

To improve representation across California, only one monitoring site is allocated per county. Selecting one monitoring site per county for the AMN will ensure that continuous evaluation is conducted in areas that encompass a variety of crops, application methods, use patterns, and weather conditions. Counties with existing AMN sites are excluded from this analysis because they are already represented in the AMN.

The previous version of the site selection analyzed the top 30 fumigant and top 30 OPs communities. The analysis is expanded to include the top 50 communities, with independent rankings for fumigant and OPs.

DPR prioritizes schools as monitoring sites (DPR 2017). California public school data for 2023-2024 was extracted from the California Department of Education (CDE 2024). DPR determines the number of schools within a 1-mile radius for each community in the top 50, and communities with schools within a 1-mile radius are prioritized.

The list of prioritized communities undergoes further prioritization, based on the number of other highly ranked (within the top 50) communities within their 10-mile radius. This allows DPR to determine the optimal area for monitoring sites that represent a wider range of prioritized communities.

In cases where prospective sites are within 10 miles of an existing site in a neighboring county, they are excluded from further consideration due to overlap in the source areas influencing trends in pesticide air concentrations within that region; a 10-mile minimum separation ensures air concentration measurements at one site are independent of those at other sites. Staff may also consider meteorological patterns and crop data to evaluate whether a prospective site falling outside of this 10-mile radius would provide information sufficiently distinct from that gained from other monitoring stations within a region.

To guide the final selection of AMN sites, communities prioritized under the fumigants category have rankings available for individual fumigants: 1,3-D, chloropicrin, MITC, and MeBr. These rankings can be used to ensure that no single fumigant is disproportionately represented, supporting a balanced evaluation of overall use patterns.

3. Conclusion

The process described in this report generates a list of communities in high-use regions where an AMN station may best capture data to characterize exposure and evaluate the effectiveness of existing protections. These communities contain schools, are clustered near other high-ranking communities, and are located in areas without a preexisting AMN station. This list acts as Phase 1 of the site selection process. That list is shared with stakeholders through a public comment process to further refine which counties or communities should be prioritized (Phase 2). In Phase 3, DPR will consider both the technical report output and public input to finalize locations for any new AMN stations.

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