Air Pollution Control District
San Luis Obispo County

2020
Ambient Air Monitoring
Network Assessment

Fiscal, Administrative, & Technical Services Division
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GLOSSARY AND LIST OF ACRONYMS:

Air Basin	An area with geographical or climatic conditions that result in a relatively physically homogeneous air mass.
APCD	Air Pollution Control District
CARB	California Air Resources Board
BAM	Beta Attenuation Monitor for particulate sampling
CFR	Code of Federal Regulation
	District San Luis Obispo County Air Pollution Control District
EPA	U.S. Environmental Protection Agency
FEM	Federal Equivalent Method particulate sample
FRM	Federal Reference Method particulate sampler
NAAMS	National Ambient Air Monitoring Strategy
NAAQS	National Ambient Air Quality Standard
NO_2	Nitrogen Dioxide
NO_X	Oxides of nitrogen
O_3	Ozone
ODSVRA	Oceano Dunes State Vehicular Recreation Area
PM_{10}	Particulate matter 10 microns or less in aerodynamic circumference
$PM_{2.5}$	Particulate matter 2.5 microns or less in aerodynamic circumference
SLAMS	State and Local Air Monitoring Stations
SLOCAPCD	San Luis Obispo County Air Pollution Control District
SO_2	Sulfur dioxide
WDV	Vector averaged wind direction
WSV	Vector averaged wind speed

1.0 INTRODUCTION

The San Luis Obispo County Air Pollution Control District (SLOCAPCD) 2020 Ambient Air Monitoring Network Assessment is an examination and assessment of the technical aspects of SLOCAPCD's network of air pollution monitoring stations.

The EPA finalized an amendment to the ambient air monitoring regulations on October 17, 2006, adding a requirement for state and local monitoring agencies to conduct a network assessment once every five years [40 CFR 58.10(e)]. The purpose is to determine, at a minimum, if the network meets the monitoring objectives defined in 40 CFR 58.10 Appendix D, if new sites are needed, if existing sites may be discontinued, and whether new technologies are appropriate for incorporation into the ambient air monitoring network.

This requirement is an outcome of implementation of the National Ambient Air Monitoring Strategy (NAAMS). The purpose of the NAAMS is to optimize air monitoring networks to achieve, with limited resources, the best possible scientific value and protection of public and environmental health and welfare.

2.0 SAN LUIS OBISPO COUNTY REGIONAL DESCRIPTION

2.1 Geography

San Luis Obispo County constitutes a land area of approximately 3,616 square miles with varied vegetation, topography, and climate which creates a diversity of environmental conditions greater than its size would suggest. See Figure 1 for a detailed map of the county. The county is bordered by Monterey County to the north, Santa Barbara County to the south, and Kern County to the east, with the Pacific Ocean as the western border. From a geographical and meteorological standpoint, the County can be divided into three general regions: the Coastal Plateau, the Upper Salinas River Valley, and the East County. Air quality in each of these regions is characteristically different, with the physical features that divide them limiting the transport of pollutants between regions.

The Coastal Plateau is about five to ten miles wide and varies in elevation from sea level to about 500 feet. It is bounded on the northeast by the Santa Lucia Mountain Range, which extends almost the entire length of the county. Rising sharply to about 3,000 feet at its northern boundary, the Santa Lucia Range gradually winds southward away from the coast, finally merging into a mass of rugged features on the north side of Cuyama Canyon.

Figure 1 – Map of San Luis Obispo County

Until monitoring began in eastern San Luis Obispo County two decades ago, the highest ozone levels in the County were measured in the Upper Salinas River Valley. Pollution transport trajectories into SLO County now indicate that pollution can come from the San Francisco Bay Area into the Sacramento delta and down the San Joaquin Valley where pollutants can impact SLO County during easterly flow. Pollution transport can also come from the San Francisco Bay Area, down the Salinas Valley and into SLO County. Southeasterly flow can bring pollution into SLO County from Southern California and the San Joaquin Valley. Santa Ana winds in southern California can send pollution up the coast and impact SLO County coastal areas. This transported pollution is mixed with emissions from within SLO County and increase ambient pollution concentrations. While there may be other transport pollution scenarios, these are the most common. This area of plains and low rolling hills is bounded on the west by the Santa Lucia Range and to the east by the Cholame Hills, a northern extension of the Temblor Range. Southward, the La Panza Range gradually rises east of Santa Margarita and runs roughly parallel to the coast, merging with the Caliente Range near the southern border of the County. Caliente Mountain, the highest peak in the County at 5,104 feet, is found in this range.

Eastern San Luis Obispo County is a large region by land area, but only one percent of the County population resides there. A significant portion of this area is a landlocked drainage basin called the Carrizo Plain, which lies between the La Panza and Caliente Ranges on the west and the Temblor Range to the east. These mountains join to close the basin at the southeastern tip of the County. The Cholame Hills occupies the extreme northeastern portion of this region and, like the Temblors, lies adjacent to the San Joaquin Valley.

2.2 Climate and Weather

The climate of the County can be generally characterized as Mediterranean, with warm, dry summers and cooler, relatively damp winters. Along the coast, mild temperatures are the rule throughout the year due to the moderating influence of the Pacific Ocean. This effect is diminished inland in proportion to distance from the ocean or by major intervening terrain features, such as the coastal mountain ranges. As a result, inland areas are characterized by a considerably wider range of temperature conditions. Maximum summer temperatures average about 21 degrees Celsius near the coast, while inland valleys are often in the range of 32 degrees Celsius to 38 degrees Celsius. Minimum winter temperatures average from -1 to 3 degrees Celsius along the coast to -4 to -1 degrees Celsius inland.

Regional meteorology is largely dominated by a persistent high-pressure area which commonly resides over the eastern Pacific Ocean. Seasonal variations in the strength and position of this pressure cell cause seasonal changes in the weather patterns of the area. The Pacific High remains generally fixed several hundred miles offshore from May through September, enhancing onshore winds and opposing offshore winds. During spring and early summer, as the onshore breezes pass over the cool water of the ocean, fog and low clouds often form in the marine air layer along the coast. Surface heating in the interior valleys dissipates the marine layer as it moves inland.

From November through April the Pacific High tends to migrate southward, allowing northern storms to move across the county. About 90% of the total annual rainfall is received during this period. Winter conditions are usually mild, with intermittent periods of precipitation followed by mostly clear days. Rainfall amounts can vary considerably among different regions in the county. In the Coastal Plain, annual rainfall averages 40 to 70 centimeters, while the Upper Salinas River Valley generally receives about 30 to 50 centimeters of rain. The Carrizo Plain is the driest area of the County with less than 30 centimeters of rain in a typical year.

Airflow around the county plays an important role in the movement and dispersion of pollutants. The speed and direction of local winds are controlled by the location and strength of the Pacific High-pressure system and other global patterns, by topographical features, and by circulation patterns resulting from temperature differences between the land and sea. In spring and summer months, when the Pacific High attains its greatest strength, onshore winds from the northwest generally prevail during the day. At night, as the sea breeze dies, weak drainage winds flow down the coastal mountains and valleys to form a light, easterly land breeze.

In fall and winter during Santa Ana wind conditions in Southern California, pollutants may accumulate over the ocean for a period of one or more days and can then be carried onshore with the return of the sea breeze, where they combine with local emissions to cause high pollutant concentrations along the central coast. When this occurs, offshore wind can transport the pollutants from southern California up the Coast – where they can come ashore in SLO County, impacting the SLO County coastal plains and inland areas.

Strong inversions can form at any time, and can trap pollutants near the surface, which can result in an increase in pollutant concentrations at SLO County monitoring stations.

2.3 Land Use, Population and Economics

The predominant land use in San Luis Obispo County is agriculture, with the production and processing of vegetable crops, wine grapes, dryland grains, and livestock as the major components. The southern and coastal areas of the County are primarily devoted to the production of row crops (strawberries, lettuce, broccoli, peas, and other vegetables) and vegetable transplants, although cattle ranching prevails along the north coast. Vineyards, grain production, livestock grazing, and horse ranching are the dominant land uses in the Upper Salinas River Valley; the East County Plain supports some cattle ranches and dryland grain farms. Much of the County's agricultural land is property committed to agricultural use for periods of up to 20 years under the Williamson Act. In 2017, agricultural acreage totaled approximately 2,112,394 acres, with total crop sales of $667,915,000 for the 1,316 operations. Production in the animal industry was valued at $33,676,000 for the same period.[1] One of the largest productions in agricultural uses in recent years have been vineyard plantings for wine grapes. In 2013 there were 36,248 bearing acres; although decreased to 32,559 bearing acres in 2017, it still generates a substantial amount of revenue.

The County's urban areas exist as separate and uniquely distinct clusters of development. San Miguel, Templeton, Atascadero, Cambria, Cayucos, Los Osos, Oceano and Nipomo are primarily residential communities; of these Atascadero is the only incorporated city. In contrast, San Luis Obispo, Morro Bay, the Five Cities area and Paso Robles have a much broader mix of commercial and residential uses. Residential development has been limited in some areas of the county as a result of moratoriums, growth management issues, and resource constraints. The 2019 estimated population of the county was 283,111. The two largest cities in the county are San Luis Obispo at 47,459 (2019, estimated) and Paso Robles at 32,153 (2019, estimated).[2]

The City of San Luis Obispo is the county seat and commercial center of the region. Commercial and industrial development has been growing steadily in the northern areas of the county, particularly in Atascadero and Paso Robles.

3.0 OVERVIEW OF NETWORK OPERATION

3.1 Air Monitoring Network Design - Objectives and Spatial Scales

Federal regulations in Appendix D of 40 CFR 58 require that a network of State and Local Air Monitoring Stations (SLAMS) be designed to meet a minimum of six basic ambient air monitoring objectives:

1. To determine the highest concentration expected to occur in the area covered by the network;
2. To determine representative concentrations in areas of high population density;
3. To determine the impact on ambient pollution levels of significant sources or source categories;
4. To determine general background concentration levels;
5. To determine the extent of regional pollutant transport among populated areas, and in support of secondary standards; and

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[1] https://www.nass.usda.gov/Statistics_by_State/California/

[2] https://www.census.gov/quickfacts/sanluisobispocountycalifornia

6. To determine the welfare-related impacts in more rural and remote areas (such as visibility impairment and effects on vegetation).

The goal in designing a SLAMS network is to establish monitoring stations that will provide data to meet these monitoring objectives. The physical siting of the air monitoring station must achieve a spatial scale of representativeness that is consistent with the monitoring objective. The spatial scale results from the physical location of the site with respect to the pollutant sources and categories. It estimates the size of the area surrounding the monitoring site that experiences uniform pollutant concentrations. The categories of spatial scale are:

- Microscale - An area of uniform pollutant concentrations ranging from several meters up to 100 meters.
- Middle Scale – uniform pollutant concentrations in an area of about 110 meters to 0.5 kilometer.
- Neighborhood Scale – an area with dimensions in the 0.5 to 4 kilometer range.
- Urban Scale – Citywide pollutant conditions with dimensions from 4 to 50 kilometers.
- Regional Scale – An entire rural area of the same general geography (this area ranges from tens to hundreds of kilometers).

Table 1: Relationship Among Monitoring Objectives and Scale of Representativeness.

Monitoring Objective	Appropriate Spatial Scale
Highest concentration	Micro, middle, neighborhood (sometimes urban)
Population	Neighborhood, urban
Source impact	Micro, middle, neighborhood
General/Background	Neighborhood, urban, regional
Regional transport	Urban, regional
Welfare-related impacts	Urban, regional

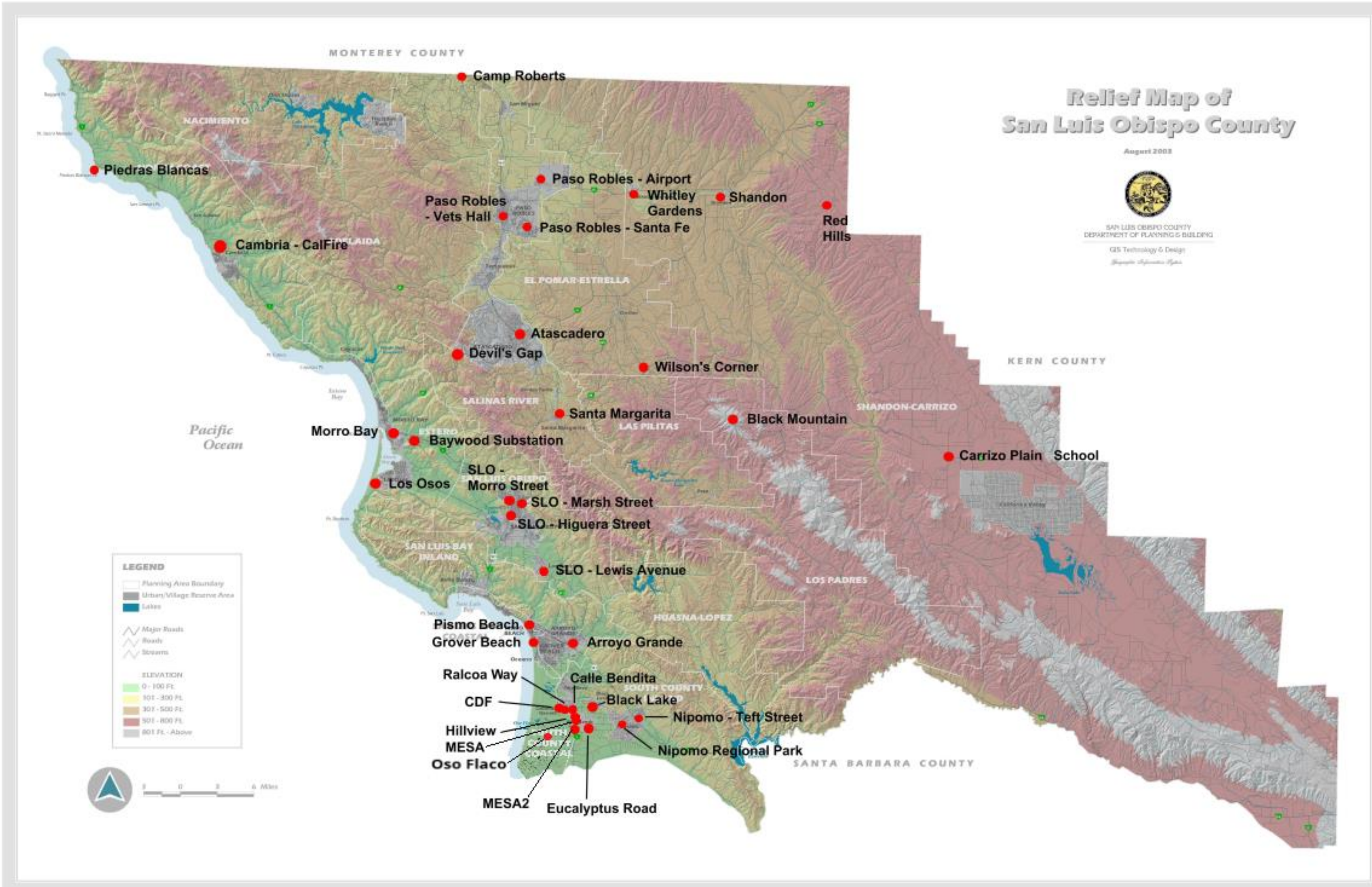

Figure 2: Historical Ambient Air Monitoring Locations in San Luis Obispo County

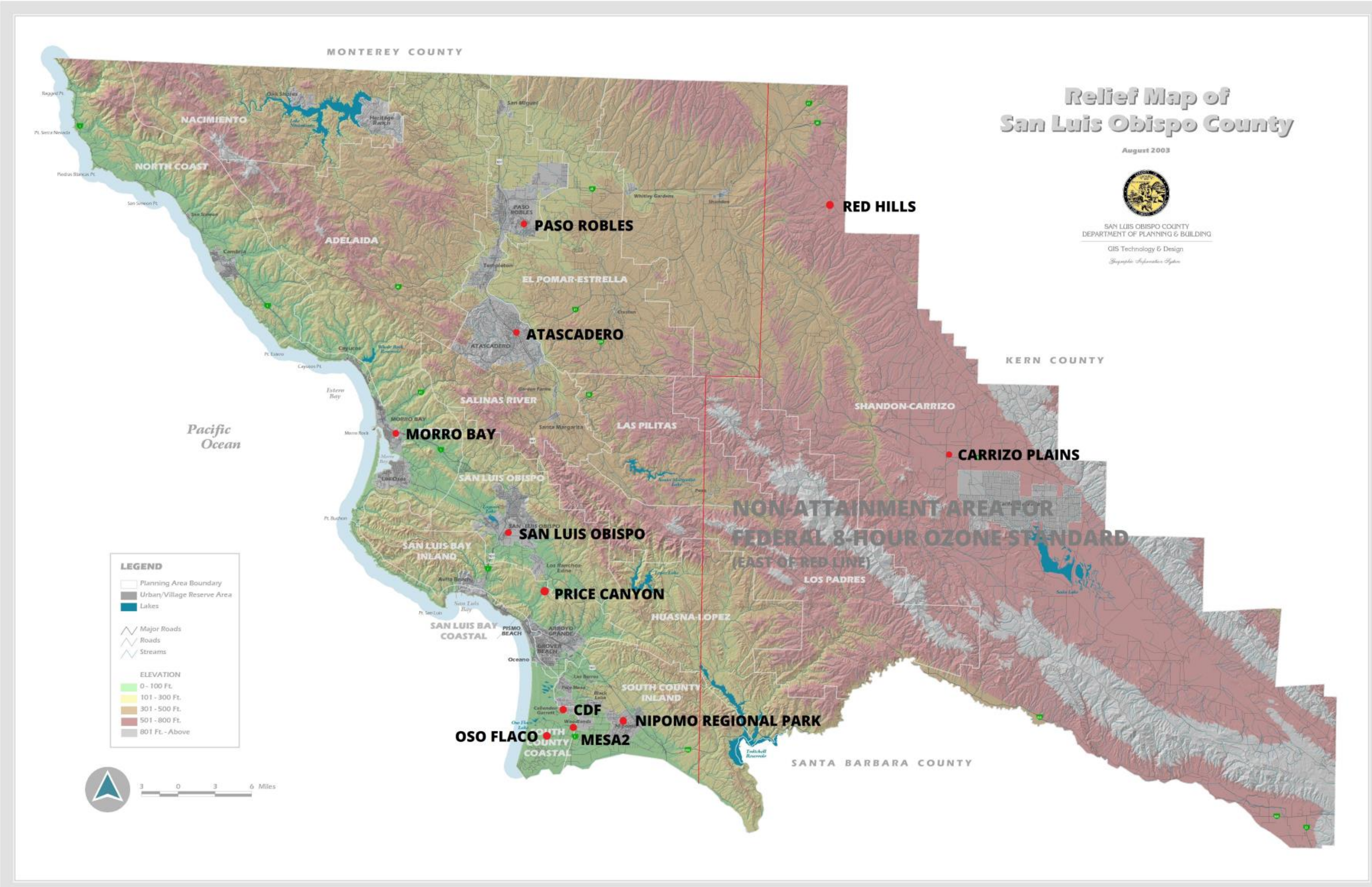

Figure 3: Ambient Air Monitoring Stations Operating in San Luis Obispo County in 2019/2020

3.2 Ambient Air Monitoring Network in San Luis Obispo County

Figure 2 shows a map of the most historical ambient air monitoring locations dating back to 1976. Some of these sites were operated for a year or less during the first few years when monitoring was conducted in the county in order to gauge the need for air quality surveillance at that location. Other sites were part of various studies the District has been involved in over the years such as the Central Coast Ozone Study, the San Joaquin Valley Air Quality Study/AUSPEX, the San Luis Obispo County Regional Ozone Study, and a number of smaller short-term monitoring efforts. The map also includes monitoring stations still in operation. It is clear that all of the populated areas and most of the rural portions of the county have had ambient air monitoring performed at some time in the past. Not included in the map are the more than 20 PM_{10} monitors that were temporarily deployed on the Nipomo Mesa in 2012 as part of the Community Monitoring Study.

Figure 3 shows a map of all currently operating ambient air monitoring stations in San Luis Obispo County. Table 2 lists these stations, the agency which operates them, the pollutant or meteorological parameters which are monitored at each location and the monitoring objective. The existing monitoring site locations are the result of years of sampling and evaluating data to determine the optimum network configuration. The SLOCAPCD air monitoring network is a dynamic system that can and should change with changing conditions.

There are currently ten permanent ambient air monitoring stations in San Luis Obispo County. Seven of these stations are operated by the District as part of our SLAMS network. This also includes the SPM PM_{10} monitor that has been collecting data in the Oso Flaco area of the Oceano Dunes State Vehicular Recreation Area since 2015. In addition to these SLAMS and SPM stations, the District also conducts temporary monitoring projects to support certain objectives. In 2016, the District received an EPA multipurpose grant for the construction of a mobile particulate monitoring platform to be used for further characterizing dust impacts downwind of the ODSVRA. The platform, which hosts meteorological sensors and PM_{10} and $PM_{2.5}$ FEM BAM monitors, was completed in the spring of 2017. Since then, it has been deployed to various locations on the Nipomo Mesa. Similarly, the District has conducted temporary PM_{10} monitoring on the Nipomo Mesa using a spare FEM BAM housed in small enclosure. In 2019, the District completed a short-term deployment of an FEM BAM in Oceano. This project was funded through Community Air Protection Program, a state program related to Assembly Bill 617. In 2020, the District is also conducting temporary PM_{10} monitoring with a non-FEM BAM near Dorothea Lange Elementary School in Nipomo. Data collected with these temporary/mobile monitors are not uploaded to AQS.CARB operates two stations in the county as part of their SLAMS network: one in Paso Robles and one in San Luis Obispo.

Table 2: Ambient Air Quality Parameters Monitored and Site Types in San Luis Obispo County in 2020

Site	Ozone[b]	Nitrogen Dioxide	Sulfur Dioxide	PM_{10}	$PM_{2.5}$	Wind[c]	Temp
Atascadero	P, C	P, C		P	P	X	X
Carrizo Plain	T, B					X	X
CDF				S, C	S, C	X	
Mesa2			S, C	S	S	X	X
Morro Bay[e]	B					X	
Nipomo Regional Park (NRP)	B	B		B		X	X
Paso Robles [a]	P			P		X	X
San Luis Obispo [a]	P			P	P	X	X
Oso Flaco				B		X	X
Red Hills	T, C					X	X

Site Types: B = General/Background, C = Highest Concentration, P = Population Exposure, T = Regional Transport, S= Source Oriented, X = Parameter measured at this site. **Notes:** [a] Paso Robles and San Luis Obispo are operated by CARB; all other sites are operated by SLOCAPCD. [b] Atascadero is the highest concentration site for the Western County attainment area, while Red Hills is the highest concentration site for the Eastern County nonattainment area. [c] Wind speed, wind direction, and sigma theta. The Grover Beach site was closed July 9, 2019. [e] Morro Bay discontinued NO_2 monitoring in **2017**

3.2.1 Ozone Monitoring Network

All ambient air monitoring stations in the county monitor for ozone except for CDF and Mesa2 (see Table 2). The SLAMS network in San Luis Obispo County thus features ozone monitors located in Atascadero, Red Hills, Carrizo Plain, Paso Robles, Morro Bay, San Luis Obispo, and Nipomo Regional Park.

Atascadero –SLOCAPCD has operated an ozone monitor in Atascadero since 1988. This station was moved in 2015 from a site located in the central business district of downtown Atascadero to a nearby city property. The original location was bounded on two sides by public schools, and the new site is adjacent to a community center. The monitor continues to be classified as population-oriented and neighborhood scale. It provides a measurement of representative ozone concentration for the City of Atascadero. Ozone concentrations at this site exhibit strong diurnal fluctuations caused by titration of ozone by oxides of nitrogen from nearby mobile and residential sources. Measured concentrations at this site are similar to those recorded at Paso Robles and are often the highest among the five ozone monitors in the western portion of the county that is classified as attaining the federal ozone standard. The highest ozone concentrations at Atascadero occur when there is transport of ozone and other pollutants into the county. Under these infrequent conditions, transported ozone enhanced by local pollutants can cause highly elevated concentrations.

Carrizo Plain – Operated by SLOCAPCD since January 2006, this station monitors background levels and ozone transport on a regional scale. The monitor is located in an outbuilding at the Carrisa Plains Elementary School. The ozone concentrations recorded here are second only to Red Hills in concentration and persistence; it is located within the Eastern San Luis Obispo County nonattainment area.

Morro Bay – Operated since 1975 by SLOCAPCD, this site provides regional scale and general/background ozone monitoring. Located in downtown Morro Bay, the monitor generally measures background levels of ozone from the predominant northwest winds blowing off of the Pacific Ocean; levels are similar to those measured in San Luis Obispo. Under Santa Ana meteorological conditions, the site can record elevated ozone concentrations transported from urban areas in Southern California. This is the closest monitor to the shore in the county and one of the longest operating; as such it is excellent for tracking long term trends in background levels of ozone.

Nipomo Regional Park (NRP) – Operated by SLOCAPCD since 1998, this station provides monitoring of background levels of ozone on a regional scale. Previously (1979 to 1996) ozone had been monitored in Nipomo on Wilson Street several miles away. The ozone concentrations measured at NRP are representative of interior portions of the Nipomo Mesa and are the highest recorded in the coastal region of San Luis Obispo County.

Paso Robles – Operated by CARB since 1974, this population-oriented neighborhood scale ozone monitor provides a representative ozone concentration for the suburban areas of the City of Paso Robles. The conditions under which elevated ozone levels occur and the location's prevailing winds are similar to Atascadero.

Red Hills – Operated by SLOCAPCD since 2000, this station is located on the summit of the Red Hills east of the community of Shandon at an elevation of about 2,000 feet. This regional scale site is often influenced by ozone transport from outside of the county and consistently records the highest and most persistent ozone concentrations in the network; its site type is thus regional and maximum concentration. In early 2012, the eastern portion of the county was designated as marginally nonattainment for the federal 8-hr ozone standard based on the design value from this site.

San Luis Obispo – CARB has operated a population-oriented, neighborhood scale ozone monitor in the City of San Luis Obispo since 1970. The monitor has been at its current site since 2005. It provides a representative ozone concentration for the City of San Luis Obispo. The monitor is located in the urban area where ozone concentrations are significantly depleted by titration with local mobile and stationary NO_x sources. As a result, the ozone concentrations recorded here are often slightly lower than at Morro Bay. In 2019, CARB informed the District of its intent to discontinue all operations at its San Luis Obispo SLAMS, which includes monitors for ozone, PM_{10}, $PM_{2.5}$, and meteorology. None of the monitors are needed for meeting the minimum monitoring requirements of 40 CFR 58 Appendix D, and all monitors qualify for shutdown under 40 CFR 58.14.

As noted in Table 2, the SLAMS site types employed by the existing ozone network are:

1. Highest Concentration – The Red Hills station typically records the highest ozone concentrations in the county. High ozone levels tend to occur in the interior areas of the county during summer, or as a result of additional transported pollutants from regions outside of SLO County (SF Bay Area – San Joaquin Valley – Southern California). Among the sites in the western portion of the county, which is classified as attaining the ozone standard, Atascadero and Paso Robles measure the highest concentrations. In 2014, Atascadero had a higher design value than Paso Robles, but in early years Paso Robles has often been higher.

2. Population Exposure – The Paso Robles, Atascadero and San Luis Obispo monitors provide a good representation of the ozone levels in the larger cities of the county.
3. Source Impact – Because ozone is a secondary pollutant the effect of emissions from any single source are experienced five to seven hours later and often many miles distant. As a regional pollutant, monitoring for specific sources of ozone is not performed.
4. General/Background – The monitors at Morro Bay, Carrizo Plain and Nipomo Regional Park provide regional background ozone levels.
5. Regional Transport – The stations located at Carrizo Plain and Red Hills provide excellent surveillance of regional transport of ozone into the interior part of the county. Coastal monitoring stations have provided evidence in the past of regional transport of ozone over water from distant urban sources.

3.2.2 Nitrogen Dioxide Monitoring Network

The SLAMS network in San Luis Obispo County features nitrogen dioxide (NO_2) monitors at Atascadero and Nipomo Regional Park. Morro Bay NO_2 measurement was discontinued in 2017. NO_2 levels have always been well below the state and federal standards at all locations in our county. For this reason, NO_2 monitoring is most useful here as an indicator of depletion of ambient ozone through titration with nitric oxide. These monitors also serve long-term air quality surveillance roles.

Atascadero – Operated by SLOCAPCD since 1990 and relocated in 2015, this population-oriented monitor is considered neighborhood scale. This is the only NO_2 monitor in the Salinas River air basin in the county, and it records the highest NO, NO_2 and NO_x levels in the county. The monitor's location downtown has established a strong diurnal inverse relationship between ozone and NO_2 levels caused by local mobile sources and residential and commercial combustion of natural gas.

Nipomo Regional Park – Operated by the SLOCAPCD since 1998, this monitor is regional in scale and representative of background concentrations on the Nipomo Mesa. The site's location in a large natural area away from local or mobile sources makes it ideal for regional surveillance of NO_2.

The SLAMS sites in the existing NO_2 network are:

1. Highest Concentration – The Atascadero monitor historically has measured the highest NO_2 concentrations in the county. NO_2 levels are the result of titration of ambient ozone by local sources of nitric oxide and as a result values are always relatively low. Levels have never exceeded the 1-hr NO_2 standard (100 ppb), with annual maximum 1-hr concentrations typically around 50% of the standard.
2. General/Background – With no significant local sources present, the monitor at Nipomo Regional Park provides excellent information on background levels of NO_2.

Regional Transport and Welfare-Related impacts of NO_2 are not currently addressed by the District's SLAMS network and are not thought to be significant. With the closure of the Morro Bay power plant—the only potentially significant point source of NO_2 in the county—no monitors in the network are considered to be source-oriented. The San Luis Obispo-Paso Robles MSA, does not have any NO_2 sites for vulnerable populations, near-road NO_2 monitoring sites, or area-wide NO_2 sites.

3.2.3 Sulfur Dioxide Monitoring Network

The sulfur dioxide (SO_2) monitoring network in San Luis Obispo County currently consists of one station: Mesa2.

Mesa2 – Established in 1989 and operated by the SLOCAPCD since 2006, this monitor performs surveillance of a nearby oil refinery. It is considered middle scale and highest concentration for SO_2. Since it is located close to and downwind of a major source of SO_2 emissions, it is representative only of the immediate area. The station was sited to optimize surveillance of the refinery's nearby coke calciner, which has since been shut down. Nonetheless, the refinery remains the largest point source of SO_2 in the county, and during upsets this monitor can record concentrations approaching and sometimes exceeding the NAAQS. In addition to meeting NAAQS compliance objectives, this site is also vital for public information and emergency response.

The SLAMS SO_2 monitoring objectives met by the network are:

1. Highest Concentration – The monitor at Mesa2 records the highest SO_2 levels in the county.
2. Source Impact – The monitor at Mesa2 is invaluable in determining the SO_2 source impact upon the immediate region.

Monitoring objectives not addressed by the existing SO_2 network are: General/Background, Population, Regional Transport, and Welfare-Related. Historical SO_2 monitoring performed elsewhere in the County (at NRP from 1998-2006; Morro Bay, 1979-1995; Grover Beach, 1982-2004; and at decommissioned stations in Arroyo Grande "Ralcoa" (06-079-1005), 1991-2002, and "Mesa1" (06-079-3002), 1987-94) suggest that monitoring for these objectives is not needed. Furthermore, background levels of SO_2 in the county are believed to be negligible, since more than 98% of hourly SO_2 levels from Mesa2 were 1 ppb or less in 2019. As demonstrated in the 2019 Annual Network Plan for San Luis Obispo County, the Mesa2 monitor fulfills minimum monitoring requirements for the county.

3.2.4 PM_{10} and $PM_{2.5}$ Particulate Monitoring Network

The particulate monitoring network in San Luis Obispo County consists of seven Federal Equivalent Method (FEM) PM_{10} monitors (Paso Robles, Atascadero, San Luis Obispo, Mesa2, CDF, OFS, and Nipomo Regional Park) and four FEM $PM_{2.5}$ monitors (Atascadero, CDF, Mesa2 and San Luis Obispo). The PM_{10} network has been in place since 1988, and $PM_{2.5}$ samplers began operation in 1999 in response to the establishment of a new federal standard for $PM_{2.5}$ in 1997. Originally, all particulate monitoring in the county was performed as part of CARB's network, but eventually all monitors except those at Paso Robles and San Luis Obispo became part of the SLOCAPCD network.

Initially, all particulate sampling was conducted by filter-based Federal Reference Method (FRM) methods. With the advent of continuous monitoring technologies, all the FRM monitors in the county have been replaced with FEM monitors in recent years. These are continuous semi-real time monitors that report hourly PM concentrations. The hourly data has greatly improved the SLOCAPCD abilities to issue timely air quality forecasts, a significant benefit for the advancement of public health goals.

Atascadero – Operated by SLOCAPCD, PM_{10} monitoring has been conducted here since 1988, initially via a FRM and currently with a continuous FEM monitor. Collocated FRM $PM_{2.5}$ monitors began operation in 1999 and have since been replaced by a single FEM. All monitors are neighborhood in scale and representative of particulate concentrations in the City of Atascadero. As previously noted, the station was moved about 400 meters north of its original location in February 2015.

Mesa2 – PM_{10} sampling began at this site in 1991, and the monitors have been operated by the SLOCAPCD since 2006. This site initially featured collocated FRM PM_{10} samplers that were replaced by a single continuous FEM PM_{10} monitor in 2009. A continuous $PM_{2.5}$ FEM monitor was installed at the same time. This site monitors source impacts from the nearby oil refinery and coastal dunes. It is neighborhood scale. These monitors record some of the highest particulate levels in the county and are strongly influenced by the extensive coastal sand dunes and the Oceano Dunes State Vehicular Recreation Area (ODSVRA) located upwind.

CDF – Originally established for the SLOCAPCD's Nipomo Mesa Phase 2 Particulate Study, this site has become a permanent part of our SLAMS particulate network. The site features continuous FEM samplers for PM_{10} and $PM_{2.5}$, which are neighborhood in scale and measure source impacts from the ODSVRA. These monitors record the highest particulate levels in the county and are strongly influenced by the ODSVRA, located directly upwind. In 2012, extensive temporary monitoring on the Nipomo Mesa confirmed that this site is located within the one square mile sector of the study area that experiences the highest PM_{10} levels.[3]

Nipomo Regional Park – Operated at this location by SLOCAPCD since 1998, it replaced a site at Wilson Street in Nipomo that operated from 1990-96. The 1-in-6-day FRM PM_{10} sampler was replaced with a continuous FEM sampler in 2010. The monitor is regional in scale and is representative of PM_{10} concentrations on the Nipomo Mesa.

Oso Flaco – Operated by SLOCAPCD on behalf of the California Department of Parks and Recreation, this PM_{10} monitor was established in July 2015 to fulfill a requirement of SLOCAPCD Rule 1001. It is classified as an SPM rather than a SLAMS monitor. It is located within the Oso Flaco area of the ODSVRA; off-road vehicular activity is not permitted upwind of the monitor. It is considered neighborhood in scale and representative of the non-riding areas of the dunes complex.

Paso Robles – Operated by CARB since 1991 this PM_{10} monitor is urban in scale and representative of the city of Paso Robles. The FRM sampler at this site was replaced with an FEM PM_{10} sampler in August 2009.

San Luis Obispo – Operated by CARB, a PM_{10} sampler has been in place since 1988, and a $PM_{2.5}$ sampler since 1999. CARB replaced the FRM samplers with continuous FEM instruments in 2011. These population-oriented monitors are neighborhood in scale and represent particulate concentrations in the City of San Luis Obispo.

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[3] San Luis Obispo County Air Pollution Control District, "South County Community Monitoring Project," January 2013. Available online: http://slocleanair.org/communitymonitoringproject

4.0 STATISTICAL ANALYSIS

A variety of statistical tests were run to examine the comprehensiveness and suitability of the SLOCAPCD monitoring network. All analyses, with the exception of the measured concentration statistics, were performed using the assessment tools provided by EPA and Lake Michigan Air Directors Consortium.[4] As discussed in greater detail below, many of these tools fail to accurately capture the on-the-ground reality of air quality in the county; however, for the sake of transparency, all results are included below.

4.1 Measured Concentration Analysis

Individual monitors are ranked based on the concentration of pollutants they measure. Monitors that measure high concentrations or have high design values are ranked higher than monitors that measure low concentrations. Results can be used to determine which monitors are less useful in meeting the monitoring objective of NAAQS compliance. Three-year average design values were calculated for the period 2017 to 2019 for ozone, NO_2, and $PM_{2.5}$. For PM_{10} the third highest 24-hour average for the period 2017 to 2019 was used. The results of the measured concentration analysis are presented in Tables 3, 4, 5, and 6.

4.1.1 Ozone Measured Concentration Analysis

For this pollutant, the District considers there to be three distinct air quality regions in the county: the Coastal Plateau, the Upper Salinas River valley, and Eastern San Luis Obispo County. Of the three population-oriented monitors only Atascadero and Paso Robles are in the same air quality region. Although the sites are very similar, Atascadero tends to record higher concentrations of ozone than Paso Robles as shown in Table 3, below.

Three ozone monitors are classified as background-oriented monitors. All three of these monitors are in different air quality regions and provide unique information.

[4] Lake Michigan Air Director's Consortium. "NetAssess," http://ladco.github.io/NetAssessApp/index.html. Accessed June 2020.

Table 3: Ozone Measured Concentration Analysis

Site	Address	AQS Site Code	Design Value 2017-2019 (ppm)	Monitoring Objective	Spatial Scale	Rank
Red Hills	3601 Gillis Canyon Road	06-079-8005	0.072	Transport/Highest Concentration	Regional	1
Carrizo Plain	9640 Carrizo Highway	06-079-8006	0.069	Background	Regional	2
Paso Robles	235 Santa Fe Avenue	06-079-0005	0.064	Population	Neighborhood	3
Atascadero	5599 Traffic Way	06-079-8002	0.061	Population	Neighborhood	4
NRP	Nipomo Regional Park	06-079-4002	0.058	Background	Regional	5
San Luis Obispo	3220 South Higuera Street	06-079-2006	0.055	Population	Neighborhood	6
Morro Bay	Morro Bay Blvd & Kern	06-079-3001	0.051	Background	Regional	7

4.1.2 $PM_{2.5}$ Measured Concentration Analysis

For this pollutant, there are three air quality regions in the county: the South County Coastal Region, which is strongly influenced by the ODSVRA, the Upper Salinas River Valley, and the Coastal Plateau. Table 4 presents the ranking of $PM_{2.5}$ monitors. Although Atascadero ranked higher than San Luis Obispo in this analysis, the samplers are in different air quality regions. The CDF monitor measured higher concentrations than the Mesa2 monitor; both are source-oriented monitors.

Table 4: $PM_{2.5}$ Measured Concentration Analysis

Site	Address	AQS Site Code	24 Hour Design Value 2017-2019(ug/m^3)	Annual Design Value 2017-2019 (ug/m^3)	Monitoring Objective	Spatial Scale	Rank
CDF	2391 Willow Rd.	06-079-2007	26	8.9	Source	Neighborhood	1
Mesa2	1300 Guadalupe Road	06-079-2004	21	7.5	Source	Neighborhood	2
San Luis Obispo	3220 South Higuera Street	06-079-2006	18	7.2	Population	Neighborhood	3
Atascadero	5599 Traffic Way	06-079-8002	20	6.2	Population	Neighborhood	4

4.1.3 PM_{10} Measured Concentration Analysis

The air quality regions for PM_{10} are the same as those for $PM_{2.5}$. The analysis ranked monitors based on the highest, if the third highest 24-hour average overall measured concentration from 2017 to 2019. The two source-oriented monitors, CDF and Mesa2, are in place to perform surveillance of a significant area source of fine particulate at the ODSVRA; recently installed mitigation measures on the ODSVRA were sited to mainly influence the CDF monitor. As was the case with ozone, of the three population-oriented monitors, only Atascadero and Paso Robles are in the same air quality region.

Table 5: PM_{10} Measured Concentration Analysis

Site	Address	AQS Site Code	3rd High 24 Hour (ug/m^3) 2017-2019	Monitoring Objective	Spatial Scale	Rank
CDF	2391 Willow Road, Arroyo Grande	06-079-2007	130 (2017)	Source	Neighborhood	1
Mesa2	1300 Guadalupe Road, Arroyo Grande	06-079-2004	111 (2018)	Source	Neighborhood	2
Paso Robles	235 Santa Fe Avenue, Paso Robles	06-079-0005	109 (2019)	Population	Urban	3
Atascadero	5599 Traffic Way, Atascadero	06-079-8002	79 (2019)	Population	Neighborhood	4
NRP	Nipomo Regional Park, Nipomo	06-079-4002	71 (2019)	Background	Regional	5
OFS	NA	06-079-9001	64 (2019)	Background	Regional	6
San Luis Obispo	3220 South Higuera Street, San Luis Obispo	06-079-2006	57 (2017)	Population	Neighborhood	7

4.1.4 NO_2 Measured Concentration Analysis

The air quality regions for NO_2 are the same as those for ozone. Table 6 presents the ranking of these monitors.

Table 6: NO_2 Measured Concentration Analysis

Site	Address	AQS Site Code	Design Value (ppb) 2017-2019	Monitoring Objective	Spatial Scale	Rank
Atascadero	5599 Traffic Way	06-079-8002	30	Population	Neighborhood	1
NRP	Nipomo Regional Park	06-079-4002	21	Background	Regional	2

4.2 Monitor to Monitor Correlation Analysis

Concentrations at one monitor are compared to concentrations measured at other monitors to determine if their concentrations correlate temporally. Monitor pairs with Pearson correlation values near one are highly correlated; monitor pairs with Pearson correlation values near zero (circle) have no correlation. Monitors that do not correlate well with other monitors exhibit unique temporal concentration variation relative to other monitors and are likely to be important for assessing local emissions, transport and spatial coverage. Monitor pairs with high Pearson correlation values (e.g., r > 0.75) exhibit similar temporal concentrations.

Monitor pairs with low average relative difference (light pink color) measure similar ozone concentrations, while monitors with high average relative differences (red to blue color) measure significantly different concentrations.

Possibly redundant sites would exhibit fairly high correlations consistently and would have low average relative difference despite the distance between them. Usually it is expected that the correlation between sites will decrease as distance increases. However, for a regional air pollutant such as ozone, sites in the same airshed can have very similar concentrations and be highly correlated. More unique sites would exhibit the opposite characteristics. They would not be very well correlated with other sites and their relative difference would be higher than other site to site pairs.

4.2.1 Correlation of Ozone Monitors in San Luis Obispo County

Figure 4, below, depicts design values and Pearson correlation for ozone monitors from San Luis Obispo County. The analysis reveals a significant correlation between ozone monitors located in Southern Coastal San Luis County. In the interior, San Luis Obispo County, Carrizo Plain, Paso Robles, and Red Hills show strong correlation. It is not surprising that a regional pollutant like ozone would show correlations within the same air basin. The analysis does show little correlation between monitors in the southern coastal region of San Luis Obispo with monitors in the interior.

Correlation of Ozone Monitors and Design Values in San Luis Obispo County 2017-2019

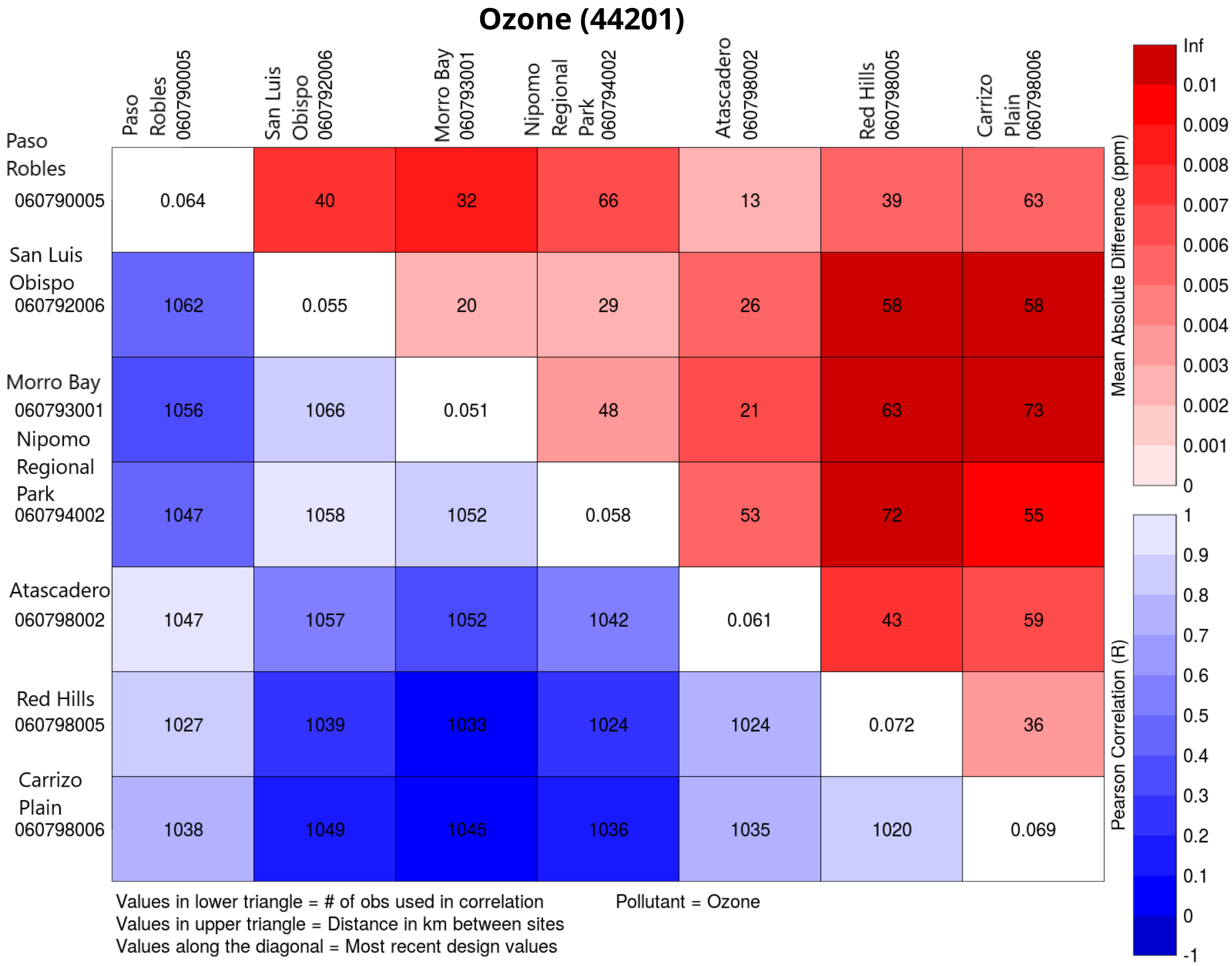


Figure 4: Correlation of Ozone Monitors in San Luis Obispo County

4.2.2 Correlation of $PM_{2.5}$ Monitors in San Luis Obispo County and Northern Santa Barbara County

Figure 5 depicts measures of similarity for $PM_{2.5}$ monitors from San Luis Obispo and adjoining counties. The only two sites in which both are in San Luis Obispo County with any significant correlation are Mesa2 and CDF. It is not surprising as they are only located 2 km apart and both sites are largely influenced by the same PM source - coastal dunes.

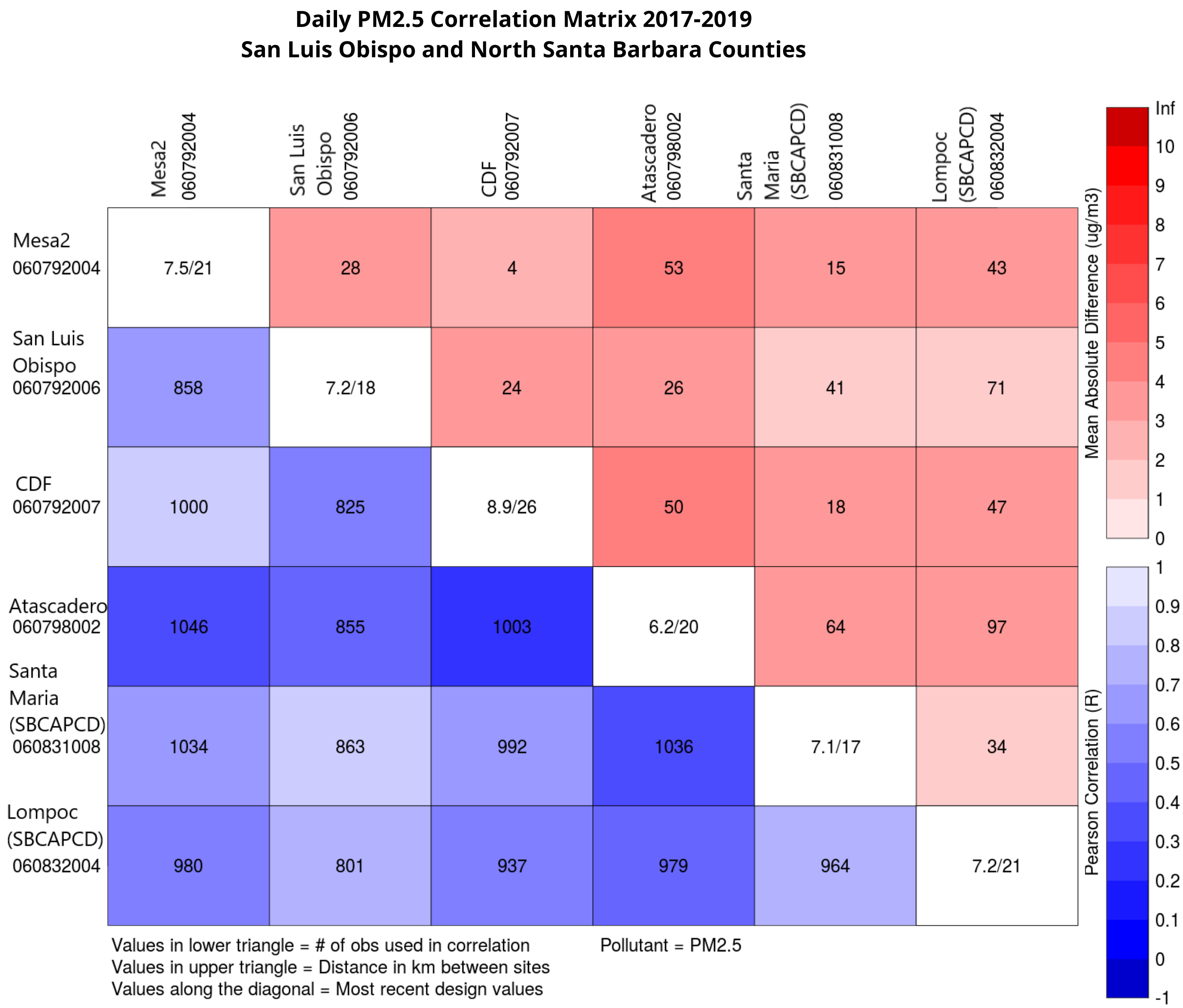


Figure 5: Correlation of FRM $PM_{2.5}$ Monitors in San Luis Obispo County

4.3 Removal Bias Analysis

The removal bias analysis is a tool used in determining possible redundant sites. The bias estimation uses nearby monitoring sites to estimate the concentration at the location of the site; however, terrain features, meteorology, and local sources are not included in the analysis. The bias was calculated for each day at each site by taking the difference between the predicted value from the interpolation and the measured concentration. A positive average bias would mean that if the site being examined was removed, the neighboring sites would indicate that the estimated concentration would be larger than the measured concentration. Likewise, a negative average bias would suggest that the estimated concentration at the location of the site is smaller than the actual measured concentration. A site with no bias indicates that the estimated concentration at the location of the site matches the actual measured concentration. Sites with little to no bias are sites where removal could be considered.

4.3.1 Removal Bias Analysis for Ozone in San Luis Obispo County

The removal bias analysis presented in Figure 6 shows low average bias for the Atascadero and Paso Robles monitors, implying that concentrations at these locations are well predicted by the other monitors. However, the maximum and minimum daily relative bias between the predicted and measured concentrations at these sites is significant, indicating that while the mean relative bias is negligible, there are periods where there is significant relative bias between the actual and predicted concentration at these sites.

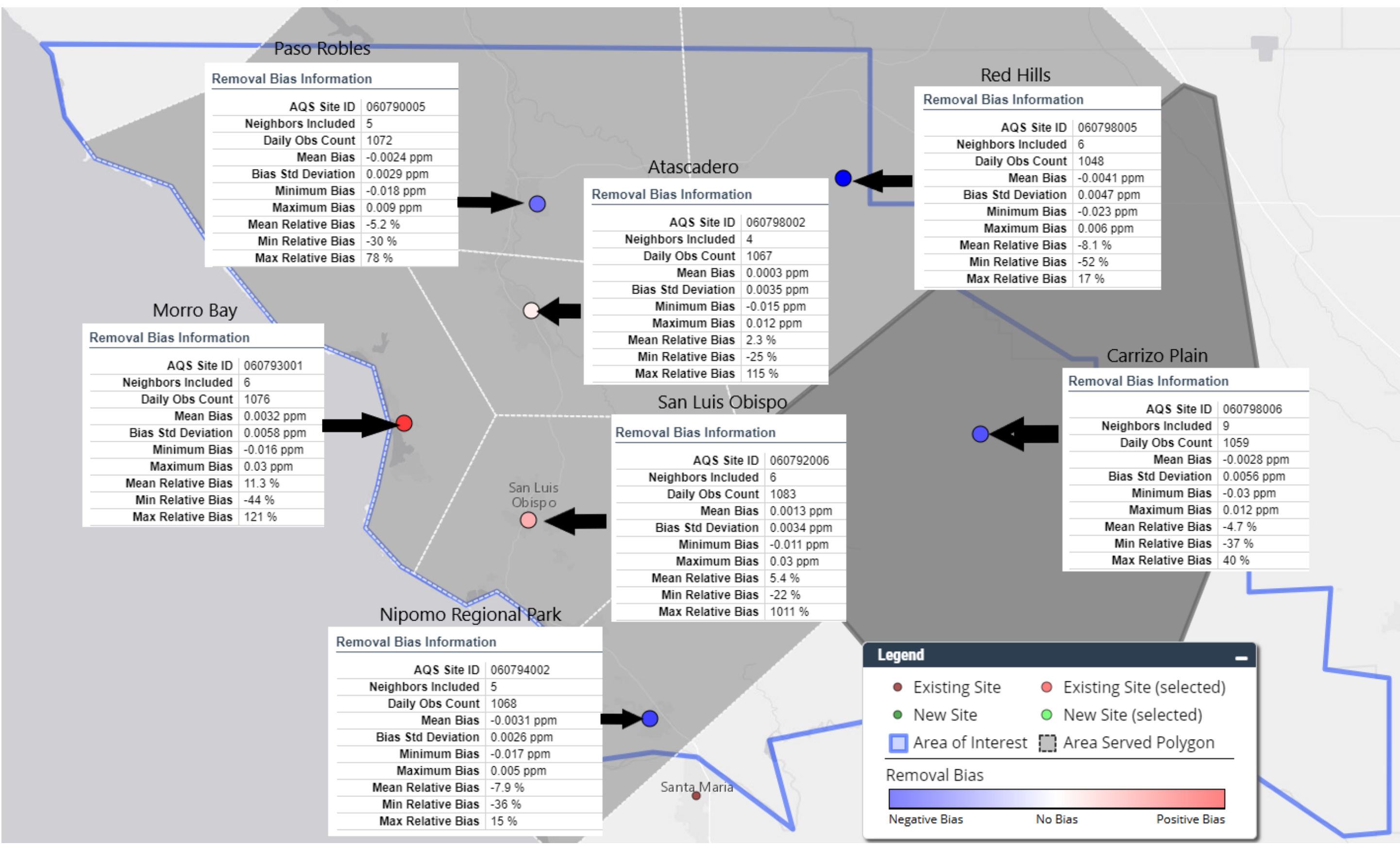


Figure 6: Removal Bias Analysis for Ozone

4.3.2 Removal Bias Analysis for $PM_{2.5}$ in San Luis Obispo County

The $PM_{2.5}$ removal bias analysis presented in Figure 7 shows significant relative bias between predicted and measured concentrations between all sites. This indicates that if any monitor was discontinued, concentrations at that site could not easily be predicted based on the levels measured at the remaining monitors.

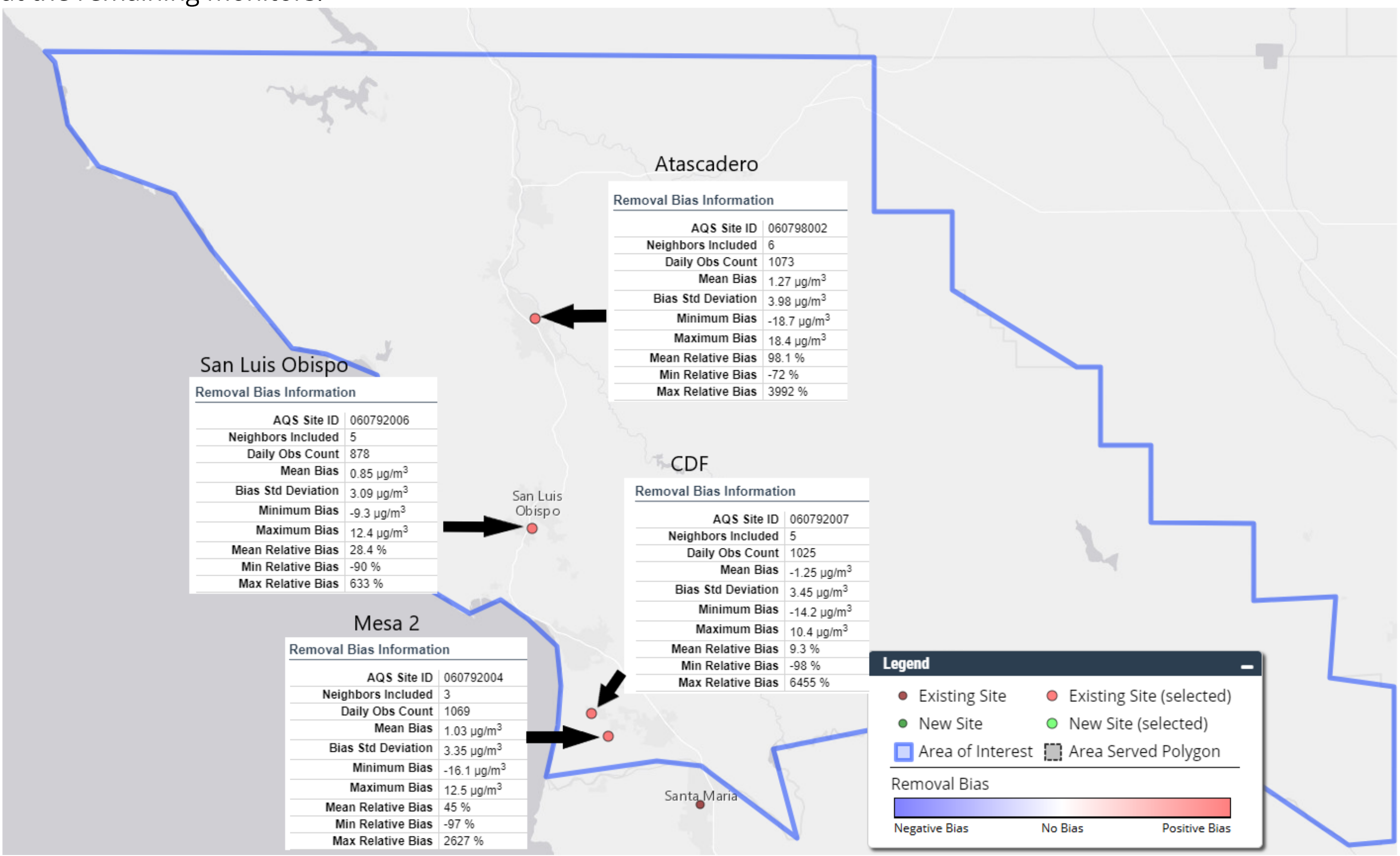


Figure 7: Removal Bias Analysis for PM2.5

4.4 Exceedance Probability Surface Maps

A significant goal of the network assessment is to determine if new sites are needed. In order to make that decision, it is helpful to have some estimation of the extreme pollution levels in areas where no monitors currently exist. To assist in understanding the probability of exceedances occurring in areas where no monitors exist, surface probability maps were generated. These maps were generated by calculating estimates of the pollutant of interest for the centroid of each census tract utilizing the LADCO assessment tool. These are statistical estimates from “fusing” modeling data and ambient monitoring data using Bayesian space-time methods.

These maps are intended to be used as a spatial comparison and not for probability estimates for a single geographic point or area. The probability estimates displayed on the map alone should not be used to justify a new monitor. The maps should be used in conjunction with existing monitoring data. This information, along with demographic and emissions data, could be used in a weight of evidence approach for proposing new monitor locations. It is important to note that in compiling the data to generate these maps, some details are lost in the fusing of modeling and monitoring data. For example, the ozone probability maps show a slightly higher probability of an exceedance occurring at the Carrizo Plain site than the Red Hills site, yet monitoring data from the two sites show the opposite. Another example is the $PM_{2.5}$ probability map, which shows low exceedance probability for the area of the CDF and Mesa2 monitors, while monitoring data show occasional exceedances of federal PM standards. It is therefore important to utilize these maps for general patterns, not absolute values.

4.4.1 Ozone Surface Probability Maps for San Luis Obispo County

In 2015, EPA announced the lower the ozone standard from the past 75 ppb level to 70 ppb. These maps are presented as Figure 8, and 9. There are a total of 7 areas served based on the ozone monitors within the county. Figure 8 shows low probability of finding a new site location in the coastal portion of San Luis Obispo County where ozone exceedances might be measured. Figure 9 shows that it is the Eastern 2 areas served of San Luis Obispo County where there is greater probability of measuring ozone exceedances. The current tool utilized has the probabilities of exceedance from 2014-2016.

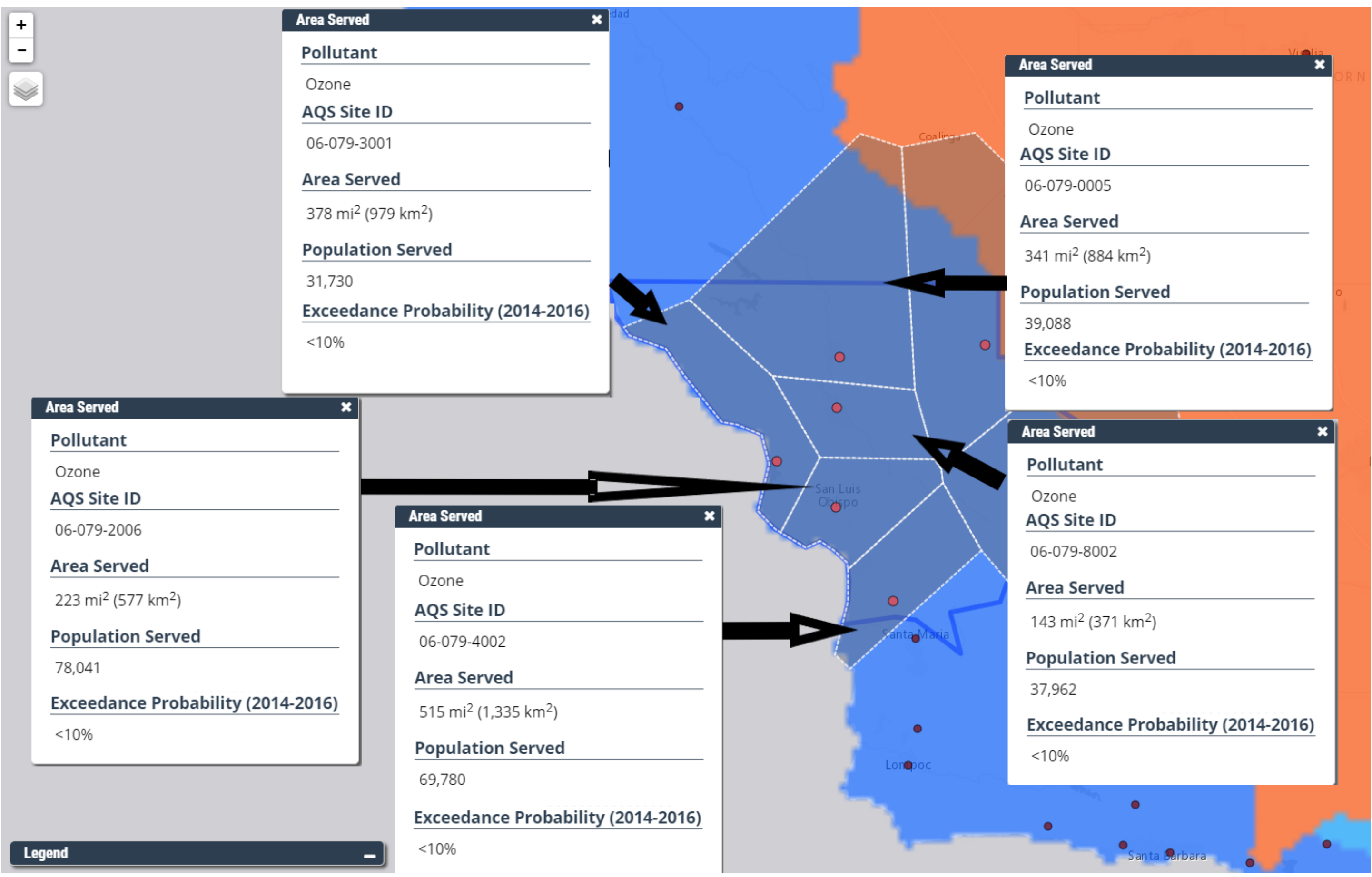


Figure 8: Surface Probability Map for Ozone Evaluated to Existing 70ppb Standard (Coastal areas served)

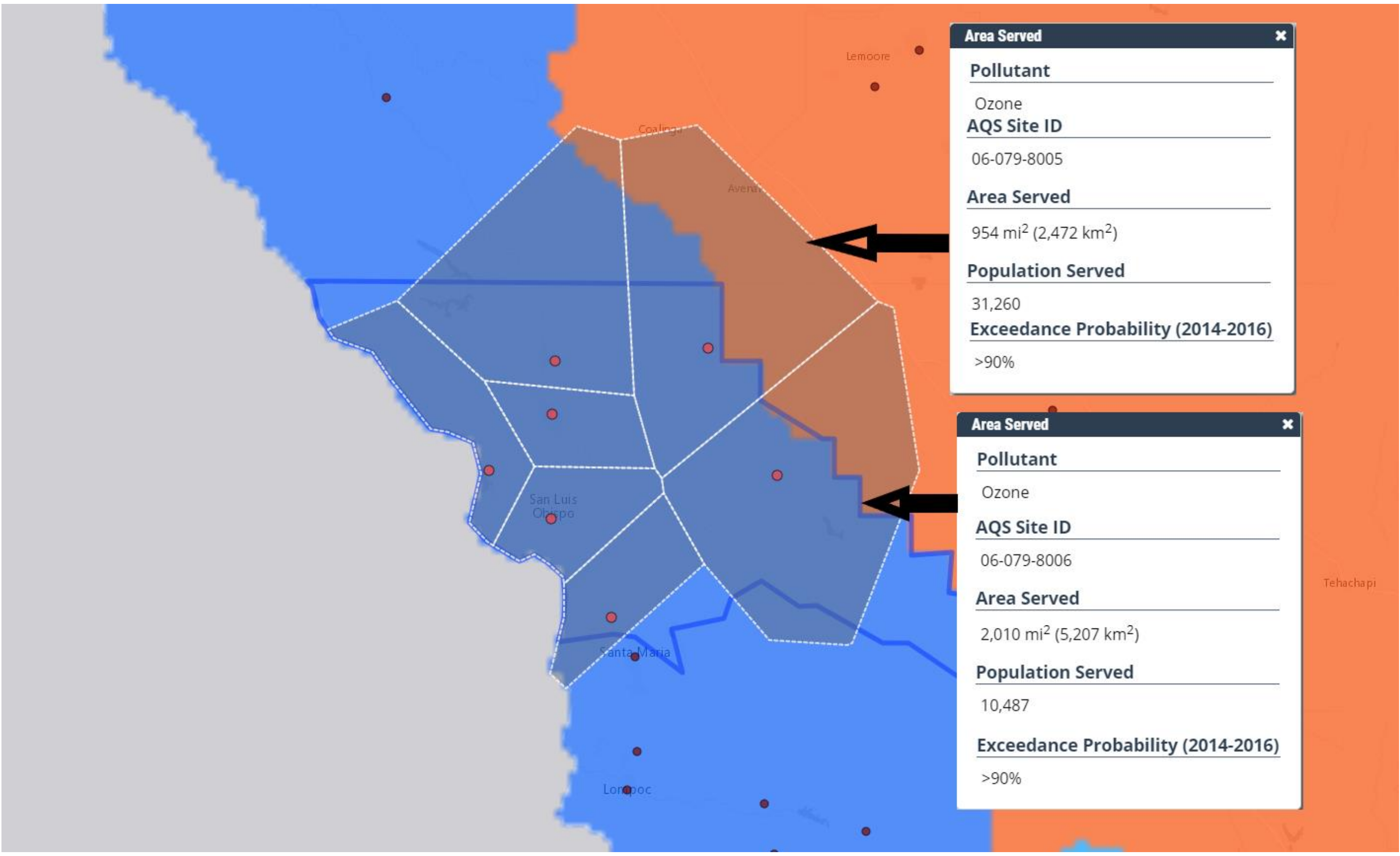


Figure 9: Surface Probability Map for Ozone Evaluated to Existing 70ppb Standard (Eastern areas served)

4.4.2 $PM_{2.5}$ Surface Probability Map for San Luis Obispo County

The $PM_{2.5}$ probability map shows a similar patter as the ozone probability maps, with a low probability of measuring exceedances in the entire region for the 2014-2016 data. Although the data reflects low probability of exceedance for the entire county, some coastal sites have experienced 24-hour averages above the EPA standard of 35µg/m³. It is interesting to note that this analysis shows a very low probability of exceeding the standard at the CDF and Mesa2 sites. Measurement data shows that these sites measure significantly higher values of $PM_{2.5}$ than any other site in the county, with the CDF site approaching the annual $PM_{2.5}$ standard.

The District has not performed $PM_{2.5}$ measurements east of Atascadero but did measure PM_{10} at the Carrizo Plain site for one year and found very low levels. Therefore, while the modeling does not include probability of exceeding the $PM_{2.5}$ standard in the southeastern portion of San Luis Obispo County, monitoring data indicate a low likelihood in the southeast portion of the county, where the Carrizo Plain site is located.

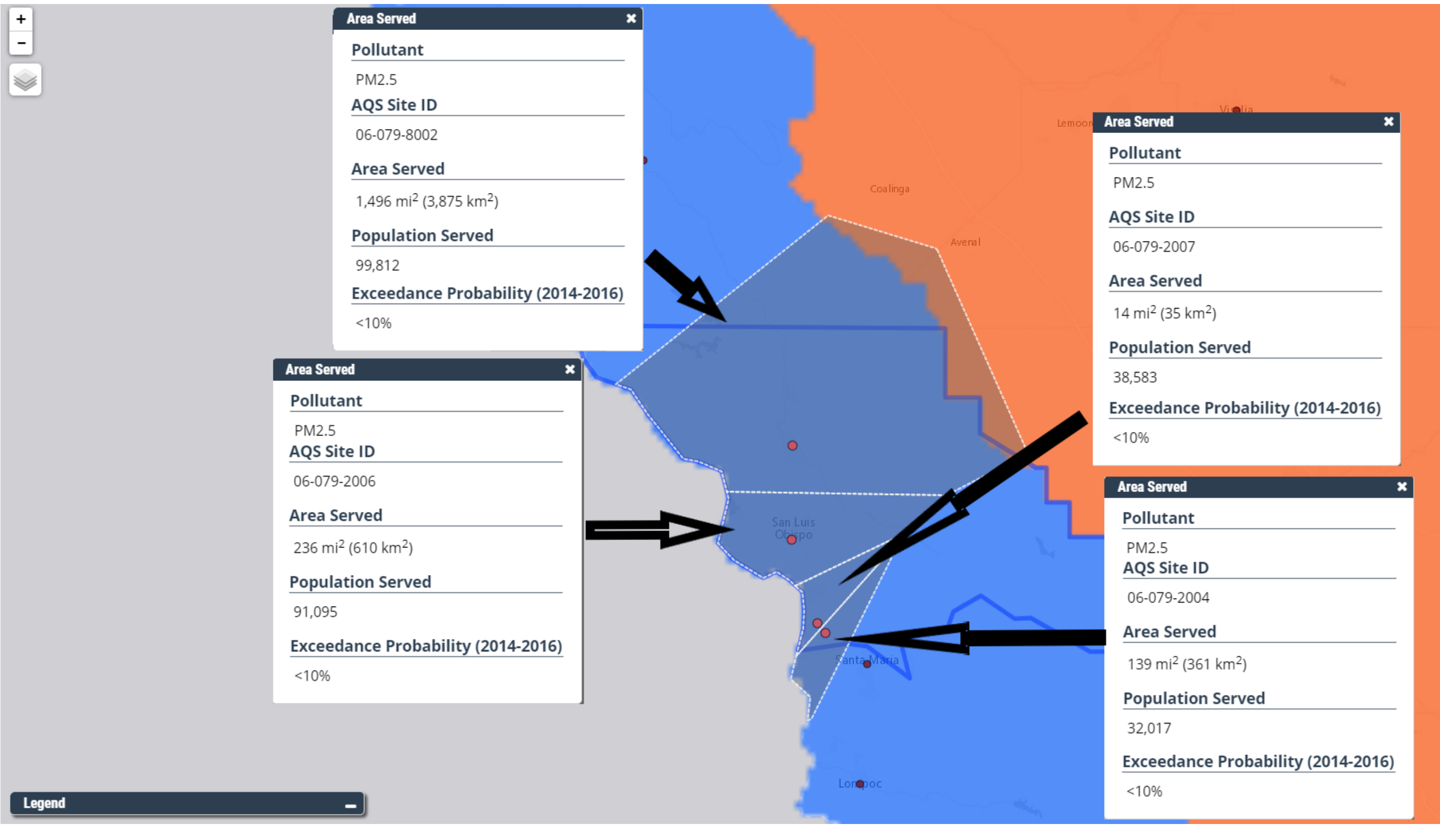


Figure 10: Surface Probability Map for $PM_{2.5}$

4.5 Area Served Analysis

This exercise uses a spatial analysis technique known as Voronoi or Thiessen polygons to approximate the area served by a monitoring site. The shape and size of each polygon is dependent on the proximity of the nearest neighboring air monitor to a particular site. While this technique provides an easy way to understand the general area and demographics represented by a particular monitoring site, it is important to understand that the polygons constructed by this analysis are based only on the distance to the nearby monitors, not on the area of representativeness for the monitor's data. Terrain, meteorology, and local pollution sources are not taken into account in this analysis. The AQI forecast map (Figure 11) developed by the District more accurately describes the area served by each monitoring station. Air quality forecast zones define geographical areas with relatively similar air quality characteristics that are represented by at least one of the air monitoring stations in SLO County. These forecast map polygons are different from the maps in Figures 13, 14, 15 and 16 in that the zone boundaries are defined by air quality characteristics, not distance from the nearest air monitoring station. The APCD issues daily air quality forecasts for each of these zones. Despite the limitations of the Voronoi/Thiessen polygon approach, understanding demographic distribution surrounding a monitor can be helpful in ensuring that a monitor is not removed that serves a historically underserved, vulnerable or disadvantaged segment of the population.

Figures 13, 14, 15 and 16 depict the results of this analysis for ozone, $PM_{2.5}$, PM_{10}, and NO_2 respectively. The demographic data displayed with each figure shows that the sites in the northern and southern portions of the county serve a slightly higher percentage of "other races"; however, there are no sites serving a high proportion of underserved, vulnerable or disadvantaged segments of the population. Data on age distribution shows that the Atascadero, Paso Robles, Mesa2, and CDF monitors serve a slightly higher proportion of children and the Morro Bay and Mesa2 monitors serve a slightly higher proportion of elderly. It would be important to consider monitors serving these sensitive populations prior to any consideration of removal of the monitor. Note, the San Luis Obispo PM_{10} monitor is not listed in this analysis due to data completeness issues.

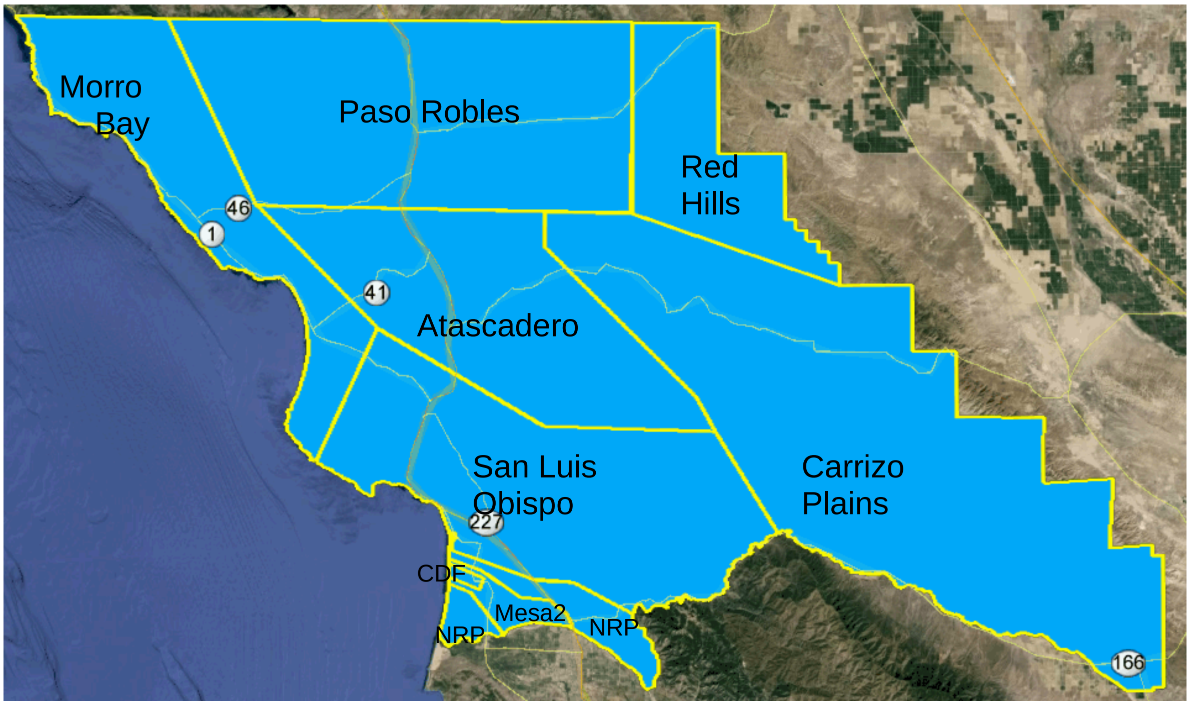
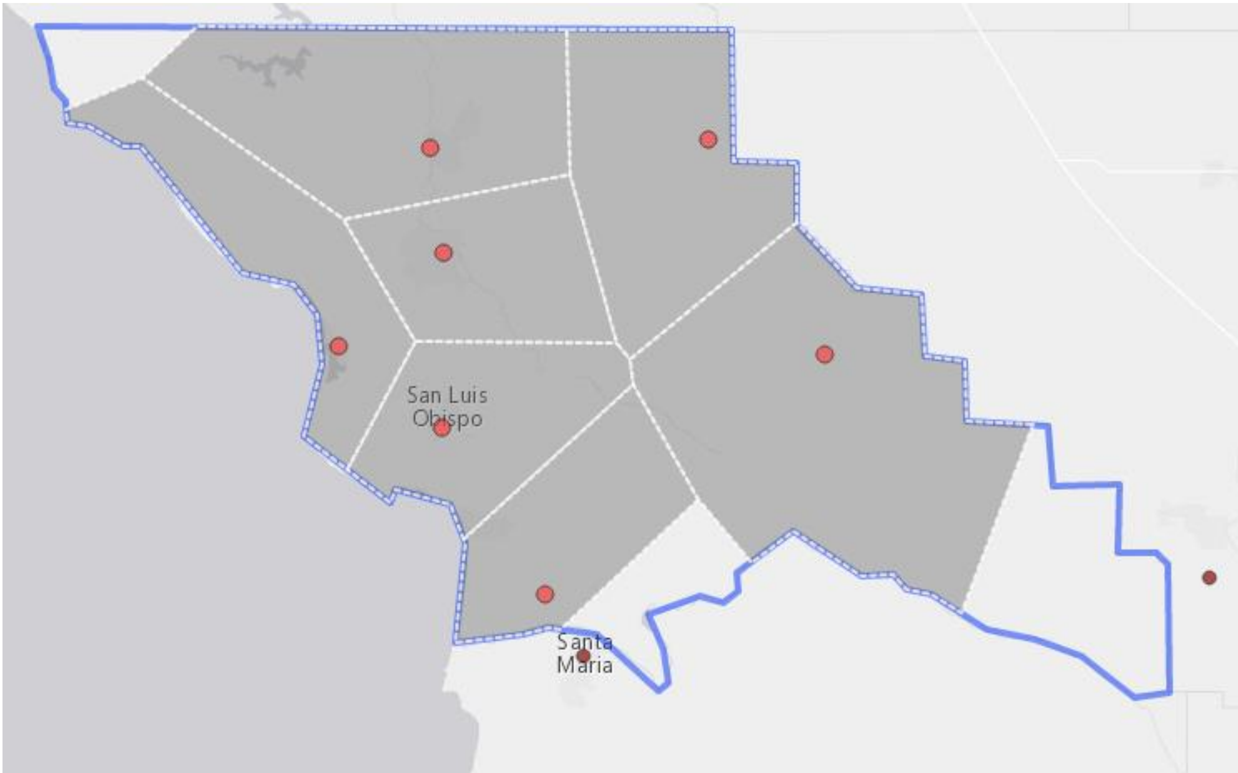


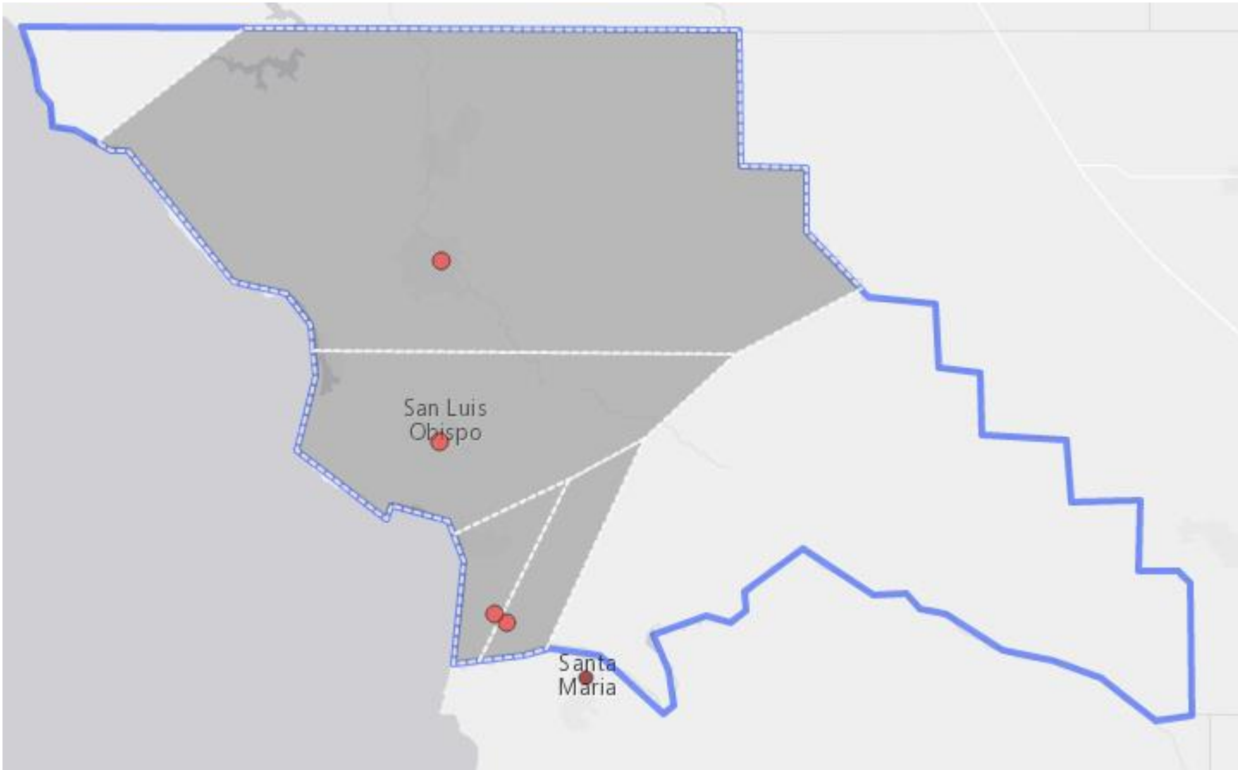
Figure 11: Air Quality Forecast Zones



Site Name	Pollutants	Area (km^2)	Total Population	Caucasian/White	African/Black	Native American	Asian	Pacific Islander	Other Race	Multiple Races	Hispanic/Latino
Paso Robles	Ozone, PM10	884	39088	31070	736	464	683	64	4621	1450	12285
Morro Bay	Ozone	979	31730	27344	150	253	1150	47	1795	991	4848
Nipomo Regional Park (NRP)	NO2, Ozone, PM10	1171	62435	49781	557	675	1866	90	6732	2734	17060
Red Hills	Ozone	1678	10043	8489	94	101	79	7	923	350	2194
San Luis Obispo	Ozone, PM10, PM2.5	577	78041	63855	3324	521	3748	96	3544	2953	12309
Carrizo Plains	Ozone	2871	6550	5754	36	83	112	5	326	234	864
Atascadero	NO2, Ozone, PM10, PM2.5	371	37962	33074	645	413	812	72	1624	1322	5861

Site Name	Male	Female	Age 0 to 9	Age 10 to 19	Age 20 to 29	Age 30 to 39	Age 40 to 49	Age 50 to 59	Age 60 to 69	Age 70 to 79	Age 80 and over
Paso Robles	19207	19881	5670	5330	5148	4860	5280	5342	3745	2134	1579
Morro Bay	15474	16256	2839	3059	3482	3239	3748	5725	4771	2597	2270
Nipomo Regional Park (NRP)	30718	31717	7291	8335	7113	6889	8252	9873	7391	4324	2967
Red Hills	5024	5019	1170	1447	977	2054	1482	1886	1215	524	288
San Luis Obispo	43462	34579	4753	11783	22456	7649	8665	9326	6477	3621	3311
Carrizo Plains	3269	3281	678	807	665	603	983	1323	841	412	238
Atascadero	19029	18933	4463	4896	4643	4353	5429	6515	4130	1992	1541

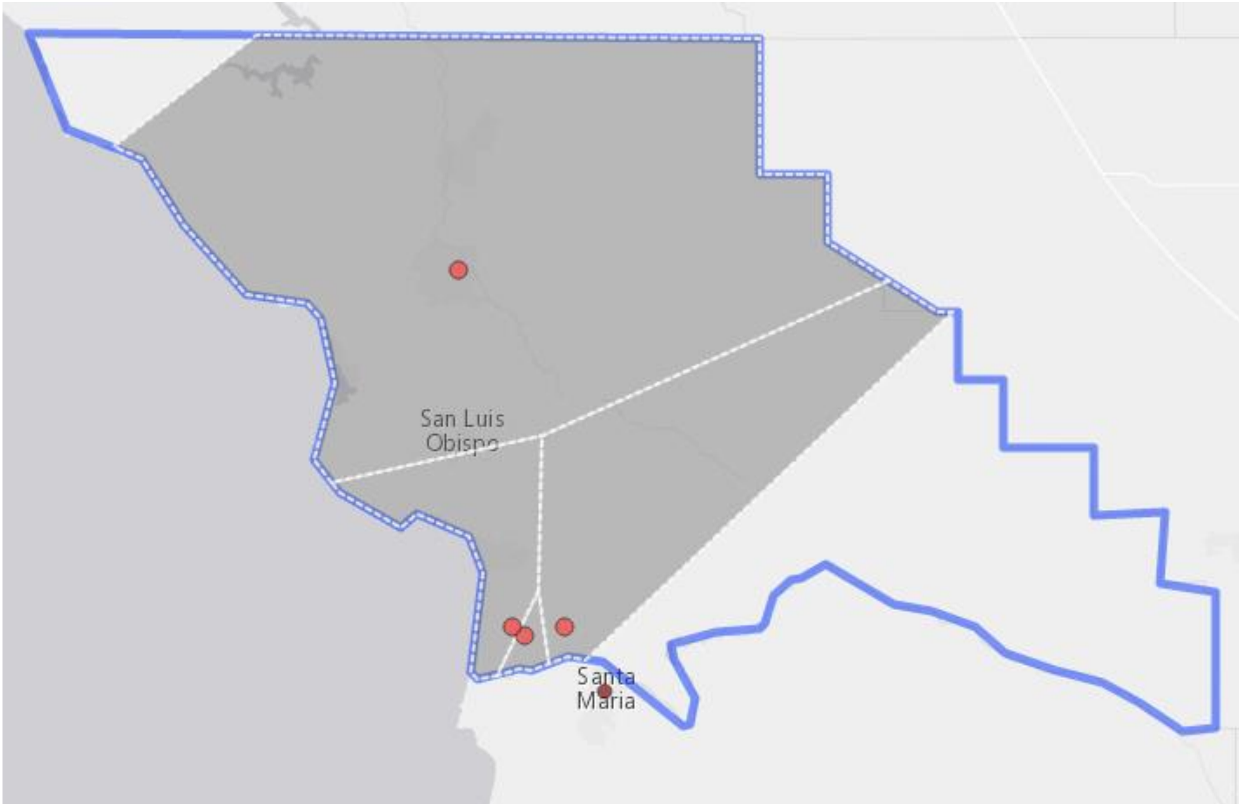
Figure 12: Area Served Plot and Demographic Data for Ozone Monitors in San Luis Obispo County



Site Name	Pollutants	Area (km^2)	PM2.5 Exceedance Probability	Total Population	Caucasian/White	African/Black	Native Americ	Asian	Pacific Island	Other Race	Multiple Races	Hispanic/Latino
Mesa2	SO2, PM10, PM2.5	196	<10%	24672	19140	240	271	672	40	3253	1056	8063
San Luis Obispo	Ozone, PM10, PM2.5	610	<10%	91095	75755	3358	586	4398	112	3676	3210	13217
Arroyo Grande CDF	PM10, PM2.5	35	<10%	38583	30580	368	445	1323	56	3962	1849	10140
Atascadero	NO2, Ozone, PM10, PM2.5	3875	<10%	99812	83487	1524	1072	1855	165	8195	3514	22567

Site Name	Male	Female	Age 0 to 9	Age 10 to 19	Age 20 to 29	Age 30 to 39	Age 40 to 49	Age 50 to 59	Age 60 to 69	Age 70 to 79	Age 80 and over
Mesa2	12185	12487	3045	3417	2675	2676	3241	3881	3010	1719	1008
San Luis Obispo	49819	41276	5737	12903	23686	8818	10094	11847	8720	4777	4513
Arroyo Grande CDF	18833	19750	4488	4949	4917	4586	5163	5916	4100	2520	1944
Atascadero	49490	50322	12420	12868	12122	11540	13677	16004	11103	5803	4275

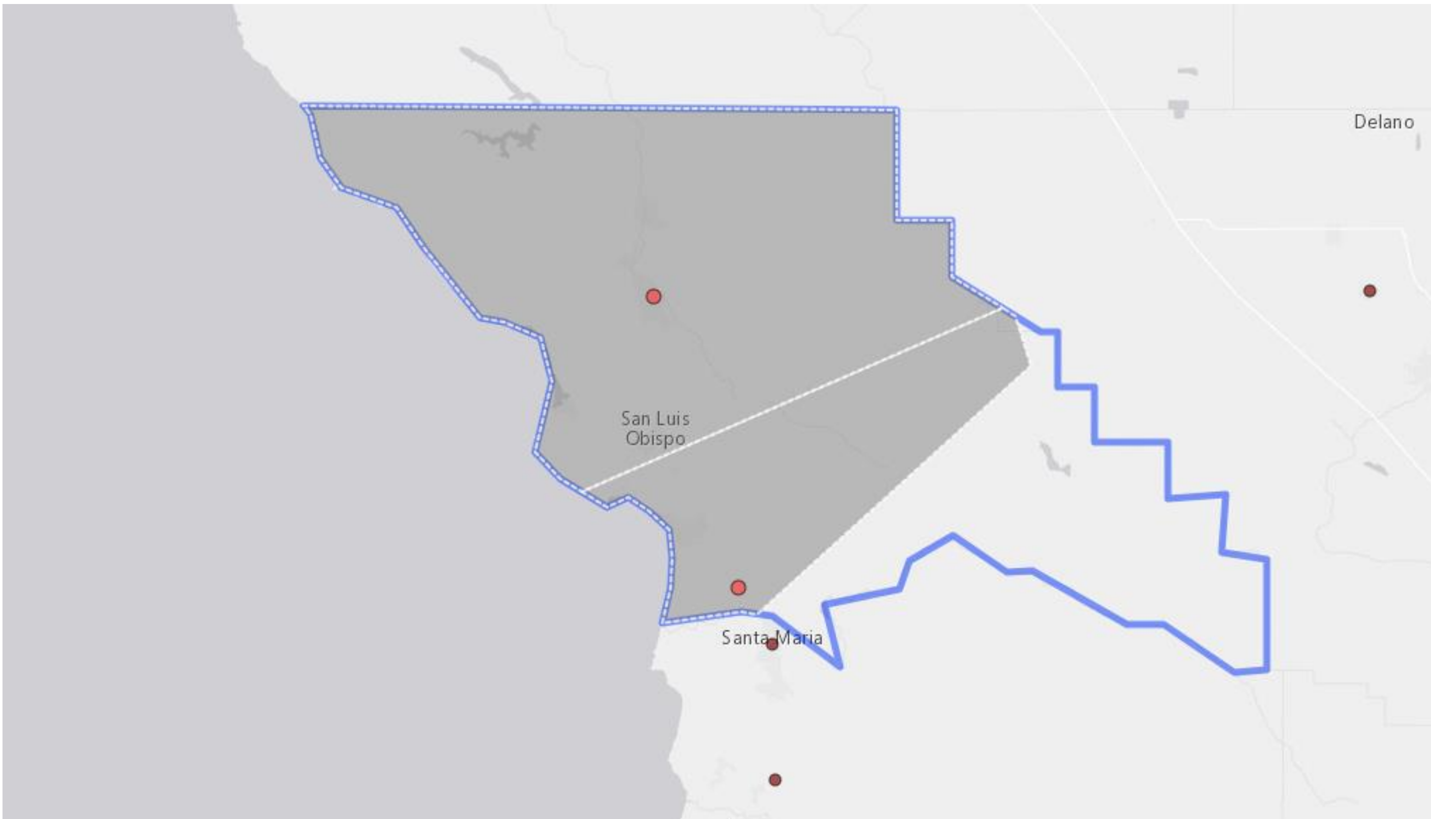
Figure 13: Area Served Plot and Demographic Data for $PM_{2.5}$ Monitors in San Luis Obispo County



AQS Site ID	Site Name	Pollutants	Area (km^2)	Total Population	Caucasian/White	African/Black	Native Amer	Asian	Pacific Islander	Other Race	Multiple Races	Hispanic/Latino
60790005	Paso Robles	Ozone, PM10	2562	49131	39559	830	565	762	71	5544	1800	14479
60792004	Mesa2	SO2, PM10, PM2.5	168	8954	7598	78	82	265	8	588	335	1756
60794002	Nipomo Regional Park (NRP)	NO2, Ozone, PM10	971	20855	16193	178	242	497	35	2818	892	6877
60792006	San Luis Obispo	Ozone, PM10, PM2.5	610	91095	75755	3358	586	4398	112	3676	3210	13217
60792007	Arroyo Grande CDF	PM10, PM2.5	35	38583	30580	368	445	1323	56	3962	1849	10140
60798002	Atascadero	NO2, Ozone, PM10, PM2.5	1313	50681	43928	694	507	1093	94	2651	1714	8088
60799001	Oso Flaco Site	PM10	NA									

AQS Site ID	Site Name	Male	Female	Age 0 to 9	Age 10 to 19	Age 20 to 29	Age 30 to 39	Age 40 to 49	Age 50 to 59	Age 60 to 69	Age 70 to 79	Age 80 and over
60790005	Paso Robles	24231	24900	6840	6777	6125	5914	6762	7228	4960	2658	1867
60792004	Mesa2	4427	4527	810	990	719	793	1069	1577	1668	876	452
60794002	Nipomo Regional Park (NRP)	10345	10510	2731	3140	2375	2307	2853	3323	2138	1216	772
60792006	San Luis Obispo	49819	41276	5737	12903	23686	8818	10094	11847	8720	4777	4513
60792007	Arroyo Grande CDF	18833	19750	4488	4949	4917	4586	5163	5916	4100	2520	1944
60798002	Atascadero	25259	25422	5580	6091	5997	5626	6915	8776	6143	3145	2408
60799001	Oso Flaco Site											

Figure 14: Area Served Plot and Demographic Data for PM_{10} Monitors in San Luis Obispo County



Site Name	Pollutants	Area (km^2)	Total Population	Caucasian/White	African/Black	Native American	Asian	Pacific Islander	Other Race	Multiple Races	Hispanic/Latino	Multiple Races	Hispanic/Latino
Nipomo Regional Park (NRP)	NO2, Ozone, PM10	1226	79653	64572	706	815	2437	117	7610	3396	19811	3396	19811
Atascadero	NO2, Ozone, PM10, PM2.5	4433	179646	149041	4800	1612	5901	259	11629	6404	34746	6404	34746

Site Name	Male	Female	Age 0 to 9	Age 10 to 19	Age 20 to 29	Age 30 to 39	Age 40 to 49	Age 50 to 59	Age 60 to 69	Age 70 to 79	Age 80 and over
Nipomo Regional Park (NRP)	39059	40594	8952	10311	9242	8703	10630	12861	9460	5594	3900
Atascadero	93855	85791	17234	24539	34577	19341	22226	25806	18269	9598	8056

Figure 15: Area Served Plot and Demographic Data for NO_2 Monitors in San Luis Obispo County

5.0 SITUATIONAL ANALYSIS

This section examines the network taking into account research, policy and resource needs.

5.1 Risk of Future NAAQS Exceedances

The exceedance probability surface maps presented above (Figures 8-11) show that Eastern San Luis Obispo County is most at risk for exceeding the current NAAQS standard for ozone; this result agrees with historical monitoring data. The $PM_{2.5}$ map also suggests that there is significant risk for exceeding the $PM_{2.5}$ 24-hr standard in this region, while predicting only a low exceedance probability for the Nipomo Mesa, a prediction that is contrary to the historical data.

Eastern San Luis Obispo County is sparsely populated, but the District operates two monitoring stations in this region to study the transport of pollutants from outside of the county. Back trajectory analysis of recent exceedances of the ozone NAAQS has demonstrated that ozone-laden air enters this part of the county from the San Joaquin Valley to the east. This is the only region of the county where ozone concentrations routinely exceed federal standards. $PM_{2.5}$ has never been measured in this region, but it is possible that under transport conditions some parts of this area could experience exceedances of the $PM_{2.5}$ NAAQS standard.

On the Nipomo Mesa, the state PM_{10} standard is exceeded frequently during blowing dust events, and the federal PM_{10} standard is exceeded occasionally. The Nipomo Mesa is downwind of a significant source of wind-blown particulate in the ODSVRA. The District is currently working with the California Department of Parks and Recreation to find ways to mitigate emissions from the ODSVRA. During blowing dust events, there is a significant amount of particulates in the $PM_{2.5}$ fraction, and during the most extreme events, $PM_{2.5}$ concentrations approach and occasionally exceed the 24-hour NAAQS standard at CDF and Mesa2. Additionally, the CDF annual $PM_{2.5}$ average for the period 2015-2019 may exceed the annual NAAQS standard. Until this source can be mitigated, the District maintains four monitoring locations at CDF, NRP, OFS and MESA2 that all measure particulate emissions. Wildfires and stagnant conditions can result in elevated $PM_{2.5}$ levels at all monitors in the county, though only rarely do such conditions result in exceedances of the NAAQS.

5.2 Criteria Allowing Reduction of Monitors

Requests to the EPA Regional Administrator to allow shut-down of criteria pollutant monitors are considered on a case by case basis, however 40CFR58.14(c)(1) provides guidance on what conditions would likely result in approval for shut-down of a criteria pollutant monitor. These conditions are described in the referenced CFR below:

40 CFR 58.14(c)(1):
Any $PM_{2.5}$, O_3, CO, PM_{10}, SO_2, Pb, or NO_2 SLAMS monitor which has shown attainment during the previous five years, that has a probability of less than 10 percent of exceeding 80 percent of the applicable NAAQS during the next three years based on the levels, trends, and variability observed in the past, and which is not specifically required by an attainment plan or maintenance plan. In a non-attainment or maintenance area, if the most recent attainment or maintenance plan adopted by the State and approved by EPA contains a contingency measure to be triggered by an air quality concentration and the monitor to be

discontinued is the only SLAMS monitor operating in the non-attainment or maintenance area, the monitor may not be discontinued.

Statistical tests to determine what monitors in San Luis Obispo County have a probability of less than 10% of exceeding 80% of NAAQS were calculated and presented below in Table 7. Based on the results of the statistical tests, the following monitors would likely not be approved for shutdown by the EPA Regional Administrator due to failing to meet the requirements in 40CFR58.14(c)(1).

Ozone Monitors Not Meeting 40CFR58.14(c)(1)

1. Nipomo Regional Park
2. Atascadero
3. Paso Robles
4. Red Hills
5. Carrizo Plain
6. San Luis Obispo

PM_{10} Monitors Not Meeting 40CFR58.14(c)(1)

1. CDF
2. Mesa2
3. Nipomo Regional Park

PM_{10} Monitors with Insufficient Data to Shut Down

1. San Luis Obispo

$PM_{2.5}$ Monitors Not Meeting 40CFR58.14(c)(1)

1. CDF

For the analysis of NO_2, Morro Bay monitoring was discontinued in 2017, and thus not included in the table. San Luis Obispo had $PM_{2.5}$ data missing from 2015-2016 due to safety issues and did not meet data completeness requirements. Data from San Luis Obispo is included but does not fully represent annual measurements.

Table 7 – Calculations of 90% Confidence of Not Measuring > 80% of NAAQS

8 Hour Ozone NAAQS

Site	Year 1 Design Value (ug/m3) 2015	Year 2 Design Value (ug/m3) 2016	Year 3 Design Value (ug/m3) 2017	Year 4 Design Value (ug/m3) 2018	Year 5 Design Value (ug/m3) 2019	Average Design Value (ug/m3) 2015-2019	Std. Dev. *s*	Student's *t* value (90% confidence)	Number of Data Values (*n*)	90% Upper CI (ug/m3)	80% NAAQS (ug/m3)	Test
60790005 Paso Robles	61	62	64	64	64	*63.00*	*1.41*	*2.13*	5	*64.3*	56	FAIL
60794002 Nipomo Regional Park (NRP)	60	62	60	58	56	*59.20*	*2.28*	*2.13*	5	*61.4*	56	FAIL
60793001 Morro Bay	54	55	52	51	51	*52.60*	*1.82*	*2.13*	5	*54.3*	56	PASS
60792006 San Luis Obispo	56	57	56	55	55	*55.80*	*0.84*	*2.13*	5	*56.6*	56	FAIL
60798002 Atascadero	62	63	62	61	60	*61.60*	*1.14*	*2.13*	5	*62.7*	56	FAIL
60798005 Red Hills	73	73	72	72	70	*72.00*	*1.22*	*2.13*	5	*73.2*	56	FAIL
60798006 Carrizo Plains	67	68	69	69	68	*68.20*	*0.84*	*2.13*	5	*69.0*	56	FAIL

24-HOUR PM10 NAAQS

Site	Year 1 Max (ug/m3) 2015	Year 2 Max (ug/m3) 2016	Year 3 Max (ug/m3) 2017	Year 4 Max (ug/m3) 2018	Year 5 Max (ug/m3) 2019	Average Max (ug/m3) 2015-2019	Std. Dev. *s*	Student's *t* value (90% confidence)	Number of Data Values (*n*)	90% Upper CI (ug/m3)	80% NAAQS (ug/m3)	Test
60790005 Paso Robles	36	44	55	85	59	*55.80*	*18.67*	*2.13*	5	*73.6*	120	*PASS*
60792004 Mesa 2	122	111	109	126	136	*120.80*	*11.12*	*2.13*	5	*131.4*	120	*FAIL*
60794002 Nipomo Regional Park (NRP)	76	78	101	89	139	*96.60*	*25.72*	*2.13*	5	*121.1*	120	*FAIL*
60792006 San Luis Obispo	42	42	67	44	100	*59.00*	*25.24*	*2.13*	5	*83.0*	120	*PASS*
60792007 Arroyo Grande CDF	149	144	145	117	132	*137.40*	*13.05*	*2.13*	5	*149.8*	120	*FAIL*
60798002 Atascadero	92	56	67	54	98	*73.40*	*20.44*	*2.13*	5	*92.9*	120	*PASS*
60799001 Oso Flaco Site	59	62	97	56	133	*81.40*	*33.28*	*2.13*	5	*113.1*	120	*PASS*

ANNUAL PM2.5 NAAQS

Site	Year 1 Design Value (ug/m3) 2015	Year 2 Design Value (ug/m3) 2016	Year 3 Design Value (ug/m3) 2017	Year 4 Design Value (ug/m3) 2018	Year 5 Design Value (ug/m3) 2019	Average Design Value (ug/m3) 2015-2019	Std. Dev. *s*	Student's *t* value (90% confidence)	Number of Data Values (*n*)	90% Upper CI (ug/m3)	80% NAAQS (ug/m3)	Test
60792004 Mesa 2	9.5	8.3	7.9	7.5	7.9	*8.22*	*0.77*	*2.13*	5	*9.0*	9.6	PASS
60792006 San Luis Obispo	6.1	6.9	7.1	7.2	6.0	*6.66*	*0.57*	*2.13*	5	*7.2*	9.6	PASS
60792007 Arroyo Grande CDF	12.1	10.7	9.6	8.9	8.2	*9.90*	*1.54*	*2.13*	5	*11.4*	9.6	FAIL
60798002 Atascadero	9.5	8.3	7.9	7.5	7.9	*8.22*	*0.77*	*2.13*	5	*9.0*	9.6	PASS

24 Hour PM2.5 NAAQS

Site	Year 1 Design Value (ug/m3) 2015	Year 2 Design Value (ug/m3) 2016	Year 3 Design Value (ug/m3) 2017	Year 4 Design Value (ug/m3) 2018	Year 5 Design Value (ug/m3) 2019	Average Design Value (ug/m3) 2015-2019	Std. Dev. *s*	Student's *t* value (90% confidence)	Number of Data Values (*n*)	90% Upper CI (ug/m3)	80% NAAQS (ug/m3)	Test
60792004 Mesa 2	22	20	20	21	21	*20.80*	*0.84*	*2.13*	5	*21.6*	28	PASS
60792006 San Luis Obispo	14	15	17	17	15.0	*15.60*	*1.34*	*2.13*	5	*16.9*	28	PASS
60792007 Arroyo Grande CDF	28	26	24	24	25	*25.40*	*1.67*	*2.13*	5	*27.0*	28	PASS
60798002 Atascadero	21	20	20	20	18	*19.80*	*1.10*	*2.13*	5	*20.8*	28	PASS

1 Hour SO2 NAAQS

Site	Year 1 Design Value (ug/m3) 2015	Year 2 Design Value (ug/m3) 2016	Year 3 Design Value (ug/m3) 2017	Year 4 Design Value (ug/m3) 2018	Year 5 Design Value (ug/m3) 2019	Average Design Value (ug/m3) 2015-2019	Std. Dev. *s*	Student's *t* value (90% confidence)	Number of Data Values (*n*)	90% Upper CI (ug/m3)	80% NAAQS (ug/m3)	Test
60792004 Mesa 2	20	3	2	1	1	*5.40*	*8.20*	*2.13*	5	*13.2*	60	PASS

1 Hour NO2 NAAQS

Site	Year 1 Design Value (ug/m3) 2015	Year 2 Design Value (ug/m3) 2016	Year 3 Design Value (ug/m3) 2017	Year 4 Design Value (ug/m3) 2018	Year 5 Design Value (ug/m3) 2019	Average Design Value (ug/m3) 2015-2019	Std. Dev. *s*	Student's *t* value (90% confidence)	Number of Data Values (*n*)	90% Upper CI (ug/m3)	80% NAAQS (ug/m3)	Test
60794002 Nipomo Regional Park (NRP)	26	22	21	21	20	*22.00*	*2.35*	*2.13*	5	*24.2*	80	PASS
60798002 Atascadero	30	28	29	30	30	*29.40*	*0.89*	*2.13*	5	*30.3*	80	PASS

5.3 Demographic Shifts

San Luis Obispo County is experiencing population growth, with most of this growth occurring in two areas: Paso Robles/Templeton and the Nipomo Mesa. Both of these fast-growing areas have an adequate complement of monitors for ozone, PM_{10} and $PM_{2.5}$, which are the pollutants of greatest concern. With a county population of 283,111 in 2019, population growth over the next 10 years would need to exceed all reasonable estimates before the current network would no longer meet Federal minimum monitoring requirements. For example, per 40 CFR 58 Appendix D, a near-road NO_2 monitor would not be required until county population reached 500,000; additional PM_{10} monitors would not be required until population exceeded 1 million. See the District's 2020 Ambient Air Monitoring Network Plan for further details.

5.4 Scientific Research and Public Health

The Atascadero monitoring station has historical importance as a research site. The station has hosted a variety of special instrumentation and has played an important role in epidemiological and other studies.

The Paso Robles site is the northernmost station in San Luis Obispo County. It has been used for EBAM location during local wildfires. This site has proven to be a benefit for this measurement, and for the collection of valuable ozone data for the northern inland population.

The particulate monitoring network on the Nipomo Mesa has been expanded in recent years to address the public health risk from particulate emissions upwind at the ODSVRA. The network may be modified to meet the needs of air quality surveillance as we move forward with mitigating impacts from the State Park. Special monitoring studies have been performed in the area to better understand the relationship between natural impacts of wind-blown dust and impacts of off-road vehicle use as well as a study to map the plume of emissions from the dunes to better understand the level of impact on the downwind communities.

5.5 Other Circumstances

The San Luis Obispo and Paso Robles monitoring stations are operated by CARB. Although they are included in this assessment, they are not under the District's authority and may not be readily modified by the results of this analysis. We expect that CARB is performing its own network assessment which will address the technical aspects related to its stations. Also note that the CDF and Oso Flaco monitoring stations are being used by the California Department of Parks and Recreation to fulfill some of their requirements under local Rule 1001, and because of this, the District receives funding from them to operate these stations. Likewise, operation of the Mesa2 station is funded in part by the Santa Maria Refinery.

6.0 DISCUSSION AND CONCLUSIONS

The 2020 Annual Network Plan for San Luis Obispo County demonstrates that the air monitoring network in the county meets the minimum monitoring requirements specified in federal regulations (40 CFR 58). The various analyses performed in this Network Assessment indicate that all monitors add value to the network and are necessary to adequately characterize air quality in the county. Furthermore, the network is anticipated to remain adequate as county population increases. As such, no network modifications are proposed at this time.

Nonetheless, if federal regulations, local priorities, emission sources, and/or District resources change significantly, network modifications may become necessary. For example, while the analysis of the probability of exceeding the NAAQS has its limitations, it does reveal a significant probability of exceeding the 24-hr $PM_{2.5}$ standard in Eastern San Luis Obispo County. Therefore, should resources become available, adding a $PM_{2.5}$ monitor to an existing East County site would be desirable.

In 2019, CARB informed the District of its intent to discontinue all operations at its San Luis Obispo SLAMS, which includes monitors for ozone, PM_{10}, $PM_{2.5}$, and meteorology. None of the monitors are needed for meeting the minimum monitoring requirements of 40 CFR 58 Appendix D, and per Table 7 the ozone monitor does not qualify for shutdown under 40 CFR 58.14. Particulate monitors at the site do qualify for shutdown under 40 CFR 58.14. CARB also informed the district of the possibility of discontinuing operations at the Paso Robles monitoring station. This station has consistently recorded high ozone concentrations, and among sites in the western attainment zone, it typically has the highest design value. It consistently has a design value higher than Atascadero, and the 3rd highest hour of PM_{10} concentration is ranked number 4 highest in the county. The station provides invaluable data for the residents of Paso Robles—the most populous city in North County--and the surrounding area.

Not captured in any of these analyses is monitoring intended for emergency response and public information in the event of an accident at Philips 66's Santa Maria Refinery. Particulates are already monitored at two nearby stations (CDF and Mesa2) and sulfur dioxide at one (Mesa2), but in the event of a catastrophic release and to fulfill requirements of California Assembly Bill 1647, the District and the Phillips 66 Santa Maria Refinery plan to establish a refinery-related community/fence-line monitoring network near the refinery. The network will consist of new monitors for oxides of nitrogen, SO_2, black carbon, and non-methane volatile organic compounds at the existing Mesa2 and CDF monitoring stations. The new monitors will be funded and operated by the refinery and their data will be made publicly available in real-time. At this time, it is undetermined whether the new monitors will formally become part of the local SLAMS network or whether the data be added to AQS. Since 2015, hydrogen sulfide monitoring is conducted for the residential area near the Price Canyon Oilfield; permit conditions make this the responsibility of the oilfield rather than the District. Odor complaints are already common in this area; with oil production increasing and proposals for new housing developments nearby, the potential for exposure to hydrogen sulfide is increasing.

Wind-blown dust from the ODSVRA remains the largest air pollution challenge in the county. As discussed in the 2020 Annual Network Plan, available evidence suggests the CDF monitor is optimally sited to characterize maximum ambient particulate levels downwind of the ODSVRA.

Newly installed particulate matter mitigations (or mitigations installed in the future) could change this. For example, it is possible the mitigations could selectively reduce particulate levels at CDF to such a degree that other areas would then experience higher particulate levels. This could necessitate establishing a new monitor in the new area of greatest impact.

It would also be valuable to establish a particulate monitor *within* the most emissive part of ODSVRA to determine PM_{10} exposure experienced by park visitors. While such a monitor would likely not be considered NAAQS comparable, it would nonetheless be important for public information and could support research on emissions from the ODSVRA. Establishing such a monitor would of course require close cooperation with the California Department of Parks and Recreation.

Additional particulate monitors along the coast north of the ODSVRA might also be beneficial. PM_{10} monitors in Los Osos and/or Morro Bay could be useful for comparing emissions from other dune systems to those from the ODSVRA. $PM_{2.5}$ monitors in Morro Bay, Cayucos, and/or Cambria could be useful for evaluating wood smoke impacts from residential wood burning and the transport of smoke from wildfires.

In response to AB 617 the SLOCAPCD has employed a network of "next gen" sensors within the county. The focus is to provide data to the public in a rapid manner to help give advance notice to members of the public with certain health vulnerabilities to avoid outdoor activities or take other precautions. Purple Air sensors have been deployed throughout the county, and $PM_{2.5}$ data can be viewed by the public at the purple air website: https://www2.purpleair.com/ . Along with Purple Air sensors, AirIQ AirVisual sensors have been deployed throughout the Oceano area in a combined effort with the SLOCAPCD and local communities. These sensors are not calibrated, and data from them is informational only, but the data collected helps members of the public to make wise health decisions on days when the air quality is less than healthy.

The analyses described above are also useful for prioritizing monitors to preserve in the event that changing priorities or funding levels necessitate shutting down currently active monitors. For example, only one NO_2 monitor is required for the county. Atascadero measures the highest NO_2 levels and concentrations there rarely approach even 50% of the 24-hr NAAQS. Therefore, the NRP monitor would be the better candidate for removal, if the need were to arise.

The analyses described above show the $PM_{2.5}$ monitor in San Luis Obispo currently measures the lowest concentrations in the county and has the lowest probability of exceeding the NAAQS. This monitor, however, is located in the most populated city in the county, so it serves vital public information goals. Finally, the only ozone monitor that qualifies for shutdown under 40 CFR 58.14(c)(1) is in Morro Bay.[5] Morro Bay has a low probability of exceeding the ozone NAAQS, even if it is revised to 65 ppb. The Morro Bay monitor, however, is extremely useful for monitoring long term trends. In addition, the air quality forecast zones associated with these monitors serve large portions of the county population beyond the boundaries of both cities (Fig. 12).

As identified above, a number of enhancements to the existing monitoring network could be implemented to provide increased area coverage and additional data for priority pollutants in

[5] Ozone levels are trending downward, but the ozone NAAQS is also likely to be revised downward, thus it is unlikely any additional sites would qualify for shutdown under 40 CFR 58.14(c)(1) in the foreseeable future.

specific areas. Sufficient funding and staffing resources, however, are not available to install and maintain such enhancements, and the current network meets the minimum requirements to adequately characterize community and regional air quality countywide. Thus, the potential enhancements cited above are not proposed for implementation.