ANNUAL AIR QUALITY REPORT | 2021

SLO COUNTY apcd | Air Pollution Control District
San Luis Obispo County

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2021 Annual Air Quality Report
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Executive Summary

Air quality improved substantially in 2021 relative to record breaking air quality impacts associated with the historic 2020 wildfire season. However, when considering the 5-year trend, 2021 data contributed to a slight degradation in our average ozone air quality:

- **Ozone** trends show marked improvement from 2020 levels, but a slight increase in both hours above 65 ppb (Figure 8) and exceedances of the ozone standard in comparison to 2019. Ozone standards were exceeded on 7 days in 2021, with both Red Hills and Carrizo Plains reporting 8-hour values over 70 parts per billion.
- **PM_{10}** on the Nipomo Mesa continued to show signs of improvement (Figures 10 – 12). The overall exceedance days decreased from both 2019 and 2020 levels showing continued air quality improvement. While conditions at CDF have improved more than at Mesa2, both sites saw a general decrease in the number of days exceeding the state 24-hour PM_{10} standard of 50 $\mu g/m^3$. Also, Oso Flaco days of exceedances decreased from 2019 and 2020.
- **$PM_{2.5}$** annual averages decreased at all sites (Figure 13), including those on the Nipomo Mesa, with no exceedances of any $PM_{2.5}$ standards (Table 4).

Smoke from wildfires and pollution transport from the San Joaquin Valley had some impacts on air quality in 2021. The San Luis Obispo County Air Pollution Control District (APCD) issued a press release on October 28th warning the public of elevated ozone and/or particulate levels related to wildfires. All but one exceedance of the ozone standard occurred between August 27th and September 6th, when the Caldor fire effects slowly migrated through the Central Valley and into eastern San Luis Obispo County. An exceedance on October 2nd was related to the transport of smoke and pollution from two fires burning in Tulare County, the KNP Complex and Windy fire.

Throughout August and September, the city of Atascadero constructed pickleball courts directly adjacent to the Atascadero monitoring station. Four of the PM_{10} exceedance days were directly related to dust from the construction of the courts, and only measured by the Atascadero monitoring station.

South County air quality continues to be impacted by dust blown from the Oceano Dunes State Vehicle Recreation Area (ODSVRA). While the federal PM_{10} standard was not exceeded anywhere in 2021, the more stringent state standard was exceeded on 50 days on the Nipomo Mesa, and most of these exceedances were due to windblown dust. In addition, the Rule 1001 performance standard was violated 31 times. This is an improvement over the previous year when Rule 1001 was violated 35 times.

There were no exceedances of the standards for nitrogen dioxide or sulfur dioxide at any stations this year.

Appendix A presents an analysis of the effects of the ODSVRA dust controls on downwind PM_{10} concentrations. Using the same methodology as in previous Annual Air Quality Reports, the APCD estimates that in 2021, the ODSVRA dust controls yielded a 33.5% decrease in event-day PM_{10} at CDF compared to the baseline year of 2017. The median wind event day PM_{10} at CDF was 52 $\mu g/m^3$ in 2021; this analysis predicts it would have been 77 $\mu g/m^3$ if these dust control projects had not been implemented.

Appendix B presents an “infographic” summarizing the main points from this annual report.

The air quality database for San Luis Obispo County is a public record and is available from the APCD office in various forms, including comprehensive records of all hourly or other sample values acquired anywhere in the county. Data summaries are published in Annual Air Quality Reports, like this one. Summary data appear weekly in the Saturday edition of The Tribune, a local newspaper. Ambient monitoring data is added to separate archives maintained by EPA and CARB. Summary data from San Luis Obispo County can be found in EPA and CARB publications and on the world wide web at the following websites:

www.slocleanair.org
APCD website
www.arb.ca.gov
CARB website
www.epa.gov
US EPA website
www.airnow.gov
Air Quality Index site

Air Quality Monitoring and Data

Air quality in San Luis Obispo County was measured by a network of 11 permanent ambient air monitoring stations in 2021; their locations are depicted in Figure 1. The San Luis Obispo County Air Pollution Control District (APCD) owned and operated seven permanent stations: Nipomo Regional Park (NRP), Morro Bay, Atascadero, Red Hills, Carrizo Plain, San Luis Obispo – Roberto Ct. (beginning January 2021), and the CDF fire station on the Nipomo Mesa. The California Air Resources Board (CARB) operated stations in San Luis Obispo and Paso Robles. Two stations are owned by third parties but operated by the APCD: Mesa2, located on the Nipomo Mesa and owned by the Phillips 66 refinery, and Oso Flaco, located within the ODSVRA and owned by the California Department of Parks and Recreation. See Table 2 for a summary of the pollutants monitored at each station.

The CARB-operated San Luis Obispo – Higuera St. station was shut down and monitoring discontinued in early January 2021. The APCD began operating the San Luis Obispo – Roberto Ct. station as a replacement on January 1, 2021 with PM_{10} and $PM_{2.5}$ monitoring. Ozone monitoring was not continued at this location due to associated costs and representative ozone concentrations continuing to be monitored in Morro Bay and Nipomo Regional Park provide data that is highly representative of the region.

The APCD prepares an *Ambient Air Monitoring Network Plan* every year. This document is an evaluation of the network of air pollution monitoring stations in the county. The annual review is required by 40 CFR 58.10 and helps ensure continued consistency with the monitoring objectives defined in federal regulations. Each report is a directory of existing and proposed monitors in the county network and serves as a progress report on the recommendations and issues raised in earlier network reviews. They are available online at http://www.slocleanair.org/airquality/monitoringstations.php.

Air quality monitoring is subject to rigorous federal and state quality assurance and quality control requirements, and equipment and data are audited periodically to ensure data validity. Gaseous pollutant levels are measured every few seconds and averaged to yield hourly values. Particulate matter ($PM_{2.5}$ and PM_{10}) is sampled hourly. All monitoring instruments are Environmental Protection Agency (EPA)-approved Federal Equivalent Methods (FEMs) or Federal Reference Methods (FRMs).

The 2021 data reviewed in this report were extracted from the EPA's Air Quality System (AQS) database. Prior to being uploaded to AQS, all data were thoroughly reviewed and validated by the collecting agency (i.e., CARB for data from Paso Robles and San Luis Obispo and the APCD for all other sites). The raw data and computer code used to compile the statistics and generate the graphs in this report are available upon request.

Figure 1: Map of Monitoring Stations in San Luis Obispo County

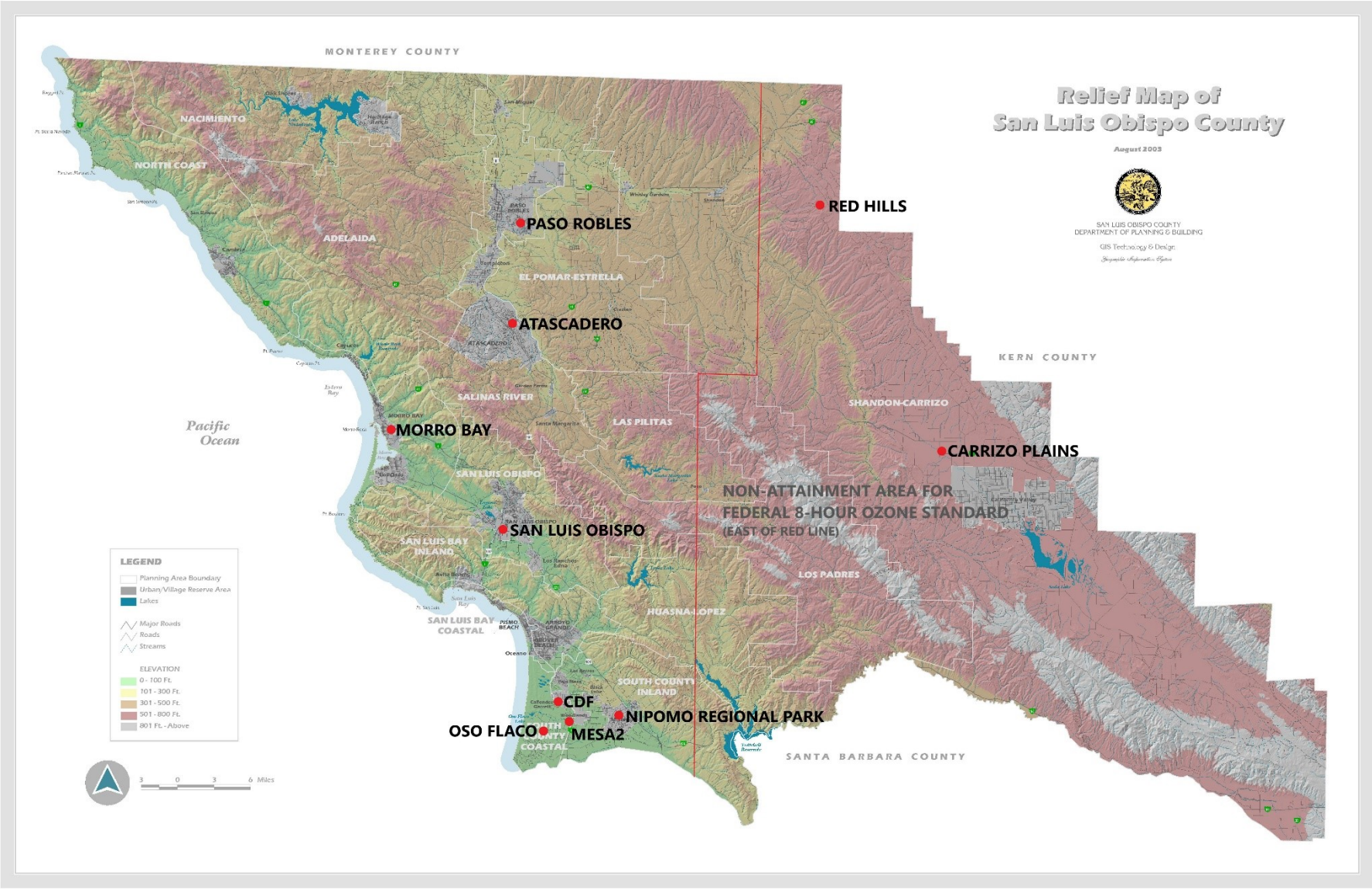

Table 1: Ambient Air Quality Parameters Monitored in San Luis Obispo County in 2021

	O_3	NO	NO_2	NO_x	SO_2	PM_{10}	$PM_{2.5}$	WS	WD	ATM
APCD Permanent Stations										
Atascadero	X	X	X	X		X	X	X	X	X
Morro Bay	X							X	X	
Nipomo Regional Park	X	X	X	X		X		X	X	X
Red Hills	X							X	X	X
Carrizo Plain	X							X	X	X
CDF						X	X	X	X	
San Luis Obispo (Roberto Ct.)						X	X			
CARB Stations										
San Luis Obispo*	X					X	X	X	X	X
Paso Robles	X					X		X	X	X
Operated by APCD										
Mesa2					X	X	X	X	X	X
Oso Flaco						X		X	X	X

*San Luis Obispo- Higuera St. was shut down January 2021

Abbreviations and Chemical Formulas:

NO	Nitric Oxide	SO_2	Sulfur Dioxide	PM_{10}	Particulates < 10 microns	WS	Wind Speed
NO_2	Nitrogen Dioxide	O_3	Ozone	$PM_{2.5}$	Particulates < 2.5 microns	WD	Wind Direction
NO_x	Oxides of Nitrogen					ATM	Ambient Temp

Ambient Air Pollutants Of Local Concern

Ozone

Ozone (O_3) is a gas that is naturally found near the earth's surface at low concentrations, typically 10 to 40 parts per billion (ppb). It is also a principal component of photochemical smog, produced when precursor pollutants such as volatile organic compounds and nitrogen oxides react under the influence of sunlight. Ozone precursors are emitted by many human activities, but industrial processes and motor vehicles are primary sources. The chemistry of atmospheric ozone is complex, and in the absence of sunlight, ozone is destroyed by reaction with the same precursor molecules that fuel its formation during the day. As a result, ozone concentrations typically increase as sunlight intensity increases, peaking midday or in the afternoon and gradually declining from there, typically reaching their lowest levels in the early morning hours and just before sunrise, as shown in Figure 2, below.

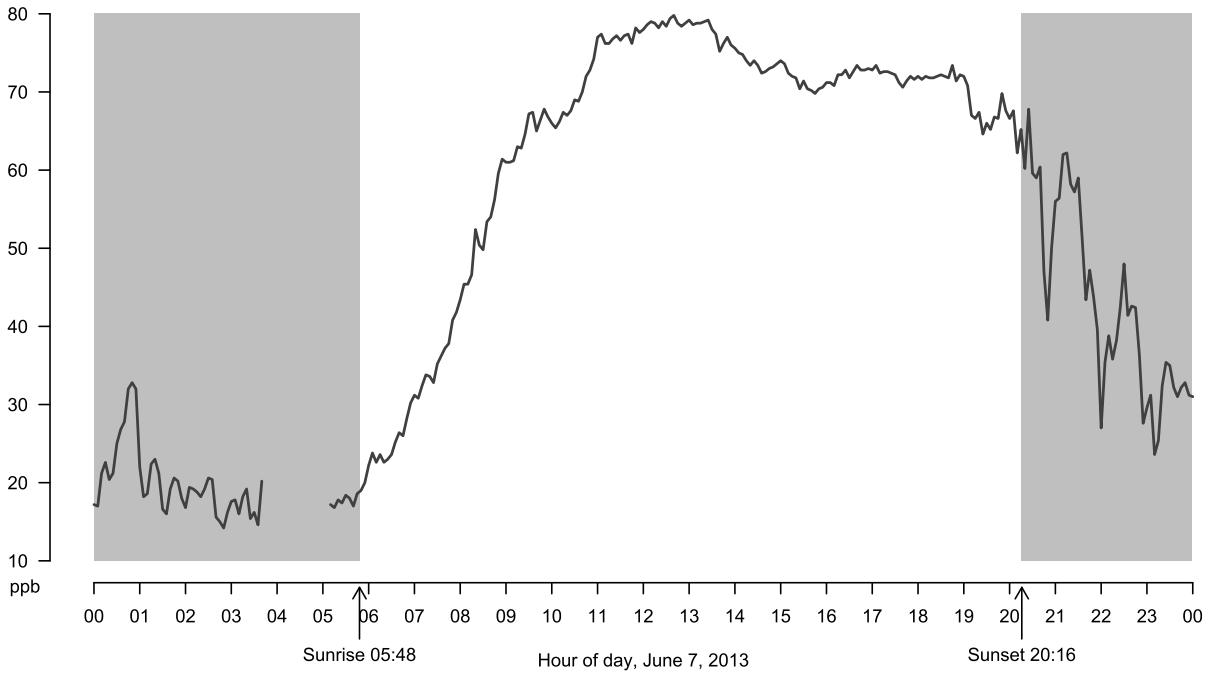

Figure 2: Example of Diurnal Ozone Pattern from Carrizo Plain

As a pollutant, ozone is a strong oxidant gas that attacks plant and animal tissues. It can cause impaired breathing and reduced lung capacity, especially among children, athletes, and persons with compromised respiratory systems; it can also cause significant crop and forest damage. Ozone is a pollutant of particular concern in California where geography, climate, and emissions from industrial and commercial sources and millions of vehicles contribute to frequent violations of health-based air quality standards.

While ground level ozone is harmful to plants and animals and is considered a pollutant, upper level (stratospheric) ozone occurs naturally and protects the earth from harmful ultra-violet energy from the sun.

Particulate Matter

Ambient air quality standards have been established for two classes of particulate matter: PM_{10} (inhalable particulate matter less than 10 microns in aerodynamic diameter), and $PM_{2.5}$ (fine particulate matter 2.5 microns or less in aerodynamic diameter). Both consist of many different types of particles that vary in

their composition and toxicity. $PM_{2.5}$ tends to be a greater health risk since these particles can get lodged deep in the lungs or enter the blood stream, causing both short and long-term damage. Sources of particulate pollution include diesel exhaust; mineral extraction and production; combustion products from industry and motor vehicles; smoke from open burning; paved and unpaved roads; condensation of gaseous pollutants into liquid or solid particles; and windblown dust from soils disturbed by demolition and construction, agricultural operations, off-road vehicle recreation, and other activities.

In addition to its harmful health effects, particulate matter can also greatly reduce visibility.

Nitrogen Dioxide, **Sulfur Dioxide**, **and Carbon Monoxide**

Nitrogen dioxide (NO_2) is the brownish-colored component of smog. NO_2 irritates the eyes, nose and throat and can damage lung tissue. Sulfur dioxide (SO_2) is a colorless gas with health effects similar to NO_2. Both pollutants are generated by fossil fuel combustion from mobile sources such as vehicles, ships, and aircraft and at stationary sources such as industry facilities, homes, and businesses. SO_2 is also emitted by petroleum production and refining operations. These pollutants can create aerosols, which may fall as acid rain causing damage to crops, forests, and lakes. They can also exacerbate asthma and harm the human respiratory system.

Carbon monoxide (CO) is a colorless and odorless gas that can interfere with the ability of red blood cells to transport oxygen. Exposure to CO can cause headaches, fatigue, and even death. CO results from fuel combustion of all types, but motor vehicles are by far the chief contributor of CO in outdoor air.

State and National Ambient Air Quality Standards

CARB and the EPA have adopted ambient air quality standards for six common air pollutants of primary public health concern: ozone, particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide, sulfur dioxide, carbon monoxide, and lead.[1] These are called "criteria pollutants" because the standards establish permissible airborne pollutant levels based on criteria developed after careful review of medical and scientific studies of the effects of each pollutant on public health and welfare.

The National Ambient Air Quality Standards (NAAQS; see Table 2) are used by EPA to designate a region as either "attainment" or "nonattainment" for each criteria pollutant. A nonattainment designation can trigger additional regulations aimed at reducing pollution levels and bringing the region into attainment. For most pollutants, the NAAQS allow a standard to be exceeded a certain number of times each calendar year without resulting in a nonattainment designation. Additionally, exceedances caused by exceptional events (see below) may be excluded from attainment/nonattainment determinations at the discretion of the EPA.

In May 2012, the EPA designated the eastern portion of San Luis Obispo County as marginally nonattainment for the 8-hour ozone standard. This was based on data from enhanced monitoring over the previous decade that revealed previously unrecognized high ozone levels in that region; the western portion of the county retained its attainment status. (See the red line in Figure 1 for the boundary between the attainment and nonattainment areas.) In October 2015, the ozone standard was lowered from 75 to 70 ppb, and in April 2018, the EPA designated the eastern portion of the county as a "Marginal" nonattainment zone for the new standard. Based on the EPA review of data, which included an exceptional events coding being applied to Ozone data during the 2018, and 2020 wildfire events, the county was found to be meeting the NAAQS design value of 70 ppb by the prescribed date. This finding, published on October 20, 2022 by EPA in the Federal Registry notice titled "Determinations of Attainment by the Attainment Date, California Areas Classified as Serious for the 2008 Ozone National Ambient Air Quality Standards and Marginal for the 2015 Ozone National Ambient Air Quality Standards." This notice shows the county will not be redesignated as "Moderate" at this time. Instead, the county will remain "Marginal", and the EPA will address the area in another action. The county is currently designated as attaining all other NAAQS.

The California Ambient Air Quality Standards are generally more restrictive (i.e., lower) than the NAAQS, and typically are specified as not to be exceeded. Thus, a single exceedance is a violation of the applicable standard and triggers a nonattainment designation. As a result, San Luis Obispo County is designated as a nonattainment area for the state 1-hour and 8-hour ozone standards, as well as the state 24-hour and annual PM_{10} standards. The county is designated as attaining the state annual $PM_{2.5}$ standard.

State and federal standards for NO_2 have never been exceeded here. The state standard for SO_2 was exceeded periodically on the Nipomo Mesa until 1993. Equipment and processes at the facilities responsible for the emissions were upgraded as a result, and the state SO_2 standard has not been exceeded since that time. The federal SO_2 standard has only been exceeded once, in 2013, when maintenance activities at these facilities resulted in emissions exceeding the 1-hour standard of 75 ppb. (This standard was established in 2011.) State CO standards have not been exceeded in the county since 1975. The county has never been required to conduct lead monitoring.

[1] In addition to these six pollutants, California also has standards for hydrogen sulfide, sulfate, vinyl chloride, and visibility reducing particles.

Exceptional Events

Exceptional events are unusual or naturally occurring events that can affect air quality but are not reasonably controllable or preventable and are unlikely to reoccur at a particular location. Examples include wildfires and tornadoes. Air quality monitoring data influenced by exceptional events can sometimes be excluded from regulatory determinations related to violations of the NAAQS (e.g., exclusion of some east county ozone data in 2018 and 2020 due to wildfires), if recommended by the APCD and CARB and approved by the EPA. The EPA will only consider exceptional event demonstrations if they have implications for an upcoming attainment determination. The APCD has not submitted any exceptional event documentation for 2021. Between August 27 and September 6, 2021, as well as, October 2, 2021 ozone exceedance days were likely influenced by wildfire smoke. An exceptional event demonstration could be prepared if a future determination of ozone attainment is dependent on these exceedances.

Table 2: Ambient Air Quality Standards for 2021 and Attainment Status*

A standard exceedance *occurs when a measured pollutant concentration exceeds (or in some cases, equals) the applicable standard prescribed by state or federal agencies. It does not necessarily constitute a violation.*

A standard violation *may occur following a single or cumulative series of standard exceedances. Criteria constituting a violation are unique for each pollutant.*

A nonattainment designation *occurs when a state or federal agency formally declares an area in violation of a standard. Typically, CARB performs designations annually. Several years often pass between EPA designations.*

	Averaging Time	California Standard†	National Standard†
Ozone (O_3)	8 Hours	**70 ppb**	**70 ppb**
	1 Hour	**90 ppb**	
Respirable Particulate Matter (PM_{10})	24 Hours	**50 μg/m³**	150 μg/m³
	1 Year‡	**20 μg/m³**	
Fine Particulate Matter ($PM_{2.5}$)	24 Hours		35 μg/m³
	1 Year‡	12 μg/m³	12 μg/m³
Carbon Monoxide (CO)	8 Hours	9.0 ppm	9 ppm
	1 Hours	20 ppm	35 ppm
Nitrogen Dioxide (NO_2)	1 Year‡	30 ppb	53 ppb
	1 Hour	180 ppb	100 ppb
Sulfur Dioxide (SO_2)	3 Hours		500 ppb (secondary)
	1 Hour	250 ppb	75 ppb (primary)
Lead (Pb)	3 Month		0.15 μg/m³
	30 Day	1.5 μg/m³	

* San Luis Obispo County (in whole or in part) is designated as nonattainment for the standards in **boldface print** as of September 2022.

† For clarity, the ozone, SO_2, and NO_2 standards are expressed in parts per billion (ppb), however most of these standards were promulgated in parts per million (ppm). When comparing to the national PM_{10} and $PM_{2.5}$ standards, federal regulations state that measurements shall be rounded to the nearest 10 μg/m³ and 1μg/m³, respectively. Thus, for PM_{10}, 24-hour averages between 150 and 154 μg/m³ are not considered exceedances of the standard, even though they are greater (or equal to) 150 μg/m³.

‡ This standard is calculated as a weighted annual arithmetic mean.

Ozone and Gaseous Pollutant Summary

In 2021, exceedances of the 8-hour state and federal standard (70 ppb) occurred on 7 days at the Red Hills monitoring station, and 4 days at the Carrizo Plains station. No other stations recorded exceedances of the standard, and the state 1-hour standard (90 ppb) was not exceeded anywhere this year. Ozone monitoring in San Luis Obispo ended in January 2021 with the closure of the CARB operated SLO Higuera station and any data is excluded from the 2021 analysis. Standards for nitrogen dioxide and sulfur dioxide were not exceeded this year either.

Table 3 lists the highest hourly (and for ozone, 8-hour) values recorded in 2021 for ozone, sulfur dioxide, and nitrogen dioxide at the stations where they are monitored. Concentrations are in parts per billion (ppb). The sample date appears under each pollutant value in the format "month/day." Values that exceed federal standards are shown in **bold**, and those exceeding state standards are underlined.
All but one exceedance of the 8-hour federal standard occurred in late August and early September, when the Caldor fire was burning near Lake Tahoe along with other large wildfires burning across the northern half of the state. The Caldor fire smoke combined with smoke from other fires in the region began to deteriorate the air quality in the Central Valley on August 14th, and the eventual transport of smoke and pollution arrived in Eastern San Luis Obispo County in late August and lingered until September 6th. Two other fires that started in Tulare County, the KNP Complex, and Windy fire, began to push smoke and pollution into Eastern San Luis Obispo County on October 1st, and the following day both stations in Eastern San Luis Obispo County exceeded the standard.

Table 3: Highest Measurements for Gaseous Pollutants in 2021 (ppb)

Station	O_3 1-hour			O_3 8-hour				SO_2 1-hour			NO_2 1-hour		
	1st	2nd	3rd	1st	2nd	3rd	4th	1st	2nd	3rd	1st	2nd	3rd
Paso Robles	70 09/05	69 08/25	69 08/26	64 09/05	64 10/03	63 10/02	62 08/25						
Atascadero	72 08/26	72 09/05	70 10/03	64 10/03	63 09/05	62 08/26	59 04/01				44 09/07	30 11/29	30 11/29
Morro Bay	57 03/01	57 04/01	57 10/16	54 04/01	52 10/16	51 04/02	51 10/15						
Red Hills	84 08/28	80 10/02	77 08/29	**79** 08/28	**76** 08/27	**73** 08/29	**72** 09/04						
Carrizo Plain	80 08/27	79 09/05	78 08/28	**75** 08/27	**74** 08/29	**73** 09/05	**71** 08/28						
Nipomo Regional Park	63 10/04	61 10/03	60 04/01	55 04/01	55 10/16	53 10/15	52 10/04				22 10/01	19 10/04	18 11/27
Mesa2, Nipomo								4 06/12	3 05/25	2 01/05			

Note: The federal and state O_3 8-hour standard is 70 ppb.

Visual Ozone Summary

Figures 3 and 4 depict the ozone values from each station where it was monitored in 2021. The maximum 8-hour average for each day is shown for each site; exceedances of the 70-ppb standard are shown in red with the day of month printed beside them. The heavy "stair step" line marks the monthly median. The vertical axis extends to the annual maximum; units are ppb.

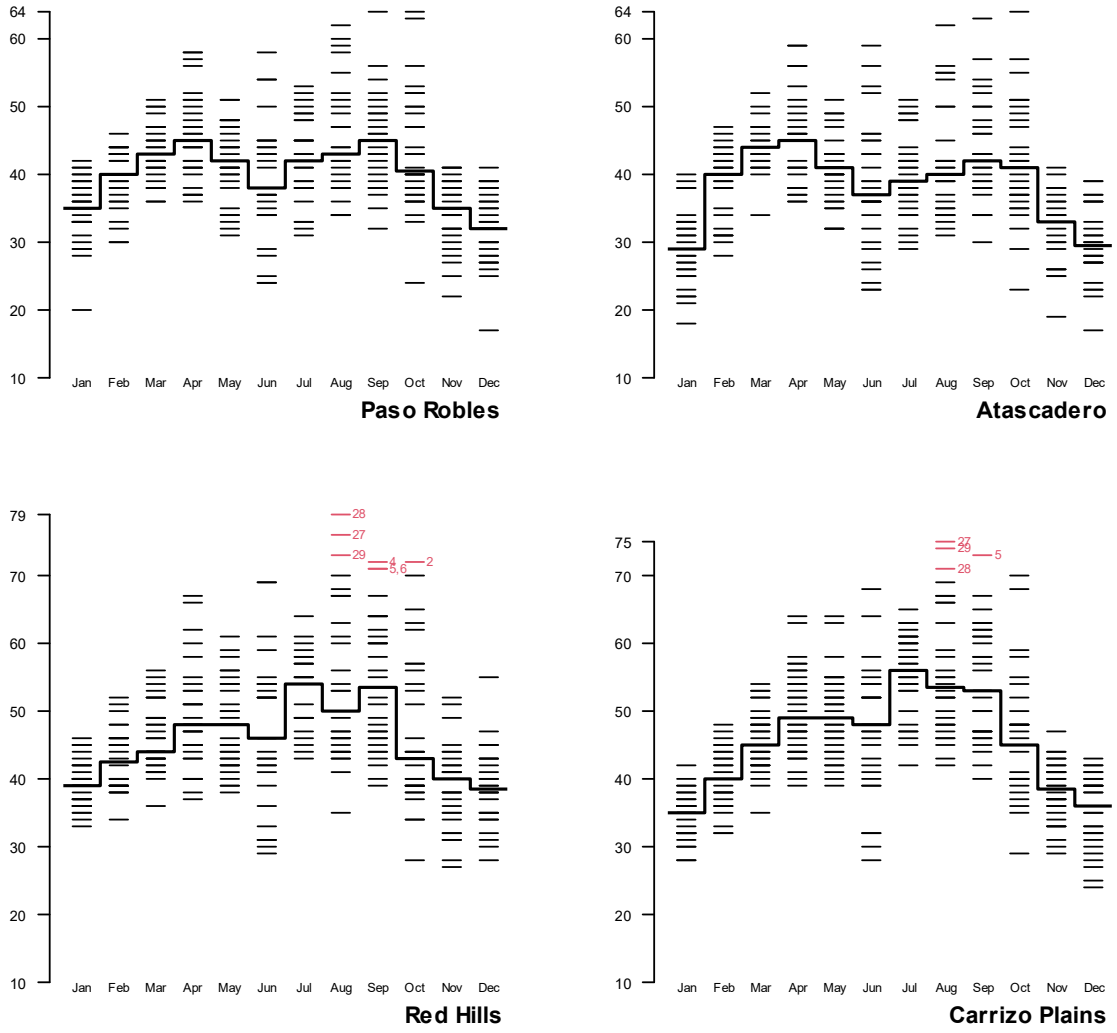

Figure 3: Daily Maximum 8-Hour Ozone Average for 2021 (ppb)

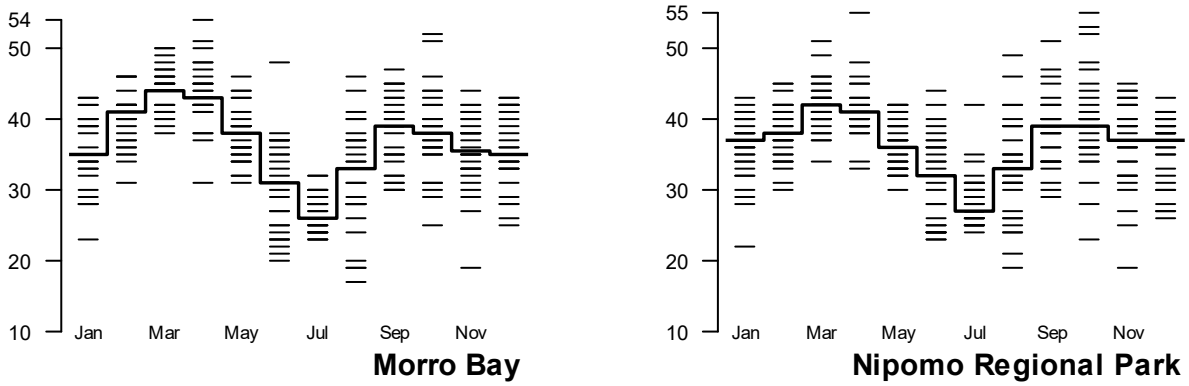

Figure 4: Daily Maximum 8-Hour Ozone Average for 2021 (ppb)

Particulate Matter Summary

In 2021, there were no exceedances of the federal 24-hour PM_{10} standard (150 $\mu g/m^3$) anywhere in the county. Exceedances of the California 24-hour PM_{10} standard (50 $\mu g/m^3$) were observed on 50 days: 38 days at CDF, 37 at Mesa2, 4 at NRP, 3 at Paso Robles, 5 at Oso Flaco, 5 at Atascadero, and 1 at San Luis Obispo.[2] This year, CDF, and Mesa2 exceeded the state annual average PM_{10} standard of 20 $\mu g/m^3$.

The San Luis Obispo (Higuera St.) station operated by CARB ceased operations in January of 2021. The APCD began operating the San Luis Obispo (Roberto Ct.) station at the start of January 2021 and all 2021 statistics and analysis is based on data from the new Roberto Ct. location while historical data prior to 2021 is associated with the Higuera St. location.

Local Rule 1001, which is intended to address windblown dust emissions and downwind air quality impacts from the Oceano Dunes State Vehicular Recreation Area (ODSVRA), states that the park operator "shall ensure that if the 24-hour average PM_{10} concentration at the [riding area] Monitor is more than 20% above the 24-hour average PM_{10} concentration at the Control Site Monitor, the 24-hour average PM_{10} concentration at the [riding area] Monitor shall not exceed 55 $\mu g/m^3$."[3] For determining compliance with this standard, the CDF and Oso Flaco monitors have been designated as the riding area and control site monitors, respectively. In 2021 there were 31 days that violated the Rule 1001 standard.

In 2021 no monitoring station in the county recorded exceedances of the federal 24-hour $PM_{2.5}$ standard (35 $\mu g/m^3$) or the federal and state annual average standards (both 12 $\mu g/m^3$).

Table 4 lists the highest 24-hour concentrations recorded in 2021 and the dates on which they occurred, as well as the annual averages for PM_{10} and $PM_{2.5}$. Concentrations are in $\mu g/m^3$. Values exceeding federal standards are shown in **bold**; those exceeding state standards are underlined.

Wind-blown dust from the San Joaquin Valley and the ODSVRA caused elevated PM_{10} and $PM_{2.5}$ this year. In general, elevated particulate levels at CDF, Mesa2, and Nipomo Regional Park are associated with windblown dust events from the ODSVRA, including this year's 2nd and 3rd highest 24-hour PM_{10} averages at Mesa 2, CDF, and Nipomo Regional Park.

October 11th saw a uniformly high 24-hour PM_{10} average at all monitors in the county. These elevated levels were associated with wind-blown dust from the San Joaquin Valley reaching San Luis Obispo County. This one-day transport event began on October 11th and dispersed by October 12th. This event was responsible for highest averages at the Paso Robles, CDF, Oso Flaco, and Mesa2 and the second highest at Atascadero.

[2] CARB and EPA apply different conventions to the handling of significant digits. The CARB website (https://www.arb.ca.gov/adam/topfour/topfour1.php) thus counts 41 exceedances of the state PM_{10} standard at CDF, 38 at Mesa2, 5 at Nipomo Regional Park, 3 at Paso Robles, 8 at Oso Flaco, 5 at Atascadero, and 1 at San Luis Obispo. The CARB database, which is populated in real time with raw data, may also contain values that were later invalidated. EPA data has been fully validated and as such is considered the data of record.

[3] San Luis Obispo County Air Pollution Control District, "RULE 1001 Coastal Dunes Dust Control Requirements," Adopted November 16, 2011, Revised by Court Order CV12-0013, March 7, 2016. Available online at https://ww3.arb.ca.gov/drdb/slo/cur.htm.

Table 4: PM_{10} and $PM_{2.5}$ Summary for 2021 ($\mu g/m^3$)

Station	Highest 24-hour PM_{10}			Annual Average PM_{10}‡	Highest 24-hour $PM_{2.5}$			Annual Average $PM_{2.5}$‡
	1st	2nd	3rd		1st	2nd	3rd	
Paso Robles	74 10/11	67 01/19	58 01/17	18.7				
Atascadero	66 08/16	62 10/11	56 09/07	16.2	19.1 11/30	18.8 01/01	18.1 01/15	6.67
San Luis Obispo* Roberto Ct.	53 01/19	44 06/17	44 10/11	16.0	17.2 05/09	16.6 06/17	16.2 09/04	5.93
CDF, Arroyo Grande	119 10/11	115 05/20	102 05/19	26.1	28.6 05/20	26.2 10/11	26.0 05/19	8.05
Nipomo Regional Park	67 06/16	54 05/19	54 06/17	19.2				
Oso Flaco	68 10/11	56 06/16	54 01/25	18.7				
Mesa2, Nipomo	110 10/11	109 06/15	106 05/20	24.7	27.0 06/15	21.5 10/11	21.1 05/19	6.53

‡ Weighted arithmetic mean as calculated by an AMP450 AQS report.

*San Luis Obispo (Roberto Ct.) began operation January 2021 and replaced the CARB operated San Luis Obispo (Higuera St.) which ceased operations in January 2021.

Note: The state PM_{10} 24-hour standard is 50 $\mu g/m^3$ and the state PM_{10} annual average standard is 20 $\mu g/m^3$. Concentrations exceeding state standards are underlined while concentrations exceeding federal standards are bold.

Visual $PM_{2.5}$ and PM_{10} Summaries

Figures 5 shows the 24-hour $PM_{2.5}$ values and Figures 6 & 7 show PM_{10} values from the stations where these pollutants were measured in 2021. As with the ozone plots in the previous section, these show daily concentrations by month for each site; exceedances of state and federal standards are shown in red with the day of month printed beside them. The heavy "stair step" line marks the monthly median. The vertical axis extends the annual maximum; units are $\mu g/m^3$.

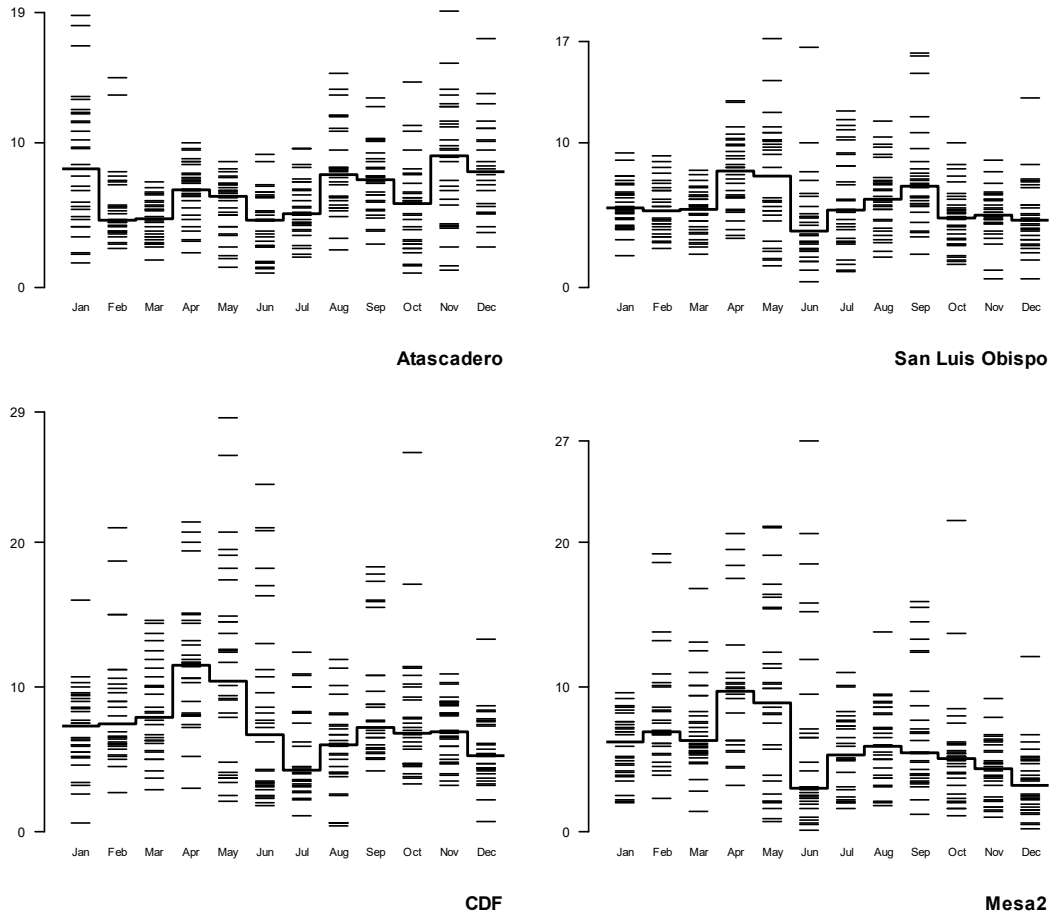

Figure 5: Daily $PM_{2.5}$ Values for 2021 ($\mu g/m^3$)

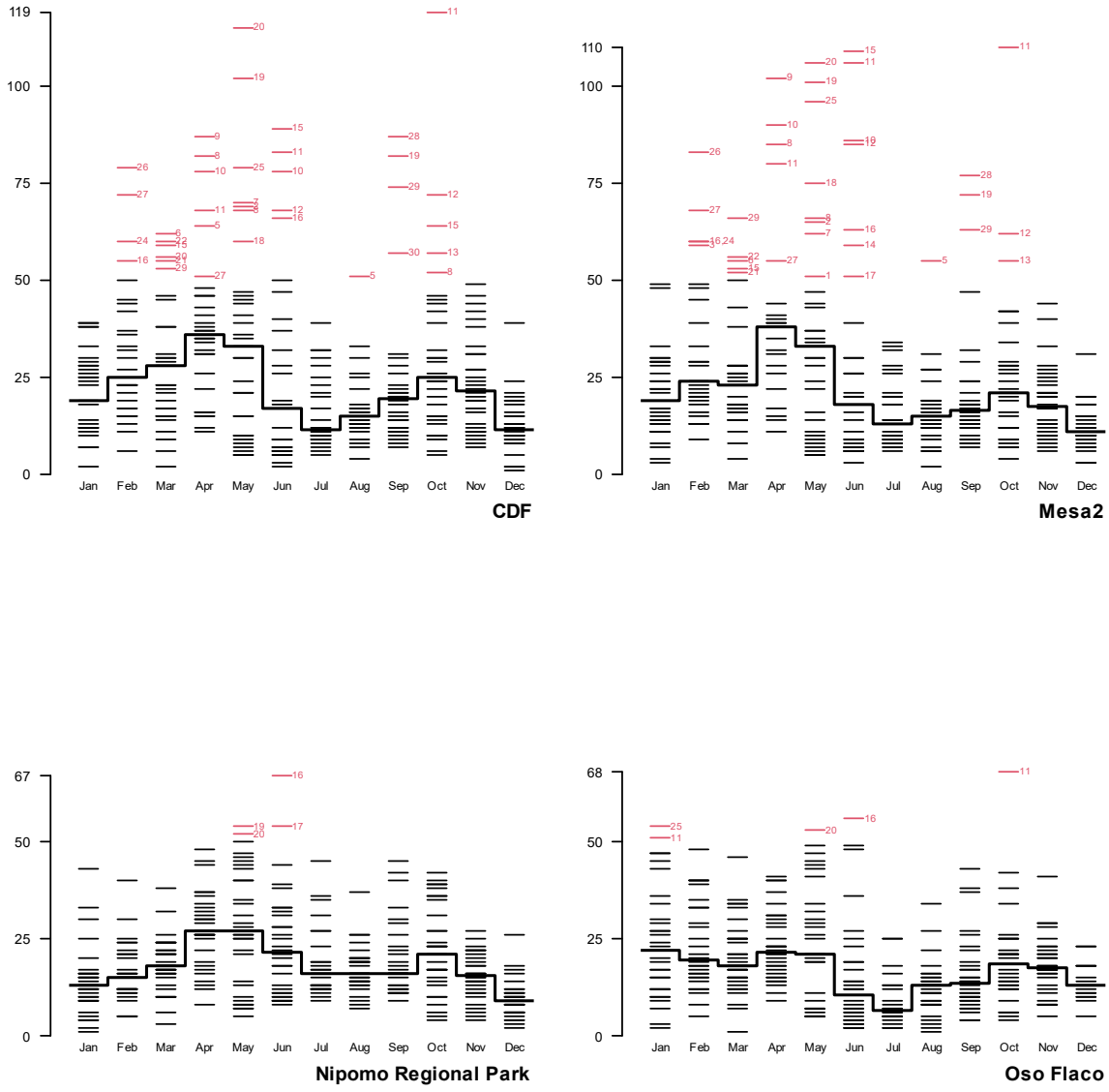

Figure 6: South County Daily PM_{10} Values for 2021 ($\mu g/m^3$)

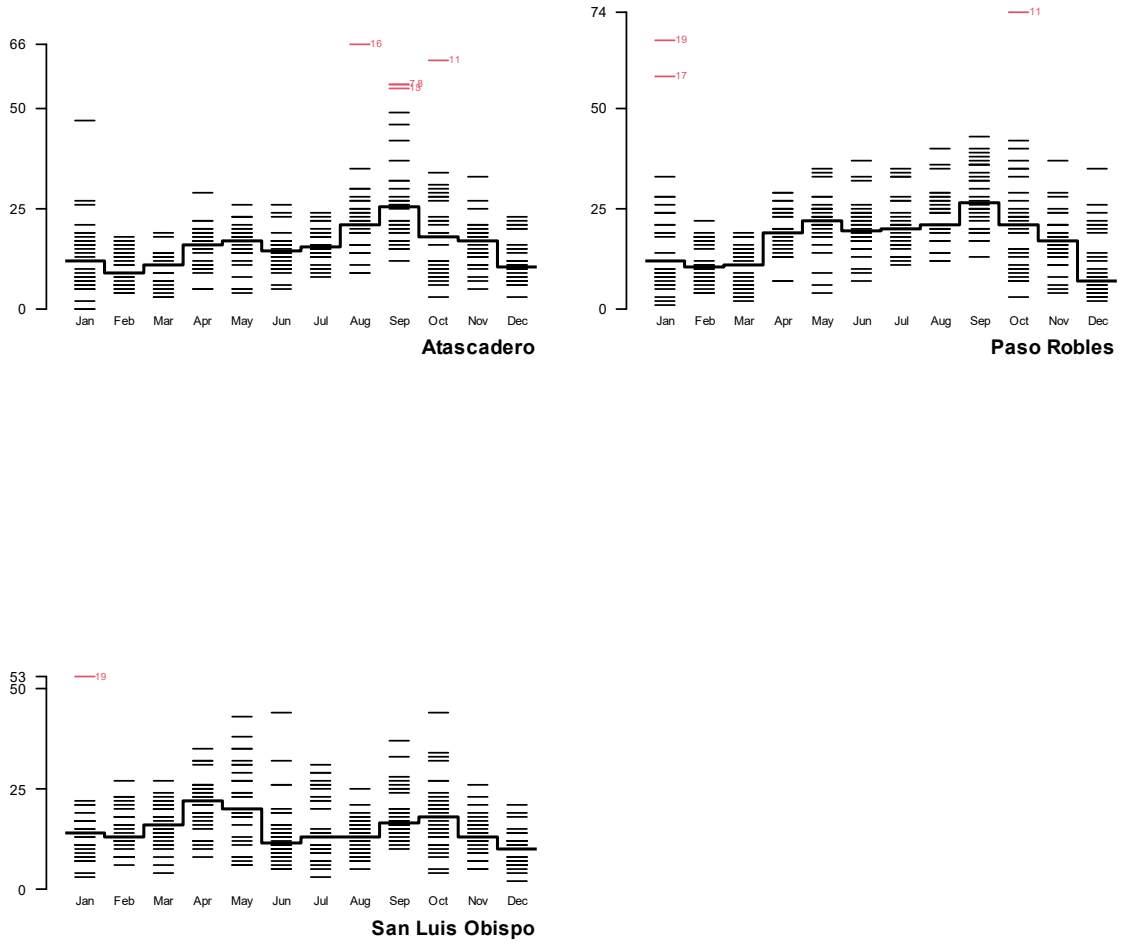

Figure 7: North County and SLO Daily PM_{10} Values for 2021 ($\mu g/m^3$)

10-Year Trends

Ozone

Figure 8, below, depicts the total number of hours each year during which the ozone concentration was at or above 65 ppb. This is a useful indicator for trends, even though there are no health standards for single-hour exposure to this level of ozone. Figure 9 shows ozone design values over the same period. Design values are used by EPA to determine whether an area attains a federal standard. For ozone, the design value is calculated by averaging the 4th highest annual 8-hour average over three consecutive years. For example, a 2016 design value is the average of the 4th highest 8-hour averages from 2014, 2015, and 2016. Only design values meeting data completeness requirements are included; the dashed red line indicates the federal 8-hour standard, which changed from 75 to 70 ppb in 2015. Select data can be excluded from design value calculations under the exceptional event rule discussed in the "State and National Ambient Air Quality Standards" section above.

Exceptional event demonstrations associated with wildfire smoke influence on ozone concentrations during 2018 and 2020 wildfire seasons were submitted and concurred upon by the EPA. Under the Exceptional Event rule Red Hill's ozone concentrations on August 3, 4, 6, 7, & 9 of 2018, as well as, August 20, 21; September 30; October 1, 2 of 2020 are excluded from design value calculations. These elevated concentrations were demonstrated to be directly influenced by wildfire smoke and were neither reasonably controllable or preventable.

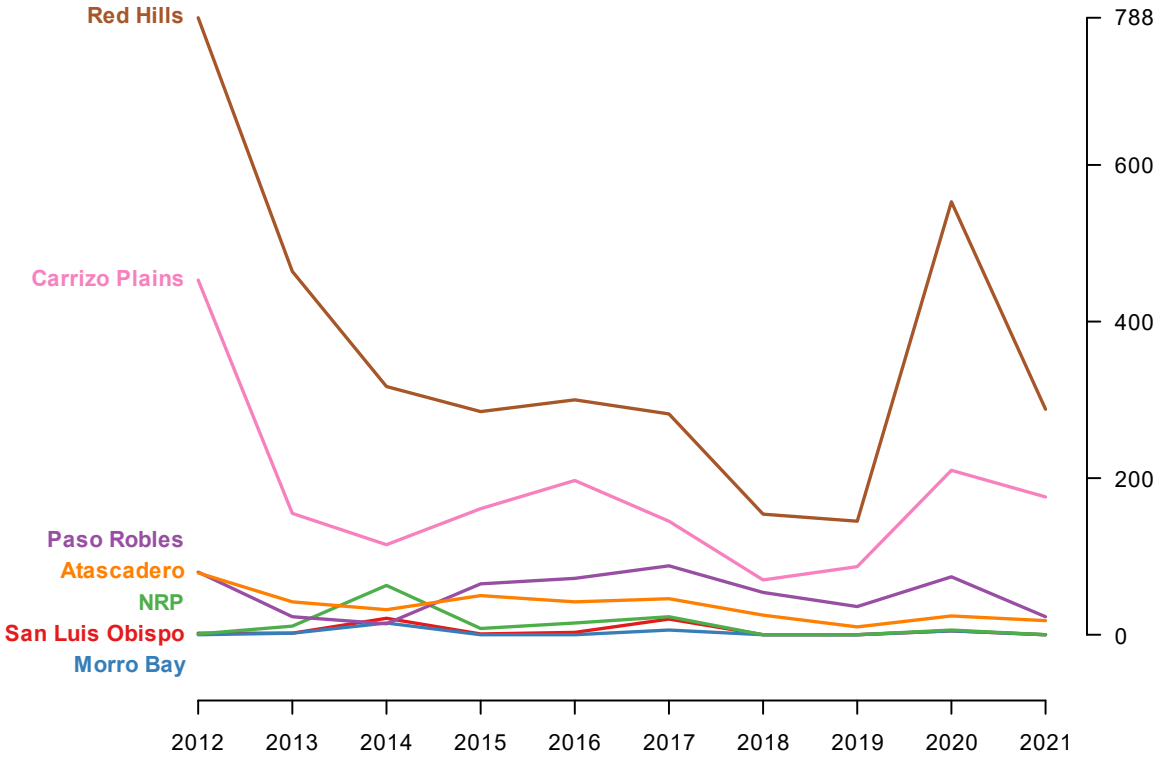

Figure 8: Hours At or Above 65 ppb Ozone, 2012-2021

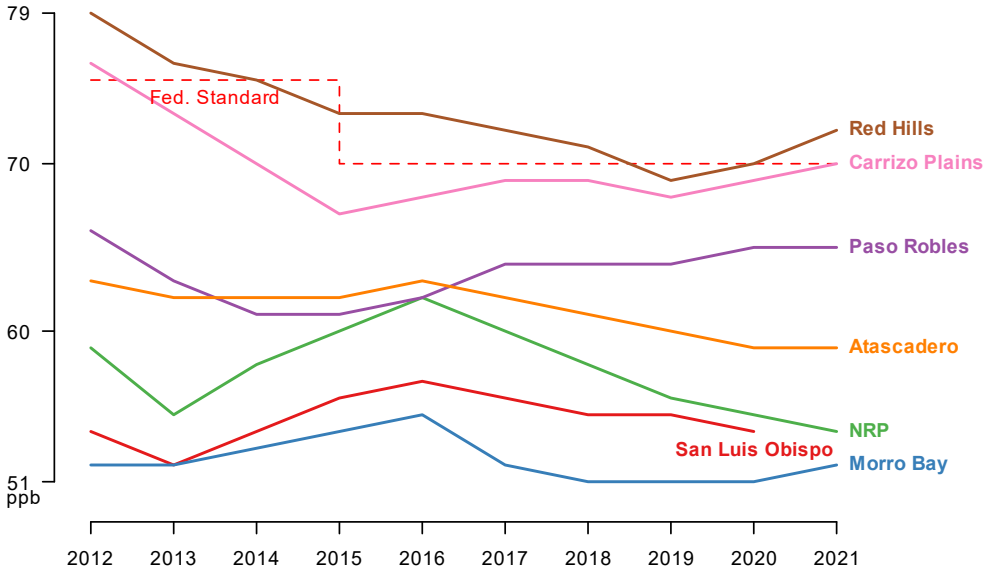

Figure 9: Ozone Design Value Trends, 2012-2021

Particulate Matter

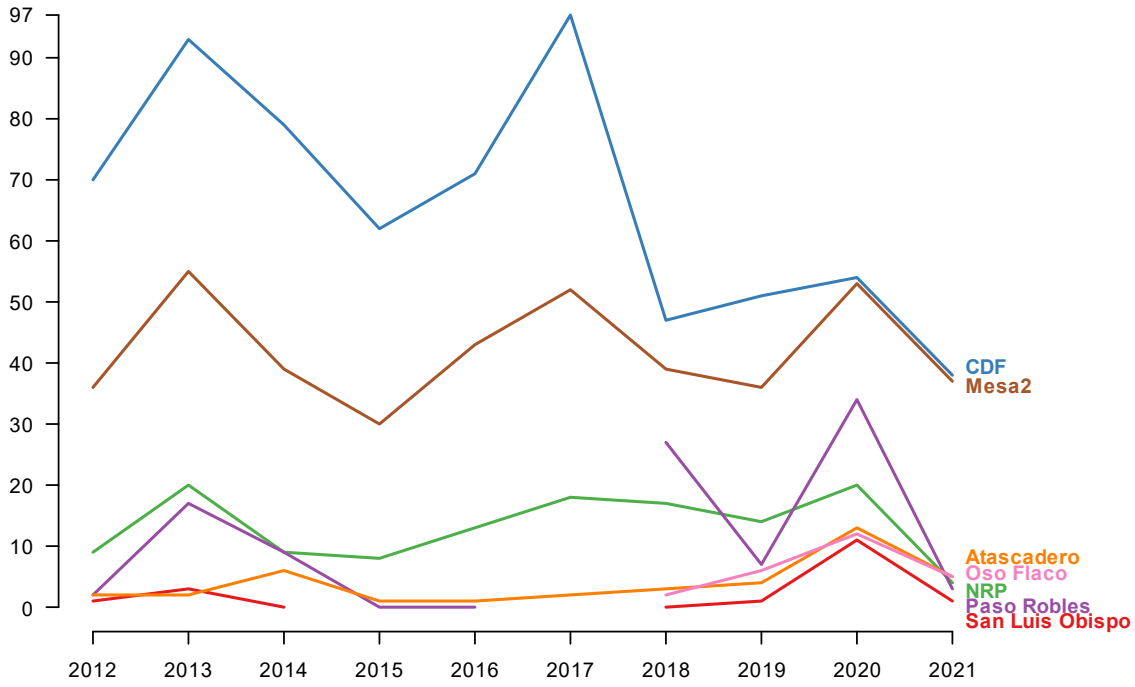

Figure 10: Exceedances of the California 24-hour PM_{10} Standard, 2012–2021

Figure 10 shows the number of exceedances of the state 24-hour PM_{10} standard (50 μg/m^3) at each site by year. Collection of daily data began in mid–2009 for some sites and later for others, and years missing more than 10% of daily values are omitted.

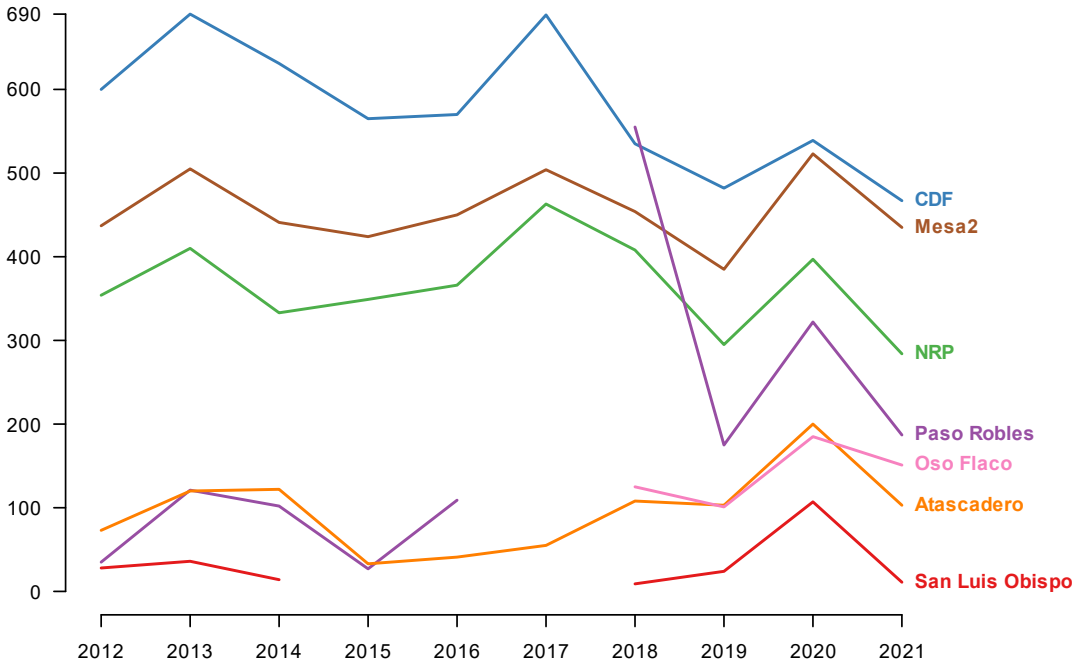

Figure 11: Number of Hours At or Above 50 μg/m³ PM_{10} between 10 a.m. and 4 p.m., 2012–2021

Figure 11 plots the total number of hours each year when PM_{10} was at or above 50 μg/m³ during the hours when people are most likely to be active (10 am to 4 pm). This metric is intended to illustrate trends in population exposure, even though there are no health standards for single-hour exposure to this level of PM_{10}. Years missing more than 10% of daily values are omitted.

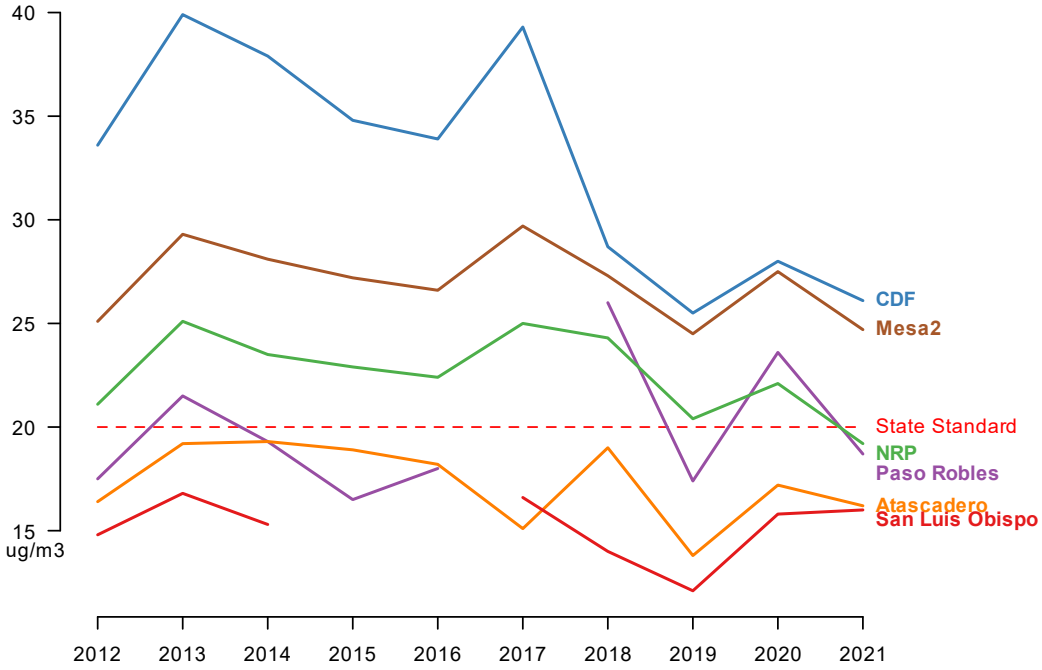

Figure 12: PM_{10} Annual Averages, 2012–2021

Figure 12 depicts annual average PM_{10} concentrations over the past 10 years;[4] years with partial data are omitted. The red dashed line marks the state standard for the annual average (20 μg/m^3).

[4] In general, these are seasonally weighted averages as calculated by AQS. For years when sampling methodology changed or a site was moved, the average depicted is the time-weighted average of the methodologies or locations.

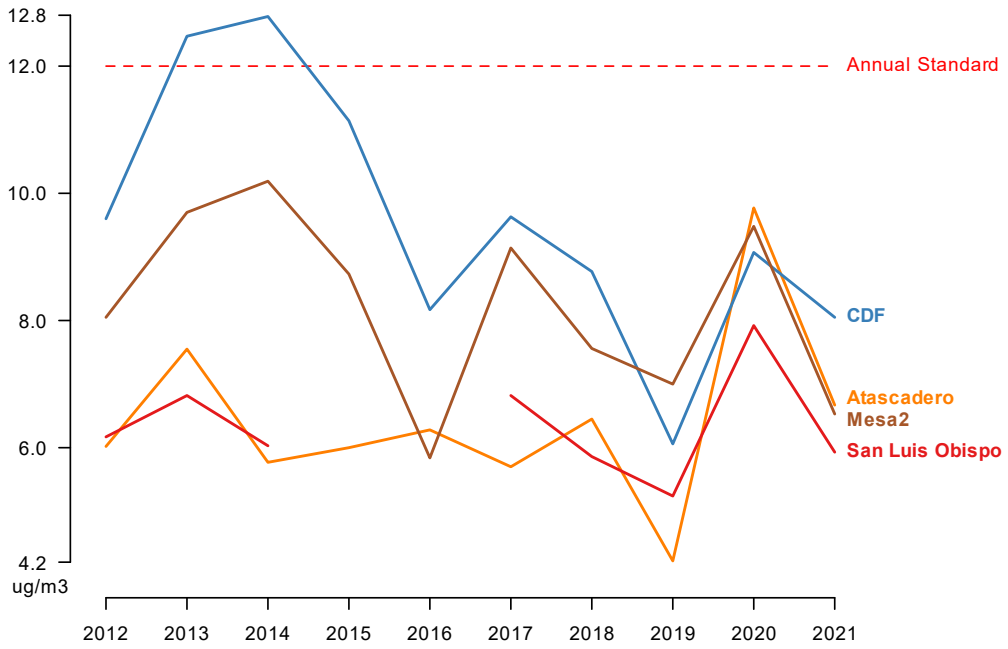

Figure 13: $PM_{2.5}$ Annual Averages, 2012-2021

Figure 13 shows trends in $PM_{2.5}$ annual averages for the four sites where it is measured. Data for the past 10 years are shown, and years with partial data are omitted. The red dashed line marks the 12 $\mu g/m^3$ state and federal $PM_{2.5}$ standard for the annual average

Appendix A: Assessing the Effectiveness of ODSVRA Mitigations

Introduction

Windblown dust from the ODSVRA remains the predominant air quality challenge affecting South San Luis Obispo County. For more than a decade, the APCD has been engaged with the California Department of Parks and Recreation (State Parks) in an effort to resolve the issue and improve the region's air quality; these actions are chronicled on the APCD's website.[5] From 2011 to 2021, the annual number of exceedances of the California PM_{10} standard at CDF varied from as few as 38 to as many as 97, with most related to ODSVRA dust. Over this period, State Parks has implemented various mitigation projects, with the total areal extent of dust controls ranging from 1 to 323.5 acres.[6] It would be overly simplistic to attribute the year-to-year changes in the number of exceedances solely to changes in the extent of State Parks' mitigation efforts. This is because downwind PM_{10} concentrations are potentially influenced not only by the mitigations, but also by non-ODSRVA sources (notably wildfire smoke and dust transported from the San Joaquin Valley), and—most importantly—meteorology, especially the strength and direction of onshore winds. It is the wind that drives the actual dust emissions, so, all else being equal, windier years are expected to be dustier and have more PM_{10} exceedances than less windy years.

To quantify the effectiveness of these dust controls, recent Annual Air Quality Reports[7] have analyzed trends in particulate matter on the Nipomo Mesa. Appendix A of the 2017 Annual Air Quality Report proposed a "Difference-in-Differences" approach to disentangling the potential effects of the mitigations from meteorology and other factors. In a nutshell, this method looks at the ratio of PM_{10} concentrations between CDF and Oso Flaco on wind event days, and then asks whether that ratio changes from one year to the next. Comparing to Oso Flaco implicitly controls for inter-annual variations in meteorology and non-ODSVRA PM_{10} sources. This is because the mitigation measures are upwind of CDF but not Oso Flaco, so changes in the mitigations should affect CDF but not Oso Flaco. Meanwhile, both sites should experience the same trends in meteorology, and they should be similarly influenced by wildfires and regional particulate matter events. The Oso Flaco station was installed in mid-2015, so this analysis is only possible for 2016 and later years. 2017 is used as the baseline to compare other years to because it had the least amount of mitigation and is thus the closest possible scenario to a fully unmitigated baseline.

For the analysis, a wind event day is defined as any day when the hourly wind speed at 15:00 at the S1 Tower within the ODSVRA exceeds 9.445 m/s and the hourly wind direction at 13:00 at CDF is between 289.5 and 360 degrees. Any day that was obviously influenced by wildfire smoke or San Joaquin Valley dust transport was excluded from the analysis. While there have been numerous such days over the years, only one—July 6, 2020—also met the criteria for being a wind event day and was thus excluded from the analysis. See the 2017 Annual Air Quality Report for a more complete description of the methodology.[8] The methodology of the 2017 Annual Air Quality Report has been used in subsequent Annual Air Quality Reports and presentations to the Hearing Board. Here, the methodology is applied to data from 2021.

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[5] https://www.slocleanair.org/air-quality/oceano-dunes-efforts.php;

[6] State of California, Department of Parks and Recreation, 2021 Annual Report and Work Plan, Conditional Approval Draft, October 1, 2021. Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/2021ARWP_CondAppDraft_withAttach_20211001.pdf

[7] San Luis Obispo County Air Pollution Control District, Annual Air Quality Reports for 2015-2020, all available at https://www.slocleanair.org/library/air-quality-reports.php.

[8] San Luis Obispo County Air Pollution Control District, Annual Air Quality Reports for 2017, November 2018. Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/2017aqrt-FINAL2.pdf.

Results

Applying the methodology to the 2021 data yields a statistically significant 33.5% improvement in event-day PM_{10} at CDF compared to the baseline year of 2017 (95% CI: 16.1 to 47.3%; p-value: 0.0009). This result, along with the results from previous years, is depicted in Figure A1, below, which shows the percent changes (compared to 2017) and 95% confidence intervals. Table A1 summarizes these same data.

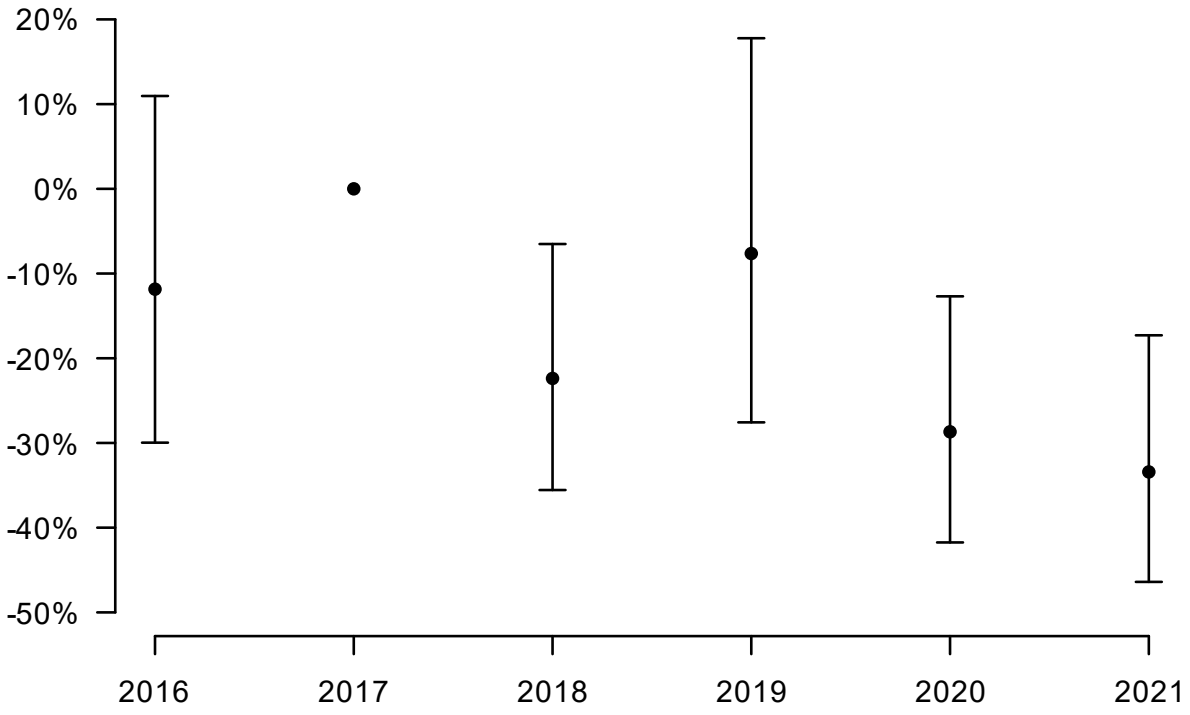


Figure A1: Percent change in wind event day PM_{10} at CDF relative to the 2017 baseline

Table A1: Summary of Change in Event-Day PM_{10} Ratio

Year	Total Dust Mitigation Extent (approx. acres)[6]	Change, vs 2017 baseline, in Ratio of Event-Day PM_{10} (CDF vs Oso Flaco)		
		Percent Change	95% Confidence Interval	P-value
2021	322.5	- 33.5%	-16.1% to -47.3%	0.0009
2020	230.2	- 28.4%	-13.9% to -40.4%	0.0007
2019	137.8	- 7.6%	+23.2% to -30.7%	0.593
2018	146.9	- 22.4%	-7.4% to -34.9%	0.006
2017	55.3	0 %	n. a.	n. a.
2016	76.8	- 12.7%	+16.8% to -38.4%	0.363

Discussion

The analysis for 2021 shows the greatest improvement yet in wind event day PM_{10} levels at CDF. As shown in Table A1, the 33.5% reduction for 2021 builds on the 28.4% improvement for 2020. This improvement is likely due to the approximately 90 acres of new dust controls installed in 2021 and the continued evolution of the 48-acre foredune restoration that was established in early 2020. In concrete terms, median wind event day PM_{10} at CDF was 52 µg/m^3 in 2021; this analysis predicts it would have been 77 µg/m^3 if these mitigation projects had not been implemented.

The *observed* improvements for 2020 and 2021 can be compared with the *modeled* changes reported in State Parks' 2021 Annual Report and Work Plan (ARWP),[6] though this is somewhat of an apples-to-oranges comparison. As discussed in Section 2.2.3.1 of the ARWP, for 2020 and 2021, the model predicts CDF PM_{10} concentrations to be lower by 41.9% and 42.1%, respectively, relative to a baseline year of 2013. The difference-in-differences analysis presented here uses 2017 as the baseline, so the estimates cannot be compared directly. The modeling results can, however, be converted to a 2017 baseline, using modeling results from State Parks' Particulate Matter Reduction Plan (PMRP), which estimated the 2017 mitigations resulted an 8.3% reduction in CDF concentrations relative to 2013. After conversion to a 2017 baseline, the modeled improvements—36.7% and 36.8%, respectively, compare very favorably with the observed improvements for 2020 and 2021—28.4% and 33.5%, respectively. In fact, these modeled values are within the 95% confidence intervals of the observed improvements (see Table A1).

Another reason why the comparison is somewhat apples-to-oranges is that the model assumes that no dust is emitted from areas with dust controls; however, wind fence arrays are somewhat less than 100% effective—especially in the first few rows of fences—and revegetation projects take several years to mature and reach full effectiveness. This suggests that the model will over-predict the improvement in air quality at CDF.

These results of this analysis are also consistent with the qualitative observation that for 2020 and 2021, there were far fewer hours at CDF with PM_{10} concentrations greater than 300 µg/m^3 than in previous years. See Figure A2, below. The results for 2020 are particularly interesting. That year had the fewest such hours, despite it having the worst wildfire smoke impacts of any year on record. Also, that year, the ODSVRA was closed to public vehicular traffic from March 27 through October 30, coinciding with most of the spring and fall windy seasons. Of the 4 hours that exceeded 300 µg/m^3 in 2020, only one occurred during the period when the park was closed to vehicles. Thus, very high hourly PM_{10} values coincide with recent off-road activity.

The results can also be compared to the annual number of violations of District Rule 1001. The ODSVRA is in violation of section C.3 of the rule every day in which the 24-hr average PM_{10} concentration at CDF exceeds 55 µg/m^3 and is more than 20% higher than the 24-hr average PM_{10} concentration at Oso Flaco.[9] As shown in Figure 3, below, the annual number of violations has generally decreased since the Oso Flaco monitor was established.[10] This trend parallels the improvement in CDF levels revealed by the difference-in-differences analysis. As with the comparison to State Parks' modeling, the comparison here is also somewhat apples-to-oranges. While the difference-in-differences analysis and Rule 1001.C.3 standard both implicitly control for variations in meteorology (though, by different means), only the difference-in-differences analysis excludes impacts of non-ODSVRA sources like wildfires and dust transport.

[9] San Luis Obispo County Air Pollution Control District, Rule 1001 Coastal Dunes Dust Control Requirements, Adopted November 16, 2011, Revised by Court Order CV12-0013, March 7, 2016. Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/Rule_1001.pdf.

[10] The Oso Flaco monitor was established in 2015. Data from that year is omitted from Figure 3, since it operated for only half of the year, not including the spring windy season when most exceedances of the State PM_{10} standard and Rule 1001 are typically observed.

Furthermore, comparing the number of Rule 1001 violations from one year to the next is complicated by the fact that the Oso Flaco monitor was offline for significant periods of certain years. For example, there were 10 days in 2017 when CDF PM_{10} exceeded 55 µg/m^3 but the Oso Flaco monitor was offline,and thus compliance with Rule 1001.C.3 could not be determined.

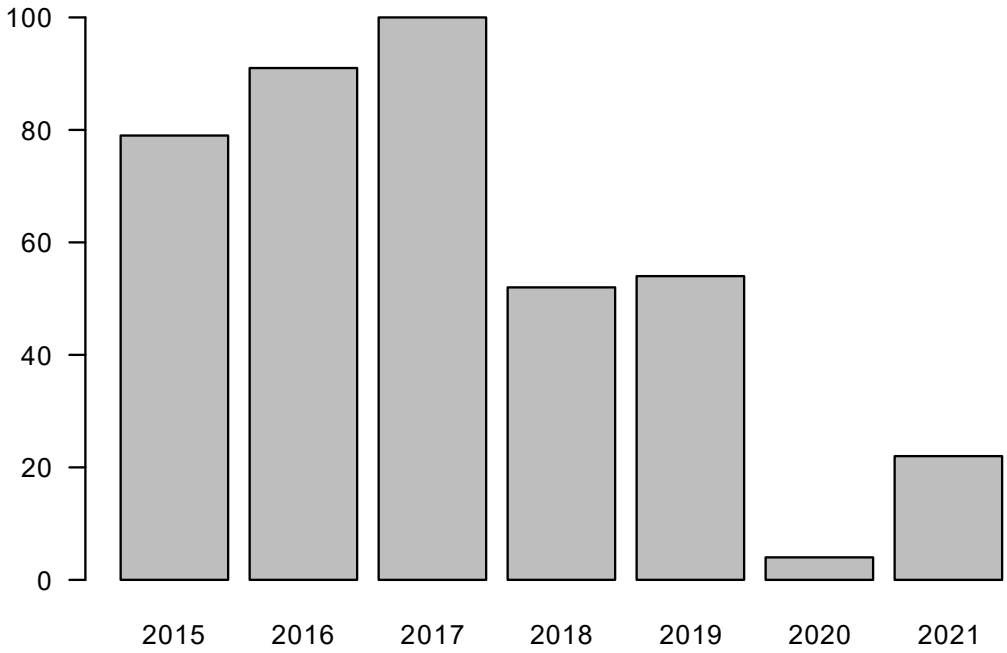


Figure A2: Annual Hours at CDF Greater than 300 µg/m^3

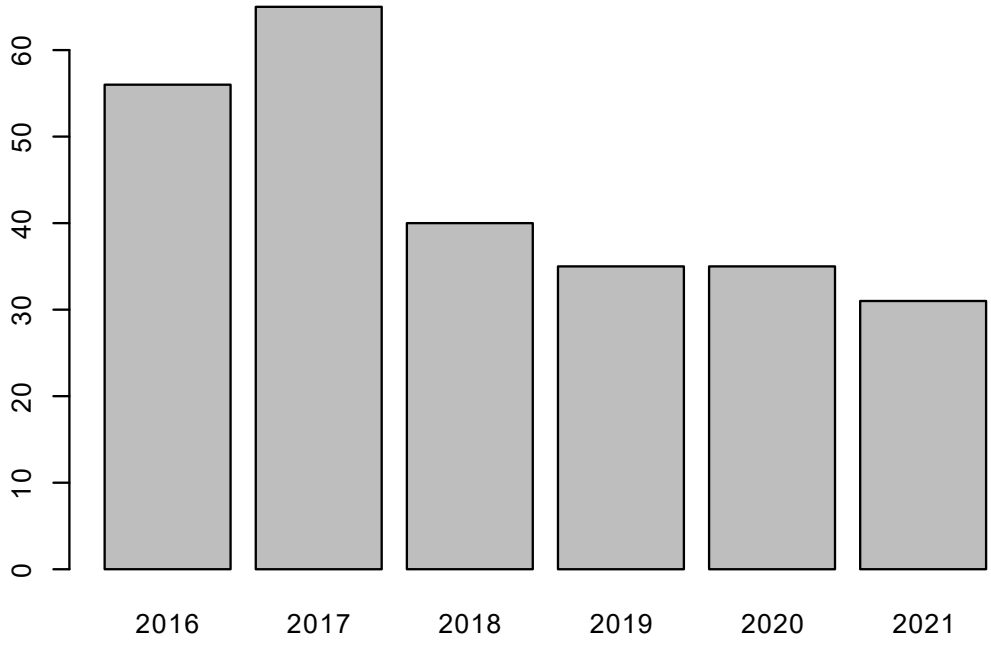
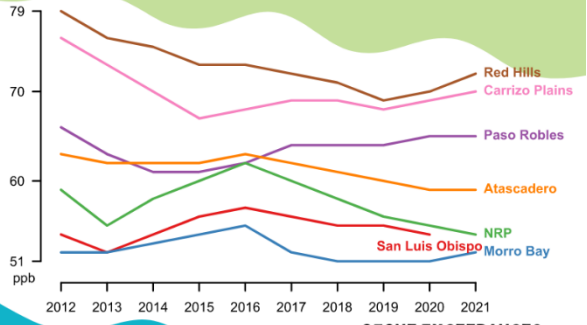


Figure 3: Annual Violations of District Rule 1001

Appendix B: Infographic Summarizing 2021 Air Quality

OZONE TRENDS

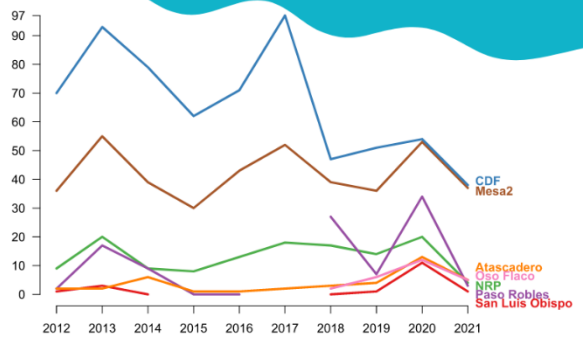
Trends show improvement from 2020 levels, but a slight increase in both hours above 65 ppb and exceedances of the ozone standard in comparison to 2019. Hours above 65ppb is a useful indicator for trends, even though there are no health standards for single-house exposure to this level of ozone. Ozone standards were exceeded on 7 days in 2021, with both Red Hills and Carrizo Plains reporting 8 hour values over 70 parts per billion.



OZONE EXCEEDANCES

PARTICULATE MATTER TRENDS

PM levels on the Nipomo Mesa continue to show signs of improvement. The overall exceedance days decreased from both 2019 and 2020 levels showing continued air quality improvement. While conditions at CDF have improved more than at Mesa2, both sites saw a general decrease in the number of days exceeding the state 24-hour PM10 standard of 50 µg/m3. Also, Oso Flaco days of exceedances decreased from 2019 and 2020. See the chart below to see the exceedance of the state 24-hour 50 µg/m3 PM10 standard.



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