

Highest AQI Levels
Sept 2023-Apr 2024

136 November 29
Portola
PM_{2.5}

128 December 4, 5, 11
Portola
PM_{2.5}

123 December 21
Portola
PM_{2.5}

113 December 10
Portola
PM_{2.5}

Portola End of Season Report | Sept 2023 - Apr 2024

Sonoma Technology forecasts wintertime fine particle (PM_{2.5}) Air Quality Index (AQI) levels for the city of Portola to support the Northern Sierra Air Quality Management District's (NSAQMD) wood stove curtailment (WSC) program. Each weekday from September through April, Sonoma Technology issues forecasts of 24-hr average PM_{2.5} concentrations with a 5-day outlook.

PM_{2.5} concentrations are typically higher during winter months because colder temperatures can lead to strong overnight temperature inversions, trapping pollutants near the surface. In addition, increased residential wood burning during winter months can contribute to higher levels of PM_{2.5} locally and regionally. As a significant fraction of wintertime PM_{2.5} pollution can be attributed to residential wood smoke, the WSC program aims to reduce burning on days when meteorological conditions are conducive to pollutant accumulation in the Portola region. The forecast threshold of 24-hr average PM_{2.5} concentrations for NSAQMD to issue a WSC day for September through April was above 20 µg/m³ (68 AQI value).

This report summarizes meteorological and air quality conditions in Portola from September 1, 2023, through April 30, 2024, and provides an analysis of air quality forecast accuracy. Air quality data are sourced from the U.S. Environmental Protection Agency's (EPA) AirNow-Tech platform.

Summary

- Observed air quality in the Portola region during the 2023-24 WSC season was in the Good AQI category on 43% of days, the Moderate category on 51% of days, and the Unhealthy for Sensitive Groups (USG) category on 6% of days.
- The highest AQI levels of the season typically occurred on days with strong temperature inversions, which limited low-level mixing and trapped pollutants near the surface. Particle levels were further increased by periods of calm winds, which allowed pollutants to accumulate in the region.
- Pile burning also contributed to particle levels in Portola this season. Five of the highest 15 AQI levels of the 2023-24 season were observed on days when NSAQMD staff reported pile burning or when pile burns were visible on regional cameras.
- A total of 79 WSC-day forecasts were issued during the 2023-24 WSC season. The average observed daily PM_{2.5} concentration on WSC days was 27.0 µg/m³. Further details are provided on page 6.
- The Percent Correct next-day forecast score was 84%. Percent Correct and other forecast statistics are defined on page 6 of this report.



Highest AQI Levels
Nov. 2022-Apr. 2023

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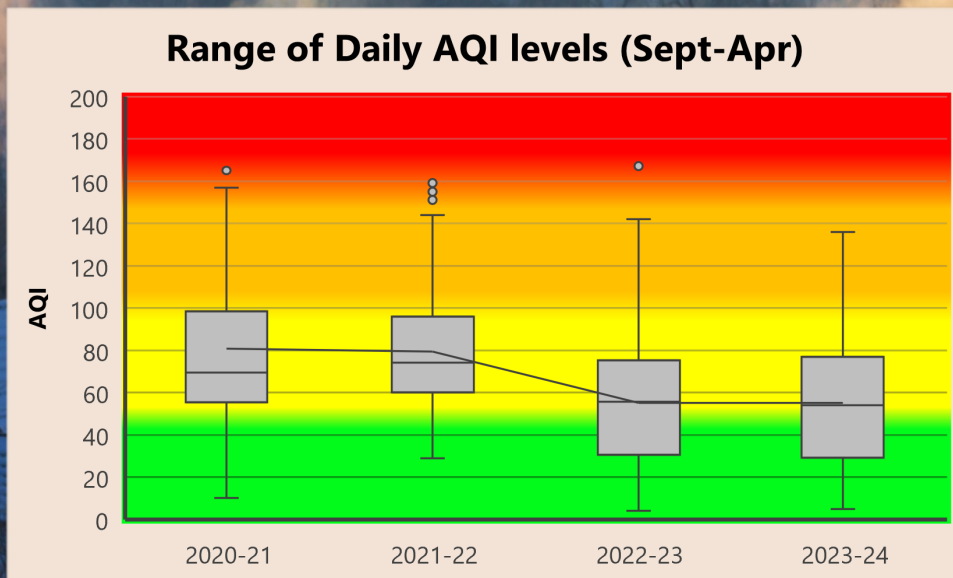
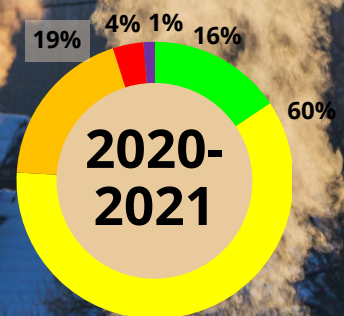
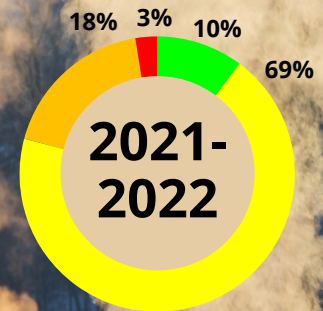
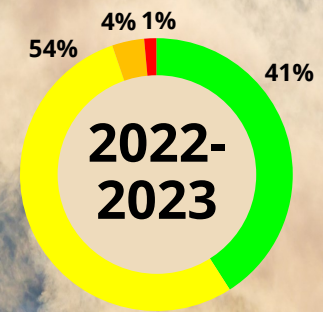
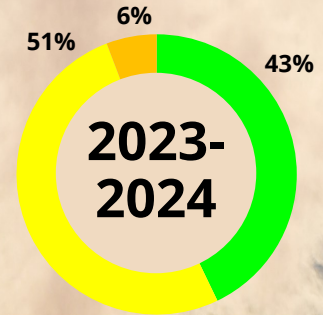
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Yearly AQI Comparison | September - April (2020-2024)

Air quality in Portola during the 2023-24 WSC season was similar to last season and better than the previous two seasons. The pie charts on the right show the percentage breakdown of observations in each AQI category for each season. These charts show a substantial increase in Good AQI levels and a substantial decrease in USG AQI levels in Portola over the two most recent WSC seasons compared to the two seasons before those.

The current WSC program began in fall 2022, which was one of the most active winter weather seasons in history, with record snowfall observed in parts of the Sierras. As such, it is noteworthy that the 2023-2024 season's AQI levels were similar to last season's despite a less active weather pattern across the northern Sierras. As shown in the box and whisker plot below, median AQI levels during the 2022-23 and 2023-24 seasons are below the inner-quartile range of the previous two seasons, indicating the effectiveness of curtailments at reducing concentrations of PM_{2.5} in Portola.



*AQI values above 200 excluded from the chart to focus on seasonal burning impacts



Seasonal Weather Summary

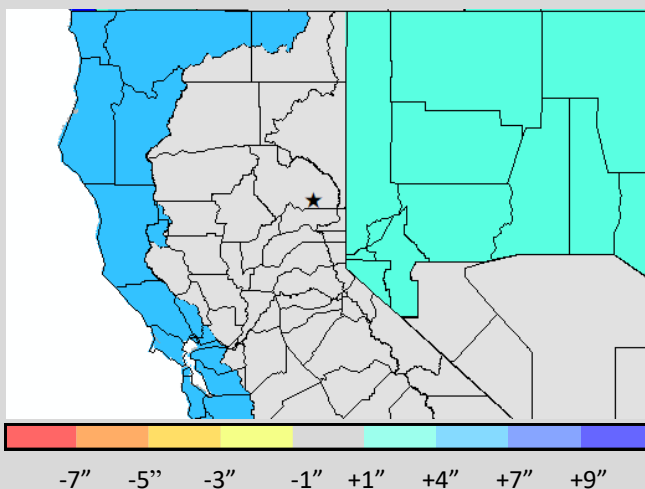
Outside of wildfire season, PM_{2.5} concentrations in the Portola region are typically highest during the winter months because strong overnight temperature inversions limit vertical mixing as PM_{2.5} emissions increase due to residential wood burning. These inversions are strengthened by the higher terrain surrounding Portola, which not only acts as a barrier to winds but causes inversions to become more stable as cold air flows downslope into the valley and traps pollutants near the surface. Even though temperatures were near-normal in Portola this WSC season, temperature inversions were a common occurrence. Large differences between daily high and low temperatures (diurnal temperature range) can be an indication of strong temperature inversions, as warmer air above the inversion mixes to the surface during the day. The highest 15 AQI levels this season occurred on days with an average diurnal temperature range of 29° F in Portola. This large difference indicates that strong temperature inversions were a primary factor in the highest AQI levels this season.

Precipitation was also near-normal this WSC season. However, a dry start to the winter allowed seasonal burning to continue well into December, which occasionally contributed to elevated particle levels in Portola. Five of the top 15 AQI levels were observed on days when either NSAQMD staff reported pile burning or pile burns were visible on regional cameras.

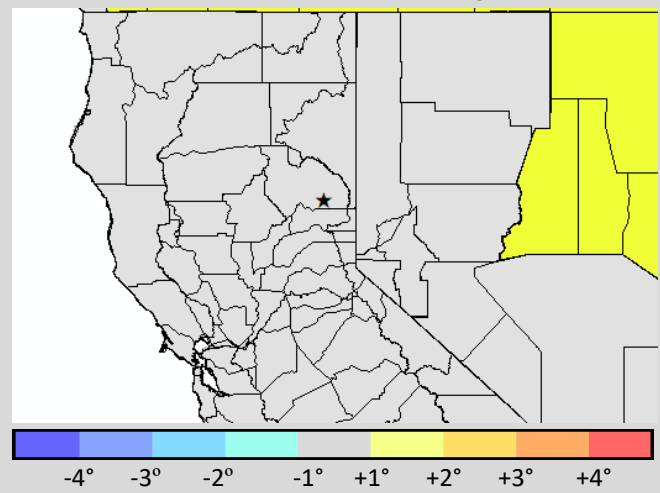
Month	Portola temperature departure from normal (°F)	Portola precipitation departure from normal (inches)	Curtailments Issued	Days with 24-hr PM _{2.5} above WSC threshold
September	-1.7	+ 0.58	1	0
October	+ 1.0	- 0.72	0	2
November	+ 1.0	- 0.73	19	15
December	+ 4.2	- 2.15	29	23
January	+ 3.2	- 2.33	16	22
February	+ 0.5	+ 2.01	9	12
March	-1.6	+ 4.08	7	5
April	+ 0.7	- 1.12	2	0
Season	+0.9	-0.05	83	79

Source: Weather data - www.weather.gov, Air quality data - www.airnowtech.org

Precipitation Anomalies (inches)
September 2023 - April 2024
Versus 1991-2020 Average



Temperature Anomalies (°F)
September 2023 - April 2024
Versus 1991-2020 Average



Meteorological data courtesy of psl.noaa.gov

Highest Observed and Forecasted AQI Levels

Observed PM_{2.5} AQI levels in the Portola region exceeded the WSC threshold (68 AQI value) on 79 days this season. WSC days were issued on 83 days. The table below shows the dates with the 15 highest AQI levels of the season. WSC days were issued for each of these days, which all exceeded the WSC threshold in the Portola region. Days are ranked from highest to lowest by observed AQI levels. Meteorological summaries of the high-AQI-level events on November 29 and December 4-5 are included on page 5.

Date	Monitoring Site	Observed AQI	Next-Day	Same-Day
11/29/2023	Portola (061131003)	136	84	84
12/4/2023	Portola (061131003)	128	N/A*	93
12/5/2023	Portola (061131003)	128	99	102
12/11/2023	Portola (061131003)	128	78	112
12/21/2023	Portola (061131003)	123	87	107
12/10/2023	Portola (061131003)	113	99	99
11/14/2023	Portola (061131003)	110	89	93
11/30/2023	Portola (061131003)	110	70	107
12/28/2023	Portola (061131003)	107	76	76
1/15/2024	Portola (061131003)	107	N/A*	97
12/20/2023	Portola (061131003)	106	63	82
1/1/2024	Portola (061131003)	106	91	93
2/13/2024	Portola (061131003)	103	78	89
12/6/2023	Portola (061131003)	100	68	99
1/16/2024	Portola (061131003)	100	82	99

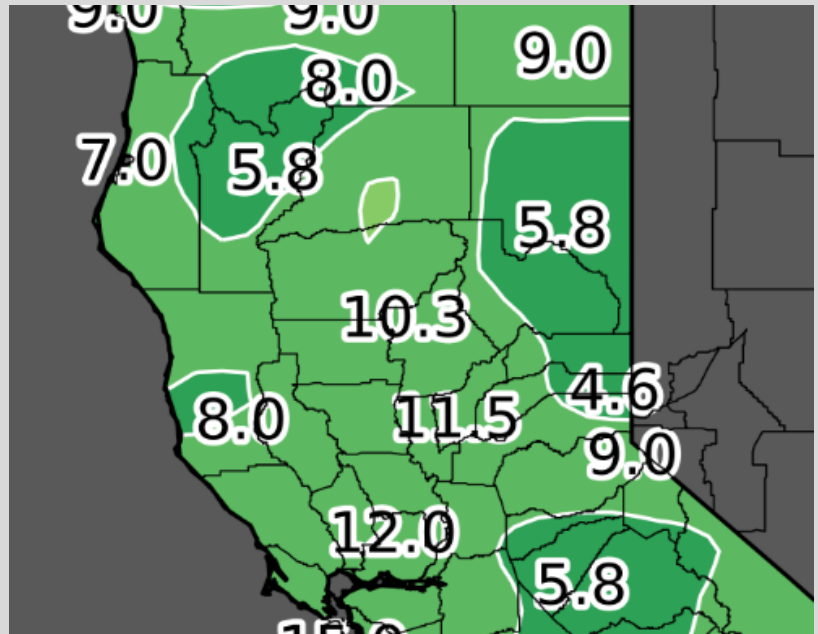
* Forecasts not issued on weekends.



Highlighted Days

November 29, 2023: **136 AQI**

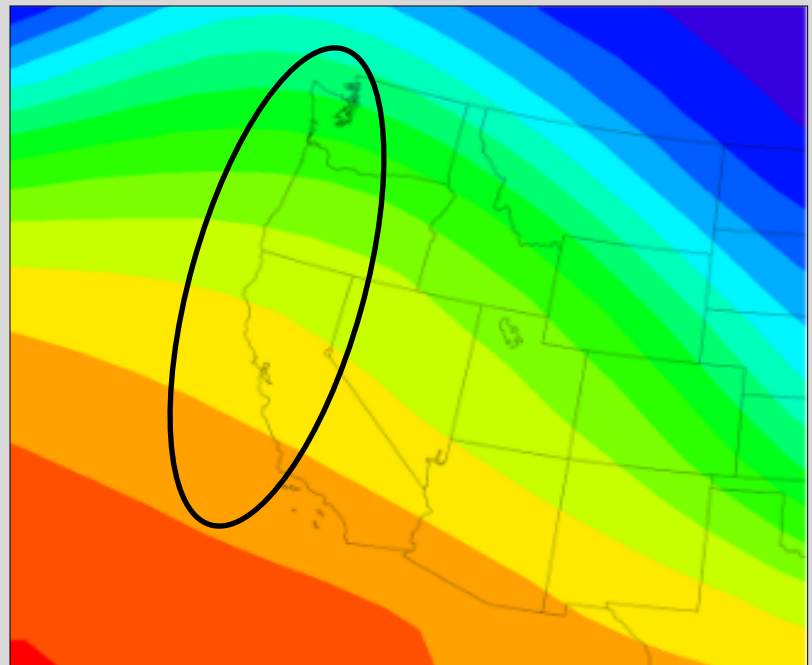
The highest AQI levels of the season were observed on November 29, 2023, as clear skies and calm winds overnight allowed a temperature inversion to develop in Portola. The diurnal temperature range of 39° F on this day tied for the largest diurnal range of the highest 15 AQI days this season, indicating the overnight inversion was exceptionally strong. A WSC day was issued for November 29 to help reduce the impacts of residential burning. However, with frigid morning temperatures of 13° F, wood smoke likely contributed to particle levels. Furthermore, winds were light and variable throughout the day, which limited dispersion and allowed pollutants to accumulate in Portola. As a result, observed AQI levels were USG.



November 29: Maximum sustained winds peaked near 5 mph in the northern Sierra valleys on this day, which limited dispersion and allowed pollutants to accumulate. *Source: Iowa State*

December 4-5, 2023: **128 AQI**

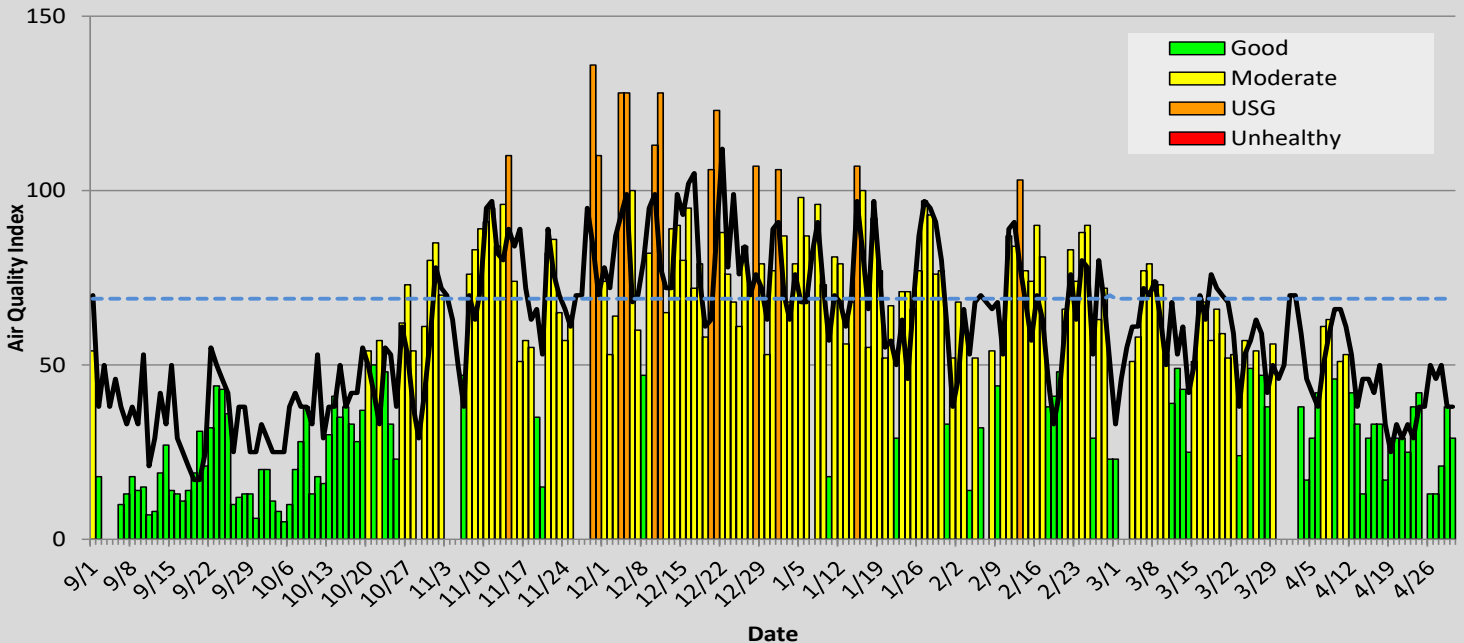
The next-highest AQI levels of the season occurred in early December as a strong ridge of high pressure aloft limited atmospheric mixing over the northern Sierras. In addition, a ridge of high pressure at the surface produced light winds throughout the period, with maximum winds only peaking in the 4-6 mph range. These conditions limited low-level mixing and dispersion each day, which led to elevated particle levels in Portola. Furthermore, NSAQMD staff reported pile burning near Portola on December 5, with smoke contributing to local PM_{2.5} concentrations. Despite WSC days being issued on both of these days, AQI levels still reached the USG category, with AQI values of 128 on both days.



December 4: A ridge of high pressure over northern California reduced atmospheric mixing. In addition, warm temperatures aloft contributed to low-level temperature inversions, allowing pollutants to accumulate in Portola. *Source: psl.noaa.gov.*

Forecast Performance

Sonoma Technology provides same-day, next-day, and extended forecasts for the Portola region. The chart below shows daily observed AQI levels (colored bars) and Sonoma Technology forecasts (black line), along with the WSC threshold (horizontal-dotted blue line). Sonoma Technology forecasts track well with the general trend of observed air quality levels in Portola. Next-day and same-day forecast accuracy statistics are below the chart.



Wood-Stove Curtailment Forecast Performance Summary

- When evaluating forecasts at the WSC threshold, the percent correct was 84% for next-day forecasts and 88% for same-day forecasts.
- The probability of detection for concentrations exceeding the WSC threshold was 74% for next-day forecasts and 89% for same-day forecasts. The false alarm rate was 20% for next-day and same-day forecasts.
- The average observed PM_{2.5} concentration on days when WSC day forecasts were issued was 27.4 µg/m³.
- The average observed PM_{2.5} concentration on non-WSC days was 10.7 µg/m³.
- Next-day forecasts were biased by +0.6 µg/m³, on average, and had a mean absolute error (MAE) of 5.2 µg/m³. Same-day forecasts were biased by +1.1 µg/m³, on average, and had a MAE of 4.0 µg/m³.

Percent Correct: The percentage of forecasts that correctly predicted whether observations would be above or below the WSC threshold.

Probability of Detection: How often a WSC day forecast was issued when observed conditions exceeded the WSC threshold.

False Alarm Rate: How often a WSC day forecast was issued and observed conditions ended up below the WSC threshold.

Bias: The average difference between forecasted and observed concentrations. A positive bias indicates that the forecasted concentrations tended to be higher than observed concentrations. A negative bias indicates that the forecasted concentrations tended to be lower than observed.

Mean Absolute Error: Indicates the average absolute difference between forecast and observed concentrations. A low MAE suggests that forecasts tend to be fairly accurate.

Although Sonoma Technology, Inc., prepares air quality forecasts using the highest professional standards, forecasting is an inexact science. Therefore, Sonoma Technology, Inc., cannot assume any liability or responsibility for any consequences that might arise due to the accuracy or inaccuracy of forecasts delivered under this contract, or for any decisions or actions taken based on the forecasts provided.