

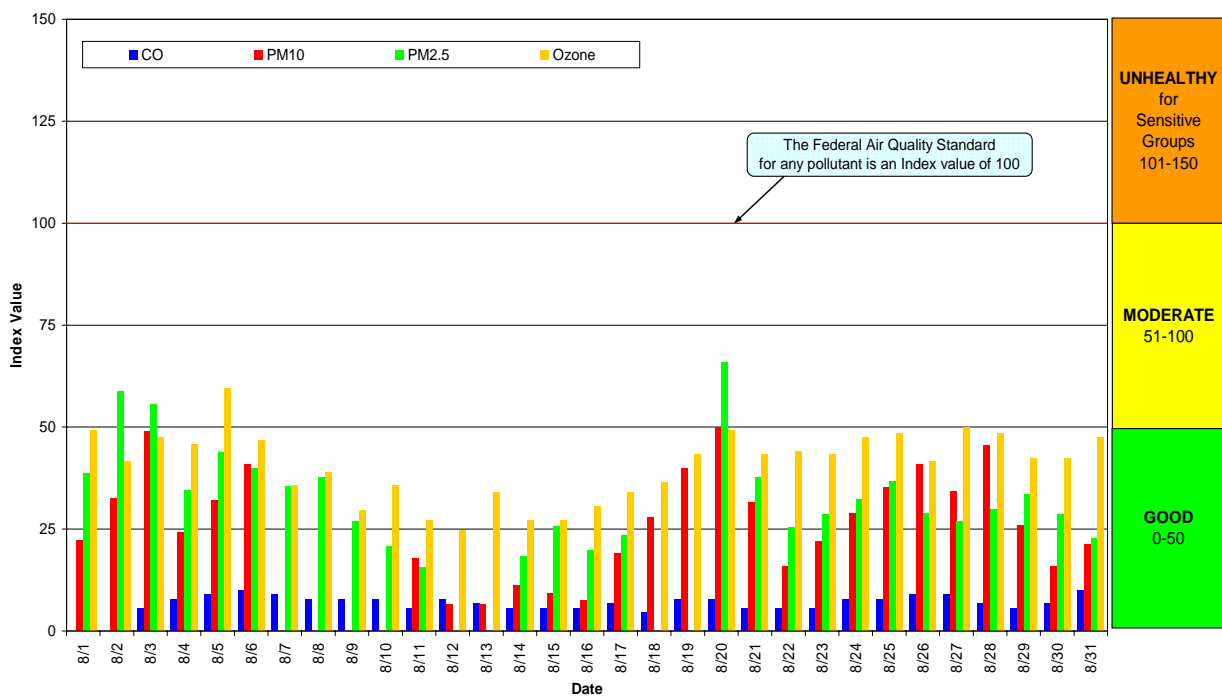
## Spokane Regional Clean Air Agency Air Quality Report - August 2009

The Clean Air Act requires EPA to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants, carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO<sub>2</sub>), particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>), ground-level ozone (O<sub>3</sub>) and sulfur dioxide (SO<sub>2</sub>). These are known as “criteria” pollutants because the US EPA established regulatory limits to concentrations in ambient air using human health or environmentally based criteria. See Appendix Table A-1 for a summary of the NAAQS. Carbon monoxide, particulate matter and ozone are monitored in Spokane County by the Spokane Regional Clean Air Agency (SRCAA) and the Washington State Department of Ecology (Ecology).

Figure 1 shows the daily maximum Air Quality Index (AQI) for each pollutant in August. The AQI is EPA’s color-coded tool for communicating daily air quality to the public and can be calculated for any of the criteria pollutants except lead, provided monitoring data are available. An index value above 100 indicates that the concentration of a criteria pollutant exceeded the limit established in the NAAQS. Categories of the AQI are “good” (green, 0-50), “moderate” (yellow, 51-100), “unhealthy for sensitive groups” (orange, 101-150), “unhealthy” (red, 151-200), “very unhealthy” (purple, 201-300) and “hazardous” (maroon, 301-500). See Appendix Table A-2 for more information about the AQI. The Spokane region’s air quality is usually in the good range of the AQI and sometimes in the moderate range, about 20-30 percent of the days each year. Only rarely, about once every three years, does it reach the unhealthy for sensitive groups category. For more information about the AQI, see EPA’s AirNow AQI web page (<http://airnow.gov/index.cfm?action=static.aqi>).

The data used for calculating the AQIs are obtained using automated air pollution monitoring methods that provide “real time” data, which the SRCAA uses in its day-to-day programs, e.g., air quality forecasting and burning curtailment. For measurement of particulate matter concentrations, the SRCAA operates a network of continuous particulate matter monitors consisting of Tapered Element Oscillating Microbalances (TEOM) and nephelometers. The Department of Ecology operates ozone monitors at Greenbluff, northeast of Spokane, and at Turnbull Wildlife Refuge, south of Cheney. Ecology also operates a CO monitor near the intersection of 3<sup>rd</sup> & Washington in downtown Spokane.

**Figure 1: Air Quality Index (AQI) values for August 2009**



An AQI value of 68 (moderate air quality), the highest of the month, was recorded at the Liberty Lake monitoring station on the 20<sup>th</sup> (Figure 1 and Table 1). This AQI value was based on a 24-hour average PM<sub>2.5</sub> concentration of 24.7 µg/m<sup>3</sup>. Ground-level ozone reached the moderate range of the AQI on the 5<sup>th</sup> when the region was under a high pressure ridge in the upper atmosphere. Tables 1 and 2 contain the maximum AQI values for each pollutant for the month and for the year to date. Table 3 summarizes the year to date daily AQIs by category and compares them to last year's AQIs. Note that the 24-hour average PM<sub>10</sub> concentration measured at Turnbull Wildlife Refuge on the 20<sup>th</sup> was the highest so far this calendar year (Table 2). The profile of this year's AQIs recorded through August are similar to last year (Table 3).

**Table 1: Maximum AQI values and pollutant concentrations for this reporting period**

Pollutant	AQI/Concentration	Location	Date
CO	10/0.9 ppm	3 <sup>rd</sup> & Washington	8/6 and 8/31/09
PM <sub>10</sub>	50/54 µg/m <sup>3</sup>	Turnbull Wildlife Refuge	8/20/09
PM <sub>2.5</sub>	68/24.7 µg/m <sup>3</sup>	Liberty Lake	8/20/09
O3	59/0.062 ppm	Greenbluff	8/5/09

**Table 2: Maximum AQI values and pollutant concentrations this year to date**

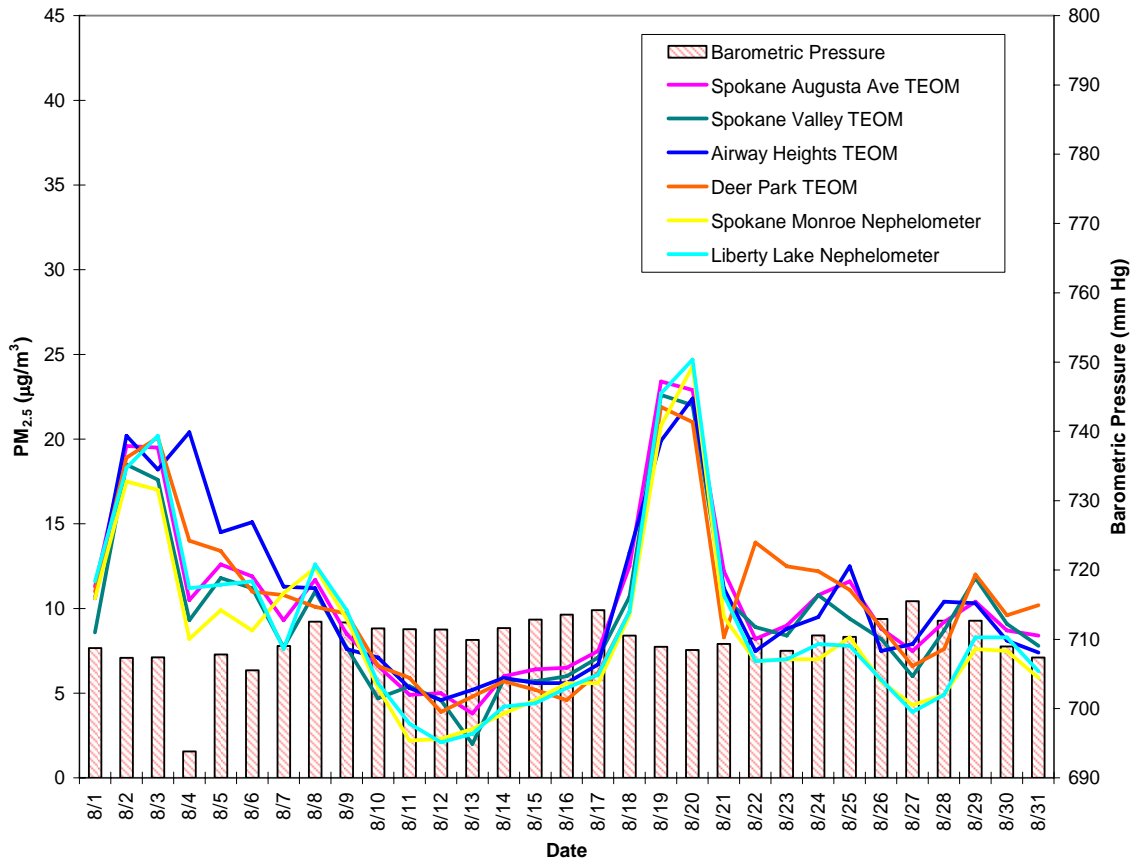
Pollutant	AQI/Concentration	Location	Date
CO	33/3 ppm	3 <sup>rd</sup> & Washington	4/1/09
PM <sub>10</sub>	50/54 µg/m <sup>3</sup>	Turnbull Wildlife Refuge	8/20/09
PM <sub>2.5</sub>	105/43 µg/m <sup>3</sup>	Airway Heights	7/4/09
O3	78/0.068 ppm	Greenbluff	7/22/09

**Table 3: AQI summary as of August 31, 2009**

Category	Number of Days This Year	Last Year to Date
Good (0-50)	220	217
Moderate (51-100)	22	26
Unhealthy for Sensitive Groups (101-150)	1	1
Unhealthy (151-200)	0	0
Very Unhealthy (201-300)	0	0
Hazardous (>300)	0	0

Figure 2 shows the 24 hour average PM<sub>2.5</sub> concentrations across the monitoring network as they as they changed through the month. The higher concentrations measured on August 2 (20.2 µg/m<sup>3</sup> at Liberty Lake) and August 3 (20.4 µg/m<sup>3</sup> at Airway Heights) and again on August 19 (23.4 µg/m<sup>3</sup> at Spokane Augusta Ave) and August 20 (24.7 µg/m<sup>3</sup> at Liberty Lake) were caused mostly by smoke from British Columbia wildfires. PM<sub>2.5</sub> concentrations did not coincide with surface pressure, with the exception of August 4, when concentrations dropped at most stations. While concentrations were strongly affected by wildfire smoke originating outside the local area in August, the PM<sub>2.5</sub> response to barometric pressure can be better determined by comparison with upper atmosphere pressure patterns.

**Figure 2: PM<sub>2.5</sub> multi-station time series for August 2009**



Surface wind directions at the Augusta Ave monitoring station for the month were mostly southwesterly (SW), south-southwesterly (SSW), easterly (E) and east-northeasterly (ENE), with generally higher wind speeds from the SW and SSW sectors (Figure 3a). The higher PM<sub>2.5</sub> concentrations for August, driven mostly by smoke from wildfires in British Columbia but also by other wildfires in the Pacific Northwest, mainly coincided with light winds from the E and ENE sectors (Figure 3b). On further inspection, it is apparent that the smoke was carried to the area not by surface winds, but by the large-scale flow at upper levels of the atmosphere (Figures 5 and 6).

**Figure 3: The wind rose (a) and PM<sub>2.5</sub> pollution rose (b) summarize the percentage of time during the month of August that wind speed and PM<sub>2.5</sub>, respectively, varied with wind direction. The charts are derived from hourly-averaged data.**

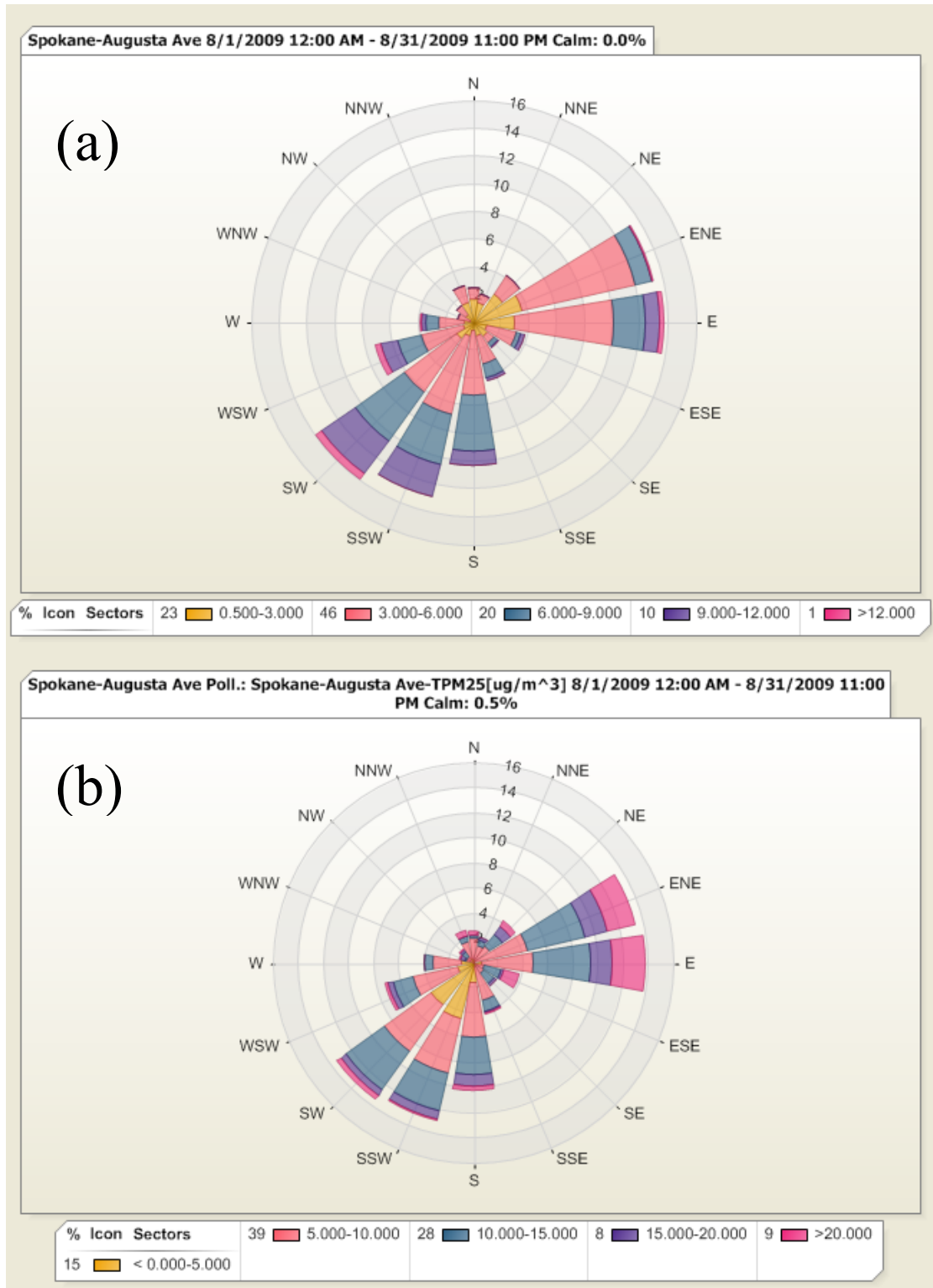
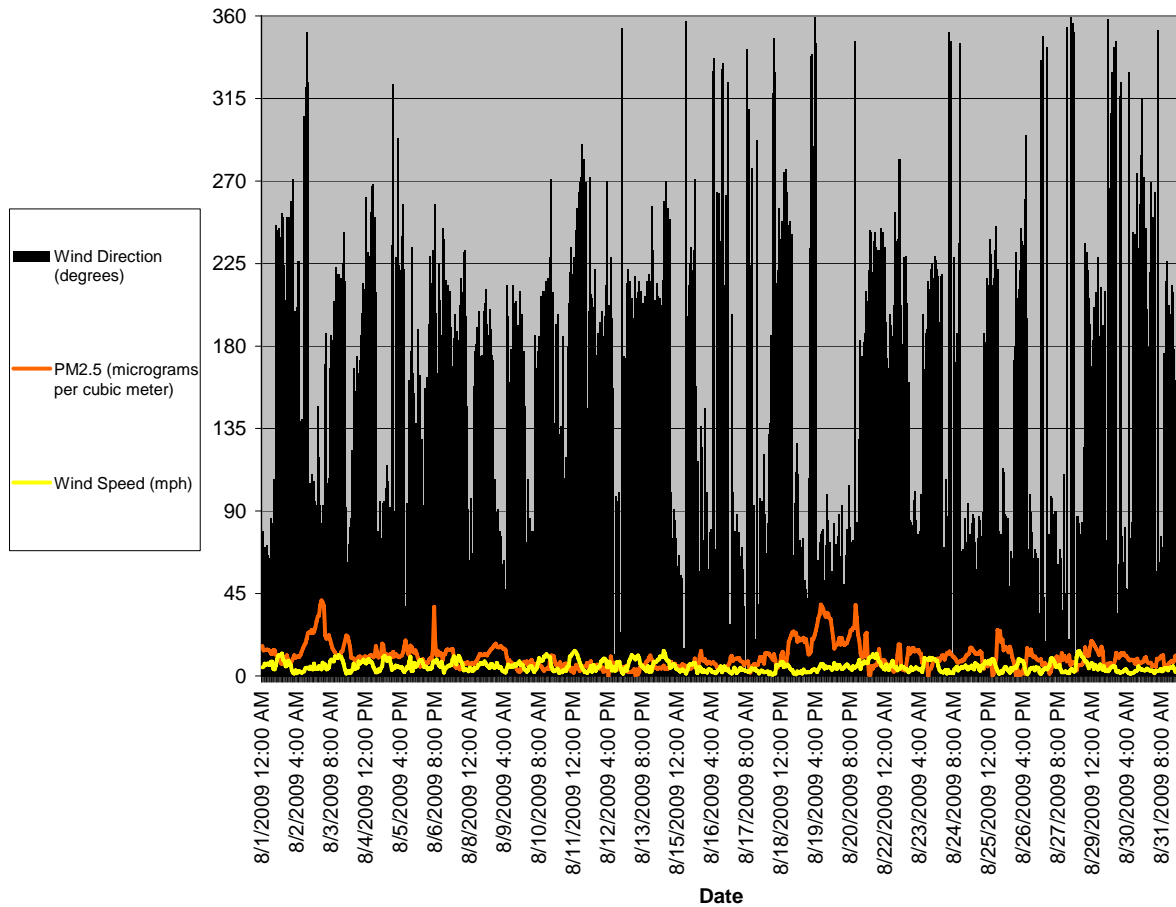
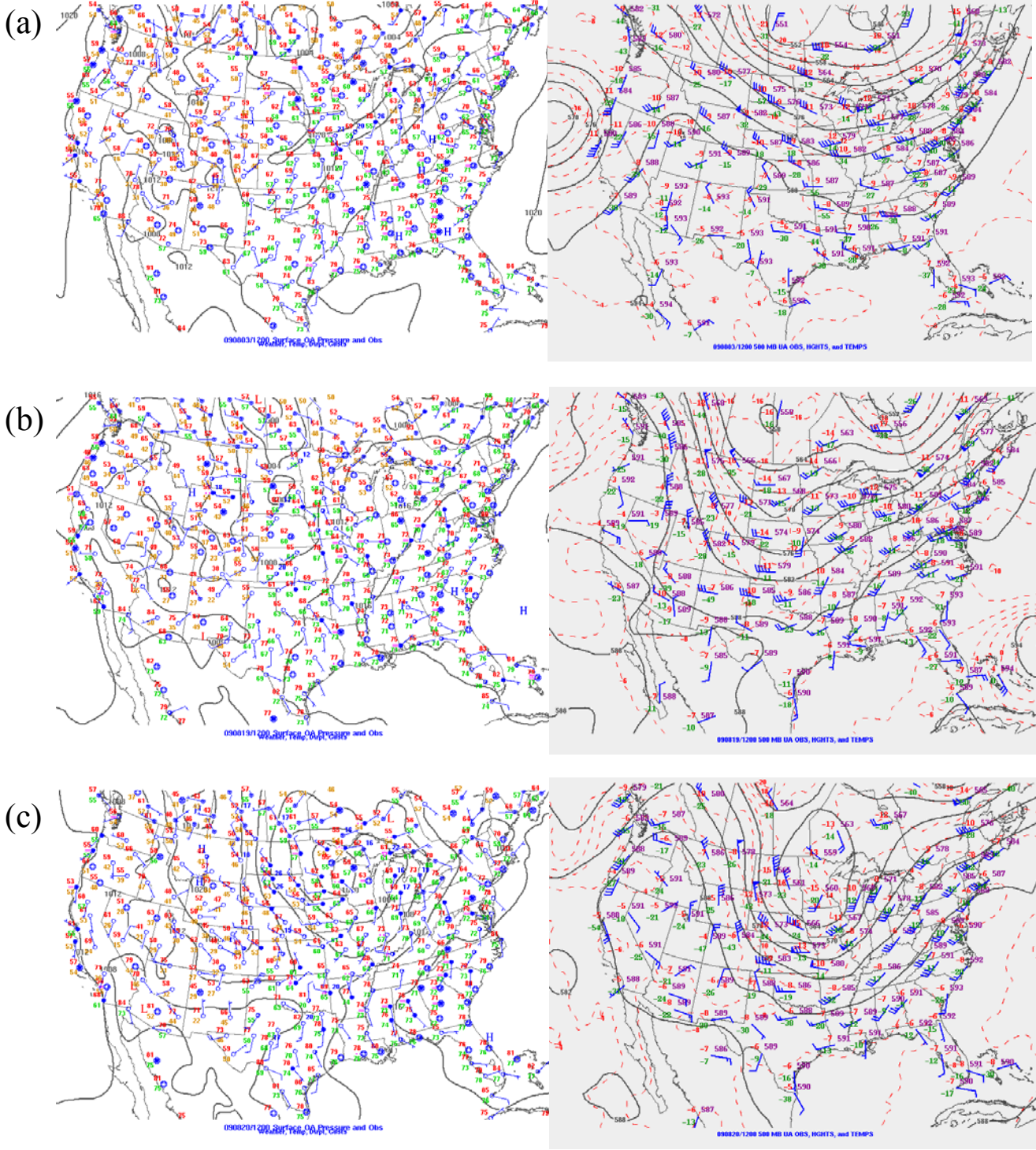


Figure 4 shows how the PM<sub>2.5</sub> concentrations at the Spokane Augusta Ave monitoring station varied with wind speed and direction through the month. The periods August 2-3 and 19-20 both had high PM<sub>2.5</sub> concentrations and light E and ENE surface, i.e., ground-level, winds. These are the same data presented in Figure 3, but in a different format to show how they varied together over time. In both cases, PM<sub>2.5</sub> concentrations decreased when cold fronts moved through region and large-scale air flow shifted to a southwesterly direction.

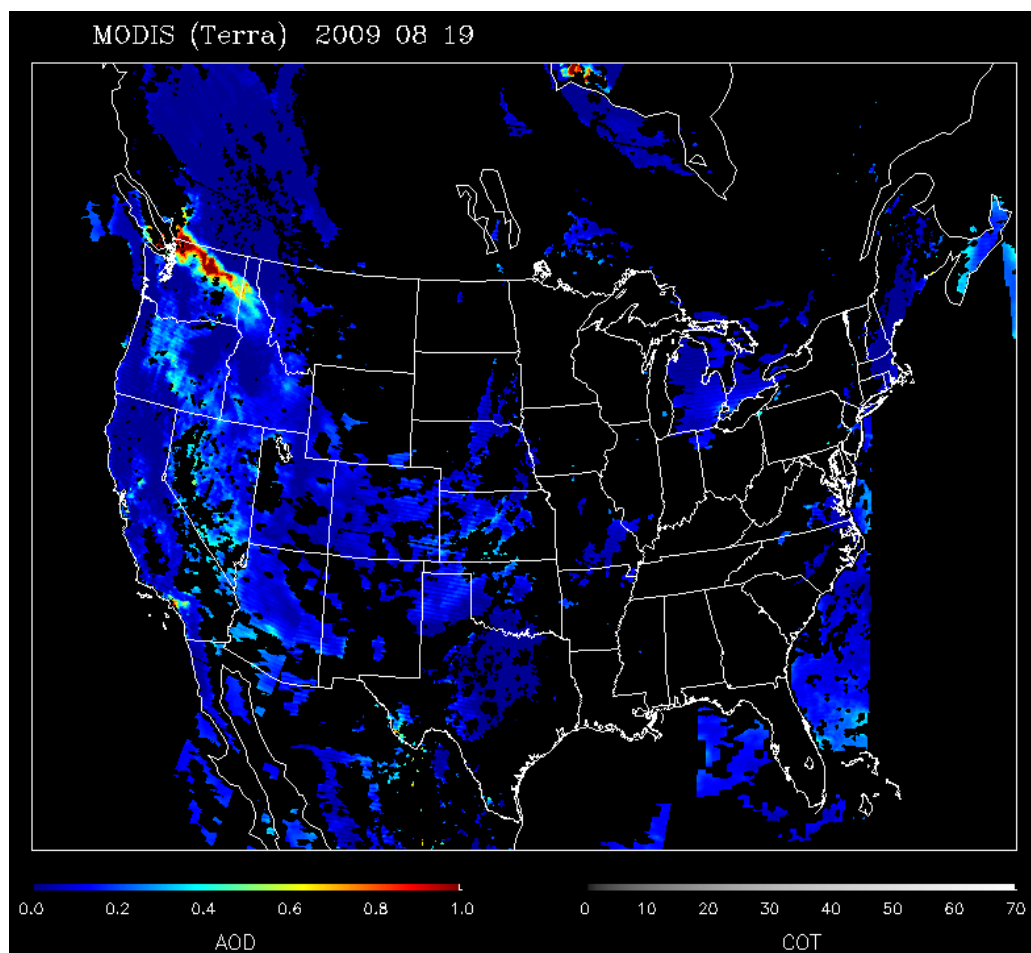
**Figure 4: Time series of hourly average PM<sub>2.5</sub>, wind speed and wind direction during the month of August. A wind direction of zero or 360 degrees means that wind is northerly (blowing from the north), 90 degrees = easterly, 180 degrees = southerly and 270 degrees = westerly.**



**Figure 5: Surface and upper atmosphere (500 mb; shaded) weather charts for August 3 (a), August 19 (b) and August 20 (c). The wind barbs (shown in blue) are like arrows flying along with the direction of the wind. Black contours show the pressure patterns. Note that surface and upper atmosphere winds can blow in opposite directions, which is the case for Spokane on these charts. Smoke from British Columbia wildfires was carried to the Spokane area by the large-scale (upper-atmosphere) air flow.**

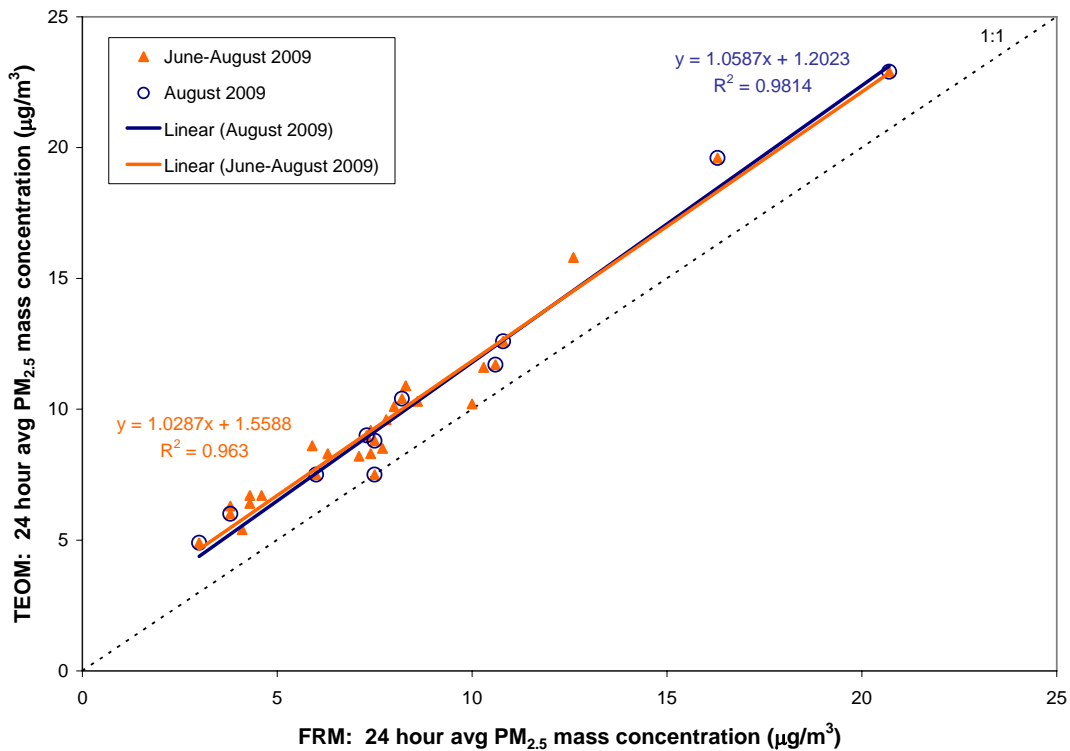


**Figure 6: Aerosol optical depth (AOD) image for August 19. Aerosol optical depth is a measure of the scattering and absorption of light by particles in a column of the atmosphere and is proportional to the particulate matter concentration. The AOD is dimensionless with a scale ranging from 0.0 to 1.0. Higher values (red) correspond to high particulate matter concentrations. Lower values are shown in blue. Clouds block the measurement of AOD and have no color. This image clearly shows the plume of smoke from wildfires in southwestern British Columbia carrying across the Spokane area. Compare this image to Figure 5b (note that the times at which the images were created do not correspond exactly).**



The Augusta monitoring station contains both automated and manual methods for monitoring PM<sub>2.5</sub>. The manually-operated Federal Reference Method (FRM) is the “gold-standard” for measurement of the 24-hour average particulate matter concentration and meets the requirements for demonstrating attainment of federal air quality standards. The accuracy of the TEOM sample data can be verified by comparison with co-located FRM data. The correlation coefficient (R<sup>2</sup>) for the PM<sub>2.5</sub> TEOM and FRM data was 0.98 for the month of August. The trend for the month was for the TEOM to over-report by about 2 µg/m<sup>3</sup> compared to the FRM (Figure 7).

**Figure 7: Comparison between Augusta Ave PM<sub>2.5</sub> TEOM and FRM data for August 2009. The combined June, July and August data are shown in orange. Blue circles and trend line represent the data for August only.**



Ground-level ozone concentrations followed the same general pattern as maximum daily temperatures in August. Ozone concentrations and ambient air temperatures increased under high pressure ridges, which allowed ample receipt of solar radiation during the long summer daylight hours with high sun angles. Figure 8 shows the eight hour running average daily maximum ozone concentrations measured within Spokane County in August.

**Figure 8: Eight hour maximum ozone concentrations for the Spokane region in August. Daily average wind speed and daily maximum temperature are also shown. Daily maximum temperature can be used as a surrogate for solar radiation (ozone is formed through a photochemical reaction) for determining potential ozone maximum concentrations. The threshold for the moderate category for the AQI for ozone is 0.06 ppm averaged over eight hours. An ozone measurement above 0.075 ppm, also averaged over eight hours, exceeds the standard set under the NAAQS.**

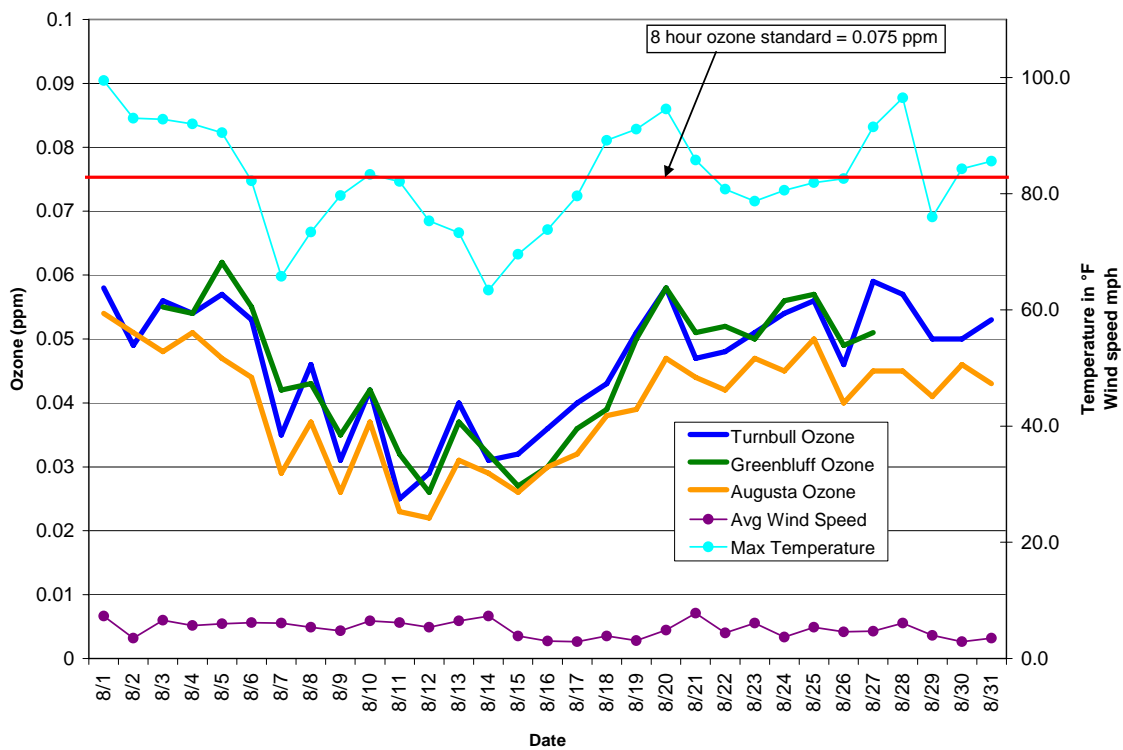


Table 4 summarizes the air quality data measured throughout the monitoring network in August.

**Table 4: Summary air quality data for August from all of the analyzers operated in Spokane County.** The CO and data are 8-hour maximums in parts per million (ppm) and the PM data are 24-hour averages in micrograms per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ). There are no Turnbull PM<sub>2.5</sub> FRM or Liberty Lake dichotomous PM data because SRCAA's microbalance was under repair.

Date	CO 3rd & Washington (ppm)	Ozone Greenbluff (ppm)	Ozone Turnbull Wildlife Refuge (ppm)	PM10 Augusta & Fiske FRM ( $\mu\text{g}/\text{m}^3$ )	M2.5 Augusta & Fiske FRM ( $\mu\text{g}/\text{m}^3$ )	PM2.5 Augusta & Fiske TEOM ( $\mu\text{g}/\text{m}^3$ )	PM2.5 Monroe & College TEOM ( $\mu\text{g}/\text{m}^3$ )	PM2.5 Monroe & Wellesley nephelometer ( $\mu\text{g}/\text{m}^3$ )	PM10 Turnbull Wildlife Refuge TEOM ( $\mu\text{g}/\text{m}^3$ )	PM10 Turnbull Wildlife Refuge FRM ( $\mu\text{g}/\text{m}^3$ )	PM2.5 Liberty Lake nephelometer ( $\mu\text{g}/\text{m}^3$ )	PM2.5 Deer Park TEOM ( $\mu\text{g}/\text{m}^3$ )	PM2.5 Spokane Valley TEOM ( $\mu\text{g}/\text{m}^3$ )	PM2.5 Airway Heights TEOM ( $\mu\text{g}/\text{m}^3$ )
8/1			0.06			11.3	11.9	10.6	24		11.6	11	8.6	10.6
8/2			0.05		16.3	19.6	19.9	17.5	35		18.3	18.9	18.5	20.2
8/3	0.5	0.06	0.06			19.5	18.3	17	53		20.2	20.1	17.6	18.2
8/4	0.7	0.05	0.05			10.5	10.6	8.2	26		11.2	14	9.3	20.4
8/5	0.8	0.06	0.06	35	10.8	12.6	13.5	9.9	32	32	11.4	13.4	11.8	14.5
8/6	0.9	0.06	0.05			11.9	12.3	8.7	44		11.6	11	11.2	15.1
8/7	0.8	0.04	0.04			9.3	10.9	10.9			7.6	10.8	7.7	11.3
8/8	0.7	0.04	0.05		10.6	11.7	11.6	12.4			12.6	10.1	11	11.2
8/9	0.7	0.04	0.03			8.5	8.3	9.4			9.9	9.7	7.7	7.6
8/10	0.7	0.04	0.04			6.6	6.4	5.3			5.6	6.6	4.7	7.1
8/11	0.5	0.03	0.03	19	3.0	4.9	4.8	2.2	19	17	3.2	5.9	5.4	5.3
8/12	0.7	0.03	0.03			5		2.3	7		2.1	3.9	4.6	4.6
8/13	0.6	0.04	0.04			3.8		2.9	7		2.6	4.8	2	5.2
8/14	0.5	0.03	0.03		3.8	6	5.6	3.8	12		4.2	5.7	5.8	5.9
8/15	0.5	0.03	0.03			6.4	7.9	4.6	10		4.4	5.2	5.7	5.6
8/16	0.5	0.03	0.04			6.5	6.1	5.6	8		5.3	4.6	6	5.6
8/17	0.6	0.04	0.04	18	7.5	7.5	7.2	5.6	20	20	6.1	6.2	7.1	6.7
8/18	0.4	0.04	0.04			12.5		9.6	30		9.8	9.8	10.7	13.3
8/19	0.7	0.05	0.05			23.4		20.8	43		22.7	21.9	22.6	19.9
8/20	0.7	0.06	0.06		20.7	22.9	23.4	24.3	54		24.7	21	22	22.4
8/21	0.5	0.05	0.05			12.2	11.6	9.5	34		10.8	8.3	10.7	11.2
8/22	0.5	0.05	0.05			8.2	7.8	6.9	17		6.9	13.9	8.9	7.5
8/23	0.5	0.05	0.05	24	7.3	9	8.8	7	22	22	7	12.5	8.4	8.8
8/24	0.7	0.06	0.05			10.8	9.9	7	31		7.9	12.2	10.8	9.5
8/25	0.7	0.06	0.06			11.6	11.3	8.3	38		7.8	11.1	9.4	12.5
8/26	0.8	0.05	0.05		7.5	8.8	8.9	5.7	44		5.8	8.9	8.2	7.5
8/27	0.8	0.05	0.06		6.0	7.5	8.3	4.3	37		3.9	6.6	6	7.9
8/28	0.6		0.06			9.2	9.2	4.9	49		4.9	7.6	8.7	10.4
8/29	0.5		0.05	28	8.2	10.4	10.3	7.6	22	18	8.3	12	11.8	10.3
8/30	0.6		0.05			8.7	8.8	7.5	17		8.3	9.6	9.1	8.1
8/31	0.9	0.06	0.05			8.4	7	5.9	23		6.3	10.2	7.8	7.4
avg	0.6	0.0	0.0	24.8	9.3	10.5	10.4	8.6	28.1	21.9	9.1	10.6	9.7	10.7
max	0.9	0.1	0.1	34.6	20.7	23.4	23.4	24.3	54.0	32.1	24.7	21.9	22.6	22.4

# Appendix

**Table A-1: National Ambient Air Quality Standards**

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide	9 ppm (10 mg/m <sup>3</sup> )	8-hour <sup>(1)</sup>	None	
	35 ppm (40 mg/m <sup>3</sup> )	1-hour <sup>(1)</sup>		
Lead	0.15 µg/m <sup>3</sup> <sup>(2)</sup>	Rolling 3-Month Average	Same as Primary	
	1.5 µg/m <sup>3</sup>	Quarterly Average	Same as Primary	
Nitrogen Dioxide	0.053 ppm (100 µg/m <sup>3</sup> )	Annual (Arithmetic Mean)	Same as Primary	
Particulate Matter (PM <sub>10</sub> )	150 µg/m <sup>3</sup>	24-hour <sup>(3)</sup>	Same as Primary	
Particulate Matter (PM <sub>2.5</sub> )	15.0 µg/m <sup>3</sup>	Annual <sup>(4)</sup> (Arithmetic Mean)	Same as Primary	
	35 µg/m <sup>3</sup>	24-hour <sup>(5)</sup>	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour <sup>(6)</sup>	Same as Primary	
	0.08 ppm (1997 std)	8-hour <sup>(7)</sup>	Same as Primary	
	0.12 ppm	1-hour <sup>(8)</sup> (Applies only in limited areas)	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Mean)	0.5 ppm (1300 µg/m <sup>3</sup> )	3-hour <sup>(1)</sup>
	0.14 ppm	24-hour <sup>(1)</sup>		

<sup>(1)</sup> Not to be exceeded more than once per year.

<sup>(2)</sup> Final rule signed October 15, 2008.

<sup>(3)</sup> Not to be exceeded more than once per year on average over 3 years.

<sup>(4)</sup> To attain this standard, the 3-year average of the weighted annual mean PM<sub>2.5</sub> concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m<sup>3</sup>.

<sup>(5)</sup> To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population oriented monitor within an area must not exceed 35 µg/m<sup>3</sup> (effective December 17, 2006).

<sup>(6)</sup> To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (Effective May 27, 2008)

<sup>(7)</sup> (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.  
(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.

<sup>(8)</sup> (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.  
(b) As of June 15, 2005 EPA revoked the 1-hour ozone standard in all areas except the 8-hour ozone nonattainment Early Action Compact (EAC) Areas.

**Table A-2: Air pollutant breakpoints for the Air Quality Index.**

Air Quality Index Levels of Health Concern	Color Code	Index Numerical Value	Breakpoints					Health Effects
			O <sub>3</sub> (ppm) 8-hour	O <sub>3</sub> (ppm) 1-hour <sup>(1)</sup>	PM <sub>2.5</sub> (µg/m <sup>3</sup> ) 24-hour	PM <sub>10</sub> (µg/m <sup>3</sup> ) 24-hour	CO (ppm) 8-hour	
<b>Good</b>	Green	0-50	0.000-0.059	<sup>(3)</sup>	0.0-15.4	0-54	0.0-4.4	Air quality is considered satisfactory and air pollution poses little or no risk.
<b>Moderate</b>	Yellow	51-100	0.060-0.075	<sup>(3)</sup>	15.5-35.4	55-154	4.5-9.4	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
<b>Unhealthy for Sensitive Groups</b>	Orange	101-150	0.076-0.095	0.125-0.164	35.5-65.4	155-254	9.5-12.4	People especially sensitive to air pollution may experience health effects. The general public is not likely to be affected. An AQI in this category or above indicates that air pollution exceeds levels acceptable under federal air quality standards.
<b>Unhealthy</b>	Red	151-200	0.096-0.115	0.165-0.204	65.5-150.4	255-354	12.5-15.4	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
<b>Very Unhealthy</b>	Purple	201-300	0.116-0.374	0.205-0.404	150.5-250.4	355-424	15.5-30.4	Health alert: everyone may experience more serious health effects.
<b>Hazardous</b>	Maroon	>300	<sup>(2)</sup>	0.405+	250.5+	425+	30.5+	Health warnings of emergency conditions. The entire population is more likely to be affected.

<sup>1</sup>Areas are generally required to report the AQI based on 8-hour ozone values. However, there are a small number of areas where an AQI based on 1-hour ozone values would be more precautionary. In these cases, in addition to calculating the 8-hour ozone index value, the 1-hour ozone index value may be calculated, and the maximum of the two values reported.

<sup>2</sup>8-hour O<sub>3</sub> values do not define higher AQI values (≥ 301). AQI values of 301 or greater are calculated with 1-hour O<sub>3</sub> concentrations.

<sup>3</sup>There is no AQI for 1-hour O<sub>3</sub> concentrations below the Unhealthy for Sensitive Groups level.