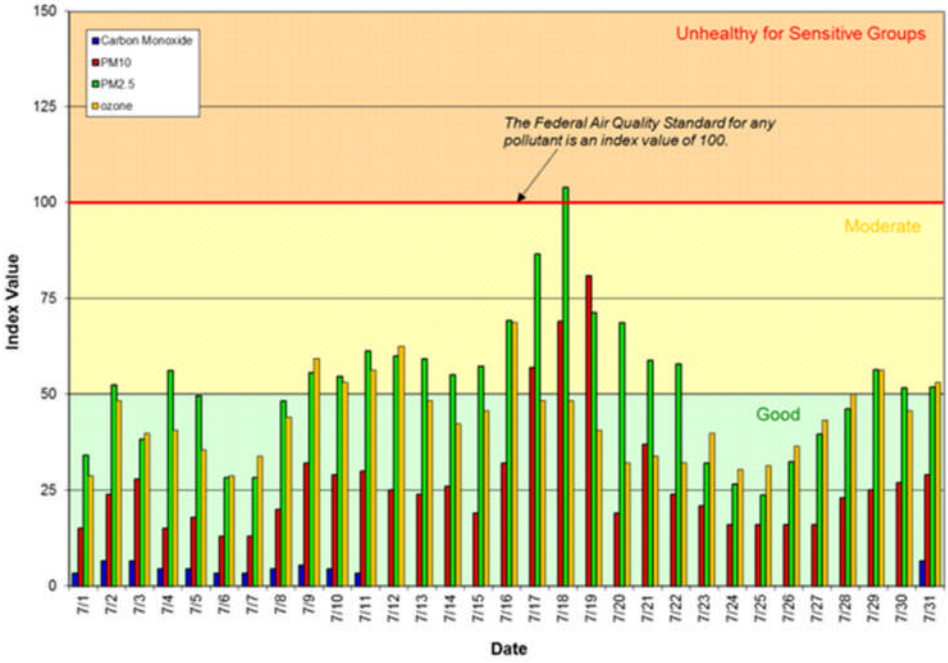
Spokane Regional Clean Air Agency
Air Quality Report - July 2014

July and August are the hottest and driest months in the Pacific Northwest and, in addition to September, are the most active in terms of wildfires. Wildfire smoke pushed fine particulate matter ($PM_{2.5}$) mass concentrations into the Unhealthy for Sensitive Groups (USG) category of the Air Quality Index (AQI) in the Spokane area for the first time this year (Figure 1). The maximum 24-hour (midnight-to-midnight) $PM_{2.5}$ mass concentration for the month was 37.3 $\mu g/m^3$ (AQI=105, USG) measured at the Colbert monitoring station. The AQI was in the Moderate category on 18 days in July, due primarily to wildfire smoke.

Figure 1: Air Quality Index (AQI) values for July 2014. The data represent the maximum AQI values across all monitoring stations within Spokane County.



An atmospheric high pressure ridge brought dry conditions and high temperatures about 10 to 15 °F above normal from July 8 through July 19. Two large eastern Washington wildfires, the Mills Canyon (22,571 acres; Chelan County) and Lake Spokane (1,016 acres; Stevens County) fires started on July 8 and 9, respectively. Spokane's air quality deteriorated starting on July 8 as hot, dry and smoky conditions took hold, conditions that allowed ground-level ozone and $PM_{2.5}$ concentrations to rise. Lightning associated with thunderstorms on July 14 ignited new fires in north central Washington, including the fires of the Carlton and Chiwaukum Complexes. Smoke plumes from these large fires are easily distinguishable on satellite imagery from July 17 (Figure 2) and resulted in a thick haze in the Spokane area (Figure 3). These fires grew slowly initially, but on July 16 and 17, a dry cold front brought strong westerly winds to the region which caused some of these fires to grow very rapidly. The Carlton Complex fires grew by 123,159 acres in a nine hour period on July 17. The fires burned mostly timber but also rangeland and about 400 structures in Okanogan County, including two square blocks of homes in the town of Pateros. Before the Carlton Complex fires were contained, they combined into one enormous burned area which covered 256,108 acres (400.2 sq. mi.), the largest in Washington's history. Fires of the Chiwaukum Complex burned 14,201 acres of timber in Chelan County. The strong westerly winds, which continued through the 19th, not only carried smoke from these fires to the Spokane area, but caused dust to blow. As a result, particulate matter (PM_{10}) reached AQI-Moderate levels for the first time this year on July 17, 18 and 19. Southwesterly wind with a maximum sustained speed of 33 mph was measured at Spokane International Airport on July 19.

One local fire of note, the Watermelon Hill Fire, seven miles southwest of Cheney in Lincoln and Spokane Counties, started on July 19 and burned about 11,071 acres. The smoke plume from the fire passed south of Spokane and was not detected by air monitors.

Figure 2: Satellite imagery showing smoke plumes from wildfires in north central Washington; July 17, 2014. The location of Spokane is marked in the right-center part of the image. National Weather Service/Spokane.

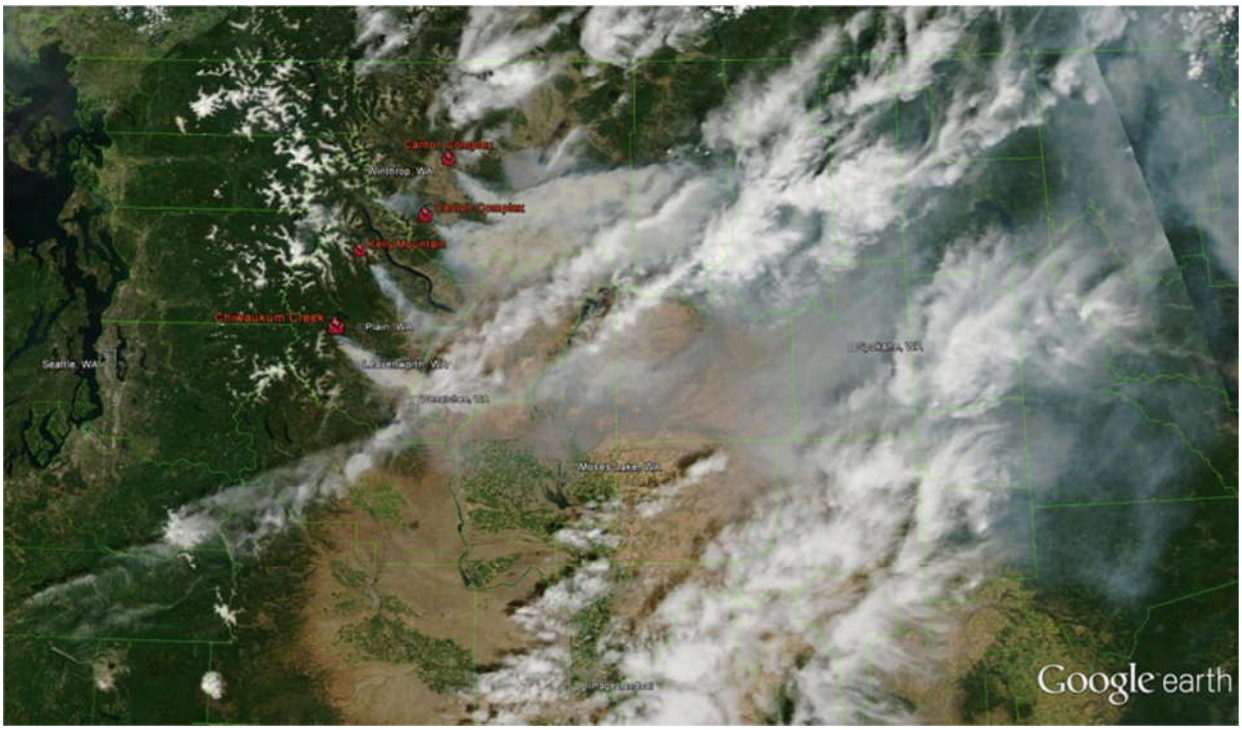


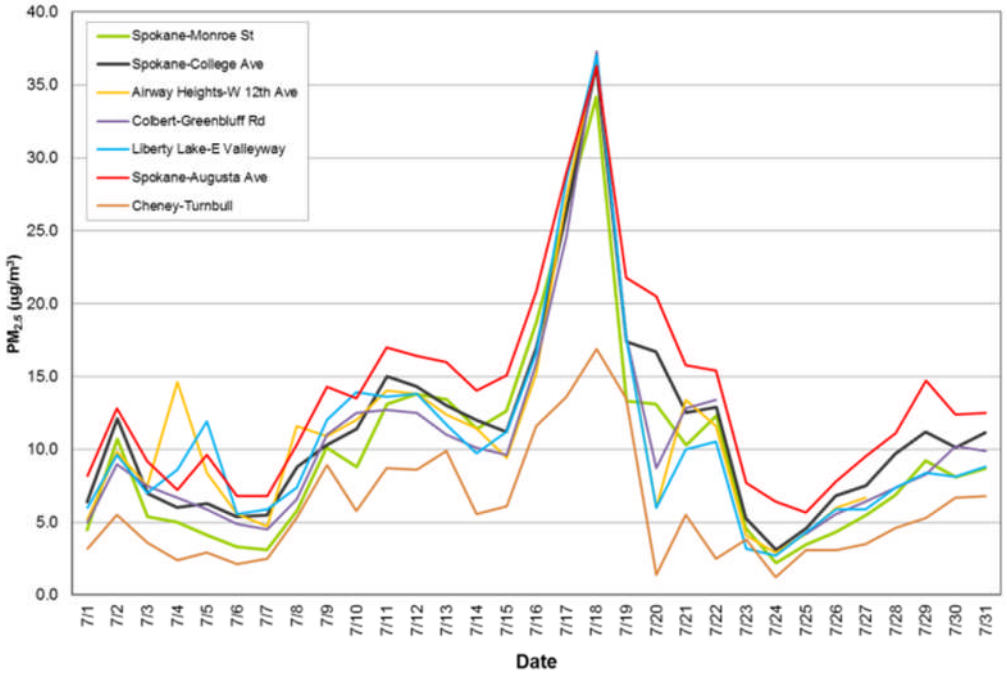
Figure 3: Spokane, looking west toward Sunset Hill; July 17, 2014. Dan Pelle/AP Photo.

Carbon monoxide was measured on twelve days in July, all of which were well within the Good range of the AQI.

See Appendix 1 of this report for information about federal air quality standards or Appendix 2 for a description of the AQI.

The particulate matter data which are used to determine the AQI and are used for other day-to-day operations are obtained using a network of automated monitors consisting of Tapered Element Oscillating Microbalances (TEOM) and nephelometers. Daily mass concentrations of $PM_{2.5}$ monitored in July throughout the network are shown in Figure 4. Background levels of $PM_{2.5}$ are monitored at the Cheney-Turnbull monitoring station, which is far from urban areas. All of the other stations measure a combination of regional and locally-generated air pollution in urban environments. Smoke from fireworks caused higher levels of $PM_{2.5}$ at the Airway Heights compared to other monitoring stations on July 4.

Figure 4: Multi-station 24-hour average $PM_{2.5}$ for July 2014; Spokane County.



The July daily air quality data for all monitoring stations in the Spokane region are provided in Appendix 3. Current and historical air quality data can be obtained electronically from Ecology's air monitoring data website, https://fortress.wa.gov/ecy/enviwa/Default.htm.

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.

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

Pollutant	AQI/Concentration	Location	Date
CO	7/0.6 ppm (8 hour)	Spokane, 3rd & Washington	7/2, 7/3 and 7/31
O_3	67/0.065 ppm (8 hour)	Spokane, Greenbluff	7/16
PM_{10}	64/81 µg/m3	Spokane, Augusta & Fiske	7/19
$PM_{2.5}$	105/37.3 µg/m3	Colbert, Greenbluff Rd.	7/18

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

Pollutant	AQI/Concentration	Location	Date
CO	18/1.6 ppm (8 hour)	Spokane, 3rd & Washington	1/14 and 5/14
O_3	67/0.065 ppm (8 hour)	Spokane, Greenbluff	7/16
PM_{10}	64/81 µg/m3	Spokane, Augusta & Fiske	7/19
$PM_{2.5}$	105/37.3 µg/m3	Colbert, Greenbluff Rd.	7/18

Table 3: AQI summary as of July 31, 2014

Category	Number of Days This Year	Last Year to Date (using post-3/18/2013 AQI)
Good (0-50)	180	153
Moderate (51-100)	31	58
Unhealthy for Sensitive Groups (101-150)	1	1
Unhealthy (151-200)	0	0
Very Unhealthy (201-300)	0	0
Hazardous (>300)	0	0

Wind speed and direction are measured at the SRCAA's office, located near the intersection of Mission Ave and Greene St in Spokane. At this site, stronger southerly (S) to southwesterly (SW) surface winds are associated with more active weather regimes and usually promote better air quality than light easterly (E) to northeasterly (NE) winds, which typically occur during periods of poor atmospheric ventilation. In July, however, southwesterly winds carried wildfire smoke to the Spokane area (Figures 5 and 6).

Figure 5: The wind rose depicts the variation of hourly average wind speed (mph) with the direction from which the wind was blowing in July.

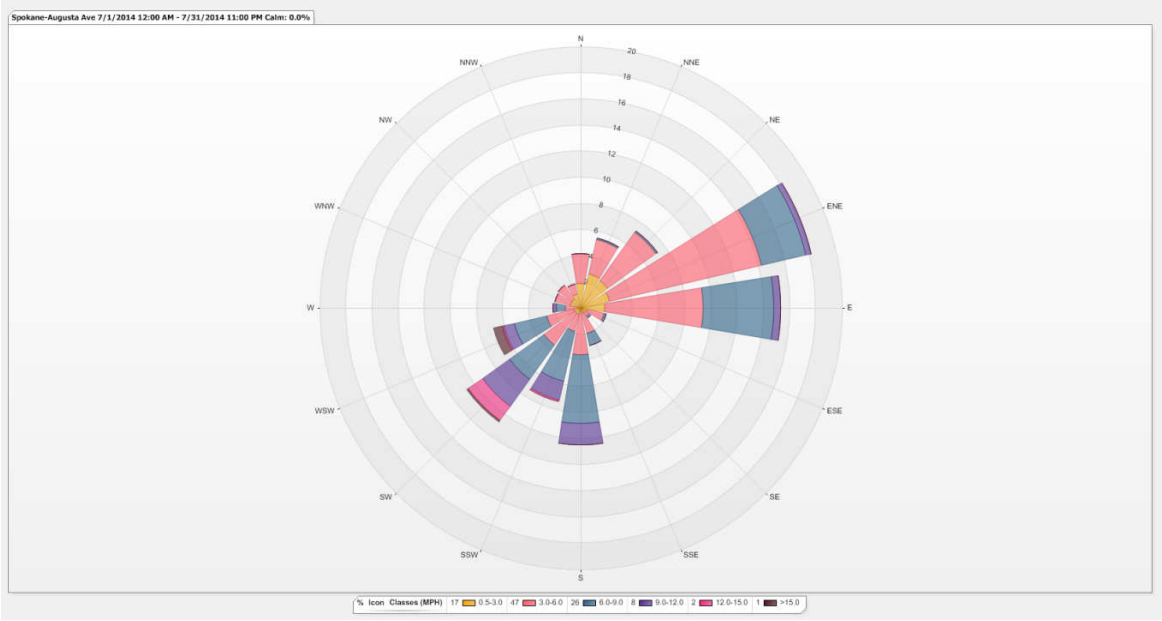
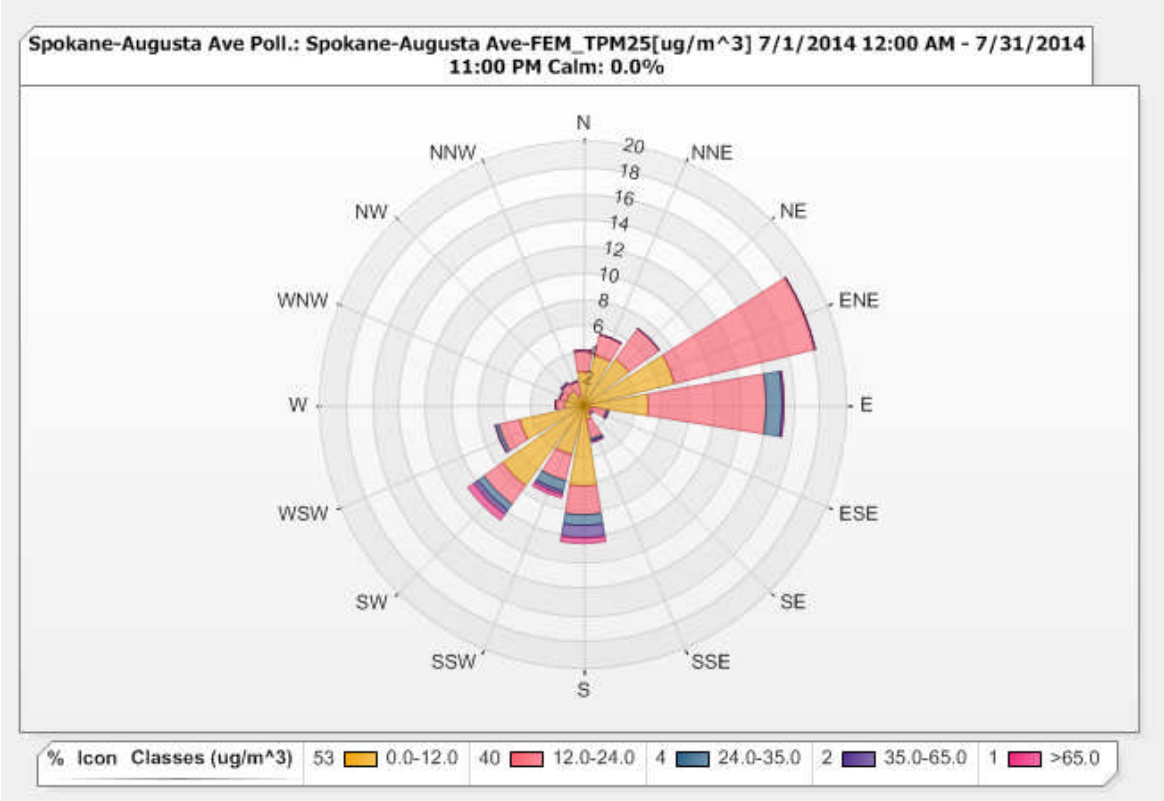


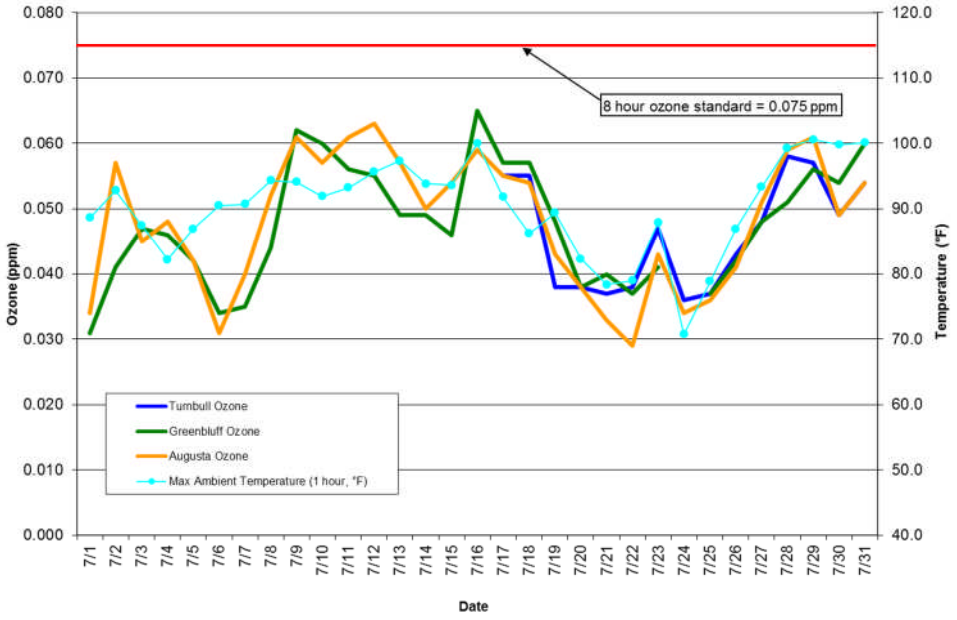
Figure 6: The $PM_{2.5}$ pollution rose depicts the variation of hourly average $PM_{2.5}$ ($\mu g/m^3$) with the direction from which the wind was blowing in July.



Ground-level ozone, a component of smog, is formed when nitrogen oxides and volatile organic compounds chemically react in the presence of sunlight. It is measured in units of parts per million (ppm) in ambient air. Ozone is a strong oxidizer and can damage lung tissue, thereby impairing respiratory function. The main sources of ozone precursors are motor vehicle emissions and refueling, gasoline storage and transport, paints, solvents and industry.

The maximum 8-hour running average ozone concentration for the month was 0.065 ppm on July 17 when the high temperature reached 100 °F (Figure 7). Eight hour average ozone concentrations in the range 0.060 to 0.075 ppm are considered "moderate" air quality by the AQI. When concentrations are below that level, air quality is "good" with respect to ground-level ozone.

<u>Figure 7</u>: Eight hour maximum ozone concentrations for the Spokane region in July. Daily 1-hour maximum temperatures 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 of the AQI for ozone is 0.06 ppm averaged over eight hours. An ozone measurement above 0.075 ppm, averaged over eight hours, is the threshold value for the federal ozone standard. It is not a violation of the standard to exceed this level on a given day because determination of attainment status is based on averaging data over a period of years. See Appendix 1 for more detailed information about attainment of federal air quality standards.



Appendix 1 – National Ambient Air Quality Standards

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_2), particulate matter (PM_{10} and $PM_{2.5}$), ground-level ozone (O_3) and sulfur dioxide (SO_2; Table A-1). 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. 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).

Table A-1: National Ambient Air Quality Standards

	Primary Standards		Secondary Standards	
Pollutant	**Level**	**Averaging Time**	**Level**	**Averaging Time**
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour [1]	None	
	35 ppm (40 mg/m^3)	1-hour [1]		
Lead	0.15 $\mu g/m^3$ [2]	Rolling 3-Month Average	Same as Primary	
	1.5 $\mu g/m^3$	Quarterly Average	Same as Primary	
Nitrogen Dioxide	53 ppb [3]	Annual (Arithmetic Average)	Same as Primary	
	100 ppb	1-hour [4]	None	
Particulate Matter (PM_{10})	150 $\mu g/m^3$	24-hour [5]	Same as Primary	
Particulate Matter ($PM_{2.5}$)	12.0 $\mu g/m^3$	Annual [6] (Arithmetic Average)	Same as Primary	
	35 $\mu g/m^3$	24-hour [7]	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour [8]	Same as Primary	
	0.08 ppm (1997 std)	8-hour [9]	Same as Primary	
	0.12 ppm	1-hour [10]	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Average)	0.5 ppm	3-hour [1]
	0.14 ppm	24-hour [1]		
	75 ppb [11]	1-hour	None	

[1] Not to be exceeded more than once per year.
[2] Final rule signed October 15, 2008.
[3] The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard
[4] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).
[5] Not to be exceeded more than once per year on average over 3 years.
[6] On March 18, 2013, EPA strengthened the annual fine particle standard by revising the level from 15.0 micrograms per cubic meter (µg/m3) to 12.0µg/m3 . An area will meet the standard if the three-year average of its annual average $PM_{2.5}$ concentration (at each monitoring site in the area) is less than or equal to 12.0 µg/m3 .
[7] 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/m3 (effective December 17, 2006).
[8] 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)
[9] (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.
(c) EPA is in the process of reconsidering these standards (set in March 2008).
[10] (a) EPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").
(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is $\leq$ 1.
[11] (a) Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.

Appendix 2 – Air Quality Index

The Air Quality Index (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; Table A-2). On March 18, 2013, EPA reduced the good to moderate breakpoint for $PM_{2.5}$ from 15.0 to 12.0 micrograms per cubic meter of air ($\mu g/m^3$).

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_3 (ppm) 8-hour	O_3 (ppm) 1-hour[1]	$PM_{2.5}$ ($\mu g/m^3$) 24-hour	PM_{10} ($\mu g/m^3$) 24-hour	CO (ppm) 8-hour	
Good	Green	0-50	0.000-0.059	[3]	0.0-12.0	0-54	0.0-4.4	Air quality is considered satisfactory and air pollution poses little or no risk.
Moderate	Yellow	51-100	0.060-0.075	[3]	12.1-35.4	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.
Unhealthy for Sensitive Groups	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.
Unhealthy	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.
Very Unhealthy	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.
Hazardous	Maroon	>300	[2]	0.405+	250.5+	425+	30.5+	Health warnings of emergency conditions. The entire population is more likely to be affected.

[1]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.

[2]8-hour O_3 values do not define higher AQI values (≥ 301). AQI values of 301 or greater are calculated with 1-hour O_3 concentrations.

[3]There is no AQI for 1-hour O_3 concentrations below the Unhealthy for Sensitive Groups level.

Appendix 3

Table A-3: Summary air quality data for July for air monitoring stations in Spokane County. The carbon monoxide and ozone data are maximum 8-hour running averages in parts per million (ppm) and the PM data are 24-hour averages in micrograms per cubic meter of air ($\mu g/m^3$). Fine particulate matter data are unavailable for East Broadway because the analyzer was at the manufacturer for repair. Monitoring was suspended at Airway Heights starting July 28 because the roof of Sunset Elementary School (where the monitor is located) was being resurfaced. The carbon monoxide monitor at 3rd & Washington and the ozone monitor at Turnbull were malfunctioning in July.

Date	CO 3rd & Washington (8 hour max, ppm)	Ozone Augusta & Fiske (ppm)	Ozone Greenbluff (ppm)	Ozone Turnbull NWR (ppm)	$PM_{2.5}$ Augusta & Fiske TEOM ($\mu g/m^3$)	$PM_{2.5}$ College Ave TEOM ($\mu g/m^3$)	$PM_{2.5}$ Colbert TEOM ($\mu g/m^3$)	$PM_{2.5}$ Airway Heights TEOM ($\mu g/m^3$)	$PM_{2.5}$ Turnbull NWR TEOM ($\mu g/m^3$)	$PM_{2.5}$ Monroe & Wellesley nephelometer ($\mu g/m^3$)	$PM_{2.5}$ Liberty Lake TEOM ($\mu g/m^3$)	PM_{10} Augusta & Fiske TEOM ($\mu g/m^3$)	PM_{10} Turnbull NWR TEOM ($\mu g/m^3$)
7/1	0.3	0.034	0.031	0.016	8.2	6.4	5.0	5.2	3.2	4.5	6.0	15	11
7/2	0.6	0.057	0.041	NA	12.8	12.1	9.0	9.8	5.5	10.7	9.6	24	16
7/3	0.6	0.045	0.047	NA	9.2	7.0	7.5	7.5	3.6	5.4	7.0	28	15
7/4	0.4	0.048	0.046	NA	7.2	6.0	6.7	14.6	2.4	5.0	8.6	15	8
7/5	0.4	0.042	0.042	NA	9.6	6.3	5.9	8.4	2.9	4.1	11.9	18	8
7/6	0.3	0.031	0.034	NA	6.8	5.4	4.9	5.6	2.1	3.3	5.6	13	9
7/7	0.3	0.040	0.035	NA	6.8	5.5	4.5	4.7	2.5	3.1	5.9	13	11
7/8	0.4	0.052	0.044	NA	10.3	8.8	6.6	11.6	5.3	5.8	7.4	20	17
7/9	0.5	0.061	0.062	NA	14.3	10.3	11.0	10.9	8.9	10.1	12.0	32	24
7/10	0.4	0.057	0.060	NA	13.5	11.4	12.5	12.0	5.8	8.8	13.9	29	17
7/11	0.3	0.061	0.056	NA	17.0	15.0	12.7	14.0	8.7	13.1	13.6	30	27
7/12	NA	0.063	0.055	NA	16.4	14.3	12.5	13.8	8.6	13.8	13.8	25	21
7/13	NA	0.057	0.049	NA	16.0	13.0	11.0	12.4	9.9	13.4	11.7	24	22
7/14	NA	0.050	0.049	NA	14.0	12.0	10.1	11.4	5.6	11.4	9.7	26	15
7/15	NA	0.054	0.046	NA	15.1	11.2	9.6	9.4	6.1	12.6	11.2	19	14
7/16	NA	0.059	0.065	NA	20.8	17.0	15.9	15.2	11.6	18.8	16.6	32	24
7/17	NA	0.055	0.057	0.055	29.0	26.1	24.6	27.3	13.6	26.3	28.5	57	36
7/18	NA	0.054	0.057	0.055	36.3	36.4	37.3	37.0	16.9	34.2	37.0	69	39
7/19	NA	0.043	0.048	0.038	21.8	17.4	17.8	17.8	13.5	13.3	17.7	81	52
7/20	NA	0.038	0.038	0.038	20.5	16.7	8.7	6.0	1.4	13.1	6.0	19	7
7/21	NA	0.033	0.040	0.037	15.8	12.5	12.8	13.4	5.5	10.3	10.0	37	22
7/22	NA	0.029	0.037	0.038	15.4	12.9	13.4	11.6	2.5	12.3	10.5	24	8
7/23	NA	0.043	0.041	0.047	7.7	5.3	NA	4.1	3.8	4.6	3.2	21	14
7/24	NA	0.034	NA	0.036	6.4	3.1	NA	2.9	1.2	2.2	2.7	16	7
7/25	NA	0.036	0.037	0.037	5.7	4.6	4.2	4.2	3.1	3.5	4.3	16	10
7/26	NA	0.041	0.042	0.043	7.8	6.8	5.6	6.0	3.1	4.3	5.9	16	10
7/27	NA	0.051	0.048	0.048	9.5	7.5	6.4	6.7	3.5	5.5	5.9	16	10
7/28	NA	0.059	0.051	0.058	11.1	9.7	7.4	NA	4.6	6.9	7.4	23	16
7/29	NA	0.061	0.056	0.057	14.7	11.2	8.3	NA	5.3	9.2	8.4	25	18
7/30	NA	0.049	0.054	0.049	12.4	10.1	10.2	NA	6.7	8.1	8.1	27	23
7/31	0.6	0.054	0.060	0.054	12.5	11.1	9.9	NA	6.8	8.7	8.8	29	24
AVG	0.4	0.048	0.048	0.044	13.7	11.4	10.8	11.2	5.9	9.9	10.6	27	18
MAX	0.6	0.063	0.065	0.058	36.3	36.4	37.3	37.0	16.9	34.2	37.0	81	52