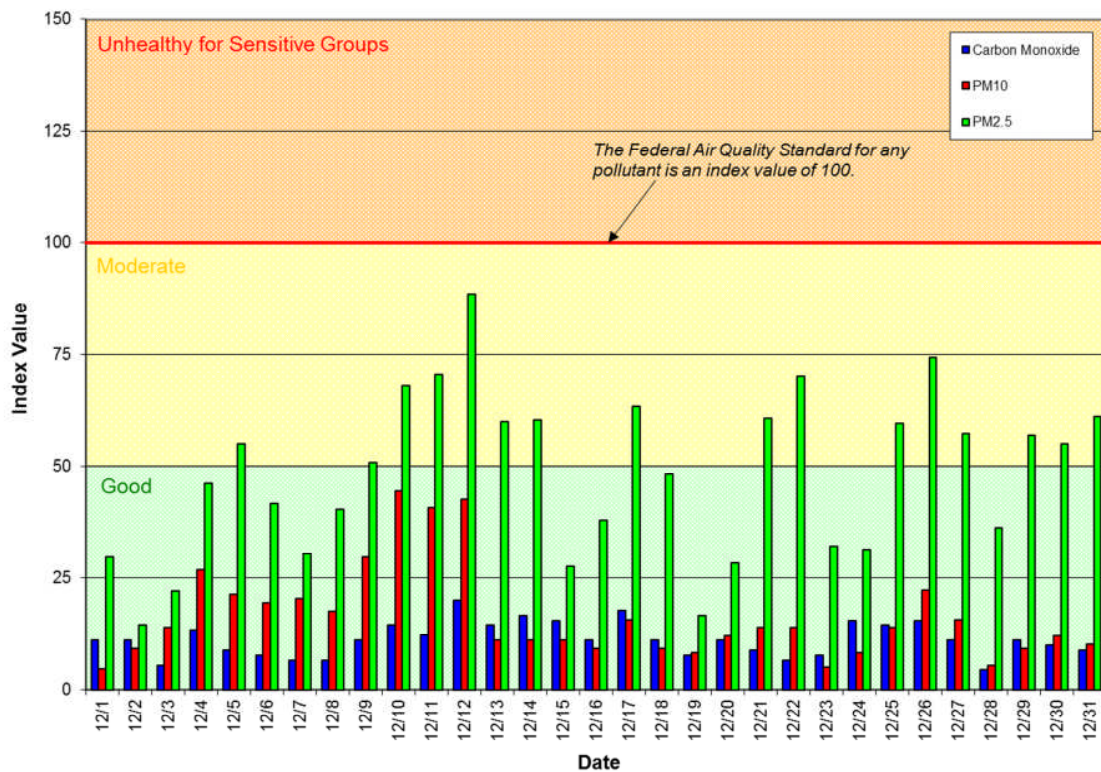


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The weather pattern in December consisted mostly of high pressure ridging, which brought rising air pollution levels, occasionally broken up by weather disturbances and improved air quality. Fine particulate matter (PM_{2.5}) deteriorated to “moderate” levels as determined by the Air Quality Index (AQI) on sixteen days in December. Particulate matter (PM₁₀) and carbon monoxide remained in the “good” range of the AQI.

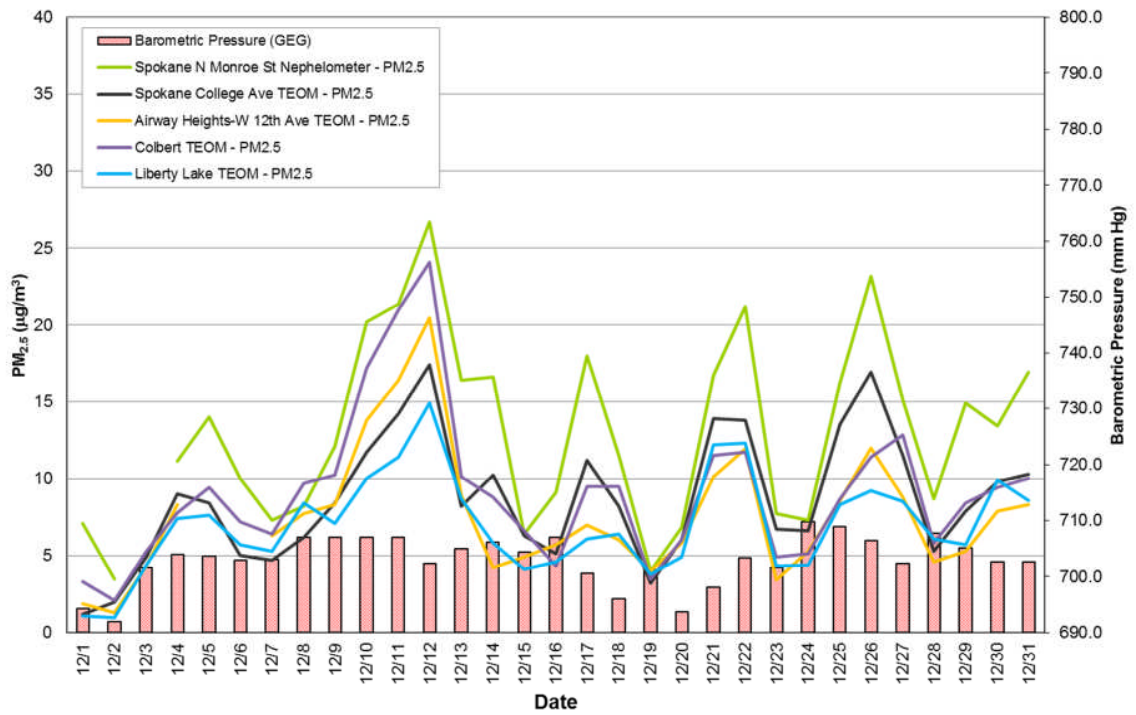
See Appendix 1 of this report for information about federal air quality standards or Appendix 2 for a description of the AQI.

Figure 1: Air Quality Index (AQI) values for December 2013



The particulate matter data used to determine the AQI and for other day-to-day operations are obtained using a network of automated particulate matter monitors consisting of Tapered Element Oscillating Microbalances (TEOM) and nephelometers. Daily mass concentrations of PM_{2.5} monitored in December throughout the network are shown in Figure 2.

Figure 2: PM_{2.5} multi-station time series for December 2013



The December 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 via their air monitoring data website, <https://fortress.wa.gov/ecy/enwiwa/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	20/1.8 ppm (8 hour)	Spokane, 3 rd & Washington	12/12
PM ₁₀	44/48 µg/m ³	Spokane, Augusta & Fiske	12/10
PM _{2.5}	88/29.9 µg/m ³	Spokane, Augusta & Fiske	12/12

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

Pollutant	AQI/Concentration	Location	Date
CO	27/2.4 ppm (8 hour)	Spokane, 3 rd & Washington	1/25
O3	88/0.071 ppm (8 hour)	Spokane, Augusta & Fiske	8/12
PM ₁₀	58/69 µg/m ³	Spokane, Augusta & Fiske	2/15
PM _{2.5}	106/38.4 µg/m ³	Spokane, Monroe & Wellesley	11/24

Table 3: AQI summary as of December 31, 2013. The numbers in parentheses are the number of days that would have fallen into each category had the AQI good-to-moderate breakpoint for PM_{2.5} not been reduced on March 18, 2013 (see Appendix 2). Otherwise the numbers here depict the number of days in each category as they were originally reported.

Category	Number of Days This Year	Last Year to Date
Good (0-50)	260 (274)	314
Moderate (51-100)	103 (89)	48
Unhealthy for Sensitive Groups (101-150)	1 (1)	3
Unhealthy (151-200)	1 (1)	0
Very Unhealthy (201-300)	0	0
Hazardous (>300)	0	0

In December, days when air quality, based on PM_{2.5}, deteriorated were characterized by light northerly (N) to northwesterly (NW) air flow in the Spokane area (Figures 3 and 4).

Figure 3: The wind rose depicts the variation of hourly average wind speed (mph) with the direction from which the wind was blowing in December.

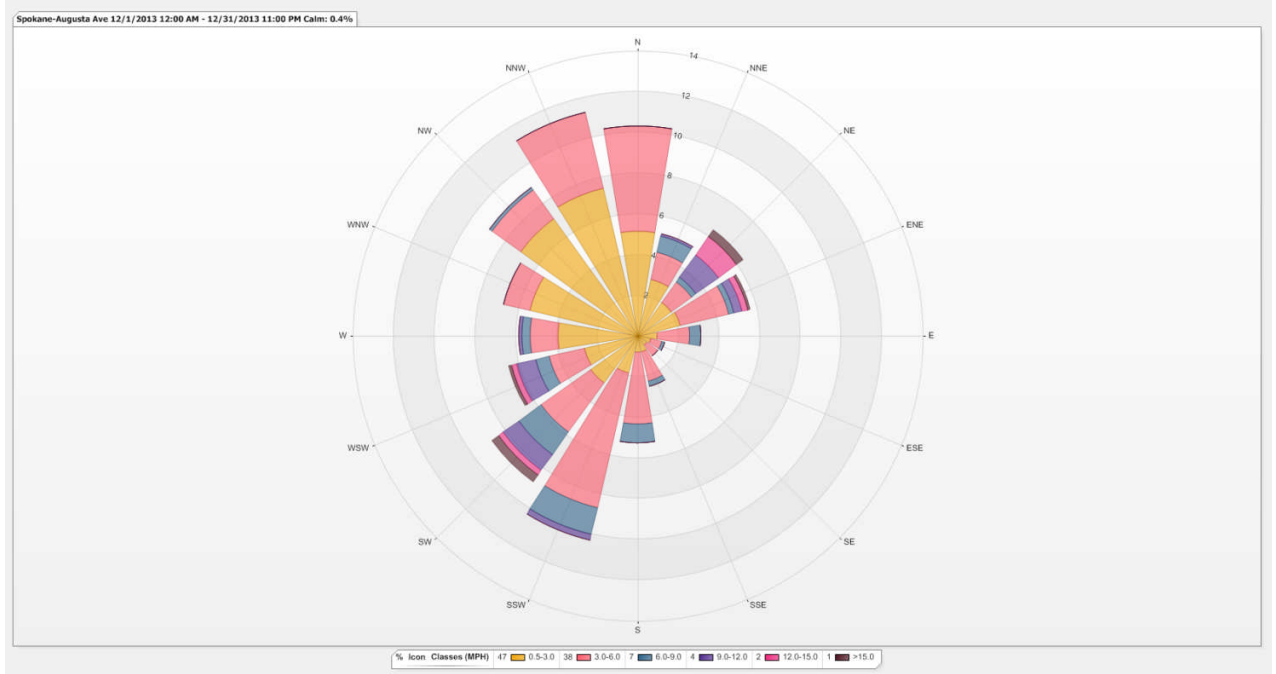
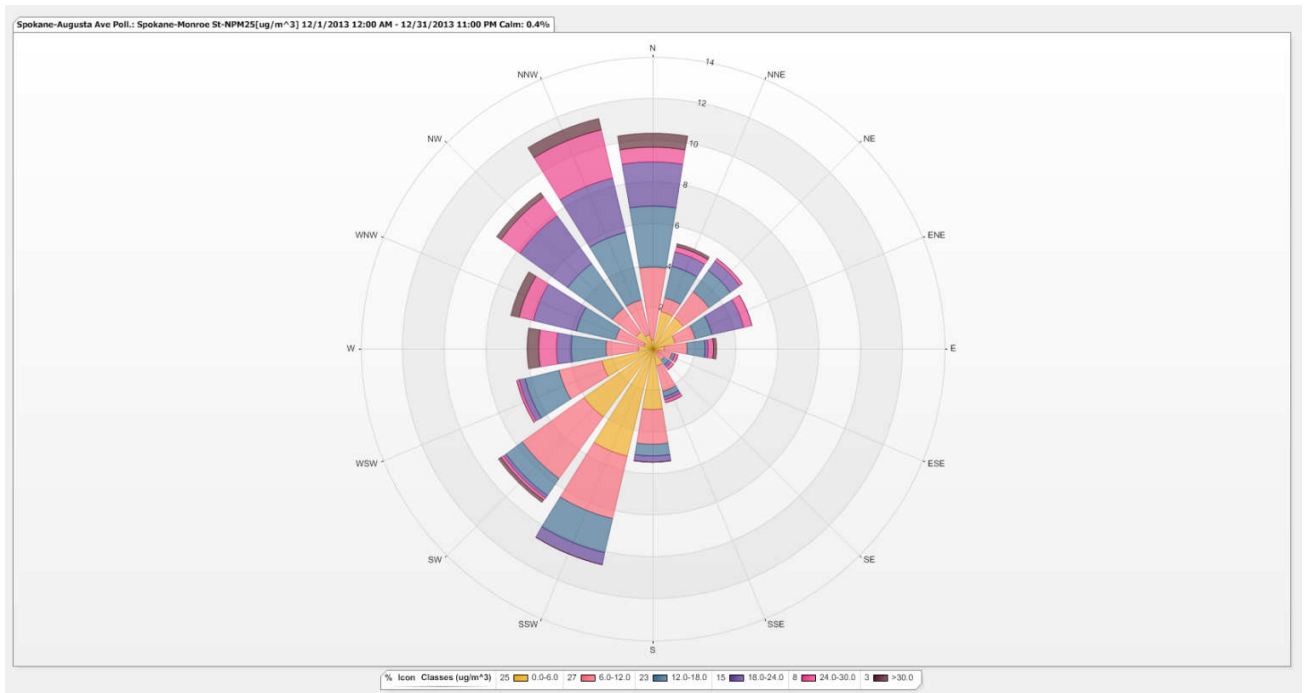


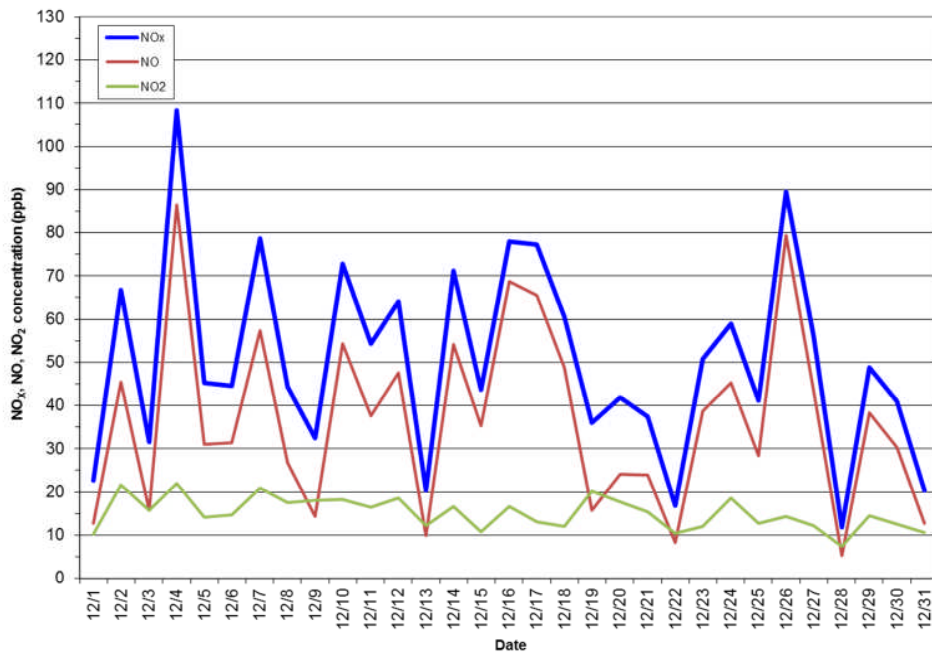
Figure 4: The PM_{2.5} pollution rose depicts the variation of hourly average PM_{2.5} ($\mu\text{g}/\text{m}^3$) with the direction from which the wind was blowing in December.



Nitrogen oxides (NO_x) are a group of highly reactive gases that contain nitrogen and oxygen. In ambient air, they consist primarily of nitric oxide (NO) and nitrogen dioxide (NO₂). The 2005 emissions inventory estimated that, on an annual basis, 59% of NO_x emissions in Spokane County are from on-road mobile sources, cars and trucks, and 24% are from non-road mobile sources, e.g., construction heavy equipment. The remaining 17% comes from a variety of sources, such as natural emissions from soil and vegetation (6%), industrial, commercial and institutional point sources (5%), residential fuel use (4%), e.g., natural gas and oil for heating and cooking, wood stoves and fireplaces (1%) and open burning, wildfires and structure and vehicle fires (1%). Nitrogen oxides react with volatile organic compounds (VOCs) in the presence of sunlight to form ozone.

The SRCAA monitors nitrogen oxides at the Spokane Augusta & Fiske monitoring station. Nitrogen dioxide is a criteria air pollutant defined in the NAAQS (see Appendix 1 of this report), but is not a significant problem in the Spokane area. The one-hour maximum concentrations of the nitrogen oxides monitored in December at the Augusta & Fiske monitoring station are shown in figure 5.

Figure 5: One hour maximum concentrations of nitrogen oxides and hydrocarbons for Spokane Augusta Ave monitoring station in December. The federal standard daily 1-hour maximum for nitrogen dioxide (NO₂) is 100 ppb. The NAAQS does not set limits on the other air pollutants shown here.



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 (NO₂), particulate matter (PM₁₀ and PM_{2.5}), ground-level ozone (O₃) and sulfur dioxide (SO₂; 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

Pollutant	Primary Standards		Secondary Standards	
	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 µg/m ³ ⁽²⁾	Rolling 3-Month Average	Same as Primary	
	1.5 µg/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 µg/m ³	24-hour ⁽⁵⁾	Same as Primary	
Particulate Matter (PM _{2.5})	12.0 µg/m ³	Annual ^(6,12) (Arithmetic Average)	Same as Primary	
	35 µg/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 NO₂ 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⁾ To attain this standard, the 3-year average of the weighted annual mean PM_{2.5} concentrations from single or multiple community-oriented monitors must not exceed 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 ≤ 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.

⁽¹²⁾ EPA revised the annual PM_{2.5} standard from 15 to 12 µg/m³, effective March 18, 2013.

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). The breakpoint between the good and moderate categories for the AQI for PM_{2.5} was changed from 15 to 12 µg m⁻³, effective March 18, 2013.

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} (µg/m ³) 24-hour	PM ₁₀ (µg/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.

¹Areas 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.

²8-hour O₃ values do not define higher AQI values (≥ 301). AQI values of 301 or greater are calculated with 1-hour O₃ concentrations.

³There is no AQI for 1-hour O₃ concentrations below the Unhealthy for Sensitive Groups level.

Appendix 3

Table A-3: Summary air quality data for December for air monitoring stations in Spokane County. The carbon monoxide 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 ($\mu\text{g}/\text{m}^3$). Missing $\text{PM}_{2.5}$ data for the Spokane Valley – E Broadway and Augusta & Fiske stations resulted from monitor malfunctions.

Date	CO 3rd & Washington (8 hour max, ppm)	PM _{2.5} Augusta & Fiske FRM ($\mu\text{g}/\text{m}^3$)	PM _{2.5} Augusta & Fiske TEOM ($\mu\text{g}/\text{m}^3$)	PM _{2.5} College Ave TEOM ($\mu\text{g}/\text{m}^3$)	PM _{2.5} Colbert TEOM ($\mu\text{g}/\text{m}^3$)	PM _{2.5} Spokane Valley - E Broadway TEOM ($\mu\text{g}/\text{m}^3$)	PM _{2.5} Airway Heights TEOM ($\mu\text{g}/\text{m}^3$)	PM _{2.5} Turnbull NWR TEOM ($\mu\text{g}/\text{m}^3$)	PM _{2.5} Monroe & Wellesley nephelometer ($\mu\text{g}/\text{m}^3$)	PM _{2.5} Liberty Lake TEOM ($\mu\text{g}/\text{m}^3$)	PM ₁₀ Augusta & Fiske TEOM ($\mu\text{g}/\text{m}^3$)	PM ₁₀ Turnbull NWR TEOM ($\mu\text{g}/\text{m}^3$)
12/1	1.0			1.2	3.3		1.9	3.2	7.1	1.1	2	5
12/2	1.0			2.0	2.1		1.3	1.2	3.5	1.0	10	2
12/3	0.5			4.9	5.3		4.3	1.6		4.4	15	4
12/4	1.2			9.0	7.8		8.3		11.1	7.4	29	
12/5	0.8			8.4	9.4			1.5	14.0	7.6	23	2
12/6	0.7	9.2		5.0	7.2			2.2	10.0	5.7	21	5
12/7	0.6			4.7	6.4		6.3	3.5	7.3	5.3	22	5
12/8	0.6			6.2	9.7		7.7	5.3	8.2	8.4	19	8
12/9	1.0			8.4	10.2		8.3	1.7	12.1	7.1	32	4
12/10	1.3			11.7	17.2		13.8	3.8	20.2	10.0	48	7
12/11	1.1			14.2	21.0		16.4	4.5	21.4	11.4	44	9
12/12	1.8	29.9		17.4	24.1		20.5	5.5	26.7	14.9	46	8
12/13	1.3			8.2	10.1		8.9	6.4	16.4	8.7	12	8
12/14	1.5			10.2	8.8		4.2	3.1	16.6	5.8	12	4
12/15	1.4			6.3	6.6		4.9	1.2	6.4	4.1	12	5
12/16	1.0			5.1	4.3		5.7	0.5	9.1	4.6	10	2
12/17	1.6			11.2	9.5		7.0	2.1	18.0	6.1	17	3
12/18	1.0	11.6		8.2	9.5		6.0	3.4	11.5	6.4	10	4
12/19	0.7			3.2	3.5		4.0	1.2	4.0	3.8	9	2
12/20	1.0			6.0	6.0		5.8	1.9	6.8	4.9	13	3
12/21	0.8			13.9	11.5		10.1	3.8	16.7	12.2	15	5
12/22	0.6			13.8	11.7		11.9	4.0	21.2	12.3	15	5
12/23	0.7			6.7	4.9		3.4	3.6	7.7	4.3	5	6
12/24	1.4	7.5		6.6	5.1		5.3	1.3	7.3	4.4	9	2
12/25	1.3			13.5	8.7		8.6	4.1	16.2	8.3	15	4
12/26	1.4			16.9	11.4		12.0	8.7	23.2	9.2	24	9
12/27	1.0			11.5	12.8		8.8	6.4	15.1	8.5	17	7
12/28	0.4			5.3	5.8		4.6	4.2	8.7	6.1	6	5
12/29	1.0			7.9	8.4		5.3	2.1	14.9	5.7	10	3
12/30	0.9	14.0		9.8	9.4		7.9	3.4	13.4	9.9	13	4
12/31	0.8			10.3	10.0		8.3	4.8	16.9	8.6	11	5
AVG	1.0	14.4		8.6	9.1		7.6	3.3	13.1	7.0	18	5
MAX	1.8	29.9		17.4	24.1		20.5	8.7	26.7	14.9	48	9