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PUGET SOUND CLEAN AIR AGENCY **www.pscleanair.org**

1998
Air Quality Data Summary

July 2000

Working Together for Clean Air

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The 1998 Air Quality Data Summary is available for viewing or download on the internet at:

www.pscleanair.org/ds98

Links to additional documents for download are also available at the web site.

This material is available in alternate formats for people with disabilities. Please call Carol Pogers at (206) 689-4080 (1-800-552-3565, ext. 4080).

Executive Overview

Air Monitoring

In 1998 the Puget Sound Clean Air Agency began a significant upgrade of the fine particulate matter monitoring network to meet federal reference method requirements. We have led the way in implementing the new $PM_{2.5}$ monitoring network and have established seven new sites on schedule. The agency has undertaken a review of the sulfur dioxide (SO_2) monitoring network and intends to discontinue monitors that continue to show low ambient concentrations. Our agency and the Washington State Department of Ecology now show real-time air monitoring data on the Internet at www.pscleanair.org or http://airr.ecy.wa.gov/Public/aqn.html, respectively.

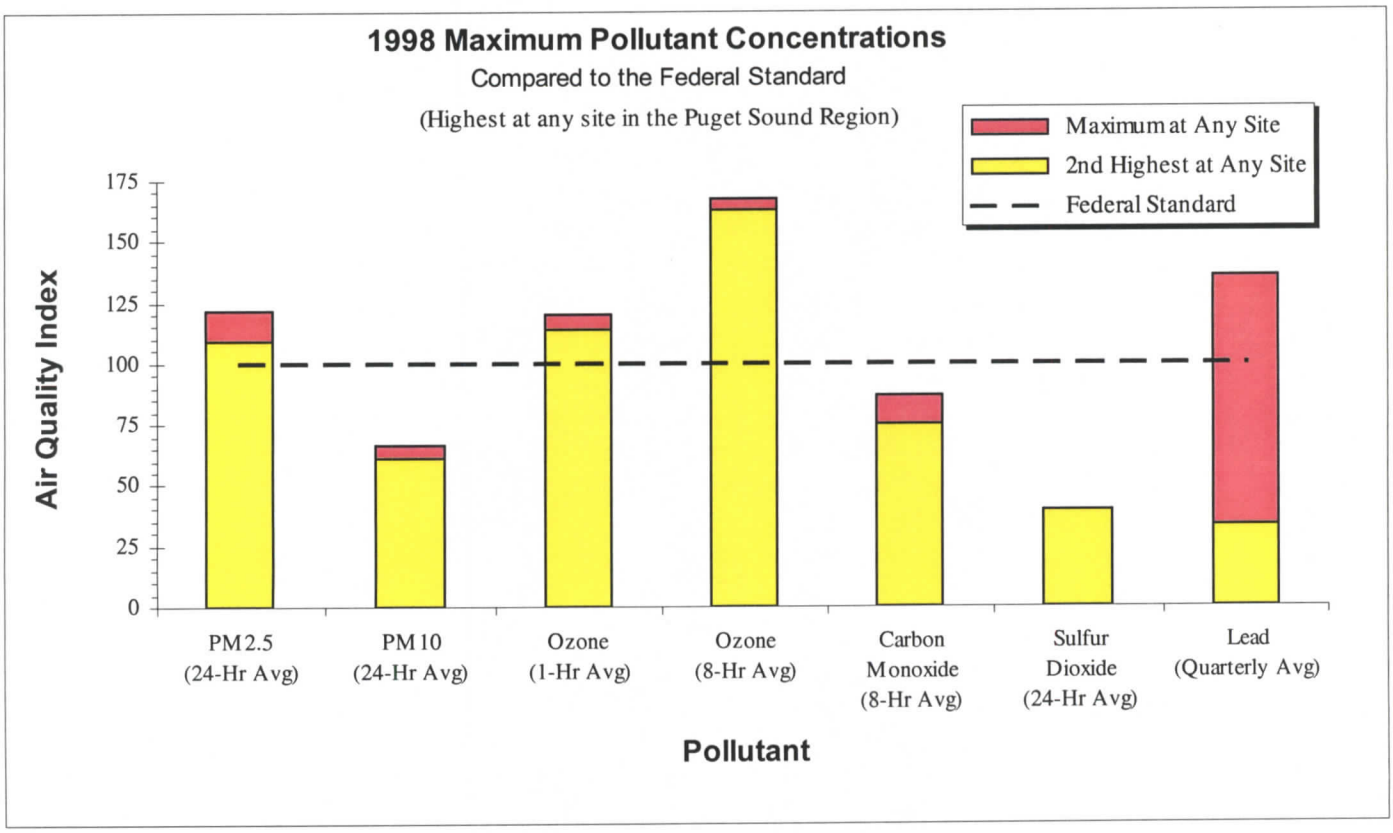
For many years, we have measured no violations of the national ambient air quality standards — our standards for clean air. In 1998, however, the quarterly federal standard for lead was violated April through June. The source of this violation was a lead smelting facility that ceased all operations in May of 1998. Enforcement action was taken against the facility and lead concentrations returned to their normal low levels during the last two quarters of the year. Based on comments from the Washington State Health Department, no significant health risk was expected from this one quarter's anomaly in lead concentrations.

During 1998 our region's weather pattern was greatly influenced by the El Niño (January -March) and La Niña (April-December) effects. This resulted in conditions conducive to good air quality due to the absence of extended air stagnation. Despite a record cool summer in 1998, there were ozone values that exceeded the one-hour and eight-hour ozone federal standards. However, the number of times these ozone values exceeded the thresholds did not constitute a violation of the federal standards.

There were no days of unhealthy air quality measured on the former Pollutant Standard Index (PSI), but there were periods that were classified as “unhealthy” as defined by the new air quality index (AQI). The number of good air quality days still continues to dominate regionally. For more information regarding the new air quality index, visit our daily AQI report on the web.

No air pollution watches or burn bans were issued in calendar year 1998. When necessary, the agency calls an air pollution watch to reduce particulate matter pollution by voluntary curtailment of wood burning. Burn bans are issued when real-time monitoring data shows "impaired air quality" as defined by state law. There were also no smog watches called in 1998. An ozone "smog watch" is called to target mobile combustion sources for voluntary reductions to prevent ozone standard exceedances.

The chart below compares 1998 maximum pollution levels to the federal standards.



The highest concentrations and lowest visibility measured during 1998

Parameter	Max/Min	Value	Units	Averaging Time	Standard	Monitoring Station	Date	Time
$PM_{2.5}$	Max	71	$\mu g/m^3$	24 Hour	65	Marysville JHS, 1605 7th St, Marysville	Tuesday, December 22nd	full day
PM_{10}	Max	87	$\mu g/m^3$	24 Hour	150	27th St NE & 54th Ave NE, Tacoma	Wednesday, April 29th	full day
Ozone	Max	140	ppb	1 Hour	120	Charles L Pack Forest, LaGrande	Monday, July 27th	5 - 6 PM
Ozone	Max	111	ppb	8 Hour	84	30525 Mud Mountain Rd, Enumclaw	Monday, July 27th	11 AM - 7 PM
Visibility	Min	4.5	miles	1 Hour	none	17711 Ballinger Way NE, Lake Forest Park	Sunday, December 20th	10 - 11 PM
Visibility	Min	12.9	miles	24 Hour	none	17711 Ballinger Way NE, Lake Forest Park	Wednesday, December 23rd	all day
CO	Max	8.1	ppm	8 Hour	9	44th Ave W & 196th St SW, Lynnwood	Tues-Wed, October 20th-21st	6 PM - 2 AM
CO	Max	14.2	ppm	1 Hour	35	44th Ave W & 196th St SW, Lynnwood	Wednesday, October 21st	5-6 PM
SO_2	Max	27	ppb	24 Hour	100	2301 Alexander Ave, Tacoma	Thursday, October 22nd	full day
Lead	Max	2.03	$\mu g/m^3$	Calendar Quarter	1.5	Harbor Island, 2555 13th Ave SW, Seattle	April-June	2nd quarter

Lead (Pb)

The quarterly federal standard for lead was violated during the period of April through June 1998. The source of this violation was determined to be a lead processing facility, which ceased all operations in May of 1998. Enforcement action was taken against the facility. Lead concentrations returned to their normally low levels during the next two quarters of the year. No significant health risk was expected from this one quarter anomaly in lead concentrations, according to the Washington State Health Department.

Other Hazardous Air Pollutants (HAP) and Toxic Air Contaminants (TAC)

In 1998 over 150 facilities reported 3,000 tons per year emissions of HAPs and 4,000 tons per year of TACs. No estimates were made for the other source categories. Estimates for the other source categories are calculated periodically. The last complete toxics emission inventory was completed in 1986. Many of the substances listed below are found in common household products. For details on their toxicity visit the EPA web site at www.epa.gov.

1998 Highest HAP Point Source Emissions

Rank	CAS #	Chemical	Tons
1	78-93-3	Methyl ethyl ketone	543
2	108-88-3	Toluene	453
3	1330-20-7	Xylenes	299
4	100-42-5	Styrene	201
5	67-56-1	Methyl alcohol	131
6	79-01-6	Trichloroethylene	127
7	108-10-1	Methyl isobutyl ketone	114
8	111-76-2	Butyl cellosolve	97
9	75-09-2	Methylene chloride	59
10	50-00-0	Formaldehyde	39

We encourage you to visit our web site at www.pscleanair.org to find more extensive air quality data, air quality education and current topics of interest. We are expanding our Internet site with monthly air quality data summaries. We also now provide a link to real-time air monitoring data from the Washington State and Local Air Monitoring (SLAM) network. We want to receive your feedback on our air quality data. Please submit concerns via email to: maryh@pscleanair.org or call us at (206) 689-4006.

Monitoring Network

The 1998 Puget Sound air monitoring network was a composite of meteorological and pollutant-specific monitoring equipment. This equipment was both manual and automated: data measurements were collected by our field staff or sent directly via a telemetry network. Our agency and the Washington State Department of Ecology operated all monitoring sites. Air quality monitoring was conducted for PM_{10}, $PM_{2.5}$, lead, carbon monoxide, ozone, sulfur dioxide, oxides of nitrogen and visibility. Meteorological parameters measured were temperature, wind speed and direction.

Monitoring equipment siting is based on numerous parameters. The use of U.S. EPA siting criteria ensures a consistent and representative picture of air quality. However, some sites are selected to focus on the emissions of a single air pollution source or group of sources. Some sites are intended to be representative of an industrial area, while others may be oriented toward residential air pollution. The map on the following page shows how these sites are spread geographically throughout our area. All 33 monitoring sites in our four-county area, their locations, and type of monitoring are listed on the following pages. The Map ID numbers correspond with numbered locations on the monitoring network map.

Note taking section

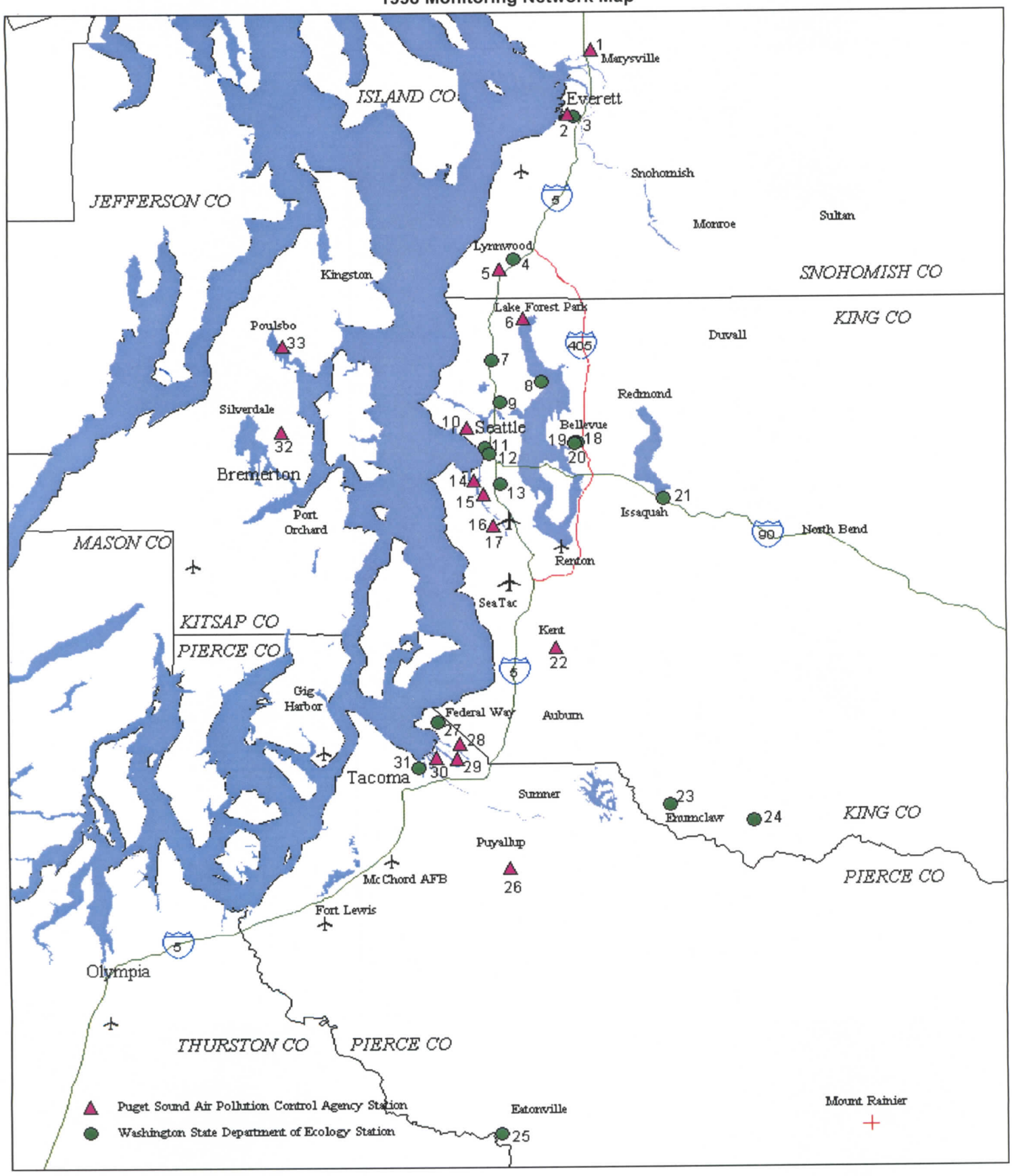
1998 Monitoring Network

Map ID	Location	Type of Sampling				
1	Marysville JHS, 1605 7th St, Marysville	PM_{10}	PM_{10eq}		$PM_{2.5}$	$PM_{2.5eq}$, Wind
2	Hoyt Avenue & 26th St, Everett	PM_{10}				SO_2, Wind
* 3	Broadway & Hewitt Ave, Everett			CO		
* 4	44th Ave W & 196th St SW, Lynnwood			CO		
5	20935 59th Place W, Lynnwood	PM_{10}	PM_{10eq}			$PM_{2.5eq}$, Wind
6	17711 Ballinger Way NE, Lake Forest Park	PM_{10}	PM_{10eq}			bsp, Wind
* 7	Northgate, 310 Northgate Way, Seattle			CO		
* 8	Sand Point, 7600 Sand Point Way, Seattle					Wind, Temp
* 9	University District, 1307 NE 45th St, Seattle			CO		
10	Queen Anne Hill, 400 W Garfield St, Seattle					Visibility photos
* 11	4th Ave & Pike St, Seattle			CO		
* 12	5th Ave & James St, Seattle			CO		
* 13	Beacon Hill, 15th S & Charlestown, Seattle					bsp, bap, Nox, O_3, Wind, Temp
14	Harbor Island, 2555 13th Ave SW, Seattle					TSP/Pb
15	Duwamish, 4752 E Marginal Way S, Seattle	PM_{10}	PM_{10eq}		$PM_{2.5}$	$PM_{2.5eq}$, $PM_{2.5di}$, bsp, SO_2, Wind
16	South Park, 8025 10th Ave S, Seattle				$PM_{2.5}$	
17	South Park, 723 South Concord St, Seattle	PM_{10}				
* 18	NE 8th Street & 108th Avenue NE, Bellevue			CO		
* 19	622 Bellevue Way NE, Bellevue			CO		
* 20	504 Bellevue Way NE, Bellevue	PM_{10}				
* 21	20050 SE 56th, Lake Sammamish State Park					O_3
22	James St & Central Ave, Kent	PM_{10}	PM_{10eq}		$PM_{2.5}$	$PM_{2.5eq}$, $PM_{2.5di}$, bsp, Wind
* 23	43407 212th Ave SE, 2 miles W of Enumclaw					NOx, Wind, Temp
* 24	Highway 410, 2 miles E of Enumclaw					O_3
* --	30525 Mud Mountain Rd, Enumclaw					O_3
* 25	Charles L Pack Forest, La Grande					O_3
26	South Hill, 9616 128th St E, Puyallup	PM_{10}	PM_{10eq}		$PM_{2.5}$	Wind
* 27	5225 Tower Drive NE, Northeast Tacoma					Wind, Temp
28	27th St NE & 54th Ave NE, Northeast Tacoma	PM_{10}				SO_2, Wind
29	2301 Alexander Avenue, Tacoma	PM_{10}			$PM_{2.5}$	$PM_{2.5eq}$, $PM_{2.5di}$, bsp, SO_2, Wind
30	Fire Station #12, 2316 E 11th St, Tacoma	PM_{10}	PM_{10eq}			$PM_{2.5di}$, Wind
* 31	1101 Pacific Avenue, Tacoma			CO		
32	Meadowdale, 7252 Blackbird Dr NE, Kitsap Co	PM_{10}	PM_{10eq}			$PM_{2.5eq}$, Wind
33	Lions Park, 6th Ave NE & Fjord Dr, Poulsbo					Wind

NOTES: **PM_{10}** = Particulate Matter <= 10 micrometers (reference method); **PM_{10eq}** = Particulate Matter <= 10 micrometers (equivalent method); **CO** = Carbon Monoxide; **Wind** = Wind Direction & Speed; **$PM_{2.5}$** = Particulate Matter <= 2.5 micrometers (reference method); **$PM_{2.5di}$** = Particulate Matter <= 2.5 micrometers (by dichot); **$PM_{2.5eq}$** = Particulate Matter <= 2.5 micrometers (continuous method); **bsp** = Light Scattering by Atmospheric Particles (by nephelometer); **bap** = Light Absorption by Atmospheric Particles (by absorption photometer); **O_3** = Ozone; **NOx** = Nitrogen Oxides; **SO_2** = Sulfur Dioxide; **Vsby** = Visibility (by camera); **TSP/Pb** = Total Suspended Particulate and Lead; **Temp** = Air Temperature

*** Indicates station operated by Washington State Department of Ecology**

1998 Monitoring Network Map



Pollutant Standards Index (PSI)

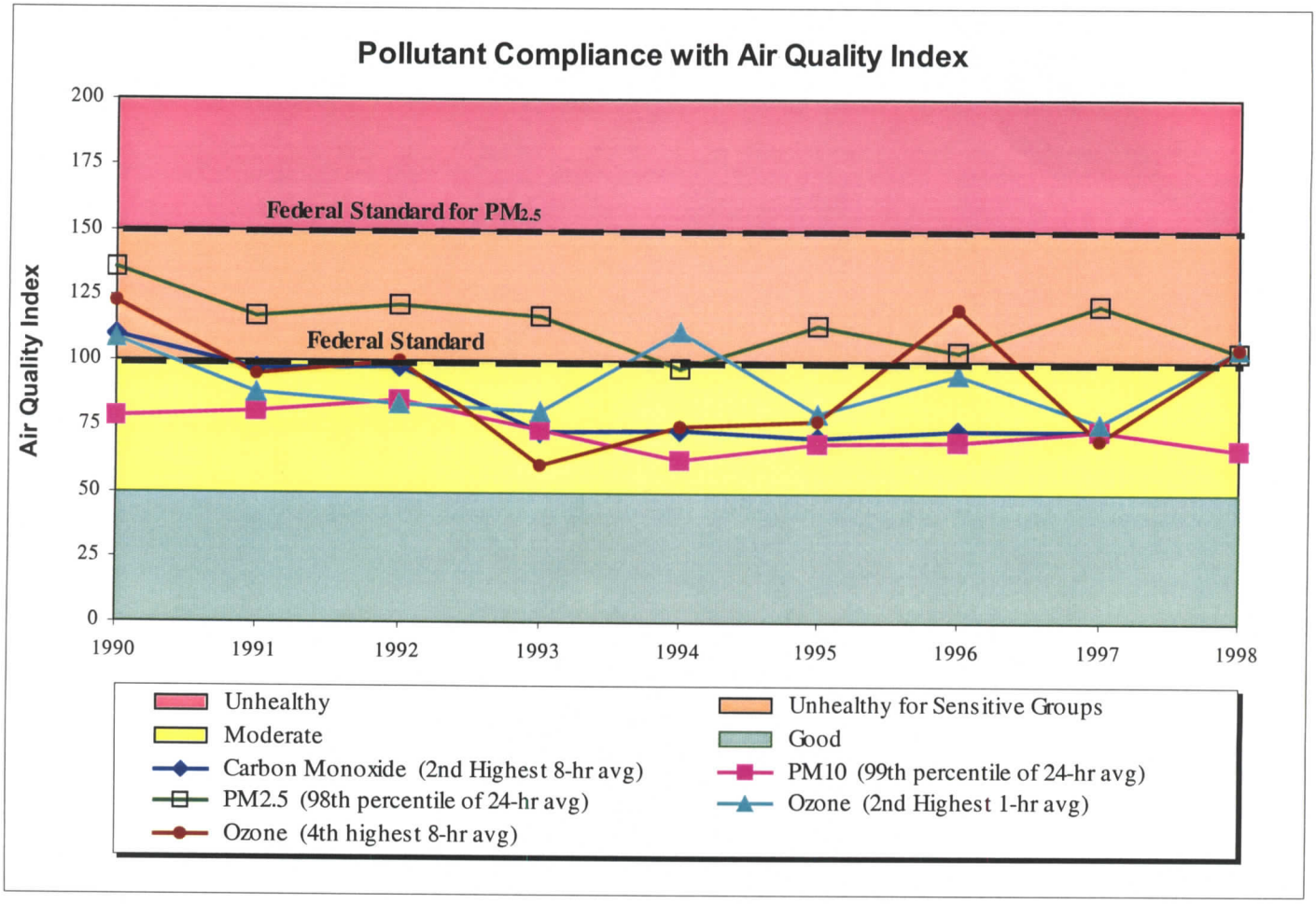
In 1998 the former Pollutant Standards Index (PSI) provided a nationally uniform method for reporting air quality as related to health effects. PSI values were calculated for every pollutant and reported daily. The numerical scale for PSI ranged from 0 to 500 with five different intervals or health categories:

From 0 to 50..... Good
From 51 to 100..... Moderate
From 101 to 199..... Unhealthful
From 200 to 299..... Very Unhealthful
From 300 to 500..... Hazardous

Effective on October 4, 1999 the U.S. EPA established a revision to the Pollutant Standard Index, creating several new air quality index (AQI) categories (Federal Register August 4, 1999). The new scale is as follows:

From 0 to 50..... Good
From 51 to 100..... Moderate
From 101 to 150..... Unhealthy for sensitive groups
From 151 to 200..... Unhealthy
From 201 to 300..... Very unhealthy
From 301 and above..... Hazardous

Measured ozone values reached the "unhealthful" category on the former PSI scale and the "unhealthy for sensitive groups" level on the new AQI scale for three successive days in July (26-28th) and one day in September (1st). It should be noted that, in general, the new standard will affect the number of days showing lower air quality. Following is a chart showing the trends from 1990-1998 of PSI values with the new air quality index and a comparison of ozone values with both index criteria. Visit our web site for a more detailed explanation of AQI.

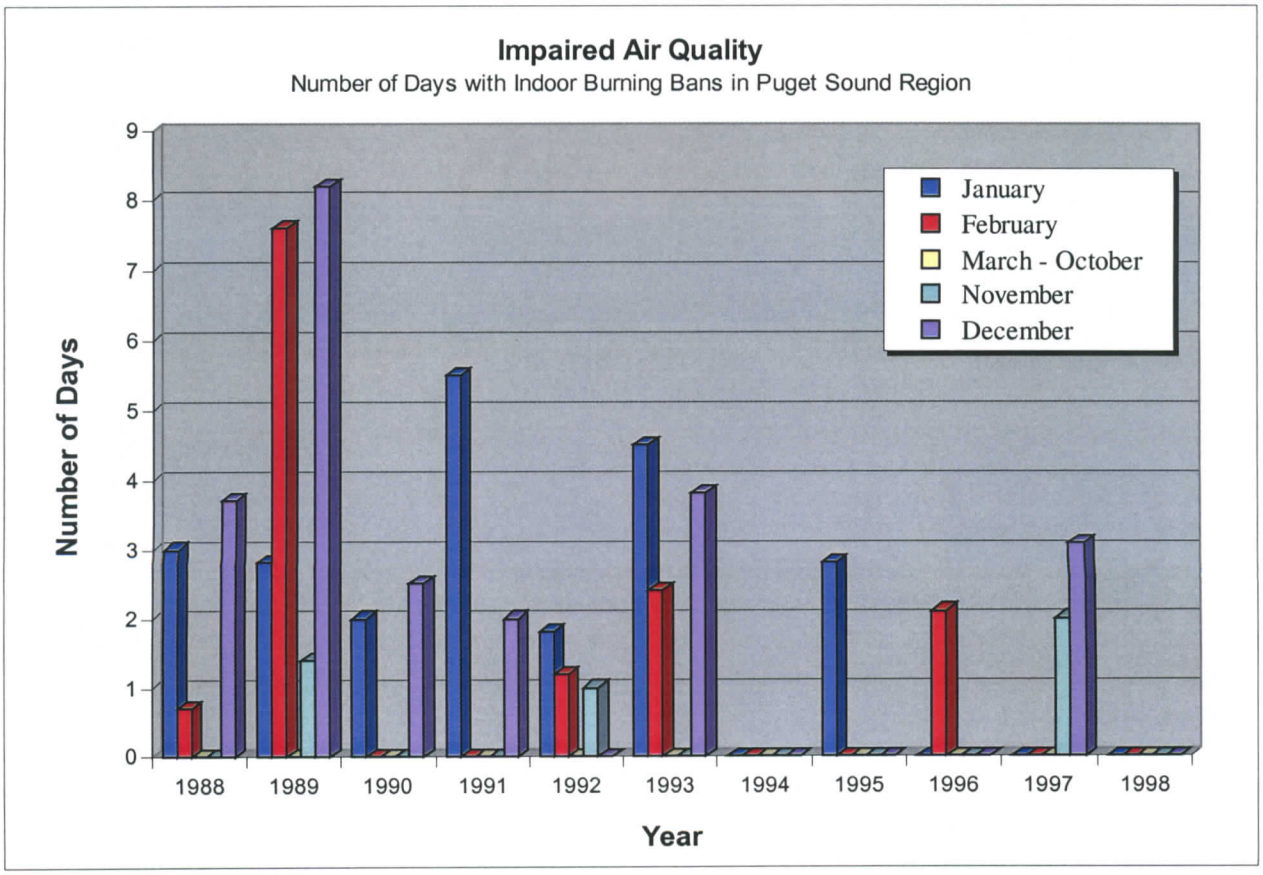


Note taking section

Impaired Air Quality

Washington State has in place a winter impaired air quality program targeted at sources of particulate matter, traditionally wood stoves and fireplaces. According to Puget Sound Clean Air Agency's Regulation I, Article 13, a first stage of impaired air quality is reached when PM_{10} concentrations rise to 60 $\mu g/m^3$ measured on a 24-hour average or carbon monoxide concentrations reach 8 ppm measured on a 8-hour average. At this level, a first stage burn ban may be declared. Residential burning in fireplaces or uncertified wood stoves is prohibited (unless it is the only adequate source of heat). At PM_{10} levels of 105 $\mu g/m^3$ on a 24-hour average, a second stage burn ban is issued, prohibiting the use of any kind of wood burning appliance. Our agency has not issued a second stage burn ban since January 1991. No wintertime air pollution watches or burn bans were issued in 1998.

Our agency also has in place a voluntary curtailment program, "Smog Watch," for the summer smog season (June through September). The purpose of the Smog Watch program is to advise residents of potential smog problems and recommend short-term actions. Smog Watch advisories are driven more by meteorology than monitored air quality data. A Smog Watch is called when forecasts call for temperatures in the upper 80s or higher with little or no wind for at least a 72-hour period. No Smog Watch advisories were issued in 1998 due to favorable meteorology. In 1996, our agency issued four Smog Watch advisories.



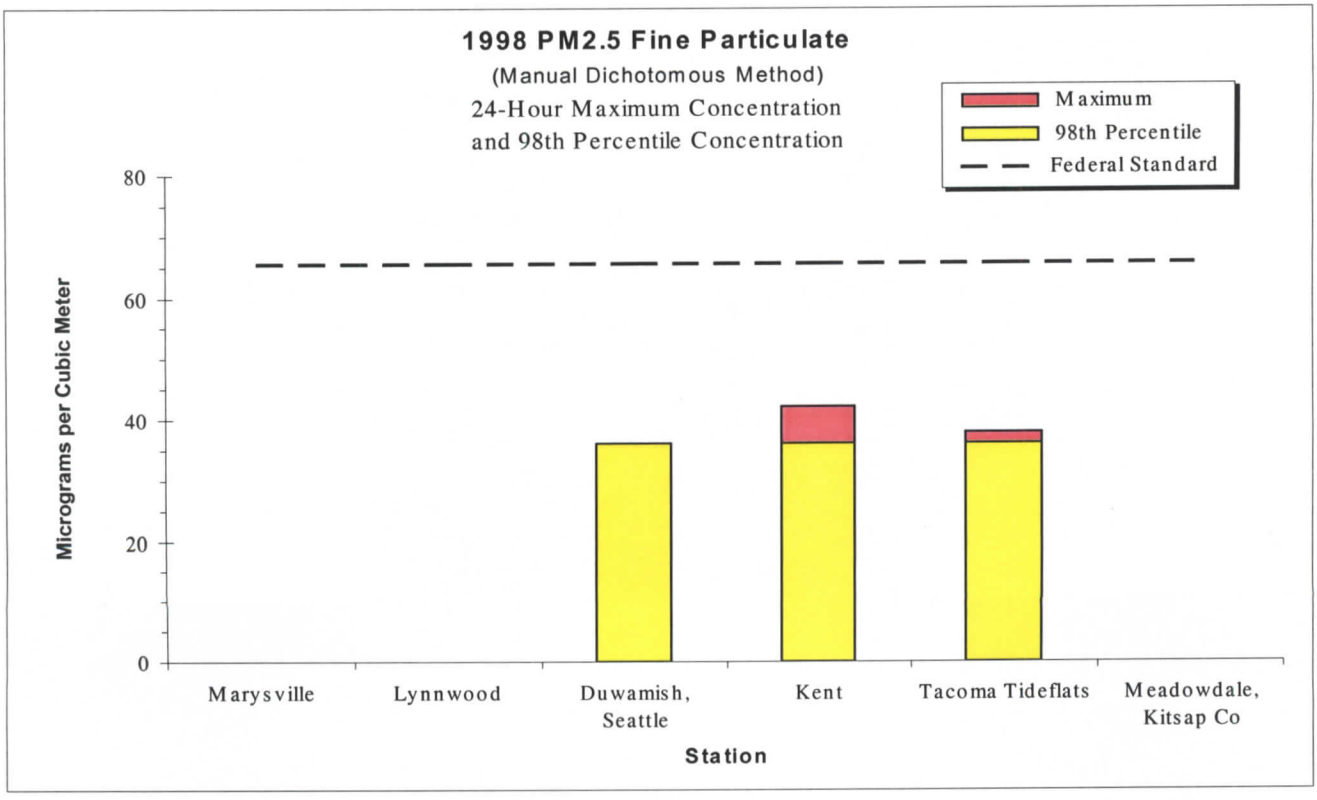
Particulate Matter

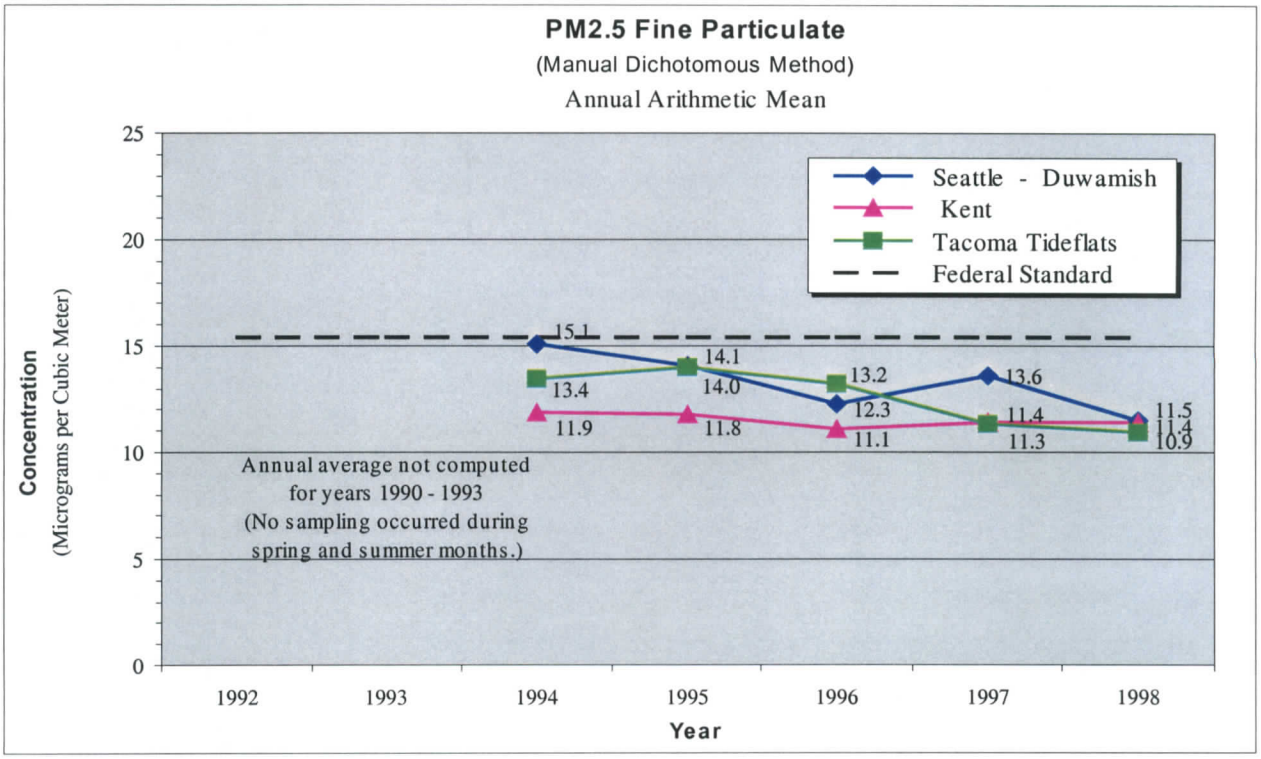
$PM_{2.5}$

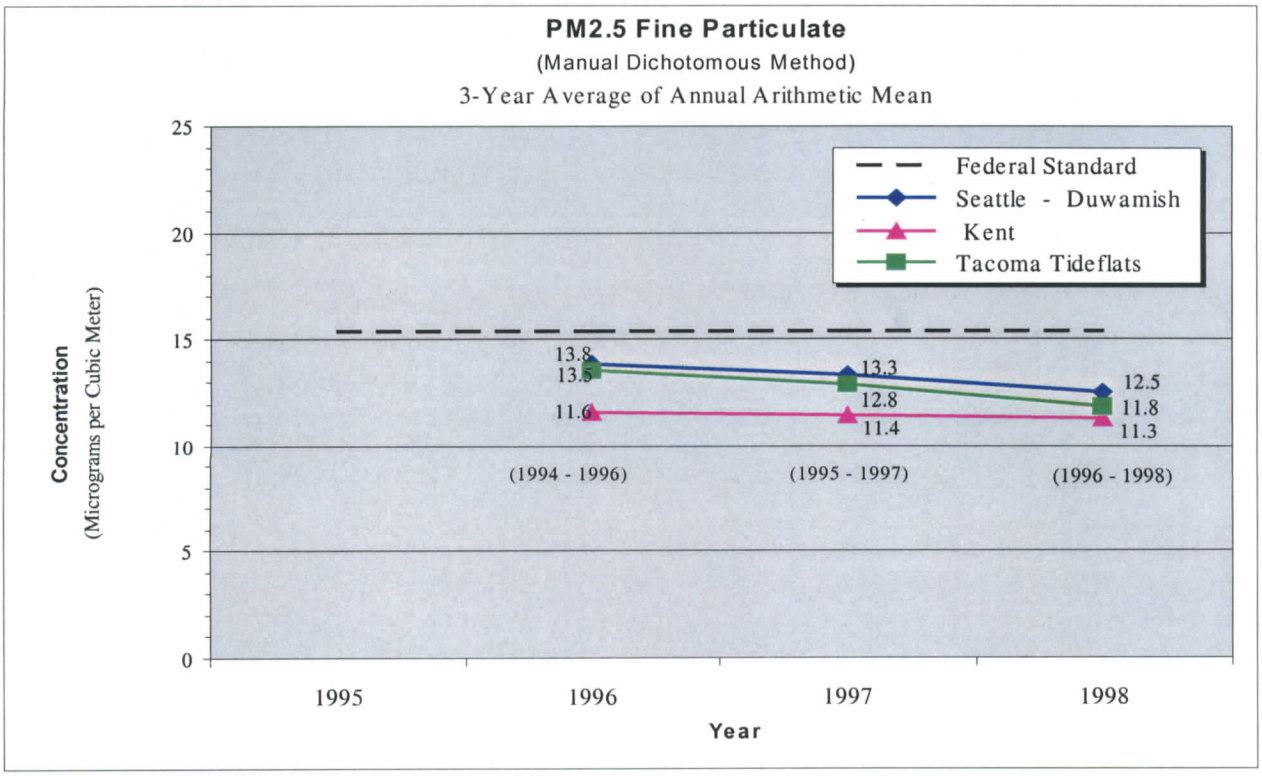
Fine particulate matter ($PM_{2.5}$) originates primarily from combustion sources. These include car, bus and truck exhaust (especially from diesel fuels), fireplaces and wood stoves, outdoor burning, and commercial/ industrial processes. Fine particulate matter also forms in the atmosphere from the chemical reactions of pollutant gases. Fine particles have greater impact than larger particles on human health because of their ability to penetrate deeper into the respiratory system. Our agency views fine particulate matter as one of the main regional air pollution issues affecting our communities. Fine particulate matter also is an important factor for regional visibility.

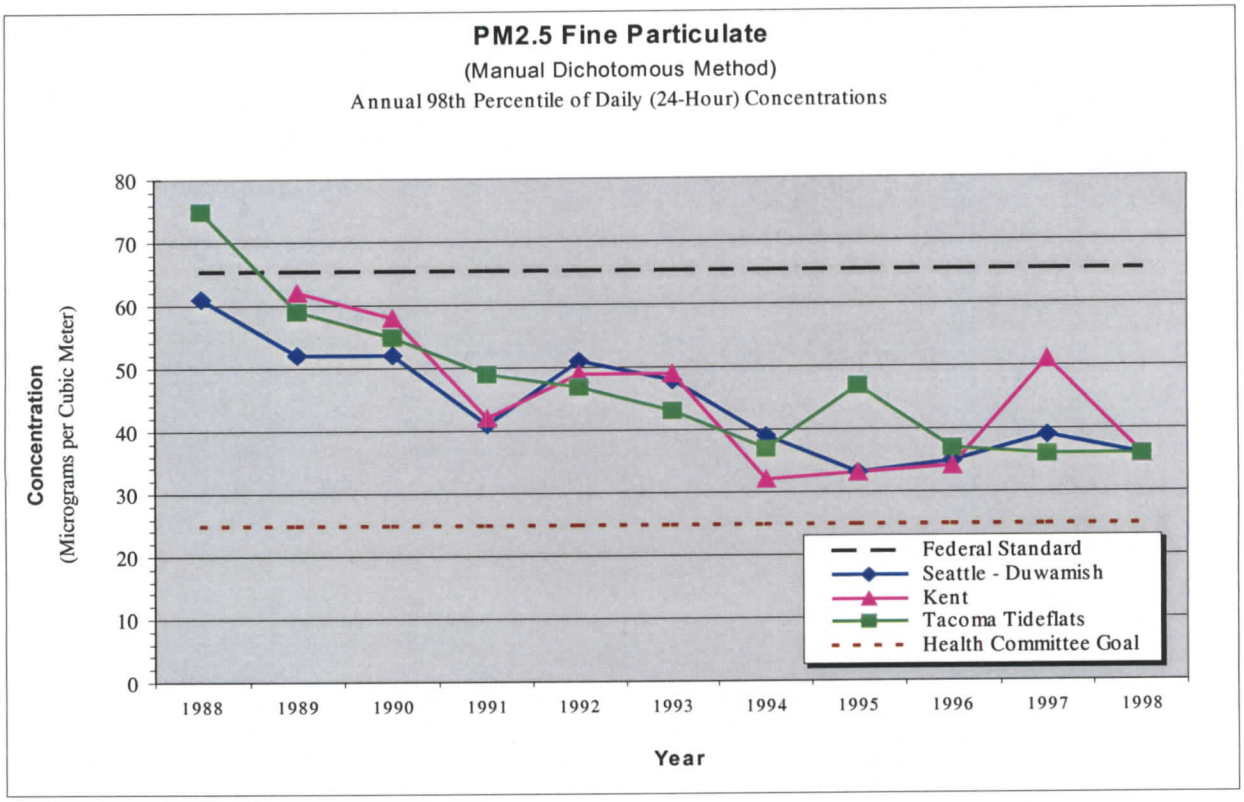
The U.S. EPA adopted a new standard for fine particulate matter in September 1997. There is a 65 $\mu g/m^3$ 24-hour standard and a 15 $\mu g/m^3$ annual standard. Since the late 80s, our agency has conducted $PM_{2.5}$ monitoring at three sites. This monitoring has provided us with a significant $PM_{2.5}$ data set. In addition, we are aggressively expanding our $PM_{2.5}$ monitoring network to measure compliance with the new $PM_{2.5}$ standards.

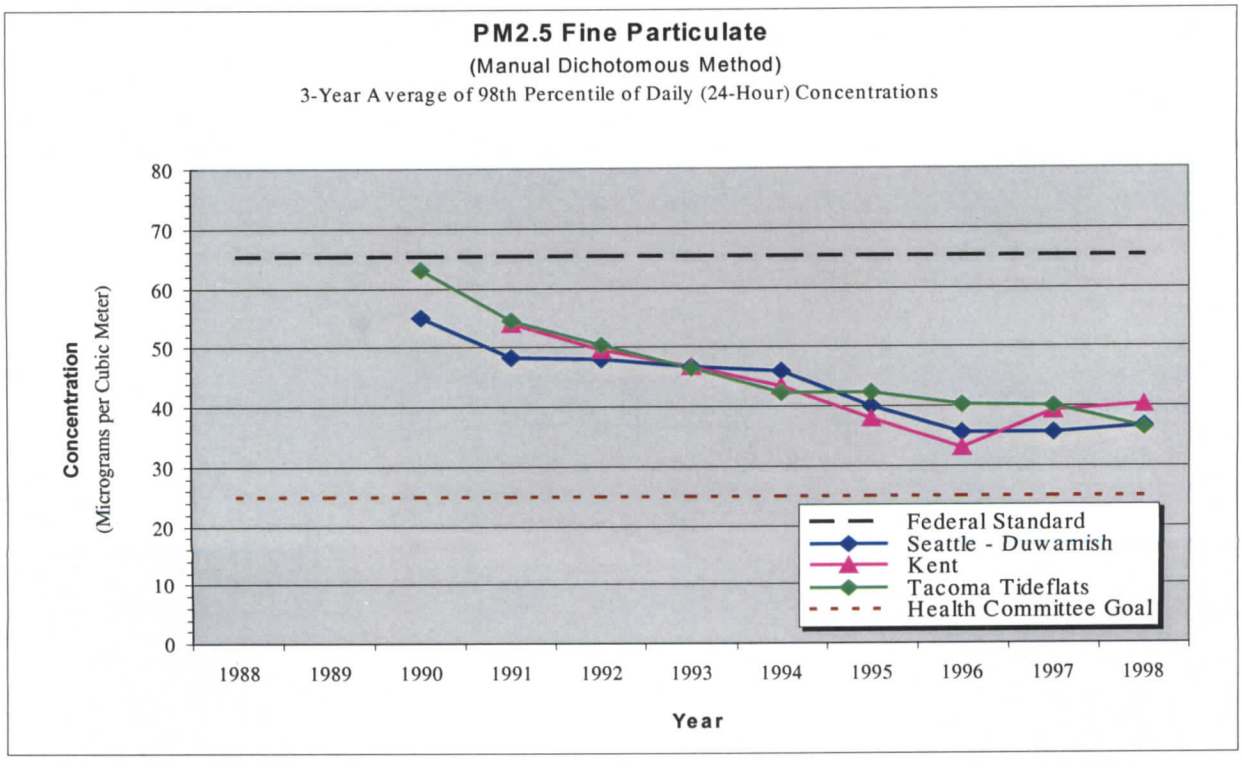
The $PM_{2.5}$ values measured using the new reference method samplers were generally below the new federal standard. However, at the Marysville station the values exceeded the new federal standard in December. This maximum $PM_{2.5}$ value corresponded to a AQI value of 153, which was in the range designated "unhealthy."




PM2.5 Fine Particulate
(Manual Dichotomous Method)
Annual Arithmetic Mean
Concentration
(Micrograms per Cubic Meter)
25
20
15
10
5
0
Seattle - Duwamish
Kent
Tacoma Tideflats
Federal Standard
15.1
14.1
13.2
13.6
13.4
14.0
12.3
11.5
11.4
11.9
11.8
11.1
11.4
11.3
10.9
Annual average not computed
for years 1990 - 1993
(No sampling occurred during
spring and summer months.)
1992
1993
1994
1995
1996
1997
1998
Year


PM2.5 Fine Particulate
(Manual Dichotomous Method)
3-Year Average of Annual Arithmetic Mean
Concentration
(Micrograms per Cubic Meter)
25
20
15
10
5
0
Federal Standard
Seattle - Duwamish
Kent
Tacoma Tideflats
13.8
13.5
13.3
12.5
11.8
12.8
11.6
11.4
11.3
(1994 - 1996)
(1995 - 1997)
(1996 - 1998)
1995
1996
1997
1998
Year


PM2.5 Fine Particulate
(Manual Dichotomous Method)
Annual 98th Percentile of Daily (24-Hour) Concentrations
Concentration
(Micrograms per Cubic Meter)
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year
Federal Standard
Seattle - Duwamish
Kent
Tacoma Tideflats
Health Committee Goal


PM2.5 Fine Particulate
(Manual Dichotomous Method)
3-Year Average of 98th Percentile of Daily (24-Hour) Concentrations
Concentration
(Micrograms per Cubic Meter)
80
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year
Federal Standard
Seattle - Duwamish
Kent
Tacoma Tideflats
Health Committee Goal

Particulate Matter ($PM_{2.5}$)
Micrograms per Cubic Meter
Sampling Method: Dichotomous Sampler - S244E Teflon Filters

Location	Number of Values	Quarterly Arithmetic Averages				Year Arith Mean
		1st	2nd	3rd	4th	
Duwamish, 4752 E Marginal Way S, Seattle, Wa	99	13.0	9.3	10.1	13.5	11.5
James St & Central Ave, Kent, Wa	96	11.6	9.1	10.8	13.9	11.4
Fire Station #12, 2316 E 11th St, Tacoma, Wa	79	10.4	7.5	9.8		
Tideflats, 2301 Alexander Ave, Tacoma, Wa	18				15.9	10.9

Blank cell indicates data was not sampled at given location during specified time, or had less than 75% of scheduled samples.

NOTES:

1. Nationally scheduled particulate matter sampling occurs each sixth day. Quarterly averages are shown only when at least one data value exists for 75 percent or more of the six day intervals.
2. Annual averages are shown only if there are at least three quarterly averages.

Summary of Maximum and 2nd High Observed Concentrations

Location	Oct 21 Wed	Oct 24 Sat	Oct 31 Sat	Dec 23 Wed
Duwamish, 4752 E Marginal Way S, Seattle, Wa		36		36
James St & Central Ave, Kent, Wa	36	42		
Fire Station #12, 2316 E 11th St, Tacoma, Wa	36	38	--	--
Tideflats, 2301 Alexander Ave, Tacoma, Wa	--	--	32	36

-- Indicates no sample on specified day.
Blank cell indicates data was below maximum and 2nd highest values at given location on specified day.

Summary of Observations Equal To or Greater Than 30

Location	Mar 21 Sat	Oct 21 Wed	Oct 24 Sat	Oct 31 Sat	Dec 23 Wed
Duwamish, 4752 E Marginal Way S, Seattle, Wa		31	36		36
James St & Central Ave, Kent, Wa	31	36	42		32
Fire Station #12, 2316 E 11th St, Tacoma, Wa		36	38	--	--
Tideflats, 2301 Alexander Ave, Tacoma, Wa	--	--	--	32	36

-- Indicates no sample on specified day.
Blank cell indicates value was less than 30 at given location on specified day.

PM_{10}

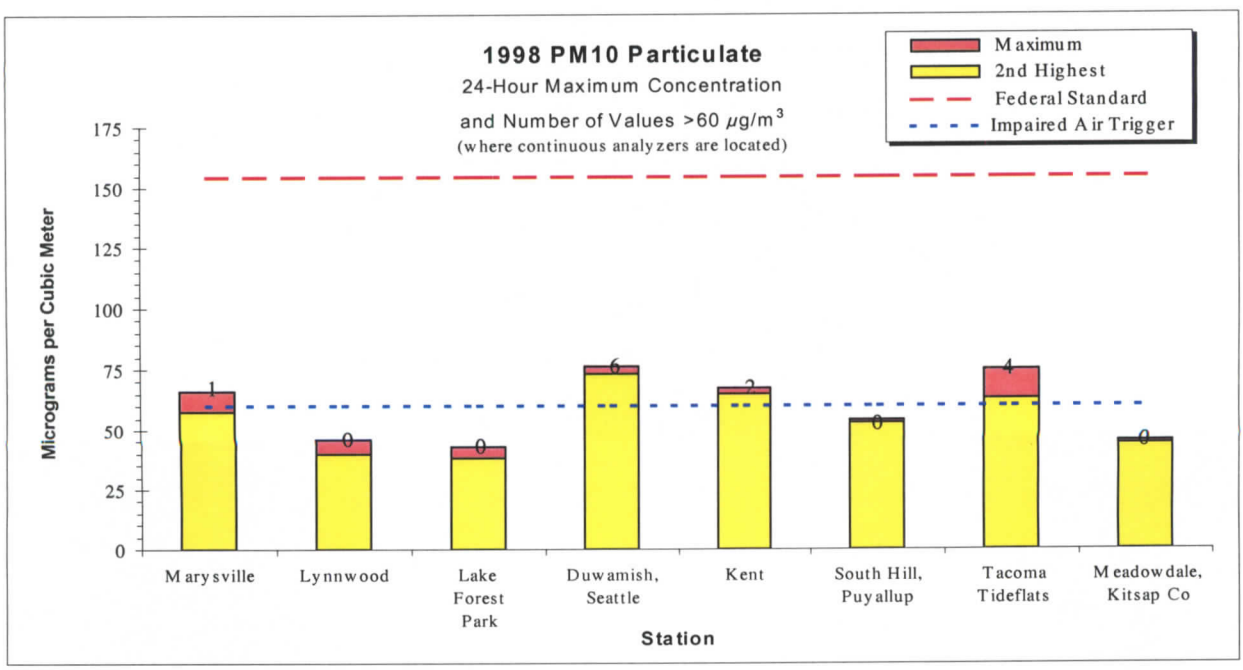
Particulate matter (PM_{10}) originates from a wide variety of sources, including car and truck exhaust, tire wear, re-suspended road dust, indoor and outdoor burning, dusty industrial processes, and wind-blown soil. In 1998 our agency operated 13 monitoring sites within our jurisdiction: three industrial sites and 10 residential or commercial sites.

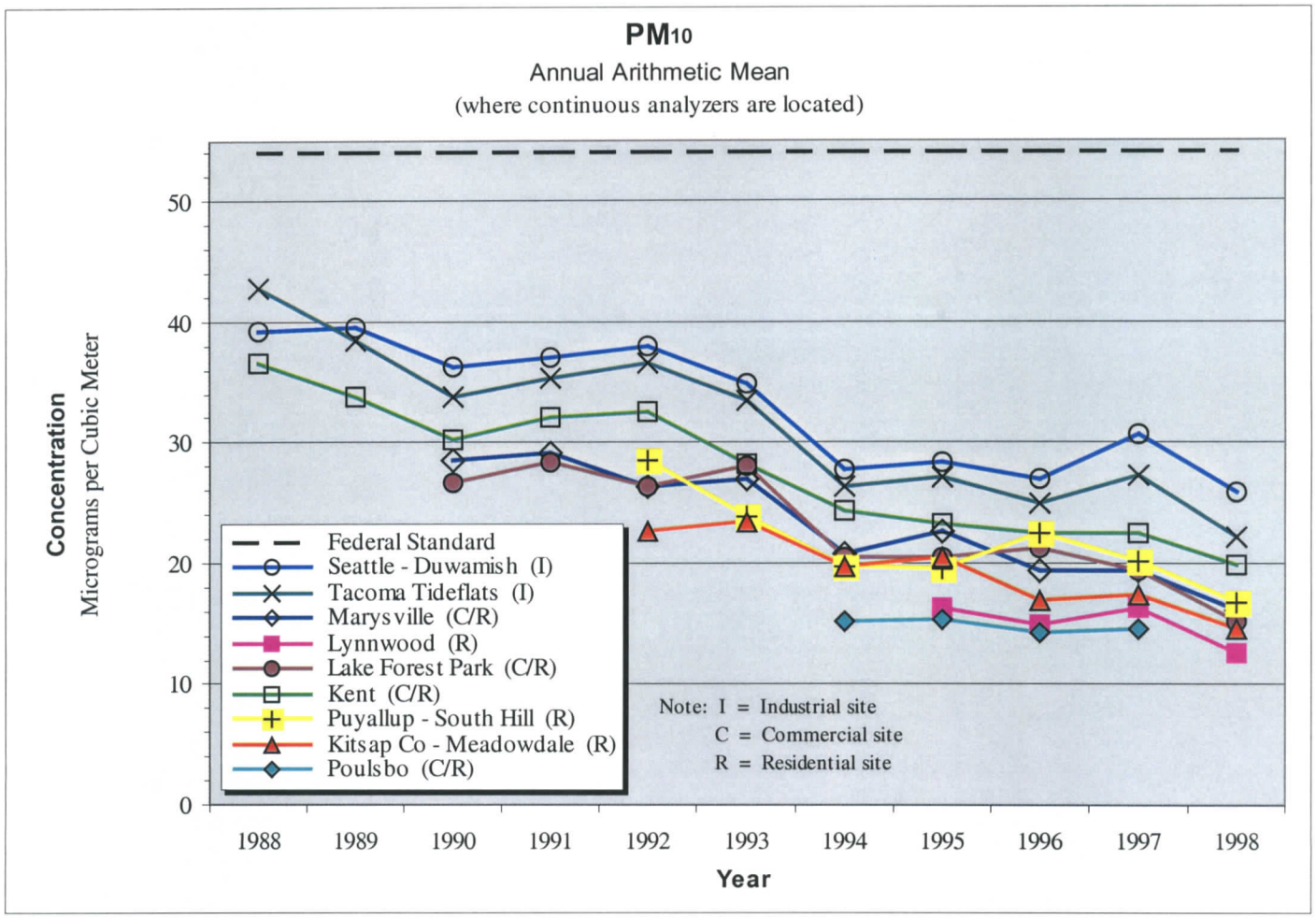
The federal PM_{10} standard encompasses particles 10 micrometers or smaller. Since 1987, the 24-hour PM_{10} standard has been 150 $\mu g/m^3$ and the annual standard has been 50 $\mu g/m^3$. In 1997, the U.S. EPA changed the method of calculating compliance with the 24-hour standard. To meet the standard, the 99th percentile of the distribution of the 24-hour monitoring results over three years must not exceed 150 $\mu g/m^3$ at each monitoring site.

In 1998 no monitored values at any of the sites exceeded the federal 24-hour or annual standards. The highest PM_{10} daily value of 87 $\mu g/m^3$ was measured on Wednesday, April 29th at the Northeast Tacoma site. There have been no exceedances of PM_{10} standards at any site since 1990.

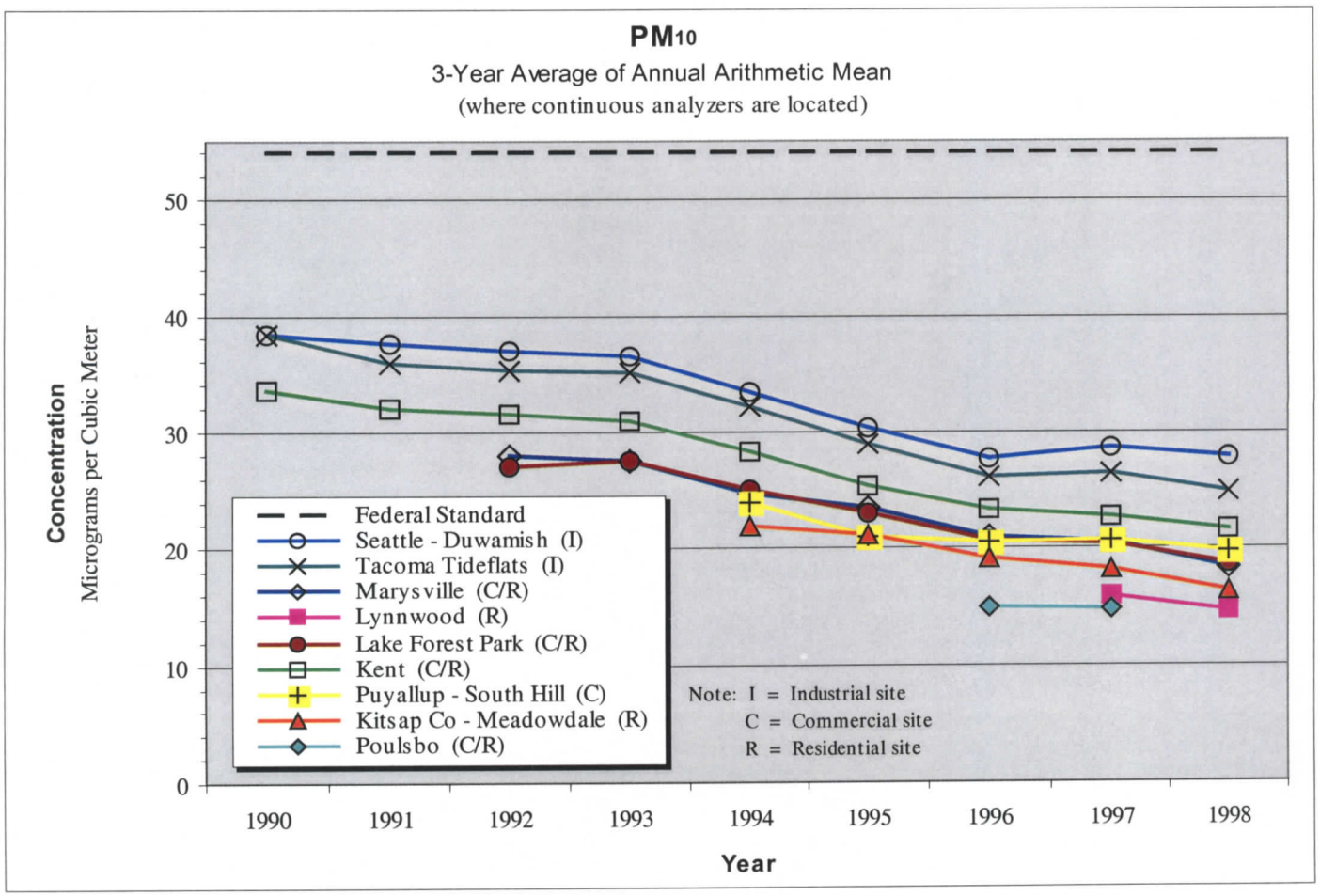
Some areas of the Puget Sound region are still formally designated as non-attainment with the PM_{10} standards, though we clearly have met all of the standards since 1990. In 1997, we submitted a plan for maintaining our successes to the Washington State Department of Ecology, to gain attainment status. We use this maintenance plan locally to assure our compliance with the standards.

The U.S. EPA revised the PM_{10} standards in 1997 and therefore intended to remove the region's non-attainment status for the old standard. The Washington State Department of Ecology has since recommended to EPA that our region be designated in attainment for the new PM_{10} standards. We anticipate gaining formal attainment status at some time in the future.

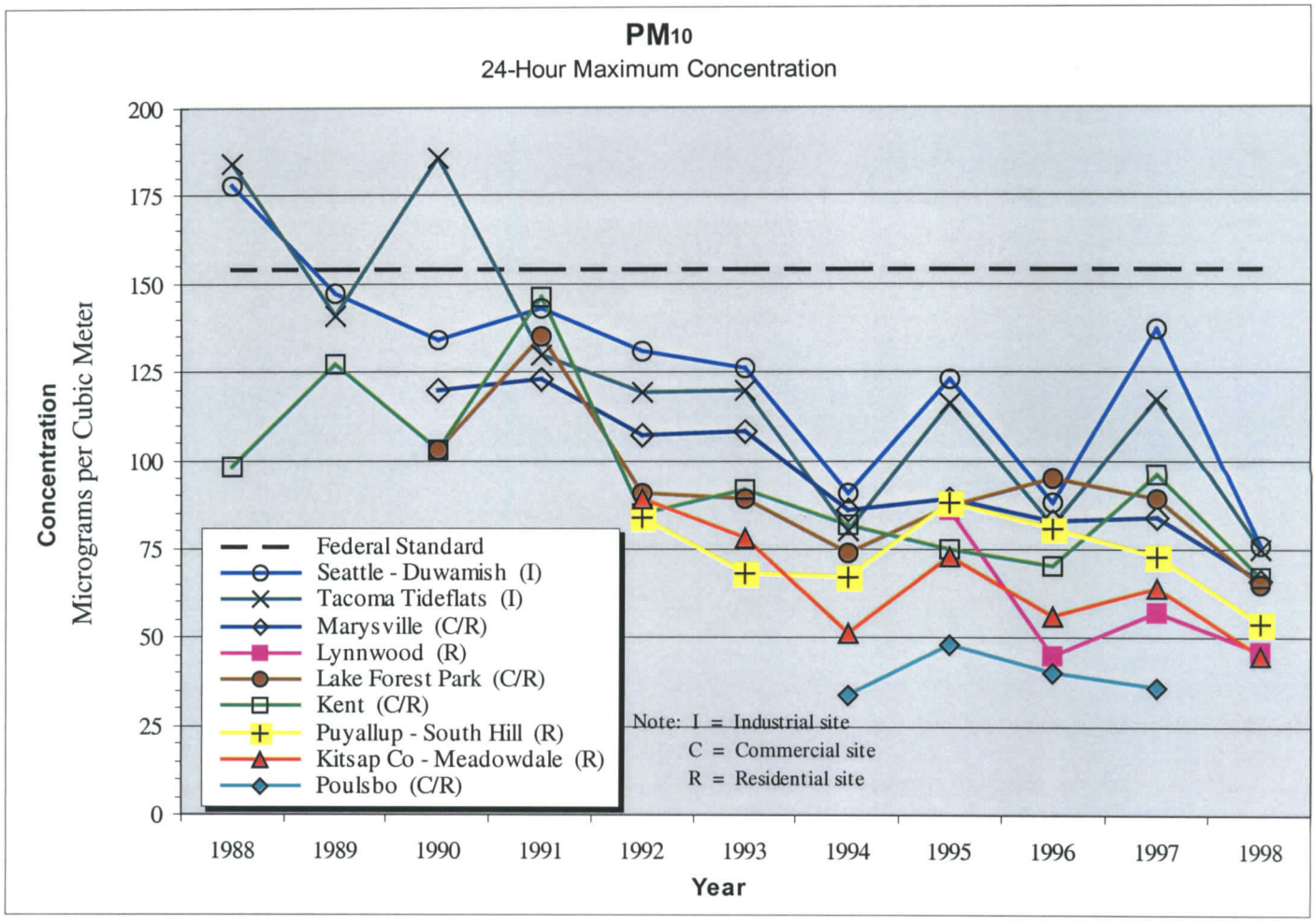




Note taking section



Note taking section



Note taking section

Particulate Matter (PM_{10})
Micrograms per Cubic Meter
Sampling Method: Reference – Hi Vol ANDERSEN/GMW 1200 – Quartz Fiber Filters

Location	Number of Values	Quarterly Arithmetic Averages				Year Arith Mean
		1st	2nd	3rd	4th	
Marysville JHS, 1605 7th St, Marysville, Wa	106	15.3	16.7	16.8	13.2	15.5
Hoyt Ave & 26th St, Everett, Wa	40	12.5	16.5	16.1		15.0
20935 59th Place West, Lynnwood, Wa	61	12.9	13.7	13.3	10.4	12.6
504 Bellevue Way NE, Bellevue, Wa	56		18.8	19.9	11.5	16.7
17711 Ballinger Way NE, Lake Forest Park, Wa	104	17.2	14.6	14.7	13.1	14.9
Duwamish, 4752 E Marginal Way S, Seattle, Wa	141	29.7	26.9	25.1	21.6	25.8
South Park, 723 Concord St, Seattle, Wa	40	17.3	15.3	23.0		18.5
SeaTac North, 2501 150th Ave S, SeaTac, Wa	34			17.9	13.1	
Tyee Golf Course, 2401 S 192nd St, SeaTac	36			20.1	10.7	
James St & Central Ave, Kent, Wa	140	18.7	20.2	25.8	14.7	19.9
27th St NE & 54th Ave NE, NE Tacoma, Wa	60	14.3	21.4	27.1	12.6	18.9
Tideflats, 2301 Alexander Ave, Tacoma, Wa	84	18.8	21.0	33.1	15.7	22.2
Fire Station #12, 2316 E 11th St, Tacoma, Wa	141	23.9	20.0	22.5	18.4	21.2
South Hill, 9616 128th St E, Puyallup, Wa	59	15.7	14.6	20.0	12.5	15.7
Meadowdale, 7252 Blackbird Dr NE, Kitsap Co, Wa	61	14.9	14.3	12.9	11.7	13.5

Blank cell indicates data was not sampled at given location during specified time.

NOTES:

1. Nationally scheduled particulate matter sampling occurs each sixth day. Quarterly averages are shown only when at least one data value exists for 75 percent or more of the six day intervals.
2. Annual averages are shown only if there are at least three quarterly averages.

Summary of Maximum and 2nd High Observed Concentrations

Location	Jan 15 Thu	Jan 27 Tue	Feb 10 Tue	Apr 5 Sun	Apr 28 Tue	Apr 29 Wed	Apr 30 Thu	May 1 Fri	May 5 Tue	Jun 22 Mon	Jul 16 Thu	Jul 28 Tue	Aug 3 Mon	Nov 7 Sat
Marysville JHS, 1605 7th St, Marysville, Wa					--	45	--	58						
Hoyt Ave & 26th St, Everett, Wa	--	--			--	42	--	--				26		--
20935 59th Place West, Lynnwood, Wa	--	--			--	33	--	--	25			25		
504 Bellevue Way NE, Bellevue, Wa	--	--			--	46	--	--			48			
17711 Ballinger Way NE, Lake Forest Park, Wa	38	38			--		--	43						
Duwamish, 4752 E Marginal Way S, Seattle, Wa		--			--		68	69						
South Park, 723 Concord St, Seattle, Wa	--	--			--	57	--	--				53		--
SeaTac North, 2501 150th Ave S, SeaTac, Wa	--	--	--	--	--	--	--	--	--	25		34	25	
Tyee Golf Course, 2401 S 192nd St, SeaTac	--	--	--	--	--	--	--	--	--			36	32	
James St & Central Ave, Kent, Wa		--			--		65	66						
27th St NE & 54th Ave NE, NE Tacoma, Wa	--	--			--	87	--	--		--		61		
Tideflats, 2301 Alexander Ave, Tacoma, Wa		--			60		--	--				75		
Fire Station #12, 2316 E 11th St, Tacoma, Wa		--			--		54	63						
South Hill, 9616 128th St E, Puyallup, Wa	--	--			--	49	--	--			--			42
Meadowdale, 7252 Blackbird Dr NE, Kitsap Co, Wa	--	--	25	25	--	37	--	--						

-- Indicates no sample on specified day.
Blank cell indicates data was below maximum and 2nd highest values at given location on specified day.

Particulate Matter (PM_{10})
Summary of Observations Equal To or Greater Than 60

Location	Mar 20 Fri	Apr 28 Tue	Apr 29 Wed	Apr 30 Thu	May 1 Fri	Jul 28 Tue
Duwamish, 4752 E Marginal Way S, Seattle, Wa	62	--		68	69	
James St & Central Ave, Kent, Wa		--		65	66	
27th St NE & 54th Ave NE, NE Tacoma, Wa	--	--	87	--	--	67
Tideflats, 2301 Alexander Ave, Tacoma, Wa	--	60		--	--	75
Fire Station #12, 2316 E 11th St, Tacoma, Wa		--			63	

-- Indicates no sample on specified day.
Blank cell indicates value was less than 60 at given location on specified day.

Note taking section

Ozone

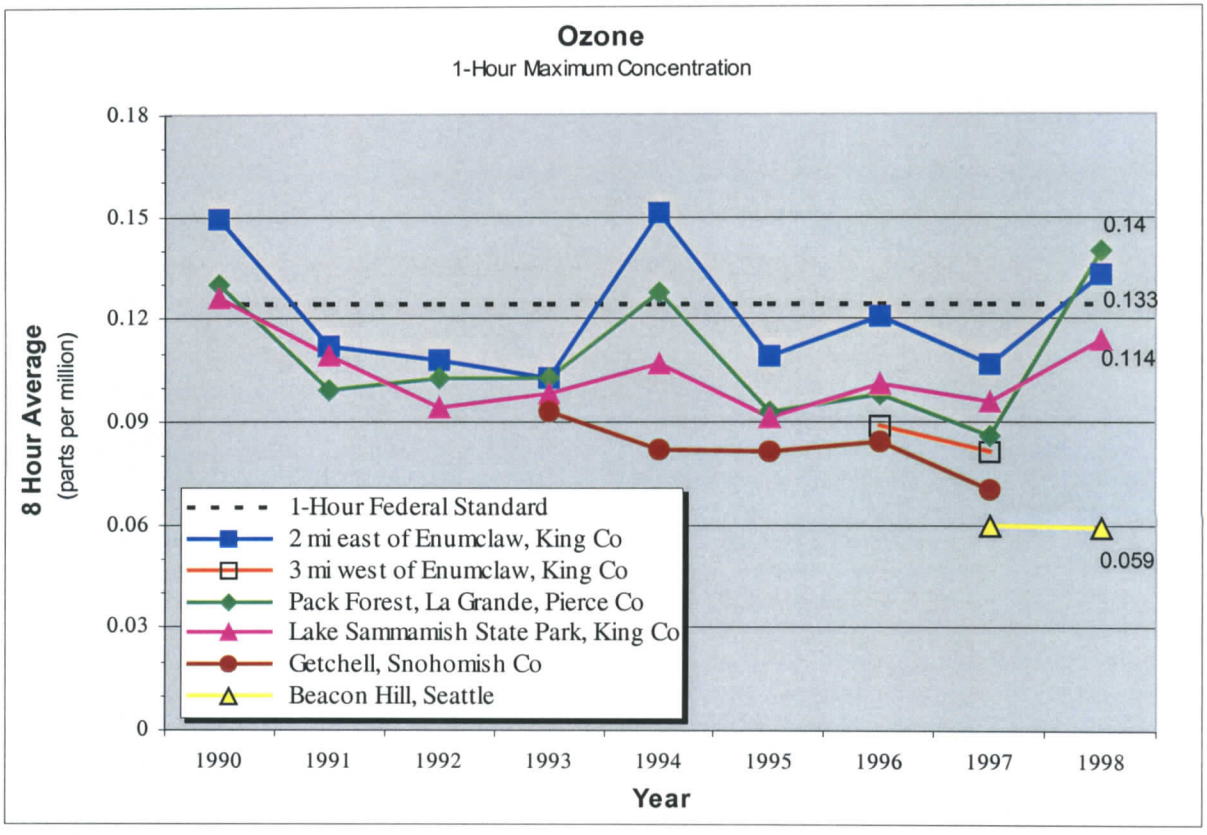
Ozone is the only criteria pollutant not emitted directly by pollution sources. It is a product of photo-chemical reactions in the atmosphere on hot, sunny days. Most of the pollutants that contribute to ozone come from cars, buses and trucks. Even sources like gasoline-powered yard equipment, paints/solvents and boat motors contribute.

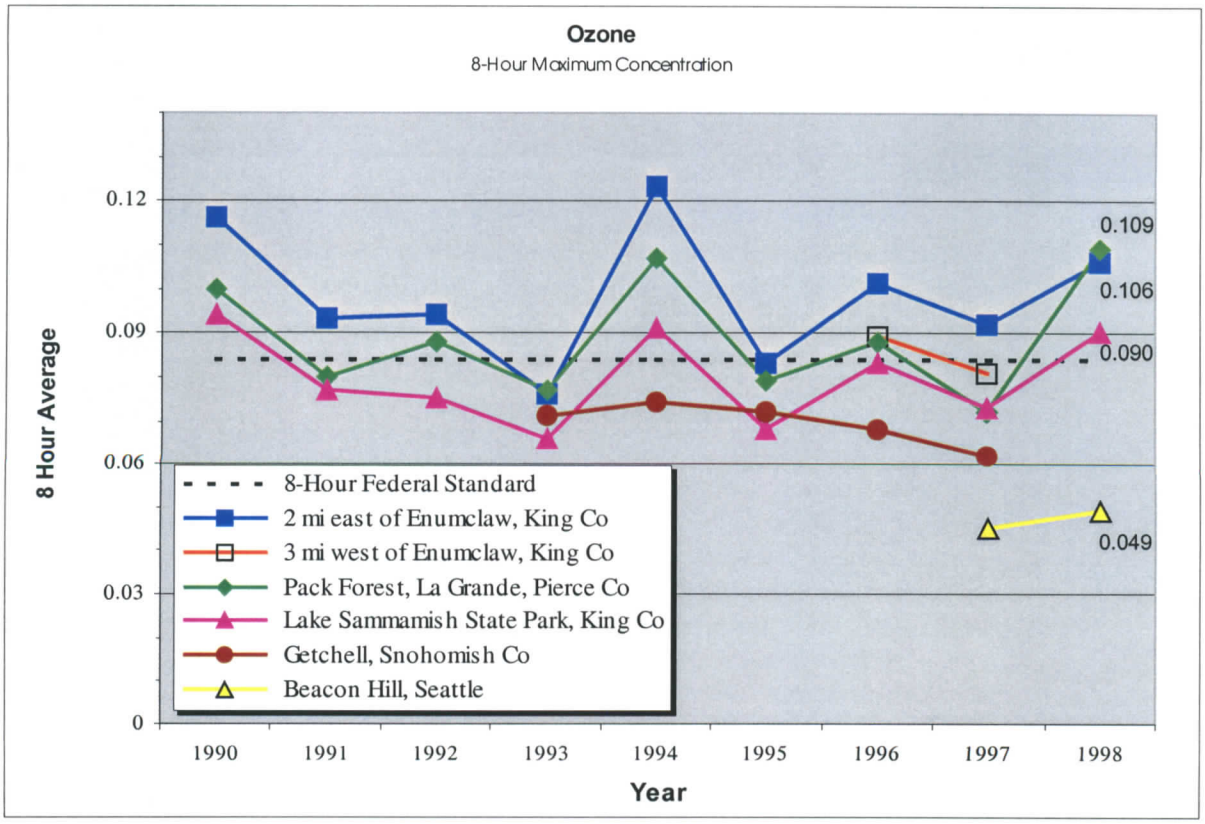
The Washington State Department of Ecology conducts all ozone monitoring in the Puget Sound area. The Washington State Department of Ecology operated five monitoring sites for ozone in 1998 – Beacon Hill in Seattle, Lake Sammamish, Highway 410 (near Enumclaw), Mud Mountain Road (also near Enumclaw) and Pack Forest near LaGrande (Eatonville).

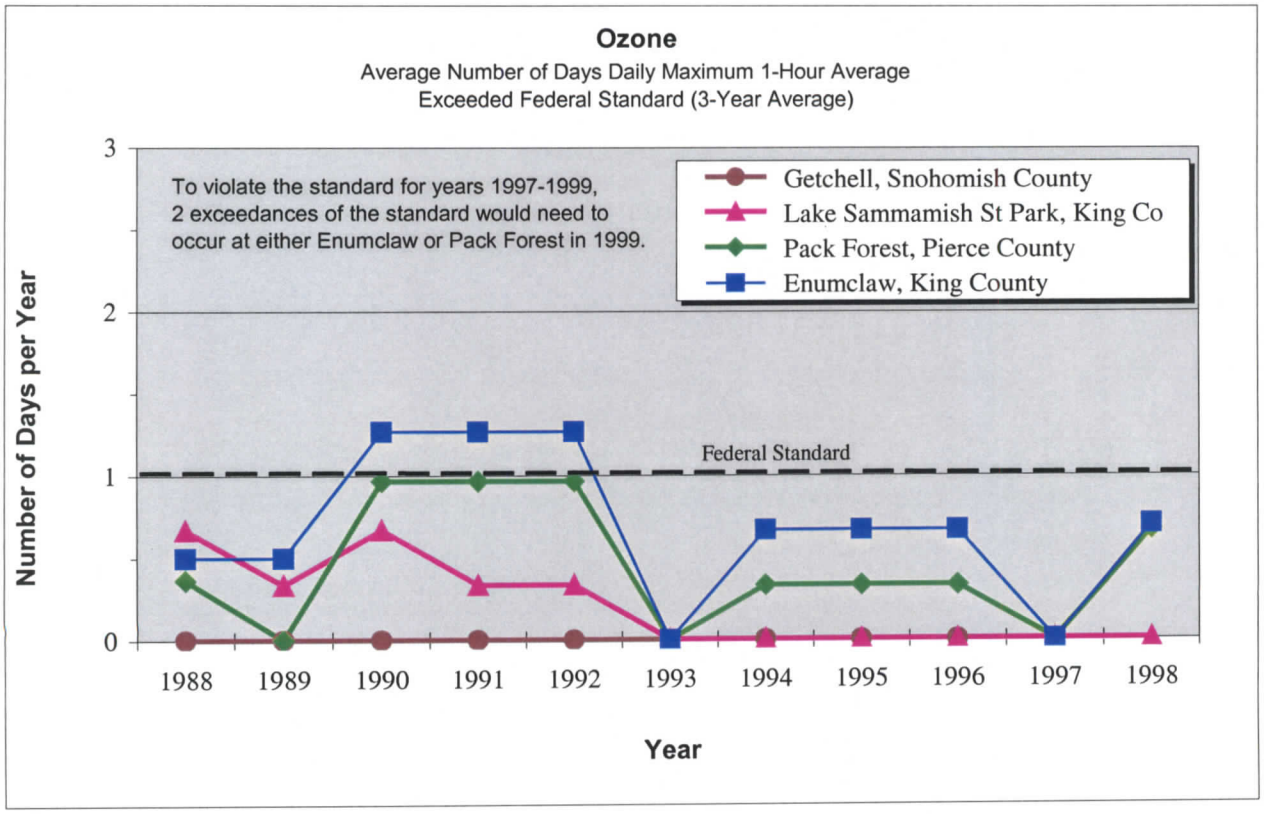
The U.S. EPA adopted a new federal standard for ozone in September 1997. The 1-hour standard of 0.12 ppm was changed to a more stringent 8-hour 0.08 ppm standard. Compliance is measured by averaging the fourth-highest monitored value per year over a three-year period. This standard was adopted based on scientific research demonstrating a more serious health impact of long-term exposure to ozone pollution than to short-term peak levels.

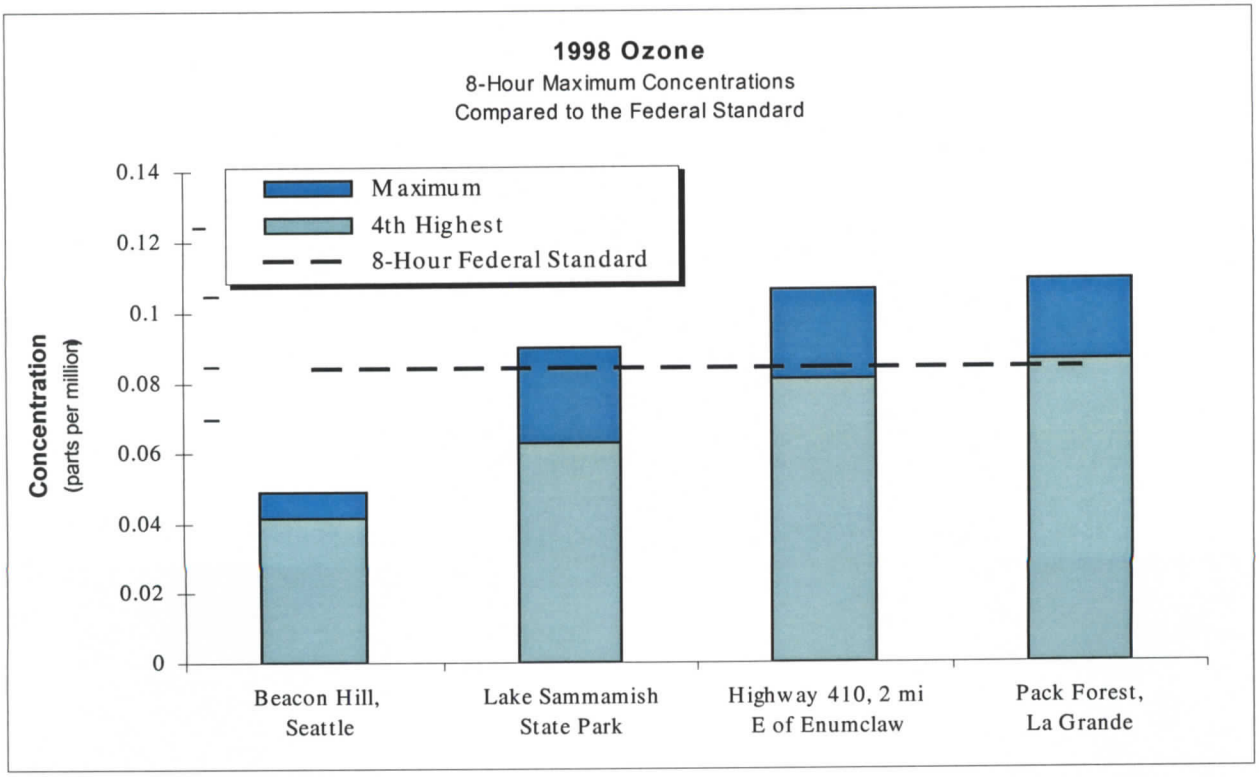
Ozone (or smog) is a summertime pollution problem. Ozone concentrations are not temperature driven, but they are driven by the amount of sunlight that occurs concurrently with high temperatures and air pollution trapped near the surface by low-level temperature inversions. In the summer of 1998 high ozone levels occurred during a three-day period from July 26th to 28th. The period was characterized by stable weather with a nighttime low-level temperature inversion followed by hot afternoon temperatures in the mid to upper 90's. Significant ozone levels were measured downwind (east to southeast) of the Everett-Seattle-Tacoma urban area. Elevated ozone levels occurred again during a two day period (August 3rd-4th) and a one day period (September 1st), the latter occurrences characterized by stable weather with a nighttime low-level temperature inversion followed by warm afternoon temperatures in the lower 80's.

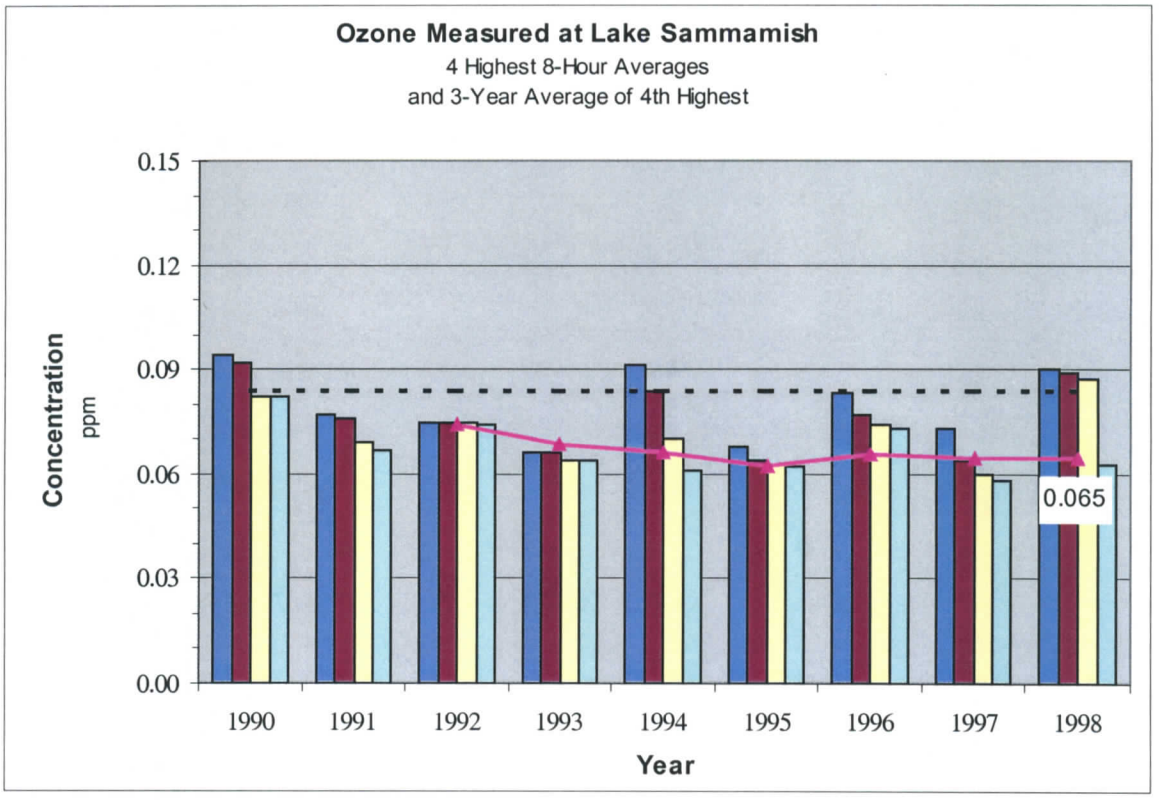
The regional ozone trend is flat and is marginally within the new federal standard. Ideal conditions for high levels of ozone are relatively infrequent. In comparison to other parts of the country, ozone pollution is not as critical a problem for us, but it still presents a potential challenge with growth in the region. The U.S. EPA designated the Puget Sound area in attainment for the 1-hour ozone standard in 1996. The following charts illustrate the trends in measured ozone values for our region.

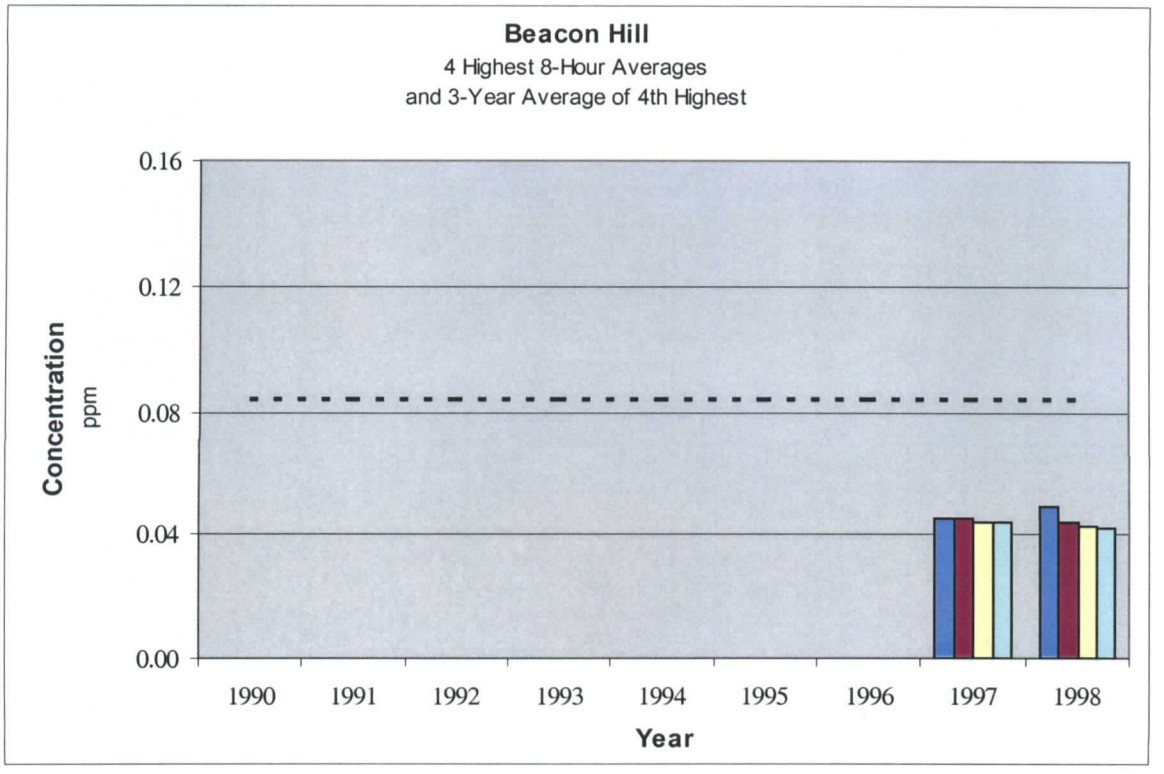

Ozone
1-Hour Maximum Concentration
8 Hour Average
(parts per million)
0.18
0.15
0.12
0.09
0.06
0.03
0
0.14
0.133
0.114
0.059
1-Hour Federal Standard
2 mi east of Enumclaw, King Co
3 mi west of Enumclaw, King Co
Pack Forest, La Grande, Pierce Co
Lake Sammamish State Park, King Co
Getchell, Snohomish Co
Beacon Hill, Seattle
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year

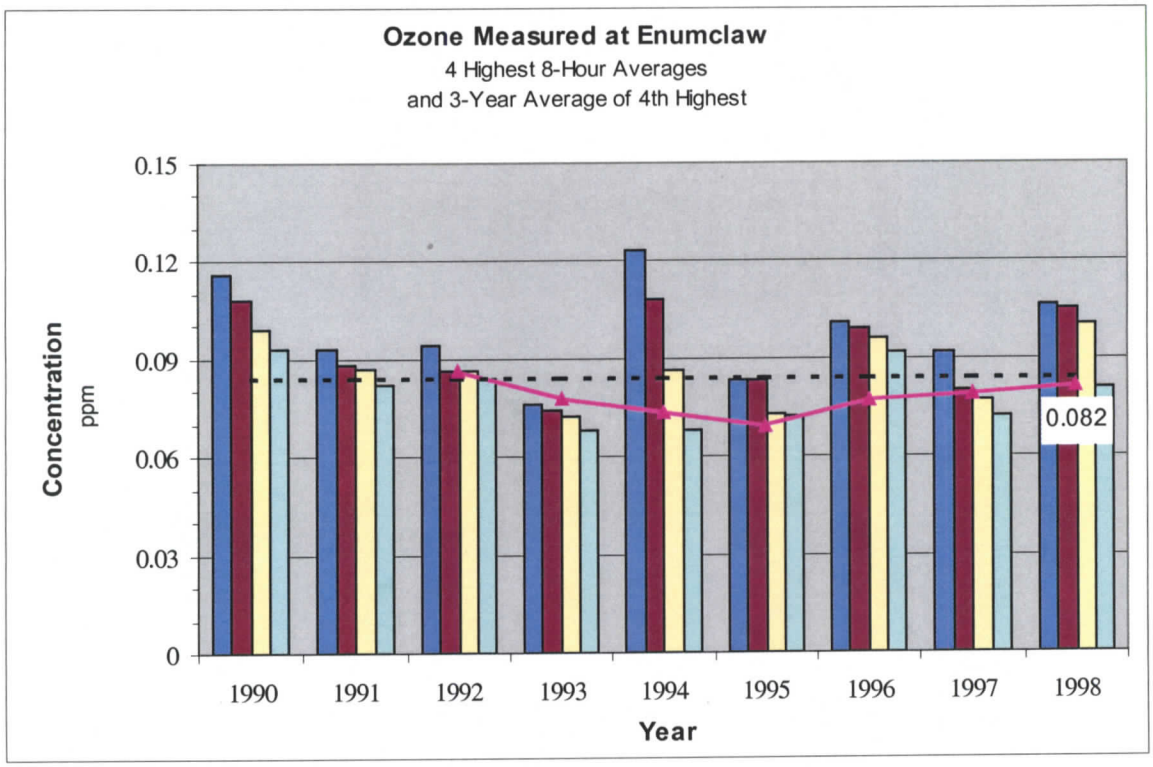

Ozone
8-Hour Maximum Concentration
8 Hour Average
0.12
0.09
0.06
0.03
0
0.109
0.106
0.090
0.049
8-Hour Federal Standard
2 mi east of Enumclaw, King Co
3 mi west of Enumclaw, King Co
Pack Forest, La Grande, Pierce Co
Lake Sammamish State Park, King Co
Getchell, Snohomish Co
Beacon Hill, Seattle
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year

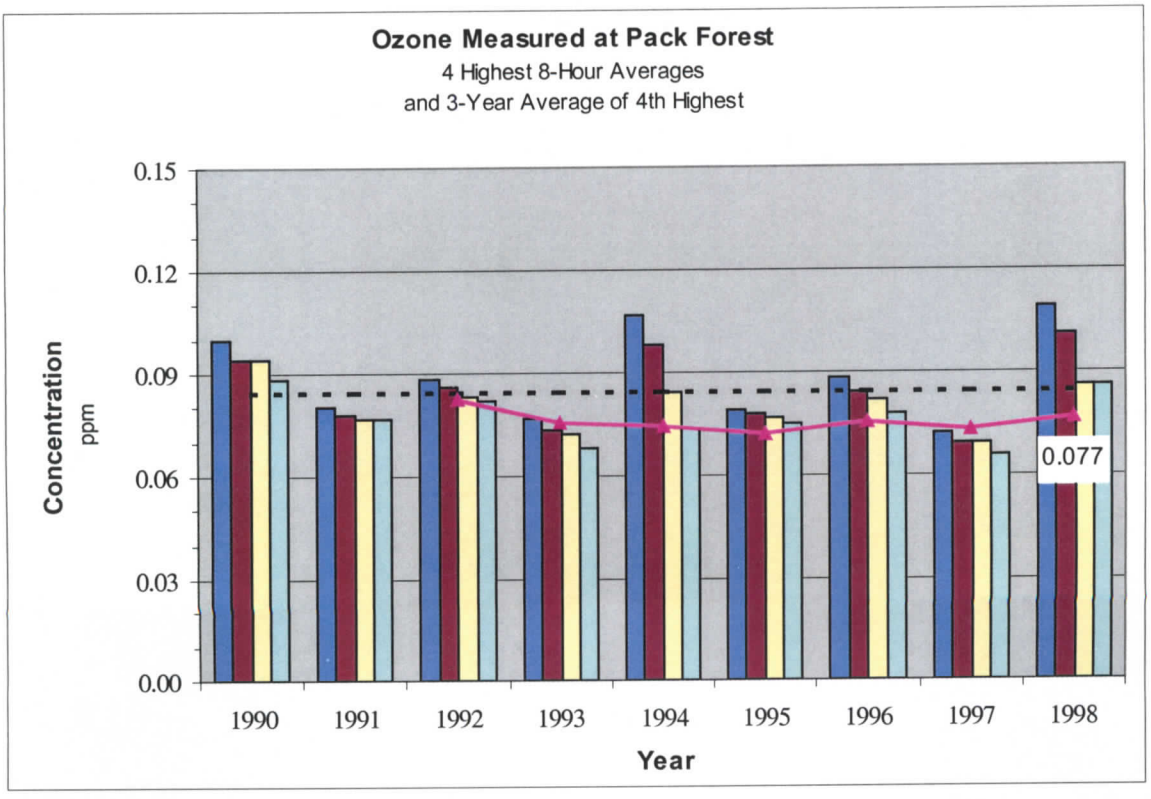

Ozone
Average Number of Days Daily Maximum 1-Hour Average
Exceeded Federal Standard (3-Year Average)
To violate the standard for years 1997-1999,
2 exceedances of the standard would need to
occur at either Enumclaw or Pack Forest in 1999.
Getchell, Snohomish County
Lake Sammamish St Park, King Co
Pack Forest, Pierce County
Enumclaw, King County
Federal Standard
Number of Days per Year
0
1
2
3
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year

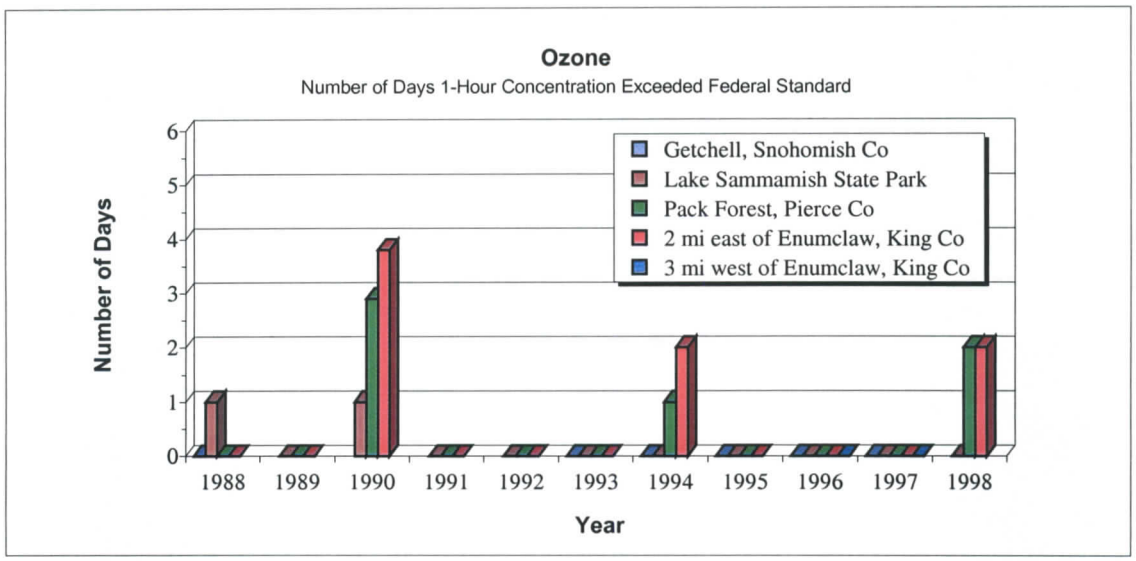

1998 Ozone
8-Hour Maximum Concentrations
Compared to the Federal Standard
Maximum
4th Highest
8-Hour Federal Standard
Concentration
(parts per million)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Beacon Hill,
Seattle
Lake Sammamish
State Park
Highway 410, 2 mi
E of Enumclaw
Pack Forest,
La Grande


Ozone Measured at Lake Sammamish
4 Highest 8-Hour Averages
and 3-Year Average of 4th Highest
Concentration
ppm
0.15
0.12
0.09
0.06
0.03
0.00
0.065
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year


Beacon Hill
4 Highest 8-Hour Averages
and 3-Year Average of 4th Highest
Concentration
ppm
0.16
0.12
0.08
0.04
0.00
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year


Ozone Measured at Enumclaw
4 Highest 8-Hour Averages
and 3-Year Average of 4th Highest
Concentration
ppm
0.15
0.12
0.09
0.06
0.03
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year
0.082


Ozone Measured at Pack Forest
4 Highest 8-Hour Averages
and 3-Year Average of 4th Highest
Concentration
ppm
0.15
0.12
0.09
0.06
0.03
0.00
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year
0.077



OZONE
(Parts per Million)
1998

Location/Continuous Sampling Period(s)	Six Highest Daily Maximum 1 Hour Averages			Estimated No. of Days Daily Maximum 1 Hour Average Exceeded .12 ppm			No. of Days Daily Maximum 1 Hour Average Expected to Exceed .12 ppm
	Value	Date	End Time	1996	1997	1998	
Beacon Hill, 15th S & Charlestown Seattle, Wa 1 Apr–31 Oct	.059 .055 .054 .052 .052 .051	29 Jul 5 May 1 May 20 Apr 30 Jun 16 Sep	1600 1900 2400 1700 1700 1700		0.0	0.0	0.0
20050 SE 56th Lake Sammamish State Park, Wa 1 Apr–31 Oct	.114 .111 .100 .088 .080 .079	28 Jul 26 Jul 27 Jul 29 Jul 3 Aug 31 Aug	1600 1700 1500 1800 1700 1500	0.0	0.0	0.0	0.0
Highway 410 2 miles east of Enumclaw, Wa 1 Apr–31 Oct	.133 .128 .123 .097 .088 .087	28 Jul 27 Jul 26 Jul 3 Aug 2 Aug 29 Jul	1800 1700 1600 1500 1800 1800	0.0	0.0	2.1	0.7
30525 Mud Mountain Rd Enumclaw, Wa 1 Apr–31 Oct	.135 .135 .115 .105 .093 .090	28 Jul 28 Jul 26 Jul 3 Aug 31 Aug 1 Sep	1700 1800 1700 1700 1600 1500				
Charles L Pack Forest La Grande, Wa 1 Apr–31 Oct	.140 .126 .102 .098 .097 .092	27 Jul 26 Jul 28 Jul 3 Aug 1 Sep 31 Aug	1700 1700 1600 1600 1400 1600	0.0	0.0	2.0	0.7

Visibility

Panoramic views are treasured as an important part of quality of life in the Northwest. Our agency also places a great importance on understanding what influences our regional visibility. We devote considerable resources to this area of exploration.

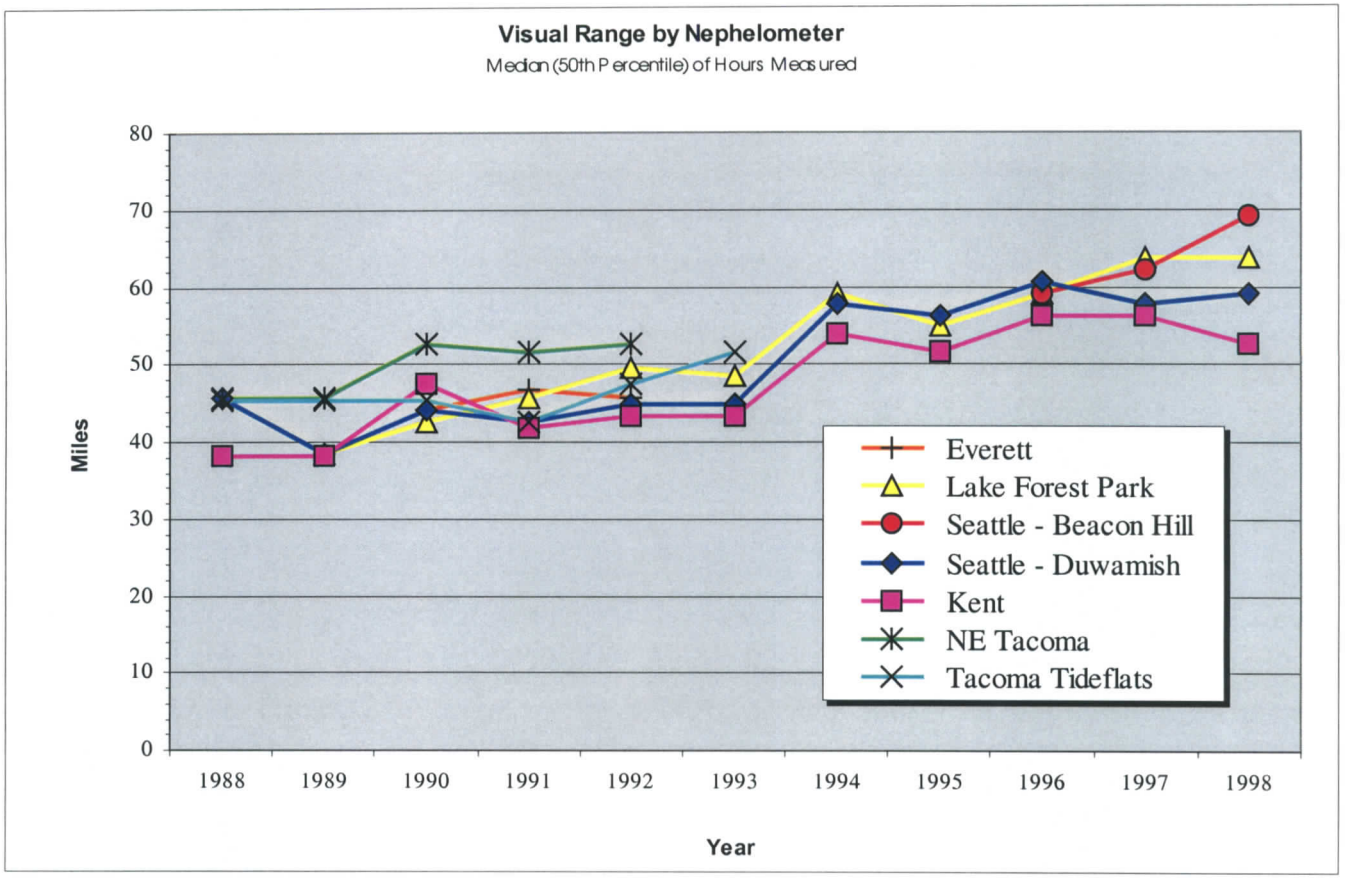
Visibility is often explained in terms of visual range and light extinction. Visual range is the maximum distance – usually miles or kilometers – that you can see a black object against the horizon. Light extinction is the sum of light scattering and light absorption by fine particles and gases in the atmosphere. The more light extinction you have, the shorter your visual range will be.

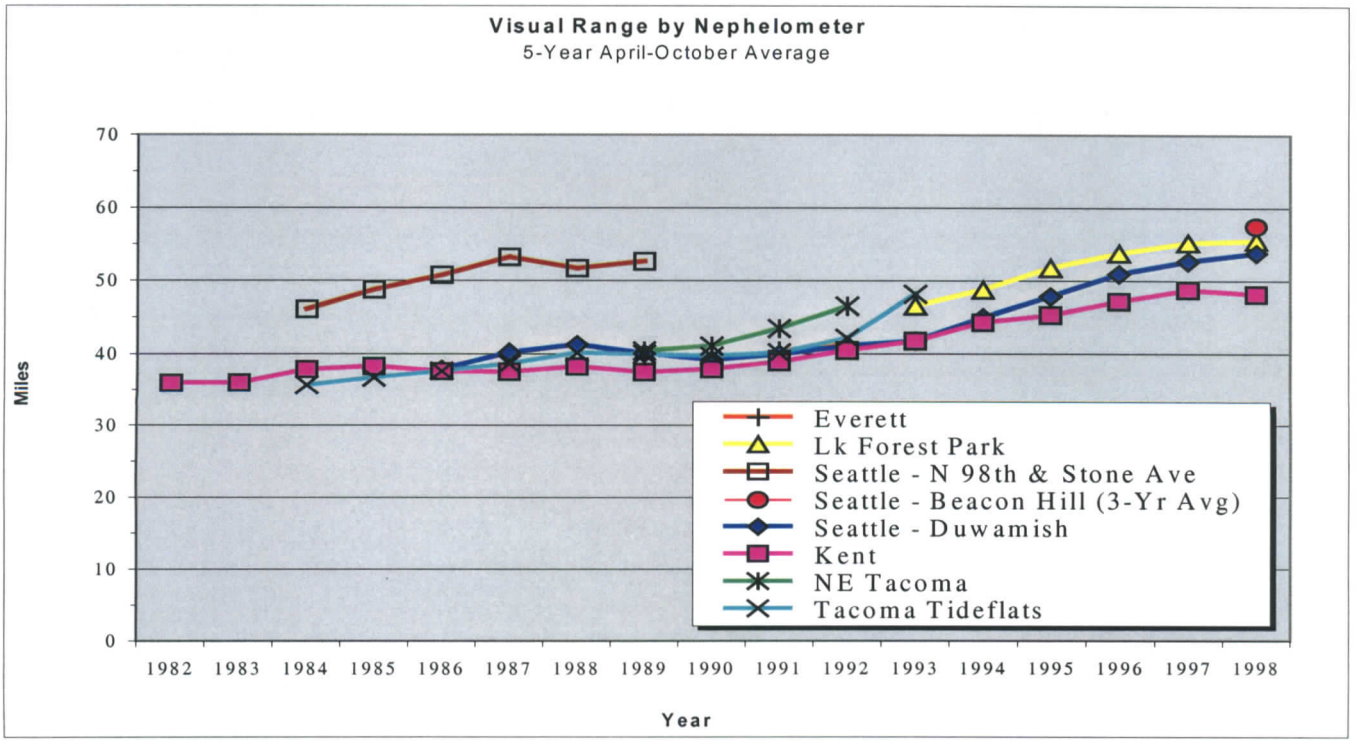
Reduced visibility (or visual range) is caused by weather (clouds, fog, and rain) and air pollution (fine particles and gases). The major pollution contributor is fine particulate matter ($PM_{2.5}$) emissions, which are transported aloft and may remain suspended for a week or longer. Fine particles seem to have a greater impact than coarse particles at locations far from the emitting source because they remain suspended in the atmosphere longer and travel farther.

Light extinction measurement is a scientific method of characterizing visibility. We use the nephelometer and the absorption photometer as instruments to measure light extinction caused by particulate pollution. The nephelometer continuously measures light scattering, the main cause of light extinction. In 1998 we operated nephelometers in Tacoma, Kent, Lake Forest Park, and in Seattle – in the Duwamish valley and on Beacon Hill. All have heated sample inlets to eliminate water vapor, and only measure dry particle scattering or pollution. By measuring light scattering this way, we get reproducible, real-time data that we can use for evaluating pollution control strategies and analyzing trends.

Nephelometers only measure light scattering at the monitoring site and may not accurately represent pollution and weather variations to a distant point. However, we believe that visual ranges derived from nephelometers are representative of visibility in the communities near the monitoring site.

Our newest visibility site on Beacon Hill in central Seattle measures both light scattering and light absorption. Site data is being evaluated and will be published in a future report. The following graphs indicate steadily improving visibility, as indicated by reduced scattering, since 1990, and are consistent with our overall improving air quality. Measurements using federal reference methods for all criteria pollutants show similar improving trends in air quality.


Visual Range by Nephelometer
Median (50th Percentile) of Hours Measured
Miles
Year
0
10
20
30
40
50
60
70
80
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Everett
Lake Forest Park
Seattle - Beacon Hill
Seattle - Duwamish
Kent
NE Tacoma
Tacoma Tideflats


Visual Range by Nephelometer
5-Year April-October Average
Miles
Year
0
10
20
30
40
50
60
70
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Everett
Lk Forest Park
Seattle - N 98th & Stone Ave
Seattle - Beacon Hill (3-Yr Avg)
Seattle - Duwamish
Kent
NE Tacoma
Tacoma Tideflats

ATMOSPHERIC PARTICLES
(b_{sp} x 10^{-4})/Meter
1998

Location	Monthly Arithmetic Averages												No of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
17711 Ballinger Way NE, Lake Forest Park	.32	.28	.37	.28	.31	.27	.30	.31	.30	.55	.41	.42	8643	.34
Beacon Hill, 15th S & Charlestown, Seattle	.22	.19	.30	.29	.24	.24	.29	.30	.30	.46	.28	.19	8584	.28
Duwamish, 4752 E Marginal Way S, Seattle	.31	.28	.35	.31	.32	.28	.33	.34	.32	.54	.38	.31	8609	.34
James St & Central Ave, Kent	.33	.30	.34	.40		.38	.42	.44		.62	.44	.39	7469	.41
Tideflats, 2301 Alexander Ave, Tacoma												.38	1017	.35

Statistical Summary

Location	No of 1 Hour Samples	Frequency Distribution – Percent												1 Hour Max	Arith Mean	Arith Std Dev
		5	10	20	30	40	50	60	70	80	90	95	99			
17711 Ballinger Way NE, Lake Forest Park	8643	.1	.1	.1	.2	.2	.3	.3	.4	.5	.6	.9	1.7	5.25	.34	.33
Beacon Hill, 15th S & Charlestown, Seattle	8584	.1	.1	.1	.2	.2	.2	.3	.3	.4	.5	.7	1.0	2.62	.28	.21
Duwamish, 4752 E Marginal Way S, Seattle	8609	.1	.1	.2	.2	.2	.3	.3	.4	.5	.6	.8	1.3	2.84	.34	.24
James St & Central Ave, Kent	7469	.1	.1	.2	.2	.3	.3	.4	.5	.6	.8	1.0	1.5	3.89	.41	.31
Tideflats, 2301 Alexander Ave, Tacoma	1017	.1	.1	.1	.1	.1	.2	.2	.4	.6	.9	1.2	2.2	2.76	.35	.43

Carbon Monoxide

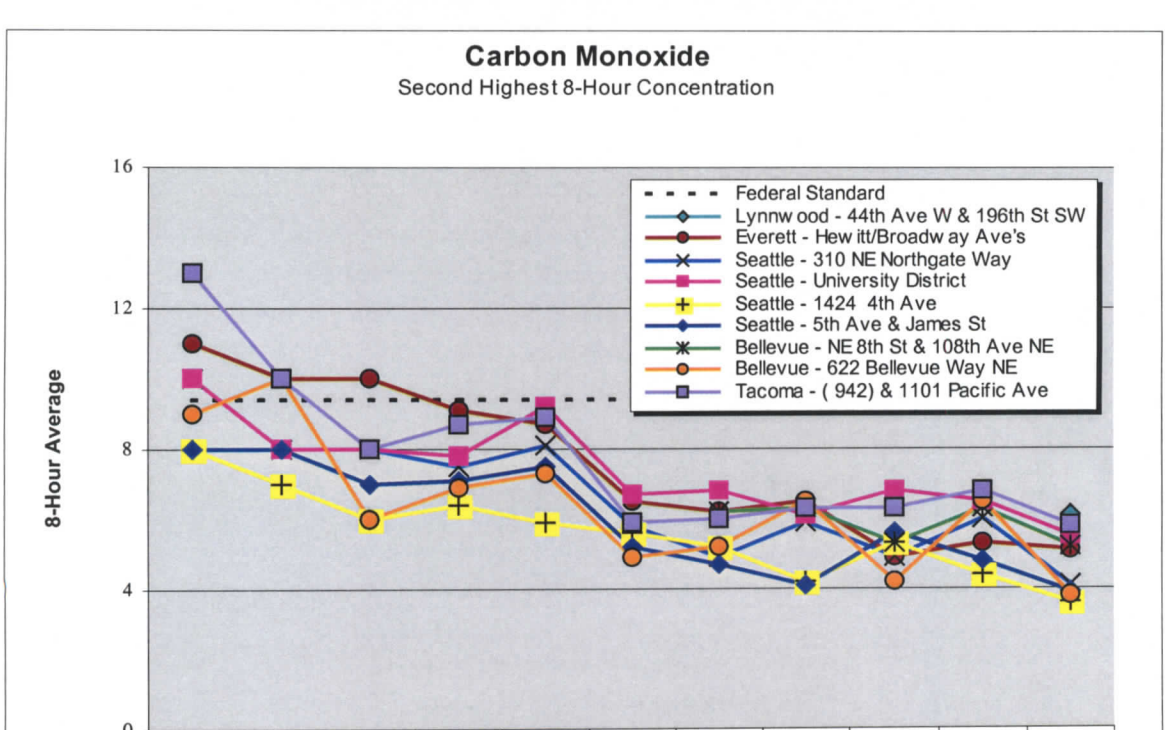
High carbon monoxide (CO) levels are primarily the result of car and truck exhaust in heavy traffic congestion.

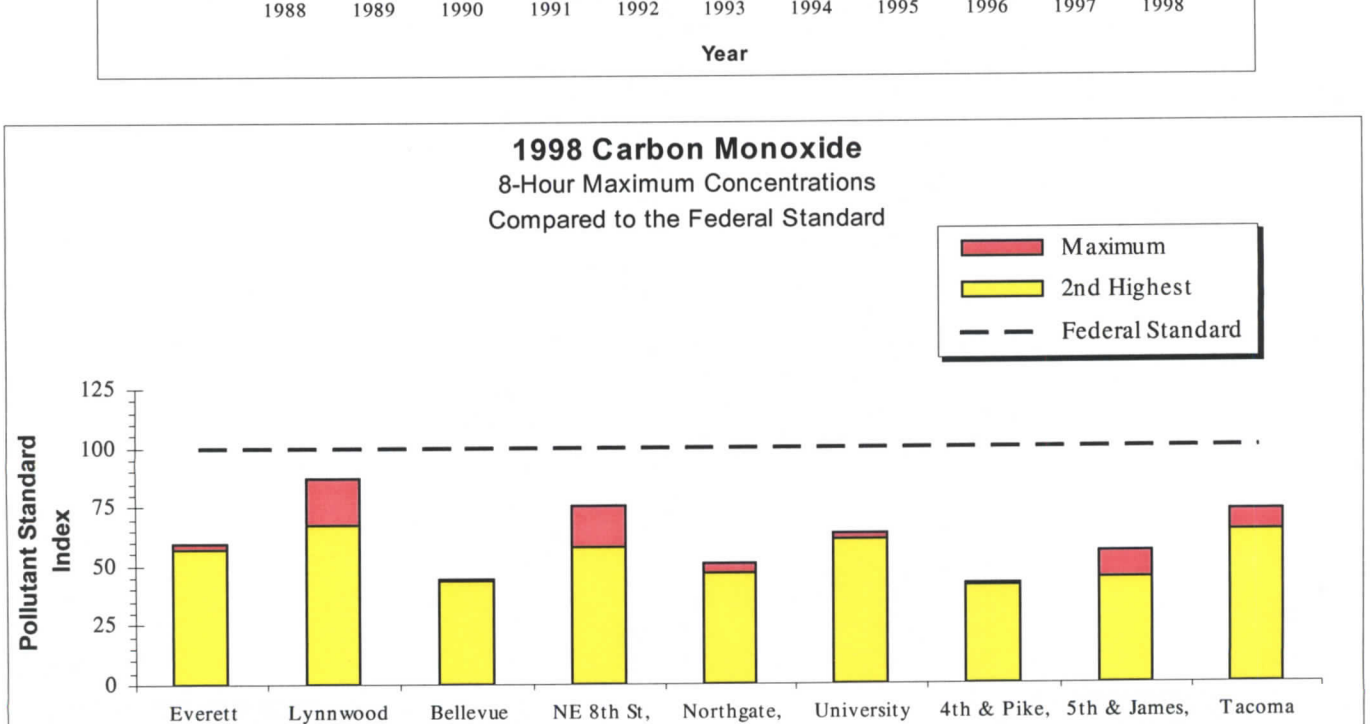
All eight monitoring sites in our jurisdiction are located in areas of traffic congestion. These include the central business districts of our largest cities, and other high traffic areas such as shopping malls. The Washington State Department of Ecology conducts all carbon monoxide monitoring in our jurisdiction. There are two federal standards for carbon monoxide: a 35 ppm 1-hour standard and a 9 ppm 8-hour standard.

No monitored values at any of the sites exceeded the federal standards in 1998. The highest 8-hour concentration of carbon monoxide was recorded at 8.1 ppm in Lynnwood in October.

Carbon monoxide levels have dropped dramatically over the last two decades. Cleaner exhaust from cars and trucks, the state motor vehicle inspection program and cleaner motor fuels are the key factors behind the decrease.

Carbon monoxide concentrations rapidly diminish only a short distance from busy traffic intersections. For this reason, air monitoring of carbon monoxide is generally done at the microscale level, depicting air quality at a maximum of 100 meters from the site. Even at some of the busiest, most congested intersections, monitoring sites have not registered any exceedances of the standards. Consequently, carbon monoxide is not considered a significant air quality problem in the Puget Sound region. Since October 1996, our region has been designated in attainment for carbon monoxide.


Carbon Monoxide
Second Highest 8-Hour Concentration
8-Hour Average
16
12
8
4
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year
Federal Standard
Lynnwood - 44th Ave W & 196th St SW
Everett - Hewitt/Broadway Ave's
Seattle - 310 NE Northgate Way
Seattle - University District
Seattle - 1424 4th Ave
Seattle - 5th Ave & James St
Bellevue - NE 8th St & 108th Ave NE
Bellevue - 622 Bellevue Way NE
Tacoma - (942) & 1101 Pacific Ave


1998 Carbon Monoxide
8-Hour Maximum Concentrations
Compared to the Federal Standard
Maximum
2nd Highest
Federal Standard
Pollutant Standard Index
125
100
75
50
25
0
Everett
Lynnwood
Bellevue Way, Bellevue
NE 8th St, Bellevue
Northgate, Seattle
University District, Seattle
4th & Pike, Seattle
5th & James, Seattle
Tacoma
Location

CARBON MONOXIDE
(Parts per Million)
1998

Location/Continuous Sampling Period(s)	Six Highest Concentrations						Number of 8 Hour Averages Exceeding 9 ppm	Number of Days 8 Hour Average Exceeded 9 ppm
	1 Hour Average			8 Hour Average				
	Value	Date	End Time	Value	Date	End Time		
Broadway & Hewitt Ave	9.1	22 Oct	1900	5.3	22 Oct	2100	0	0
Everett, Wa	7.9	6 Oct	0700	5.1	3 Dec	2400		
1 Jan-31 Dec	7.5	21 Dec	1800	5.0	21 Dec	2200		
	7.3	22 Oct	1700	4.7	29 Oct	2200		
	7.2	3 Nov	1800	4.7	3 Nov	1900		
	6.9	21 Oct	0800	4.6	6 Oct	1300		
44th Ave W & 196th St SW	16.2	16 Nov	2400	8.1	22 Oct	0100	0	0
Lynnwood, Wa	14.2	21 Oct	2200	6.1	16 Nov	2400		
1 Oct-31 Dec	11.8	21 Oct	2300	5.7	30 Oct	0100		
	10.8	17 Nov	0400	5.7	4 Dec	0200		
	9.3	21 Oct	2100	5.5	23 Oct	2300		
	9.3	22 Oct	1900	5.1	21 Oct	0100		
622 Bellevue Way NE	5.6	22 Oct	1800	3.9	21 Oct	2400	0	0
Bellevue, Wa	5.5	22 Oct	1700	3.8	22 Oct	2300		
1 Jan-31 Dec	5.2	21 Oct	1800	3.5	4 Dec	0200		
	5.1	3 Dec	2100	3.0	31 Oct	0300		
	4.8	9 Feb	1900	2.8	23 Oct	2300		
	4.8	22 Oct	1900	2.8	29 Oct	2400		
NE 8th St & 108th Ave NE	8.2	21 Oct	2000	6.9	21 Oct	2400	0	0
Bellevue, Wa	7.9	21 Oct	1800	5.2	3 Dec	2400		
1 Jan-31 Dec	7.9	21 Oct	2100	4.5	22 Dec	2300		
	7.5	21 Oct	1900	4.4	22 Oct	2200		
	7.4	21 Oct	2200	4.3	31 Oct	0100		
	7.1	22 Oct	1800	4.2	23 Oct	2200		
Northgate, 310 NE Northgate Way	8.1	21 Oct	0800	4.5	22 Oct	0100	0	0
Seattle, Wa	6.6	22 Oct	0800	4.1	21 Oct	1200		
1 Jan-31 Dec	6.6	3 Dec	2100	4.0	4 Dec	0300		
	6.2	21 Oct	2100	3.9	22 Oct	1300		
	5.9	21 Oct	2200	3.4	30 Oct	0200		
	5.7	21 Oct	0700	3.4	31 Oct	0100		
University District, 1307 NE 45th St	11.2	22 May	0800	5.7	24 Oct	0100	0	0
Seattle, Wa	7.9	21 Oct	1900	5.5	30 Oct	2400		
1 Jan-31 Dec	7.8	23 Oct	2000	5.3	22 Oct	1300		
	7.4	23 Oct	1900	5.2	22 Oct	2300		
	6.9	23 Oct	2100	5.0	22 Oct	0100		
	6.8	12 Mar	0900	4.9	24 Oct	2100		
1424 4th Ave	5.8	21 Oct	0900	3.7	22 Oct	1800	0	0
Seattle, Wa	5.7	21 Oct	1700	3.6	30 Jan	2400		
1 Jan-31 Dec	5.6	30 Jan	2100	3.4	23 Oct	2400		
	5.5	22 Oct	1700	3.3	21 Oct	1200		
	5.4	21 Oct	0800	3.3	21 Oct	2400		
	5.2	21 Oct	1800	3.1	22 Oct	1000		
5th Ave & James St	8.3	28 Jan	1800	4.9	22 Oct	1800	0	0
Seattle, Wa	7.0	21 Oct	0900	3.9	21 Oct	1300		
1 Feb-31 Dec	6.7	21 Oct	0800	3.8	28 Jan	1900		
	6.7	22 Oct	1700	3.8	30 Oct	2200		
	6.1	30 Jan	1800	3.7	11 Dec	1700		
	5.9	19 Feb	1800	3.6	29 Oct	2400		
1101 Pacific Ave	10.9	21 Oct	1700	6.7	21 Oct	2300	0	0
Tacoma, Wa	9.3	13 Jan	1800	5.8	22 Oct	1900		
1 Jan-31 Dec	9.2	22 Oct	1700	4.2	7 Nov	0300		
	8.8	21 Oct	1800	4.1	22 Oct	0900		
	8.7	22 Oct	1800	4.1	24 Oct	2400		
	6.2	16 Jan	1800	4.1	23 Dec	0300		

NOTES

1. All carbon monoxide stations operated by the Washington State Department of Ecology.
2. Ending times are reported in Pacific Standard Time.
3. For equal concentration values the date and time refer to the earliest occurrences.
4. Continuous sampling periods are those with fewer than 10 consecutive days of missing data.
5. At all stations carbon monoxide was measured using the continuous nondispersive infrared method.

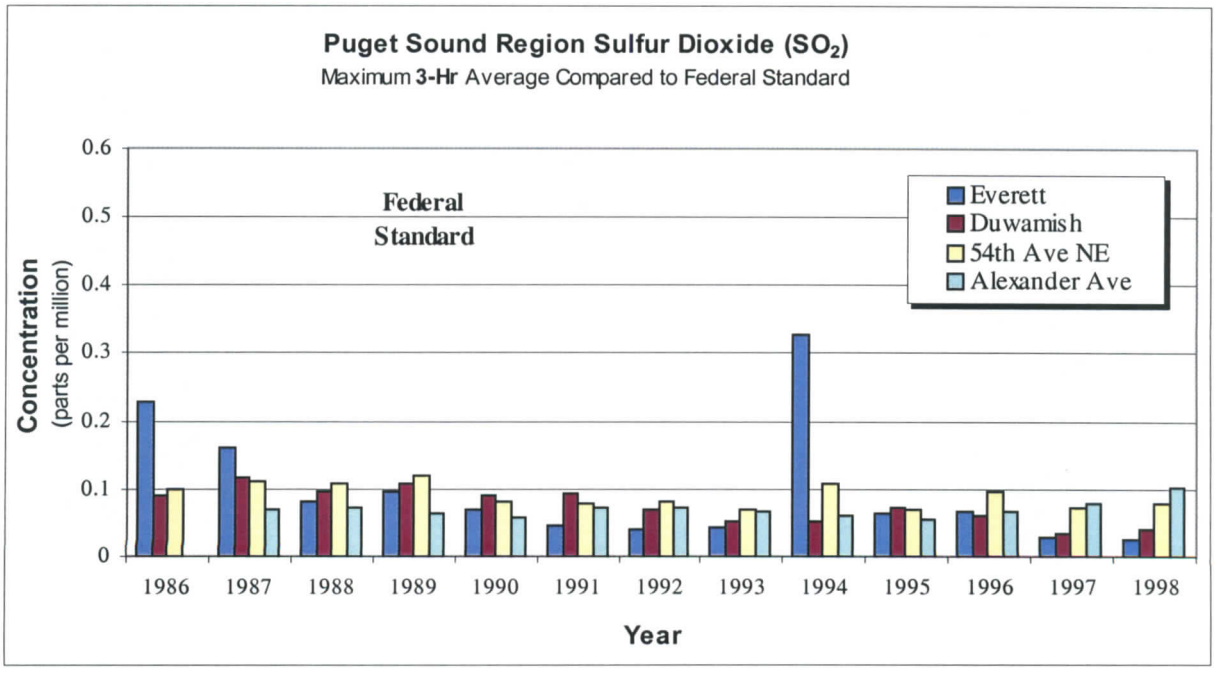
Note taking section

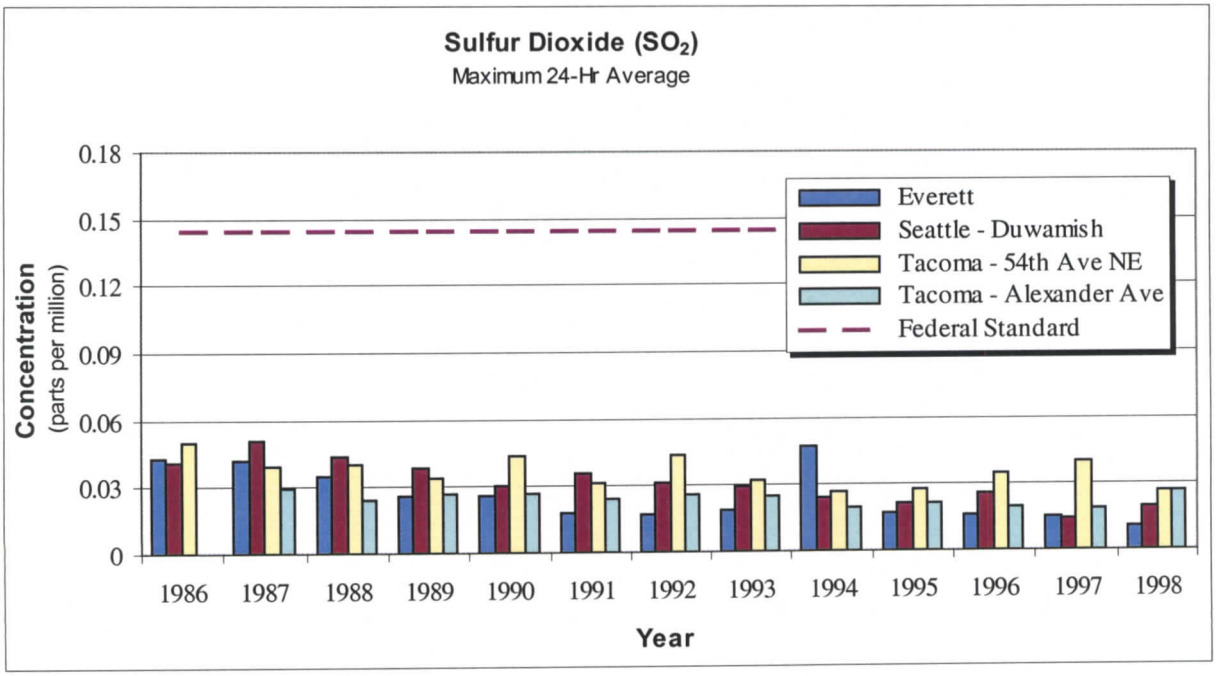
Sulfur Dioxide

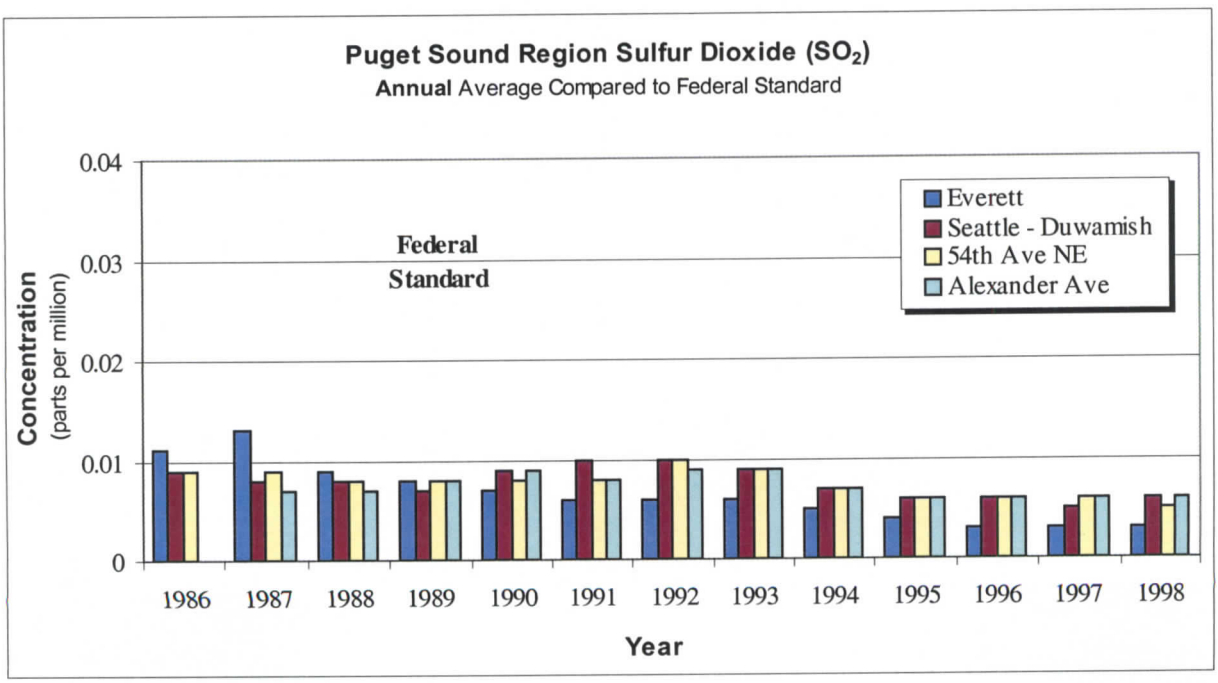
High levels of sulfur dioxide are the result of emissions from large coal or oil burning power plants, sulfuric acid production facilities, and other industrial operations such as pulp mills and cement plants. The dominant regional sulfur dioxide source was the ASARCO smelter in Tacoma, which closed in 1984. Four monitoring stations sited in the Everett, Seattle, and Tacoma industrial areas measure sulfur dioxide.

Measured levels of sulfur dioxide continue to be low. No level of SO_2 reached even 30 percent of any of the state or federal standards during 1998.

The only SO_2 exceedance in the past ten years was attributed to an upset emission from an Everett pulp and paper mill in 1994. This single exceedance did not constitute a violation of the Washington state 1-hour standard, nor did it exceed or violate any federal standard. The Puget Sound area remains in attainment for sulfur dioxide.




Sulfur Dioxide (SO_2)
Maximum 24-Hr Average
Concentration (parts per million)
0.18
0.15
0.12
0.09
0.06
0.03
0
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
Year
Everett
Seattle - Duwamish
Tacoma - 54th Ave NE
Tacoma - Alexander Ave
Federal Standard


Puget Sound Region Sulfur Dioxide (SO_2)
Annual Average Compared to Federal Standard
Concentration (parts per million)
0.04
0.03
0.02
0.01
0
Federal Standard
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
Year
Everett
Seattle - Duwamish
54th Ave NE
Alexander Ave

Lead

Airborne lead typically has been associated with automobile exhaust and lead smelters. Since the phase-out of lead in fuel, exhaust from cars and trucks is no longer a major source of lead. Seattle's lead smelter on Harbor Island ceased lead smelting over ten years ago, and will end all lead processing in 1998. Our only remaining lead monitoring site measures lead from this facility. Data from this site has very limited relevance to regional ambient air quality.

This year the quarterly federal standard for lead was violated during the period of April through June 1998. The source of this violation was determined to be a lead processing facility, which ceased all operations in May of 1998. Enforcement action was taken against the facility. Lead concentrations returned to their normally low levels during the next two quarters of the year. No significant health risk was expected from this one quarter anomaly in lead concentrations, according to the Washington State Health Department.

LEAD
Micrograms per Standard Cubic Meter
Sampling Method: Standard High Volume Quartz Fiber Filters
1998

Location	Monthly Arithmetic Averages												No. of Obs	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Harbor Island, 2555 13th Ave. SW, Seattle, Wa	.41	.31	.78	.74	2.88	2.48	.21	.11	.04	.04	.06	.04	81	.67

Location	Quarterly Arithmetic Averages			
	1st	2nd	3rd	4th
Harbor Island, 2555 13th Ave. SW, Seattle, Wa	.50	2.03	.12	.05

Summary of Individual 24 Hour Average Lead Values				
Location	Highest Value		Values Higher Than .50	
	Value	Date	Value	Date
Harbor Island, 2555 13th Ave. SW, Seattle, Wa	7.30	4 Jun	7.30	4 Jun
			3.80	23 May
			2.90	30 Mar
			2.90	17 May
			2.80	5 May
			2.80	16 Jun
			2.60	29 May
			2.30	11 May
			2.10	23 Apr
			2.10	10 Jun
			0.96	11 Apr
			0.88	10 Feb
			0.79	29 Jan
			0.58	17 Apr
			0.55	28 Feb