1987 AIR QUALITY DATA SUMMARY

Counties Of

King
Kitsap
Pierce
Snohomish

PUGET SOUND

AIR POLLUTION CONTROL AGENCY

200 West Mercer Street, Room 205

Seattle, Washington 98119-3958

PUGET SOUND AIR POLLUTION CONTROL AGENCY Serving King, Kitsap, Pierce and Snohomish Counties

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Sound Region during 1987 for which at least one PM_{10} value exceeded a 24 hour average of 150 ug/m^3 .

Location	Maximum PM10 Value (ug/m³)	Number of PM10 Values Exceeding 150 ug/m ³
Seattle,		
Duwamish	164	2
Tacoma,		
Alexander	220	1
Tacoma, E 11th St	203	4

Daily Air Quality

The Agency reports on daily air quality by using the national Pollutant Standards Index. The Index value is calculated directly from measurements for each of the pollutants, and the report includes a descriptive term for the daily Index value.

These terms describe the air quality (in progressively more polluted stages) as "Good", "Moderate", "Unhealthful", or "Very Unhealthful". Any pollutant measurement exceeding the short term national primary standard causes the Index value to be in the Unhealthful or a worse category.

The daily Pollutant Standards Index values provide an easy way to summarize the air quality for the entire year. In 1987:

Everett had 203 Good, 158 Moderate, and 3 Unhealthful days;

Seattle had 120 Good, 238 Moderate, and 7 Unhealthful days;

Tacoma had 173 Good, 177 Moderate, 13 Unhealthful, and 2 Very Unhealthful days.

Weather Variables

Finally, another variable that influences the air quality on a given day is the weather. Weather never causes high pollutant levels, but sometimes under stable conditions the pollutants emitted from people's activities are not quickly dispersed.

Poor dispersion exists on about onethird of the days during nighttime and early morning hours, but the weather effectively disperses pollutants by afternoon on most of these days. A few times each year poor dispersion persists for 24 or more hours. These cases are often associated with the higher pollutant levels.

During 1987 in western Washington, the Department of Ecology formally declared the Forecast Stage of an air pollution episode on two occasions because of stagnant weather conditions. The dates with the Forecast Stage in effect were October 21-24 and December 24-26.

Emission Inventory

The air contaminant emission inventory is compiled each year by the Agency's Engineering Division from registered information, source Notice Construction permit data, published emission factors, census statistics and source test results. This additional data has been received and incorporated from the U. S. EPA's toxic air contaminant reports for selected facilities within the Puget Region. The air contaminants tabulated include: total suspended particulate matter (TSPM), particulate matter less 10 micrometers (PM10), $oxides (SO_x)$, nitrogen oxides (NO,),

volatile organic compounds (VOC), carbon monoxide (CO) and toxic air contaminants (TAC). The Puget Sound Region emission inventory for 1987 is summarized below.

Emiss	ions
	Thsds
	of
Contaminant	Tons
TSPM	232
PM10	94
so_x	36
NO.	102
VOĈ	153
CO	891
TAC	29

Other Information Sources

All data collected are reported to the Washington State Department of Ecology; some of it is forwarded from there to

National Aerometric Data Bank maintained by the U. S. EPA. Department of Ecology conducts air monitoring within the Puget Sound area in addition to that done by our Agency. Department publishes an summary of data for the entire state. Requests for the state summary should be directed to the Washington Department of Ecology - PV11, Air Program, Olympia, WA 98504-8711.

Anyone may also obtain the current Pollutant Standards Index from the American Lung Association of Washington in Seattle by dialing 441-5100 or by dialing 1-800-732-9339 from outside Seattle.

The Index is also available from the Puget Sound Air Pollution Control Agency by dialing 296-5100 or by dialing 1-800-433-2215 from outside Seattle.

1987 SAMPLING NETWORK

Location	Туре	of Sam	pling	
Tolt River Watershed, King County, Wa		TSP		4
*Snohomish FD #22, 9921 84th NE, Arlington, Wa				03
*Legion Park, W Marine View Dr, Everett, Wa				SO ₂
Medical-Dental Bldg, 2730 Colby, Everett, Wa	PM10			b _{sp} , SO ₂ , Wind
*Broadway & Hewitt Ave, Everett, Wa			CO	
*622 Bellevue Way NE, Bellevue, Wa			CO	
*504 Bellevue Way NE, Bellevue, Wa	PM10	TSP		•
*20050 SE 56th, Lake Sammamish State Park, Wa				03
*Northgate, 310 NE Northgate Way, Seattle, Wa			CO	
North 98th St & Stone Ave N, Seattle, Wa	PM10	TSP		bsp, SO ₂ , Pb, Wind
*Marshall School, 520 NE Ravenna, Seattle, Wa		TSP		Pb
*5701 8th Ave NE, Seattle, Wa		TSP		Pb
*4511 University Way NE, Seattle, Wa			CO	
*1960 NE Pacific Ave, Seattle, Wa			CO	
*3921 Linden Ave N, Seattle, Wa			CO	
*1424 4th Ave, Seattle, Wa			СО	
*5th Ave & James St, Seattle, Wa			CO	
*Courthouse, 4th Ave & James St, Seattle, Wa			CO	
*Fire Station #10, 301 2nd Ave S, Seattle, Wa	PM10	TSP	CO	Wind
Harbor Island, 2555 13th Ave SW, Seattle, Wa		TSP		Pb
Harbor Island, 3400 13th Ave SW, Seattle, Wa	PM10	TSP		Pb
Duwamish, 4752 E Marginal Way S, Seattle, Wa	PM10	TSP		PM2.5, bsp, SO ₂ , Wind
*Georgetown, 6431 Corson Ave S, Seattle, Wa		TSP		
South Park, 723 S Concord St, Seattle, Wa	PM10	TSP		Pb
Duwamish Valley, 12026 42nd Ave S, King Co, Wa		TSP		

Notes- (1) Type	of Sampling:		
	PM10	<pre>= Particulate Matter 10 micrometers or smaller</pre>	bsp	<pre>= Atmospheric Particles (by nephelometer)</pre>
	TSP	= Total Suspended Particulates	03	= Ozone
	CO	= Carbon Monoxide	SO,	<pre>= Sulfur Dioxide</pre>
	PM2.5	= Particulate Matter smaller	Pb	= Lead

than 2.5 micrometers

As = Arsenic Wind = Wind Direction & Speed

^{(2) *} Station operated by Washington State Department of Ecology.

1987 SAMPLING NETWORK

Location	Туре	of Samplin	g
Memorial Park, 850 N Central Ave, Kent, Wa	PM10	TSP	
James St & Central Ave, Kent, Wa	PM10	TSP	b _{sp} , Wind
115 E Main St, Auburn, Wa		TSP	
Pac Coast Coal, 270th Ave SE, Black Diamond, Wa		TSP	
*Highway 410, 2 miles east of Enumclaw, Wa			03
Sumner Jr HS, 1508 Willow St, Sumner, Wa		TSP	03
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	PM10	TSP	b _{sp} , SO ₂ , Wind
2340 Taylor Way, Tacoma, Wa	PM10	TSP	-
2301 Alexander Ave, Tacoma, Wa	PM10	TSP	SO ₂ , Wind
Fire Station #12, 2316 E 11th St, Tacoma, Wa	PM10	TSP	PM2.5, b _{sp} , Wind
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa		TSP	
Cascadia, 2002 E 28th St, Tacoma, Wa		TSP	7 %
Willard School, S 32nd & S 'D' St, Tacoma, Wa		TSP	
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa		TSP	
*942 Pacific Ave, Tacoma, Wa		CO	
*1101 Pacific Ave, Tacoma, Wa		CO	í
SW 283rd & 101st Ave SW, Maury Island, Wa		TSP	Pb, As
Ruston School, 5219 N Shirley St, Tacoma, Wa		TSP	Pb, As
4716 North Baltimore St, Tacoma, Wa		TSP	Pb, As
North 26th & Pearl Sts, Tacoma, Wa		TSP	SO ₂ , Pb, As, Wind
*Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa		TSP	Wind
City Hall, 239 4th St, Bremerton, Wa		TSP	
*Burwell St & Pacific Ave, Bremerton, Wa		CO	
*Pierce Co Fire D #21, 8102 304th, Graham, Wa			0,
*Charles L Pack Forest, La Grande, Wa			0,
*Mount Rainier National Park, Longmire, Wa			0,
			3

Notes-	(1)	Type	of	Sampling:

PM10	<pre>= Particulate Matter 10 micrometers or smaller</pre>	bsp	<pre>= Atmospheric Particles (by nephelometer)</pre>
TSP	= Total Suspended Particulates	03	= Ozone
CO	= Carbon Monoxide	SO ₂	= Sulfur Dioxide
PM2.5	= Particulate Matter smaller than 2.5 micrometers	Pb	= Lead
Wind	= Wind Direction & Speed	As	= Arsenic

^{(2) *} Station operated by Washington State Department of Ecology.

POLLUTANT STANDARDS INDEX

The Pollutant Standards Index (PSI) provides a nationally uniform way to report daily air quality levels. In cooperation with the Washington State Department of Ecology, the Agency began reporting the PSI in 1980 for the Everett, Seattle, and Tacoma areas.

The PSI places pollutant levels during a 24 hour period on a scale indicating whether there are potential health effects. The PSI scale of zero to 500 classifies the air quality by the following descriptions:

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.

Whenever the PSI is above 100, a measured pollutant level exceeds the national primary air quality standard. An index value of 200 means the pollutant concentration has reached the "Alert" level in the Washington Episode Avoidance Plan.

The Agency reviews pollutant levels within the cities of Everett, Seattle and Tacoma to calculate the Index. The Index value for each day in each city is determined by the pollutant with the

highest value on the PSI scale. Since the highest PSI value generally occurs near congested traffic or near an industrial area, the values for suburban residential areas are normally lower.

The accompanying tables summarize each daily PSI value for Everett, Seattle, and The higher PSI values tend to occur during the fall and winter months often coinciding with air stagnation periods. A 1987 summary table shows for each month the number of days in each PSI interval, the maximum Index, the date of the maximum and the pollutant determining the maximum value. A summary table for 1980 through 1987 presents by year the number of days in each air quality category and the number of days each pollutant determined the PSI. For the unhealthful days each year (Index values greater than 100), this summary tabulates the pollutant responsible.

The PSI values are indexed to actual concentrations of pollutants for which a national primary standard has been set. The following table shows the averaging period and the pollutant concentration for each break-point of the Index. Values between break-points are determined by linear interpolation.

<u>Pollutant</u> Carbon Monoxide	(CO)	<u>Averaging Period & Units</u> 8 hour average in parts per million
Particulate Matter Sulfur Dioxide Ozone	(PM10) (SO ₂) (O ₃)	24 hour average in micrograms per cubic meter 24 hour average in parts per million 1 hour average in parts per million

PSI Break-points and Pollutant Concentrations

PSI value 50 100 200 300 400	CO (8 hrs) 4.5 9.0 15.0 30.0 40.0	PM10 (24 hrs) 50 150 350 420 500	SO ₂ (24 hrs) 0.03 0.14 0.30 0.60 0.80	0 ₃ (1 hr) 0.06 0.12 0.20 0.40 0.50 0.60
500	50.0	600	1.00	0.60

POLLUTANT STANDARDS INDEX

1987

EVERETT														
AIR QUALITY	(PSI Interval)	JAN	FEB	Number MAR	of Days APR	in Each MAY	PSI I JUN	nterval JUL	during AUG	Each M SEP	onth OCT	NOA	DEC	ANNUAL
GOOD	(0 to 50)	24	24	30	22	23	11	13	12	11	3	19	11	203
MODERATE	(51 to 100)	7	3	1	8	8	17	18	19	19	28	11	19	158
UNHEALTHFUL	(101 to 199)	0	0	0	0	0	2	0	0	0	0	0	1	3
ERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI	each month	59	61	51	67	78	117	100	89	100	100	89	117	117
Da	ate	22nd	7th	30th	1st#	5th#	26th#	21st	3rd#	4th	9th	25th	28th	Jun 26
Polli	ıtant	PM	PM	PM	CO	CO	CO	СО	CO	CO	CO	CO	CO	СО
					SEA	ATTLE								
				Number	of Days	in Each	PSI I	nterval	during	Each M	onth			
AIR QUALITY	(PSI Interval)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOA	DEC	ANNUAL
GOOD	(0 to 50)	9	7	7	8	17	16	14	13	10	3	9	7	120
MODERATE	(51 to 100)	20	18	24	22	14	14	17	18	20	27	20	24	238
UNHEALTHFUL	(101 to 199)	2	3	0	0	0	0	0	0	0	1	1	0	7
ERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI		145	184	91	89	100	89	67	78	100	117	167	100	184
A 1440	ate	22nd	6th	31st	27th	21st	29th	2nd#		30th	21st	19th	11th	Feb 6
Polli	ıtant	PM	PM	PM	CO	CO	СО	СО	CO	СО	СО	CO	CO	PM
					T	ACOMA								
				Number	of Days	in Each	PSI I	nterval	during	Each M	onth			
AIR QUALITY	(PSI Interval)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOA	DEC	ANNUAL
GOOD	(0 to 50)	10	10	15	16	18	16	16	25	17	9	10	11	173
MODERATE	(51 to 100)	20	14	16	13	13	14	15	6	13	19	17	17	177
UNHEALTHFUL	(101 to 199)	1	2	0	1	0	0	0	0	0	3	3	3	13
ERY UNHEALTHFUL	(200 to 299)	0	2	0	0	0	0	0	0	0	0	0	0	2
Maximum PSI		167	220	94	133	71	71	82	67	78	167	135	133	220
200	ate	8th	5th	30th	27th	18th	26th	13th	31st	30th	1st	19th	17th	Feb :
Polli	ıtant	CO	CO	PM	PM	PM	PM	PM	CO	PM	CO	PM	СО	CO

[#] Earliest date of occurrence

POLLUTANT STANDARDS INDEX

1980 - 1987

							EVER	ETT					
	Day	ys in Eacl	h Air Qualit	7 Category	Po	llutar	nt Det	erminin	g the	PSI		Highest	Value
				Very		All Da	57000 Company	Unheal				200	
	Good	Moderate	Unhealthful	Unhealthful	PM	co	S02	PM	co	S02	PSI	Date	Pollutan
980	340	19	0	0	356	_	3	0	_	0	60	Jan 23	PM
981	350	11	0	0	340	_	21	0	-	0	62	Jan 16	PM
982	334	30	1	0	277	70	18	0	1	0	117	Dec 30	co
983	308	56	1	0	191	150	24	0	1	0	117	Nov 30	CO
984	309	57	0	0	105	217	44	0	0	0	92	Sep 28	PM
985	300	64	1	0	152	166	47	0	1	0	117	Dec 11	CO
986	324	41	0	0	169	148	48	0	0	0	89	Jan 25	co
987	203	158	3	0	96		18	0	3	0	117	Jun 26#	
otals	2468	436	6	0	1686	1001	223	0	6	0			
	Day	rs in Eacl	n Air Quality	Category	Pol	llutar	SEAT	TLE erminin	g the	PSI		Highest	Value
												0	
				Very	I	All Da	ıys	Unheal	thful	Days			
	Good	Moderate	Unhealthful	Unhealthful	PM	CO	S02	PM	CO	S02	PSI	Date	Pollutan
980	73	275	18	0	95	270	1	1	17	0	194	Jan 23	PM
981	69	267	28	1	109	254	2	5	24	0	213	Jan 15	CO
982	86	268	10	1	96	264	5	1	10	0	214	Feb 6	PM
983	98	258	9	0	101	261	3	0	9	0	183	Jan 28	CO
984	146	218	2	0	111	242	13	2	0	0	103	Dec 6	PM
985	150	202	10	3	156	206	3	6	7	0	204	Dec 12	PM
986	130	226	8	1	113	246	6	1	8	0	206	Jan 7	PM
987	120	238	7	0	119	246	0	3	4	0	184	Feb 6	PM
otals	972	1952	92			1000		10					
otals	6/2	1932	92	6	900	1989	33	19	79	0			
							TACO	MA					
	Day	s in Each	Air Quality	Category	Pol	.lutan	t Det	erminin	g the	PSI		Highest	Value
				Very	A	ll Da	ys	Unhealt	thful	Days			
	Good	Moderate	Unhealthful	Unhealthful	PM	co	S02	PM	CO	S02	PSI	Date	Pollutant
980	83	271	12	0	256	107	3			0	160	Apr 12	PM
981	74	278	10	3	222	137	6	1	12	0		Apr 12	CO
982	119	242	4	0			9				227	Jan 12	
983	140	222	3	0	255	101		0	4	0	167	Dec 30	CO
983 984	162	198		0	228	128	9	1	2	0	137	Dec 23	PM
984 985			6	177	207	149	10	0	6	0	117	Jan 19#	CO
	140	213	12	0	252	109	4	1	11	0	165	Dec 13	PM
986	161	197	7	0	247	114	4	2	5	0	167	Oct 23	CO
987	173	177	13	2	227	136	2	5	10	0	220	Feb 5	CO
			(V										

[#] Earliest date of occurrence

Introduction

Particulate Matter as a general term includes small particles of dust, soot, organic matter and compounds containing sulfur, nitrogen, and metals. In July, changed the U. S. EPA particulate matter standards from the Suspended measurement of Total Particulates (TSP) to the measurement of only that fraction of particulate matter with particle diameters smaller than or equal to 10 micrometers (PM10). revision set the same levels for the primary and secondary national 150 ug/m^3 24 hour for a standards, average and 50 ug/m³ annual arithmetic The new PM10 standards calculation formulas include statistically determining whether the standards are attained.

Particulate Sources and Air Quality

Particulates directly enter the air from operations, from industrial combustion, from auto and truck traffic, and from other construction, from These emissions change from day due to intermittent day industrial operations, equipment upset traffic cycles breakdown, building heating requirements. Gaseous transformation products like sulfates, nitrates, and some organics are also a component of particulate matter. In the air particulate matter disperses and is transported by low level air motions. Ambient levels change from day to day responding to how much enters the air and how quickly meteorological processes disperse the particulates.

Reference Sampling Methods

The approved U. S. EPA reference methods all collect sample PM10 particulate matter on a filter drawing ambient air through the filter for 24 hours usually from midnight to After sampling, preweighed filter is manually removed following conditioning controlled atmosphere to remove moisture effects, the filter is weighed on a precise balance to determine the net weight of particulate matter collected. The volume of air sampled, corrected to standard temperature and pressure conditions, is calculated from the flow rate and sampling time. The ambient PM10 concentration is the weight (mass) of the particulate collected divided by the volume of air sampled, and is reported in micrograms per standard cubic meter.

method measures TSP the total particulate concentration following a similar procedure to that described The TSP sampler is a small shelter where air is drawn through space between the roof and shelter walls. principal change required for a PM10 sampler is the installation of ambient air inlet which traps particulates larger than 10 micrometers so that only PM10 is collected on the Such an inlet installed on a filter. high volume sampler in place of the shelter roof is called а selective inlet.

Continuous Sampling

An instrument called an integrating nephelometer continuously measures the light scattering extinction coefficient. component of the scattering coefficient, (bsp), is a measure particles. This atmospheric dry particle scattering coefficient has correlation to fine high particulate mass concentration. The level measured by this particulate method is reported as a scattering coefficient per meter times 10-4.

When operated at a site along with the reference method sampling, it is possible to develop a relationship between the two methods for that site. Each relationship (multiple regression equation) enables use of the continuous nephelometer measurement to provide a satisfactory real-time prediction of the manual reference PM10 value.

Data Summaries

The following tables summarize TSP, PM10, and nephelometer measurements during 1987. The areas documented as exceeding both the TSP and PM10 standards are the industrialized Seattle Harbor Island-Duwamish area, the Kent area and the industrialized Tacoma Port area.

Sampled by Standard High Volume

Glass Fiber filters

1987

Location	Number of Values	Quarte 1st	2nd	hmetic 3rd	Averages 4th	Year Arith Mean	Year Geom Mean
Tolt River Watershed, King County, Wa	58	3.9	15.1	19.3	8.4	11.7	9.2
Medical-Dental Bldg, 2730 Colby, Everett, Wa	59	44.3	44.2	46.9	46.5	45.5	41.7
504 Bellevue Way NE, Bellevue, Wa	58	76.6	54.3	53.6	59.2	60.9	54.1
North 98th St & Stone Ave N, Seattle, Wa	61	54.5	58.7	53.9	58.9	56.5	52.3
Marshall School, 520 NE Ravenna, Seattle, Wa	56	-	40.4	34.6	64.1	46.4	42.4
5701 8th Ave NE, Seattle, Wa	58	76.2	48.7	47.8	67.6	60.1	55.4
Fire Station #10, 301 2nd Ave S, Seattle, Wa	56	79.6	64.7	54.0	74.9	68.3	61.0
Harbor Island, 2555 13th Ave SW, Seattle, Wa	61	89.4	55.1	44.3	72.5	65.3	56.7
Harbor Island, 3400 13th Ave SW, Seattle, Wa	59	108.7	76.7	63.9	97.9	86.8	78.0
Duwamish. 4752 E Marginal Way S, Seattle, Wa	346	105.4	78.8	76.3	101.6	90.5	80.3
Georgetown, 6431 Corson Ave S, Seattle, Wa	56	92.6	84.8	77.0	82.1	84.1	76.0
South Park, 723 S Concord St, Seattle, Wa	61	81.8	54.5	59.6	78.6	68.6	57.6
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	61	83.2	48.7	53.6	78.5	66.0	57.5
Memorial Park, 850 N Central Ave, Kent, Wa	30	80.1	70.6			-	_
James St & Central Ave, Kent, Wa	38		-	69.6	105.9	-	_
115 E Main St, Auburn, Wa	60	76.3	48.1	51.4	75.1	62.7	56.1
Pac Coast Coal, 270th Av SE, Black Diamond, Wa	54	14.5	35.9	45.8	31.4	31.9	24.7
Sumner Jr HS, 1508 Willow St, Sumner, Wa	38	63.9	_		68.3	-	-
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	120	62.3	70.9	70.0	86.9	72.5	62.4
2340 Taylor Way, Tacoma, Wa	59	93.7	78.8	107.3	108.3	97.0	83.4
2301 Alexander Ave, Tacoma, Wa	131	-	54.6	68.4	94.6	72.5	62.7
Fire Station #12, 2316 E 11th St, Tacoma, Wa	294	88.3	75.8	101.3	106.2	92.9	78.6
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	61	91.1	65.2	82.4	92.6	82.8	74.2
Cascadia, 2002 E 28th St, Tacoma, Wa	57	76.5	55.9	85.9	83.7	75.5	64.2
Willard School, S 32nd & S'D' St, Tacoma, Wa	61	82.8	53.3	55.0	76.7	67.0	56.2
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	59	57.6	35.5	40.7	59.7	48.4	41.9
SW 283rd & 101st Ave SW, Maury Island, Wa	61	36.3	25.7	22.0	35.2	29.8	25.9
Ruston School, 5219 N Shirley St, Tacoma, Wa	59	60.4	29.7	31.6	50.7	43.1	36.4
4716 North Baltimore St, Tacoma, Wa	72	53.1	40.4	_		-	-
North 26th & Pearl Sts, Tacoma, Wa	61	48.5	28.3	32.5	53.6	40.7	34.7
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	58	75.9	43.1	49.0	80.6	62.2	49.8
City Hall, 239 4th St, Bremerton, Wa	59	38.5	30.9	31.1	46.1	36.7	34.2

⁽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.

Sampled by Standard High Volume

Glass Fiber filters

1987

Summary of Maximum and 2nd High Observed Concentrations

	9		Jan 22			•	-	Aug 25			•		12					Dec 17
Location	Fri	Wed	Thu	Fri	Sun	Mon	Fri	Tue	Tue	Fri	Wed	Tue	Mon	Thu	Wed	Tue	Thu	Thu
Tolt River Watershed, King County, Wa	1					35		35										
Medical-Dental Bldg, 2730 Colby, Everett, Wa	100	100				92												
504 Bellevue Way NE, Bellevue, Wa	1				180	135												
North 98th St & Stone Ave N, Seattle, Wa	34					137							104					
Marshall School, 520 NE Ravenna, Seattle, Wa	112				146													
5701 8th Ave NE, Seattle, Wa		119			189													
Fire Station #10, 301 2nd Ave S, Seattle, Wa		225			163													
Harbor Island, 2555 13th Ave SW, Seattle, Wa	168	204																
Harbor Island, 3400 13th Ave SW, Seattle, Wa	208	210																
Duwamish, 4752 E Marginal Way S, Seattle, Wa			312	357														
Georgetown, 6431 Corson Ave S, Seattle, Wa		173				177												
South Park, 723 S Concord St, Seattle, Wa		184											187					
Duwamish Valley, 12026 42nd Ave S, King Co, Wa		157			158													
Memorial Park, 850 N Central Ave, Kent, Wa		159				152												
James St & Central Ave, Kent, Wa														131		131		186
115 E Main St, Auburn, Wa	203	144																
Pac Coast Coal, 270th Av SE, Black Diamond, Wa						112							118					
Sumner Jr HS, 1508 Willow St, Sumner, Wa		129																
27th St NE & 54th Ave NE, Northeast Tacoma, Wa						245							231					
2340 Taylor Way, Tacoma, Wa										243	259							
2301 Alexander Ave, Tacoma, Wa									169								311	
Fire Station #12, 2316 E 11th St, Tacoma, Wa						298											332	
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	176	173																
Cascadia, 2002 E 28th St, Tacoma, Wa	152						160											
Willard School, S 32nd & S 'D' St, Tacoma, Wa		221																
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa		165														123		
SW 283rd & 101st Ave SW, Maury Island, Wa		80			72													
Ruston School, 5219 N Shirley St, Tacoma, Wa		161			113													
4716 North Baltimore St, Tacoma, Wa		172			128													
North 26th & Pearl Sts, Tacoma, Wa	1	115																97
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	183														178			
City Hall, 239 4th St, Bremerton, Wa	103											78			_, 0	64		

⁻⁻ Indicates no sample on specified day

Sampled by Standard High Volume Glass Fiber filters

Jan - Mar, 1987

Location	7	8	9	10	16	21	22	29	5	6	8	9	10	12	Feb 25 Wed	26	4	30	Mar 31 Tue
504 Bellevue Way NE, Bellevue, Wa						9					180								4-
5701 8th Ave NE, Seattle, Wa											189								
Fire Station #10, 301 2nd Ave S, Seattle, Wa						225					163								
Harbor Island, 2555 13th Ave SW, Seattle, Wa			168			204													
Harbor Island, 3400 13th Ave SW, Seattle, Wa			208			210										159	152		
Duwamish, 4752 E Marginal Way S, Seattle, Wa	193	182	219		152	220	312		202	357		268	177	163	152	184	171	191	227
Georgetown, 6431 Corson Ave S, Seattle, Wa						173													
South Park, 723 S Concord St, Seattle, Wa						184													
Duwamish Valley, 12026 42nd Ave S, King Co, Wa						157					158								
Memorial Park, 850 N Central Ave, Kent, Wa						159													
James St & Central Ave, Kent, Wa																			
115 E Main St, Auburn, Wa			203																
27th St NE & 54th Ave NE, Northeast Tacoma, Wa																			183
2340 Taylor Way, Tacoma, Wa			177			181													
2301 Alexander Ave, Tacoma, Wa																			
Fire Station #12, 2316 E 11th St, Tacoma, Wa		153		160	164	163	191	168	173	196		268		160		151		236	183
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa			176			173													
Cascadia, 2002 E 28th St, Tacoma, Wa			152																
Willard School, S 32nd & S'D' St, Tacoma, Wa			178			221													
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa						165													
Ruston School, 5219 N Shirley St, Tacoma, Wa						161													
4716 North Baltimore St, Tacoma, Wa						172													
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa			183			173													

⁻⁻ Indicates no sample on specified day

Sampled by Standard High Volume Glass Fiber filters

Apr - Sep, 1987

	Apr	Apr	Apr	May	Jun	Jul	Jul	Jul	Jul	Jul	Aug	Aug	Aug	Sep	Sep	Sep	Sep	Sep	Sep	Sep	Se
Location	1	2	27	18	26	10	11	13	14	15	7	18	31	1	2	9	17	18	21	22	3
Location	Wed	Thu	Mon	Mon	Fri	Fri	Sat	Mon	Tue	Wed	Fri	Tue	Mon	Tue	Wed	Wed	Thu	Fri	Mon	Tue	We
504 Bellevue Way NE, Bellevue, Wa	i																				
5701 8th Ave NE, Seattle, Wa													1000								
Fire Station #10, 301 2nd Ave S, Seattle, Wa										15.5											
Harbor Island, 2555 13th Ave SW, Seattle, Wa																					
Harbor Island, 3400 13th Ave SW, Seattle, Wa	ł																				
Ouwamish, 4752 E Marginal Way S, Seattle, Wa				-																	
Georgetown, 6431 Corson Ave S, Seattle, Wa		180												154						160	18
			177																		15
South Park, 723 S Concord St, Seattle, Wa																					
Ouwamish Valley, 12026 42nd Ave S, King Co, Wa																					
Memorial Park, 850 N Central Ave, Kent, Wa			152																		-
James St & Central Ave, Kent, Wa																					
15 E Main St, Auburn, Wa																					
27th St NE & 54th Ave NE, Northeast Tacoma, Wa			245																		16
2340 Taylor Way, Tacoma, Wa			181		153						151		180					243			-
2301 Alexander Ave, Tacoma, Wa														169						36	
Fire Station #12, 2316 E 11th St, Tacoma, Wa		158	298	153		183	152	193	166	183		159	151	164	156	214	196	241	167	156	
reatment Plant, 1241 Cleveland Wy, Tacoma, Wa																		~~-			
Cascadia, 2002 E 28th St, Tacoma, Wa											160										13
Villard School, S 32nd & S'D' St, Tacoma, Wa											100				200	122					
less Bldg, 901 Tacoma Ave S, Tacoma, Wa															200	1000000					
uston School, 5219 N Shirley St, Tacoma, Wa														1000							
716 North Baltimore St, Tacoma, Wa												200,000		3000							
t Tahoma HS, 6404 S Adams St, Tacoma, Wa				-		-	72020														-

⁻⁻ Indicates no sample on specified day

Sampled by Standard High Volume Glass Fiber filters

Oct - Dec, 1987

Location	1	7	12	13	2.0	21	22	23	Oct 28 Wed	29	11	17	18	19	20	17	18	28	30
004 Bellevue Way NE, Bellevue, Wa							-			==									
5701 8th Ave NE, Seattle, Wa								-		==									
Fire Station #10, 301 2nd Ave S, Seattle, Wa													7.7						
Harbor Island, 2555 13th Ave SW, Seattle, Wa															-	155	2000000		
Harbor Island, 3400 13th Ave SW, Seattle, Wa														000		163	172	208	155
Duwamish, 4752 E Marginal Way S, Seattle, Wa	211	175			166	207	180	228	191	180		160	225	233	213	103	1/2	200	133
Georgetown, 6431 Corson Ave S, Seattle, Wa																			
South Park, 723 S Concord St, Seattle, Wa			187																
Duwamish Valley, 12026 42nd Ave S, King Co, Wa																		15.5	
Memorial Park, 850 N Central Ave, Kent, Wa																		1.00	
James St & Central Ave, Kent, Wa									===							186			
115 E Main St, Auburn, Wa																			
27th St NE & 54th Ave NE, Northeast Tacoma, Wa			231			176													
2340 Taylor Way, Tacoma, Wa			219									186				163			
2301 Alexander Ave, Tacoma, Wa	167				161										1.70				
Fire Station #12, 2316 E 11th St, Tacoma, Wa	167		155	165	175	156	159	218					280	332	193			250)
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa																	==		-
Cascadia, 2002 E 28th St, Tacoma, Wa																	===	100	-
Willard School, S 32nd & S'D' St, Tacoma, Wa												151						8-1	
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa																•			-
Ruston School, 5219 N Shirley St, Tacoma, Wa																			-
																			-
4716 North Baltimore St, Tacoma, Wa Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa											178	i							

⁻ Indicates no sample on specified day

PARTICULATE MATTER (PM10) Micrograms per Standard Cubic Meter

Sampled by Size Selective Inlet - Hi Vol

Quartz Fiber filters

1987

	Number of	Quarte	rly Arit	hmetic	Averages	Year
Location	Values	1st	2nd	3rd	4th	Mean
Medical-Dental Bldg, 2730 Colby, Everett, Wa	59	26.5	24.1	25.6	36.2	28.
504 Bellevue Way NE, Bellevue, Wa	113	35.1	23.0	29.0	40.9	32.
North 98th St & Stone Ave N, Seattle, Wa	61	37.7	25.1	21.9	39.7	31.
Fire Station #10, 301 2nd Ave S, Seattle, Wa	55	49.3	31.2	31.4	47.8	39.
Harbor Island, 3400 13th Ave SW, Seattle, Wa	58	59.6	36.1	31.1	57.4	46.
Duwamish, 4752 E Marginal Way S, Seattle, Wa	348	51.2	34.4	34.7	57.6	44.
South Park, 723 S Concord St, Seattle, Wa	61	50.6	29.2	31.1	50.9	40.
Memorial Park, 850 N Central Ave, Kent, Wa	30	48.4	31.2			
James St & Central Ave, Kent, Wa	31			32.3	55.1	4
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	61	43.3	39.5	37.2	52.4	43.
2340 Taylor Way, Tacoma, Wa	59	49.3	37.1	41.3	55.0	45
2301 Alexander Ave, Tacoma, Wa	132	1 - 2	28.7	31.7	63.4	41
Fire Station #12, 2316 E 11th St, Tacoma, Wa	305	50.8	35.4	40.8	64.3	47

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

HVHIGHP

									Nov 18		
Location	100								Wed		
Medical-Dental Bldg, 2730 Colby, Everett, Wa		70									62
504 Bellevue Way NE, Bellevue, Wa		88			128						
North 98th St & Stone Ave N, Seattle, Wa		91			87						
Fire Station #10, 301 2nd Ave S, Seattle, Wa		126			128						
Harbor Island, 3400 13th Ave SW, Seattle, Wa	103	132									
Duwamish, 4752 E Marginal Way S, Seattle, Wa			164	159							
South Park, 723 S Concord St, Seattle, Wa		133			112						
Memorial Park, 850 N Central Ave, Kent, Wa	1	125			107						-
James St & Central Ave, Kent, Wa								82			10
27th St NE & 54th Ave NE, Northeast Tacoma, Wa						133	128				
2340 Taylor Way, Tacoma, Wa		127		-				109			
2301 Alexander Ave, Tacoma, Wa								111		220	
Fire Station #12, 2316 E 11th St, Tacoma, Wa	1								184	203	

	Jan					
				18		
Location	Thu	Fri	Mon	Wed	Thu	Mon
Duwamish, 4752 E Marginal Way S, Seattle, Wa	164	159				
					220	
2301 Alexander Ave, Tacoma, Wa					203	200

⁻⁻ Indicates no sample on specified day

ATMOSPHERIC PARTICLES (bsp (X 10 Exp-4)/M) 1987

Statistical Summary

	No. of		F	requ	ency	Dis	trib	utio	n -	Pero	cent			Arith	Geom	Geom	
Location	1 Hour Samples	5	10	20	30	40	50	60	70	80	90	95	99	Mean	Mean	Dev	Dev
Medical-Dental Bldg, 2730 Colby, Everett, Wa	5917	.1	.2	. 3	. 3	. 4	. 4	. 6	. 7	. 9	1.3	1.6	2.5	.62	.46	2.14	.51
North 98th St & Stone Ave N, Seattle, Wa	8607	. 1	.1	. 2	. 2	. 3	. 3	. 4	. 6	. 9	1.4	2.1	3.9	.61	.37	2.72	.73
Duwamish, 4752 E Marginal Way S, Seattle, Wa	8678	. 2	. 2	. 3	. 3	. 4	. 5	. 6	. 8	1.1	1.7	2.5	4.2	.77	.53	2.29	.82
James St & Central Ave, Kent, Wa	5060	.1	. 2	. 3	. 3	. 4	. 5	. 7	. 9	1.3	2.1	3.1	4.7	. 91	.57	2.69	. 99
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	8540	. 1	. 2	. 2	. 3	. 4	. 5	. 6	. 8	1.2	1.9	2.8	4.8	.81	.52	2.51	. 93
Fire Station #12, 2316 E 11th St, Tacoma, Wa	8657	.1	. 2	. 2	. 3	. 4	. 5	.6	. 9	1.3	2.5	3.6	6.0	. 94	.53	2.88	1.19

				Mont	hly A	rithm	etic	Avera	ges				No. of 1 Hour	
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	0ct	Nov	Dec		
Medical-Dental Bldg, 2730 Colby, Everett, Wa					.43	.37	.33	.40	. 63	1.08	. 84	.84	5917	. 62
North 98th St & Stone Ave N, Seattle, Wa	. 98	.71	.41	.35	.26	.23	.20	.36	.54	1.07	1.04	1.21	8607	.6
Duwamish, 4752 E Marginal Way S, Seattle, Wa	1.28	1.08	.61	.54	.40	.37	.38	.41	.59	1.25	1.25	1.09	8678	. 7
James St & Central Ave, Kent, Wa						.43	.37	. 45	.73	1.42	1.65	1.31	5060	. 9:
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	1.33	1.12	.60	.55	. 47	. 44	.43	. 42	.63	1.14	1.46	1.19	8540	.8
Fire Station #12, 2316 E 11th St, Tacoma, Wa													8657	. 9

YR RATIOP

PARTICULATE MATTER RATIOS (PM10)/(TSP)

1987

Particulate Matter Fraction
----PM10
DIVIDED BY

Method

Size Selective Inlet - Hi Vol SA321A

Filter Medium

Quartz Fiber

Standard High Volume

Glass Fiber

			. 	Av	erage	Mont	hly R	atios					No.	Year
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	0ct	Nov	Dec	0bs	Ratio
Medical-Dental Bldg, 2730 Colby, Everett, Wa	.59	.67	.49	. 57	.56	. 51	. 46	. 58	.62	.72	.82	.80	59	.616
504 Bellevue Way NE, Bellevue, Wa		.59	. 44	. 46	.50	.52	. 44	. 49	.56	.78	.64	.69	50	.556
North 98th St & Stone Ave N, Seattle, Wa	.74	.69	.53	. 44	.46	.40	.39	. 41	.49	.60	.69	.74	60	.548
Fire Station #10, 301 2nd Ave S, Seattle, Wa	. 58	.60	.74	. 51	.54	.46	.56	. 49	. 58	.64	.59	.72	51	.583
Harbor Island, 3400 13th Ave SW, Seattle, Wa	.52	.54	.50	. 45	.49	.48	. 47	. 47	.52	.56	.61	.61	58	.518
Duwamish, 4752 E Marginal Way S, Seattle, Wa	.55	.46	. 47	. 45	.46	.43	. 44	. 46	.50	. 55	.54	.61	342	. 494
South Park, 723 S Concord St, Seattle, Wa	. 68	.59	.57	. 57	.56	. 52	.49	.50	.60	. 61	.67	.72	61	.591
Memorial Park, 850 N Central Ave, Kent, Wa	. 65	. 61	.46	. 46	.43	.46							30	. 511
James St & Central Ave, Kent, Wa							.42	. 44	.53	. 56	.53	. 53	30	.502
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	.64	.69	.41	. 55	.49	.54	.49	. 54	.52	.56	.71	.78	59	.576
2340 Taylor Way, Tacoma, Wa	.55	.50	. 47	. 49	. 47	. 45	.38	. 35	.43	. 45	. 53	.60	58	.473
2301 Alexander Ave, Tacoma, Wa		. 63	.60	.60	.55	.48	.48	. 45	.50	.61	. 67	.70	131	. 570
Fire Station #12, 2316 E 11th St, Tacoma, Wa	.69	.56	.53	.50	.50	. 44	.39	. 41	.45	.56	. 68	.73	291	.536

Introduction

As a group, motor vehicles emit more carbon monoxide than any other source. For Puget Sound area cities, motor vehicles are the principal source of carbon monoxide causing the ambient levels to exceed air quality standards. high ambient levels of monoxide occur mainly during autumn and winter months. The highest levels are measured in the vicinity of congested motor vehicle traffic present during late afternoon commuting and around shopping centers particularly during holiday shopping. A contributing factor during some periods when levels are high is the existence of stable weather and light wind, thus temporarily reducing the means to disperse carbon monoxide emitted into the air.

Pollutant Standards Index and Washington State Episode Levels

The level of the 8 hour average standard is 9 parts per million (ppm), and this is equivalent to 100 on the Pollutant Standards Index scale. PSI values exceeding 100 are termed "Unhealthful". An 8 hour average of 15 ppm equals 200 on the PSI scale. Pollutant Standards Index values of 200 to 299 are described as "Very Unhealthful".

Episode criteria are specified in the Washington Episode Plan (Washington Administrative Code 173-435). The Alert stage is reached when the ambient carbon monoxide concentration reaches 15 ppm 8 hour an average, meteorological conditions are such that the carbon monoxide concentration can be expected to remain at or above that level for 12 or more hours, or to recur unless control actions are Correspondingly, the carbon monoxide concentration for the Warning stage is 30 ppm for an 8 hour average, and for the Emergency stage is 40 ppm for an 8 hour average.

Summary of 1987 Data

The tables on the next two pages summarize the six highest 1 hour and 8 hour average carbon monoxide levels at each station during 1987. These data were obtained from Department of Ecology data summaries.

Measurements at seven stations exceeded an 8 hour average of 9 ppm at least twice. Therefore, all of these seven stations, one located in Everett, one located in Bellevue, three located in Seattle, and two located in Tacoma, violated the 8 hour average standard.

Multi-Year Summary

A multi-year summary following the 1987 tables presents data and column graphs to show the long term historical trend. For the longest term sampling sites in the cities of Seattle, Everett, Bellevue, and Tacoma, the summary charts show by year the number of days on which the 8 hour average exceeded 9 ppm and list in the bottom row the value which was the 2nd high 8 hour average.

first complete year of monoxide data for one Seattle station was 1972. The results at this station improved from over 100 exceeding the primary standard in 1972 and 1973, to none exceeding the standard in 1987. Two other Seattle stations which began in 1978 confirm same trend.

A review of the data if begun with 1980 shows the decrease (improvement) in carbon monoxide values has leveled off. To show the standard has been attained, the U. S. EPA requires that the number of cases exceeding the standard averaged over a two year period at a station not exceed one. The significant improvement from levels in the mid 1970's is due mainly to the federal emission standards for new motor vehicles and the program to annually test vehicle emissions for compliance with these standards.

CARBON MONOXIDE (Parts per Million) 1987

		Six Hig	hest C	oncentr	ations		Number of	Number o
	1 H	lour Aver	age	8 H	our Aver	age	8 Hour Averages	8 Hour Average
Location / Continuous Sampling Period(s)	Value	Date	End Time	Value	Date	End Time	Exceeding 9 ppm	_
	16	28 Dec	1800	 10	26 Jun	1700	3	3
Broadway & Hewitt Ave, Everett, Wa	16	28 Dec	1900	10	29 Jun	1700		
1 Apr-31 Dec	15	17 Dec	1800	10	28 Dec	1900	1	
	14	29 Jun	1600	9	21 Jul			
	14	25 Nov	1900	9	4 Sep	1700		
	13	26 Jun	1500	9	9 Oct	1900		
622 Bellevue Way NE, Bellevue, Wa	17	8 Jan	1800	12	8 Jan	2400	4	4
1 Jan-31 Dec	14	19 Nov	1800	10	6 Feb	2400		
	13	8 Jan	2000	10	7 Feb	2400		
	13	5 Feb	1900	10	19 Nov			
	13	7 Feb	1900	8	5 Jan	2200 2300	1	
	12	5 Jan	1800	8	17 Nov	2300		
Northgate, 310 NE Northgate Way, Seattle, Wa	14	21 Jan	1800	11	6 Feb	2100	3	3
1 Jan-31 Dec	14	6 Feb	1900	10	22 Jan			
	14	6 Feb	2000	10	8 Feb	0100		
	14	17 Nov		9	22 Jan	2100 2300		
	13	22 Jan	2000	9	11 Dec 5 Jan			
	13	21 Oct	0800		Juan	1400		
4511 University Way NE, Seattle, Wa	18	19 Nov	1800	13	19 Nov		2	2
1 Jan-20 Jan; 11 Feb-31 Dec	17	19 Nov	2000	10	21 Oct			
	17	19 Nov	2100	9	30 Sep			
	16	19 Nov		9 8	28 Oct 7 Jan			
	16 14	19 Nov 1 Apr	2200 2300	8		1900		
	1							
1960 NE Pacific Ave, Seattle, Wa	16	6 Feb	2200	13	6 Feb		3	3
8 Jan-28 Jun; 15 Jul-16 Oct; 1 Nov-31 Dec	14	19 Nov		12	19 Nov			
	14	19 Nov		9	8 Feb 22 Jan		1	
	13	6 Feb		8	7 Feb		1	
	13 13	6 Feb 6 Feb	2000 2100	7	22 Jan			
						0400	0	0
3921 Linden Ave N, Seattle, Wa	11	7 Feb		8	7 Feb	2400 2400	0	"
1 Jan-31 Mar	10	6 Feb		7 7		2300		
	10	6 Feb		6	21 Jan		1	
	10	7 Feb 7 Feb		6	22 Jan		-	
	10	7 Feb		6	6 Feb			

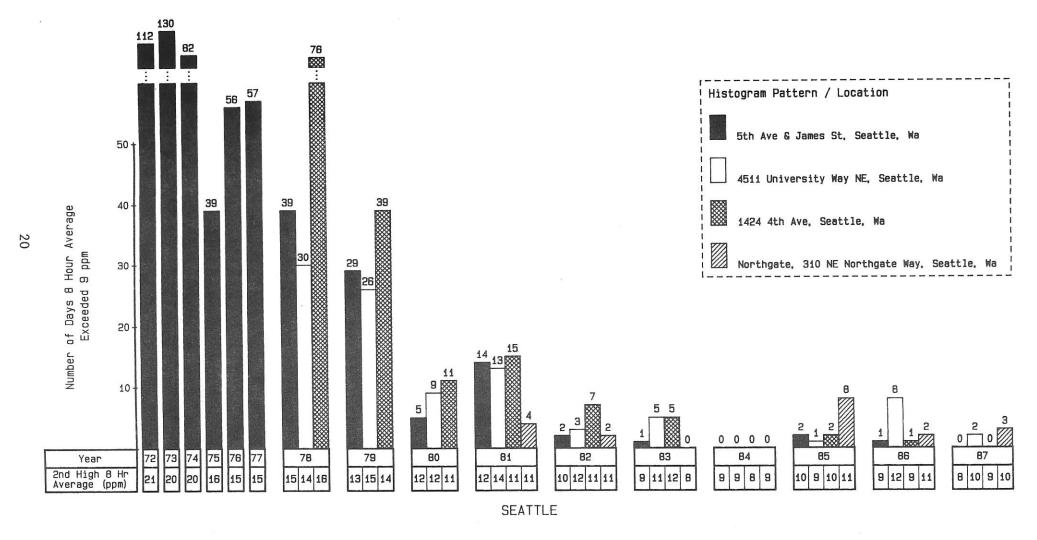
- (1) Ending times are reported in Pacific Standard Time.
- (2) For equal concentration values the date and time refer to the earliest occurrences.
- (3) Continuous sampling periods are those with fewer than 10 consecutive days of missing data.
- (4) At all stations carbon monoxide was measured using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

CARBON MONOXIDE (Parts per Million) 1987

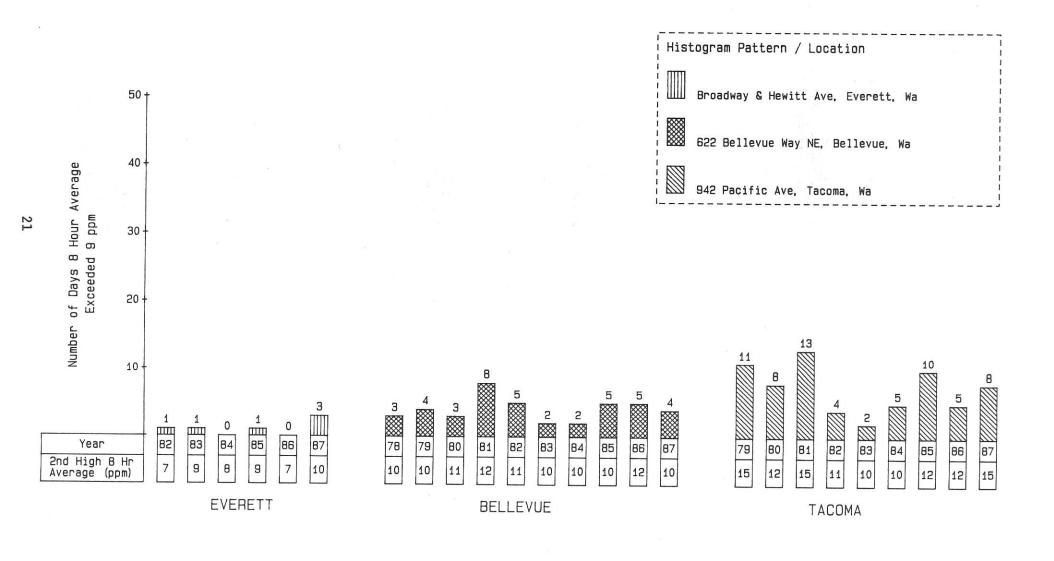
		Six Hig	hest C					Number of	Number of
	1 H	Hour Aver	age	4	Hour			8 Hour Averages	8 Hour Average
Location / Continuous Sampling Period(s)	Value	Date	End Time	Value	Da	te	End Time	Exceeding 9 ppm	Exceeded 9 ppm
1424 4th Ave, Seattle, Wa	13	6 Feb	2000	9	21	Jan	2300	0	0
1 Jan-31 Dec	13	12 Feb	1000	9	6	Feb	2000		
	12	6 Feb	1700	8			1700		
	11	6 Feb		8			1900		
	11	7 Feb 20 Feb	2400 1800	8		Jan Feb	2400 2400		
5th Ave & James St, Seattle, Wa	14	27 Apr	1700	8	5	Ian	1800	0	0
1 Jan-31 Dec	14	1 Oct		8			2400	"	
	13	25 Feb		8			2300		
	13	1 Oct		8			1800		
	12	6 Feb	1700	8	7	Feb	0200		
	12	7 Feb	0300	8	25	Feb	1500		
Courthouse, 4th Ave & James St, Seattle, Wa	15	29 Jun		9		Feb	1800	0	0
1 Jan-31 Dec	14	29 Jun		9			1700		
	13	5 Feb		8			2300		
	13	6 Feb		8			0300		
	13 12	7 Feb 7 Feb	0300 0200	7			2100 2000		
Fire Station #10, 301 2nd Ave S, Seattle, Wa	18	5 Feb	1800	13	7	Feb	0500	1	1
1 Jan-31 Dec	18	7 Feb	0300	9		Feb		_	-
	16	5 Feb	1900	9	8	Nov	0400		
	16	7 Feb	0200	8	7	Jan	2200		
	14	6 Feb	2400	8	21	Jan	2200		
	13	6 Feb	2300	8	21	0ct	1000		
942 Pacific Ave, Tacoma, Wa	38	5 Feb	1800	18		Feb		9	8
1 Jan-30 Nov; 17 Dec-31 Dec	25	8 Jan		15		Feb			
	24	1 Oct	15722	13			2300		
	22	5 Feb		13			1900		100
	22 20	6 Feb 31 Dec		11		Feb Dec	1300 2200		
1101 Pacific Ave, Tacoma, Wa	19	1 Oct	1600	11	1	Oct	2000	5	4
29 May-31 Dec	17	19 Nov		11		Nov			"
	15	1 Oct		10	- E	Oct		1	
	13	1 Oct		10		Oct			
	13	21 Oct		10		Nov	1400		
	13	18 Nov	1700	9		Nov	2200		
Burwell St & Pacific Ave, Bremerton, Wa	23	5 Jun	2300	10	7	Feb	0100	1	1
1 Jan-31 Dec	22	9 May	2400	9	8	Aug	0100		
	19	3 Apr	2400	9	4	Sep	2400		
	19	13 Jun		8		Apr			
	19	22 Aug	2200	8		May			
	18	8 May	2400	8	10	May	0100	1	1

Notes

- Ending times are reported in Pacific Standard Time.
 For equal concentration values the date and time refer to the earliest occurrences.
- (3) Continuous sampling periods are those with fewer than 10 consecutive days of missing data.(4) At all stations carbon monoxide was measured using the continuous nondispersive infrared method.



CARBON MONOXIDE Multi-Year Summary



Introduction

found in principal oxidant The photochemical smog is ozone, a very form of oxygen. reactive photochemical oxidants are products of chemical reactions in the ambient air between nitrogen oxides and volatile organic compounds (VOC) under the effect The highest ozone of radiant energy. levels occur on hot summer days during the more intense radiant energy of afternoon summer sunlight.

On any given day the photochemical reactions proceed for several hours and generally produce maximum ozone levels between noon and early evening at locations several miles away from the sources of nitrogen oxides and VOC. Each day after nightfall the high ozone diminish because levels However, the photochemical effect ends. photochemical smog is such a complex mixture that significant ozone levels hours into continue for sometimes the night.

In the Puget Sound area the highest ozone levels occur from mid May to mid September on the few days favorable for photochemical activity. significant These high values develop when urban area emissions are trapped beneath a morning temperature and nighttime high by very followed inversion Light northerly winds temperatures. often develop on these hot days. As a highest ozone the normally occur south to southeast of the major cities or source areas.

Ozone Standard and Pollutant Standards Index

The U. S. EPA has set the level of the ozone standard at a value of 0.12 ppm. The federal regulation says the standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than one.

If an "exceedance" is defined to be a day on which the maximum 1 hour average is higher than 0.12 ppm, the standard is attained when the expected number of exceedances is equal to or less than one. In the case of a complete data set, the expected number of exceedances is simply the average number of observed exceedances at a particular location during the most recent three years.

When the data set for a given year is incomplete, the number of exceedances in that year must be adjusted to estimate the true number. This estimate is based upon the observed number of exceedances, the number of required monitoring days, the number of days upon which a valid maximum was recorded, and the number of days assumed to be less than the level of the standard.

For each year the estimated number of exceedances is always equal to or greater than the observed number of exceedances. For stations where no exceedances are observed, the estimate is zero. The expected number of exceedances is then the three year average of the annual estimates.

A 1 hour average ozone level of 0.12 ppm is equivalent to 100 on the Pollutant Standards Index scale. Since the high some distance occur levels ozone downwind of major cities, ozone never Everett, the Index for determines Seattle or Tacoma, but may occasionally quality for unhealthful air such as Lake locations outlying Sammamish, Enumclaw or Graham.

The 1987 ozone summary table on the following page lists the four highest daily maximum 1 hour ozone averages for each monitoring location. For the three year period ending with 1987, the average number of ozone exceedances is less than 1.0 for all locations. On January 2, 1987, the U. S. EPA formally redesignated the Puget Sound area as in attainment of the ozone standard.

OZONE (Parts per Million) 1987

	Da	ur Highe ily Maxi our Aver	.mum	1 Hou	ed No. Ly Maxi ur Aver ded .12	mum age	No. of Days Daily Maximum 1 Hour Average
Location / Continuous Sampling Period(s)	Value	Date	End Time	1985	1986	1987	Expected To Exceed .12 ppm
Snohomish FD #22, 9921 84th NE, Arlington, Wa* 6 Apr-31 Oct	.08 .07 .07	29 Jun 27 Apr 7 May 9 May	1800 1400 1700 1500	0.0	0.0	0.0	0.0
20050 SE 56th, Lake Sammamish State Park, Wa* 1 Apr-21 May; 1 Jun-5 Sep; 17 Sep-31 Oct	.11 .09 .09	29 Jun 27 Apr 8 May 9 May	1700	0.0	1.0	0.0	0.3
Highway 410, 2 miles east of Enumclaw, Wa* 20 May-31 Oct	.14 .11 .10	29 Jun31 Aug25 Jun1 Sep	1600	0.0	0.0	1.5	0.5
Summer Jr HS, 1508 Willow St, Summer, Wa 6 Apr-31 Oct	.11 .10 .10	29 Jun 8 May 1 Sep 9 May	1600 1500	0.0	0.0	0.0	0.0
Pierce Co Fire D #21, 8102 304th, Graham, Wa* 1 May-31 Oct	.10 .09 .09	8 May 29 Jun 30 Aug 25 Jun		0.0	0.0	0.0	0.0
Charles L Pack Forest, La Grande, Wa* 8 Apr-29 Oct	.11 .10 .10	8 May 27 Apr 31 Aug 6 May	1500 1600 1700 1800	1.0	1.1	0.0	0.7
Mount Rainier National Park, Longmire, Wa* 14 May-8 Oct	.11 .10 .09	25 Jun29 Jun26 Jun27 Aug	1900		0.0	0.0	0.0

- * Station operated by the Washington State Department of Ecology.
 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 ozone was measured using the continuous ultraviolet photometric detection method.

The ambient air quality standard for lead is 1.5 micrograms per cubic meter averaged over one calendar quarter. Lead emissions to the air across urban areas come principally from automobile exhaust. In some places localized industrial emissions of lead come from stationary sources such as primary and secondary nonferrous smelters.

The tables below present the results of lead sampling in the Puget Sound area during 1987. The lead levels shown for the Harbor Island station at 2555 13th Ave SW now meet the standard, but still document some effect from the nearby secondary lead smelter which ceased operation several years ago. Lead concentrations measured at all stations were lower than the ambient standard. These current ambient lead levels compared to levels prior to 1980 show significant improvement due primarily to the phase down of lead in gasoline.

ARSTATP

LEAD Micrograms per Standard Cubic Meter

Sampled by Standard High Volume

Glass Fiber filters

1987

				Mont	hly A	rithm	etic	Avera	ges				-0.00000	Year Arith
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Obs.	Mear
A Control Wa	.12	.07	.06	.07	.04	. 04	.04	.06	.07	.08	.07	.10	60	. 07
North 98th St & Stone Ave N, Seattle, Wa			.11		.06	.07	.05	.07	.09	.13	.09	.16	54	.10
Marshall School, 520 NE Ravenna, Seattle, Wa	.17	.18	.13	.13		.11	.12	.13	.17	.14	.14	.12	58	.1
5701 8th Ave NE, Seattle, Wa	1			. 52	.34	.30	.32	.26	.24	.33	.61	.34	61	. 4
Marbor Island, 2555 13th Ave SW, Seattle, Wa	.24								.24			.18	59	. 2
Marbor Island, 3400 13th Ave SW, Seattle, Wa	.18	.10	.10	.09				.09	.12	.14	.11	.20	61	. 1
South Park, 723 S Concord St, Seattle, Wa	.06	.03		.03				.02				.05	61	. 0
SW 283rd & 101st Ave SW, Maury Island, Wa	.16	.06			.02	. 02	.02	. 05	.14	.09	.06	.09	59	. 0
Ruston School, 5219 N Shirley St, Tacoma, Wa	.08	.08		.07			.07	.10					72	. 0
4716 North Baltimore St, Tacoma, Wa North 26th & Pearl Sts, Tacoma, Wa	.14				.03				.05	.07	.06	.10	61	.0

	Quarter	ly Arith	metic Av	erages
Location	1st	2nd	3rd	4th
North 98th St & Stone Ave N, Seattle, Wa	.08	.05	.06	.08
Marshall School, 520 NE Ravenna, Seattle, Wa	.14	.07	.07	.13
701 8th Ave NE, Seattle, Wa	.16	.11	.14	.1
arbor Island, 2555 13th Ave SW, Seattle, Wa	. 49	. 39	. 27	. 4
arbor Island, 3400 13th Ave SW, Seattle, Wa	.22	.18	.18	.2
outh Park, 723 S Concord St, Seattle, Wa	.13	.07	.09	.1
W 283rd & 101st Ave SW, Maury Island, Wa	.04	.02	.02	.0
uston School, 5219 N Shirley St, Tacoma, Wa	.09	.03	.07	.0
716 North Baltimore St, Tacoma, Wa	.07	.06	.08	
orth 26th & Pearl Sts, Tacoma, Wa	.08	.03	.04	.0

ARSENIC

Under the federal Clean Air Act the U.S. EPA has designated inorganic arsenic as a hazardous air pollutant. The principal source of arsenic in the Puget Sound area is the closed Tacoma Smelter site at Ruston. Smelting ceased in March, 1985 and arsenic processing ended in January, 1986. Site dismantling and reclamation followed under U. S. EPA supervision. The Washington Department of Ecology has set community exposure

standards for arsenic as follows:
Maximum 24 hour concentration 2.0 micrograms per cubic meter

Maximum annual arithmetic mean - 0.3 micrograms per cubic meter

Arsenic sampling for 1987 is summarized below. The Ruston School and North Baltimore stations are less than one mile from the Tacoma Smelter site.

ARSTATP

ARSENIC Micrograms per Standard Cubic Meter

Sampled by Standard High Volume

Glass Fiber filters

1987

				Mont	hly A	rithn	netic	Avera	ges					Year Arith
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Mean
SW 283rd & 101st Ave SW, Maury Island, Wa	.01	<.01	<.01	.01	<.01	.01	<.01	<.01	.01	<.01	<.01	<.01	61	<.01
Ruston School, 5219 N Shirley St, Tacoma, Wa	.32	.07	.01	.10	.01	.01	.02	.06	.27	.05	.05	.13	59	.09
4716 North Baltimore St, Tacoma, Wa	.06	.09	.03	. 05	.05	.14	.14	.08					72	.08
North 26th & Pearl Sts, Tacoma, Wa	.01	.01	.01	.01	<.01	.01	.01	.02	.01	.01	.01	.01	61	.01

Yearly arithmetic mean calculated using .0025 as a substitute for each <.01 value.

_		t Value	Values Higher than .					
ruston School, 5219 N Shirley St, Tacoma, W. 716 North Baltimore St, Tacoma, Wa	Value	Date	Value	Date				
SW 283rd & 101st Ave SW, Maury Island, Wa	.03	21 Apr						
Ruston School, 5219 N Shirley St, Tacoma, Wa	.74	9 Jan	.74	9 Jan				
			.70	18 Sep				
			.57	30 Sep				
4716 North Baltimore St, Tacoma, Wa	. 73	14 Jul	.73	14 Jul				
North 26th & Pearl Sts, Tacoma, Wa	.04	7 Aug		002				

SULFUR DIOXIDE

Sulfur dioxide is a common air pollutant have standards which A summary of established nation-wide. the national, state and local sulfur dioxide standards appears on page 50. Sulfur dioxide enters the air mainly from industrial processes and from the combustion of sulfur-containing fuels In the Puget such as coal and oil. Sound area, the four main industrial areas with sulfur dioxide point sources are the Everett Port area, Seattle Harbor Island-Duwamish Valley Tacoma Port area and the Bremerton Naval In the air, reactions occur Shipyard. to partially convert sulfur dioxide to other sulfur compounds such as sulfuric acid and various sulfate salts. Local sulfur dioxide standards have been in The tables below effect since 1968. summarize sulfur dioxide data collected during 1987.

HRSTATP

SULFUR DIOXIDE (Parts per Million) 1987

			No. of 1 Hour											
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Samples	Mean
Medical-Dental Bldg, 2730 Colby, Everett, Wa				.013	.013		.015	.016	.014	.014	.008	.008	7085	.013
North 98th St & Stone Ave N, Seattle, Wa		.006		.004	.004	.003	.003	.004	.004	.006	.005		7087	.005
Duwamish, 4752 E Marginal Way S, Seattle, Wa	.007	.009						.008					8300	.008
	.011		.011	.008		.006	.007	.008	.008	.011	.012	.009	7829	.009
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	1.011			.006				.007			.009		7360	.007
2301 Alexander Ave, Tacoma, Wa North 26th & Pearl Sts, Tacoma, Wa		.008									.005	.005	7740	.005

SOZOCC 25, SOZUSER

Summary of Maximum and Second Highest Concentrations for Various Averaging Periods

	5 Mi	nute Av	erage	1 H	our Ave	rage	3 H	our Ave	rage	24 H	our Ave	erage
Location / Continuous Sampling Period(s)	Value	Date	End Time	Value	Date	End Time	Value	Date	End Time	Value	Date	End Time
Medical-Dental Bldg, 2730 Colby, Everett, Wa 1 Jan-8 Jan; 28 Jan-14 Feb; 19 Mar-31 Dec	1.58	23 Jul 23 Jul		1888	23 Jul 31 Aug			23 Jul 11 Aug		.042		r 1100 n 1300
North 98th St & Stone Ave N, Seattle, Wa 1 Jan-30 Nov				.04	8 Jan 22 Jan		.033	8 Jan 22 Jan		.019	9 Jan 22 Jan	n 0500 n 2100
Duwamish, 4752 E Marginal Way S, Seattle, Wa 1 Jan-23 Nov; 8 Dec-31 Dec				1	7 Apr 30 Mar		.117	8 Apr 30 Mar		.051		r 1900 c 1300
27th St NE & 54th Ave NE, Northeast Tacoma, Wa 1 Jan-31 Dec				1040445345	12 Oct 28 Oct		.110 .107	12 Oct 29 Oct		.039	18 No	v 2400 t 2300
2301 Alexander Ave, Tacoma, Wa 10 Feb-31 Dec				.08	29 Jun 18 Jul		.070	19 Nov 18 Jul		.029		v 1400 v 1400
North 26th & Pearl Sts, Tacoma, Wa 23 Jan-31 Dec				.07	30 Mar 5 Feb		.053		1700 0100	.022		b 0300 v 2300

- (1) 5 minute average reported only for concentrations exceeding 1.00 ppm.
- (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 sulfur dioxide was measured using the continuous ultraviolet fluorescence method.

Introduction

(QA) includes all Quality Assurance activities for the purpose of obtaining valid data and documenting the quality of the data. Quality Assurance is an integral part of all monitoring activities. Some specific QA activities are: selection of methods and analyzers; installation of equipment; calibration; zero and span checks and adjustments; control checks, limits, and corrective maintenance; recording actions: validating data; and documentation of quality control information.

The Agency participates in audit programs conducted independently by the U.S. Environmental Protection Agency and Washington State Department Ecology. For the EPA, this consists of (1) an annual on-site audit of some Agency instruments by EPA or their representative, designated and (2) Agency participation in EPA's national performance audits as they are The Department of Ecology announced. also independently selects and audits some of the Agency instruments on-site each quarter.

Precision and Accuracy Audits

The documentation for the QA program is established in Title 40, Code of Federal Regulations, Part 58, published May 10, 1979, and amended November 9, 1979, September 3, 1981, March 19, 1986, and July 1, 1987. The important characteristics which the regulations require to be developed and reported are precision and accuracy. In simple terms, precision means the ability to repeat a measurement of the same, known sample at a different time; accuracy agreement between means the measurement and the true value.

Each instrument measuring a pollutant at a location must be audited for precision at least every two weeks and for accuracy at least once per year. For each audit the percentage difference between the instrument indicated concentration and the true concentration of the reference sample is calculated. For each calendar quarter the average and the standard deviation of these percentage differences are calculated. These two statistics are then pooled for all audits involving the same pollutant.

Probability Limits

The federal regulation requires summary of the precision and accuracy audit results by computing the 95 Percent Probability Limits for each pollutant from the weighted average percent difference, D, and the pooled standard deviation, S2, as follows:

Upper 95 Percent Probability Limit = $D + 1.96(S_0)$

Lower 95 Percent Probability Limit = $D - 1.96(S_2)$

These upper and lower limits reflect data quality and they document that, with 95 percent probability, pollutant measurements during the audit period are within the limits. As an example, if the average of the percent differences is zero and the standard deviation of the percent differences is 4.1 percent, the upper and 95 percent probability limits are respectively +8 and -8 percent.

Agency Precision and Accuracy

For many Agency monitoring locations precision audits are performed each week and accuracy audits are completed each month or each quarter. The table following this page summarizes precision and accuracy probability limits by quarter for all air quality data which the Agency originated in For each pollutant the type of audit (accuracy or precision) followed by a brief phrase description of the audit method. The number of audits and the lower and probability limits are presented for each quarter.

DATA QUALITY ASSESSMENT 1987

Lower and Upper 95 Percent Probability Limits of Percent Differences

ļ				Audi	t Results	s by Quarter	
1		1	st	1 2	2nd	3rd	4th
Pollutant	Number	No.	Prob.	No.	Prob.	No. Prob.	No. Prob.
&	of	of	Limits	of	Limits	of Limits	
Type of Audit	Stations	Audits	Lwr Upı	Audits	Lwr Upr	Audits Lwr Up	r Audits Lwr Upr
Particulate Matter (TSP, Hi-Vol) Accuracy Flow Rate	 27 	 30	-8 +4	 27	-5 +5	 26 -6 +6	30 -7 +4
Precision Collocated Sam	 ples	 35	-9 +12	36	-5 +12	 42 -5 +11	42 -3 +15
Particulate Matter (PM10, SSI Hi Vol)	 10						
Accuracy Flow Rate Precision	ļ	22	-4 +4	17	-5 +4	I 29 -7 +4 	17 -5 +4
Collocated Sam	ples	16	-10 +6	12	-4 +2	12 -4 +5	12 -4 +4
Sulfur Dioxide	6			I			1
Accuracy		1 15	-10 +14	1 17	-13 +14	 14 -6 +14	1 15 -2 +15
Level 1 Level 2	l	1 15	-8 +14	1 17	-8 +8		
Level 2	1	1 15	-9 +12	1 17	-8 +7	■	1
Level 4	10	1 2	-4 +12	3	-7 +7		
Precision	8 8	_					i
One point chec	k	45	-9 +9	69	-9 +9	76 -8 +8	3 j 62 -8 +9
Ozone Accuracy	1						. !
Level 1 Level 2 Level 3	waste prince waste	Pages sales sales				$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	5 j
Precision One point chec	 k			1 13	-4 +6	 14 -1 +12 	2 4 +2 +10
Atmospheric Particl (Nephelometer) Precision One point chec	j 6	 31	-5 +4	37	-6 +6	 	 40 -6 +6

AIR STAGNATION ADVISORY and WASHINGTON EPISODE AVOIDANCE PLAN

The National Weather Service issues an Air Stagnation Advisory when poor atmospheric dispersion conditions exist and are forecast to persist for 24 hours or more. The Washington Clean Air Act defines air pollution episodes and the policy for establishing an avoidance plan in RCW 70.94.710 through 70.94.730. The Washington State Department of Ecology has adopted WAC 173-435 which implements an episode avoidance plan.

The **First** or **Forecast** stage of the Episode Plan is declared by the Department of Ecology when an Air Stagnation Advisory is issued by the National Weather Service or there is equivalent indication of stagnant atmospheric conditions and conditions are forecast to persist for 24 hours.

Outdoor fires are prohibited during any declared stage of the Washington Episode Plan. A new section added to the Washington Clean Air Act by the 1987 Legislature states that any person who has an adequate source of heat without burning wood shall not burn wood in any solid fuel heating device during any declared stage of the Washington Episode Plan.

In 1987, the Forecast stage was in effect in the Puget Sound region during the following periods:

4 pm, Wednesday, October 21 - 9 am, Saturday, October 24

12 noon, Thursday, December 24 - 4 pm, Saturday, December 26

LOWER ATMOSPHERE TEMPERATURE SOUNDINGS

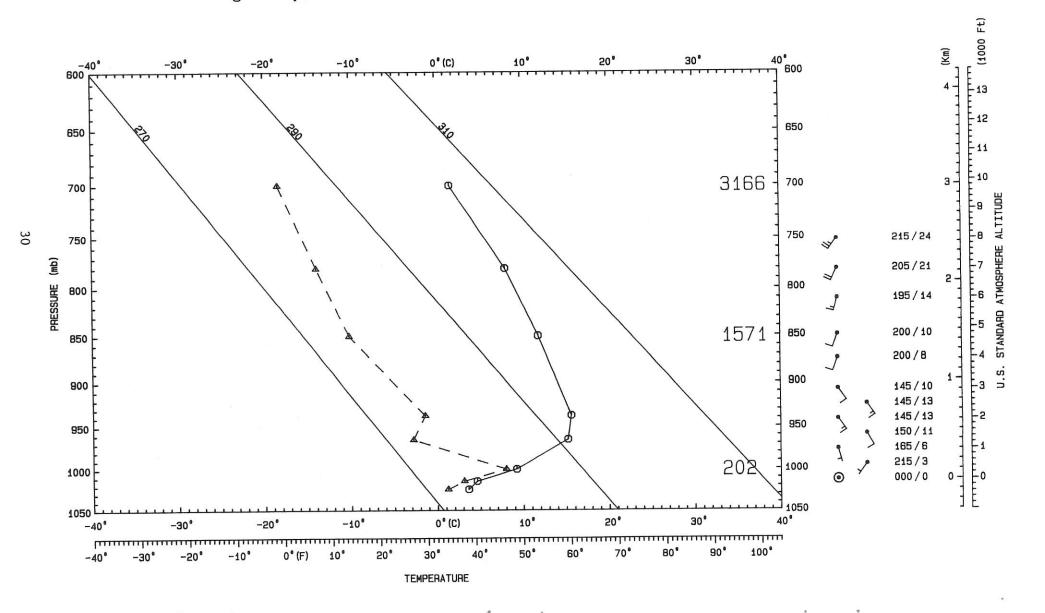
The Washington State Department Ecology operates a lower atmosphere sounding unit on the east shore of Portage Bay in Seattle. Normal operation provides one sounding 700 millibars about 7 am local time each Monday through Friday except holidays. This sounding provides the primary lower atmosphere data in the Puget Sound region and is an essential basis for many forecasts including Air Stagnation The Agency regularly uses Advisories. the sounding to evaluate and interpret air quality data and also enters the sounding in a computerized data base.

Some important features may be determined from each sounding and these are important to the determination of air stagnation. Temperature increasing with height is termed a Temperature Inversion. A temperature inversion limits the height to which pollutants are mixed or dispersed vertically. The Mixing Depth is the height from the surface to the temperature inversion base. The mixing depth continuously

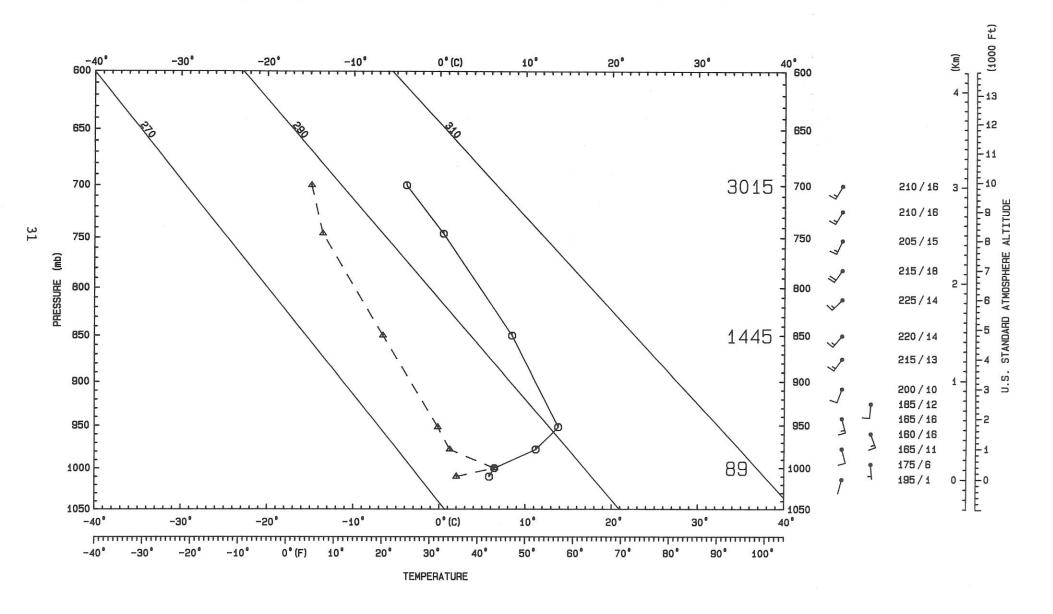
changes in response to diurnal surface temperature changes and to other processes. On days with no temperature inversion the mixing depth is unlimited, and this contributes to rapid pollutant dispersion and good air quality. In contrast, a temperature inversion near the surface which is too thick to be reversed during the daytime significantly restricts vertical dispersion. This stable condition is associated with higher pollutant levels.

Several soundings from 1987 are included on the following pages. These soundings all reveal stagnant conditions on days when some pollutant values exceeded the level of an ambient standard. On each sounding, temperature is represented by a solid line connecting actual circular data points. The dewpoint temperature is represented by a dashed line connecting actual triangular data points. The wind at regular altitude intervals is plotted and also printed in degrees/knots to the right of the temperature sounding.

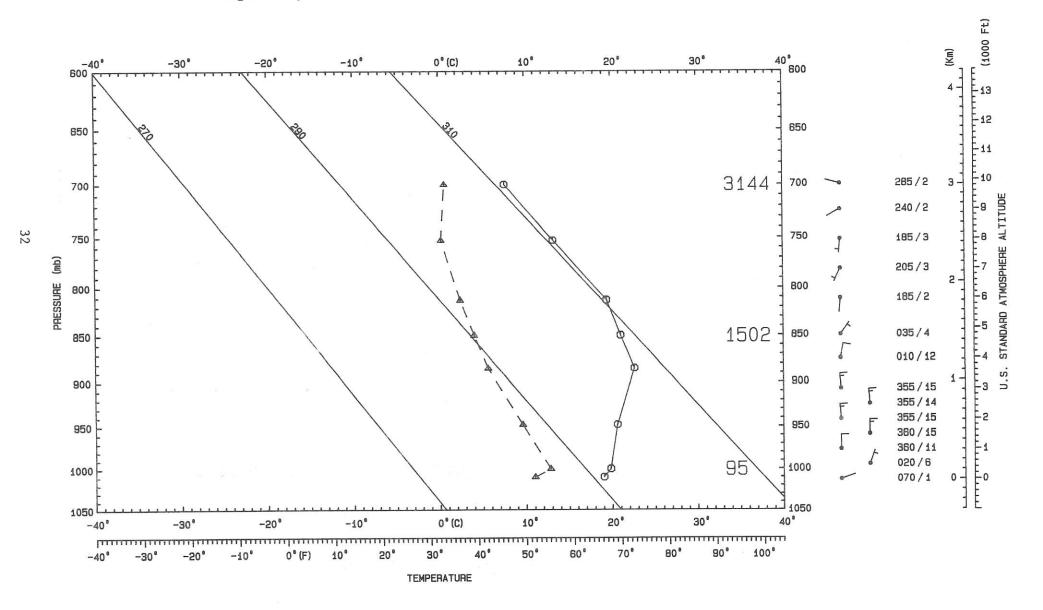
0700 PST Feb 6, 1987 Portage Bay, 2725 Montlake Blvd E, Seattle, WA



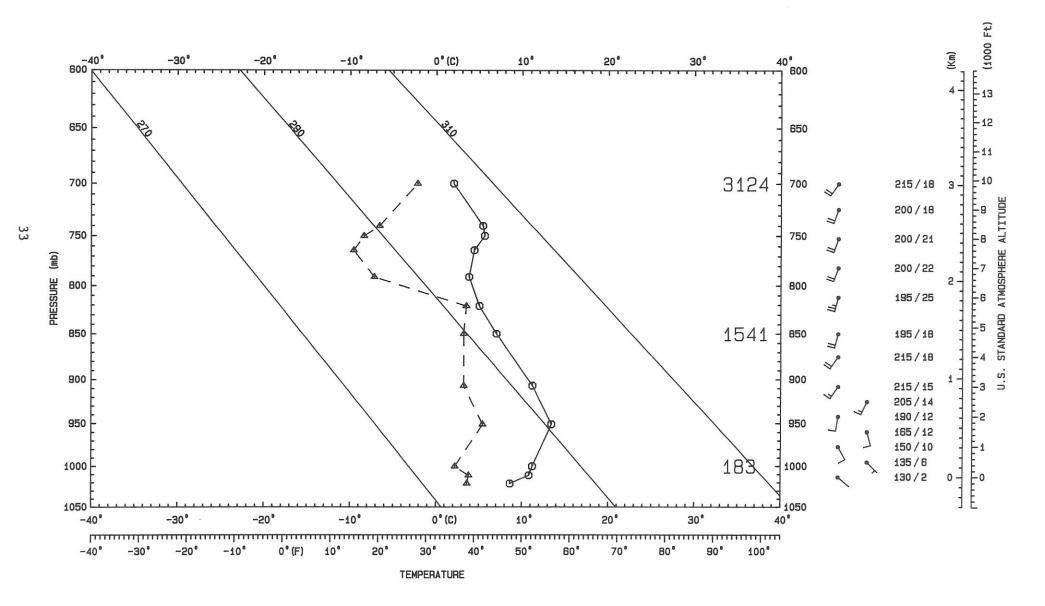
0700 PST Feb 9, 1987 Portage Bay, 2725 Montlake Blvd E, Seattle, WA



0600 PST Jun 29, 1987 Portage Bay, 2725 Montlake Blvd E, Seattle, WA



0700 PST Nov 19, 1987 Portage Bay, 2725 Montlake Blvd E, Seattle, WA



Wind Data

Everyone has a qualitative sense of surface wind and some effects produced by the wind. The wind direction helps identify the sources or source areas affecting a specific location.

From an air pollution standpoint, low wind speed poorly dilutes pollutants and is therefore associated with higher air pollutant concentrations. During a stable, temperature inversion condition, the wind is often light or calm. When this condition persists, the natural process which effectively disperses pollutants is greatly diminished, and pollutant levels are higher near the source areas.

Wind Speed Averages

The table below presents monthly and annual average wind speed computed from hour average surface wind speed at wind These average monitoring locations. values are sometimes used to compare locations and months or to provide data for calculations needing average speed stagnation Individual air values. by this exposed not episodes are

analysis unless episode conditions predominate during most of a month.

Wind Roses

A wind rose is a quantitative graphical summary of the wind direction and speed for a given time period. It is a count, expressed on the following graphs as a percentage frequency, of the number of observations or hours which had a particular direction and speed during the summary period.

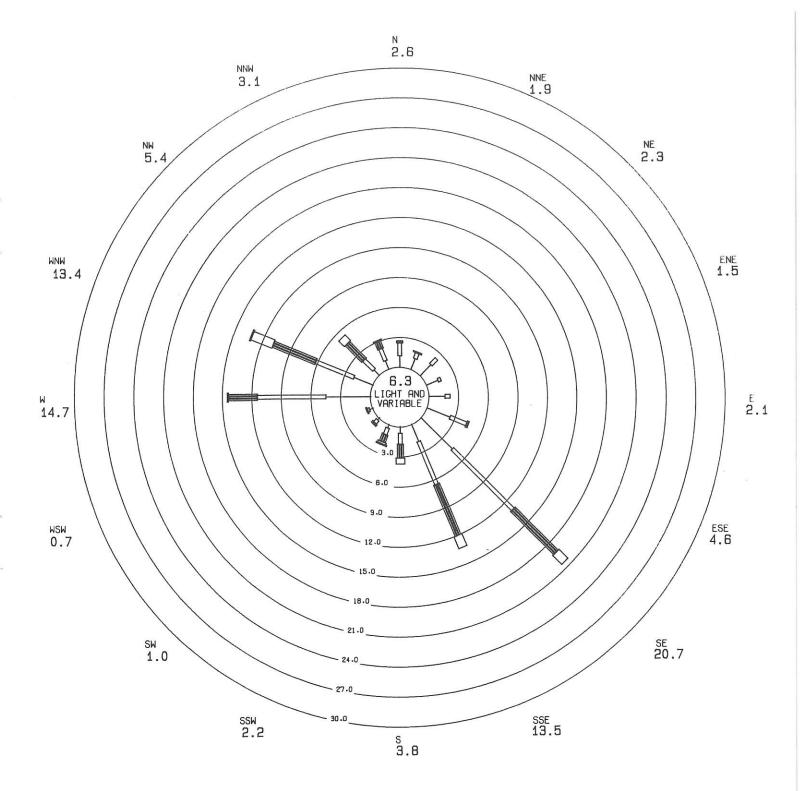
The wind rose spokes or arms represent 16 points of the compass and are labeled by wind direction. The percentage frequency of winds from a given direction (without regard to speed) is expressed numerically beneath that direction on the perimeter of each rose.

The length of each segment of a spoke represents the frequency of wind within a speed category. From this frequency and the total observations, the number of hours within each speed category may be determined. The percentage frequency of light and variable winds (winds less than 1.5 knots) is printed in the center of the rose.

HRSTATP

WIND SPEED (Knots)

9	Monthly Arithmetic Averages													Yea
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Samples	
	6.9	6.0	6.2	6.1	6.5	6.4	5.6	5.5	4.5	4.3	6.1	5.9	8593	
dical-Dental Bldg, 2730 Colby, Everett, Wa		2.9	2.8	3.5	3.3	3.1	3.0	2.8	2.2	1.7	2.8	2.8	8690	
rth 98th St & Stone Ave N, Seattle, Wa		3.9	3.7	4.4	4.3	4.2	3.9	3.5	3.0	2.5	3.7	3.7	8691	
wamish, 4752 E Marginal Way S, Seattle, Wa		A 100			3.1	3.1	2.7	2.4	1.9	1.6	2.6	2.5	5654	
nes St & Central Ave, Kent, Wa	2 9	3.2	3.0	3.1	2.9	3.1	2.6	2.8	2.5	2.4	2.7	3.0	8680	
th St NE & 54th Ave NE, Northeast Tacoma, Wa	1		3.2	3.9	4.1	4.0	4.1	3.7	3.2	2.5	3.0	3.3	7698	
Ol Alexander Ave, Tacoma, Wa	3.3	3.6	3.3	4.1	4.4	4.3	4.2	3.8	3.3	2.6	3.5	3.6	8676	
re Station #12, 2316 E 11th St, Tacoma, Warth 26th & Pearl Sts, Tacoma, Wa	3.7	3.9	3.8	4.1	3.8	4.0	3.5	3.5	3.1	2.9	3.3	3.9	8690	



HOUR AVERAGE SURFACE WINDS

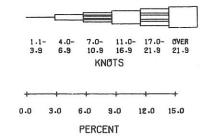
PERCENTAGE FREQUENCY OF OCCURRENCE

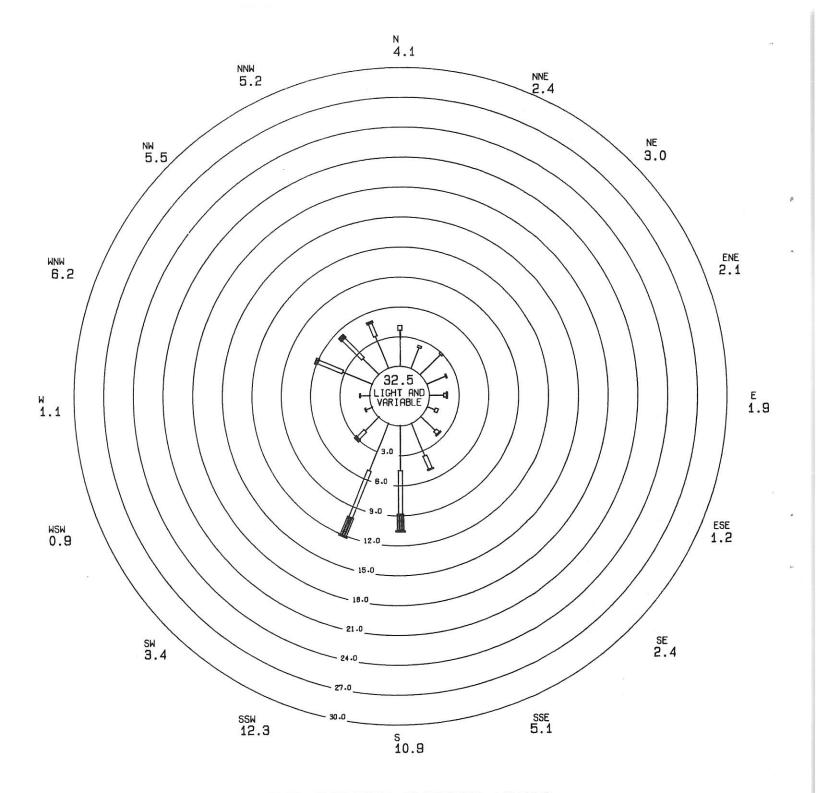
STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY Medical-Dental Bldg, 2730 Colby, Everett, W

INCLUSIVE DATES-

ALL MONTHS 1987

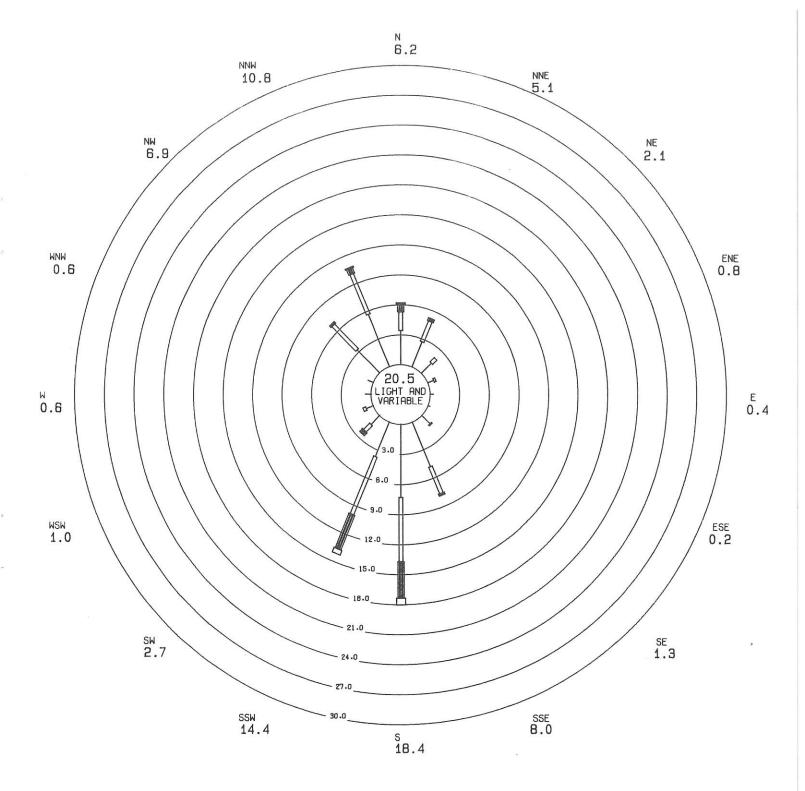
TOTAL OBSERVATIONS- 8, 593





HOUR AVERAGE SURFACE WINDS PERCENTAGE FREQUENCY OF OCCURRENCE

PUGET SOUND AIR POLLUTION CONTROL AGENCY North 98th St & Stone Ave N, Seattle, Wa STATION LOCATION-7.0- 11.0- 17.0- OVER 10.9 16.9 21.9 21.9 4.0-6.9 ALL MONTHS 1987 KNOTS INCLUSIVE DATES-8,690 12.0 15.0 TOTAL OBSERVATIONS-PERCENT



HOUR AVERAGE SURFACE WINDS

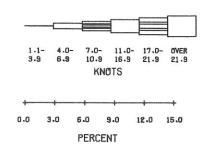
STATION LOCATION-

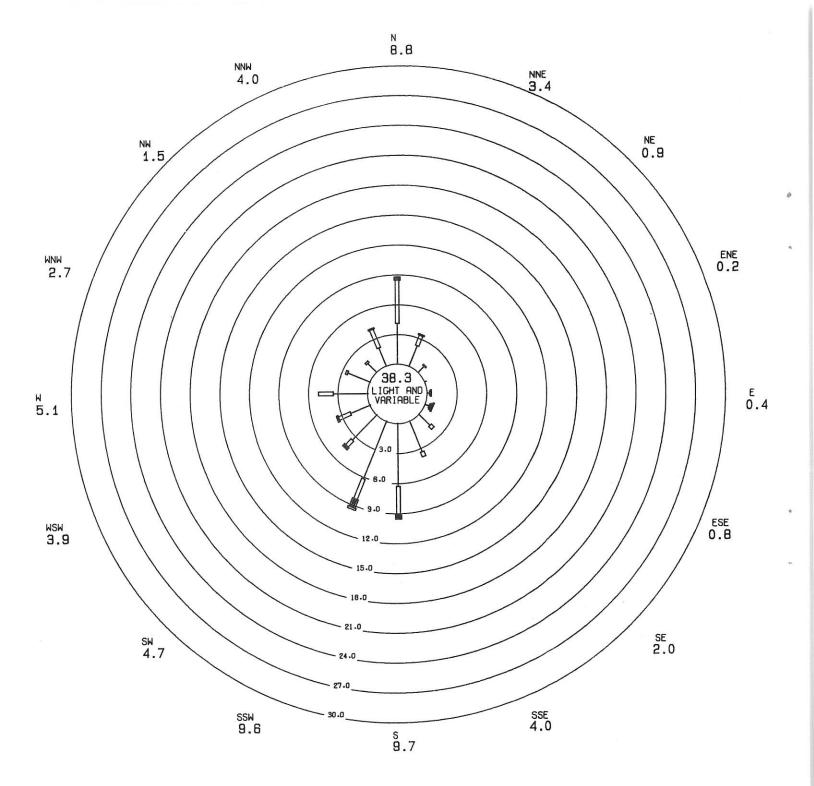
PUGET SOUND AIR POLLUTION CONTROL AGENCY Duwamish, 4752 E Marginal Way S, Seattle, Wa

INCLUSIVE DATES-

ALL MONTHS 1987

TOTAL OBSERVATIONS- 8, 691



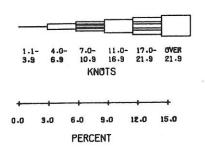


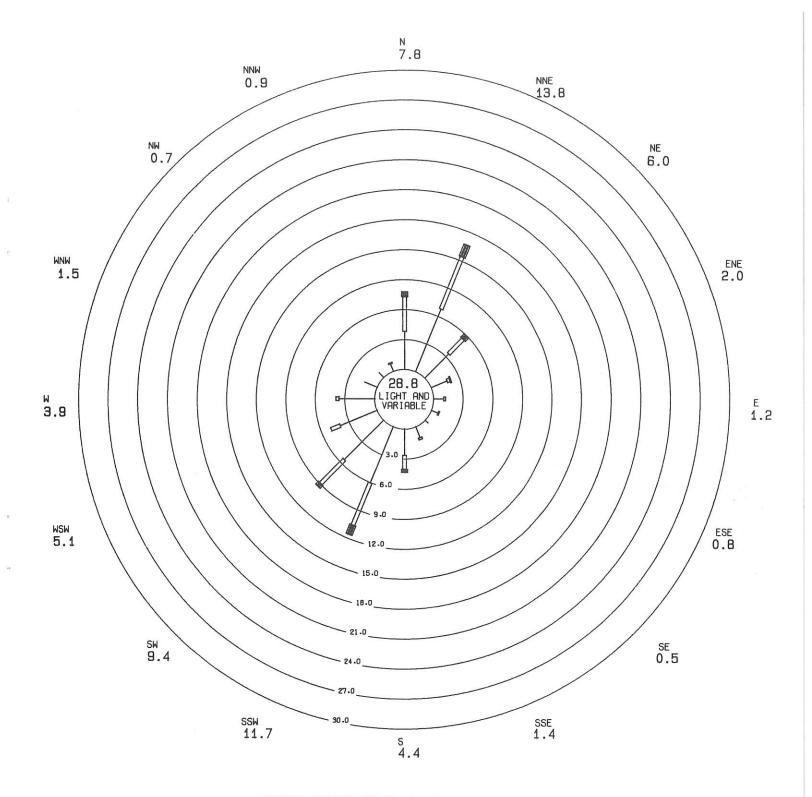
HOUR AVERAGE SURFACE WINDS

PUGET SOUND AIR POLLUTION CONTROL AGENCY
James St & Central Ave, Kent, Wa

INCLUSIVE DATES- MAY - DEC, 1987

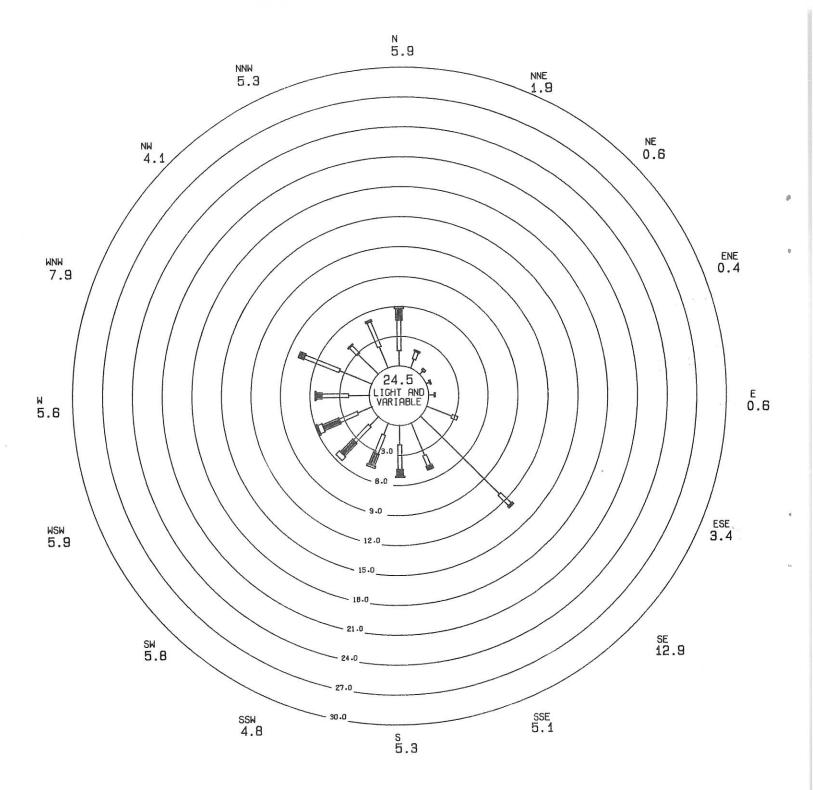
TOTAL OBSERVATIONS- 5, 654





HOUR AVERAGE SURFACE WINDS PERCENTAGE FREQUENCY OF OCCURRENCE

PUGET SOUND AIR POLLUTION CONTROL AGENCY 27th St NE & 54th Ave NE, Northeast Tacoma, Wa STATION LOCATION-7.0- 11.0-10.9 16.9 17.0- OVER 21.9 21.9 ALL MONTHS 1987 INCLUSIVE DATES-KNOTS 8,680 TOTAL OBSERVATIONS-0.0 6.0 9.0 12.0 15.0 PERCENT



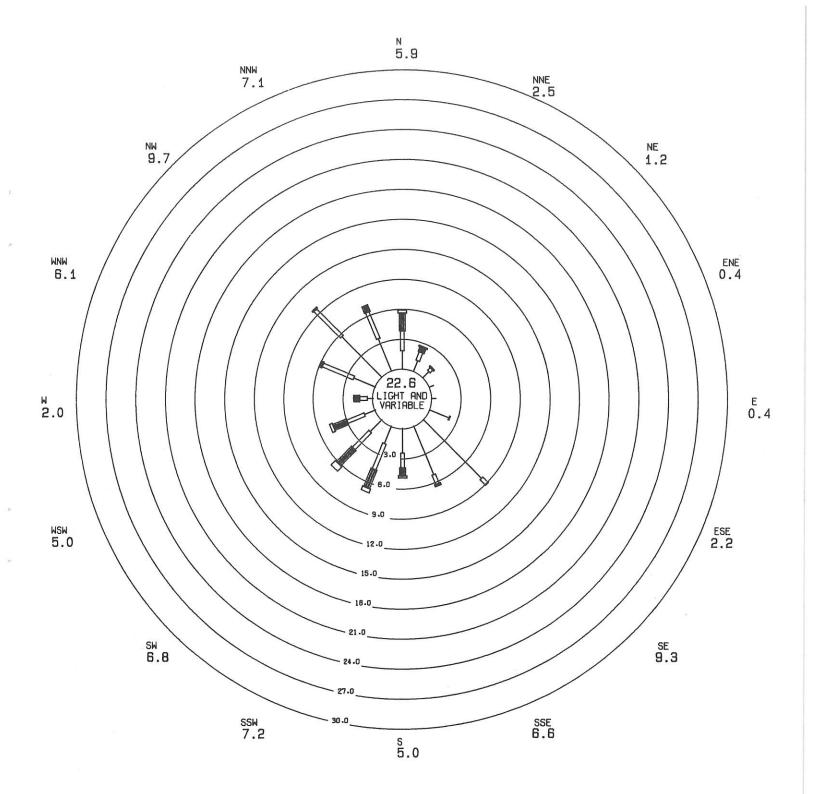
HOUR AVERAGE SURFACE WINDS

PUGET SOUND AIR POLLUTION CONTROL AGENCY 2301 Alexander Ave, Tacoma, Wa

INCLUSIVE DATES- FEB - DEC, 1987

TOTAL OBSERVATIONS- 7,698

1.1- 4.0- 7.0- 11.0- 17.0- OVER 3.9 6.9 10.9 16.9 21.9 21.9 KNOTS



HOUR AVERAGE SURFACE WINDS

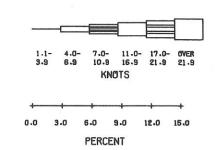
STATION LOCATION-

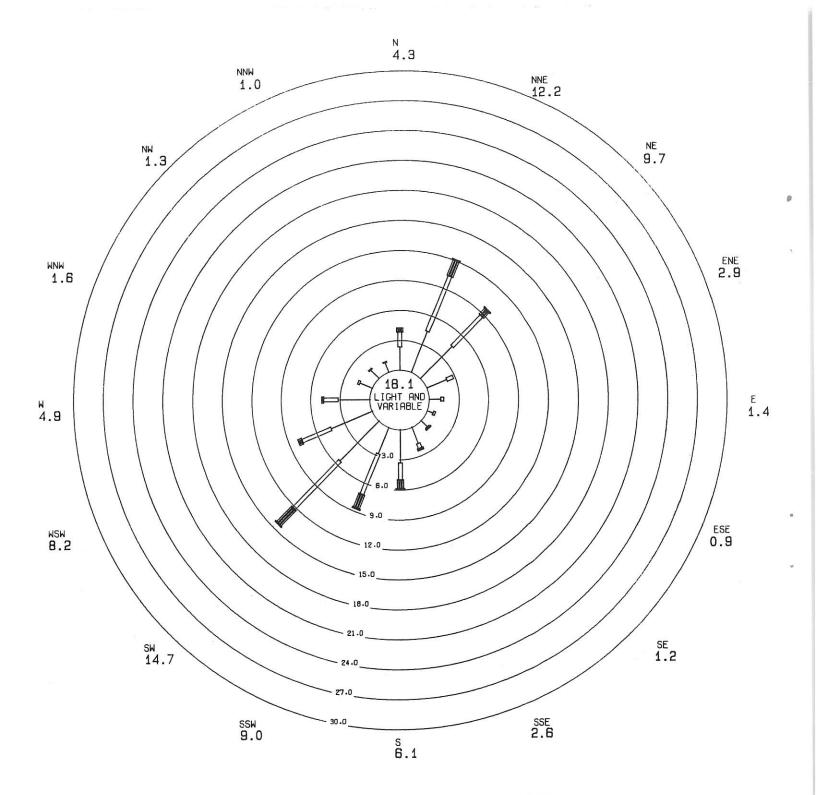
PUGET SOUND AIR POLLUTION CONTROL AGENCY Fire Station #12, 2316 E 11th St, Tacoma, Wa

INCLUSIVE DATES-

ALL MONTHS 1987

TOTAL OBSERVATIONS- 8, 676





HOUR AVERAGE SURFACE WINDS

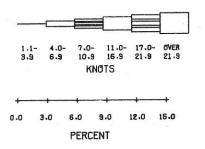
PERCENTAGE FREQUENCY OF OCCURRENCE

PUGET SOUND AIR POLLUTION CONTROL AGENCY STATION LOCATION- North 26th & Pearl Sts, Tacoma, Wa

INCLUSIVE DATES-

ALL MONTHS 1987

TOTAL OBSERVATIONS- 8,690



AIR CONTAMINANT EMISSION INVENTORY

Introduction

Registered facilities within the Puget Sound Agency's control region are required to report annually their air contaminant emissions and/or process quantities. These data enable calculation of air contaminant emissions from published emission factors. The resulting emission quantities have been tabulated by county and by source category in the pages which follow.

<u>Definitions</u>

Area sources: County-wide categories of
 sources.

Emission factor: A value derived from source tests, material balance, engineering comparison with similar processes or other published data which is used to estimate annual emissions from process quantities.

Off road transportation: Farm vehicles, construction/industrial vehicles, logging/governmental vehicles, small marine craft, railroads, vessels, tugs, and ferries.

On road transportation: Motor vehicle fuel combustion by-products and resuspended roadway particulate matter.

Other area sources: Architectural surface coating, automobile surface coating, cold solvent degreasing, commercial/consumer solvents, cutback asphalt, dry cleaning, graphic arts, waste incineration, fireplaces without inserts, stationary diesel engines, and small utility engines.

<u>Point sources</u>: Facilities which have an air contaminant annual emission exceeding twenty-five tons.

Process quantity: An indicator of air contaminant emitting activities used to calculate emissions, such as amount of fuel burned, materials handled, coatings applied, etc.

Registered facility: The sum total of all the pollutant emitting activities located on one or more contiguous or adjacent properties, which is owned or operated by the same person and includes buildings, structures, equipment, control apparatus and storage piles.

Residential heating: Natural gas and distillate fuel oil combustion in homes; wood combustion in stoves and fireplaces with inserts.

<u>Slash burns</u>: Prescribed burning on private, state and federal land.

<u>Small boilers</u>: Commercial natural gas and distillate fuel oil combustion.

Volatile organic compound (VOC): A hydrocarbon or derivative with a pressure exceeding 0.002 pounds per square inch (psi) at 20°C and 14.7 psi excluding methane, ethane, trichlorotrifluoroethane (CFC-113), methylene chloride, 1,1,1-trichloroethane, chlorodifluoromethane (CFC-22), dichlorodifluoromethane (CFC-12), trifluoromethane (FC-23), dichlorotetrafluoroethane (CFC-114), trichlorofluoromethane (CFC-11) and chloropentafluoroethane (CFC-115).

Comments

It should be noted that the air contaminant categories are not necessarily mutually exclusive. Toxic air contaminants may also be tabulated under TSPM, PM10 or VOC; and PM10 is a subset of TSPM. Estimates for toxic air contaminants have come primarily from source calculated emissions evaporation estimates of substances which were reported as hazardous ingredients on material safety data Toxic air contaminants represent a wide range of toxicity.

All Counties Tons per 1987

	TSPM	PM10	SOx	NOx	VOC	co	TAC
POINT SOURCES							
1-INDUSTRIAL BOILERS	1686	1448	4833	2560	553	9940	632
2-FOREST PRODUCTS A-PULP MILLS B-WOOD PRODUCTS	986 304	686 196	1289	1125	5 5	3576	640
3-PRIMARY METALS A-ALUMINUM B-COPPER C-OTHER	1043 253	341 132	1677	8 32	44	10921 2 2092	409
4-PETROLEUM REFINERIES	5		136	264	508	108	-
5-ELECTRIC UTILITIES	1	1	5	1			
6-CHEMICAL PRODUCTION			-		37	42	43
7-CEMENT PRODUCTION	316	187	301	539			2
8-OTHER POINTS A-POLLUTANT >25 T/Y B-POLLUTANT <25 T/Y	3668 300	714 142	788 54	1534 1593	6067 465	6817 396	5045 635
POINT SOURCE TOTAL	8562	3847	9083	7656	7684	33894	7407
AREA SOURCES							
1-TRANSPORTATION A-ON ROAD B-OFF ROAD	217969 962	85013 910	5732 1592	75030 10462	106675 7612	795618 30310	8688 18
2-SMALL BOILERS	588	454	12962	4251	117	882	
3-SLASH BURNS	1206	1206		115	718	7462	
4-RESIDENTIAL HEATING	2116	1852	6522	2990	4550	12189	209
5-OTHER AREA SOURCES	1084	980	115	1187	25598	10823	12683
AREA SOURCE TOTAL	223925	90415	26923	94035	145270	857284	21598
GRAND TOTAL	232487	94262	36006	101691	152954	891178	29005

Notes

(1) TSPM=Total Suspended Particulate Matter PM10=Particulate Matter <10 Micrometers SOx =Sulfur Oxides TAC =Toxic Air Contaminants

(2) Unit Conversion: 1 Ton=907.18 kg

NOx=Nitrogen Oxides VOC=Volatile Organic Compounds CO =Carbon Monoxide

King County Tons per 1987

	TSPM	PM10	SOx	NOx	VOC	CO	TAC
POINT SOURCES							
1-INDUSTRIAL BOILERS	243	209	564	585	83	1473	198
2-FOREST PRODUCTS A-PULP MILLS B-WOOD PRODUCTS	64	62			2		
3-PRIMARY METALS A-ALUMINUM B-COPPER C-OTHER	253	132		1 32	0	0 2092	1
4-PETROLEUM REFINERIES							
5-ELECTRIC UTILITIES	1	1	5	1	0	0	0
6-CHEMICAL PRODUCTION					37		42
7-CEMENT PRODUCTION	316	187	301	539			2
8-OTHER POINTS A-POLLUTANT >25 T/Y B-POLLUTANT <25 T/Y	1672 155	419 75	565 0	1102 1568	3575 214	215 392	3165 104
POINT SOURCE TOTAL	2704	1085	1435	3828	3911	4172	3512
AREA SOURCES							
1-TRANSPORTATION A-ON ROAD B-OFF ROAD	126225 472	49280 420	3462 852	45315 5653	60120 3658	453585 20003	5170 8
2-SMALL BOILERS	491	377	11045	3441	90	720	0
3-SLASH BURNS	185	185	0	18	110	1144	
4-RESIDENTIAL HEATING	888	769	3669	1850	1838	4992	90
5-OTHER AREA SOURCES	468	427	72	696	14133	5260	7009
AREA SOURCE TOTAL	128729	51458	19100	56973	79949	485704	12277
GRAND TOTAL	131433	52543	20535	60801	83860	489876	15789

Notes

(1) TSPM=Total Suspended Particulate Matter PM10=Particulate Matter <10 Micrometers SOx =Sulfur Oxides

TAC =Toxic Air Contaminants
(2) Unit Conversion: 1 Ton=907.18 kg

rs VO

NOx=Nitrogen Oxides VOC=Volatile Organic Compounds CO =Carbon Monoxide

Kitsap County Tons per 1987

	TSPM	PM10	SOx	NOx	VOC	СО	TAC
POINT SOURCES							
1-INDUSTRIAL BOILERS	66	50	1023	211	4	30	3
2-FOREST PRODUCTS A-PULP MILLS B-WOOD PRODUCTS	33	16					
3-PRIMARY METALS A-ALUMINUM B-COPPER C-OTHER							
4-PETROLEUM REFINERIES							
5-ELECTRIC UTILITIES							
6-CHEMICAL PRODUCTION							
7-CEMENT PRODUCTION							*
8-OTHER POINTS A-POLLUTANT >25 T/Y B-POLLUTANT <25 T/Y	385	49	104	65	352 30	23	200 29
POINT SOURCE TOTAL	484	115	1127	276	386	53	232
AREA SOURCES							
1-TRANSPORTATION A-ON ROAD B-OFF ROAD	12510 50	4884 50	342 232	4481 225	6847 106	52664 870	530 2
2-SMALL BOILERS	7	6	80	53	2	9	0
3-SLASH BURNS	34	34	0	3	20	208	
4-RESIDENTIAL HEATING	302	271	216	103	704	1841	30
5-OTHER AREA SOURCES	156	140	6	68	1815	1212	913
AREA SOURCE TOTAL	13059	5385	. 876	4933	9494	56804	1475
GRAND TOTAL	13543	5500	2003	5209	9880	56857	1707

Notes

(1) TSPM=Total Suspended Particulate Matter PM10=Particulate Matter <10 Micrometers SOx =Sulfur Oxides TAC =Toxic Air Contaminants

(2) Unit Conversion: 1 Ton=907.18 kg

NOx=Nitrogen Oxides VOC=Volatile Organic Compounds CO =Carbon Monoxide

Pierce County Tons per 1987

	TSPM	PM10	SOx	NOx	VOC	CO	TAC
POINT SOURCES							
1-INDUSTRIAL BOILERS	783	683	2039	1067	271	4902	402
2-FOREST PRODUCTS A-PULP MILLS B-WOOD PRODUCTS	454 119	432 74	682	191	5 3	2496	458
3-PRIMARY METALS A-ALUMINUM B-COPPER C-OTHER	858	334	1677	7	44 0	10921 2	409
4-PETROLEUM REFINERIES	5	0	136	264	508	108	0
5-ELECTRIC UTILITIES							
6-CHEMICAL PRODUCTION					0	42	1
7-CEMENT PRODUCTION							
8-OTHER POINTS A-POLLUTANT >25 T/Y B-POLLUTANT <25 T/Y	1033 126	146 59	46 41	148 18	737 193	95 4	366 478
POINT SOURCE TOTAL	3378	1728	4621	1695	1761	18570	2114
AREA SOURCES							
1-TRANSPORTATION A-ON ROAD B-OFF ROAD	43184 301	16802 301	1018 326	13328 2815	20401 3422	156627 6776	1562 4
2-SMALL BOILERS	67	55	1205	484	17	92	0
3-SLASH BURNS	672	672	0	64	400	4160	
4-RESIDENTIAL HEATING	544	469	2349	853	1121	3031	50
5-OTHER AREA SOURCES	254	228	19	229	5564	2470	2747
AREA SOURCE TOTAL	45022	18527	4917	17773	30925	173156	4363
GRAND TOTAL	48400	20255	9538	19468	32686	191726	6477

Notes

(1) TSPM=Total Suspended Particulate Matter PM10=Particulate Matter <10 Micrometers SOx =Sulfur Oxides TAC =Toxic Air Contaminants

(2) Unit Conversion: 1 Ton=907.18 kg

NOx=Nitrogen Oxides VOC=Volatile Organic Compounds CO =Carbon Monoxide

Snohomish County Tons per 1987

	TSPM	PM10	SOx	NOx	VOC	CO	TAC
POINT SOURCES							
1-INDUSTRIAL BOILERS	594	506	1207	697	195	3535	29
2-FOREST PRODUCTS A-PULP MILLS B-WOOD PRODUCTS	532 88	254 44	607	934		1080	182
3-PRIMARY METALS A-ALUMINUM B-COPPER C-OTHER	185	7					
4-PETROLEUM REFINERIES							
5-ELECTRIC UTILITIES							
6-CHEMICAL PRODUCTION							
7-CEMENT PRODUCTION							
8-OTHER POINTS A-POLLUTANT >25 T/Y B-POLLUTANT <25 T/Y	578 19	100 8	73 13	219 7	1403 28	6484 0	1314 24
POINT SOURCE TOTAL	1996	919	1900	1857	1626	11099	1549
AREA SOURCES							
1-TRANSPORTATION A-ON ROAD B-OFF ROAD	36050 139	14047 139	910 182	11906 1769	19307 426	132742 2661	1426 4
2-SMALL BOILERS	23	16	632	273	8	61	0
3-SLASH BURNS	315	315	0	30	188	1950	
4-RESIDENTIAL HEATING	382	343	288	184	887	2325	39
5-OTHER AREA SOURCES	206	185	18	194	4086	1881	2014
AREA SOURCE TOTAL	37115	15045	2030	14356	24902	141620	3483
GRAND TOTAL	39111	15964	3930	16213	26528	152719	5032

Notes

(1) TSPM=Total Suspended Particulate Matter PM10=Particulate Matter <10 Micrometers SOx =Sulfur Oxides TAC =Toxic Air Contaminants

(2) Unit Conversion: 1 Ton=907.18 kg

NOx=Nitrogen Oxides VOC=Volatile Organic Compounds CO =Carbon Monoxide

AIR QUALITY UNITS CONVERSION TABLE

Air quality standards for gases are defined in terms of micrograms (ug) or milligrams (mg) per cubic meter as well as in parts per million (ppm). As this data summary expresses measurements for gaseous pollutants in terms of ppm, the following conversion table is for the

convenience of those who wish to interpret our results in terms of ug/cubic meter or mg/cubic meter. These conversion factors from the Federal Register assume a pressure of 760 mm Hg and a temperature of 25 degrees C.

	The second secon	
<u>Pollutant</u>	Multiply ppm by	To Obtain
Carbon Monoxide	1.145	mg/cubic meter
Nitrogen Dioxide	1880	ug/cubic meter
Ozone	1961	ug/cubic meter
Sulfur Dioxide	2619	ug/cubic meter

AMBIENT AIR QUALITY STANDARDS

POLLUTANT	NATI Primary	ONAL Secondary	WASHINGTON STATE	PUGET SOUND REGION
CARBON MONOXIDE	9 ppm		9 ppm	9 ppm
8 Hour Average 1 Hour Average	35 ppm		35 ppm	35 ppm
PARTICULATE MATTER (PM10)		9.1	- 10	
Annual Arithmetic Average 24 Hour Average ^a	50 ug/m ³ 150 ug/m ³			
TOTAL SUSPENDED PARTICULATES				
Annual Geometric Average 24 Hour Average			60 ug/m ³ 150 ug/m ³	60 ug/m ³ 150 ug/m ³
OZONE				
1 Hour Average ^b	0.12 ppm	0.12 ppm	0.12 ppm	0.12 ppm
SULFUR DIOXIDE				*
Annual Average	0.03 ppm		0.02 ppm	0.02 ppm 0.04 ppm
30 Day Average 24 Hour Average	0.14 ppm	0.50 ppm	0.10 ppm	0.10 ppm ^c
3 Hour Average 1 Hour Average ^d	E -	0.50 ppm	0.25 ppm	0.25 ppm
1 Hour Average 5 Minute Average ^e		*	0.40 ppm	0.40 ppm ^c 1.00 ppm
LEAD				
Calendar Quarter Average	1.5 ug/m ³	1.5 ug/m ³		1.5 ug/m ³
NITROGEN DIOXIDE				
Annual Average	0.05 ppm	0.05 ppm	0.05 ppm	0.05 ppm

Notes

- (1) ppm = parts per million
- (2) $ug/m^3 = micrograms per cubic meter$
- (3) Annual, Quarter and 30 Day standards never to be exceeded, shorter term standards not to be exceeded more than once per year unless noted.
- a Standard attained when expected number of days per year with a 24 hour concentration above 150 ug/m^3 is equal to one or less.
- b Standard attained when expected number of days per year with an hourly average above 0.12 ppm is equal to one or less.
- c Sulfur Dioxide short-term standard never to be exceeded.
- d Not to be exceeded more than twice in seven days.
- e Not to be exceeded more than once in eight hours.

Carbon Monoxide

Carbon monoxide is a colorless. odorless, toxic gas commonly formed when carbon-containing fuel is not burned completely. It chemically combines with the hemoglobin in the red blood cells to decrease the oxygen-carrying capacity of the blood. Carbon monoxide also weakens the contractions of the heart, thus reducing the amount of blood pumped throughout the body. People with heart and pregnant women particularly at risk because of the effects of carbon monoxide.

Particulate Matter (PM10 and TSP)

Particulate matter with an aerodynamic diameter of less than or equal to 10 micrometers (PM10) and Total Suspended Particulates (TSP) are small discrete masses of solid or liquid matter dispersed in the atmosphere. Slash and wood burning, and transportation and industrial activity are the major sources of particulate matter. Those particulates one micrometer or less in diameter are especially associated with a variety of adverse effects on public health and welfare. Particulate in the respiratory tract may produce injury by itself, or it may act in conjunction with gases to increase the effect on the body. The elderly, those suffering from respiratory illness, and young children are especially prone to the deleterious effects of particulates. Soiling of buildings and other property, reduced visibility are further results of high particulate matter levels.

<u>Ozone</u>

Ozone is a pungent-smelling, colorless gas produced in the atmosphere when nitrogen oxides and some hydrocarbons chemically react under the effect of strong sunlight. It is a pulmonary irritant that affects lung tissues and respiratory functions. Ozone impairs the normal function of the lung and, at concentrations between 0.15 0.25 ppm, causes lung tightness, coughing and wheezing. Other oxidants that often accompany ozone cause eye irritation. Persons with chronic

respiratory problems, such as asthma, seem most sensitive to increases in ozone concentration.

Sulfur Dioxide

Sulfur dioxide is a colorless, corrosive gas, that has a bitter taste, but no appreciable smell between 0.3 - 1.0 ppm. Industrial sites which use coal and oil for fuel - such as smelters, paper mills, power plants and manufacturing plants - are the main sources of sulfur dioxide pollution. The presence of sulfur dioxide in the ambient air has been associated with a variety of respiratory diseases and increased mortality rates. When sulfur dioxide is inhaled with small particles, the effect on health is increased. Inhalation of sulfur dioxide can cause increased airway resistance constricting lung passages.

Lead

Lead particles or its compounds enter the air from vehicle exhaust and from industries that smelt, process and/or handle the metal. Lead affects humans in numerous ways, but the greatest impacts appear to be on the bloodforming system, the nervous system, and the kidneys. It affects some people more than others. Young children (ages 1 - 5) are particularly sensitive to lead exposure. The standard for lead in air is intended to prevent most children from exceeding blood levels of 30 micrograms per deciliter of blood.

Nitrogen Dioxide

Nitrogen dioxide poisonous, is brownish gas which, in addition to being a strong oxidizing agent, quickly reacts with water vapor to form corrosive nitric acid. Nitrogen dioxide is formed as the result of high temperature fuel combustion and subsequent atmospheric reactions. The presence of nitrogen dioxide in ambient air has connected with a range of respiratory Further, nitrogen dioxide diseases. plays an essential role in production of ozone.