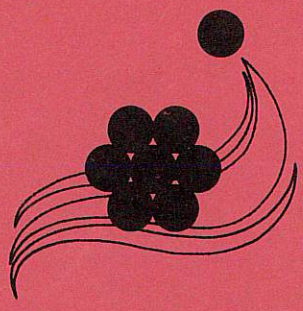
KNECHTEL

1985 AIR QUALITY DATA SUMMARY

Counties Of

King
Kitsap
Pierce
Snohomish



Puget Sound
Air Pollution Control Agency

Puget Sound Air Pollution Control Agency

Serving King, Kitsap, Pierce and Snohomish Counties

1985
AIR QUALITY
DATA SUMMARY

measured and compiled by the

Technical Services Division

PUGET SOUND
AIR POLLUTION CONTROL AGENCY
200 West Mercer Street
P.O. Box 9863
Seattle, Washington 98109

1985 AIR QUALITY DATA SUMMARY

CONTENTS

REFERENCE COPIES OF THIS SUMMARY HAVE BEEN PLACED IN PUBLIC AND COLLEGE LIBRARIES WITHIN THE PUGET SOUND REGION. INDIVIDUAL COPIES ARE FOR SALE AT THE PUGET SOUND AIR POLLUTION CONTROL AGENCY SEATTLE HEADQUARTERS OFFICE.

PRICE: $4.00 (plus $2.00 postage and handling if mailed)

PUBLISHED AUGUST, 1986
TECHNICAL SERVICES DIVISION
(206) 344-7326

INTRODUCTION

This fourteenth annual data summary presents air quality and meteorological data measured in the Puget Sound Region during 1985. The report begins with a table outlining the sampling network (with addresses) and a map of the network. Within the report are summaries of pollutant measurements together with interpretive comments. The last sections present meteorological data consisting of lower atmosphere temperature soundings, wind roses, and stability wind roses. The outside back cover outlines the National, Washington State, and Puget Sound Region ambient air quality standards. Summaries within the report show whether the actual pollutant levels in the Puget Sound Region meet or exceed these standards.

After two years (1983 and 1984) without an Air Stagnation Advisory, there were three Stagnation Advisory periods during January and one 18 day period during December, 1985. The times and dates of each Advisory and the relationship to the Washington Episode Avoidance Plan are presented in the section on page 39. Beginning with 1972 the only other years without a Stagnation Advisory were 1973 and 1975. Historically about two Stagnation Advisory periods occur each year.

A section summarizing air quality using the nationally uniform Pollutant Standards Index (PSI) begins on page 5. The PSI provides a daily index of air quality using a simple numerical scale. This numerical scale is designed around the short term standard for each pollutant which is set to protect health. A table showing each pollutant concentration which occurs at a numerical breakpoint of the Index appears on the inside back cover. Every weekday the Agency reports the current PSI to the news media and the public. Anyone may obtain the current PSI also from the American Lung Association of Washington in Seattle by dialing 282-5565 or by dialing 1-800-732-9339 from outside Seattle.

In March, 1984, the U.S. Environmental Protection Agency proposed revisions to the national ambient air quality standards for particulate matter. As of July, 1986, final action on this proposal is still pending. Along with other changes the proposal defines a size specific method of measuring particulate matter as the method for the national primary standard. This method is designed to measure suspended particulates smaller than or equal to 10 micrometers in diameter termed PM10. Our report includes an isopleth map of annual PM10 levels on page 11 and a summary of PM10 measurements on page 19.

It is important that air quality measurements be precise and accurate. Nationally uniform requirements establish the procedures to audit and document the Precision and Accuracy of air quality data. A section beginning on page 34, titled Quality Assurance, summarizes the program and presents the Precision and Accuracy audit results.

The Agency operates one acid rain monitoring station as part of the state network. This station is located in Seattle at 14th Ave NE & NE 85th St. Weekly samples are sent to the Washington State Department of Ecology for analysis and final reporting.

All data collected are reported quarterly to the Washington State Department of Ecology; some of it is forwarded from there to the National Aerometric Data Bank maintained by the U.S. Environmental Protection Agency. The Department of Ecology conducts air monitoring within the Puget Sound area in addition to that done by our Agency. The Department also publishes an annual summary of data for the entire state. Inquiries concerning the statewide data should be directed to the Washington State Department of Ecology-PV11, Office of Air Programs, Olympia, Washington 98504-8711.

PUGET SOUND AIR POLLUTION CONTROL AGENCY

Atmospheric Sampling Network

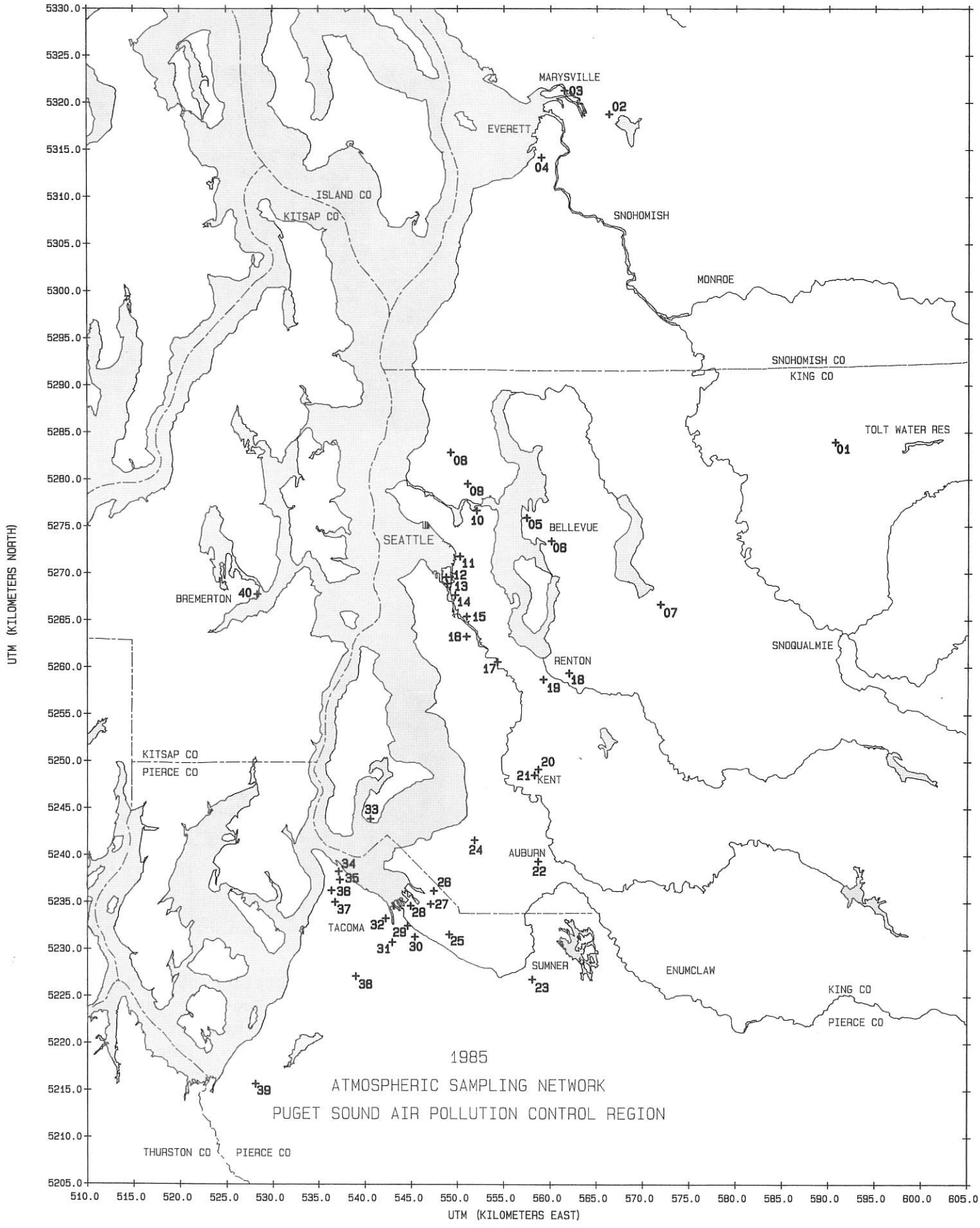
1985

	Location	Type of Sampling[a] A	B	C	D	E	F	G	H	I
01	Tolt River Watershed, King County, Wa	A								
*02	Highway 9 & 28th St NE, Lake Stevens, Wa	A								
*03	South End of Columbia Street, Marysville, Wa	A								
04	Medical-Dental Bldg, 2730 Colby, Everett, Wa	A	B	C	D					I
*05	Evergreen Point Bridge Toll Plaza, Medina, Wa							G		
*06	504 Bellevue Way NE, Bellevue, Wa	A						G		I
*07	20050 SE 56th, Lake Sammamish State Park, Wa	A				E				
08	North 98th St & Stone Ave N, Seattle, Wa	A	B		D		F	G		I
*09	5701 8th Ave NE, Seattle, Wa	A						G		
*10	Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	A						G		
*11	Fire Station #10, 301 2nd Ave S, Seattle, Wa	A								I
12	Harbor Island, 2555 13th Ave SW, Seattle, Wa	A						G	H	I
13	Harbor Island, 3400 13th Ave SW, Seattle, Wa	A						G	H	I
14	Duwamish, 4401 E Marginal Way S, Seattle, Wa	A	B	C	D		F			I
*15	Georgetown, 6431 Corson Ave S, Seattle, Wa	A								
16	South Park, 723 S Concord St, Seattle, Wa	A						G	H	I
17	Duwamish Valley, 12026 42nd Ave S, King Co, Wa	A								
18	SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	A								
19	200 South 2nd St, Renton, Wa	A								
20	22916 86th Ave S, Kent, Wa	A			D	E	F			
21	Memorial Park, 850 N Central Ave, Kent, Wa	A								I
22	115 E Main St, Auburn, Wa	A								
23	Sumner Jr HS, 1508 Willow St, Sumner, Wa	A			D	E		G	H	
24	Federal Way HS, 1401 S 304 St, Federal Way, Wa	A	B		D					
25	Fife Sr High School, 5616 20th E, Fife, Wa	A								
26	27th St NE & 54th Ave NE, Northeast Tacoma, Wa	A	B		D		F			I
27	2340 Taylor Way, Tacoma, Wa	A								I
28	Fire Station #12, 2316 E 11th St, Tacoma, Wa	A		C	D		F			I
29	Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	A								
30	Cascadia, 2002 E 28th St, Tacoma, Wa	A								
31	Willard School, S 32nd & S 'D' St, Tacoma, Wa	A								
32	Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	A								
33	SW 283rd & 101st Ave SW, Maury Island, Wa	A	B		D			G	H	
34	Ruston School, 5219 N Shirley St, Tacoma, Wa	A						G	H	
35	4716 North Baltimore St, Tacoma, Wa	A						G	H	
36	North 37th & Vassault Sts, Tacoma, Wa		B		D					
37	North 26th & Pearl Sts, Tacoma, Wa	A	B		D			G	H	
*38	Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	A								
*39	City Water Supply Pump House, Dupont, Wa	A						G	H	
40	City Hall, 239 4th St, Bremerton, Wa	A								

* Station operated by Washington State Department of Ecology (Additional ozone and all nitrogen dioxide and carbon monoxide sampling is performed by the Department of Ecology. Summaries of these data are included in this publication).

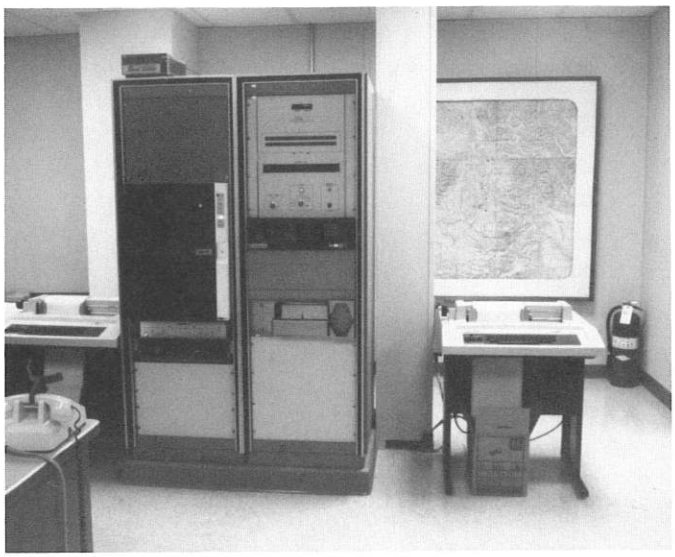
Type of Sampling

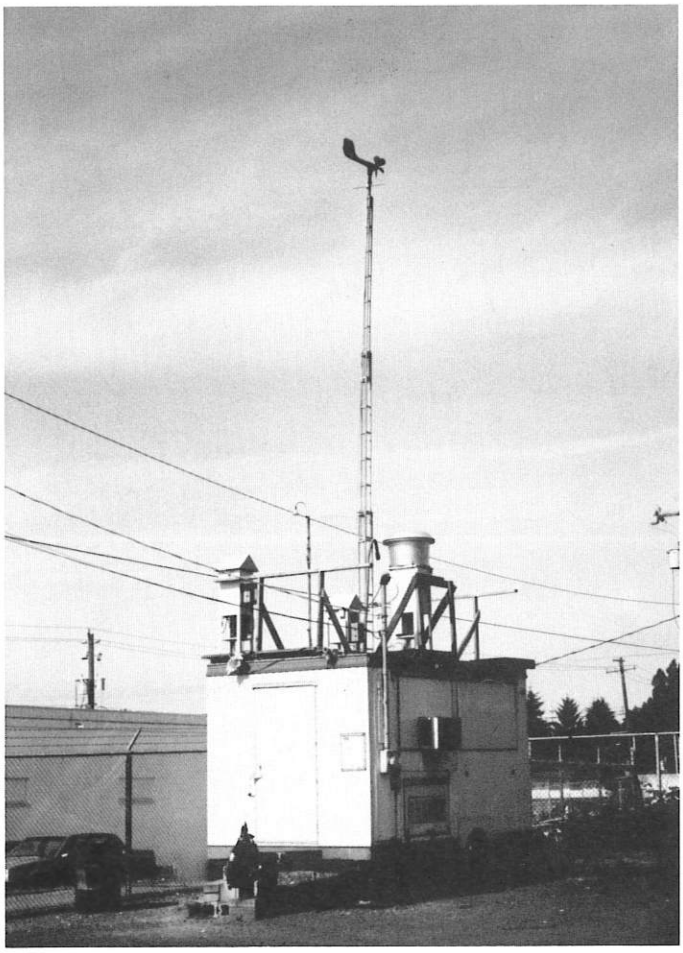
A Suspended Particulates (Total)
B Sulfur Dioxide (SO2)
C Suspended Particulates-COH'S
D Wind Direction & Speed
E Ozone (O3)
F Atmospheric Particles (b - scattering)
G Lead
H Arsenic
I Suspended Particulates (PM10)


1985
ATMOSPHERIC SAMPLING NETWORK
PUGET SOUND AIR POLLUTION CONTROL REGION
MARYSVILLE
EVERETT
ISLAND CO
KITSAP CO
SNOHOMISH
MONROE
SNOHOMISH CO
KING CO
TOLT WATER RES
BELLEVUE
SEATTLE
BREMERTON
RENTON
SNOQUALMIE
KITSAP CO
PIERCE CO
KENT
AUBURN
TACOMA
SUMNER
ENUMCLAW
KING CO
PIERCE CO
THURSTON CO
PIERCE CO
UTM (KILOMETERS NORTH)
UTM (KILOMETERS EAST)

Air quality and wind measurements are conducted at a variety of different locations as tabulated on page 2.

To the right is the Seattle central station to which many of the monitoring stations are connected by a phone data circuit. The central station provides continuous real time data to maintain air quality surveillance and to report the Pollutant Standards Index to the public.





The monitoring station above is located at North 98th St & Stone Ave N, Seattle. This station is representative of all those providing real time data over the phone data circuit. The wind sensor is mounted on a 10 meter tower. Sampling probes near the tower continuously sample the ambient air for analysis by a nephelometer and a sulfur dioxide analyzer within the station. Manual samplers for TSP and PM10 stand separately on the roof.

The monitoring station above is located at 2340 Taylor Way, Tacoma. The two samplers shown are manual methods for measuring particulate matter. The sampler on the left is a high volume sampler with a Size Selective Inlet used to measure PM10. The sampler to the right is a standard high volume sampler which measures TSP. Values for TSP and PM10 are computed after a sampled filter from each instrument is removed and transported to the Seattle laboratory where it is conditioned and weighed.

POLLUTANT STANDARDS INDEX

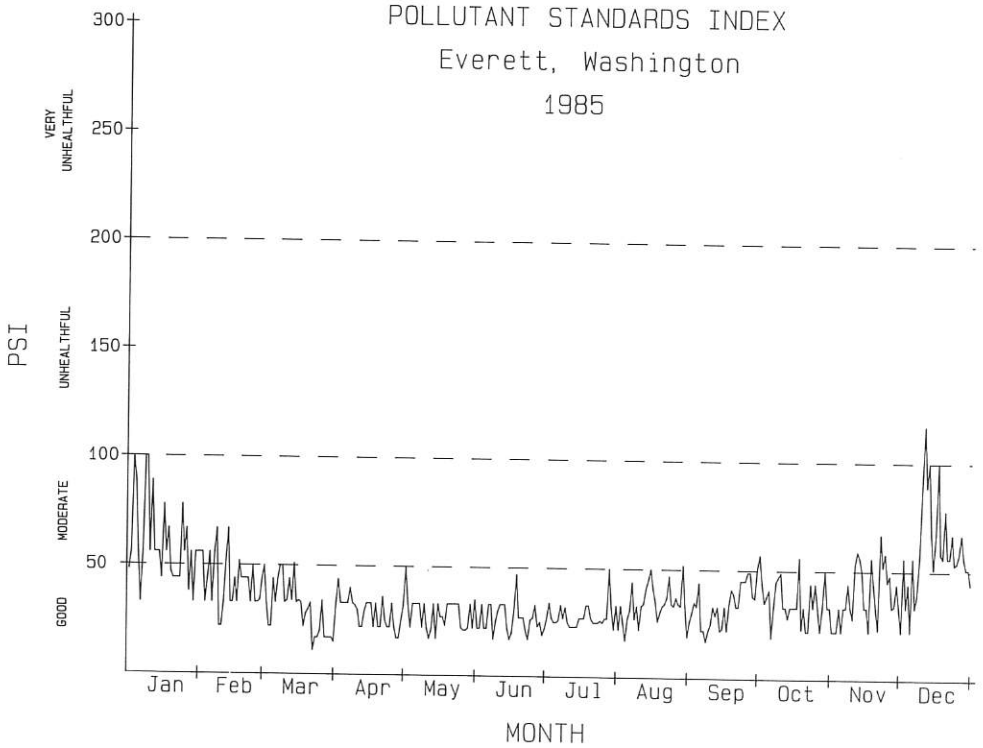
The Pollutant Standards Index (PSI) is a nationally uniform index for daily air quality reporting. In cooperation with the Washington State Department of Ecology, the Agency began reporting the PSI in 1980 for the Everett, Seattle, and Tacoma areas.

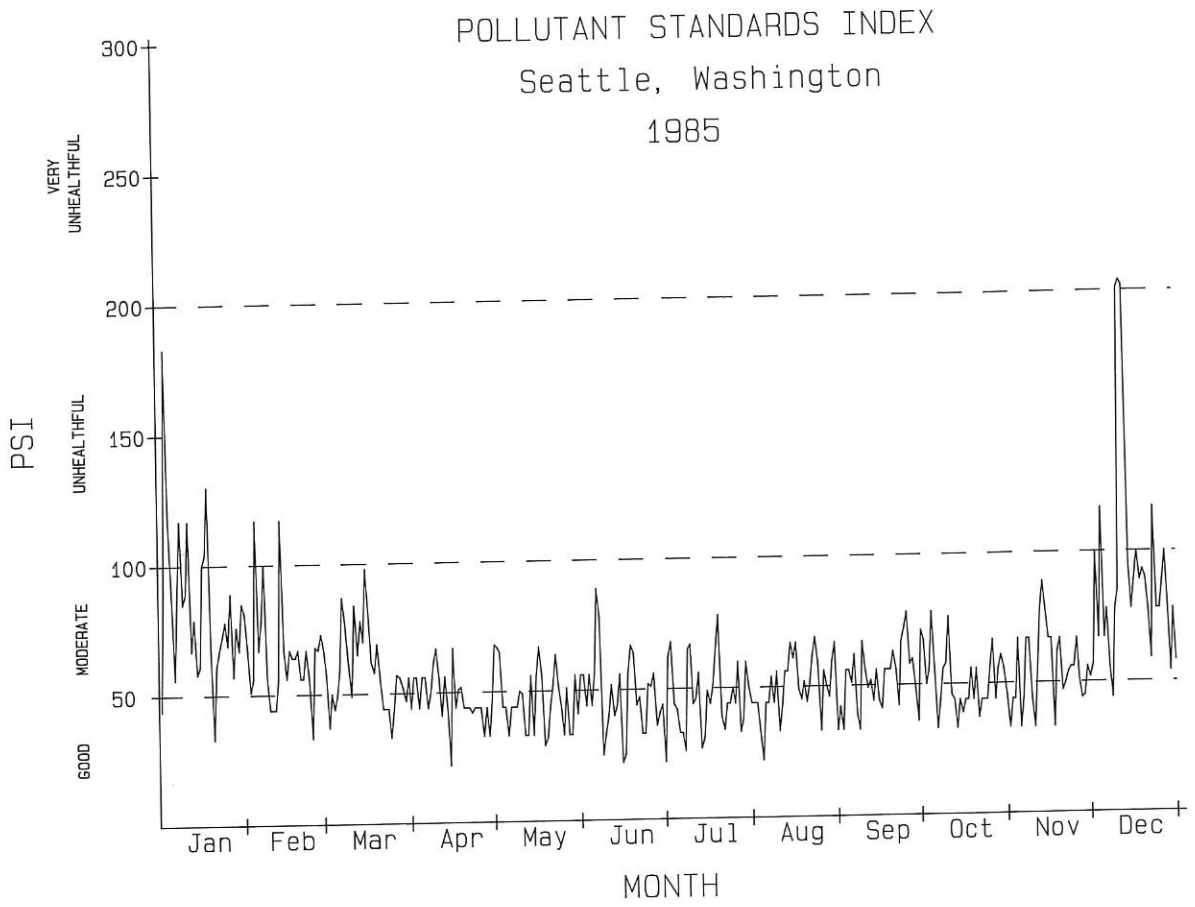
The PSI associates pollutant levels during a 24 hour period with potential health effects. The PSI is a range of values between zero and 500, with 0 to 50 indicating "Good" air quality, 51 to 100 being "Moderate", 101 to 199 considered "Unhealthful", 200 to 299 being "Very Unhealthful", and 300 and above "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.

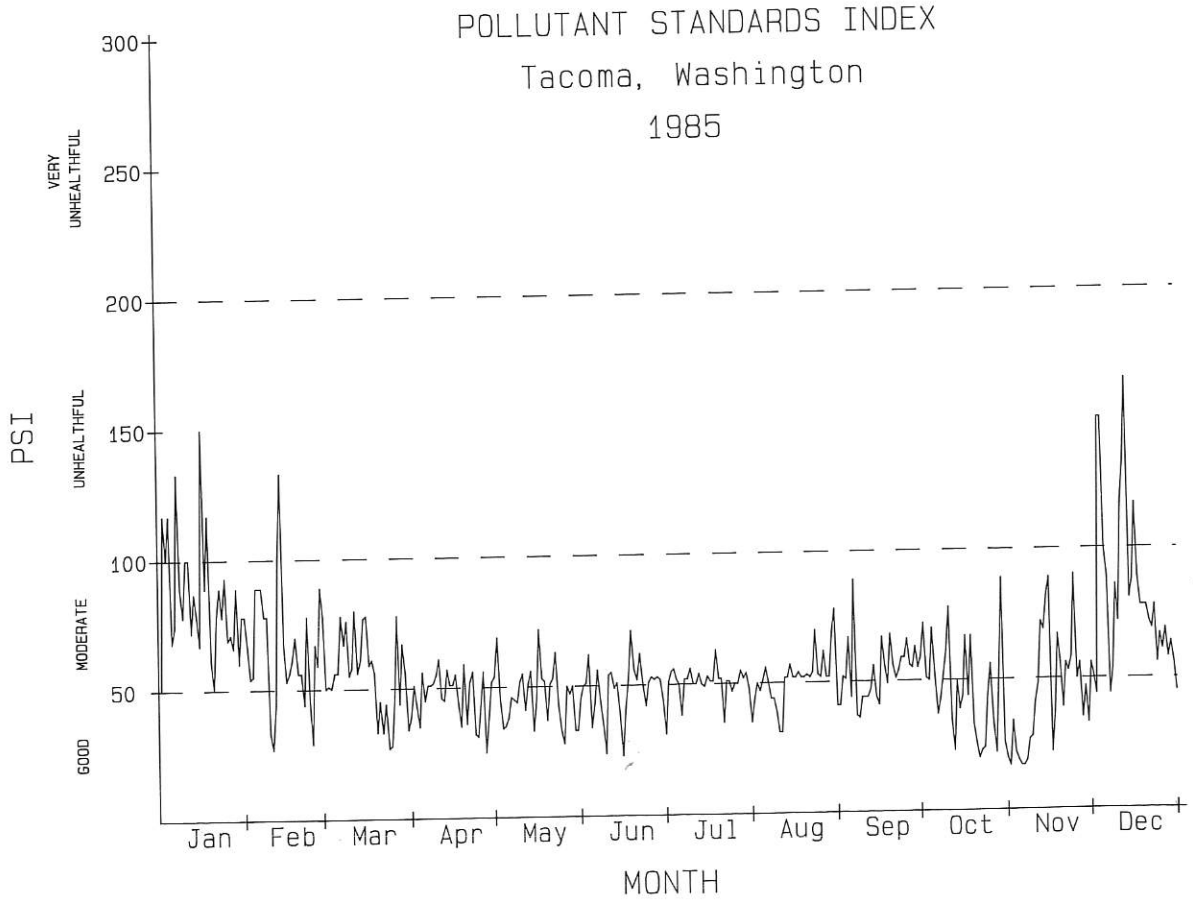
The U.S. Environmental Protection Agency designed the PSI to report upon five major air pollutants of concern for health: suspended particulates, sulfur dioxide, carbon monoxide, ozone, and nitrogen dioxide. The Agency reviews carbon monoxide, suspended particulates, and sulfur dioxide in the Everett, Seattle and Tacoma areas to calculate the index. The index value for each day in each area is determined by the pollutant with the highest value on the PSI scale. Since the highest PSI value for each city generally occurs near congested traffic or near an industrial area, the values for suburban residential areas are normally lower.

The accompanying graphs plot each daily PSI for Everett, Seattle, and Tacoma during 1985. The higher PSI values tend to occur during the fall and winter months often coinciding with air stagnation periods. A 1985 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 1985 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.

Air quality in Bellevue is principally determined by levels of carbon monoxide. During 1985 the air quality in Bellevue was unhealthful due to carbon monoxide on 5 days during January, November, and December.




POLLUTANT STANDARDS INDEX
Seattle, Washington
1985
PSI
300
250
200
150
100
50
VERY UNHEALTHFUL
UNHEALTHFUL
MODERATE
GOOD
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
MONTH


POLLUTANT STANDARDS INDEX
Tacoma, Washington
1985
PSI
300
250
200
150
100
50
VERY UNHEALTHFUL
UNHEALTHFUL
MODERATE
GOOD
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
MONTH

POLLUTANT STANDARDS INDEX

1985

EVERETT

AIR QUALITY	(PSI Interval)	Number of Days in Each PSI Interval during Each Month												ANNUAL
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
GOOD	(0 to 50)	10	20	30	30	31	30	31	30	29	29	23	7	300
MODERATE	(51 to 100)	21	8	1	0	0	0	0	1	1	2	7	23	64
UNHEALTHFUL	(101 to 199)	0	0	0	0	0	0	0	0	0	0	0	1	1
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		100	67	51	44	50	47	50	52	51	57	67	117	117
Date		3rd#	8th#	14th	2nd	1st	18th	28th	29th	30th	1st	22nd	11th	Dec 11
Pollutant		CO	CO	TSP	CO	TSP	TSP	SO2	TSP	TSP	TSP	CO	CO	CO

SEATTLE

AIR QUALITY	(PSI Interval)	Number of Days in Each PSI Interval during Each Month												ANNUAL
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
GOOD	(0 to 50)	2	4	12	18	19	17	21	16	11	17	12	1	150
MODERATE	(51 to 100)	23	22	19	12	12	13	10	15	19	14	18	25	202
UNHEALTHFUL	(101 to 199)	6	2	0	0	0	0	0	0	0	0	0	2	10
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	3	3
Maximum PSI each month		183	117	98	68	67	89	78	69	78	78	89	204	204
Date		3rd	4th#	15th	30th	1st#	6th	19th	23rd	25th	4th	13th	12th	Dec 12
Pollutant		CO	TSP	TSP	TSP	TSP	CO	CO	TSP	CO	CO	TSP	TSP	TSP

TACOMA

AIR QUALITY	(PSI Interval)	Number of Days in Each PSI Interval during Each Month												ANNUAL
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
GOOD	(0 to 50)	2	6	12	13	20	14	12	10	11	19	18	3	140
MODERATE	(51 to 100)	24	21	19	17	11	16	19	21	19	12	12	22	213
UNHEALTHFUL	(101 to 199)	5	1	0	0	0	0	0	0	0	0	0	6	12
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		150	133	80	61	72	71	63	78	89	89	90	165	165
Date		16th	13th	11th	10th	16th	18th	18th	30th	6th	29th	24th	13th	Dec 13
Pollutant		CO	CO	TSP	TSP	TSP	TSP	TSP	CO	CO	CO	TSP	TSP	TSP

TSP = Total Suspended Particulates; CO = Carbon Monoxide; SO2 = Sulfur Dioxide.

Earliest date of occurrence

POLLUTANT STANDARDS INDEX

1980 - 1985

EVERETT

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
					All Days			Unhealthful Days					
	Good	Moderate	Unhealthful	Very Unhealthful	TSP	CO	SO2	TSP	CO	SO2	PSI	Date	Pollutant
1980	340	19	0	0	356	-	3	0	-	0	60	Jan 23	TSP
1981	350	11	0	0	340	-	21	0	-	0	62	Jan 16	TSP
1982	334	30	1	0	277	70	18	0	1	0	117	Dec 30	CO
1983	308	56	1	0	191	150	24	0	1	0	117	Nov 30	CO
1984	309	57	0	0	105	217	44	0	0	0	92	Sep 28	TSP
1985	300	64	1	0	152	166	47	0	1	0	117	Dec 11	CO
Totals	1941	237	3	0	1421	603	157	0	3	0			

SEATTLE

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
					All Days			Unhealthful Days					
	Good	Moderate	Unhealthful	Very Unhealthful	TSP	CO	SO2	TSP	CO	SO2	PSI	Date	Pollutant
1980	73	275	18	0	95	270	1	1	17	0	194	Jan 23	TSP
1981	69	267	28	1	109	254	2	5	24	0	213	Jan 15	CO
1982	86	268	10	1	96	264	5	1	10	0	214	Feb 6	TSP
1983	98	258	9	0	101	261	3	0	9	0	183	Jan 28	CO
1984	146	218	2	0	111	242	13	2	0	0	103	Dec 6	TSP
1985	150	202	10	3	156	206	3	6	7	0	204	Dec 12	TSP
Totals	622	1488	77	5	668	1497	27	15	67	0			

TACOMA

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
					All Days			Unhealthful Days					
	Good	Moderate	Unhealthful	Very Unhealthful	TSP	CO	SO2	TSP	CO	SO2	PSI	Date	Pollutant
1980	83	271	12	0	256	107	3	4	8	0	160	Apr 12	TSP
1981	74	278	10	3	222	137	6	1	12	0	227	Jan 12	CO
1982	119	242	4	0	255	101	9	0	4	0	167	Dec 30	CO
1983	140	222	3	0	228	128	9	1	2	0	137	Dec 23	TSP
1984	162	198	6	0	207	149	10	0	6	0	117	Jan 19#	CO
1985	140	213	12	0	252	109	4	1	11	0	165	Dec 13	TSP
Totals	718	1424	47	3	1420	731	41	7	43	0			

Earliest date of occurrence

Introduction

Suspended Particulates is a general term for small particles of dust, soot, organic matter, and compounds containing sulfur, nitrogen, and metals. Particulate matter, when sampled by the standard high volume federal reference method, is termed Total Suspended Particulates (TSP). Total Suspended Particulate samplers effectively collect particulate matter up to diameters in the range of 25 to 45 micrometers.

In March, 1984, the U.S. Environmental Protection Agency proposed revisions to the national ambient air quality standards for particulate matter. The proposal would: (1) define a size specific method of measuring particulate matter; (2) establish new numerical levels for the standards; and (3) revise the statistical form of the standards. For the primary standard the measurement method would collect only those particulates smaller than or equal to 10 micrometers in diameter (PM10). During 1985 measurements of the PM10 fraction of particulate matter continued at seven stations. PM10 sampling was begun at four other stations and was ended at one station. All of the PM10 measurements were made using the Size Selective Inlet (SSI) high volume sampler. PM10 data is summarized in this section along with the analysis of TSP from a continuing more extensive network.

Particulate Sources and Measured Levels

Particulates directly enter the air from industrial operations, from fuel combustion, from auto and truck traffic, from construction, and from other sources. These emissions may change from day to day due to intermittent industrial operations, equipment upset or breakdown and traffic variations. Gaseous transformation products such as sulfates, nitrates, and some organics are also a component of particulate matter, principally adding to the fine particulate fraction.

Once present in the air particulate matter begins to disperse and to be transported by the wind. Valleys, hills, and large bodies of water affect the local direction and speed of the wind. Lower atmosphere stability influences how quickly particulates are dispersed. Measured 24 hour particulate levels often differ significantly from day to day responding to how much enters the air and how quickly meteorological processes disperse the particulates. Tables in this section summarize 24 hour measurements and document that high 24 hour levels are often recorded at many stations on the same day.

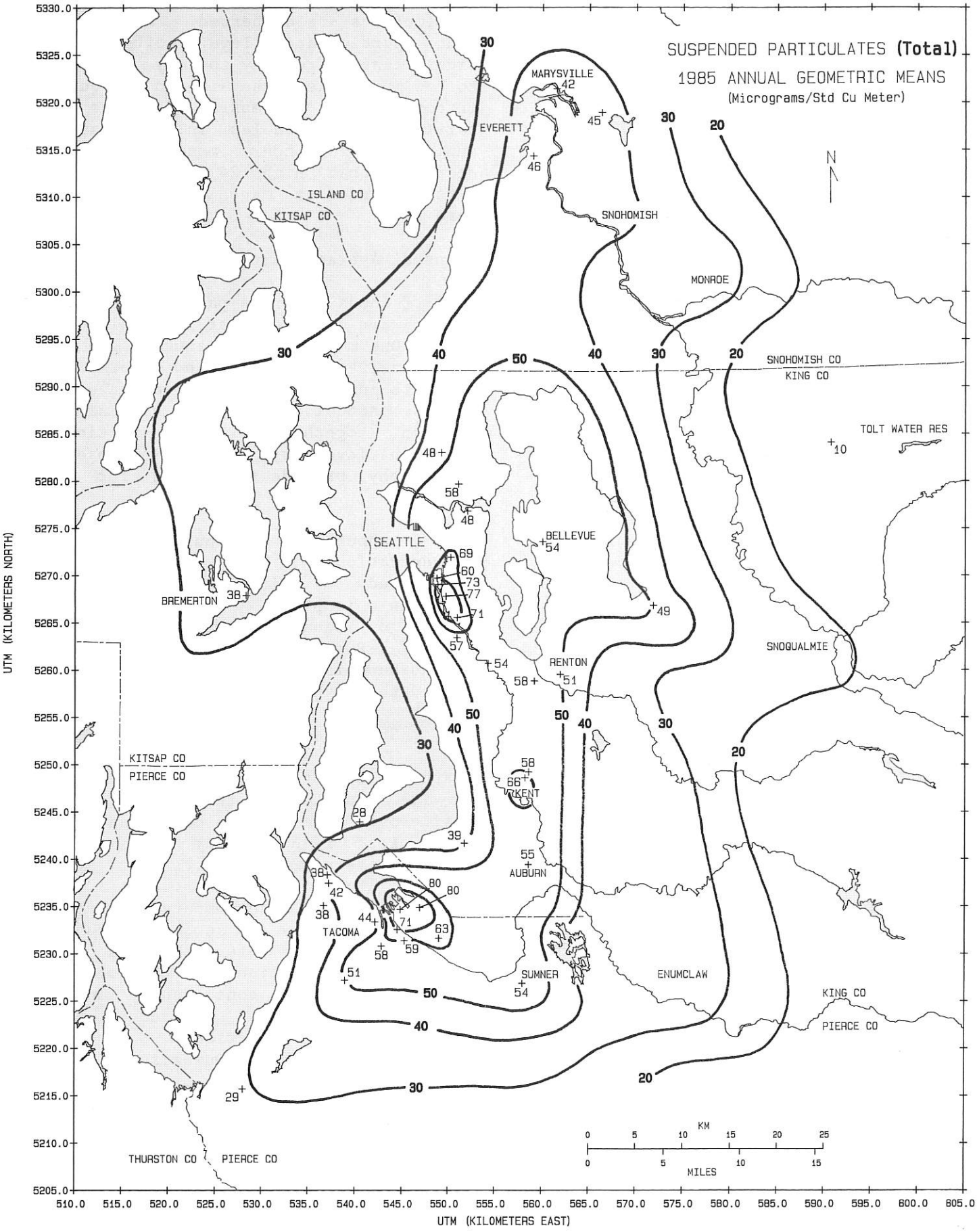
Annual Average Particulate Matter Maps

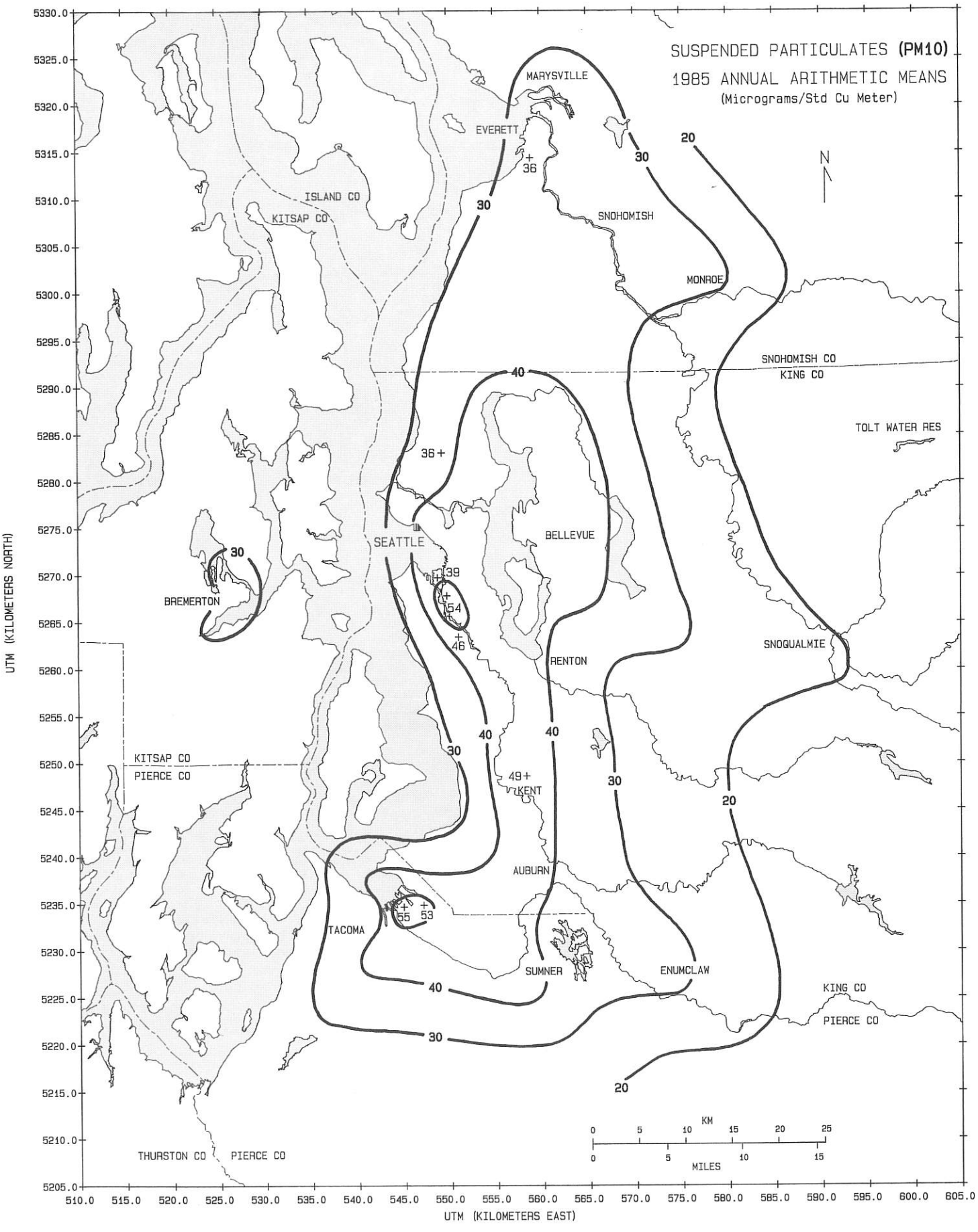
Maps of annual average particulate matter values for calendar year 1985 follow this page. One map presents annual geometric mean values of TSP and another map presents annual arithmetic mean values of PM10. Actual values at each sampling station, together with a particulate emission inventory, local wind roses and topography, provide the basis for these maps.

The annual particulate matter concentration at a location may be determined by interpolating between adjacent isopleths (lines connecting points of equal concentration). The Tacoma Port area and the Harbor Island-Duwamish Valley area of Seattle record the highest concentrations.

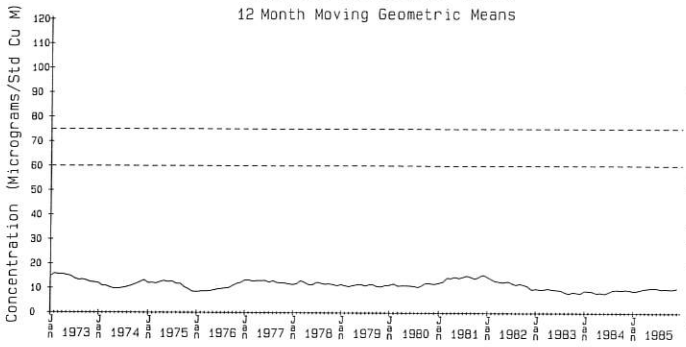
Suspended Particulate Trends

Graphic plots of 12 month geometric means provide a picture of the concentration at a site over time, but to depict any trend such plots require many years of data. Moving geometric mean charts for several stations follow the maps. A 12 month moving geometric mean compares directly to the annual primary and secondary standards which are shown by reference lines on the charts. One station near the Tolt Water Reservoir presents consistently low TSP values, which appear unaffected by the urban areas. Stations in the industrialized Seattle Duwamish Valley and Tacoma Port area show values lower than the annual primary standard at the end of 1975, rising above this standard from 1977 through 1981, decreasing to values between the primary and secondary standards for the period 1982 through 1984, and then increasing to values above the primary standard by year end 1985.


SUSPENDED PARTICULATES (Total)
1985 ANNUAL GEOMETRIC MEANS
(Micrograms/Std Cu Meter)
N
MARYSVILLE
EVERETT
ISLAND CO
KITSAP CO
SNOHOMISH
MONROE
SNOHOMISH CO
KING CO
TOLT WATER RES
SEATTLE
BELLEVUE
BREMERTON
RENTON
SNOQUALMIE
KITSAP CO
PIERCE CO
AUBURN
TACOMA
SUMNER
ENUMCLAW
KING CO
PIERCE CO
THURSTON CO
PIERCE CO
KM
MILES
UTM (KILOMETERS NORTH)
UTM (KILOMETERS EAST)

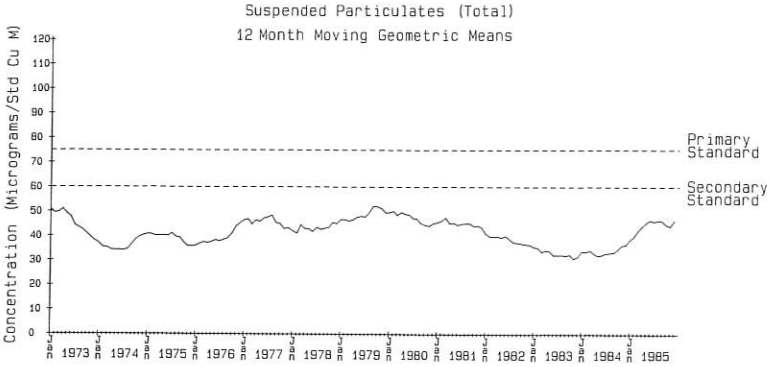

SUSPENDED PARTICULATES (PM10)
1985 ANNUAL ARITHMETIC MEANS
(Micrograms/Std Cu Meter)
N
MARYSVILLE
EVERETT
36
ISLAND CO
KITSAP CO
SNOHOMISH
MONROE
SNOHOMISH CO
KING CO
TOLT WATER RES
36+
SEATTLE
BELLEVUE
39
54
46
BREMERTON
RENTON
SNOQUALMIE
KITSAP CO
PIERCE CO
49+
KENT
AUBURN
55
53
TACOMA
SUMNER
ENUMCLAW
KING CO
PIERCE CO
THURSTON CO
PIERCE CO
KM
MILES
UTM (KILOMETERS NORTH)
UTM (KILOMETERS EAST)

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



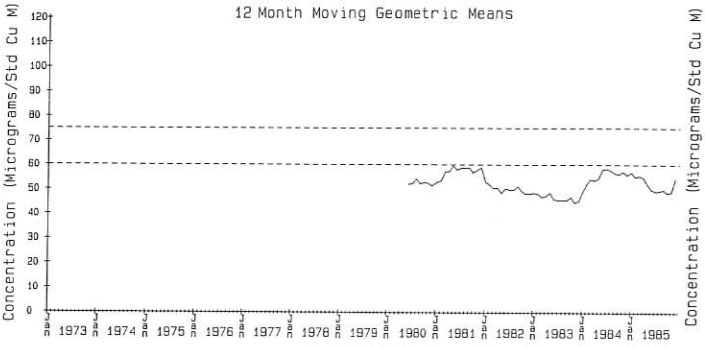
TOLT RIVER WATERSHED, KING COUNTY, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



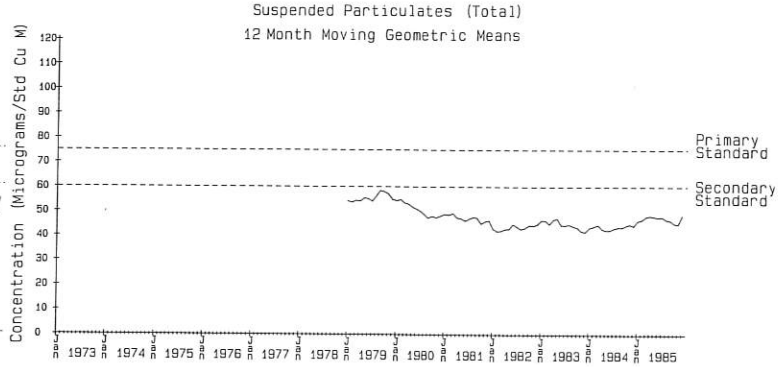
MEDICAL-DENTAL BLDG, 2730 COLBY, EVERETT, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



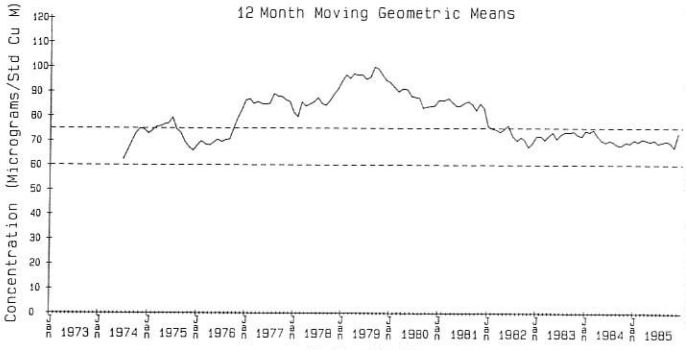
504 BELLEVUE WAY NE, BELLEVUE, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



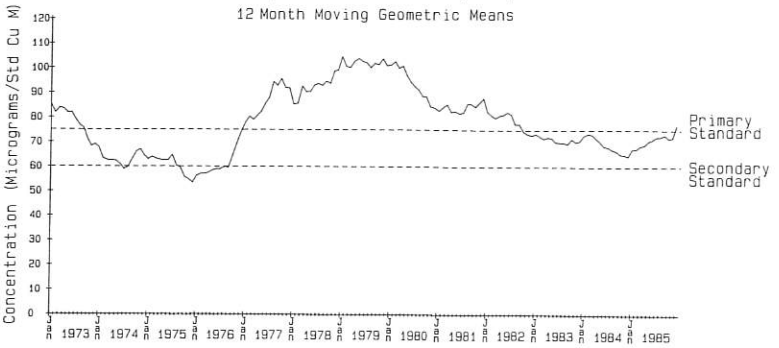
NORTH 98TH ST & STONE AVE N, SEATTLE, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means

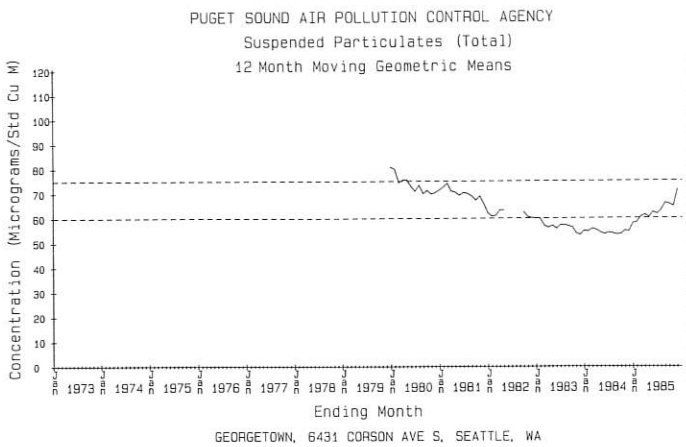


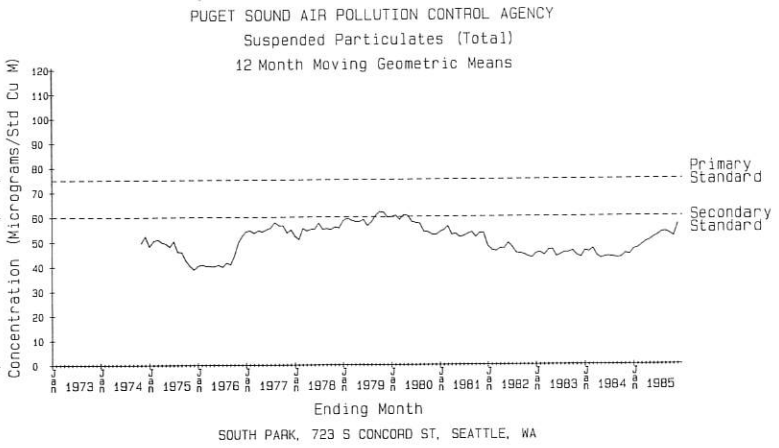
HARBOR ISLAND, 3400 13TH AVE SW, SEATTLE, WA

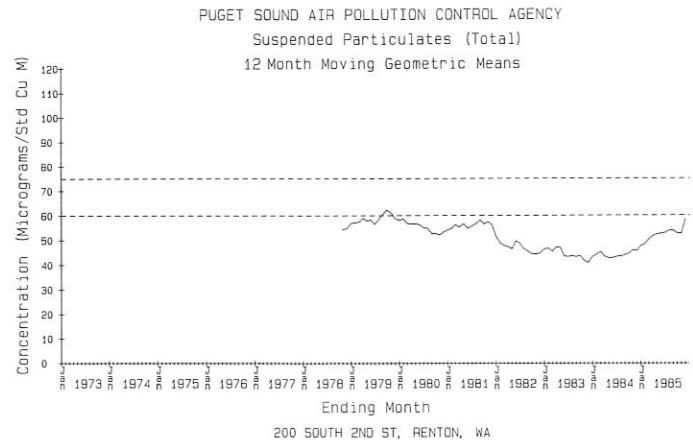
PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means

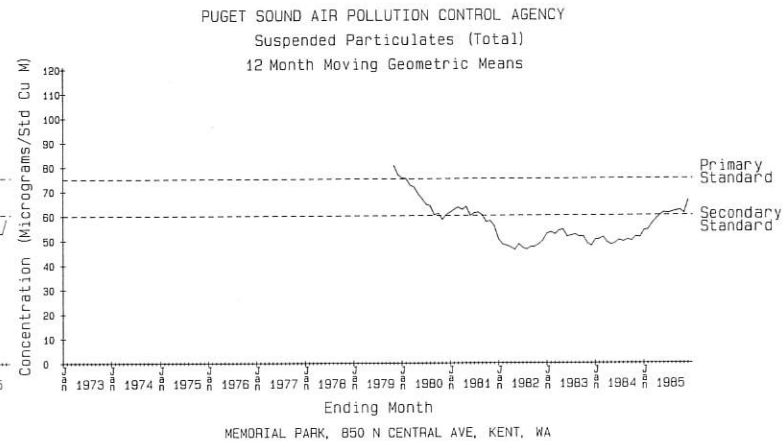


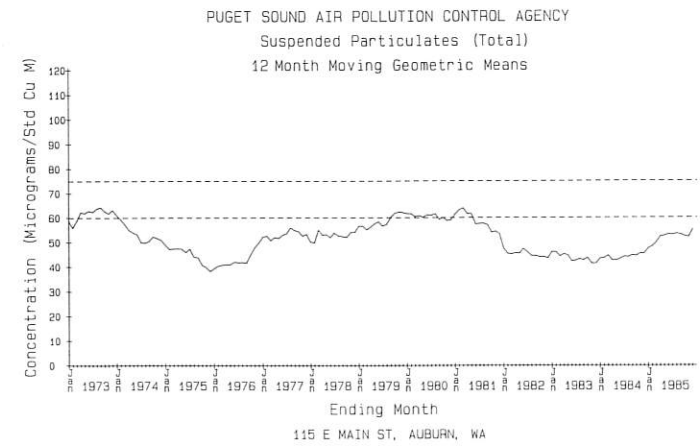
DUWAMISH, 4401 E MARGINAL WAY S, SEATTLE, WA

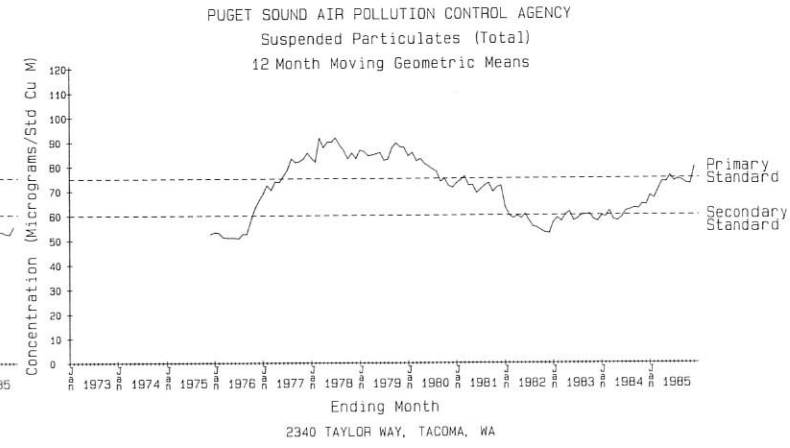

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
GEORGETOWN, 6431 CORSON AVE S, SEATTLE, WA


PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Primary Standard
Secondary Standard
Concentration (Micrograms/Std Cu M)
Ending Month
SOUTH PARK, 723 S CONCORD ST, SEATTLE, WA

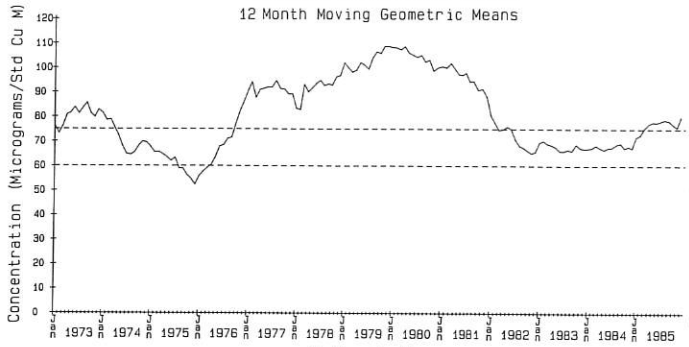

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
200 SOUTH 2ND ST, RENTON, WA


PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Primary Standard
Secondary Standard
Concentration (Micrograms/Std Cu M)
Ending Month
MEMORIAL PARK, 850 N CENTRAL AVE, KENT, WA


PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
115 E MAIN ST, AUBURN, WA


PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Primary Standard
Secondary Standard
Concentration (Micrograms/Std Cu M)
Ending Month
2340 TAYLOR WAY, TACOMA, WA

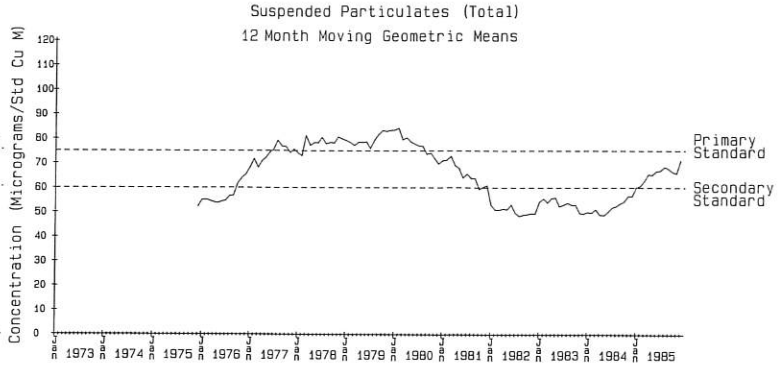
PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



Ending Month

FIRE STATION #12, 2316 E 11TH ST, TACOMA, WA

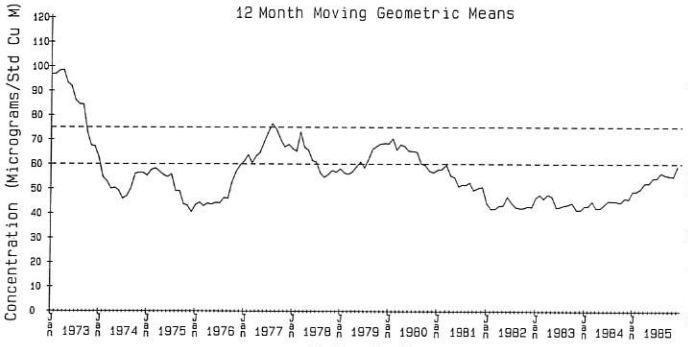
PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



Ending Month

TREATMENT PLANT, 1241 CLEVELAND WY, TACOMA, WA

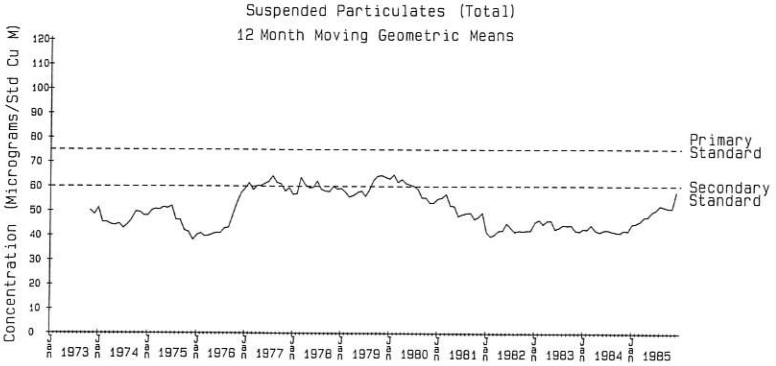
PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



Ending Month

CASCADIA, 2002 E 28TH ST, TACOMA, WA

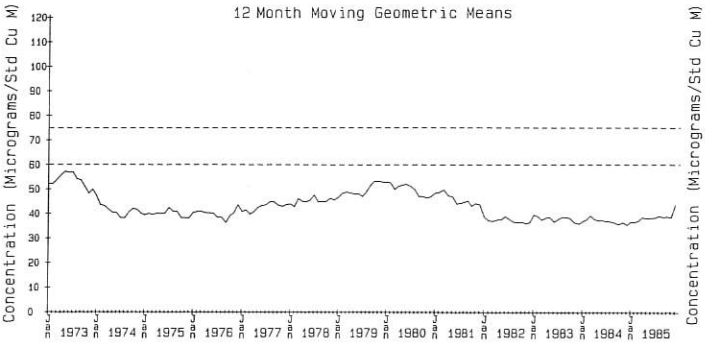
PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



Ending Month

WILLARD SCHOOL, S 32ND & S 'D' ST, TACOMA, WA

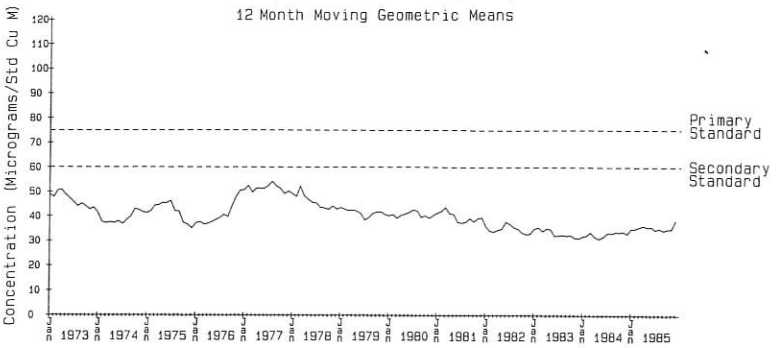
PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



Ending Month

HESS BLDG, 901 TACOMA AVE S, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



Ending Month

NORTH 26TH & PEARL STS, TACOMA, WA

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1985

Location	Number of Values	Quarterly Arithmetic Averages 1st	2nd	3rd	4th	Year Arith Mean	Year Geom Mean
Tolt River Watershed, King County, Wa	57	9	16	25	7	14	10
Highway 9 & 28th St NE, Lake Stevens, Wa	58	85	42	42	44	53	45
South End of Columbia Street, Marysville, Wa	56	92	36	38	39	51	42
Medical-Dental Bldg, 2730 Colby, Everett, Wa	61	68	43	46	45	50	46
504 Bellevue Way NE, Bellevue, Wa	60	90	44	56	64	64	54
20050 SE 56th, Lake Sammamish State Park, Wa	60	71	48	55	51	56	49
North 98th St & Stone Ave N, Seattle, Wa	62	74	38	48	56	54	48
5701 8th Ave NE, Seattle, Wa	60	103	49	44	71	67	58
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	60	84	37	38	64	56	48
Fire Station #10, 301 2nd Ave S, Seattle, Wa	63	81	52	81	96	77	69
Harbor Island, 2555 13th Ave SW, Seattle, Wa	61	87	48	54	82	68	60
Harbor Island, 3400 13th Ave SW, Seattle, Wa	61	105	59	68	94	82	73
Duwamish, 4401 E Marginal Way S, Seattle, Wa	353	120	63	75	106	91	77
Georgetown, 6431 Corson Ave S, Seattle, Wa	60	108	60	84	81	83	71
South Park, 723 S Concord St, Seattle, Wa	61	94	45	58	72	67	57
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	61	95	43	50	65	63	54
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	46	95	40	51		62	51
200 South 2nd St, Renton, Wa	60	101	46	53	70	67	58
22916 86th Ave S, Kent, Wa	61	93	52	66	65	69	58
Memorial Park, 850 N Central Ave, Kent, Wa	64	107	58	67	72	76	66
115 E Main St, Auburn, Wa	60	92	48	52	62	64	55
Sumner Jr HS, 1508 Willow St, Sumner, Wa	60	79	44	56	69	62	54
Federal Way HS, 1401 S 304 St, Federal Way, Wa	61	63	31	39	48	45	39
Fife Sr High School, 5616 20th E, Fife, Wa	46	98	53	65		72	63
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	43		-	79	70	-	-
2340 Taylor Way, Tacoma, Wa	66	113	71	88	93	91	80
Fire Station #12, 2316 E 11th St, Tacoma, Wa	165	122	79	79	87	92	80
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	61	110	59	80	79	82	71
Cascadia, 2002 E 28th St, Tacoma, Wa	60	92	49	68	72	70	59
Willard School, S 32nd & S 'D' St, Tacoma, Wa	61	94	45	55	89	70	58
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	58	76	33	39	66	53	44
SW 283rd & 101st Ave SW, Maury Island, Wa	91	58	20	24	39	35	28
Ruston School, 5219 N Shirley St, Tacoma, Wa	60	63	28	35	57	46	38
4716 North Baltimore St, Tacoma, Wa	117	66	32	48	54	50	42
North 26th & Pearl Sts, Tacoma, Wa	61	64	27	37	62	47	38
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	56	100	42	44	84	67	51
City Water Supply Pump House, Dupont, Wa	47	40	24	34	49	37	29
City Hall, 239 4th St, Bremerton, Wa	61	60	36	33	40	42	38

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.

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

Jan - Mar, 1985

Summary of Observations Greater Than 150

Location	Jan 3 Thu	Jan 4 Fri	Jan 7 Mon	Jan 8 Tue	Jan 9 Wed	Jan 10 Thu	Jan 11 Fri	Jan 13 Sun	Jan 16 Wed	Jan 17 Thu	Jan 18 Fri	Jan 23 Wed	Jan 24 Thu	Jan 26 Sat	Jan 28 Mon	Jan 30 Wed	Jan 31 Thu	Feb 4 Mon	Feb 13 Wed	Feb 18 Mon	Feb 27 Wed	Mar 7 Thu	Mar 8 Fri	Mar 11 Mon	Mar 13 Wed	Mar 14 Thu	Mar 15 Fri	Mar 16 Sat
Highway 9 & 28th St NE, Lake Stevens, Wa	--	--		--	--	--	--		--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
South End of Columbia Street, Marysville, Wa	--	--	176	--	--	--	--	180	--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
504 Bellevue Way NE, Bellevue, Wa	--	--	176	--	--	--	--		--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
5701 8th Ave NE, Seattle, Wa	--	--	197	--	--	--	--	180	--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	--	--	181	--	--	--	--	151	--	--	--	--	--	--	--	--		--	--		--	--		--	--	--	--	--
Fire Station #10, 301 2nd Ave S, Seattle, Wa	--	--				--			--	--		--	--	--	--	--		--	--		--	--		--	--		--	--
Harbor Island, 2555 13th Ave SW, Seattle, Wa	--	--		--	--	--	--	152	--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
Harbor Island, 3400 13th Ave SW, Seattle, Wa	--	--	167	--	--	--	--	169	--	--	--	--	--	--	--	--	189	--	--		--	--		--	--		--	--
Duwamish, 4401 E Marginal Way S, Seattle, Wa	171	188	188	170	205	178	201	181	243	265	294	155	156	166	172	206		279	271		159	211	159	200	180		253	195
Georgetown, 6431 Corson Ave S, Seattle, Wa	--	--	153	--	--	--	--	176	--	--	--	--	--	--	--	--	182	--	--		--	--	170	--	--	162	--	--
South Park, 723 S Concord St, Seattle, Wa	--	--	176	--	--	--	--	154	--	--	--	--	--	--	--	--		--	--		--	--	151	--	--		--	--
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	--	--	162	--	--	--	--	189	--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	--	--	207	--	--	--	--	168	--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
200 South 2nd St, Renton, Wa	--	--	208	--	--	--	--	191	--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
22916 86th Ave S, Kent, Wa	--	--		--	--	--	--	172	--	--	--	--	--	--	--	--	156	--	--		--	--		--	--		--	--
Memorial Park, 850 N Central Ave, Kent, Wa	--	--	152	--	172	--	--	196	--	--	--	--	--	--	--	--	159	--	--		--	--		--	--	151	--	--
115 E Main St, Auburn, Wa	--	--		--	--	--	--	160	--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
Sumner Jr HS, 1508 Willow St, Sumner, Wa	--	--		--	--	--	--		--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
Fife Sr High School, 5616 20th E, Fife, Wa	--	--		--	--	--	--	198	--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2340 Taylor Way, Tacoma, Wa	--	--	156	--		--	--	190	--	206	--		--	--	--	--	172	--	--		--	--	168	--	--	175	--	--
Fire Station #12, 2316 E 11th St, Tacoma, Wa		201		154		152	179	179	173	151	207		234	--		--	153	--	--		218	--	173	186	--	173	--	--
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	--	--	164	--	--	--	--	220	--	--	--	--	--	--	--	--	159	--	--		--	--		--	--	172	--	--
Cascadia, 2002 E 28th St, Tacoma, Wa	--	--		--	--	--	--	199	--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
Willard School, S 32nd & S 'D' St, Tacoma, Wa	--	--		--	--	--	--	212	--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	--	--		--	--	--	--	169	--	--	--	--	--	--	--	--	--	--	--		--	--		--	--		--	--
Ruston School, 5219 N Shirley St, Tacoma, Wa	--	--		--	--	--	--	167	--	--	--	--	--	--	--	--		--	--		--	--		--	--		--	--
4716 North Baltimore St, Tacoma, Wa	--			--	--	--		167	--		--	--		--	--			--	--		--	--		--			--	--
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	--	--	--	--	--	--	--	256	--	--	--	--	--	--	--	--		--	--	164	--	--		--	--		--	--

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

May - Dec, 1985

Summary of Observations Greater Than 150

Location	May 16 Thu	Jun 18 Tue	Aug 29 Thu	Sep 24 Tue	Sep 30 Mon	Oct 1 Tue	Oct 4 Fri	Oct 10 Thu	Nov 13 Wed	Nov 14 Thu	Dec 4 Wed	Dec 9 Mon	Dec 10 Tue	Dec 11 Wed	Dec 12 Thu	Dec 13 Fri	Dec 14 Sat	Dec 15 Sun	Dec 16 Mon	Dec 17 Tue	Dec 18 Wed	Dec 19 Thu	Dec 20 Fri	Dec 21 Sat	Dec 23 Mon	Dec 26 Thu	Dec 27 Fri	Dec 30 Mon
Highway 9 & 28th St NE, Lake Stevens, Wa	--			--	--	--			--	--	--	--	--	--	--	--	--	163	--	--	--	--	--	--	--	--	--	--
South End of Columbia Street, Marysville, Wa	--			--	--	--			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
504 Bellevue Way NE, Bellevue, Wa	--			--	--	--			--	--	--	153	--	--	--	--	--		--	--	--	--	--		--	--		--
5701 8th Ave NE, Seattle, Wa	--				--	--			--	--	--		--	--	--	--	--	162	--	--	--	--	--		--	--		--
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	--			--	--	--			--	--	--		--	--	--	--	--		--	--	--	--	--		--	--	152	--
Fire Station #10, 301 2nd Ave S, Seattle, Wa	--		242	--	--	--	188		--	--	--	159	--	--	--	--	--		--	--	--	--	--		--	--	171	--
Harbor Island, 2555 13th Ave SW, Seattle, Wa	--			--	--	--			--	--	--		--	--	--	--	--		--	--	--	--	--		--	--	184	--
Harbor Island, 3400 13th Ave SW, Seattle, Wa	--			--	--	--		171	--	--	--		--	--	--	--	--	177	--	--	--	--	--		--	--	186	--
Duwamish, 4401 E Marginal Way S, Seattle, Wa				156	151				221	177	196	164	205	378	386	380	240	171	201	238	155	234	222		190	213	206	176
Georgetown, 6431 Corson Ave S, Seattle, Wa	--	181		--	--	--			--	--	--		--	--	--	--	--	161	--	--	--	--	--		--	--	163	--
South Park, 723 S Concord St, Seattle, Wa	--			--	--	--			--	--	--		--	--	--	--	--	163	--	--	--	--	--		--	--		--
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	--			--	--	--			--	--	--		--	--	--	--	--	171	--	--	--	--	--		--	--		--
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	--			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
200 South 2nd St, Renton, Wa	--			--	--	--			--	--	--		--	--	--	--	--	157	--	--	--	--	--		--	--		--
22916 86th Ave S, Kent, Wa	--			--	--	--			--	--	--		--	--	--	--	--	178	--	--	--	--	--		--	--		--
Memorial Park, 850 N Central Ave, Kent, Wa	--			--	--	--			--	--	--		--	--	--	--	--	226	--	176	--		--		--	--		--
115 E Main St, Auburn, Wa	--			--	--	--			--	--	--	169	--	--	--	--	--	--	--	--	--	--	--		--	--		--
Sumner Jr HS, 1508 Willow St, Sumner, Wa	--			--	--	--			--	--	--		--	--	--	--	--	197	--	--	--	--	--		--	--		--
Fife Sr High School, 5616 20th E, Fife, Wa	--			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	--	158		--	--	--			--	--	--			--	--	--	--	161	168	--	--	--	--		--	--		--
2340 Taylor Way, Tacoma, Wa	--	151		--	--	--			--	--	--		--	--	--	--	--	207	--	157	--		--		--	--		--
Fire Station #12, 2316 E 11th St, Tacoma, Wa	157			--	--	157		178		192		169	155	273	--	335	--	183	246									
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	--			--	--	--			--	--	--		--	--	--	--	--	198	--	--	--	--	--		--	--		--
Cascadia, 2002 E 28th St, Tacoma, Wa	--			--	--	--			--	--	--		--	--	--	--	--	213	--	--	--	--	--		--	--		--
Willard School, S 32nd & S 'D' St, Tacoma, Wa	--			--	--	--			--	--	--	207	--	--	--	--	--	215	--	--	--	--	--	155	--	--		--
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	--			--	--	--			--	--	--		--	--	--	--	--	170	--	--	--	--	--		--	--		--
Ruston School, 5219 N Shirley St, Tacoma, Wa	--			--	--	--			--	--	--		--	--	--	--	--		--	--	--	--	--		--	--		--
4716 North Baltimore St, Tacoma, Wa	--			--	--	--			--	--				--	--	--	--		--	--	--	--	--		--	--		--
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	--			--	--	--			--	--	--	167	--	--	--	--	--	300	--	--	--		--			--		--

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1985

Summary of Maximum and 2nd High Observed Concentrations

Location	Jan 7 Mon	Jan 13 Sun	Jan 17 Thu	Jan 25 Fri	Jan 31 Thu	Feb 18 Mon	Mar 8 Fri	Mar 14 Thu	Apr 1 Mon	Jun 18 Tue	Jul 12 Fri	Jul 18 Thu	Aug 29 Thu	Sep 22 Sun	Oct 4 Fri	Dec 9 Mon	Dec 10 Tue	Dec 11 Wed	Dec 12 Thu	Dec 13 Fri	Dec 15 Sun	Dec 16 Mon	Dec 27 Fri
Tolt River Watershed, King County, Wa			--						37			37	--	46			--	--	--	--		--	
Highway 9 & 28th St NE, Lake Stevens, Wa			--			133										--	--	--	--	--	163	--	--
South End of Columbia Street, Marysville, Wa	176	180	--													--	--	--	--	--	--	--	--
Medical-Dental Bldg, 2730 Colby, Everett, Wa		98	--	86													--	--	--	--		--	
504 Bellevue Way NE, Bellevue, Wa	176		--													153	--	--	--	--		--	
20050 SE 56th, Lake Sammamish State Park, Wa	112		--														--	--	--	--	--	--	116
North 98th St & Stone Ave N, Seattle, Wa		124	--														120	--	--	--		--	120
5701 8th Ave NE, Seattle, Wa	197	180	--											--			--	--	--	--		--	
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	181		--					--									--	--	--	--		--	152
Fire Station #10, 301 2nd Ave S, Seattle, Wa			--										242		188		--	--	--	--		--	
Harbor Island, 2555 13th Ave SW, Seattle, Wa		152	--														--	--	--	--		--	184
Harbor Island, 3400 13th Ave SW, Seattle, Wa			--		189												--	--	--	--		--	186
Duwamish, 4401 E Marginal Way S, Seattle, Wa																			386	380			
Georgetown, 6431 Corson Ave S, Seattle, Wa			--		182					181							--	--	--	--		--	
South Park, 723 S Concord St, Seattle, Wa	176		--														--	--	--	--	163	--	
Duwamish Valley, 12026 42nd Ave S, King Co, Wa		189	--														--	--	--	--	171	--	
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	207	168	--												--	--	--	--	--	--	--	--	--
200 South 2nd St, Renton, Wa	208	191	--														--	--	--	--		--	
22916 86th Ave S, Kent, Wa		172	--														--	--	--	--	178	--	
Memorial Park, 850 N Central Ave, Kent, Wa		196	--														--	--	--	--	226	--	
115 E Main St, Auburn, Wa		160	--													169	--	--	--	--	--	--	
Sumner Jr HS, 1508 Willow St, Sumner, Wa		140	--														--	--	--	--	197	--	
Federal Way HS, 1401 S 304 St, Federal Way, Wa		148	--														--	--	--	--	115	--	
Fife Sr High School, 5616 20th E, Fife, Wa		198	--					150							--	--	--	--	--	--	--	--	--
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	--	--	--	--	--	--	--	--	--									--	--	--	161	168	
2340 Taylor Way, Tacoma, Wa			206														--	--	--	--	207	--	
Fire Station #12, 2316 E 11th St, Tacoma, Wa												--						273	--	335			
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa		220	--														--	--	--	--	198	--	
Cascadia, 2002 E 28th St, Tacoma, Wa		199	--														--	--	--	--	213	--	
Willard School, S 32nd & S 'D' St, Tacoma, Wa		212	--														--	--	--	--	215	--	
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa		169	--		--												--	--	--	--	170	--	
SW 283rd & 101st Ave SW, Maury Island, Wa		134	--				139										--	--	--	--		--	--
Ruston School, 5219 N Shirley St, Tacoma, Wa		167	--														--	--	--	--	138	--	
4716 North Baltimore St, Tacoma, Wa		167																--	--	--		--	133
North 26th & Pearl Sts, Tacoma, Wa		146	--												136		--	--	--	--		--	
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	--	256	--									--					--	--	--	--	300	--	
City Water Supply Pump House, Dupont, Wa	--		--	--	--						91	--					--	--	--	--	107	--	
City Hall, 239 4th St, Bremerton, Wa		118	--					83									--	--	--	--		--	

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (PM10)
Micrograms per Standard Cubic Meter

Sampled by Size Selective Inlet - High Volume

1985

Location	Number of Values	Quarterly Arithmetic Averages 1st	2nd	3rd	4th	Year Arith Mean
Medical-Dental Bldg, 2730 Colby, Everett, Wa	54	45	25	33	40	36
504 Bellevue Way NE, Bellevue, Wa	14				43	-
North 98th St & Stone Ave N, Seattle, Wa	61	52	23	29	43	36
Fire Station #10, 301 2nd Ave S, Seattle, Wa	41		-	33	50	-
Harbor Island, 2555 13th Ave SW, Seattle, Wa	43	60	28	30		39
Harbor Island, 3400 13th Ave SW, Seattle, Wa	17			-	55	-
Duwamish, 4401 E Marginal Way S, Seattle, Wa	181	79	33	43	61	54
South Park, 723 S Concord St, Seattle, Wa	61	69	29	35	51	46
Memorial Park, 850 N Central Ave, Kent, Wa	61	72	30	38	56	49
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	3				-	-
2340 Taylor Way, Tacoma, Wa	65	73	42	45	54	53
Fire Station #12, 2316 E 11th St, Tacoma, Wa	130	80	41	42	59	55

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 7 Mon	Jan 13 Sun	Dec 12 Thu	Dec 13 Fri	Dec 15 Sun	Dec 16 Mon	Dec 27 Fri
Medical-Dental Bldg, 2730 Colby, Everett, Wa		80	--	--	--	77	
504 Bellevue Way NE, Bellevue, Wa	--	--	--	--	97	--	107
North 98th St & Stone Ave N, Seattle, Wa		103	--	--	95	--	
Fire Station #10, 301 2nd Ave S, Seattle, Wa	--	--	--	--	100	--	105
Harbor Island, 2555 13th Ave SW, Seattle, Wa	94	122	--	--	--	--	--
Harbor Island, 3400 13th Ave SW, Seattle, Wa	--	--	--	--	128	--	113
Duwamish, 4401 E Marginal Way S, Seattle, Wa			223	248			
South Park, 723 S Concord St, Seattle, Wa	131		--	--	129	--	
Memorial Park, 850 N Central Ave, Kent, Wa		155	--	--	173	--	
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	--	--	--	--	140	--	77
2340 Taylor Way, Tacoma, Wa		162	--	--	152	--	
Fire Station #12, 2316 E 11th St, Tacoma, Wa			206	211	--		

Summary of Observations Greater Than 150

Location	Jan 3 Thu	Jan 9 Wed	Jan 13 Sun	Jan 17 Thu	Nov 14 Thu	Dec 11 Wed	Dec 12 Thu	Dec 13 Fri	Dec 14 Sat	Dec 15 Sun	Dec 16 Mon	Dec 17 Tue
Duwamish, 4401 E Marginal Way S, Seattle, Wa	166	153		194		201	223	248	173			184
Memorial Park, 850 N Central Ave, Kent, Wa	--		155	--	--	--	--	--	--	173	--	
2340 Taylor Way, Tacoma, Wa	--		162		--	--	--	--	--	152	--	
Fire Station #12, 2316 E 11th St, Tacoma, Wa	--		174		163	178	206	211		--	167	

-- Indicates no sample on specified day

↓ eg national run day

Coefficient of Haze (COH) is a measure of suspended particulates derived from the decrease in light transmission through a cellulose filter tape as particulates accumulate on the tape. Ambient air is drawn through the cellulose filter tape continuously for 28 minutes; the decrease in light transmission due to particulate loading is measured; the instrument then sequences to a clean section of cellulose tape; and the sampling cycle repeats again and again providing "continuous sampling". The concentration measured by this method is reported in COH-units per thousand linear feet of air.

An instrument called an integrating nephelometer "continuously measures" the light scattering extinction coefficient. A component of the scattering coefficient, (bsp), is a measure of atmospheric particles. This particle scattering coefficient is inversely related to visibility and has shown high correlation to fine particulate mass concentrations. The particulate level measured by this method is reported as a scattering coefficient per meter that must be multiplied by 10 to the exponent -4. The Agency preheats the sample air stream 6 to 10 degrees C above ambient air temperature to dry the particles. A comprehensive description of the integrating nephelometer method appears in a paper by Michael G. Ruby published in the "Journal of the Air Pollution Control Association", March, 1985.

The Federal reference method for particulate matter measures Total Suspended Particulates (TSP). This is often described as the high volume method. The method is completely specified in Title 40, Code of Federal Regulations, Part 50, Appendix B, as amended, December 6, 1982. High volume samplers fitted with a Size Selective Inlet measure the Particulate Matter fraction with particle diameters smaller than or equal to 10 micrometers (PM10). These methods "integrate a sample" for the duration of sampling on a filter, usually for 24 hours from midnight to midnight. The particulate concentration measured by these methods is reported in micrograms per standard cubic meter of air.

For stations with collocated sampling the following tables present correlation coefficients calculated between: (1) the "continuous" methods and (2) the "continuous" and "integrated" methods. In general the results are site specific with better correlation between "continuous" and "integrated" sampling for the PM10 data than for the TSP data.

Correlation between Continuous Sampling Methods

	Jan Feb Mar	Apr May Jun	Jul Aug Sep	Oct Nov Dec	Annual
Duwamish, 4401 E Marginal Way S, Seattle, Wa					
1 Hour COH Vs 1 Hour bsp					
Correlation Coefficient	.88	.72	.79	.85	.86
Number of 1 Hour Samples	2148	2172	2152	2142	8614
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient	.94	.74	.84	.92	.93
Number of 24 Hour Samples	90	91	90	87	358
Fire Station #12, 2316 E 11th St, Tacoma, Wa					
1 Hour COH Vs 1 Hour bsp					
Correlation Coefficient	.91	.79	.72	.88	.89
Number of 1 Hour Samples	1965	2054	2195	1988	8202
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient	.96	.84	.76	.93	.94
Number of 24 Hour Samples	79	84	92	77	332

Note: 24 Hour averages computed for calendar day midnight to midnight time period.

SUSPENDED PARTICULATES
1985

Correlation between Continuous and Integrated Sampling Methods

	Jan Feb Mar	Apr May Jun	Jul Aug Sep	Oct Nov Dec	Annual
Medical-Dental Bldg, 2730 Colby, Everett, Wa					
24 Hour COH Vs TSP Corr. Coeff.	.78	.63	.67	.84	.65
Number of Common Samples	15	16	15	15	61
Medical-Dental Bldg, 2730 Colby, Everett, Wa					
24 Hour COH Vs PM10 Corr. Coeff.	.93	.75	.84	.90	.84
Number of Common Samples	13	16	13	12	54
North 98th St & Stone Ave N, Seattle, Wa					
24 Hour bsp Vs TSP Corr. Coeff.	.75	.54	.03	.89	.80
Number of Common Samples	15	15	15	16	61
North 98th St & Stone Ave N, Seattle, Wa					
24 Hour bsp Vs PM10 Corr. Coeff.	.93	.81	.44	.97	.93
Number of Common Samples	15	15	15	15	60
Duwamish, 4401 E Marginal Way S, Seattle, Wa					
24 Hour COH Vs TSP Corr. Coeff.	.79	.68	.74	.88	.84
24 Hour bsp Vs TSP Corr. Coeff.	.72	.67	.57	.87	.81
Number of Common Samples	86	90	87	84	347
Duwamish, 4401 E Marginal Way S, Seattle, Wa					
24 Hour COH Vs PM10 Corr. Coeff.	.93	.73	.77	.93	.91
24 Hour bsp Vs PM10 Corr. Coeff.	.91	.75	.58	.95	.93
Number of Common Samples	32	32	31	81	176
22916 86th Ave S, Kent, Wa					
24 Hour bsp Vs TSP Corr. Coeff.	.79	.57	.44	.93	.78
Number of Common Samples	15	16	15	15	61
27th St NE & 54th Ave NE, Northeast Tacoma, Wa					
24 Hour bsp Vs TSP Corr. Coeff.		.96	.28	.82	.56
Number of Common Samples		3	13	25	41
Fire Station #12, 2316 E 11th St, Tacoma, Wa					
24 Hour COH Vs TSP Corr. Coeff.	.78	.63	.71	.81	.75
24 Hour bsp Vs TSP Corr. Coeff.	.71	.56	.56	.84	.76
Number of Common Samples	31	28	28	60	147
Fire Station #12, 2316 E 11th St, Tacoma, Wa					
24 Hour COH Vs PM10 Corr. Coeff.	.91	.55	.67	.94	.91
24 Hour bsp Vs PM10 Corr. Coeff.	.90	.53	.62	.95	.93
Number of Common Samples	16	13	15	71	115

Note: 24 Hour averages computed for calendar day midnight to midnight time period.

SUSPENDED PARTICULATES
(COH's/1000 Lin Ft)
1985

Statistical Summary

Location	No. of 1 Hour Samples	Frequency Distribution - Percent												Arith Mean	Geom Mean	Geom Std Dev	Arith Std Dev
		5	10	20	30	40	50	60	70	80	90	95	99				
Medical-Dental Bldg, 2730 Colby, Everett, Wa	8670	.1	.1	.2	.3	.3	.4	.5	.6	.8	1.1	1.4	2.0	.53	.38	2.37	.43
Duwamish, 4401 E Marginal Way S, Seattle, Wa	8690	.2	.2	.3	.4	.5	.7	.9	1.1	1.5	2.2	2.8	3.6	.97	.70	2.33	.83
Fire Station #12, 2316 E 11th St, Tacoma, Wa	8288	.2	.2	.3	.4	.6	.7	.9	1.2	1.7	2.4	3.1	4.1	1.06	.73	2.43	.94

Location	Monthly Arithmetic Averages												No. of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Medical-Dental Bldg, 2730 Colby, Everett, Wa	.95	.50	.37	.35	.29	.33	.36	.37	.48	.52	.70	1.13	8670	.53
Duwamish, 4401 E Marginal Way S, Seattle, Wa	1.94	1.13	.91	.64	.55	.55	.53	.61	.77	.83	1.16	2.08	8690	.97
Fire Station #12, 2316 E 11th St, Tacoma, Wa	2.30	1.15	.93	.54	.59	.57	.68	.66	.86	.88	1.33	2.32	8288	1.06

ATMOSPHERIC PARTICLES
(bsp (X 10 Exp-4)/M)
1985

Statistical Summary

Location	No. of 1 Hour Samples	Frequency Distribution - Percent												Arith Mean	Geom Mean	Geom Std Dev	Arith Std Dev
		5	10	20	30	40	50	60	70	80	90	95	99				
North 98th St & Stone Ave N, Seattle, Wa	8666	.1	.1	.2	.2	.3	.3	.5	.6	1.0	1.9	2.7	4.6	.71	.38	3.01	.93
Duwamish, 4401 E Marginal Way S, Seattle, Wa	8681	.1	.2	.2	.3	.4	.5	.6	.9	1.3	2.3	3.5	5.9	.93	.54	2.73	1.16
22916 86th Ave S, Kent, Wa	8723	.1	.2	.2	.3	.4	.5	.7	1.0	1.7	3.2	4.5	6.8	1.14	.62	2.94	1.45
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	4362	.1	.2	.3	.3	.4	.5	.6	.8	1.2	2.1	3.1	5.4	.89	.56	2.52	1.06
Fire Station #12, 2316 E 11th St, Tacoma, Wa	8669	.1	.2	.2	.3	.4	.5	.6	.9	1.7	3.2	4.2	6.7	1.10	.58	3.06	1.42

Location	Monthly Arithmetic Averages												No. of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
North 98th St & Stone Ave N, Seattle, Wa	2.02	.89	.53	.32	.29	.24	.23	.26	.45	.51	.88	1.80	8666	.71
Duwamish, 4401 E Marginal Way S, Seattle, Wa	2.61	1.04	.82	.45	.40	.32	.37	.40	.64	.65	.93	2.47	8681	.93
22916 86th Ave S, Kent, Wa	3.40	1.19	1.01	.53	.45	.37	.44	.48	.68	.65	1.39	3.00	8723	1.14
27th St NE & 54th Ave NE, Northeast Tacoma, Wa							.48		.71	.58	1.09	1.95	4362	.89
Fire Station #12, 2316 E 11th St, Tacoma, Wa	3.30	1.19	.99	.42	.41	.38	.44	.44	.68	.68	1.41	2.74	8669	1.10

LEAD

The ambient air quality standard for lead is 1.5 micrograms per cubic meter averaged over one calendar quarter. About 90 percent of the lead emitted into the air comes from automobile exhaust. The remainder is released from stationary sources such as primary and secondary nonferrous smelters.

The tables below present the results of sampling during 1985. The Harbor Island station at 2555 13th Ave SW shows continuing effects from closure activities at the secondary lead smelter just south of the station. Lead concentrations measured at all other stations were lower than the ambient standard.

LEAD
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1985

Location	Monthly Arithmetic Averages												No. Of Obs.	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Evergreen Point Bridge Toll Plaza, Medina, Wa	.63	.29	.39	.25	.24	.36	.17	.23	.20	.14	.06	.23	#	.27
504 Bellevue Way NE, Bellevue, Wa	.54	.26	.21	.15	.14	.11	.11	.12	.12	.09	.08	.17	#	.18
North 98th St & Stone Ave N, Seattle, Wa	.45	.26	.16	.14	.13	.09	.09	.13	.12	.10	.07	.18	#	.16
5701 8th Ave NE, Seattle, Wa	.75	.50	.43	.39	.37	.30	.25	.26	.32	.21	.13	.28	#	.35
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	.50	.33	.25	.22	.16	.13	.09	.13	.15	.13	.10	.21	#	.20
Harbor Island, 2555 13th Ave SW, Seattle, Wa	1.66	2.05	.87	.85	.99	.52	1.14	.67	1.47	1.53	.62	1.00	61	1.11
Harbor Island, 3400 13th Ave SW, Seattle, Wa	.66	.25	.91	.20	.27	.59	.59	.50	.19	.38	.15	.30	61	.42
South Park, 723 S Concord St, Seattle, Wa	.62	.37	.31	.14	.14	.16	.13	.16	.13	.14	.12	.24	61	.22
Sumner Jr HS, 1508 Willow St, Sumner, Wa	.36	.17	.16	.09	.10	.10	.07	.07	.07	.07	.07	.19	59	.13
SW 283rd & 101st Ave SW, Maury Island, Wa	.21	.10	.08	.04	.03	.03	.03	.04	.03	.05	.02	.11	90	.06
Ruston School, 5219 N Shirley St, Tacoma, Wa	.39	.21	.22	.07	.18	.08	.09	.36	.15	.16	.26	.31	60	.21
4716 North Baltimore St, Tacoma, Wa	.52	.14	.36	.12	.11	.08	.29	.22	.30	.13	.14	.17	115	.22
North 26th & Pearl Sts, Tacoma, Wa	.47	.25	.20	.07	.13	.08	.08	.10	.07	.09	.08	.18	61	.15
City Water Supply Pump House, Dupont, Wa	.23	.10	.13	.04	.04	.07	.06	.03	.07	.05		.10	51	.08

# indicates a composite monthly average was used.

Location	Quarterly Arithmetic Averages			
	1st	2nd	3rd	4th
Evergreen Point Bridge Toll Plaza, Medina, Wa	.44	.28	.20	.14
504 Bellevue Way NE, Bellevue, Wa	.34	.13	.12	.11
North 98th St & Stone Ave N, Seattle, Wa	.29	.12	.11	.12
5701 8th Ave NE, Seattle, Wa	.56	.35	.28	.21
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	.36	.17	.12	.15
Harbor Island, 2555 13th Ave SW, Seattle, Wa	1.53	.79	1.09	1.05
Harbor Island, 3400 13th Ave SW, Seattle, Wa	.61	.35	.43	.28
South Park, 723 S Concord St, Seattle, Wa	.43	.15	.14	.17
Sumner Jr HS, 1508 Willow St, Sumner, Wa	.23	.10	.07	.11
SW 283rd & 101st Ave SW, Maury Island, Wa	.13	.03	.03	.06
Ruston School, 5219 N Shirley St, Tacoma, Wa	.27	.11	.20	.24
4716 North Baltimore St, Tacoma, Wa	.34	.10	.27	.15
North 26th & Pearl Sts, Tacoma, Wa	.31	.09	.08	.12
City Water Supply Pump House, Dupont, Wa	.15	.05	.05	.08

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 Tacoma Smelter. Though smelting ceased in March, 1985, arsenic processing continued until January, 1986. The Washington Department of Ecology has adopted 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

The tables below summarize arsenic measurements during 1985 from nine stations. The Ruston School and North Baltimore stations are less than one mile from the Tacoma Smelter.

ARSENIC
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1985

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	.02	.04	.02	.01	.01	<.01	.01	.01	.01	.01	.01	.01	61	.01
Harbor Island, 3400 13th Ave SW, Seattle, Wa	.01	.03	.02	.01	.01	<.01	.01	.01	<.01	.01	.01	.01	61	.01
South Park, 723 S Concord St, Seattle, Wa	.01	.03	.01	.01	<.01	<.01	.01	.01	<.01	.01	<.01	.01	61	.01
Sumner Jr HS, 1508 Willow St, Sumner, Wa	.01	<.01	.01	<.01	<.01	<.01	<.01	.01	<.01	<.01	.01	.01	60	.01
SW 283rd & 101st Ave SW, Maury Island, Wa	.05	.05	.03	.03	.01	<.01	.01	.03	.01	.02	.01	.01	90	.02
Ruston School, 5219 N Shirley St, Tacoma, Wa	.59	1.04	.65	.17	.18	.06	.04	1.77	.22	1.43	1.30	1.80	60	.77
4716 North Baltimore St, Tacoma, Wa	.45	.71	.44	.40	.22	.15	.65	.78	.51	.54	.82	.26	115	.49
North 26th & Pearl Sts, Tacoma, Wa	.10	.36	.11	.03	.03	.02	.07	.08	.05	.16	.03	.01	61	.09
City Water Supply Pump House, Dupont, Wa	.02	.02	.02	.01	<.01	<.01	<.01	.01	<.01	<.01		.01	51	.01

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

Summary of Individual 24 Hour Average Arsenic Values

Location	Highest Value		Values Higher than 1.70	
	Value	Date	Value	Date
Harbor Island, 2555 13th Ave SW, Seattle, Wa	.09	13 Jan		
Harbor Island, 3400 13th Ave SW, Seattle, Wa	.05	12 Feb		
South Park, 723 S Concord St, Seattle, Wa	.04	24 Feb		
Sumner Jr HS, 1508 Willow St, Sumner, Wa	.03	13 Jan		
SW 283rd & 101st Ave SW, Maury Island, Wa	.16	11 Aug		
Ruston School, 5219 N Shirley St, Tacoma, Wa	6.89	27 Dec	6.89	27 Dec
			6.48	16 Oct
			5.03	11 Aug
			3.58	18 Feb
			3.36	23 Aug
			2.33	15 Nov
			2.08	9 Nov
			1.96	21 Nov
			1.94	9 Dec
4716 North Baltimore St, Tacoma, Wa	5.16	18 Feb	5.16	18 Feb
			4.16	28 Oct
			4.08	20 Nov
			3.18	12 Jul
			2.29	23 Aug
			2.03	8 Mar
			1.94	10 Dec
			1.78	21 Aug
			1.78	10 Nov
			1.75	30 Apr
North 26th & Pearl Sts, Tacoma, Wa	1.39	18 Feb		
City Water Supply Pump House, Dupont, Wa	.08	8 Mar		

Introduction

The Washington State Department of Ecology has statewide jurisdiction over motor vehicle emissions. As a group, motor vehicles emit more carbon monoxide than any other source. For the cities of the Puget Sound area, motor vehicle traffic is the principal contributor to the carbon monoxide levels which exceed ambient air quality standards.

For the Puget Sound area the high ambient levels of carbon monoxide occur principally during autumn and winter months. The highest levels are measured in the vicinity of congested motor vehicle traffic notable during late afternoon commuting and around shopping centers. A further contributing factor to high levels is the presence of persistently stable meteorological conditions and light wind thus temporarily suspending effective dispersion of carbon monoxide emissions.

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 considered "Unhealthful". An 8 hour average of 15 ppm equals 200 on the PSI scale. Pollutant Standards Index values of 200 to 299 are termed "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 for an 8 hour average, and 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 taken. 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 1985 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 1985. These data were obtained from Department of Ecology data summaries. One Seattle station was discontinued on April 30 and two Tacoma stations were discontinued on March 31.

Review of the data shows that six of the fourteen stations exceeded an 8 hour average of 9 ppm at least twice. Therefore all of these six stations, one located in Bellevue, three located in Seattle, and two located in Tacoma, violated the 8 hour average carbon monoxide standard. Since the maximum 1 hour average recorded at any of the stations was 23 ppm, the 1 hour carbon monoxide standard of 35 ppm was not exceeded.

Multi-Year Summary

A multi-year summary following the 1985 tables presents data and bar graphs which help to show the long term historical trend. For 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. This summary compiles data at stations operated for several years.

The first complete year of carbon monoxide data for one Seattle station is 1972. The results at this station show significant improvement from over 100 days exceeding the primary standard in 1972 to two days exceeding the standard in 1985. Other stations beginning in 1978 confirm the same trend. Data for other cities begins too recently to show the major improvement, but the results for each concurrent year are consistent with those in Seattle. Though the Puget Sound area has not yet attained the carbon monoxide standard, improvement in the levels for this pollutant is clearly evident.

CARBON MONOXIDE
(Parts per Million)
1985

Location / Period of Sampling	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		
2005 Hewitt Avenue, Everett, Wa	19	8 Jan	1900	10	11 Dec	2200	1	1
1 Jan-21 Mar; 2 Apr-31 Dec	19	13 Dec	1800	9	3 Jan	2100		
	18	11 Dec	1900	9	8 Jan	2100		
	17	9 Jan	1700	9	9 Jan	1900		
	16	10 Dec	1800	9	13 Dec	1900		
	16	11 Dec	1800	9	17 Dec	2200		
622 Bellevue Way NE, Bellevue, Wa	17	13 Dec	1800	11	4 Dec	2200	5	5
1 Jan-20 Jul; 20 Aug-31 Dec	16	14 Nov	1800	10	11 Jan	2300		
	15	12 Dec	1800	10	14 Nov	2300		
	15	13 Dec	1900	10	13 Dec	2100		
	15	17 Dec	1900	10	17 Dec	2200		
	14	11 Jan	1900	9	3 Jan	2300		
Northgate, 310 NE Northgate Way, Seattle, Wa	19	3 Jan	1900	14	3 Jan	2300	10	8
1 Jan-19 Nov; 2 Dec-31 Dec	17	3 Jan	0900	11	3 Jan	1500		
	16	3 Jan	2000	11	13 Dec	1500		
	16	4 Dec	0800	11	13 Dec	2300		
	15	3 Jan	2200	10	4 Jan	1600		
	15	14 Nov	0800	10	8 Jan	2200		
4511 University Way NE, Seattle, Wa	18	3 Jan	1900	12	3 Jan	2000	1	1
1 Jan-31 Oct; 13 Nov-31 Dec	17	3 Jan	1800	9	8 Jan	2000		
	17	4 Dec	1000	9	11 Jan	2100		
	14	3 Jan	2000	9	18 Jan	1800		
	14	13 Feb	2000	9	13 Feb	2100		
	14	4 Dec	0900	9	4 Dec	1300		
3921 Linden Ave N, Seattle, Wa	12	3 Jan	2000	9	4 Jan	0100	0	0
1 Jan-31 Dec	11	4 Dec	0900	7	13 Feb	2400		
	9	3 Jan	1800	7	12 Dec	2400		
	9	3 Jan	1900	7	13 Dec	2300		
	9	3 Jan	2400	7	14 Dec	2300		
	9	4 Jan	0100	7	17 Dec	0200		
1424 4th Ave, Seattle, Wa	16	3 Jan	1800	12	3 Jan	2300	2	2
1 Jan-17 Dec	15	3 Jan	1700	10	13 Feb	2400		
	13	3 Jan	1900	9	4 Jan	1600		
	12	4 Jan	1500	8	2 Dec	1600		
	12	13 Feb	2300	7	2 Jan	1700		
	12	2 Dec	1600	7	4 Jan	0700		
1016 1st Ave, Seattle, Wa	13	3 Jan	1800	10	3 Jan	2200	1	1
1 Jan-30 Apr	12	3 Jan	1700	9	13 Feb	2300		
	12	13 Feb	2100	8	4 Jan	1600		
	11	3 Jan	2100	7	3 Jan	1300		
	11	13 Feb	1800	7	4 Jan	0600		
	10	3 Jan	1600	7	7 Jan	2100		

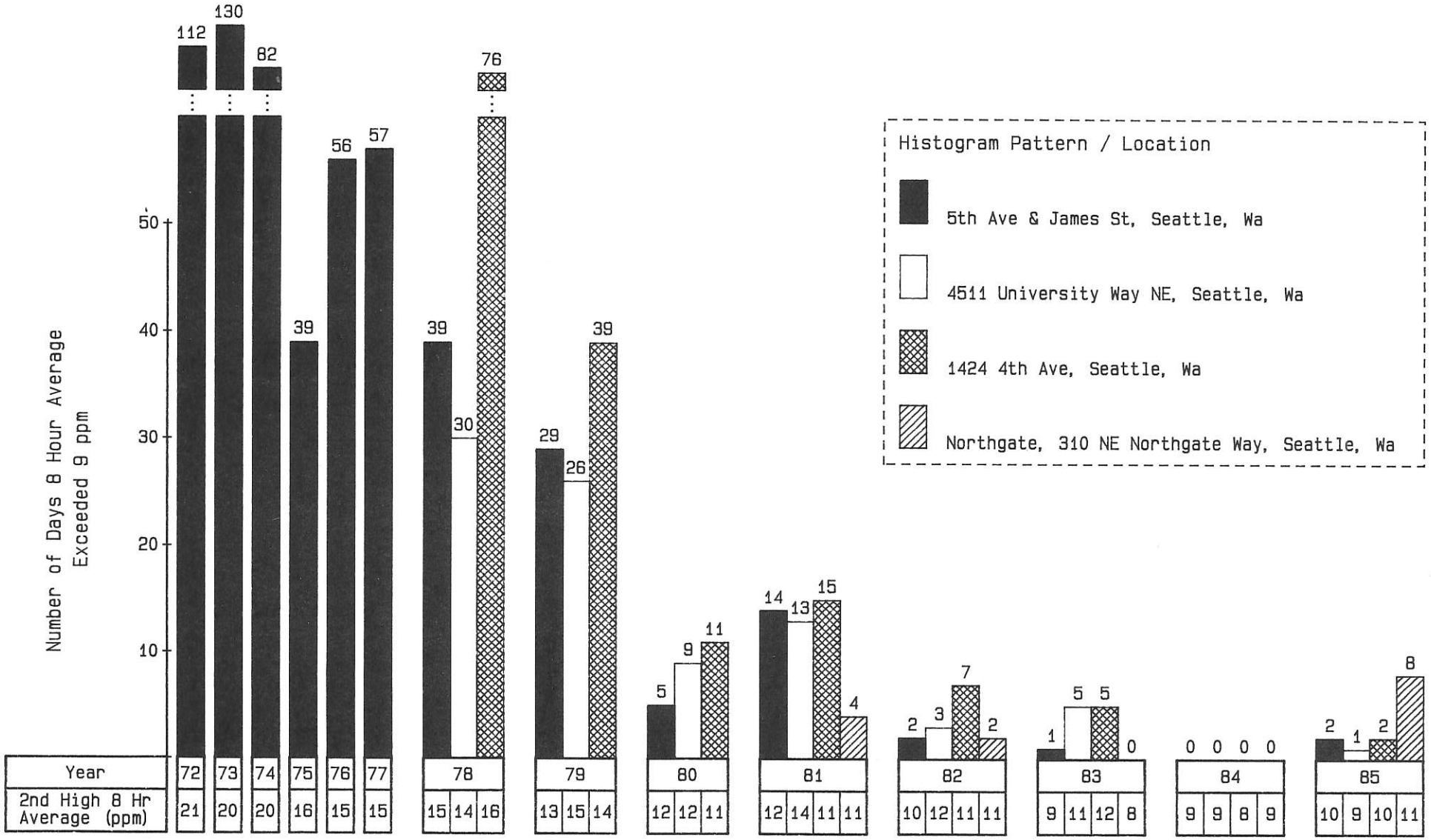
Notes
(1) Ending times are reported in Pacific Standard Time.
(2) For equal concentration values the reported date and time refer to the earliest occurrences during the year.
(3) A block of data missing for more than 10 consecutive days is shown by dates beneath the location of each station.
(4) At all stations carbon monoxide was continuously measured using the nondispersive infrared method.

CARBON MONOXIDE
(Parts per Million)
1985

Location / Period of Sampling	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		
5th Ave & James St, Seattle, Wa	15	11 Jan	1800	11	3 Jan	2200	2	2
1 Jan-7 Feb; 20 Feb-31 Dec	14	3 Jan	2000	10	23 Dec	1600		
	14	6 Jun	1600	9	17 Jan	1800		
	14	11 Dec	1800	9	2 Dec	1800		
	14	23 Dec	1500	9	17 Dec	2100		
	13	17 Jan	1600	8	2 Jan	1800		
Courthouse, 4th Ave & James St, Seattle, Wa	12	18 Jan	1500	10	3 Jan	2200	1	1
1 Jan-28 Feb; 27 Mar-17 Jun; 16 Jul-31 Dec	11	3 Jan	1800	9	13 Feb	2200		
	11	3 Jan	2000	8	18 Jan	1500		
	11	17 Dec	2100	7	3 Jan	1400		
	10	3 Jan	0900	7	4 Jan	0600		
	10	3 Jan	1700	7	4 Jan	1400		
Fire Station #10, 301 2nd Ave S, Seattle, Wa	13	16 Jan	1900	10	13 Feb	2400	1	1
1 Jan-31 Dec	12	2 Jan	2300	9	3 Jan	2100		
	12	3 Jan	1800	9	16 Jan	2300		
	12	13 Feb	2000	8	9 Jan	0100		
	11	3 Jan	2000	8	2 Jan	2400		
	11	13 Feb	2100	7	4 Jan	1000		
2809 26th Ave S, Seattle, Wa	19	6 Feb	1000	9	13 Dec	2300	0	0
1 Jan-31 Dec	14	6 Feb	1800	8	3 Jan	1900		
	13	31 Jan	0900	8	4 Jan	1800		
	13	17 Dec	1800	8	8 Jan	2400		
	12	13 Dec	0900	8	13 Feb	2300		
	11	5 Jan	2000	8	12 Dec	2300		
942 Pacific Ave, Tacoma, Wa	23	3 Dec	1800	12	16 Jan	2200	11	10
1 Jan-16 Jun; 1 Aug-29 Oct; 15 Nov-31 Dec	22	13 Feb	1800	12	3 Dec	1900		
	22	4 Dec	0900	12	4 Dec	1300		
	21	4 Feb	1800	12	4 Dec	2100		
	21	8 Feb	1800	12	13 Dec	2200		
	21	3 Dec	1700	11	7 Jan	1900		
South 11th & A Streets, Tacoma, Wa	13	31 Jan	0800	10	16 Jan	2200	1	1
1 Jan-31 Mar	11	16 Jan	1900	9	18 Jan	1700		
	11	16 Jan	2000	8	2 Jan	2200		
	11	16 Jan	2100	8	4 Jan	1400		
	11	17 Jan	0800	8	17 Jan	1400		
	11	18 Jan	1700	8	13 Feb	2300		
1103 Pacific Ave, Tacoma, Wa	16	4 Jan	1700	11	16 Jan	2200	2	2
1 Jan-31 Mar	13	4 Jan	1800	10	18 Jan	1500		
	13	11 Jan	1800	9	2 Jan	1900		
	13	16 Jan	2100	9	3 Jan	2300		
	12	3 Jan	1800	9	4 Jan	1500		
	12	10 Jan	1700	9	10 Jan	1800		

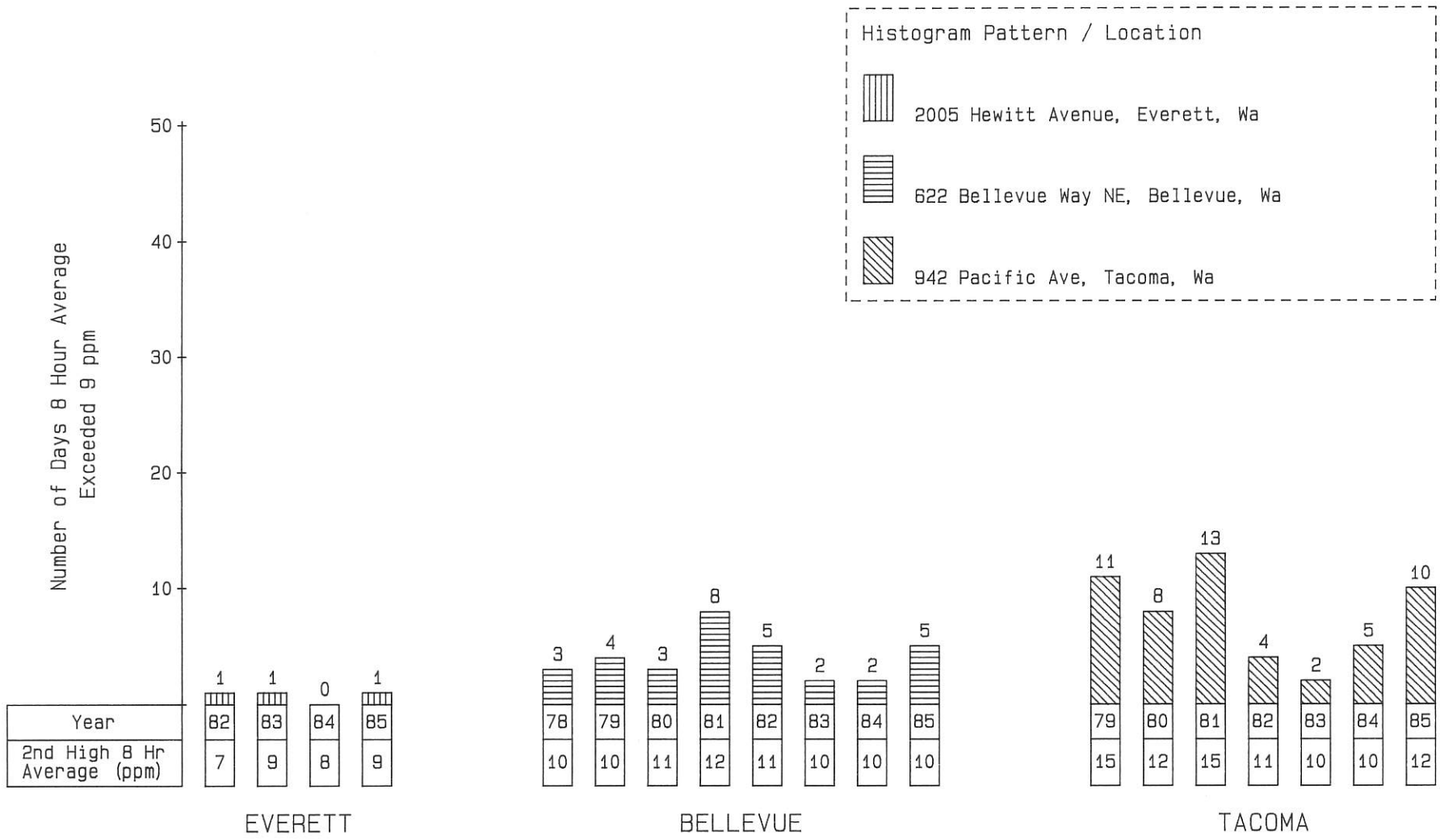
Notes
(1) Ending times are reported in Pacific Standard Time.
(2) For equal concentration values the reported date and time refer to the earliest occurrences during the year.
(3) A block of data missing for more than 10 consecutive days is shown by dates beneath the location of each station.
(4) At all stations carbon monoxide was continuously measured using the nondispersive infrared method.

CARBON MONOXIDE
Multi-Year Summary



SEATTLE

CARBON MONOXIDE
Multi-Year Summary



Sulfur dioxide is a common air pollutant for which standards have been established nationwide. Sulfur dioxide enters the air primarily from industrial processes or from the combustion of sulfur-containing fuels such as coal and oil. In the Puget Sound area the Tacoma Smelter has been the principal sulfur dioxide source, but the Smelter permanently ceased copper smelting on March 24, 1985. In the air, reactions occur to partially convert sulfur dioxide to other sulfur compounds such as sulfuric acid and various sulfate salts. Local sulfur dioxide standards have been in effect since 1968. The tables below summarize sulfur dioxide data collected during 1985. There were no violations of the national standards, but in Everett there were two incidents where measured 5 minute averages exceeded 1.00 ppm and one case where the measured 1 hour average exceeded 0.40 ppm.

SULFUR DIOXIDE
(Parts per Million)
1985

Location	Monthly Arithmetic Averages												No. of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Medical-Dental Bldg, 2730 Colby, Everett, Wa	.013	.012	.012	.012	.013	.011	.012	.012	.011	.009	.009		8190	.011
North 98th St & Stone Ave N, Seattle, Wa	.011	.007	.005	.004	.004	.006	.005	.005		.007	.006		7846	.006
Duwamish, 4401 E Marginal Way S, Seattle, Wa	.014	.012	.009	.010	.010	.006	.008		.009	.008	.009	.010	8339	.009
Federal Way HS, 1401 S 304 St, Federal Way, Wa	.014	.010	.010	.008	.008	.007	.009	.009	.008	.007	.008	.009	8258	.009
27th St NE & 54th Ave NE, Northeast Tacoma, Wa							.013	.012	.009	.013	.011	.014	4648	.012
SW 283rd & 101st Ave SW, Maury Island, Wa	.013	.014		.007	.007	.006	.006	.005	.005	.007	.006	.009	8031	.008
North 37th & Vassault Sts, Tacoma, Wa		.012		.007	.008	.007							3851	.010
North 26th & Pearl Sts, Tacoma, Wa	.021	.014	.014	.006	.007	.006	.007	.007	.009	.009	.011	.013	8653	.010

Number of Concentrations Exceeding Selected Values
for Various Averaging Periods

Location	5 Minute Average	1 Hour Average		3 Hour Average	24 Hour Average	
	1.00 ppm	0.40 ppm	0.25 ppm	0.50 ppm	0.10 ppm	0.14 ppm
Medical-Dental Bldg, 2730 Colby, Everett, Wa	2	1	2	0	0	0
North 98th St & Stone Ave N, Seattle, Wa	0	0	0	0	0	0
Duwamish, 4401 E Marginal Way S, Seattle, Wa	0	0	0	0	0	0
Federal Way HS, 1401 S 304 St, Federal Way, Wa	0	0	0	0	0	0
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	0	0	0	0	0	0
SW 283rd & 101st Ave SW, Maury Island, Wa	0	0	0	0	0	0
North 37th & Vassault Sts, Tacoma, Wa	0	0	0	0	0	0
North 26th & Pearl Sts, Tacoma, Wa	0	0	1	0	0	0

SULFUR DIOXIDE
(Parts per Million)
1985

Summary of Maximum and Second Highest Concentrations
for Various Averaging Periods

Location	5 Minute Average			1 Hour Average			3 Hour Average			24 Hour Average		
	Value	Date	End Time	Value	Date	End Time	Value	Date	End Time	Value	Date	End Time
Medical-Dental Bldg, 2730 Colby, Everett, Wa	1.95	28 Jul	1902	.57	28 Jul	1953	.200	28 Jul	2000	.038	29 Jul	1300
	1.58	28 Jul	1948	.13	2 Jul	1600	.080	10 Mar	1700	.034	25 Feb	0100
North 98th St & Stone Ave N, Seattle, Wa				.13	30 Jan	1600	.113	30 Jan	1800	.032	31 Jan	0900
				.12	30 Jan	1700	.063	30 Jan	2100	.030	5 Jan	1300
Duwamish, 4401 E Marginal Way S, Seattle, Wa				.17	4 Feb	1700	.107	30 Jan	1800	.033	6 Sep	1000
				.13	30 Jan	1600	.100	4 Feb	1700	.032	14 Jun	1800
Federal Way HS, 1401 S 304 St, Federal Way, Wa				.10	16 Mar	2400	.060	11 Jan	0600	.032	27 Jan	0800
				.09	15 Jan	1600	.060	17 Mar	0100	.031	4 Jan	1300
27th St NE & 54th Ave NE, Northeast Tacoma, Wa				.17	17 Aug	0700	.130	14 Aug	1000	.047	13 Dec	1000
				.16	14 Aug	0900	.107	2 Jul	1000	.040	7 Jul	1100
SW 283rd & 101st Ave SW, Maury Island, Wa				.17	21 Feb	1800	.090	9 Feb	1300	.034	10 Feb	0900
				.13	21 Mar	1400	.080	21 Feb	1900	.032	5 Feb	0800
North 37th & Vassault Sts, Tacoma, Wa				.21	17 Feb	1200	.167	17 Feb	1300	.037	18 Feb	0900
				.16	17 Feb	1100	.117	10 Jan	0200	.036	10 Jan	2200
North 26th & Pearl Sts, Tacoma, Wa				.34	22 Jan	0747	.127	22 Jan	0900	.042	23 Jan	0100
				.14	14 Mar	1400	.123	14 Mar	1500	.035	10 Jan	1500

Notes
(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 reported date and time refer to the earliest occurrences during the year.
(4) At all stations sulfur dioxide was continuously measured using the method of ultraviolet fluorescence.

Photochemical Oxidants

The principal oxidant found in photochemical smog is ozone, a very reactive form of oxygen. Most photochemical oxidants are generated during chemical reactions in the ambient air between nitrogen oxides and reactive hydrocarbons in the presence of summer sunlight. These "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 reactive hydrocarbons.

In the Puget Sound region the highest ozone levels occur during summer months. These high values develop when urban area emissions are trapped beneath a nighttime and morning temperature inversion followed by very high temperatures. Light northerly winds often develop on these hot days. As a result, the highest ozone values normally occur south to southeast of the major cities.

Ozone Standard and Pollutant Standards Index

The level of the ozone standard is 0.12 ppm. 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 "exceedence" 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 exceedences is equal to or less than one.

In the case of a complete data set, the expected number of exceedences is simply the average number of observed exceedences at a particular location during the most recent 3 years.

When the data set for a given year is incomplete, the number of exceedences in that year must be adjusted to estimate the true number. This estimate is based upon the observed number of exceedences, 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 standard level.

The estimated number of exceedences is always equal to or greater than the observed number of exceedences. However, for stations where no exceedences are observed, the estimate is zero. The expected number of exceedences is then the three year average of the estimated number of exceedences.

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

The ozone summary table for 1985 lists the four highest daily maximum 1 hour ozone averages for each monitoring location. For the three year period ending with 1985 the number of ozone exceedences is 1.0 or less. Six stations have not measured any ozone values exceeding 0.12 ppm during the past four years.

NITROGEN OXIDES

Nitric oxide (NO) and nitrogen dioxide (NO2) are released to the atmosphere as the result of high temperature fuel combustion. Motor vehicles and power plants are the most common fuel combustion sources emitting oxides of nitrogen. Nitric oxide oxidizes rather quickly to nitrogen dioxide. Nitrogen dioxide plays an important role in the photochemical reactions which produce ozone. The nitrogen dioxide standard is an annual arithmetic average of 0.05 ppm. Nitrogen dioxide levels exceeding this annual standard would be termed unhealthful, but this has never occurred in the Puget Sound Region.

OZONE
(Parts per Million)
1985

Location / Period of Sampling	Four 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	1983	1984	1985	
Snohomish FD #22, 9921 84th NE, Arlington, Wa*	.11	11 Jun	1600	0.0	0.0	0.0	0.0
1 May - 19 Jun; 28 Jun - 22 Oct	.11	2 Jul	1400				
	.11	9 Jul	1600				
	.09	19 Jul	1600				
Tolt River Watershed, King County, Wa*	.10	29 Jul	1700			0.0	0.0
1 Jun - 11 Jun; 18 Jun - 5 Aug; 19 Aug - 7 Oct	.09	7 Jul	1900				
	.09	9 Jul	1500				
	.08	21 Jun	1700				
20050 SE 56th, Lake Sammamish State Park, Wa*	.12	20 Jul	1400	0.0	0.0	0.0	0.0
1 Jan - 31 Jul; 12 Aug - 31 Dec	.11	18 Jun	1600				
	.11	7 Jul	1500				
	.10	8 Jul	1500				
22916 86th Ave S, Kent, Wa	.09	9 Jul	1400	0.0	0.0	0.0	0.0
1 Jan - 10 Jun; 19 Jun - 31 Dec	.09	19 Jul	1600				
	.08	2 Jul	1200				
	.08	7 Jul	1600				
Enumclaw, Wa*	.10	24 Aug	1600			0.0	0.0
12 Aug - 31 Aug; 9 Sep - 11 Oct	.09	17 Aug	1600				
	.08	14 Aug	1600				
	.08	23 Aug	1500				
Sumner Jr HS, 1508 Willow St, Sumner, Wa	.11	18 Jun	1400	0.0	0.0	0.0	0.0
1 Jan - 5 Jun; 12 Jun - 31 Dec	.11	19 Jul	1500				
	.10	7 Jul	1400				
	.10	8 Jul	1400				
Firwood Fire Sta, 4418 Freeman Rd, Fife, Wa*	.09	18 Jun	1400	0.0	0.0	0.0	0.0
1 Jan - 31 Dec	.08	2 Jul	1300				
	.08	7 Jul	1300				
	.08	8 Jul	1300				
Pierce Co Fire D #21, 8102 304th, Graham, Wa*	.10	24 Aug	1400	0.0	0.0	0.0	0.0
23 Apr - 26 Jun; 1 Aug - 30 Sep	.09	18 Jun	1500				
	.08	22 May	1600				
	.08	14 Aug	1400				
Charles L Pack Forest, La Grande, Wa*	.13	19 Jul	1500			1.0	1.0
30 May - 31 Oct	.12	7 Jul	1700				
	.12	24 Aug	1600				
	.11	17 Jun	1800				

Notes
(1) * Station operated by the Washington State Department of Ecology.
(2) Ending times are reported in Pacific Standard Time.
(3) For equal values the date and time refer to the earliest occurrences during the year.
(4) At all stations ozone was continuously measured using ultraviolet photometric detection.

NITROGEN DIOXIDE
(Parts per Million)
1985

Location	Monthly Arithmetic Averages												No. of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
4th Ave South & Jackson St, Seattle, Wa*	.036	.033	.037	.033	.036		.037	.034	.030	.033		.036	7436	.034
15th Ave S & Charlestown St, Seattle, Wa*	.017			.014	.014	.018	.024	.025	.024	.023			6274	.019

Notes
(1) Monthly averages are shown only for months with 75 percent or higher data completeness.
(2) Year arithmetic means are calculated from all valid samples; the number of samples shows how completely the year mean represents the full year.
(3) At all stations nitrogen dioxide was continuously measured using gas phase chemiluminescence.

Introduction

Quality Assurance (QA) includes all 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 actions; maintenance; recording and validating data; and documentation of quality control information.

Independent Audits

The Agency participates in audit programs conducted independently by the U.S. Environmental Protection Agency and the Washington State Department of Ecology. For the EPA, this consists of (1) an annual onsite audit of some Agency instruments by EPA or their designated representative, and (2) Agency participation in EPA's national performance audits as they are announced. The Department of Ecology also independently selects and audits Agency instruments onsite such that a part of the network is audited 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, and March 19, 1986. The important QA 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 means the agreement between a measurement and the true value.

Each pollutant measuring instrument 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. At the end of a 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 for Precision and Accuracy

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 differences, D, and the pooled standard deviation, Sa, as follows.

$$\text{Upper 95 Percent Probability Limit} = D + 1.96(Sa)$$

$$\text{Lower 95 Percent Probability Limit} = D - 1.96(Sa)$$

These calculated limits signify that with 95 percent probability all air quality data compiled 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 lower 95 percent probability limits are respectively +8 and -8 percent.

Agency Precision and Accuracy

For many Agency instruments precision audits are performed each week and accuracy audits are completed each six months or each quarter. The table on the following page summarizes the Precision and Accuracy statistics by quarter for all air quality data which the Agency originated in 1985. For each pollutant the type of audit (Accuracy or Precision) is followed by a brief phrase description of the audit method. For each quarter the number of audits and the resulting lower and upper probability limits are presented. Audits for the integrating nephelometer, which measures atmospheric particles, are conducted only as a one point precision check.

DATA QUALITY ASSESSMENT
1985

Lower and Upper 95 Percent Probability Limits
of Percent Differences

Pollutant & Type of Audit	Number of Stations	Audit Results by Quarter											
		1st			2nd			3rd			4th		
		No. of Audits	Prob. Limits Lwr	Upr	No. of Audits	Prob. Limits Lwr	Upr	No. of Audits	Prob. Limits Lwr	Upr	No. of Audits	Prob. Limits Lwr	Upr
Suspended Particulates (Total, Hi Vol)	28												
Accuracy													
Flow Rate		16	-6	+3	44	-6	+7	16	-6	+6	31	-8	+7
Precision													
Collocated Samples		36	-6	+4	34	-9	+8	31	-7	+11	26	-3	+13
Suspended Particulates (PM10, SSI Hi Vol)	9												
Accuracy													
Flow Rate		12	-3	+1	8	-11	+7	11	-6	+3	14	-5	+2
Precision													
Collocated Samples		83	-7	+3	51	-10	+4	56	-5	+13	21	-5	+2
Sulfur Dioxide	7												
Accuracy													
Level 1		15	-10	+12	19	-5	+10	10	-6	+10	8	-13	+19
Level 2		15	-10	+14	19	-8	+7	10	-7	+12	8	-12	+18
Level 3		15	-9	+13	19	-8	+6	10	-7	+13	8	-13	+17
Level 4		15	-10	+12	19	-9	+6	10	-8	+14	8	-13	+14
Precision													
One point check		84	-8	+9	92	-9	+8	93	-9	+9	85	-8	+9
Ozone	2												
Accuracy													
Level 1					2	-10	+6				2	-3	+22
Level 2					2	-14	+11				2	-2	+10
Level 3					2	-17	+13				2	-1	+5
Precision													
One point check		19	-5	+10	19	-4	+16	24	-8	+4	23	-10	+7
Atmospheric Particles (Nephelometer)	5												
Precision													
One point check		25	-6	+5	26	-5	+4	34	-6	+5	37	-4	+6

A lower atmosphere sounding unit began operating on the east shore of Portage Bay in Seattle during 1971. The Washington State Department of Ecology operates the station. Normal operation provides one sounding to 700 millibars about 0700 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 forecasts. Each sounding is reasonably representative of the lower atmosphere throughout the Puget Sound area. The Agency regularly uses the sounding to evaluate and interpret air quality data and also enters the sounding in a computerized data base.

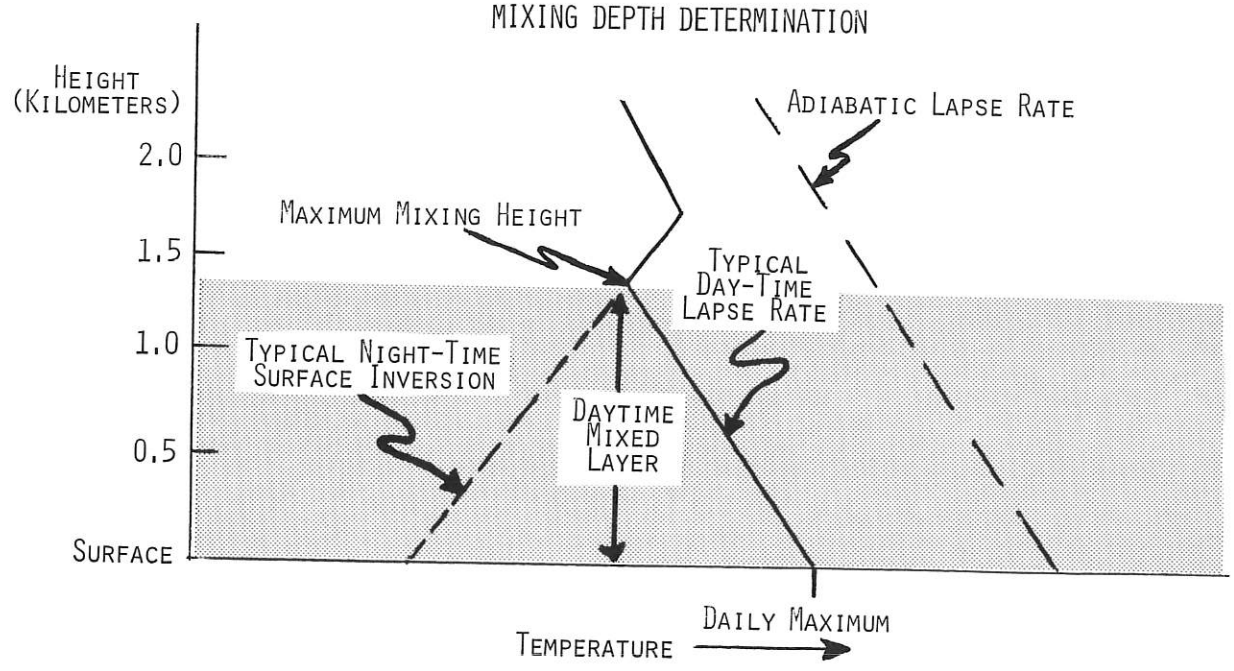
The figure below illustrates some key concepts. Temperature increasing with height is termed a TEMPERATURE INVERSION. A temperature inversion limits the height to which pollutants are mixed or dispersed vertically. The MIXING DEPTH is the height from the surface to the temperature inversion base. The 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, thick enough so that the daytime mixing depth will not exceed the depth of the inversion, significantly restricts vertical dispersion. This stable condition is associated with higher pollutant levels.

Four soundings from 1985 are presented on the following pages. Temperature is represented by a solid line connecting actual data values enclosed by circles. The dewpoint temperature is represented by a dashed line connecting actual data values enclosed by triangles. The wind at regular altitude intervals is plotted and also printed in degrees/knots to the right of the temperature sounding. Wind data above the surface is not always available.

The soundings for January 3 and 11, December 13 and 17 are all on days of Air Stagnation. They illustrate cases of a near surface temperature inversion which persists and restricts pollutant dispersion. Data tables in this report show the highest carbon monoxide levels of the year occurred on January 3; the highest TSP levels of the year occurred on December 12 and 13.

MIXING DEPTH DETERMINATION

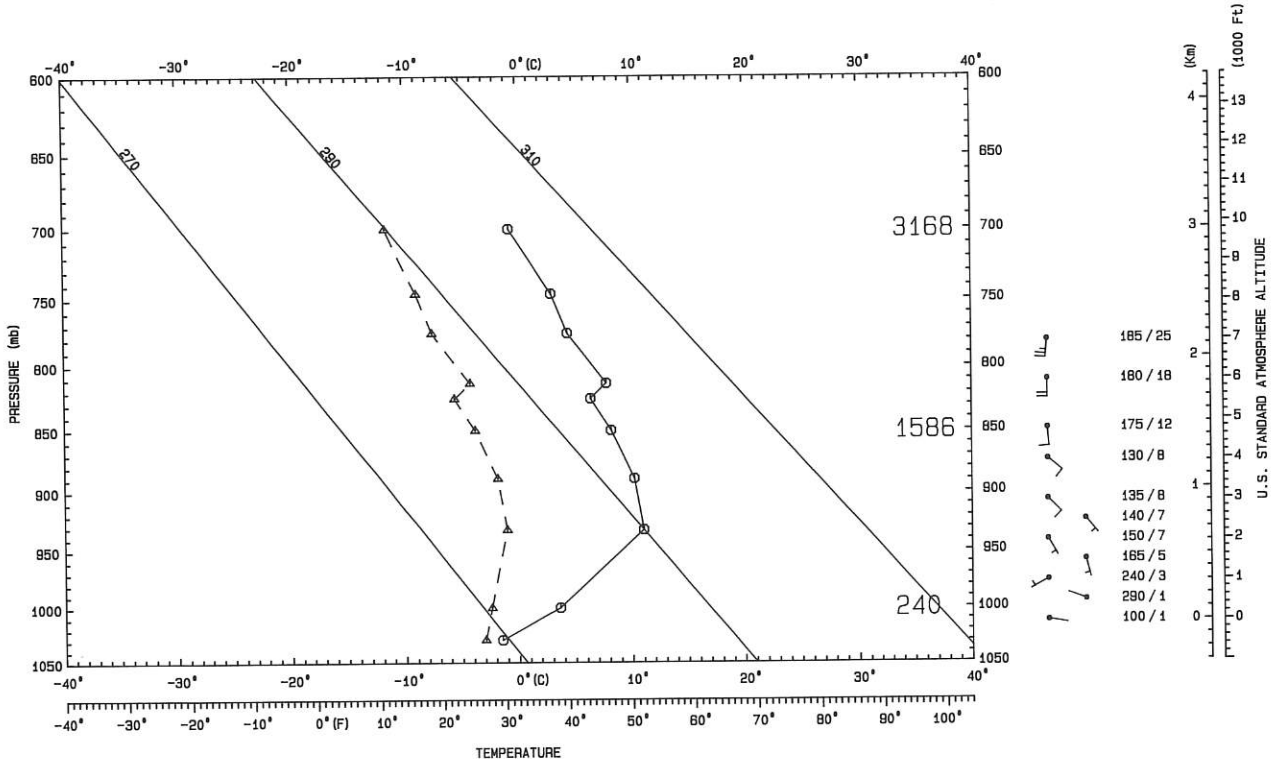


PUGET SOUND AIR POLLUTION CONTROL AGENCY

PSEUDO-ADIABATIC CHART

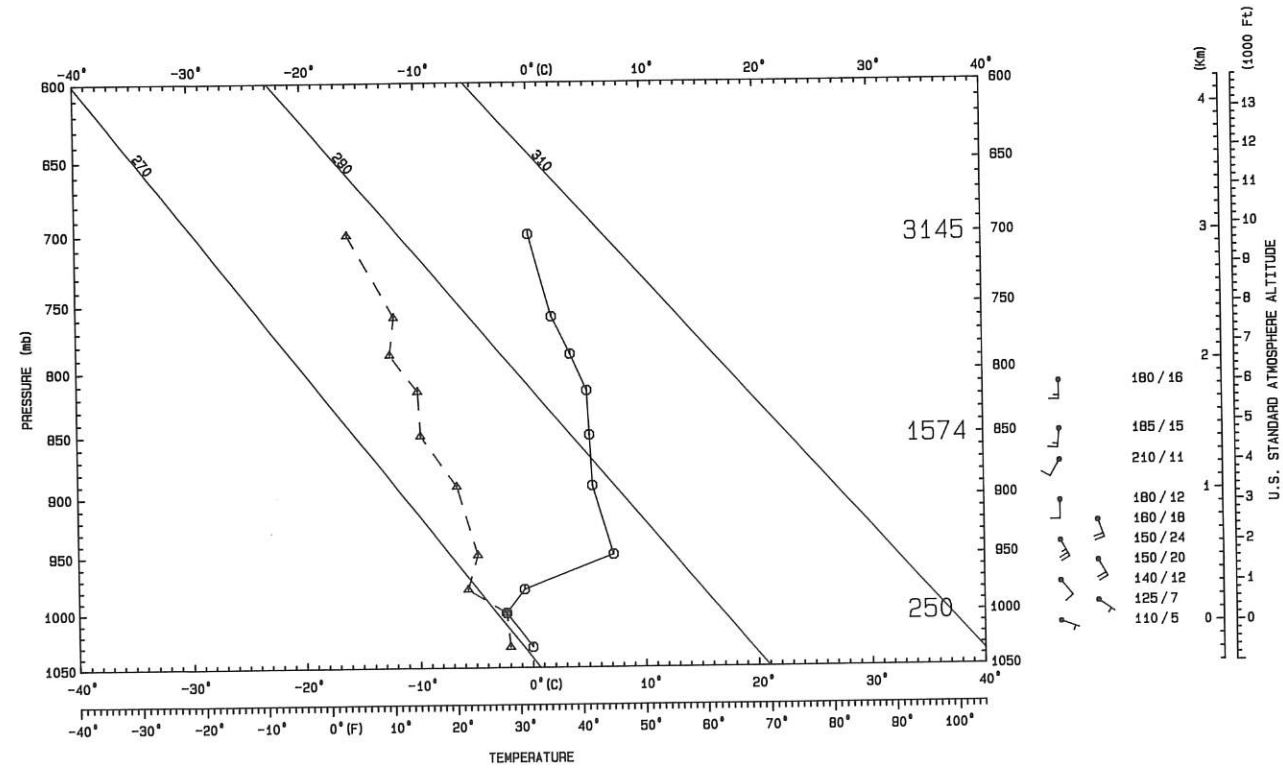
0700 PST Jan 3, 1985

Portage Bay, 2725 Montlake Blvd E, Seattle, WA



0700 PST Jan 11, 1985

Portage Bay, 2725 Montlake Blvd E, Seattle, WA

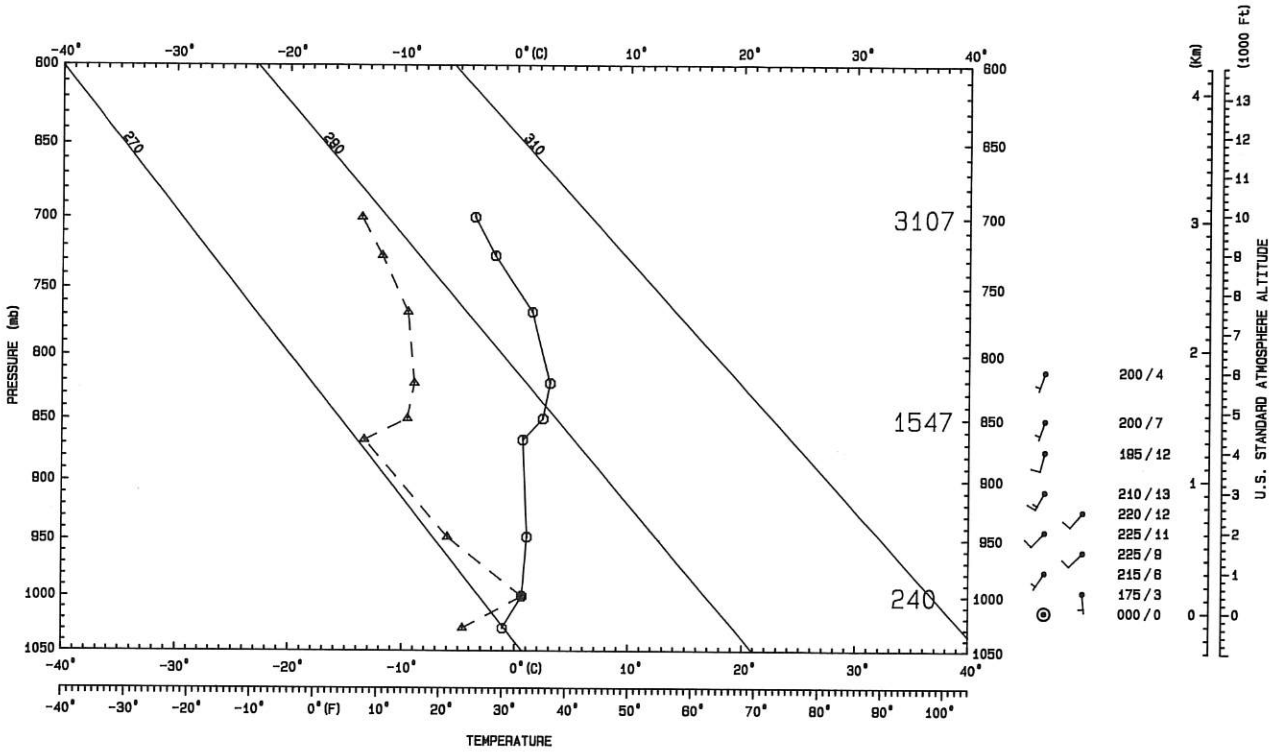


PUGET SOUND AIR POLLUTION CONTROL AGENCY

PSEUDO-ADIABATIC CHART

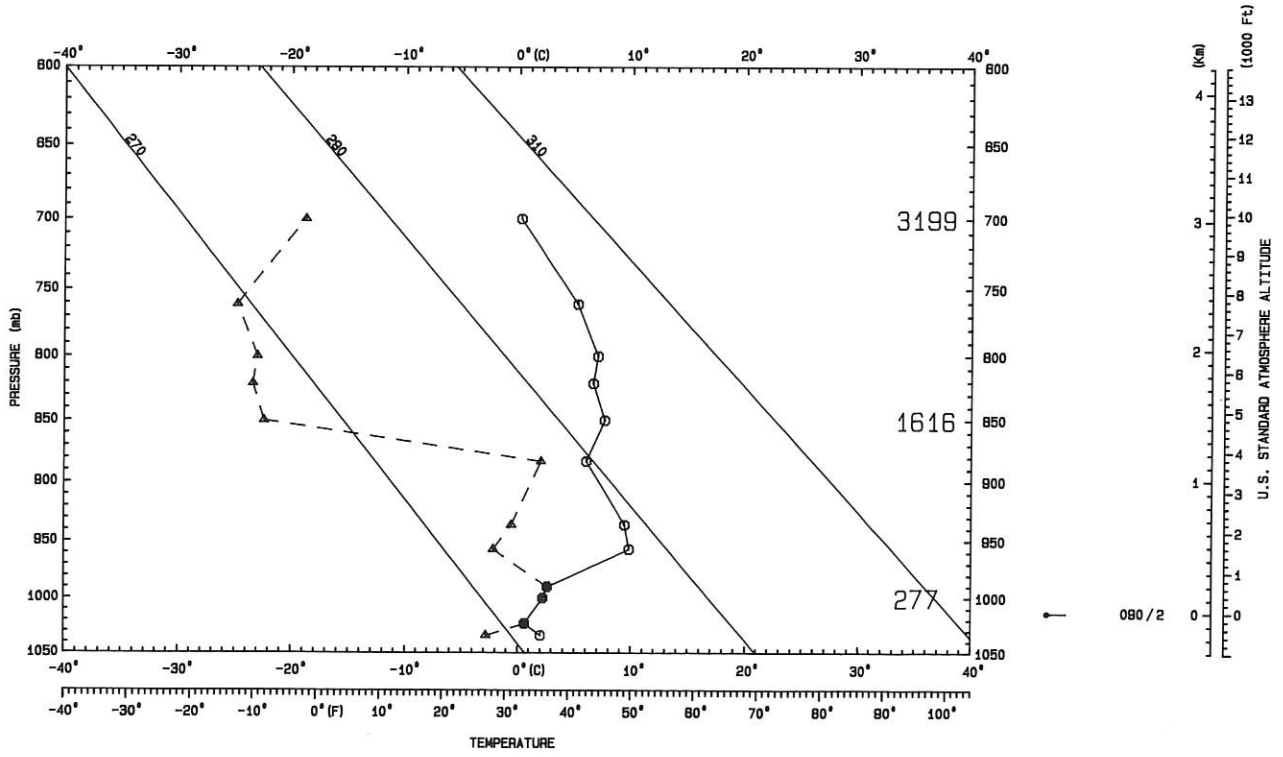
0700 PST Dec 13, 1985

Portage Bay, 2725 Montlake Blvd E, Seattle, WA



0700 PST Dec 17, 1985

Portage Bay, 2725 Montlake Blvd E, Seattle, WA



AIR STAGNATION ADVISORY AND WASHINGTON EPISODE AVOIDANCE PLAN

An "Air Stagnation Advisory" is issued by the National Weather Service when poor atmospheric dispersion conditions exist and these conditions 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. The Forecast stage was in effect in the Puget Sound region in 1985 during the following periods:

From:	To:
3 PM, Thursday, January 3	10 AM, Saturday, January 5
3 PM, Wednesday, January 9	5 PM, Friday, January 11
3 PM, Thursday, January 17	10 AM, Saturday, January 19
10 AM, Thursday, December 12	10 AM, Sunday, December 29

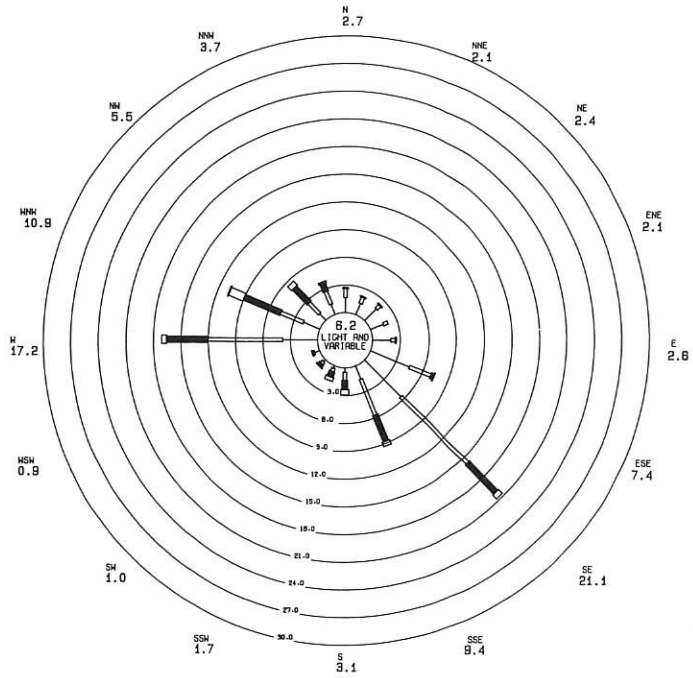
WIND ROSES

The measurement of local area wind speed and direction is important in the evaluation of air pollution. Low wind speed results in slowing the dispersion of pollutants and is therefore associated with higher air pollutant concentrations, particularly near major urban or industrialized areas. Wind direction data suggests which sources or source areas affect a specific location.

A wind rose is a graphical means of summarizing the winds for a given time period. It is essentially 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, each pointing to a wind direction compass point. 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 winds within each speed category. Using the percent scale located to the lower right of each rose, these lengths may be converted to the number of observations or hours during which a wind speed within the category occurred. The percentage frequency of light and variable winds (winds less than 1.5 knots) is printed in the center of the rose.



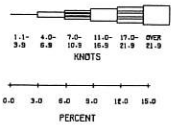
HOUR AVERAGE SURFACE WINDS

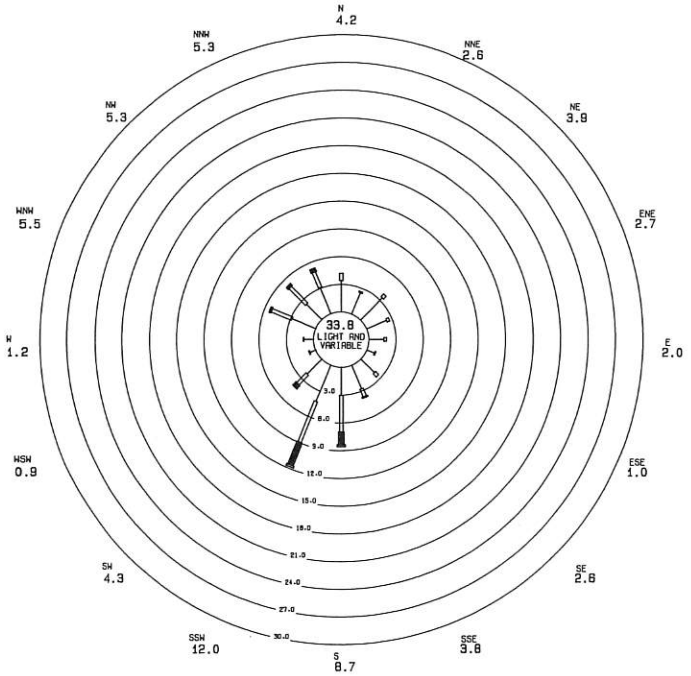
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1985

TOTAL OBSERVATIONS- 8,722





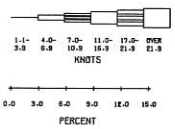
HOUR AVERAGE SURFACE WINDS

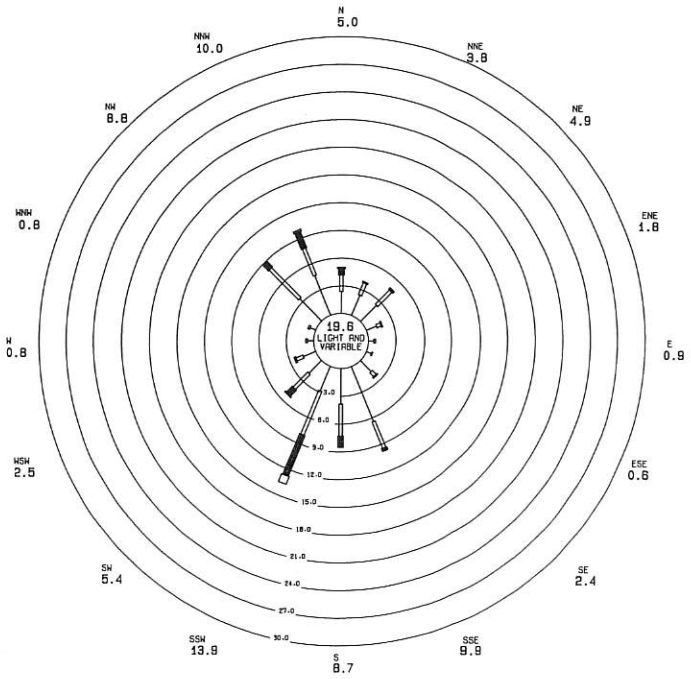
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
North 98th St & Stone Ave N, Seattle, Wa

INCLUSIVE DATES- ALL MONTHS 1985

TOTAL OBSERVATIONS- 8,723





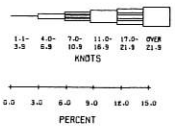
HOUR AVERAGE SURFACE WINDS

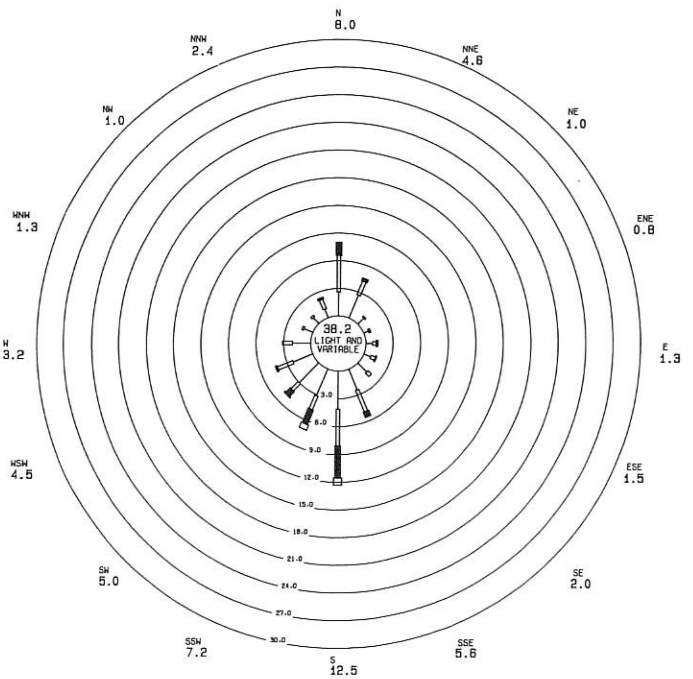
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Duwamish, 4401 E Marginal Way S, Seattle, Wa

INCLUSIVE DATES- ALL MONTHS 1985

TOTAL OBSERVATIONS- 8,719





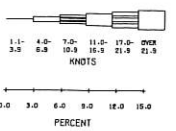
HOUR AVERAGE SURFACE WINDS

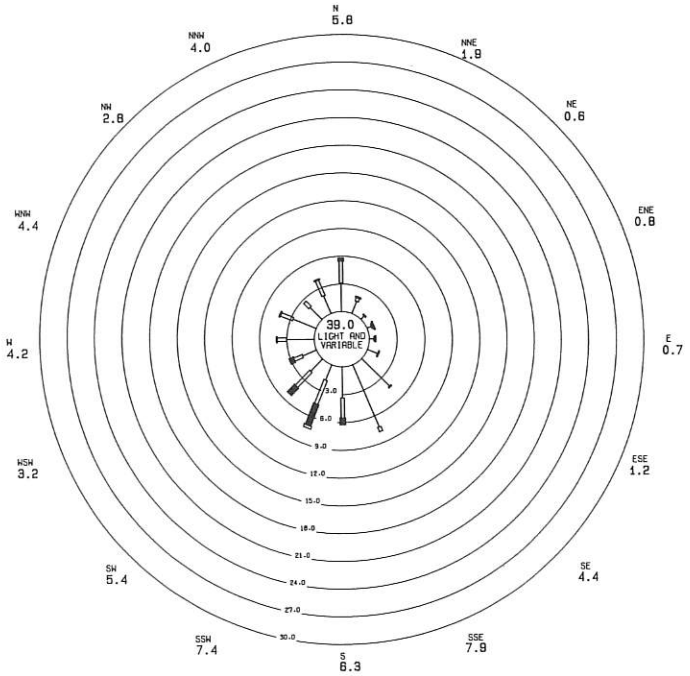
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
22918 86th Ave S, Kent, Wa

INCLUSIVE DATES- ALL MONTHS 1985

TOTAL OBSERVATIONS- 8,568





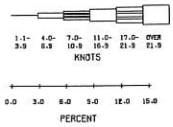
HOUR AVERAGE SURFACE WINDS

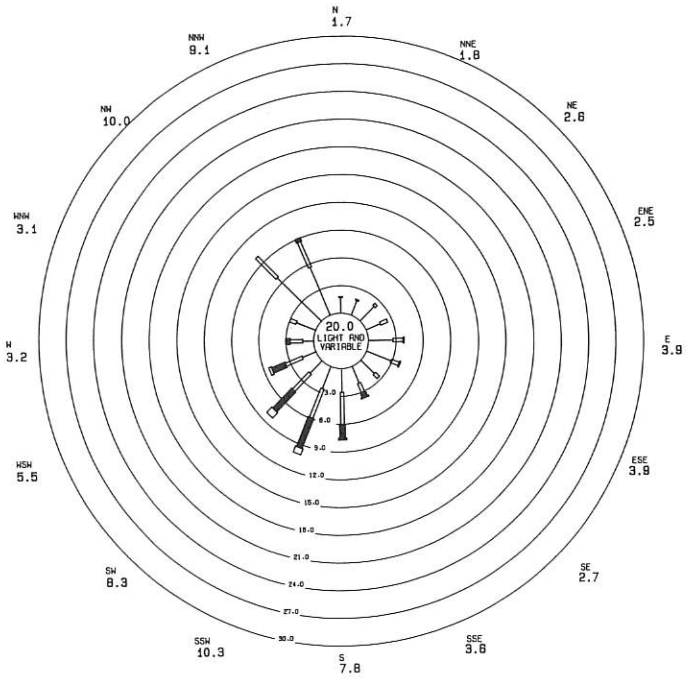
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Sumner Jr HS, 1508 Willow St, Sumner, Wa

INCLUSIVE DATES- ALL MONTHS 1985

TOTAL OBSERVATIONS- 8, 721





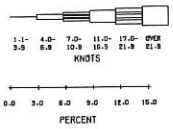
HOUR AVERAGE SURFACE WINDS

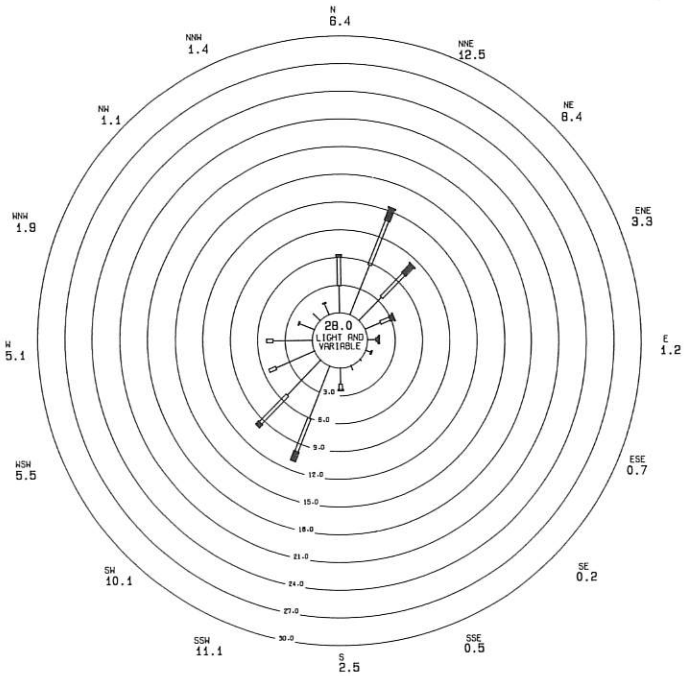
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Federal Way HS, 1401 S 304 St, Federal Way, Wa

INCLUSIVE DATES- ALL MONTHS 1985

TOTAL OBSERVATIONS- 8, 406





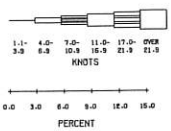
HOUR AVERAGE SURFACE WINDS

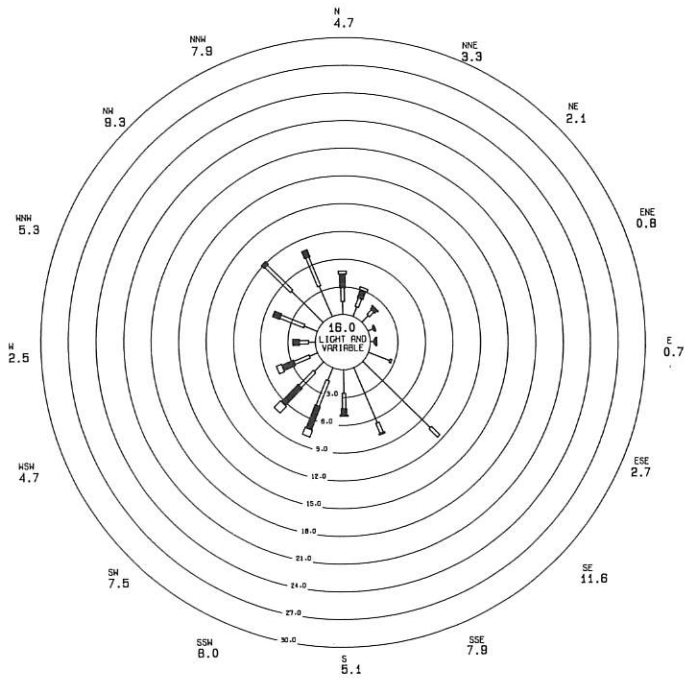
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
27th St NE & 54th Ave NE, Northeast Tacoma, Wa

INCLUSIVE DATES- JUN, JUL, AUG, SEP, OCT, NOV, DEC, 1985

TOTAL OBSERVATIONS- 4, 719





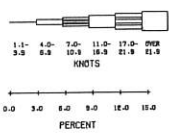
HOUR AVERAGE SURFACE WINDS

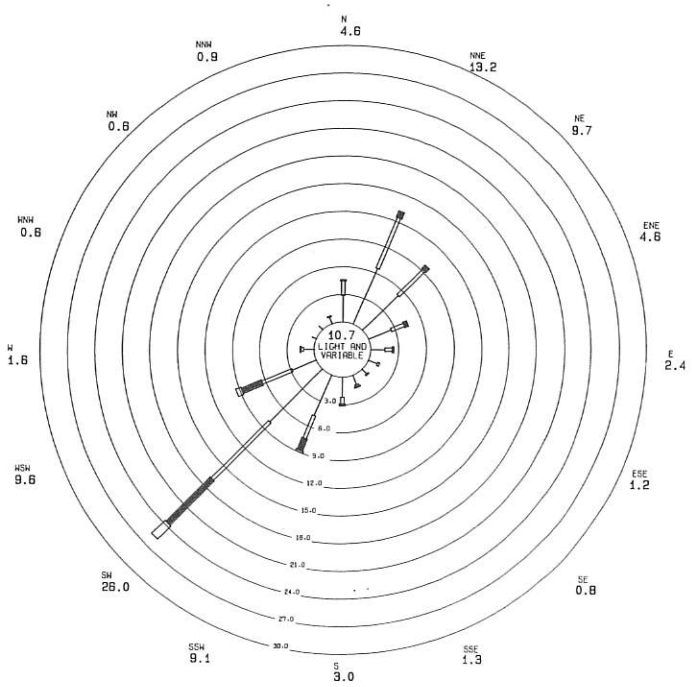
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Fire Station #12, 2318 E 11th St, Tacoma, Wa

INCLUSIVE DATES- ALL MONTHS 1985

TOTAL OBSERVATIONS- 8, 719





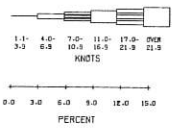
HOUR AVERAGE SURFACE WINDS

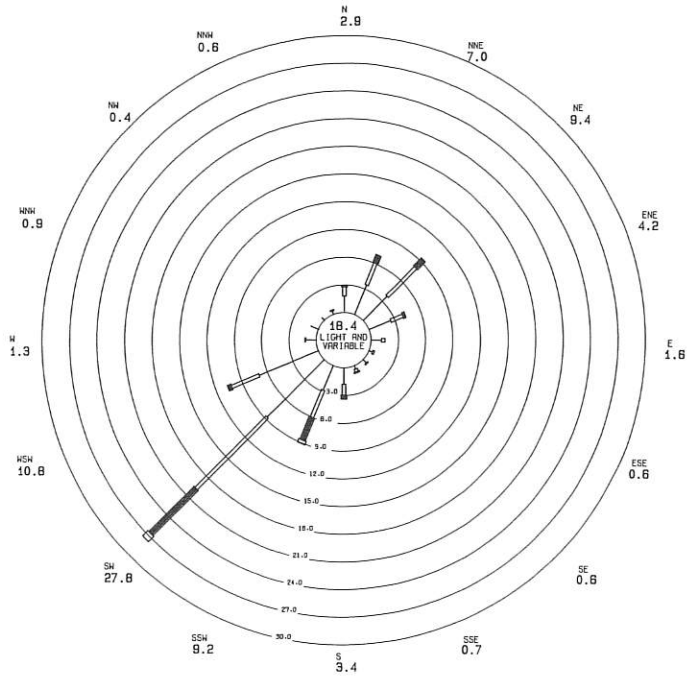
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
SW 283rd & 101st Ave SW, Maury Island, Wa

INCLUSIVE DATES- ALL MONTHS 1985

TOTAL OBSERVATIONS- 8,719





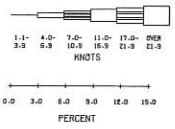
HOUR AVERAGE SURFACE WINDS

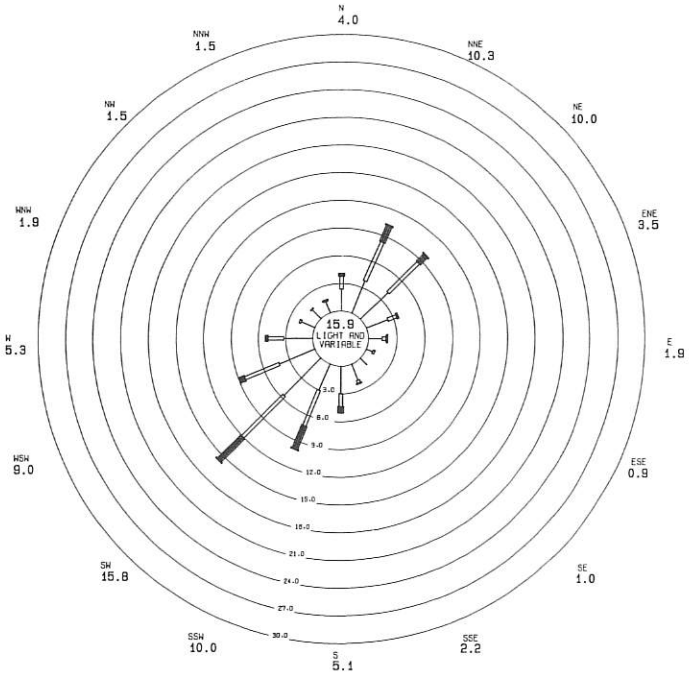
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
North 37th & Vassault Sts, Tacoma, Wa

INCLUSIVE DATES- JAN, FEB, MAR, APR, MAY, JUN, 1985

TOTAL OBSERVATIONS- 4,340





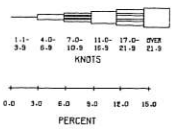
HOUR AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1985

TOTAL OBSERVATIONS- 8,709



Introduction

The stability wind rose summarizes concurrent observations of wind direction, wind speed and an objective calculation of low level stability. Each hourly observation is added to a three dimensional table at the position indicated by the wind direction assigned to the nearest of 16 compass points, by the wind speed assigned to one of 6 separate intervals, and by the low level stability category.

The low level stability is calculated following an objective procedure documented by D. Bruce Turner in the "Journal of Applied Meteorology", February, 1964. Wind speed and net radiation are needed to determine the stability. Each hourly estimate of daytime incoming radiation at a location is calculated from solar altitude for the time and date. Daytime incoming radiation is then decreased for increased cloud cover and lower cloud ceiling height. The estimate of nighttime outgoing radiation is also decreased for increased total cloud cover.

Stability Classes

A. EXTREMELY UNSTABLE. Daytime occurrence with high positive net radiation and wind speed 5 knots or less.

B. UNSTABLE. Daytime occurrence with wind speed less than 10 knots.

C. SLIGHTLY UNSTABLE. Daytime occurrence.

D. NEUTRAL. Characterized by low or zero net radiation. Separated into daytime or nighttime occurrence by local daily sunrise and sunset times.

E. STABLE. Nighttime occurrence in conjunction with lighter wind speeds. All stable conditions are combined within this class since urban areas do not become as stable in the lower layers as rural areas.

Discussion of Local Stability Wind Roses

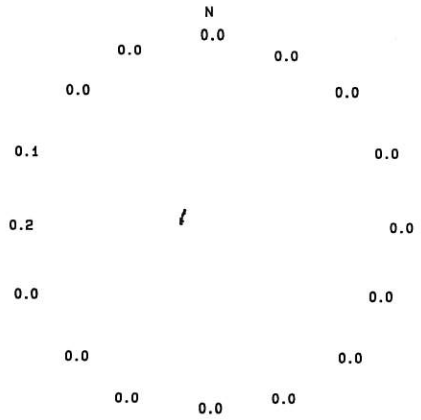
The local area stability wind roses are developed principally from measured 1 hour average wind data at the specific location. For the cloud data needed as one parameter in determining stability, data recorded for Seattle Tacoma International Airport are used. This 3 hour interval cloud data is extended to 1 hour intervals by assuming persistence for the hour preceding and the hour following the recorded cloud data.

Stability wind roses for three locations in the Puget Sound region follow this discussion. Description of wind roses in the preceding section provides information to interpret the wind rose for each stability class. There are two main differences. First, each wind rose for a stability class includes only the observations for that stability class, but the percentage frequencies refer to the total of all observations. Thus the sum of the frequency of winds from 16 compass points displayed around each wind rose equals the frequency of occurrence for that stability class. Second, light and variable wind cases are distributed within the lowest wind speed class based upon actual occurrences in the lowest two wind speed classes.

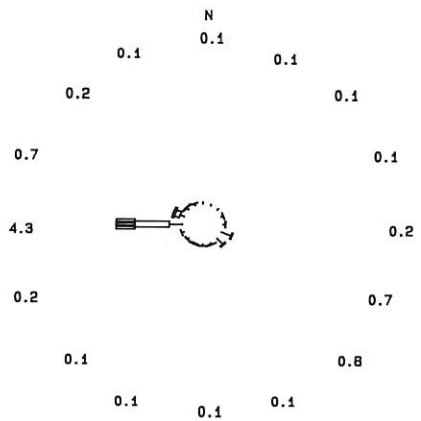
The stability wind rose summaries are required for air quality modeling. The Climatological Dispersion Model uses the same frequency tables used here to plot the stability wind roses.

The wind pattern is a unique feature for each location. Each stability class occurs with similar frequency at each location. Neutral stability existed somewhat less than one-half of the time and stable nighttime conditions occurred about one-third of the time. The Everett stability wind rose shows about a six percent greater frequency in the neutral category, probably due to stronger wind speeds measured at this top of a multi-story building location. At each station the wind rose for the stable class probably best documents the conditions of poor pollutant dispersion.

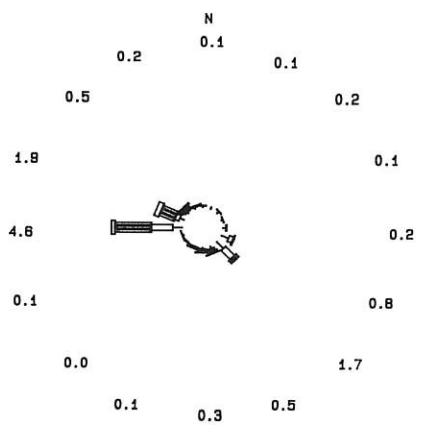
PUGET SOUND AIR POLLUTION CONTROL AGENCY



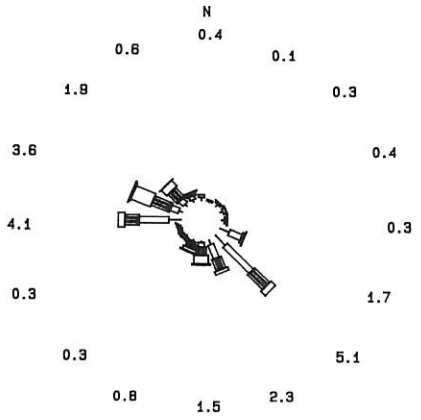
Extremely Unstable
0.2 %



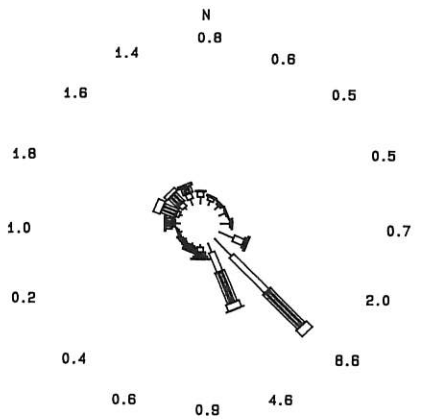
Unstable
7.6 %



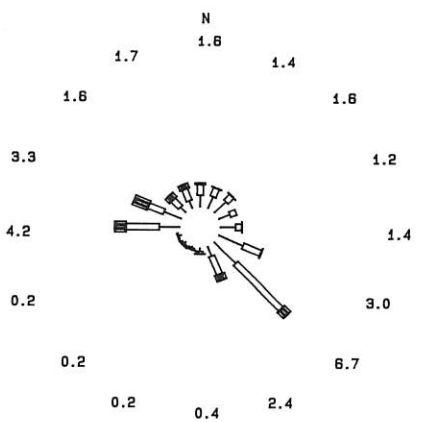
Slightly Unstable
11.4%



Neutral Daytime
23.6%



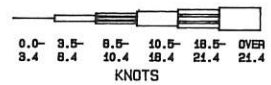
Neutral Nighttime
26.3%

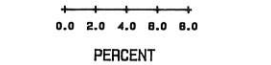


Stable
30.9%

STABILITY WIND ROSES

MEDICAL-DENTAL BLDG, 2730 COLBY, EVERETT, WA





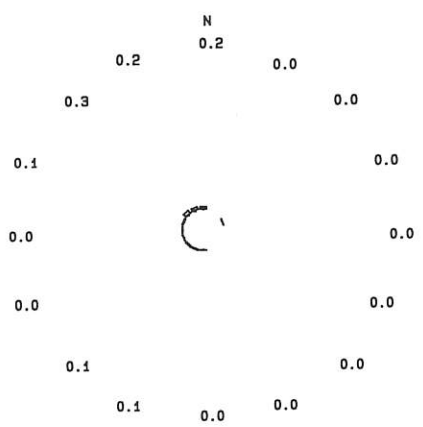
Period of Record: JAN - DEC, 1985

1 Hr Wind Location: MEDICAL-DENTAL BLDG, 2730 COLBY, EVERETT, WA

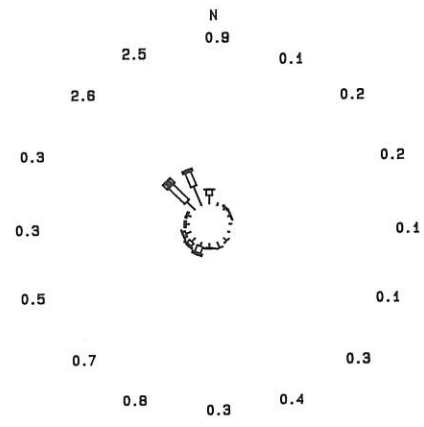
3 Hr Cloud Location: SEATTLE TACOMA INTERNATIONAL AIRPORT, WA

Percentage Frequency of Occurrence

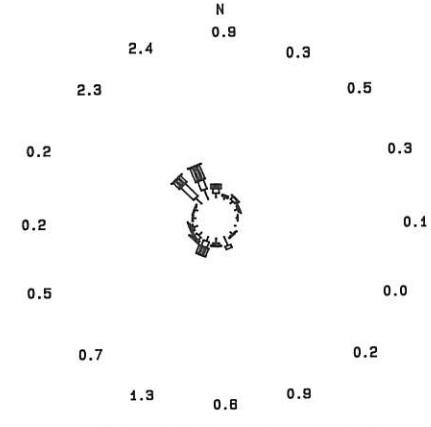
PUGET SOUND AIR POLLUTION CONTROL AGENCY



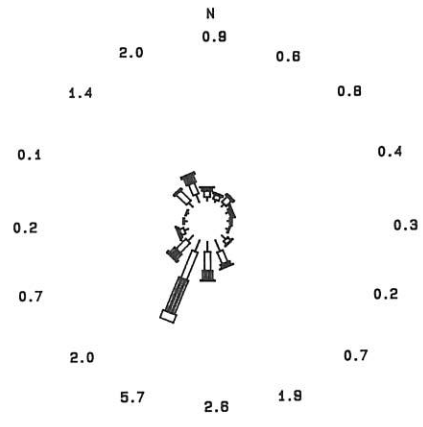
Extremely Unstable
1.0 %



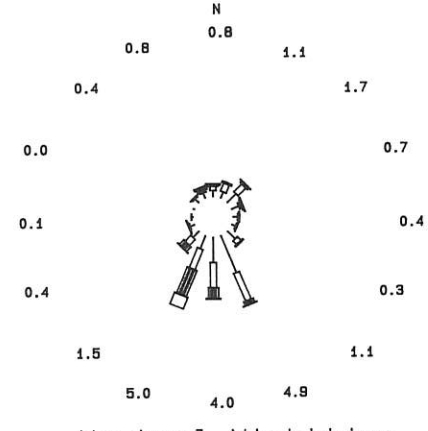
Unstable
10.2%



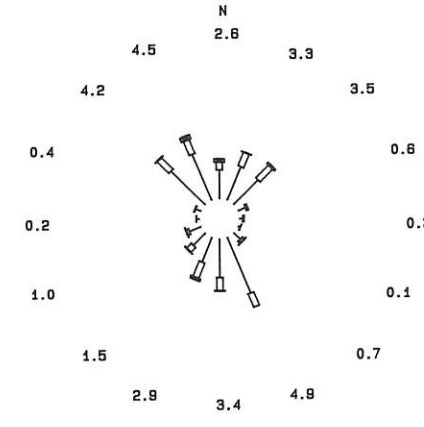
Slightly Unstable
11.2%



Neutral Daytime
20.4%



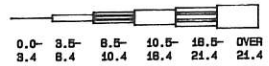
Neutral Nighttime
23.2%

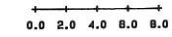


Stable
34.0%

STABILITY WIND ROSES

DUWAMISH, 4401 E MARGINAL WAY S, SEATTLE, WA





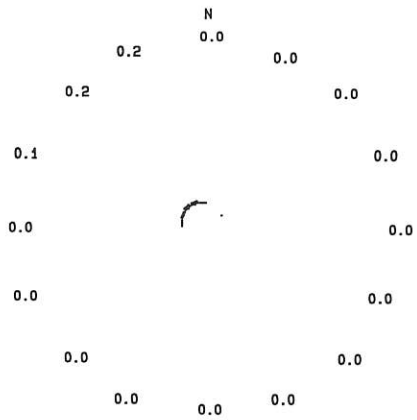
Period of Record: JAN - DEC, 1985

1 Hr Wind Location: DUWAMISH, 4401 E MARGINAL WAY S, SEATTLE, WA

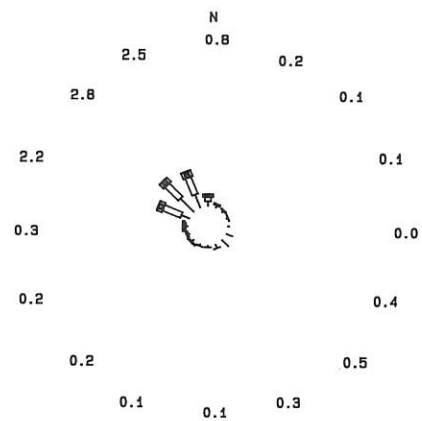
3 Hr Cloud Location: SEATTLE TACOMA INTERNATIONAL AIRPORT, WA

Percentage Frequency of Occurrence

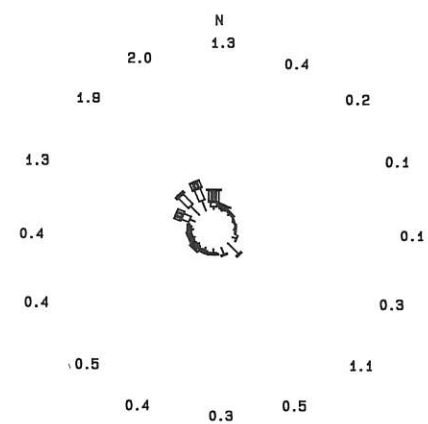
PUGET SOUND AIR POLLUTION CONTROL AGENCY



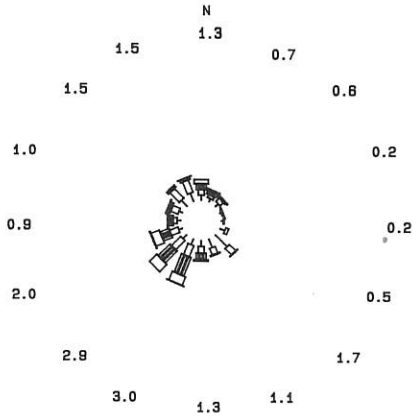
Extremely Unstable
0.5 %



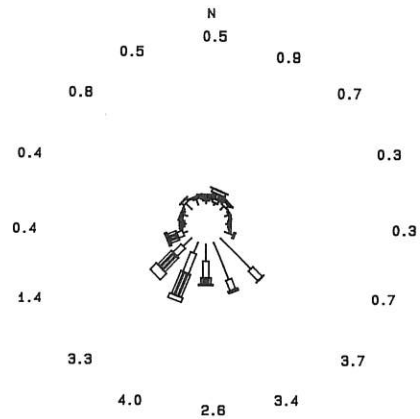
Unstable
10.8%



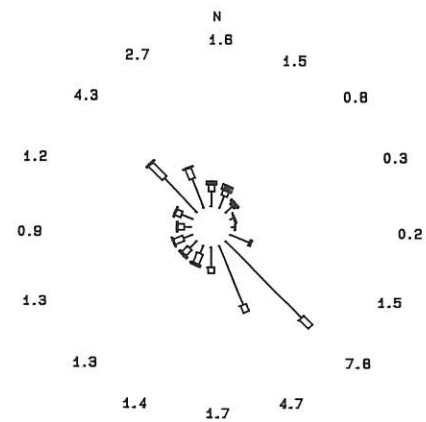
Slightly Unstable
11.1%



Neutral Daytime
20.5%



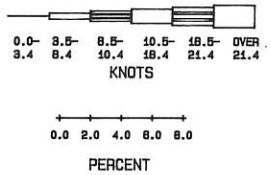
Neutral Nighttime
24.0%



Stable
33.2%

STABILITY WIND ROSES

FIRE STATION #12, 2316 E 11TH ST, TACOMA, WA



Period of Record: JAN - DEC, 1985

1 Hr Wind Location: FIRE STATION #12, 2316 E 11TH ST, TACOMA, WA

3 Hr Cloud Location: SEATTLE TACOMA INTERNATIONAL AIRPORT, WA

Percentage Frequency of Occurrence

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.

Pollutant	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

POLLUTANT STANDARDS INDEX

The Pollutant Standards Index 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 breakpoint of the Index. Values between breakpoints may be determined by linear interpolation.

Pollutant		Concentration
Carbon Monoxide	(CO)	8 hour average in parts per million
Total Suspended Particulates	(TSP)	24 hour average in micrograms per cubic meter
Sulfur Dioxide	(SO2)	24 hour average in parts per million
Ozone	(OZ)	1 hour average in parts per million

PSI Breakpoints and Pollutant Concentrations

PSI value	CO (8 hrs)	TSP (24 hrs)	SO2 (24 hrs)	OZ (1 hr)
50	4.5	75	0.03	0.06
100	9.0	260	0.14	0.12
200	15.0	375	0.30	0.20
300	30.0	625	0.60	0.40
400	40.0	875	0.80	0.50
500	50.0	1000	1.00	0.60

AMBIENT AIR QUALITY STANDARDS

SULFUR OXIDES

The presence of sulfur oxides in the ambient air has been associated with a variety of respiratory diseases and increased mortality rates. They represent a significant economic burden and have a nuisance impact. When sulfur oxides are inhaled with small particles, the effect on health is increased. Inhalation of sulfur dioxide can cause increased airway resistance by constricting lung passages.

PARTICULATES

Small discrete masses of solid or liquid matter dispersed in the atmosphere, especially those of one micron or less in diameter, are associated with a variety of adverse effects on public health and welfare. Particulate matter in the respiratory tract may produce injury by itself, or it may act in conjunction with gases to increase the effect on the body. Small particles suspended in the air are chiefly responsible for reduced visibility in the Puget Sound area. Soiling of buildings and other property is a common effect of high particulate levels.

CARBON MONOXIDE

Carbon monoxide reacts with the hemoglobin in red blood cells to decrease the oxygen-carrying capacity of the blood. The national primary standard for carbon monoxide was based on evidence that levels of carboxyhemoglobin in human blood as low as 2.5% may be associated with impairment of ability to discriminate time intervals. The national ambient air quality standards for carbon monoxide are intended to protect against the occurrence of carboxyhemoglobin levels above 2%. Smoking 2 packs of cigarettes a day raises carboxyhemoglobin levels to 5%.

	NATIONAL			WASHINGTON STATE		PUGET SOUND REGION	
	PRIMARY	SECONDARY					
SULFUR OXIDES	ppm	ppm	*	ppm	*	ppm	*
Annual Average	0.03		a	0.02	a	0.02	a
30 day Average						0.04	a
24 hour Average	0.14		b	0.10	b	0.10	a
3 hour Average		0.50	b				
1 hour Average				0.25	c	0.25	c
1 hour Average				0.40	b	0.40	a
5 min Average						1.00	d
SUSPENDED PARTICULATES	ug/cubic meter	ug/cubic meter		ug/cubic meter		ug/cubic meter	
Annual Geometric Mean	75	60	a	60	a	60	a
24 hour Average	260	150	b	150	b	150	b
CARBON MONOXIDE	ppm			ppm		ppm	
8 hour Average	9		b	9	b	9	b
1 hour Average	35		b	35	b	35	b
OZONE	ppm	ppm		ppm		ppm	
1 hour Average	0.12	0.12	e	0.12	e	0.12	e
NITROGEN DIOXIDE	ppm	ppm		ppm		ppm	
Annual Average	0.05	0.05	a	0.05	a	0.05	a
LEAD	ug/cubic meter	ug/cubic meter				ug/cubic meter	
Calendar Quarter Average	1.5	1.5	a			1.5	a

ppm = parts per million

ug/cubic meter = micrograms per cubic meter

*

a Never to be exceeded
b Not to be exceeded more than once per year
c Not to be exceeded more than twice in seven days
d Not to be exceeded more than once in eight hours
e Standard attained when expected number of days per year with maximum hourly average above 0.12 ppm is equal to or less than one

OZONE

Oxidants are produced in the atmosphere when nitrogen oxides and some hydrocarbons are exposed to sunlight. Ozone is the oxidant found in largest amounts. 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 and 0.25 ppm, causes lung tightness, coughing, and wheezing. Other oxidants, produced in smaller amounts than ozone, cause eye irritation. Persons with chronic respiratory problems such as asthma seem most sensitive to changes in ozone concentration.

NITROGEN DIOXIDE

Nitric oxide results from the fixation of nitrogen and oxygen at high temperatures as in fuel combustion. There are several atmospheric reactions which lead to the oxidation of nitric oxide to nitrogen dioxide, and the presence of nitrogen dioxide in ambient air is essential to the production of photochemical oxidants. The presence of nitrogen dioxide in ambient air has been associated with a variety of respiratory diseases.

LEAD

Lead affects humans in numerous ways, but the greatest effects appear to be on the blood-forming system, the nervous system, and the kidneys. It affects some persons 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 lead levels of 30 micrograms per deciliter of blood.

Revised 4/86