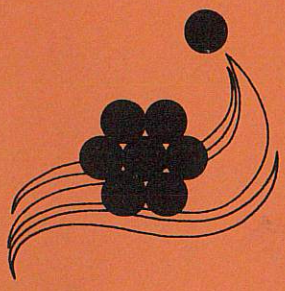
Puget Sound
Air Pollution Control Agency

1982
AIR QUALITY
DATA SUMMARY

Counties Of



King
Kitsap
Pierce
Snohomish

Puget Sound Air Pollution Control Agency

200 West Mercer Street, Room 205, P.O. Box 9863
Seattle, Washington 98109
(206) 344-7330

Serving King, Kitsap, Pierce and Snohomish Counties

BOARD OF DIRECTORS (1983)

Harvey Poll, Chairman
Member at Large

Joe Stortini, Vice Chairman
Pierce County Councilman

James B. Haines
Snohomish County Councilman

Ray Aardahl
Kitsap County Commissioner

Randy Revelle
King County Executive

Morrie Dawkins
Mayor, City of Bremerton

William E. Moore
Mayor, City of Everett

Doug Sutherland
Mayor, City of Tacoma

Charles Royer
Mayor, City of Seattle

ADVISORY COUNCIL

Wayne Dappen
Industrial Representative, Everett

William Giddings
Public Representative, Tacoma

Paul McCurley
Public Representative, Everett

August T. Rossano, Jr.
Public Representative, Seattle

Carl W. Virgil
Industrial Representative, Tacoma

AIR POLLUTION CONTROL OFFICER

Arthur R. Dammkoehler

1982
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

1982 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 JUNE, 1983
TECHNICAL SERVICES DIVISION
(206) 344-7326

INTRODUCTION

This eleventh annual data summary presents air quality and meteorological data measured in the Puget Sound Region during 1982. The format is similar to that of past annual summaries. 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.

A section summarizing air quality using the nationally uniform Pollutant Standards Index (PSI) begins on page 6. The PSI provides a capsule summary of daily air quality using a simple reference scale. This reference scale relates to the short term standard for each of the pollutants set to protect health. Each daily PSI value during 1982 for Everett, Seattle and Tacoma is displayed on a graph and summarized in a table. Every weekday the Agency reports the current PSI to the news media and the public. Anyone may obtain the current PSI also from the Washington Lung Association in Seattle by dialing ~~322-7110~~ 282-5565 or by dialing 1-800-732-9339 toll-free from outside Seattle.

New this year is a summary of suspended particulates smaller than 15 micrometers measured with a Size Selective Inlet (SSI) high volume sampler. These measurements were taken at three stations each sixth day on the national sampling schedule. This data is summarized on page 22 and included in the correlation analysis on page 25.

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 32, titled Quality Assurance, summarizes the program and presents the Precision and Accuracy audit results.

All data collected are reported quarterly to the 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 region in addition to that done by the Agency. The Department 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, Support Services Section, Olympia, Washington 98504.

PUGET SOUND AIR POLLUTION CONTROL AGENCY

Atmospheric Sampling Network

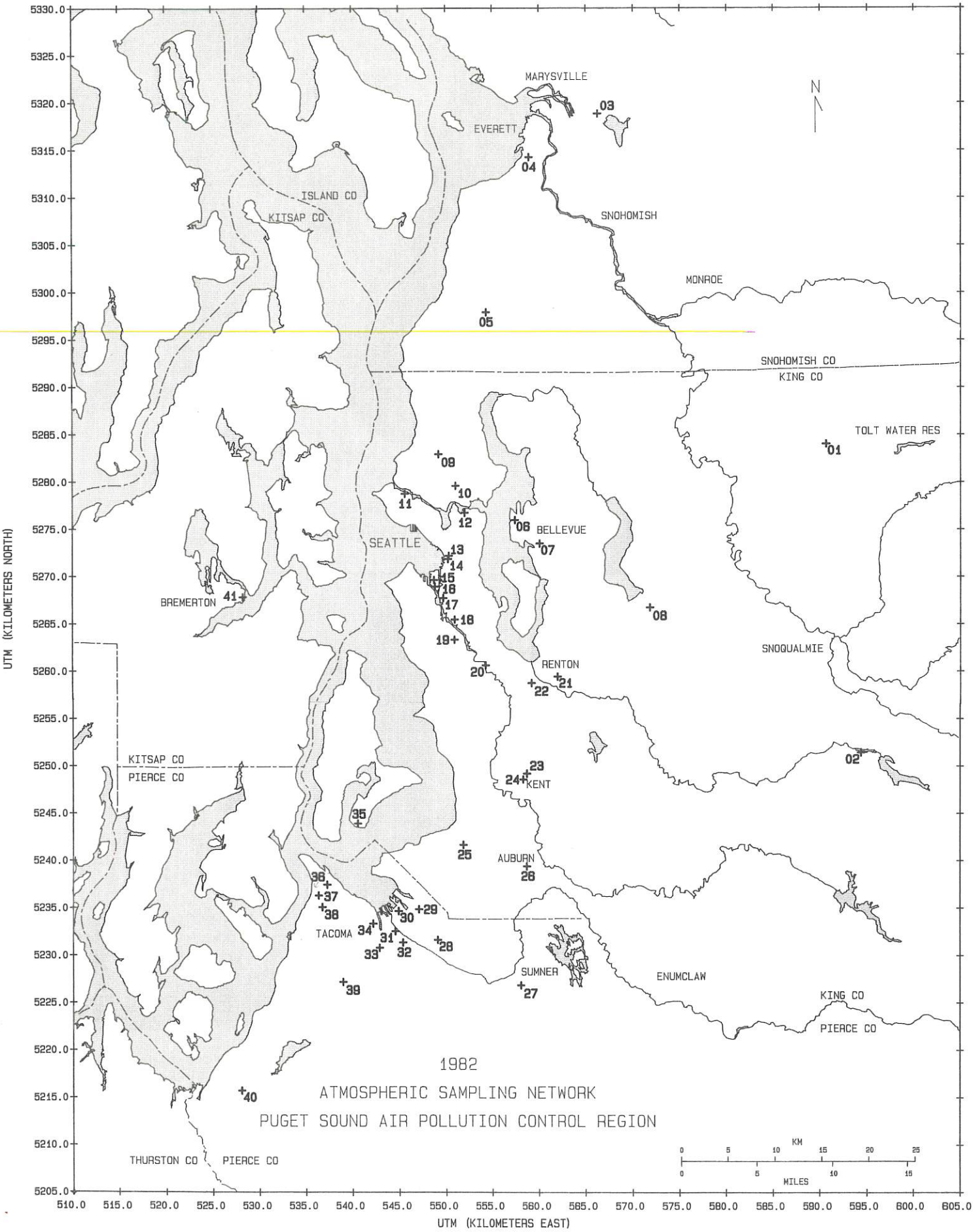
1982

	Location	Type of Sampling[a] A	B	C	D	E	F	G	H	I	J
01	Tolt River Watershed, King County, Wa	A									
02	Cedar River Masonry Dam, King County, Wa	A									
*03	Highway 9 & 28th St NE, Lake Stevens, Wa	A									
04	Medical-Dental Bldg, 2730 Colby, Everett, Wa	A	B	C	D						
*05	Lynnwood HS, 3001 184th St SW, Lynnwood, Wa	A									
*06	Evergreen Point Bridge Toll Plaza, Medina, Wa									I	
*07	504 Bellevue Way NE, Bellevue, Wa	A								I	
*08	20050 SE 56th, Lake Sammamish State Park, Wa	A						G			J
09	North 98th St & Stone Ave N, Seattle, Wa	A	B	C	D				H	I	J
*10	5701 8th Ave NE, Seattle, Wa	A								I	
11	2700 W Commodore Way, Seattle, Wa	A									
*12	Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	A			D					I	
13	Public Safety Bldg, 604 3rd Ave, Seattle, Wa	A									
*14	Fire Station #10, 301 2nd Ave S, Seattle, Wa	A									
15	Harbor Island, 2555 13th Ave SW, Seattle, Wa	A								I	
16	Harbor Island, 3400 13th Ave SW, Seattle, Wa	A								I	
17	Duwamish, 4401 E Marginal Way S, Seattle, Wa	A	B	C	D				H		J
*18	Georgetown, 6431 Corson Ave S, Seattle, Wa	A									J
19	South Park, 723 S Concord St, Seattle, Wa	A									
20	Duwamish Valley, 12026 42nd Ave S, King Co, Wa	A									
21	SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	A									
22	200 South 2nd St, Renton, Wa	A									
23	22916 86th Ave S, Kent, Wa	A			D			G	H		
24	Memorial Park, 850 N Central Ave, Kent, Wa	A									
25	Federal Way HS, 1401 S 304 St, Federal Way, Wa	A	B		D						
26	115 E Main St, Auburn, Wa	A									
27	Sumner Jr HS, 1508 Willow St, Sumner, Wa	A			D			G			
28	Fife Sr High School, 5616 20th E, Fife, Wa	A									
29	2340 Taylor Way, Tacoma, Wa	A									J
30	Fire Station #12, 2316 E 11th St, Tacoma, Wa	A		C	D				H		J
31	Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	A									
32	Cascadia, 2002 E 28th St, Tacoma, Wa	A									
33	Willard School, S 32nd & S 'D' St, Tacoma, Wa	A		C	D						
34	Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	A									
35	SW 283rd & 101st Ave SW, Maury Island, Wa		B		D						
36	4716 North Baltimore St, Tacoma, Wa	A								I	
37	North 37th & Vassault Sts, Tacoma, Wa		B		D						
38	North 26th & Pearl Sts, Tacoma, Wa	A	B		D					I	
*39	Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	A									
*40	City Water Supply Pump House, Dupont, Wa	A									
41	City Hall, 239 4th St, Bremerton, Wa	A									

* Station operated by Washington State Department of Ecology (Additional Ozone and Nitrogen Dioxide sampling and all Carbon Monoxide sampling is performed by the Department of Ecology. Summaries of these data are included in this publication).

[a] Type of Sampling

A Suspended Particulates (Total)
B Sulfur Dioxide (SO2)
C Suspended Particulates-COH'S
D Wind Speed & Direction
E Nitrogen Dioxide (NO2)
F Nitric Oxide (NO)
G Ozone (O3)
H Atmospheric Particles (b - Scattering)
I Lead
J Suspended Particulates (size selective sampling)


MARYSVILLE
EVERETT
ISLAND CO
KITSAP CO
SNOHOMISH
MONROE
SNOHOMISH CO
KING CO
TOLT WATER RES
SEATTLE
BELLEVUE
BREMERTON
SNOQUALMIE
RENTON
KENT
KITSAP CO
PIERCE CO
AUBURN
TACOMA
SUMNER
ENUMCLAW
KING CO
PIERCE CO
THURSTON CO
PIERCE CO
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
N
1982
ATMOSPHERIC SAMPLING NETWORK
PUGET SOUND AIR POLLUTION CONTROL REGION
KM
MILES
UTM (KILOMETERS NORTH)
UTM (KILOMETERS EAST)

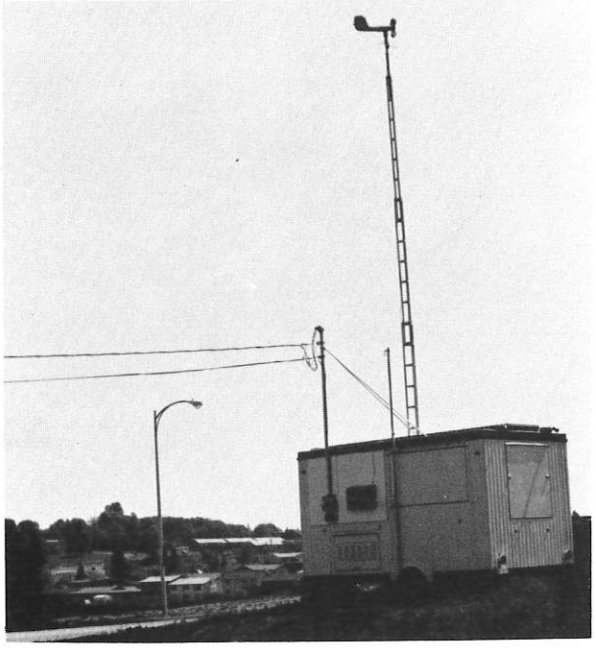
AIR QUALITY AND METEOROLOGICAL SAMPLING SYSTEM

- All remote telemetry stations continuously monitor:
  WIND DIRECTION and WIND SPEED

Each Station continuously measures one or more of these pollutants:
SUSPENDED PARTICULATES (COH's)
ATMOSPHERIC PARTICLES
(b scattering)
SULFUR DIOXIDE
NITROGEN DIOXIDE
NITRIC OXIDE
OZONE

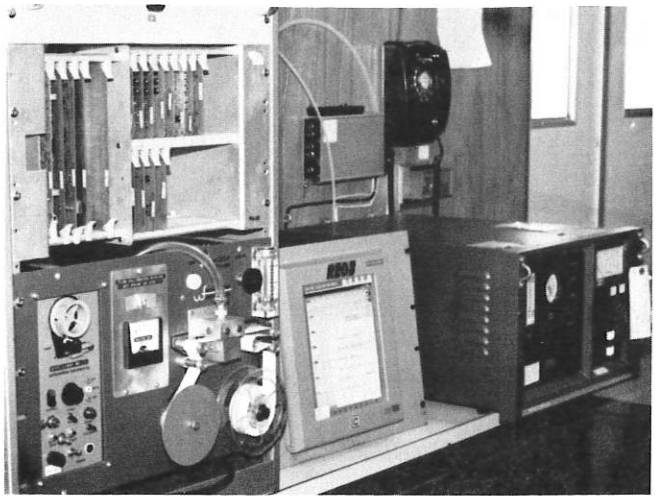
N. 98th St. and
Stone Ave. North,
Seattle

The WIND DIRECTION and SPEED sensor is mounted on a 10 meter tower. A sampling probe immediately left of the tower obtains an ambient air sample for analysis by instruments inside the station. Self-contained high volume samplers and a dichotomous sampler are located on the roof.

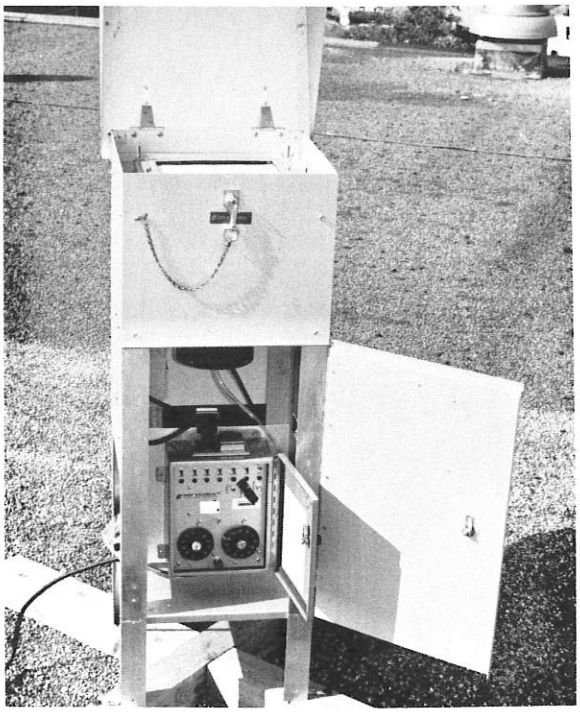


North 37th
and Vassault
Sts., Tacoma

Pictures on this page and one on the following page show sites where sampling is conducted. The monitoring objective and therefore the parameters actually sampled are often different. Actual sampling at each station is documented in the table on page 2.



Inside a station are the telemetry electronics which translate all the instrument signals for transmission over phone lines at the command of the central control station computer. A tape sampler analyzes SUSPENDED PARTICULATES measured as COHs. An analyzer operating on the principle of ultraviolet fluorescence measures SULFUR DIOXIDE. This measurement is also recorded at the site on a strip chart recorder.



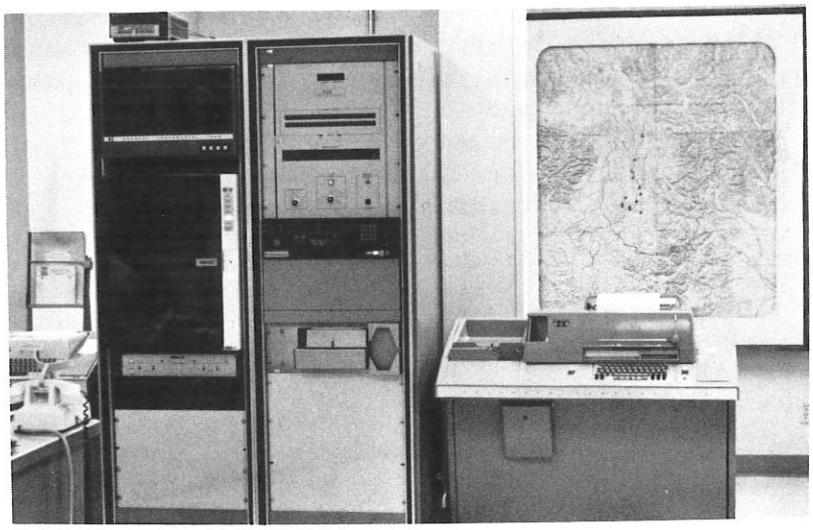
A high volume sampler is the federal reference method for measuring TOTAL SUSPENDED PARTICULATES. The instrument in the picture above is open to show the filter (in frame beneath hinged sampler cover) on which the sample is collected. An electric high flow rate blower pulls air through the filter at about 45 cubic feet per minute. Particulates are collected on the filter, and this provides an integrated sample for the period of sampling, usually a 24-hour midnight to midnight time period every sixth day.

Station at Duwamish
4401 E Marginal Way S, Seattle

On the roof several standard high volume samplers enable every day sampling of suspended particulates. A high volume sampler with a Size Selective Inlet (circular, dome shaped top) also operates at this station.

Most data from all remote stations is immediately telemetered to the central station computer via phone lines.

Central station computer controls the entire network. It processes all incoming data, and computes 15-minute, 1-hour, and 24-hour averages for immediate printout on a continuous schedule around the clock every day of the year.



- Values for suspended particulates measured by the high volume samplers are computed after each sampled filter is removed and transported to the laboratory where it is conditioned and weighed.
- All data is checked for validity by air quality specialists.
- After validation, the data is stored in permanent computer files and summarized at least monthly and annually. Once stored in final computer files, the data is readily available to meet a variety of needs.
- The data is used to document air quality levels throughout the region and thereby determine areas in which air quality standards are exceeded; to report the Pollutant Standards Index to the public; to maintain continuous surveillance for real-time episode avoidance; and to evaluate the effect of control and enforcement activities.

POLLUTANT STANDARDS INDEX

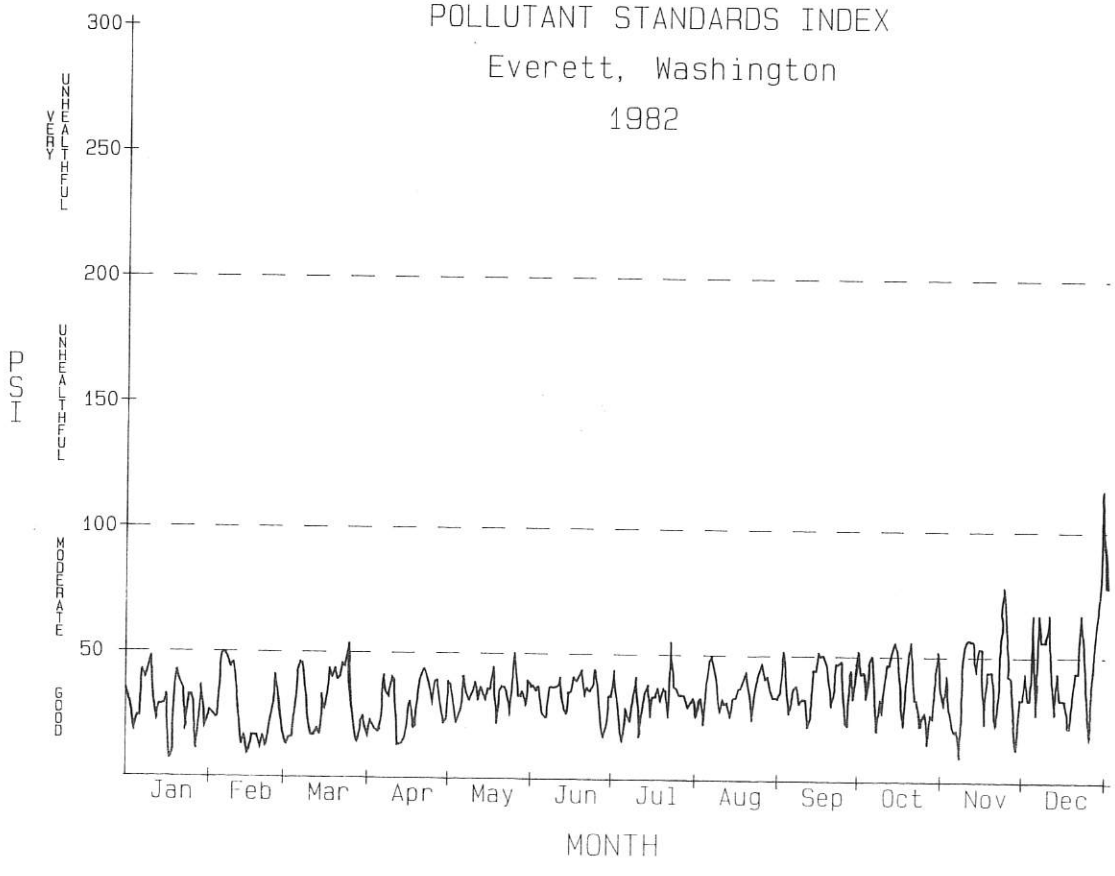
The Pollutant Standards Index (PSI) is a nationally uniform index for daily reporting of air quality. In cooperation with the State Department of Ecology, the Agency began reporting the PSI in 1980 for the Everett, Seattle, and Tacoma areas.

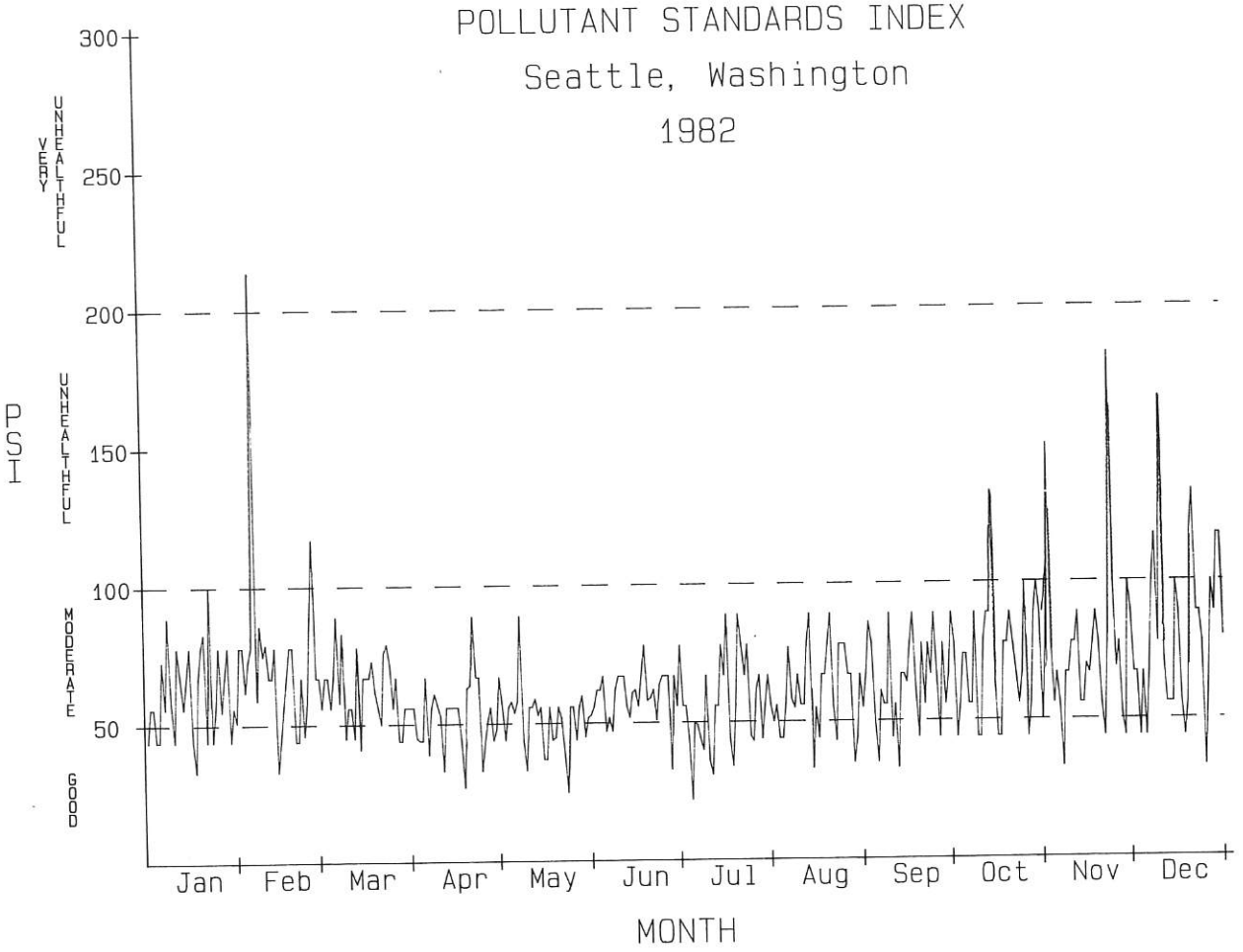
The PSI places maximum emphasis on short term health effects of 24 hours or less. The PSI is a range of values between zero and 500, with 0 to 50 indicating "Good" air quality, 51 to 100 being "Moderate", 101 to 199 considered "Unhealthful", 200 to 299 being "Very Unhealthful", and 300 and above "Hazardous". Whenever the PSI is higher than 100, a primary air quality standard has been exceeded. An index value of 200 means the pollutant concentration has reached the "Alert" level listed in the Washington Episode Plan.

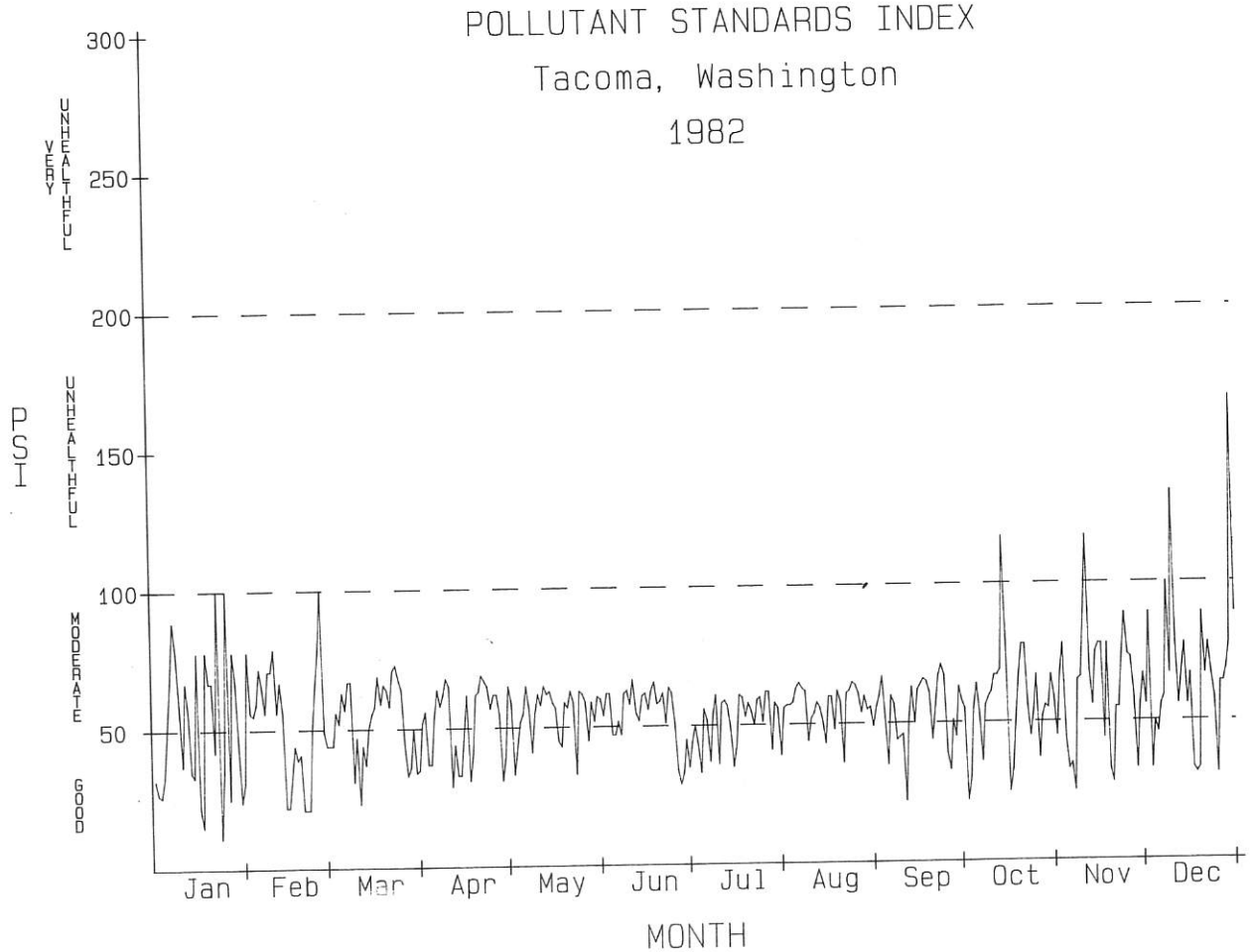
The PSI is designed to report upon five major air pollutants of concern for health: suspended particulates, sulfur dioxide, carbon monoxide, ozone, and nitrogen dioxide. The Agency reviews carbon monoxide, suspended particulates, and sulfur dioxide to report the index for Everett, Seattle and Tacoma. The index value for each day in each area is determined by the pollutant with the highest value on the PSI scale.

The accompanying graphs plot each daily PSI for Everett, Seattle, and Tacoma during 1982. The higher PSI values tend to occur during the fall and winter months often coinciding with air stagnation periods. A summary table shows the number of days in each PSI interval by month and also lists the maximum index for each month, the date of occurrence, and the pollutant causing that index value. During 1982 air quality was unhealthful on 1 day in Everett, on 10 days in Seattle (1 additional day was very unhealthful in Seattle), and on 4 days in Tacoma.

Air quality in Bellevue is principally determined by levels of carbon monoxide. During 1982 the air quality in Bellevue was unhealthful due to carbon monoxide on 5 days, all during Nov and Dec. The PSI for Bellevue reached 133 on Nov 23, Dec 10, 22, and 31. The other unhealthful day was Nov 24 when the PSI reached 117.




POLLUTANT STANDARDS INDEX
Seattle, Washington
1982
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
1982
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

1982

EVERETT

AIR QUALITY	(PSI Interval)	Number of Days in Each PSI Interval during Each Month												
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
GOOD	(0 to 50)	31	28	30	30	31	30	30	31	27	26	22	18	334
MODERATE	(51 to 100)	0	0	1	0	0	0	1	0	3	5	8	12	30
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		48	50	53	44	50	44	55	50	52	56	78	117	117
Date		9th	5th	24th	21st	25th	19th	22nd	6th	15th	14th	23rd	30th	Dec 30
Pollutant		TSP	TSP	TSP	TSP	SO2	TSP	SO2	TSP	TSP	CO	CO	CO	CO

SEATTLE

AIR QUALITY	(PSI Interval)	Number of Days in Each PSI Interval during Each Month												
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
GOOD	(0 to 50)	9	5	6	11	11	3	13	8	6	7	3	4	86
MODERATE	(51 to 100)	22	21	25	19	20	27	18	23	24	23	25	21	268
UNHEALTHFUL	(101 to 199)	0	1	0	0	0	0	0	0	0	1	2	6	10
VERY UNHEALTHFUL	(200 to 299)	0	1	0	0	0	0	0	0	0	0	0	0	1
Maximum PSI each month		100	214	89	89	89	78	89	89	89	133	183	167	214
Date		22nd	6th	6th	21st	7th	18th	16th	13th	9th	14th	23rd	10th	Feb 6
Pollutant		CO	TSP	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	TSP

TACOMA

AIR QUALITY	(PSI Interval)	Number of Days in Each PSI Interval during Each Month												
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
GOOD	(0 to 50)	17	12	14	11	7	8	12	5	10	7	9	7	119
MODERATE	(51 to 100)	14	16	17	19	24	22	19	26	20	23	20	22	242
UNHEALTHFUL	(101 to 199)	0	0	0	0	0	0	0	0	0	1	1	2	4
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		100	100	73	69	65	67	62	65	71	117	117	167	167
Date		22nd	26th	23rd	21st	6th	11th	26th	6th	23rd	14th	11th	30th	Dec 30
Pollutant		CO	CO	TSP	TSP	TSP	TSP	TSP	TSP	TSP	CO	CO	CO	CO

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

SUSPENDED PARTICULATES

Introduction

Suspended Particulates is a general term for small particles composed of dust, soot, organic matter, and compounds containing sulfur, nitrogen, and metals. These particulates, when sampled by the standard high volume federal reference method are called Total Suspended Particulates (TSP). Total Suspended Particulates range in diameter from 0.1 micrometer to an upper diameter range which is not very specific, but for many locations the upper diameter is about 25 to 30 micrometers.

In recent years some sampling methods specifically collect only the particulates less than 15 micrometers diameter (sometimes called inhalable particulates) or only the particulates less than 2.5 micrometers diameter (often termed fine particulates). Within the last year another method which selectively samples only the particulates less than 10 micrometers diameter has become commercially available. This instrument modification responded to the continuing review of the particulate standard at the national level which, in draft form, specifies a 10 micrometer cutpoint. Though revision of the national particulate standard has been under consideration for several years, no new standard has yet been established.

Particulate Sources and Measured Levels

Particulates are released from industrial operations, from auto and truck traffic, and from other sources. These emissions change from day to day due to intermittent industrial operations, equipment upset or breakdown and traffic variations.

Once into the air, particulates are dispersed and 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 may 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 Suspended Particulate Maps

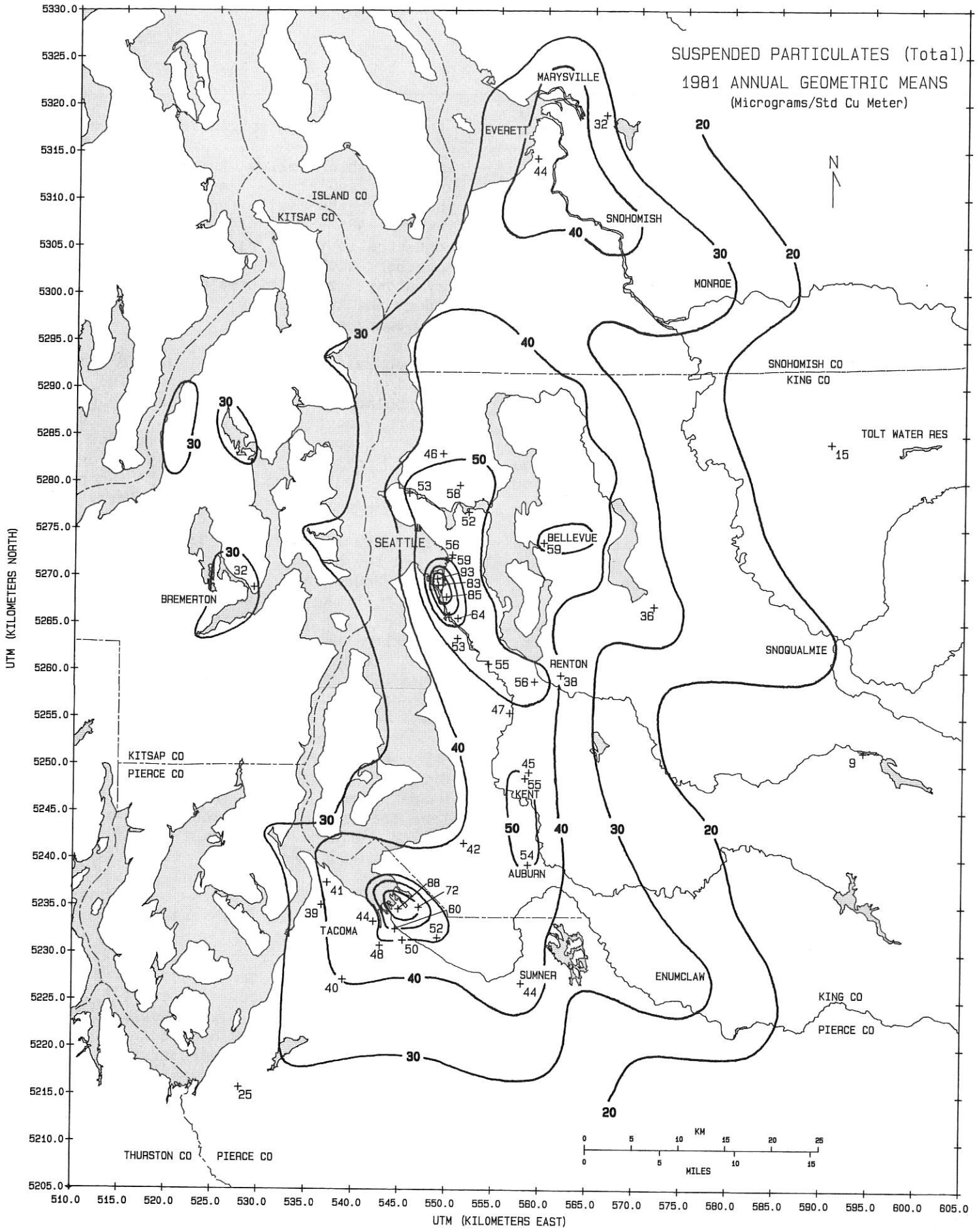
The maps which follow this page present annual geometric mean TSP values throughout the region for each of calendar years 1981 and 1982. Measured concentrations at each sampling station, together with a particulate emission inventory and information about local winds and topography, were used in developing each map.

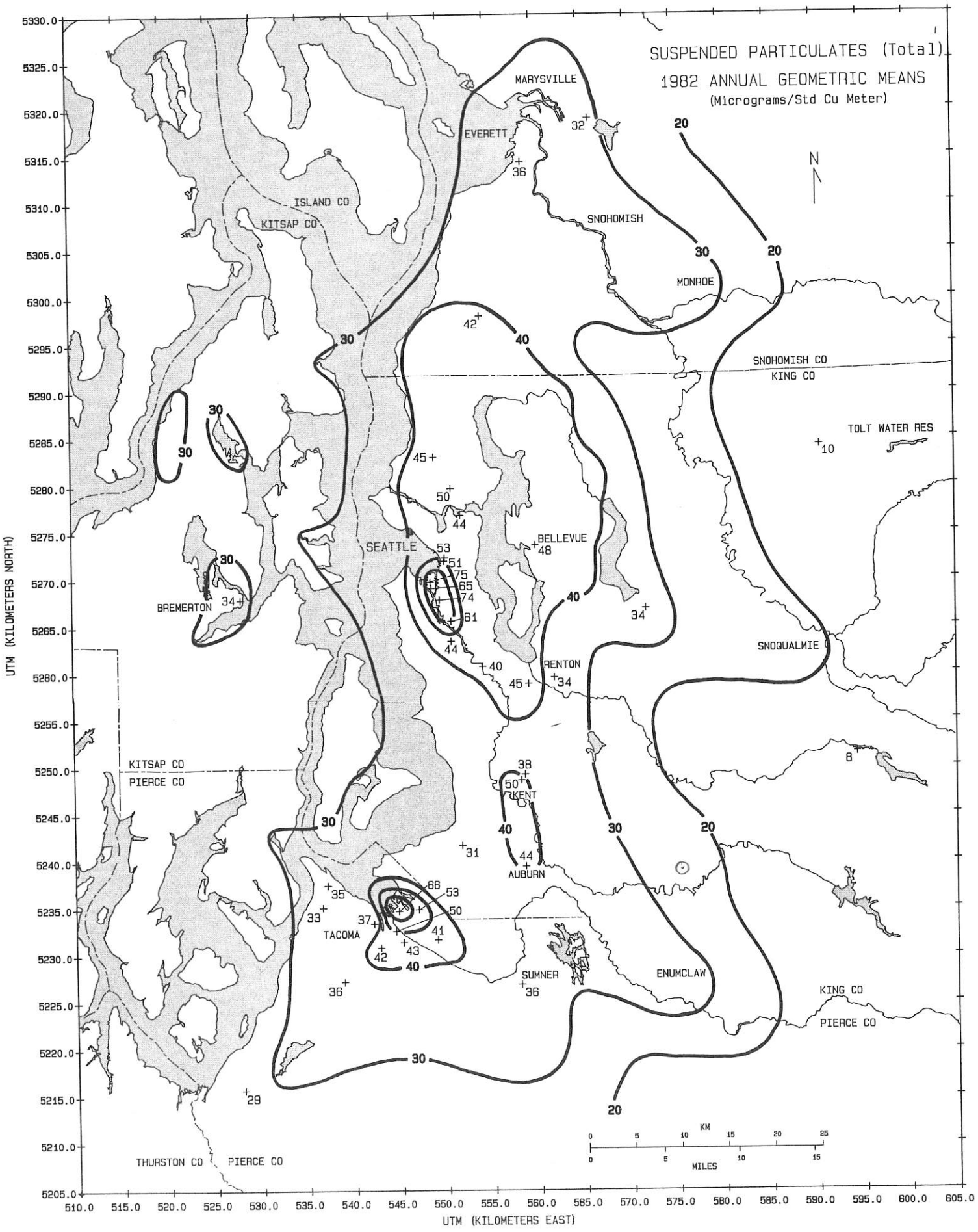
The annual concentration of TSP at a location may be determined by interpolating between adjacent isopleths (lines connecting points of equal concentration). Areas which exceed the annual primary standard of 75 micrograms per cubic meter and the annual secondary standard of 60 are clearly outlined. The Tacoma Port area and the Harbor Island-Duwamish Valley area of Seattle record the highest concentrations in the Puget Sound area. At the end of 1982 the annual primary standard has been met, however the long history of readings exceeding the primary standard in these two industrial areas suggests the potential exists for this standard to be exceeded in the future.

Suspended Particulate Trends

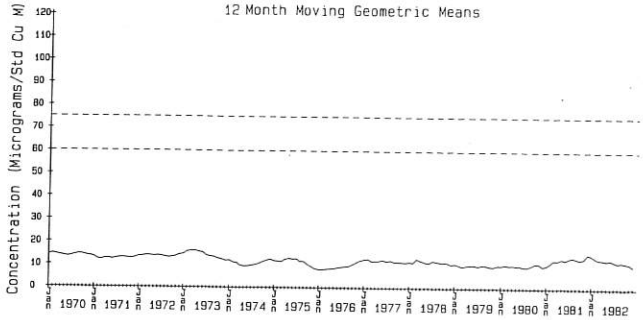
Graphic plots of moving TSP geometric means permit quick visual review of long term trends, but to depict any trend such charts require many years of data. A 12 month moving geometric mean compares directly to the annual primary and secondary standards which are shown by reference lines on these charts.

Plotted moving geometric mean charts for several stations are presented in this section. One station near the Tolt Water Reservoir presents a steady unchanging low TSP value apparently unaffected by the urbanized areas. Other stations in the industrialized Seattle Duwamish Valley and Tacoma Port area show values exceeding the annual primary standard for many past years, but during 1982 these values decreased to just about the level of the primary standard.


SUSPENDED PARTICULATES (Total)
1981 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
KENT
AUBURN
TACOMA
SUMNER
ENUMCLAW
KING CO
PIERCE CO
THURSTON CO
PIERCE CO
KM
MILES
UTM (KILOMETERS NORTH)
UTM (KILOMETERS EAST)

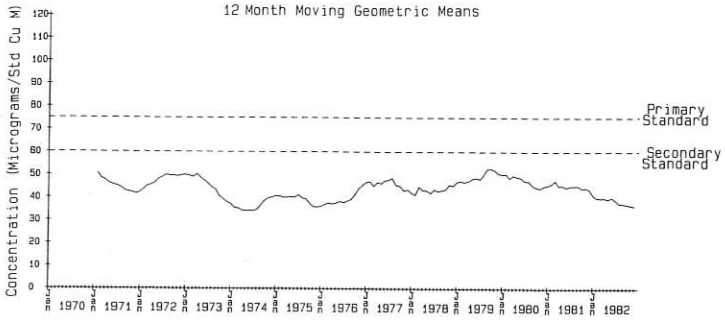

SUSPENDED PARTICULATES (Total)
1982 ANNUAL GEOMETRIC MEANS
(Micrograms/Std Cu Meter)
N
MARYSVILLE
EVERETT
ISLAND CO
KITSAP CO
SNOHOMISH
MONROE
SNOHOMISH CO
KING CO
TOLT WATER RES
SEATTLE
BELLEVUE
BREMERTON
RENTON
SNOQUALMIE
KENT
AUBURN
TACOMA
SUMNER
ENUMCLAW
KITSAP CO
PIERCE CO
KING CO
PIERCE CO
THURSTON 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



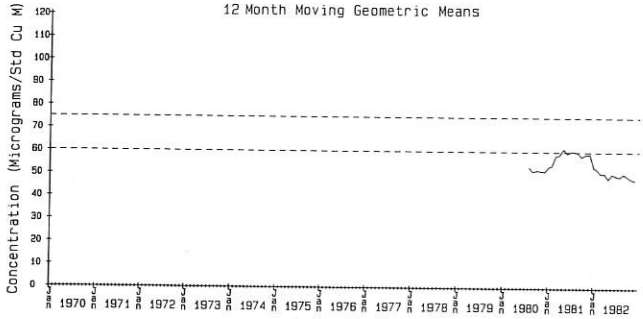
TOLT RIVER WATERSHED, KING COUNTY, WA

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



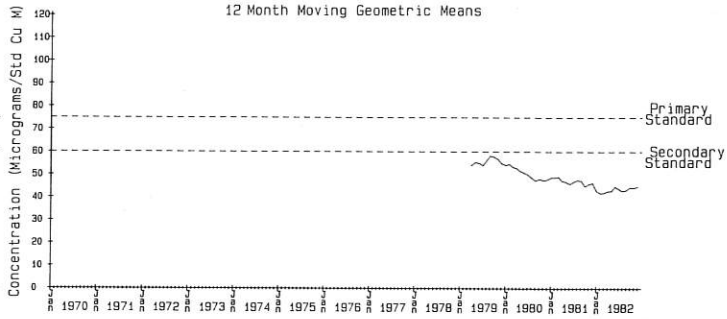
MEDICAL-DENTAL BLDG, 2730 COLBY, EVERETT, WA

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



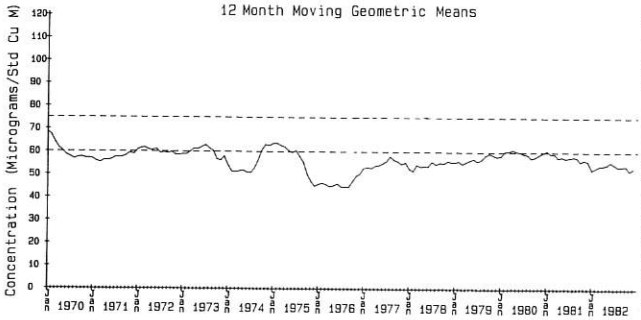
504 BELLEVUE WAY NE, BELLEVUE, WA

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



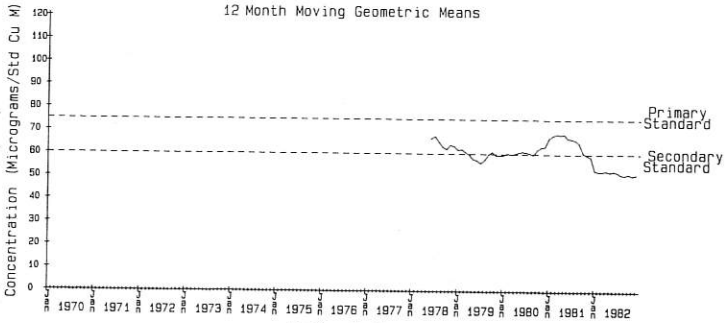
NORTH 98TH ST & STONE AVE N, SEATTLE, WA

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

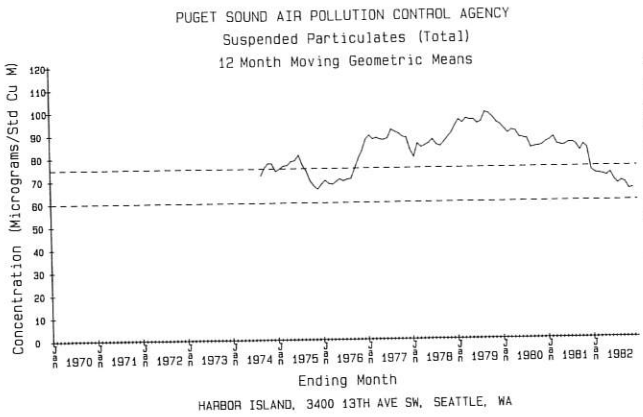


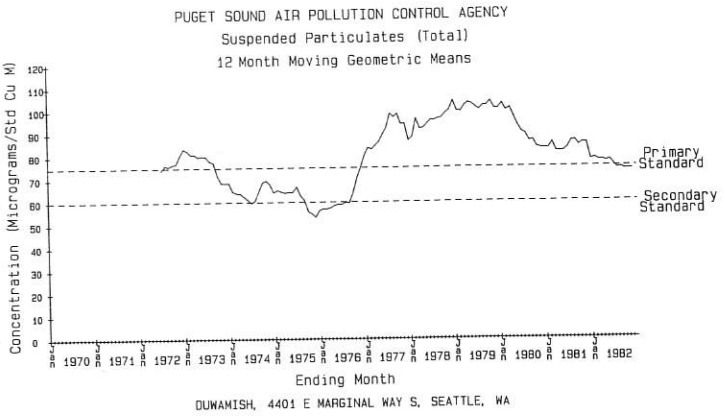
PUBLIC SAFETY BLDG, 604 3RD AVE, SEATTLE, WA

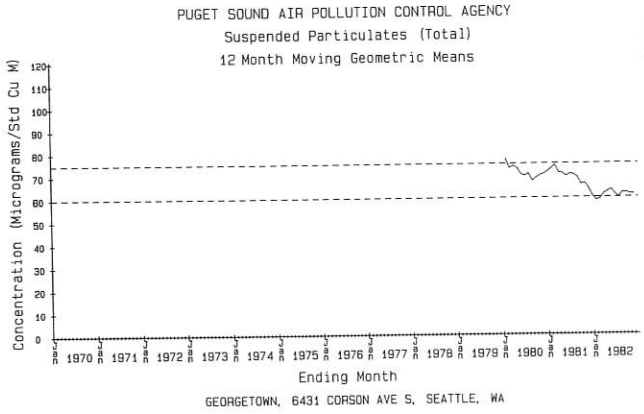
PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means

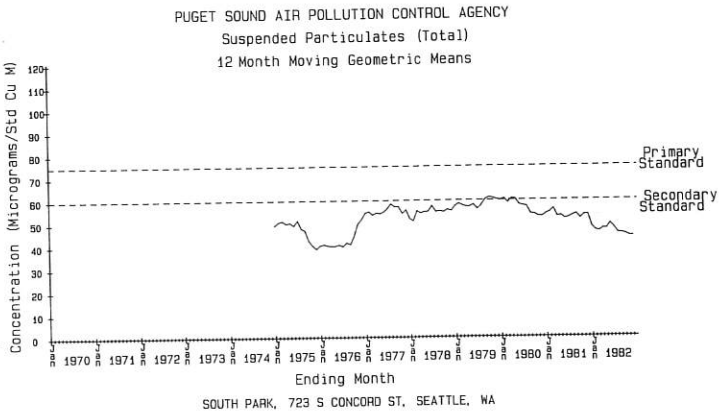


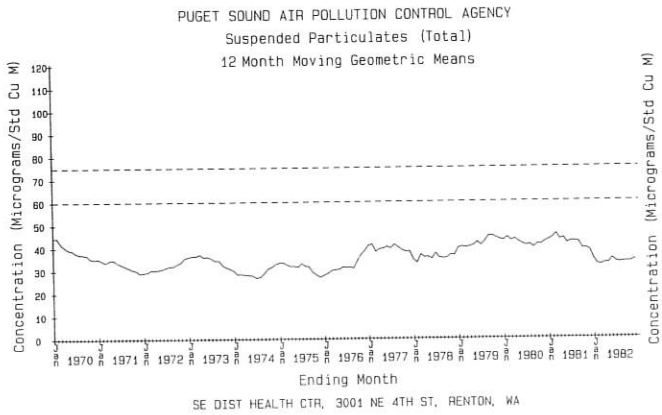
FIRE STATION #10, 301 2ND AVE S, SEATTLE, WA

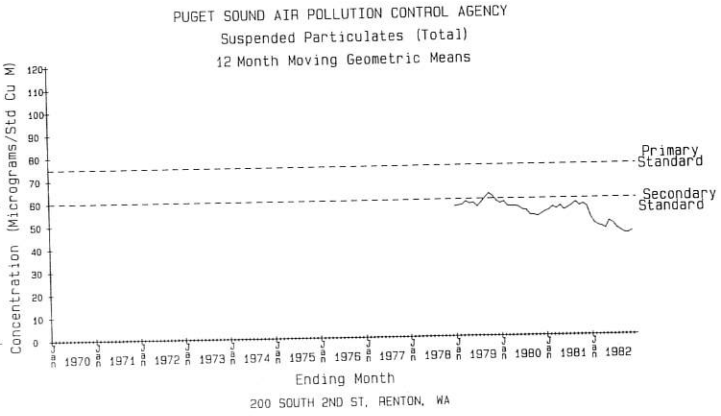

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
HARBOR ISLAND, 3400 13TH AVE SW, SEATTLE, WA

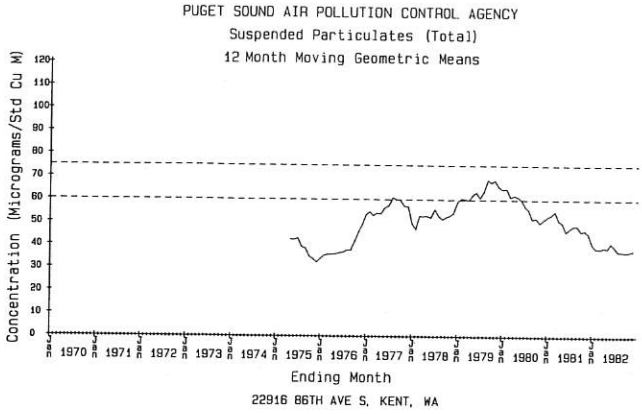

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
DUWAMISH, 4401 E MARGINAL WAY S, SEATTLE, WA

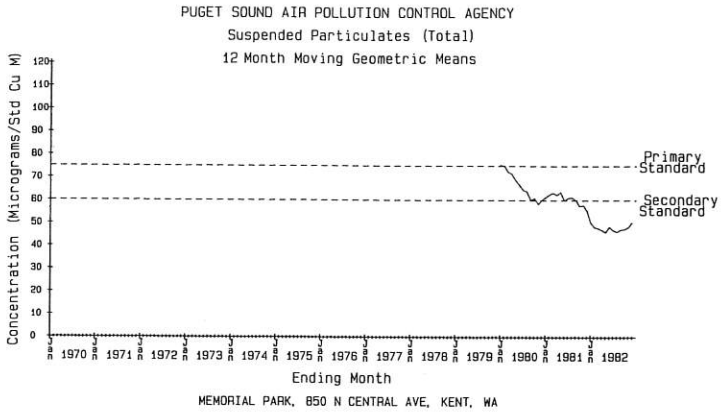

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
GEORGETOWN, 6431 CORSON AVE S, SEATTLE, WA

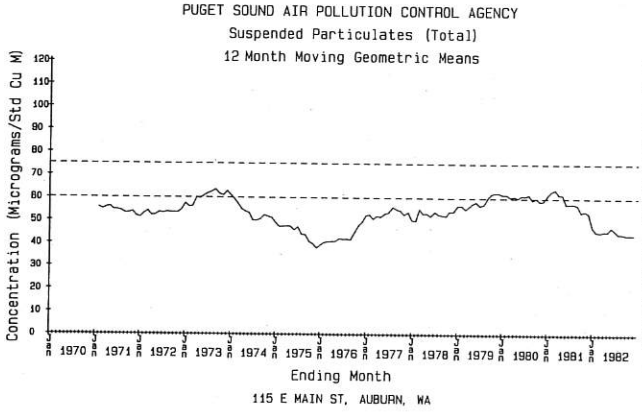

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
SOUTH PARK, 723 S CONCORD ST, SEATTLE, WA

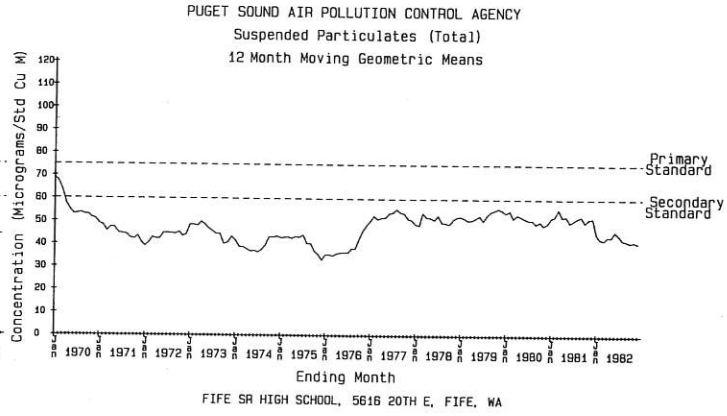

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
SE DIST HEALTH CTR, 3001 NE 4TH ST, RENTON, WA

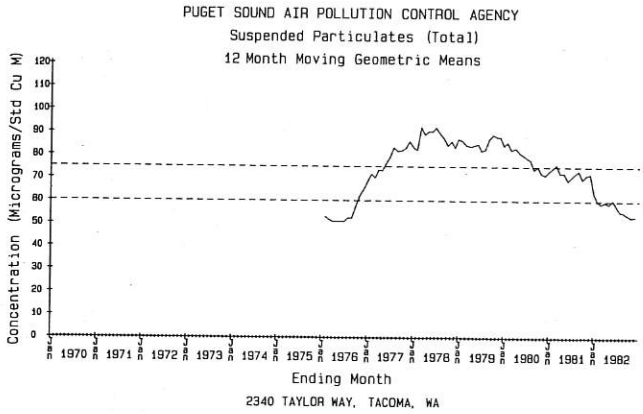

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
200 SOUTH 2ND ST, RENTON, WA

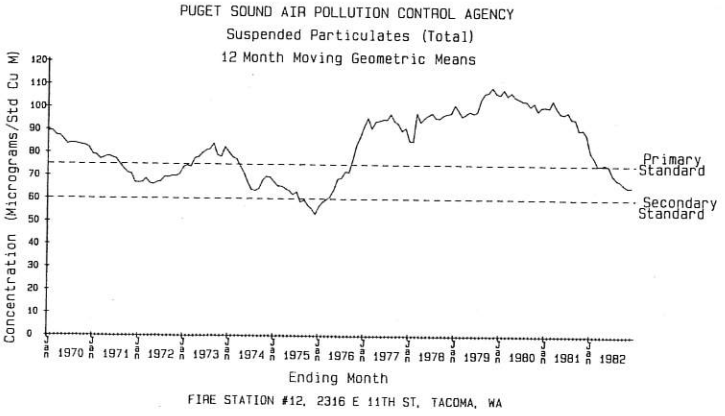

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
22916 86TH AVE S, KENT, WA

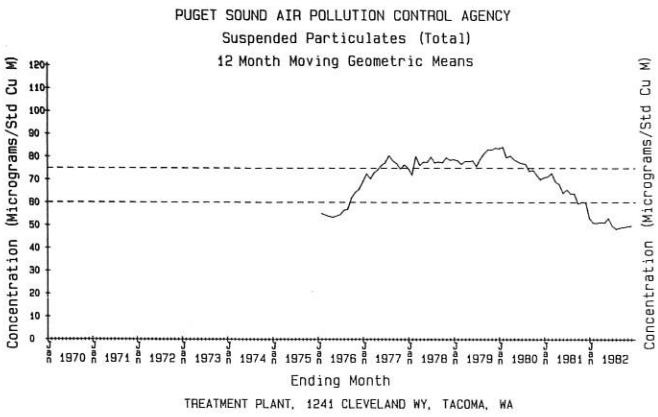

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
MEMORIAL PARK, 850 N CENTRAL AVE, KENT, WA

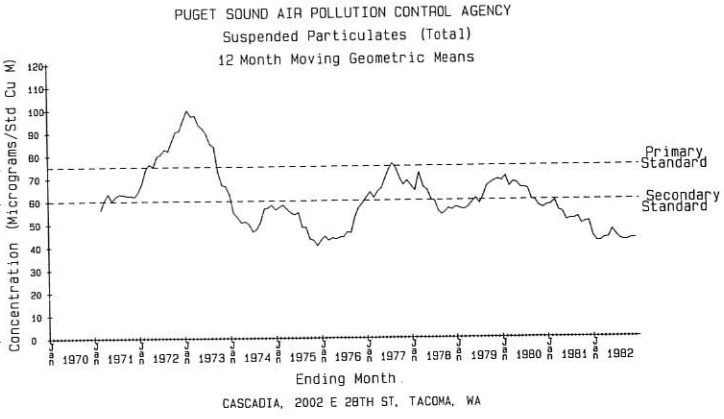

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
115 E MAIN ST, AUBURN, WA

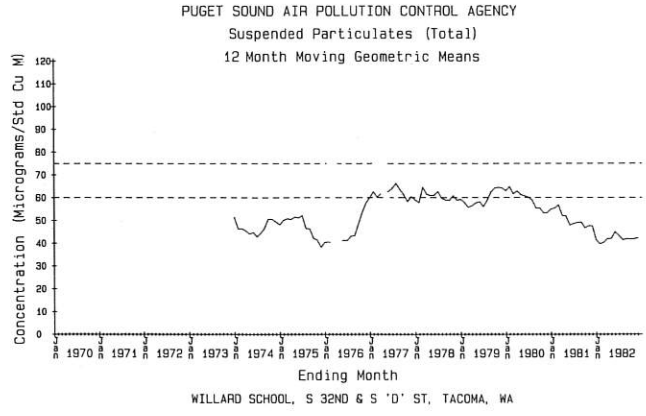

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
FIFE SR HIGH SCHOOL, 5616 20TH E, FIFE, WA

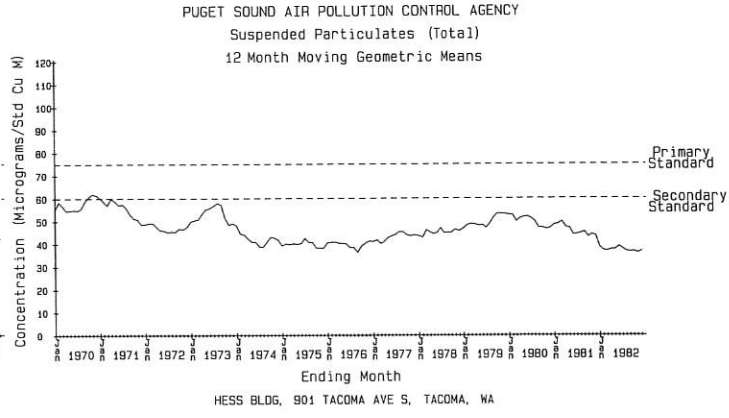

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
2340 TAYLOR WAY, TACOMA, WA

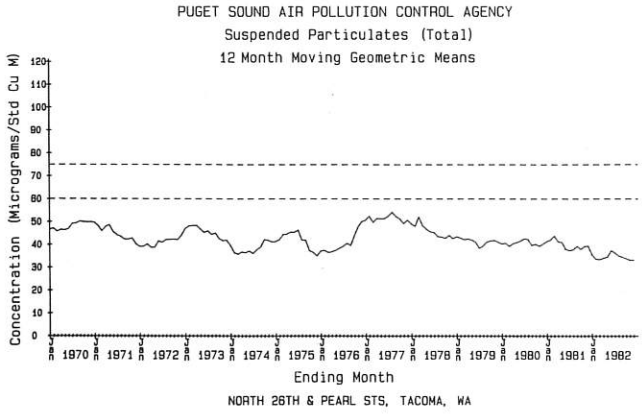

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
FIRE STATION #12, 2316 E 11TH ST, TACOMA, WA

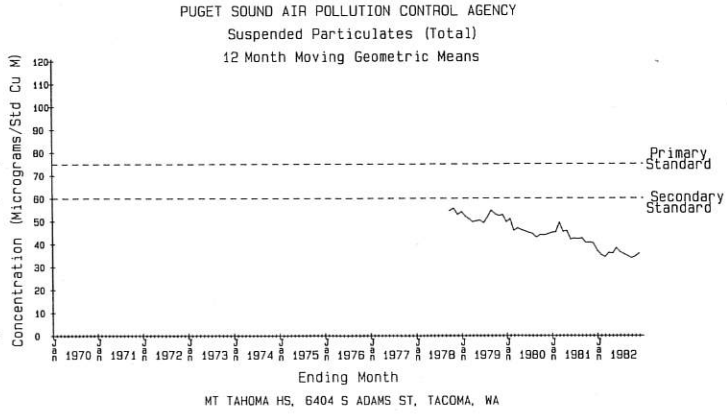

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
TREATMENT PLANT, 1241 CLEVELAND WY, TACOMA, WA


PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
CASCADIA, 2002 E 28TH ST, TACOMA, WA


PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
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
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
HESS BLDG, 901 TACOMA AVE S, TACOMA, WA


PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
NORTH 26TH & PEARL STS, TACOMA, WA


PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
MT TAHOMA HS, 6404 S ADAMS ST, TACOMA, WA

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1982

Location	Monthly Arithmetic Averages												No. Of Obs.	Year Arith Mean	Year Geom Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Tolt River Watershed, King County, Wa	8	11	20	12	18	23	18	26	22	14	3	3	53	15	10
Cedar River Masonry Dam, King County, Wa	4	5	11	13	18	27	25	36	19	11	6	2	351	15	8
Highway 9 & 28th St NE, Lake Stevens, Wa	27	44	56	26	31	49	31	34	37	29	31	39	60	36	32
Medical-Dental Bldg, 2730 Colby, Everett, Wa	28	38	55	35	39	48	34	41	47	39	41	33	60	40	36
Lynnwood HS, 3001 184th St SW, Lynnwood, Wa [a]			69	27	46	61	34	41	38	65	63	59	48	50	42
504 Bellevue Way NE, Bellevue, Wa	31	60	65	51	42	82	59	57	65	50	57	48	56	56	48
20050 SE 56th, Lake Sammamish State Park, Wa	19	56	47	32	39	51	34	47	42	34	41	49	58	41	34
North 98th St & Stone Ave N, Seattle, Wa	27	47	58	38	42	70	44	57	54	68	56	57	58	51	45
5701 8th Ave NE, Seattle, Wa	53	58	84	38	47	51	38	41	49	70	70	67	57	56	50
2700 W Commodore Way, Seattle, Wa [b]	28	58	76	31	33	37	26						36	41	36
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	41	58	69	34	35	40	32	39	44	61	68	69	60	49	44
Public Safety Bldg, 604 3rd Ave, Seattle, Wa	34	110	80	50	60	71	43	47	57	69	50	69	60	62	53
Fire Station #10, 301 2nd Ave S, Seattle, Wa	40	77	72	51	44	58	47	46	50	74	51	67	58	56	51
Harbor Island, 2555 13th Ave SW, Seattle, Wa	55	125	114	75	69	96	51	75	80	104	79	79	60	84	75
Harbor Island, 3400 13th Ave SW, Seattle, Wa	31		126	67	65	88	53	67	78	98	84	82	55	75	65
Duwamish, 4401 E Marginal Way S, Seattle, Wa	73	110	92	78	73	87	66	80	88	78	94	87	345	83	74
Georgetown, 6431 Corson Ave S, Seattle, Wa		66	96	65		54	58	62	73	86	76	71	48	71	61
South Park, 723 S Concord St, Seattle, Wa	30	69	63	39	46	66	35	40	53	66	65	62	61	53	44
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	31	48	63	32	37	55	32	38	45	60	70	62	60	48	40
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	20	30	49	31	37	56	33	50	48	44	49	49	61	42	34
200 South 2nd St, Renton, Wa	30	47	57	37	47	101	44	43	48	60	65	65	61	54	45
22916 86th Ave S, Kent, Wa	23	39	60	33	42	63	42	43	46	49	57	53	59	46	38
Memorial Park, 850 N Central Ave, Kent, Wa	32	51	71	44	49	69	48	61	55	65	77	74	61	58	50
Federal Way HS, 1401 S 304 St, Federal Way, Wa	20	28	45	33	35	39	29	29	32	42	52	53	61	37	31
115 E Main St, Auburn, Wa	28	58	67	42	46	56	40	44	45	54	68	60	61	51	44
Sumner Jr HS, 1508 Willow St, Sumner, Wa [c]	15	41	60	32	48	60						52	37	46	36
Fife Sr High School, 5616 20th E, Fife, Wa	22	48	67	40	48	61	40	45	47	62	76	47	61	50	41
2340 Taylor Way, Tacoma, Wa	26	68	73	51	54	74	55	60	71	86	71	78	58	64	53
Fire Station #12, 2316 E 11th St, Tacoma, Wa	47	82	76	83	82	78	64	80	85	76	76	76	120	76	66
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	25	55	69	43	52	69	42	54	72	79	82	63	61	59	50
Cascadia, 2002 E 28th St, Tacoma, Wa	19	47	67	38	58	77	39	45	56	64	76	59	61	54	43
Willard School, S 32nd & S 'D' St, Tacoma, Wa	25	51	64	34	43	60	36	36	60	74	75	60	61	52	42
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	24	49	47	30	36	42	27	33		76	73	62	55	45	37
4716 North Baltimore St, Tacoma, Wa	24	36	55	31	40	41	33	34	46	57	61	60	61	43	35
North 26th & Pearl Sts, Tacoma, Wa	21	35	46	28	44	54	30	33	39	46	52	55	61	40	33
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	27	44	53	33	41	48	31	42		66	84	61	55	48	36
City Water Supply Pump House, Dupont, Wa	17	26	43	33	51	58	36	39	28	34	36	31	57	36	29
City Hall, 239 4th St, Bremerton, Wa [d]									37	37	40	35	22	37	34

[a] Sampling started 3/18/82 [b] Sampling ended 8/09/82 [c] Sampling stopped for roof repair 7/06/82 - 11/22/82
[d] Sampling started 8/27/82

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1982

Statistical Summary

Location	No. Of Obs.	Frequency Distribution - Percent										Arith Mean	Geom Mean	Geom Std Dev	Arith Std Dev
		10	20	30	40	50	60	70	80	90	95				
Tolt River Watershed, King County, Wa	53	2	3	5	8	10	16	21	27	34	36	15	10	2.70	12.57
Cedar River Masonry Dam, King County, Wa	351	1	3	5	7	9	13	19	24	34	48	15	8	3.19	14.87
Highway 9 & 28th St NE, Lake Stevens, Wa	60	18	21	24	27	31	33	38	51	64	73	36	32	1.64	19.67
Medical-Dental Bldg, 2730 Colby, Everett, Wa	60	21	25	28	32	36	41	46	56	66	69	40	36	1.59	17.48
Lynnwood HS, 3001 184th St SW, Lynnwood, Wa	48	20	28	30	35	39	41	55	72	96	110	50	42	1.74	30.17
504 Bellevue Way NE, Bellevue, Wa	56	23	28	37	41	45	57	62	69	95	128	56	48	1.75	32.38
20050 SE 56th, Lake Sammamish State Park, Wa	58	16	19	24	30	36	44	51	59	68	80	41	34	1.82	22.23
North 98th St & Stone Ave N, Seattle, Wa	58	23	29	31	35	44	52	62	69	92	99	51	45	1.69	26.70
5701 8th Ave NE, Seattle, Wa	57	29	34	39	42	47	52	59	70	94	113	56	50	1.57	28.87
2700 W Commodore Way, Seattle, Wa	36	21	22	24	30	35	38	41	50	71	94	41	36	1.65	24.72
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	60	26	29	34	36	41	44	47	55	90	106	49	44	1.59	28.86
Public Safety Bldg, 604 3rd Ave, Seattle, Wa	60	28	36	41	45	53	55	61	75	99	123	62	53	1.67	45.07
Fire Station #10, 301 2nd Ave S, Seattle, Wa	58	31	39	41	44	48	52	59	69	87	98	56	51	1.53	28.74
Harbor Island, 2555 13th Ave SW, Seattle, Wa	60	43	50	59	65	75	83	93	104	139	170	84	75	1.59	40.31
Harbor Island, 3400 13th Ave SW, Seattle, Wa	55	32	43	50	61	66	74	78	98	150	159	75	65	1.74	40.72
Duwamish, 4401 E Marginal Way S, Seattle, Wa	345	42	49	55	61	69	81	96	114	147	175	83	74	1.63	45.62
Georgetown, 6431 Corson Ave S, Seattle, Wa	48	32	41	46	51	57	63	77	82	142	176	71	61	1.70	43.56
South Park, 723 S Concord St, Seattle, Wa	61	20	25	31	35	39	45	55	65	108	136	53	44	1.82	37.37
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	60	20	25	30	33	36	41	47	55	96	111	48	40	1.77	33.38
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	61	14	18	23	31	34	40	48	60	82	93	42	34	1.92	26.71
200 South 2nd St, Renton, Wa	61	22	30	34	37	40	46	55	67	104	136	54	45	1.76	36.88
22916 86th Ave S, Kent, Wa	59	17	21	25	34	41	43	50	68	83	93	46	38	1.89	29.91
Memorial Park, 850 N Central Ave, Kent, Wa	61	27	32	38	44	48	54	67	83	105	110	58	50	1.73	34.16
Federal Way HS, 1401 S 304 St, Federal Way, Wa	61	17	21	23	26	30	33	39	50	61	66	37	31	1.71	24.28
115 E Main St, Auburn, Wa	61	22	28	34	38	44	48	53	62	97	101	51	44	1.72	30.37
Sumner Jr HS, 1508 Willow St, Sumner, Wa	37	14	16	22	34	37	47	54	66	80	116	46	36	2.11	33.04
Fife Sr High School, 5616 20th E, Fife, Wa	61	13	23	33	39	45	48	57	68	91	114	50	41	1.98	32.42
2340 Taylor Way, Tacoma, Wa	58	22	32	37	52	58	62	65	75	120	161	64	53	1.84	39.90
Fire Station #12, 2316 E 11th St, Tacoma, Wa	120	31	41	48	54	66	76	96	107	129	153	76	66	1.72	40.39
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	61	24	30	38	42	49	55	63	81	118	136	59	50	1.78	36.77
Cascadia, 2002 E 28th St, Tacoma, Wa	61	16	21	33	38	42	48	55	85	116	130	54	43	2.00	37.36
Willard School, S 32nd & S 'D' St, Tacoma, Wa	61	19	25	29	36	43	47	52	71	102	113	52	42	1.89	35.66
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	55	19	25	27	30	31	38	45	57	98	115	45	37	1.82	33.46
4716 North Baltimore St, Tacoma, Wa	61	16	20	23	26	38	43	47	63	74	98	43	35	1.90	30.89
North 26th & Pearl Sts, Tacoma, Wa	61	15	18	24	26	33	37	47	61	71	87	40	33	1.89	27.48
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	55	10	18	28	32	38	47	51	57	98	123	48	36	2.17	40.18
City Water Supply Pump House, Dupont, Wa	57	11	12	18	23	30	37	49	56	69	80	36	29	2.00	23.00
City Hall, 239 4th St, Bremerton, Wa	22	20	23	27	28	31	35	40	50	60	68	37	34	1.48	15.68

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

January - June, 1982

Summary of Observations Greater Than 150

Location	Jan 6 Wed	Jan 20 Wed	Feb 4 Thu	Feb 5 Fri	Feb 6 Sat	Feb 8 Mon	Feb 9 Tue	Feb 10 Wed	Feb 25 Thu	Feb 28 Sun
504 Bellevue Way NE, Bellevue, Wa	--	--		--	--	--	--		--	
5701 8th Ave NE, Seattle, Wa	--	--		--	--	--	--		--	
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	--	--		--	--	--	--		--	
Public Safety Bldg, 604 3rd Ave, Seattle, Wa	--	--		--	--	--	--		--	332
Fire Station #10, 301 2nd Ave S, Seattle, Wa	--	--		--	--	--	--		--	
Harbor Island, 2555 13th Ave SW, Seattle, Wa	--	--		--	--	--	--	186	--	
Harbor Island, 3400 13th Ave SW, Seattle, Wa	--			--	--		--	--	--	--
Duwamish, 4401 E Marginal Way S, Seattle, Wa	159	197	160	168	409	208	169	184	159	
Georgetown, 6431 Corson Ave S, Seattle, Wa	--	--		--	--	--	--	--	--	
South Park, 723 S Concord St, Seattle, Wa	--	--		--	--	--	--		--	
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	--	--		--	--	--	--		--	
200 South 2nd St, Renton, Wa	--	--		--	--	--	--		--	
22916 86th Ave S, Kent, Wa	--	--		--	--	--	--		--	
Memorial Park, 850 N Central Ave, Kent, Wa	--	--		--	--	--	--		--	
115 E Main St, Auburn, Wa	--	--		--	--	--	--		--	
Sumner Jr HS, 1508 Willow St, Sumner, Wa	--	--		--	--	--	--		--	
Fife Sr High School, 5616 20th E, Fife, Wa	--	--		--	--	--	--		--	
2340 Taylor Way, Tacoma, Wa	--	--		--	--	--	--	165	--	
Fire Station #12, 2316 E 11th St, Tacoma, Wa	--	--		--	--	--	--	184	164	
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	--	--		--	--	--	--		--	
Cascadia, 2002 E 28th St, Tacoma, Wa	--	--		--	--	--	--		--	
Willard School, S 32nd & S 'D' St, Tacoma, Wa	--	--		--	--	--	--		--	
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	--	--		--	--	--	--		--	
4716 North Baltimore St, Tacoma, Wa	--	--		--	--	--	--		--	
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	--	--		--	--	--	--		--	

Location	Mar 8 Mon	Mar 18 Thu	Mar 22 Mon	Mar 23 Tue	Mar 24 Wed	Apr 21 Wed	Jun 10 Thu	Jun 16 Wed	Jun 18 Fri	Jun 22 Tue
504 Bellevue Way NE, Bellevue, Wa	--		--	--		--			--	160
5701 8th Ave NE, Seattle, Wa	--		--	--		--			--	
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	--		--	--		--			--	
Public Safety Bldg, 604 3rd Ave, Seattle, Wa	--		--	--		--			--	
Fire Station #10, 301 2nd Ave S, Seattle, Wa	--		--	--		--			--	--
Harbor Island, 2555 13th Ave SW, Seattle, Wa	--			--		--			--	
Harbor Island, 3400 13th Ave SW, Seattle, Wa	--	159		--		--			--	
Duwamish, 4401 E Marginal Way S, Seattle, Wa	195	159	171	181	158	208	174		173	
Georgetown, 6431 Corson Ave S, Seattle, Wa	--		--	--		--	--	--	203	
South Park, 723 S Concord St, Seattle, Wa	--		--	--		--			--	
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	--		--	--		--			--	
200 South 2nd St, Renton, Wa	--		--	--		--		173	--	
22916 86th Ave S, Kent, Wa	--		--	--		--			--	
Memorial Park, 850 N Central Ave, Kent, Wa	--		--	--		--			--	
115 E Main St, Auburn, Wa	--		--	--		--			--	
Sumner Jr HS, 1508 Willow St, Sumner, Wa	--		--	--		--			--	
Fife Sr High School, 5616 20th E, Fife, Wa	--		--	--		--			--	
2340 Taylor Way, Tacoma, Wa	--		--	--		--			--	
Fire Station #12, 2316 E 11th St, Tacoma, Wa	--		--	--		--			--	
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	--		--	--		--			--	
Cascadia, 2002 E 28th St, Tacoma, Wa	--		--	--		--			--	
Willard School, S 32nd & S 'D' St, Tacoma, Wa	--		--	--		--			--	
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	--		--	--		--			--	
4716 North Baltimore St, Tacoma, Wa	--		--	--		--			--	
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	--		--	--	--	--			--	

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

July - December, 1982

Summary of Observations Greater Than 150

Location	Aug 6 Fri	Sep 2 Thu	Sep 17 Fri	Sep 23 Thu	Oct 11 Mon	Oct 14 Thu	Oct 20 Wed	Nov 3 Wed	Nov 10 Wed	Nov 11 Thu	Nov 12 Fri
504 Bellevue Way NE, Bellevue, Wa	--		--	--	--			--	--	--	--
5701 8th Ave NE, Seattle, Wa	--		--	--	--			--	--	--	--
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	--		--	--	--			--	--	--	--
Public Safety Bldg, 604 3rd Ave, Seattle, Wa	--		--	--	--			--	--	--	--
Fire Station #10, 301 2nd Ave S, Seattle, Wa	--		--	--	--		157	--	--	--	--
Harbor Island, 2555 13th Ave SW, Seattle, Wa	--		--	--	--	170	199	--	--	--	--
Harbor Island, 3400 13th Ave SW, Seattle, Wa	--		--	--	--	185	157	--	--	--	--
Duwamish, 4401 E Marginal Way S, Seattle, Wa	175	209	215		184	194				159	205
Georgetown, 6431 Corson Ave S, Seattle, Wa	--		--	--	--	182		--	--	--	--
South Park, 723 S Concord St, Seattle, Wa	--		--	--	--			--	--	--	--
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	--		--	--	--			--	--	--	--
200 South 2nd St, Renton, Wa	--		--	--	--			--	--	--	--
22916 86th Ave S, Kent, Wa	--		--	--	--			--	--	--	--
Memorial Park, 850 N Central Ave, Kent, Wa	--		--	--	--			--	--	--	--
115 E Main St, Auburn, Wa	--		--	--	--			--	--	--	--
Sumner Jr HS, 1508 Willow St, Sumner, Wa	--	--	--	--	--	--	--	--	--	--	--
Fife Sr High School, 5616 20th E, Fife, Wa	--		--	--	--			--	--	--	--
2340 Taylor Way, Tacoma, Wa	--		--	--	--	164	161	--	--	--	--
Fire Station #12, 2316 E 11th St, Tacoma, Wa				153			178	194	155	--	--
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	--		--	--	--	168		--	--	--	--
Cascadia, 2002 E 28th St, Tacoma, Wa	--		--	--	--			--	--	--	--
Willard School, S 32nd & S 'D' St, Tacoma, Wa	--		--	--	--			--	--	--	--
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	--		--	--	--			--	--	--	--
4716 North Baltimore St, Tacoma, Wa	--		--	--	--			--	--	--	--
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	--	--	--	--	--		151	--	--	--	--

Location	Nov 24 Wed	Nov 25 Thu	Dec 7 Tue	Dec 8 Wed	Dec 9 Thu	Dec 10 Fri	Dec 11 Sat	Dec 29 Wed	Dec 30 Thu	Dec 31 Fri
504 Bellevue Way NE, Bellevue, Wa	--			--	--	--	--	--	--	
5701 8th Ave NE, Seattle, Wa	--			--	--	--	--	--	--	153
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	--		--		--	--	--	--	--	167
Public Safety Bldg, 604 3rd Ave, Seattle, Wa	--			--	--	--	--	--	--	
Fire Station #10, 301 2nd Ave S, Seattle, Wa	--			--	--	--	--	--	--	175
Harbor Island, 2555 13th Ave SW, Seattle, Wa	--			--	--	--	--	--	--	197
Harbor Island, 3400 13th Ave SW, Seattle, Wa	--	164		--	--	--	--	--	--	185
Duwamish, 4401 E Marginal Way S, Seattle, Wa	193			210	162	194	157	171	184	186
Georgetown, 6431 Corson Ave S, Seattle, Wa	--	176		--	--	--	--	--	--	220
South Park, 723 S Concord St, Seattle, Wa	--			--	--	--	--	--	--	190
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	--	164		--	--	--	--	--	--	174
200 South 2nd St, Renton, Wa	--			--	--	--	--	--	--	187
22916 86th Ave S, Kent, Wa	--		--	--	--	--	--	--	--	162
Memorial Park, 850 N Central Ave, Kent, Wa	--	154		--	--	--	--	--	--	200
115 E Main St, Auburn, Wa	--			--	--	--	--	--	--	164
Sumner Jr HS, 1508 Willow St, Sumner, Wa	--			--	--	--	--	--	--	154
Fife Sr High School, 5616 20th E, Fife, Wa	--	167		--	--	--	--	--	--	
2340 Taylor Way, Tacoma, Wa	--	--		--	--	--	--	--	--	180
Fire Station #12, 2316 E 11th St, Tacoma, Wa	--	165		--	160	230	--	--	209	
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	--	187		--	--	--	--	--	--	
Cascadia, 2002 E 28th St, Tacoma, Wa	--	179		--	--	--	--	--	--	
Willard School, S 32nd & S 'D' St, Tacoma, Wa	--	186		--	--	--	--	--	--	
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	--	172		--	--	--	--	--	--	
4716 North Baltimore St, Tacoma, Wa	--			--	--	--	--	--	--	179
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	--	203	178	--	--	--	--	--	--	

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1982

Summary of Maximum and 2nd High Observed Concentrations

Location	Jan 18 Mon	Feb 4 Thu	Feb 6 Sat	Feb 10 Wed	Feb 28 Sun	Mar 24 Wed	May 29 Sat	Jun 10 Thu	Jun 16 Wed	Jun 18 Fri	Jun 22 Tue	Jul 27 Tue	Aug 18 Wed	Aug 19 Thu	Aug 27 Fri	Sep 2 Thu	Sep 17 Fri	Oct 14 Thu	Oct 20 Wed	Nov 25 Thu	Dec 7 Tue	Dec 8 Wed	Dec 10 Fri	Dec 30 Thu	Dec 31 Fri
Tolt River Watershed, King County, Wa	--		--		--	46	--			--		--	--	--	41		--	--				--	--	--	
Cedar River Masonry Dam, King County, Wa												74	71	71											
Highway 9 & 28th St NE, Lake Stevens, Wa	--	101	--							--		--	--	--			--				--		--	--	88
Medical-Dental Bldg, 2730 Colby, Everett, Wa	--		--			85				--		--	--	--		77	--					--	--	--	
Lynnwood HS, 3001 184th St SW, Lynnwood, Wa	--	--	--	--	--					--		--	--	--			--		135			--	--	--	123
504 Bellevue Way NE, Bellevue, Wa	134		--							--	160	--	--	--			--					--	--	--	
20050 SE 56th, Lake Sammamish State Park, Wa	--		--	95						--		--	--	--			--					--	--	--	101
North 98th St & Stone Ave N, Seattle, Wa	--		--							--		--	--	--			--	122				--	--	--	115
5701 8th Ave NE, Seattle, Wa	--		--							--		--	--	--			--			148		--	--	--	153
2700 W Commodore Way, Seattle, Wa	--		--	110		111				--		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	--		--							--		--	--	--			--			139	--	139	--	--	167
Public Safety Bldg, 604 3rd Ave, Seattle, Wa	--		--		332					--		--	--	--			--					--	--	--	145
Fire Station #10, 301 2nd Ave S, Seattle, Wa	--		--							--	--	--	--	--	--		--		157			--	--	--	175
Harbor Island, 2555 13th Ave SW, Seattle, Wa	--		--							--		--	--	--			--		199			--	--	--	197
Harbor Island, 3400 13th Ave SW, Seattle, Wa	--		--	--	--					--		--	--	--			--	185				--	--	--	185
Duwamish, 4401 E Marginal Way S, Seattle, Wa			409														215								
Georgetown, 6431 Corson Ave S, Seattle, Wa	--		--	--			--	--	--	203		--	--	--			--					--	--	--	220
South Park, 723 S Concord St, Seattle, Wa	--		--	148						--		--	--	--			--					--	--	--	190
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	--		--							--		--	--	--			--			164		--	--	--	174
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	--		--					103		--		--	--	--		103	--					--	--	--	128
200 South 2nd St, Renton, Wa	--		--						173	--		--	--	--			--					--	--	--	187
22916 86th Ave S, Kent, Wa	--		--							--		--	--	--			--			129	--	--	--	--	162
Memorial Park, 850 N Central Ave, Kent, Wa	--		--							--		--	--	--			--			154		--	--	--	200
Federal Way HS, 1401 S 304 St, Federal Way, Wa	--		--							--		--	--	--			--			120		--	--	--	150
115 E Main St, Auburn, Wa	--		--							--		--	--	--			--			138		--	--	--	164
Sumner Jr HS, 1508 Willow St, Sumner, Wa	--		--			117				--		--	--	--	--	--	--	--	--			--	--	--	154
Fife Sr High School, 5616 20th E, Fife, Wa	--		--			139				--		--	--	--			--			167		--	--	--	
2340 Taylor Way, Tacoma, Wa	--		--	165						--		--	--	--			--			--		--	--	--	180
Fire Station #12, 2316 E 11th St, Tacoma, Wa	--		--							--		--		--								--	230	209	
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	--		--							--		--	--	--			--	168		187		--	--	--	
Cascadia, 2002 E 28th St, Tacoma, Wa	--		--							--		--	--	--			--			179		--	--	--	142
Willard School, S 32nd & S 'D' St, Tacoma, Wa	--		--							--		--	--	--			--	150		186		--	--	--	
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	--		--							--		--	--	--			--		141	172		--	--	--	
4716 North Baltimore St, Tacoma, Wa	--		--							--		--	--	--			--			134		--	--	--	179
North 26th & Pearl Sts, Tacoma, Wa	--		--							--		--	--	--			--			128		--	--	--	149
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	--		--			--				--		--	--	--		--	--			203	178	--	--	--	
City Water Supply Pump House, Dupont, Wa	--		--			--	83			--		--	--	--	85		--					--	--	--	
City Hall, 239 4th St, Bremerton, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--			--			72		--	--	--	68

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

1980-1982

Summary of Observations

Location	Annual Geometric Mean			Number of Observations Greater than 150			Number of Observations Greater than 260			2nd Highest Concentration Greater than 150		
	1980	1981	1982	1980	1981	1982	1980	1981	1982	1980	1981	1982
Tolt River Watershed, King County, Wa	10	15	10	0	0	0	0	0	0			
Cedar River Masonry Dam, King County, Wa	12	9	8	2	0	0	0	0	0	153		
Highway 9 & 28th St NE, Lake Stevens, Wa	-	32	32	-	0	0	-	0	0			
Medical-Dental Bldg, 2730 Colby, Everett, Wa	45	44	36	0	0	0	0	0	0			
504 Bellevue Way NE, Bellevue, Wa	51	59	48	0	3	1	0	1	0		190	
20050 SE 56th, Lake Sammamish State Park, Wa	-	36	34	-	0	0	-	0	0			
North 98th St & Stone Ave N, Seattle, Wa	48	46	45	0	0	0	0	0	0			
5701 8th Ave NE, Seattle, Wa	59	58	50	1	2	1	0	0	0		157	
2700 W Commodore Way, Seattle, Wa	48	53	-	0	1	-	0	0	-			
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	54	52	44	1	1	1	0	0	0			
Public Safety Bldg, 604 3rd Ave, Seattle, Wa	60	56	53	0	0	1	0	0	1			
Fire Station #10, 301 2nd Ave S, Seattle, Wa	63	59	51	1	5	2	0	0	0		224	157
Harbor Island, 2555 13th Ave SW, Seattle, Wa	-	93	75	1	6	4	0	1	0		244	197
Harbor Island, 3400 13th Ave SW, Seattle, Wa	84	83	65	6	5	5	0	2	0	203	268	185
Duwamish, 4401 E Marginal Way S, Seattle, Wa	83	85	74	19	58	32	1	6	1	191	355	215
Georgetown, 6431 Corson Ave S, Seattle, Wa	70	64	61	4	5	4	0	0	0	178	165	203
South Park, 723 S Concord St, Seatle, Wa	53	53	44	0	3	1	0	0	0		155	
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	51	55	40	1	1	2	0	0	0			164
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	42	38	34	0	0	0	0	0	0			
200 South 2nd St, Renton, Wa	53	56	45	0	1	2	0	0	0			173
22916 86th Ave S, Kent, Wa	51	45	38	1	0	1	0	0	0			
Memorial Park, 850 N Central Ave, Kent, Wa	60	55	50	1	2	2	1	0	0		154	154
Federal Way HS, 1401 S 304 St, Federal Way, Wa	40	42	31	0	0	0	0	0	0			
115 E Main St, Auburn, Wa	59	54	44	1	2	1	0	0	0		163	
Sumner Jr HS, 1508 Willow St, Sumner, Wa	48	44	36	1	0	1	0	0	0			
Fife Sr High School, 5616 20th E, Fife, Wa	50	52	41	1	1	1	0	0	0			
2340 Taylor Way, Tacoma, Wa	71	72	53	4	3	4	0	0	0	181	180	165
Fire Station #12, 2316 E 11th St, Tacoma, Wa	101	88	66	29	27	10	4	1	0	310	217	209
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	70	60	50	5	1	2	0	0	0	173		168
Cascadia, 2002 E 28th St, Tacoma, Wa	56	50	43	2	3	1	0	0	0	182	163	
Willard School, S 32nd & S 'D' St, Tacoma, Wa	53	48	42	2	2	1	0	0	0	176	166	
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	47	44	37	2	2	1	0	0	0	153	153	
4716 North Baltimore St, Tacoma, Wa	42	41	35	1	0	1	0	0	0			
North 26th & Pearl Sts, Tacoma, Wa	40	39	33	0	0	0	0	0	0			
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	44	40	36	2	6	3	0	0	0	175	179	178
City Water Supply Pump House, Dupont, Wa	31	25	29	0	0	0	0	0	0			
East 16th St & Ironsides Ave, Bremerton, Wa	30	32	-	0	0	-	0	0	-			
City Hall, 239 4th St, Bremerton, Wa	-	-	34	-	-	0	-	-	0			

- Indicates incomplete data or no data for the year

SUSPENDED PARTICULATES (Smaller than 15 micrometers)
Micrograms per Standard Cubic Meter

Sampled by Size Selective Inlet - High Volume Glass Fiber filters

1982

Location	Monthly Arithmetic Averages												No. Of Obs.	Year Arith Mean	Year Geom Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
North 98th St & Stone Ave N, Seattle, Wa	20	30	40	20	23	33	21	29	31	44	46	45	56	32	27
Duwamish, 4401 E Marginal Way S, Seattle, Wa	30	59	62	36	34	54	36	34	65	68	57	60	60	50	42
2340 Taylor Way, Tacoma, Wa[a]				31	34	48	32	40	48	47	74	38	39	44	38

[a] Sampling started 4/17/82

Statistical Summary

Location	No. Of Obs.	Frequency Distribution - Percent										Arith Mean	Geom Mean	Geom Std Dev	Arith Std Dev
		10	20	30	40	50	60	70	80	90	95				
North 98th St & Stone Ave N, Seattle, Wa	56	14	17	20	24	26	31	33	40	57	74	32	27	1.74	20.34
Duwamish, 4401 E Marginal Way S, Seattle, Wa	60	21	27	31	34	39	46	50	64	89	123	50	42	1.75	31.90
2340 Taylor Way, Tacoma, Wa	39	19	25	30	33	38	40	41	49	79	88	44	38	1.72	30.35

Summary of Maximum and 2nd High Observed Concentrations

Location	Oct 14 Thu	Nov 25 Thu	Dec 31 Fri
North 98th St & Stone Ave N, Seattle, Wa		100	97
Duwamish, 4401 E Marginal Way S, Seattle, Wa	128		161
2340 Taylor Way, Tacoma, Wa	111	177	--

-- Indicates no sample on specified day.

SUSPENDED PARTICULATES
(COH's/1000 Lin Ft)
1982

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	8710	.1	.1	.2	.2	.3	.3	.4	.5	.6	.9	1.1	1.6	.43	.32	2.28	.33
North 98th St & Stone Ave N, Seattle, Wa	8441	.1	.2	.2	.3	.3	.4	.5	.6	.8	1.2	1.6	2.6	.56	.40	2.23	.52
Duwamish, 4401 E Marginal Way S, Seattle, Wa	8559	.1	.1	.2	.3	.4	.5	.7	.9	1.2	1.8	2.2	3.0	.77	.52	2.57	.67
Fire Station #12, 2316 E 11th St, Tacoma, Wa	8301	.2	.2	.3	.5	.6	.7	.9	1.2	1.6	2.4	3.0	4.1	1.04	.73	2.42	.91
Willard School, S 32nd & S 'D' St, Tacoma, Wa	8697	.1	.1	.2	.3	.4	.4	.6	.7	1.0	1.4	1.8	2.6	.61	.41	2.58	.56

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	.50	.44	.48	.33	.30	.32	.24	.35	.48	.50	.61	.55	8710	.43
North 98th St & Stone Ave N, Seattle, Wa	.72	.54	.47	.36	.31	.32	.26	.35	.56	.79	.98	1.07	8441	.56
Duwamish, 4401 E Marginal Way S, Seattle, Wa	.80	.92	.77	.54	.43	.46	.45	.57	.81	1.07	1.16	1.25	8559	.77
Fire Station #12, 2316 E 11th St, Tacoma, Wa	1.12	1.18	1.02	.73	.57	.59	.61	.71	1.02	1.50	1.92	1.69	8301	1.04
Willard School, S 32nd & S 'D' St, Tacoma, Wa	.60	.62	.62	.45	.35	.38	.32	.45	.68	.83	1.16	.94	8697	.61

ATMOSPHERIC PARTICLES
(bsp (X 10 Exp-4)/M)
1982

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	8696	.1	.1	.2	.3	.3	.4	.5	.6	.9	1.5	2.2	4.1	.66	.42	2.50	.79
Duwamish, 4401 E Marginal Way S, Seattle, Wa	5018	.2	.2	.3	.4	.4	.5	.7	.9	1.2	1.8	2.5	5.0	.84	.57	2.34	.92
22916 86th Ave S, Kent, Wa	8715	.1	.1	.2	.3	.4	.5	.6	.7	1.0	1.9	2.7	5.1	.79	.48	2.64	.99
Fire Station #12, 2316 E 11th St, Tacoma, Wa	8654	.1	.2	.3	.3	.4	.5	.6	.8	1.2	2.2	3.2	5.8	.91	.55	2.66	1.14

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	.78	.63	.71	.34	.34	.33	.30	.38	.74	.92	1.26	1.20	8696	.66
Duwamish, 4401 E Marginal Way S, Seattle, Wa						.49	.38	.54	.86	1.04	1.20	1.32	5018	.84
22916 86th Ave S, Kent, Wa	.83	.66	.82	.44	.39	.42	.42	.56	.79	.97	1.43	1.69	8715	.79
Fire Station #12, 2316 E 11th St, Tacoma, Wa	1.02	.87	.88	.56	.44	.45	.44	.63	.86	1.15	1.84	1.77	8654	.91

Coefficient of Haze (COH) represents 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 calculated concentration measured by this method is reported in COH-units per thousand linear feet of sampled air.

The light scattering extinction coefficient (bsp) represents a measure of atmospheric particles. The light scattering extinction coefficient is inversely related to visibility and has been shown highly correlated to fine particle mass concentration. Values of bsp summarized in this book were continuously measured using an integrating nephelometer. The sample air stream was heated 6 to 12 degrees C above ambient air temperature to dry the particles. The particulate concentration measured by this method is reported as a scattering coefficient per meter that must be multiplied by 10 to the exponent, -4.

The Federal reference method using standard high volume sampling measures Total Suspended Particulates (TSP). High volume sampling with a Size Selective Inlet (SSI) measures suspended particulates smaller than 15 or smaller than 10 micrometers depending on the inlet design. These methods integrate a sample for the duration of sampling on a filter, usually a 24 hour midnight to midnight time period. The concentration of suspended particulates is reported in micrograms per standard cubic meter of air.

SUSPENDED PARTICULATES
1982

Correlation between Continuous Sampling Methods

	Jan Feb Mar	Apr May Jun	Jul Aug Sep	Oct Nov Dec	Annual
North 98th St & Stone Ave N, Seattle, Wa					
1 Hour COH Vs 1 Hour bsp					
Correlation Coefficient	.88	.74	.72	.90	.89
Number of 1 Hour Samples	1981	2095	2199	2109	8384
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient	.87	.77	.78	.95	.93
Number of 24 Hour Samples	80	87	92	86	345
Duwamish, 4401 E Marginal Way S, Seattle, Wa					
1 Hour COH Vs 1 Hour bsp					
Correlation Coefficient		.63	.69	.79	.78
Number of 1 Hour Samples		615	2195	2141	4951
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient		.71	.79	.86	.86
Number of 24 Hour Samples		26	92	89	207
Fire Station #12, 2316 E 11th St, Tacoma, Wa					
1 Hour COH Vs 1 Hour bsp					
Correlation Coefficient	.78	.70	.69	.84	.82
Number of 1 Hour Samples	1952	2161	2121	2005	8239
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient	.85	.78	.80	.92	.91
Number of 24 Hour Samples	79	91	86	80	336

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

SUSPENDED PARTICULATES
1982

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 24 Hour TSP					
Correlation Coefficient	.76	.35	.73	.93	.63
Number of Common 24 Hour Samples	14	14	15	16	59
North 98th St & Stone Ave N, Seattle, Wa					
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient	.94	.60	.72	.97	.96
24 Hour COH Vs 24 Hour TSP					
Correlation Coefficient	.69	.44	.23	.92	.62
24 Hour bsp Vs 24 Hour TSP					
Correlation Coefficient	.72	.10	.16	.89	.63
Number of Common 24 Hour Samples	13	14	13	12	52
North 98th St & Stone Ave N, Seattle, Wa					
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient	.94	.60	.72	.98	.96
24 Hour COH Vs 24 Hour SSI 15					
Correlation Coefficient	.84	.50	.67	.95	.85
24 Hour bsp Vs 24 Hour SSI 15					
Correlation Coefficient	.91	.20	.53	.95	.87
Number of Common 24 Hour Samples	12	14	13	11	50
Duwamish, 4401 E Marginal Way S, Seattle, Wa					
24 Hour COH Vs 24 Hour TSP					
Correlation Coefficient	.51	.71	.69	.84	.61
Number of Common 24 Hour Samples	79	89	88	83	339
Duwamish, 4401 E Marginal Way S, Seattle, Wa					
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient		.83	.77	.89	.90
24 Hour COH Vs 24 Hour SSI 15					
Correlation Coefficient		.89	.75	.97	.88
24 Hour bsp Vs 24 Hour SSI 15					
Correlation Coefficient		.95	.57	.95	.85
Number of Common 24 Hour Samples		4	14	15	33
22916 86th Ave S, Kent, Wa					
24 Hour bsp Vs 24 Hour TSP					
Correlation Coefficient	.86	.23	.37	.98	.79
Number of Common 24 Hour Samples	14	15	15	15	59
Fire Station #12, 2316 E 11th St, Tacoma, Wa					
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient	.88	.71	.82	.91	.91
24 Hour COH Vs 24 Hour TSP					
Correlation Coefficient	.88	.68	.73	.96	.77
24 Hour bsp Vs 24 Hour TSP					
Correlation Coefficient	.76	.61	.73	.86	.73
Number of Common 24 Hour Samples	25	30	29	30	114
Willard School, S 32nd & S 'D' St, Tacoma, Wa					
24 Hour COH Vs 24 Hour TSP					
Correlation Coefficient	.92	.78	.80	.99	.92
Number of Common 24 Hour Samples	15	15	15	16	61

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

SULFUR DIOXIDE
(Parts per Million)
1982

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	.008	.008	.009	.009	.009	.008	.009	.009	.008	.008	.008	.008	8567	.009
North 98th St & Stone Ave N, Seattle, Wa	.008	.006	.006	.006	.004	.003	.004	.004	.005	.005	.007	.009	8453	.006
Duwamish, 4401 E Marginal Way S, Seattle, Wa	.013	.013	.013	.015	.011	.019	.016	.023	.018	.015	.015	.013	8619	.015
Federal Way HS, 1401 S 304 St, Federal Way, Wa	.007	.005	.008	.007	.008	.011		.008	.005	.005	.004	.004	8261	.007
SW 283rd & 101st Ave SW, Maury Island, Wa	.019	.018	.009	.011	.007	.005	.005	.007	.006	.011	.010	.012	8650	.010
North 37th & Vassault Sts, Tacoma, Wa	.009	.012	.008	.011	.011	.012	.013	.014	.014	.011	.014	.012	8184	.012
North 26th & Pearl Sts, Tacoma, Wa	.006	.009	.011	.009	.010	.011	.009	.009	.011	.008	.011	.010	8640	.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	0	0	1	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	3	0	0	0
Federal Way HS, 1401 S 304 St, Federal Way, Wa	0	0	2	0	0	0
SW 283rd & 101st Ave SW, Maury Island, Wa	0	2	9	0	0	0
North 37th & Vassault Sts, Tacoma, Wa	2	0	5	0	0	0
North 26th & Pearl Sts, Tacoma, Wa	2	1	9	0	0	0

At all stations, Sulfur Dioxide was continuously measured using the method of ultraviolet fluorescence.

SULFUR DIOXIDE
(Parts per Million)
1982

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				.29	22 Jul	1520	.153	22 Jul	1600	.044	23 Jul	1200
				.13	13 Sep	1100	.087	8 Nov	1500	.032	10 Dec	1800
North 98th St & Stone Ave N, Seattle, Wa				.11	7 Jan	2300	.057	7 Jan	1900	.031	7 Jan	2300
				.06	7 Jan	1700	.053	7 Jan	2400	.016	25 Nov	0600
Duwamish, 4401 E Marginal Way S, Seattle, Wa				.30	10 Dec	1028	.150	21 Aug	1100	.066	24 Jun	1900
				.28	24 Jun	0409	.140	24 Jun	0400	.050	10 Dec	1600
Federal Way HS, 1401 S 304 St, Federal Way, Wa				.35	13 Mar	1244	.147	13 Mar	1400	.036	4 Oct	1600
				.32	25 Mar	0524	.130	25 Mar	0700	.032	2 May	1400
SW 283rd & 101st Ave SW, Maury Island, Wa				.42	24 Feb	1354	.260	4 Dec	1700	.083	23 Jan	2100
				.41	4 Dec	1611	.183	23 Jan	0400	.055	30 Jan	0400
North 37th & Vassault Sts, Tacoma, Wa	1.15	25 May	1329	.39	21 Jul	2332	.173	21 Jul	2400	.060	22 Jul	0900
	1.07	5 May	1146	.38	17 Aug	2027	.150	5 May	1400	.049	9 Nov	0800
North 26th & Pearl Sts, Tacoma, Wa	1.32	9 Feb	1104	.50	24 Apr	2151	.217	24 Mar	1300	.051	10 Jun	0400
	1.14	21 May	0431	.36	20 Mar	1405	.180	24 Apr	2300	.045	25 Apr	1100

(1) 5 minute average reported only for concentrations exceeding 1.00 ppm.
(2) Ending times are reported in Pacific Standard Time.
(3) For equal, high concentration values, the reported date and time refer to the earliest occurrences during the year.

OZONE

Photochemical Oxidants

The oxidant found in largest amounts in photochemical smog is ozone, a very reactive form of oxygen. Most oxidants are not emitted directly into the atmosphere but instead result from a series of chemical reactions between nitrogen oxides and reactive hydrocarbons in the presence of sunlight. This series of "photochemical" reactions proceeds for several hours generally producing maximum ozone levels between noon and early evening.

In the Puget Sound region the highest ozone concentrations occur during summer months when urban area emissions are trapped beneath a temperature inversion during nighttime and morning hours followed by hot afternoon temperatures. Light northerly winds often develop on these hot days. As a result, the highest ozone concentrations normally occur 5 to 15 miles south to southeast of the major urban centers.

Ozone Standard

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 with the maximum 1 hour average greater 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 during the most recent 3 years.

An incomplete data set for a given year requires an estimate of the number of exceedences in that year. 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 calculated as the three year average of the estimated number of exceedences. A shorter sampling period may shorten the averaging period to a minimum of one year.

Using the Ozone Table to Assess Attainment

The 1982 ozone table summarizes the four highest daily maximum 1 hour ozone averages and shows whether the standard was attained in 1982. The rightmost column documents that 1 of 6 stations had a value for expected number of exceedences greater than 1.0, and thus exceeded the ozone standard for the three year period ending in 1982.

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.

OZONE
(Parts per Million)
1982

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	1980	1981	1982	
Snohomish FD#22, 9921 84th NE, Arlington, Wa*	.11	19 Jun	1300	0.0	0.0	0.0	0.0
1 Apr - 22 Oct	.09	11 Jun	1700				
	.09	24 Jun	1800				
	.08	17 Jun	1500				
20050 SE 56th, Lake Sammamish State Park, Wa*	.12	27 Jul	1600	0.0	1.0	0.0	0.3
1 Jan - 31 Dec	.09	19 Jun	1300				
	.08	11 Jun	1400				
	.08	24 Jun	1600				
22916 86th Ave S, Kent, Wa	.10	19 Jun	1500	0.0	0.0	0.0	0.0
1 Jan - 31 Dec	.09	27 Jul	1500				
	.08	25 Jul	1400				
	.08	8 Aug	1600				
Sumner Jr HS, 1508 Willow St, Sumner, Wa	.11	19 Jun	1600	0.0	3.1	0.0	1.0
1 Jan - 31 Dec	.11	25 Jul	1700				
	.11	7 Aug	1600				
	.10	24 Jun	1500				
Pierce Co Firwood FS, 4418 Freemn Rd, Fife, Wa*	.09	19 Jun	1500	0.0	1.2	0.0	0.4
1 Jan - 31 Dec	.08	17 Jun	1500				
	.08	18 Jun	1400				
	.08	24 Jun	1500				
Pierce Co, Fire D #21, 8102 304th, Graham, Wa*	.11	14 Aug	1400	0.0	4.0	0.0	1.3
13 Apr - 8 Oct	.10	17 Jun	1700				
	.10	19 Jun	1300				
	.10	20 Aug	1500				

(1) * Station operated by Washington State Department of Ecology.
(2) Ending times are reported in Pacific Standard Time.
(3) For equal, high concentration values, the reported 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)
1982

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*	.083	.087	.075			.033	.027	.032	.034			.029	5613	.049
15th Ave S & Charlestown St, Seattle, Wa*					.017			.021					3659	.017

(1) * Station operated by the Washington State Department of Ecology.
(2) Monthly averages are shown only for months with 75 percent or higher data completeness.
(3) Year averages are calculated from all valid samples; the number of samples shows how completely the year mean represents the full year.
(4) At all stations, Nitrogen Dioxide was continuously measured using gas phase chemiluminescence.

CARBON MONOXIDE

Introduction

The Department of Ecology has statewide jurisdiction over motor vehicle emissions. Motor vehicles are the largest source of carbon monoxide and are the principal contributor to the carbon monoxide levels which exceed standards in the cities of the Puget Sound area.

The high ambient levels of carbon monoxide occur most often near congested, slow-moving motor vehicle traffic when low level winds are light and stable meteorological conditions exist. The highest hour average concentrations frequently coincide with the weekday evening traffic peaks. The lower hour average values normally occur during low traffic periods after midnight and on many hours of the weekends.

Pollutant Standards Index and 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 PSI scale. PSI values exceeding 100 are considered "Unhealthful". An 8 hour average of 15 ppm equals 200 on the PSI scale. PSI values of 200 to 299 are termed "Very Unhealthful".

Episode criteria are specified in the Washington Episode Plan. 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 that level for 12 or more hours or increase 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.

Data Summary

The following tables summarize the six highest 1 hour and 8 hour average carbon monoxide levels at each station. These data were obtained from Department of Ecology data summaries. Nine of the twelve stations for which data is presented were in operation during several previous years.

Review of the data shows that 6 of the 12 stations exceeded an 8 hour average of 9 ppm at least twice. Therefore all of these 6 stations violated the 8 hour average standard. The maximum 1 hour average recorded at any of the stations was 23 ppm. Therefore the 1 hour standard of 35 ppm was not exceeded.

CARBON MONOXIDE
(Parts Per Million)
1982

Location / Period of Sampling	Six Highest Concentrations						Number of Days	Number of Days
	1 Hour Average			8 Hour Average			Number of 8 Hour Averages Exceeding 9 ppm	8 Hour Average Exceeded 9 ppm
	Value	Date	End Time	Value	Date	End Time		
2005 Hewitt Avenue, Everett, Wa	15	30 Dec	1800	10	30 Dec	2100	1	1
20 Apr - 31 Dec	15	30 Dec	1900	7	23 Nov	1900		
	14	23 Nov	1900	7	29 Dec	2000		
	13	30 Dec	1700	7	31 Dec	1900		
	12	29 Dec	1900	6	24 Nov	2300		
	12	31 Dec	1900	6	4 Dec	2100		
622 Bellevue Way NE, Bellevue, Wa	17	24 Nov	1800	11	23 Nov	2300	5	5
9 Feb - 31 Dec	15	23 Nov	1800	11	10 Dec	2200		
	15	22 Dec	1900	11	22 Dec	2300		
	14	23 Nov	1900	11	31 Dec	2300		
	14	10 Dec	1800	10	24 Nov	2200		
	14	22 Dec	1800	9	8 Dec	2200		

CARBON MONOXIDE
(Parts Per Million)
1982

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		
Northgate, 310 NE Northgate Way, Seattle, Wa	17	10 Dec	1900	11	23 Nov	2300	2	2
1 Jan - 31 Dec	16	23 Nov	1900	11	22 Dec	2200		
	16	22 Dec	1800	9	8 Jan	2200		
	15	8 Dec	1800	9	24 Nov	2300		
	15	8 Dec	1900	9	8 Dec	1900		
	14	31 Dec	1900	9	10 Dec	2000		
4511 University Way NE, Seattle, Wa	17	23 Nov	2000	14	23 Nov	2400	3	3
1 Jan - 31 Dec	17	23 Nov	2100	12	2 Nov	2400		
	15	2 Nov	1900	11	14 Oct	2100		
	15	23 Nov	1900	8	8 Jan	1900		
	15	23 Nov	2200	8	25 Feb	2100		
	14	2 Nov	2000	8	6 Mar	2400		
3921 Linden Ave N, Seattle, Wa	8	23 Nov	1900	6	15 Oct	200	0	0
1 Jan - 31 Dec	8	23 Nov	2100	6	23 Nov	2200		
	7	5 Feb	1900	5	2 Nov	2300		
	7	14 Oct	2100	5	11 Nov	2400		
	7	14 Oct	2300	5	25 Nov	100		
	7	14 Oct	2400	5	4 Dec	2400		
1424 4th Ave, Seattle, Wa	21	10 Dec	1700	13	10 Dec	1800	7	7
1 Jan - 23 Jul; 9 Aug - 31 Dec	17	22 Jan	1400	11	21 Dec	1800		
	17	10 Dec	1800	10	26 Feb	1800		
	16	27 May	1900	10	2 Nov	2000		
	16	20 Dec	1800	10	20 Dec	1800		
	15	2 Nov	1800	10	29 Dec	1800		
2nd Ave & University St, Seattle, Wa	13	3 Sep	1700	8	22 Dec	2200	0	0
1 Jan - 31 Dec	12	22 Jan	1800	7	12 Nov	100		
	12	8 Dec	1800	7	8 Dec	1800		
	12	21 Dec	1800	7	21 Dec	1800		
	12	22 Dec	1800	7	23 Dec	2000		
	12	23 Dec	1600	6	22 Jan	1800		
5th Ave & James St, Seattle, Wa	16	7 Dec	1800	10	8 Dec	1900	2	2
1 Jan - 31 Dec	16	21 Dec	1700	10	10 Dec	1700		
	15	8 Dec	1800	9	14 Oct	1700		
	14	24 Aug	2300	9	7 Dec	1800		
	14	10 Dec	1000	9	21 Dec	1700		
	14	10 Dec	1700	9	30 Dec	1600		
Fire Station #10, 301 2nd Ave S, Seattle, Wa	15	20 Oct	2400	8	22 Dec	2300	0	0
1 Jan - 31 Dec	12	21 Oct	100	7	21 Oct	100		
	12	8 Dec	1800	7	12 Nov	100		
	12	22 Dec	2100	7	8 Dec	1800		
	11	22 Dec	2000	6	25 Feb	2400		
	11	22 Dec	2200	6	9 Dec	200		
2809 26th Ave S, Seattle, Wa	13	24 Nov	900	8	8 Dec	2300	0	0
1 Jan - 31 Dec	12	9 Feb	900	7	10 Dec	2300		
	12	8 Dec	1800	6	8 Jan	2400		
	11	20 Jan	900	6	12 Jan	1800		
	11	29 Dec	1000	6	16 Jan	1600		
	10	20 Oct	700	6	18 Jan	2300		
15th Ave S & Charlestown St, Seattle, Wa	5	8 Mar	900	3	8 Jan	2200	0	0
1 Jan - 16 Aug	4	8 Jan	1800	3	9 Jan	600		
	4	9 Jan	200	3	7 Mar	200		
	4	9 Jan	300	2	9 Jan	1400		
	3	9 Jan	1700	2	11 Jan	1100		
	3	9 Jan	1900	2	12 Jan	1100		
942 Pacific Ave, Tacoma, Wa	23	30 Dec	1800	13	30 Dec	2300	4	4
1 Jan - 31 Dec	20	23 Nov	1800	11	10 Dec	2300		
	20	30 Dec	1900	10	14 Oct	2300		
	17	12 Feb	1700	10	11 Nov	2400		
	17	14 Oct	1700	9	22 Jan	1800		
	17	10 Dec	1700	9	25 Jan	1700		

(1) Ending times are reported in Pacific Standard Time.
(2) For equal, high concentration values, the reported date and time refer to the earliest occurrences during the year.
(3) At all stations, Carbon Monoxide was continuously measured using the nondispersive infrared method.

QUALITY ASSURANCE

Introduction

Quality Assurance (QA) includes all the activities which focus attention on obtaining valid data and documenting the quality of the data. The QA process 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 State Department of Ecology. For the EPA, this consists of (1) an annual onsite audit of some Agency analyzers 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 analyzers 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, and September 3, 1981. 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 the percentage differences for each instrument are calculated. These two statistics are then pooled for all analyzers monitoring 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 pooled 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 mean that with 95 percent probability all air quality data compiled during the audit period agree with the true value by a percentage 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

The following two tables summarize the Precision and Accuracy statistics for all air quality data which the Agency originated in 1982. Audits for the integrating nephelometer, which measures atmospheric particles, are presented only in the Precision table since separate accuracy audits are not applicable for the nephelometer measurement. In some cases the number of analyzers for a particular pollutant is small, and the accuracy audits over two quarters are combined.

PRECISION OF AIR QUALITY DATA
1982

Upper and Lower 95 Percent Probability Limits
of Percent Differences

Pollutant	Probability Limit	Quarter 1st	2nd	3rd	4th	Annual Average
Suspended Particulates (Total, Hi Vol)	Upper	+12.5	+6.0	+8.1	+6.7	+8.3
	Lower	-13.3	-15.0	-11.3	-11.9	-12.9
Sulfur Dioxide	Upper	+9.5	+10.5	+7.6	+9.1	+9.2
	Lower	-10.5	-7.9	-7.6	-8.5	-8.6
Ozone	Upper	+10.9	+0.8	+5.8	+2.3	+5.0
	Lower	-3.3	-7.0	-8.8	-11.1	-7.6
Atmospheric Particles (Nephelometer)	Upper	+8.3	+3.4	+5.9	+6.1	+5.9
	Lower	-7.7	-4.0	-5.5	-4.9	-5.5

ACCURACY OF AIR QUALITY DATA
1982

Upper and Lower 95 Percent Probability Limits
of Percent Differences

Pollutant	Probability Limit	Quarter 1st	2nd	3rd	4th	Annual Average
Suspended Particulates (Total, Hi Vol)	Upper	+10.5	+8.8	+6.0	+6.5	+8.0
	Lower	-10.3	-8.4	-5.8	-4.5	-7.3
Sulfur Dioxide	Upper		+3.1	+1.6	+3.7	+2.8
	Lower		-9.5	-5.5	-7.4	-7.5
Ozone	Upper				+7.4	+7.4
	Lower				-7.0	-7.0

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 comes from stationary sources such as primary and secondary nonferrous smelters.

Data from a coordinated network operated by the Department of Ecology and the Agency previously identified two areas in the Puget Sound region which exceeded the lead standard. These were both in Seattle. One area was a strip bordering Interstate 5 from Spokane Street to Northgate. The other area was the Harbor Island industrial region.

The table below presents the results of sampling during 1982. A single station on Harbor Island located near a secondary lead smelter continues to record quarterly averages exceeding the lead standard. Lead concentrations measured at all other stations were lower than the standard requires.

LEAD
(Micrograms per Standard Cubic Meter)

1982
Quarterly Arithmetic Averages

Location	1st	2nd	3rd	4th
Evergreen Point Bridge Toll Plaza, Medina, Wa	0.53	0.55	0.48	0.50
504 Bellevue Way NE, Bellevue, Wa	0.37	0.28	0.29	0.31
North 98th St & Stone Ave N, Seattle, Wa	0.27	0.19	0.23	0.45
5701 8th Ave NE, Seattle, Wa	0.67	0.60	0.78	0.82
Portage Bay,2725 Montlake Blvd E, Seattle, Wa	0.47	0.27	0.35	0.62
Harbor Island, 2555 13th Ave SW, Seattle, Wa	8.41	6.97	5.24	3.88
Harbor Island, 3400 13th Ave SW, Seattle, Wa	0.89	0.86	1.05	0.68
4716 North Baltimore St, Tacoma, Wa	0.42	0.42	0.35	0.37
North 26th & Pearl Sts, Tacoma, Wa	0.28	0.25	0.30	0.36

LOWER ATMOSPHERE TEMPERATURE SOUNDINGS

A lower atmosphere sounding unit began operating on the east shore of Portage Bay in Seattle during 1971. The Department of Ecology operates the station. Normal operation provides one slow ascent sounding to 700 millibars about 0700 local time each Monday through Friday except on holidays. This sounding is the primary source of lower atmosphere data in the Puget Sound Basin and is an essential basis for many forecasts including air stagnation forecasts. Each sounding is reasonably representative of the lower atmosphere in the entire Puget Sound area. The Agency makes regular use of the sounding in evaluating and interpreting 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 simply 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 1982 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 printed in degrees/knots to the right of the sounding.

These soundings provide a meteorological picture of four days when Suspended Particulate and Carbon Monoxide levels reached high values exceeding standards at several stations. An Air Stagnation Advisory was in effect on three of the days. The Suspended Particulate and Carbon Monoxide summaries outline those values and dates; dates of soundings and the noteworthy items are listed below.

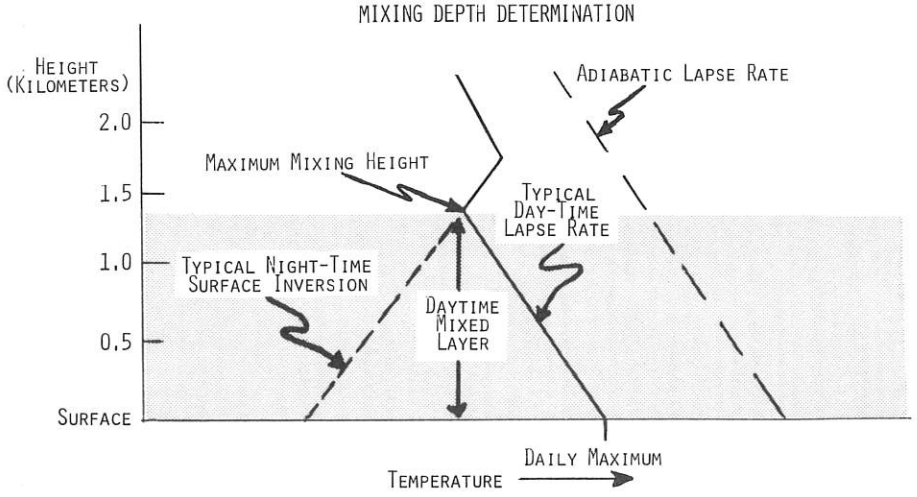
OCT 14; DEC 30,31

Air Stagnation Advisory
Suspended Particulates
Carbon Monoxide

NOV 24

Suspended Particulates
Carbon Monoxide (night of Nov 23)

MIXING DEPTH DETERMINATION

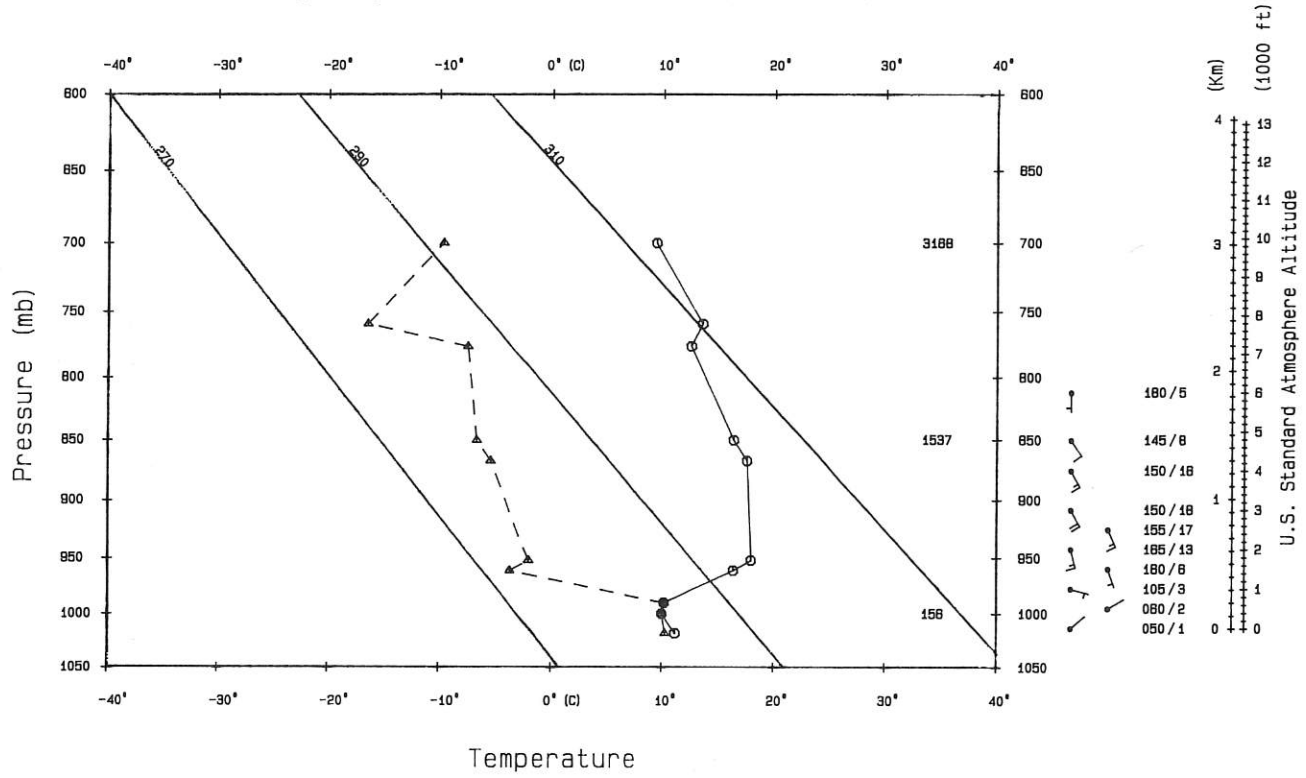


PUGET SOUND AIR POLLUTION CONTROL AGENCY

PSEUDO-ADIABATIC CHART

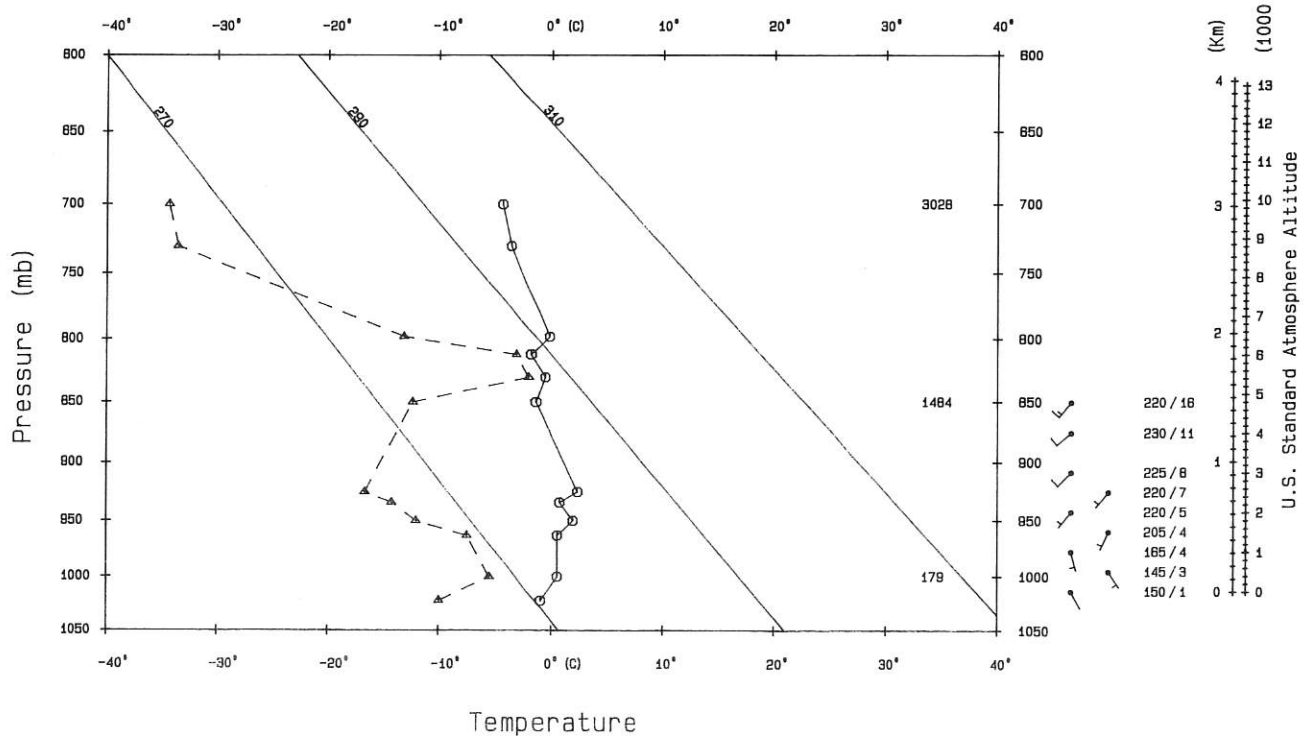
0600 PST 14 Oct 1982

Portage Bay, 2725 Montlake Blvd E, Seattle, WA



0700 PST 24 Nov 1982

Portage Bay, 2725 Montlake Blvd E, Seattle, WA

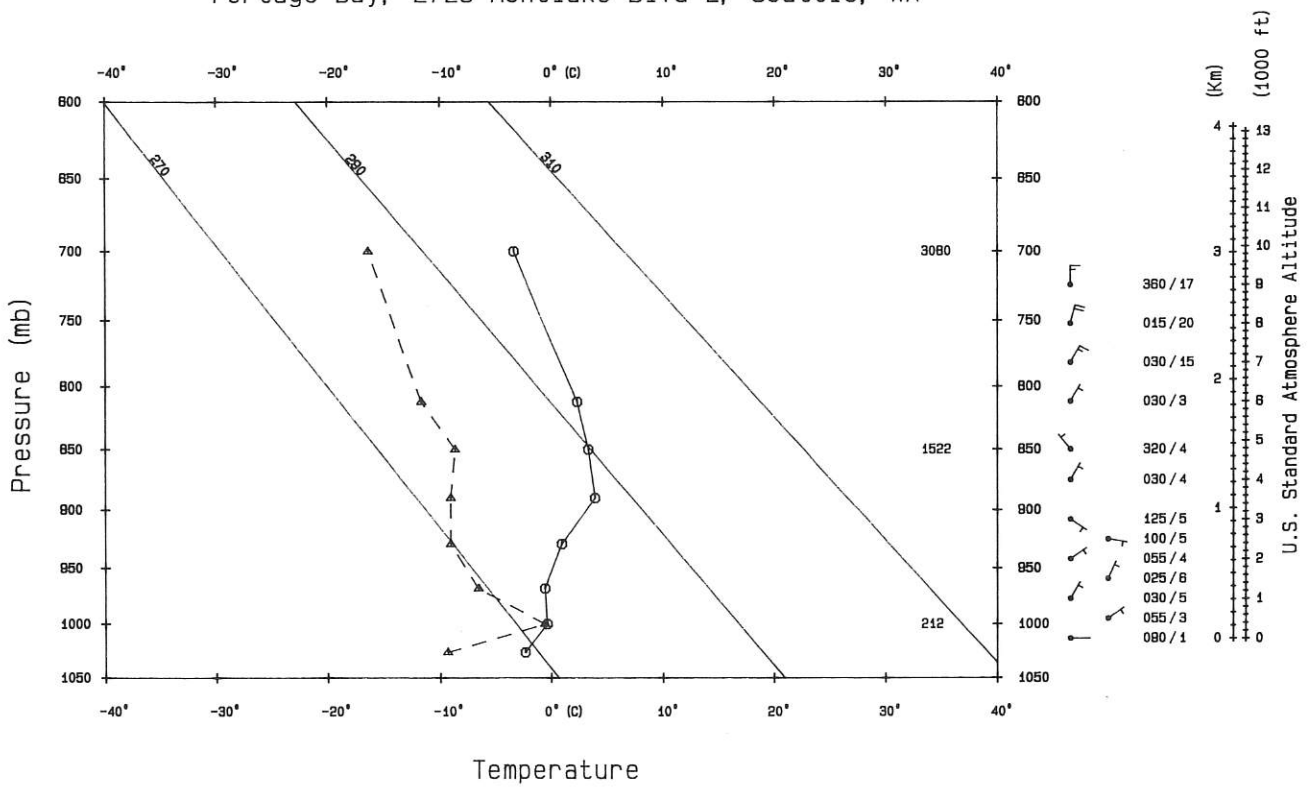


PUGET SOUND AIR POLLUTION CONTROL AGENCY

PSEUDO-ADIABATIC CHART

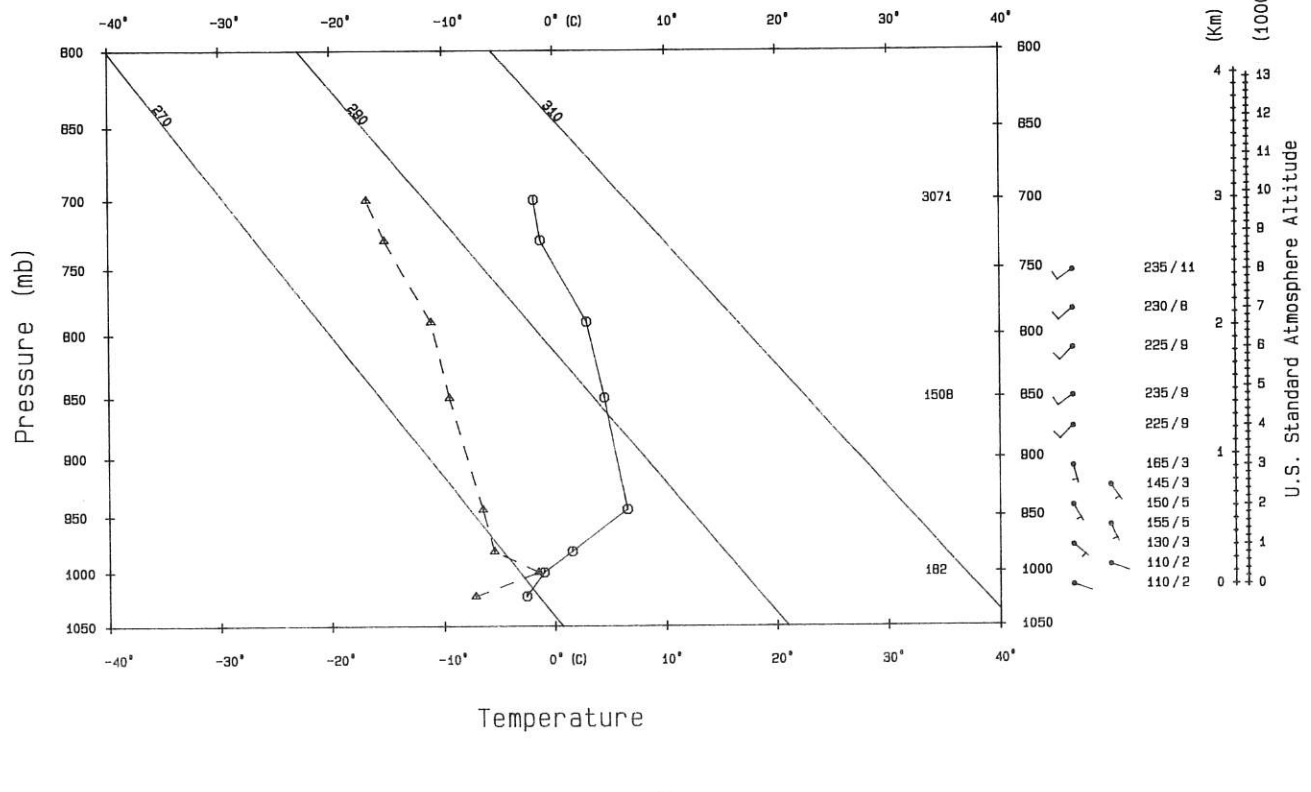
0700 PST 30 Dec 1982

Portage Bay, 2725 Montlake Blvd E, Seattle, WA



0700 PST 31 Dec 1982

Portage Bay, 2725 Montlake Blvd E, Seattle, WA



LOWER ATMOSPHERE TEMPERATURE SOUNDING CLIMATOLOGY

The Agency has developed a lower atmosphere climatology from the sounding data base. Each individual temperature sounding is analyzed to determine the vertical lapse rate of temperature, (-DT/DZ), between significant levels. These "significant level" layers are then grouped into sounding layers by the following four stability categories:

1) Temperature inversion (a stable condition)
2) Stable (no inversion)
3) Conditionally stable
4) Unstable

Two types of summary tables of these sounding layers are presented below. On the right the tables present a distribution of TEMPERATURE INVERSION LAYERS showing the number of inversions of a given thickness (or depth) by height of the inversion base. Tables on the left present the distribution of the four mutually exclusive SOUNDING LAYERS by height of the base of each layer.

This analysis includes tables summarizing eleven years of data (1972 through 1982) as well as tables for calendar year 1982 alone. Seasonal variations are shown by monthly tables presented in the Air Quality Data Summary for 1977.

FREQUENCY DISTRIBUTION OF SOUNDING LAYERS
(Within Given Lapse Rate Interval Based At or Below Given Height)

Portage Bay, 2725 Montlake Blvd E, Seattle, Wa

ALL MONTHS 1982
Morning Soundings (0600 to 0800 PST)

Height of Base (GPM) At or Below	LAPSE RATE CATEGORIES (DEGREES C/KM) Stable < 0.0	Stable 0.0 to 5.0	Cond Stable 5.1 to 10.0	Unstable > 10.0	Total No. Sounding Layers
SFC	31	23	59	105	218
150	50	36	122	106	314
300	84	56	163	109	412
500	115	99	183	110	507
1000	141	158	260	110	669
1500	169	228	336	113	846
2000	197	292	400	115	1004
2500	223	341	463	120	1147
3000	244	385	508	125	1262
700 MB	244	385	508	125	1262

Number of Soundings: 218

ALL MONTHS 1972-82
Morning Soundings (0600 to 0800 PST)

Height of Base (GPM) At or Below	LAPSE RATE CATEGORIES (DEGREES C/KM) Stable < 0.0	Stable 0.0 to 5.0	Cond Stable 5.1 to 10.0	Unstable > 10.0	Total No. Sounding Layers
SFC	379	412	749	1177	2717
150	641	645	1403	1218	3907
300	1001	909	1889	1260	5059
500	1313	1331	2241	1273	6158
1000	1721	2209	3148	1325	8403
1500	2180	3085	4091	1414	10770
2000	2635	3833	4935	1494	12897
2500	3066	4524	5734	1580	14904
3000	3383	5047	6308	1644	16382
700 MB	3393	5050	6313	1646	16402

Number of Soundings: 2717

FREQUENCY DISTRIBUTION OF TEMPERATURE INVERSION LAYERS
(Within Given Thickness Interval Based At or Below Given Height)

Portage Bay, 2725 Montlake Blvd E, Seattle, Wa (Elevation 8 M Above MSL)

ALL MONTHS 1982
Morning Soundings (0600 to 0800 PST)

Height of Base (GPM) At or Below	Thickness (GPM) 0 to 150	151 to 300	301 to 450	451 to 600	601 to 750	751 to 900	> 900	Total No. Temperature Inversions	Total No. Sounding Layers
SFC	11	4	2	5	3	2	4	31	218
150	15	9	5	10	3	2	6	50	314
300	24	21	8	12	6	4	9	84	412
500	31	29	15	14	7	6	13	115	507
1000	40	35	22	16	9	6	13	141	669
1500	49	46	25	20	10	6	13	169	846
2000	53	61	27	24	12	7	13	197	1004
2500	60	74	30	26	13	7	13	223	1147
3000	65	86	34	26	13	7	13	244	1262
700 MB	65	86	34	26	13	7	13	244	1262

Number of Soundings: 218

ALL MONTHS 1972-82
Morning Soundings (0600 to 0800 PST)

Height of Base (GPM) At or Below	Thickness (GPM) 0 to 150	151 to 300	301 to 450	451 to 600	601 to 750	751 to 900	> 900	Total No. Temperature Inversions	Total No. Sounding Layers
SFC	96	95	69	41	28	23	27	379	2717
150	140	162	113	86	51	39	50	641	3907
300	245	244	170	120	79	60	83	1001	5059
500	347	337	213	151	95	71	99	1313	6158
1000	510	464	266	184	108	75	114	1721	8403
1500	713	626	310	215	116	81	119	2180	10770
2000	888	789	380	239	135	84	120	2635	12897
2500	1065	937	445	263	148	87	121	3066	14904
3000	1204	1067	488	268	148	87	121	3383	16382
700 MB	1214	1067	488	268	148	87	121	3393	16402

Number of Soundings: 2717

NOTES:

(1) All Heights are measured in Geopotential Meters above Mean Sea Level.
(2) Sounding terminates at 700 MB (3010 GPM - U.S. Standard Atmosphere).
(3) Because the Numbers in each Column are cumulative, Totals may be read Directly from the last Row (Height of Base At or Below 700 MB).
(4) The Lapse Rate is defined as -DT/DZ where DT is Temperature Difference and DZ is Height Difference (or Thickness) between consecutive Sounding Layers. Thus an Inversion is defined by a negative Lapse Rate.

AIR STAGNATION ADVISORIES

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. An Air Stagnation Advisory was in effect in the Puget Sound region for the following periods during 1982:

Valid From:	To:
10 AM, Wednesday, October 13	3 PM, Friday, October 15
10 AM, Thursday, December 30	12 Noon, Saturday, January 1, 1983

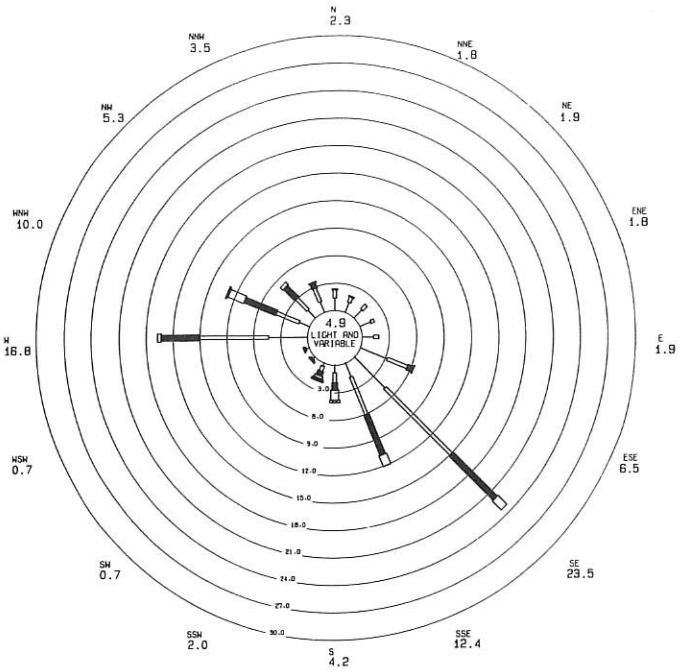
WIND ROSES

The measurement of local area wind speed and direction is important in the evaluation of air pollution. Low wind speeds contribute to 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 shown in the center of the rose.



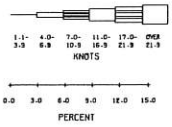
HOUR AVERAGE SURFACE WINDS

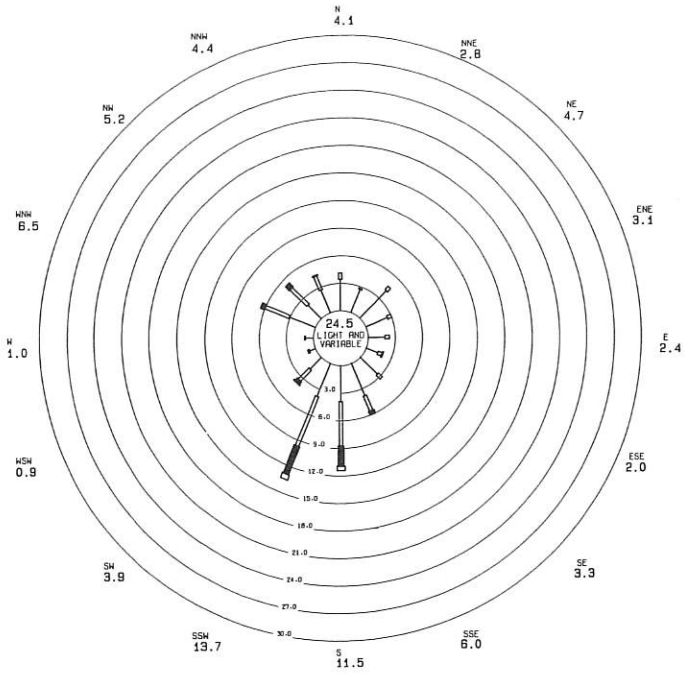
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,733





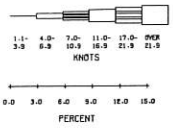
HOUR AVERAGE SURFACE WINDS

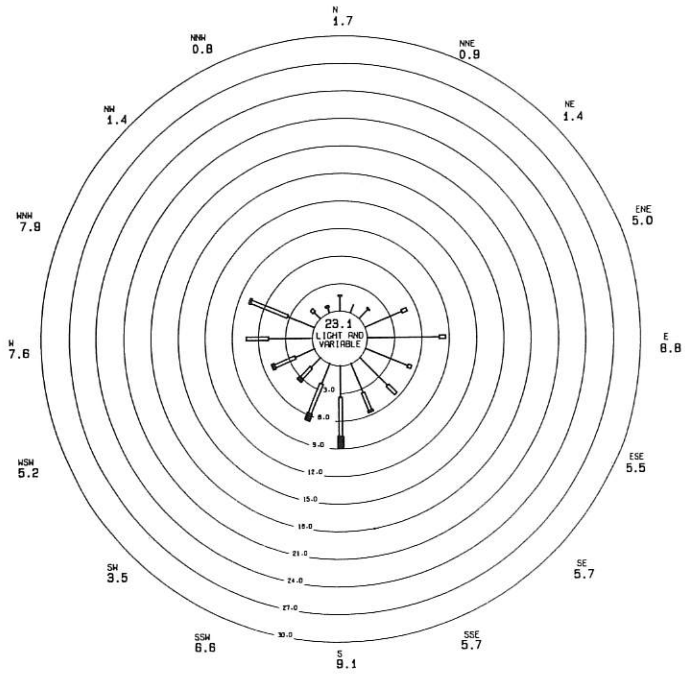
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,668





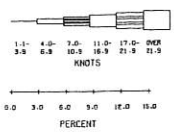
HOUR AVERAGE SURFACE WINDS

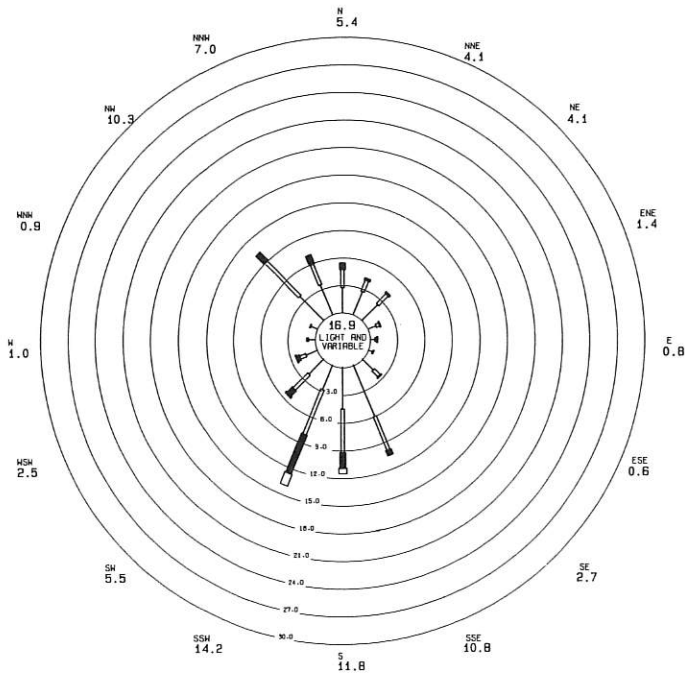
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,337





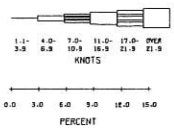
HOUR AVERAGE SURFACE WINDS

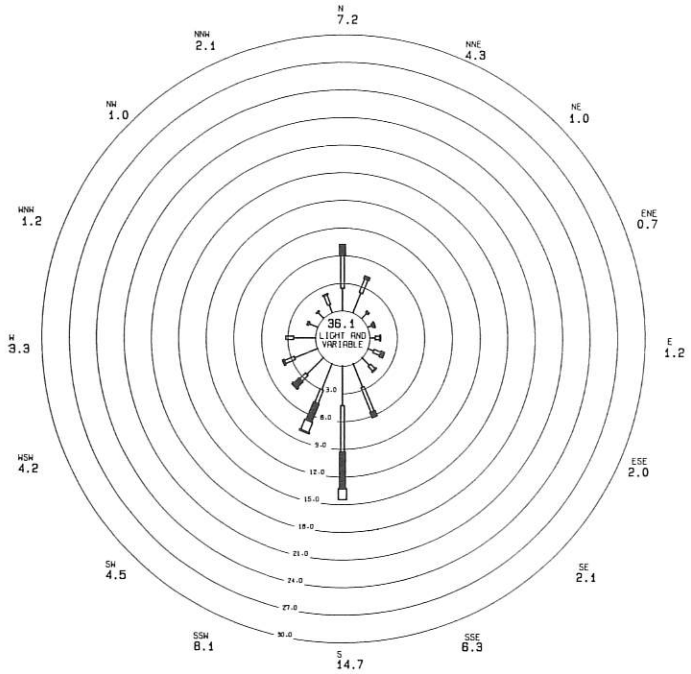
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,617





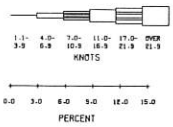
HOUR AVERAGE SURFACE WINDS

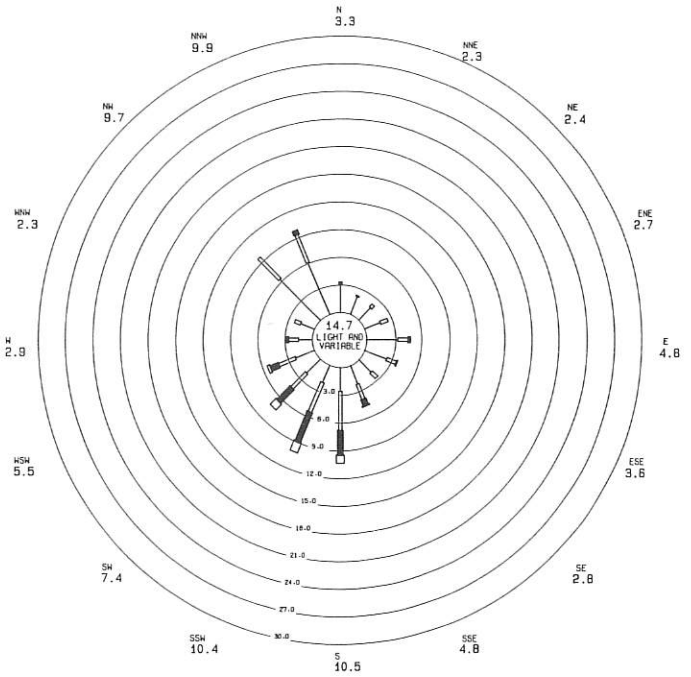
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
22916 86th Ave S, Kent, Wa

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,743





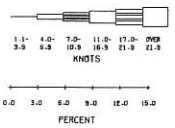
HOUR AVERAGE SURFACE WINDS

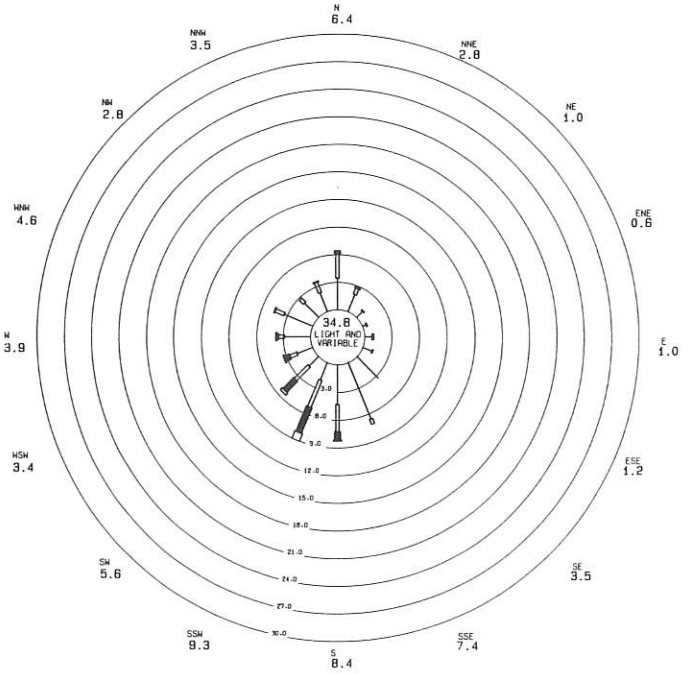
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,739





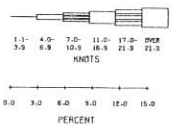
HOUR AVERAGE SURFACE WINDS

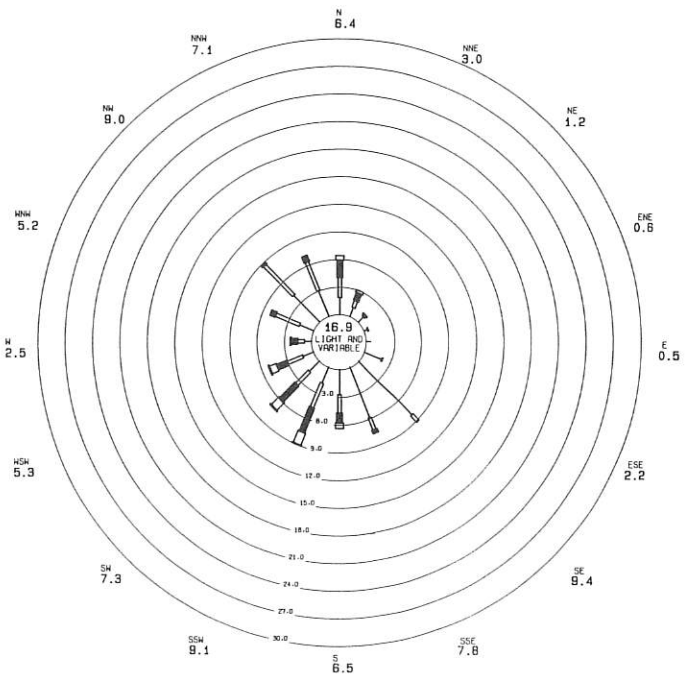
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,627





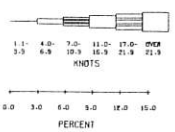
HOUR AVERAGE SURFACE WINDS

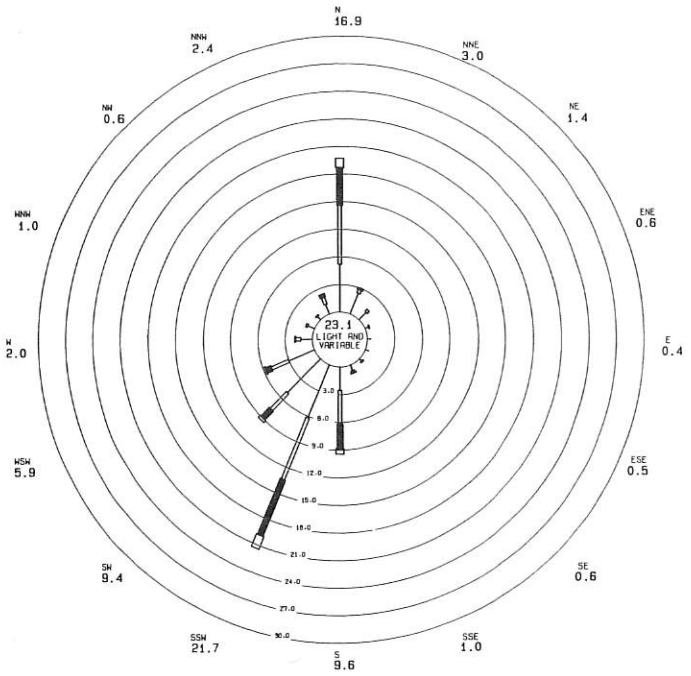
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,697





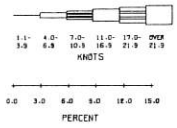
HOUR AVERAGE SURFACE WINDS

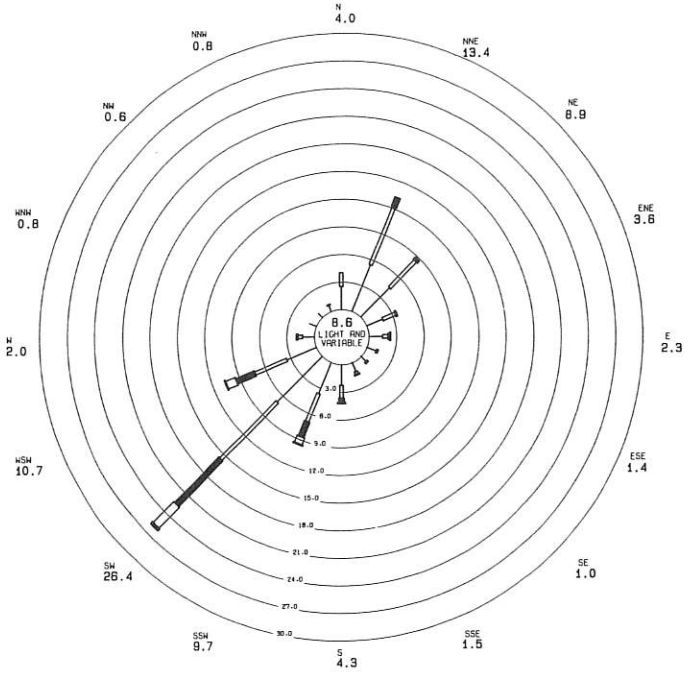
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Willard School, S 32nd & S 'D' St, Tacoma, Wa

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,749





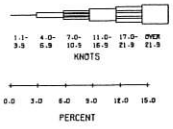
HOUR AVERAGE SURFACE WINDS

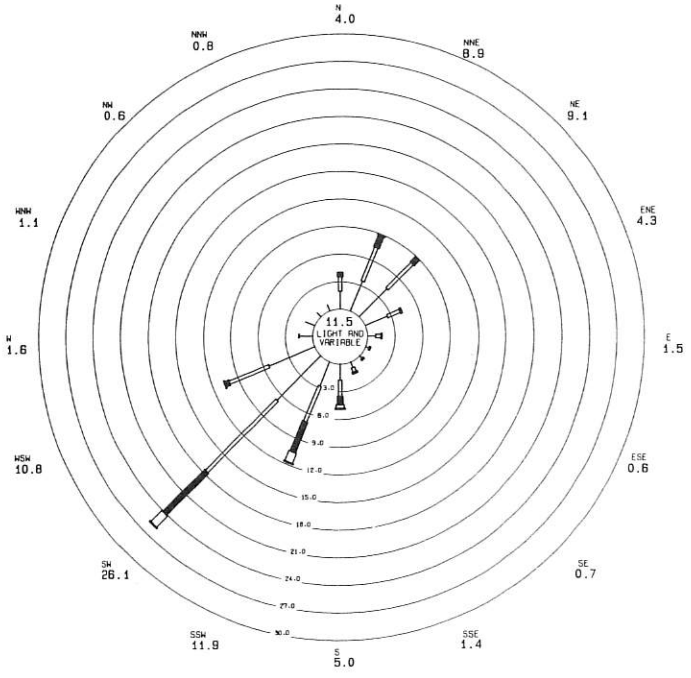
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,726





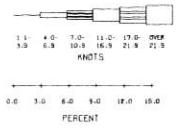
HOUR AVERAGE SURFACE WINDS

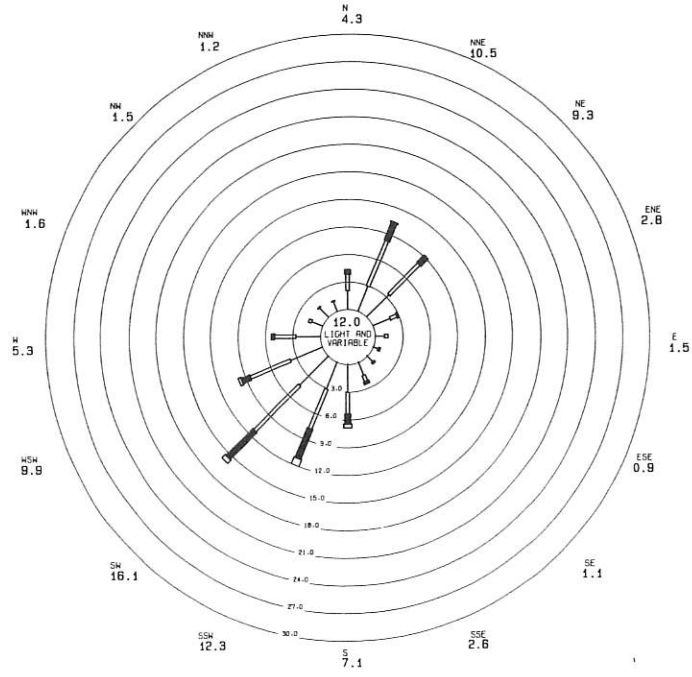
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,741





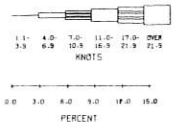
HOUR AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1982

TOTAL OBSERVATIONS- 8,745



STABILITY WIND ROSES

Introduction

The stability wind rose summarizes individual observations of wind direction and wind speed plus an objective calculation of low level stability existing at the same time. 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 graphical presentation is similar to the wind rose except that separate wind roses are constructed for each stability category.

Determination of Stability

The low level stability is calculated following an objective procedure documented by D. Bruce Turner in the "Journal of Applied Meteorology", February, 1964. Low level stability depends primarily upon net radiation and wind speed. In this technique the estimate of daytime incoming radiation is developed from solar altitude for time of day and time of year at the particular location. 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

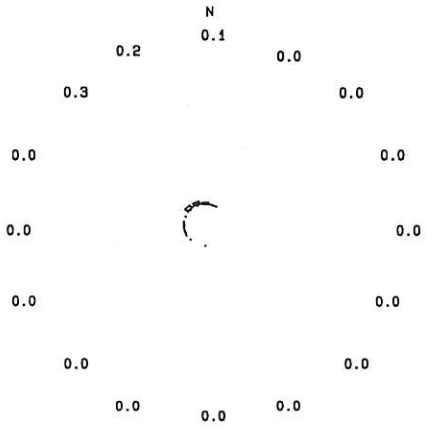
The local area stability wind roses are developed using 3 hour interval cloud data recorded for Seattle Tacoma International Airport. Persistence in cloud data is assumed for the hour preceding and the hour following the observation. This cloud data extended to 1 hour intervals is then used with the 1 hour average wind data measured at the location for which the stability wind rose is constructed.

Stability wind roses for three locations in the Puget Sound region follow this discussion. The wind rose for each stability class may be interpreted by reviewing the discussion in the preceding section on wind roses. There are two main differences. First, percent 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.

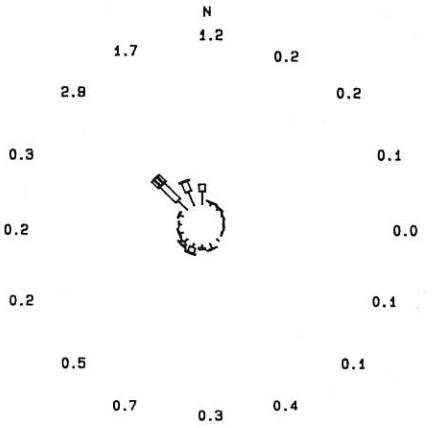
The stability wind rose summaries are required for air quality modeling. The Climatological Dispersion Model uses the frequency tables from which the accompanying stability wind roses were plotted.

Clearly the wind pattern represents the most significant difference between locations. Each stability class occurs a similar percentage of time at each station. During 1982 neutral stability existed from 45 to 48 percent of the time. Stable nighttime conditions occurred 33 to 34 percent of the time. The wind rose associated with these stable conditions is probably the most important in describing poor pollutant dispersion and is generally different than that occurring during any other stability class.

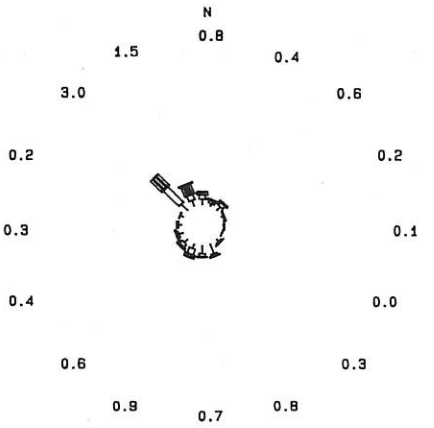
PUGET SOUND AIR POLLUTION CONTROL AGENCY



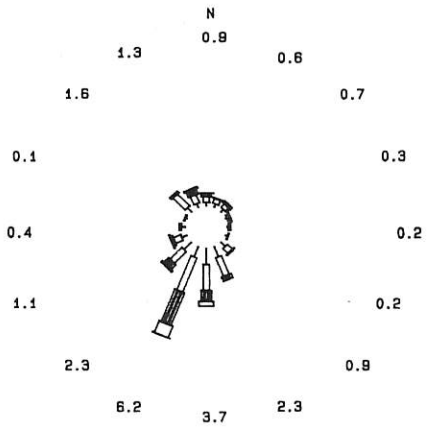
Extremely Unstable
0.7 %



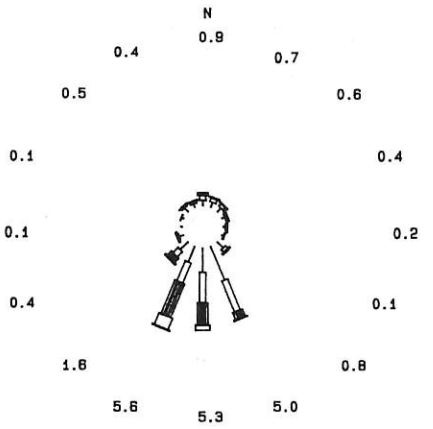
Unstable
8.9 %



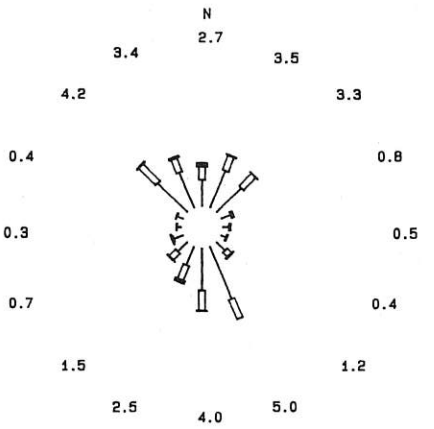
Slightly Unstable
10.8%



Neutral Daytime
22.6%



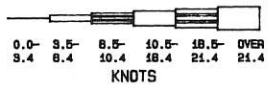
Neutral Nighttime
22.7%

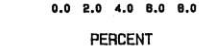


Stable
34.3%

STABILITY WIND ROSES

DUWAMISH, 4401 E MARGINAL WAY S, SEATTLE, WA





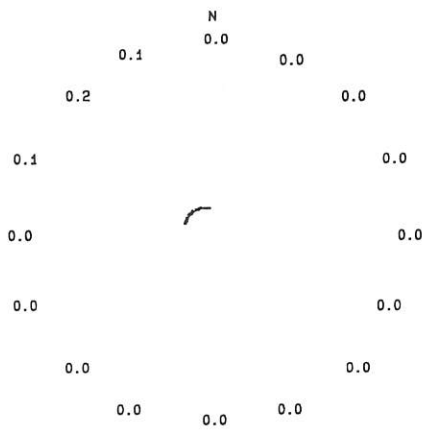
Period of Record: JAN - DEC, 1982

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

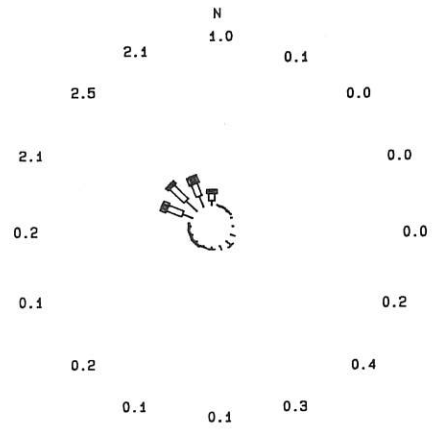
3 Hr Cloud Location: SEATTLE TACOMA INTERNATIONAL AIRPORT, WA

Percentage Frequency of Occurrence

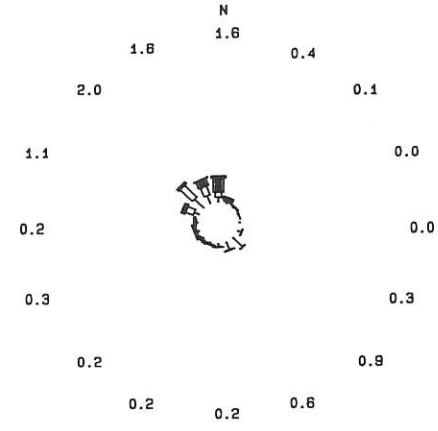
PUGET SOUND AIR POLLUTION CONTROL AGENCY



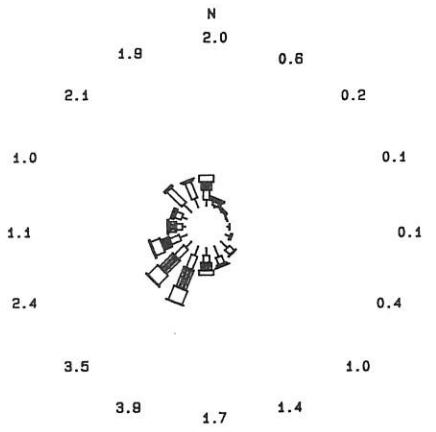
Extremely Unstable
0.4 %



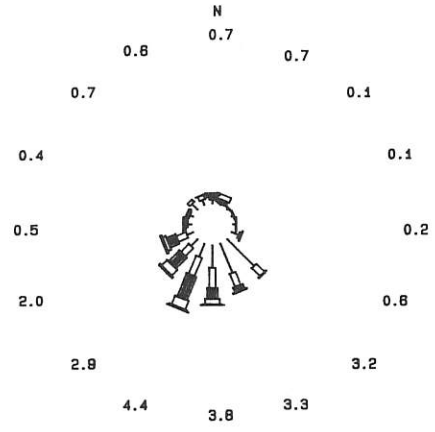
Unstable
9.5 %



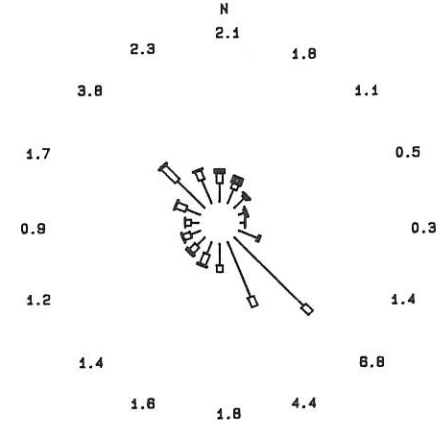
Slightly Unstable
9.7 %



Neutral Daytime
23.3%



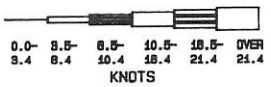
Neutral Nighttime
24.2%

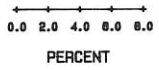


Stable
32.9%

STABILITY WIND ROSES

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





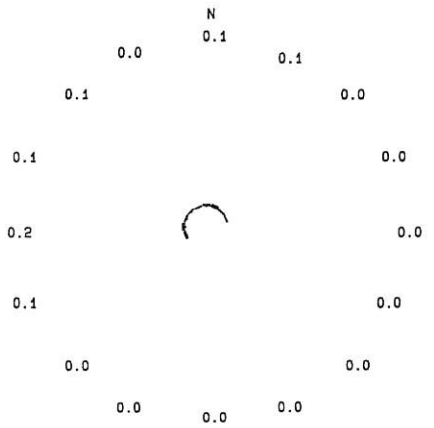
Period of Record: JAN - DEC, 1982

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

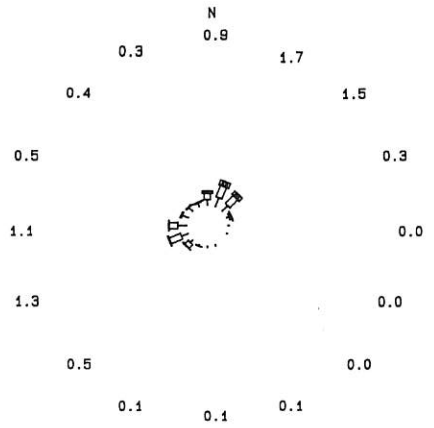
3 Hr Cloud Location: SEATTLE TACOMA INTERNATIONAL AIRPORT, WA

Percentage Frequency of Occurrence

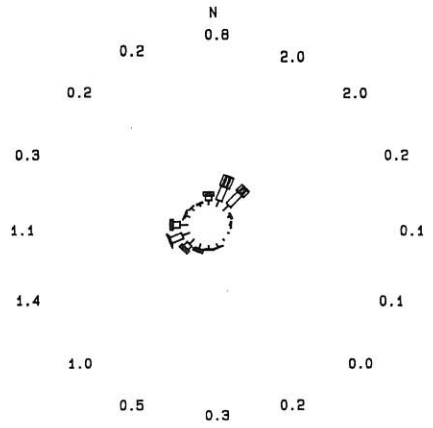
PUGET SOUND AIR POLLUTION CONTROL AGENCY



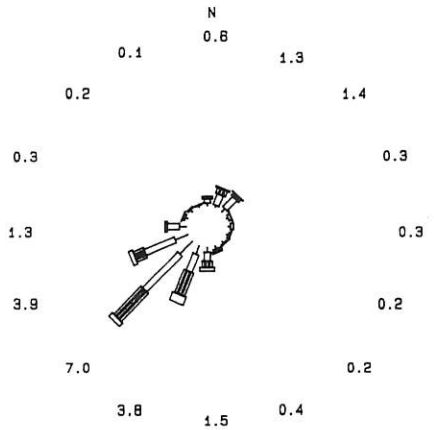
Extremely Unstable
0.8 %



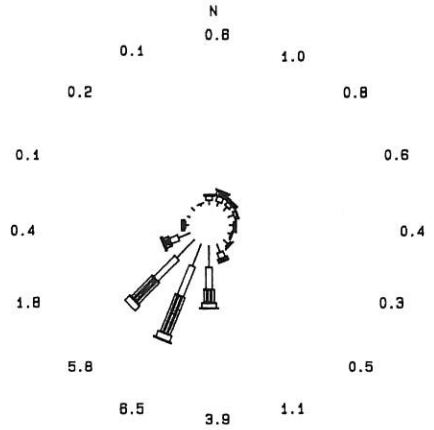
Unstable
8.7 %



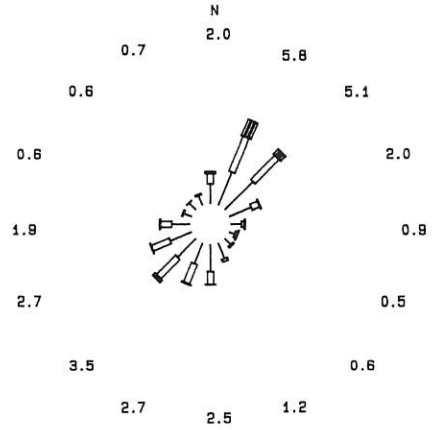
Slightly Unstable
10.4%



Neutral Daytime
23.0%



Neutral Nighttime
24.0%

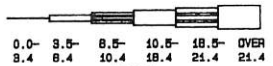


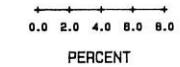
Stable
33.2%

STABILITY WIND ROSES

NORTH 26TH & PEARL STS, TACOMA, WA

Percentage Frequency of Occurrence





Period of Record: JAN - DEC, 1982

1 Hr Wind Location: NORTH 26TH & PEARL STS, TACOMA, WA

3 Hr Cloud Location: SEATTLE TACOMA INTERNATIONAL AIRPORT, WA

AIR QUALITY UNITS CONVERSION TABLE

Air quality standards for gases are defined in terms of micrograms (µg) 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 of our readers who wish to interpret our results in terms of $\mu g/m^3$ or mg/m^3. Conversion factors, extracted from the Federal Register, assume a pressure of 760 mm Hg and a temperature of $25^{o}C$.

Pollutant	Multiply PPM by	To Obtain
CO	1.145	mg/m^3
NO_2	1880	$\mu g/m^3$
O_3	1961	$\mu g/m^3$
SO_2	2619	$\mu g/m^3$

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		ppm	
8 hour Average	9	9	b	9	b	9	b
1 hour Average	35	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.

PSAPCA 4/83