

# AIR QUALITY DATA SUMMARY

for counties of

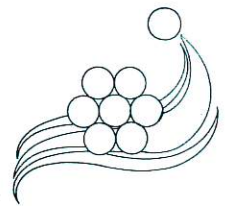
King

Kitsap

Pierce

Snohomish

1976



measured and compiled by  
Technical Services Division

Puget Sound Air Pollution Control Agency

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1976  
AIR QUALITY  
DATA SUMMARY

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Technical Services Division

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

# Puget Sound Air Pollution Control Agency

Serving King, Kitsap, Pierce and Snohomish Counties  
410 W. Harrison St., P.O. Box 9863, Seattle, WA 98109

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\* Deceased. Mr. Peterson, Vice President, U. S. Oil and Refining Company, Tacoma, served on the Advisory Council from July, 1970, until his death in May, 1977.



# 1976 AIR QUALITY DATA SUMMARY

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## AIR QUALITY UNITS CONVERSION TABLE

Air quality standards for gases are defined in terms of micrograms ( $\mu\text{g}$ ) 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  $\mu\text{g}/\text{m}^3$  or  $\text{mg}/\text{m}^3$ . Conversion factors are extracted from the Federal Register, assuming a pressure of 760 mm Hg and a temperature of 25°C.

<u>Pollutant</u>	<u>Multiply PPM by</u>	<u>To Obtain</u>
CO	1.145	$\text{mg}/\text{m}^3$
NO <sub>2</sub>	1880	$\mu\text{g}/\text{m}^3$
O <sub>3</sub>	1961	$\mu\text{g}/\text{m}^3$
SO <sub>2</sub>	2619	$\mu\text{g}/\text{m}^3$

## INTRODUCTION

Air quality and meteorological data collected within the Central Puget Sound Region during 1976 are presented in this fifth annual data summary. 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. Both air quality and meteorological data are necessary to compare existing air quality with established standards, to project probable effects of additional pollutant loading to the atmosphere, and to demonstrate long-term trends.

The summary begins with a table showing addresses of the Agency's air sampling sites. The locator map on page 4 makes clear that monitoring is concentrated in or near industrial/urban centers. Budgetary constraints do not permit regular air monitoring in most outlying areas; air quality in many such areas can only be estimated on the basis of the few locations where monitoring has been conducted. The State Department of Ecology conducts some air monitoring within the region in addition to that done by the Agency. The Department of Ecology publishes its own annual summary which contains data for the state as a whole. Requests for specific information on such air pollutants as carbon monoxide, oxidants, and oxides of nitrogen should be directed to the Washington State Department of Ecology, Olympia, WA 98504, (206) 753-2843.

The Agency collects air quality and meteorological data by means of telemetry. In addition, a network of high-volume air samplers obtains suspended particulate measurements in accordance with the Federal reference method. A detailed description of the data collection system begins on page 5. The body of the report contains summaries of pollutant measurements for 1976 and several interpretive analyses and comments on the data. The report ends with meteorological data summarized in a series of wind roses.

The data presented in these annual summaries are increasingly used by public agencies and private consultants for such purposes as community planning, for inclusion in Environmental Impact Statements, and for computer modeling of area-wide air quality. General public interest ranges from the casual to specific concerns of those who suffer from one or more of a variety of respiratory ailments. Considerable detail must be included for those who require the information for decision-making or scientific purposes. Persons who are not familiar with air quality terms or meteorological data should, with a little study, be able to understand the data sufficiently well to fill their needs. Those who need help in interpreting data may call the Agency's Technical Services Division.

PUGET SOUND AIR POLLUTION CONTROL AGENCY

ATMOSPHERIC SAMPLING NETWORK

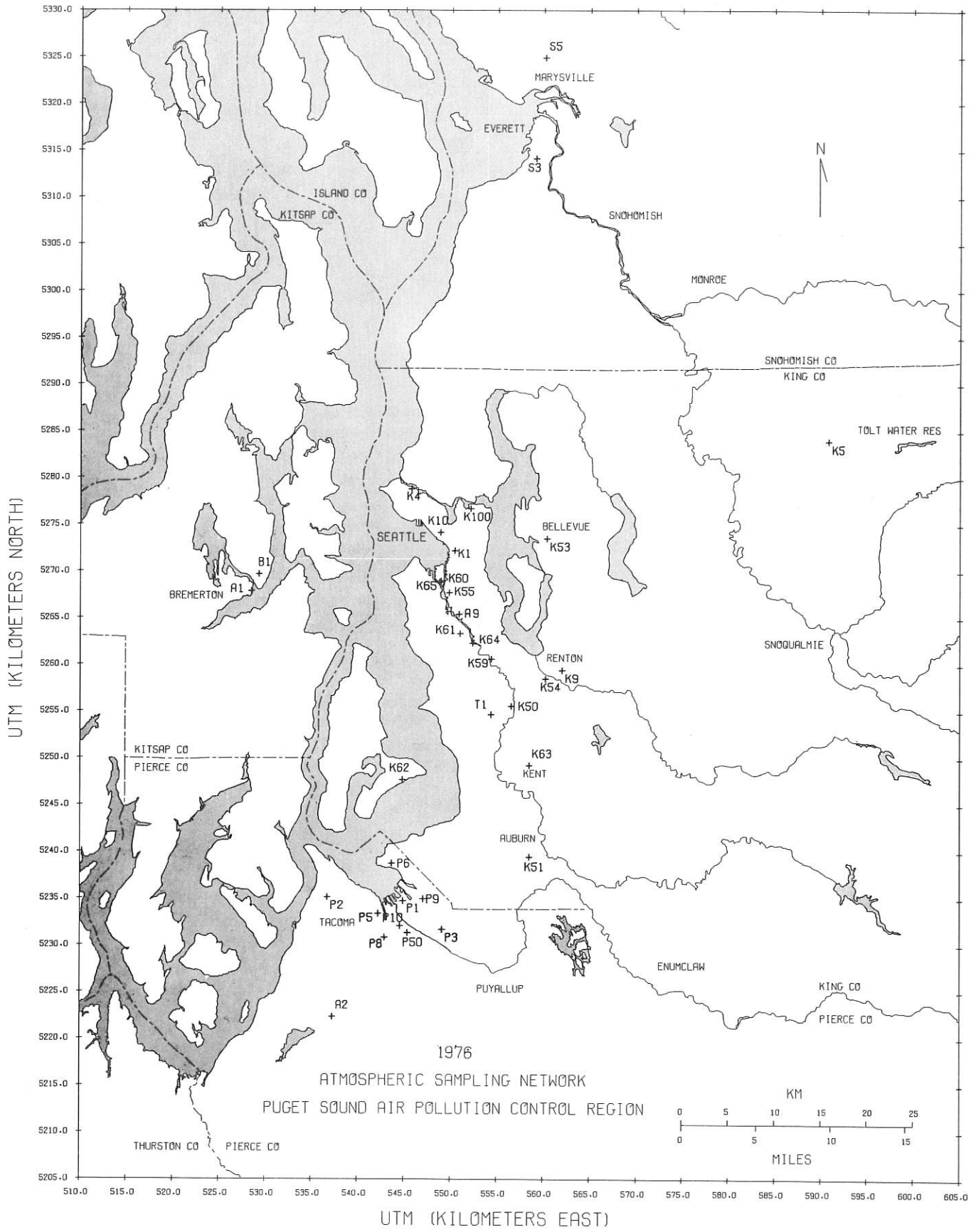
1976

Sta. Code	Location	Type of Sampling*										
		1	2	3	4	5	6	7	8	9	10	11
S 3	Medical-Dental Bldg., 2730 Colby Ave., Everett	x	x	x	x							
S 5	Tulalip Test Facility, Snohomish County	x		x	x	x	x		x	x	x	
K 1	Public Safety Bldg., 604 3rd Ave., Seattle	x										
K 4	USCG Station, 2700 W. Commodore Way, Seattle	x										
K 5	Tolt River Watershed (East of Lake Joy)	x										
K 9	S.E. Dist. Health Center, 12015 S.E. 128th St., Renton	x										
K10	Food Circus Building, Seattle Center	x	x	x	x							
K50	Southcenter, Andover Park E., Tukwila	x	x	x	x							
K51	115 East Main St. & Auburn Ave., Auburn	x										
K53	Puget Power Bldg., 10604 N.E. 4th, Bellevue	x										
K54	Municipal Bldg., 200 Mill Ave. S., Renton	x										
K55	Duwamish, 4500 Blk. E. Marginal Way S., Seattle	x	x	x	x							
K59	Duwamish Valley, 12026 42nd Ave. S., King County	x										
K60	Harbor Island, 3400 13th Ave. S.W., Seattle	x										
K61	South Park, 723 S. Concord St., Seattle	x										
K62	S.W. 248th & 59th Ave. S.W., Maury Island		x		x							
K63	1234 N. Central Ave., Kent	x	x	x	x			x				x
K64	10000 W. Marginal Way S.W., Seattle	x	x	x	x	x	x		x	x	x	
K65	Harbor Island, 3419 13th Ave. S.W., Seattle		x		x							
K100	NWS Urban Site, 2725 Montlake Blvd. E., Seattle				x							
T 1	McMicken Hts., S. 176th & 42nd Ave. S., King County	x	x	x	x			x				
P 1	2316 E. 11th St. & Thorne Rd., Tacoma	x		x	x							
P 2	N. 26th & Pearl St., Tacoma	x	x	x	x							
P 3	Fife Sr. H.S., 5616 20th E., Fife	x										
P 5	Hess Bldg., 901 Tacoma Ave. S., Tacoma	x										
P 6	Meeker Jr. H.S., 1526 51st St. N.E., Tacoma	x	x	x	x							
P 8	Willard Elementary School, S. 32nd & S. "D" St., Tacoma	x		x	x							
P 9	2340 Taylor Way, Tacoma	x										
P10	Treatment Plant, 1241 Cleveland Way, Tacoma	x										
P50	Cascadia, 2002 E. 28th St., Tacoma	x										
B 1	Dewey Jr. H.S., Perry Ave. & Holman St., Bremerton	x	x	x	x							
A 1	City Hall, 239 4th St., Bremerton	x										
A 2	5132 112th St. S.W., Lakewood	x										
A 9	S. River St. & Maynard Ave., Seattle	x										

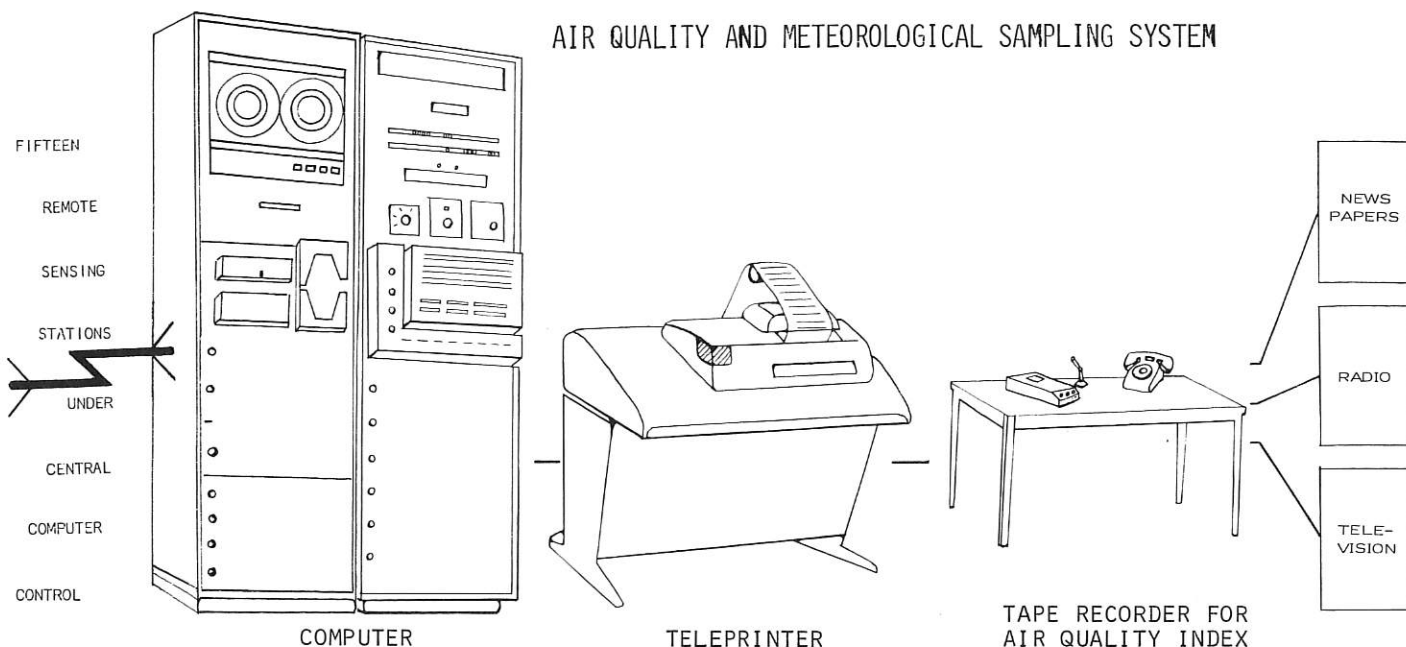
"A" Code stations operated by Washington State Department of Ecology

\*Type of Sampling

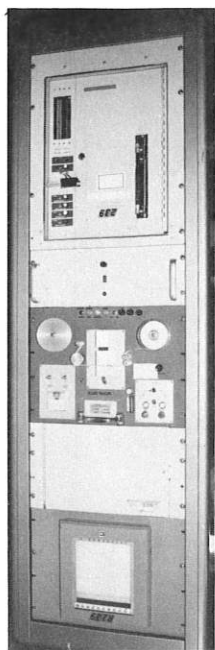
- |   |  |                           |
|---|--|---------------------------|
| 1. Suspended Particulates (High-Volume) | 5. Nitrogen Dioxide (NO <sub>2</sub> ) | 9. Carbon Monoxide (CO)   |
| 2. Sulfur Dioxide (SO <sub>2</sub> )    | 6. Nitrogen Oxides (NO <sub>x</sub> )  | 10. Delta Temperature     |
| 3. Suspended Particulates (COH's)       | 7. Ozone (O <sub>3</sub> )             | 11. Atmospheric Particles |
| 4. Wind Speed & Direction               | 8. Hydrocarbons (nonmethane)           | (b - scattering)          |



## AIR QUALITY AND METEOROLOGICAL SAMPLING SYSTEM



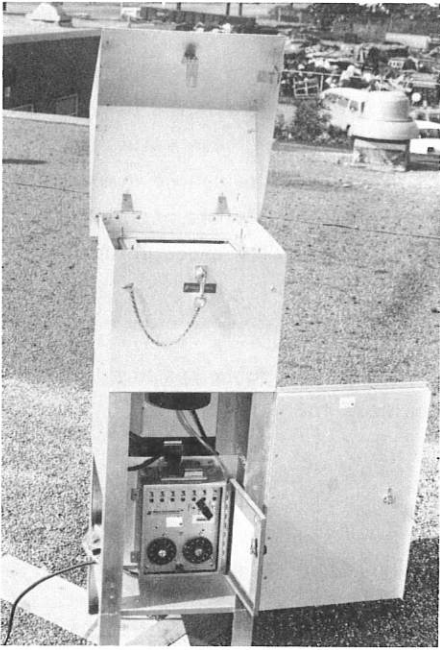
- Fifteen remote stations in the Puget Sound Region continuously monitor.....  
 WIND DIRECTION    WIND SPEED    SULFUR DIOXIDE    SUSPENDED PARTICULATES (COH's)  
 (Four stations have additional sensors)
- Raw data is immediately telemetered to the central station computer via phone lines.
- Central station computer controls the entire network. It processes all raw data, and computes 15-minute, 1-hour, and 24-hour averages for immediate printout.
- Processed averages are printed by teleprinter on a continuous schedule around the clock each day of the year.
- All data is checked for validity or instrument malfunction by air quality specialists prior to use.
- Data is used to evaluate the attainment of ambient air quality standards; to maintain real-time surveillance for episode avoidance; and to report an air quality index to the public.
- After validation and deletion of any erroneous data, the data is processed by off-line computer to provide a monthly summary containing the specific hourly averages, daily maximum, minimum, and mean, monthly arithmetic and geometric means, selected moving averages and pertinent identifying information.
- Permanent data files stored on magnetic tape or disk allow rapid retrieval for correlation with other data, trend analyses, atmospheric modeling, land use planning and special studies.
- Nontelemetered data from twenty-eight high volume (suspended particulates) instruments is manually reduced, punched on cards, processed, printed, and stored in permanent computer files for rapid retrieval.



On the left is one of the fifteen remote station equipment cabinets housing the sulfur dioxide monitor, the wind speed and direction signal conditioner and translator, the tape sampler for suspended particulates measured as COH (soiling index) and the telemetry electronics. The anemometer, wind direction sensor, and probes for SO<sub>2</sub> and COH are installed to obtain representative samples in the ambient air. Each station has a capability of fourteen separate sensors. Two stations are presently equipped with eleven sensors, one with six sensors and one with five.



On the right is the central station computer whose functions are described above. One equipment rack contains the magnetic tape recorder and high speed paper tape reader; the 32K byte computer and telemetry interface electronics are in the other equipment rack. Next to it is a console printer which also serves as a standby system printer. The large teletype console prints the processed data. At the extreme right is a weather teletype.

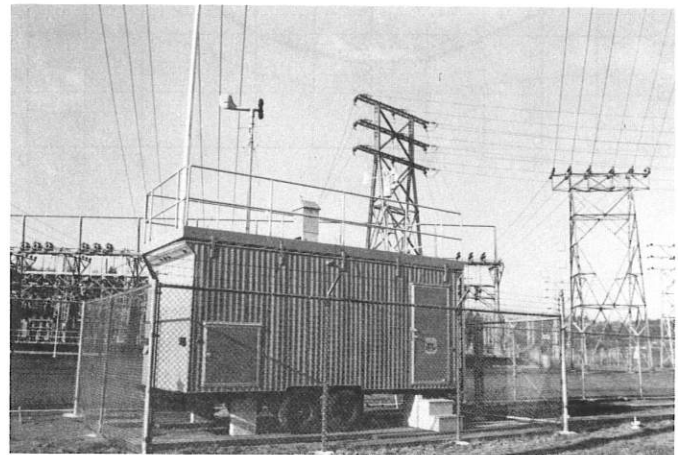


Above is a high volume air sampler used for measuring suspended particulates. This instrument, open for illustrative purposes, contains a special filter in the top portion of the protective cabinet and an electric timer at the base. This instrument is normally operated for a 24-hour period every sixth day and will collect particulates as small as 0.3 micron with 99.7% efficiency. A micron is 0.001 millimeters or 0.000039 inches.

Most of the Agency equipment is located in schools, fire stations, city halls and commercial buildings. In some areas, buildings do not exist or do not meet the siting criteria. In these areas, trailers or portable buildings must be used as shelters for sampling equipment. At the top center is a semi-portable building used at the McMicken Heights Reservoir, east of SEA-TAC Airport. Visible on the roof are the high volume sampler, the wind sensing equipment, and the probes for SO<sub>2</sub>, COH (tape sampler) and ozone. The analyzers and the telemetry electronics are located inside the building.

On the top right is a trailer used at Kent. On the roof are the high volume sampler, the wind sensing equipment and probes for bringing air to the analyzers. This station measures SO<sub>2</sub>, Ozone, COH, b<sub>scat</sub> (a measure of light scatter by aerosols), wind speed, direction and suspended particulates by high volume sampler. All the data except suspended particulates measured by the high volume sampler are telemetered.

Below is one of two trailers owned by Seattle City Light and operated by the Agency. These well instrumented special purpose units provide environmental information for Seattle City Light at a power substation in the Duwamish Basin Industrial area and at a site near Marysville. Measurements include HC, CO, NO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, COH, delta-temperature, wind and suspended particulates. All data is telemetered except suspended particulate measured by high volume samplers.



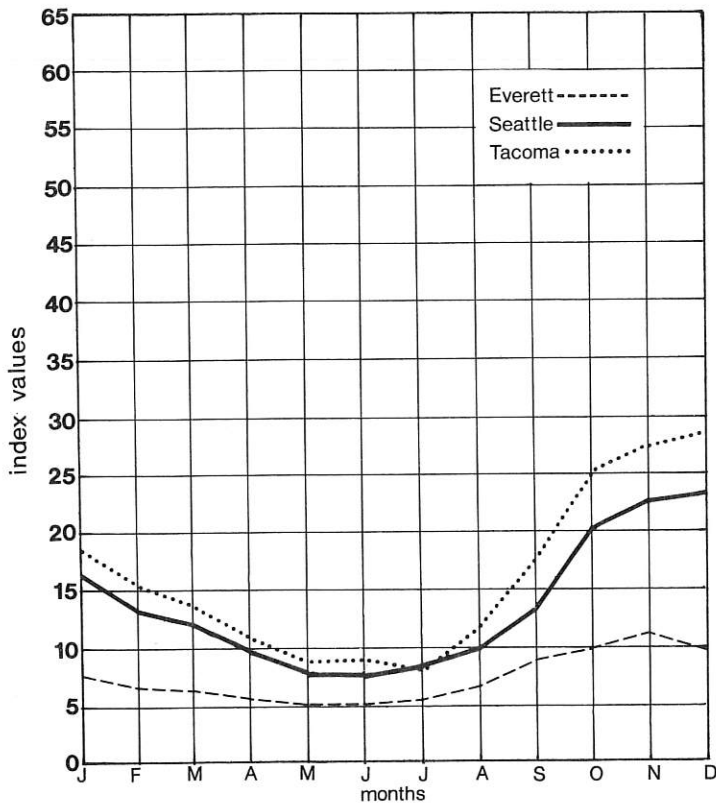


## AIR QUALITY INDEX

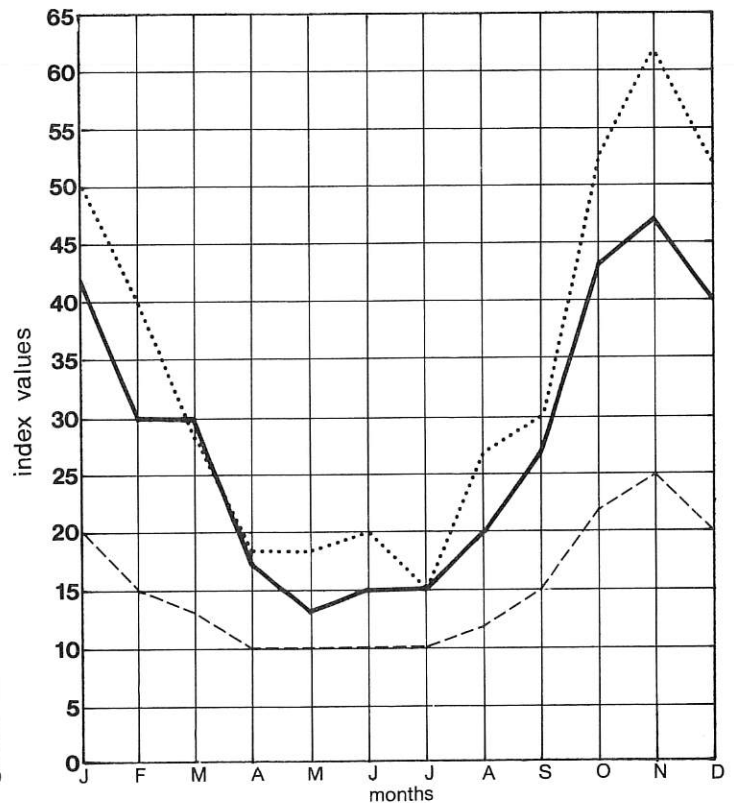
The air quality index is a scalar value representing the average concentration of suspended particulates and/or sulfur dioxide at a particular location over a 24-hour period. An index is calculated three times a day, at 8 AM, 12 noon, and 4 PM, for each of the three geographic areas - Everett, Seattle and Tacoma. These values are tape-recorded Monday through Friday and are available to the news media through an unlisted telephone number. An index of 50 corresponds to the alert stage of the Washington State Episode Avoidance Plan. Values of 100 and 150 correspond to the warning and emergency stages, respectively. This index, in use locally since October, 1971, is compatible with the national Pollutant Standards Index.

The charts below depict variations from month to month in air quality index values for the Everett, Seattle, and Tacoma areas during 1976. The chart at the left gives monthly arithmetic means of calculated daily index values while the chart at the right indicates maximum index values reached during each month of the year.

Monthly arithmetic mean for each area during 1976



24-hour maximum value by month for each area during 1976



"AIR STAGNATION ADVISORIES" are issued by the National Weather Service when poor atmospheric dispersion conditions exist and these conditions are forecast to persist for 24 hours or more. Air stagnation advisories were in effect during 1976 for the following periods:

Valid From:

10 AM, Thursday, November 4  
 10 AM, Wednesday, November 10  
 10 AM, Friday, November 12  
 3 PM, Monday, November 29

To:

12 Noon, Saturday, November 6  
 12 Noon, Thursday, November 11  
 12 Noon, Saturday, November 13  
 12 Noon, Saturday, December 4



## SUSPENDED PARTICULATES

### Acquisition of Data

The Agency operates a network of high volume samplers which monitors suspended particulates at various locations within Snohomish, King, Kitsap, and Pierce Counties. These samplers have operated on an intermittent schedule sampling continuously for 24 hours every third day from February, 1965, through December, 1968, every fourth day from January, 1969, through December, 1972, and every sixth day since January, 1973. A total of 19 stations have acquired at least four years of data through the end of 1976; two Seattle area stations have been operating continuously since February, 1965, thus accumulating twelve years of data.

### The Annual Standard

In April, 1971, the Federal Government promulgated national primary and secondary ambient air standards. Later in the year, the Agency's existing standard for suspended particulates was modified so that it was identical to the national secondary standard. This sets a value of 60 micrograms per cubic meter, annual geometric mean, which shall not be exceeded. The standard is written in terms of a geometric mean rather than an arithmetic mean because the distribution of air quality data is better described by the geometric statistic.

As a result of the averaging period indicated by the standard, a minimum of one year of sampling is required at any location to assess the suspended particulate concentrations with respect to the annual standard. As additional years of data are acquired, the suspended particulate concentrations become better documented at that location.

### Factors Influencing Concentrations

The ambient suspended particulate concentrations are a complex function of emissions from many sources, meteorological diffusion and dispersion of these emissions, and the surrounding topographic features. For example, valleys are topographic features that limit the free movement of air, thus contributing to the trapping of suspended particulates emitted from sources in the valley. Meteorological patterns follow average seasonal and annual cycles; however, each year varies somewhat from average conditions. Source emissions also change with time.

### Action to Reduce Concentrations

In urban areas where suspended particulate levels exceeded the standards, action was required by the Clean Air Act to reduce concentrations of suspended particulates to meet the standards. The Agency has implemented emission standards and required sources to comply with these standards, encouraged paving of roads and parking lots, reduced open burning, and taken many other individual actions designed to reduce source emissions of suspended particulates.

### Assessing The Results

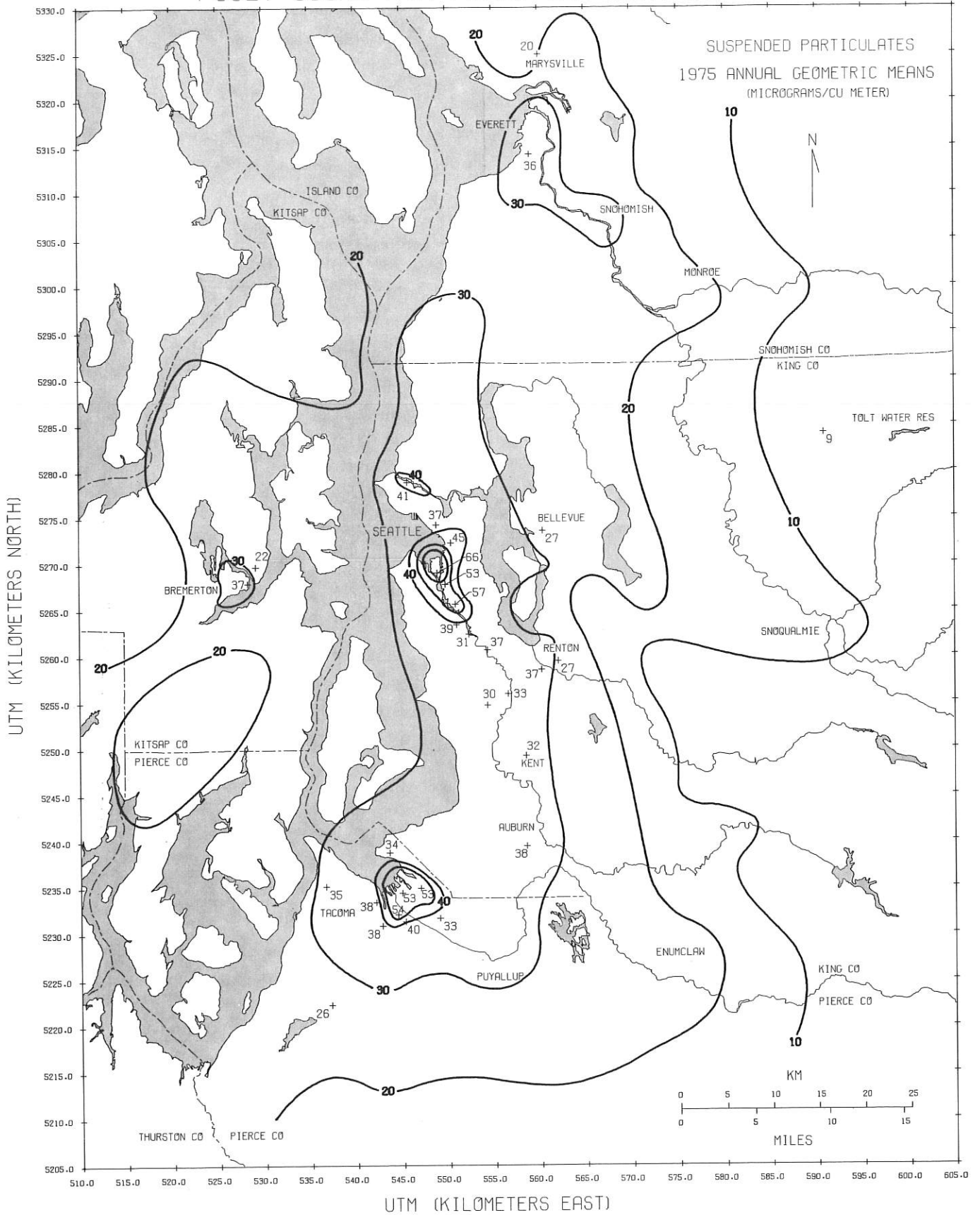
Since the air quality levels measured at sampling stations are a complex function of other factors in addition to changes in source emissions, it is never absolutely evident whether an increase or decrease in measured suspended particulate concentrations is a direct result of corresponding changes in source emissions. Meteorological conditions on sampling days that are slightly different from normal can have considerable influence on the concentrations measured at a sampling station. Analysis of trends in the air quality must, therefore, be considered with all factors in mind. Assessment of a trend based on only a year or two of data may be quite erroneous.

### Suspended Particulate Maps - 1975 & 1976

The maps which follow this page summarize suspended particulate concentrations throughout the region for each of calendar years 1975 and 1976. Each map presents annual geometric mean suspended particulate concentrations and depicts the horizontal distribution of this pollutant. Observed concentrations at each sampling station, together with information about meteorological conditions, topography, a detailed particulate emission inventory, and demography, were used in developing each map.

These maps enable the determination of the suspended particulate concentration at any desired location by interpolating between adjacent isopleths (lines connecting points of equal concentration). Areas which exceed the annual standard of 60 micrograms per cubic meter are clearly delineated. Areas exceeding the standard in 1976 are the Tideflats - Puyallup Valley area of Tacoma, and the Harbor Island - Duwamish Valley area of Seattle.

# PUGET SOUND AIR POLLUTION CONTROL AGENCY





## SUSPENDED PARTICULATE TRENDS

### A Technique to Examine Trends

An analysis technique which allows a reasonable determination of trends is the moving mean or average. As applied to suspended particulates, a 12 month moving geometric mean relates directly to the annual standard. This moving mean is calculated simply by computing the 12 month geometric mean for consecutive 12 month intervals and identifying each resultant value with the ending month for the particular 12 month interval. These values may be easily plotted on a graph and related directly to the annual standard. As more and more years of data are acquired at a sampling station, the power of the technique to portray a trend is enhanced.

A variation of this technique which does even a better job of portraying a trend, but requires more years of data, is calculation of the moving geometric mean in multiples of 12 months. For example, 24 and 36 month moving geometric means smooth out some of the year to year variations in meteorology and short-term changes in source emissions to more clearly depict the trend.

These analysis techniques were applied to suspended particulate monitoring stations in the Puget Sound region which had acquired at least two years of data through the end of 1976. Sixty-six individual graphs are presented in the following pages. The longer moving geometric means were applied as the period of sampling at each station permitted.

### Trends - Background Areas

The Agency has operated a single station near the Tolt Water Reservoir in the foothills of the Cascade Mountains since November, 1966. The 12, 24, and 36 month moving geometric mean graphs all depict a rather low and steady value ranging between 10 and 14 micrograms per cubic meter. This station exhibits no change in trend and appears unaffected by the urbanized areas in the Puget Sound. The value documented at Tolt is considered to be an average background value for the air of the Puget Sound region.

### Trends - Portrayed by Long-Term Sampling

Data has been acquired at the Public Safety Building in Seattle since February, 1965. The long-term trend appears to be gradually downward as most clearly depicted by the 24 and 36 month moving geometric mean

graphs. Assessment of a trend based on isolated segments of the 12 month moving geometric mean plot could easily be erroneous; for example, the period from July to December, 1974, indicates a sharp upward trend and just the opposite is indicated during the same period in 1975. A substantial period of sampling is needed to accurately depict the trend.

### Trends - Industrialized Areas

Two areas in the Puget Sound region have exceeded the annual standard most of the time since monitoring was initiated. As delineated by the preceding maps, these are the industrialized Duwamish Valley in South Seattle and the industrialized Tidelands area in Tacoma. Moving geometric mean graphs are presented for several stations in each of these areas. Though the period of record is too short to depict a trend at some of the stations, where a 36 month moving geometric mean is presented, there is evidence of a long-term downward trend.

### 1976 Versus 1975

The data documents that annual mean suspended particulate concentrations were higher at the end of 1976 than at the end of 1975. This increase (in micrograms per cubic meter) amounts to about 20 or more in the industrialized areas, about 10 in the commercial/suburban areas, and 5 or less in the rural areas. Compiled information on emissions suggests the total suspended particulate emissions from sources were about the same in 1976 as compared to 1975.

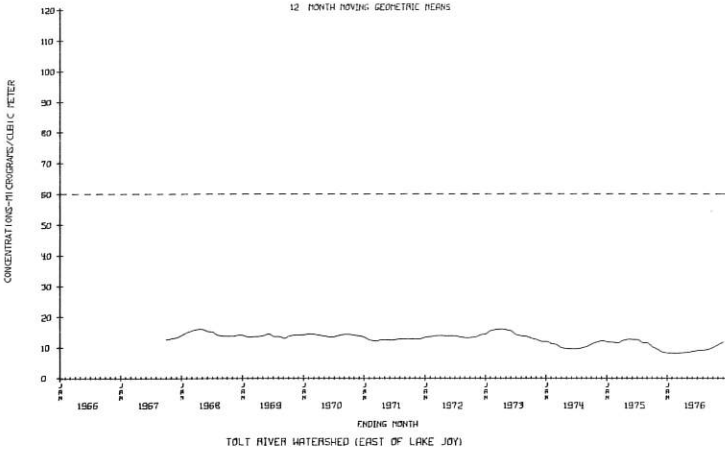
The majority of the 12 month moving geometric mean charts show the sharpest increase beginning about October, 1976. Several air stagnation periods occurred during the October to December, 1976, time period. No similar stagnation periods occurred during the same months in 1975. Stagnant meteorological conditions always contribute to the accumulation of pollutants in local areas where they are emitted, whereas windy, unstable conditions tend to disperse and dilute these pollutants.

Since observed pollutant concentrations are a complex result of several factors, it is difficult to attribute observed changes in the results of sampling to simple reasons. In fact, it is never appropriate to say a trend has been established or changed based upon short-term sampling results.

PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

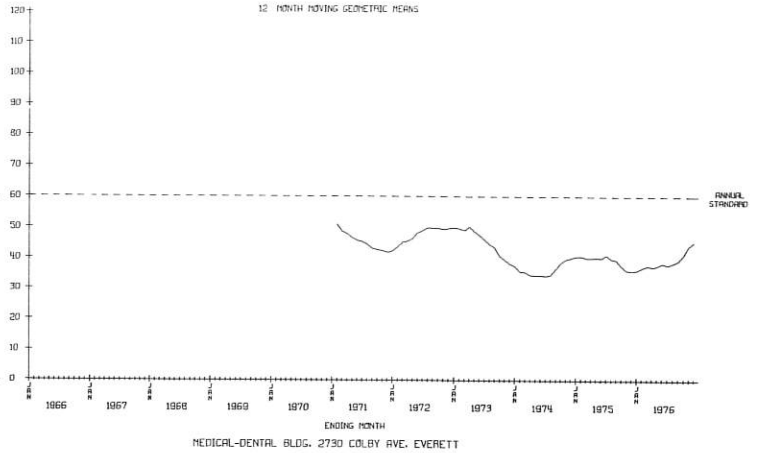
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

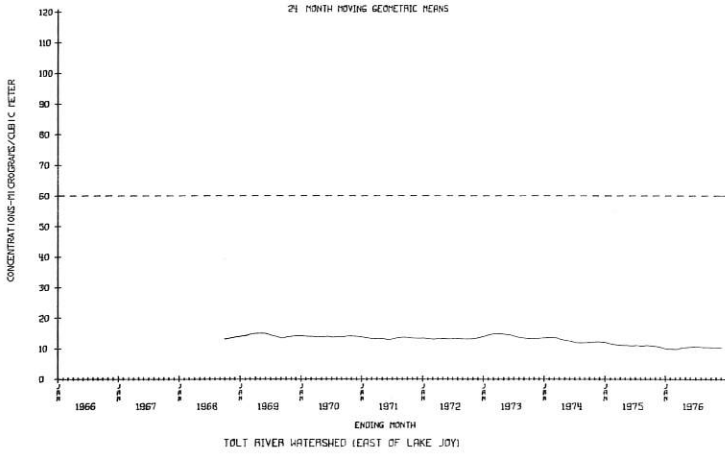
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

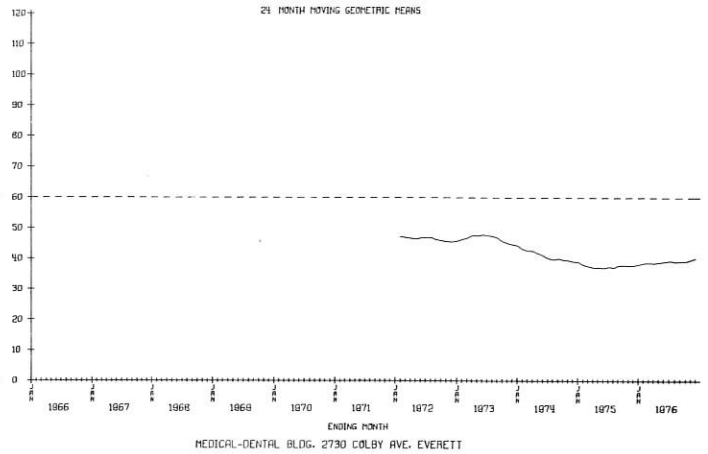
24 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

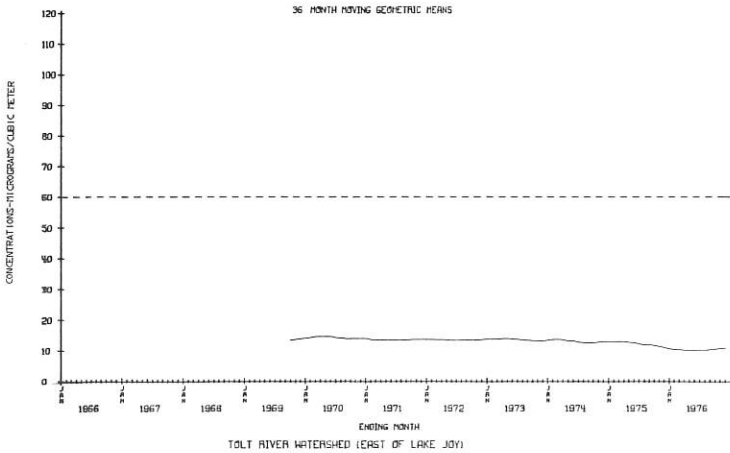
24 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

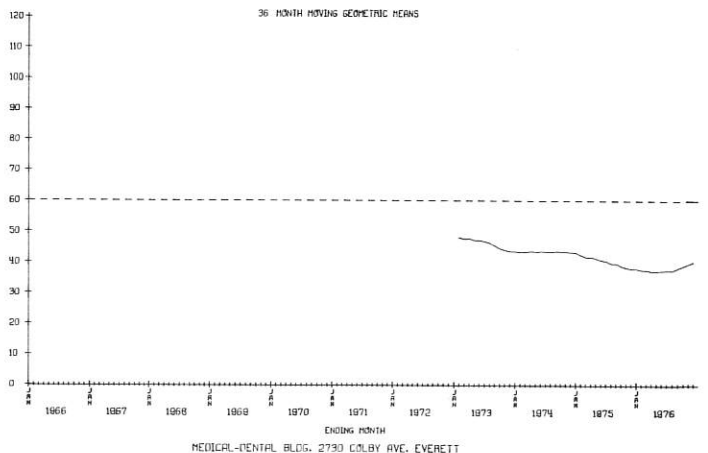
36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

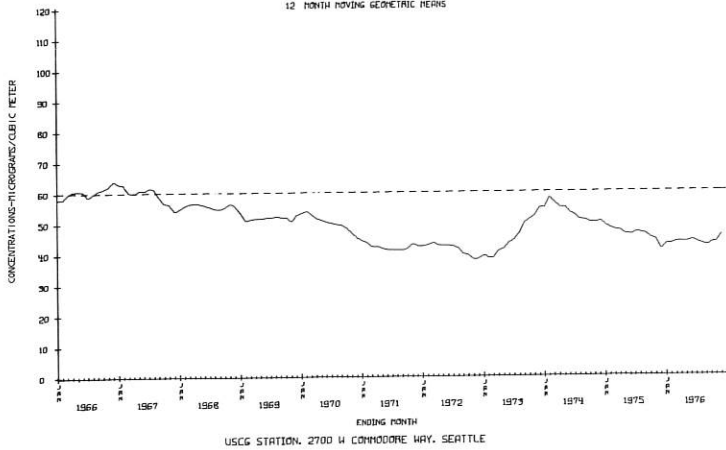
36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

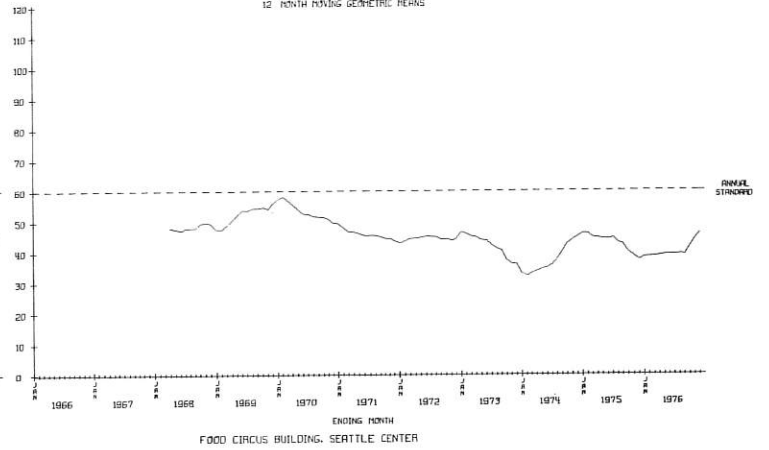
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

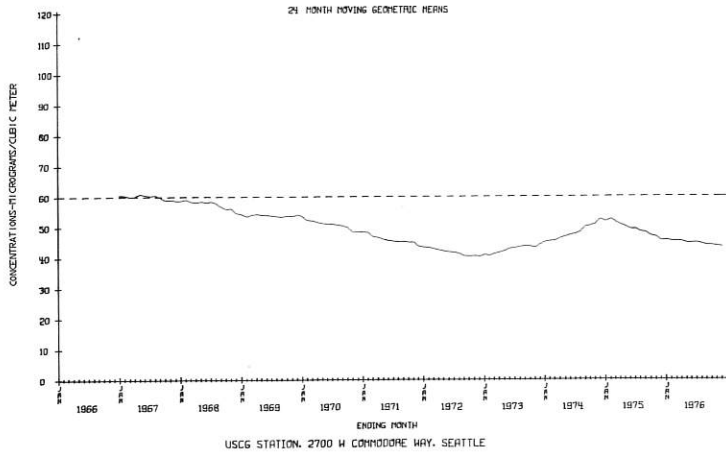
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

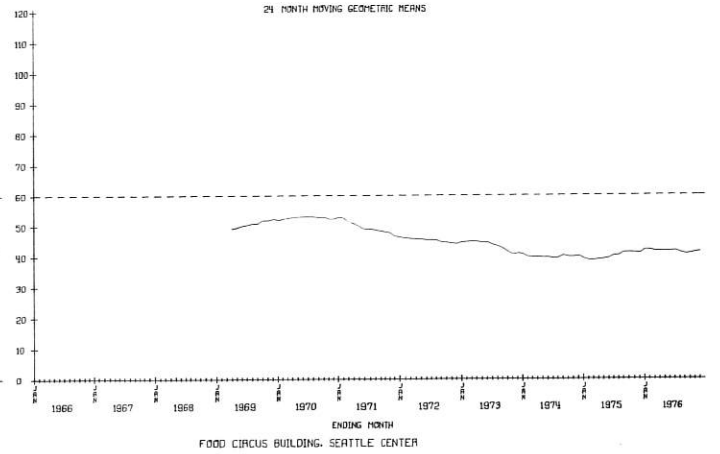
24 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

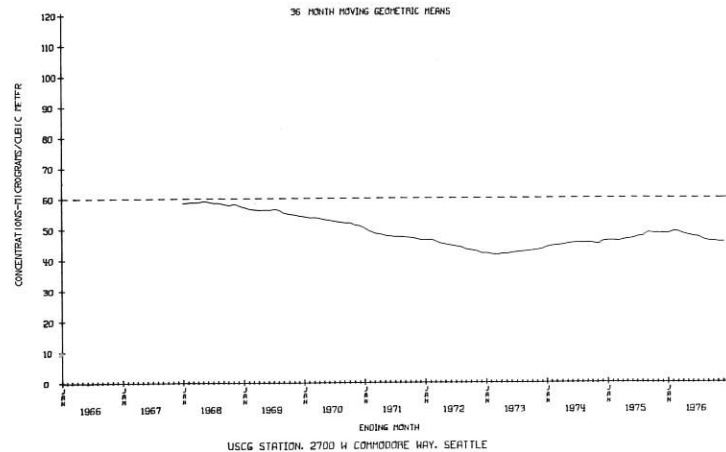
24 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

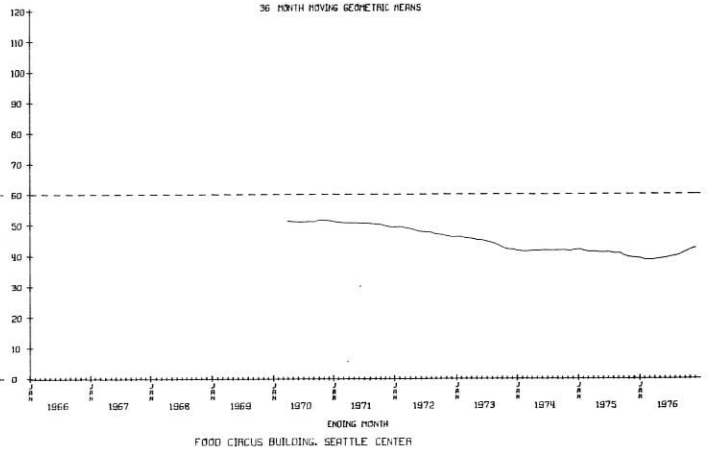
36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

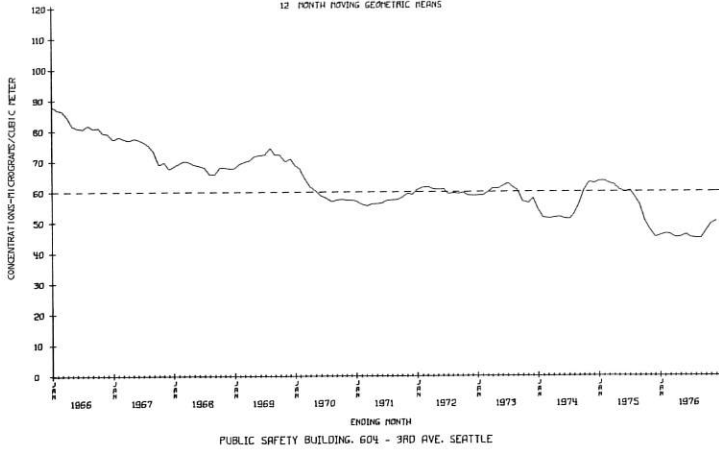
36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

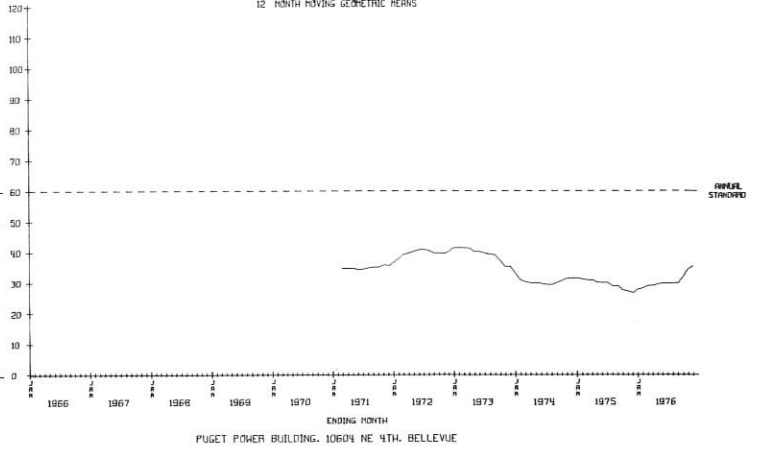
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

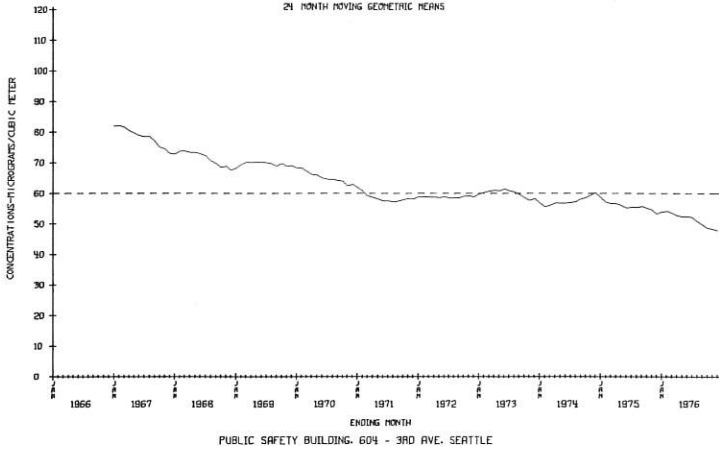
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

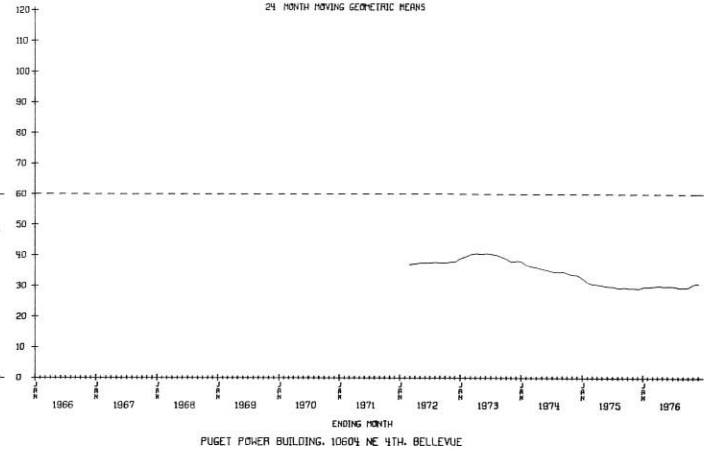
24 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

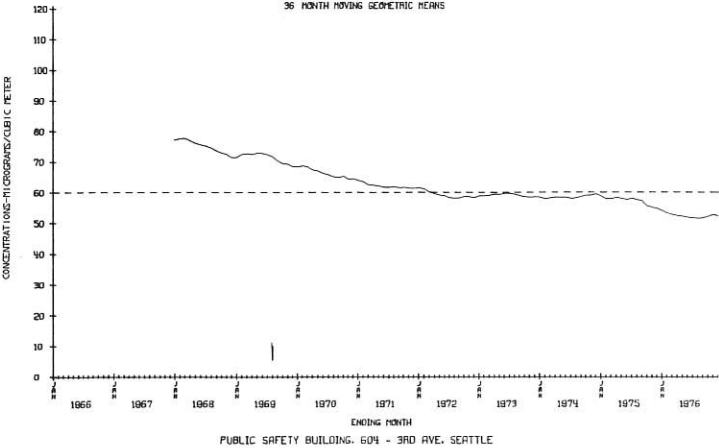
24 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

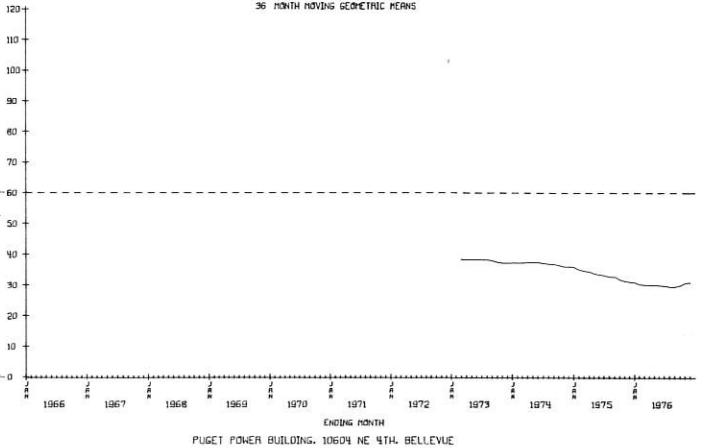
36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

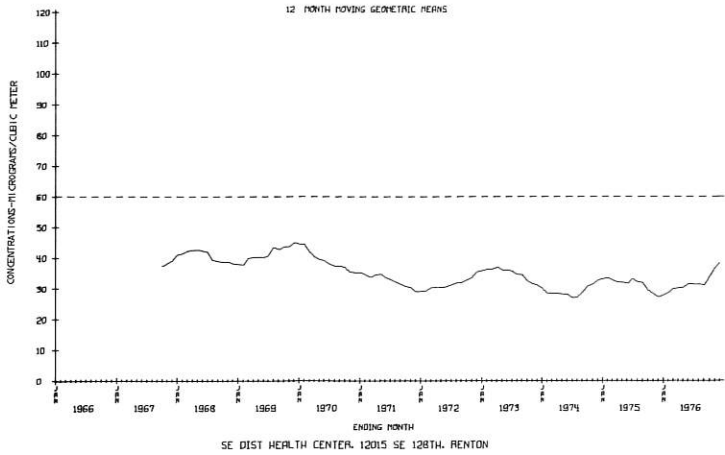
36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

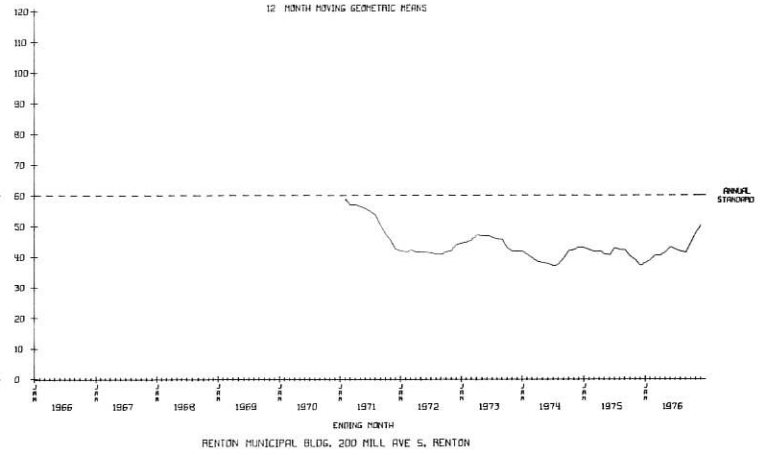
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

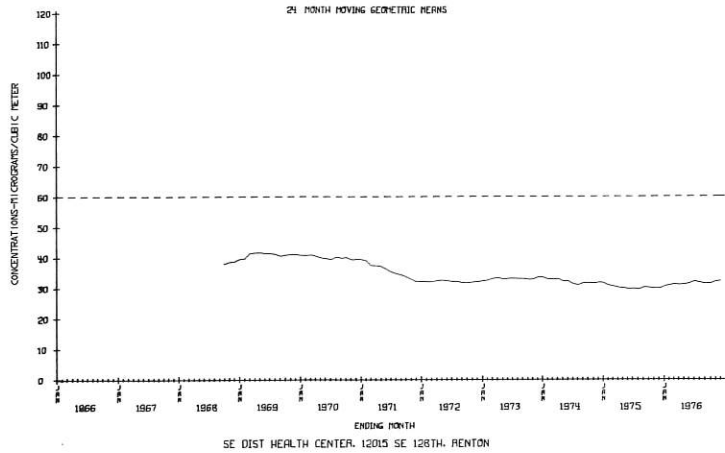
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

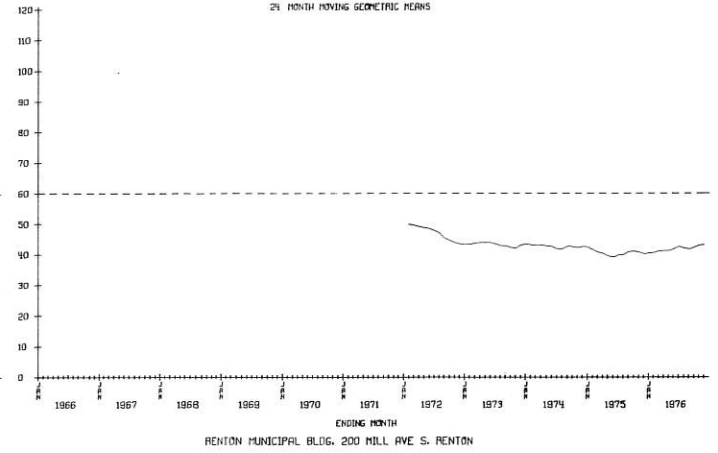
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

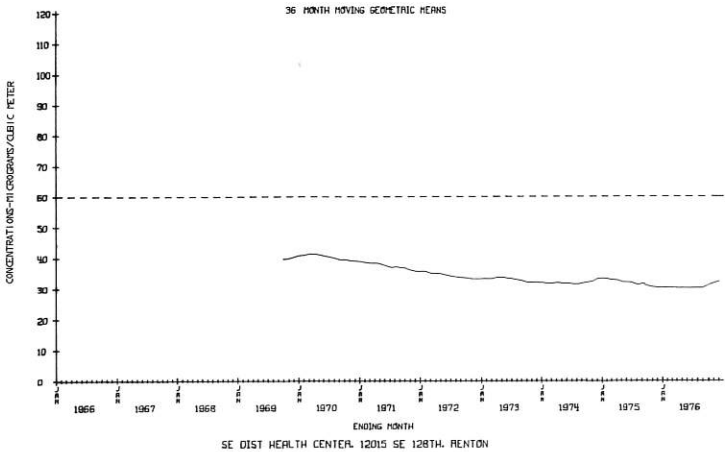
24 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

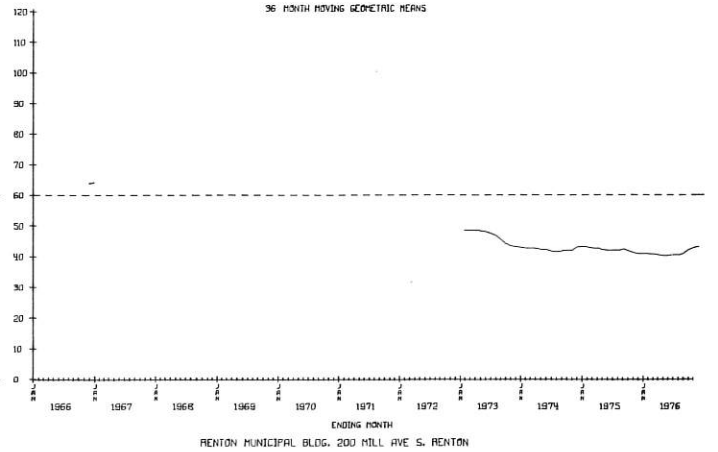
36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

36 MONTH MOVING GEOMETRIC MEANS

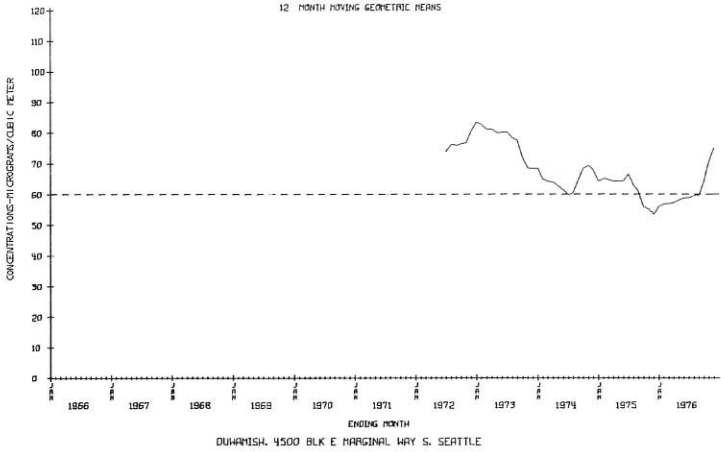




PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

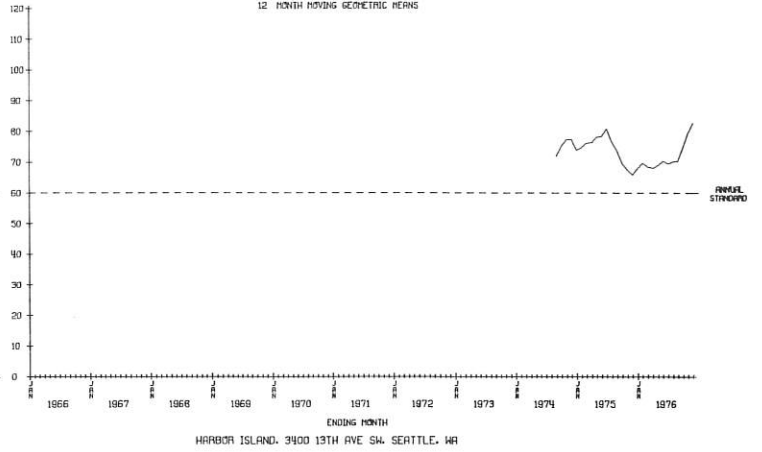
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

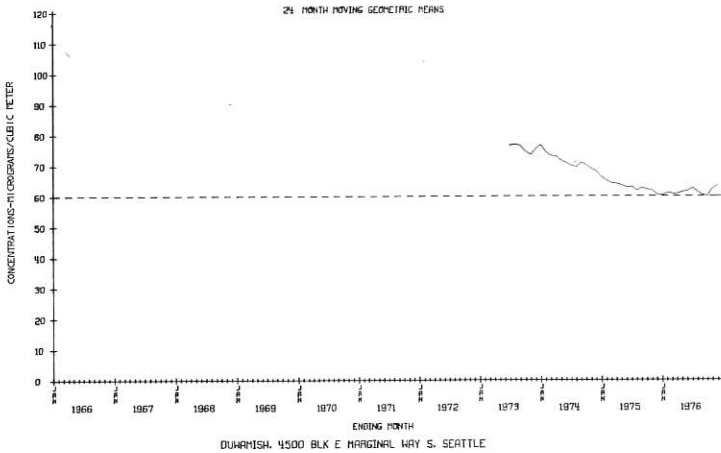
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SUSPENDED PARTICULATES

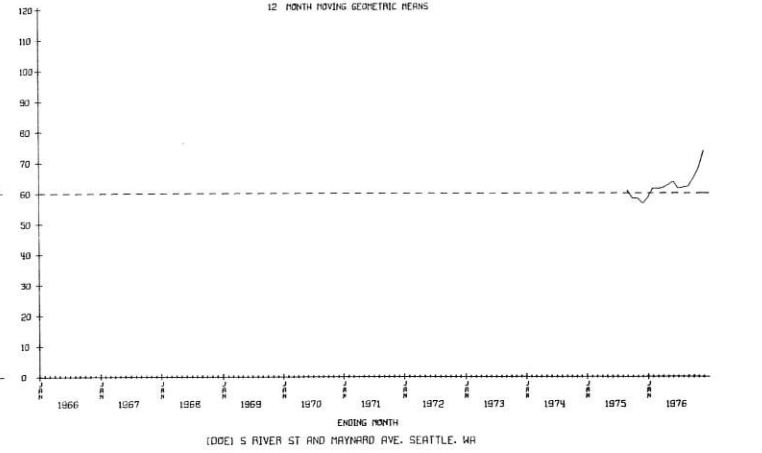
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

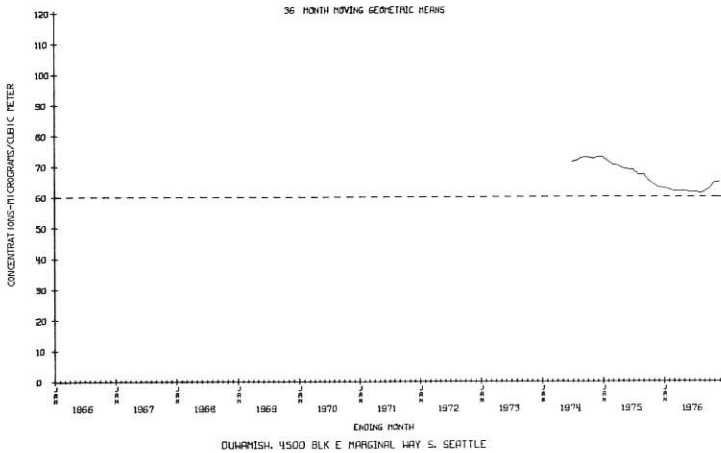
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

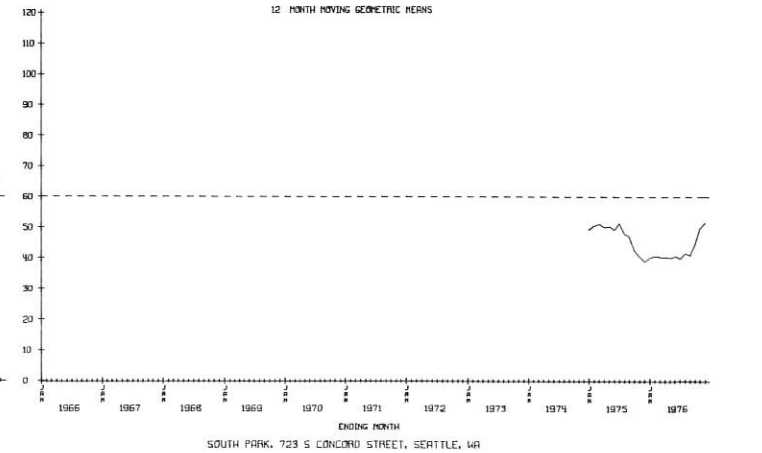
36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

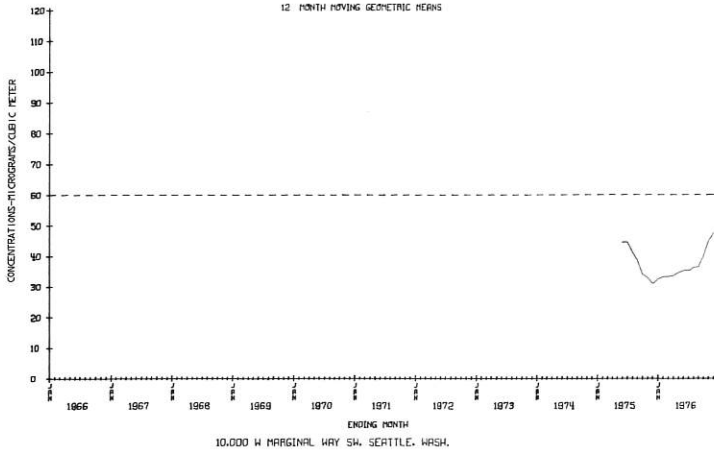
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

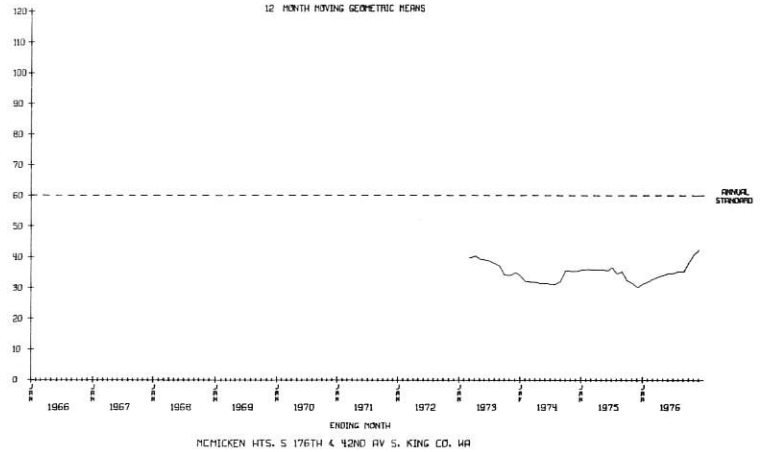
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

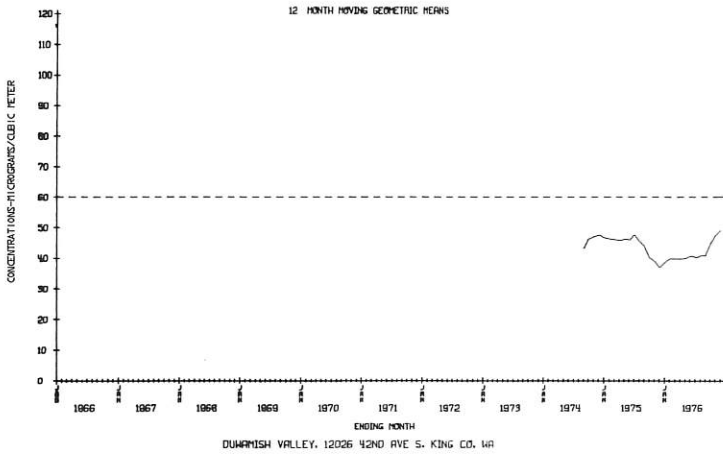
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

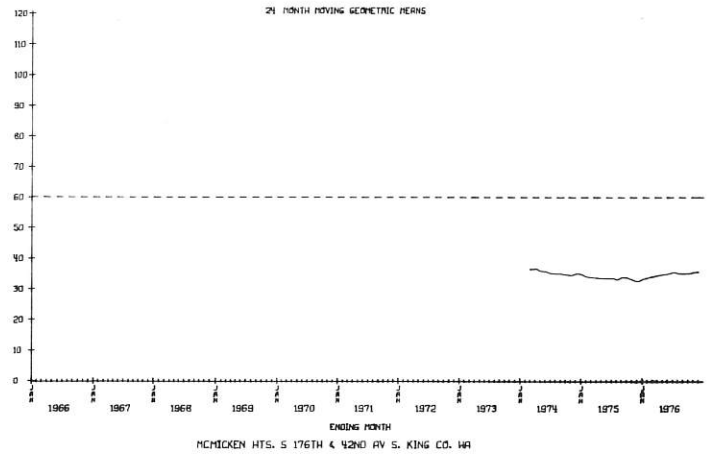
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

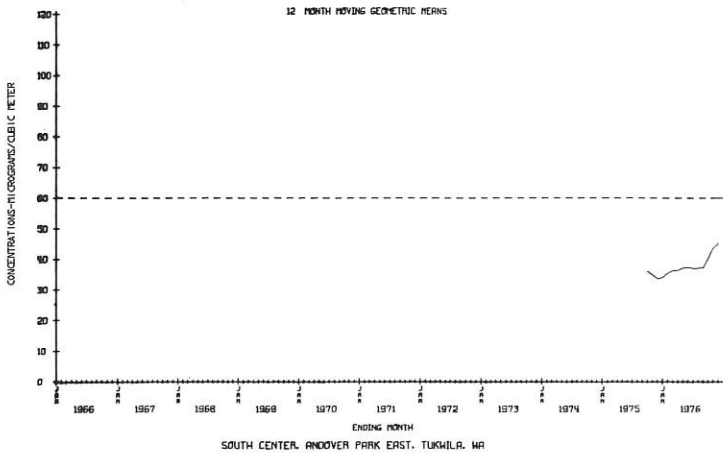
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

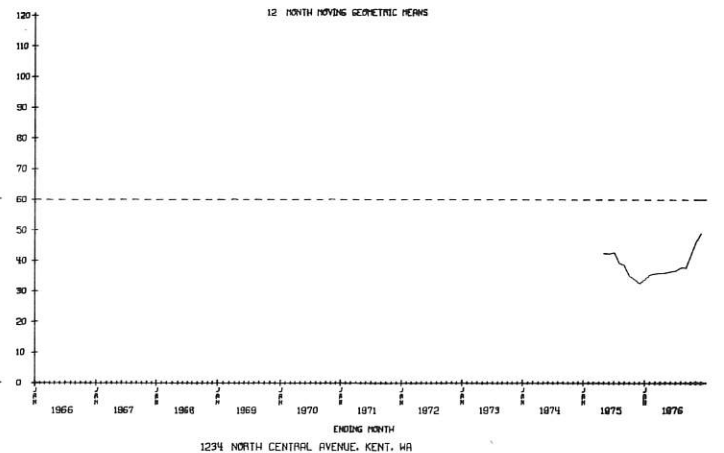
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

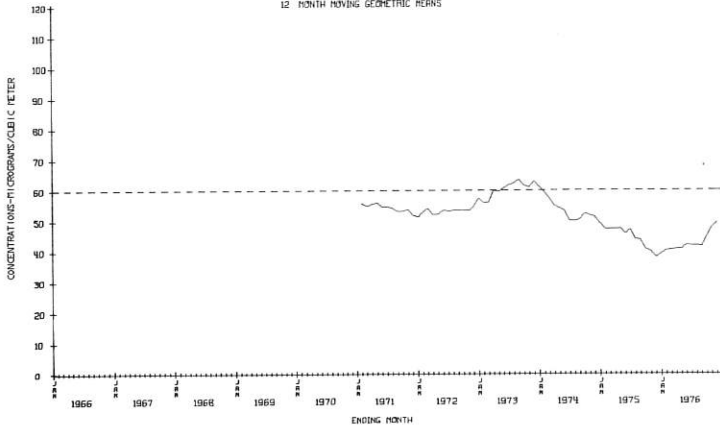
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

12 MONTH MOVING GEOMETRIC MEANS

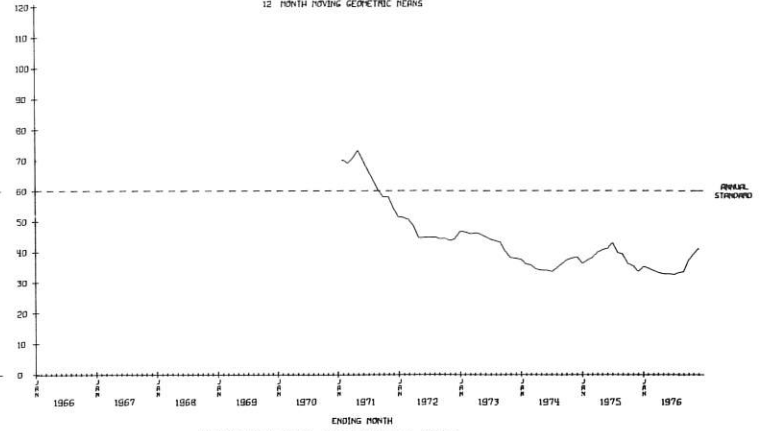


115 EAST MAIN STREET & AUBURN AVE., AUBURN, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

12 MONTH MOVING GEOMETRIC MEANS

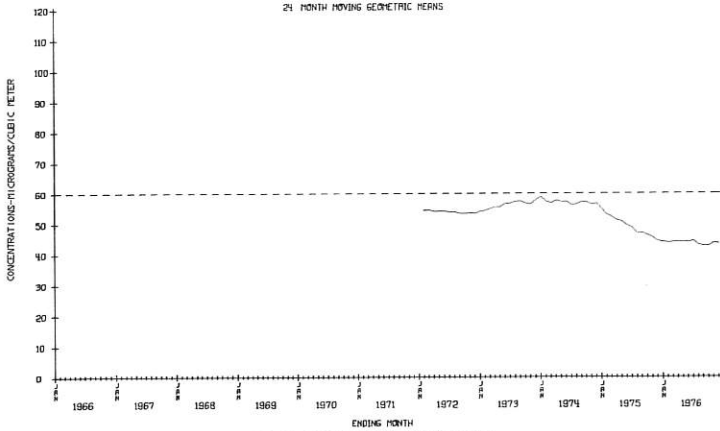


MEEKER JR HS. 1526 - 51ST STREET NE, TACOMA

PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

24 MONTH MOVING GEOMETRIC MEANS

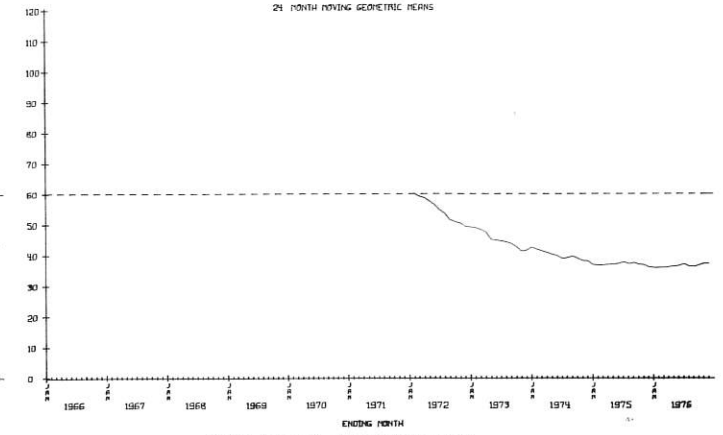


115 EAST MAIN STREET & AUBURN AVE., AUBURN, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

24 MONTH MOVING GEOMETRIC MEANS

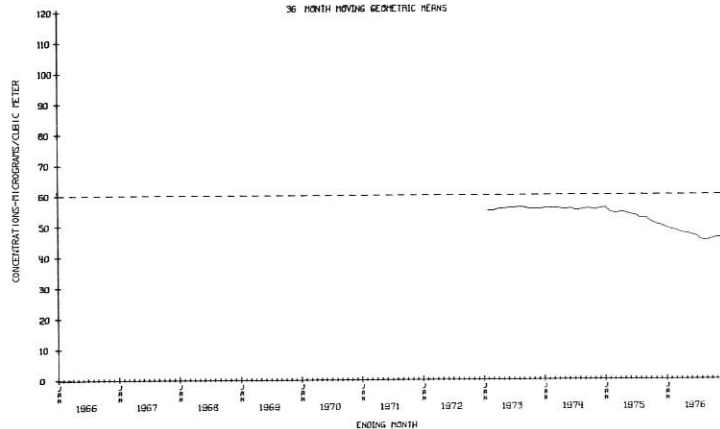


MEEKER JR HS. 1526 - 51ST STREET NE, TACOMA

PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

36 MONTH MOVING GEOMETRIC MEANS

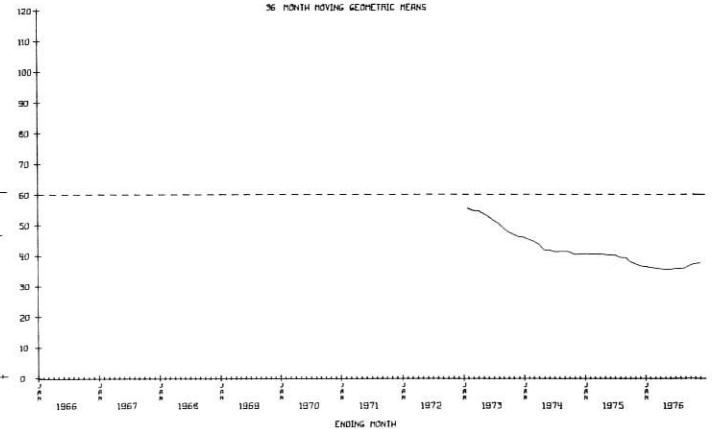


115 EAST MAIN STREET & AUBURN AVE., AUBURN, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

36 MONTH MOVING GEOMETRIC MEANS

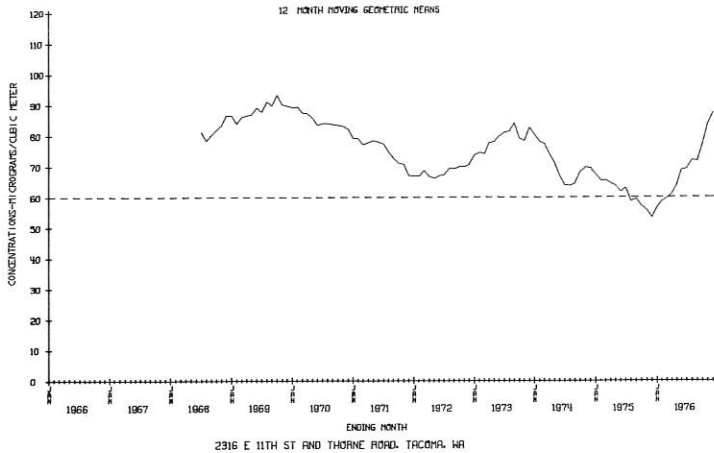


MEEKER JR HS. 1526 - 51ST STREET NE, TACOMA

PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

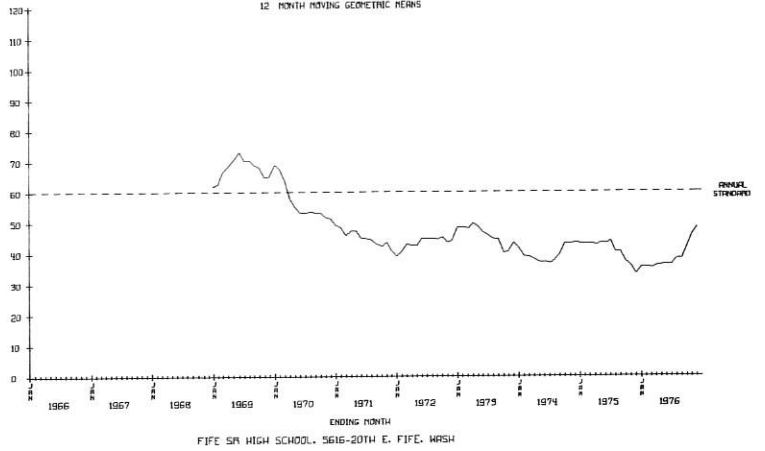
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

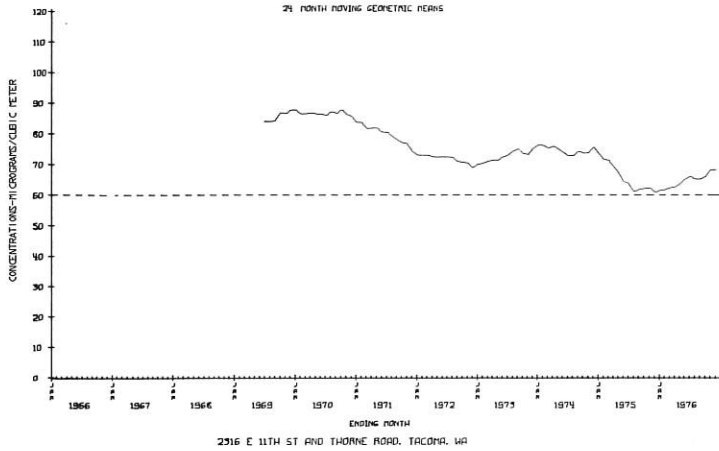
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

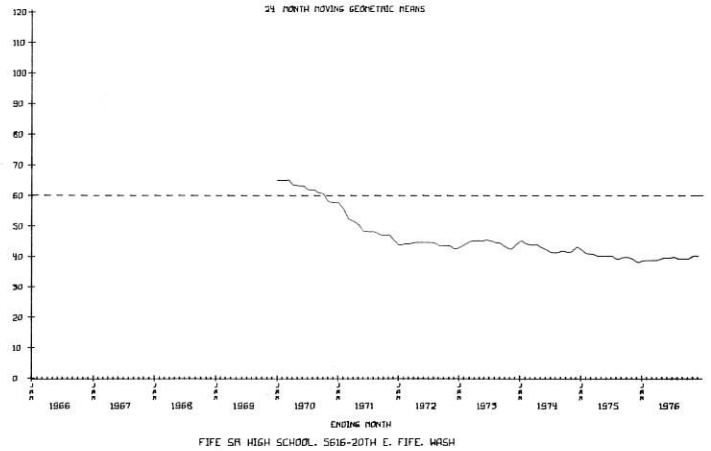
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

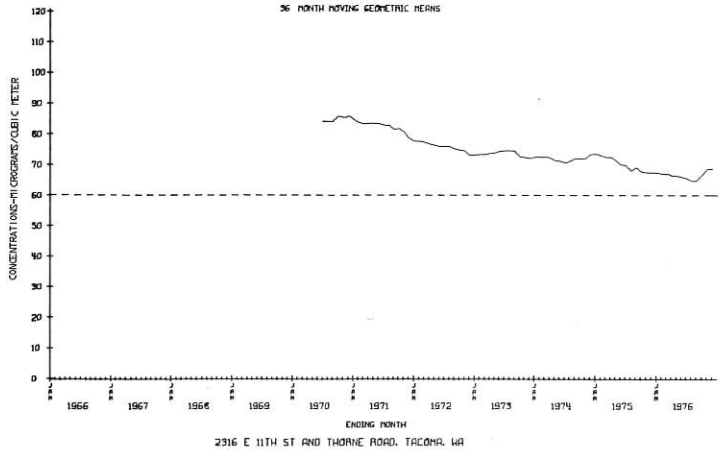
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SUSPENDED PARTICULATES

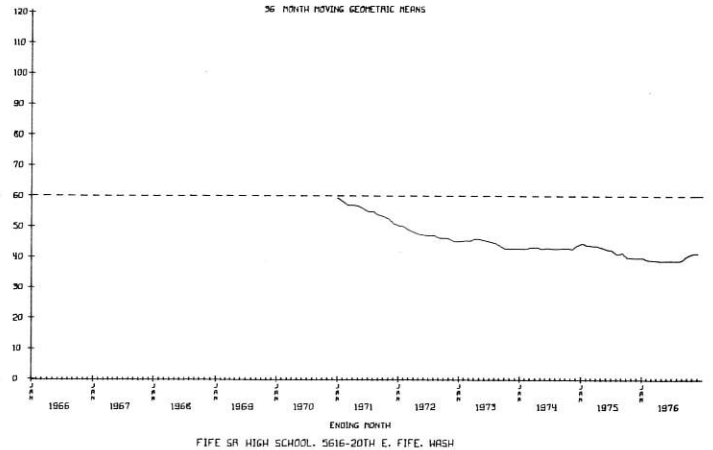
36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

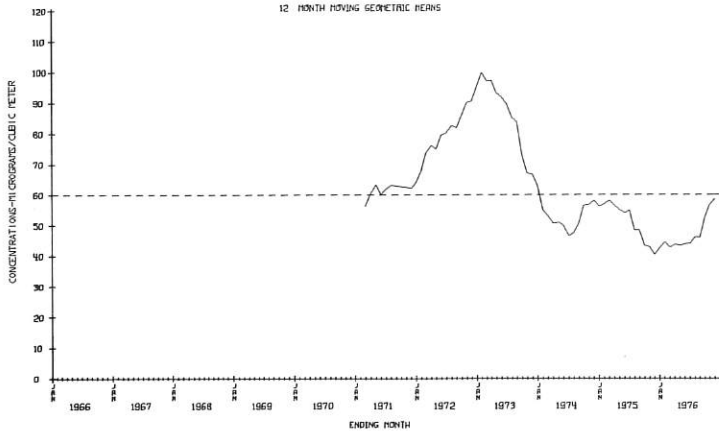
36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

12 MONTH MOVING GEOMETRIC MEANS

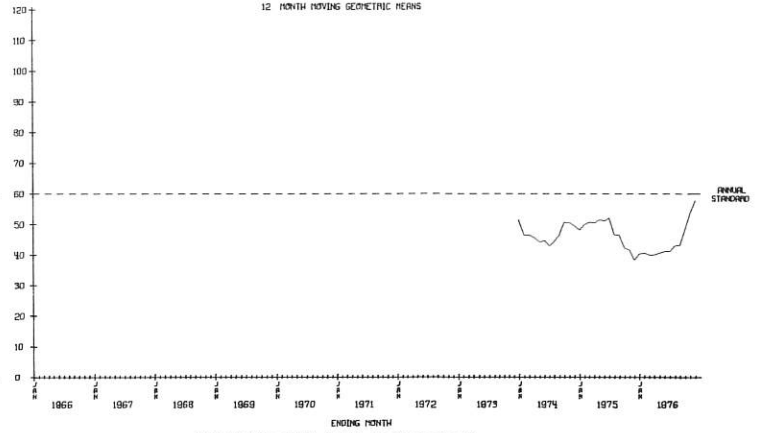


CASCADIA, 2002 E 28TH ST, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

12 MONTH MOVING GEOMETRIC MEANS

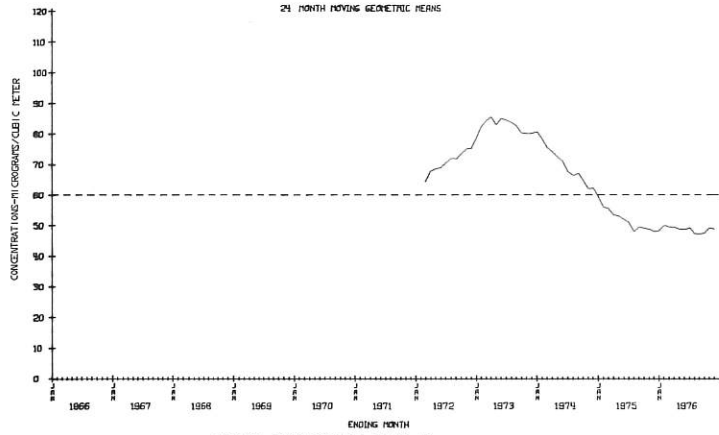


WILLARD ELEM SCHOOL, S 32ND & S 10th ST, TACOMA

PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

24 MONTH MOVING GEOMETRIC MEANS

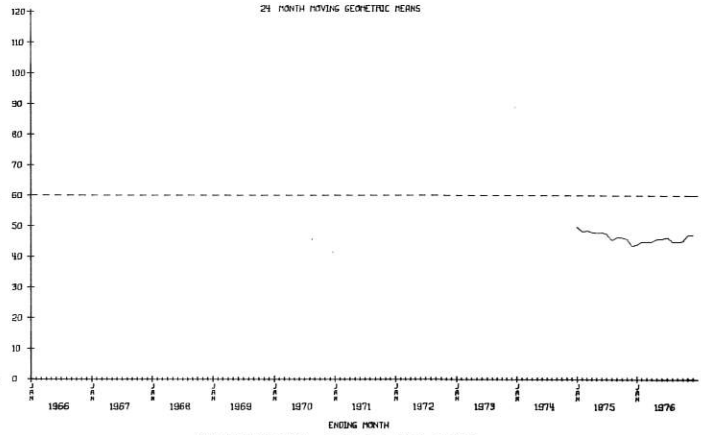


CASCADIA, 2002 E 28TH ST, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

24 MONTH MOVING GEOMETRIC MEANS

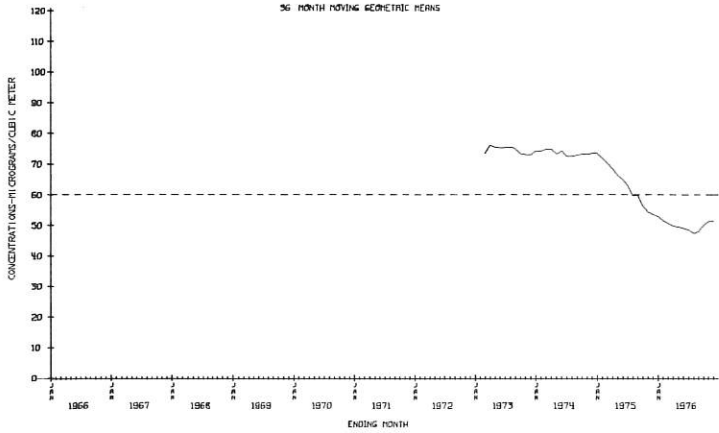


WILLARD ELEM SCHOOL, S 32ND & S 10th ST, TACOMA

PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

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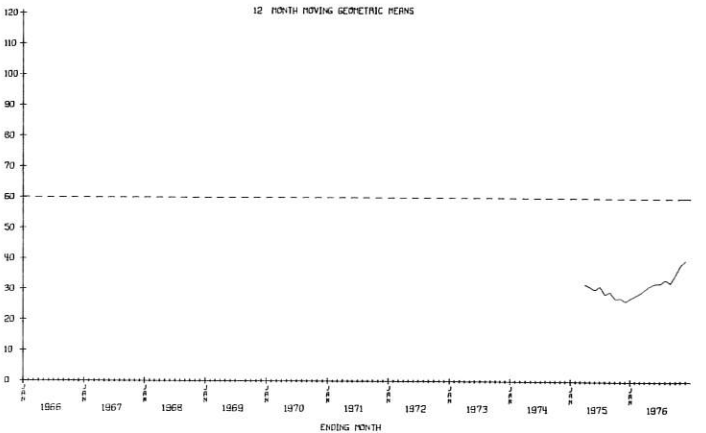


CASCADIA, 2002 E 28TH ST, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY

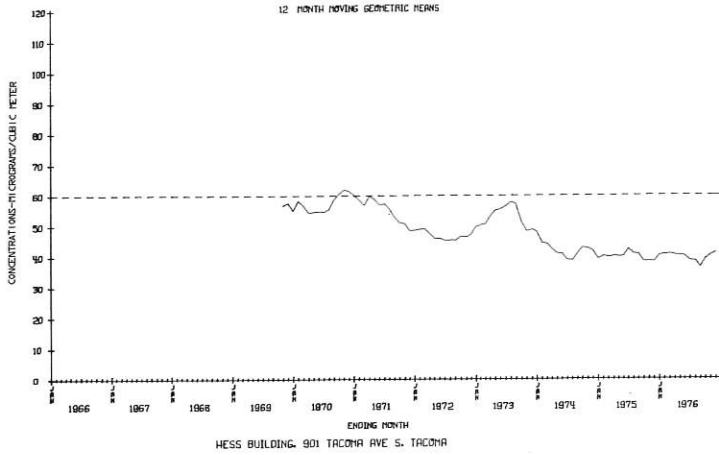
SUSPENDED PARTICULATES

12 MONTH MOVING GEOMETRIC MEANS

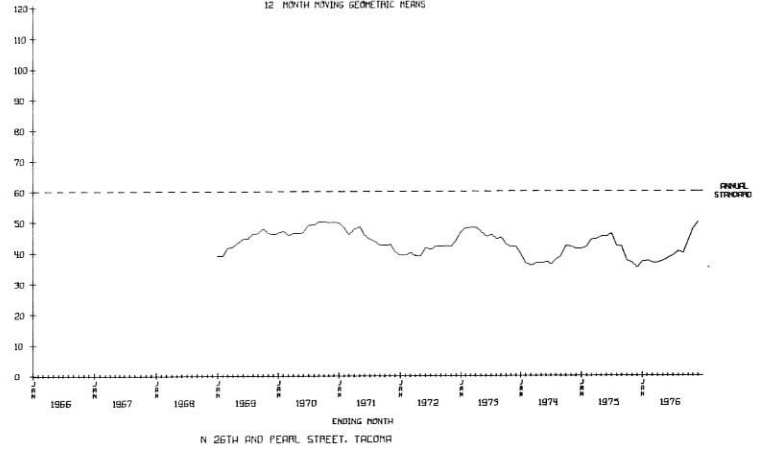


(DOE) 5132 - 112TH STREET SW, LAKEWOOD, WASH.

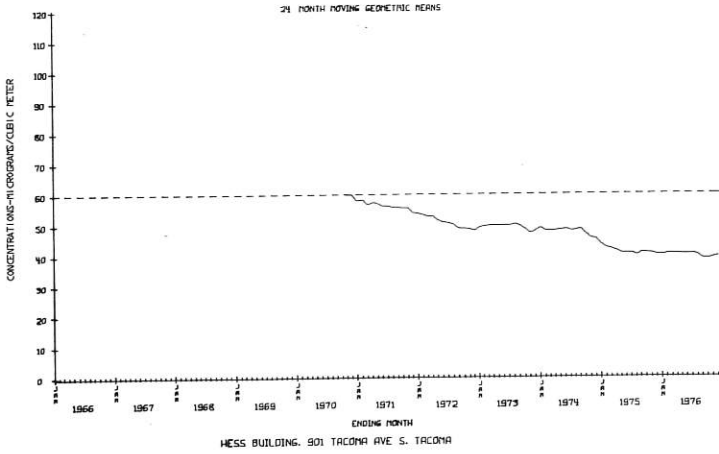
PUGET SOUND AIR POLLUTION CONTROL AGENCY  
 SUSPENDED PARTICULATES  
 12 MONTH MOVING GEOMETRIC MEANS



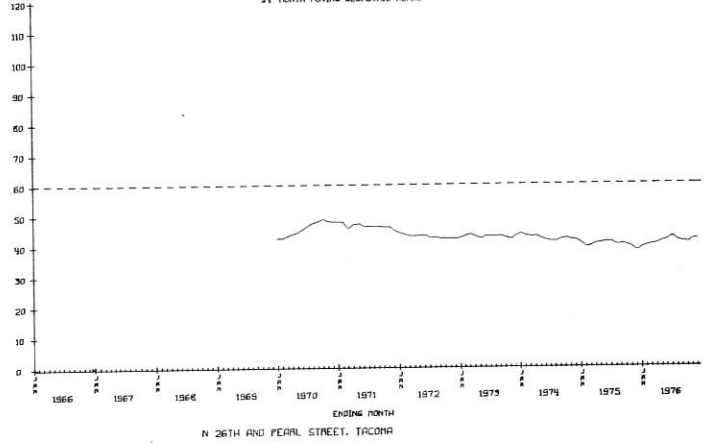
PUGET SOUND AIR POLLUTION CONTROL AGENCY  
 SUSPENDED PARTICULATES  
 12 MONTH MOVING GEOMETRIC MEANS



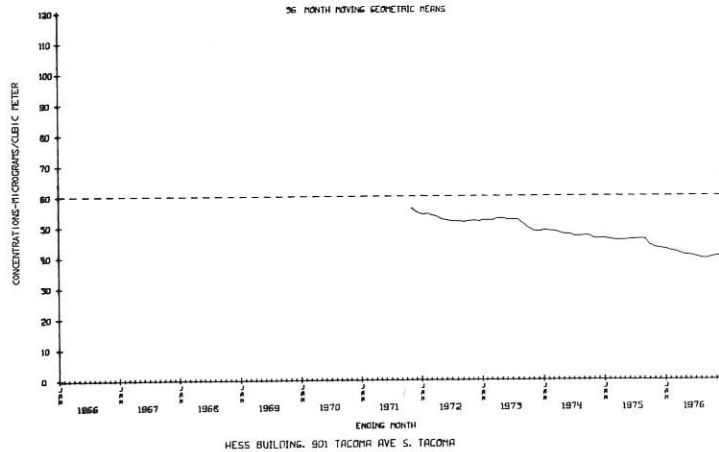
PUGET SOUND AIR POLLUTION CONTROL AGENCY  
 SUSPENDED PARTICULATES  
 24 MONTH MOVING GEOMETRIC MEANS



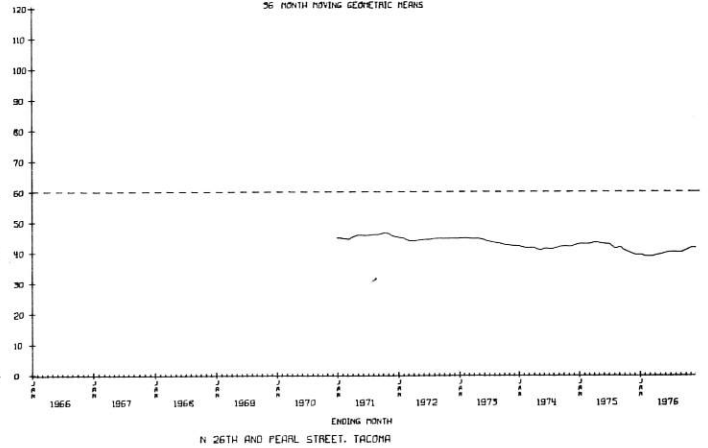
PUGET SOUND AIR POLLUTION CONTROL AGENCY  
 SUSPENDED PARTICULATES  
 24 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY  
 SUSPENDED PARTICULATES  
 36 MONTH MOVING GEOMETRIC MEANS



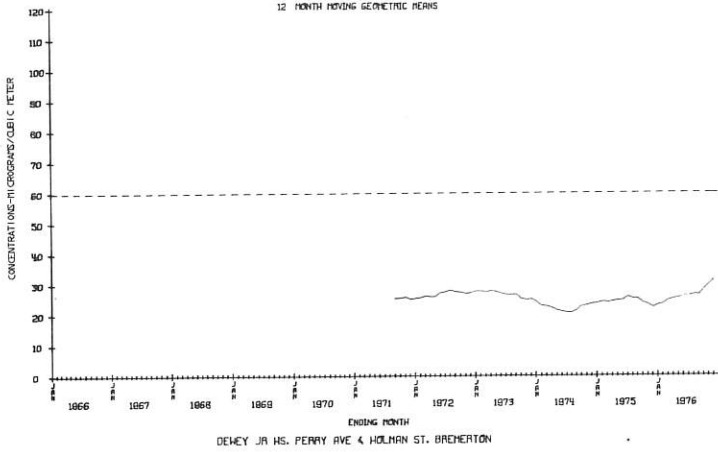
PUGET SOUND AIR POLLUTION CONTROL AGENCY  
 SUSPENDED PARTICULATES  
 36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

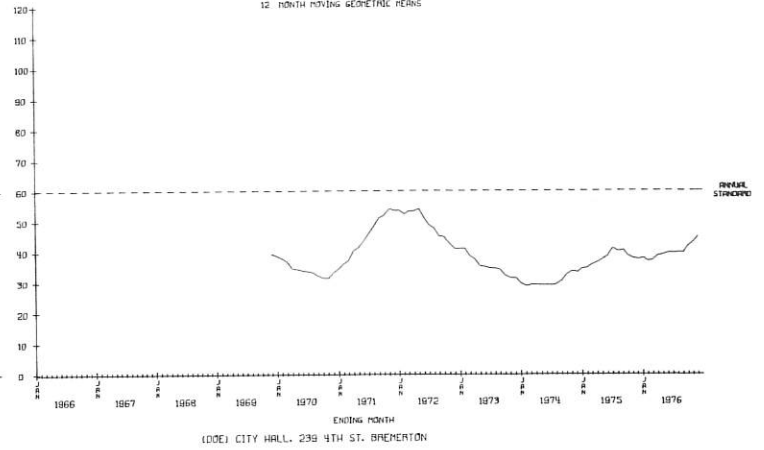
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

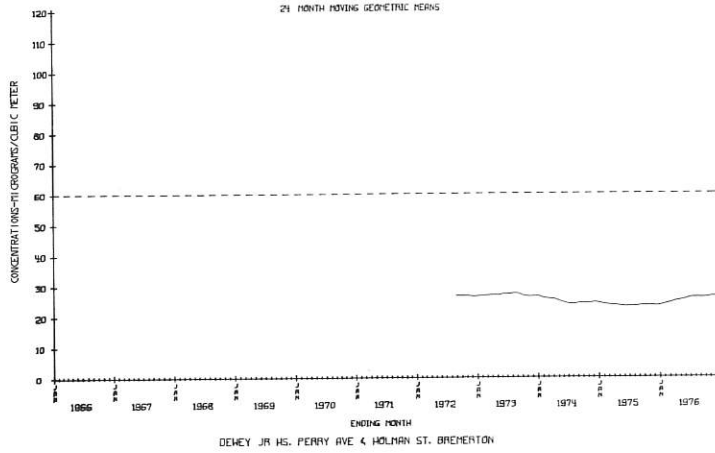
12 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

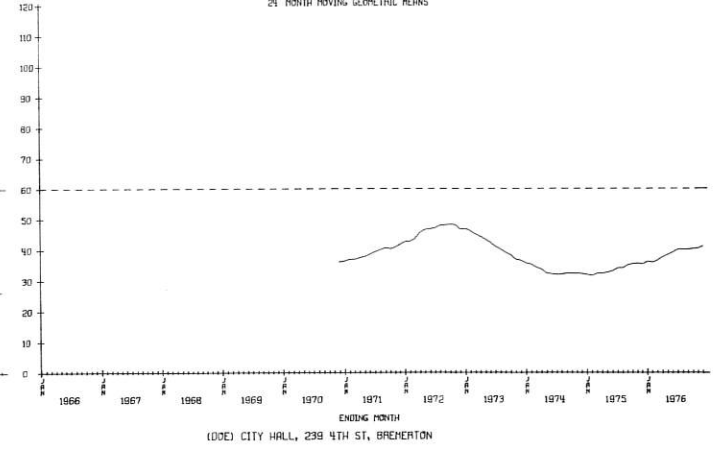
24 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

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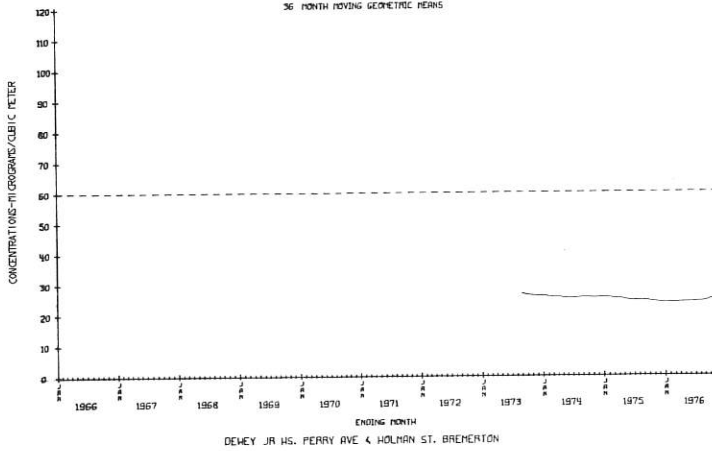
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PUGET SOUND AIR POLLUTION CONTROL AGENCY

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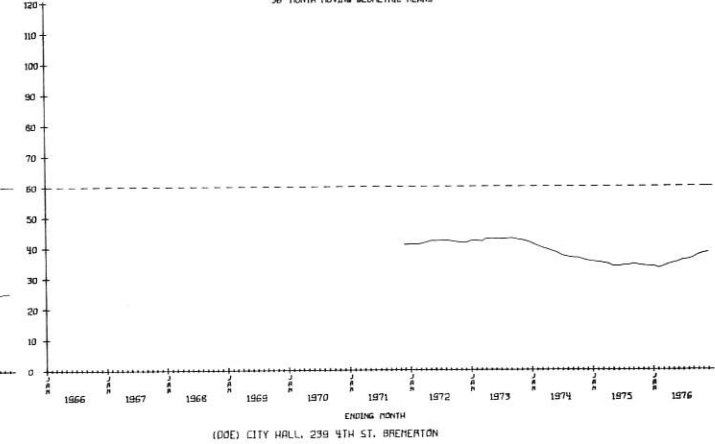
36 MONTH MOVING GEOMETRIC MEANS



PUGET SOUND AIR POLLUTION CONTROL AGENCY

SUSPENDED PARTICULATES

36 MONTH MOVING GEOMETRIC MEANS



SUSPENDED PARTICULATE  
Statistical Summary  
(Micrograms per cubic meter)  
1976

Location	No. of Samples	Min. Date	Frequency Distribution-Percent											Max. Date	Arith. Mean	Geo. Mean	Std. Geo. Dev.	Std. Arith. Dev.
			10	20	30	40	50	60	70	80	90	95						
Tolt River Watershed	61	2 Jan 1	3	6	7	10	13	17	20	27	37	46	57	Sep 21	17	12	2.40	13.90
Tulalip Test Facility	59	8 Jan 7	14	16	18	23	25	28	34	44	53	58	86	Mar 7	30	26	1.73	16.69
Medical-Dental Bldg., Everett	61	18 Dec 26	26	30	35	41	46	54	58	67	74	85	112	Apr 30	49	45	1.52	20.31
USCG Station, Seattle	61	19 Feb 24	28	29	35	39	45	48	49	64	95	110	134	Dec 14	51	46	1.56	25.69
Food Circus Bldg., Seattle Center	61	22 Jan 7	27	30	36	42	49	51	54	68	76	87	146	Oct 21	50	46	1.50	22.05
Public Safety Bldg., Seattle	61	17 Dec 26	31	37	39	43	50	52	61	68	85	94	161	Oct 21	55	50	1.52	26.55
3400 13th Ave. S.W., Seattle	62	27 Dec 26	42	50	66	78	85	90	102	112	157	202	274	Feb 6	93	83	1.62	48.15
4500 Blk. E. Marg. Way S., Seattle	63	30 Dec 26	37	44	59	66	72	88	94	117	146	158	314	Feb 6	86	75	1.66	49.75
S. River St. & Maynard Ave., Seattle*	61	17 Jan 7	35	49	53	62	72	85	96	117	131	205	311	Feb 6	86	74	1.73	52.45
South Park, Seattle	61	14 Jul 17	20	26	40	46	58	62	75	86	96	126	183	Feb 6	61	52	1.82	34.74
10000 W. Marg. Way S.W., Seattle	62	16 Feb 24	22	27	38	42	46	54	61	80	94	123	166	Feb 6	55	48	1.72	31.72
Duwamish Valley, King County	60	16 Mar 31	24	31	38	46	52	57	59	74	89	98	205	Feb 6	56	49	1.68	31.64
Puget Power Bldg., Bellevue	61	11 Feb 24	19	26	29	31	38	39	43	48	59	66	108	Oct 21	39	36	1.54	17.51
S.E. Dist. Health Center, Renton	61	8 Jan 7	19	24	31	35	42	48	53	58	68	77	161	Feb 6	45	38	1.79	25.53
Municipal Bldg., Renton	61	14 Feb 24	26	36	41	43	50	56	65	72	82	90	182	Oct 21	56	50	1.62	29.73
Southcenter, Tukwila	62	12 Dec 26	22	27	34	45	48	52	59	68	76	91	163	Feb 6	52	45	1.68	28.34
McMicken Hts., King County	61	16 Dec 26	25	29	34	38	44	46	52	59	67	82	136	Oct 21	46	42	1.53	21.51
1234 N. Central Ave., Kent	61	14 Jan 7	23	26	35	46	54	63	74	81	94	107	171	Feb 6	58	49	1.81	31.93
Main St. & Auburn Ave., Auburn	61	17 Dec 26	26	34	39	45	53	58	60	67	77	99	142	Feb 6	54	49	1.54	24.43
Meeker Jr. H.S., Tacoma	61	14 Dec 26	23	26	29	34	42	45	54	60	72	97	130	Oct 21	46	41	1.61	24.19
2340 Taylor Way, Tacoma	61	22 Feb 24	27	38	45	53	65	76	92	106	150	170	219	Feb 6	78	65	1.84	48.88
2316 E. 11th St. & Thorne Rd., Tacoma	63	21 Dec 26	45	56	69	82	90	99	113	127	157	184	321	Feb 6	98	87	1.64	49.94
1241 Cleveland Way, Tacoma	62	17 Dec 26	34	44	49	59	66	75	84	96	120	154	193	Apr 30	74	66	1.65	38.75
Fife Sr. H.S., Fife	61	11 Feb 24	19	24	36	50	57	65	70	74	84	95	177	Apr 30	57	48	1.88	32.79
Cascadia, 2002 E. 28th St., Tacoma	61	12 Dec 26	20	27	43	49	61	69	86	101	153	260	337	Apr 30	78	59	2.12	67.10
Willard Elem. School, Tacoma	62	18 Aug 16	22	33	43	49	63	71	79	101	124	153	208	Feb 6	69	58	1.83	41.31
Hess Bldg., Tacoma	55	15 Dec 26	24	27	30	33	36	42	54	68	86	94	160	Feb 6	48	41	1.69	30.35
5132 112th St. S.W., Lakewood*	62	7 Jan 7	13	27	32	34	41	48	55	64	81	104	127	Feb 6	47	40	1.86	26.65
N. 26th & Pearl, Tacoma	59	15 Feb 24	19	26	39	44	56	65	71	80	97	111	172	Feb 6	59	50	1.82	33.06
City Hall, Bremerton*	59	11 Feb 12	28	36	40	43	48	50	54	59	65	73	111	May 7	49	45	1.52	18.59
Dewey Jr. H.S., Bremerton	59	14 Nov 26	19	22	28	29	31	34	36	40	47	53	80	Oct 21	33	31	1.43	12.04

\* Washington State Department of Ecology Station



SUSPENDED PARTICULATE  
Summary of Observations Greater Than 150 µg/m<sup>3</sup>  
(Micrograms per cubic meter)  
1976

- A. Number of observations exceeding 260 µg/m<sup>3</sup>.  
B. Number of observations exceeding 150 µg/m<sup>3</sup>.  
C. Total number of observations.

Location	Jan.			Feb.			Mar.			Apr.			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			Annual		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Tolt River Watershed	6		4			6		5			5		5		5		5		5		5		5		5		5		5		5		5		61				
Tulalip Test Facility	6		4			6		5			3		5		5		5		5		5		5		5		5		5		5		59						
Medical-Dental Bldg., Everett	6		4			6		5			5		5		5		5		5		5		5		5		5		5		5		61						
USCG Station, Seattle	6		4			6		5			5		5		5		5		5		5		5		5		5		5		5		61						
Food Circus Bldg., Seattle Center	6		4			6		5			5		5		5		5		5		5		5		5		5		5		5		61						
Public Safety Bldg., Seattle	6		4			6		5			5		5		5		5		5		5		5		1	5		5		5		1	61						
3400 13th Ave. S.W., Seattle	6	1	1	4		6	1	5		1	5		5		5		5		5		5		5		1	5		1	6		2	5	1	7	62				
4500 Blk. E. Marg. Way S., Seattle	6	1	1	4		6		5			5		5		5		5		5		5		5		1	5		2	7		1	5	1	5	63				
S. River St. & Maynard Ave., Sea.*	1	6	1	1	5		6	1	5		5		5		5		5		5		5		5		4		1	5		5		1	4	61					
South Park, Seattle	6		1	4		6		5			5		5		5		5		5		5		5		1	5		5		5		2	61						
10000 W. Marg. Way S.W., Seattle	6		1	4		6		5			5		5		5		5		5		5		5		5		6		5		1	62							
Duwamish Valley, King County	6		1	4		6		5			5		5		5		4		5		5		5		5		5		5		5		1	60					
Puget Power Bldg., Bellevue	6		4			6		5			5		5		5		5		5		5		5		5		5		5		5		5		61				
S.E. Dist. Health Center, Renton	6		1	4		6		5			5		5		5		5		5		5		5		5		5		5		5		1	61					
Municipal Bldg., Renton	6		1	4		6		5			5		5		5		5		5		5		5		5		1	5		5		5		2	61				
Southcenter, Tukwila	6		1	4		6		5			5		5		5		5		5		5		5		5		6		5		1	62							
McMicken Hts., King County	6		4			6		5			5		5		5		5		5		5		5		5		5		5		5		5		61				
1234 N. Central Ave., Kent	6		1	4		6		5			4		5		5		5		5		5		5		5		5		6		5		1	61					
Main St. & Auburn Ave., Auburn	6		4			6		5			5		5		5		5		5		5		5		5		5		5		5		5		61				
Meeker Jr. H.S., Tacoma	6		4			6		5			5		5		5		5		5		5		5		5		5		5		5		5		61				
2340 Taylor Way, Tacoma	6		1	4		6		1	5		2	5		5		5		5		5		5		5		2	5		5		5		6	61					
2316 E. 11th St. & Thorne Rd., Tac.	6	1	1	4		6	1	5		1	5		5		5		5		1	5		5		5		2	5		2	7		5	1	8	63				
1241 Cleveland Way, Tacoma	6		1	4		6		1	5		5		5		5		5		5		5		5		1	5		1	6		5		4	62					
Fife Sr. H.S., Fife	6		1	4		6		1	5		5		5		5		5		5		5		5		5		5		5		5		2	61					
Cascadia, 2002 E. 28th St., Tacoma	6	1	1	4		6	1	1	5		5		5		5		5		5		5		3	5	1	2	4		6		5	3	7	61					
Willard Elem. School, Tacoma	6		1	4		6		1	5		5		5		5		5		5		5		5		2	5		6		5		4	62						
Hess Bldg., Tacoma	6		1	4		6		5			5		4		5		5		2		3		1	5		5		5		5		2	55						
5132 112th St. S.W., Lakewood*	6		5			6		5			5		5		5		5		5		5		5		5		5		5		5		1	59					
N. 26th & Pearl, Tacoma	4		1	4		6		5			5		5		5		5		5		5		5		5		5		5		5		5		59				
City Hall, Bremerton*	6		3			6		5			5		5		5		5		5		5		5		4		5		5		5		5		59				
Dewey Jr. H.S., Bremerton	6		4			6		5			5		5		5		5		5		5		5		5		5		5		3		59						
All Station Totals	1	184	5	18	125	186	1	8	155	4	152	154	154	1	152	3	153	1	15	152	7	166	3	153	7	60	1886												

\* Washington State Department of Ecology Station.

SUSPENDED PARTICULATE  
Monthly Arithmetic Averages  
(Micrograms per cubic meter)  
1976

Location	Monthly Arithmetic Averages												No. of Obs.	Arith. Mean	Geo. Mean
	J	F	M	A	M	J	J	A	S	O	N	D			
Tolt River Watershed	4.0	6.6	12.2	17.5	20.4	23.6	29.0	18.6	37.1	19.2	9.5	8.8	61	17	12
Tulalip Test Facility	17.7	21.9	32.0	43.1	45.3	29.2	29.3	22.9	49.2	30.7	21.1	21.4	59	30	26
Medical-Dental Bldg., Everett	42.6	44.5	45.2	46.5	49.9	47.4	44.3	45.1	76.4	59.7	49.2	41.7	61	49	45
USCG Station, Seattle	75.2	68.2	48.9	42.7	40.2	42.4	37.7	28.8	46.0	64.6	40.3	72.8	61	51	46
Food Circus Bldg., Seattle Center	57.0	49.9	44.9	44.3	44.4	40.2	42.8	37.2	50.4	74.1	52.1	62.1	61	50	46
Public Safety Bldg., Seattle	61.2	69.9	50.1	48.8	48.1	47.0	35.7	41.3	60.6	81.3	63.2	58.6	61	55	50
3400 13th Ave. S.W., Seattle	89.1	125.9	73.2	90.4	94.5	87.4	71.0	67.0	96.2	121.0	96.4	112.5	62	93	83
4500 Blk. E. Marg. Way S., Seattle	94.0	118.7	59.2	77.8	77.5	61.2	66.6	52.9	86.4	113.3	113.7	106.8	63	86	75
S. River St. & Maynard Ave., Seattle*	84.3	116.8	63.3	94.2	89.2	72.8	58.6	57.4	114.0	86.2	99.0	99.8	61	86	74
South Park, Seattle	69.1	72.1	45.9	54.7	51.3	51.4	43.6	48.4	64.0	84.0	91.0	59.8	61	61	52
10000 W. Marg. Way S.W., Seattle	58.3	63.3	41.6	51.4	45.6	46.5	39.4	39.5	59.6	80.1	80.0	54.4	62	55	48
Duwamish Valley, King County	63.0	78.8	45.6	50.8	46.9	45.9	47.9	43.8	59.6	81.8	58.9	53.8	60	56	49
Puget Power Bldg., Bellevue	48.3	42.4	40.1	33.4	29.6	30.9	29.1	29.1	41.8	55.3	45.1	41.0	61	39	36
S.E. Dist. Health Center, Renton	43.5	57.9	43.3	35.1	33.2	42.8	44.2	41.8	49.8	69.3	38.1	41.1	61	45	38
Municipal Bldg., Renton	51.0	64.3	53.6	40.9	40.7	53.8	50.7	45.9	67.9	94.7	51.2	65.0	61	56	50
Southcenter, Tukwila	48.5	68.8	42.4	44.3	47.1	42.4	45.3	38.8	58.1	72.0	66.2	50.6	62	52	45
McMicken Hts., King County	49.9	47.5	47.8	45.8	38.1	42.5	43.0	36.1	51.0	67.2	47.2	40.7	61	46	42
1234 N. Central Ave., Kent	52.1	64.6	39.2	47.9	51.2	54.8	54.6	43.3	73.5	79.8	71.9	59.9	61	58	49
Main St. & Auburn Ave., Auburn	53.3	65.7	49.7	51.2	49.5	49.9	46.7	39.2	58.8	73.9	59.7	55.6	61	54	49
Meeker Jr. H.S., Tacoma	39.6	49.8	36.0	42.6	40.7	40.2	38.3	40.9	56.4	87.5	38.6	48.5	61	46	41
2340 Taylor Way, Tacoma	65.2	73.3	45.0	78.5	92.8	61.0	68.3	63.3	104.9	132.0	77.0	79.8	61	78	65
2316 E. 11th St. & Thorne Rd., Tacoma	82.8	117.8	76.6	86.7	93.6	96.5	88.9	89.9	120.1	131.1	115.9	81.8	63	98	87
1241 Cleveland Way, Tacoma	65.1	81.8	52.8	74.9	58.3	67.7	68.1	60.1	94.6	116.8	85.8	70.6	62	74	66
Fife Sr. H.S., Fife	60.6	55.9	39.2	64.2	48.6	47.5	60.4	54.4	69.4	82.6	58.4	51.0	61	57	48
Cascadia, 2002 E. 28th St., Tacoma	60.9	96.8	44.4	104.1	49.6	66.7	59.7	69.9	116.1	182.3	71.6	49.6	61	78	59
Willard Elem. School, Tacoma	70.4	75.8	46.4	62.8	58.9	54.0	47.4	48.1	94.9	122.0	85.3	60.2	62	69	58
Hess Bldg., Tacoma	58.6	60.4	37.8	40.4	35.0	32.8	31.6	38.2	34.6	88.1	46.0	60.4	55	48	41
5132 112th St. S.W., Lakewood*	46.0	40.8	40.2	45.4	41.0	43.4	34.2	34.6	53.8	80.8	66.2	39.6	62	47	40
N. 26th & Pearl, Tacoma	68.2	60.6	41.0	60.0	68.0	72.2	62.3	44.7	63.2	76.2	51.6	44.8	59	59	50
City Hall, Bremerton*	47.0	21.0	52.8	63.6	54.4	46.0	49.4	41.0	47.2	73.5	42.0	38.8	59	49	45
Dewey Jr. H.S., Bremerton	36.4	28.4	36.8	34.5	26.5	27.8	29.4	27.9	35.1	46.1	36.8	28.8	59	33	31

\* Washington State Dept. of Ecology Station

SUSPENDED PARTICULATE  
(COH's/1000 Linear Feet)  
1976

Location	Monthly Arithmetic Averages												Arith. <sup>a</sup>	Geo. <sup>a</sup>
	J	F	M	A	M	J	J	A	S	O	N	D	Mean	Mean
Tulalip Test Facility	0.34	0.25	0.23	0.19	0.15	0.15	0.15	0.21	0.27	0.40	0.52	0.44	0.27	0.20
Medical-Dental Bldg., Everett	0.48	0.40	0.38	0.33	0.30	0.31	0.33	0.41	0.56	0.59	0.68	0.56	0.44	0.37
Food Circus Bldg., Seattle Center	0.63	0.52	0.47	0.40		0.48	0.47	0.55	0.64	0.85	0.95	0.93	0.63	0.51
4500 Blk. E. Marg. Way S., Seattle	0.94	0.78	0.70	0.57	0.44	0.40	0.44	0.57	0.85	1.17	1.30	1.32	0.79	0.57
10000 W. Marg. Way S.W., Seattle	1.00	0.60	0.63	0.47	0.36	0.33	0.32	0.47	0.65	1.19	1.33	1.26	0.73	0.48
Southcenter, Tukwila	0.69	0.56	0.39	0.38	0.33	0.29	0.33	0.43	0.61	0.82	1.09	0.94	0.56	0.41
McMicken Hts., King County	0.64	0.54	0.58	0.47	0.37	0.33	0.35	0.43	0.54	0.87	1.08	0.98	0.61	0.47
1234 N. Central Ave., Kent	0.55	0.44	0.48	0.37	0.31	0.27	0.27	0.38	0.56	0.85	1.01	0.92	0.54	0.38
Meeker Jr. H.S., Tacoma	0.51	0.40	0.40	0.30	0.25	0.21	0.25	0.31	0.47	0.70	0.81	0.80	0.46	0.33
2316 E. 11th St. & Thorne Rd., Tacoma	1.07	0.82	0.79	0.59	0.51	0.52	0.53	0.80	1.07	1.49	1.70	1.66	0.98	0.72
Willard Elem. School, Tacoma	0.99	0.78	0.76	0.62	0.41	0.36	0.39	0.55	0.79	1.11	1.31	1.18	0.77	0.55
N. 26th & Pearl, Tacoma	0.59	0.41	0.46	0.32	0.30	0.25	0.24	0.32	0.50	0.80	1.04	0.98	0.52	0.36
Dewey Jr. H.S., Bremerton <sup>c</sup>	0.35	0.29	0.29	0.25	0.21	0.19	0.17	0.22	0.29	0.44	0.50		0.29	0.23
Weighted Arithmetic Mean <sup>b</sup>	0.67	0.52	0.50	0.41	0.33	0.31	0.32	0.43	0.60	0.87	1.03	1.01		

<sup>a</sup> Developed from all available hourly values

<sup>c</sup> Sampling ended December 2, 1976

<sup>b</sup> Means weighted by number of readings per month

Coefficient of Haze (COH) represents a measure of suspended particulates derived from the decrease in light transmission through a filter tape as particulates accumulate on the tape. Ambient air is drawn through the filter tape continuously for about 30 minutes; the final reading is taken; the tape then quickly advances to a new position and the cycle repeats again and again to provide continuous sampling. In the Washington State Episode Avoidance Plan, a 24-hour average of 3.0 COH's is the Alert stage, 5.0 COH's is the Warning stage, and 7.0 COH's is the Emergency stage. The highest 24-hour average observed during 1976 was 3.5 COH's for the period ending at 7 AM on November 30. This occurred in the Tacoma Tideflats industrial area at the 2316 E. 11th Street monitoring station.

## SULFUR DIOXIDE POLLUTION ROSE FREQUENCY DISTRIBUTIONS

During 1976, sulfur dioxide and wind were measured continuously on a simultaneous basis at 12 monitoring stations. Hour average readings for each parameter were stored in historical data files for further summary and analysis. The Sulfur Dioxide Pollution Rose is an analysis depicting the wind direction associated with various sulfur dioxide concentrations for each simultaneous hour of observation.

The sulfur dioxide pollution roses on the pages which follow are tabular arrays with sulfur dioxide summarized in columns and wind direction summarized in rows. Each table value is the total number of hours for which the indicated sulfur dioxide concentration was observed at a given wind direction. Occurrences of sulfur dioxide with very light winds at the station appear in the next to the last row of the table.

This analysis allows an assessment of the location of source(s) having the most prominent effect on sulfur dioxide air quality at the station. When the period of sampling is substantial enough (a full year or more of data) this analysis technique becomes a reliable method to document source-receptor relationships. Caution must be exercised in the interpretation of these relationships since the wind direction at the receptor may not completely represent the transport wind between a source and the receptor.

This analysis also provides a frequency distribution of all the hour average sulfur dioxide concentrations at the station. The distribution is presented in the row of column totals. The first column (0.00 to 0.00) presents specifically the occurrence of 0.00 hour average sulfur dioxide readings.

Finally, the column of row totals provides a frequency distribution of hourly wind direction (to 16 points of the compass) or simply a wind rose without respect to speed.

PUGET SOUND AIR POLLUTION CONTROL AGENCY - FREQUENCY DISTRIBUTION  
OF HOURLY AVERAGES

MEDICAL-DENTAL BLDG, 2730 COLBY AVE, EVERETT  
ALL MONTHS 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)															OVER TOTALS
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70	
N (349 - 011)	202	18														220
NNE (012 - 033)	177	15	2													194
NE (034 - 056)	170	22														192
ENE (057 - 078)	114	14	1													129
E (079 - 101)	123	22														145
ESE (102 - 123)	316	74	2													392
SE (124 - 146)	1470	247	8	1												1726
SSE (147 - 168)	1101	249	9													1359
S (169 - 191)	291	82	2													375
SSW (192 - 213)	176	32	1													209
SW (214 - 236)	102	21														123
WSW (237 - 258)	48	18	3													69
W (259 - 281)	643	305	43	8	1	1										1001
WNW (282 - 303)	383	348	126	66	33	26	18	4	3	1		2		1		1011
NW (304 - 326)	195	216	103	44	13	7	6				2	1				587
NNW (327 - 348)	246	56	2	1												305
CALM AND LIGHT/VARIABLE	205	77	11	2			3									298
TOTALS	5962	1816	313	122	47	34	27	4	3	1	2	3		1		8335

FOOD CIRCUS BUILDING, SEATTLE CENTER  
JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)															OVER TOTALS
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70	
N (349 - 011)	301	26	9	1												337
NNE (012 - 033)	160	15	4													179
NE (034 - 056)	408	59	7													474
ENE (057 - 078)	392	66	4	3												465
E (079 - 101)	106	20														126
ESE (102 - 123)	43	9		1												53
SE (124 - 146)	36	6			1											43
SSE (147 - 168)	64	16	1	1	1											83
S (169 - 191)	289	159	43	11	2	1	3									508
SSW (192 - 213)	696	373	77	14	4			1								1165
SW (214 - 236)	476	96	5	3												580
WSW (237 - 258)	167	60	5	1	1											234
W (259 - 281)	265	78	13	4	1	2	1									364
WNW (282 - 303)	122	40	4	2		2										170
NW (304 - 326)	39	13	2													54
NNW (327 - 348)	154	22	9													185
CALM AND LIGHT/VARIABLE	277	118	17	3	2											417
TOTALS	3995	1176	200	44	12	5	4	1								5437

PUGET SOUND AIR POLLUTION CONTROL AGENCY - FREQUENCY DISTRIBUTION  
OF HOURLY AVERAGES

HARBOR ISLAND, 3419 13TH AVE SW, SEATTLE, WA  
ALL MONTHS 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)															OVER .70	TOTALS
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70		
N (349 - 011)	91	111	40	30	14	16	25	12	1	1	1	3	1				346
NNE (012 - 033)	60	65	19	10	8	3	2	1	1	1							170
NE (034 - 056)	148	85	6	2	1												242
ENE (057 - 078)	101	71	6														178
E (079 - 101)	44	34	5														83
ESE (102 - 123)	40	36															76
SE (124 - 146)	213	136	12	1	1	1	1										365
SSE (147 - 168)	791	554	47	12	2		1	1									1408
S (169 - 191)	822	625	91	16	6		1	1									1561
SSW (192 - 213)	386	163	9	1	1		1	1									561
SW (214 - 236)	176	58	4														238
WSW (237 - 258)	92	42	1	1	1	1											138
W (259 - 281)	24	26															50
WNW (282 - 303)	54	32	9	1		1											97
NW (304 - 326)	783	355	27	9	1		2	1									1178
NNW (327 - 348)	485	303	47	26	17	12	10	7	5	2							914
CALM AND LIGHT/VARIABLE	541	389	40	14	5	4		1									994
TOTALS	4851	3085	363	123	57	38	43	23	7	4	1	3	1				8599

DUWAMISH, 4500 BLK E MARGINAL WAY S, SEATTLE  
ALL MONTHS 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)															OVER .70	TOTALS
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70		
N (349 - 011)	232	157	67	28	14	4	5	2	2		2	2					515
NNE (012 - 033)	217	82	32	10	5	1	1		1								349
NE (034 - 056)	320	70	16	1			1										408
ENE (057 - 078)	184	46	3	1													234
E (079 - 101)	86	22	3														111
ESE (102 - 123)	47	14	2														63
SE (124 - 146)	71	30	7	2													110
SSE (147 - 168)	344	197	25	7	1	1	3										578
S (169 - 191)	662	272	55	10	3	2	1										1005
SSW (192 - 213)	659	227	59	10	3	1		1									960
SW (214 - 236)	703	185	37	9	2		1										937
WSW (237 - 258)	246	30	1	1													278
W (259 - 281)	113	21	4	2													140
WNW (282 - 303)	37	16	9	2	1												65
NW (304 - 326)	198	108	39	11	2		3										361
NNW (327 - 348)	366	185	96	32	16	3	7	2			1						708
CALM AND LIGHT/VARIABLE	582	348	71	7	5	6	1			1							1021
TOTALS	5067	2010	526	133	52	18	23	5	3	1	3	2					7843

PUGET SOUND AIR POLLUTION CONTROL AGENCY - FREQUENCY DISTRIBUTION  
OF HOURLY AVERAGES

10,000 W MARGINAL WAY SW, SEATTLE, WASH.

MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC, 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)															OVER TOTALS
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70	
N (349 - 011)	285	35	1													321
NNE (012 - 033)	294	9														303
NE (034 - 056)	233	7														240
ENE (057 - 078)	109	4														113
E (079 - 101)	44															44
ESE (102 - 123)	33	4														37
SE (124 - 146)	201	23	7	1												232
SSE (147 - 168)	1166	173	16	12	2		2	2								1373
S (169 - 191)	440	167	33	9	6	9	4	1								669
SSW (192 - 213)	287	194	42	14	12	2	5	2								558
SW (214 - 236)	279	87	19	5	6				1							397
WSW (237 - 258)	160	27	1		1											189
W (259 - 281)	72	10	1													83
WNW (282 - 303)	143	74	10		1											228
NW (304 - 326)	349	203	25	6	1	3										587
NNW (327 - 348)	361	181	14	3	1	2										562
CALM AND LIGHT/VARIABLE	461	136	12	2	1											612
TOTALS	4917	1334	181	52	31	16	11	5	1							6548

SOUTH CENTER, ANDOVER PARK EAST, TUKWILA, WA  
FEB, MAR, APR, MAY, JUN, JUL, 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)															OVER TOTALS
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70	
N (349 - 011)	389	21	1													411
NNE (012 - 033)	144	7														151
NE (034 - 056)	61	4														65
ENE (057 - 078)	31	5			1											37
E (079 - 101)	41	3	1													45
ESE (102 - 123)	62	3	2													67
SE (124 - 146)	56	6			1											63
SSE (147 - 168)	125	12														137
S (169 - 191)	526	39	6	1	1		1									574
SSW (192 - 213)	589	66	6	2	3											666
SW (214 - 236)	377	132	30	10	1		1	2				1				554
WSW (237 - 258)	154	35	14	4	3		1	1								212
W (259 - 281)	49	2														51
WNW (282 - 303)	34	2	3	1												40
NW (304 - 326)	87	9	2	2												100
NNW (327 - 348)	277	32	1	1												311
CALM AND LIGHT/VARIABLE	356	35	1	1	1		1									395
TOTALS	3358	413	67	22	11		3	3	1			1				3879

PUGET SOUND AIR POLLUTION CONTROL AGENCY - FREQUENCY DISTRIBUTION  
OF HOURLY AVERAGES

MCMICKEN HTS, S 176TH & 42ND AV S, KING CO, WA  
JAN, FEB, MAR, APR, MAY, JUL, AUG, OCT, NOV, DEC, 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)															OVER .70	TOTALS
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70		
N (349 - 011)	211	129	12				1										353
NNE (012 - 033)	476	207	7	1													691
NE (034 - 056)	182	67	7														256
ENE (057 - 078)	48	35	2														85
E (079 - 101)	19	19	1														39
ESE (102 - 123)	36	20	1														57
SE (124 - 146)	55	33															88
SSE (147 - 168)	129	100	5														234
S (169 - 191)	365	204	15	4	2												590
SSW (192 - 213)	357	289	25	6	2		2		1								682
SW (214 - 236)	469	424	125	52	24	6	4	1	1	1							1107
WSW (237 - 258)	136	82	19	2	2	1	2			1							245
W (259 - 281)	71	29	10	2	1												113
WNW (282 - 303)	32	13	3														48
NW (304 - 326)	22	20			1												43
NNW (327 - 348)	40	24	3														67
CALM AND LIGHT/VARIABLE	727	352	34	7	1	1	2										1124
TOTALS	3375	2047	269	74	33	8	10	2	2	2							5822

1234 NORTH CENTRAL AVENUE, KENT, WA  
JAN, FEB, APR, JUL, AUG, SEP, OCT, 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)															OVER .70	TOTALS
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70		
N (349 - 011)	279	72	1														352
NNE (012 - 033)	133	15															148
NE (034 - 056)	37	2															39
ENE (057 - 078)	25	1															26
E (079 - 101)	47	1															48
ESE (102 - 123)	53	3	1														57
SE (124 - 146)	101	8															109
SSE (147 - 168)	257	21			1												279
S (169 - 191)	413	39	4	2													458
SSW (192 - 213)	180	40	4	5													229
SW (214 - 236)	117	30	7	4	2		1										161
WSW (237 - 258)	71	33	12	8													124
W (259 - 281)	77	59	14	2													152
WNW (282 - 303)	52	27	3	1													83
NW (304 - 326)	33	20	2														55
NNW (327 - 348)	63	33															96
CALM AND LIGHT/VARIABLE	1061	397	12	1		2			1	1							1475
TOTALS	2999	801	60	23	3	2	1		1	1							3891



PUGET SOUND AIR POLLUTION CONTROL AGENCY - FREQUENCY DISTRIBUTION  
OF HOURLY AVERAGES

SW 248TH & 59TH AVE. SW, MAURY ISLAND, WASH.  
ALL MONTHS 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)																OVER TOTALS
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70		
N (349 - 011)	186	59	5	1												251	
NNE (012 - 033)	55	17	2													74	
NE (034 - 056)	54	13	2													69	
ENE (057 - 078)	66	16	1													83	
E (079 - 101)	51	17	1													69	
ESE (102 - 123)	383	211	53	23	5	4	3									682	
SE (124 - 146)	268	175	48	18	5	3	1	2	1	1		1				523	
SSE (147 - 168)	325	118	32	11	2	3				2						493	
S (169 - 191)	275	191	59	28	12	4	12	4								585	
SSW (192 - 213)	262	244	94	63	38	13	23	8	1	4	1	1				752	
SW (214 - 236)	317	90	18	9	1	1	4	1								441	
WSW (237 - 258)	136	39	6		2			1								184	
W (259 - 281)	74	26	3	3	4	1										111	
WNW (282 - 303)	70	22	2													94	
NW (304 - 326)	525	249	6													780	
NNW (327 - 348)	732	314	21	1												1068	
CALM AND LIGHT/VARIABLE	345	415	92	21	4	3	4									884	
TOTALS	4124	2216	445	178	73	32	47	16	2	7	1	2				7143	

MEEKER JR HS, 1526 - 51ST STREET NE, TACOMA  
ALL MONTHS 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)																OVER TOTALS
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70		
N (349 - 011)	528	142	10	2	2											684	
NNE (012 - 033)	651	207	6													864	
NE (034 - 056)	191	88	3	3												285	
ENE (057 - 078)	38	17	1													56	
E (079 - 101)	50	8		1		1										60	
ESE (102 - 123)	53	22	4		1											80	
SE (124 - 146)	157	128	46	11	1	1		2								346	
SSE (147 - 168)	330	287	101	19	6	4	5									752	
S (169 - 191)	445	182	36	15	2		1									681	
SSW (192 - 213)	710	112	9	1												832	
SW (214 - 236)	464	74	3	3	2											546	
WSW (237 - 258)	134	55	12	5	2	1										209	
W (259 - 281)	33	34	12	3	2	2	3	1		1						91	
WNW (282 - 303)	64	32	15	6	5	4	2	1	1							130	
NW (304 - 326)	92	63	16	9	3	3	7		1	1		1				196	
NNW (327 - 348)	137	38	7	3	3						2					190	
CALM AND LIGHT/VARIABLE	643	422	93	49	9	6	4	3								1229	
TOTALS	4720	1911	374	130	38	22	22	9	2	2		1				7231	

PUGET SOUND AIR POLLUTION CONTROL AGENCY - FREQUENCY DISTRIBUTION  
OF HOURLY AVERAGES

N 26TH AND PEARL STREET, TACOMA  
ALL MONTHS 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)															OVER .70	TOTALS	
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70			
N (349 - 011)	137	98	39	13	13	4	9	6	1	1	3	2	1					327
NNE (012 - 033)	376	320	102	49	26	26	24	13	9	6				1	1			953
NE (034 - 056)	418	244	57	12	15	10	11	1	3	1	2	1					1	776
ENE (057 - 078)	77	57	9	3	1	3	1		3	1	2		1					158
E (079 - 101)	51	35	23	4	2		1	1	1									118
ESE (102 - 123)	69	28	11		1		2											111
SE (124 - 146)	61	29	5	1	1												1	98
SSE (147 - 168)	189	57	6				3											255
S (169 - 191)	456	52	2															510
SSW (192 - 213)	809	52	1				1											863
SW (214 - 236)	1180	105	6	1	1													1293
WSW (237 - 258)	800	76	9	1		1	1	1										889
W (259 - 281)	310	55	8	2	2													377
WNW (282 - 303)	88	24	10			1	2	1										126
NW (304 - 326)	44	31	8	2	5		3	1										94
NNW (327 - 348)	59	28	8	5	3	2		2	1			1						109
CALM AND LIGHT/VARIABLE	576	308	85	27	18	4	16	11	8	5	3		4	2			3	1070
TOTALS	5700	1599	389	120	88	51	74	37	26	14	10	4	6	3	2	4		8127

DEWEY JR HS, PERRY AVE & HOLMAN ST, BREMERTON  
JAN, FEB, MAR, APR, 1976

WIND DIRECTION ( DEGREES )	SULFUR DIOXIDE (PPM)															OVER .70	TOTALS	
	.00 TO .00	.01 TO .02	.03 TO .04	.05 TO .06	.07 TO .08	.09 TO .10	.11 TO .15	.16 TO .20	.21 TO .25	.26 TO .30	.31 TO .35	.36 TO .40	.41 TO .50	.51 TO .60	.61 TO .70			
N (349 - 011)	104	4																108
NNE (012 - 033)	209	6																215
NE (034 - 056)	88	4																92
ENE (057 - 078)	68	3																71
E (079 - 101)	95	4	1															100
ESE (102 - 123)	56	9					1											66
SE (124 - 146)	48	4		1														53
SSE (147 - 168)	47	10	2	1														60
S (169 - 191)	132	24	1															157
SSW (192 - 213)	476	96	11	2		1	1											587
SW (214 - 236)	387	196	18	7	1	1												610
WSW (237 - 258)	124	41	2	1														168
W (259 - 281)	31	7	2															40
WNW (282 - 303)	28	2																30
NW (304 - 326)	30	2																32
NNW (327 - 348)	50	1																51
CALM AND LIGHT/VARIABLE	307	73	9	5		1	2											397
TOTALS	2280	486	46	17	1	2	3	2										2837

SULFUR DIOXIDE  
 (Concentrations in parts per million by volume)  
 1976

Location	Maximum 24-Hour Average	Maximum 3-Hour Average	Maximum 1-Hour Average	Maximum 5-Min. Avg. Exceeding 1.00 ppm
Medical-Dental Bldg., Everett	.06	.24	.60	1.63
Food Circus Bldg., Seattle Center	.03	.10	.18	
3419 13th Ave. S.W., Seattle	.08	.28	.45	
4500 Blk. E. Marginal Way S., Seattle	.07	.27	.46	
10000 W. Marginal Way S.W., Seattle	.03	.15	.22	
Southcenter, Tukwila <sup>a</sup>	.03	.14	.36	
McMicken Hts., King County	.04	.16	.29	
1234 N. Central Ave., Kent <sup>a</sup>	.02	.16	.34	
Maury Island, King County	.07	.18	.47	
Meeker Jr. H.S., Tacoma	.05	.18	.38	
N. 26th & Pearl, Tacoma	.19	.82	1.29	1.70
Dewey Jr. H.S., Bremerton <sup>a</sup>	.04	.13	.28	

<sup>a</sup> More than 50% of possible data missing.

Sulfur dioxide is measured on a continuous basis using the conductometric method or the flame photometric detection method.

SULFUR DIOXIDE  
 Monthly and Annual Arithmetic Averages  
 (Concentrations in parts per million by volume)  
 1976

Location	Monthly Arithmetic Averages												Annual Arith. Average
	J	F	M	A	M	J	J	A	S	O	N	D	
Medical-Dental Bldg., Everett	.006	.004	.008	.009	.004	.008	.009	.008	.009	.004	.007	.003	.007
Food Circus Bldg., Seattle Center	.009	.007	.006	.003	.003	.003	.007	.002	.002				.005
3419 13th Ave. S.W., Seattle	.012	.011	.015	.008	.008	.007	.004	.005	.007	.010	.012	.010	.009
4500 Blk. E. Marg. Way S., Seattle	.005	.003	.004	.004	.007	.005	.007	.005	.009	.012	.017	.018	.008
10000 W. Marg. Way S.W., Seattle			.006	.004	.004	.006	.005	.004	.007	.005	.005	.003	.005
Southcenter, Tukwila		.002	.003	.002	.003	.003	.005						.003
McMicken Hts., King County	.011	.010	.012	.013	.007		.009	.001		.003	.003	.011	.008
1234 N. Central Ave., Kent	.002	.002		.005			.005	.005	.004	.002			.004
Maury Island, King County	.010	.007	.005	.005	.008	.011	.011	.009	.014	.012	.016	.021	.010
Meeker Jr. H.S., Tacoma	.003	.002	.005	.007	.005	.002	.006	.006	.006	.010	.014	.017	.007
N. 26th & Pearl, Tacoma	.010	.013	.013	.006	.010	.013	.005	.007	.009	.008	.020	.019	.011
Dewey Jr. H.S., Bremerton	.004	.004	.003	.002									.003

SULFUR DIOXIDE  
 Summary of Concentrations Exceeding Selected Values  
 (Concentrations in parts per million by volume)  
 1976

- A. Number of occurrences > 1.00 ppm for 5 minutes.  
 B. Number of occurrences > 0.25 ppm for 1 hour.  
 C. Number of occurrences > 0.40 ppm for 1 hour.

- D. Number of occurrences > 0.50 ppm for 3 hours.  
 E. Number of occurrences > 0.10 ppm for 24 hours.  
 F. Number of occurrences > 0.14 ppm for 24 hours.

Location	Jan.			Feb.			Mar.			Apr.			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			Annual					
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C			
Medical-Dental Bldg., Everett							2												1	3	1				1			1			2	3	2				3	10	3			
Food Circus Bldg., Seattle Center																																										
3419 13th Ave. S.W., Seattle													1	1								3	1		1			4	1		1						10	3				
4500 Blk. E. Marg. Way S., Seattle																			1									6	2		1						8	2				
10000 W. Marg. Way S.W., Seattle																																										
Southcenter, Tukwila <sup>a</sup>													1																											1		
McMicken Hts., King County		1											1																											2		
1234 N. Central Ave., Kent <sup>a</sup>		1											1																											2		
Maury Island, King County		5	1							1			2			2															1			1			12	1				
Meeker Jr. H.S., Tacoma					1																	1																		3		
N. 26th & Pearl, Tacoma	8	9	5	2	7	5				1			4	6	1	3						1	1	2	4			2			16	11	4	9	7	2	40	53	17			
Dewey Jr. H.S., Bremerton <sup>a</sup>					1																																			1		
All Station Totals	8	16	6	2	9	5	2			2			4	12	2	5			1	4	1	1	7	1	6			14	3	18	17	6	9	8	2	43	102	26				

Location	Jan.			Feb.			Mar.			Apr.			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			Annual					
	D	E	F	D	E	F	D	E	F	D	E	F	D	E	F	D	E	F	D	E	F	D	E	F	D	E	F	D	E	F	D	E	F	D	E	F	D	E	F	D	E	F
N. 26th & Pearl, Tacoma	1	1		1	1	1																												1	1	1	1	2	1	4	5	3

<sup>a</sup> More than 50% of possible data missing.

PHOTOCHEMICAL OXIDANTS

Photochemical reactivity may be defined as the tendency of an atmospheric system containing organic substances (such as reactive hydrocarbons) and nitrogen oxides to undergo, under the influence of ultraviolet radiation and appropriate meteorological conditions, a series of chemical reactions that result in the formation of photochemical oxidants. This reaction requires some time (2 to 5 hours) to take place; therefore, the maximum concentrations of photochemical oxidants normally occur from 5 to 15 miles downwind of the sources that emit reactive hydrocarbons and nitrogen oxides.

Since ultraviolet radiation is a necessary part of this reaction, the highest photochemical oxidant concentrations occur during the summer months when there are more hours of sunlight with the sun at a higher elevation angle. Light northerly winds frequently accompany the sunny, clear days in the Puget Sound Region during the summer. As a result, the highest photochemical oxidant concentrations are normally observed 5 to 15 miles south of the major urban centers. The maximum values generally occur between noon and sunset.

PHOTOCHEMICAL OXIDANTS (OZONE)					
(Concentration in parts per million)					
1976					
Location	Period of Operation	Maximum 24-Hour Average	Maximum 4-Hour Average	Maximum 1-Hour Average	Hours Exceeding 0.08 ppm
Public Works Bldg., Bothell*	June 25 - Sept. 26	.02	.07	.09	1
Lake Sammamish State Park*	Jan. 1 - Dec. 31	.03	.07	.09	1
6770 E. Marg. Way S.W., Seattle*	Jan. 1 - Dec. 31	.02	.04	.05	0
McMicken Hts., King County	Apr. 19 - Dec. 31	.03	.07	.07	0
1234 N. Central Ave., Kent	Jan. 1 - Dec. 31	.03	.06	.08	0
5132 112th St. S.W., Lakewood*	Jan. 1 - Dec. 31	.04	.07	.07	0

\* Washington State Department of Ecology Station  
 Ozone is measured on a continuous basis using the gas phase chemiluminescence method, or the ultraviolet photometric detection method.

OXIDES OF NITROGEN (NO<sub>x</sub>)  
(Concentration in parts per million)  
1976

Location	Period of Operation	Annual Arith. Mean	Maximum 24-Hour Average	Maximum 1-Hour Average
Tulalip Test Facility 10000 W. Marg. Way S.W., Seattle	Jan. 1 - Dec. 31	.029	0.13	0.27
	Jan. 1 - Dec. 31	.086	0.52	0.98

Nitrogen Oxides are measured on a continuous basis using the gas phase chemiluminescence method.

NITROGEN DIOXIDE (NO<sub>2</sub>)  
(Concentration in parts per million)  
1976

Location	Period of Operation	Annual Arith. Mean	Maximum 24-Hour Average	Maximum 1-Hour Average
Tulalip Test Facility 10000 W. Marg. Way S.W., Seattle	Jan. 1 - Dec. 31	.009	0.03	0.06
	Jan. 1 - Dec. 31	.027	0.11	0.18

Nitrogen Dioxide is measured on a continuous basis using the gas phase chemiluminescence method.

HYDROCARBONS (NONMETHANE)  
(Concentration in parts per million)  
1976

Location	Period of Operation	Maximum 3-Hour Average <sup>a</sup>	No. Days 3-Hour Avg. Exceeded 0.24 ppm <sup>a</sup>
Tulalip Test Facility 10000 W. Marg. Way S.W., Seattle	Jan. 1 - Dec. 31	0.43	5
	Jan. 1 - Dec. 31	1.61	150

<sup>a</sup> Applies only to the period 6 AM through 9 AM daily.

Nonmethane Hydrocarbons are measured on a continuous basis using the catalytic combustion - flame ionization detection method.

CARBON MONOXIDE

The Washington State Department of Ecology (DOE) has statewide jurisdiction over motor or vehicular sources of pollution. The DOE operates equipment that measures motor vehicle related pollutants in certain areas of the State. During 1976, carbon monoxide analyzers were operated at 17 locations in the Puget Sound Air Quality Control Region for periods varying from several weeks to a full year. Some of these stations were in operation prior to 1976.

In general, high ambient levels of carbon monoxide occur near congested, slow-moving motor vehicle traffic when low level winds are light and stable meteorological conditions exist. Peak concentrations generally coincide with the weekday morning and evening traffic peaks. Minimum values generally occur during the night and on weekends.

Episode criteria are specified in the Washington State Episode Avoidance Plan

(Washington Administrative Code (WAC) 18-08). The Alert stage is to be declared 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 Warning stage is 30 ppm for an 8-hour average, and the Emergency stage is 40 ppm for an 8-hour average, each with a similar statement on the forecast of meteorological conditions.

The carbon monoxide data presented below were extracted from the Department of Ecology monthly data summary and from the DOE publication, "Washington State Air Monitoring Data for 1976." Detailed information regarding site locations; hourly, daily and seasonal averages; and trends may be obtained by contacting the Department of Ecology.

CARBON MONOXIDE  
(Concentration in parts per million)  
1976

Location	Period of Record	Maximum 1-Hour Average	Maximum 8-Hour Average	No. 8-Hr. Avgs. Exceeding 9 ppm	No. Days 8-Hr. Avg. Exceeded 9 ppm
Tulalip Test Facility, Snohomish Co.	Jan. 1 - Dec. 31	2	1	0	0
606 110th Ave. N.E., Bellevue	Jan. 1 - Nov. 5	22	14	4	4
1307 N.E. 45th, Seattle	Nov. 16 - Dec. 31	31	24	48	31
3921 Linden N., Seattle	Nov. 1 - Dec. 31	12	8	0	0
1300 Madison, Seattle	Dec. 17 - Dec. 31	15	10	1	1
1004 Boren Ave., Seattle	Jan. 1 - Nov. 30	27	18	11	9
1408 4th Ave., Seattle	Jan. 1 - Oct. 29	22	17	18	14
2nd & University Ave., Seattle	Jan. 1 - Dec. 31	25	20	30	25
City Hall, 5th & James St., Seattle	Jan. 1 - Dec. 31	24	16	74	56
301 2nd Ave. S., Seattle	Oct. 12 - Dec. 31	19	11	1	1
1000 4th Ave. S., Seattle	Jan. 1 - Dec. 31	15	11	1	1
2809 26th S., Seattle	Dec. 11 - Dec. 31	18	12	2	2
6770 E. Marg. Way S., Seattle	Jan. 1 - Nov. 4	14	8	0	0
10000 W. Marg. Way S., Seattle	Jan. 1 - Dec. 31	13	9	0	0
901 Tacoma Ave. S., Tacoma	Jan. 1 - Dec. 31	17	11	2	2
715 S. 11th St., Tacoma	Jan. 1 - June 6	20	13	2	2
5132 112th St. S.W., Lakewood	Jan. 1 - June 6	10	8	0	0

Carbon monoxide is measured on a continuous basis using the nondispersive infrared method or the gas chromatographic separation - flame ionization detection method.



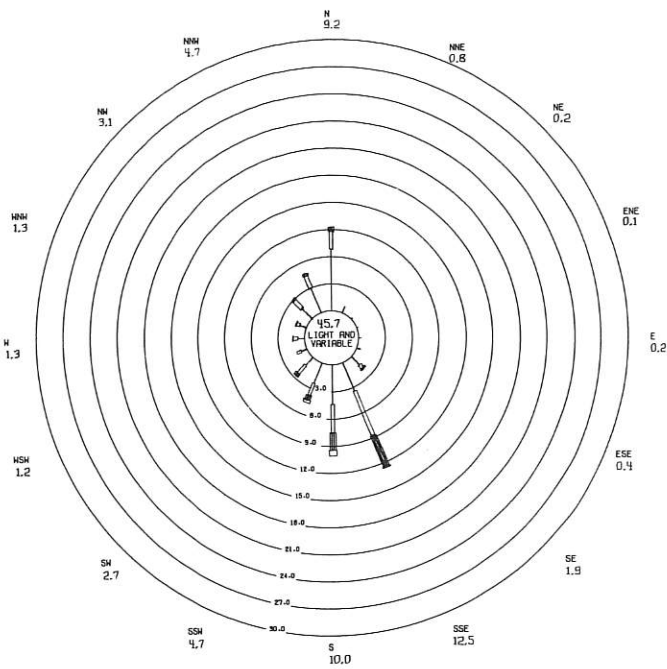
## WIND ROSES

The measurement of wind speed and direction, concomitant with air quality, is essential to the evaluation and control of air pollution in any given area. Wind speeds below four knots usually result in higher air pollutant concentrations. Wind direction information is essential for determining which sources or source areas affect a specific station.

A wind rose is a graphical means of summarizing the winds for a given time period. It is essentially a count, expressed as a percentage frequency, of the number of observations which had a particular direction and speed during that time period.

In these roses, representing 1976 winds, each spoke points in the direction from which the wind blows. The length of each segment of a spoke indicates the relative frequency of winds of different speeds. Using the scale located to the lower right of each rose, these lengths may be converted to percentages of the total observations.

The percentage frequency of winds from any given direction (without regard to speed) is expressed numerically beneath that direction on the perimeter of the roses. The percentage frequency of light and variable winds (winds less than 1.5 knots) is shown in the center of the rose.

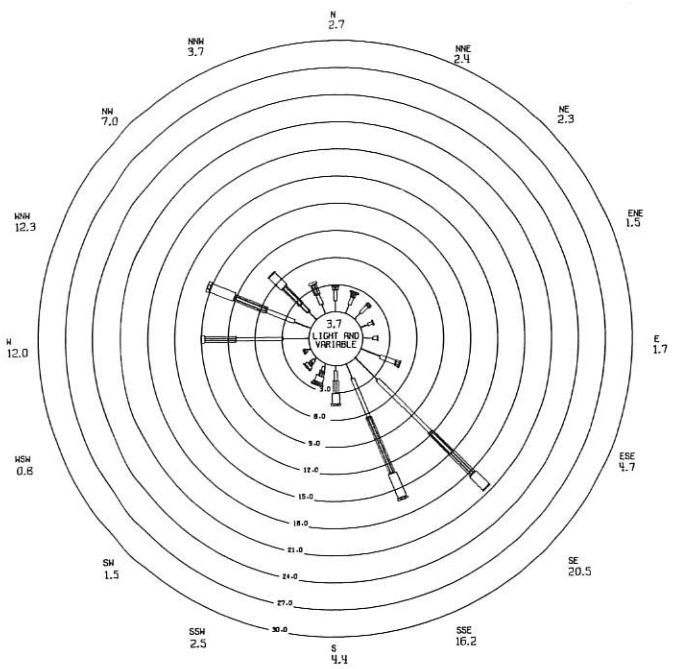
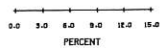
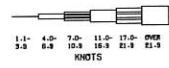


HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
TULALIP TEST FACILITY, SNOHOMISH CO, WA

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 6,402

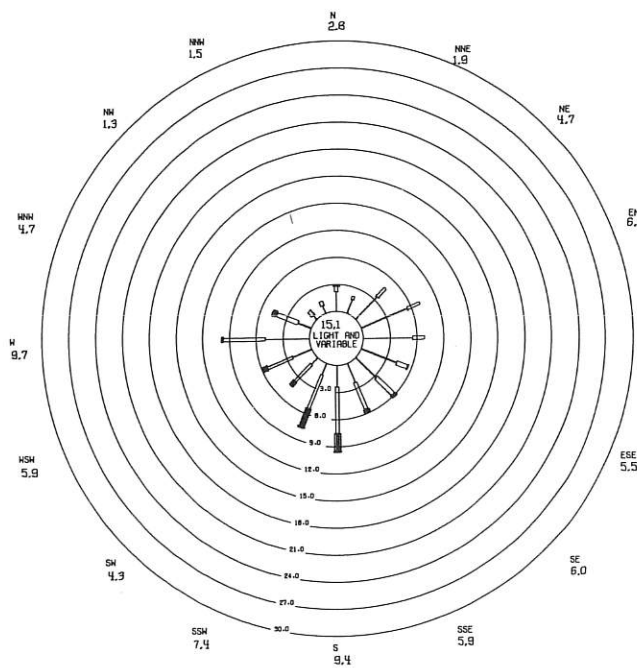
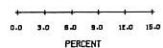
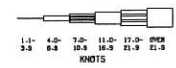


HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
MEDICAL-DENTAL BLDG, 2730 COLBY AVE, EVERETT

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 8,517

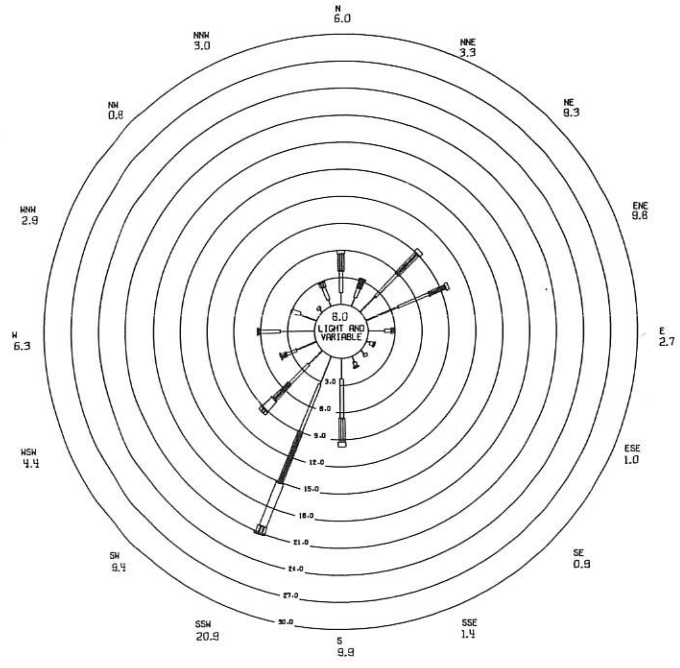
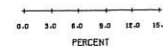
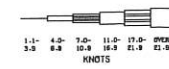


HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
NHS URBAN SITE, 2725 MONTLAKE BLVD E, SEATTLE

INCLUSIVE DATES- JAN-FEB, APR-NOV, 1976

TOTAL OBSERVATIONS- 6,217

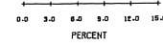
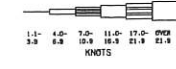


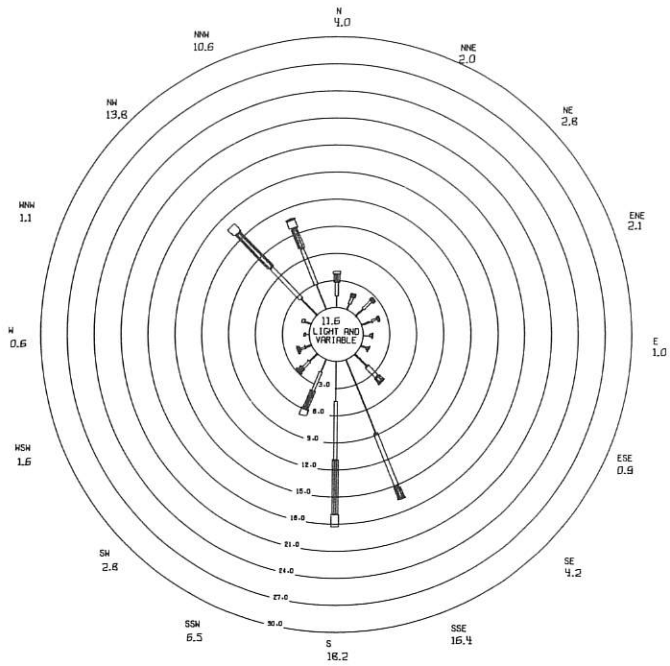
HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
FOOD CIRCUS BUILDING, SEATTLE CENTER

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 8,263





HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

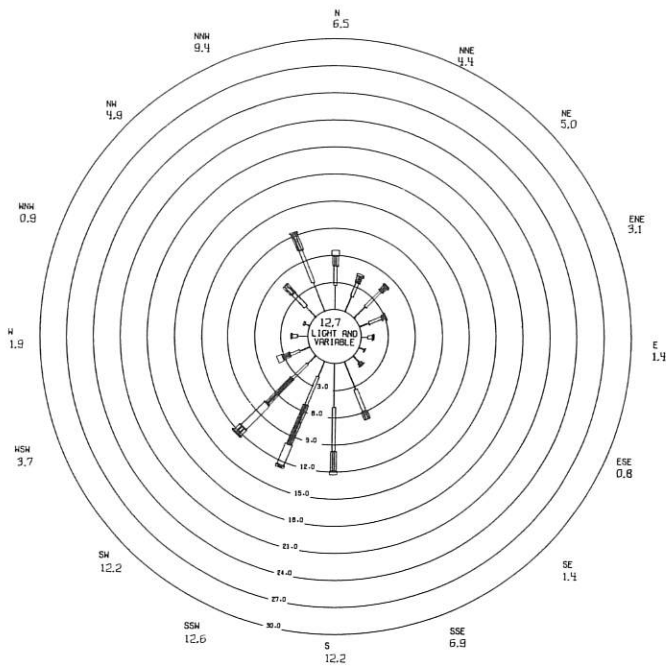
STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
HARBOR ISLAND, 3419 13TH AVE SW, SEATTLE, WA

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 6,645

1.1- 4.0 7.0- 11.0- 17.0- OVER  
3.0 6.0 10.0 16.0 21.0 27.0  
KNOTS

0.0 3.0 6.0 9.0 12.0 15.0  
PERCENT



HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

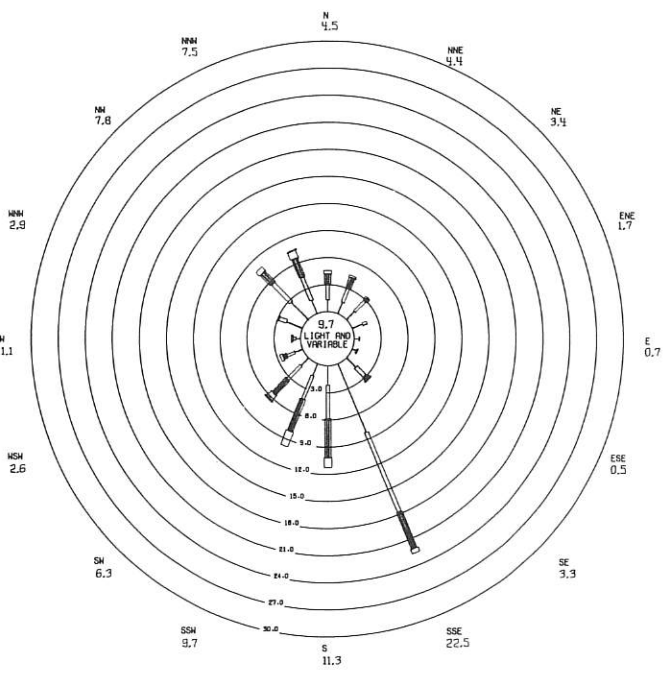
STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
DUWAMISH, 4500 BLK E MARGINAL WAY S, SEATTLE

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 6,545

1.1- 4.0 7.0- 11.0- 17.0- OVER  
3.0 6.0 10.0 16.0 21.0 27.0  
KNOTS

0.0 3.0 6.0 9.0 12.0 15.0  
PERCENT



HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

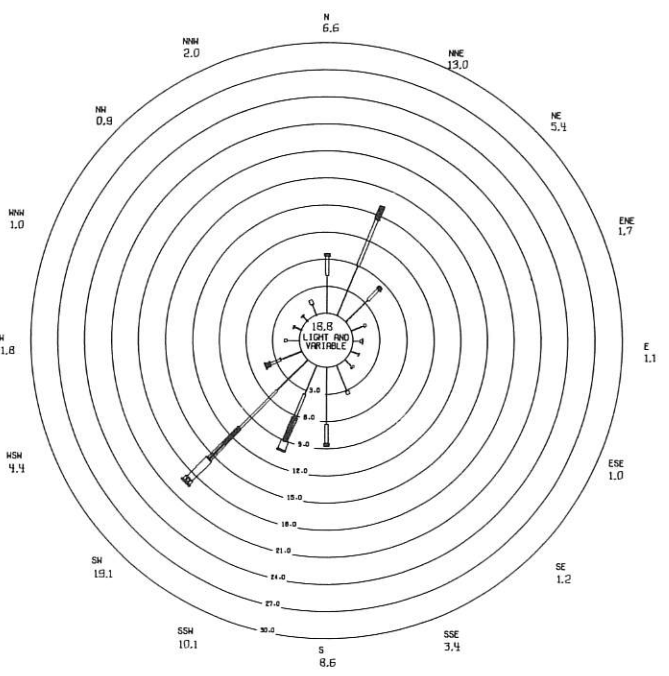
STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
10,000 W MARGINAL WAY SW, SEATTLE, WASH.

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 8,441

1.1- 4.0 7.0- 11.0- 17.0- OVER  
3.0 6.0 10.0 16.0 21.0 27.0  
KNOTS

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PERCENT



HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

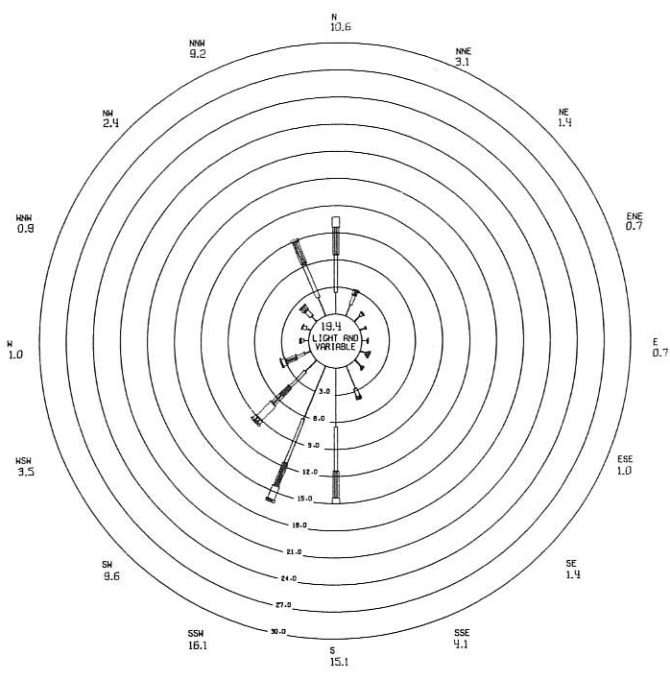
STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
MEMICKEN HTS., S 176TH & 42ND AV S, KING CO. WA

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 8,663

1.1- 4.0 7.0- 11.0- 17.0- OVER  
3.0 6.0 10.0 16.0 21.0 27.0  
KNOTS

0.0 3.0 6.0 9.0 12.0 15.0  
PERCENT

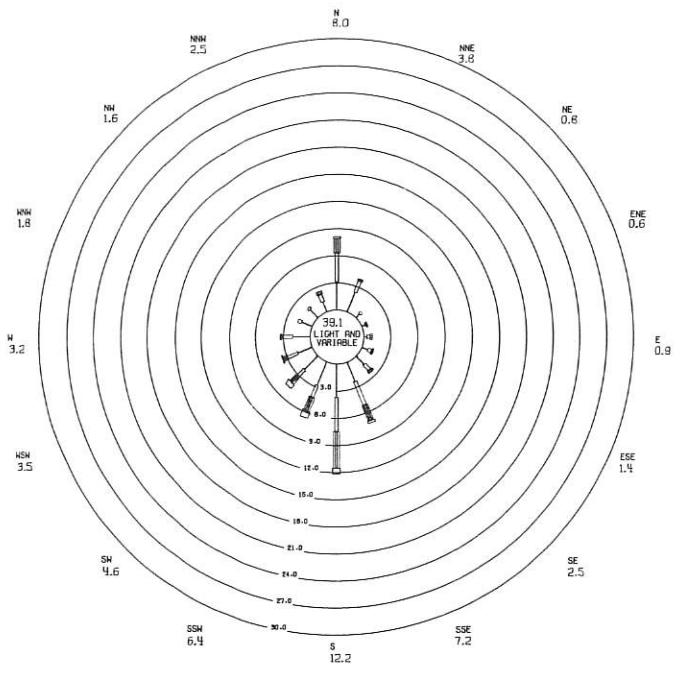
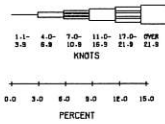


HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
SOUTH CENTER, ANDOVER PARK EAST, TUKWILA, WA

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 6,608

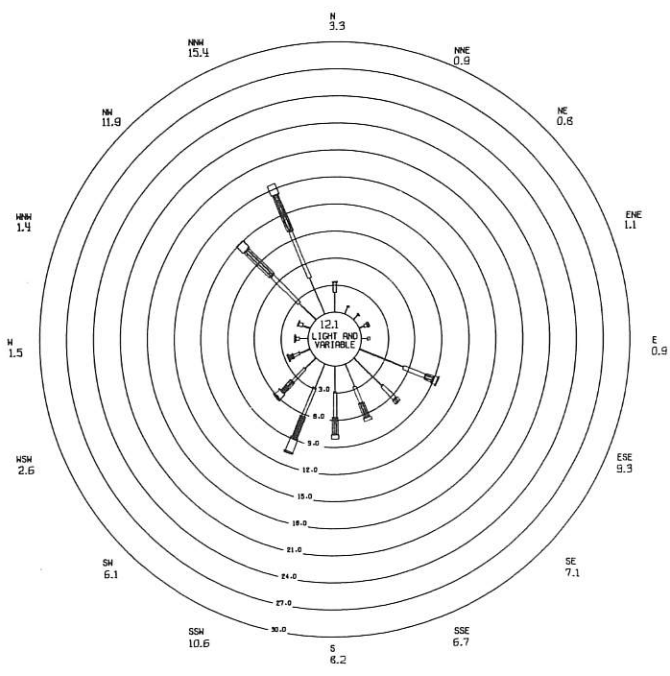
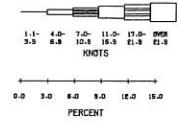


HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
1234 NORTH CENTRAL AVENUE, KENT, WA

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 6,466

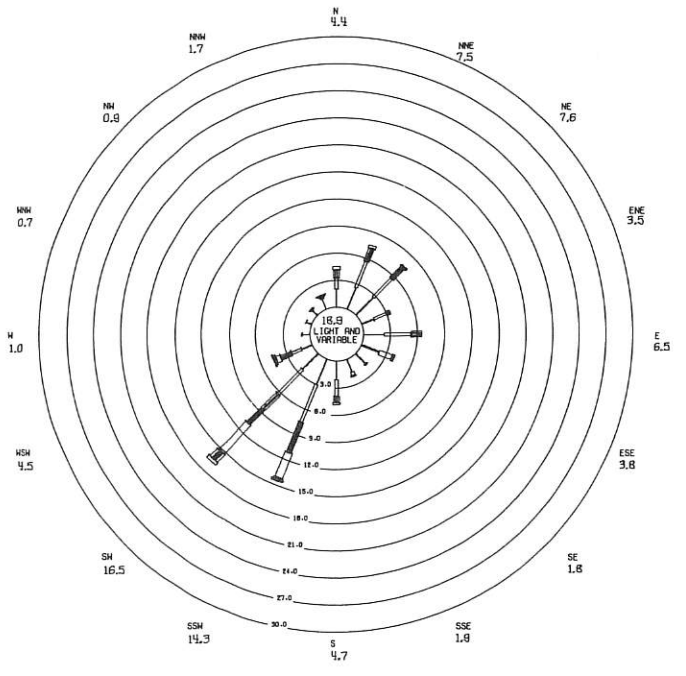
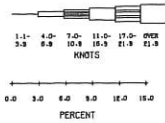


HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
SW 248TH & 59TH AVE. SW, MATORY ISLAND, WASH.

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 6,536

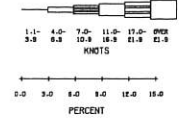


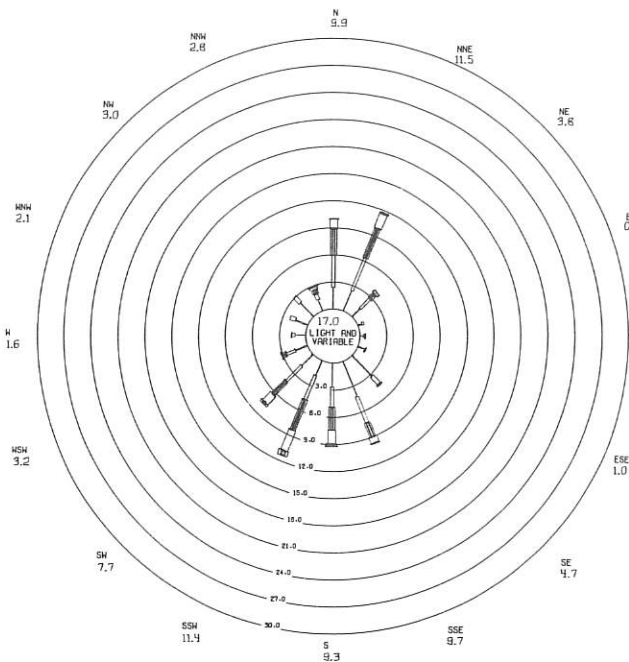
HOUR AVERAGE SURFACE WINDS  
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
DONEY JR HS, PERRY AVE & HOLMAN ST, BREMERTON

INCLUSIVE DATES- JAN-NOV. 1976

TOTAL OBSERVATIONS- 7,900





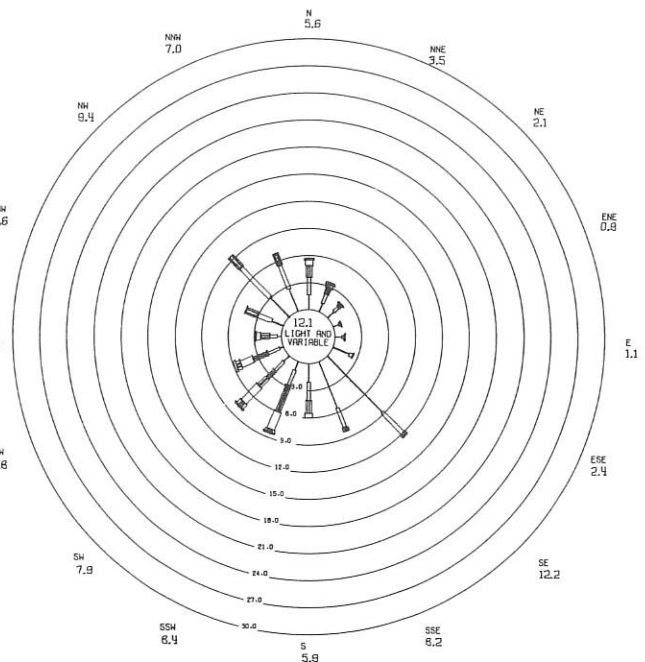
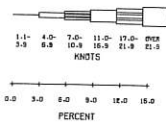
HOUR AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
MEEKER JA HS. 1526 - 51ST STREET NE, TACOMA

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 8,420



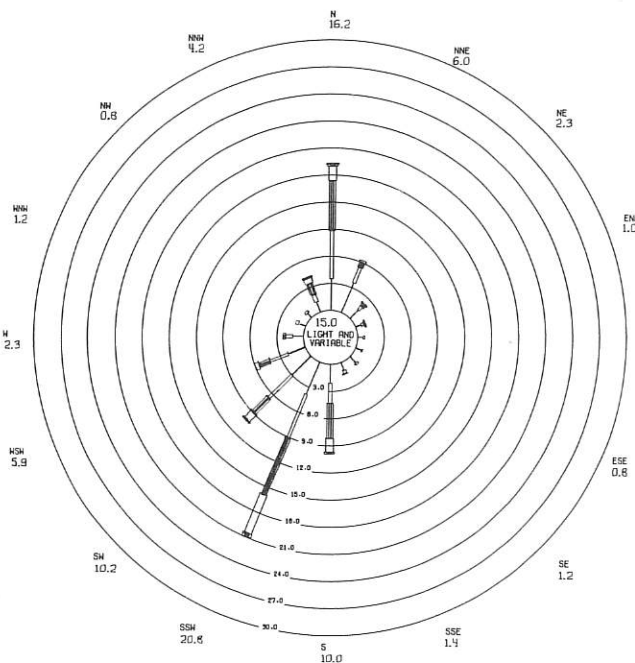
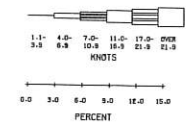
HOUR AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
2316 E 11TH ST AND THORNE ROAD, TACOMA, WA

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 8,623



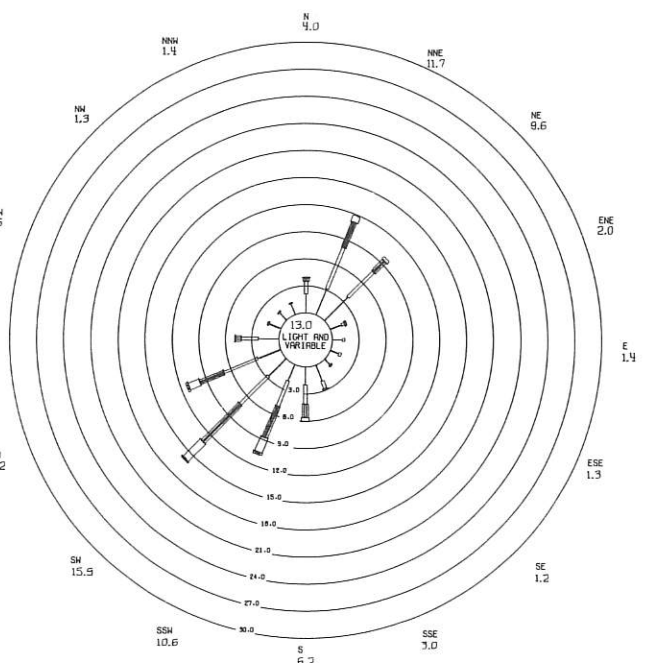
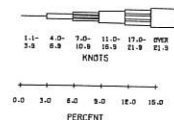
HOUR AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
WILLARD ELEN SCHOOL, S 32ND & 5th ST, TACOMA

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 6,518



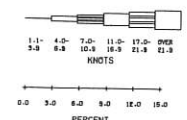
HOUR AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY  
N 26TH AND PEARL STREET, TACOMA

INCLUSIVE DATES- ALL MONTHS 1976

TOTAL OBSERVATIONS- 6,598





## 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%. Note: Smoking up to 2 packs of cigarettes a day raises carboxyhemoglobin levels to about 5%. This is equivalent to exposure for 8 or more hours to 30 ppm of carbon monoxide.

	NATIONAL				Notes	WASHINGTON STATE		Notes	PUGET SOUND REGION		Notes
	PRIMARY	SECONDARY									
SULFUR OXIDES	$\mu\text{g}/\text{m}^3$	ppm	$\mu\text{g}/\text{m}^3$	ppm		ppm		ppm			
Annual Average	80	.03			a	.02	a	.02	a		
30-day Average								.04	a		
24-hour Average	365	.14			b	.10	b	.10	a		
3-hour Average			1300	.50	b			.25	c		
1-hour Average						.25	c	.25	c		
1-hour Average						.40	b	.40	a		
5-min. Average								1.00	d		
SUSPENDED PARTICULATES	$\mu\text{g}/\text{m}^3$	ppm	$\mu\text{g}/\text{m}^3$	ppm		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$			
Annual Geom. Mean	75	---	60	---	a	60	a	60	a		
24-hour Average	260	---	150	---	b	150	b	150	b		
CARBON MONOXIDE	$\text{mg}/\text{m}^3$	ppm									
8-hour Average	10	9	same		b	same		same			
1-hour Average	40	35			b						
PHOTOCHEMICAL OXIDANTS	$\mu\text{g}/\text{m}^3$	ppm									
1-hour Average	160	.08	same		b	same but applies only 10 a.m. - 4 p.m. 4/1 thru 10/31		same as National			
NITROGEN DIOXIDE	$\mu\text{g}/\text{m}^3$	ppm									
Annual Average	100	.05	same		a	same		same			
HYDROCARBONS (Less Methane)	$\mu\text{g}/\text{m}^3$	ppm									
3-hour Average	160	.24	same		b e	same but applies only 4/1 thru 10/31		same as National			
PARTICLE FALLOUT						grams/m <sup>2</sup> /mo.					
Industrial Areas						10					
Commercial-Residential Areas						5					

ppm = parts per million  
 $\mu\text{g}/\text{m}^3$  = micrograms per cubic meter  
 $\text{mg}/\text{m}^3$  = milligrams 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 Applies to 3-hour period 6 to 9 a.m. daily

### PHOTOCHEMICAL OXIDANTS

Photochemical oxidants are produced in the atmosphere when nitrogen oxides and some hydrocarbons are exposed to sunlight. Photochemical oxidants cause irritation to the mucous membranes, damage to vegetation and deterioration of materials. They affect the clearance mechanism of the lungs and alter resistance to respiratory bacterial infections. The national primary air quality standard for photochemical oxidants is based on evidence of increased frequency of asthma attacks for some people on days when hourly averages reach 0.1 ppm. Eye irritation is possible when atmospheric concentrations reach this level.

### 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.

### HYDROCARBONS

Defined as organic compounds composed exclusively of carbon and hydrogen, hydrocarbons are primarily associated with the use of petroleum products. They are the main components of photochemical smog. Hydrocarbons alone have no known effect on human health; therefore the sole purpose of prescribing a hydrocarbon standard is to control photochemical oxidants.