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Regional Air Pollution Study

High Volume Filter Measurement of Suspended Particulate Matter

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January 1979

REGIONAL AIR POLLUTION STUDY

High Volume Filter Measurements of Suspended Particulate Matter

by

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ABSTRACT

High volume air samplers have been used for many years for collection of suspended particulate matter, thus becoming established as an EPA reference method. For this reason, ten RAMS stations located in various environments were equipped with high volume air samplers during the RAPS program. Preweighed, quality controlled filters were used to collect particulate samples every third day at these sites. Samples were transported to a chemical laboratory where total suspended particulates (TSP) were determined and wet chemical analyses performed for sulfates ($SO_4^=$) and nitrates (NO_3^-). A total of 2,358 filter samples were collected and analyzed. All data obtained were reported in micrograms meter^{-3}.

The concentration data for the three parameters studied appeared to vary both seasonally and between stations. To further examine the variability, the annual mean for each parameter was computed and plotted for each sampling station. The geometric mean for TSP ranged from 33.0 to 90.9 micrograms meter^{-3}, $SO_4^=$ ranged from 7.0 to 12.7 micrograms meter^{-3} and NO_3^- from 2.3 to 3.8 micrograms meter^{-3}. Each year was divided into quarters for each sampling station and the quarterly mean computed and plotted. A one way analysis of variance technique was used to test the significance of the variations in concentration. The results of the analysis of variance did indeed show a statistically significant difference in concentration between stations and also between quarters or seasons of the year.

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1.0 INTRODUCTION AND SUMMARY

An important element of the Regional Air Pollution Study (RAPS) conducted in the St. Louis area was the characterization of the urban aerosol. A series of experiments, measurement and analyses of suspended particulates were conducted to determine the character of aerosols in the St. Louis region in terms of their chemical and physical properties and their probable origins and evolution. Measurements of suspended particulates were made in either real time or as aerosol samples which were collected for subsequent chemical analysis using various traditional laboratory techniques. High volume sampler measurements, the subject of this task order, were to be used primarily for comparison with historical data and with other techniques for measurement of atmospheric aerosols, and to broadly characterize the distribution of total suspended particulates (TSP), sulfates ($SO_4^=$), and nitrates (NO_3^-) in the St. Louis region.

Two high volume samplers were installed at each of the following RAMS stations: 103, 105, 106, 108, 112, 115, 118, 120, 122, and 124. The samplers were equipped with constant flow controllers (Sierra Model 310B) to insure a constant air flow through the filter regardless of filter loading within limits of the sampler's capabilities. However, the constant flow section was not connected during the first year of operation, but was connected for the remainder of the sampling period and the percentage of recoverable valid data was vastly increased. For accurate and reliable flow data, the setpoint output voltage from the constant flow controller should be periodically checked with a calibrating device, preferably the top loading orifice calibrator.

High volume filters were Government Furnished Equipment (GFE) and were inspected, numbered and weighed before and after each sample collection, utilizing the Community Health Air Monitoring Program (CHAMP) procedures. Filters were stored in an environment of 23°C and 40% relative humidity except during filter transit and while installed in the sampler.

One filter sample was collected every third day including weekends and holidays at each of the ten RAMS stations in synchronism with the National Air Surveillance Network (NASN) schedule. The period of sampling was from midnight to midnight. The RAMS data acquisition and control system was used to initiate and terminate sampling. Flow rate measurements from each operating sampler flow transducer were recorded by the RAMS data acquisition system. During scheduled visits to each station for sample collection, new filters were installed, flow rates verified, sampler system inspection made, and preventative maintenance performed where required.

All collected samples with associated documentation were packaged in accordance with the CHAMP sample handling and shipping procedures and mailed to the Rockwell International Air Monitoring Center (RIAMC) Analytical Chemistry Laboratory in Newbury Park, California, for analysis. The results of the analyses for TSP, $SO_4^{=}$, and NO_3^{-} were compiled in SAROAD format and placed on magnetic tape for inclusion into the RAPS data bank.

A comprehensive quality assurance plan was submitted and approved by the EPA Task Coordinator. As part of quality assurance, the following guidelines were established with the recommendation that data exceeding these limits be considered for further investigation.

$$20 < TSP < 200$$
$$4 < SO_4^{=} < 50 \qquad \text{values in } \mu g/m^3$$
$$1 < NO_3^{-} < 10$$

Monthly progress reports were submitted which included descriptions of quality assurance activities, sample status, operational performance of each station, reasons for sampler failure, major problems and planned corrective action and plans for future activities. Under Task Order No. 51 (Contract DU-68-02-1081), the twenty high volume samplers of the Regional Air Monitoring System (RAMS) were operated and maintained from 14 January 1975 to 15 August 1975. The operation and maintenance of these twenty high volume samplers were then continued under Task Order No. 101 from 16 August 1975 to 31 March 1977. During that period, 2,358 filters were collected out of a possible 2,456 for a capture rate of 96 percent. Samples were inspected after collection and validated. A sample could be invalidated because of questionable

flow rate data, site computer malfunction, bird excrement and scratches, sampling time outside the prescribed limits (23-25 hours), mechanical damage to filter and waterspots caused by flowing rain or snow. Some samples were included in the Particulate Data Summary although they were outside the sample time limits because of the useful information they might contain. These samples are identified in the Particulate Data Summary. Eighty-eight percent of the samples analyzed were reported. For completeness, the summaries of data contained in this report include the data resulting from Task Order No. 51 as well as Task Order No. 101.

Cursory data analysis showed that two stations exceeded the National Ambient Air Quality Standards. Graphical presentation of the data and rudimentary statistical tests also revealed significant variations between stations and seasonal patterns.

2.0 NETWORK OPERATIONS

Prior to initiating formal work on Task Order No. 51, the predecessor to this task order, the installation of two each Sierra Model 305, high volume samplers with flow controllers and computer tie-in control, was accomplished at ten RAMS sites. This effort was performed by a change order to the basic RAMS contract. Samplers were installed at RAMS sites 103, 105, 106, 108, 112, 115, 118, 120, 122, and 124. Installations were completed in late January 1975. The flow controller portion of the mass flow controller was not connected to the motor. The motor was controlled with a manually operated motor controller separate and apart from the Sierra 310B constant flow device. The manual controller was set so that the flow through a clean filter was approximately 1.13 m^3/min. The first two weeks of February 1975 were used to operate the samplers for systems checkout, equipment burn-in and operator training. Operations under Task Order No. 51 were continued under Task Order No. 101 beginning 16 August 1975 and terminating 31 March 1977. Beginning 12 February 1975, samples were collected every third day at ten stations; on 13 March 1975, the schedule was altered to coincide with the federal, state and city schedule (NASN schedule). The filters collected for the month of February were not analyzed because old filters from a previous task were used. The new batch of filters had not been received from the EPA soon enough to complete the pre-weighing and shipment to St. Louis by 12 February 1975.

2.1 PERSONNEL ACQUISITION AND TRAINING

Implementation of the support services required by Task Order No. 51 was performed by two full-time technicians who also supported two other field sampling task orders. At the time work began on this task order, the required skilled personnel were available from other programs being phased out. Both operators had previous experience operating high volume samplers. Since the RAMS computer system was used to control operation of the high volume samplers and flow data acquisition, additional training was required in this area.

Also, new solid state automatic flow controllers were used with the high volume samplers thereby requiring more operator training.

2.2 HIGH VOLUME SAMPLER NETWORK

An all metal filter holder was used in the installation and removal of the samples. The exposed filter was removed inside the shelter and the appropriate entires made on the Daily Hi-Vol Data Record (Figure 1), and the Total Particulate Raw Data Card (Figure 2). The exposed filter was placed in a manila folder and put into an envelope along with the Data Record Cards. The collected samples were later returned to the RAPS office where they were recorded in a high volume sampler record book. On 19 January 1976, a new system for recording filter data was initiated. The new system incorporated the Particulate Raw Data Record and the manila folder into one unit. The combined folder and Raw Data Record consisted of the folder with three copies of the Raw Data Record attached to the folder. When data were recorded on the first sheet, it was transferred to the other sheets and the folder. When the exposed filters were analyzed, three copies of the Raw Data Record were returned to the RAPS St. Louis facility for their records.

Prior to April 1976, flow rate data were not sent with the exposed filters. The filters were analyzed at the chemistry lab in California after which the raw analyses were sent back to the St. Louis facility where the flow rate data were merged with the raw analyses in the RAMS computer. The output from the RAMS computer resulted in a printout of concentrations and a magnetic tape in SAROAD format. During the month of March 1976, a new method for reporting filter data and filter validation was conceived. The new reporting system resulted in the printout and magnetic tape being produced at the time the filter analyses were performed. This was accomplished because all the necessary information was placed on the new Total Suspended Particulates form. The printout of high volume data for each site contained the following information:

EPA (DL:) 202

DAILY HI-VOL DATA RECORD

City & State _____

Year 19 __ __ Site Number _____ _____ _____ _____

Type of Sampler: Regular _____

Other _____

Sampler Serial Number ____ ____ ____ ____ ____

Filter Number ____ ____ ____ ____ ____

						FOR LAB USE ONLY
Time Start	____	____	____	____	____	(__ __)
	mo.	day	hr	min	CFM	CFM
Time Stop	____	____	____	____	____	(__ __)
	mo.	day	hr	min	CFM	CFM

Total Minutes Sampled _____ _____ _____ _____

FIELD NOTES:

_____

_____

_____

SIGNATURES:

Sample On: _____

Sample Off: _____

For lab use only:

PARTICULATE DATA

Gross Wgt.-Filter _____ _____ . _____ ___ ___ (grams)

Tare Wgt.-Filter _____ _____ . ___ ___ ___ ___ (grams)

Particulate Wgt. _____ _____ . ___ ___ ___ ___ (grams)

ORGANIC DATA

Tube & Sample _____ _____ . ___ ___ ___ ___ (grams)

Tube Tare Wgt. _____ _____ . ___ ___ ___ ___ (grams)

Wgt. of Extract _____ _____ . ___ ___ ___ ___ (grams)

Total Wgt. (9 x 2) _____ _____ . ___ ___ ___ ___ (grams)

CUT

FIGURE 1. DAILY HI-VOL DATA RECORD

TOTAL SUSPENDED PARTICULATES

FMT.	2	1	(1-2)	
SITE				(3-6)

NOTE: X 0 - COMPUTER, 1 - MANUAL; * 0-REG., 1-DUP.

	DATE YR	DATE MO	DATE DAY	TIME	FLOW (m^3/m)	
START						(7-19)
STOP						(20-32)

X	*	STATUS CODE	MOTOR SERIAL NO.	FILTER NO.	
					(33-47)

FLOWMETER SERIAL NO.	ANALYSIS DATE YR	ANALYSIS DATE MO	ANALYSIS DATE DAY	
				(48-58)

LAB. ANALYSIS	C.C.	TYPE OF ANALYSIS	
	(59-63)	SAMP. + TARE WT. (mg.)	
	(64-68)	TARE WT. (mg.)	
	(69-73)	NO_x WT. (mg.)	VALIDATION CODE
	(74-78)	SO_x WT. (mg.)	0 0 (79-80)

EPA(DUR)328

CITY:

JULIAN STOP DATE:

METER FLOW OBSERVED

START _____ (m^3/m)

STOP _____ (m^3/m)

FIELD COMMENTS:

ON BY:

OFF BY:

LAB. COMMENTS:

ANALYZED BY:

FIGURE 2. TOTAL PARTICULATE RAW DATA CARD

1. Julian date - start and stop
2. Start time - stop time
3. Filter number
4. Start weight - stop weight (of filter)
5. Flow in cubic meters
6. A four digit code, having the following meaning

FIELD		CODE	MEANING
Raw data card	SAROAD		
33	70	0	Flow controlled operation
		1	Manually set operation
34	71	0	Normal operation--24 hour data
		1	Interrupted operation--less than 24 hours
		2	Interpolated data; 24 hour operation, but some computer entries missing
35-36	72-73	00	Normal 24 hour operation
		XX	Hours of operation, if code in field 34 and 71 is 1
		XX	Interpolated hours, if code in field 34 and 71 is 2

7. Total suspended particulates (TSP) in mg on filter; concentration in μg/ml; airborne concentration in $\mu g/m^3$.
8. Sulfate - same units
9. Nitrate - same units
10. Comments

The constant flow circuit of the controller was connected before the start of sampling scheduled for 19 January 1976. The controls were set to yield flows of approximately 1.27 m^3/min. at all stations except to sampler No. 2 at RAMS site 118. The output voltage at 1.27 m^3/min. was at the upper limit of 5 volts that could be measured by the station's data acquisition system. The flow for sampler No. 2 at RAMS site 118 was set for approximately 0.91 m^3/min.

Programs were written for the RAMS data acquisition system to convert the average total flows which were in cfm to cubic meters. With the addition of this information on the flow data printout sheets all manual computations were eliminated. The flows were entered on the raw data cards sent to the chemistry lab. The flow data printout information seemed to indicate that the constant flow controllers maintained a constant flow through the filters for all practical purposes.

In March 1976 a protective device was designed to keep birds from using the high volume shelter as a nesting and roosting site. Sparrows seemed to give the most trouble. No trouble was experienced with the birds in populated areas. Several methods had been tried in the past to protect the samplers, including toy snakes. The snakes were successful for only a short time until the birds would actually physically remove them or build nests beside them. The newly designed device consisted of an aluminum frame with a 15.9 mm mesh plastic net material draped over the frame. This device proved to be the only means for effectively protecting the samplers from the birds.

During the month of August 1976 extra high volume filters were sampled by running the spare sampler on four consecutive sampling days with the regular sampler. At the end of the sample period the extra high volume filters were treated with NH_3. Before the filters were removed the sampler was turned on and approximately 150 cc of NH_3 was released over the filter. These filters and five blanks were given to the EPA Task Coordinator to be analyzed at Research Triangle Park.

Occasionally flow data would be lost in the data acquisition for no apparent reason. Careful investigation by RAMS personnel indicated losses usually occurred when the minicomputer malfunctioned and had to be reprogrammed. The high volume sampler would continue to run after the computer malfunctioned but if for some reason it had to be reprogrammed the sampler motor would be stopped and would not start again until it received a command from the computer. Two "start" commands were available to the operator, (1) an abbreviated command, requiring few instructions and (2) a longer command requiring about twice as many instructions. It was discovered that when the abbreviated command was used the data loss would sometimes occur, though not always, but would never occur when the longer command was used. When this glitch was

identified, the longer command was the only one used to restart a sampler.

RAMS site 124 was deactivated in February 1977. The remaining network continued to operate normally until the close of business on 31 March 1977, after which time the samplers were removed from the shelter roofs and stored inside the shelters.

During the period of performance of the sampling network 2,358 filters were collected out of a possible 2,456 for collection efficiency of 96%. The collection efficiency by station is presented in Table 1. Tables 2 and 3 present a compilation of the most prevalent sampler and non-sampler related malfunctions experienced during the life of the network.

2.3 EQUIPMENT MAINTENANCE

During scheduled visits to each station for sample collection, sampler systems were inspected and preventative maintenance performed as required. Motor brush replacement proved to be the biggest maintenance item. A table was constructed for each sampler indicating all maintenance required. The table was used to project the expected date of brush replacement. It proved to be superior to the usual practice of changing brushes after a fixed number of hours of operation because each sampler motor exhibited its own peculiar characteristics. During preventative maintenance periods, it became apparent that periodic checks for leaks should be performed. Leaks in the system will give a false flow output voltage reading because the feedback circuit controlling the flow would compensate for the leak. The output voltage was a function of the sample flow through the filter.

For the lifetime of the sampling network, seventy-five sets of motor brushes, five solid state a.c. relays, and two sampler motors were replaced and ten constant flow controllers were repaired at the Rockwell International Air Monitoring Center in St. Louis.

2.4 SAMPLE ANALYSIS

Total suspended particulates were determined gravimetrically from the weights of the glass fiber filters before and after sampling on a Mettler H20 analytical balance. Gnats and/or other insects embedded in the particulate matter were removed with Teflon-tipped tweezers, being careful not to

TABLE 1. HIGH VOLUME FILTER MEASUREMENTS OF SUSPENDED PARTICULATE MATTER-SYSTEM PERFORMANCE 1975-1977

RAMS Station	Sample Period (Hours)	Total Possible Samples	Total Samples Collected	Total Samples Failed	Total Failures Due to Sampler Malfunction	Total Failures Due to Miscellaneous Causes	Per Cent Failures Due to Sampler Malfunction	Per Cent Failures Due to Miscellaneous Causes	Station Efficiency
103	24	247	240	7	5	2	2.02	0.81	97.17
105	24	247	243	4	2	2	0.81	0.81	98.38
106	24	247	236	11	5	6	2.02	2.43	95.55
108	24	247	239	8	4	4	1.62	1.62	96.76
112	24	247	235	12	5	7	2.02	2.83	95.14
115	24	247	238	9	4	5	1.62	2.02	96.36
118	24	247	236	11	4	7	1.62	2.83	95.55
120	24	248	231	17	4	13	1.62	5.24	93.15
122	24	247	242	5	1	4	0.40	1.62	97.98
124*	24	232	218	14	3	11	1.29	4.74	93.97
TOTAL		2456	2358	98	37	61			

* RAMS Station De-Activated 14 February 1977

TABLE 2. FAILURES BY SAMPLER MALFUNCTION

CAUSES	NUMBER	PERCENT
Brushes	24	64.86
Flow Controller	8	21.62
Relay	4	10.81
Motor	1	2.70

TABLE 3. NON-SAMPLER FAILURES

CAUSES	NUMBER	PERCENT
Computer	37	60.65
Various Misc.	17	27.87
Station Power	4	6.56
Thunderstorm	3	4.92

displace any more of the particulate matter than necessary. If the number was greater than 10, a report to a supervisor was made for a decision on whether to accept or reject the sample. Filters were weighed to the nearest milligram. The exposed filter weight was recorded in the laboratory logbook and on the filter folder. All documentation was checked and compared for completeness and accuracy. The exposed filter was also inspected for signs of air leakage or physical damage. When accuracy of documentation was assured, the difference between the two weights gave the total suspended particulates.

A 19 x 200 mm filter strip was cut from the center of the exposed glass fiber high volume filter using a Honeywell-Nikor paper cutter equipped with spring loaded stops to provide a 19 mm cut. The strip folded in four was placed in a 125 ml Erlenmeyer flask, 30 ml distilled H_2O was added, and the solution was refluxed for thirty minutes. After that, the heat was turned off and when the boiling stopped, the inside surfaces of the condenser and adaptor were rinsed down from the upper opening of the condenser with small amounts of distilled water. Finally, the Erlenmeyer, while it was still warm, was disconnected from the condenser and the aqueous extract was filtered through Whatman No. 41 filter paper into a 50 ml volumetric flask. The filter strip which remained in the Erlenmeyer was washed at least 5 times with small amounts of distilled water and the washings were filtered through the same paper into the 50 ml volumetric flask. The solution was then diluted to volume with distilled water. An aliquot of the solution was transferred from the volumetric flask to a capped culture tube and was placed in a refrigerator until time for analysis. The samples were usually analyzed within three days of extraction. This was the method used to extract water soluble sulfates and nitrates.

Sulfate and nitrate were determined from the same sample using a two-channel Technicon Autoanalyzer II. For this, the two channels were connected with the sampler by means of a sampler splitter, through which the appropriate volume of sample required for each analysis was transferred into the analytical cartridges. In this way, the determination of sulfate and nitrate was performed simultaneously from the same solution. Calibration curves were obtained using mixed standards containing sulfate and nitrate ions.

The sulfates were analyzed by the methylthymol blue (MTB) method and were based on the spectral difference which exists in basic solutions (ph 12.5-13.0), between the barium complex of MTB and the free MTB.

The nitrate extracted from the exposed filter was reduced to nitrite by a copperized-cadmium reductor column and was reacted with sulfanilamide in an acidic solution to form a diazo compound. This compound was then coupled with an N-1-naphthyl ethylenediamene dihydrochloride for form a reddish-purple azo dye which was determined spectrophotometrically at 560 nm.

While the network collection rate was 96%, the valid data capture rate was 88% because filters were invalidated as a result of bird damage (excrement and scratches) and questionable flow data from the data acquisition system.

2.5 QUALITY ASSURANCE

High volume filters were Government Furnished Equipment (GFE) and were inspected, numbered and weighed before and after each sample collection at the RIAMC laboratory utilizing the Community Health Air Monitoring Program (CHAMP) procedures. Each filter was visually inspected with the aid of a light table and all filters with pinholes, tears, creases or lumps were discarded. A serial number was assigned to each filter and stamped on two diagonally opposite corners, one stamp on each side of the filter. The filters were equilibrated in a conditioned environment with the average temperature between 20°C and 25°C and a relative humidity maintained at about 35-40 percent for 24 hours before weighing. The temperature and relative humidity of the room was monitored continuously. The numbered filters were recorded in a logbook. The number was rechecked after weighing and the weight of the filter corresponding to that filter number was also checked again. The balance was checked on a daily basis, using a standard weight in the same mass range as the samples. The standard was one that was traceable to the National Bureau of Standards (NBS) and was recertified on an annual basis. When possible, filters were numbered and weighed in quantities sufficient for at least a three month sampling period. The inspected filters were shipped to the St. Louis Air Monitoring Center where they were stored in an environment of approximately 23°C and 40% relative humidity until placed in the sampler for exposure. After exposure, the filters were returned to the

controlled environment until shipment back to the analytical laboratory. The filters were in a controlled environment at all times except while installed in the sampler and during transit.

Quality assurance checks for mass determination for both exposed and unexposed filters were done for 10% of the filters. The selection of the filters for the quality assurance check was done on a random basis and by a different operator from the one that originally had weighed the filters. All the quality check values were recorded in the balance logbook and were used for the construction of quality control charts. In addition to the temperature and humidity controlled weighing room, a large desiccating chamber was used to condition the exposed filters before weighing. The humidity of the chamber was maintained at about 35-40% by using solid desiccants such as SiO_2.

All inorganic reagent chemicals used during the analyses were from reputable manufacturers and were ACS reagent grade with the analysis given on the bottle. Where the concentration of impurities in the reagents was high enough to interfere, an ultra-pure grade of chemical was used. After each lot of each chemical had been characterized and found to be satisfactory, they were used until the supply was reduced by approximately 80%. Solutions were made from the new chemicals and compared with the analytical results of the old chemicals to insure that no differences existed between the different lots of chemicals.

When new chemical solutions had to be prepared for the analytical procedure, even though the same (previously tested) bottle of chemical was used, a careful comparison of analytical results obtained with the two solutions were made. This was done by running three standards and three samples with both reagents. All bottles of reagent solutions not currently in use with the Technicon Autoanalyzers were stored in a refrigerator in dark or covered bottles to prevent possible deterioration. This also included stock solutions of all standards.

The Technicon Autoanalyzer II, which was used for the determination of sulfates and nitrates, was calibrated against synthetic standard solutions. Five point calibration plots were run at the beginning and at the end of each batch of samples. Four different control samples were used to monitor

the performance of the instrument during the run. The first control sample was an aqueous extract which had been analyzed in the previous tray. The second was a blank which had been spiked with known amounts of sulfate and nitrate once a week. The third was a standard solution and the fourth was a duplicate exposed strip which occasionally was spiked with known amounts of sulfate and nitrate. Control samples unknown to the operator but known to a supervisor were used once a week. The latter was either a spiked sample or a standard solution.

A 10-point calibration was used to calibrate each sampler. Once calibrated and set for a specific flow rate, each sampler's output voltage was noted and routinely checked each time a filter was placed in the sampler and also each time a station was visited and a sampler was running. If and when a ±5% variation in voltage was noted, the sampler was recalibrated with the 330 Top-Loading Orifice Calibrator and a water manometer. The manufacturer claims that once calibrated and set for a specific flow rate, the Model 310 would maintain the flow rate constant at that level for at least a six month period. Routine calibration checks seemed to bear out that claim. However, after the first six months of operation, calibrations were performed approximately every three months and routine spot checks were made monthly with the calibration equipment. The results of the calibrations, spot checks and the percent differences were reported in the monthly progress reports.

As part of the quality control program, the EPA Quality Assurance Branch (QAB) sent RIAMC unknown samples to be analyzed during their routine determination of pollutant concentrations in air samples. The number and type of quality control samples sent to RIAMC are given in Table 4.

Table 4. Quality Control Samples Sent to RIAMC

Pollutant	Sample Matrix	Number of Samples in a Set	Frequency
Sulfate	Glass fiber filter	10	Weekly
Nitrate	Glass fiber filter	10	Weekly

The sulfate blind samples analyzed by RIAMC during the period from April 1975 to March 1976 were all from the same lot. The amount of sulfate in the quality control (QC) samples was determined from the gravimetric preparation of the samples by a contractor and verified by QAB analysis.

A summary of the accuracy and precision of the RIAMC sulfate analysis over the time period is given in Table 5. Except for the lowest level, RIAMC sulfate mean results are within ±8% of the spike. The higher percentages at the lowest levels probably result from fluctuations in the blank response which also effect the lower sulfate levels. The mean range is the mean of the range of results for each week for the sample level being analyzed.

The only analytical problem encountered during these analyses was the high chloride blank value. St. Louis blank filter strips were extracted during the start of sampling for Cl^-. The average concentration of chloride for the blank (1/12 of filter diluted to 50 ml) was 4.38 ± 0.60 ppm. Using regular scale, 12 ppm was full scale, and the blank at 33% of full scale, was as high as many samples. Though Cl^- analysis was not required by this task order, the analysis was attempted as it was trivial to perform in conjunction with the other analyses done on the sample. Because of the high background, the results were considered of limited usefulness and not reported in this task order.

Nitrate was spiked on the same filters that were analyzed for sulfate. Thus, the frequency and number of samples analyzed were identical to the sulfate schedule. As was the case for sulfates, most of the largest percent differences occurred in the lowest nitrate levels. A summary of the accuracy and precision of RIAMC nitrate analysis is given in Table 6.

For the period from March 1976 to October 1976, Table 7 summarizes the RIAMC blind sulfate analytical results according to spike level. For samples spiked with 500 to 6500 μg $SO_4^=$ per strip (3 to 32 μg/m^3) RIAMC recoveries ranged from 101% to 96% while the precision, measured by the coefficient of variation (CV) ranged from 1% to 6%. The sample containing 5500 μg $SO_4^=$ shows 107% recovery, but the sample was later found to be manufactured incorrectly. Half the filters in this batch were spiked at 5500 μg while the other half was spiked at 6875 μg. Therefore, the 107% recovery and the large CV in

TABLE 5. SUMMARY OF RIAMC ANALYSIS OF BLIND SULFATE QC SAMPLES, APRIL 1975 TO MARCH 1976

Sample (μg SO_4)	RIAMC Mean (μg SO_4)	% Difference	Mean Range	% Mean Range
181	264	+ 46	35.0	13
477	513	+ 8	36.7	7
752	749	0	44.3	6
1508	1428	- 5	30.5	2
2373	2240	- 6	48.5	2
3857	3627	- 6	53.8	1
5078	4777	- 6	115.0	2
6417	6021	- 6	131.6	2

TABLE 6. SUMMARY OF RIAMC ANALYSIS OF BLIND NITRATE QC SAMPLES, APRIL 1975 TO MARCH 1976

Sample (μg NO_3)	RIAMC Mean (μg NO_3)	% Difference	Mean Range	% Mean Range
92	52	- 43	17.0	33
229	188	- 18	16.0	9
476	392	- 18	25.6	7
679	615	- 9	30.0	5
884	839	- 5	21.4	3
1116	1043	- 7	25.4	2
1381	1352	- 2	24.5	2
1608	1562	- 3	25.7	2

TABLE 7. SUMMARY OF RIAMC ANALYSIS OF BLIND SULFATE QC SAMPLES, MARCH 1976 to OCTOBER 1976

Spike Values	AVE Results	Std. Dev.	AVE Range	% Recovery AVE/Spike 100	CV Std. Dev./AVE 100	N
.00	168.81	.00	.00	.00	.00	31
200.00	318.80	36.96	57.60	159.40	11.59	15
250.00	319.00	39.65	59.40	127.60	12.43	15
405.00	465.53	37.70	66.00	114.95	8.10	18
498.00	502.07	54.74	63.60	100.82	10.90	15
650.00	653.53	36.77	51.40	100.54	5.63	15
746.00	740.40	32.81	63.80	99.25	4.43	15
1400.00	1341.73	45.36	83.80	95.84	3.38	15
1725.00	1694.40	37.65	69.60	98.23	2.22	15
1737.00	1720.47	24.04	35.80	99.05	1.40	15
2400.00	2309.83	93.62	153.83	96.24	4.05	18
2670.00	2633.33	43.40	84.40	98.63	1.65	15
3588.00	3490.20	63.26	107.00	97.27	1.81	15
4240.00	4127.33	74.48	126.00	97.34	1.80	15
4600.00	4457.40	89.68	116.80	96.90	2.01	15
5500.00	5899.39	705.96	1273.00	107.26	11.97	18
5694.00	5642.93	93.80	138.40	99.10	1.66	15
6300.00	6079.93	141.93	192.60	96.51	2.33	15
6549.00	6413.13	72.03	143.80	97.93	1.12	15

Table 7 are due to incorrect filters rather than analytical variability.

Table 8 summarizes the RIAMC blind nitrate analytical results according to spike level. RIAMC obtained recoveries of 93% to 100% for samples which contained 300 μg NO_3^- to 2000 μg NO_3^- (1.5 μg/m^3 to 10 μg/m^3) and precisions measured by the CV between 1% and 6%. Below 300 μg (6 μg NO_3^-/ml in filter extract) both recoveries and precision are much worse.

RIAMC developed a more sensitive nitrate and sulfate procedure for the recovery of low levels of spiked extracts. When spiked extracts were analyzed by both the routine and sensitive procedures, an improvement in both precision and recovery was achieved with the sensitive method.

Replicate analyses of selected sample filters were also used as part of the quality control program. The samples selected for the check were picked by the Task Order Coordinator. Tables 9 through 11 present the results of checks for 1975 and 1976. However, particulate deposits and blank value may be non-uniform as a function of position on the filter. TSP data were checked and verified in every case.

TABLE 8. SUMMARY OF RIAMC ANALYSIS OF BLIND NITRATE QC SAMPLES, MARCH 1976 TO OCTOBER 1976

Spike Values	AVE Results	Std. Dev.	AVE Range	% Recovery AVE/Spike 100	CV Std. Dev./AVE 100	N
.00	13.42	.00	.00	.00	.00	31
91.00	56.40	13.71	13.00	61.98	24.30	15
110.00	30.87	13.88	20.80	28.06	44.97	15
173.00	148.93	9.03	10.80	86.09	6.06	15
200.00	174.78	43.62	68.33	87.39	24.96	18
347.00	322.12	9.88	16.00	92.83	3.07	15
400.00	373.53	21.44	21.60	93.38	5.74	15
575.00	559.40	15.34	27.40	97.29	2.74	15
700.00	650.53	32.72	55.20	92.93	5.03	15
850.00	776.50	49.89	55.33	91.35	6.42	18
894.00	869.13	24.90	41.80	97.22	2.86	15
1000.00	993.60	22.39	24.40	99.36	2.25	15
1036.00	1006.93	11.42	17.80	97.19	1.13	15
1273.00	1243.07	19.53	33.40	97.65	1.57	15
1400.00	1346.47	74.65	89.40	96.18	5.54	15
1597.00	1537.87	27.58	52.20	96.30	1.79	15
1600.00	1543.58	67.84	67.83	96.47	4.39	18
1878.00	1799.87	26.76	43.20	95.84	1.49	15
3500.00	3501.87	44.15	85.40	100.05	1.26	15

TABLE 9. SUMMARY OF RIAMC REPLICATE ANALYSIS OF SELECTED SAMPLES - 1975

Station	Exposure Date	$SO_4^=$ µg/ml First Analysis	$SO_4^=$ µg/ml Second Analysis	$SO_4^=$ Percent Difference	NO_3^- µg/ml First Analysis	NO_3^- µg/ml Second Analysis	NO_3^- Percent Difference
106	9 September	55.22	51.03	- 8.2	14.85	13.34	- 11.3
108	26 December	40.31	41.41	2.7	10.69	11.00	2.8
112	11 July	23.01	21.86	- 5.3	12.27	12.12	- 1.2
112	26 November	75.42	36.84	-104.7	32.77	16.09	-103.7
118	22 August	62.18	63.70	2.4	1.25	0.87	- 43.7*
120	16 August	68.72	64.39	- 6.7	5.98	4.98	- 20.1*
122	22 March	26.32	25.83	- 1.9	27.04	26.84	- 7.5
122	26 June	211.95	213.15	5.6	0.39	0.71	- 45.1*
122	3 October	28.62	28.01	- 2.2	12.19	11.87	- 2.7
124	11 December	33.23	34.46	3.6	6.93	6.37	- 8.8

*These concentrations are below the limit for precise, accurate determination.

TABLE 10. SUMMARY OF RIAMC REPLICATE ANALYSIS OF SELECTED SAMPLES - 1976

Station	Exposure Date	$SO_4^=$ µg/ml First Analysis	$SO_4^=$ µg/ml Second Analysis	$SO_4^=$ Percent Difference	NO_3^- µg/ml First Analysis	NO_3^- µg/ml Second Analysis	NO_3^- Percent Difference
103	23 December				2.8	4.3	34.9*
105	17 December	20.4	22.2	8.1			
106	3 February	91.6	87.6	-4.6	0.0	0.0	0.0
108	24 September	11.3	10.4	-8.7	5.7	5.9	3.4
108	30 October				7.5	7.5	0.0
112	17 July	15.8	15.0	-5.3			
112	2 December				15.1	15.9	5.0
115	25 August	83.3	77.7	-7.2	0.0	0.0	0.0
118	25 August	104.3	102.1	-2.1	0.0	0.0	0.0
118	24 September				11.3	10.0	-13.0
120	24 September				11.4	9.8	-16.3
122	25 August	84.8	82.8	-2.4	0.0	0.0	0.0
122	21 October	12.0	12.2	1.6	6.5	6.0	- 8.3
124	1 January	24.9	23.7	-5.1			
124	19 August	46.5	45.6	-2.0	0.3	0.4	25.0*
124	25 August	95.5	89.7	-6.5	0.0	0.0	0.0

*These concentrations are below the limit for precise, accurate determination.

TABLE 11. SUMMARY OF RIAMC REPLICATE ANALYSIS OF SELECTED SAMPLES - 1977

Station	Exposure Date	$SO_4^=$ µg/m^3 First Analysis	$SO_4^=$ µg/m^3 Second Analysis	$SO_4^=$ Percent Difference	NO_3^- µg/m^3 First Analysis	NO_3^- µg/m^3 Second Analysis	NO_3^- Percent Difference
103	27 February	3.56	4.02	11.4	0.13**	0.32*	59.4
105	27 February	5.27	5.11	- 3.1	2.63	2.82	6.7
105	28 March	5.27	5.22	- 1.0	2.63	2.82	6.7
106	28 January	5.53	5.49	- 0.7	1.10**	1.21**	9.1
120	28 March	3.00**	5.09	41.1	2.36	2.67	11.6
122	3 February	6.61	6.72	1.6	6.80	6.99	2.7
122	6 February	3.84	4.07	5.7	4.95	5.18	4.4
122	18 February	6.88	6.19	-11.1	7.63	7.78	1.9
122	27 February	----	6.69*	- 6.1	----	4.33	5.7
122	27 February	7.11	6.28	-13.2	4.09	4.14	1.2

*Duplicate strip analyzed at time of second analysis.

**Exposure level is low, 10% analytical precision is not achieved.

3.0 DATA SUMMARY

All reduction of continuous data was performed at the RAPS central computing facility and recorded on magnetic tape in SAROAD format. Output signals from each high volume sampler's flow controller were fed into the RAMS station computer where they were read every one-half second and averaged every sixty seconds. These data were then transmitted back to the central computer facility where subsequent operations transformed the high volume flow through the filters into cubic meters. The flow data in cubic meters were sent to the analytical laboratory with the exposed high volume filter and after the filters were analyzed, the data were returned on magnetic tape in micrograms per cubic meter ($\mu g/m^3$).

3.1 TOTAL SUSPENDED PARTICULATES (TSP)

The arithmetic mean and standard deviation, and the geometric mean and standard deviation for 1975, 1976 and the first quarter of 1977 are presented in Table 12 for the ten monitoring stations. The Federal Air Quality Standard for the annual geometric mean for TSP is 75 $\mu g/m^3$. The annual geometric means of the network for 1975, 1976 and the first quarter of 1977 are also presented graphically in Figure 3. Stations 103 and 105 exceeded the Federal Standard for 1975 and 1976. Station 105 was slightly above the standard for the first quarter of 1977. There was a slight increase in 1976 over the 1975 mean at every station except at stations 112, and 120, which showed a slight decrease.

3.2 SULFATES ($SO_4^=$), NITRATES (NO_3^-)

There are no Federal Air Quality Standards for particulate sulfates or nitrates at this time. Table 13 presents the arithmetic mean and standard deviation, geometric mean and standard deviation for sulfates for 1975, 1976 and the first quarter of 1977. The annual geometric means for sulfates are plotted in Figure 4 and show a decrease in the annual mean for all stations

TABLE 12. TOTAL SUSPENDED PARTICULATES (TSP) $\mu g/m^3$

RAMS Stations	103	105	106	108	112	115	118	120	122	124
Year-1975										
A Mean	97.0	85.3	77.2	83.0	81.7	57.7	65.8	69.6	51.1	56.4
A Std. Dev.	36.3	30.1	34.3	35.6	45.4	25.0	35.7	42.0	29.2	53.0
G Mean	90.5	80.4	69.9	74.5	71.7	52.7	57.2	59.7	44.7	45.4
G Std. Dev.	1.5	1.4	1.6	1.7	1.7	1.5	1.8	1.7	1.7	1.8
Year-1976										
A Mean	99.4	89.8	79.6	90.9	79.8	60.0	68.1	54.1	59.8	54.6
A Std. Dev.	44.5	35.6	35.2	56.7	51.0	27.7	32.8	22.6	43.3	31.2
G Mean	90.0	83.3	73.3	77.8	69.9	54.4	61.4	50.2	52.0	48.0
G Std. Dev.	1.5	1.5	1.5	1.7	1.6	1.5	1.9	1.5	1.6	1.7
Year-1977*										
A Mean	71.4	81.7	69.2	71.3	56.7	44.8	43.0	49.9	38.2	34.3
A Std. Dev.	33.4	33.5	36.6	50.5	28.9	24.1	14.2	26.5	22.0	9.5
G Mean	62.5	75.7	62.6	59.3	51.4	39.8	41.1	44.9	33.6	33.0
G Std. Dev.	1.8	1.5	1.5	1.8	1.5	1.6	1.4	1.7	1.6	1.3

*1977--First Quarter Only

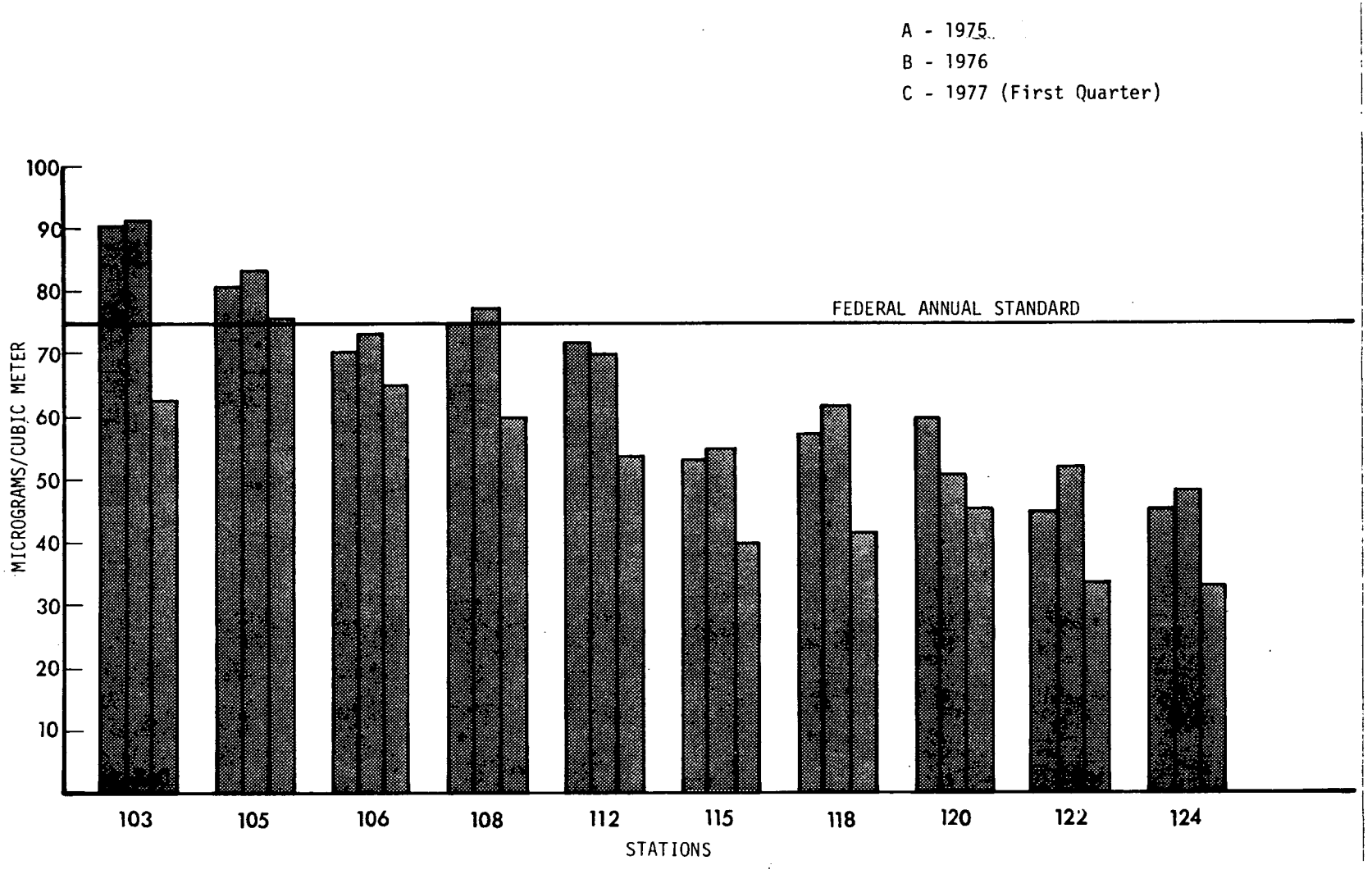


FIGURE 3. TOTAL SUSPENDED PARTICULATES (TSP) - ANNUAL GEOMETRIC MEANS

TABLE 13. SULFATES ($SO_4^=$) $\mu g/m^3$

RAMS Stations	103	105	106	108	112	115	118	120	122	124
Year-1975										
A Mean	13.1	12.5	13.8	14.5	13.1	12.7	10.9	13.9	11.9	11.6
A Std. Dev.	6.6	6.1	8.7	7.6	8.4	7.9	6.2	11.1	9.5	9.2
G Mean	11.7	11.3	12.0	12.7	11.1	11.1	9.7	11.4	9.8	9.8
G Std. Dev.	1.6	1.6	1.7	1.7	1.7	1.6	1.6	1.8	1.8	1.7
Year-1976										
A Mean	13.3	12.6	11.9	13.7	11.7	11.0	11.7	10.3	11.4	10.3
A Std. Dev.	8.7	7.9	7.6	11.1	8.0	6.0	7.8	7.1	8.4	6.4
G Mean	11.6	10.0	10.3	11.3	10.0	9.8	10.2	8.8	9.6	9.1
G Std. Dev.	1.6	1.7	1.7	1.8	1.7	1.8	1.7	1.7	1.7	1.6
Year-1977*										
A Mean	10.1	9.7	8.3	10.2	7.9	8.5	8.2	7.4	8.0	8.3
A Std. Dev.	3.8	4.8	2.8	3.9	2.6	3.4	2.3	2.6	2.6	2.4
G Mean	9.5	8.9	7.9	9.6	7.5	8.1	7.9	7.0	7.6	8.0
G Std. Dev.	1.5	1.5	1.4	1.4	1.3	1.4	1.3	1.4	1.4	1.3

*1977--First Quarter Only

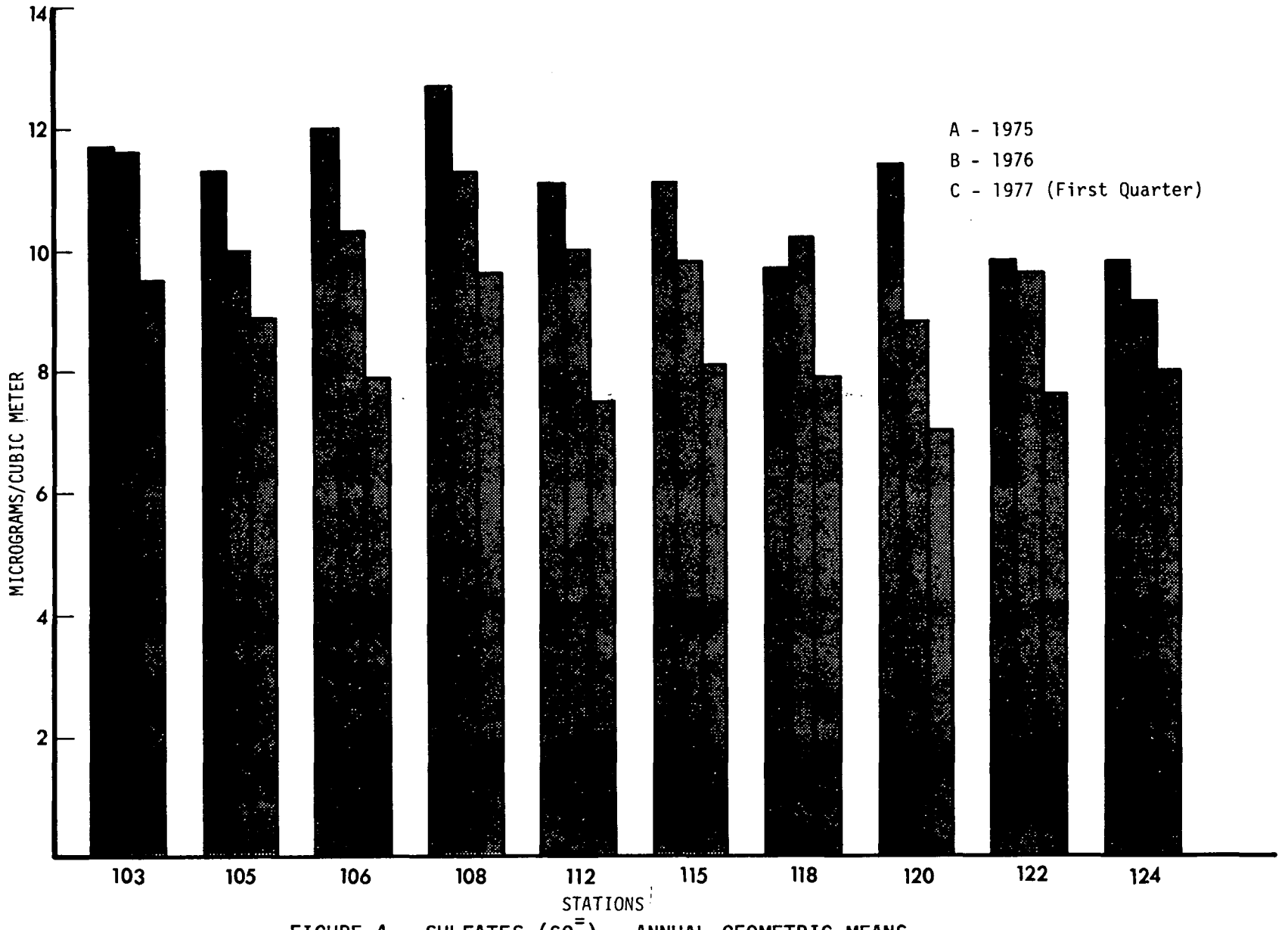


FIGURE 4. SULFATES ($SO_4^=$) - ANNUAL GEOMETRIC MEANS

except station 118. Sulfates appear to be fairly well distributed throughout the area under test.

The arithmetic mean and standard deviation for nitrates is presented in Table 14 for 1975, 1976 and the first quarter of 1977. The annual geometric means for nitrates are presented in Figure 5 and show an increase for stations 103, 105, 106, 115, 118, and 122 in 1976 and 1975. During the same period, stations 108, 112, 120, and 124 had a decrease.

3.3 FREQUENCY DISTRIBUTION - TSP, $SO_4^=$, NO_3^-

Figure 6 presents the geographical location of all the RAMS stations and Table 15 describes the immediate area surrounding each station. The high volume stations were located in both urban and non-urban localities. Tables 16, 17, and 18 present TSP, $SO_4^=$, and NO_3^- frequency distributions for RAPS high volume samples. These tables contain values not only for the complete twenty-four hour samples, but also for samples terminated prematurely.

It may be noted from Table 16, that for TSP, the urban stations had fewer filter loadings of less than 25 $\mu g/m^3$. All stations are more closely grouped in the 50 to 100 $\mu g/m^3$ range. At the highest range, > 200 $\mu g/m^3$, all stations have a fair representation. The heavy loading for the non-urban stations, in part, probably resulted from activities related to harvesting of grain or other agricultural activities.

Table 17 presents the frequency distribution for $SO_4^=$. The two groups of stations follow pretty much the same pattern for $SO_4^=$ as they did for TSP for the lightest loadings. The stations are more closely grouped for loadings between 5 and 20 $\mu g/m^3$. At the high end of the range, > 40 $\mu g/m^3$, the representation is again fairly equal for both groups. However, agricultural activity cannot explain this phenomena. The NO_3^- distribution is shown in Table 18 and here the differences between the two groups are not as well defined as they are for TSP and $SO_4^=$.

3.4 ANNUAL MAXIMUM FILTER LOADINGS

Tables 19, 20, and 21 show the maximum filter loadings for TSP, $SO_4^=$, and NO_3^- and the dates on which the maximum loadings occurred, only for complete twenty-four samples. It may be noted that in no instance did the maximums for all three particulates occur on the same date.

TABLE 14. NITRATES (NO_3^-) $\mu g/m^3$

RAMS Stations	103	105	106	108	112	115	118	120	122	124
Year-1975										
A Mean	3.6	4.1	3.7	4.1	3.6	3.2	2.7	4.3	3.2	3.1
A Std. Dev.	2.4	2.4	2.6	2.6	2.1	1.7	1.6	2.5	2.1	1.9
G Mean	2.9	3.5	3.0	3.4	3.1	2.6	2.3	3.5	2.5	2.6
G Std. Dev.	1.9	1.7	2.1	1.9	1.8	2.2	1.9	1.9	2.2	1.9
Year-1976										
A Mean	3.9	4.0	3.5	3.7	3.4	3.4	3.1	3.2	3.7	2.9
A Std. Dev.	2.0	2.1	2.1	2.2	1.8	1.7	1.8	1.8	2.4	1.7
G Mean	3.5	3.6	3.1	3.1	3.0	3.0	2.6	2.8	3.2	2.4
G Std. Dev.	1.7	1.6	1.7	1.9	1.7	1.6	1.9	1.7	1.7	1.9
Year-1977*										
A Mean	3.8	4.3	3.6	4.3	3.7	4.0	3.7	3.8	3.9	3.9
A Std. Dev.	1.8	1.9	1.8	2.0	1.9	1.9	1.6	1.6	1.7	2.0
G Mean	3.1	3.8	3.1	3.8	3.3	3.6	3.3	3.4	3.5	3.3
G Std. Dev.	2.2	1.7	1.8	1.7	1.7	1.7	1.7	1.6	1.7	1.9

*1977--First Quarter Only

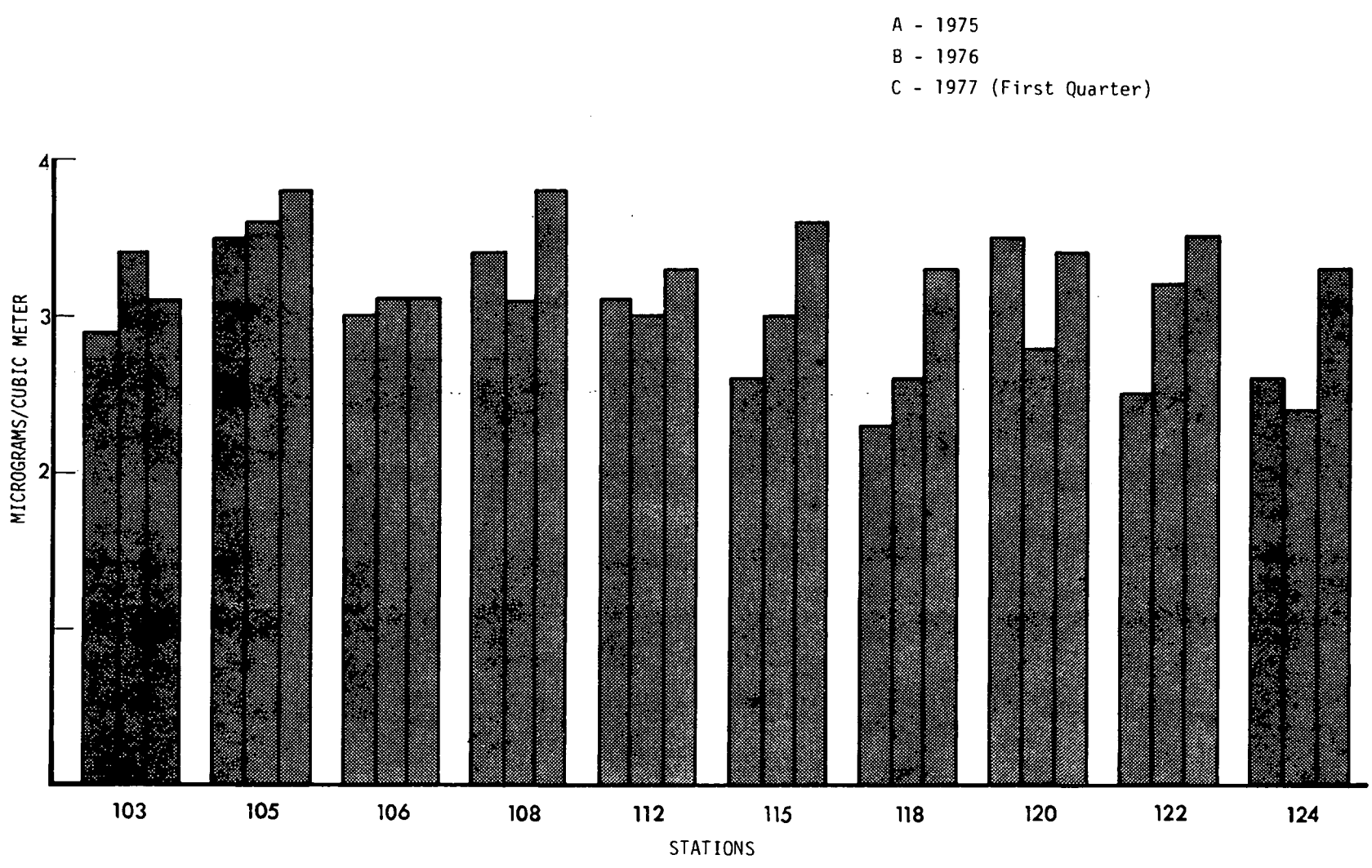


FIGURE 5. NITRATES (NO_3^-) - ANNUAL GEOMETRIC MEANS

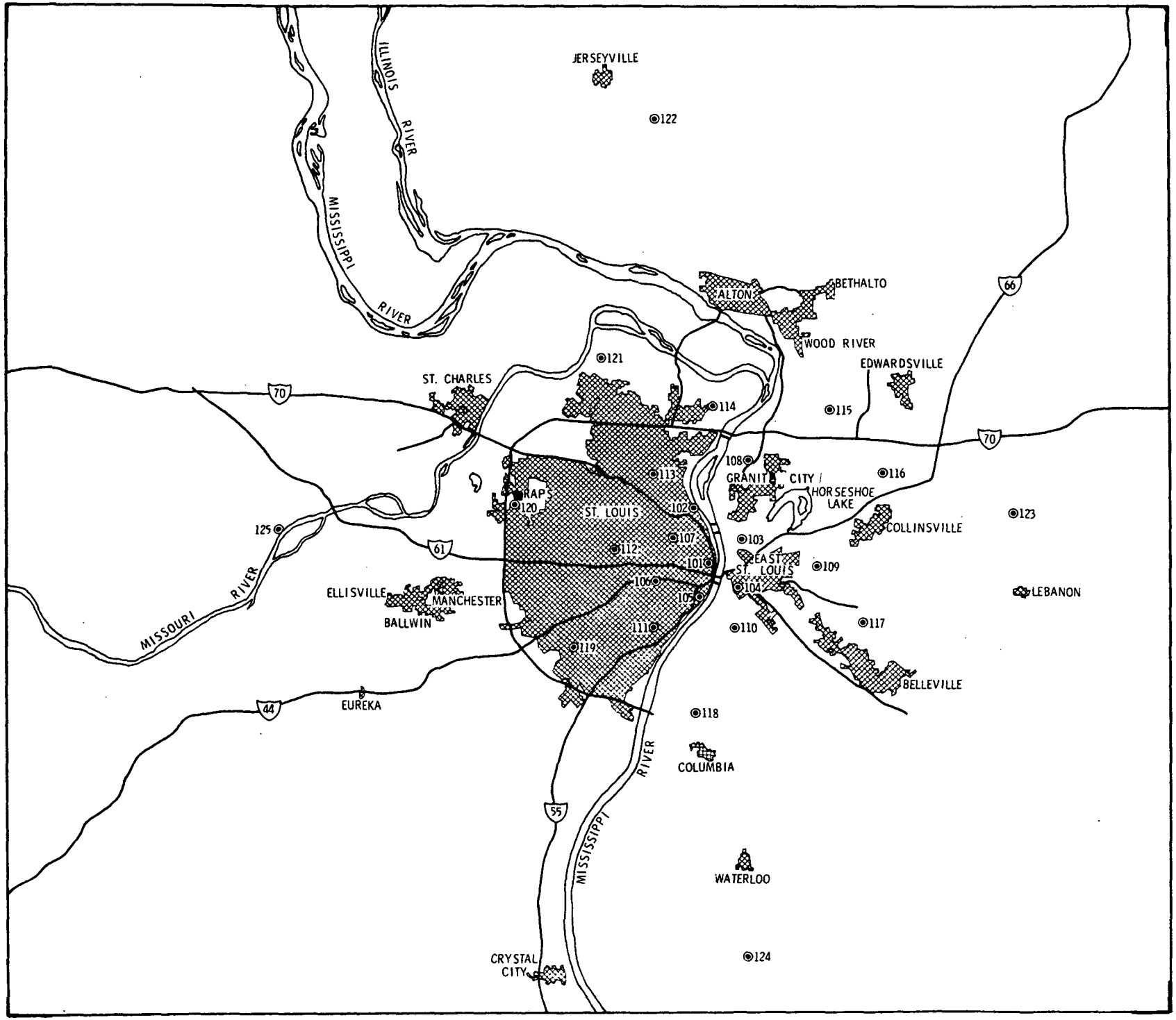


FIGURE 6. RAPS STATION LOCATIONS

TABLE 15. STATION LOCATION AND SURROUNDING ENVIRONMENT

RAMS Station	Station Location	Immediate Surrounding Area
103	National City, Illinois Big Bend Road	Immediate area around station was mostly farmland, fertilizer plant utilizing waste and bone material and dog food plant approximately 1/4 mile to the northeast.
105	St. Louis, Missouri Seventh Street and Shenandoah Avenue	On rear parking lot of fire department station in urban commercial-industrial and residential area.
106	St. Louis, Missouri Missouri Botanical Gardens	Located on the grounds of the Missouri Botanical Gardens with nearby residential buildings.
108	Granite City, Illinois Pontoon Road	Immediate area around station was farmed extensively. Several heavy industries located more than 3 miles away to the south and southeast.
112	Clayton, Missouri Washington University athletic field	Located on the athletic field containing a cinder track in front of the station and a ball field to the rear.
115	Poag, Illinois Poag Road	Entirely surrounded by farmland.
118	St. Clair County, Illinois-Diehl farm Mule Road	Entirely surrounded by farmland.
120	St. Louis County, Missouri Lackland Road	Located on Ferguson Machinery parking lot in an area of light commercial businesses.
122	Jersey County, Illinois-Norton farm County Route 4	Entirely surrounded by farmland.
124	Monroe County, Illinois-Noble farm County Route 1	Entirely surrounded by farmland.

TABLE 16. TOTAL SUSPENDED PARTICULATES (TSP) $\mu g/m^3$ FREQUENCY DISTRIBUTION 1975, 1976, 1977*

RAMS Stations	<25	25-50	50-75	75-100	100-125	125-150	150-175	175-200	>200
103	2	23	51	48	52	22	10	3	5
105	1	18	73	73	30	19	8	2	2
106	1	41	80	46	30	7	4	2	3
108	4	52	60	44	30	21	11	3	6
112	3	61	74	43	26	11	7	2	4
115	8	90	65	35	11	3	0	1	0
118	7	79	71	40	11	4	5	2	1
120	6	94	55	25	12	1	3	0	1
122	30	98	68	23	8	4	0	0	2
124	19	81	44	17	8	1	1	1	2

*1977--First Quarter Only

TABLE 17. SULFATES ($SO_4^{=}$) $\mu g/m^3$ FREQUENCY DISTRIBUTION
1975, 1976, 1977*

RAMS Stations	<5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	>40
103	3	92	66	26	15	9	2	0	3
105	8	99	64	29	15	6	1	1	3
106	8	103	54	23	14	5	3	1	3
108	2	90	72	36	12	8	3	2	6
112	10	117	53	25	14	4	4	1	3
115	3	118	53	21	8	4	2	2	2
118	17	106	61	22	7	3	2	0	2
120	19	105	36	19	9	5	0	0	4
122	24	118	47	25	9	3	2	1	4
124	12	91	44	16	4	3	1	1	2

*1977--First Quarter Only

TABLE 18. NITRATES (NO_3^-) $\mu g/m^3$ FREQUENCY DISTRIBUTION
1975, 1976, 1977*

RAMS Stations	<1	1-3	3-5	5-7	7-9	9-11	11-13	13-15	>15
103	6	89	68	22	15	4	2	0	0
105	0	87	84	36	8	9	2	0	0
106	6	97	75	24	7	1	2	1	1
108	9	89	70	45	8	9	0	0	1
112	6	112	72	26	11	3	1	0	0
115	10	97	71	31	5	0	0	0	0
118	19	108	73	14	6	1	0	0	0
120	5	86	65	26	9	6	0	0	0
122	10	98	86	24	14	1	0	0	0
124	14	90	44	21	5	0	0	0	0

*1977--First Quarter Only

TABLE 19. TOTAL SUSPENDED PARTICULATES (TSP) $\mu g/m^3$

RAMS Stations	103	105	106	108	112	115	118	120	122	124
Year-1975										
Annual 24-hr. Max.	208.3	193.9	209.5	163.3	288.6	138.7	203.5	124.9	228.0	351.0
Date Occurred	6 October	9 May	3 July	3 July	8 July	3 July	6 June	19 July	26 June	3 June
Year-1976										
Annual 24-hr. Max.	243.1	202.1	209.3	193.4	483.5	195.9	197.1	144.5	144.8	165.2
Date Occurred	24 September	15 October	28 January	27 February	17 July	25 August	18 April	15 October	15 October	15 October
Year-1977*										
Annual 24-hr. Max.	153.0	172.2	194.3	189.6	161.0	118.7	92.7	123.4	107.4	54.2
Date Occurred	14 March	14 March	28 January	9 February	14 March	14 March	29 March	1 January	14 March	12 February

*1977--First Quarter Only

TABLE 20. SULFATES ($SO_4^{=}$) $\mu g/m^3$

RAMS Stations	103	105	106	108	112	115	118	120	122	124
Year-1975										
Annual 24-hr. Max.	32.8	40.7	57.5	47.7	50.3	44.6	48.9	28.6	73.4	64.1
Date Occurred	29 October	29 July	3 July	3 July	8 July	3 July	3 July	19 July	26 June	3 June
Year-1976										
Annual 24-hr. Max.	27.3	35.7	50.4	28.5	50.4	46.9	31.2	28.4	46.3	46.8
Date Occurred	3 September	19 August	25 August	8 June	25 August	25 August	9 March	11 June	25 August	25 August
Year-1977*										
Annual 24-hr. Max.	19.9	28.9	16.2	22.3	15.7	12.4	11.9	14.6	12.0	13.0
Date Occurred	4 January	4 January	4 January	9 February	4 January	9 February	14 February	4 January	4 January	4 January

*1977--First Quarter Only

TABLE 21. NITRATES (NO_3^-) $\mu g/m^3$

RAMS Stations	103	105	106	108	112	115	118	120	122	124
Year-1975										
Annual 24-hr. Max.	10.6	13.7	10.3	9.3	11.3	6.8	8.9	10.5	8.9	8.6
Date Occurred	6 October	15 April	16 March	3 March	26 November	23 December	23 December	15 April	9 April	16 April
Year-1976										
Annual 24-hr. Max.	10.0	9.7	11.1	8.8	8.6	8.5	10.8	9.4	8.6	9.0
Date Occurred	8 December	6 April	28 January	8 December	14 November	6 April	6 February	6 February	14 November	14 November
Year-1977*										
Annual 24-hr. Max.	7.5	9.0	8.3	9.2	9.0	7.8	7.3	8.0	7.6	6.8
Date Occurred	22 January	22 January	22 January	18 February	22 January	22 January	22 January	22 January	18 February	22 January

*1977--First Quarter Only

3.5 DATA ANALYSIS

High volume data collected during 1975, 1976 and the first quarter of 1977 display a considerable amount of variability for each parameter (TSP, NO_3^-, $SO_4^=$) per station over time. This dispersion suggests that there may be a seasonal effect for the parameters tested. Visual interpretation of the histograms (Figures 7a - 9b) support this hypothesis; however, it became necessary to see if the data differed significantly between quarters and stations. Data from each station were broken down into four three month intervals (Tables 22 - 30) and a one-way analysis of variance (ANOVA) technique was employed to test the credibility of this hypothesis.*

ANOVA

ANOVA is based upon the comparison of separate estimates of population variances with each other. Each estimate is derived by observing the variation among values comprising actual samples and describing that variation in terms of sum of squares deviations and dividing by the appropriate degrees of freedom. When the null is true ($HO: \mu_{11} = \mu_{12} = \mu_{13} \cdots\cdots = \mu_{ij}$) the separate estimates should be nearly equal to each other (F ratio $\sim$ 1), if the estimates are of the same population. The F ratio describes, in its simplest case, the estimate derived from variation among groups as a multiple of the estimate derived from within group variation. For the null to be true the F ratio, as stated above, must approximate unity, if not the relationship becomes inconsistent with the existence of the null condition and the inference to reject the hypothesis that the difference among these groups is small enough to be attributable solely to sampling error seems in order.

Each specific data table (22 - 30) is accompanied by its ANOVA result and conclusion (F ratio, both degrees of freedom and the probability level associated with the reported F). The criteria used for acceptance or rejection is based upon the table F ratio (upper 5 percent points, F.95) value being greater than the calculated F ratio value. It should be emphasized that the conclusion to reject the null is based upon our above discussion of the F

*Due to small sample size (N) of Quarter 1, 1975, these data were eliminated from the ANOVA.

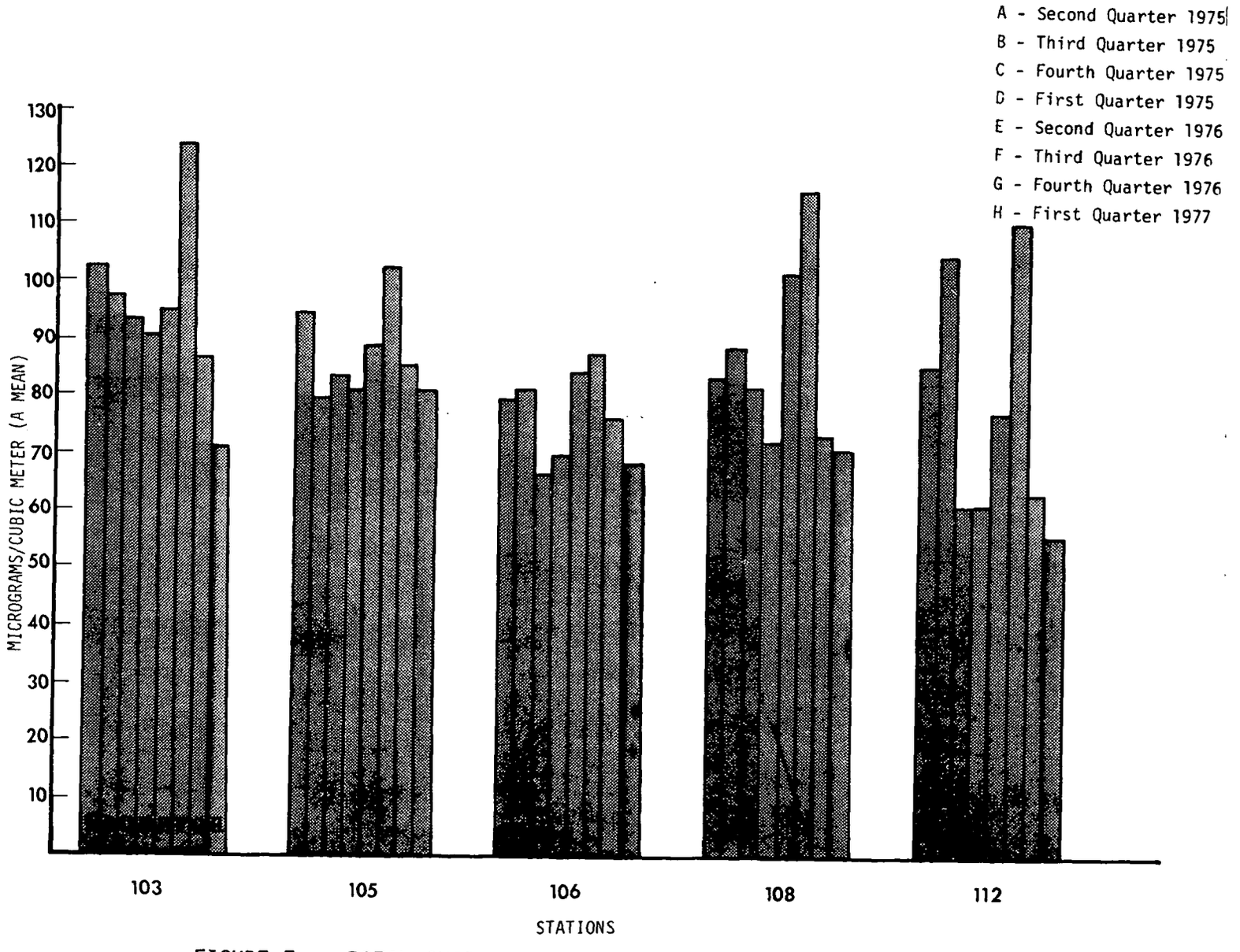


FIGURE 7a. TOTAL SUSPENDED PARTICULATES (TSP) - BY QUARTER

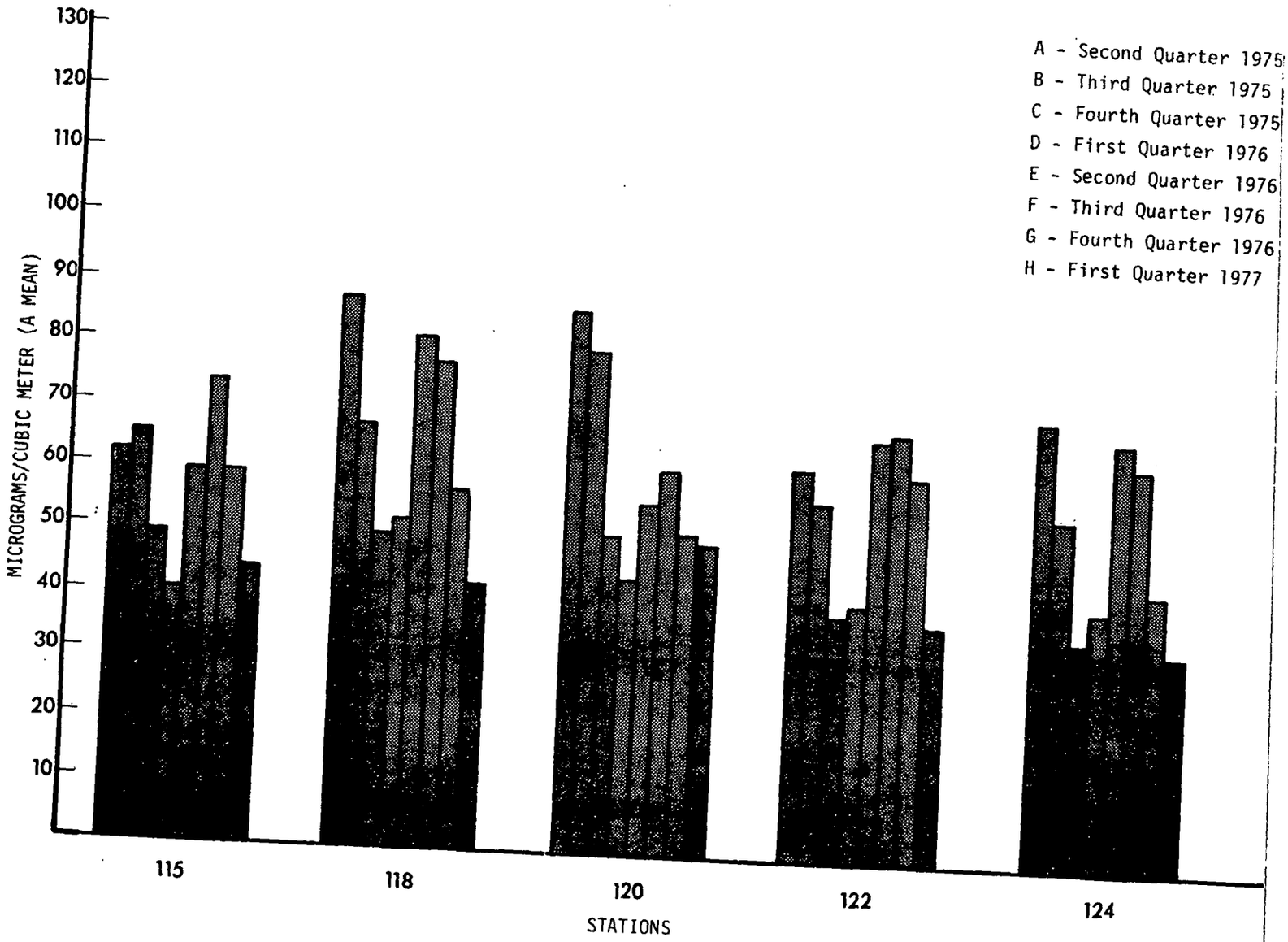


FIGURE 7b. TOTAL SUSPENDED PARTICULATES (TSP) - BY QUARTER

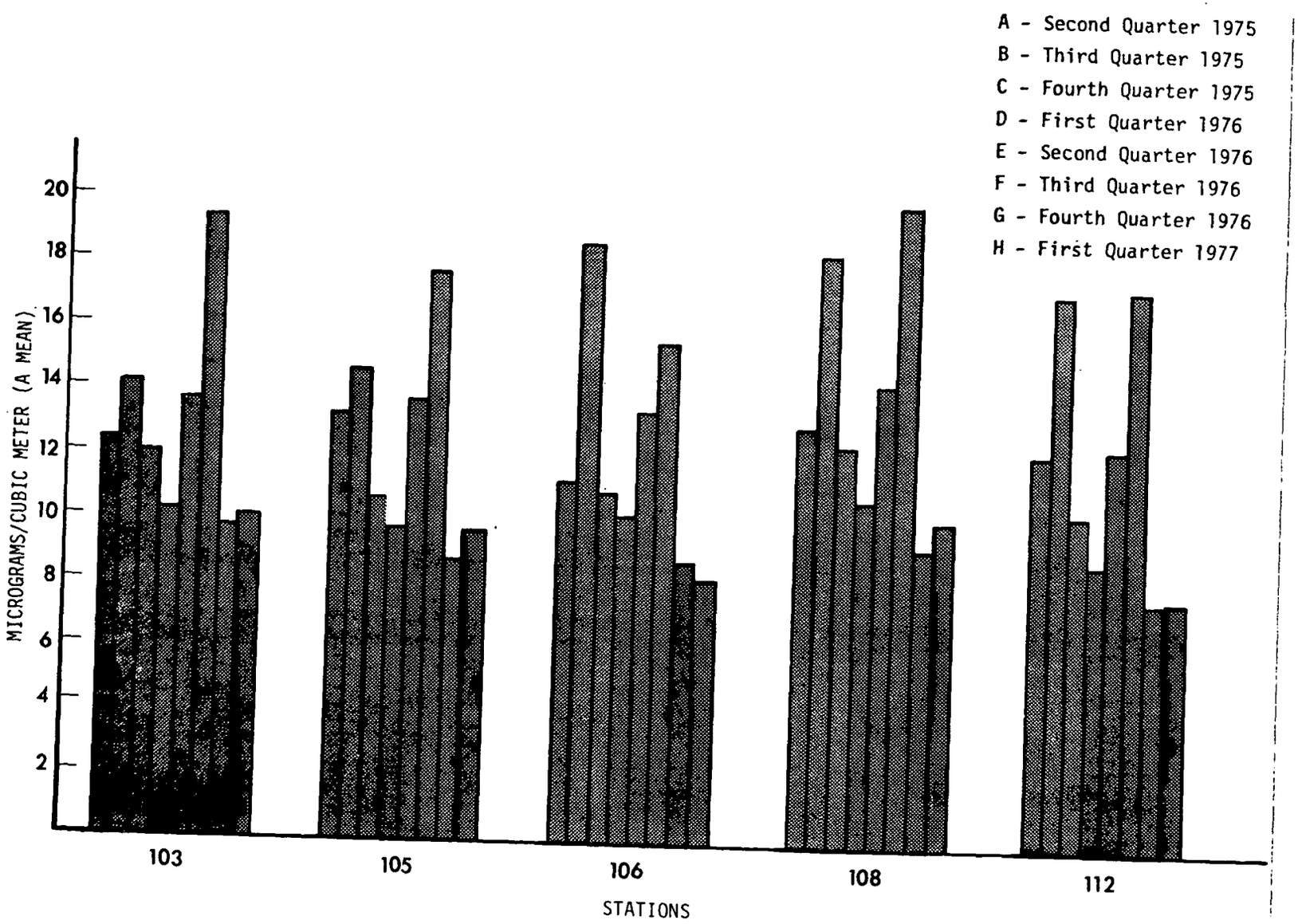


FIGURE 8a. SULFATES ($SO_4^{=}$) - BY QUARTER

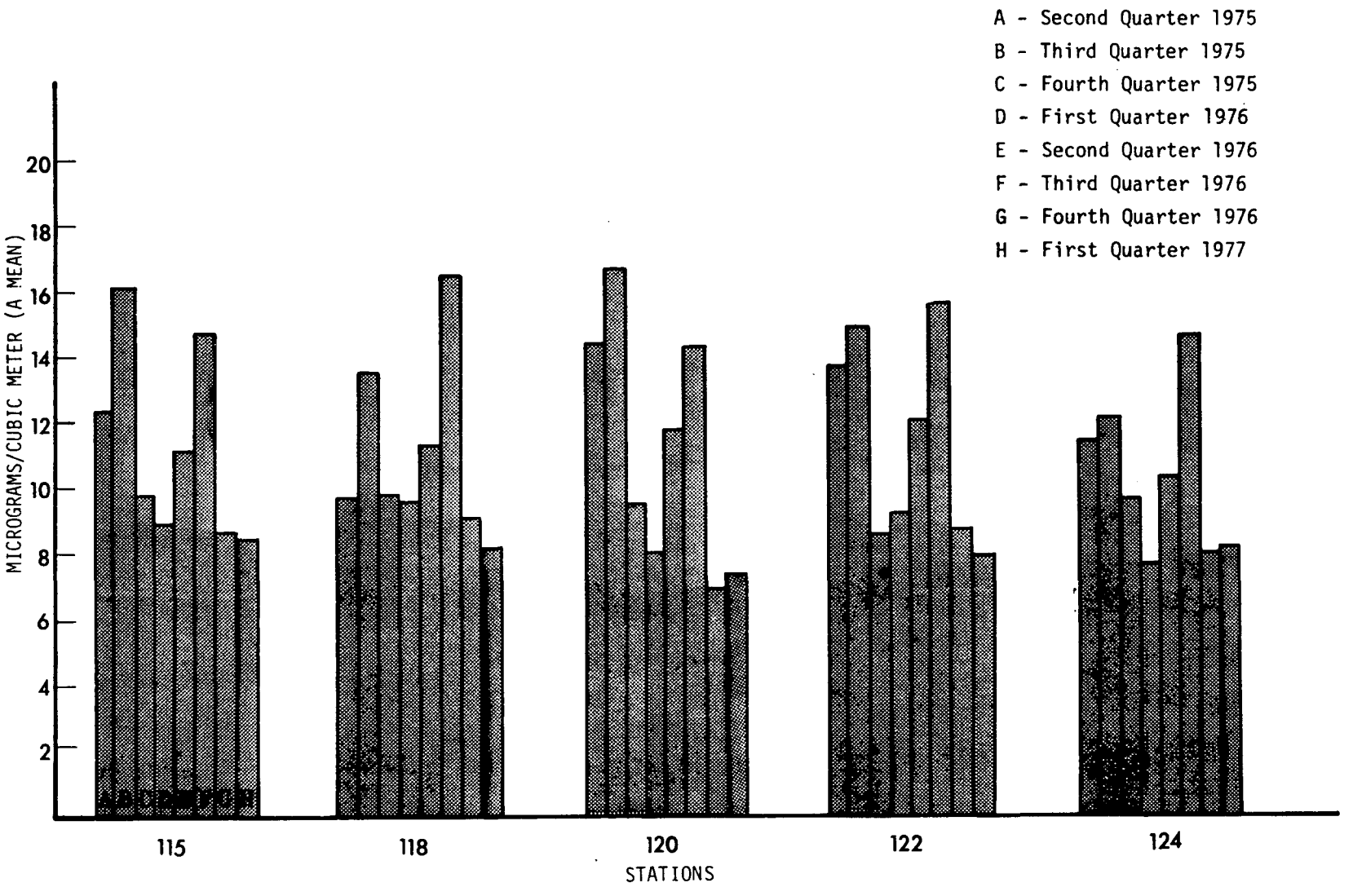


FIGURE 8b. SULFATES ($SO_4^{=}$) - BY QUARTER

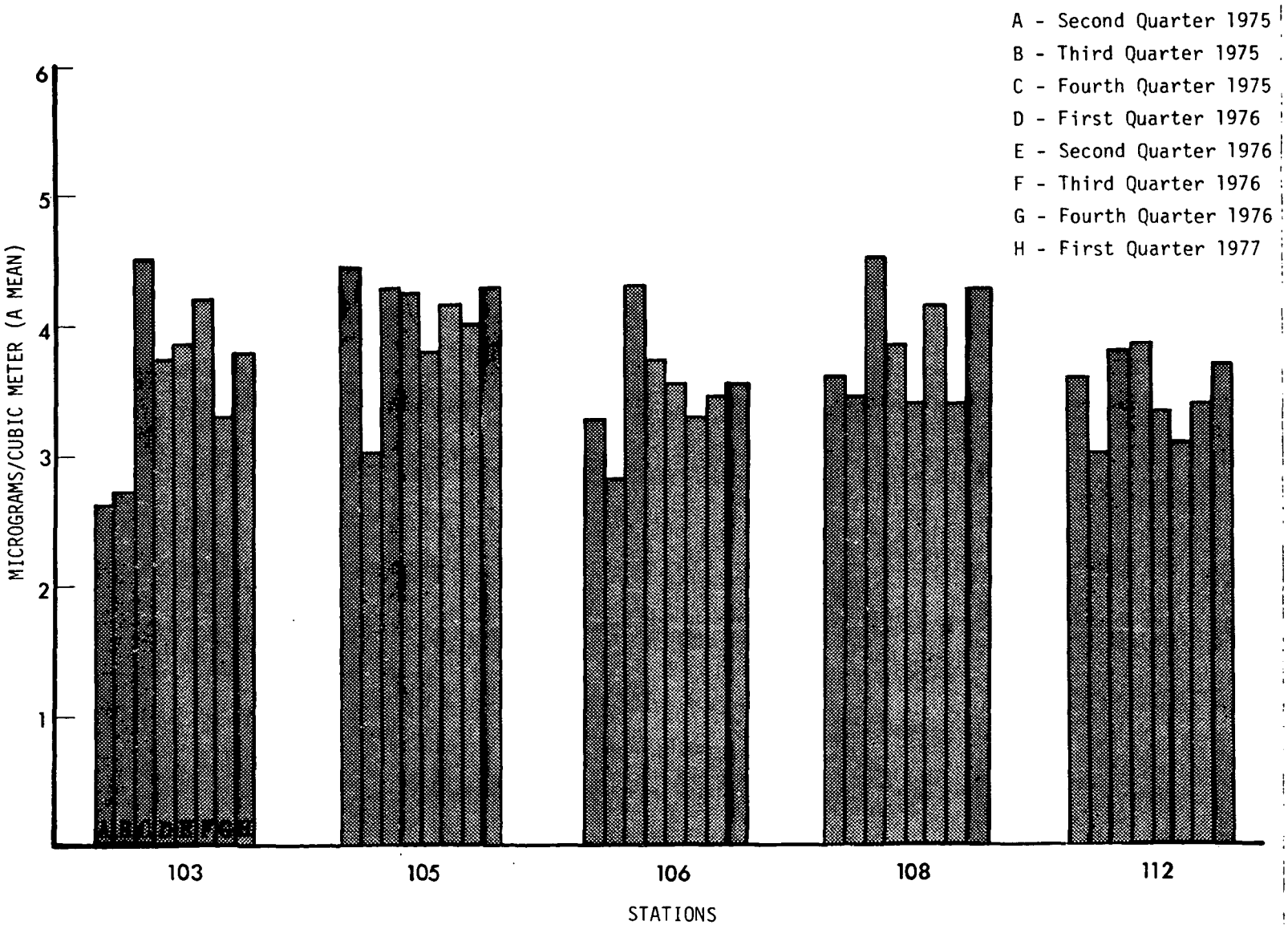


FIGURE 9a. NITRATES (NO_3^-) - BY QUARTER

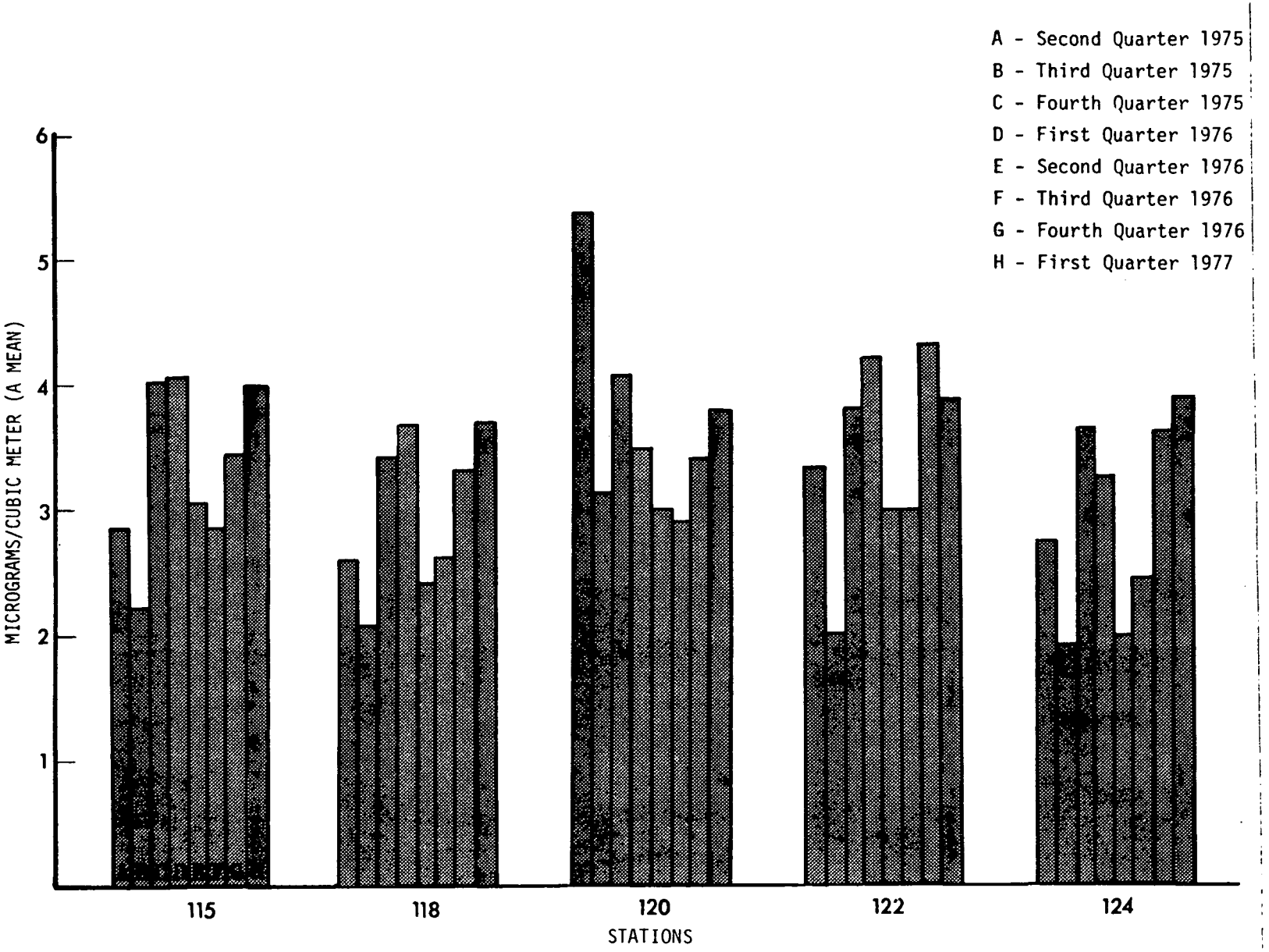


FIGURE 9b. NITRATES (NO_3^-) - BY QUARTER

TABLE 22. TOTAL SUSPENDED PARTICULATES (TSP) $\mu g/m^3$
1975 A MEAN

RAMS Stations	103	105	106	108	112	115	118	120	122	124
First Quarter*	N = 2	N = 6	N = 4	N = 7	N = 6	N = 4	N = 2	N = 4	N = 7	N = 6
A Mean	101.35	79.63	107.23	63.77	60.48	45.73	30.40	62.00	33.31	36.52
A Std. Dev.	20.29	38.31	33.30	21.18	18.94	17.54	12.59	37.59	13.16	14.95
Second Quarter	N = 16	N = 22	N = 18	N = 25	N = 23	N = 25	N = 24	N = 12	N = 25	N = 11
A Mean	102.63	94.55	79.90	83.53	85.69	62.20	87.51	86.53	62.42	71.81
A Std. Dev.	32.84	34.71	26.79	30.70	33.29	21.10	44.52	58.06	40.50	49.28
Third Quarter	N = 28	N = 22	N = 21	N = 26	N = 27	N = 26	N = 25	N = 16	N = 26	N = 14
A Mean	97.43	79.93	81.21	88.92	104.90	65.24	67.20	80.14	57.80	55.86
A Std. Dev.	39.43	23.94	40.50	36.84	60.91	29.57	29.09	31.11	23.67	33.85
Fourth Quarter	N = 28	N = 29	N = 24	N = 27	N = 29	N = 26	N = 27	N = 21	N = 29	N = 19
A Mean	93.06	83.63	66.70	81.90	61.20	49.55	50.17	51.00	39.53	36.05
A Std. Dev.	36.83	28.71	31.26	41.29	28.20	21.27	18.71	33.72	17.51	12.19

*March 1975 Only

ANOVA FOR STATIONS

Sources of Variation	Σx^2	df	Estimate of σ^2
Among:	5795.04	9	663.89
Within:	3766.55	20	188.33
Total:	9741.59	29	

$F = 3.52$, $F_{.95}(9,20) = 2.39$

Conclusion: there is a significant difference between stations

ANOVA FOR SEASONS

Sources of Variation	Σx^2	df	Estimate of σ^2
Among:	2352.18	2	1176.09
Within:	7389.41	27	273.68
Total:	9741.59	29	

$F = 4.30$, $F_{.95}(2,27) = 3.32$

Conclusion: there is a significant difference between seasons

TABLE 23. SULFATES (SO_4^-) $\mu g/m^3$

1975 A MEAN

RAMS Stations	103	105	106	108	112	115	118	120	122	124
First Quarter*	N = 2	N = 6	N = 4	N = 7	N = 6	N = 4	N = 2	N = 4	N = 7	N = 6
A Mean	21.55	9.98	16.85	11.94	9.73	11.50	4.30	11.15	7.80	9.08
A Std. Dev.	8.13	4.03	11.84	4.34	4.28	6.95	0.57	2.69	2.68	4.23
Second Quarter	N = 16	N = 22	N = 18	N = 25	N = 23	N = 16	N = 25	N = 12	N = 25	N = 11
A Mean	12.20	13.29	11.29	13.06	12.30	12.38	9.77	14.43	13.72	11.04
A Std. Dev.	7.76	6.28	4.97	5.71	8.31	6.86	4.54	14.25	14.56	9.24
Third Quarter	N = 28	N = 22	N = 21	N = 26	N = 27	N = 25	N = 25	N = 16	N = 26	N = 14
A Mean	14.13	14.69	18.76	18.57	17.33	16.18	13.53	16.69	14.87	12.16
A Std. Dev.	6.62	7.69	11.23	10.42	10.31	10.74	8.88	14.15	7.99	4.75
Fourth Quarter	N = 28	N = 29	N = 24	N = 27	N = 29	N = 26	N = 28	N = 21	N = 29	N = 19
A Mean	12.04	10.75	10.92	12.49	10.40	9.82	9.86	9.46	8.58	9.64
A Std. Dev.	5.57	4.11	5.70	5.07	5.28	3.17	3.40	3.71	3.29	2.97

*March 1975 Only

ANOVA FOR STATIONS

Sources of Variation	Σx^2	df	Estimate of σ^2
Among:	35.57	9	3.95
Within:	180.68	20	9.03
Total:	216.26	29	

$F = .438$, $F_{.95}(9,20) = 2.39$

Conclusion: there is NO significant difference between stations

ANOVA FOR SEASONS

Sources of Variation	Σx^2	df	Estimate of σ^2
Among:	143.41	2	71.71
Within:	72.84	27	2.69
Total:	216.26	29	

$F = 26.58$, $F_{.95}(2,27) = 3.32$

Conclusion: there is a significant difference between seasons

TABLE 24. NITRATES (NO_3^-) $\mu g/m^3$

1975 A MEAN

RAMS Stations	103	105	106	108	112	115	118	120	122	124
First Quarter*	N = 2	N = 6	N = 4	N = 7	N = 6	N = 4	N = 2	N = 4	N = 7	N = 6
A Mean	11.15	5.70	8.18	6.00	5.12	3.98	1.20	5.20	3.71	4.98
A Std. Dev.	1.77	3.93	5.06	5.26	3.23	2.72	0.14	1.99	2.94	3.13
Second Quarter	N = 16	N = 22	N = 18	N = 25	N = 23	N = 16	N = 24	N = 12	N = 25	N = 11
A Mean	2.62	4.47	3.27	3.65	3.65	2.85	2.60	5.36	3.32	2.79
A Std. Dev.	1.74	3.23	1.70	1.72	2.03	1.29	1.64	2.95	1.94	1.91
Third Quarter	N = 28	N = 22	N = 21	N = 26	N = 27	N = 25	N = 25	N = 16	N = 26	N = 14
A Mean	2.72	3.03	2.83	3.45	3.01	2.24	2.07	3.13	2.00	1.91
A Std. Dev.	1.31	1.21	1.52	2.13	1.57	1.44	1.14	2.43	1.41	0.72
Fourth Quarter	N = 28	N = 29	N = 24	N = 27	N = 29	N = 26	N = 28	N = 21	N = 29	N = 19
A Mean	4.50	4.30	4.13	4.53	3.81	4.02	3.44	4.07	3.82	3.63
A Std. Dev.	2.39	1.83	2.82	2.40	2.24	1.69	1.61	2.03	1.98	1.53

*March 1975 Only

ANOVA FOR STATIONS

Sources of Variation	Σx^2	df	Estimate of σ^2
Among:	6.83	9	.76
Within:	13.71	20	.69
Total:	20.55	29	

$F = 1.11$, $F_{.95}(9,20) = 2.39$

Conclusion: there is no significant difference between stations

ANOVA FOR SEASONS

Sources of Variation	Σx^2	df	Estimate of σ^2
Among:	9.70	2	4.85
Within:	10.85	27	.40
Total:	20.55	29	

$F = 12.07$, $F_{.95}(2,27) = 3.32$

Conclusion: there is a significant difference between seasons

TABLE 25. TOTAL SUSPENDED PARTICULATES (TSP) $\mu g/m^3$

1976 A MEAN

RAMS Stations	103	105	106	108	112	115	118	120	122	124
First Quarter	N = 27	N = 28	N = 30	N = 28	N = 28	N = 25	N = 26	N = 29	N = 28	N = 27
A Mean	90.55	81.01	70.11	72.53	61.63	40.69	52.81	44.16	41.11	41.57
A Std. Dev.	28.55	32.25	33.60	36.74	25.99	14.07	21.50	16.46	14.11	17.90
Second Quarter	N = 25	N = 28	N = 28	N = 28	N = 29	N = 27	N = 28	N = 28	N = 28	N = 24
A Mean	94.97	89.01	84.68	101.63	82.50	59.40	81.55	56.05	67.47	68.48
A Std. Dev.	35.53	29.82	41.39	50.02	33.64	26.94	35.62	18.28	26.35	29.17
Third Quarter	N = 30	N = 31	N = 30	N = 30	N = 29	N = 31	N = 30	N = 28	N = 30	N = 31
A Mean	123.71	102.62	87.83	115.59	110.54	73.93	77.42	61.41	68.28	64.49
A Std. Dev.	59.50	36.15	27.83	79.94	79.71	31.67	26.06	24.65	27.05	36.82
Fourth Quarter	N = 30	N = 30	N = 30	N = 30	N = 30	N = 30	N = 29	N = 28	N = 29	N = 28
A Mean	86.88	85.41	76.28	73.30	63.27	59.53	57.07	51.54	49.14	44.23
A Std. Dev.	37.30	40.51	36.10	37.99	30.12	25.81	38.87	27.01	26.65	28.90

ANOVA FOR STATIONS

Sources of Variation	Σx^2	df	Estimate of σ^2
Among:	10382.41	9	1153.60
Within:	6682.97	30	222.77
Total:	17065.38	39	

$F = 5.29$, $F_{.95}(3,36) = 2.84$

Conclusion: there is a significant difference between stations

ANOVA FOR SEASONS

Sources of Variation	Σx^2	df	Estimate of σ^2
Among:	5223.66	3	1741.22
Within:	11841.72	36	328.94
Total:	17065.38	39	

$F = 5.18$, $F_{.95}(9,30) = 2.21$

Conclusion: there is a significant difference between seasons

TABLE 26. SULFATES ($SO_4^=$) $\mu g/m^3$

1976 A MEAN

RAMS Stations	103	105	106	108	112	115	118	120	122	124
First Quarter	N = 27	N = 28	N = 30	N = 28	N = 28	N = 25	N = 26	N = 29	N = 28	N = 27
A Mean	10.23	9.79	10.20	10.79	8.95	8.98	9.57	7.98	9.21	7.96
A Std. Dev.	3.48	3.02	7.06	3.65	2.77	2.22	2.87	2.49	3.55	2.13
Second Quarter	N = 25	N = 28	N = 28	N = 28	N = 29	N = 27	N = 28	N = 28	N = 28	N = 24
A Mean	13.71	13.76	13.05	14.42	12.57	11.17	11.35	11.82	12.00	10.28
A Std. Dev.	6.78	7.56	7.41	10.56	6.36	6.10	6.75	6.70	6.32	6.74
Third Quarter	N = 30	N = 31	N = 30	N = 30	N = 29	N = 31	N = 30	N = 28	N = 31	N = 31
A Mean	19.40	17.72	15.62	19.96	17.56	14.75	16.53	14.38	15.60	14.59
A Std. Dev.	12.84	10.54	9.37	16.78	11.65	7.96	11.44	10.75	12.34	8.42
Fourth Quarter	N = 30	N = 30	N = 30	N = 30	N = 30	N = 30	N = 30	N = 28	N = 29	N = 28
A Mean	9.63	8.78	8.79	9.29	7.74	8.59	9.13	6.95	7.60	7.97
A Std. Dev.	4.04	4.52	4.29	4.36	3.92	3.54	4.48	2.49	3.65	3.54

ANOVA FOR STATIONS

Sources of Variation	Σx^2	df	Estimate of σ^2
Among:	48.22	9	5.36
Within:	424.14	30	14.14
Total:	472.36	39	

$F = .379$, $F_{.95}(9,30) = 2.21$

Conclusion: there is no significant difference between stations

ANOVA FOR SEASONS

Sources of Variation	Σx^2	df	Estimate of σ^2
Among:	406.56	3	135.52
Within:	65.80	36	1.83
Total:	472.36	39	

$F = 74.13$, $F_{.95}(3,36) = 2.84$

Conclusion: there is a significant difference between seasons

TABLE 27. NITRATES (NO_3^-) $\mu g/m^3$

1976 A MEAN

RAMS Stations	103	105	106	108	112	115	118	120	122	124
First Quarter	N = 27	N = 28	N = 30	N = 28	N = 28	N = 25	N = 26	N = 29	N = 28	N = 27
A Mean	3.75	4.24	3.74	3.85	3.86	4.07	3.68	3.49	4.23	3.26
A Std. Dev.	1.55	1.73	2.18	1.75	1.76	1.50	1.89	1.93	1.91	1.47
Second Quarter	N = 25	N = 28	N = 28	N = 28	N = 29	N = 27	N = 28	N = 28	N = 28	N = 24
A Mean	3.84	3.77	3.55	3.41	3.36	3.06	2.43	3.01	3.00	2.02
A Std. Dev.	2.14	1.99	2.70	2.19	1.58	1.58	1.67	1.53	1.13	1.13
Third Quarter	N = 30	N = 31	N = 30	N = 30	N = 29	N = 31	N = 30	N = 28	N = 31	N = 31
A Mean	4 .19	4.15	3.28	4.16	3.14	2.87	2.63	2.92	3.01	2.47
A Std. Dev.	2.26	2.30	1.38	2.78	1.58	1.67	1.44	1.44	1.80	1.61
Fourth Quarter	N = 30	N = 30	N = 30	N = 30	N = 30	N = 30	N = 30	N = 28	N = 30	N = 28
A Mean	3.93	4.01	3.44	3.40	3.42	3.46	3.36	3.42	3.75	3.62
A Std. Dev.	2.19	2.38	2.07	1.92	2.04	1.75	2.00	2.07	1.87	1.91

ANOVA FOR STATIONS

Source of Variation	Σx^2	df	Estimates of σ^2
Among:	5.05	9	.56
Within:	5.85	30	.19
Total:	10.90	39	

$F = 2.88$, $F_{.95}(9,30) = 2.21$

Conclusion: there is a significant difference between stations

ANOVA FOR SEASONS

Source of Variation	Σx^2	df	Estimates of σ^2
Among:	2.73	3	.91
Within:	8.17	36	.23
Total:	10.90	39	

$F = 4.01$, $F_{.95}(3,36) = 2.84$

Conclusion: there is a significant difference between seasons

TABLE 28. TOTAL SUSPENDED PARTICULATES (TSP) $\mu g/m^3$
1977 A MEAN

RAMS Stations	103	105	106	108	112	115	118	120	122	124
First Quarter	N = 29	N = 30	N = 30	N = 30	N = 30	N = 30	N = 29	N = 30	N = 30	N = 14
A Mean	71.4	81.7	69.2	71.3	56.7	44.8	43.0	49.9	38.2	34.3
A Std. Dev.	33.4	33.5	36.6	50.5	28.9	24.1	14.2	26.5	22.0	9.5

TABLE 29. SULFATES ($SO_4^=$) $\mu g/m^3$
1977 A MEAN

RAMS Stations	103	105	106	108	112	115	118	120	122	124
First Quarter	N = 30	N = 30	N = 30	N = 30	N = 30	N = 30	N = 29	N = 30	N = 30	N = 14
A Mean	10.1	9.7	8.3	10.2	7.9	8.5	8.2	7.4	8.0	8.3
A Std. Dev.	3.8	4.8	2.8	3.9	2.6	3.4	2.3	2.6	2.6	2.4

TABLE 30. NITRATES (NO_3^-) $\mu g/m^3$
1977 A MEAN

RAMS Stations	103	105	106	108	112	115	118	120	122	124
First Quarter	N = 30	N = 30	N = 30	N = 30	N = 30	N = 30	N = 29	N = 30	N = 30	N = 14
A Mean	3.8	4.3	3.6	4.3	3.7	4.0	3.7	3.8	3.9	3.9
A Std. Dev.	1.8	1.9	1.8	2.0	1.9	1.9	1.6	1.6	1.7	2.0

ratio and states that there does exist a difference between sample means, however, it does not attempt to identify which sample or how many samples display this difference. This identification would require further investigation.

PAIRED COMPARISON T-TEST

The paired comparison t-test is used to test the null hypothesis $HO:\mu_1=\mu_2$. This hypothesis specifies that there is no difference in the mean treatment effect within pairs of observations, more specifically it hypothesizes that the mean difference between pairs is zero ($\mu_1 - \mu_2 = 0$) at some specified critical value of t.

Essentially this test involved pairing average values of all high volume stations per quarter per year with the average values of all high volume stations for like quarter of a different year, for example, quarter one of 1976 was paired with quarter one of 1977. All tests were performed under identical statistical constraints, i.e., $\alpha = .05$, t-critical for a two-tailed test was $\pm$ 2.26 and the null hypothesis (HO) was that like quarters of two successive years were equal; Quarter X = Quarter X_1, with alternate hypothesis being Quarter X < Quarter X_1, or Quarter X > Quarter X_1. The decision to accept the null or one of the two alternate hypothesis was based on the calculated t value, i.e., the null was rejected if $t < -2.26$ or $t > 2.26$. Results of this test can be found in Table 31 of this report. (Again, Quarter 1 of 1975 did not offer enough samples to be considered in this test.)

3.6 STATION GROUPING

In Figures 7a through 9b, the histograms of the quarters seem to indicate that the stations could be grouped according to their geographical locations and with this in mind three categories were chosen: (1) Industrial, (2) Residential and (3) Rural. Stations 103, 105 and 108 were placed in the Industrial group; 106, 112 and 120 in the Residential; 115, 118, 122 and 124 in the Rural group. Although the stations were grouped under three categories, the actual location of any one station could be and in actuality was geographically distant from others in the same group.

TABLE 31. PAIRED COMPARISON t-TEST RESULTS

Parameter	1975	1976	1977	Calculated t	Decision
TSP	Quarter 2	Quarter 2		.80	Accept Null*
TSP	Quarter 3	Quarter 3		-2.58	Reject Null, Accept $\bar{Q}_3^{75} < \bar{Q}_3^{76}$
TSP	Quarter 4	Quarter 4		-1.59	Accept Null
TSP		Quarter 1	Quarter 1	1.55	Accept Null
$SO_4^=$	Quarter 2	Quarter 2		-0.13	Accept Null
$SO_4^=$	Quarter 3	Quarter 3		-1.09	Accept Null
$SO_4^=$	Quarter 4	Quarter 4		7.78	Reject Null, Accept $\bar{Q}_4^{75} > \bar{Q}_4^{76}$
$SO_4^=$		Quarter 1	Quarter 1	3.30	Reject Null, Accept $\bar{Q}_1^{76} > \bar{Q}_1^{77}$
NO_3^-	Quarter 2	Quarter 2		1.11	Accept Null
NO_3^-	Quarter 3	Quarter 3		-4.22	Reject Null, Accept $\bar{Q}_3^{75} < \bar{Q}_3^{76}$
NO_3^-	Quarter 4	Quarter 4		4.03	Reject Null, Accept $\bar{Q}_4^{75} > \bar{Q}_4^{76}$
NO_3^-		Quarter 1	Quarter 1	-0.88	Accept Null

*In all cases the Null hypothesis was testing for equality between quarters at the .05 level of significance.

The years were divided into quarters to coincide with the seasons of the year, e.g., Winter (January, February, March); Spring (April, May, June); Summer (July, August, September); and Fall (October, November, December). Plots depicting the station groups and parameters are presented in Figures 10 - 18. For each group the trends tend to be in the same directions although the magnitudes could be and were different.

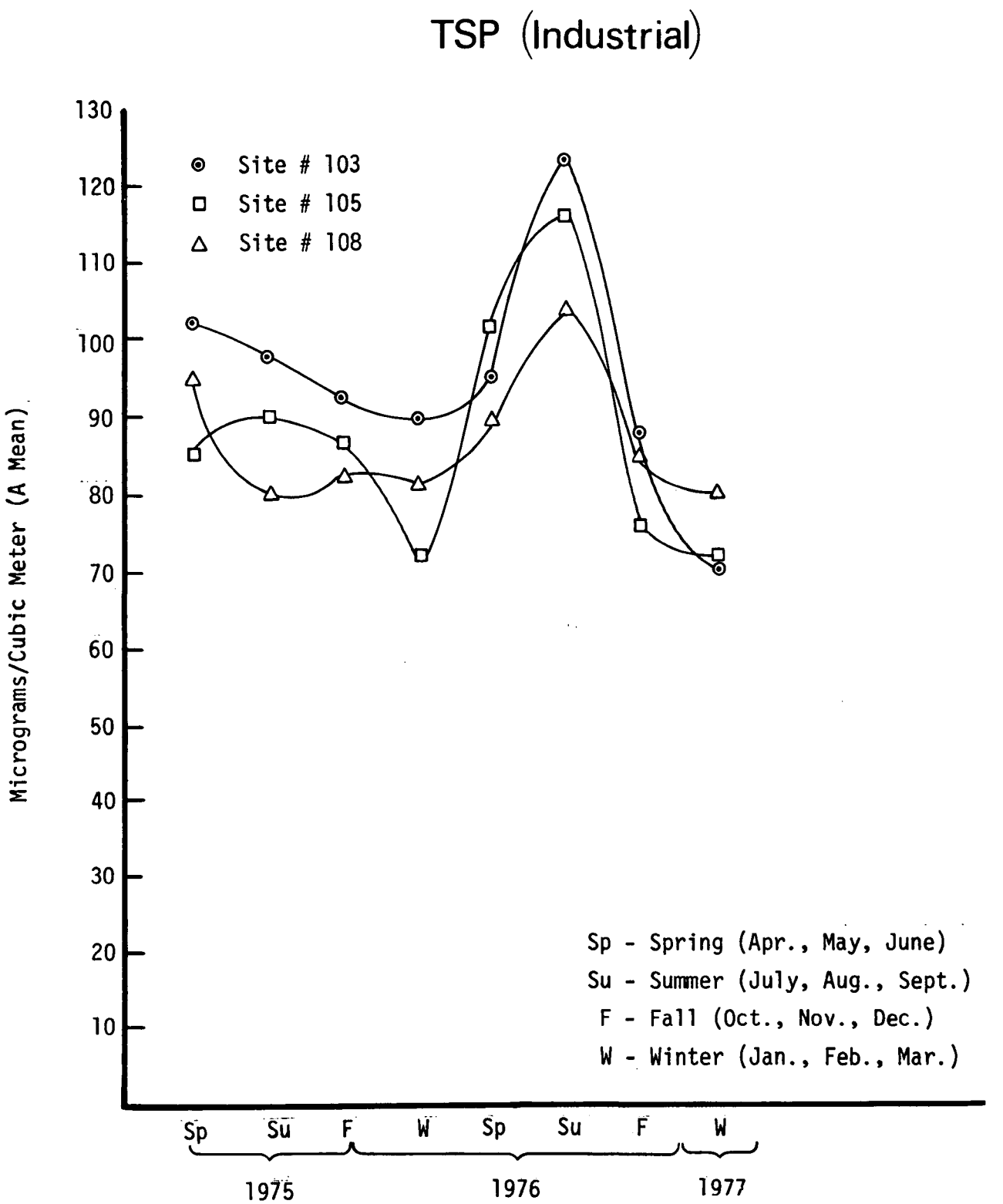

TSP (Industrial)
Site # 103
Site # 105
Site # 108
Micrograms/Cubic Meter (A Mean)
130
120
110
100
90
80
70
60
50
40
30
20
10
Sp - Spring (Apr., May, June)
Su - Summer (July, Aug., Sept.)
F - Fall (Oct., Nov., Dec.)
W - Winter (Jan., Feb., Mar.)
Sp
Su
F
W
Sp
Su
F
W
1975
1976
1977

FIGURE 10

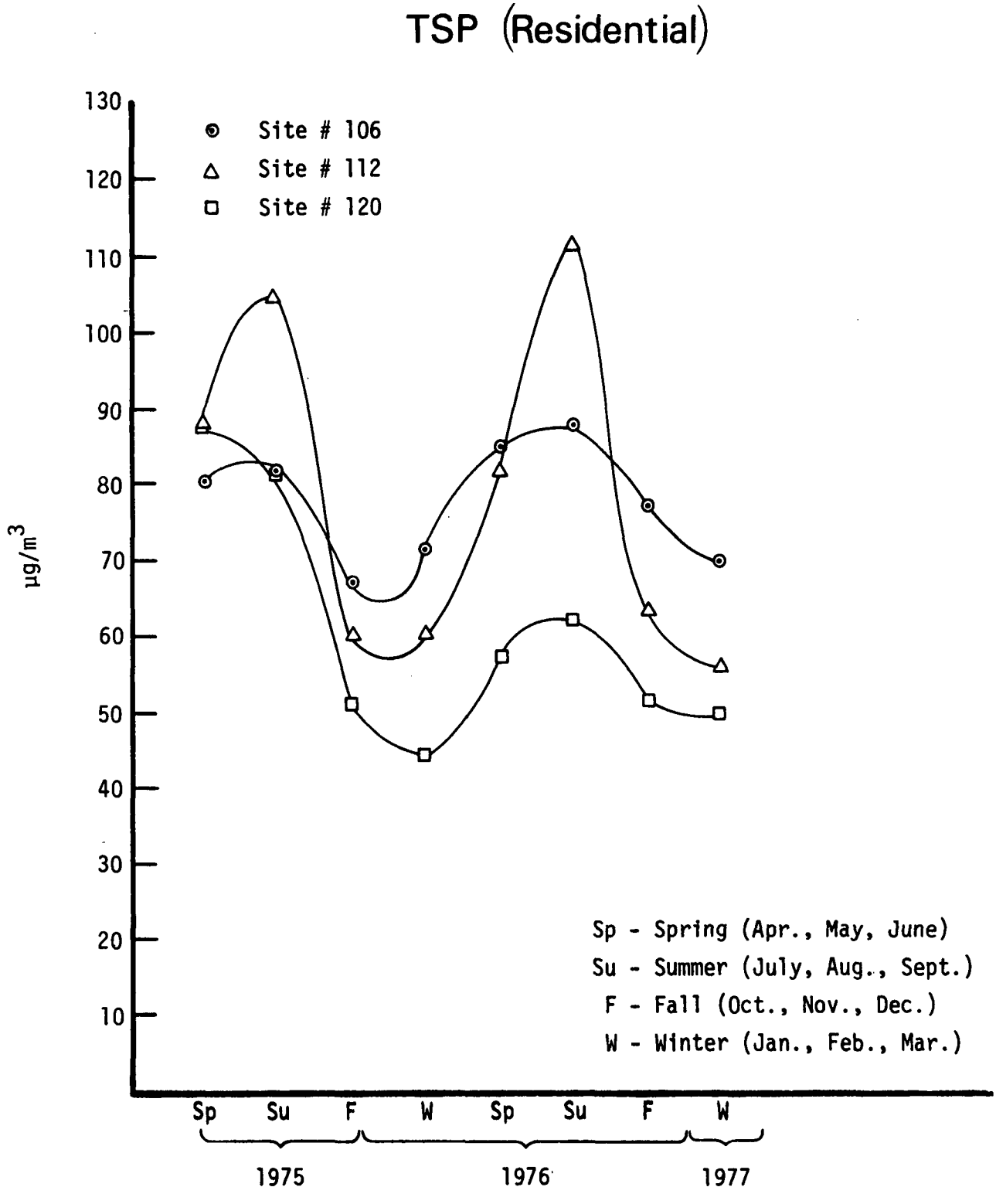

TSP (Residential)
Site # 106
Site # 112
Site # 120
130
120
110
100
90
80
70
60
50
40
30
20
10
µg/m3
Sp - Spring (Apr., May, June)
Su - Summer (July, Aug., Sept.)
F - Fall (Oct., Nov., Dec.)
W - Winter (Jan., Feb., Mar.)
Sp
Su
F
W
Sp
Su
F
W
1975
1976
1977

FIGURE 11

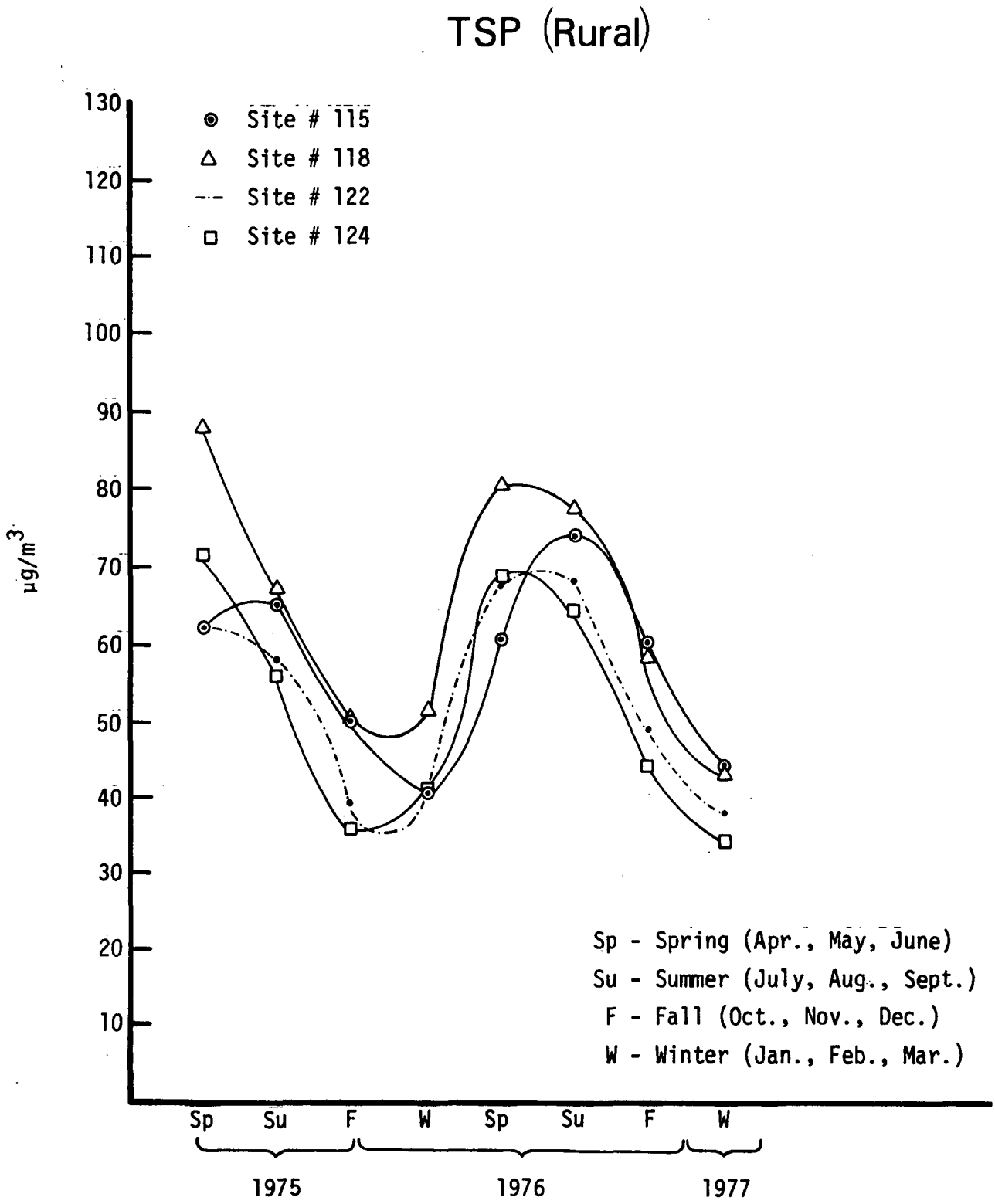

TSP (Rural)
Site # 115
Site # 118
Site # 122
Site # 124
130
120
110
100
90
80
70
60
50
40
30
20
10
µg/m3
Sp - Spring (Apr., May, June)
Su - Summer (July, Aug., Sept.)
F - Fall (Oct., Nov., Dec.)
W - Winter (Jan., Feb., Mar.)
Sp
Su
F
W
Sp
Su
F
W
1975
1976
1977

FIGURE 12

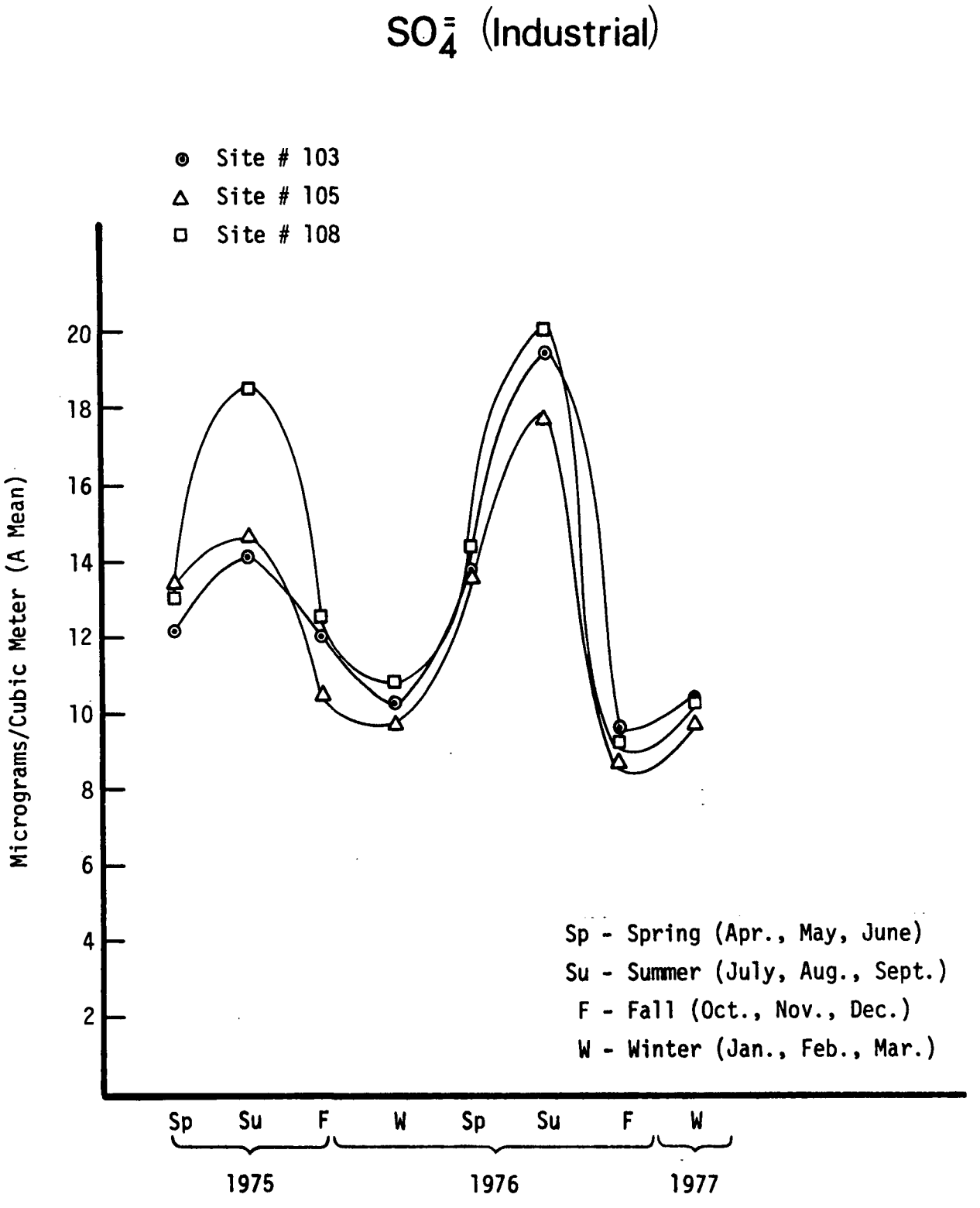

$SO_4^{=}$ (Industrial)
Site # 103
Site # 105
Site # 108
Micrograms/Cubic Meter (A Mean)
20
18
16
14
12
10
8
6
4
2
Sp - Spring (Apr., May, June)
Su - Summer (July, Aug., Sept.)
F - Fall (Oct., Nov., Dec.)
W - Winter (Jan., Feb., Mar.)
Sp Su F W Sp Su F W
1975
1976
1977

FIGURE 13

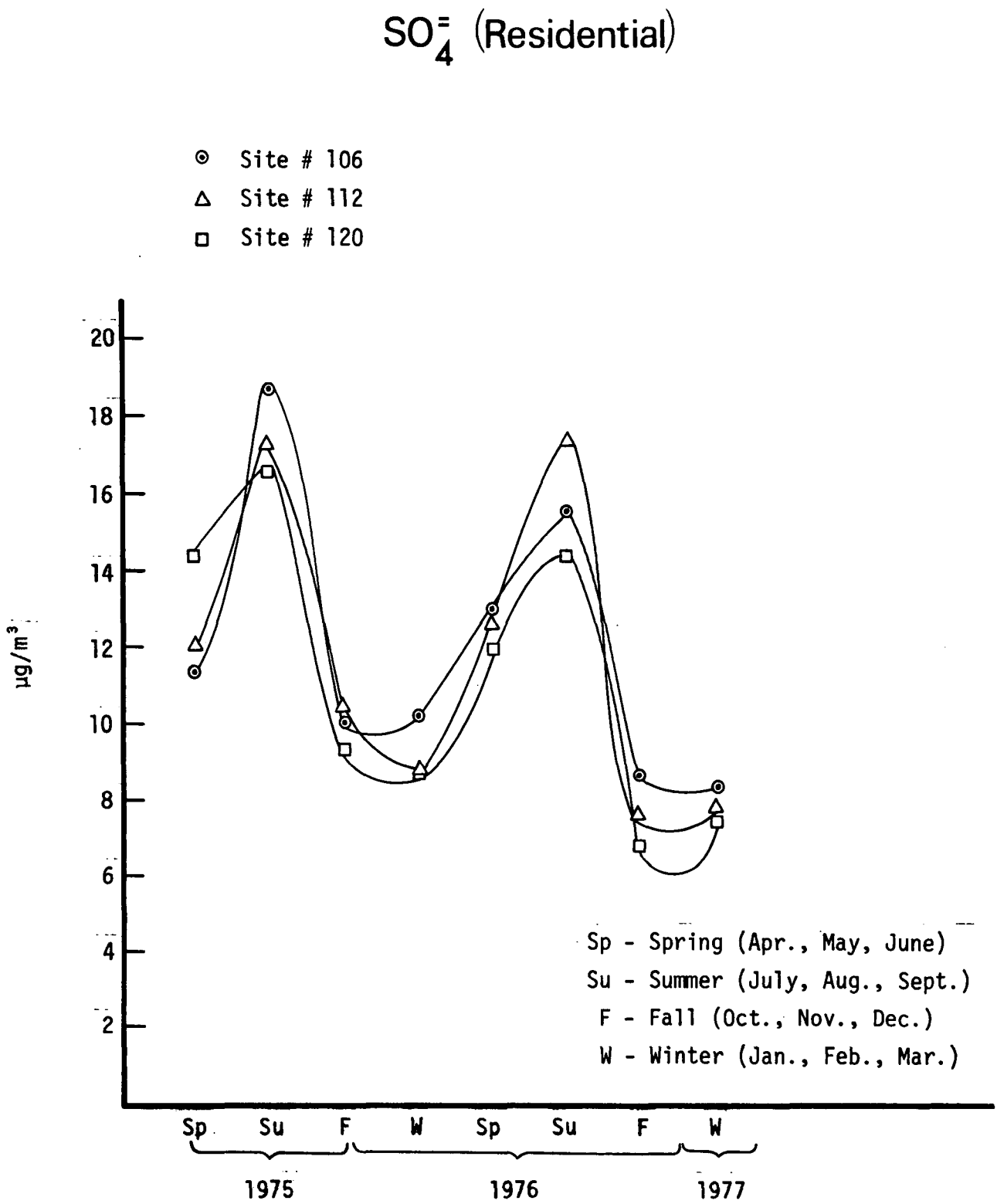

$SO_4^=$ (Residential)
Site # 106
Site # 112
Site # 120
µg/m³
20
18
16
14
12
10
8
6
4
2
Sp - Spring (Apr., May, June)
Su - Summer (July, Aug., Sept.)
F - Fall (Oct., Nov., Dec.)
W - Winter (Jan., Feb., Mar.)
Sp
Su
F
W
Sp
Su
F
W
1975
1976
1977

FIGURE 14

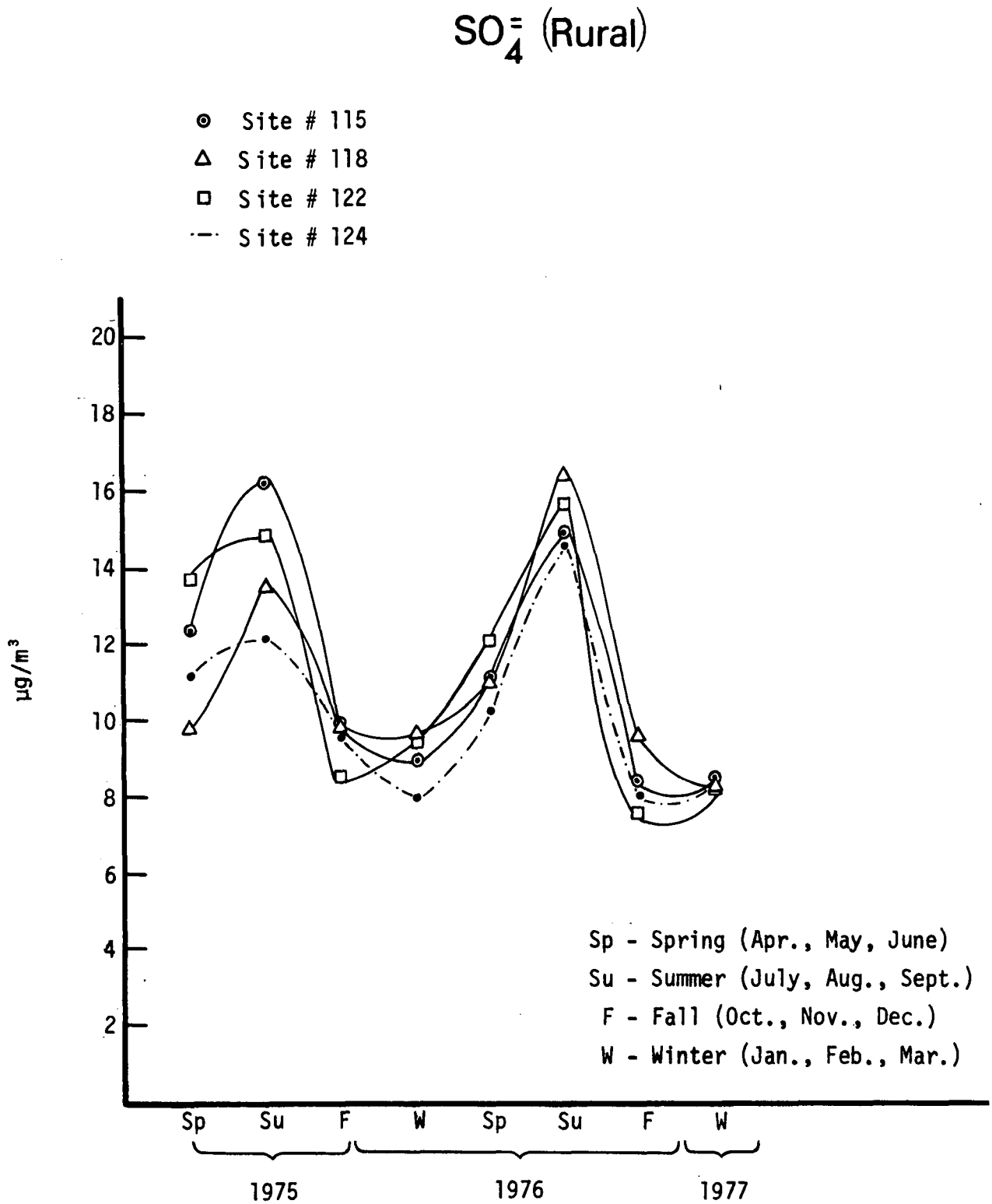

$SO_4^=$ (Rural)
Site # 115
Site # 118
Site # 122
Site # 124
µg/m³
20
18
16
14
12
10
8
6
4
2
Sp - Spring (Apr., May, June)
Su - Summer (July, Aug., Sept.)
F - Fall (Oct., Nov., Dec.)
W - Winter (Jan., Feb., Mar.)
Sp
Su
F
W
Sp
Su
F
W
1975
1976
1977

FIGURE 15

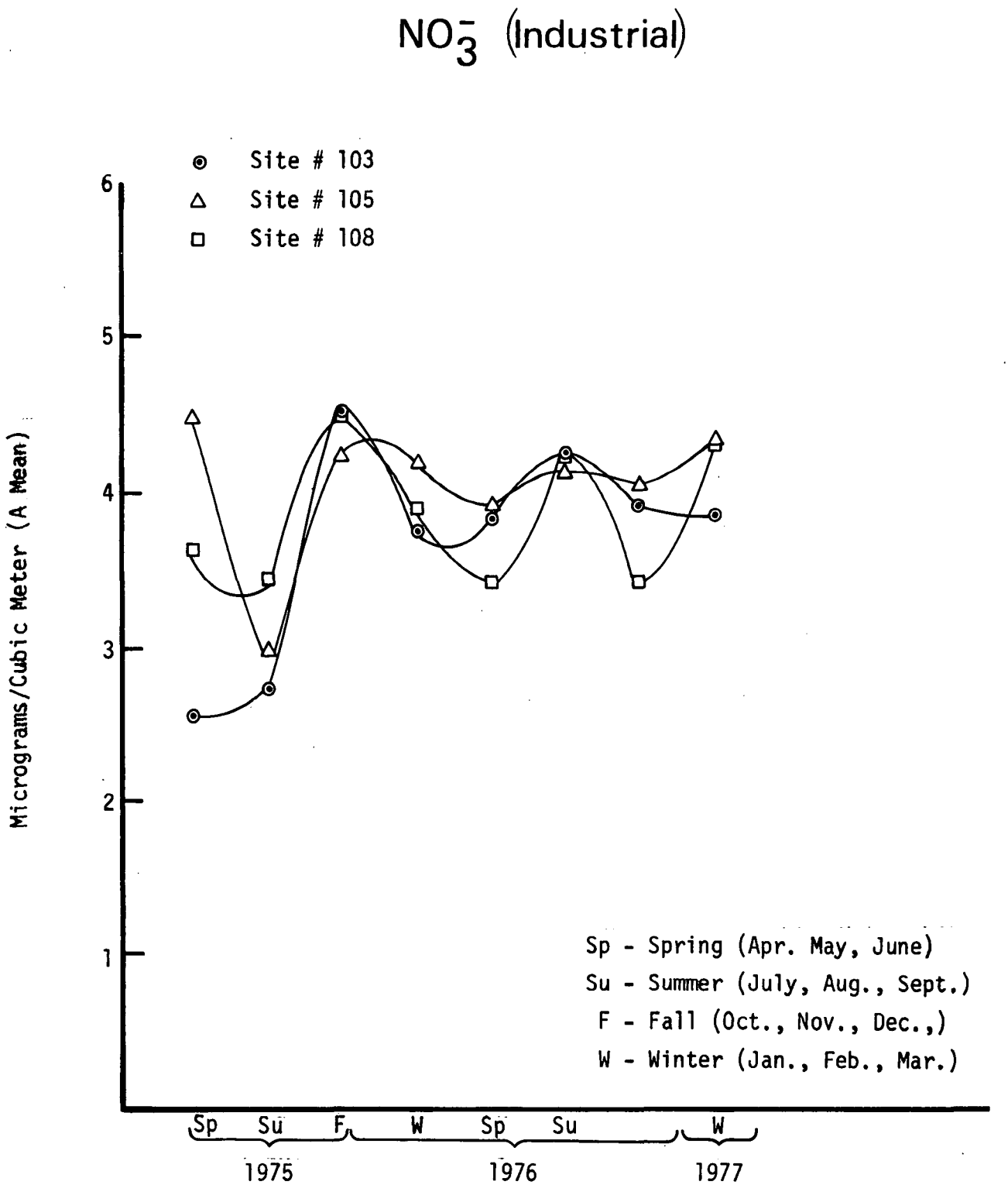
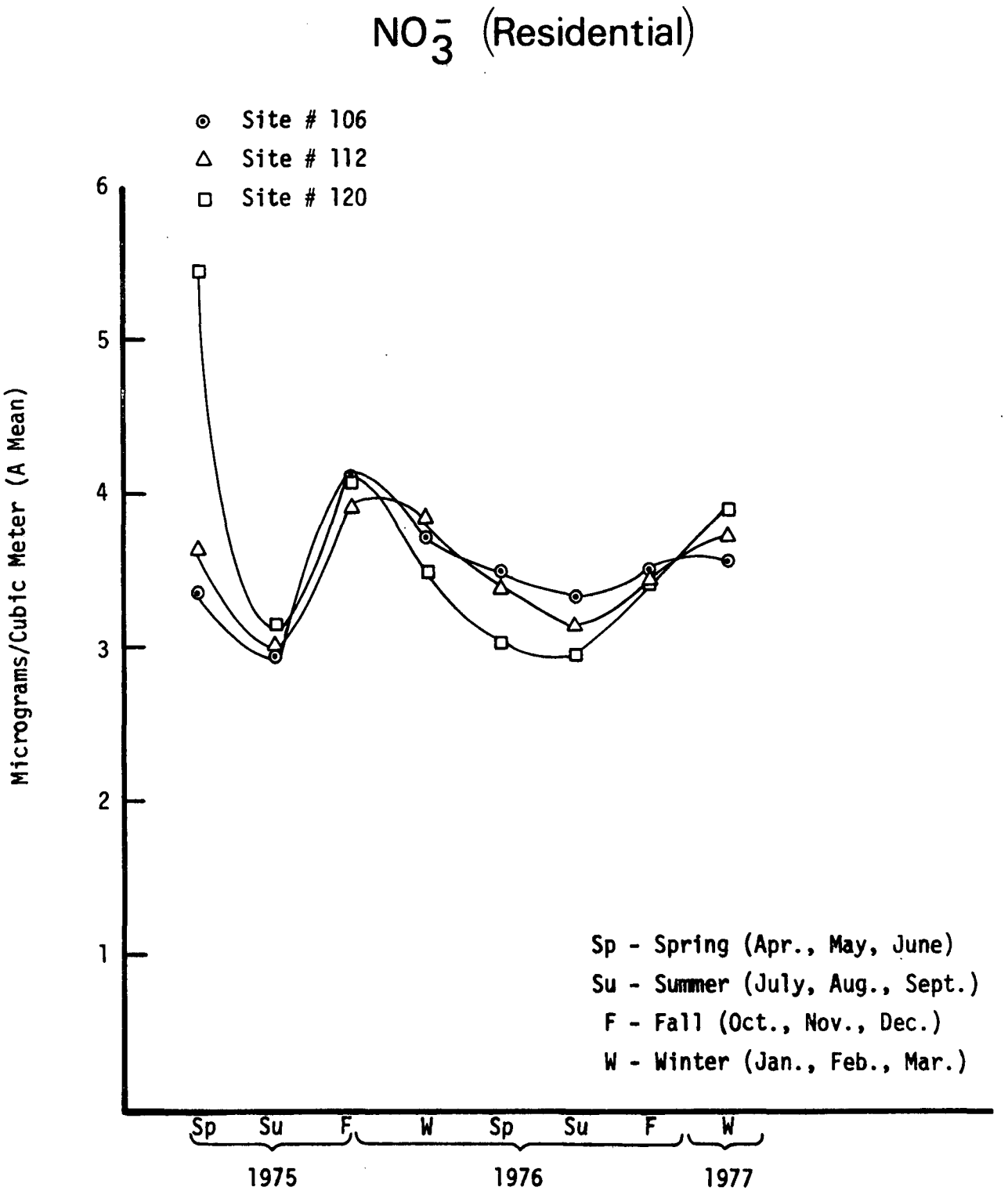

NO_3^- (Industrial)
Site # 103
Site # 105
Site # 108
Micrograms/Cubic Meter (A Mean)
6
5
4
3
2
1
Sp - Spring (Apr. May, June)
Su - Summer (July, Aug., Sept.)
F - Fall (Oct., Nov., Dec.,)
W - Winter (Jan., Feb., Mar.)
Sp
Su
F
W
Sp
Su
W
1975
1976
1977

FIGURE 16


NO_3^- (Residential)
Site # 106
Site # 112
Site # 120
Micrograms/Cubic Meter (A Mean)
6
5
4
3
2
1
Sp - Spring (Apr., May, June)
Su - Summer (July, Aug., Sept.)
F - Fall (Oct., Nov., Dec.)
W - Winter (Jan., Feb., Mar.)
Sp Su F W Sp Su F W
1975
1976
1977

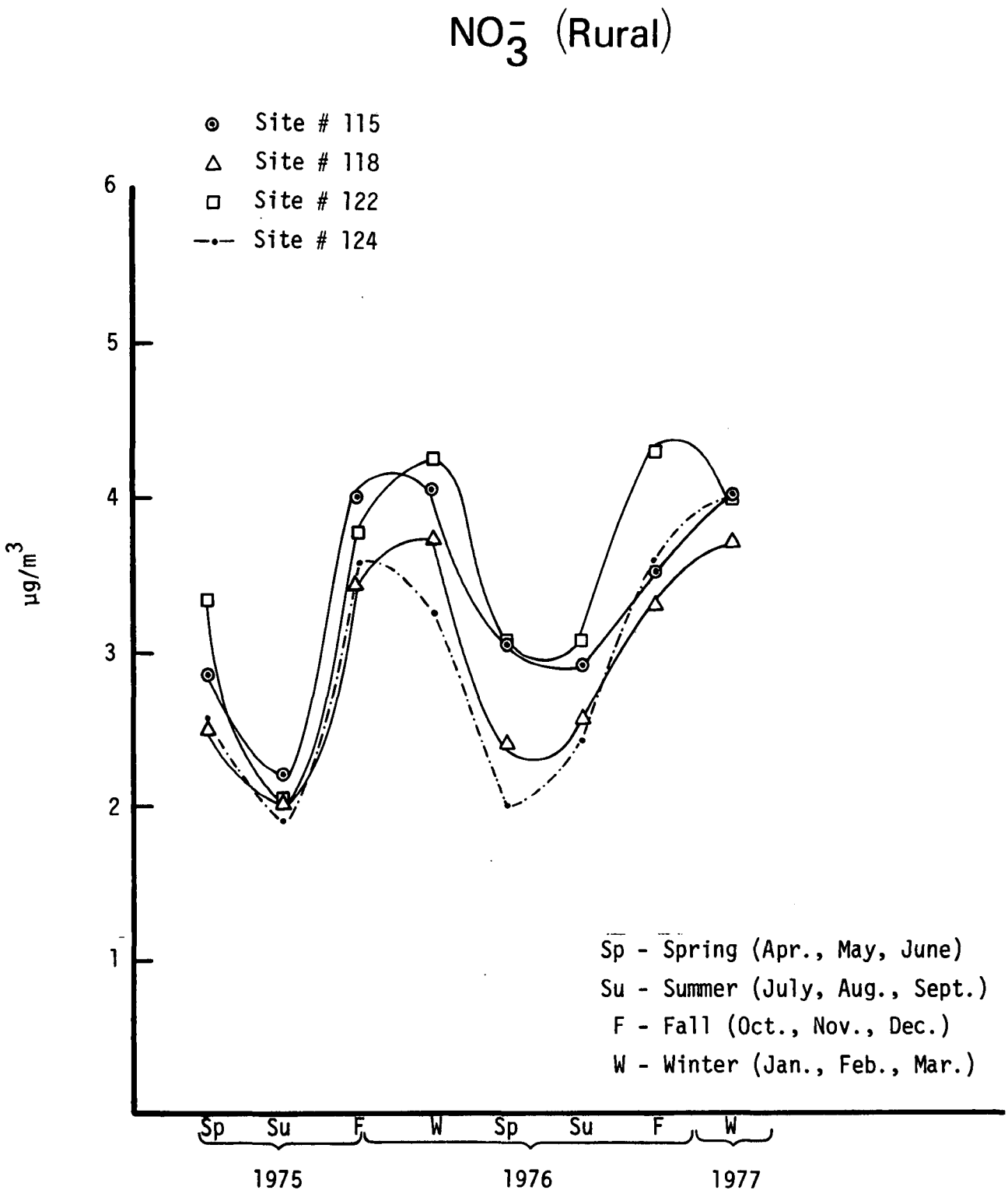

NO_3^- (Rural)
Site # 115
Site # 118
Site # 122
Site # 124
6
5
4
3
2
1
µg/m3
Sp - Spring (Apr., May, June)
Su - Summer (July, Aug., Sept.)
F - Fall (Oct., Nov., Dec.)
W - Winter (Jan., Feb., Mar.)
Sp
Su
F
W
Sp
Su
F
W
1975
1976
1977

FIGURE 18

4.0 CONCLUSIONS

For all high volume stations during the year 1975, the quarterly arithmetic means showed that: there was a significant difference between stations and also between quarters for TSP; no significant difference between stations for $SO_4^=$ but a significant difference between quarters; no significant difference between stations but a significant difference between quarters for NO_3^-. In 1976: there again was a significant difference between stations and quarters for TSP; again no significant difference between stations but there was a significant difference between seasons for $SO_4^=$, there was a significant difference between stations and quarters for NO_3^-.

The station grouping appears to indicate that levels of TSP and NO_3^- are more influenced by local sources while $SO_4^=$ is an area-wide occurrence producing the same trends in all quarters. The highest levels of $SO_4^=$ for the sampling period occurred during the summer quarters and the lowest levels during the fall and winter quarters.

REFERENCES

1. Senter, R. J. Analysis of Data. Scott, Foresman and Company, Glenview, Illinois. 1969. pp 241-281.

2. Dixon, W. J. and F. J. Massey, Jr. Introduction to Statistical Analysis. McGraw-Hill Book Company, USA. 1969. pp 119-123.

3. Federal Register. Vol. 36, No. 84, April 30, 1971. Appendix B.

APPENDIX A

HIGH VOLUME AIR SAMPLER - AS USED IN THE RAMS NETWORK

FIGURES

Number		Page
A-1	Installation Diagram	71

HIGH VOLUME AIR SAMPLER - AS USED IN THE RAMS NETWORK

The high volume air sampler is an instrument used to capture suspended particulate matter on a filter by passing relatively large volumes of air (1.5 to 2.0 cubic meters per minute). The sampler consists essentially of a motor driven blower and a supporting screen for the filter, upstream from the blower unit. The sampler was supported in a protective aluminum housing so that the 20.3 by 25.4 cm surface of the filter was in a horizontal position. The shelter was fabricated from 2.03 mm aluminum sheet metal with 3.17 mm aluminum angle braces and legs.

The Sierra 305 high volume samplers used in the high volume filter measurements of suspended particulate matter network of the Regional Air Pollution Study (RAPS) were equipped with the Sierra 310B solid state constant flow controllers. The model 310B had a range of 0.425 to 1.56 standard cubic meters-per-minute (m^3/min STP) and a 0 to 5 vdc output voltage proportional to flow rate (m^3/min STP). The constant flow controller used a constant temperature anemometer which was mounted in the throat of the filter holder to control the flow rate through the sampler at a constant value measured in units of m^3/min (STP), independent of line voltage variation, ambient pressure, ambient temperature and filter loading. The flow rate was adjusted with an adjustable resistor mounted within the electronics package. The output voltage from the controller was fed into the Regional Air Monitoring System (RAMS) Station Data Acquisition System (DAS). The use of Model 310B simplified calibration and operational procedures because calibration was not required when motor brushes or the motor/blower assembly was replaced. Figure A-1 depicts the installation diagram of the high volume sampler as used in the RAMS network. The use of the constant flow controller made the sampler rather unique and it met or exceeded specifications set forth in the Federal Register (3) regarding accuracy and the requirement that all measurements be referenced to standard conditions.

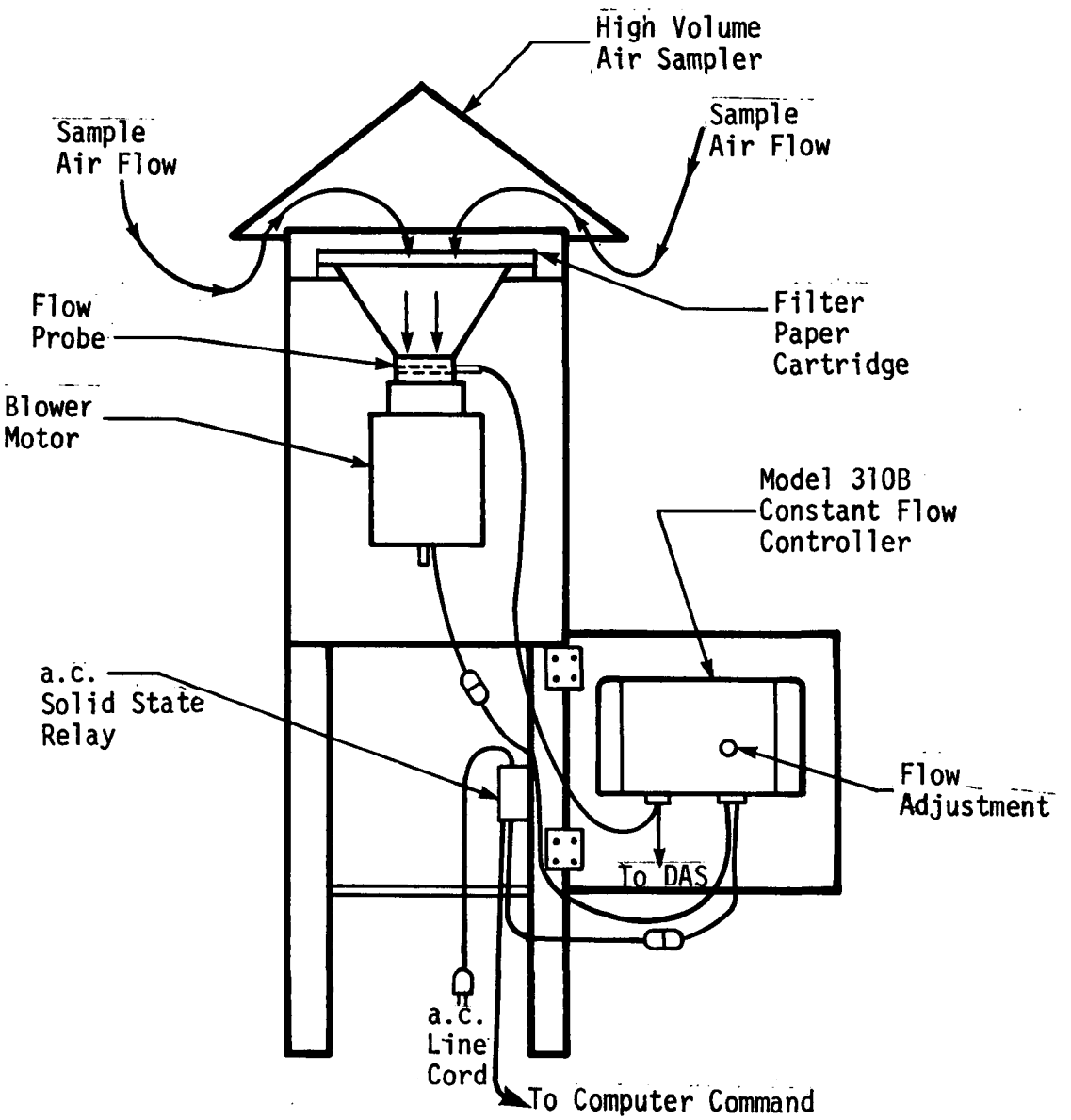


FIGURE A-1. INSTALLATION DIAGRAM

CALIBRATION METHOD FOR MODEL 330 TOP-LOADING ORIFICE CALIBRATOR

The recommended method of calibrating a system equipped with the 310 constant flow controller was to use the Model 330 Top-Loading High Volume Orifice Calibrator. The Model 330 easily attached to the top of the filter holder and thereby eliminated the need to disconnect the motor/blower from the sampler in order to perform the calibration.

Each Model 330 calibrator was factory calibrated. A U-tube water manometer was used to measure the pressure drop across the orifice plate. A calibration curve and formulas were provided to correct for ambient temperature and pressure conditions. Corrections for ambient temperatures and barometric pressure had to be made to reference the calibration flow rate to standard conditions as required in the EPA high volume sampler method.

The procedure used to calibrate the high volume sampler equipped with the Model 310 constant flow controller and the Model 330 Top-Loading Orifice Calibrator was as follows:

A clean standard filter was placed on the filter holder and the Model 330 was mounted on top of the filter and the holder tightly pulled down with the wing nuts. A hose was connected between the pressure tap on the calibrator and a center zero water manometer. The sampler was allowed to run approximately five minutes for stabilization. The feedback section of the constant flow controller was disconnected and a manually operated motor controller was connected to the motor. By varying the speed of the sampler motor ten points were obtained. The value of ΔP was obtained by reading the water manometer and the output voltage from the flow controller by reading the voltage from the station Data Acquisition System (DAS). The DAS provided two means by which voltage readings were made: digital voltmeter, teletype writer printout from the computer of half-second readings and one minute averages, the latter was preferred. Barometric pressure and temperature

readings were taken at each point. The data thus obtained were fitted to a parobolic cure to yield the general equation $y = a_0+a_1x+a_2x^2$. This equation was entered into the central computing system to indicate the average hourly sample air flow in cfm and with subsequent conversions to m^3 for the total volume of air drawn through each filter.

CORRECTION METHOD FOR MODEL 330 TOP-LOADING ORIFICE CALIBRATOR*

This procedure was used to convert the data obtained from the Model 330 Calibrator to standard conditions, as required by the EPA:

$$Q_s = \sqrt{(Pa/Ps) \times Ts/Ta)} \quad \times \quad Q_{ind.} = \sqrt{(Pa/Ta)} \times 3.156 \times Q_{ind.}$$

where Q_s = Flow rate in SCFM, corrected for local barometric pressure and ambient temperature.

$Q_{ind.}$ = Flow rate obtained from factory calibration curve corresponding to measured orifice pressure drop.

Pa = Barometric pressure, 29.92 in. Hg.

Ta = Ambient temperature in absolute units, degrees Kelvin (°K).

Ts = Standard temperature in absolute units, 25°C = 298°K.

°K = Degrees Centigrade (°C) = 273.

*From Sierra Instruments Manual

APPENDIX B
PARTICULATE DATA SUMMARY

RAMS/RAPS PARTICULATE SUMMARY: TOTAL SUSPENDED PARTICULATES (TSP) 01-JAN-75 THROUGH 31-DEC-75

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
3/ 8/75								28.4 *		
3/13/75				46.5		52.9 *			21.0	
3/16/75	87.0	150.1	94.8	66.8	83.5			114.9	46.7	56.1
3/19/75		88.1	109.3 *	74.7	72.9	64.9 *			40.3	44.6
3/22/75		83.0		99.8 *	74.6			60.3	52.7	45.7
3/25/75		47.9	72.3	44.8	36.2	41.4	39.3		19.6	31.4
3/28/75	115.7 *	52.6	152.5 *	40.9	48.9			44.4	27.1	25.9
3/31/75		56.1		72.9	46.8	23.7	21.5		25.8	18.4
4/ 3/75		60.4 *	58.3 *	23.3	32.7 *		47.8	31.6	16.3	21.3
4/ 6/75		64.3	50.9	35.4	105.5	29.7	54.0		36.3	32.2
4/ 9/75		133.7		91.5	140.0		104.1	102.1	61.3	57.4
4/12/75	69.4	68.9	75.2	57.3	61.3	53.0	66.0		35.3	
4/15/75		113.6					155.2	87.1	47.5	
4/18/75		117.9		145.3 *		61.3	74.6		48.5	62.0 *
4/21/75		89.7	160.6 *		104.1		142.1	68.0	68.6	91.9
4/24/75		65.7 *		63.2	71.9	36.1	38.3			
4/27/75	90.2	76.0	83.7	82.1	113.0		168.4		75.7	53.7 *
4/30/75		80.6	73.8		67.7		58.6		63.8 *	
5/ 3/75	101.0			80.6					62.0	
5/ 9/75	111.6	193.9	118.4	81.0	98.5		80.2		67.7	81.9
5/12/75		159.6 *	64.9	55.6	52.0		52.3		37.7	
5/15/75	100.0	95.1	74.9	119.8			93.5	77.3	82.0	115.1
5/18/75	167.1 *	112.6		71.0	161.5	96.0			45.7	
5/21/75			76.2		72.8	100.2 *		79.5		
5/24/75		84.7	68.8	96.9	94.1	81.1	82.2		56.4	
5/27/75		99.0		125.2 *	69.7		85.6	55.4	49.8	
5/30/75	141.2	65.2		69.8		49.4				
6/ 2/75	66.1		78.8 *	76.6	52.2			54.2 *	27.3	
6/ 5/75			76.3 *	65.4	56.4	69.3	79.4 *		39.6	
6/ 8/75	92.0	89.2	103.8	72.1	113.5		203.5	91.2 *	46.9	
6/11/75	102.0	87.9 *	64.9 *	61.8	105.0 *	53.7	59.2			32.7
6/14/75	86.5	62.3	69.4	102.4	70.6	72.4	145.1	52.4	63.2	
6/17/75	69.5	50.1	43.6 *	54.8	44.7	34.5	34.6		30.6	47.3
6/20/75	108.0	109.7	96.1	118.0	74.8	60.9	59.0 *	79.6 *	70.1 *	
6/23/75	109.5			93.2		50.6	100.8		113.2 *	
6/26/75	59.1			110.9	79.9 *	85.1	64.1	260.0 *	228.0	
6/29/75	168.9			135.0	128.9	61.9	51.6		87.2	194.4
7/ 3/75			209.5	163.3		138.7	169.4	151.9 *	118.8	351.0 *
7/ 5/75	156.0				145.7	127.5 *	85.2		64.1	
7/ 8/75	103.4		92.3	77.7	288.6	54.7	64.5	85.4 *	45.3	135.0
7/11/75	103.2			68.9	221.2	48.4	63.9 *			57.2
7/14/75	93.6	69.8	71.0	87.0	58.7	50.3		48.6	86.2 *	56.4
7/17/75	181.9 *			114.5	131.3 *		78.3 *		74.4	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: TOTAL SUSPENDED PARTICULATES (TSP) 01-JAN-75 THROUGH 31-DEC-75

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
7/20/75	64.3 *	70.3 *	96.8 *	65.9 *			89.7 *	46.4 *	41.6	
7/23/75	106.5	94.2		100.0	72.4				42.9	76.3 *
7/26/75	93.6		98.0	147.2 *	184.5	108.5	101.1	94.0 *	63.2	
7/29/75	160.4	144.3	120.2	101.5	201.0	112.4			97.1	
8/ 1/75	38.1	61.9 *	44.6 *	35.5	49.1 *	28.2	56.1		32.2	
8/ 4/75	106.2		74.0	57.0	76.6 *	49.2 *	86.2		66.8	106.6
8/ 7/75	114.6	108.1 *	73.5	67.0	96.7 *	42.2	84.4	118.8 *	80.0	
8/10/75	131.5	66.2	76.4	137.8	164.3	72.2				
8/13/75	81.8		91.3	91.1	97.8	62.2	76.2 *		57.9	
8/16/75	73.6	80.7	82.4	89.2	85.5	57.9	76.3 *	118.8 *	28.6	37.2
8/19/75	69.2	78.9	58.9	95.3		79.7 *	34.9	71.7	66.0 *	18.7
8/22/75	78.6	88.6	91.9	126.9	76.7	79.7	63.8		79.2	50.2 *
8/25/75	190.7 *	72.7			65.9	57.9 *	33.7		58.1	
8/28/75	54.0	91.7	60.0	124.8	72.5 *		50.9	124.9	62.0	61.6 *
8/31/75	53.6	52.3	39.8	59.0	41.3	37.7	39.5	78.4	22.0	36.7
9/ 3/75	81.3	63.1	93.6	124.8	84.2	86.5	64.3	48.1	58.1	
9/ 6/75	68.8	66.3		46.9	105.7	35.3	45.1	85.5	21.9	35.4
9/ 9/75	80.4	107.8	9.4		108.2	58.6	58.9		62.1	
9/12/75	100.2 *	81.2 *			87.4 *	59.4 *		46.6 *		70.6 *
9/15/75	79.8	85.4	69.8	102.4	67.4	55.5	59.0			
9/18/75		64.4		114.9	96.3		39.2	78.4	36.3	33.8
9/21/75	40.3	22.9	30.1	33.4 *	20.3	28.2	24.5	46.9 *	26.1	
9/24/75	85.0	93.0		60.1	52.4	41.7	80.7	86.8 *	30.9	56.4
9/27/75	138.2	94.6	122.0 *	19.8	80.7	58.3	54.1		60.9	
10/ 3/75	132.5	127.9		158.0	67.1	68.9	48.6		10.0	
10/ 6/75	208.3	124.7		150.2	88.7 *	101.1	60.6	69.8	49.4	60.5
10/10/75	116.4	150.7	117.9	160.7	155.4	84.8	70.7	18.8 *	74.4	
10/12/75	88.2	81.5		94.6		71.2	59.2	93.6	49.7	62.5
10/15/75	79.2	68.6	55.1	68.1	63.5	49.9	57.3	67.5 *	27.3	
10/18/75	121.5	101.5		51.3	44.6	42.9	79.2 *	157.4	44.8	31.5
10/21/75	65.9 *	54.7	110.1	117.5	97.6	84.9			55.9	
10/24/75	90.0	104.1		97.4	107.0	64.9	62.0	33.0	51.4	44.4
10/27/75	48.7	63.6	95.1	107.6	69.1	52.3 *	98.0		54.9	
10/30/75	113.8	70.8	57.5	104.6	64.8	29.1	52.9 *	46.1 *	19.9	29.4 *
11/ 2/75	45.6	67.9	58.1	62.1	54.5		43.0	38.2	47.8	
11/ 5/75	59.5	89.0	69.7	67.8	70.0				25.1	
11/ 8/75	99.6	79.7	72.9	106.2	67.4		48.4	39.0 *	49.9	
11/11/75		80.0 *	63.2 *		59.6 *	39.3	28.5		34.5 *	34.3
11/14/75	105.5	78.0 *	67.4 *	99.8	64.7 *	58.1	48.4		46.0	
11/17/75	128.5	101.2			71.9	67.3	42.8	75.6 *	57.0 *	40.9
11/20/75	37.6		25.5	35.8	22.1	16.8	20.6		14.1	
11/23/75	109.6	65.2	47.7	86.2	42.8	53.3	38.2	43.1	47.4 *	29.9
11/26/75	105.1	74.1	43.1	15.7	49.7	34.5	32.7	38.1	18.2	31.3

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: TOTAL SUSPENDED PARTICULATES (TSP) 01-JAN-75 THROUGH 31-DEC-75

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
11/29/75	91.7	42.4	32.0	71.2	29.4	34.3	42.9	27.7	33.6	37.8 *
12/ 2/75		104.4	84.5		79.8	61.3	44.3	33.6	35.4	27.8
12/ 5/75	124.1	109.0	64.5	143.4 *	60.5	27.9	34.2		78.7 *	31.3
12/ 8/75	112.2	86.8	162.5 *	82.8	48.2	43.8	47.8		29.2	29.2
12/11/75	79.0	95.6	65.9	87.9	69.2	41.9	46.4	55.6	25.0	24.5
12/14/75	65.5	42.5	36.3	44.0	30.9	25.1	29.7	65.0	50.1	17.8
12/17/75	48.7	58.7	44.2	31.2	27.0	26.0	30.1	17.6	20.4	44.9 *
12/20/75	54.6	44.6 *	41.8	26.9	21.0	31.8	43.7	29.8	23.5	21.9
12/23/75	130.1	140.0	91.6	70.2	70.8	47.4	95.2	20.4 *	52.4	52.1
12/26/75	52.7	46.0	41.8	25.9	30.9	29.4	49.2	101.5	20.4	32.9
12/29/75	91.4	72.2	52.3	44.3	46.9		2.8	25.9		

STATISTICS	103	105	106	108	112	115	118	120	122	124
# OBS	74	79	67	85	85	71	79	54	87	51
ARITH MEAN	97.0	85.3	77.2	83.0	81.7	57.7	65.8	69.6	51.1	56.4
ARITH SDEV	36.3	30.1	34.3	35.6	45.4	25.0	35.7	42.0	29.2	53.0
GEO MEAN	90.5	80.4	69.9	74.5	71.7	52.7	57.2	59.7	44.7	45.4
GEO SDEV	1.46	1.42	1.61	1.65	1.67	1.54	1.79	1.75	1.69	1.81
ANNUAL MAX	208.3	193.9	209.5	163.3	288.6	138.7	203.5	260.0	228.0	351.0
DATE OF MAX	10/ 6/75	5/ 9/75	7/ 3/75	7/ 3/75	7/ 8/75	7/ 3/75	6/ 8/75	6/26/75	6/26/75	7/ 3/75
DISTRIBUTION:										
< 25.	0	1	1	3	3	2	4	3	12	6
25.- 50.	6	5	12	13	16	27	26	19	36	24
50.- 75.	15	27	25	24	31	28	24	10	28	13
75.-100.	19	26	18	19	16	8	16	13	8	3
100.-125.	21	12	7	15	8	4	3	6	2	2
125.-150.	6	4	0	7	4	2	2	0	0	1
150.-175.	4	3	3	4	3	0	3	2	0	0
175.-200.	2	1	0	0	1	0	0	0	0	1
>200.	1	0	1	0	3	0	1	1	1	1

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: SULFATES 01-JAN-75 THROUGH 31-DEC-75

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
3/ 8/75								8.8 *		
3/13/75				11.8		12.5 *			6.6	
3/16/75	15.8	16.0	14.7	15.1	15.1			14.8	12.4	15.7
3/19/75		10.4	15.2 *	11.5	10.4	20.9 *			9.3	11.5
3/22/75		11.5		19.1 *	10.8			9.5	8.4	10.1
3/25/75		5.2	4.5	5.2	4.6	7.2	4.7		3.9	5.3
3/28/75	27.3 *	11.1	33.0 *	11.3	12.8			11.5	7.8	7.5
3/31/75		5.7		9.6	4.7	5.4	3.9		6.2	4.4
4/ 3/75		6.8 *	8.4 *	5.6	7.8 *		4.6	5.3	4.4	5.2
4/ 6/75		10.3	7.8	6.4	8.2	6.8	5.1		6.4	6.0
4/ 9/75		19.2		13.6	16.9		10.5	15.6	12.8	11.1
4/12/75	10.4	7.3	5.7	6.8	6.9	9.4	6.5		5.5	
4/15/75		22.6					17.0	19.6	13.4	
4/18/75		11.3		23.6 *		9.5	7.0		9.8	12.1 *
4/21/75		8.9	20.7 *		8.3		6.1	7.9	9.7	6.9
4/24/75		18.3 *		12.3	11.9	9.6	7.7			
4/27/75	15.1	17.5	16.9	18.4	17.5		13.8		18.2	3.1 *
4/30/75		8.9	7.4		7.8		4.8		13.5 *	
5/ 3/75	9.8			12.1					9.9	
5/ 9/75	25.0	26.9	22.7	22.0	21.1		14.6		20.7	18.7
5/12/75		24.0 *	11.7	16.6	11.6		12.1		9.6	
5/15/75	6.0	7.3	6.4	13.6			8.8	9.0	8.2	8.1
5/18/75	20.5 *	14.4		7.5	10.7	15.7			4.1	
5/21/75			7.7		5.8	10.2 *		6.3		
5/24/75		13.1	12.1	13.8	10.7	12.4	12.0		7.5	
5/27/75		11.3		13.9 *	5.8		5.5	6.0	4.3	
5/30/75	8.0	8.5		11.6		8.6				
6/ 2/75	7.7		14.9 *	7.4	7.7			13.1 *	4.9	
6/ 5/75			8.7 *	6.5	6.4	8.3	10.8 *		6.3	
6/ 8/75	5.1	13.7	9.7	7.9	8.0		8.0	10.9 *	8.3	
6/11/75	13.5	19.4 *	15.2 *	14.1	28.4 *	15.9	14.7			11.0
6/14/75	7.0	5.6	6.3	9.0	8.5	6.9	4.4	6.3	6.3	
6/17/75	5.0	4.7	9.6 *	7.5	5.4	8.5	4.6		6.5	3.8
6/20/75	8.2	12.3	11.3	15.0	9.1	11.0	12.8 *	16.0 *	15.6 *	
6/23/75	11.1			15.5		11.4	7.3		33.9 *	
6/26/75	10.0			19.5	18.2 *	34.7	15.6	57.2 *	73.4	
6/29/75	32.8			26.2	39.8	19.1	20.2		29.7	35.4
7/ 3/75			57.5	47.7		44.6	48.9	49.3 *	40.4	64.1 *
7/ 5/75	20.5				19.9	35.8 *	21.4		16.1	
7/ 8/75	7.7		8.5	8.9	50.3	8.1	7.5	7.9 *	5.9	17.5
7/11/75	7.7			8.6	5.7	7.8	6.9 *			6.3
7/14/75	7.1	7.4	8.6	10.9	7.8	9.2		5.4	19.5 *	5.5
7/17/75	21.3 *			17.9	24.9 *		18.9 *		19.8	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: SULFATES 01-JAN-75 THROUGH 31-DEC-75

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
7/20/75	7.1 *	10.9 *	16.0 *	9.2 *			10.4 *	8.1 *	9.2 *	
7/23/75	14.0	13.9		15.3	15.4				12.0	18.1 *
7/26/75	13.7		23.9	28.4 *	34.9	31.0	13.2	22.7 *	17.5	
7/29/75	32.2	40.7	35.0	33.4	33.9	35.7			21.3	
8/ 1/75	7.3	14.5 *	11.3 *	8.4	9.8 *	7.7	6.9		7.8	
8/ 4/75	17.6		14.8	14.6	20.0 *	13.5 *	20.1		6.0	18.4
8/ 7/75	7.8	16.5 *	11.2	10.9	16.8 *	8.5	7.3	21.1 *	23.9	
8/10/75	22.7	18.2	21.4	31.6	21.3	18.9				
8/13/75	11.1		16.4	14.4	10.1	12.3	18.1 *		12.7	
8/16/75	21.7	24.6	23.8	25.0	23.5	19.7	11.5 *	21.1 *	10.6	14.2
8/19/75	9.9	10.2	10.0	13.3		16.3 *	6.8	54.1	17.1 *	4.1
8/22/75	17.4	20.4	23.1	28.5	21.4	22.3	18.5		24.4	12.6 *
8/25/75	27.5 *	10.4			7.5	9.6 *	4.8		15.9	
8/28/75	12.5	17.0	15.7	21.0	19.6 *		14.3	28.6	18.4	17.2 *
8/31/75	14.6	15.9	15.1	20.7	15.1	16.4	14.7	22.2	8.9	13.1
9/ 3/75	17.9	12.1	22.3	31.3	19.8	25.5	18.2	17.1	18.2	
9/ 6/75	9.6	9.7		6.9	17.8	6.3	9.4	20.2	3.7	10.8
9/ 9/75	14.2	21.8	19.7		9.3	13.1	13.9		15.1	
9/12/75	9.6 *	8.5 *			11.5 *	8.4 *		8.3 *		12.0 *
9/15/75	12.2	13.3	14.8	18.5	11.1	12.2	11.9			
9/18/75		13.6		27.0	19.8		12.2	9.1	19.4	12.2
9/21/75	6.0	3.3	4.7	5.3 *	3.3	5.3	5.0	16.0 *	7.2	
9/24/75	11.2	7.9		8.3	6.3	5.2	8.0	12.6 *	3.7	8.3
9/27/75	13.5	12.3	20.2 *	16.7	11.0	11.1	9.5		11.9	
10/ 3/75	15.4	15.0		17.8	9.7	10.8	7.9		8.8	
10/ 6/75	26.8	15.8		18.6	16.3 *	19.4	12.8	12.3	6.6	13.7
10/10/75	11.6	9.2	13.6	10.1	9.2	7.8	9.1	11.9 *	7.8	
10/12/75	12.7	11.2		14.6		11.9	11.1	8.7	10.6	13.1
10/15/75	6.7	5.7	6.8	7.2	4.7	6.9	6.5	12.3 *	4.4	
10/18/75	11.2	7.7		6.9	6.3	6.2	17.3 *	15.1	3.9	5.8
10/21/75	5.7 *	6.2	8.7	9.4	5.9	8.0			6.1	
10/24/75	9.6	8.9		13.0	10.6	8.6	8.5	4.1	10.0	8.5
10/27/75	6.7	6.8	11.2	16.2	10.0	11.4 *	10.0		12.4	
10/30/75	29.5	8.9	8.5	18.8	9.0	5.8	9.1 *	8.8 *	4.4	7.3 *
11/ 2/75	8.8	10.9	13.5	9.2	12.2		9.7	7.3	13.5	
11/ 5/75	9.8	11.7	12.0	11.6	11.3				5.4	
11/ 8/75	11.3	11.4	9.9	15.9	10.4		10.3	12.0 *	9.7	
11/11/75		6.1 *	8.4 *		6.7 *	5.5	5.1		6.8 *	7.6
11/14/75	8.6	7.2 *	7.3 *	10.6	27.2 *	9.7	7.0		6.7	
11/17/75	11.9	7.6			7.9	10.1	6.3	12.4 *	8.5 *	6.8
11/20/75	5.6		5.3	6.9	5.1	5.3	4.9		5.0	
11/23/75	12.7	9.7	7.2	11.5	6.8	9.5	8.0	8.9	12.2 *	8.9
11/26/75	14.0	19.0	11.9	2.3	26.1	12.2	10.7	6.4	8.8	10.3

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: SULFATES 01-JAN-75 THROUGH 31-DEC-75

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
11/29/75	10.1	11.7	11.0	15.8	9.5	11.9	11.7	8.5	12.6	13.3 *
12/ 2/75		8.6	7.9		7.8	8.5	6.8	9.3	5.4	4.9
12/ 5/75	11.3	10.3	10.5	26.1 *	9.6	9.5	11.4		17.1 *	8.7
12/ 8/75	17.7	14.2	33.9 *	15.7	11.6	12.0	12.1		9.7	10.3
12/11/75	12.5	12.2	10.1	13.5	10.3	9.4	11.1	5.2	7.3	11.3
12/14/75	10.8	9.4	10.2	11.6	9.2	8.5	8.4	11.2	13.1	7.4
12/17/75	5.7	6.7	5.6	5.9	5.1	7.5	7.6	6.4	5.4	14.7 *
12/20/75	7.3	6.7 *	5.7	6.0	5.5	11.0	7.0	4.2	7.0	6.2
12/23/75	15.7	20.3	14.3	15.7	12.5	12.0	19.9	4.7 *	12.0	12.6
12/26/75	12.1	12.7	12.2	11.9	11.2	15.8	13.3	16.9	7.7	11.8
12/29/75	15.3	20.0	16.4	14.4	13.4		12.4	9.1		

STATISTICS	103	105	106	108	112	115	118	120	122	124
# OBS	74	79	67	85	85	71	79	54	87	51
ARITH MEAN	13.1	12.5	13.8	14.5	13.1	12.7	10.9	13.9	11.9	11.6
ARITH SDEV	6.6	6.1	8.7	7.6	8.4	7.9	6.2	11.1	9.5	9.2
GEO MEAN	11.7	11.3	12.0	12.7	11.1	11.1	9.7	11.4	9.8	9.8
GEO SDEV	1.59	1.57	1.68	1.67	1.73	1.63	1.60	1.82	1.79	1.73
ANNUAL MAX	32.8	40.7	57.5	47.7	50.3	44.6	48.9	57.2	73.4	64.1
DATE OF MAX	6/29/75	7/29/75	7/ 3/75	7/ 3/75	7/ 8/75	7/ 3/75	7/ 3/75	6/26/75	6/26/75	7/ 3/75
DISTRIBUTION:										
< 5.	0	2	2	1	4	0	8	3	10	5
5.- 10.	28	28	23	25	34	35	32	23	40	18
10.- 15.	25	28	21	26	21	19	27	11	16	20
15.- 20.	9	12	9	19	13	9	8	8	13	6
20.- 25.	5	7	8	4	6	2	3	5	4	0
25.- 30.	5	1	0	6	3	1	0	1	1	0
30.- 35.	2	0	2	3	2	2	0	0	1	0
35.- 40.	0	0	1	0	1	2	0	0	0	1
> 40.	0	1	1	1	1	1	1	3	2	1

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: NITRATES 01-JAN-75 THROUGH 31-DEC-75

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
3/ 8/75								2.4 *		
3/13/75				3.1		5.8 *			3.7	
3/16/75	9.9	10.9	10.3	9.2	9.0			7.0	8.1	8.6
3/19/75		5.8	8.4 *	5.2	5.6	6.8 *			4.7	6.3
3/22/75		9.3		16.2 *	8.0			5.3	8.6	8.0
3/25/75		1.5	1.1	1.1	1.3	1.7	1.1		1.2	1.9
3/28/75	12.4 *	5.4	12.9 *	5.5	5.4			6.1	5.8	3.9
3/31/75		1.3		1.7	1.4	1.6	1.3		1.9	1.2
4/ 3/75		3.8 *	3.9 *	2.8	4.2 *		1.8	3.2	2.8	3.0
4/ 6/75		5.2	5.2	4.7	5.2	4.8	4.4		4.7	4.9
4/ 9/75		10.0		10.0	10.7		4.7	10.2	8.9	6.7
4/12/75	3.6	3.2	2.7	3.4	3.6	4.0	3.5		3.3	
4/15/75		13.7					7.1	10.5	8.1	
4/18/75		2.8		3.9 *		2.7	2.1		3.0	3.3 *
4/21/75		3.0	6.9 *		3.3		1.7	3.5	4.9	3.6
4/24/75		2.0 *		3.7	3.3	3.8	3.0			
4/27/75	2.0	3.6	3.4	3.1	3.4		1.8		3.6	0.5 *
4/30/75		3.0	2.7		3.2		2.4		3.1 *	
5/ 3/75	2.7			4.6					3.7	
5/ 9/75	5.7	9.2	3.8	2.5	2.6		4.8		3.4	2.8
5/12/75		10.0 *	3.0	4.1	2.8		3.9		3.7	
5/15/75	1.1	3.6	2.8	4.7			4.2	3.1	3.9	3.1
5/18/75	7.0 *	4.3		3.2	3.5	3.5			2.1	
5/21/75			2.5		2.8	4.5 *		2.8		
5/24/75		2.9	1.9	2.7	2.8	2.5	2.2		2.5	
5/27/75		2.7		4.4 *	2.6		2.5	3.2	2.5	
5/30/75	2.1	2.8		2.9		3.0				
6/ 2/75	2.9		6.8 *	2.1	2.8			5.5 *	1.4	
6/ 5/75			2.1 *	2.3	2.2 *	2.2	1.1 *		1.8	
6/ 8/75	2.2	3.1	3.8	3.3	4.2		1.9	5.9 *	3.3	
6/11/75	1.1	1.6 *	0.2 *	1.7	3.3 *	0.9	0.7			0.9
6/14/75	1.1	2.0	2.2	2.9	2.2	2.4	0.4	2.2	2.4	
6/17/75	1.3	1.7	1.4 *	2.3	2.1	1.2 *	1.3		1.7	1.1
6/20/75	1.4	4.1	3.6	6.2	3.7	3.9	3.1 *	5.5 *	4.0 *	
6/23/75	2.0			3.6		3.4	1.5		3.5 *	
6/26/75	4.3			4.6	7.8 *	0.2	2.4	8.7 *	0.1	
6/29/75	1.4			1.5	0.7	2.6	0.0		0.6	0.8
7/ 3/75			2.0	2.1		0.1	1.9	1.9 *	0.3	2.7 *
7/ 5/75	3.1				2.6	3.3 *	1.1		1.7	
7/ 8/75	1.6		4.6	3.9	1.2	3.1	4.0	5.1 *	2.2	1.3
7/11/75	3.0			2.5	3.0	2.0	2.6 *			2.4
7/14/75	2.1	3.0	3.5	4.9	3.0	4.1		1.5	5.6 *	1.7
7/17/75	6.3 *			5.1	7.3 *		3.8 *		1.1	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: NITRATES 01-JAN-75 THROUGH 31-DEC-75

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
7/20/75	0.9 *	4.4 *	3.7 *	3.6 *			3.1 *	3.5 *	2.3 *	
7/23/75	2.4	3.1		2.9	2.9				1.5	3.5 *
7/26/75	4.6		3.3	10.1 *	2.1	3.0	0.5	7.5 *	3.1	
7/29/75	2.6	3.7	2.0	0.9	2.7	0.4			2.8	
8/ 1/75	0.9	1.7 *	1.7 *	1.9	2.0 *	1.4	0.9		1.2	
8/ 4/75	4.6		3.5	2.9	4.6 *	2.2 *	1.8		1.6	1.5
8/ 7/75	2.5	4.6 *	4.3	3.8	4.7 *	3.4	2.7	9.2 *	1.0	
8/10/75	3.0	2.0	0.8	2.5	3.0	1.9				
8/13/75	2.6		3.3	3.8	2.8	3.3	2.2 *		1.8	
8/16/75	1.7	2.4	1.4	1.8	2.8	2.2	2.3 *	9.2 *	1.3	1.3
8/19/75	3.0	3.9	2.8	5.6		5.6 *	1.7	4.7	3.2 *	1.0
8/22/75	2.1	1.5	1.0	1.4	0.8	1.2	0.3		0.2 *	1.7 *
8/25/75	2.9 *	1.8			1.8	2.1 *	0.8		2.2	
8/28/75	3.6	4.7	3.0	6.0	3.7 *		2.3	1.1	2.8	2.6 *
8/31/75	1.8	1.9	1.2	0.7	1.6	0.9	1.2	2.0	0.6	1.4
9/ 3/75	1.6	3.0	1.1	1.6	1.2	0.9	1.3	0.9	0.5	
9/ 6/75	2.5	3.2		2.3	5.5	1.7	2.6	2.1	1.1	2.2
9/ 9/75	4.1	4.9	5.3		2.3	2.6	3.7		3.8	
9/12/75	1.6 *	1.6 *			5.0 *	1.5 *		3.0 *		2.9 *
9/15/75	4.6	5.0	5.6	6.4	5.2	4.7	3.9			
9/18/75		3.3		5.3	2.7		0.9	2.1	2.6	1.4
9/21/75	0.7	1.0	0.8	0.9 *	0.8	0.9	0.7	1.0 *	0.8	
9/24/75	1.7	2.5		2.2	2.0	1.8	2.1	0.9 *	1.3	1.9
9/27/75	4.0	3.5	4.5 *	4.8	4.0	3.8	3.4		5.5	
10/ 3/75	3.4	4.0		5.4	4.3	4.5	4.2		3.7	
10/ 6/75	10.6	6.5		8.0	3.6 *	6.2	2.7	3.6	2.1	3.3
10/10/75	3.3	3.6	2.3	5.4	3.3	4.2	2.3	5.3 *	2.3	
10/12/75	4.2	4.5		5.1		4.8	3.3	5.0 *	3.4	3.3
10/15/75	1.9	2.6	1.6	2.1	1.8	1.7	2.4	4.2	1.2	
10/18/75	7.5	2.0		1.9	1.4	1.6	3.1 *	6.3	1.8	2.2
10/21/75	1.4 *	1.8	2.5	2.4	2.8	2.8			1.8	
10/24/75	2.4	2.5		2.8	2.5	2.5	1.9	1.4	2.6	2.4
10/27/75	2.0	3.0	3.9	4.3	1.9	4.5 *	4.2		2.7	
10/30/75	7.4	4.5	4.0	4.9	4.0	4.0	5.9 *	2.3 *	2.6	5.7 *
11/ 2/75	2.6	3.4	3.1	4.2	3.0		3.2	3.1	4.0	
11/ 5/75	5.5	5.8	5.5	5.8	5.5				4.5	
11/ 8/75	6.1	5.2	4.9	6.7	4.1		4.3	3.2 *	4.7	
11/11/75		3.0 *	2.7 *		1.1 *	3.2	1.5		4.3 *	3.2
11/14/75	5.1	5.2 *	3.6 *	6.7	7.6 *	5.7	3.1		4.2	
11/17/75	5.1	4.5			4.2	6.0	2.3	7.0 *	5.2 *	3.7
11/20/75	0.6		0.6	1.0	0.7	0.9	0.5		0.7	
11/23/75	5.2	5.7	4.7	5.9	4.4	5.6	2.9	3.8	7.5 *	4.1
11/26/75	5.4	5.5	4.9	0.6	11.3	5.8	4.1	4.1	4.1	3.9

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: NITRATES 01-JAN-75 THROUGH 31-DEC-75

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
11/29/75	3.6	3.1	2.9	4.2	2.6	4.1	3.9	3.8	4.2	3.0 *
12/ 2/75		2.9	3.2		3.2	4.4	1.9	2.7	2.7	1.8
12/ 5/75	5.4	5.5	4.4	10.5 *	4.0	5.6	4.0		8.8 *	4.6
12/ 8/75	8.0	5.6	14.8 *	5.6	4.9	5.2	4.4		4.5	3.4
12/11/75	5.1	6.1	4.6	5.3	4.9	5.5	5.0	3.2	3.7	2.3
12/14/75	1.7	1.9	1.7	1.8	2.3	1.9	1.9	5.5	7.4	2.2
12/17/75	2.3	2.8	2.4	2.1	2.7	2.3	2.3	1.6	2.1	4.5 *
12/20/75	2.4	2.6	2.3	2.3	2.9	2.4	3.1	2.6	3.0	2.4
12/23/75	8.0	10.2	8.7	8.4	8.4	6.8	8.9	2.1 *	7.7	8.3
12/26/75	3.9	4.5	5.0	3.1	4.1	2.2	4.8	10.2	3.4	4.7
12/29/75	5.8	6.3	4.8	5.7	3.6		4.2	3.9		

STATISTICS	103	105	106	108	112	115	118	120	122	124
# OBS	74	79	67	85	85	71	79	54	87	51
ARITH MEAN	3.6	4.1	3.7	4.1	3.6	3.2	2.7	4.3	3.2	3.1
ARITH SDEV	2.4	2.4	2.6	2.6	2.1	1.7	1.6	2.5	2.1	1.9
GEO MEAN	2.9	3.5	3.0	3.4	3.1	2.6	2.2	3.5	2.5	2.6
GEO SDEV	1.93	1.71	2.06	1.88	1.78	2.17	1.93	1.88	2.25	1.86
ANNUAL MAX	12.4	13.7	14.8	16.2	11.3	6.8	8.9	10.5	8.9	8.6
DATE OF MAX	3/28/75	4/15/75	12/ 8/75	3/22/75	11/26/75	12/23/75	12/23/75	4/15/75	4/ 9/75	3/16/75
DISTRIBUTION:										
< 5.	55	58	55	60	70	59	75	35	75	45
5.- 10.	17	16	9	21	13	12	4	16	12	6
10.- 15.	2	5	3	3	2	0	0	3	0	0
15.- 20.	0	0	0	1	0	0	0	0	0	0
20.- 25.	0	0	0	0	0	0	0	0	0	0
25.- 30.	0	0	0	0	0	0	0	0	0	0
30.- 35.	0	0	0	0	0	0	0	0	0	0
35.- 40.	0	0	0	0	0	0	0	0	0	0
> 40.	0	0	0	0	0	0	0	0	0	0

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: TOTAL SUSPENDED PARTICULATES (TSP) 01-JAN-76 THROUGH 31-DEC-76

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
1/ 1/76	61.1	51.2	37.9	34.6	38.9	31.4	34.9	26.1	29.0	23.9
1/ 4/76	55.6	37.6	27.6	39.0	26.3	28.6		40.5	27.8	22.7
1/ 7/76	106.5	61.6	56.3	43.4		43.9	50.8	36.2	62.9	44.7
1/10/76		56.8	50.8	66.9 *	53.1	28.7		43.0	39.0	26.3
1/13/76	62.2	51.8	38.7	44.9	52.3	34.8	31.3 *	34.7	28.2	20.7
1/16/76		78.2	59.1	45.0	44.4	36.9	53.6	41.2	30.1	30.6
1/19/76	114.7	95.7	62.3	78.7	50.0	35.3	48.2	30.8	37.7	29.1
1/22/76		130.4	83.2	75.4	102.5	51.3	30.0	71.2	24.8	94.9
1/25/76	82.2	64.3	50.2	34.1	40.5	33.2	46.4	37.4	39.5	31.8
1/28/76	139.6	105.3	209.3	54.1	53.2	41.0	46.2	36.8	45.2	24.8
1/31/76	97.0	75.6	62.0	78.5	61.3	45.1	41.6	39.0	39.4	34.9
2/ 3/76	102.8	72.8	96.8	111.4	74.9	39.3			61.5	29.2
2/ 6/76	80.3		65.4	138.1	37.7	29.9	79.3	106.2	47.9 *	
2/ 9/76	126.8	123.1	78.9	42.7	112.3	39.8		39.9	62.2 *	37.3
2/12/76	106.0	131.3	83.9	98.1	61.8	27.2 *	40.0	35.1	42.6	46.7
2/15/76	118.6	79.7	65.9	83.0	70.2	44.5	60.5	40.1	40.9	39.1
2/18/76	113.8	80.0	76.8	63.5	45.3	34.4	43.5	50.2	28.6	50.2
2/21/76	111.9		78.4	77.2	88.2	57.2	54.1	53.8	58.3	34.5
2/27/76	125.4	161.9	99.8	193.4	109.1	86.3	123.8	56.1	68.3	55.4
3/ 1/76	136.6	145.9	125.0	108.3	121.3	56.3	65.7	69.4	63.1	51.1
3/ 4/76	58.7	66.0	54.1	51.2	72.7	41.5	51.0 *	37.4		36.6
3/ 7/76	108.8	65.1	48.1		42.0	27.8	33.4	34.9	19.9	67.5
3/10/76	104.0	99.2	71.4	72.8	51.2	66.5	90.7	32.9	41.4	
3/13/76	55.0	37.8	41.6		37.0	29.5	47.0	52.7	24.6	37.0
3/16/76	46.8	55.2	52.5	37.3	32.5	26.9	33.4	27.7	29.9	37.0
3/19/76	76.2	76.3	68.1	92.9	68.5		80.0	52.4	51.4	80.3
3/22/76	74.9	73.2	80.9	57.2	69.8		58.9	52.4	36.9	
3/25/76	62.0 *	82.8	73.3 *	119.2	79.0		44.5	43.7	48.2	64.0
3/28/76	43.5	55.5	46.1	38.9			57.8	28.9	21.7	32.0
3/31/76	73.8	54.0	59.6	50.9	29.5		26.4	29.9		40.2
4/ 3/76	72.0	88.2	69.6	86.9	134.0	59.4	119.4	49.5	55.7	82.4
4/ 6/76	143.7	144.3	110.5	153.4	167.0	95.2	82.4	89.6		122.4
4/ 9/76	94.3 *	96.4		65.1	116.8	64.2	70.5	55.1 *	105.9 *	69.6
4/12/76	82.2	98.4	125.7 *	73.4	88.0		66.8	68.6	87.7 *	65.4
4/15/76	96.4 *	88.4	137.9	107.9	148.6		34.5	46.3	86.2	91.9
4/18/76	120.1	66.4	68.3	155.7		49.8	197.1	52.1	58.0	123.3
4/21/76		69.4	44.8	88.6	55.7	54.9 *	69.9 *	78.5 *	44.8	33.6
4/24/76	63.4	82.2	66.7	87.8	51.9	40.7	53.3	45.8	50.7	110.3
4/27/76	108.3	65.7	55.4	54.6	71.4	34.7	71.6	42.8	42.2	
4/30/76	143.0		241.8 *	120.8	85.5	87.1	69.8	63.4	88.3	96.9
5/ 3/76	29.3	60.8 *	50.5	39.0	36.8	40.5	53.7	27.5	78.0	41.4
5/ 6/76		169.6 *	56.6	84.8	96.7 *	56.2	39.3	43.9	31.4	37.4
5/ 9/76	130.2 *	47.3	70.4	111.9	76.0	47.7		37.4	101.2	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: TOTAL SUSPENDED PARTICULATES (TSP) 01-JAN-76 THROUGH 31-DEC-76

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
5/12/76	104.5		123.2 *		92.7	82.3	88.9	85.7	73.7	100.3
5/15/76	45.8	54.0	42.8 *	50.1	54.0	29.9	52.3	28.5	32.4	33.8
5/18/76	61.1	76.3	46.7	43.3	42.4	25.8	40.8	32.6	23.4	
5/21/76	126.9	94.2	89.8	101.1	67.6	78.8	69.5	45.5	59.7	60.1
5/24/76	77.2	99.3	100.4	76.6 *	76.6	67.8	78.5	76.4	65.9	60.8
5/27/76	167.4	128.2	99.4	101.4	97.8	110.3	120.0	63.6	69.0	
5/30/76	68.6 *	77.3	60.3	86.3	61.7		56.8	67.6 *	33.7	
6/ 2/76	79.8	93.9	80.7	50.5	90.9	56.7	111.7	46.0	51.7	53.0
6/ 5/76		71.8	53.5	51.6	47.2	42.2		52.9	43.6	44.9
6/ 8/76		133.6	104.7	132.7	103.5	102.5	73.5	64.3	103.2	82.1
6/11/76	138.7	127.3	118.9	137.9	96.1	104.3	118.2	101.9	125.5	86.9
6/14/76		107.1	103.2	156.6	126.7	84.9	68.7	49.9	90.5	60.0
6/17/76	105.1	78.7	65.2 *	86.3 *	83.6	53.6	45.6	56.2 *	75.1	51.3
6/20/76	106.1	68.4			34.7	43.6	104.2			
6/23/76	35.4	76.7	54.2	196.0 *	45.3	27.7 *	89.7 *	41.5	68.6 *	25.6
6/26/76	104.8	87.6	75.1	261.4 *	108.4	62.9	143.9 *	56.4 *	97.7	79.5
6/29/76	70.0	40.9	54.8	84.2	65.7 *		92.8 *		45.4	30.5
7/ 2/76	78.4	114.7 *	63.7	133.0 *	72.4	121.7 *	40.1		53.0	57.0
7/ 5/76	90.5	74.2	62.3	57.0	64.1	62.2	102.6	49.5	49.5	54.7
7/ 8/76	93.8	94.7	88.2	87.2	163.6	91.5	69.4 *	57.5	72.5	70.9
7/11/76	95.5	58.4	38.7	51.3 *		36.0	45.3	32.4	30.7	25.7
7/14/76	116.4	103.7	81.3	85.5	103.2	99.5	85.1	48.4	93.8 *	79.4 *
7/17/76	113.4	83.1	63.6	93.9	483.5	78.3	96.6	57.7		55.6
7/20/76	130.5	118.2	100.7	128.9 *	104.9	98.1	85.6	64.2	75.4	109.5
7/23/76	110.9	119.5 *	82.8	142.9 *	53.9	75.7 *	131.9		54.4	225.4 *
7/26/76	283.0 *	110.3 *	98.4	235.2 *	99.5	81.9	67.4	49.9	70.6 *	63.5 *
7/29/76	94.1	91.3	79.7	374.2 *	127.9 *	59.0	90.9	68.2	47.5	24.5
8/ 1/76	44.3	46.9	41.5	47.7	40.9	27.4	47.2	25.7	25.8	22.2
8/ 4/76	106.0	104.8	85.5	313.3 *		67.2	51.7	95.1 *	64.3	42.1
8/ 7/76	47.2	60.6	48.1	39.2	50.3	34.6		32.0	35.9	32.3
8/10/76	100.3	91.9	114.5 *	111.7	95.2	64.0	54.8	70.0	84.7	52.5
8/13/76	272.4 *	217.0 *	106.1	105.5	94.0	87.4 *	109.5 *		57.6	65.8 *
8/16/76		88.9		34.2 *	101.4	44.1	40.9	66.1	37.4	39.5
8/19/76	106.4	135.0	102.3	72.0	114.2	78.2	88.0	67.1	64.6	65.6
8/22/76	113.9	103.3	104.7		94.5	91.4	78.2	78.3	139.6 *	75.1
8/25/76	210.5 *	182.3	173.1	208.3 *	157.8	195.9	156.3 *	152.3 *	110.6	96.1
8/28/76	92.9	81.6	66.2	64.5	63.9	68.0	75.8	43.8 *	74.6	66.2
8/31/76	168.8	157.0	125.6	128.7	111.1	108.3	81.6	58.9	92.1	61.6
9/ 3/76	106.6	98.9	103.7	155.0 *	127.5	84.8	83.8	51.4	97.4	64.9
9/ 6/76	77.0	80.4	89.9	48.0	90.2	50.0	65.3	37.2	47.3	38.2
9/ 9/76	88.3	67.6	73.6	44.8	65.8 *	57.9	56.4	64.5	62.3 *	55.2
9/12/76	93.8	72.5	69.6	93.2	82.2	62.1	65.0	58.0	70.8	50.9
9/15/76	128.8	134.1	111.2	113.5	119.2 *	74.5	89.5	94.3	127.3	75.0

* Indicates Samples of less than 24 hours

AMS/RAPS PARTICULATE SUMMARY: TOTAL SUSPENDED PARTICULATES (TSP) 01-JAN-76 THROUGH 31-DEC-76

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
9/18/76	156.9	124.6	113.6	164.6	175.3	86.4	86.4	73.3	88.9	67.9
9/21/76	168.3	82.5	82.4	83.7	92.0	57.6	91.4	64.3	63.4	106.5
9/24/76	243.1	122.7	111.5	126.8	141.7	48.6	67.9	69.2	60.8	70.4
9/27/76	69.0	71.6	60.2	48.3	46.8	43.6	63.8	55.8	49.8	49.1
9/30/76	110.4	88.9	92.2	75.7	68.8	76.0	54.1	34.3	45.7	36.0
10/ 3/76	140.4	122.6	118.7	151.2	111.3	92.2	83.5		102.9	77.4
10/ 6/76	54.2	58.3	42.7	28.1	36.3	30.2	55.3		32.3	33.5
10/ 9/76	105.2	77.2 *	69.0	128.5	69.1	63.9	64.5	59.7	55.0	50.4
10/12/76	125.3	93.9	86.9 *	134.0	86.8	71.4	60.2	36.6	74.3	43.4
10/15/76	172.4	202.1	199.8	145.3	128.6 *	136.4	189.8 *	144.5	144.8	165.2
10/18/76	97.4	116.5	110.4	86.9	80.8	77.3	82.5	87.6	59.3 *	39.5
10/21/76	87.5	59.4	51.8	52.1	39.4	52.1	63.4	38.3	424.9 *	34.1 *
10/24/76	37.7	32.2	34.0	35.4	26.8	36.7	40.5	30.4	25.1	25.3
10/27/76	51.3	75.1	59.3	43.7	50.6	72.8	81.2	43.3	32.1	36.3
10/30/76	46.7	47.0	31.9	28.0	25.4	35.6	24.9 *	25.3	23.8	20.5
11/ 2/76	77.3	72.8	61.5	73.6	43.6	44.0	50.4	44.8	39.8	38.7
11/ 5/76	82.0 *	62.0 *	58.1 *	68.1 *	44.9 *	52.4 *	41.9 *	36.8 *	33.7 *	28.9 *
11/ 8/76	103.8	76.1	81.9	87.9	57.7	70.7	61.8	41.9	69.7	41.9
11/11/76	68.1	72.5	73.0	50.5	56.2	62.7	74.1 *	65.0	55.6	62.9
11/14/76	117.4	123.5	99.6	95.5	118.3	79.5		106.3	59.8	63.7
11/17/76	92.5	90.9	103.4	69.0	114.0	87.6	62.2	45.8	40.4	36.7
11/20/76	186.9	151.6	135.4	128.2	69.3	107.0	161.9	80.9	84.8	37.2
11/23/76	81.4 *	65.2	52.8	71.4	43.3	54.8	48.6	49.1	39.6	86.4
11/26/76	36.2	27.7	30.4	36.1	26.0	22.7	19.3	16.3	19.1	13.7
11/29/76	45.9	40.2	48.5	28.2	30.7	31.1	18.0	37.9	24.9 *	21.1
12/ 2/76	56.5	67.8	72.4	43.5	48.4	33.7	53.2	45.3	35.0	35.5
12/ 5/76	67.9	90.7	75.5	23.4	66.4	42.7	34.5	55.9	34.1	41.4
12/ 8/76	82.1	95.5	67.3	75.9	108.8	61.1	62.2	59.1	48.4	47.4
12/11/76	117.1	148.7	117.0	110.3	73.2	80.2	54.4	83.8	52.8	42.6
12/14/76	89.9	114.4	78.4	119.3	92.3	21.2	21.1	44.1	55.8	24.3
12/17/76	122.5	148.9	105.7	74.4	76.6	71.7	58.8	80.7	37.0	38.7
12/20/76	65.9	61.8	63.3	39.9	35.1	57.2	44.9 *	35.1	28.1	28.0
12/23/76	83.2	71.8	69.2	69.1	52.5	50.7	41.6	62.2	34.0	
12/26/76	53.2	38.3	38.8	42.8	34.0	40.7	33.8	35.3	37.9	23.8
12/29/76	58.6	57.5	51.7	59.7	51.6	45.5	26.4	55.9 *	44.9 *	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: TOTAL SUSPENDED PARTICULATES (TSP) 01-JAN-76 THROUGH 31-DEC-76

STATISTICS	103	105	106	108	112	115	118	120	122	124
# OBS	112	117	118	116	116	112	113	113	116	110
ARITH MEAN	99.4	89.8	79.6	90.9	79.8	60.0	68.1	54.1	59.8	54.6
ARITH SDEV	44.5	35.6	35.2	56.7	51.0	27.7	32.8	22.6	43.3	31.2
GEO MEAN	90.9	83.3	73.3	77.8	69.9	54.4	61.4	50.2	52.0	48.0
GEO SDEV	1.53	1.48	1.50	1.73	1.64	1.55	1.58	1.47	1.64	1.65
ANNUAL MAX	283.0	217.0	241.8	374.2	483.5	195.9	197.1	152.3	424.9	225.4
DATE OF MAX	7/26/76	8/13/76	4/30/76	7/29/76	7/17/76	8/25/76	4/18/76	8/25/76	10/21/76	7/23/76
DISTRIBUTION:										
< 25.	0	0	0	1	0	2	4	1	8	11
25.- 50.	11	10	18	26	29	45	30	57	48	47
50.- 75.	22	35	45	26	35	34	42	39	36	30
75.-100.	27	38	26	25	23	23	23	11	14	14
100.-125.	29	16	20	13	17	6	8	3	5	6
125.-150.	13	11	5	12	7	1	2	1	4	0
150.-175.	5	4	1	6	3	0	2	1	0	1
175.-200.	1	1	1	2	1	1	2	0	0	0
>200.	4	2	2	5	1	0	0	0	1	1

RAMS/RAPS PARTICULATE SUMMARY: SULFATES 01-JAN-76 THROUGH 31-DEC-76

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
1/ 1/76	17.0	16.5	14.7	14.3	16.0	14.1	14.2	11.6	14.6	12.9
1/ 4/76	5.8	6.8	5.6	6.4	5.5	8.3		6.8	7.4	7.2
1/ 7/76	8.3	7.7	6.2	6.2		11.2	7.1	4.5	6.6	7.2
1/10/76		8.6	7.6	11.4 *	7.0	6.9		8.1	10.4	6.5
1/13/76	10.2	9.7	6.5	9.6	9.2	8.9	10.5 *	9.0	8.7	7.6
1/16/76		7.9	6.2	6.8	6.8	11.4	9.0	6.7	6.2	7.0
1/19/76	10.4	9.6	7.5	10.5	8.3	7.5	7.4	6.0	7.7	7.7
1/22/76		13.2	9.4	11.1	10.4	9.9	7.1	11.0	8.1	9.2
1/25/76	13.1	12.4	9.2	10.4	10.1	12.1	11.1	8.6	9.1	10.9
1/28/76	8.5	9.1	12.9	8.0	6.5	6.4	8.1	5.5	7.0	5.7
1/31/76	10.2	10.2	8.9	10.3	8.9	9.3	9.4	6.7	7.9	8.6
2/ 3/76	22.1	16.0	45.0	22.3	12.4	10.1			17.6	11.2
2/ 6/76	8.6		8.8	13.4	8.4	8.0	18.1	16.8	15.3 *	
2/ 9/76	10.5	8.7	8.9	7.9	12.8	8.0		8.0	18.1 *	7.8
2/12/76	9.7	11.1	9.2	13.8	8.3	8.4 *	10.4	7.4	7.5	10.7
2/15/76	13.4	11.6	9.6	13.8	11.6	10.5	12.5	8.4	10.1	9.6
2/18/76	9.5	8.0	8.4	11.4	7.9	8.2	10.1	8.2	7.3	7.2
2/21/76	8.2		6.4	8.9	7.9	7.1	5.4	5.9	7.1	4.3
2/27/76	11.7	10.9	13.0	13.3	6.2	8.4	6.0	4.5	7.1	5.4
3/ 1/76	12.3	14.2	8.9	14.0	12.4	9.1	12.0	12.0	10.2	10.3
3/ 4/76	8.9	10.7	10.2	10.6	12.2	7.2	12.0 *	7.6		7.6
3/ 7/76	5.7	6.5	6.0		6.8	5.0	8.0	5.8	5.2	8.1
3/10/76	13.9	13.7	12.6	14.8	12.7	13.7	12.3	8.5	12.2	
3/13/76	8.0	5.1	7.8		6.0	6.7	9.0	8.2	5.2	6.4
3/16/76	7.5	7.1	7.5	7.2	6.5	8.2	6.7	5.5	6.1	10.6
3/19/76	8.6	9.1	10.0	12.3	7.9		9.9	8.1	8.2	7.3
3/22/76	8.2	7.0	9.4	6.8	8.8		9.5	7.2	6.6	
3/25/76	9.9 *	8.8	15.3 *	13.7	9.4		9.7	8.6	13.0	6.5
3/28/76	9.4	9.5	9.3	7.5			7.5	8.3	7.5	7.3
3/31/76	6.5	4.4	4.9	5.4	3.8		5.8	8.0		4.2
4/ 3/76	7.5	6.2	4.8	6.6	8.3	7.0	5.6	4.3	4.9	4.8
4/ 6/76	17.9	18.0	18.0	18.6	16.2	16.5	14.9	15.9		15.2
4/ 9/76	10.0 *	6.0		5.7	5.8	5.0	4.2	8.1 *	14.5 *	4.7
4/12/76	6.4	9.9	7.6 *	6.1	6.3		6.5	7.3	13.0 *	7.5
4/15/76	14.9 *	14.0	14.1	17.9	15.7	12.5	3.7	10.1	17.4	9.4
4/18/76	6.7	6.4	7.0	7.0		5.0	16.5	6.6	6.7	3.6
4/21/76		6.3	6.1	11.1	6.9	8.6 *	6.7 *	15.1 *	8.1	4.4
4/24/76	7.6	9.4	7.9	6.4	9.1	9.2	8.4	8.1	8.3	5.2
4/27/76	23.8	8.2	8.1	7.8	8.7	5.9	4.8	6.4	7.7	
4/30/76	20.2		31.9 *	14.1	14.6	17.2	13.4	13.4	16.4	10.9
5/ 3/76	5.9	7.2 *	5.1	4.9	4.6	6.9	4.4	4.1	4.8	5.6
5/ 6/76		25.3 *	8.7	7.0	14.4 *	7.6	7.1	7.8	7.5	5.9
5/ 9/76	16.5 *	6.4	10.7	15.8	11.0	8.6		7.7	12.5	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: SULFATES 01-JAN-76 THROUGH 31-DEC-76

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
5/12/76	10.6		8.9 *		6.8	5.7	9.0	7.1	5.4	6.7
5/15/76	8.9	9.7	7.1 *	8.1	10.3	6.9	5.7	7.4	7.7	7.1
5/18/76	7.6	9.2	7.2	5.4	6.5	4.3	7.5	5.3	4.7	
5/21/76	14.2	10.5	9.4	11.1	9.9	10.9	8.7	8.3	7.7	10.0
5/24/76	10.7	11.9	10.7	10.5 *	9.9	8.9	10.4	10.6	8.5	10.3
5/27/76	22.2	21.0	16.8	14.7	17.8	13.9	11.7	13.0	15.3	
5/30/76	21.8 *	23.1	20.7	15.1	19.9		19.0	27.2 *	13.4	
6/ 2/76	23.8	24.3	21.4	17.6	20.0	16.4	20.3	15.6	14.3	19.6
6/ 5/76		19.0	13.6	12.9	14.5	12.3		18.4	13.0	14.0
6/ 8/76		32.1	27.9	28.5	30.6	29.3	19.4	23.1	28.8	30.7
6/11/76	27.7	26.4	26.1	26.1	23.3	25.4	29.4	28.4	26.3	25.5
6/14/76		13.9	14.7	15.6	12.9	11.0	9.2	7.6	12.0	8.6
6/17/76	11.9	9.1	8.1 *	8.8 *	10.1	10.5	9.8	7.8 *	13.0	9.2
6/20/76	8.7	10.0			5.8	7.9	9.4			
6/23/76	7.6	14.8	13.3	43.8 *	11.9	10.0 *	14.5 *	15.5	14.5 *	8.9
6/26/76	21.8	21.8	22.2	46.7 *	24.2	18.3	27.7 *	20.8 *	23.4	13.5
6/29/76	7.9	5.1	7.4	9.8	8.5 *		9.9 *		6.2	5.5
7/ 2/76	15.9	23.6 *	14.3	23.3 *	13.5	20.8 *	12.7		13.8	11.3
7/ 5/76	12.5	11.9	10.7	10.1	9.9	11.4	10.2	10.4	7.6	10.3
7/ 8/76	17.4	15.5	14.8	15.9	17.5	18.9	17.6 *	12.8	9.9	16.9
7/11/76	9.1	8.0	6.7	7.5 *		6.6	6.4	5.8	4.0	5.3
7/14/76	10.4	9.8	8.6	8.4	8.7	9.3	9.1	6.4	12.7 *	8.8 *
7/17/76	8.6	5.9	5.8	6.4	8.0	8.2	7.8	4.8		7.7
7/20/76	15.1	14.7	14.0	17.0 *	13.7	15.4	12.6	10.9	13.6	10.8
7/23/76	9.8	13.0 *	8.7	14.4 *	6.5	9.0 *	14.1		4.9	23.0 *
7/26/76	59.9 *	23.7 *	21.0	38.7 *	20.7	22.9	18.4	14.6	20.1 *	20.1 *
7/29/76	14.7	16.2	16.1	40.9 *	53.4 *	15.3	12.2	18.8	11.0	8.0
8/ 1/76	9.6	9.1	8.3	7.7	8.0	5.3	16.0	8.0	5.9	5.7
8/ 4/76	18.7	17.4	17.0	66.8 *		15.3	16.5	26.5 *	17.8	12.8
8/ 7/76	14.3	14.2	12.6	12.5	15.1	10.0		10.9	12.2	12.2
8/10/76	17.9	18.8	22.2 *	20.9	21.5	17.8	17.0	21.9	24.0	17.3
8/13/76	46.6 *	40.2 *	19.2	22.0	19.4	18.7 *	33.1 *		14.5	18.6 *
8/16/76		19.8		13.0 *	19.9	13.0	15.8	19.1	11.3	15.0
8/19/76	25.1	35.7	29.3	21.9	27.0	23.5	27.6	19.4	22.5	23.8
8/22/76	26.3	28.2	28.8		24.6	23.1	24.3	25.2	62.0 *	25.1
8/25/76	55.0 *	53.9	50.4	74.9 *	50.4	43.5	64.6 *	58.7 *	46.3	46.8
8/28/76	10.8	10.9	10.0	10.0	9.6	8.9	12.4	6.9 *	8.5	11.5
8/31/76	18.3	17.2	16.1	17.6	14.9	14.3	13.4	11.9	19.7	11.8
9/ 3/76	27.3	28.1	28.3	39.0 *	33.9	27.9	31.2	20.6	32.9	25.3
9/ 6/76	8.6	13.0	9.4	8.2	10.4	7.6	8.0	6.8	7.5	7.2
9/ 9/76	8.4	7.4	7.1	7.4	7.3 *	10.5	6.3	8.6	10.7 *	6.6
9/12/76	15.8	14.2	15.2	15.9	17.9	14.4	16.7	12.5	18.2	16.5
9/15/76	17.1	15.9	14.5	17.0	13.7 *	12.2	13.1	12.8	13.2	15.0

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: SULFATES 01-JAN-76 THROUGH 31-DEC-76

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
9/18/76	19.8	18.6	19.7	22.0	22.1	17.1	18.1	15.0	15.5	17.5
9/21/76	17.3	4.7	5.5	7.1	6.4	5.9	6.5	4.3	3.6	6.5
9/24/76	20.0	10.3	6.6	5.6	7.7	4.7	5.4	5.1	5.2	7.0
9/27/76	17.0	17.2	16.1	16.1	15.6	15.1	18.0	17.4	17.1	18.2
9/30/76	14.6	12.2	11.7	10.7	12.0	10.8	10.7	6.5	8.7	9.9
10/ 3/76	22.3	20.8	20.8	22.0	23.2	22.6	21.3		23.7	22.9
10/ 6/76	7.1	6.1	5.3	5.0	5.1	8.0	9.0		6.0	7.1
10/ 9/76	12.9	10.9 *	10.0	13.5	9.4	10.7	11.6	10.6	9.3	9.3
10/12/76	9.5	6.8	19.1 *	10.8	6.8	8.2	7.6	6.4	8.4	5.7
10/15/76	6.5	6.3	6.0	5.3	5.1 *	7.6 *	12.4 *	5.1	4.6	6.6
10/18/76	8.5	8.7	6.5	5.9	6.2	6.3	6.1	7.9	9.1 *	6.8
10/21/76	7.1	5.3	4.5	5.9	5.1	6.5	22.4	4.7	39.8 *	6.6 *
10/24/76	10.9	7.2	10.2	12.5	10.3	13.3	4.8	11.9	9.1	9.8
10/27/76	9.0	8.9	9.5	8.4	8.7	6.3	13.2	7.6	6.0	9.5
10/30/76	11.6	11.4	9.8	9.3	10.3	10.0	9.8 *	9.4	8.9	8.8
11/ 2/76	9.0	8.3	7.8	11.0	7.5	8.2	10.1	7.5	7.9	7.8
11/ 5/76	7.3 *	5.2 *	6.2 *	7.8 *	5.2 *	5.2 *	4.9 *	4.6 *	4.8 *	4.9 *
11/ 8/76	6.7	4.7	4.3	6.9	4.5	6.7	6.2	4.3	5.9	5.3
11/11/76	7.2	6.3	6.2	6.2	5.2	8.7	7.9 *	6.3	5.5	7.7
11/14/76	14.2	16.1	15.3	9.7	11.6	10.6		10.4	10.2	10.7
11/17/76	10.3	10.7	11.1	9.8	5.0	10.6	9.9	9.1	8.9	8.9
11/20/76	8.6	7.4	6.3	5.7	8.5	9.3	9.9 *	5.1	4.7	6.4
11/23/76	9.7 *	6.2	5.7	12.8	5.5	7.7	6.3	6.4	6.0	7.3
11/26/76	7.8	5.7	8.1	9.4	6.1	7.2	7.6	5.8	6.8	5.4
11/29/76	6.5	4.7	5.8	5.3	3.7	6.6	4.9	5.3	8.3 *	5.5
12/ 2/76	6.3	6.9	7.7	6.5	6.6	5.1	8.6	6.1	5.6	6.6
12/ 5/76	9.8	15.7	11.6	5.7	11.5	9.2	7.9	10.1	7.8	8.4
12/ 8/76	14.5	14.6	11.5	13.1	13.1	12.2	15.2	10.7	10.3	13.3
12/11/76	17.8	20.3	15.8	18.3	12.5	13.9	11.0	11.0	9.1	9.1
12/14/76	10.3	10.4	10.4	16.5	8.2	5.3	5.0	5.7	9.3	6.4
12/17/76	6.4	6.5	5.8	13.2	6.2	7.2	5.2	4.8	4.3	5.5
12/20/76	6.6	5.8	6.2	6.5	5.2	7.0	8.4 *	5.2	5.5	6.3
12/23/76	4.0	4.4	4.0	5.5	5.4	5.6	4.5	4.0	4.5	
12/26/76	15.7	4.5	4.6	5.1	4.3	5.8	5.4	3.8	4.2	4.5
12/29/76	7.7	6.5	7.5	5.2	6.1	6.1	5.0	5.1 *	5.8 *	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: SULFATES 01-JAN-76 THROUGH 31-DEC-76

STATISTICS	103	105	106	108	112	115	118	120	122	124
# OBS	112	117	118	116	116	113	114	113	117	110
ARITH MEAN	13.3	12.6	11.9	13.7	11.7	11.0	11.7	10.3	11.4	10.3
ARITH SDEV	8.7	7.9	7.6	11.1	8.0	6.0	7.8	7.1	8.4	6.4
GEO MEAN	11.6	10.8	10.3	11.3	10.0	9.8	10.2	8.8	9.6	9.1
GEO SDEV	1.63	1.70	1.68	1.77	1.70	1.57	1.67	1.67	1.72	1.62
ANNUAL MAX	59.9	53.9	50.4	74.9	53.4	43.5	64.6	58.7	62.0	46.8
DATE OF MAX	7/26/76	8/25/76	8/25/76	8/25/76	7/29/76	8/25/76	8/25/76	8/25/76	8/22/76	8/25/76
DISTRIBUTION:										
< 5.	1	6	6	1	5	2	8	12	12	8
5.- 10.	51	51	59	50	59	61	53	60	57	63
10.- 15.	28	29	26	35	28	29	29	21	26	20
15.- 20.	16	15	13	14	11	12	14	11	11	10
20.- 25.	9	8	6	7	8	5	4	4	5	4
25.- 30.	4	4	5	2	1	3	3	4	2	3
30.- 35.	0	1	1	0	2	0	2	0	1	1
35.- 40.	0	1	0	2	0	0	0	0	1	0
> 40.	3	2	2	5	2	1	1	1	2	1

RAMS/RAPS PARTICULATE SUMMARY: NITRATES 01-JAN-76 THROUGH 31-DEC-76

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
1/ 1/76	4.7	5.9	3.3	2.5	2.5	3.7	3.5	2.3	2.5	2.2
1/ 4/76	1.0	1.4	1.4	0.9	1.4	1.4		1.3	1.4	1.7
1/ 7/76	2.5	3.0	2.8	2.6		2.4	3.0	2.1	2.7	2.9
1/10/76		4.7	4.1	4.1 *	4.2	4.6		4.7	4.7	4.3
1/13/76	4.9	4.9	4.2	5.0	4.6	4.5	3.8 *	3.8	4.2	2.8
1/16/76		5.1	4.8	4.4	5.1	3.6	5.4	5.7	5.4	5.3
1/19/76	3.6	3.7	3.3	3.7	3.5	3.7	3.5	2.6	3.5	3.2
1/22/76		8.6	6.6	6.6	7.6	6.4	4.5	7.9	6.9	6.4
1/25/76	6.6	7.4	6.4	6.1	6.9	5.6	6.1	5.7	6.1	5.9
1/28/76	3.0	3.3	11.1	1.8	2.8	3.2	2.5	2.4	3.9	2.3
1/31/76	7.1	7.1	6.6	7.8	6.7	7.2	4.8	5.2	7.4	6.3
2/ 3/76	4.7	4.7	0.0	4.2	4.3	3.7			4.3	4.6
2/ 6/76	5.6		6.4	4.8	7.0	5.7	10.8	9.4	10.2 *	
2/ 9/76	4.4	4.3	3.5	6.5	3.6	5.6		2.4	6.2 *	3.7
2/12/76	4.2	4.2	3.3	4.5	3.1	3.6 *	4.3	2.9	4.1	3.6
2/15/76	4.1	3.3	2.8	4.1	3.3	3.9	2.2	2.6	4.1	2.9
2/18/76	2.9	3.4	4.3	2.7	2.5	2.8	2.8	3.4	3.0	2.6
2/21/76	2.0		1.9	1.9	2.1	2.0	1.4	1.6	2.6	1.2
2/27/76	3.3	2.8	5.8	3.1	2.6	4.7	2.6	2.0	3.7	2.8
3/ 1/76	5.5	6.5	2.4	5.9	6.8	5.5	4.6	6.4	5.9	2.6
3/ 4/76	2.7	3.3	3.0	2.8	3.4	3.1	3.7 *	2.0		3.4
3/ 7/76	3.8	4.4	3.6		3.5	3.4	3.9	3.3	3.3	3.6
3/10/76	5.9	5.6	4.9	5.3	4.7	6.3	3.4	2.9	4.9	
3/13/76	1.8	1.8	1.6		1.3	2.0	1.8	1.5	1.3	1.5
3/16/76	3.1	3.3	3.0	3.3	3.4	3.2	3.0	2.6	3.3	3.9
3/19/76	2.0	2.7	2.2	2.7	2.5		2.6	2.9	3.1	1.9
3/22/76	2.7	3.0	2.7	3.0	3.5		4.9	2.7	2.9	
3/25/76	4.3 *	4.7	1.8 *	3.1	3.6		3.3	3.3	3.6	1.7
3/28/76	3.3	3.7	2.8	4.0			2.2	2.8	3.3	3.5
3/31/76	1.6	1.8	1.6	0.4	1.6		1.1	2.7		1.2
4/ 3/76	2.7	3.0	3.2	2.9	3.3	2.5	2.7	2.6	3.1	2.8
4/ 6/76	9.5	9.7	6.8	7.4	7.7	8.5	6.9	7.5		5.2
4/ 9/76	3.2 *	4.4		3.6	4.5	3.8	2.1	2.9 *	5.0 *	2.9
4/12/76	4.9	6.0	6.1 *	3.0	4.8		4.4	6.0	5.3 *	2.3
4/15/76	3.0 *	2.9	1.9	2.8	2.6	2.5	1.0	1.8	2.5	2.1
4/18/76	2.1	1.8	1.6	0.9		2.1	2.8	2.1	2.1	0.8
4/21/76		2.2	1.6	2.1	1.8	2.4 *	0.7 *	4.2 *	2.1	0.9
4/24/76	2.1	5.6	5.1	1.0	1.9	2.7	1.6	2.2	2.6	1.0
4/27/76	6.8	2.5	2.4	5.2	5.8	4.5	1.9	4.1	4.1	
4/30/76	8.5		15.1 *	4.1	5.4	5.8	5.2	4.2	3.2	2.9
5/ 3/76	1.4	1.5 *	1.2	1.1	1.4	1.1	0.6	0.9	1.2	0.6
5/ 6/76		7.9 *	2.6	0.9	5.0 *	3.4	1.8	3.0	2.3	1.8
5/ 9/76	4.1 *	1.8	3.7	3.5	4.1	3.0		3.2	3.7	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: NITRATES 01-JAN-76 THROUGH 31-DEC-76

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
5/12/76	3.1		3.6 *		3.4	4.8	3.6	4.8	3.4	2.5
5/15/76	3.9	3.7	2.8 *	4.0	3.3	3.1	1.6	2.7	3.2	2.8
5/18/76	2.3	3.5	2.1	1.2	2.0	2.2	2.9	1.9	2.2	
5/21/76	5.1	5.0	4.2	4.3	4.7	4.3	1.2	3.2	4.2	2.4
5/24/76	4.5	4.9	4.9	3.1 *	4.5	4.2	5.5	4.6	4.6	3.9
5/27/76	7.3	6.7	4.9	3.7	3.6	2.4	2.1	4.3	2.7	
5/30/76	2.2 *	2.1	1.0	1.9	1.3		1.6	1.4 *	1.3	
6/ 2/76	3.3	2.4	2.9	1.5	1.0	1.5	2.6	2.0	2.5	1.4
6/ 5/76		3.5	2.3	2.5	1.9	1.3		1.6	1.3	1.3
6/ 8/76		4.6	3.5	4.4	3.2	2.4	0.7	1.0	1.3	0.3
6/11/76	2.9	3.4	4.3	3.9	3.8	2.1	1.9	3.7	2.2	0.6
6/14/76		3.1	3.3	3.8	4.6	3.6	0.7	2.5	4.2	2.1
6/17/76	3.5	3.5	2.0 *	2.4 *	3.2	3.0	2.3	2.5 *	4.0	2.5
6/20/76	3.2	3.7			1.7	2.3	1.2			
6/23/76	1.3	2.3	2.6	6.5 *	2.0	1.3 *	1.5 *	1.4	3.6 *	1.5
6/26/76	2.6	2.4	1.3	11.0 *	2.2	1.8	5.6 *	2.1 *	3.5	2.2
6/29/76	2.4	1.4	2.4	2.7	2.7 *		1.3 *		2.6	1.6
7/ 2/76	4.1	6.7 *	3.7	6.1 *	3.8	4.5 *	2.2		3.6	1.7
7/ 5/76	4.0	3.5	3.5	2.6	3.9	2.1	2.1	3.8	2.7	3.4
7/ 8/76	4.8	6.0	4.9	4.5	4.8	3.1	2.9 *	2.7	3.8	1.5
7/11/76	2.2	2.5	2.4	2.1 *		1.7	0.3	1.9	1.7	0.9
7/14/76	4.1	4.0	4.0	4.2	4.2	4.0	3.4	2.7	4.7 *	2.9 *
7/17/76	3.8	4.0	3.4	3.1	3.6	2.5	2.0	3.5		3.5
7/20/76	3.9	3.5	3.5	3.9 *	3.3	2.9	2.6	2.5	1.7	2.8
7/23/76	3.1	3.8 *	3.0	4.9 *	2.2	3.4 *	3.0 *		2.6	6.7 *
7/26/76	12.2 *	4.4 *	3.4	10.9 *	3.2	1.5	1.5	2.0	2.2 *	1.4 *
7/29/76	6.5	7.0	5.4	12.4 *	5.7 *	2.4	2.2	3.4	3.3	1.7
8/ 1/76	1.6	2.1	2.3	2.0	2.4	2.1	3.3	1.7	1.8	2.1
8/ 4/76	3.7	3.1	3.9	9.5 *		2.7	1.9	6.2 *	1.8	2.5
8/ 7/76	2.6	3.4	2.8	1.5	1.2	2.3		1.4	2.1	1.3
8/10/76	4.0	3.3	4.2 *	3.0	3.0	1.5	2.6	2.4	1.3	1.2
8/13/76	9.0 *	12.9 *	3.4	2.9	1.4	8.7 *	1.6 *		1.1	1.3 *
8/16/76		3.8		1.6 *	2.4	1.6	2.1	2.4	2.3	1.2
8/19/76	3.2	2.7	1.3	1.3	1.3	0.9	0.9	2.5	1.8	0.2
8/22/76	2.8	2.0	0.6		1.4	1.5	1.6	1.1	8.9 *	0.7
8/25/76	3.1 *	2.9	1.8	5.4 *	0.6	0.0	0.0 *	1.0 *	0.0	0.0
8/28/76	2.3	2.3	1.8	1.7	1.7	2.1	2.6	1.3 *	1.5	2.2
8/31/76	6.0	7.0	5.5	6.2	6.1	5.1	5.0	4.4	4.6	4.1
9/ 3/76	1.6	1.5	1.2	2.7 *	1.4	1.5	0.5	0.7	1.0	0.6
9/ 6/76	3.2	2.2	2.5	2.6	3.2	3.3	3.2	3.4	3.2	2.7
9/ 9/76	1.7	2.1	2.1	1.3	2.1 *	1.7	2.3	2.9	3.5 *	2.8
9/12/76	3.3	3.4	2.3	3.4	3.1	3.2	2.4	3.1	3.5	2.2
9/15/76	5.6	6.8	5.8	5.2	5.6 *	4.6	6.2	6.3	5.5	6.1

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: NITRATES 01-JAN-76 THROUGH 31-DEC-76

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
9/18/76	6.7	6.6	5.1	6.6	5.6	4.4	4.3	4.4	5.8	3.2
9/21/76	2.5	2.0	2.1	2.1	2.0	1.7	2.4	2.1	1.3	2.7
9/24/76	4.7	4.9	5.5	3.2	5.9	3.9	5.0	5.3	2.8	5.1
9/27/76	3.5	3.7	2.9	2.6	2.5	2.8	4.7	3.4	4.1	4.3
9/30/76	5.8	4.5	4.0	5.3	3.5	5.4	4.1	3.3	4.6	3.5
10/ 3/76	6.2	6.4	5.2	0.5	5.7	5.2	6.4		3.7	3.4
10/ 6/76	3.2	3.0	2.4	2.4	2.8	2.3	3.6		2.9	3.6
10/ 9/76	5.0	5.3 *	4.9	5.6	5.4	4.7	4.3	4.7	6.2	4.7
10/12/76	2.7	2.1	3.4 *	3.6	3.0	3.2	2.1	1.9	3.2	2.4
10/15/76	2.0	2.4	2.3	1.9	1.8 *	2.0	3.2 *	1.5	1.5	3.1
10/18/76	2.9	3.5	3.2	2.8	3.0	3.0	3.0	3.2	3.7 *	3.4
10/21/76	1.4	2.2	1.4	2.2	2.0	2.0	5.0	1.7	21.5 *	2.1 *
10/24/76	2.6	2.7	2.4	3.0	2.2	2.5	1.0	3.0	5.3	2.2
10/27/76	5.3	6.1	5.6	5.2	5.3	4.8	4.4	4.5	5.0	5.3
10/30/76	2.6	2.0	1.8	2.4	1.8	2.6	1.8 *	2.2	2.6	1.6
11/ 2/76	3.9	4.7	3.0	3.9	3.3	3.8	3.3	3.1	3.5	3.1
11/ 5/76	3.0 *	2.9 *	2.1 *	2.4 *	2.1 *	3.0 *	2.6 *	2.4 *	2.4 *	2.3 *
11/ 8/76	4.5	2.4	1.7	2.4	1.6	2.7	2.1	2.1	3.1	2.0
11/11/76	3.9	4.1	3.8	3.5	3.6	4.3	3.9 *	3.8	3.0	4.2
11/14/76	8.9	9.7	8.6	6.9	8.6	7.4		9.0	8.6	9.0
11/17/76	3.4	3.8	3.2	3.4	3.2	3.6	3.2	2.9	3.3	2.9
11/20/76	4.7	3.8	3.4	3.7	2.7	3.5	3.9 *	2.5	2.7	4.0
11/23/76	3.2 *	3.8	3.2	3.2	2.9	2.9	4.2	3.2	2.9	3.5
11/26/76	1.6	1.3	1.4 *	1.6	1.4	1.6	1.4	1.9	2.5	1.1
11/29/76	1.9	2.2	2.0	1.8	1.8	1.9	1.2	2.5	2.8 *	2.1
12/ 2/76	5.2	5.8	5.6	5.8	4.9	4.8	6.0	5.6	5.3	5.8
12/ 5/76	7.4	8.8	7.1	3.4	7.2	6.7	5.5	7.9	6.4	7.2
12/ 8/76	10.0	9.5	8.2	8.8	5.9	7.6	8.2	7.3	7.8	6.7
12/11/76	6.4	7.1	6.1	6.8	8.0	5.8	3.0	6.4	5.8	5.8
12/14/76	4.9	4.6	3.1	5.3	3.6	2.8	2.9	3.3	4.3	4.1
12/17/76	2.9	3.6	2.9	3.2	2.9	3.3	3.6	3.2	4.0	2.1
12/20/76	1.9	2.0	1.7	1.9	1.7	1.9	2.2 *	1.7	1.8	2.1
12/23/76	0.9	1.4	1.1	1.1	1.2	1.1	1.5	1.3	1.2	
12/26/76	3.9	1.3	1.2	1.5	1.3	1.4	1.0	1.3	1.4	1.6
12/29/76	1.6	1.9	1.5	1.8	1.6	1.5	1.3	1.6 *	1.8 *	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: NITRATES 01-JAN-76 THROUGH 31-DEC-76

STATISTICS	103	105	106	108	112	115	118	120	122	124
# OBS	112	117	118	116	116	113	114	113	117	110
ARITH MEAN	3.9	4.0	3.5	3.7	3.4	3.3	3.0	3.2	3.6	2.9
ARITH SDEV	2.0	2.1	2.1	2.2	1.8	1.7	1.8	1.8	2.4	1.7
GEO MEAN	3.5	3.6	3.0	3.1	3.0	3.0	2.6	2.8	3.1	2.4
GEO SDEV	1.65	1.64	1.71	1.85	1.70	1.62	1.87	1.68	1.69	1.92
ANNUAL MAX	12.2	12.9	15.1	12.4	8.6	8.7	10.8	9.4	21.5	9.0
DATE OF MAX	7/26/76	8/13/76	4/30/76	7/29/76	11/14/76	8/13/76	2/ 6/76	2/ 6/76	10/21/76	11/14/76
DISTRIBUTION:										
< 5.	87	89	96	89	94	96	98	97	96	96
5.- 10.	23	27	20	24	22	17	15	16	19	14
10.- 15.	2	1	1	3	0	0	1	0	1	0
15.- 20.	0	0	1	0	0	0	0	0	0	0
20.- 25.	0	0	0	0	0	0	0	0	1	0
25.- 30.	0	0	0	0	0	0	0	0	0	0
30.- 35.	0	0	0	0	0	0	0	0	0	0
35.- 40.	0	0	0	0	0	0	0	0	0	0
> 40.	0	0	0	0	0	0	0	0	0	0

RAMS/RAPS PARTICULATE SUMMARY: TOTAL SUSPENDED PARTICULATES (TSP) 01-JAN-77 THROUGH 31-MAR-77

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
1/ 1/77	51.7 *	51.8	45.3 *	57.2 *	37.9	45.1	49.0	123.4	37.1	36.5 *
1/ 4/77	57.8	102.1	55.6	36.3	52.0	30.1	32.5	45.4	32.6	41.5
1/ 7/77	73.0	91.7 *	70.8	56.7	61.9	72.2 *	36.7	36.3 *	26.4	35.8
1/10/77	56.3	37.5	35.7	33.4	42.6 *	24.5	33.1	28.6	27.1	24.5
1/13/77	50.9	64.1	49.9	63.1	41.0 *	23.3	27.2	38.7 *	22.3	25.1 *
1/16/77	33.8	34.1	33.8	25.3	30.0	27.1	38.5	28.1	17.6	24.4
1/19/77	53.5	55.7	46.6	54.9	29.2 *	37.2	28.8	22.8 *	29.7	
1/22/77	75.0	80.2	64.4	52.3	71.4	33.1	52.8	64.8	33.1	40.0 *
1/25/77	61.2	51.5	43.5	33.5 *	26.0	22.7	29.1	23.1	13.4	17.7
1/28/77	72.4	80.5	194.3	46.9	50.2	57.4	45.6	52.1 *	42.0	30.9
1/31/77	63.6	70.0 *	46.8	44.5	34.9	37.3	37.4	30.3	22.7	45.4
2/ 3/77	57.7	69.5	50.1	40.5	39.9	34.1	32.2 *	34.1	23.8	33.6
2/ 6/77	45.9	82.4	45.9	33.2	48.0	27.1	49.1	34.6	23.5	33.6
2/ 9/77	108.3	127.8	75.9	189.6	55.8	76.5	49.9	45.3	48.1	36.9 *
2/12/77	43.2	81.7	52.5	58.5	44.9	39.0	36.4 *	40.9	41.4	54.2
2/15/77	61.7	73.3	56.8	27.5	43.6	30.1	37.3	47.0	18.3	
2/18/77	127.8	133.6	102.7	129.0	85.2	60.1		70.6	39.3	
2/21/77	70.4	108.7	115.8 *	124.4	80.1	47.7	45.9	63.0 *	53.4	
2/24/77	46.1	60.6	56.5	63.4 *	35.4	36.1	27.6	39.8 *	67.7 *	
2/27/77	5.4	43.2	39.6	33.9	33.2	27.9	25.3	29.8	17.0	
3/ 2/77	71.6 *	77.4 *	50.7	48.4	60.1	13.7	34.1	41.4	31.0	
3/ 5/77		54.1	49.8	39.1	34.7	32.6	39.0	33.2	24.0	
3/ 8/77	130.2	136.6	138.3	218.4 *	99.2	88.8 *	55.6	51.6	59.8	
3/11/77	45.6	56.6	56.4	60.4	44.0	34.1	37.4	32.6	33.9	
3/14/77	153.0	172.2	133.5	169.3	161.0	118.7	56.0	122.4	107.4	
3/17/77	71.4	77.9	66.9	69.6	65.0 *	41.1	48.7	48.7	36.1	
3/20/77	48.4	55.7	45.2	39.6	42.3	32.2	60.6	32.5	24.3	
3/23/77	88.9	81.2	60.3	53.5	53.9	34.7 *	44.5	55.7	34.2	
3/26/77	118.6	96.4	82.6	100.7	102.6	75.6	65.0	77.1	66.2	
3/29/77	126.3	142.6	110.3 *	136.3 *	94.4	84.8	92.7	104.4	94.0	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: TOTAL SUSPENDED PARTICULATES (TSP) 01-JAN-77 THROUGH 31-MAR-77

STATISTICS	103	105	106	108	112	115	118	120	122	124
# OBS	29	30	30	30	30	30	29	30	30	14
ARITH MEAN	71.4	81.7	69.2	71.3	56.7	44.8	43.0	49.9	38.2	34.3
ARITH SDEV	33.4	33.5	36.6	50.5	28.9	24.1	14.2	26.5	22.0	9.5
GEO MEAN	62.5	75.7	62.6	59.3	51.4	39.8	41.1	44.9	33.6	33.0
GEO SDEV	1.83	1.49	1.54	1.79	1.54	1.62	1.35	1.56	1.64	1.34
ANNUAL MAX	153.0	172.2	194.3	218.4	161.0	118.7	92.7	123.4	107.4	54.2
DATE OF MAX	3/14/77	3/14/77	1/28/77	3/ 8/77	3/14/77	3/14/77	3/29/77	1/ 1/77	3/14/77	2/12/77
DISTRIBUTION:										
< 25.	1	0	0	0	0	4	0	2	10	3
25.- 50.	6	3	11	13	16	18	23	18	14	10
50.- 75.	14	11	11	10	8	3	5	6	4	1
75.-100.	2	9	2	0	4	4	1	1	1	0
100.-125.	2	2	3	2	1	1	0	3	1	0
125.-150.	3	4	2	2	0	0	0	0	0	0
150.-175.	1	1	0	1	1	0	0	0	0	0
175.-200.	0	0	1	1	0	0	0	0	0	0
>200.	0	0	0	1	0	0	0	0	0	0

RAMS/RAPS PARTICULATE SUMMARY: SULFATES 01-JAN-77 THROUGH 31-MAR-77

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
1/ 1/77	6.6 *	6.0	5.4 *	5.4 *	5.1	6.9	6.9	9.6	6.5	6.6 *
1/ 4/77	19.9	28.9	16.2	11.8	15.7	11.6	11.9	14.6	12.0	13.0
1/ 7/77	12.9	16.6 *	11.2	12.3	11.9	23.7 *	10.3	7.1 *	8.5	10.9
1/10/77	10.7	8.3	7.6	7.5	8.3 *	7.5	8.0	6.2	10.9	7.1
1/13/77	12.0	13.2	9.8	16.5	9.5 *	6.1	8.8	10.9 *	9.0	9.7 *
1/16/77	5.8	5.3	5.7	6.6	6.2	8.5	6.1	6.1	6.1	6.0
1/19/77	12.2	9.0	7.4	12.8	8.3 *	9.2	8.4	6.1 *	8.4	
1/22/77	14.9	16.2	12.9	11.9	13.7	9.0	11.8	10.6	9.9	10.6 *
1/25/77	9.9	6.0	7.1	9.8 *	6.8	6.8	7.7	6.3	5.3	5.4
1/28/77	6.6	5.5	5.5	5.9	5.7	8.7	6.3	6.7 *	4.8	6.5
1/31/77	12.2	6.0 *	5.1	7.6	5.4	6.7	7.1	3.3	5.6	6.2
2/ 3/77	9.4	7.7	6.9	6.9	6.1	7.4	9.0 *	6.8	6.6	7.4
2/ 6/77	7.1	12.2	5.8	6.0	6.3	5.7	9.3	5.6	3.8	7.4
2/ 9/77	13.4	13.8	10.7	22.3	7.1	12.4	10.2	8.8	11.1	8.0 *
2/12/77	7.0	11.8	8.6	10.4	7.7	8.4	14.9 *	8.4	10.0	11.8
2/15/77	10.4	8.0	5.9	5.9	6.1	7.5	8.3	6.6	5.5	
2/18/77	11.2	7.2	7.7	12.1	6.4	7.2		6.4	6.9	
2/21/77	8.4	8.9	12.9 *	17.0	7.7	7.3	6.4	9.7 *	8.2	
2/24/77	4.9	5.2	5.6	10.1 *	4.9	5.6	5.2	5.5 *	16.5 *	
2/27/77	3.6	8.2	8.1	8.7	7.1	8.8	7.0	7.6	7.1	
3/ 2/77	20.1 *	10.1 *	7.6	7.4	9.0	4.6	9.0	7.6	7.7	
3/ 5/77		7.9	7.2	7.8	7.5	9.5	6.7	7.6	7.7	
3/ 8/77	8.1	7.4	12.3	15.0 *	7.2	11.3 *	7.4	4.8	7.1	
3/11/77	10.1	12.5	11.0	13.0	10.9	10.3	10.6	9.9	10.3	
3/14/77	13.4	9.6	7.2	10.3	11.0	6.8	7.2	5.5	8.6	
3/17/77	7.4	6.5	6.8	8.0	6.5 *	6.7	6.6	7.2	5.8	
3/20/77	11.1	11.3	10.2	10.8	9.4	10.6	9.7	12.7	9.0	
3/23/77	10.9	7.9	5.9	7.1	6.2	6.7 *	5.1	4.4	6.1	
3/26/77	8.8	8.5	8.0	10.0	7.5	8.8	7.8	6.3	8.8	
3/29/77	7.2	5.3	5.3 *	8.2 *	5.2	5.6	4.4	3.0	5.5	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: SULFATES 01-JAN-77 THROUGH 31-MAR-77

STATISTICS	103	105	106	108	112	115	118	120	122	124
# OBS	30	30	30	30	30	30	29	30	30	14
ARITH MEAN	10.1	9.7	8.3	10.2	7.9	8.5	8.2	7.4	8.0	8.3
ARITH SDEV	3.8	4.8	2.8	3.9	2.6	3.4	2.3	2.6	2.6	2.4
GEO MEAN	9.5	8.9	7.9	9.6	7.5	8.1	7.9	7.0	7.6	8.0
GEO SDEV	1.46	1.49	1.37	1.42	1.34	1.37	1.31	1.42	1.36	1.32
ANNUAL MAX	20.1	28.9	16.2	22.3	15.7	23.7	14.9	14.6	16.5	13.0
DATE OF MAX	3/ 2/77	1/ 4/77	1/ 4/77	2/ 9/77	1/ 4/77	1/ 7/77	2/12/77	1/ 4/77	2/24/77	1/ 4/77
DISTRIBUTION:										
< 5.	2	0	0	0	1	1	1	4	2	0
5.- 10.	13	20	22	15	24	23	22	22	22	10
10.- 15.	13	7	7	11	4	5	6	4	5	4
15.- 20.	1	2	1	3	1	0	0	0	1	0
20.- 25.	1	0	0	1	0	1	0	0	0	0
25.- 30.	0	1	0	0	0	0	0	0	0	0
30.- 35.	0	0	0	0	0	0	0	0	0	0
35.- 40.	0	0	0	0	0	0	0	0	0	0
> 40.	0	0	0	0	0	0	0	0	0	0

RAMS/RAPS PARTICULATE SUMMARY: NITRATES 01-JAN-77 THROUGH 31-MAR-77

DATE \ SITE	103	105	106	108	112	115	118	120	122	124
1/ 1/77	2.5 *	2.6	1.5 *	2.6 *	2.4	2.4	2.5	5.4	2.8	2.4 *
1/ 4/77	5.1	3.8	4.5	3.9	4.2	4.0	3.5	4.4	3.9	2.6
1/ 7/77	7.1	6.5 *	7.1	6.4	7.8	8.1 *	7.2	4.6 *	4.6	6.1
1/10/77	3.1	3.0	3.0	3.5	3.9 *	2.9	3.2	2.9	3.0	2.7
1/13/77	4.5	4.9	4.1	4.3	3.8 *	1.3	4.1	4.9 *	2.0	4.7 *
1/16/77	1.4	1.4	1.3	1.4	1.4	3.7	1.8	1.5	1.0	1.4
1/19/77	3.5	3.8	3.2	3.6	2.7 *	3.6	3.0	3.1 *	3.6	
1/22/77	7.5	9.0	8.3	9.2	9.0	7.8	7.3	8.0	5.5	6.8 *
1/25/77	2.2	2.4	2.1	3.3 *	2.2	2.5	1.9	2.8	2.2	2.1
1/28/77	2.7	1.1	1.1	1.0	0.9	1.1	1.0	0.9 *	0.8	0.7
1/31/77	2.6	3.1 *	2.8	3.4	2.7	2.8	2.6	2.8	2.9	3.3
2/ 3/77	5.8	6.4	5.3	6.5	5.3	5.7	5.1 *	5.9	6.8	5.6
2/ 6/77	4.9	5.4	4.3	5.3	4.4	4.9	5.9	4.2	4.9	6.6
2/ 9/77	5.0	5.2	4.0	5.5	3.5	6.8	4.4	2.5	5.8	4.5 *
2/12/77	3.0	4.3	3.6	4.8	4.1	4.9	4.5 *	4.1	5.4	5.4
2/15/77	4.7	3.5	3.1	3.3	3.7	2.9	3.4	3.9	3.0	
2/18/77	6.6	6.7	6.5	9.2	6.6	7.2		6.8	7.6	
2/21/77	3.9	4.4	4.3 *	4.5	3.9	4.4	4.1	4.5 *	5.1	
2/24/77	1.2	1.2	1.0	1.3 *	1.1	1.4	0.9	1.2 *	2.2 *	
2/27/77	0.1	4.2	3.9	4.0	3.5	3.7	3.4	4.1	4.1	
3/ 2/77	3.9 *	8.0 *	5.3	6.8	6.2	2.0	5.8	5.6	7.4	
3/ 5/77		3.6	3.0	2.8	2.9	2.8	3.2	2.9	2.6	
3/ 8/77	3.7	3.5	3.1	6.0 *	2.9	6.8 *	3.0	3.1	3.9	
3/11/77	1.4	1.9	2.6	2.3	1.5	2.3	1.9	1.6	2.4	
3/14/77	5.2	5.0	1.6	4.7	3.8	5.6	3.4	4.0	5.1	
3/17/77	3.4	4.4	3.6	3.5	3.0 *	3.7	3.8	3.8	4.1	
3/20/77	5.1	5.5	5.0	4.4	4.5	4.8	4.0	4.8	4.0	
3/23/77	3.2	3.7	3.1	3.0	2.9	3.0 *	3.8	2.9	3.6	
3/26/77	5.0	6.5	4.6	6.3	4.8	5.0	5.8	5.3	5.4	
3/29/77	1.6	2.6	1.1 *	2.2 *	2.3	2.6	1.7	2.4	2.5	

* Indicates Samples of less than 24 hours

RAMS/RAPS PARTICULATE SUMMARY: NITRATES 01-JAN-77 THROUGH 31-MAR-77

STATISTICS	103	105	106	108	112	115	118	120	122	124
# OBS	30	30	30	30	30	30	29	30	30	14
ARITH MEAN	3.8	4.3	3.6	4.3	3.7	4.0	3.7	3.8	3.9	3.9
ARITH SDEV	1.8	1.9	1.8	2.0	1.9	1.9	1.6	1.6	1.7	2.0
GEO MEAN	3.1	3.8	3.1	3.8	3.3	3.6	3.3	3.4	3.5	3.3
GEO SDEV	2.24	1.69	1.75	1.70	1.70	1.69	1.67	1.65	1.69	1.94
ANNUAL MAX	7.5	9.0	8.3	9.2	9.0	8.1	7.3	8.0	7.6	6.8
DATE OF MAX	1/22/77	1/22/77	1/22/77	2/18/77	1/22/77	1/ 7/77	1/22/77	1/22/77	2/18/77	1/22/77
DISTRIBUTION:										
< 5.	21	20	24	21	25	22	23	24	21	9
5.- 10.	9	10	6	9	5	8	6	6	9	5
10.- 15.	0	0	0	0	0	0	0	0	0	0
15.- 20.	0	0	0	0	0	0	0	0	0	0
20.- 25.	0	0	0	0	0	0	0	0	0	0
25.- 30.	0	0	0	0	0	0	0	0	0	0
30.- 35.	0	0	0	0	0	0	0	0	0	0
35.- 40.	0	0	0	0	0	0	0	0	0	0
> 40.	0	0	0	0	0	0	0	0	0	0

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/4-79-003	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE REGIONAL AIR POLLUTION STUDY High Volume Filter Measurements of Suspended Particulate Matter		5. REPORT DATE January 1979
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) E. Nelson		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Rockwell International Environmental Monitoring & Services Center 11640 Administration Drive Creve Coeur, MO 63141		10. PROGRAM ELEMENT NO. 1AA603
		11. CONTRACT/GRANT NO. 68-02-2093 Task Order 101
12. SPONSORING AGENCY NAME AND ADDRESS Environmental Sciences Research Laboratory - RTP, NC Office of Research and Development U.S. Enviornmental Protection Agency Research Triangle Park, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED Final
		14. SPONSORING AGENCY CODE EPA/600/09

15. SUPPLEMENTARY NOTES

16. ABSTRACT

Ten of the 25 stations making up the Regional Air Monitoring System were equipped with dichotomous samplers and high volume filter samplers for aerosol measurements. The high volume samplers collected samples every third day for 24-hour periods (0000-2400). Sample filters were returned to a chemical laboratory where weights of total suspended particulate (TSP) were determined, and wet chemical analyses performed for sulfates and nitrates. A total of 2358 samples were obtained between March 1975 and March 1977. The report describes both the operation of the sampling network, including equipment maintenance, and analysis and quality control procedures and results.

Analyses were made to determine seasonal and spatial variations of the three parameters measured. The station geometric mean concentrations of TSP varied from 33.0 to 90.9 $\mu g\ m^{-3}$, sulfate ranged from 7.0 to 12.7 $\mu g\ m^{-3}$, and nitrate from 2.3 to 3.8 $\mu g\ m^{-3}$ Sulfate showed the greatest seasonal variation, peaking in the summer months, and nitrate the least, with no consistent patterns discernable.

An Appendix lists all individual sampling results obtained. These data are stored in the RAPS Data Bank in Research Triangle Park, N.C.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
*Air pollution		13B
*Aerosols		07D
*Weight(mass)		07B
*Sulfates		04B
*Inorganic nitrates		
*Seasonal variations		
*Spatial distribution		

18. DISTRIBUTION STATEMENT RELEASE TO PUBLIC	19. SECURITY CLASS *(This Report)* UNCLASSIFIED	21. NO. OF PAGES 112
	20. SECURITY CLASS *(This page)* UNCLASSIFIED	22. PRICE

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