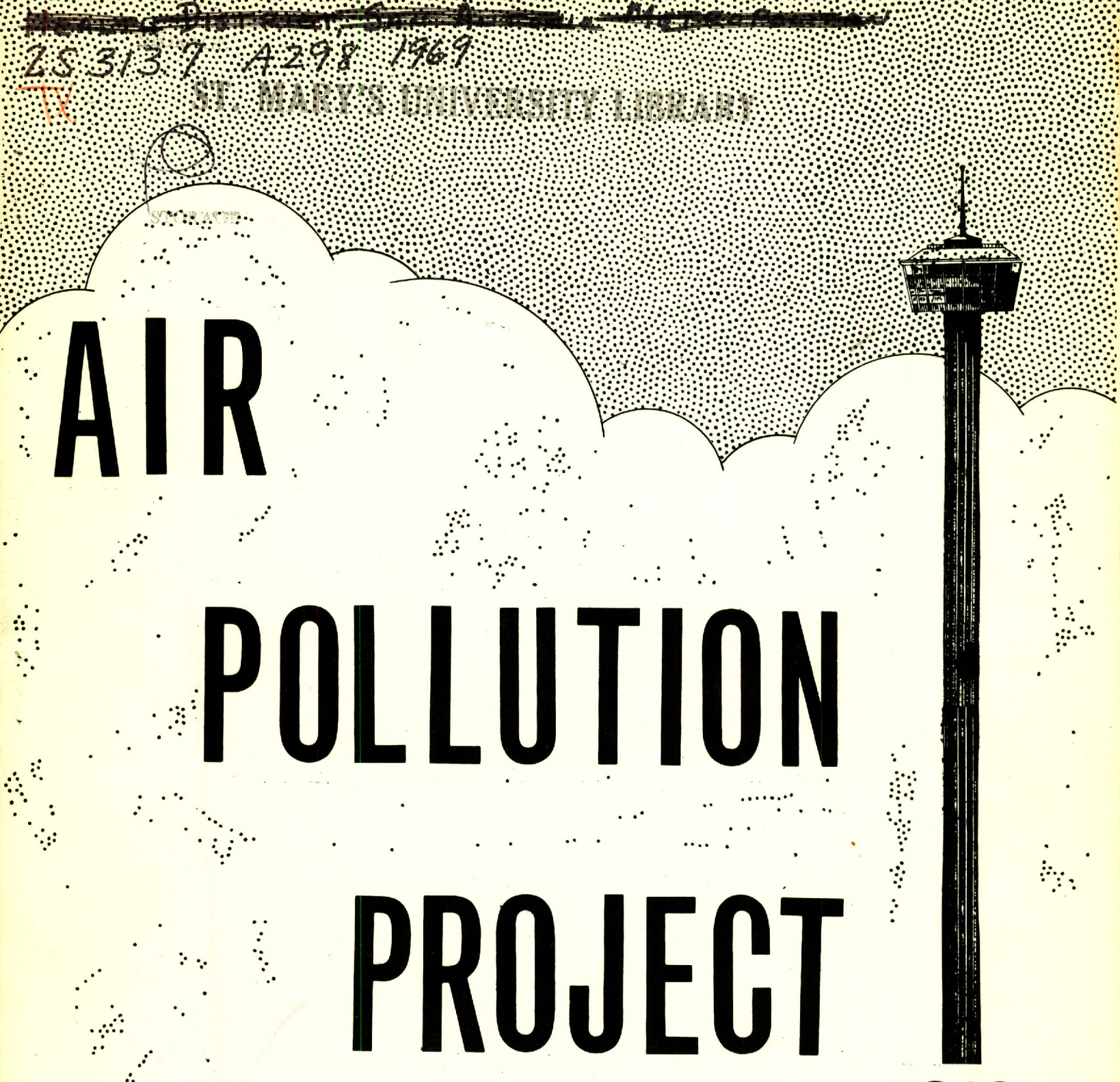

AIR POLLUTION PROJECT

1969

SAN ANTONIO METROPOLITAN HEALTH DISTRICT

131 W. NUEVA STREET SAN ANTONIO, TEXAS 78204

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Foreword

The 1969 Annual Report of the Air Pollution Project of the San Antonio Metropolitan Health District is the second such report for this activity within Bexar County and the City of San Antonio.

The data presented in this report include that for suspended particulate matter, both total and organic soluble; settled particulate matter; windblown particulate matter; sulfation rate; reflectance loss of silver; and deterioration of nylon fabric. Compiled monthly and yearly values are given for all determinations except for windblown particulate and nylon fabric deterioration which are given as compiled yearly values. Data of the National Air Surveillance Network reported herein are for the dates on which the samples were collected and compiled yearly values. Additional unpublished data are available for use by the department and will be made available to those having a legitimate need for such.

The evaluation of data reported herein is limited, but there are indications that improvement of air quality can be demonstrated by decreased values for settled particulate matter and sulfation rate for 1969 as compared to values reported for 1968. These decreases coincide with abatement of certain industrial emissions and of open burning in many locations.

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Director of Health

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I. INTRODUCTION

Project Support by National Air Pollution Control Administration

The work program during this reporting period was funded partly by the final year of a grant from the National Air Pollution Control Administration for the development phase of the project for which $159,640 was made available on a Federal-Local matching funding basis. Beginning August 1, 1969, a new grant for the establishment phase of the project was awarded by the National Air Pollution Control Administration. $148,743 was made available for the first year of this grant on a Federal-Local matching funding basis. This phase of funding can be provided for up to three years, after which funding for the maintenance of the fully established control program may become available.

Participation in National Air Surveillance Network

The San Antonio Metropolitan Health District during 1969 continued its cooperation with the National Air Surveillance Network to collect samples of particulates and gases to be analyzed by the National Air Surveillance Network laboratories. The results of the San Antonio portion of the network are shown in Table 1. A comparison of annual arithmetic averages of these results for the years 1968 and 1969 are shown in Table 2. The sampling site of this network during 1969 was located at 302 S. Laredo Street, the same location as that of Site Number 14 of the Health District.

Participation with State of Texas Emission Inventory

In order to provide for a more comprehensive emission inventory for the purpose of producing an implementation plan for the San Antonio Air Quality Control Region designated by the Department of Health, Education and Welfare, the Health District agreed to conduct its 1969 emission inventory according to the requirements specified by the Air Control Program of the Texas State Department of Health. The forms necessary for conducting this inventory were not received until late this year and gathering of the data is still in progress. The results of this emission inventory will be included in the next project report.

II. METHODOLOGY

Description of Sampling Sites

A total of nineteen (19) fixed sampling sites were utilized during 1969 in a continuing study of the air quality in the City of San Antonio and Bexar County. The locations of these sites are shown in Figure 1 and a general description of each is given in Table 3. Several of these sites were discontinued during the year for the reason that either the site was no longer available or the equipment at the site was necessary for short term determinations of air quality in the vicinity of sources emitting particulate contaminants. Since over a year of data had been obtained at the discontinued sites under varying weather conditions it will be possible to go back to these sites for further evaluation in the future.

Each of the nineteen (19) sites was equipped with a high volume sampler for the collection of suspended particulates, a dustfall jar for the collection of settled particulates, and a sulfation plate for the determination of sulfur dioxide rate of reaction. In addition to the foregoing, six (6) of the sites within the City of San Antonio were equipped with various devices and materials to determine the effects of some pollutants. These six (6) sites are shown in Figure 1. Included in the study at these sites were jars on which adhesive paper was mounted with the sticky surface exposed so that dust particles would adhere to it from each direction of the compass. Also, silver plates were exposed to determine the tarnishing effect of hydrogen sulfide and nylon hose were stretched on polaroid slide mounts to determine the deteriorating effect of oxidants, especially acid mist.

Sampling and Analytical Procedures

Suspended particulate matter was collected on glass fiber filters which were placed in the high volume samplers for a total sampling period of twenty four (24) hours every third day. The average concentration of total suspended particulates was determined by weight difference between the initial weight of the unused filter and final weight after the sampling period together with the total volume of air which was passed through the filter.

Organic soluble particulate matter was determined by extraction of a portion of the glass fiber filter with benzene for at least two of the samples taken during each month at each site. The residue left after evaporation of the benzene solvent was weighed in a preweighed weighing dish and reported as organic soluble particulates.

Settled particulates were determined by weighing the material collected in the dustfall jars over a thirty (30) day period. Any water collected was evaporated before the weight determination.

Sulfation rate determinations were made by the Huey Method (1). This method consists of exposing petri dishes containing lead dioxide to the ambient air and analyzing the plate material after exposure for the quantity of sulfate contained in the sample by the turbidimetric barium sulfate procedure. Sulfation plates were exposed for a fourteen (14) day period at each site with two (2) consecutive exposures each month.

Windblown particulates were determined by comparing the surface of the sticky paper tape exposed to each of eight (8) sectors of the compass to standard photographic specimens which represented an estimated number of particles per square inch. Exposures were for a week with four (4) consecutive exposures each month.

The reflectance loss of silver plates was determined by the means of a laboratory reflectometer. The difference in reflectance before and after exposure was reported as a percentage loss of reflectance for exposures of thirty (30) days.

The deterioration of nylon fabric by oxidants was determined by exposing nylon hose for thirty (30) and ninety (90) day periods. The samples exposed for each period were examined for fabric breaks which were reported as number of defects for the sample exposed.

III. METEOROLOGICAL ASPECTS FOR 1969

Monthly and annual values during 1969 for temperature, wind and rainfall data are given in Table 4. Seasonal and annual data for resultant wind direction, wind speed, rainfall and temperature are given in Table 5. Amounts of rainfall throughout the year show that during the Spring and Fall months rainfall would tend to keep ground dust at a minimum, although this would be more likely true in Fall when the average temperature would keep evaporation loss at a minimum. It would also be expected that the highest levels of ground dust would be during the Summer when rainfall is least and temperatures are highest.

The influence of wind direction and speed on the transport of pollutants would tend to have differing effects during Fall and Winter months as compared to Spring and Summer months since the resultant directions shift from northeasterly in Winter and Fall to southeasterly during Spring and Summer. The wind roses for 1969 shown in Figure 2 depict this for Winter and Summer months.

IV. AIR QUALITY DETERMINATIONS FOR 1969

Total Suspended Particulate Matter

Total suspended particulate matter annual arithmetic average for the nineteen (19) sampling sites in Bexar County was 55 ug/m^3. The annual arithmetic average for the nine (9) sampling sites located within the corporate limits of San Antonio was 66 ug/m^3. The ten (10) sampling sites outside the corporate limits of the City of San Antonio had an annual arithmetic average of 43 ug/m^3. The San Antonio portion of the National Air Surveillance Network results for the year 1969 was 54 ug/m^3 annual arithmetic average. Although the site for this network is the same as Site Number 14 shown in Figure 1, samples for this network were collected on different days than those for the values reported at this site in Table 6. Monthly and annual averages for each sampling site are shown in Table 6.

The annual distribution of total suspended particulates throughout the metropolitan area are shown by the isopleths in Figure 3. The quarterly seasonal variations for sites located within the City of San Antonio as compared with those outside the City of San Antonio are shown in Figure 4. The levels of suspended particulates approach lower values in the second and third quarters at sites in the City of San Antonio. The opposite effect is observed for sites outside of the City of San Antonio where higher values are observed during the same quarters.

Organic Soluble Particulate Matter

The annual arithmetic average for organic soluble particulate matter for all sampling sites in 1969 was 5.4 ug/m^3. The annual arithmetic average for the nine (9) sites in the City of San Antonio was 5.8 ug/m^3. The ten (10) sites outside the City of San Antonio had an annual arithmetic average of 3.6 ug/m^3. The National Air Surveillance Network results for San Antonio during 1969 were reported as 4.4 ug/m^3. Monthly and annual averages for each site are shown in Table 7.

The annual distribution of organic soluble particulates is shown in Figure 5. The quarterly variations for sites located within the City of San Antonio as compared with those outside the City of San Antonio are shown in Figure 4. Higher values are shown during the fourth quarter at sites both within and outside of the City of San Antonio.

Settled Particulate Matter

The annual arithmetic average for monthly amount of settled particulates at all sites during 1969 was 2.53 grams per square meter. The annual average at sites within the City of San Antonio was 3.06 g/m^2. Sites outside of the City of San Antonio had an annual average of 1.95 g/m^2. There is a decrease of about 52% in the annual average for the composite of all sites during 1969 as compared to 1968. Reductions in the annual average for individual sites range from about 20% to about 70% with the greatest reductions generally in the northern part of the metropolitan area. Monthly amounts and the annual averages for each site are shown in Table 8.

The distribution of settled particulates is shown in Figure 6. The quarterly variations for sites in the City of San Antonio and those outside the City of San Antonio are shown in Figure 7. Highest levels are shown for the third quarter and lowest levels are shown for the fourth quarter at sites both within and outside of the City of San Antonio.

Sulfation Rate

The annual arithmetic average sulfation rate of sulfur dioxide at all sites during 1969 was 0.041 milligrams of sulfur trioxide (SO_3) per square centimeter per day. Annual arithmetic average for all sites in the City of San Antonio was 0.040 mg $SO_3/cm^2/day$. The sites outside of the City of San Antonio had an annual arithmetic average of 0.043 mg $SO_3/cm^2/day$. The monthly and annual arithmetic averages for each sampling site are shown in Table 9. Since the distribution of sulfation rate levels were varied throughout the metropolitan area during 1969 no lines of equal distribution could be determined. The quarterly variations for sites in the City of San Antonio as compared with sites outside of the City of San Antonio are shown in Figure 7. Levels of sulfation rate were highest in the second quarter and lowest in the third and fourth quarters. The lower levels are coincidental with the discontinuing of open burning of municipal garbage and trash which became effective July 1, 1969 for those municipalities which were utilizing this method of disposal.

Windblown Particulates

The annual geometric averages of numbers of particles collected on sticky paper jars at each site where this determination was made are shown in Table 10. The values are given for each sector from which the wind originated. At each site the southwest sector contributed the greatest number of particles. This result indicates that windblown dust in the atmosphere coming from the area southwest of the San Antonio metropolitan area was present in greater amounts than from any other sector since the wind originated from the southwest less than most other directions of the compass.

Reflectance Loss of Silver Plates

Annual arithmetic average and monthly percentages of reflectance loss of silver plates are given in Table 11. The reflectance loss was greatest at the midcity sampling site. The highest percentage of reflectance loss occurred in the summer months for most sites. Somewhat higher values were determined in February and March at the sites located in the east and southeast. This data indicates that reflectance loss due to the effect of hydrogen sulfide is fairly widespread and is probably not the result of a single point source of this contaminant.

Deterioration of Nylon Fabric

The effect of oxidants on nylon fabric is given in Table 12 as total number of defects for the year for both thirty (30) and ninety (90) day exposures. The data for Site Number 8 indicates a higher rate of deterioration than for all other sites. Since sulfuric acid is the oxidizing agent usually associated with this effect it would appear that a source of this contaminant was located in the vicinity of this sampling site. A further evaluation of the suspected source of this contaminant is planned. The data for Site Number 15 appears to be an error in that more defects were determined for thirty (30) day exposures than for ninety (90) day exposures.

V. CONTROL OF SOURCES OF AIR POLLUTION

Several of the major stationary sources of air pollution in Bexar County abated their emissions during 1969 by installing control equipment or by changing the type of operation to a less polluting one. In some cases there was a discontinuation of the operation entirely, such as in the abatement of open burning at some locations.

The installation of dust control equipment on the kilns of two cement plants north of the City of San Antonio abated a potential amount of particulate pollution totaling approximately 72,000 tons per year from both sources. One of these plants installed the control equipment early in the year while the other one completed its installation of control equipment by midyear. The control equipment utilized in each case was the electrostatic precipitator. One plant with three kilns installed a separate electrostatic precipitator on each of the three kilns. The other plant installed a dual electrostatic precipitator on its one kiln. The total cost of both installations amounted to about 2 million dollars.

The abatement of open burning by several auto salvage yards by the beginning of 1969 resulted in a potential reduction of emissions totaling approximately 40 tons per year of pollutants including both particulates and gases. Part of this reduction was possible due to modifications of a local hammer mill installation which allowed unburned automobile bodies to be processed. The modifications included increased dust control equipment. Another salvage firm in the southern section of San Antonio installed an incinerator with smoke control equipment.

The converting of open burning dumps to sanitary landfill operations during the first half of 1969 resulted in a potential reduction of emissions totaling approximately 2,350 tons per year of pollutants including both particulates and gases. One site operated by the City of San Antonio for the open burning of brush was continued throughout the year under a variance granted by the Texas Air Control Board. During this time an experimental open pit burner with a forced air blower was under development at another site which allowed brush to be burned with reduced smoke emissions. This form of modified open burning is considered an acceptable means of disposing of easily combustible solid waste provided that the smoke is controlled to meet the emission limits specified for incinerators.

Although a compilation of emissions for the year 1969 is not presently available, comparisons to the 1968 emission inventory figures can be made for the figures given as reduced potential emissions since all of these were derived from 1968 emission data. The reduction of 72,000 tons per year of particulates in the industrial category accounts for about a 50% reduction of this contaminant which amounted to 143,140 tons during 1968. The reduction of emissions from abatement of open burning of junk car bodies accounts for a neglible percentage reduction but when added to the reduction of particulates from the cement plants the resulting reduction in all pollutants in the industrial category is about 49% of the category total of 146,060 tons per year during 1968.

The reduction of 2,350 tons of pollutants as the result of abatement of open burning of solid waste accounts for about 68% of the category total of 3,450 tons per year of pollutants. This category reduction together with the industrial category reduction accounts for about an 11% reduction of the total of all emissions which amounted to 691,650 tons per year during 1968.

VI. DEFINITION OF TERMS

Air Pollution	The presence in the atmosphere of one or more air contaminants or combinations thereof in such concentration and of such duration as are or may tend to be injurious to or to adversely affect human health or welfare, animal life, vegetation or property, or as to interfere with the normal use and enjoyment of animal life, vegetation or property.
Ambient Air	The envelope of air that surround the earth and particularly the very lowest layers.
Cubic Meter (m^3)	A metric measure of volume equivalent to 35.31 cubic feet.
Gram (g)	A metric measure of weight equivalent to 0.03527 ounces.
Isopleth	A line indicating equal levels of contaminants on points along that line.
Meter (m)	A metric measure of length equivalent to 39.37 inches.
Microgram (ug)	A metric measure of weight equal to one millionth (0.000001) of a gram.
Milligram (mg)	A metric measure of weight equal to one thousandth (0.001) of a gram.
Organic Soluble Particulates	Particulate matter which is soluble in benzene and having a chemical structure containing carbon, hydrogen and other elements.
Settled Particulates	Particles which tend to fall to the ground under the influence of gravity.
Square Centimeter (cm^2)	A metric measure of area equal to one ten thousandth (0.0001) of a square meter.
Suspended Particulates	Solid or liquid matter which because of its small size tends to remain suspended in air.

VII. REFERENCES

1. "The Lead Dioxide Estimation of Sulfur Dioxide Pollution", N. A. Huey, APCA Paper No. 67-198 presented at the 60th Annual Meeting of the Air Pollution Control Administration, Cleveland, Ohio.

2. 1969 Local Climatological Data, San Antonio, Texas. Environmental Science Services Administration, U. S. Department of Commerce.

TABLE 1

1969 NATIONAL AIR SURVEILLANCE NETWORK SAMPLING RESULTS (ug/m^3)

Date	Suspended Particulates	Sulfur Dioxide	Nitrogen Dioxide	Total Oxidant	Aldehydes	Ammonia
Jan. 4	43	9	115	11	9	49
Jan. 16	69	11	173	14	13	43
Jan. 28	31	7	83	5	26	55
Feb. 12	82	6	182	10	24	45
Feb. 27	54	14	130	14	19	41
Mar. 11	38	13	95	-	9	58
Mar. 23	49	6	163	-	10	55
Apr. 7	42	5	90	14	13	43
Apr. 25	43	34	108	9	27	37
May 4	26	9	45	-	17	73
May 20	-	7	51	21	14	49
May 22	40	-	-	-	-	-
June 7	35	11	108	21	16	34
June 18	36	7	154	16	-	60
July 2	40	7	58	26	14	100
July 18	43	7	136	21	9	57
July 29	64	7	129	37	13	72
Aug. 16	33	7	90	11	19	63
Aug. 28	40	5	100	-	-	33
Sept. 7	33	8	86	10	-	-
Sept. 22	36	7	88	-	11	58
Oct. 6	46	7	67	13	8	50
Oct. 23	57	8	164	-	8	36
Nov. 7	142	8	239	9	23	57
Nov. 19	90	5	221	8	4	35
Dec. 2	81	-	194	11	14	52
Dec. 14	89	7	128	8	18	43

TABLE 2

COMPARISON OF NASN YEARLY ARITHMETIC AVERAGES (ug/m^3)

Contaminant	1968	1969
Total Particulates	63(57)*	54(49)*
Organic Particulates	4.4	4.4
Sulfur Dioxide	7	9
Nitrogen Dioxide	128	123
Total Oxidants	13	14
Aldehydes	8	15
Ammonia	48	52

( )* Geometric Mean

TABLE 3

1969 FIXED SAMPLING STATION SITE DESCRIPTIONS

Site No.	Location	Property Use	Geographic Area	Height
1	Helotes Park	water pump station	Bexar County	ground level
2	Fredericksburg Rd.	trailer park	Bexar County	ground level
3	Northwood Estates	water pump station	Bexar County	ground level
4	Culebra Rd.	residence	Bexar County	ground level
5	Oak Hills	country club	City of San Antonio	ground level
6	Cadillac Dr.	water pump station	Bexar County	ground level
7	Northern	city service center	City of San Antonio	ground level
8	Newport	water pump station	City of San Antonio	ground level
9	Converse	sewage treatment	Bexar County	ground level
11	Lackland	water pump station	Bexar County	ground level
12	Lady of the Lake	water pump station	City of San Antonio	ground level
13	Edison Dr.	water pump station	City of San Antonio	ground level
14	Midcity	corporation court	City of San Antonio	15 feet above ground level
15	Seale Rd.	water pump station	City of San Antonio	ground level
17	Rhoda Ave.	water pump station	City of San Antonio	ground level
18	South East	city service center	City of San Antonio	ground level
19	Beck Rd.	residence	Bexar County	ground level
20	Somerset	water pump station	Bexar County	ground level
21	Braunig Lake	electric power plant	Bexar County	ground level

TABLE 4

1969 METEOROLOGICAL DATA, SAN ANTONIO, TEXAS

	TEMPERATURE (Averages)			WIND					PRECIPITATION
Month	Daily Maximum	Daily Minimum	Monthly	Resultant Direction	Resultant Speed	Average Speed	Fastest Mile	Direction	Total (inches)
January	62.2	42.7	52.5	NE	1.5	8.4	34	N	1.76
February	63.6	43.6	53.6	NE	3.7	8.9	30	N	2.90
March	65.2	44.5	54.9	NE	3.5	10.9	35	NW	2.35
April	79.1	58.8	69.0	ESE	4.3	10.0	31	NW	2.46
May	82.9	64.0	73.5	ESE	4.3	8.5	35	N	4.61
June	90.9	71.5	81.2	SE	7.3	10.8	29	N	2.32
July	97.6	75.9	86.8	SSE	7.4	9.3	37	E	0.36
August	97.1	74.3	85.7	SE	5.1	8.2	27	SE	4.19
September	90.3	68.8	79.6	E	3.0	7.5	31	SE	1.32
October	79.4	60.2	69.8	ENE	3.8	9.7	27	N	5.85
November	71.1	45.1	58.1	N	3.0	8.6	32	N	1.02
December	67.7	42.5	55.1	NNW	2.5	8.1	33	N	2.28
Year	78.9	57.7	68.3	E	2.5	9.1	37	E	31.42

Reference - 1969 Local Climatological Data, San Antonio, Texas, U.S. Department of Commerce (2)

TABLE 5

1969 SEASONAL METEOROLOGICAL DATA

Weather Factor	Winter	Spring	Summer	Fall	Annual
Wind Direction (resultant)	NE	ESE	SE	NNE	E
Wind Speed (average mph)	9.4	9.8	8.3	8.8	9.1
Rainfall Total (inches)	7.01	9.39	5.87	9.15	31.42
Temperature (average)	63.7	84.3	95.0	72.7	78.9

Compiled from 1969 Local Climatological Data, San Antonio, Texas, U.S. Department of Commerce.

TABLE 6

1969 TOTAL SUSPENDED PARTICULATES (ug/m^3)

Site No.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average
1	37	31	44	47	36	44	48	49	Station	Discontinued			41
2	45	63	61	94	55	70	92	104	"	"			69
3	34	28	48	55	35	76	37	38	"	"			44
4	26	29	48	58	34	34	36	38	32	23	Sta.	Disc.	36
5	39	39	54	58	43	40	44	40	48	40	29	44	43
6	28	24	26	42	34	33	37	30	35	32	22	40	32
7	73	73	72	69	75	72	72	66	78	62	61	70	70
8	46	60	54	42	35	73	39	33	36	40	43	52	46
9	32	33	46	34	31	60	36	34	36	38	31	35	37
11	38	39	49	41	42	40	44	42	39	39	32	35	40
12	123	150	117	123	144	42	96	96	116	104	115	163	120
13	71	79	73	69	74	61	67	62	67	66	72	79	70
14	88	67	68	58	51	36	41	51	60	58	81	91	62
15	72	78	78	90	82	104	86	81	87	79	69	104	84
17	40	50	57	53	50	52	60	49	49	52	39	50	49
18	47	59	58	49	36	40	46	44	44	45	48	68	49
19	33	50	52	75	55	64	89	74	Station	Discontinued			60
20	37	39	58	65	53	62	83	76	"	"			57
21	38	31	45	38	32	41	41	37	36	32	27	39	37

TABLE 7

1969 ORGANIC SOLUBLE PARTICULATES (ug/m^3)

Site No.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average
1	4.9	4.3	2.4	4.4	4.8	4.2	4.2	Station	Discontinued				4.2
2	3.0	2.4	3.9	4.8	4.2	2.3	3.6	"		"			3.4
3	2.2	3.8	3.2	4.5	4.6	2.3	3.3	"		"			3.3
4	5.6	1.8	1.6	2.6	4.4	1.9	2.8	4.8	4.6	5.1	Sta.	Disc.	3.6
5	3.4	4.8	1.6	5.8	3.9	3.1	3.6	1.9	4.9	5.6	3.9	7.9	4.1
6	1.2	-	1.1	1.6	4.1	4.3	3.8	1.8	4.5	2.7	3.6	9.8	3.4
7	5.7	3.7	4.0	2.6	4.9	6.8	6.1	2.9	5.7	6.4	6.9	5.5	5.2
8	3.4	7.0	5.4	4.6	7.4	2.9	3.9	3.8	4.4	4.6	5.1	3.4	4.7
9	1.6	4.3	5.2	3.6	3.6	4.4	3.7	4.8	4.7	4.7	3.6	4.2	3.9
11	3.2	2.0	2.5	3.2	3.9	2.1	3.7	4.3	4.3	4.7	4.2	5.0	3.6
12	8.7	9.0	6.6	10.2	7.5	4.9	6.0	7.5	9.0	5.4	9.6	9.8	7.9
13	6.9	7.6	5.1	5.4	9.6	4.9	4.7	6.5	6.7	6.5	7.4	7.8	6.7
14	10.7	5.7	4.9	4.2	4.4	3.3	3.3	3.8	5.6	5.4	8.8	7.5	5.4
15	3.1	5.8	4.4	5.6	8.7	5.7	6.2	6.6	5.9	6.4	7.6	6.2	6.0
17	3.6	3.2	3.1	5.5	5.1	1.8	3.1	4.4	4.0	6.0	4.2	7.2	4.1
18	4.7	5.4	4.8	4.1	5.7	4.1	4.5	4.9	5.3	5.1	6.8	5.5	5.1
19	1.8	4.6	4.2	1.6	4.7	2.3	3.5	Station	Discontinued				3.2
20	2.8	3.1	3.3	3.6	1.7	3.9	2.6	"		"			2.9
21	1.9	3.7	4.1	3.8	1.7	4.1	2.7	3.8	5.0	5.2	4.4	5.6	3.7

TABLE 8

1969 SETTLED PARTICULATES (g/m^2)

Site No.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average
1	5.46	.39	2.27	2.94	1.44	1.14	3.76	3.74	Station	Discontinued			2.6
2	1.11	1.13	4.84	3.34	.99	-	4.80	5.10	"	"			3.0
3	.65	.79	3.03	3.49	.79	.70	1.61	1.57	"	"			1.6
4	1.28	.74	2.13	3.23	.79	1.80	1.30	1.01	1.39	2.14	Sta.	Disc.	1.6
5	1.61	1.34	2.82	2.87	.85	1.94	3.70	.21	.83	1.41	1.61	1.63	1.7
6	.82	.68	1.65	1.16	.34	.64	1.17	.71	1.05	.82	.18	1.08	.9
7	3.53	1.56	5.50	2.80	5.60	3.39	3.43	2.18	.35	1.95	1.70	2.27	2.9
8	4.59	2.15	1.18	3.11	1.76	13.60	10.35	5.60	1.14	1.47	.88	1.19	3.9
9	2.02	.99	2.83	1.69	1.57	.95	1.48	1.22	1.01	1.13	1.01	-	1.4
11	1.05	.79	2.64	2.09	2.47	.42	1.89	3.98	1.36	-	.49	.32	1.6
12	3.65	3.22	6.15	4.57	2.82	6.05	3.34	1.93	1.77	2.16	4.06	5.30	3.8
13	4.71	1.65	.73	7.59	1.37	3.83	5.06	1.62	2.63	1.59	.86	2.24	2.8
14	-	1.14	-	3.85	4.11	2.47	1.47	1.04	1.06	1.28	2.66	2.58	2.2
15	2.86	1.02	1.16	6.04	4.31	4.41	11.66	4.04	1.56	.99	2.76	3.81	3.7
17	1.54	.64	2.85	4.60	.69	3.23	28.17	12.60	2.02	1.53	.70	1.43	5.0
18	1.42	.74	3.29	1.74	1.44	1.57	.88	1.19	1.85	.94	.82	1.23	1.4
19	3.38	1.25	5.22	1.37	4.97	3.17	4.61	2.21	Station	Discontinued			3.3
20	1.41	.96	3.93	3.73	1.88	3.08	2.81	2.21	"	"			2.5
21	2.52	.65	1.84	4.66	1.53	1.92	1.45	3.46	1.77	1.43	1.44	1.65	2.0

TABLE 9

1969 SULFATION RATE (mg SO_3/100 cm^2/day)

Site No.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average
1	.013	.049	.018	.076	.102	0	.022	0	Station	Discontinued			.038
2	.028	.099	.033	.050	.136	.024	.002	.008	"	"			.050
3	.020	.164	.108	.030	.142	.026	0	0	"	"			.063
4	.068	.062	.043	.127	.148	.033	.014	.011	0	.059	Sta.	Disc.	.058
5	.038	.197	.034	.046	.181	.002	0	.006	.010	0	.004	.004	.038
6	.012	.180	.034	.058	.227	.062	.002	.006	.038	.038	.008	.004	.053
7	.026	.030	.043	.046	.136	.084	0	.006	0	.024	.011	.005	.036
8	.038	.056	.064	.020	.128	.038	.046	.004	0	.012	0	.004	.034
9	.032	.099	.020	.050	.160	0	0	.022	.154	.004	0	0	.042
11	.026	.036	.043	.020	.119	.002	0	.004	0	.022	.016	.013	.020
12	.015	.147	.081	.149	.195	.008	.017	.020	0	0	0	.007	.053
13	.032	.171	.014	.026	.144	.011	.002	.001	0	.020	0	.017	.032
14	.006	.082	.079	.016	.174	.011	0	.006	.012	.036	.007	.008	.037
15	.013	.082	.028	.035	.142	0	0	.007	.008	.024	0	.008	.029
17	.020	.184	.024	.020	.170	0	.115	.008	.041	.019	.004	.007	.045
18	.026	.296	.092	.050	.138	.016	0	.016	.008	.082	.004	.007	.053
19	.028	.132	.025	.020	.130	0	0	0	Station	Discontinued			.041
20	.073	.017	.072	.036	.124	0	0	.054	"	"			.052
21	.028	.017	.034	.035	.142	0	0	.037	.012	0	.004	.008	.028

TABLE 10

1969 WINDBLOWN PARTICULATES*

Wind Direction	Site Number 8	12	13	14	15	18
North	600	1,200	1,300	2,000	1,900	1,200
Northwest	600	1,500	1,500	2,300	1,600	900
West	700	5,200	1,600	2,400	1,900	900
Southwest	1,000	6,500	1,700	3,300	4,400	1,700
South	800	4,700	1,500	2,100	4,000	1,500
Southeast	600	3,400	1,000	1,300	1,600	900
East	500	2,100	800	900	1,000	700
Northeast	500	1,200	800	1,300	1,400	800

*Annual geometric mean of number of particles per square inch per week collected on sticky paper jars.

TABLE 11

1969 SILVER PLATE REFLECTANCE LOSS (%)

Month	Site No. 8	12	13	14	15	18
February	57.6	65.3	67.2	81.3	68.2	79.0
March	53.5	75.9	73.8	67.9	75.6	75.0
April	34.9	68.7	54.2	77.8	65.1	73.8
May	48.2	66.3	61.6	71.4	70.6	68.6
June	52.9	83.7	56.0	77.9	75.0	68.6
July	46.6	85.0	50.0	73.6	71.9	73.3
August	55.7	-	77.0	86.0	68.6	-
September	37.7	62.8	37.2	81.2	72.2	70.6
October	48.8	53.4	51.2	75.5	61.1	75.4
November	42.5	45.7	48.2	77.0	57.2	57.3
December	43.6	37.0	44.3	49.6	44.7	57.6
Yearly Average	47.5	64.4	56.4	74.5	66.4	69.9

TABLE 12

1969 OXIDANT DETERIORATION OF NYLON FABRIC*

Site Number	30 Day Exposure	90 Day Exposure
8	7/12	13/4
12	0/12	1/4
13	1/12	1/4
14	1/12	1/4
15	4/12	1/4
18	0/12	0/4

*Total number of defects/Total number of exposure

1969 FIXED SITE SAMPLING LOCATIONS

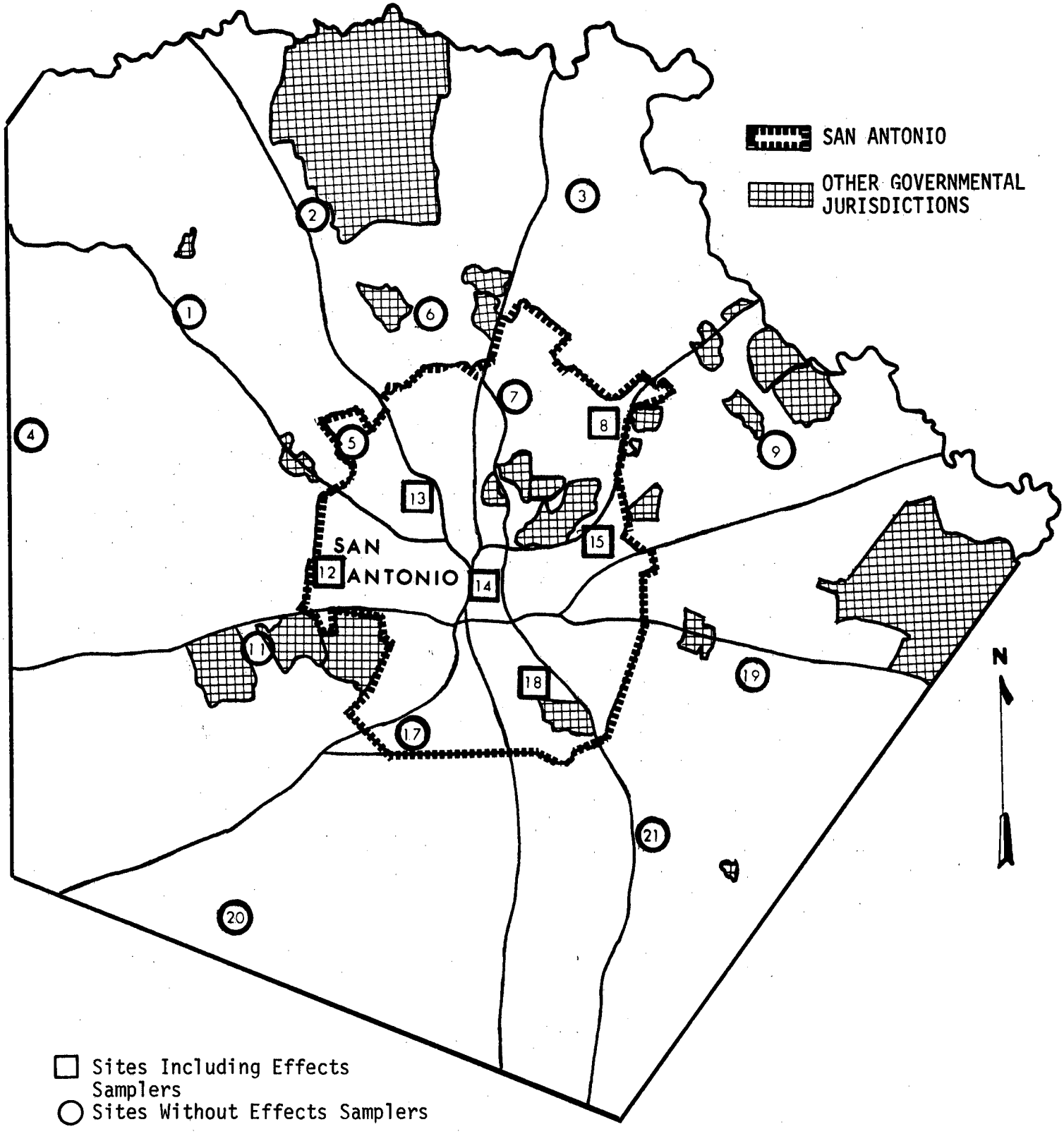
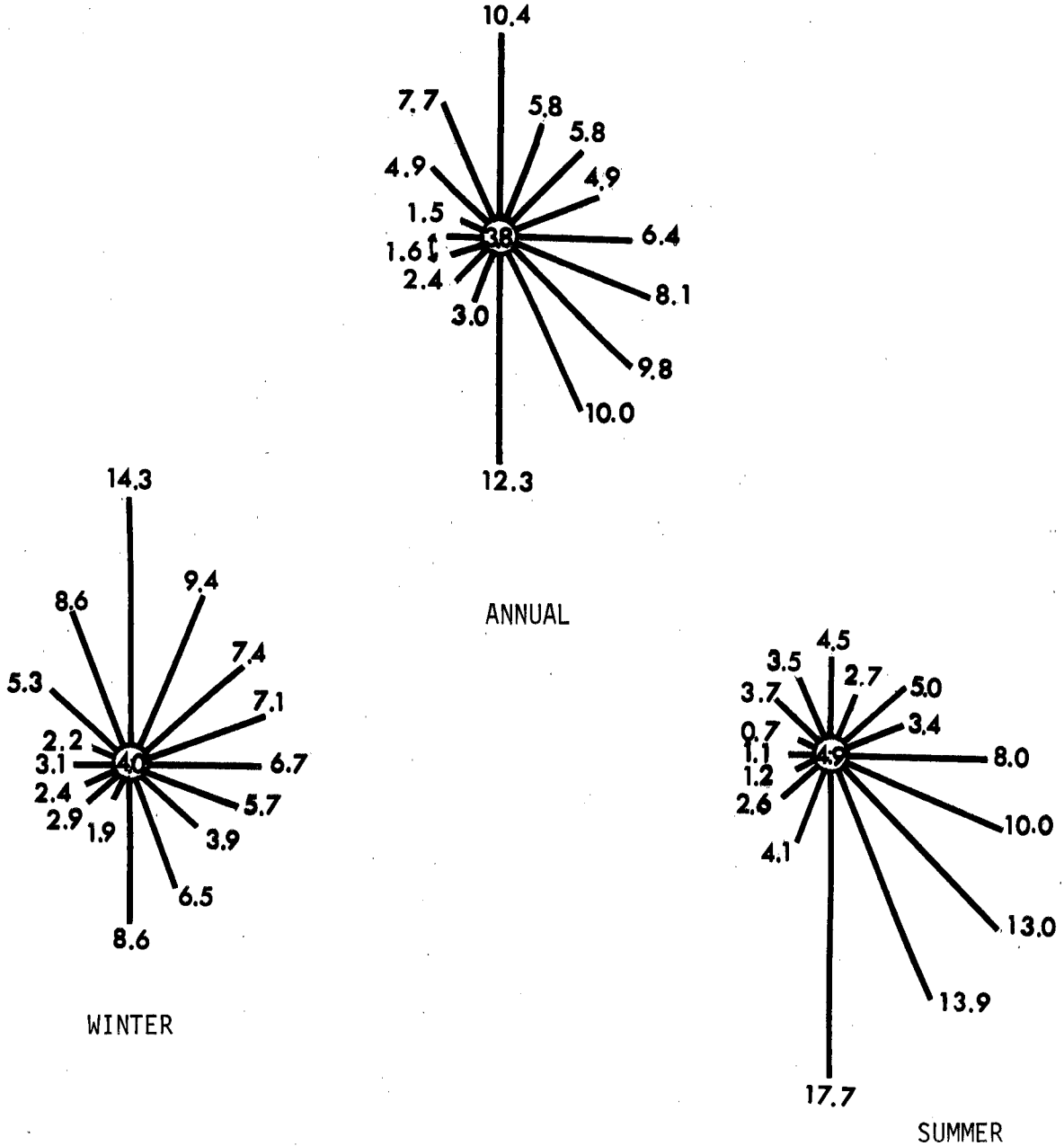


FIGURE 1

1969 WIND ROSES FOR METROPOLITAN SAN ANTONIO



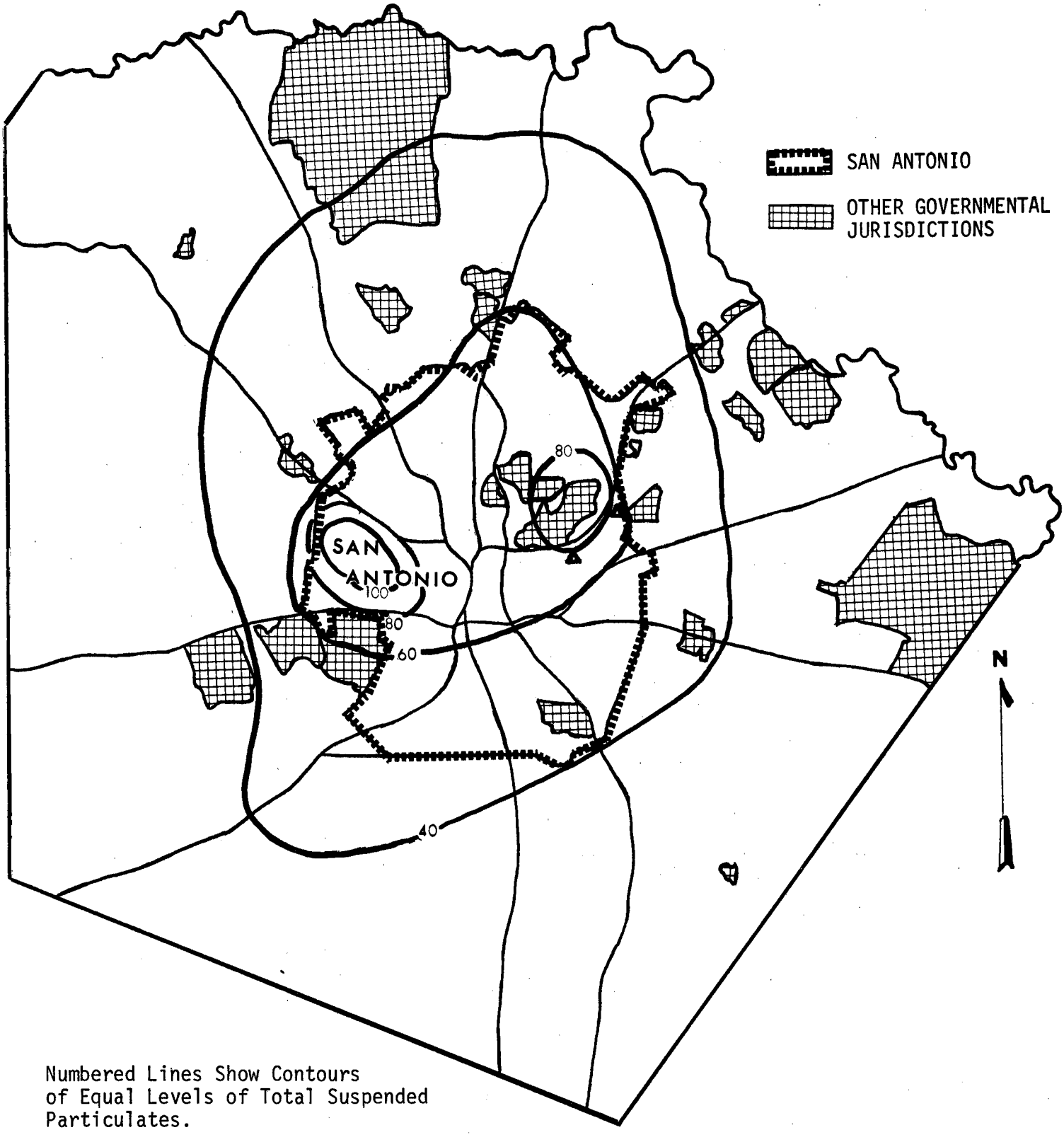
NOTES

1. Directions are to the 16 compass points with North at the top.
2. Number is the per cent of time wind originates from that direction. (Number in circle is per cent of calm readings)
3. Percentages were calculated from readings reported in the 1969 Local Climatological Data for San Antonio, Texas (2)

FIGURE 2

1969 DISTRIBUTION OF TOTAL SUSPENDED PARTICULATES (ug/m^3)

Bexar County



Numbered Lines Show Contours of Equal Levels of Total Suspended Particulates.

FIGURE 3

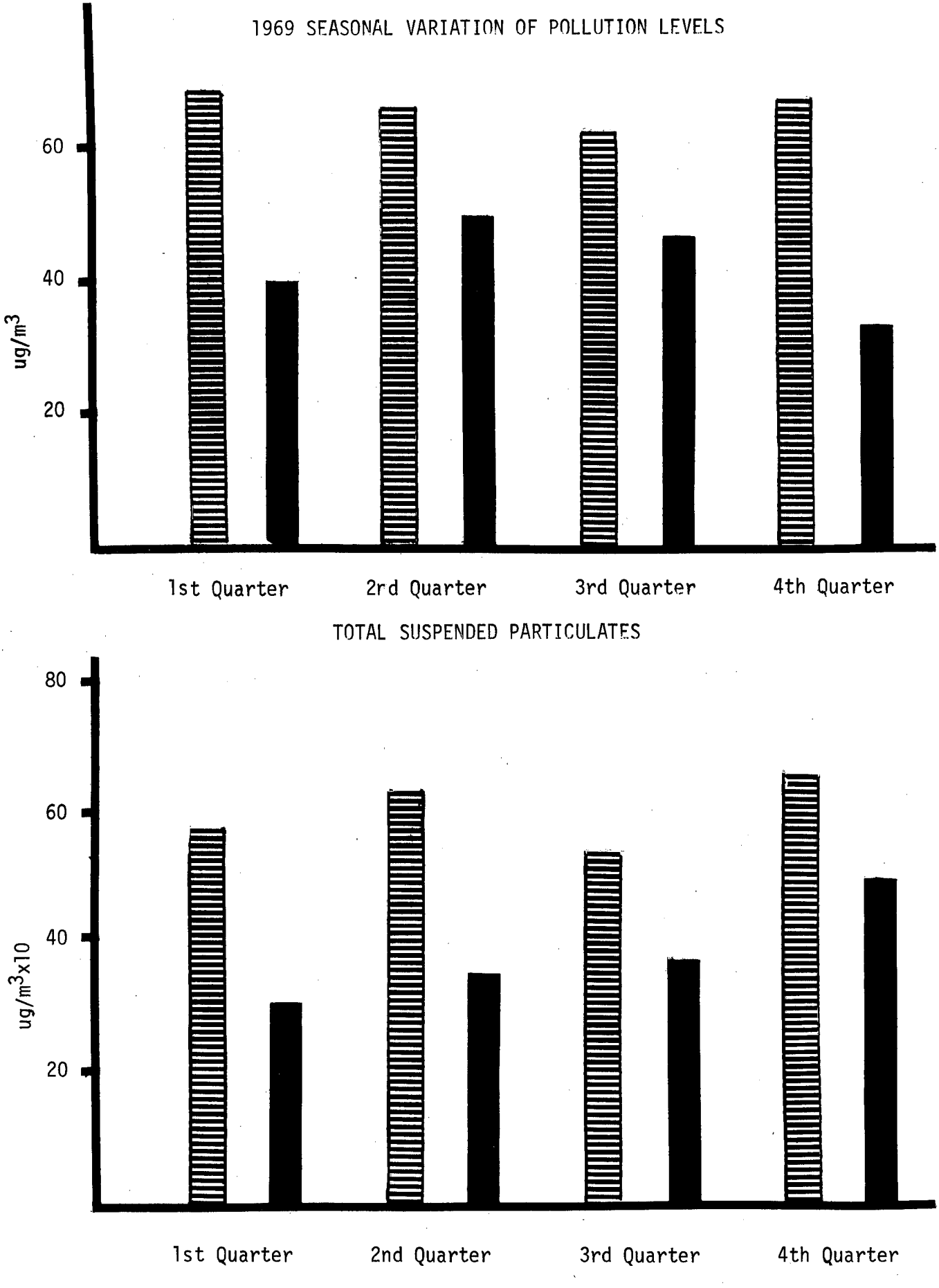
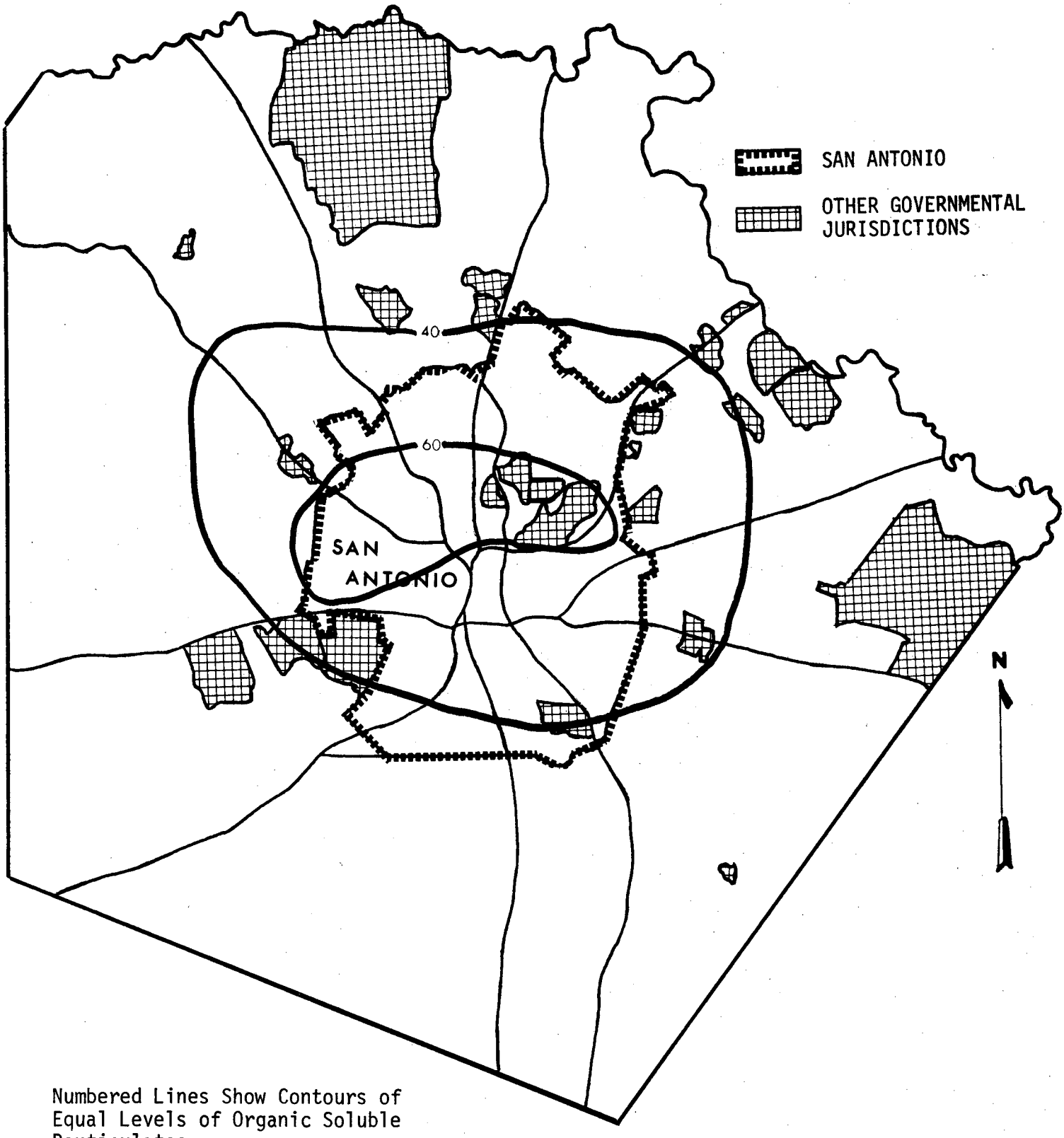

1969 SEASONAL VARIATION OF POLLUTION LEVELS
60
40
20
ug/m3
1st Quarter
2rd Quarter
3rd Quarter
4th Quarter
TOTAL SUSPENDED PARTICULATES
80
60
40
20
ug/m3x10
1st Quarter
2nd Quarter
3rd Quarter
4th Quarter
ORGANIC SOLUBLE PARTICULATES
ALL URBAN SITES
ALL RURAL SITES

FIGURE 4

1969 DISTRIBUTION OF ORGANIC SOLUBLE PARTICULATES (ug/m^3) x 10

Bexar County

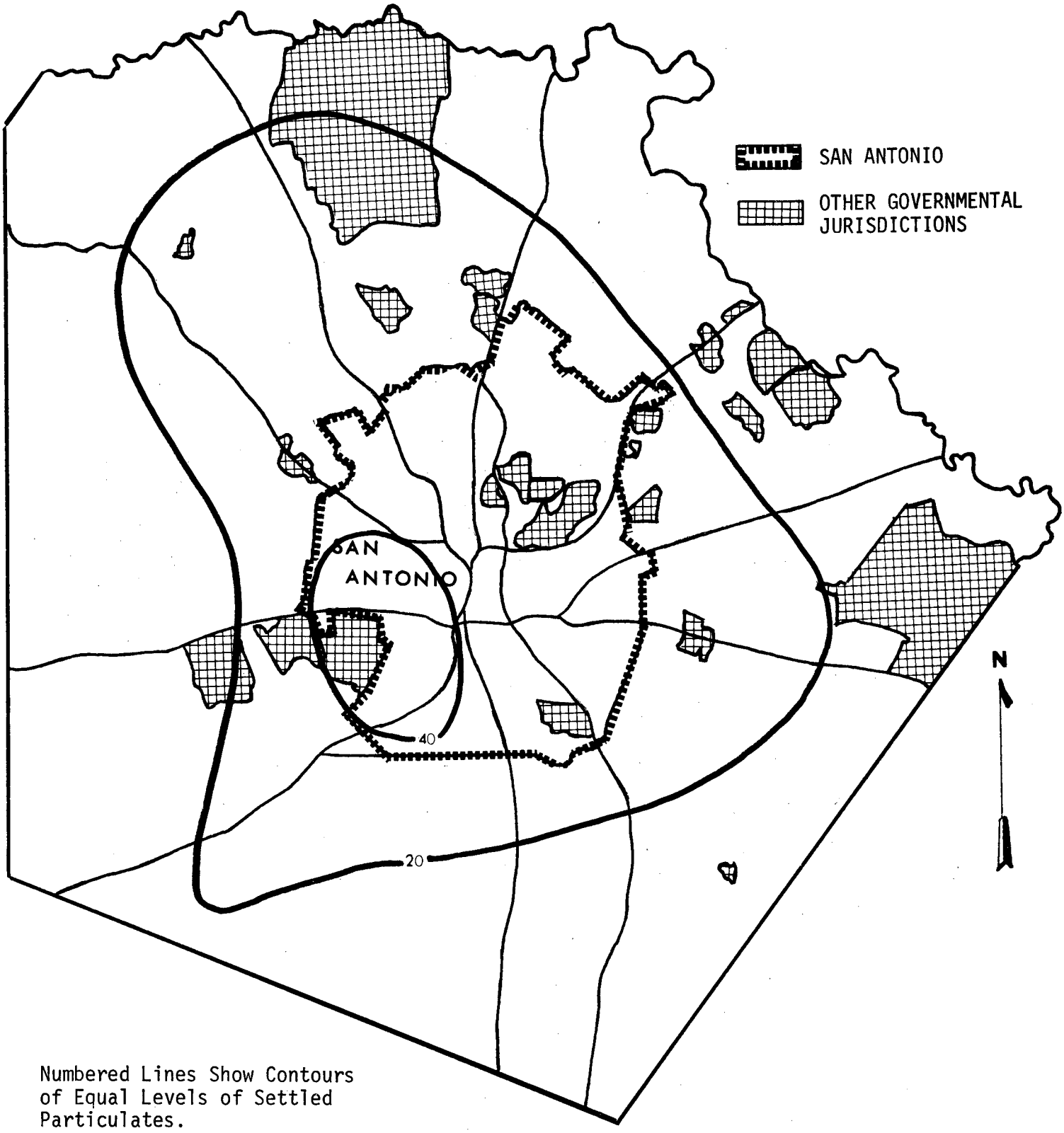


Numbered Lines Show Contours of Equal Levels of Organic Soluble Particulates

FIGURE 5

1969 DISTRIBUTION OF SETTLED PARTICULATES (g/m^2/month) x 10

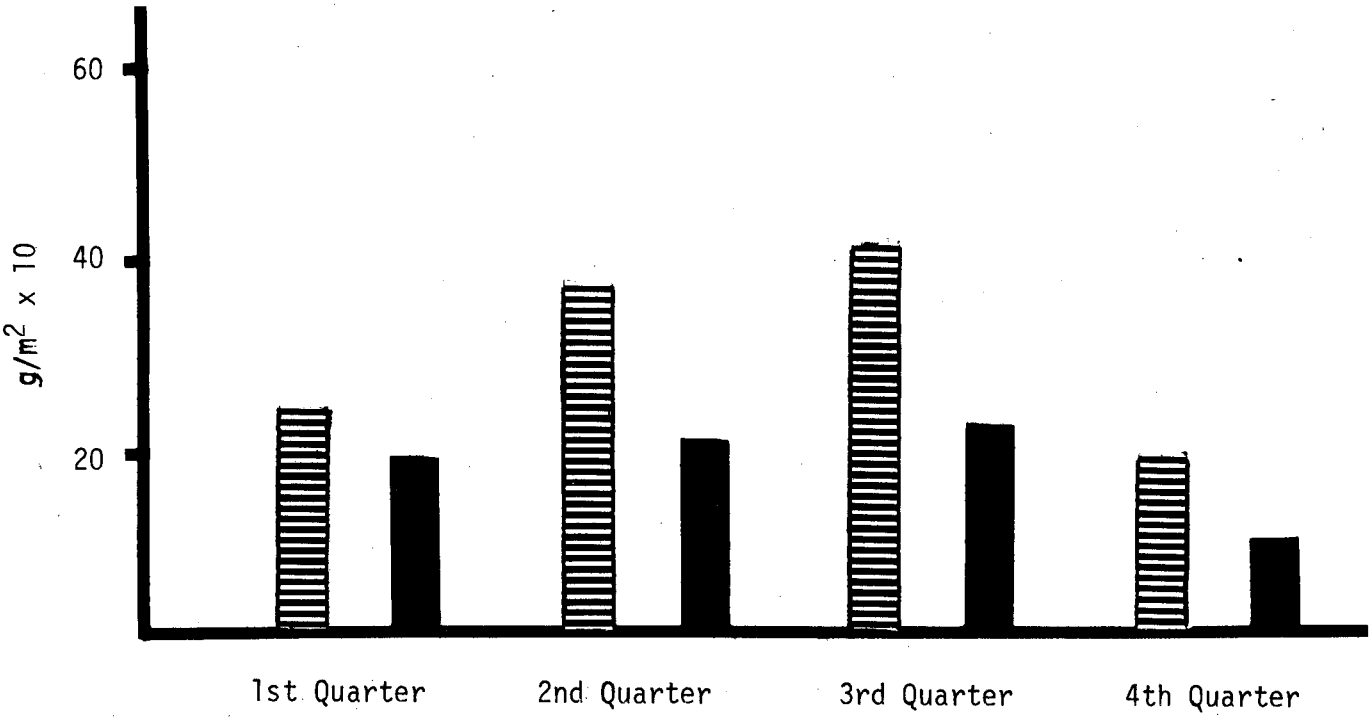
Bexar County



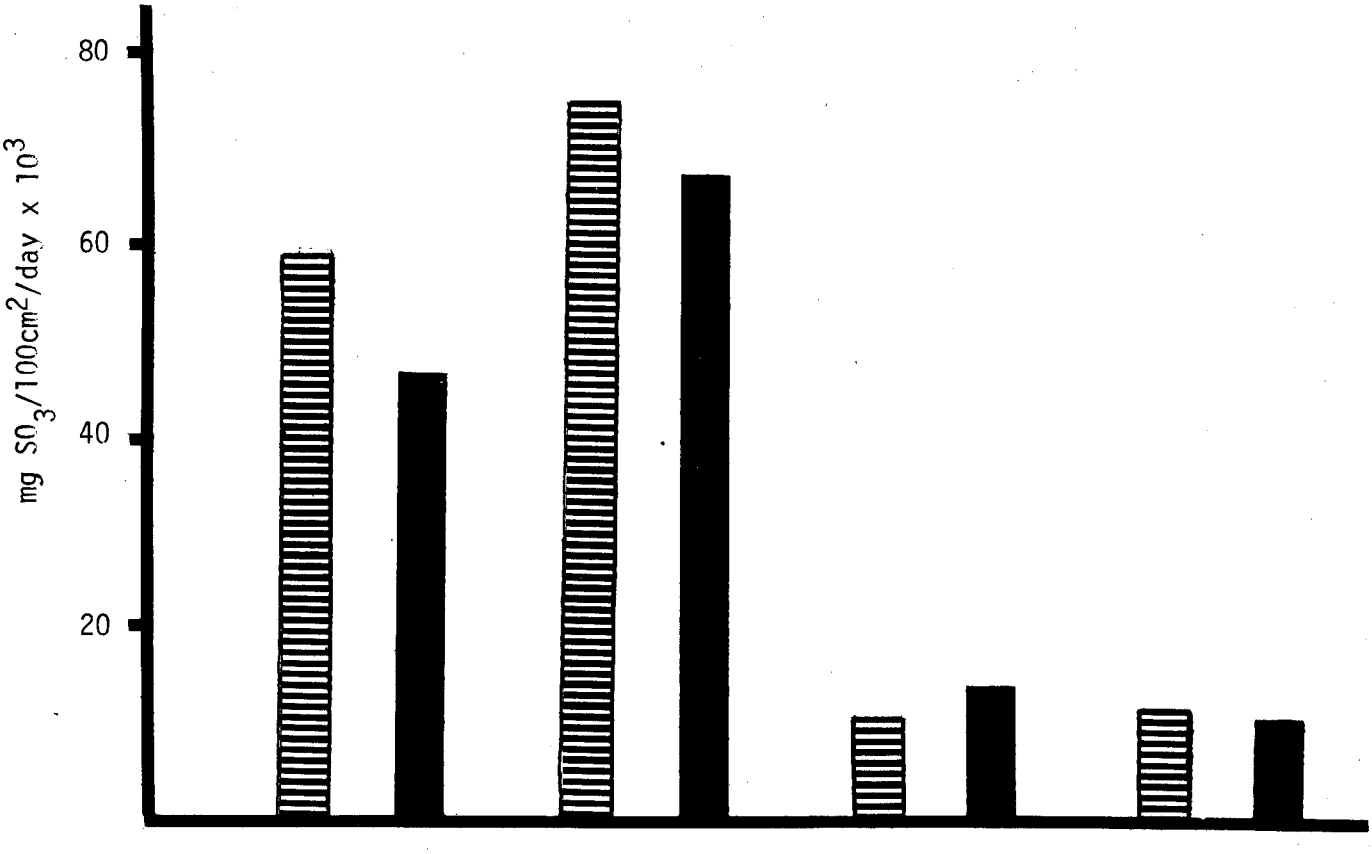
Numbered Lines Show Contours of Equal Levels of Settled Particulates.

FIGURE 6

1969 SEASONAL VARIATION OF POLLUTION LEVELS



SETTLED PARTICULATES



SULFATION RATE

ALL URBAN SITES
ALL RURAL SITES

FIGURE 7