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Environmental Protection
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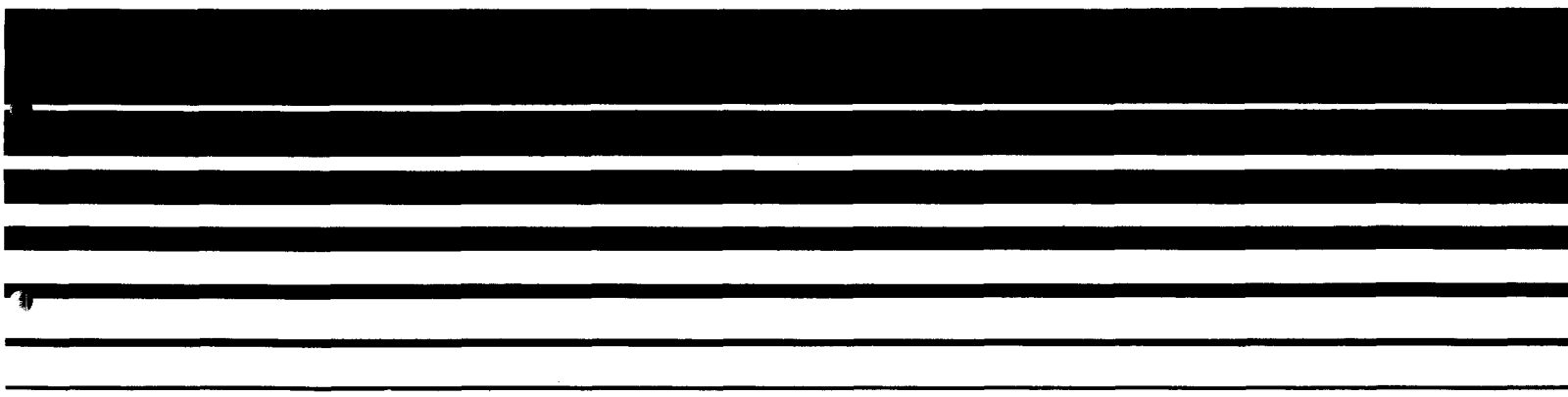
EPA

Evaluation Of Ambient Air Quality

In The State of Kansas

Based on Monitoring Data Through 1982



EVALUATION OF AMBIENT AIR QUALITY

IN THE STATE OF KANSAS

Prepared by
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Environmental Monitoring and
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August 1983

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EXECUTIVE SUMMARY

This report presents an evaluation of recent ambient air quality in Kansas, based on 1981 and 1982 monitoring data for the criteria pollutants [Total Suspended Particulates (TSP), Sulfur Dioxide (SO_2), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Ozone (O_3) and Lead (Pb)]. Trend evaluations are based on five years of data, 1978-1982. All monitoring data used were retrieved from the Storage and Retrieval of Aerometric Data (SAROAD) system.

The report presents the following information in graphical form:

- Recent air quality and trends
- Boundaries of designated non-attainment areas
- Spatial scale of representativeness and data completeness by monitor
- Emissions and stack height relative to monitor locations
- Population within designated non-attainment areas.

Tabular summaries in the Appendices show the numerical data on which the graphics are based.

The findings and recommendations of the evaluation can be summarized in three categories: Attainment/Non-Attainment Designations; Areas of Continuing Air Quality Concern; and Monitor Operation.

A. Attainment/Non-Attainment Designations

Recent data show sufficient air quality improvement to clearly meet the National Ambient Air Quality Standards in three areas which have been designated non-attainment. Redesignations are recommended for:

TSP in Topeka (Secondary Non-Attainment to Attainment);
TSP in Kansas City (significant size reductions for the Primary and Secondary Non-Attainment areas)
CO in Kansas City (Unclassified to Attainment)

The State has already submitted redesignation requests for two of those areas (TSP in Topeka and CO in Kansas City), and for O_3 in Kansas City. Those requests are under review by the Air Branch of EPA Region VII.

B. Areas of Continuing Air Quality Concern

Relatively few serious air quality problems were found in the State, based on the monitoring data available in SAROAD. The recent data show violation of the health-related (primary) standards in two areas of the State:

° TSP in part of Kansas City (in 1981, but not in 1982)
° CO in Wichita (in 1981 and 1982).

Those areas are the focus of Section XII, which summarizes previous studies in the areas, presents pollution roses for each monitor which showed violations, and evaluates possible causes of the high concentrations observed. While the conclusions of that section generally agree with those of previous

studies, the pollution roses provide a different perspective which may be useful to the continuing efforts of the State and local agencies to improve air quality in those two areas.

C. Monitor Operation

The overall picture of monitor operation in Kansas shows commendable performance by State and local agency personnel in ensuring data completeness, in performing the quality control checks required by the regulations of 40 CFR 58, Appendix A, and in performing a modeling study to resolve a question of whether or not monitoring was needed near a large point source.

ACKNOWLEDGEMENTS

This report draws on the work and talents of several people in addition to the author.

State and local agency personnel collected, processed and reported the monitoring data which forms the basis of this evaluation. Based on their first-hand experience at the monitoring locations, they have also provided valuable insights into local conditions, both in cooperative discussions and in formal reports which they have prepared. We appreciate their help.

Jeff Wandtke, of EPA Region VII, who has a special ability to coax useful data and graphic output from reluctant computers, provided data retrievals and map production runs in a consistently timely manner. Carl Hess, of the Computer Sciences Corporation, wrote the software to translate air quality data and emissions data into symbols for the maps in the text. That software is now available from Region VII. Mick Daye, the Regional Meteorologist for EPA Region VII, provided the meteorological data for pollution roses and useful, objective insights into the utility and the limitations of pollution roses.

Barbara Nichols of EPA Region VII typed the manuscript. Rob Ireson of Systems Applications, Inc., developed software which we requested for computing population estimates for designated non-attainment areas. Tim Matzke of the Environmental Results Branch, OMSE, EPA Headquarters, provided coordination for the funding of that software.

The unique contributions of each of those individuals to this project are gratefully acknowledged.

CONTENTS

INDEX OF TABLES AND FIGURES

I. INTRODUCTION

The Environmental Services Division of EPA Region VII prepares an annual evaluation of ambient air quality for each State within the Region. The evaluation report serves as a basic reference document which summarizes the following information for the State:

- recent monitoring data
- current attainment and non-attainment area designations
- air quality trends
- ambient monitor locations
- emissions
- population
- data completeness
- monitor scales of representativeness
- precision and accuracy estimates

Data summaries are presented both in graphical form (on maps) and in tabular form.

While the format and evaluation methods are similar to the FY-82 report, three features have been added this year. First, pollution roses have been constructed, subject to data availability, to aid in identifying possible sources of high pollutant concentrations. (The description of evaluation methods in Section II.C of this report highlights the nature and limitations of those roses.) Second, maps showing the locations of point sources and the locations of ambient monitors have been prepared for selected areas. Third, estimates of population within designated non-attainment areas have been calculated. (The population density maps on which those calculations were based are included as Appendix C.)

The evaluation is based on information available as of March 31, 1983. That information includes non-attainment area designation changes which were made during 1982. Emissions data reflect the latest National Emissions Data System (NEDS) update supplied by the State. Ambient monitoring data for 1981 and 1982 are included for all pollutants. In addition, since the ozone standard is based on a three-year average, 1980 data are included for ozone.

II. GRAPHICAL EVALUATION PROCEDURES

A primary goal of the Clean Air Act is the protection of public health and welfare through the attainment and maintenance of National Ambient Air Quality Standards (NAAQS's). Those standards have been set for six "criteria pollutants" [total suspended particulates (TSP), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2) and lead (Pb).] Before the standards were set, studies of the effects of each pollutant were carefully reviewed and evaluated. Primary standards are designed to protect human health, and are required by law to provide a margin of safety in order to protect sensitive segments of the population. Secondary standards protect public welfare (crops, building materials, animals, etc.). Numerical values of those standards are given in Table 1.

The regulations which implement the Clean Air Act require that public announcement be made and that measures be taken to reduce pollutant emissions when the ambient concentration exceeds the alert level for that pollutant. Numerical values for these alert levels are also given in Table 1.

The evaluation of air quality presented in this report is based on the National Ambient Air Quality Standards. So that the results of the evaluation may be readily seen, the body of the text is designed around graphic presentations which summarize a wide variety of air quality information. Those presentations include pollution roses and two different types of maps. Detailed numerical data summaries, from which the graphical summaries were prepared, are included as appendices to the report.

The first type of maps show:

- the boundaries of designated non-attainment and unclassified areas,
- the locations and scales of representativeness of ambient monitors,
- the comparison of ambient data with the standards,
- the specific standard(s) exceeded (if any) at each site,
- the statistical trend observed at each site (subject to data availability), and
- data completeness (relative to the National Aerometric Data Branch data summary criteria.)

The second type of maps show:

- the locations of large point sources (emitting 100 or more tons/year of particulates or CO)
- the magnitude of emissions for each source
- the stack height for each source, if available from NEDS
- the locations of ambient monitors
- the monitor type designation--National Air Monitoring Station (NAMS), State and Local Air Monitoring Station (SLAMS) or Special Purpose Monitoring Station (SPMS)--for each monitor

TABLE 1

SUMMARY OF NATIONAL AMBIENT AIR QUALITY STANDARDS AND ALERT LEVELS

POLLUTANT	AVERAGING TIME	PRIMARY STANDARDS	SECONDARY STANDARDS	ALERT LEVEL
Particulate Matter	Annual (Geometric Mean)	75 ug/m^3		
	24-hour*	260 ug/m^3	150 ug/m^3	375 ug/m^3
Sulfur Dioxide	Annual (Arithmetic Mean)	80 ug/m^3 (0.03 ppm)	-	
	24-hour*	365 ug/m^3 (0.14 ppm)	-	800 ug/m^3 (0.3 ppm)
	3-hour*	-	1300 ug/m^3 (0.5 ppm)	
Carbon Monoxide	8-hour*	10 mg/m^3 (9 ppm)	(Same as primary)	17 mg/m^3 (15 ppm)
	1-hour*	40 mg/m^3 (35 ppm)		
Nitrogen Dioxide	Annual (Arithmetic Mean)	100 ug/m^3 (0.05 ppm)	(Same as primary)	
	1-hour	-		1130 ug/m^3 (0.6 ppm)
	24-hour	-		282 ug/m^3 (0.15 ppm)
Ozone	1-hour**	0.12 ppm (235 ug/m^3)	(Same as primary)	400 ug/m^3 (0.2 ppm)
Lead	Calendar Quarter	1.5 ug/m^3	(Same as primary)	

* Not to be exceeded more than once per year, for primary and secondary standards.

** Not more than 1.0 expected exceedance per year, three-year average.

The above items are illustrated in the legends to the maps (Tables 2 and 3). The following paragraphs explain in detail the interpretation of the maps. For convenience, an extra copy of the legends, a map with county names, and a map of population density by county are inserted unbound at the back of this report.

A. Monitoring Data Maps

For each monitor, the symbol location on the map shows the monitor location. The symbol size displays the scale of representativeness of the monitor - microscale, middle scale, neighborhood scale, urban scale or regional scale. Symbol shading indicates data completeness. If the data did not meet the completeness criteria described in Section III.F in any one year evaluated, an open symbol "O" is shown. If the data met the criteria in each year included in the evaluation, a filled circle is shown. The symbol color presents the comparison of recent monitoring data with the NAAQS's. Green indicates no violation of the standards. Blue depicts violation of the secondary standard, but no violation of the primary standard. Red highlights violation of the primary standard. If the alert level was exceeded during the years evaluated, a red flag is placed on top of the symbol. If any violation of standards was observed, annotations next to the symbol specify which standard(s) was (were) violated. Red annotations specify primary standards, while blue annotations specify secondary standards. Where the primary and secondary standards are identical, only the primary standard is shown. Possible annotations include A, Q, 24, 8, 3 and 1, signifying annual, quarterly, 24-hour, 8-hour, 3-hour and 1-hour standards, respectively.

The boundaries of the designated non-attainment areas and unclassified areas are shown as lines on the map. Red solid lines outline primary non-attainment areas, blue solid lines outline secondary non-attainment areas, and dashed lines show unclassified areas. Consequently, if the attainment status designations are consistent with recent data, red monitor symbols should appear only in red-outlined areas, and blue monitor symbols only in blue-outlined areas.

For monitors which have recorded sufficient data during the five years from 1978 through 1982, trends are presented as an additional annotation. The trend labels and their respective symbols are: increasing trend (↑), probable increasing trend (∧), no trend (-), probable decreasing trend (∨), and decreasing trend (↓). For pollutants which have only short-term standards (CO and O_3), the trend presented is for the 90th percentile hourly concentrations observed each month over those five years. For NO_2, which has only an annual standard, the trend presented is for the monthly average concentrations. For pollutants which have both short-term and long-term standards (TSP and SO_2), two trend symbols are presented. The first symbol is for long-term averages, the second for 90th percentile concentrations. For lead, lack of sufficient data and software precludes trend analysis at this time. Further details of the trend analysis procedure are given later in this report (Section III. C).

TABLE 2

LEGEND FOR AMBIENT MONITORING DATA MAPS

Boundaries

Primary Nonattainment Area

Secondary Nonattainment Area

Unclassified Area

Monitor Symbol Colors and Flag

No Violation of Standard

Violation of Secondary Standard

Violation of Primary Standard

Exceedance of Alert Level

Annotation for Standards Violated

A Annual Primary Standard

Q Quarterly Primary Standard

24 24-hour Primary Standard

24 24-hour Secondary Standard

8 8-hour Primary Standard

3 3-hour Secondary Standard

1-hour Primary Standard

Annotation for Trends

↑ Increasing Trend

∧ Probable Increasing Trend

– No Trend

∨ Probable Decreasing Trend

↓ Decreasing Trend

(Where two trend symbols are shown, the first is for long-term averages, the second for 24-hour observations.)

Monitor Symbol Sizes

Microscale

Middle Scale

Neighborhood Scale

Urban Scale

Regional Scale

Data Completeness

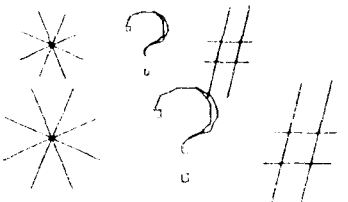
Data met completeness criteria each year.

Data did not meet completeness criteria one or more years.

TABLE 3

LEGEND FOR EMISSIONS DATA MAPS

POINT SOURCE SYMBOL SIZE -- EMISSIONS (TONS/YEAR)



	NON--LEAD	LEAD
? #	100 - 1000	5 - 25
? #	1001 - 5000	26 - 100
? #	OVER 5000	OVER 100

POINT SOURCE SYMBOL COLOR -- STACK HEIGHT (METERS)

?	UNKNOWN
	1 - 45
	46 - 120
	OVER 120

AMBIENT MONITOR SYMBOLS

■	NAMS
●	SLAMS
▲	SPMS

B. Emissions Data Maps

In the present report, emissions data maps are used as background information in the analysis of possible pollutant sources in problem areas (Section XII). Such maps can also provide an overview of the monitoring network, if the locations and stack heights for large point sources are available in NEDS. That information is not available for over 200 large sources in Kansas. If the locations and stack heights can be included in the next NEDS update which the State submits, those overviews can be prepared for the FY-84 air quality evaluation report.

The locations of large point sources are shown by an asterisk. The size of the symbol indicates the magnitude of the emissions, in three ranges: 100-1000 tons/year, 1001-5000 tons/year and over 5000 tons/year The symbol color indicates the stack height as follows: red for 1-45 meters, blue for 46-120 meters, and green for 121 meters or taller. If the stack height is shown as zero in NEDS, a red question mark replaces the asterisk.

Ambient monitor locations are shown as squares, circles or triangles indicating NAMS, SLAMS and SPMS monitors, respectively.

C. Pollution Roses

In areas where the NAAQS's have been exceeded, pollution roses can be useful in evaluating possible sources of high pollutant concentrations. Those roses show the wind speeds and the directions from which the wind blew when high pollutant concentrations were monitored in the ambient air. The longest arms of the rose point toward the locations of possible causes of the high concentrations. Section III.I discusses the meaning, construction, and limitations of the roses. Because of their inherent limitations, the roses do not provide positive identifications of the definitive causes of elevated concentrations. They do, however, provide useful indications of possible causes.

III. DATA DESCRIPTION - Information Sources, Limitations and Analysis Procedures

The evaluation procedure described above requires detailed examination of various kinds of data from various sources. The following paragraphs describe the information sources, the limitations and the analysis procedures for the necessary data.

A. Ambient Air Monitoring Data

A network of ambient air monitoring stations has been established by the State of Kansas, as required by 40 CFR §58.20 and §58.30. The network includes not only the required National Air Monitoring Stations (NAMS) and State and Local Air Monitoring Stations (SLAMS), but also a number of Special Purpose Monitoring Stations (SPMS) designed to address short-term monitoring needs or special situations of interest to the State.

During the early and mid-1970's, an extensive air monitoring network was maintained across the State, including monitors for all five pollutants for which NAAQS's had been established by that time. (The NAAQS for lead was promulgated in 1978, and siting criteria for lead monitors were published as final rules in 1981.) Because the observed concentrations at most sites were well below the respective standards, the extent of the network was reduced considerably such that monitoring resources were focused on populous areas where higher concentrations had been monitored. The current network includes monitoring for several pollutants in Kansas City and Wichita, plus particulate sampling in Topeka, Goodland, Concordia and Dodge City.

The locations of those monitors, shown in the graphical presentations of this report, were obtained from the site file of the Storage and Retrieval of Aerometric Data (SAROAD) system.

The ambient data used in this report were obtained from the SAROAD data base. A copy of the SAROAD Quick Look Summary is included as Table A1 of the Appendix. The recorded values were compared with the alert levels, the primary standards and the secondary standards for graphical display on the maps. Data for 1981 and 1982 were used in the analysis of recent air quality for all six criteria pollutants. Since the ozone standard is based on a three-year average, 1980 data were also included for ozone. For the analysis of trends, five years of data (1978 through 1982) were used.

B. Precision and Accuracy

Each organization which reports air monitoring data is required to calculate and report 95 percent probability limits for precision and accuracy for all NAMS data collected after January 1, 1981, and for all SLAMS data collected after January 1, 1983. Those probability limits, which are calculated using specific equations from 40 CFR 58

Appendix A, summarize the results of quality control checks which those same regulations require. The meaning of the probability limits and the procedures for performing the quality control checks are discussed below in Section X.

The precision and accuracy reports available in SAROAD as of April 1983 are provided as Table A2 of the Appendix.

C. Trends

The trend analyses were performed on data from 1978 through 1982, using the same statistical procedure as in prior years. That procedure calculates the Sen non-parametric statistic, using the NADB*TRENDRUN programs on the UNIVAC computer associated with the National Aerometric Data Branch (NADB).

The analysis procedure can be visualized as follows. From all the data for a given month, one single value is computed. The monthly values are adjusted to account for seasonal variation. Each month's adjusted value is compared with the value for every preceding month in the measurement period. Next, for each month, tallies are made of how many preceding months' values were higher and how many were lower than the month in question. Those tallies are then summed to give grand totals of months with higher readings and months with lower readings. Those two grand totals are compared using the Sen statistic to determine whether or not a statistically significant trend existed. Appendix B gives the detailed step-by-step procedure, including the mathematical equation for the Sen statistic. That appendix also provides a sample calculation.

The values used for each month were selected as follows. Two trend calculations were performed for TSP. For the first calculation, the value used for a month was the geometric mean of all values measured during the month. For the second calculation, the value used was the 90th percentile 24-hour concentration for all concentrations measured during the month. (Because of the small number of TSP samples each month, the 90th percentile concentration is also the maximum concentration.) Two calculations were likewise performed for SO_2. The first used the monthly arithmetic mean, the second the 90th percentile 24-hour concentration. For NO_2, the monthly arithmetic mean was used. For CO and O_3, which have only short-term standards, the value used was the 90th percentile 1-hour concentration. The computer program, which was used to perform the trends analyses, was not equipped for lead analyses. Furthermore, since final lead monitor siting criteria were not promulgated until late 1981, with deadlines for monitor siting in 1982 and 1983, historical lead data from sites meeting those criteria are scarce. Therefore, trend analyses were not performed for lead.

As noted above, the trend evaluations for short-term high concentrations use 90th percentile concentrations, rather than maximum concentrations. The reason for that choice is that the 90th percentile values give more

stable trend estimates, and minimize the bias which would result from extreme values caused by data handling errors, unusual weather conditions, etc.

Since the trend evaluation uses a statistical technique, erroneous results could be obtained if a limited amount of data were used. Minimum criteria chosen were at least 50% complete data for the five years 1978-1982, and at least 75% complete data for at least three of those years. These criteria disallowed trend evaluation at many monitoring sites.

The results of recent pollution abatement actions may not be reflected in the five-year trend analysis, since concentration increases early in the time period could mask recent short-term improvements. As mentioned before, the trends are based on 1978 through 1982 data. The data used in reviewing attainment or non-attainment of the NAAQS's, however, cover only the periods 1980-1982 for ozone and 1981-1982 for the other pollutants.

D. Scale of Representativeness

Spatial Scales of Representativeness are described in 40 CFR Part 58, Appendix D. The scale of representativeness identifies the size of an air parcel around a monitor which is homogeneous in terms of pollutant concentrations, population density and geographical features. The scales pertinent to the present analysis are, in order of increasing size: microscale (part of a city block); middle scale (a few square blocks); neighborhood scale (a few square kilometers); urban scale (the size of an entire city); and regional scale (several hundred to several thousand square kilometers, generally in rural areas). The air quality analysis includes the scale of representativeness for each monitor in order to depict the expected geographical extent of the concentrations monitored. The scales of representativeness for the monitors were obtained from the report entitled "Kansas Ambient Air Monitoring Annual Summary Report for Calendar Year 1982," which was prepared by the Kansas Department of Health and Environment.

E. Attainment Status Designations

The designations of attainment, non-attainment and unclassified areas are found in 40 CFR §81.317. The designations used in the analysis are included as Table A3 of Appendix A. Because of the logistics of graphics preparation, a cut-off date of March 31, 1983 was used. The map presentations show boundaries for non-attainment areas and unclassified areas, obtained from those designations. In cases where the wording of 40 CFR §81.317 does not provide specific boundaries, the boundaries were obtained from maps which the state submitted to EPA with the designation requests. Where non-attainment or unclassified area boundaries follow county lines, those lines on the map do not precisely coincide, in order that both lines can be clearly seen. In some cases, larger discrepancies in the boundaries are evident,

because the county boundaries in the ZMAP computer mapping system are not exact.

F. Data Completeness

If monitoring data for a site are incomplete, they may give a distorted picture of air quality. Annual or quarterly averages calculated from incomplete data may be biased either high or low, making comparisons with long-term NAAQS's uncertain. Where the NAAQS's are based on short-term averages (1, 3, 8 or 24 hours), incomplete data may reduce the number of detected exceedances of the standard. For all such pollutants except ozone, any bias resulting from incomplete data would make short-term air quality appear better than it actually was. For ozone, the standard is based on "expected exceedances," which consider both the number of measured exceedances and the time period over which they were measured, in order to project the number of exceedances expected for a full year of monitoring. Therefore, incomplete ozone data could make the air quality appear either better or worse. For the analysis presented in this report, the data are considered "complete" if they include enough observations (reported as valid) to meet the minimum NADB data requirements for calculating average concentrations. (Sites which do not meet these criteria are indicated by a question mark in Table A1 of Appendix A). Those criteria are applied by the NADB to pollutants which have NAAQS's based on annual or quarterly averages (TSP, SO_2, NO_2 and Pb). For CO and O_3, however, annual averages are not computed by the NADB. For those two pollutants, a minimum criterion of 75% complete data for the entire year is chosen for the analysis in this report.

G. Emissions Data

The emissions data used in this report were obtained from the National Emissions Data System (NEDS). The graphical analysis procedure applied to those data shows the locations and stack heights of large point sources. The emission estimates stored in NEDS for Kansas sources were hand-calculated by the KDHE.

On the maps, a single symbol is shown for each plant. If a plant has two or more stacks, it is still treated as a single source. In that case, the stack height used is a weighted average of the heights of the individual stacks. The weighting factors are the fractions of the total emissions coming from each stack.

H. Meteorological Data

Construction of wind roses or pollution roses requires wind speed and direction data. The ideal is to have meteorological instrumentation at the pollutant monitoring site. Data collected by such instrumentation would be stored in SAROAD.

The SLAMS sites in Kansas do not include wind measurements, however. Therefore, data from a nearby National Weather Service station are used. The pollutant monitoring station and the meteorological station are identified for each pollution rose presented.

I. Pollution Roses

The pollution roses presented in this report are diagrams which summarize wind speeds and wind directions during periods when elevated pollutant concentrations were observed. The term "elevated pollutant concentrations" implies a threshold concentration, which must be selected as appropriate for the specific pollutant and averaging time of interest. For example, TSP has three different standards, as shown in Table 1:

a) a primary standard of 75 ug/m^3, annual geometric mean concentration;

b) a secondary standard of 150 ug/m^3, 24-hour concentration, not to be exceeded more than once per year; and

c) a different primary standard of 260 ug/m^3, 24-hour concentration, not to be exceeded more than once per year.

For sites exceeding the annual primary standard, only days with concentrations over 75 ug/m^3 will contribute to the exceedance, so only those days are included in the pollution rose. The resulting rose indicates possible sources of chronic, moderately elevated TSP concentrations. Where sites also show exceedances of the 24-hour secondary standard, a pollution rose constructed from only those days when TSP concentrations exceeded 150 ug/m^3 could indicate different or fewer sources of those higher concentrations.

The following threshold values were used in constructing the pollution roses in this report:

For TSP - Days with TSP concentrations above 75 ug/m^3, for sites exceeding the annual primary standard.

- Days with TSP concentrations above 150 ug/m^3 for sites showing many exceedances of the 24-hour secondary standard.

For CO - Hours with CO concentrations above 10 mg/m^3 for sites exceeding the eight-hour standard. (Only those hours could contribute to eight-hour averages above the standard.)

The following steps were followed in constructing pollution roses:

1. The times (days or days and hours) when pollutant concentrations exceeded the threshold concentration were identified. That information was obtained from the raw data (daily or hourly concentrations) in SAROAD.

2. The wind speed and wind direction were retrieved for each of the times identified in Step 1. On-site meteorological data are preferred, if available. Otherwise, National Weather Service data from a nearby

station may be used, with the understanding that the separation between the weather station and the pollutant monitoring station introduces uncertainty into the interpretation of the pollution rose.

3. The weather data were summarized by ranges of wind speeds (e.g. 1-3 mph) and ranges of wind directions (e.g. 15-45°). The frequency of occurrence was then computed for each combination of speed range and direction range.

4. The rose was plotted, using different bar widths and shading patterns for each wind speed range.

Interpretation of a pollution rose considers not only the wind directions displayed, but also the wind speeds and significant pollutant sources in the vicinity of the monitor. If the rose is strongly directional (one or two arms much longer than the others), influence of a single point source or a small cluster of sources is indicated. A more diverse directional pattern would indicate influence by line or area sources or by several point sources located in various directions from the monitor. As stated earlier, if off-site meteorological data are used, uncertainty in the meaning of the pollution rose is introduced. The following three factors tend to increase that uncertainty:

a) short observation times,

b) large distances between the pollutant monitoring site and the weather station,

c) large variations in terrain between the pollutant monitor and the weather station.

Therefore, due caution should be exercised and the advice of the Regional Meteorologist should be sought in interpreting roses constructed from off-site weather data.

Uncertainty of a different type is introduced where a resultant wind speed and direction are used to represent winds for a 24-hour period for a TSP pollution rose. Wind shifts of more than 90° are common over the course of a day. The high pollutant concentrations may occur during only a part of the day, when the wind direction may be different from the resultant direction. In that case, the time resolution of pollutant monitoring data is not sufficient to detect that effect. Therefore, these pollution roses can provide only preliminary indications of probable sources of high concentrations.

The following description of the pollution rose, shown in Figure 1 (a) illustrates the evaluation process. The rose was constructed from on-site weather data for hours during which the CO concentration exceeded 10 mg/m^3. With very few exceptions, wind speeds were low (below 3 mph) when those concentrations were observed. From the spread of the directional pattern, a single point source is probably not the cause of the elevated

Figure 1(a). Sample Pollution Rose

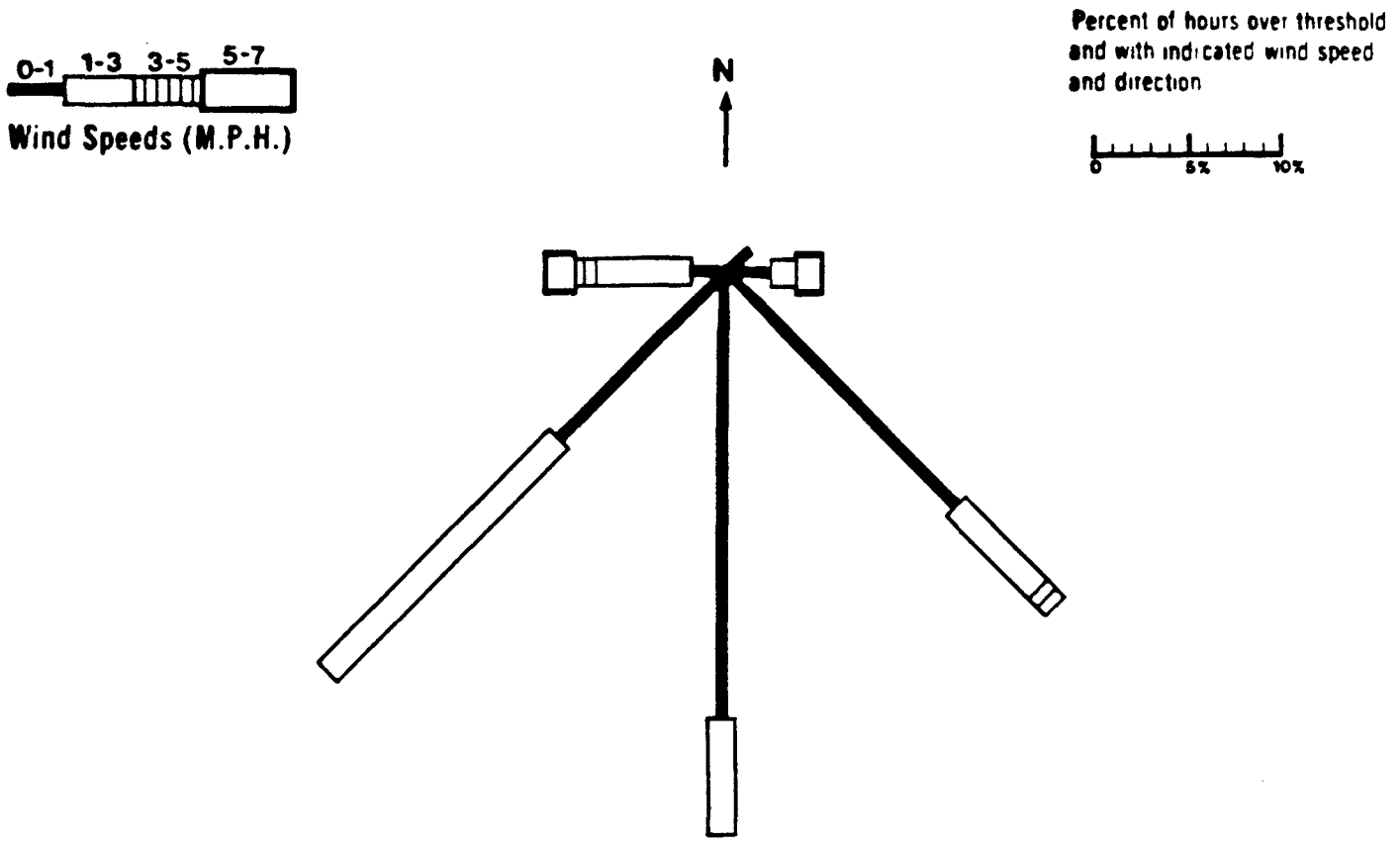
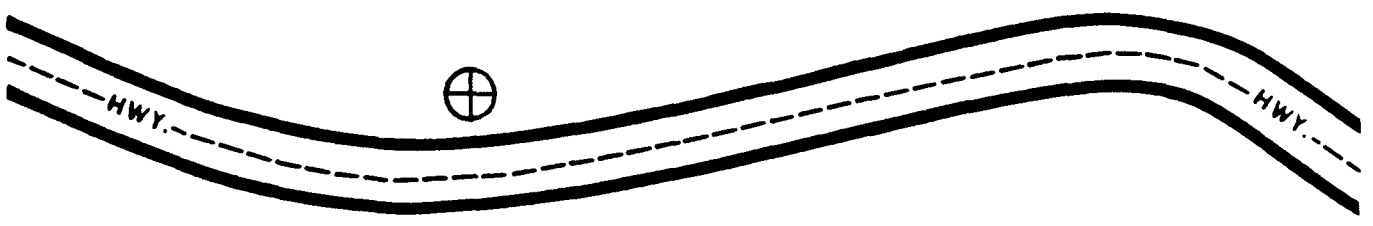


Figure 1(b). Monitor Location for the Rose of Figure 1(a).



concentrations. Rather, an area source or a line source would be expected. In Figure 1(b), the monitor location is shown, along with the adjacent freeway. Considering the location, wind speeds and wind directions, vehicle traffic on the freeway is indicated as the probable cause of the elevated concentrations.

J. Population Data

Population data are used in two contexts in the report. First, a map of population density by county is provided at the back of the report. That map is based on 1980 population data which was obtained directly from the U.S. Bureau of the Census. Second, population exposure estimates are presented in Section XIV for non-attainment areas, based on 1970 census data which are available at a higher level of spatial resolution. Those estimates were produced by Systems Applications, Inc., using block group and enumeration district population data, and were scaled to approximate 1978 values using county-level growth factors. Appendix C describes the procedures used for those calculations.

IV. TOTAL SUSPENDED PARTICULATES (TSP)

The State map shows an extensive TSP monitoring network in Kansas City, Topeka and Wichita, and additional monitors in three smaller cities in the central and western portions of the State. This review will focus first on the smaller cities, then on information presented for the larger cities on inset maps.

Data from Concordia and Dodge City show no violation of any of the particulate standards in 1981 or 1982. However, the 1982 data from Dodge City were only about 50% complete.

Data from Goodland show an annual geometric mean of 84 ug/m^3 in 1981 (an apparent violation of the annual primary standard of 75 ug/m^3). The data showed five and six 24-hour observations in 1981 and 1982, respectively, in excess of 150 ug/m^3 (apparent violations of the secondary standards). However, under the EPA fugitive dust policy (described below), Goodland may claim attainment of the TSP standards.

The fugitive dust policy was described in the Federal Register, Volume 3, Number 43 (Friday, March 3, 1978) page 8963.

> "EPA's fugitive dust policy recognizes the generally greater health impact due to fugitive dust in urban areas in contrast to rural areas. In urban areas, the windblown soil contains various man-made toxic pollutants. But, rural windblown dust is usually not significantly contaminated by industrial pollutants. Therefore, for the purposes of these designations [TSP attainment status designations], any rural areas experiencing TSP violations which could be attributed to fugitive dust could claim attainment of the TSP NAAQS. Rural areas for this purpose are defined as those which have: (1) a lack of major industrial development or the absence of significant industrial particulate emissions, and (2) low urbanized population densities."

The following comments highlight the detailed analyses presented on the inset maps. The abbreviations PNA and SNA are used for "primary non-attainment area" and "secondary non-attainment area," respectively, based on current designations.

Kansas City - Data throughout the area show attainment of both primary and secondary standards, with the exception of two monitors. The monitor in Fairfax shows two exceedences of the secondary standard in 1982. The monitor at 420 Kansas Avenue shows violations of the annual primary standard and the secondary standard in 1981 (but no violations of either standard in 1982). Both of those monitors are located in industrial areas, and both have shown large decreases in TSP concentrations in recent years. The portion of those decreases which is due to reduced industrial production during the economic recession is unknown. Another factor which has decreased the monitored concentrations at both sites is the installation of a sample savers on the Hi-vols in September of

1981. Data collected with and without the sample saver are not really comparable for trend analysis. However, the use of recent data is valid for assessing compliance with the NAAQS.

Based on the 1981-1982 data, significant reductions in the sizes of the non-attainment areas appear justified. Specifically, we recommend redesignating the Fairfax industrial area to secondary non-attainment, shrinking the PNA to the Armourdale area, and redesignating the remainder of the area to attainment. The question of the size of the PNA in the Armourdale area is clouded by the absence of recent monitoring data in the residential area west of 7th Street. Based on the findings of previous studies that fugitive sources account for most of the particulate matter in the air, and based on visual comparisons of street loadings in the areas east and west of 7th Street, the Environmental Services Division has recommended inclusion of both areas in the PNA. After industrial production increases again, the most current monitoring data should be reviewed to verify that the primary NAAQS's are still being met in the Fairfax area.

Topeka - Data throughout the area show no violation of the NAAQS's during 1981 or 1982. Furthermore, those data meet the NADB summary criteria for completeness. Therefore, redesignation of the SNA to attainment would be supported by the data.

Wichita - The entire area is designated as "Better Than National Standards." Since monitoring data for 1981 and 1982 show no violation of the standards, that designation remains appropriate.

Synopsis and Recommendations

Decreases in monitored TSP concentrations have been observed in recent years in each of the designated non-attainment areas. Based on the recent data, several changes in attainment status designations are recommended, as shown in Table 4. The State has formally requested redesignation in Topeka, and is considering a redesignation request for Kansas City.

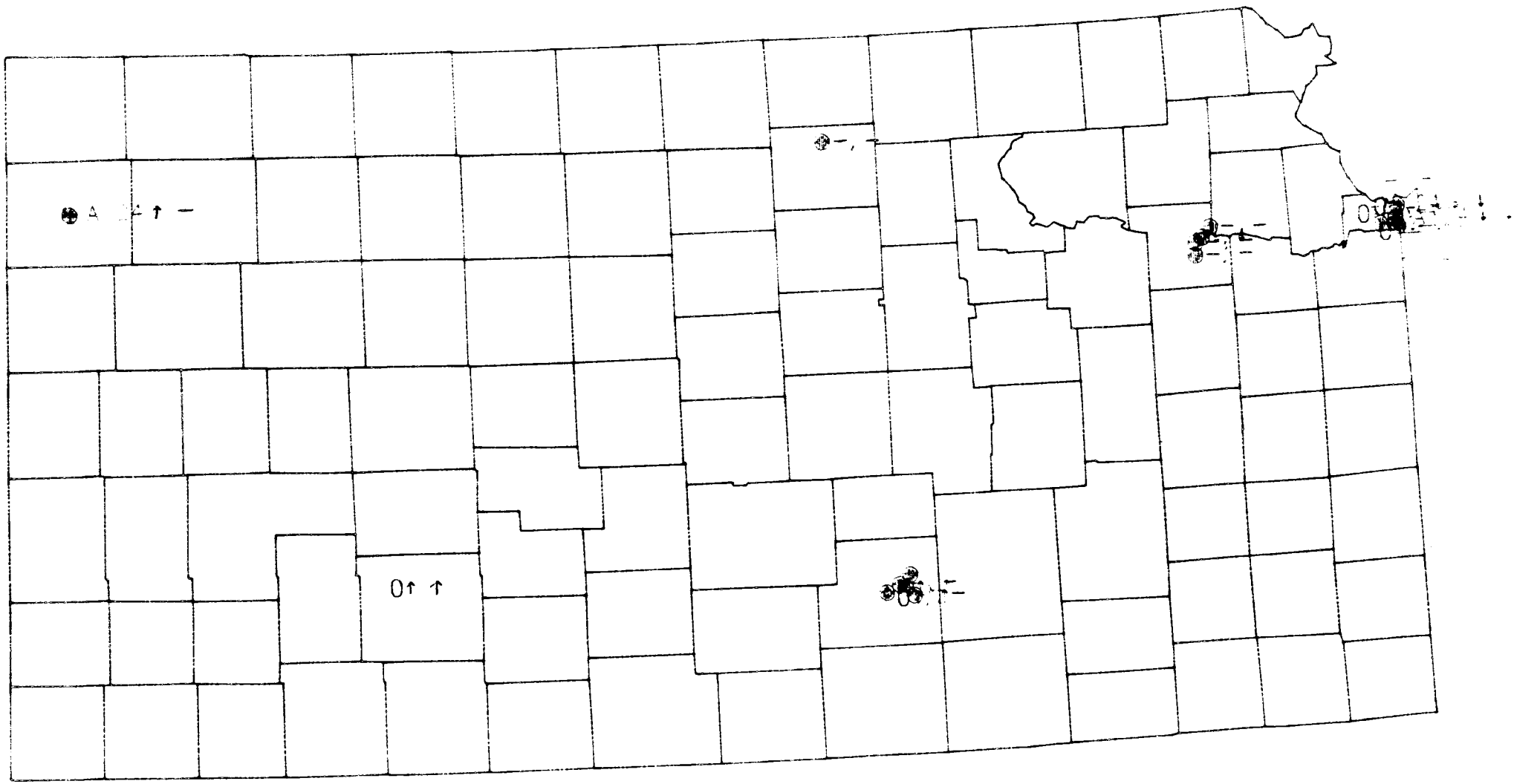
Only one urban area in the State has recorded recent violations of the primary standard. That area contains the monitor at 420 Kansas Avenue in Kansas City. Section XII of this report will focus in more detail on that area, summarizing the results of studies conducted to identify possible sources of the high concentrations. If the concentration levels observed prior to 1982 recur, that summary may be useful in the State's efforts to ensure that the particulate standards are met.

TABLE 4

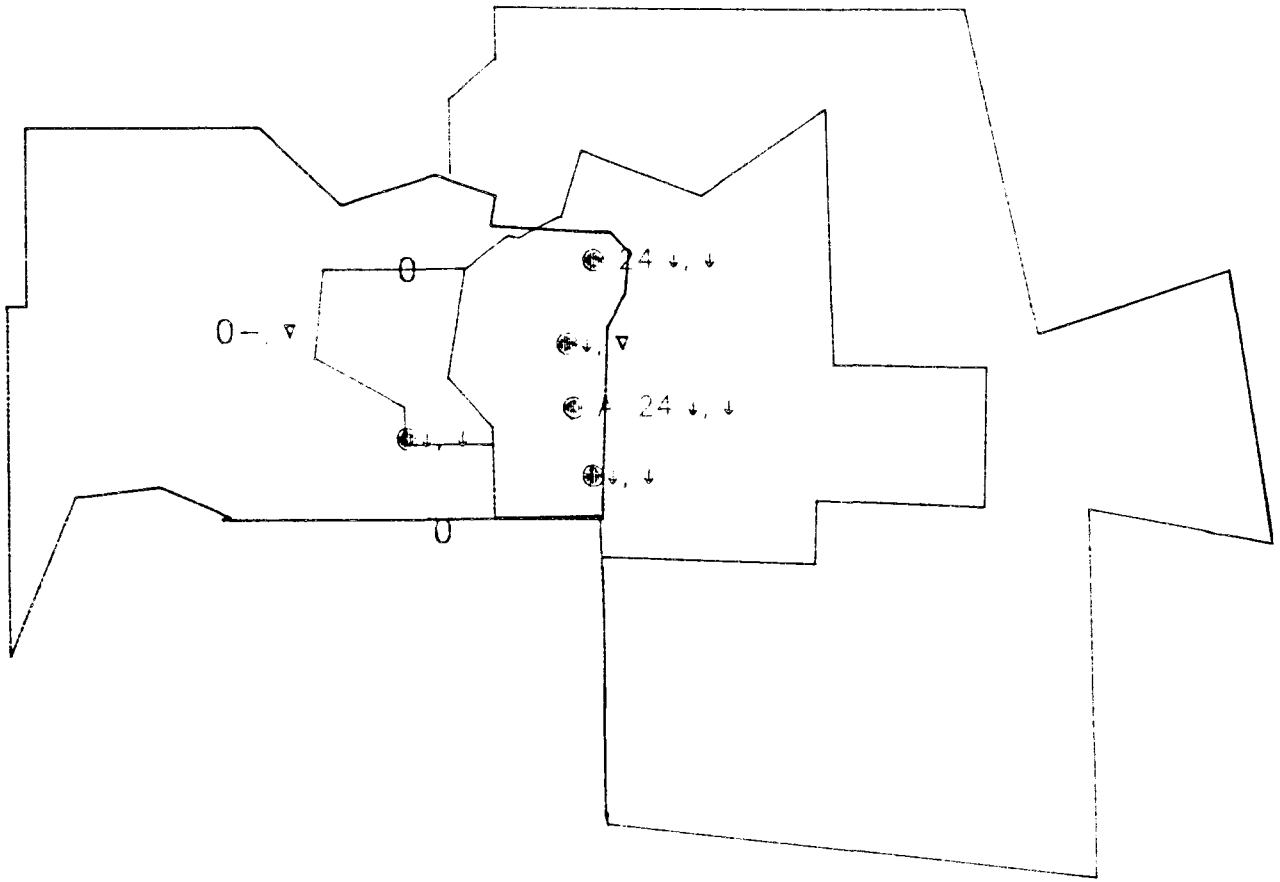
SUMMARY OF TSP RECOMMENDATIONS

Kansas City	Redesignate Fairfax from primary non-attainment to secondary non-attainment Shrink the primary non-attainment area to the industrial-residential area around the 420 Kansas Avenue site. Redesignate the rest of the area to attainment
Topeka	*Redesignate the secondary non-attainment area to attainment

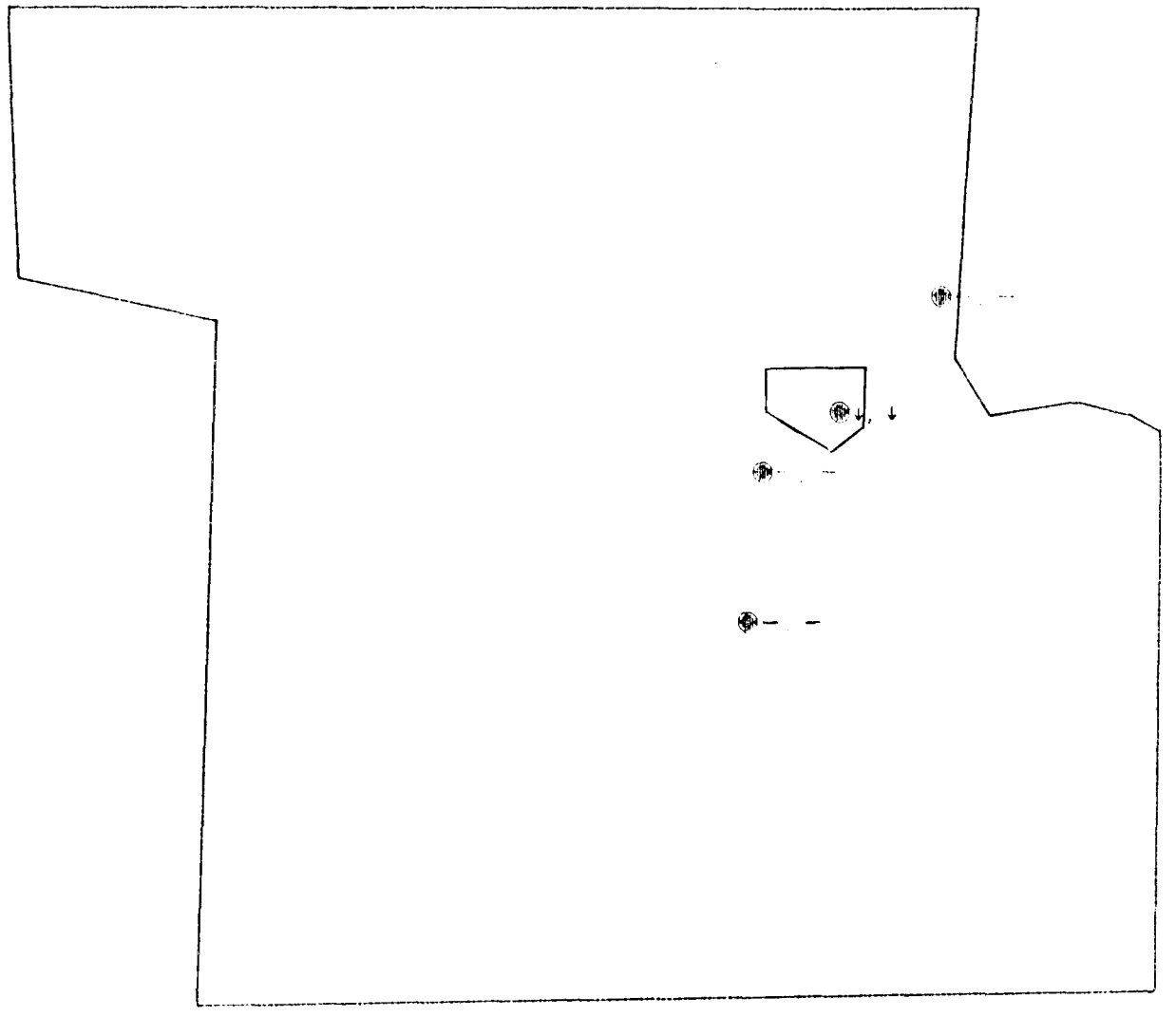
* Request has been submitted by the State.



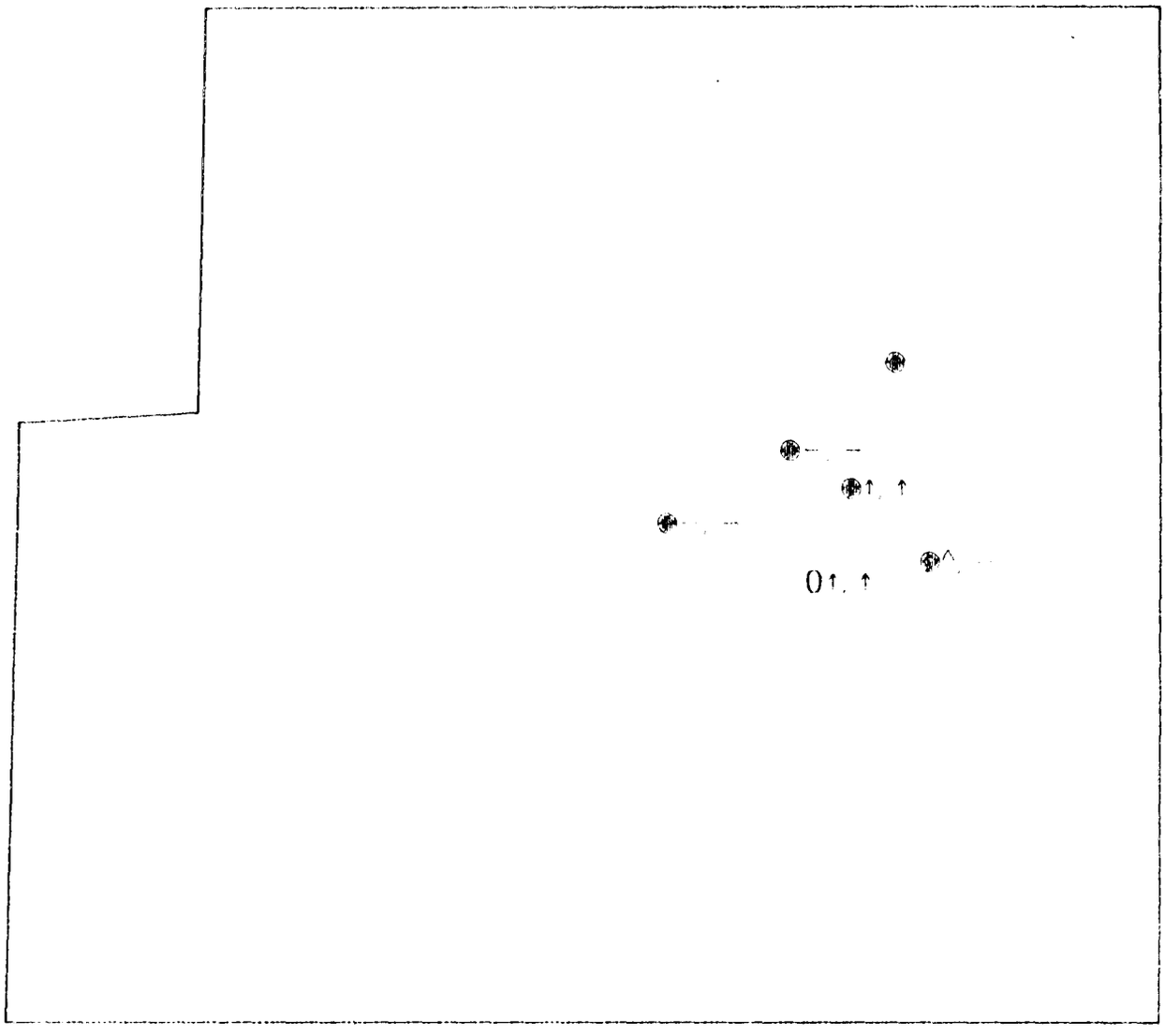
AMBIENT TSP DATA



AMBIENT TSP DATA – KANSAS CITY AREA



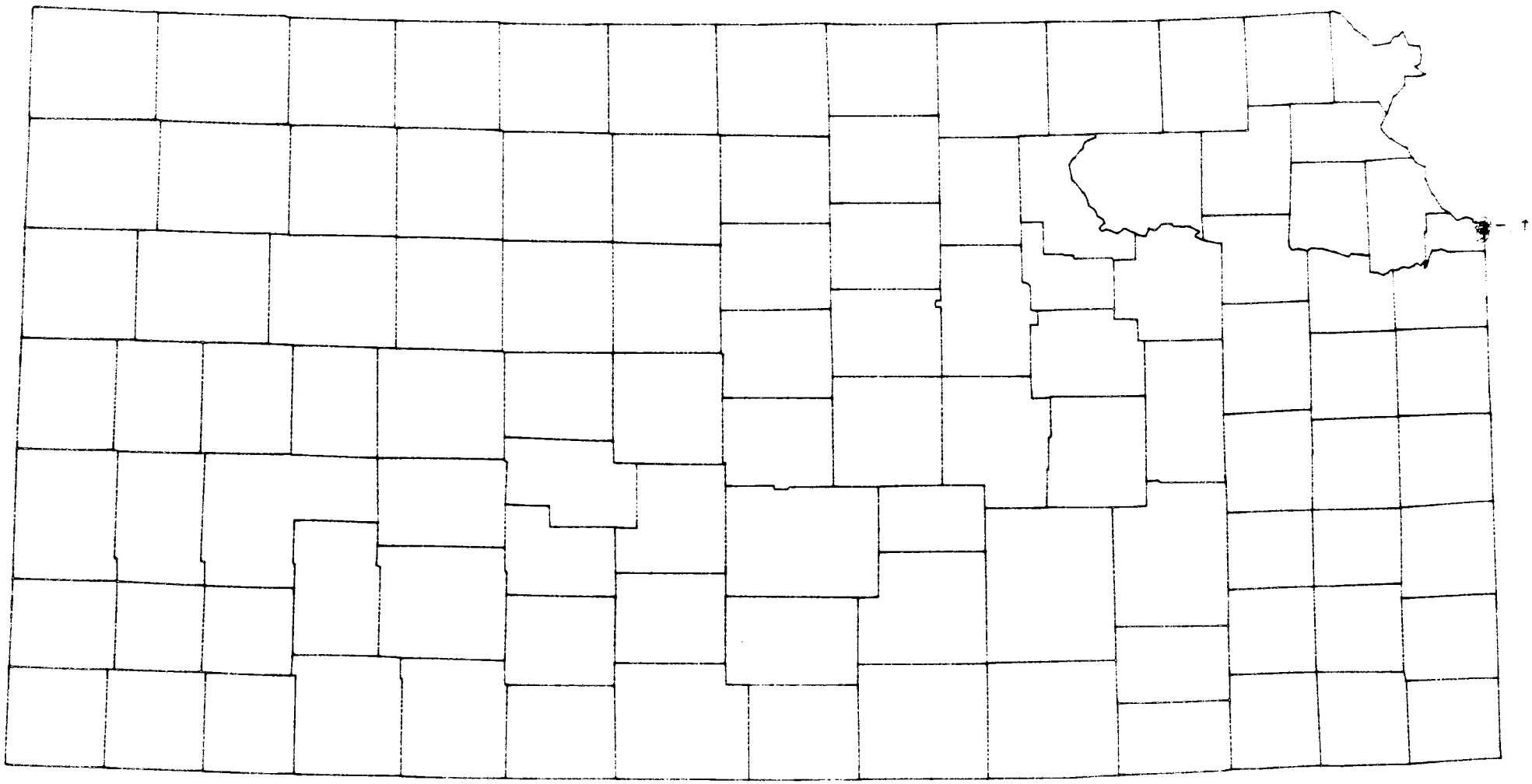
AMBIENT TSP DATA – TOPEKA AREA



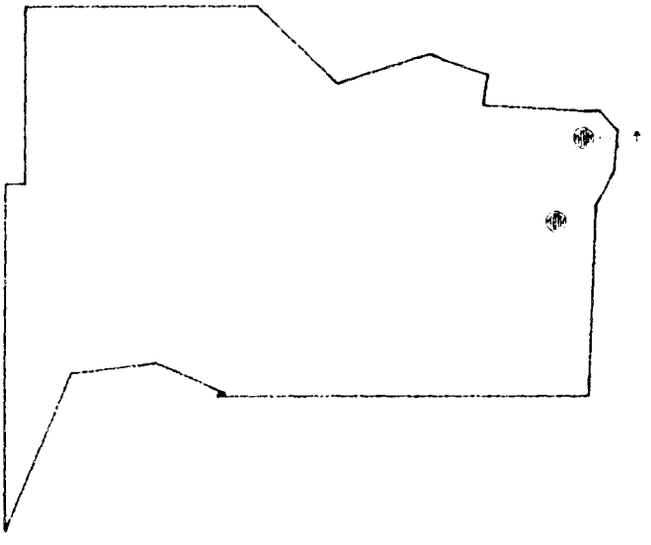
AMBIENT TSP DATA – WICHITA AREA

V. SULFUR DIOXIDE (SO_2)

Sulfur dioxide monitoring is conducted at two SLAMS locations in the Kansas City area. The entire area is designated as "Better Than National Standards" for SO_2. Since recent monitoring data show no violation of standards, that designation remains consistent with the data. The site on Fairfax Road shows an increasing trend in 90th percentile concentrations over the period 1978 through 1982. However, since the second maximum 24-hour concentrations do not exceed half of the NAAQS, it seems unlikely that the present SO_2 standards will be exceeded in the Kansas City area in the near future.



AMBIENT SO2 DATA



AMBIENT SO2 DATA -- KANSAS CITY AREA

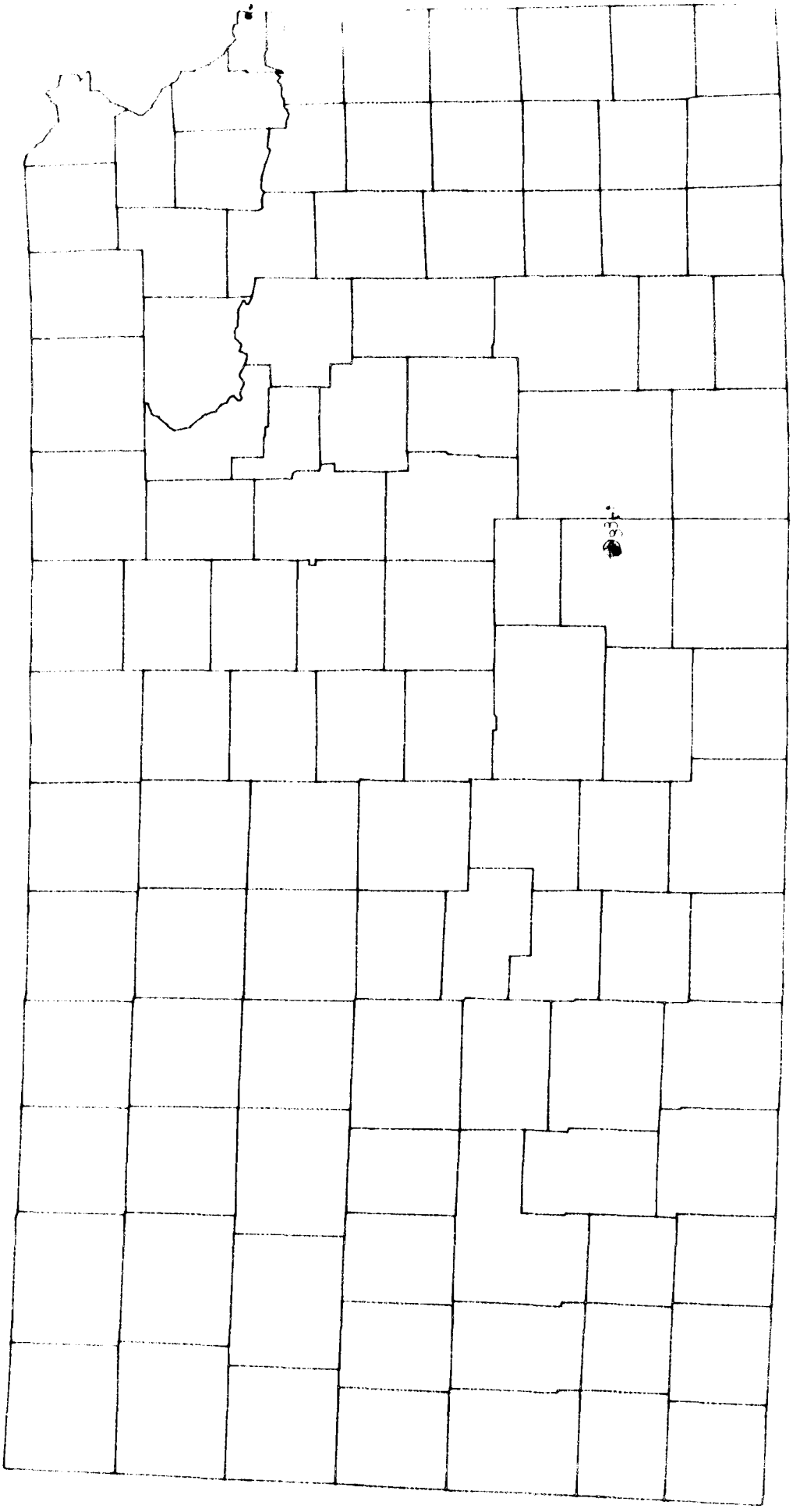
VI. CARBON MONOXIDE (CO)

Carbon monoxide monitoring is conducted in the Kansas City and Wichita areas. The following comments refer to the detailed analyses presented on the inset maps.

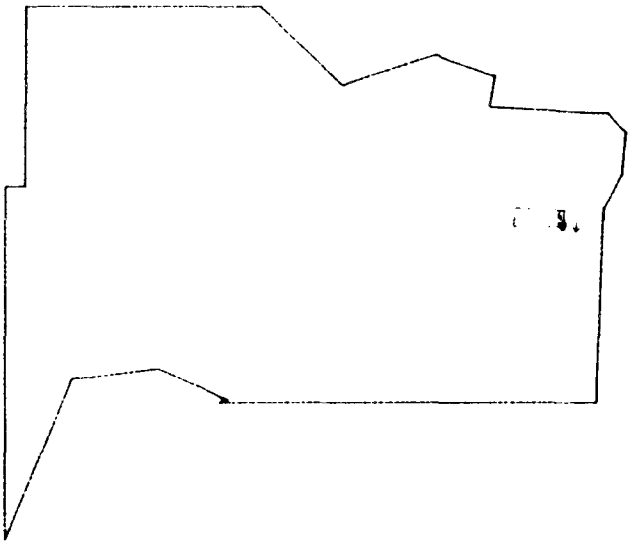
Kansas City - A small area in downtown Kansas City, Kansas is designated as unclassified for CO. When that designation was made, a special purpose monitor at 7th and State was operated for one year to resolve the question of the CO attainment status. Data from that monitor showed no violation of the standard during that year.

The FY-82 air quality evaluation recommended redesignation to attainment, and the State has recently requested that redesignation. The data for 1981 and 1982 continue to support an attainment designation around the current SLAMS monitor.

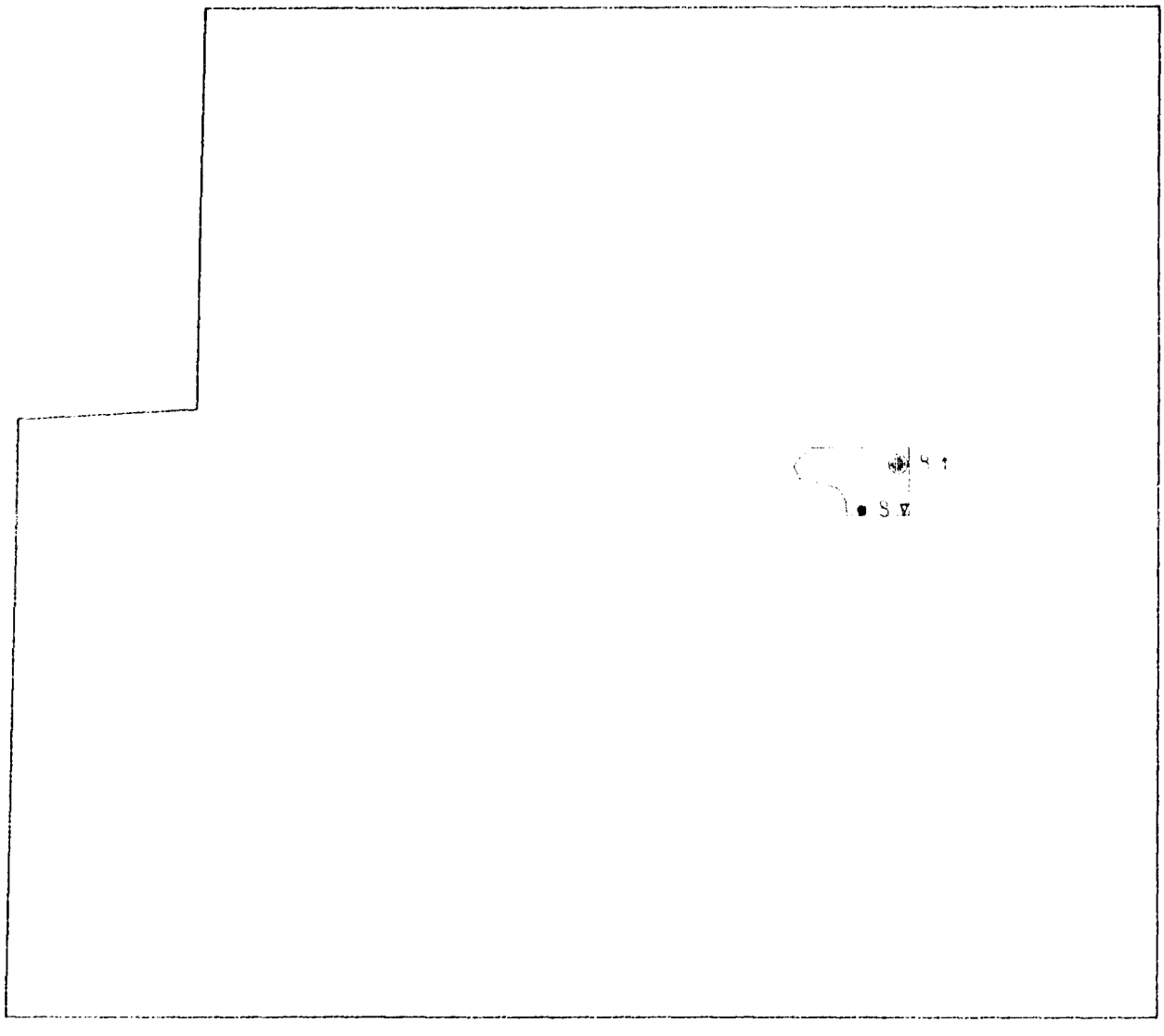
Wichita - Part of Wichita, including the downtown area, is designated as non-attainment for CO. Monitoring data are available in SAROAD from two SLAMS monitors in the non-attainment area. In addition, a special purpose monitor (SPM) was established in July of 1982 to determine whether or not maximum CO concentrations were being measured by the SLAMS monitors. Data from the SPM are not available in SAROAD. The 1981 and 1982 SLAMS data continue to show a few exceedances of the standard each year, and are more than 97% complete. Because of the continuing exceedances of the standard, the non-attainment designation is still appropriate. Section XII presents pollution roses for the two SLAMS sites, in order to indicate possible sources of the high concentrations. Those observations may be useful to the efforts to meet the CO standards.



ALBERT CO DATA



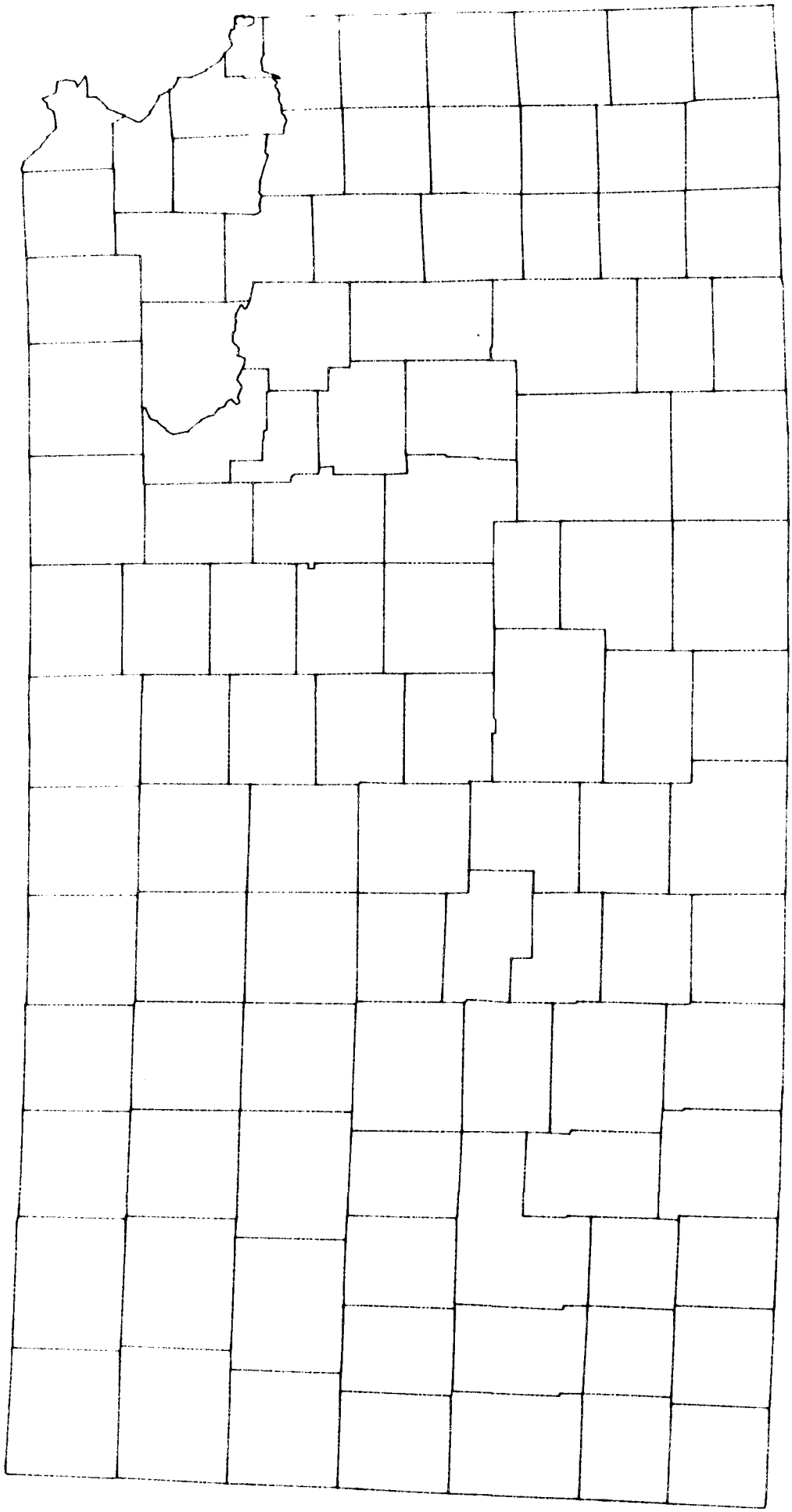
AMBIENT CO DATA – KANSAS CITY AREA



AMBIENT CO DATA -- WICHITA AREA

VII. NITROGEN DIOXIDE (NO_2)

Monitoring for NO_2 is conducted in the Kansas City area only at 619 Ann Street. Monitoring was resumed in April, 1982, after being discontinued in 1979. Data from the last three quarters of 1982 show an average of about one-third of the standard. Those concentrations are consistent with the concentrations measured in the 1970's. The monitor reported data for 99% of the total possible hourly observations after it was installed. The entire area is designated as "Better Than National Standards" for NO_2, which is consistent with the most recent data.



AMBIENT NO2 DATA

VIII. OZONE (O_3)

Three counties in Kansas (Wyandotte and Johnson Counties in the Kansas City area, and Douglas County surrounding Lawrence) are designated as non-attainment areas for ozone. SLAMS monitors are operated in the Kansas City and Wichita areas. A special purpose monitor has been established in Lawrence to resolve the question of whether or not that non-attainment designation should be changed.

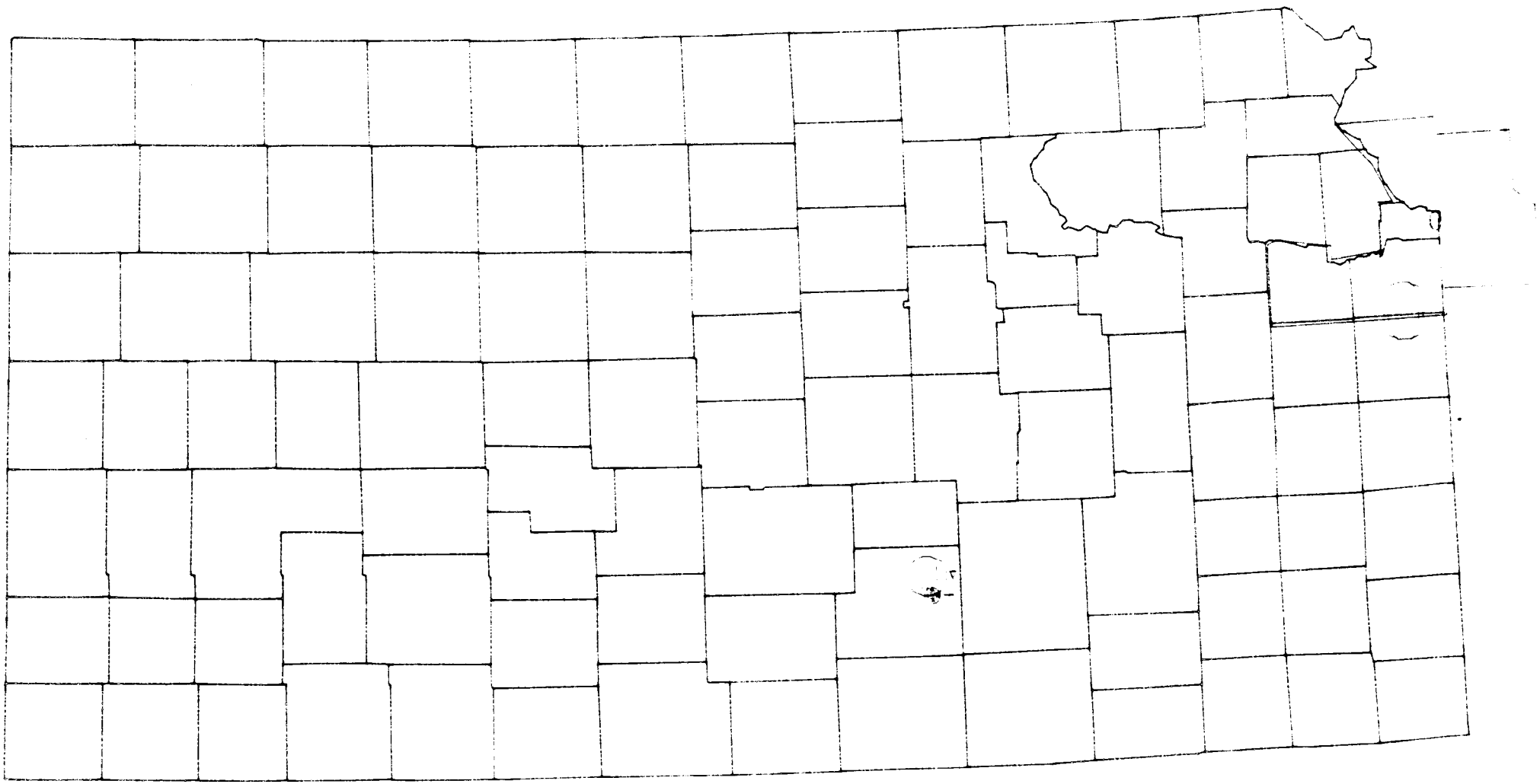
Ozone is formed by a complex photochemical reaction among non-methane hydrocarbons, oxides of nitrogen and oxygen in the atmosphere. The reaction time is measured in hours, and during that time the wind usually carries the pollutants tens of miles from the locations where the precursors were emitted. Therefore, ozone concentrations measured at a point some 25-50 miles downwind of a city may indicate a need for emission reductions throughout the city. Consequently, the following ozone evaluations focus on entire metropolitan areas, rather than on limited areas around specific monitors. Furthermore, the inset map for Kansas City includes both Kansas and Missouri counties, in order to show that broader perspective.

Kansas City - The inset map shows limited monitoring data on the Kansas side. The monitor in Johnson County was operated on a temporary basis as part of a special study, and observed only one exceedance of the standard during the year it was operated. (That was not a violation of the standard, since one exceedance per year is allowed.) The monitor in Wyandotte County was established early in 1982, and reported over 98% complete data for 1982, with no exceedances of the standard.

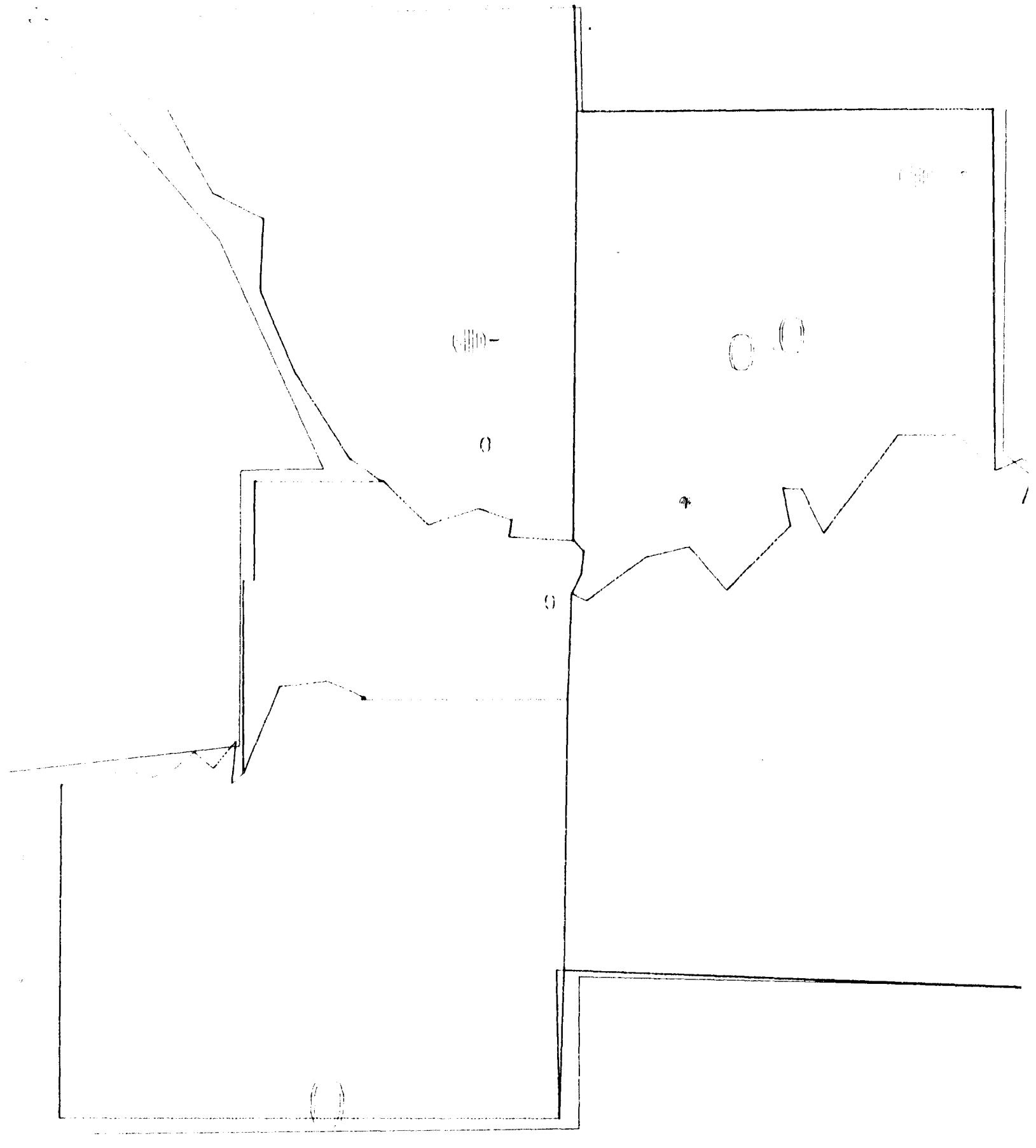
Data on the Missouri side show several exceedances of the standard at three sites in 1980, one exceedance each at two sites in 1981, and no exceedance at any site in 1982. Based on the 1981-82 data, coupled with documented hydrocarbon emission reductions, redesignation of Kansas City to attainment has been requested by the State agencies of Kansas and Missouri. That request is under review by the Air Branch of EPA Region VII.

Lawrence - Since the SPMS data have not been reported to SAROAD, this report makes no recommendations regarding changes in the non-attainment designation. The data would be included with any redesignation request submitted by the State, and will be reviewed when such a request is received.

Wichita - Data from both monitoring sites in the Wichita area show no violation of the ozone standard and stable or probable decreasing trends in concentrations. The attainment designation, therefore, remains consistent with the data.



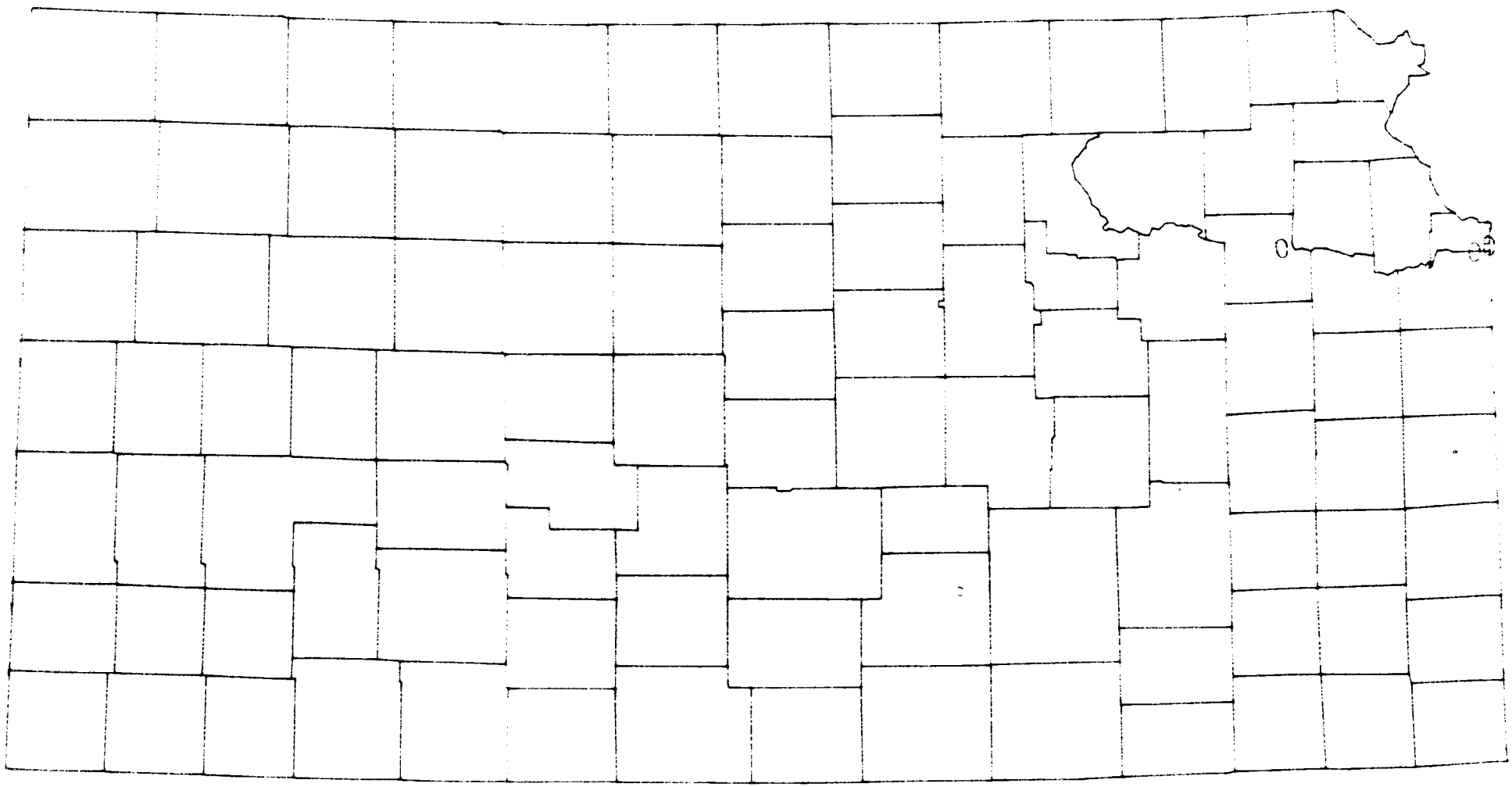
AMBIENT O3 DATA



AMBIENT O3 DATA — KANSAS CITY AREA

IX. LEAD (Pb)

The State established two SLAMS lead monitoring sites (including one NAMS site) on February 1, 1982, well ahead of the deadlines of July 1, 1982 for NAMS and January 1, 1983 for SLAMS. In addition, data were reported to SAROAD in 1981 for lead analyses performed by EPA Headquarters on TSP Hi-vol filters from two sites in Kansas City and one site in Topeka. None of the data showed any violation of the lead standard. The establishment of SLAMS monitors specifically sited for lead analyses is a significant step in documenting lead concentrations relative to the standard. Because those monitors were installed in the middle of the time interval covered by this report, they are shown on the map as having incomplete data. However, the last three quarters of 1982 show data completeness which meets the NADB summary criteria at each monitor.



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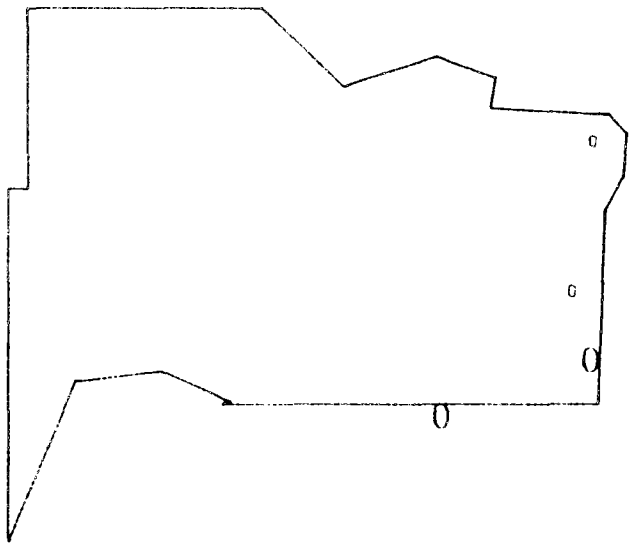

AMBIENT PB DATA — KANSAS CITY AREA

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X. PRECISION AND ACCURACY

For continuous monitors (CO, SO_2, NO_2, and O_3), the regulations of 40 CFR Part 58, Appendix A require precision checks in order to assess precision for each pollutant, and audits in order to assess accuracy.

Precision checks are performed by introducing a gas of known concentration into the analyzer, and comparing the concentration reading from the monitor with the known concentration of the gas. These checks are required every two weeks, and involve one gas concentration. Audits likewise involve comparison of known gas concentrations with the analyzer readings. Audits are more extensive than precision checks, requiring at least three different concentrations of gases. Audit of each analyzer is required annually, and audit of at least 25% of the SLAMS analyzers for each pollutant is required each quarter.

For manual methods (TSP, Pb, SO_2 bubblers and NO_2 bubblers), the regulations require duplicate (collocated) sampling to assess precision and audits to assess accuracy. Each collocated sampler is operated at the same time and in the same manner as the SLAMS monitor at the same site. The percent difference between the two sample concentrations forms the basis for precision estimates. For lead, analysis of duplicate portions of a single Hi-vol filter may be substituted for collocated sampling.

Audits for manual methods differ by method. For TSP, the audits are performed by comparing the flow rate indicated by the Hi-vol sampler to the true flow rate determined from a flow standard. The audit frequency required for Hi-vol samplers is the same as that required for continuous monitors.

Audit procedures for SO_2 bubblers, NO_2 bubblers and Pb, require that the analytical measurement process be audited. Details of those procedures are found in 40 CFR Part 58, Appendix A.

Use of specific equations is required for the calculation of precision and accuracy. Each organization which reports data is required to calculate and report precision and accuracy estimates for all NAMS data collected after January 1, 1981, and for all SLAMS data collected after January 1, 1983.

Table A2 of Appendix A summarizes the precision and accuracy estimates reported by the State during 1981 and 1982. The numbers under the heading "YR-Q" near the left of each printout specify the year and calendar quarter to which the precision and accuracy data apply. (For example, 82-2 refers to the second quarter of 1982.) Composite data for the entire year are identified as quarter number 5. (For example, 81-5 gives the estimates for the full calendar year 1981).

The accuracy estimates are arranged by concentration levels L1 (low concentration) through L4 (high concentration). Specific ranges for the concentration levels are required by 40 CFR 58, Appendix A, as follows:

	NO_2, O_3, SO_2 (ppm)	CO (ppm)	TSP (cfm)	Pb (ug/strip)
L1	.03 to .08	3 to 8	---	100-300
L2	.15 to .20	15 to 20	40-60	600-1000
L3	.40 to .45	40 to 45	---	---
L4	.80 to .90	80 to 90	---	---

The precision and accuracy estimates are expressed as 95% probability limits, as required by the same regulations. The meaning of those limits is illustrated by the following three examples taken from Table A2.

a. The precision data for CO show composite limits of -07 and +07 for calendar year 1982 (line 82-5), based on a total of 72 precision checks. Therefore, 95% of the precision checks would be expected to fall between 7% below and 7% above the known concentration of the test gas used for the precision checks.

b. The accuracy data for SO_2 show limits of -18 and +01 for the audits performed at concentration level 2 (column L2) during the fourth quarter of 1981 (line 81-4). Therefore, 95% of the audits performed at that time at that concentration level would be expected to fall between 18% below and 1% above the known concentration of the audit gas.

c. The precision data for TSP show probability limits of -20 and +09 for the first quarter of 1982 (line 82-1), based on 23 valid collocated data pairs. Therefore, 95% of the concentrations measured by the collocated sampler would be expected to fall between 20% lower and 9% higher than the corresponding concentrations measured at the same time by the SLAMS monitor at the same site.

The following observations are drawn from Table A2.

TSP — The precision and accuracy data reflect conscientious performance of the required collocated sampling and monitor audits.

SO_2 — The number of audits thus far is limited. Since both monitors are designated as NAMS, at least one audit per calendar quarter is required by the regulations. Since the reporting of probability limits for accuracy must be based on at least two audits, semi-annual reporting is permitted. The table shows a total of only two audits in 1982. We encourage the State to ensure that at least the required minimum number of SO_2 audits are performed.

CO — The total number of audits is more than the minimum number required by 40 CFR 58 Appendix A.

an encouraging trend.

O_3 Data from both the precision checks and the audits show a narrowing of the probability limits from 1981 to 1982, an encouraging trend.

NO_2 The one NO_2 SLAMS monitor is not designated as a NAMS monitor. Therefore, precision and accuracy estimates were not required to begin until January 1, 1983.

The overall conclusion which emerges from the precision and accuracy summaries is that the State has conscientiously performed the data assessment and reporting activities required by 40 CFR 58, Appendix A. We commend the State personnel, and encourage them to continue those efforts to provide timely assessments of precision and accuracy.

XI. TRENDS

The results of trend analyses were presented graphically in the preceding sections for each monitor whose data met the required completeness criteria (described in Section III.C). The following table gives a summary of the trend evaluations, with the last column designed to highlight areas of concern.

Pollutant	Total Monitors	Monitors with Sufficient Data for Trend Analysis	Monitors with Decreasing or Probable Decreasing Trend	Monitors with Increasing or Probable Increasing Trend	Monitors with Violations and Increasing or Probable Increasing Trend
TSP	21	18	7	5	1
SO_2	2	1	0	1	0
CO	5	3	2	1	1
O_3	4	2	1	0	0
NO_2	1	0	0	0	0
Pb	6	0	0	0	0

The TSP site which showed apparent violations of the standards and an increasing trend in geometric mean concentrations is located in Goodland. As noted in the text, the elevated concentrations are due to rural fugitive dust, and the area can claim attainment of the primary NAAQS's. The CO site which showed violations of the 8-hour primary standard and an increasing trend in the 90th percentile concentrations is located at 1900 East Ninth Street in Wichita.

In summary, the trend analyses show more sites with improving trends than with worsening trends. Areas of immediate concern (identified by the combination of violations of a primary standard and increasing trends in concentrations) were limited to one monitor in Wichita.

XII. FURTHER EVALUATION OF SELECTED PROBLEM AREAS

The following subsections examine in greater detail the two areas where pollutant concentrations during some portion of the period 1981-1982 exceeded the primary (health-related) standards. For both areas, pollution roses are presented and evaluated, and the results of any previous special studies are summarized, in an attempt to understand the causes of the high concentrations. At the time the pollution rose preparation was begun, available meteorological data included 1980 and 1981, but not 1982. Therefore, the roses are based on air quality data and meteorological data for 1980 and 1981. Consequently, any significant new pollutant sources or any recent pollution abatements are not reflected in the roses. Because of the limitations discussed in Section III.I, the roses provide indications of possible causes, rather than concrete identifications of definite causes.

A. TSP in Kansas City

A special study was conducted by PEDCO Environmental, Inc. during the period July 24 through November 25, 1980, in order to better define contributing particulate sources around the 420 Kansas Avenue monitoring site. The study included collection and analysis of 90 samples, each covering a 12-hour period. Of those 90 samples, 36 showed concentrations over 150 ug/m^3 (the secondary standard for a 24-hour sampling time). The final report of the study (EPA 907/9-81-006) identified the following sources as the predominant contributors to the TSP concentrations:

Traffic on Kansas Avenue

Construction activity across Kansas Avenue from the monitor

Traffic in the truck terminal or rail yard northwest of the monitor.

The attached map (Figure 2), reproduced from that report, shows the locations of those non-point sources. While a number of point sources are located in the general vicinity, the largest are over a mile away from the monitor. A list of point sources within five miles of the monitor is shown in Table 5, which is reproduced from the PEDCO report. In that report, contributions from point sources were found to account for only about 4% of the observed TSP concentrations.

Since separate samples were run from 6 a.m. to 6 p.m. and from 6 p.m. to 6 a.m., the results were analyzed separately for daytime and nighttime conditions. That analysis showed prominent daytime contributions from the north, south, east and northwest. Prominent nighttime contributions came from the northwest and southwest. Nighttime concentrations were significantly lower than daytime concentrations.

The study described above was based on intensive sampling during a period of four months. An additional perspective is provided by the TSP SLAMS data for a longer time period. The two-year period 1980-81

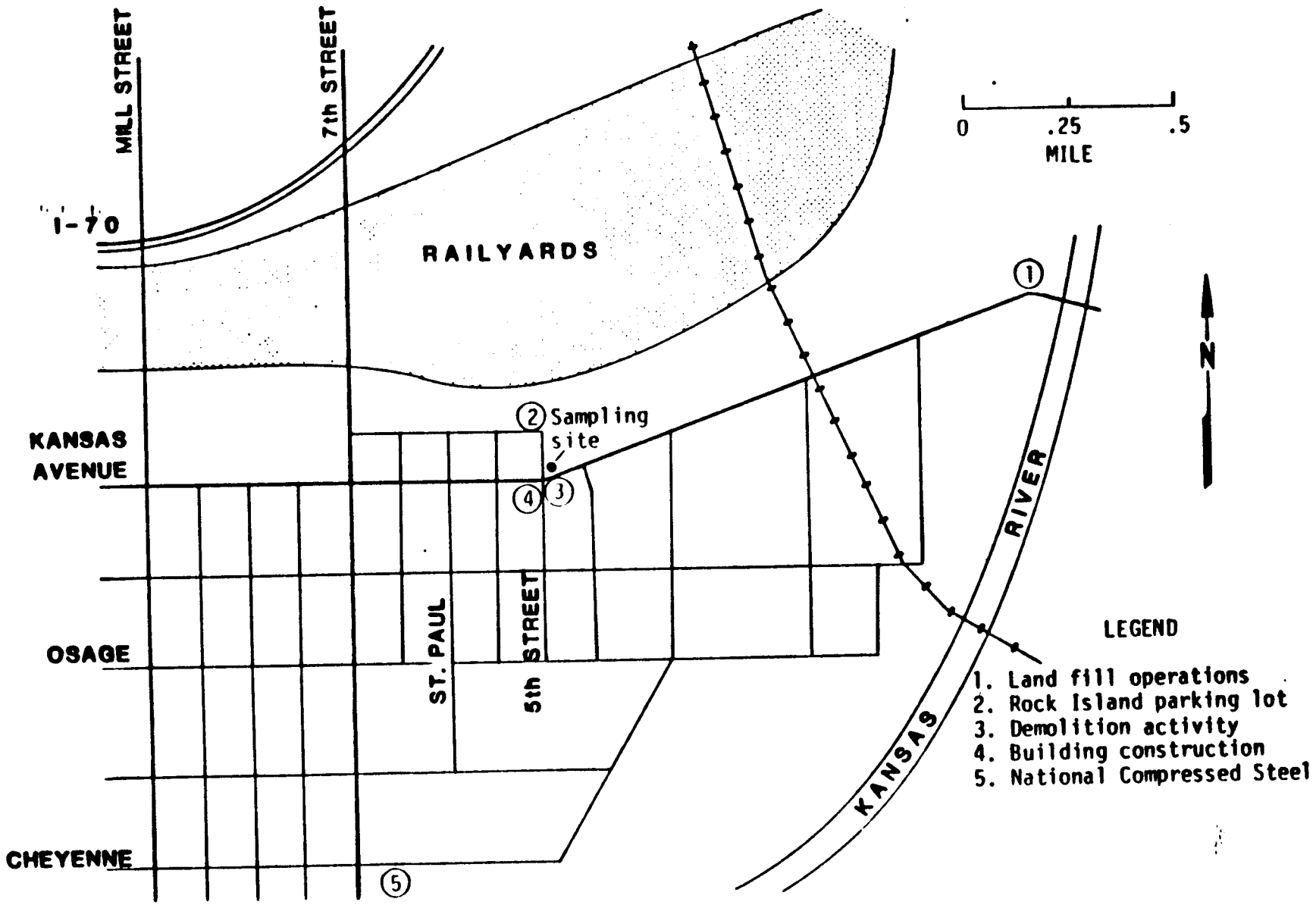


Figure 2 - Area surrounding 420 Kansas Avenue site.

TABLE 5 - POINT SOURCE SUMMARY, 420 KANSAS AVENUE

Plant ID number	Plant name	Emission level, ton/year	Distance from site, mi	Wind quadrant	UTM coordinates x	y
1	KCP&L, Grand	341.3	2.8	1	363.4	4330.2
2	KCP&L, Northeast	48.6	4.1	1	365.2	4331.3
3	Ralston Purina	117.5	4.3	1	365.7	4331.1
4	Checkerboard	125.8	4.5	1	364.8	4332.7
5	Gouch Mill	33.0	5.0	1	365.3	4333.7
6	CSG No. 7 (Certainteed)	522.0	3.7	1	360.4	4333.5
7	Tobin Construction	46.0	1.3	3	358.1	4326.5
8	Onwes Corning	552.0	4.2	1	360.5	4334.3
9	Proctor and Gamble	72.0	1.7	3	357.0	4327.6
10	Smoot Grain	96.0	1.4	3	357.4	4327.5
11	Phillips Petroleum	336.0	3.3	1	361.5	4332.7
12	Far-Mar-Co.	45.5	4.3	4	359.2	4334.5
13	Bartlett Grain	53.3	2.2	1	360.6	4331.1
14	Bunge	30.5	1.5	2	360.5	4325.5
15	Cargill	185.3	2.9	4	355.0	4328.0
16	Natrena Feeds	128.0	1.3	1	360.9	4329.3
17	CSG No. 5 (Certainteed)	75.0	3.6	1	360.4	4334.4
18	Quindaro Power Plant	3187.0	4.3	4	358.3	4334.5
19	Kaw Power Plant	6879.0	1.6	3	357.2	4327.5
20	McFadden Company	17.0	1.9	3	359.6	4324.6
21	S-G Metals	74.3	1.3	1	360.4	4329.7
22	Turnpike Elevator	62.3	0.94	4	358.2	4327.8
23	Wolcott & Lincoln	16.4	2.7	1	361.8	4331.4
24	Lone Star Industries	13.0	0.7	1	359.8	4328.9
25	Nearman Creek	44.4	3.9	3	353.5	4327.0

was chosen, based on availability of weather data. During those years, 115 samples were collected on the National Aerometric Schedule, with each sample covering 24 hours. Of those 115 samples, 22 showed concentrations over 150 ug/m^3 and 87 were over 75 ug/m^3. The two pollution roses prepared are shown in Figures 3 and 4.

Figure 3 shows that, when the 24-hour secondary standard (150 ug/m^3) was exceeded, the winds were most often from the east-northeast. However, a few such concentrations were also observed for most of the other wind directions. Figure 4 indicates that the most frequent contributions to annual averages above the primary standard (75 ug/m^3) occurred when the winds were from the east-northeast, south and south-southwest. Examination of the raw data shows that those concentrations include every month of the year.

The locations of sources which emitted over 100 tons/year are shown in Figure 5. That figure is based on the emission data and UTM coordinates shown in Table 5, and reflects the point source emissions corresponding to the time frame of the pollution roses. (It should be noted that the latest NEDS submittals reflect substantial emission reductions at several locations, especially the Kaw and Quindaro Power plants. The emissions increase at the Nearman Creek plant when it began full operation was only about 10% as large as the decrease at the other two plants. Table 6 shows the most recent emission estimates for the sources in Table 5.)

Based on the distance of the sources from the monitor and the directional pattern of the pollution roses, area sources appear to be the predominant contributors to the observed concentrations.

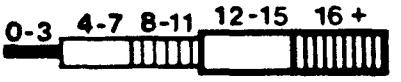
A different kind of meteorological rose, a wind rose, is shown in Figure 6. Two essential differences distinguish the wind rose from the pollution roses shown in Figures 3 and 4.

- First, the wind rose includes all wind observations, regardless of the pollutant concentrations. The pollution roses included only the wind observations recorded when the pollutant concentrations exceeded a specified threshold.

- Second, since the data summaries used to construct the wind rose classify wind directions in 16 directional sectors, the rose includes 16 arms, each representing a 22.5° sector. By contrast, the wind data used for constructing pollution roses were reported by the National Weather Service in 10° increments. Those roses present 12 arms, each representing a 30° sector (three of the 10° directional increments). Conversion formulas are not available for transforming a 12-arm rose to a 16-arm rose, or vice versa. Therefore, comparisons between the wind roses and the pollution roses are qualitative, rather than quantitative.

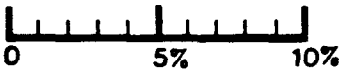
Figure 6 shows a wind rose for Kansas City based on a summary of historical weather data collected at the Downtown Airport. If all of the pollutant

Figure 3. TSP in Kansas City



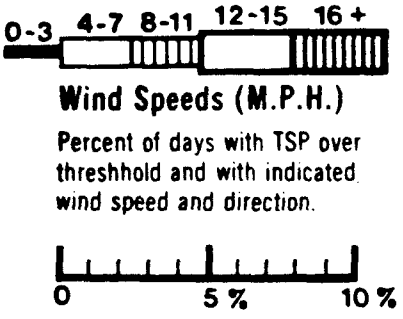
Wind Speeds (M.P.H.)

Percent of days with TSP over threshhold and with indicated wind speed and direction.

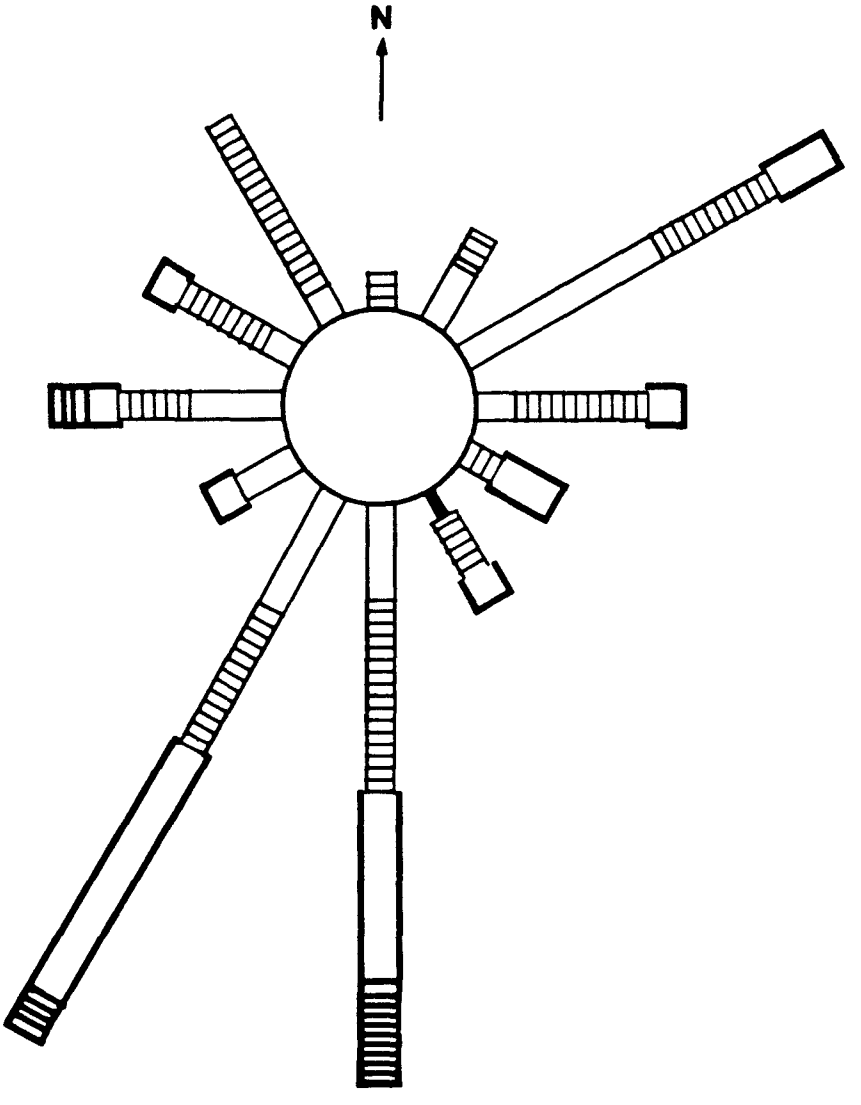


Met. Station: Downtown Airport
Air Quality Site: 420 Kansas Ave.
TSP >150 $\mu g/m^3$
22 Observations
1980 and 1981 data

Figure 4. TSP in Kansas City



Met. Station: Downtown Airport
Air Quality Site: 420 Kansas Ave.
TSP >75 $\mu g/m^3$
87 Observations
1980 and 1981 data



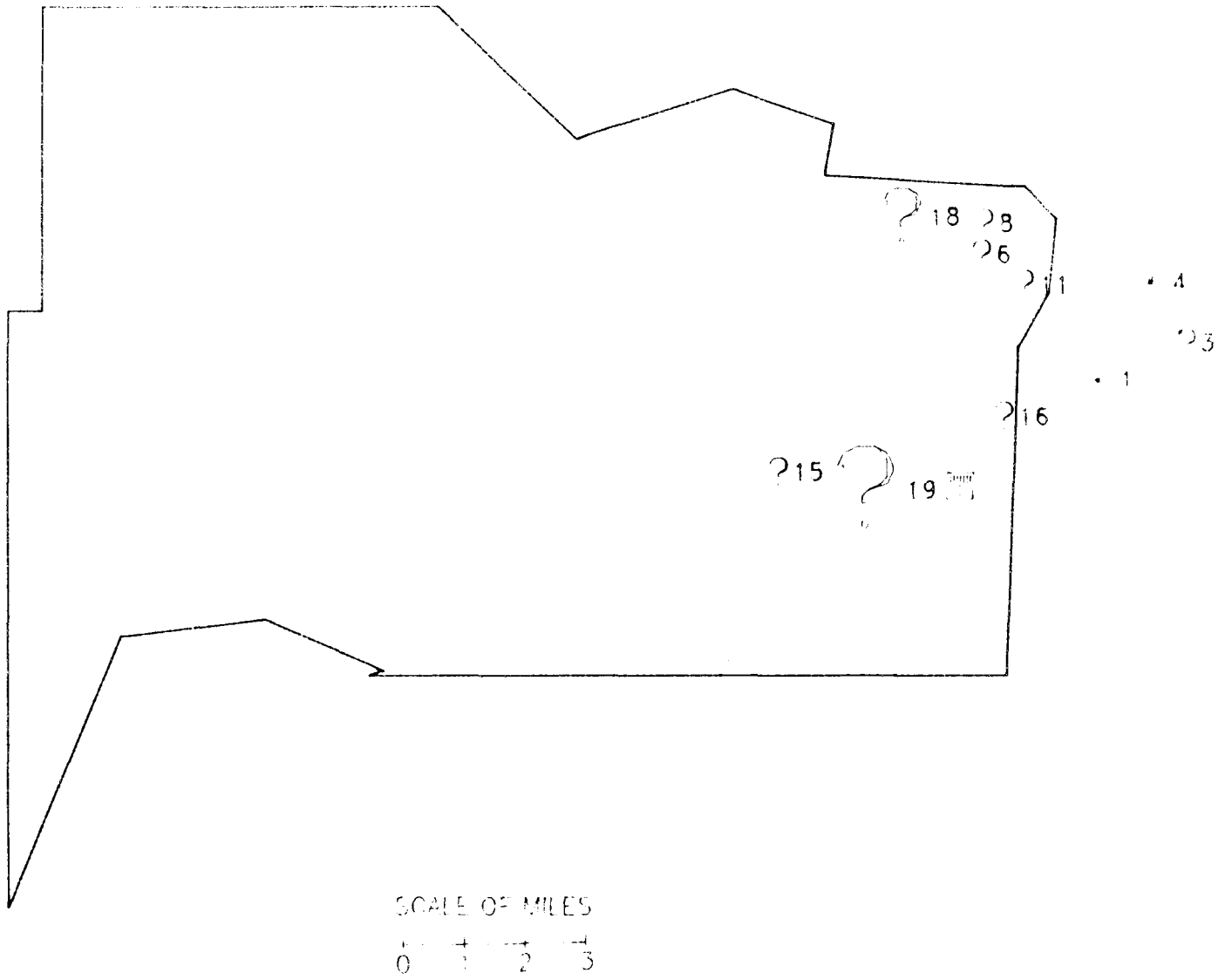


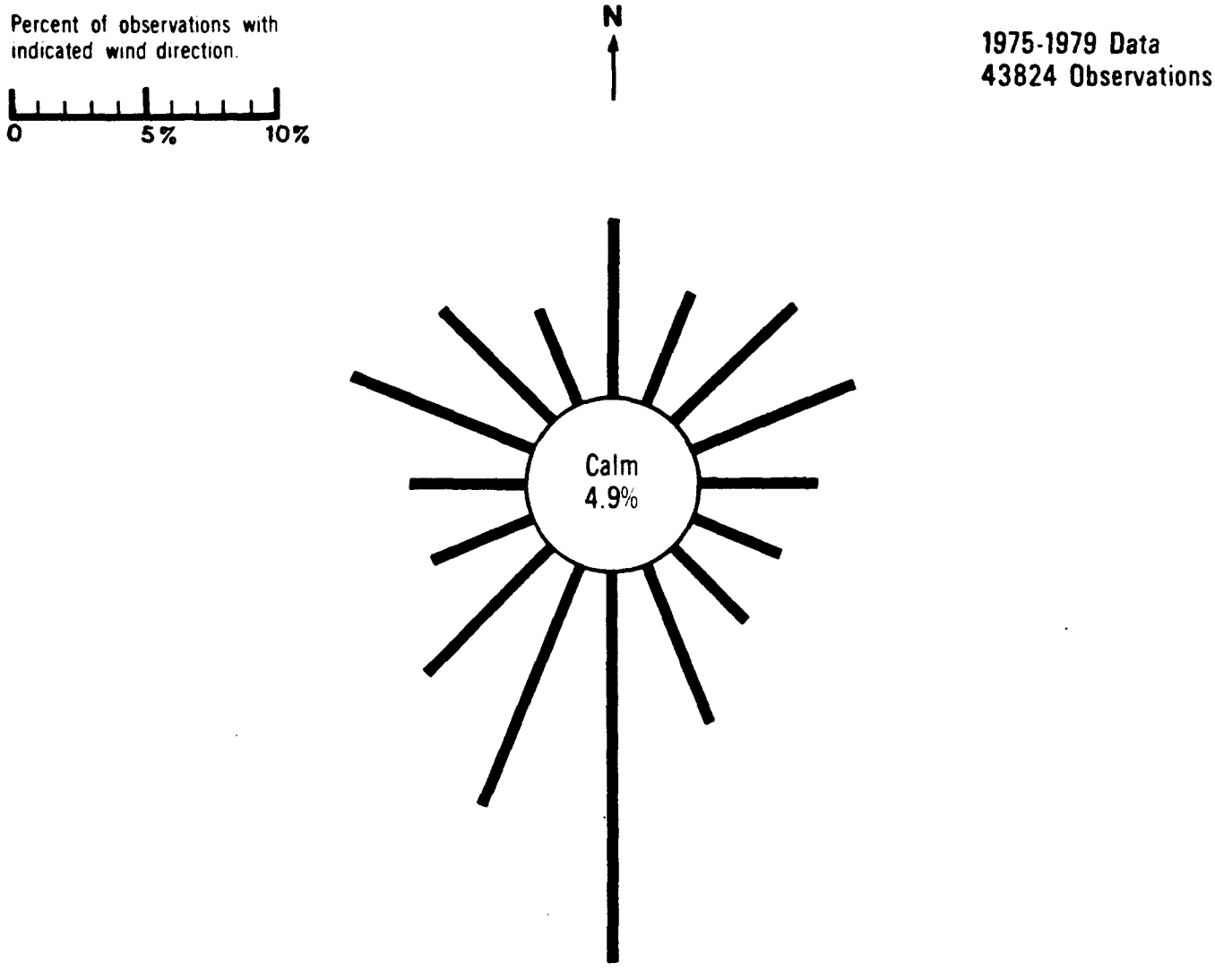
FIGURE 5

PARTICULATE POINT SOURCES AROUND 420 KANSAS AVE

TABLE 6
UPDATED POINT SOURCE SUMMARY, 420 KANSAS AVENUE

Plant ID number	Plant name	Emission level, ton/year
1	KCP&L, Grand	202
2	KCP&L, Northeast	1
3	Ralston Purina	117.5
4	Checkerboard	316
5	Gouch Mill	310
6	CSG No. 7 (Certainteed)	22
7	Tobin Construction	1
8	Owens Corning	34
9	Proctor and Gamble	0
10	Smoot Grain	27
11	Phillips Petroleum	28
12	Far-Mar-Co.	169
13	Bartlett Grain	36
14	Bunge	8
15	Cargill	48
16	Natrena Feeds	100
17	CSG No. 5 (Certainteed)	582
18	Quindaro Power Plant	930
19	Kaw Power Plant	849
20	McFadden Company	11
21	S-G Metals	0
22	Turnpike Elevator	6
23	Wolcott & Lincoln	23
24	Lone Star Industries	1
25	Nearman Creek	881

Figure 6. Historical Wind Rose-Kansas City Downtown Airport



emission sources were equally distributed around the monitor, the wind rose and the pollution rose should approximately coincide. Comparison of Figures 3 and 4 with Figure 6 indicates larger contributions to high concentrations with east-northeasterly and possibly southerly winds than would be expected solely from the wind rose.

While these pollution roses are in basic agreement with the PEDCo study, they may indicate a more extensive impact from traffic on Kansas Avenue over the longer time period.

B. CO in Wichita

Previous studies of CO in Wichita have attributed the elevated concentrations to vehicular traffic.

The pollution rose of Figure 7 shows wind speeds and directions when hourly CO concentrations monitored at the Fire Station exceeded the 8-hour standard of 10 mg/m^3. (Only those hours could contribute to 8-hour averages exceeding the standard). Figure 8 shows the historical wind rose for the area. Since those two figures show distinctly different patterns, the wind distributions alone are not sufficient to explain the pollution rose. Increased contributions to high concentrations are noted under calm conditions, and with light-to-moderate winds in a 150° sector west of the monitor.

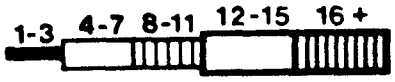
Table 7 lists point source emissions for the county, based on the State-submitted NEDS data. Figure 9 shows the locations of those point sources emitting 100 or more tons/year of CO. Based on the distances and directions of those sources from the monitor, negligible point source impact is indicated. Figure 10 shows traffic counts near the monitor, which is located at Topeka and Lewis Streets. The pollution rose indicates that traffic along Topeka, Broadway and Kellogg Streets is probably the major source of the elevated CO concentrations. That interpretation is based on the directional pattern of the rose (major contributions from the directions SSW through NNW) and on the wind speeds (generally 0-7 knots).

Therefore, the indications of the pollution roses further support the previous conclusion that traffic is the major cause of the CO concentrations.

Figure 11 shows the pollution rose for the monitor located at the Wichita-Sedgwick County Health Department (1900 East 9th Street).

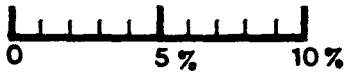
Comparison of Figures 8 and 11 shows that, as for the previous CO rose, this pollution rose cannot be explained in terms of the wind rose and a uniform distribution of emission sources. Increased contributions to high CO concentrations are noted under calm conditions, and with light to moderate winds from the northwest and the southwest.

Figure 7 . CO in Wichita



Wind Speeds (Kts.)

Percent of hours over threshold and with indicated wind speed and direction.



Met. Station: Mid-Continent Airport
Air Quality Site: Topeka at Lewis
CO > 10 mg/m^3
94 Observations
1980 and 1981 data

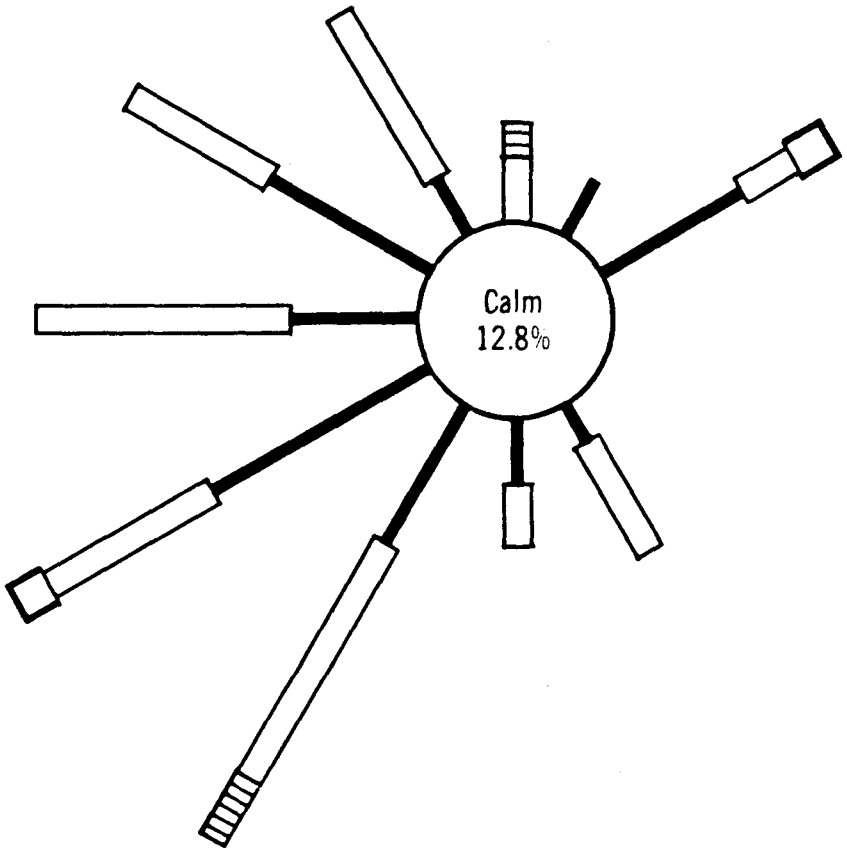


Figure 8. Historical Wind Rose-Mid Continent Airport, Wichita

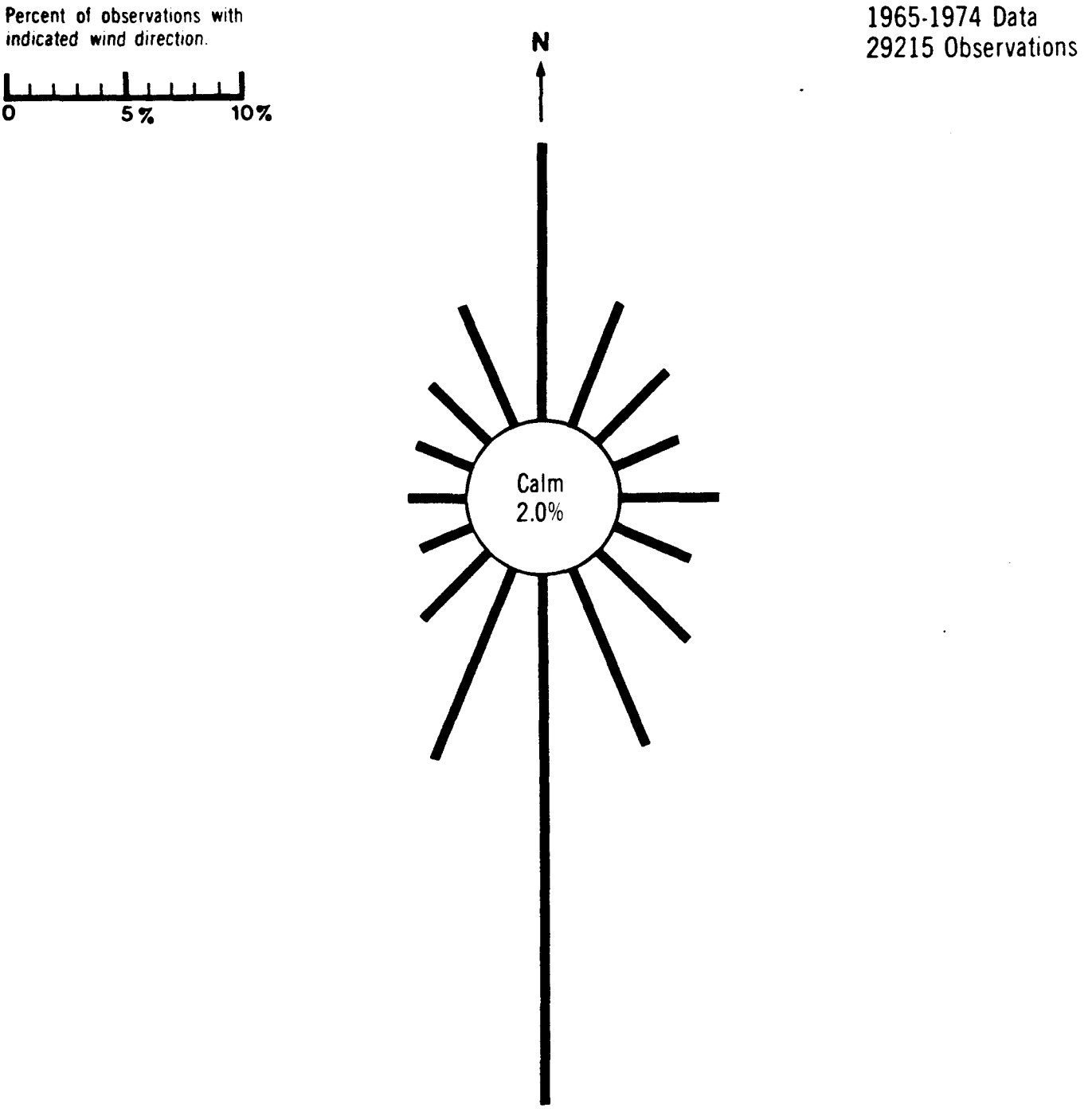


TABLE 7 EMISSIONS SUMMARY - SEDGWICK COUNTY

STATE:17 KANSAS COUNTY:3320 SEDGWICK CO

PLNT	NAME AND ADDRESS	CONTACT	SIC	AQR	CITY	UTMX	UTMY	PT	YR	PARTIC	SO2	NOX	VOC	CO
0001	CEREAL FOOD PROCESSORS INC. 701 E 17TH	DAVE MATTS	2041	099	3740	6473	41753	06	80	190*	0	25*	0	2
0002	ROOFERS SERVICE SUPPLY,INC.	RON BENT	2952	099	3740	6470	41779	01	81	3	0	0	3	1
0003	CITIES SERVICE OIL CO.-WICHITA	W TEMPLETO	4922	099	3740			03	81	4	0	142*	38*	21
0004	HAYSVILLE FARM CENTER- HAYSVILLE	D MINEAR	5153	099	0000	6455	41580	04	81	0	0	0	0	0
0005	MC CONNELL AFB WICHITA KANSAS 67221	J R EDWAR	9711	099	3740	6560	41670	02	81	0	0	0	6	0
0006	GREDE FOUNDRIES INC. 1320 S 1ST	F.R.H. ALL	3321	099	3740	6476	41699	04	81	20	0	0	0	0
0007	SERVICE IRON FOUNDRY 240 N. ROCK ISLAND	FLOYD BOWE	3321	099	3740	6474	41727	04	81	1	0	0	0	0
0008	FERROLOY FOUNDRY 515 E 29TH ST,N. 67201	W.J. EASTO	3321	099	3740	6470	41778	05	81	15	0	0	0	0
0009	FARMERS CO-OP ELEVATOR CO MT. HOPE	R NATTIER	5153	099		6173	41915	06	81	24	0	0	0	0
0010	MIDLAND REFINING CO.	C HARPSTER	2992	099	3740			03	81	0	0	0	0	0
0011	ROSS INDUSTRIES(DEPT.-CARGILL)-TERMINAL		5153	099	3740			05	81	24	0	0	0	0
0012	KANSAS G&E GORDON EVANS STN COLWICH	G KOESTER	4911	099	0000	6304	41835	02	80	35*	24	6116*	16	445*
0013	KANSAS G&E RIPLEY STN 4400 N SENECA ST.	KOESTER	4911	099	3740	6451	41808	05	80	1	344	1308	1	10
0014	KANSAS G&E MURRY GILL STN 6100 WSSTH	PINKSTAFF	4911	099	3740	6401	41619	04	80	36	285*	2575*	9	188*
0015	INTERNATIONAL PLASTICS, INC. COLWICH	L. PAUL	2818	099	0000			01	78	0	0	0	0	0
0016	CHANCE MFG. CO.,INC.		3599	099	3740			01	81	0	0	0	6	0
0017	PEOPLES NATURAL GAS-CHENEY STA.	R HELLER	4922	099	0000			01	80	0	0	323*	133*	41*
0018	CITIES SERVICE GAS CO.-HAYSVILLE	J DANCER	4922	099	0000			01	80	0	0	260*	107*	33*
0019	CESSNA AIRCRAFT CO.(WALLACE DIV.)	J LANE	3724	099	3740			04	80	1	0	22	1848	2
0020	DERBY REFINING CO. 1100 E.21ST ST. 67210	R W KERSEY	2911	099	3740	6478	41762	19	80	33*	223*	808*	1630*	181*
0021	SERVICE BRASS AND ALUMINUM FOUNDRY INC	F WESTWOOD	3361	099	3740	6475	41729	02	81	0	0	0	0	0
0022	BEECH AIRCRAFT CORP.-WICHITA	T FERGUSON	3721	099	3740			03	80	0	0	0	0	0
0023	ABBOTT LABORATORIES- WICHITA	B FOUTY	2869	099	3740			03	81	1	0	0	0	0
0024	MAJOR INC 4323 W 31ST SOUTH 67217	G TOMLIN	2951	099	3740	6416	41666	02	80	0	0	0	0	0
0025	RALSTON PURINA CO 710 E 11TH 67201	T. VAN LON	2048	099	3740	6473	41746	06	80	97	0	1	0	0
0026	TWECO PRODUCTS INC BOX 666	J KESTER	3362	099	3740	6419	41697	02	81	0	0	0	4	0
0027	WESTERN IRON & FOUNDRY 702 E.2ND 67202	E.E. URBAN	3321	099	3740	6474	41725	04	81	14	0	0	0	0
0028	BERT & WETTA SALES INC BOX 117 MAIZE	R E BERT	2048	099	0000	6349	41823	02	81	2	0	0	0	0
0029	CARGILL INC. 1501 N MOSLEY 67214	WEST MOREL	2075	099	3740	6473	41750	14	80	158*	1	27	1	5
0030	MULVANE COOPERATIVE UNION PECK	C LONG	5153	099		6437	41495	05	80	18	0	0	0	0
0031	RACON, INC BOX 198 WICHITA KS 67201	E. MCCRILL	2869	099	3740			01	80	0	0	0	408	0
0032	A-1 CONCRETE,INC. 5460 N.BROADWAY 67219	KEN HARRI	3273	099	3740	6466	41829	01	78	0	0	0	0	0
0034	HEIMAN ELEVATOR,INC.-WICHITA		5153	099	3740			04	81	8	0	0	0	0
0035	ACME BRICK CO 1337 NORTH MOSLEY	BILL CONNE	3271	099	3740	6473	41747	01	81	4	0	0	0	0
0036	MID-KANSAS CONSTRUCTION INC.		2951	099	3740			01	81	0	0	0	0	0
0037	AIR CAPITAL CONCRETE INC PO BOX 17104	L MANESS	3273	099	3740	6456	41605	01	78	0	0	0	0	0
0038	MAJOR,INC.	G TOMLIN	2951	099	3740			01	81	1	0	0	0	0
0039	PEOPLES NATURAL GAS-ANADARKO STA.	R HELLER	4922	099				01	81	0	0	70*	29*	9
0040	ALLEN'S,INC. 45TH AT ROCK ROAD 67204	DEAN RITCH	3273	099	3740	6550	41639	01	78	0	0	0	0	0
0041	ALLEN'S CONCRETE,INC.-1820 N. MOSLEY	DEAN RITCH	3273	099	3740	6476	41756	01	80	1	0	0	0	0
0042	ALLEN'S,INC. 31ST S. AND K-15 67204	DEAN RITCH	3273	099	3740	6498	41665	01	78	0	0	0	0	0
0043	ALLEN'S,INC. 200W. 10TH 67204	DEAN RITCH	3273	099	3740	6463	41739	01	78	0	0	0	0	0
0044	ALLEN'S CONCRETE,INC.-6500 W. 21ST	DEAN RITCH	3273	099	3740	6476	41754	01	80	1	0	0	0	0
0045	PHILLIPS PIPE LINE CO.-WICHITA TERMINAL		4226	099	3740			04	82	0	0	54*	242*	7
[illegible]	ANDALE READY MIX ANDALE 67001	JIM MOLITE	3273	099	0000	6207	41836	01	81	1	0	0	0	0

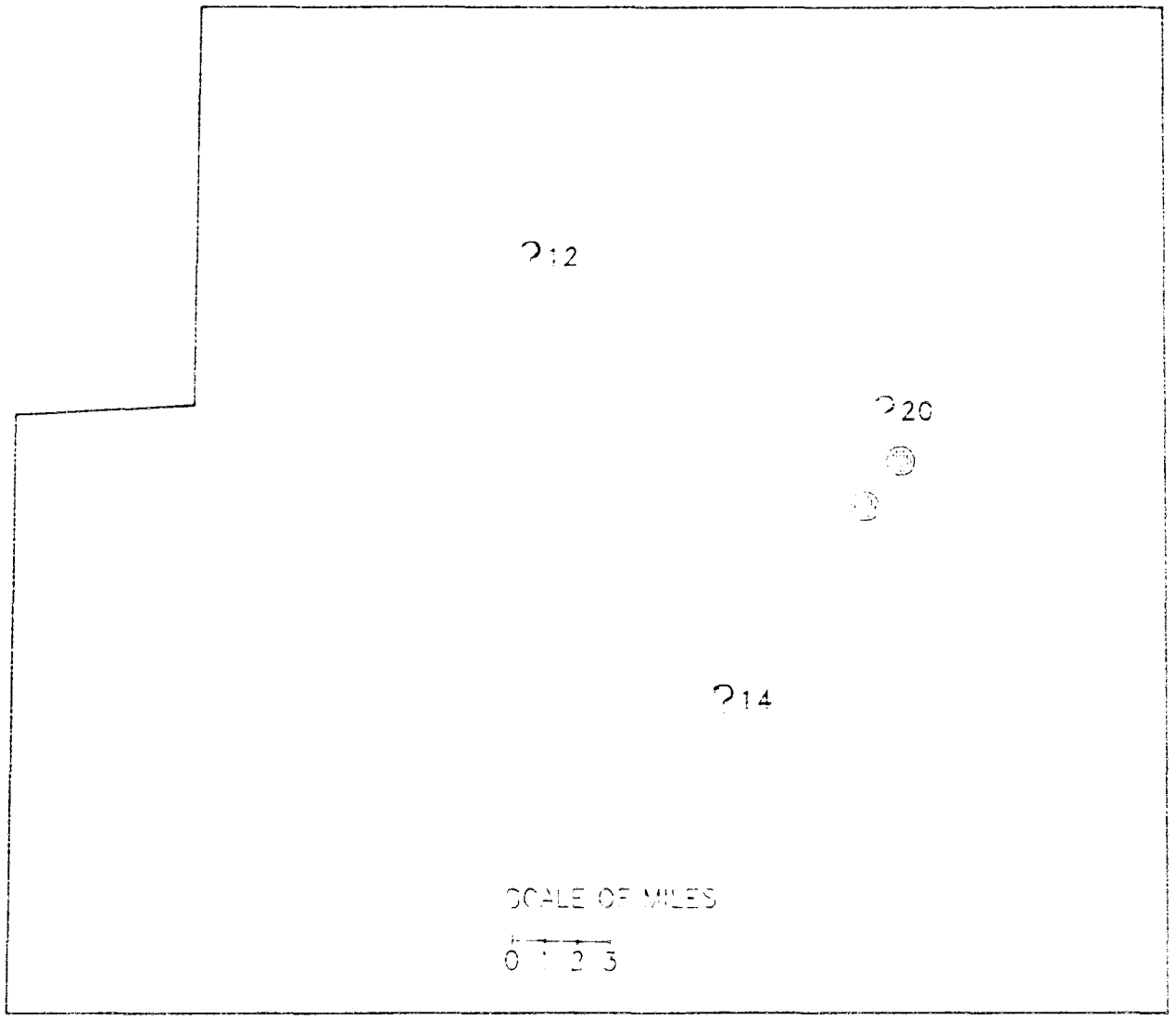


FIGURE 9

CO POINT SOURCES AND CO MONITORS - WICHITA AREA

FIGURE 10 - TRAFFIC DENSITY MAP - WICHITA

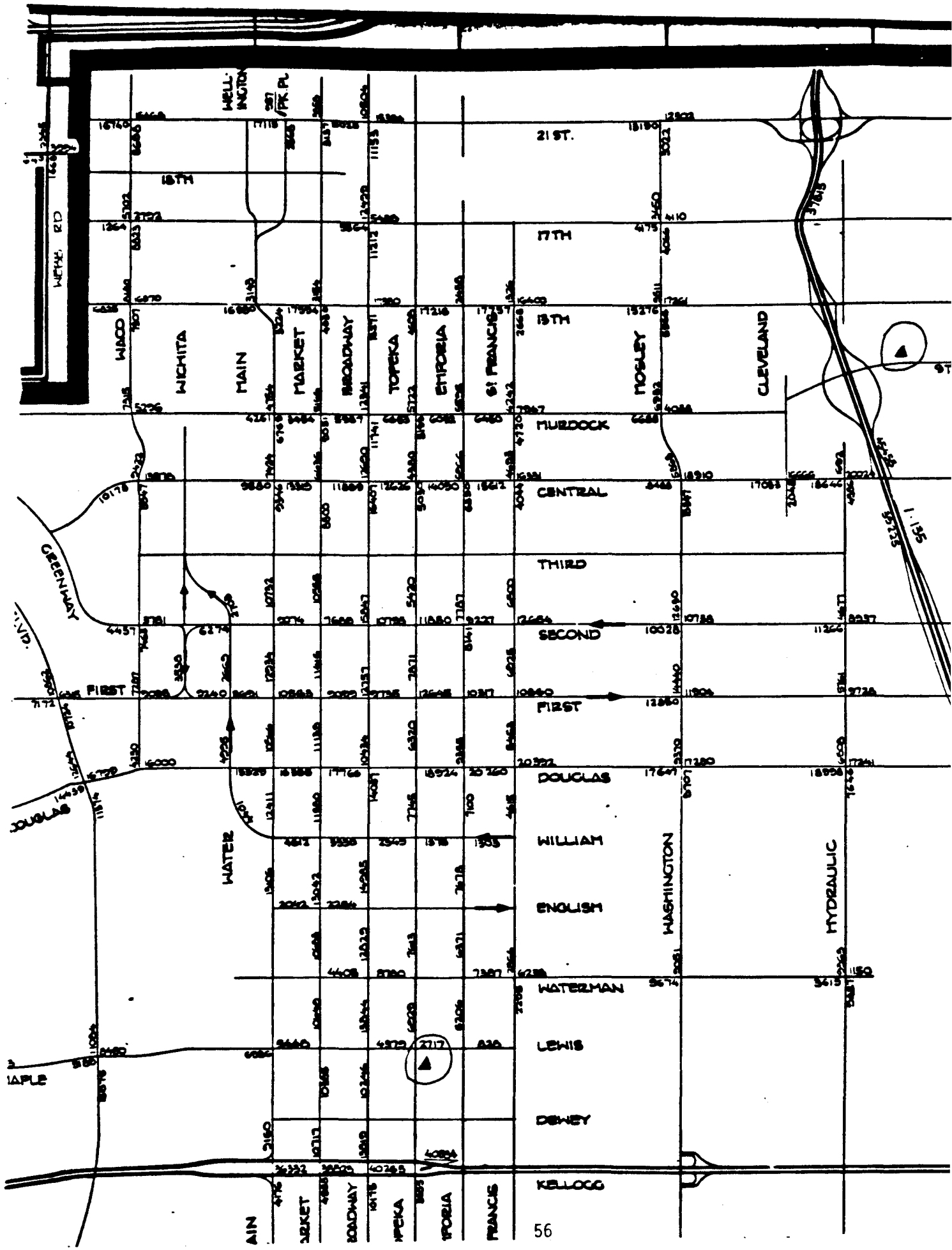
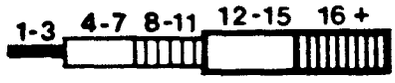
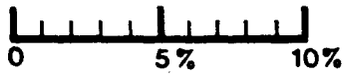


Figure 11. CO in Wichita



Wind Speeds (Kts.)

Percent of hours over threshold and with indicated wind speed and direction.



Met. Station: Mid-Continent Airport
Air Quality Site: Health Department
CO > 10 mg/m³
139 Observations
1980 and 1981 data

Figure 9 shows one point source emitting over 100 tons/year, located about two miles northwest of the monitor. Based on the distance and the magnitude of emissions, the impact of that source on the monitored concentrations is probably small. When Figures 10 and 11 are overlaid, the longest arms of the pollution rose coincide with the directions of interchanges on I-135. The pollution rose indicates that traffic on, and/or approaching, I-135 is probably the major source of the elevated CO concentrations.

XIII. EMISSIONS

In addition to the two graphical overviews of point sources and ambient monitors included in Section XII, the NEDS listing was reviewed to identify any extremely large emissions with no monitoring nearby. One such source was identified in Grant County, with estimated CO emissions over 50,000 tons/year. (The emissions summary for the County is shown in Table 8.) The stack height for that source is not available in NEDS. The SAROAD data do not include any CO monitoring nearby, as far back as 1971. The emissions from that single source are more than 85% as large as the total NEDS estimated emissions for Wyandotte County. With that magnitude of emissions emanating from a small area, large CO concentrations might be expected in the ambient air.

The State has verified the emission estimates, and has modeled ambient air concentrations around the source. The results of that modeling study showed no predicted violations of the ambient air quality standards.

TABLE 8 - EMISSIONS SUMMARY - GRANT COUNTY

STATE:17 KANSAS COUNTY:1300 GRANT CO — TOTAL REPORT PAGE: 34 — STATE REPORT PAGE: 17- 34

PLNT	NAME AND ADDRESS	CONTACT	SIC	AQR	CITY	UTMX	UTMY	PT	YR	PARTIC	SO2	NOX	VOC	CO
0001	CITIES SERVICE HELEX INC.6MI E OF HICKOK	P H WILHAM	2911	100	0000			02	80	19	1	15858	1078	668
0003	AMOCO PROD,CO ULYSSES PLT ULYSSES 5T29R38	G BENNET	2813	100	0000			04	80	12	1	869*	289*	103*
0004	AMOCO PROD,CO-KINSLER PLT,ULYSSES	L L HURST	2999	100	0000			04	74	0	0	0	0	0
0005	BUNGE CORP GAND DIV HICKOK	J R DUTTON	5153	100	0000			04	71	HR*	0	0	0	0
0006	DEKALB AGRESEARCH BOX 704 ULYSSES 67880	DAN WIDDER	5153	100	3600			05	72	82*	0	0	0	0
0007	COLUMBIAN CHEMICALS CO.-HICKOK		2895	100	0000			04	80	130*	2	23	2670*	81923*
0008	MOBIL OIL CORP.HICKOK GAS PLANT.ULYSSES	J L DOUGLA	2813	100	0000			05	80	5	0	10828	4298	1368
0009	SULLIVAN INC.,HWY 25 & US 160 ULYSSES	J L SULLIV	5153	100	3600			05	80	44	0	0	0	0
0010	MESA PETROLEUM US HWY 270 67880	J FARRELL	4922	100	0000			03	80	1	0	337*	131*	50*
0011	PIONEER ELECTRIC COOP BOX 368 ULYSSES	K CONAWAY	4911	100	3600			04	80	0	0	0	0	0
0013	SULLIVAN INC HICKOK	J SULLIVAN	5153	100	0000			05	80	20	0	0	0	0
0014	ULYSSES COOP,222 E.INDUSTRIAL AVE 67880	H C MORTON	5153	100	3600			04	80	2	0	0	0	0
0015	ULYSSES COOP OIL&SUPPLY,SULLIVAN TRACK	H C MORTON	5153	100	0000			03	80	13	0	0	0	0
0016	ULYSSES COOP OIL & SUPPLY, HICKOK	H C MORTON	5153	100	0000			04	80	17	0	0	0	0
0017	CITIES SERVICE GAS CO ASHLAND A 26T29R35	A BLANCHAR	4922	100	0000			01	80	0	0	22	9	3
0018	CITIES SERVICE GAS CO ASHLAND B 35T30R35	A BLANCHAR	4922	100	0000			01	80	0	0	33*	14	4
0019	CITIES SERVICE GAS CO S ULYSSES A	C HENSLEY	4922	100	0000			01	74	0	0	7	0	1
0020	CITIES SERVICE GAS CO S ULYSSES B	C HENSLEY	4922	100	0000			01	74	0	0	7	0	1
0021	CITIES SERVICE GAS CO S ULYSSES C	C HENSLEY	4922	100	0000			01	80	0	0	828	91	7
0022	CITIES SERVICE GAS CO W ULYSSES A	C HENSLEY	4922	100	0000			01	74	0	0	5	0	1
0023	CITIES SERVICE GAS CO W ULYSSES B	C HENSLEY	4922	100	0000			01	80	0	0	24	10	3
0024	CITIES SERVICE GAS CO W ULYSSES C	C HENSLEY	4922	100	0000			01	80	0	0	40*	17	5
0025	PANHANDLE EASTERN PL CO COLUMBIAN	C KENT	4922	100	0000			01	80	0	0	473*	195*	60*
0026	PANHANDLE EASTERN PL CO ULYSSES	C KENT	4922	100	0000			01	80	0	0	279*	115*	35*
0027	ULYSSES IRRIGATION PIPE CO BOX687 67880	F WILSON	3079	100	3600			03	73	0	0	0	498	0
0028	BUNGE CORP SULLIVAN SPUR RFD ULYSSES	J DUTTON	5153	100	0000			03	71	19	0	0	0	0
0029	CITIES SERV GAS CO HUGOTON 3T29R35	A BLANCHAR	4922	100	0000			01	80	0	0	2325*	958*	294*
0030	CITIES SERV GAS CO SOUTH ULYSSES 5T30R38	C HENSLEY	4922	100	0000			01	72	0	0	256*	110*	34*
0031	CITIES SERV GAS CO UNITED 3T29R35	A BLANCHAR	4922	100	0000			02	80	0	0	617*	251*	81*
0032	CITIES SERV GAS CO WEST ULYSSES 28T28R38	C HENSLEY	4922	100	0000			01	80	0	0	607*	250*	77*
0033	COLLINGWOOD GRAIN INC RYUS R2 SATANTA	J RAMSEY	5153	100	0000			04	80	39	0	0	0	0
0034	EL PASO NTL GAS CO GRANT SNWULYSSES	E KOEN	4922	100	0000			02	80	0	0	303*	125*	38*
0035	KANSAS PWR & LT CO ULYSSES 10T30R37	D ANDERSON	4922	100	0000			02	80	0	0	1277*	526*	161*
0036	PEOPLES NTL GAS DIV ULYSSES 12T29R38	M HAYS	4922	100	0000			01	72	0	0	51*	1	6
0037	PEOPLES NTL GAS DIV ULYSSES N T28R37	M HAYS	4922	100	0000			01	72	0	0	26*	1	3
0038	SULLIVAN INC SULLIVAN SPUR BOX703ULYSSES	J SMITH	5153	100	0000			04	74	49*	0	0	0	0
0039	ULYSSES CP OIL & SUP CO 1WULYSSES MILL	L MARTIN	5153	100	0000			06	80	9	0	0	0	0
0040	WEAVER POPCORN CO INC BOX687 67880	M TRASTER	5153	100	3600			04	74	39	0	0	0	0
0043	WHEATLAND ELECTRIC ULYSSES 67880	R HEER	4911	100	3600			02	74	4	2	446*	12	59*
0044	COLORADO INTERSTATE GAS CO HUGOTON NO 6	R SCOTT	4922	100				01	80	0	0	164*	67*	21
0045	MOBIL OIL CORP LATERAL G COMP STA	J DOUGLASS	4922	100				01	80	0	0	101*	42*	13
0046	MOBIL OIL CORP LATERAL H COMP STA	J DOUGLASS	4922	100				01	80	0	0	205*	84*	26*
0047	PANHANDLE EASTERN PIPELINE CO COGNAC STA	H. JOHNSON	4922	100	0000			01	80	0	0	112*	46*	14

XIV. POPULATION EXPOSURE

Population exposure to elevated pollutant concentrations is difficult to measure accurately. (People spend varying amounts of time in different parts of a city which may have localized areas with high pollutant concentrations. Population estimates within such localized areas are difficult to compute manually because that calculation requires locating and summing the populations of numerous small, detailed geographical areas.) Previous attempts to estimate population exposure have focused on populations of entire counties or metropolitan areas, even though the designated non-attainment areas were only portions of those counties or cities. While such approximations are understandable, given the difficulty of obtaining and using population data with more detailed spatial resolution, they may greatly overestimate the populations exposed to elevated pollutant concentrations. A better approximation of exposed population would be a determination of just that segment of the population living within the designated non-attainment areas. (For O_3, while that number may over-estimate the population actually exposed to high ozone concentrations, it should closely approximate the population affected by pollution control measures.) At our request, Systems Applications, Inc. (SAI) has developed software to estimate the population within any given closed polygon, using the detailed census Block Group/Enumeration District data in their computer data base. The non-attainment areas shown on the maps in Sections IV through VIII of this report were sent to SAI for computation of the enclosed populations. Table 9 summarizes the results of those calculations. The population density maps from which the table was prepared are shown in Appendix C. That Appendix also describes the calculation procedure more fully.

It should be noted that redesignations were recommended which would reduce the size of some non-attainment areas. The populations in the table show that significant numbers of people have benefitted from the recent reductions in pollutant concentrations.

TABLE 9

POPULATIONS WITHIN DESIGNATED NON-ATTAINMENT AREAS

TSP	Primary	Secondary
Kansas City	90,000	117,000 (includes PNA)
Topeka	-	7,000
CO	Primary and Secondary	
Wichita	22,000	
O_3	Primary and Secondary	
Kansas City	434,000	
Lawrence	67,000	

XV. SUMMARY AND RECOMMENDATIONS

A. Attainment Status Designations

The evaluations of ambient air quality based on recent monitoring data found the attainment status designations to be generally consistent with recent data. Recommendations were made in this report for attainment status changes for TSP and CO. The TSP recommendations, which were summarized in Table 4, would redesignate the remaining secondary non-attainment area in Topeka to attainment, and would significantly reduce the size of the primary and secondary non-attainment areas in Kansas City. The Topeka redesignation request has been submitted by the State, and is under review by the Air Branch of EPA Region VII. The CO recommendation would redesignate the unclassified area in Kansas City to attainment. That request has, likewise, been submitted by the State and is under review. Redesignation of the Kansas City ozone non-attainment area to attainment has also been requested by the State agencies of Missouri and Kansas. That request is also under review by the Air Branch.

B. Air Quality Concern Areas

Two areas of the State exceeded the primary (health-related) NAAQS's during 1981 and/or 1982.

- TSP data collected at 420 Kansas Avenue in Kansas City exceeded the annnual primary standard in 1981, but not in 1982
- CO data collected at two sites in Wichita show a few exceedances of the 8-hour primary standard each year.

Those areas were addressed more extensively in Section XII, which included indications of possible sources of the elevated concentrations. We encourage the State personnel to continue their efforts to reduce the CO concentrations in Wichita. Should the high TSP concentrations recur in Kansas City, we would encourage further efforts to identify and control the sources of those particulates.

In recent years, there have been reductions in both the number and the size of areas which exceed the primary standards. Those reductions are encouraging indications of progress made by the State and local agencies.

C. Monitor Operation

The monitors were operated in such a way that the data from those monitors generally meet or exceed the minimum completeness criteria used by the National Aerometric Data Bank. The precision and accuracy data generally indicate a conscientious effort toward meeting the data assessment and reporting requirements of 40 CFR 58, Appendix A. An increase in the number of SO_2 audits is recommended. The overall picture of monitor operation shows commendable performance by State and local agency

personnel. The review of emissions data highlighted a need for CO modeling around a large point source in Grant County. The State performed the needed modeling study, and found no predicted violations of the ambient air quality standards. The prompt attention which the State gave to that project reflects the spirit of cooperation between EPA and the State.

APPENDIX A

Tabular Summaries of Data

Table	Description
A1	Ambient Air Monitoring Data
A2	Precision and Accuracy Estimates for Ambient Air Monitoring Data
A3	Attainment Status Designations

ABBREVIATIONS AND SYMBOLS USED IN TABLE A1

SITE ID	Site identification number
YR	Year
REP ORG	Reporting organization
# OBS	Number of observations
MAX 24-HR 1ST	Highest value recorded in a 24-hour period
MAX 24-HR 2ND	Second highest value recorded in a 24-hour period
OBS >260	Number of observations greater than 260
OBS >150	Number of observations greater than 150
ARIT MEAN	Arithmetic mean
GEO MEAN	Geometric mean
GSD	Geometric standard deviation
METH	Method
QTRLY ARITH MEAN 1ST	First quarter arithmetic mean
QTRLY ARITH MEAN 2ND	Second quarter arithmetic mean
QTRLY ARITH MEAN 3RD	Third quarter arithmetic mean
QTRLY ARITH MEAN 4TH	Fourth quarter arithmetic mean
MEANS >1.5	Number of quarterly means greater than 1.5
MAX VALUES 1ST	Highest value recorded for the year
MAX VALUES 2ND	Second highest value recorded for the year
MAX 1-HR 1ST	Highest value recorded in a one-hour period
MAX 1-HR 2ND	Second highest value recorded in a one-hour period
OBS >40	Number of observations greater than 40
MAX 8-HR 1ST	Highest value recorded in an eight-hour period
MAX 8-HR 2ND	Second highest value recorded in an eight-hour period
OBS >10	Number of observations greater than 10
OBS >365	Number of observations greater than 365
MAX 3-HR 1ST	Highest value recorded in a three-hour period
MAX 3-HR 2ND	Second highest value recorded in a three-hour period
OBS >1300	Number of observations greater than 1300
DAILY MAX 1-HR 1ST	Maximum hourly ozone value for a day
DAILY MAX 1-HR 2ND	Second maximum hourly ozone value for a day
DAILY MAX 1-HR 3RD	Third maximum hourly ozone value for a day

ABBREVIATIONS AND SYMBOLS USED IN TABLE A1 (Continued)

VALS >.125 MEAS	Number of measured values greater than .125
VALS >.125 EST	Number of expected violations
NBR VALID DAILY MAX	Number of valid daily maximum values
MISS DAYS ASS < STD	Number of missing days assumed to be less than the standard
?	The mean does not satisfy summary criteria

QUICK LOOK REPORT

SUSPENDED PARTICULATE MATTER (UG/M3) KANSAS 81-82

METHOD: GRAVIMETRIC, 24-HOUR HI-VOLUME FILTER SAMPLE-91

SITE ID	LOCATION	COUNTY	ADDRESS	YR	REP ORG	#OBS	MAX 24-HR 1ST	MAX 24-HR 2ND	OBS> 260	OBS> 150	ARIT MEAN	GEO MEAN	GSD
170680001F01	CONCORDIA	CLOUD CO	135 EAST 6TH ,CI	81	001	60	143	119			70	65	1.5
170680001F01	CONCORDIA	CLOUD CO	135 EAST 6TH ,CI	82	001	55	214	126		1	78	70	1.6
170800001F01	DODGE CITY	FORD CO	PUMP STA.,2100 1	81	001	55	164	105		1	51	45	1.7
170800001F01	DODGE CITY	FORD CO	PUMP STA.,2100 1	82	001	29	286	150	1	1	62?	49?	1.9
171240001F01	GOODLAND	SHERMAN CO	CITY FIRE STA 10	81	001	60	185	183		5	92	84	1.6
171240001F01	GOODLAND	SHERMAN CO	CITY FIRE STA 10	82	001	56	231	231		6	90	75	1.8
171800001F01	KANSAS CITY	WYANDOTTE CO	619 ANN ST	81	001	53	165	150		1	73	67	1.5
171800001F01	KANSAS CITY	WYANDOTTE CO	619 ANN ST	82	001	53	177	140		1	65	59	1.5
171800007F01	KANSAS CITY	WYANDOTTE CO	1312 S 55TH ST	81	001	56	106	101			57	53	1.5
171800007F01	KANSAS CITY	WYANDOTTE CO	1312 S 55TH ST	82	001	58	118	116			53	48	1.5
171800011F02	KANSAS CITY	WYANDOTTE CO	3105 FAIRFAX RD	81	001	58	160	140		1	80	73	1.6
171800011F02	KANSAS CITY	WYANDOTTE CO	3105 FAIRFAX RD	82	001	53	153	151		2	68	61	1.6
171800013F01	KANSAS CITY	WYANDOTTE CO	9400 STATE AVE	81	001	59	98	78			49	46	1.4
171800014F01	KANSAS CITY	WYANDOTTE CO	36TH & RAINBOW B	81	001	55	132	120			68	63	1.5
171800014F01	KANSAS CITY	WYANDOTTE CO	36TH & RAINBOW B	82	001	61	131	121			58	54	1.5
171800015F02	KANSAS CITY	WYANDOTTE CO	420 KANSAS AVE.	81	001	57	244	215		12	109	96	1.7
171800015F02	KANSAS CITY	WYANDOTTE CO	420 KANSAS AVE.	82	001	61	183	147		1	77	71	1.5
171800017J03	KANSAS CITY	WYANDOTTE CO	2815 NORTH 115TH	81		176	132	126			51?	46?	1.6
171800018F01	KANSAS CITY	WYANDOTTE CO	5429 LEAVENWORT	82		54	110	87			50	47	1.5
172340001F01	MERRIAM	JOHNSON CO	8715 WEST 49TH,S	82		41	120	110			50?	45?	1.6
173320004F01	SEDGWICK CO	SEDGWICK CO	CO.FIRE STA#3,40	81	001	61	142	141			76	71	1.5
173320004F01	SEDGWICK CO	SEDGWICK CO	CO.FIRE STA#3,40	82	001	61	167	140		1	75	69	1.5
173380003F01	SHAWNEE CO	SHAWNEE CO	1941 NE 39TH	81	001	60	124	91			52	48	1.5
173380003F01	SHAWNEE CO	SHAWNEE CO	1941 NE 39TH	82	001	53	113	90			47	43	1.5
173560002F01	TOPEKA	SHAWNEE CO	HEALTH CENTER 16	81	001	58	107	106			59	55	1.5
173560002F01	TOPEKA	SHAWNEE CO	HEALTH CENTER 16	82	001	57	142	128			66	60	1.6
173560005F01	TOPEKA	SHAWNEE CO	37TH & BURLINGAM	81	001	55	121	106			61	57	1.4
173560005F01	TOPEKA	SHAWNEE CO	37TH & BURLINGAM	82	001	61	131	120			56	51	1.5
173560007F02	TOPEKA	SHAWNEE CO	1500 N.QUINCY	81	001	54	139	133			71	65	1.5
173560007F02	TOPEKA	SHAWNEE CO	1500 N.QUINCY	82	001	56	186	125		1	70	64	1.6
173740001F01	WICHITA	SEDGWICK CO	FIRE STA #1 402	81	001	54	145	128			69	64	1.5
173740001F01	WICHITA	SEDGWICK CO	FIRE STA #1 402	82	001	55	173	135		1	71	66	1.5
173740007F01	WICHITA	SEDGWICK CO	ST PAUL & WEST 1	81	001	61	145	144			76	68	1.7
173740007F01	WICHITA	SEDGWICK CO	ST PAUL & WEST 1	82	001	58	151	139		1	69	63	1.5
173740008F01	WICHITA	SEDGWICK CO	GEO WASH BLVD &	81	001	58	134	133			66	61	1.5
173740008F01	WICHITA	SEDGWICK CO	GEO WASH BLVD &	82	001	61	116	112			61	57	1.5
173740009F01	WICHITA	SEDGWICK CO	GLEN & WEST PAWN	81	001	60	128	123			71	66	1.5
173740009F01	WICHITA	SEDGWICK CO	GLEN & WEST PAWN	82	001	30	131	118			71?	67?	1.4
173740012F02	WICHITA	SEDGWICK CO	COLEMAN CO 3600	81	001	52	132	129			68	64	1.5

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA

QUICK LOOK REPORT

SUSPENDED PARTICULATE MATTER (UG/M3) KANSAS 81-82

METHOD: GRAVIMETRIC, 24-HOUR HI-VOLUME FILTER SAMPLE-91

SITE ID	LOCATION	COUNTY	ADDRESS	YR	REP ORG	#OBS	MAX 24-HR 1ST	MAX 24-HR 2ND	OBS> 260	OBS> 150	ARIT MEAN	GEO MEAN	GSD
173740012F02	WICHITA	SEDGWICK CO	COLEMAN CO 3600	82	001	54	191	146		1	75	68	1.6

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA

SULFUR DIOXIDE (UG/M3) KANSAS 81-82

METHODS: HOURLY VALUES WEST-GAEKE COLORIMETRIC-11, CONDUCTIMETRIC-13, COULOMETRIC-14, FLAME PHOTOMETRIC-16, HYDROGEN PEROXIDE NAOH TITRATION-18, CATALYST FLAME PHOTOMETRIC-19, PULSED FLUORESCENT-20, SECOND DERIVATIVE SPECTROSCOPY-21, CONDUCTANCE ASARCO-22, ULTRA VIOLET STIMULATED FLUORESCENCE-23,SEQUENTIAL CONDUCTIMETRIC-33, 24-HOUR GAS BUBBLERS PARAROSANILINE-SULFAMIC ACID-91, PARAROSANILINE SULFAMIC ACID TEMPERATURE CONTROLLED-97

SITE ID	LOCATION	COUNTY	ADDRESS	YR	REP ORG	#OBS	MAX 24-HR 1ST	MAX 24-HR 2ND	OBS> 365	MAX 3-HR 1ST	MAX 3-HR 2ND	OBS> 1300	MAX 1-HR 1ST	MAX 1-HR 2ND	ARIT MEAN	MTH
171800001F01	KANSAS CITY	WYANDOTTE CO	619 ANN ST	81	001	6287	150	133		530	450		700	700	32?	20
171800001F01	KANSAS CITY	WYANDOTTE CO	619 ANN ST	81	001	1445	150	131		490	357		1000	1000	39?	23
171800001F01	KANSAS CITY	WYANDOTTE CO	619 ANN ST	82	001	8470	198	183		593	543		1000	1000	26	23
171800011F02	KANSAS CITY	WYANDOTTE CO	3105 FAIRFAX RD	81	001	8599	102	100		483	437		1000	940	18	16
171800011F02	KANSAS CITY	WYANDOTTE CO	3105 FAIRFAX RD	82	001	8083	165	131		353	333		790	500	15	16
171800017J03	KANSAS CITY	WYANDOTTE CO	2815 NORTH 115TH	81		4713	71	68		210	175		381	251	15?	20

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA

CARBON MONOXIDE (MG/M3) KANSAS 81-82

METHOD: NONDISPERSIVE INFRARED (NDIR) CONTINUOUS, HOURLY VALUES-11, FLAME IONIZATION-21

SITE ID	LOCATION	COUNTY	ADDRESS	YR	REP ORG	#OBS	MAX 1-HR 1ST	MAX 1-HR 2ND	OBS> 40	MAX 8-HR 1ST	MAX 8-HR 2ND	OBS> 10	METH
171800001F01	KANSAS CITY	WYANDOTTE CO	619 ANN ST	81	001	8667	21.0	13.0		10.1	8.0		11
171800001F01	KANSAS CITY	WYANDOTTE CO	619 ANN ST	82	001	7897	11.0	11.0		6.9	6.5		11
171800016F05	KANSAS CITY	WYANDOTTE CO	7TH & STATE	81		335	15.0	12.0		8.3	7.6		11
172780002F05	OVERLAND PARK	JOHNSON CO	FIRE STA2 9500	81		1310	21.0	14.0		4.6	4.6		11
173740003F01	WICHITA	SEDGWICK CO	FIRE STA TOPEKA	81	001	8564	22.0	21.0		16.8	12.4	5	11
173740003F01	WICHITA	SEDGWICK CO	FIRE STA TOPEKA	82	001	8640	22.0	19.0		13.5	11.4	2	11
173740010F01	WICHITA	SEDGWICK CO	1900 E NINTH ST	81	001	8664	19.0	18.0		15.0	12.9	7	11
173740010F01	WICHITA	SEDGWICK CO	1900 E NINTH ST	82	001	8717	20.0	20.0		13.4	12.3	4	11

NITROGEN DIOXIDE (UG/M3) KANSAS 81-82

METHODS: HOURLY VALUES COLORIMETRIC-LYSHKOW-11, COLORIMETRIC-GRIESS-SALTZMAN-12, COULOMETRIC-13, CHEMILUMINESCENCE-14, 24-HOUR GAS BUBBLERS NASN SODIUM ARSENITE ORIFICE-84, NASN SODIUM ARSENITE FRIT-94, TEA METHOD-95, TGS METHOD-96

SITE ID	LOCATION	COUNTY	ADDRESS	YR	REP ORG	#OBS	MAX 1-HR 1ST	MAX 1-HR 2ND	MAX 24-HR 1ST	MAX 24-HR 2ND	ARIT MEAN	METH
171800001F01	KANSAS CITY	WYANDOTTE CO	619 ANN ST	82		6550	180	170			32?	14
171800017J03	KANSAS CITY	WYANDOTTE CO	2815 NORTH 115TH	81		4533	163	134			27?	14

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA

QUICK LOOK REPORT

OZONE (PARTS PER MILLION) KANSAS 80-82

METHODS: HOURLY VALUES CHEMILUMINESCENCE-11, ULTRA VIOLET DASIBI CORPORATION-14, CHEMILUMINESCENCE RHODAMINE B DYE-15

SITE ID	LOCATION	COUNTY	ADDRESS	YR	REP ORG	#OBS	DAILY MAX 1-HR 1ST	2ND	3RD	VALS > .125 MEAS	EST	NBR VALID DAILY MAX	MISS DAYS ASS < STD	ME
171760005F05	JOHNSON CO	JOHNSON CO	WASHINGTON & ALL	80		5599	.133	.117	.107	1	1.6	233	2	11
171760005F05	JOHNSON CO	JOHNSON CO	WASHINGTON & ALL	81	001	1957	.076	.076	.071	0	0.0	82	0	11
171800001F01	KANSAS CITY	WYANDOTTE CO	619 ANN ST	82		8650	.112	.102	.097	0	0.0	360	1	14
171800017J03	KANSAS CITY	WYANDOTTE CO	2815 NORTH 115TH	81		4754	.155	.124	.110	1	1.8	200	2	14
173320001F01	SEDGWICK CO	SEDGWICK CO	200 E 53RD NORTH	80		8282	.092	.092	.076	0	0.0	343	2	11
173320001F01	SEDGWICK CO	SEDGWICK CO	200 E 53RD NORTH	81	001	7406	.090	.089	.087	0	0.0	303	6	11
173320001F01	SEDGWICK CO	SEDGWICK CO	200 E 53RD NORTH	82	001	8073	.090	.075	.075	0	0.0	333	3	11
173740010F01	WICHITA	SEDGWICK CO	1900 E NINTH ST	80		8693	.112	.094	.087	0	0.0	361	3	11
173740010F01	WICHITA	SEDGWICK CO	1900 E NINTH ST	81	001	8596	.100	.095	.095	0	0.0	357	3	11
173740010F01	WICHITA	SEDGWICK CO	1900 E NINTH ST	82	001	8545	.115	.095	.085	0	0.0	355	3	11

QUICK LOOK REPORT

LEAD (UG/M3) KANSAS 81-82

METHODS: JARRELL-ASH EMISSION SPECTRA ICAP-90, EMISSION SPECT MUFFLE FURNACE-91, ATOMIC ABSORPTION-92, DITHIOZONE METHOD-93
EMISSION SPECT (LOW TEMP ASH)-95, X-RAY FLUORESCENCE-96, FLAMELESS ATOMIC ABSORPTION-97

SITE ID	LOCATION	COUNTY	ADDRESS	YR	REP ORG	#OBS	METH	QTRLY 1ST	ARITH 2ND	ARITH 3RD	MEAN 4TH	MEANS> 1.5	MAX VALUES 1ST	MAX VALUES 2ND
171800011A01	KANSAS CITY	WYANDOTTE CO	KANSAS CITY	81		27	90	.30	.14	.19?	.19		.64	.43
171800014F01	KANSAS CITY	WYANDOTTE CO	36TH & RAINBOW B	82		61	92	.15	.14	.08	.12		.30	.28
171800015A01	KANSAS CITY	WYANDOTTE CO	420 KANSAS AVE	81		29	90	.43	.19	.30	.30		1.10	.92
172340001F01	MERRIAM	JOHNSON CO	8715 WEST 49TH,S	82	001	41	92	.05?	.22	.13	.10		.44	.38
173560007A01	TOPEKA	SHAWNEE CO	QUINCY SCHOOL	81		29	90	.33	.12	.14	.20		.85	.40
173740012A02	WICHITA	SEDGWICK CO	WICHITA	82		11	90	.29	.11				.75	.43

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA

TABLE A2. PRECISION AND ACCURACY ESTIMATES FOR AMBIENT AIR MONITORING DATA

PRECISION-ACCURACY DATA KEY		PRECISION DATA				ACCURACY DATA											
RG ST RO TYP POLL	YR-Q	# OF ANLYZRS	PRECIS CHECKS	PROB LIM LO	UP	SOURCE AUD	GAS	TRACE ABLTY	# AUDITS L1-3	L4	PROB LIM LO-L1-UP		PROB LIM LO-L2-UP		PROB LIM LO-L3-UP		PROB LIM LO-L4-UP
07 17 001 C 42101	81-1								003				-06	+07			
** CARBON MONOXIDE **	81-2	003	0012	-11	+13				002						-05	+05	
	81-3	003	0014	-09	+06				003		-01	+05	-02	+05	-01	+01	
	81-4	003	0017	-11	+06				003				-06	+07	-05	+06	
	81-5	003	0043	-10	+08				0011	0000	-01	+05	-05	+06	-04	+04	
	82-1	003	0016	-07	+03	B		2	005	000	-21	+09	-04	+06	-03	+03	
	82-2	003	0019	-06	+03												
	82-3	003	0020	-09	+13												
	82-4	003	0017	-05	+07	C		2	002	000	-15	+10	-09	+08	-04	-01	
	82-5	003	0072	-07	+07				0007	0000	-18	+10	-07	+07	-04	+01	
07 17 001 C 42401	81-3	002	0005	-14	+17												
** SULFUR DIOXIDE ***	81-4	002	0013	-30	+12				003		-25	+02	-18	+01			
	81-5	002	0018	-22	+15				0003	0000	-25	+02	-18	+01			
	82-1	002	0011	-20	-01												
	82-2	002	0011	-24	+02												
	82-3	002	0008	-36	-04												
	82-4	002	0011	-38	+06	C		2	002	000	-25	+04	-20	+01	-10	-00	
	82-5	002	0041	-30	+01				0002	0000	-25	+04	-20	+01	-10	+00	
07 17 001 C 44201	81-1								002		-47	+17	-12	-07	-08	-06	
******* OZONE *******	81-2	002	0004	-13	+04												
	81-3	002	0006	-50	+33												
	81-4	002	0005	-55	+25												
	81-5	002	0015	-39	+21				0002	0000	-47	+17	-12	-07	-08	-06	
	82-1	003	0018	-11	+12	D		2	002	000	-02	+08	+03	+04	-07	+05	
	82-2	003	0018	-12	+16	D		2	002	000	-17	+14			-01	-01	
	82-3	003	0017	-29	+14												
	82-4	003	0017	-28	+04	D		2	003	000	-16	+11	-02	+04	-08	+10	
	82-5	003	0070	-20	+12				0007	0000	-12	+11	+01	+04	-05	+05	

PRECISION-ACCURACY DATA KEY		PRECISION DATA						ACCURACY DATA				
RG ST RO TYP POLL	YR-Q	# OF SAMPLRS	COLLOC SITES	PROB LIM LO	PROB LIM UP	COLL SAMP BELOW LIM	VAL COLL DATA PRS	# AUDITS LEV 1-3	PROB LIM LO-L1-UP	PROB LIM LO-L2-UP	PROB LIM LO-L3-UP
07 17 001 I 11101	81-1	21	3	-09	+14	0		011		-11 +15	
**** PARTICULATE ****	81-2	19	3	-15	+12	0		013		-19 +09	
	81-3	19	3	-17	+27	0		010		-16 +13	
	81-4	19	1	-08	+15	0		009		-10 +13	
	81-5	20	3	-12	+17	0	0	0043		-14 +13	
	82-1	20	2	-20	+09	0	23	004		-10 +08	
	82-2	20	2	-12	+04	0	27	007		-13 +08	
	82-3	20	2	-19	+21	0	28	005		-14 +12	
	82-4	20	2	-18	+62	0	26	017		-12 +20	
	82-5	20	2	-17	+24	0	104	0033		-12 +12	
07 17 001 I 12128	82-1							024	-21 -01		
******* LEAD ********	82-2							002	-31 +08	-05 -05	
	82-3	2	1	-29	+38	4	6	005	-34 +08	-21 -01	
	82-4	2	1	-43	+78	13	15	006	-30 +06	-25 -04	
	82-5	2	1	-36	+58	17	21	0037	-29 +05	-17 -03	

Iowa—TSP

Designated area	Does not meet primary standards	Does not meet secondary standards	Cannot be classified	Better than national standards
College Township			X	
Fairfax Township			X	
Marion Township			X	
Monroe Township			X	
Putnam Township			X	
Remainder of Linn County				X
The central portion of Marshalltown		[1]X		
Remainder of Marshall County				X
The central and southern portions of Muscatine		[1]X		
Fruitland Township			X	
Sweetland Township			X	
Montpelier Township			X	
Remainder of Muscatine County				X
Areas in central Des Moines, Ankeny and part of West Des Moines	X	X		
An area around the above area generally including Des Moines and parts of West Des Moines, Urbandale and Windsor Heights		[1]X		
Clay Township			X	
Douglas Township			X	
Jefferson Township			X	
Remainder of Polk County				X
The western portion of Council Bluffs and Carter Lake		[1]X		
Lake Township			X	
Lewis Township			X	
Remainder of Pottawattamie County				X
The central portion of Davenport	X	X		
Portions of Buffalo, Davenport, Bettendorf and Riverdale		[1]X		
Remainder of Scott County				X
Center Township			X	
Remainder of Wapello County				X
The central portion Fort Dodge		[1]X		
Otho Township			X	
Remainder of Webster County				X
The central and southern portions of Sioux City		[1]X		
Liberty Township			X	
Woodbury Township			X	
Remainder of Woodbury County				X
Remainder of State				X

[1]EPA designation replaces State designation.

Iowa—SO_2

Designated area	Primary standard exceeded § (d)(1)(B)	Secondary standard exceeded § (d)(1)(C)	Unclassifiable § (d)(1)(D)	Attainment
Julien Township	[1]X	[1]X		
Remainder of Dubuque County				X
Remainder of State				X

[1]EPA designation replaces State designation.

Iowa—O_3

Designated area	Primary standard exceeded § (d)(1)(A)	Unclassifiable and/or attainment § (d)(1)(E)
Entire State		X

Iowa—CO

Designated area	Does not meet primary standards	Cannot be classified or better than national standards
Des Moines Township	X	
Lee Township	X	
Remainder of Polk County		X
City of Dubuque (partial)	X	
Remainder of Dubuque County		X
Remainder of State		X

Iowa—NO_2

Designated area	Does not meet primary standards	Cannot be classified or better than national standards
Entire State		X

[43 FR 8964, Mar. 3, 1978, as amended at 45 FR 14574, Mar. 6, 1980; 46 FR 17558, Mar. 19, 1981; 46 FR 46930, Oct. 5, 1981; 47 FR 19526, May 6, 1982]

Effective Date Note: At 47 FR 19526, May 6, 1982, effective July 6, 1982, in the table "Iowa-TSP," the line reading "areas in central and southern Des Moines, Ankeny and part of West Des Moines" was amended by removing the words "and southern."

§ 81.317 Kansas.

Kansas—TSP

Designated Area	Does not meet primary standards	Does not meet secondary standards	Cannot be classified	Better than national standards
Wyandotte County:				
a. Most of the area between I-635 and the Missouri state line	X			
b. An area extending about three miles west of the above area		X		
Topeka, Kansas, area bounded by: Kansas River on the east and south, Vail Avenue on the west and Lyman Avenue on the north		X		
Remainder of State				X

Kansas—SO_x

Designated area	Does not meet primary standards	Does not meet secondary standards	Cannot be classified	Better than national standards
Entire State				X

Kansas—O_x

Designated area	Does not meet primary standards	Cannot be classified or better than national standards
Kansas City AQCR (094):		
Wyandotte County	[1]X	
Johnson County	[1]X	
South Central AQCR (098): Sedgwick County		X
Northwest AQCR (085): Douglas County	[1]X	
Remainder of State		X

[1]EPA designation replaces State designation.

Kansas—CO

Designated area	Does not meet primary standards	Cannot be classified or better than national standards
Kansas City, Kansas area, bounded by: 6th Street on the east, Washington Street on the north, 18th Street on the west, and Barnett Street on the south		X
Wichita, Kansas area, bounded by: Grove Street on the east, 13th Street on the north, the Arkansas River on the west, and Kellogg Avenue on the south	X	
Remainder of State		X

Kansas—NO_x

Designated area	Does not meet primary standards	Cannot be classified or better than national standards
Entire State		X

[43 FR 8964, Mar. 3, 1978, as amended at 45 FR 73048, Nov. 4, 1980]

§ 81.318 Kentucky.

Kentucky—TSP

Designated area	Does not meet primary standards	Does not meet secondary standards	Cannot be classified	Better than national standards
That portion of Henderson Co. in Henderson	X			
Jefferson County	X			
That portion of Lawrence Co. in Louisa	X			
McCracken County		X		
Marshall County	X			
That portion of Madison Co. in Richmond	X			
Muhlenberg County	X			
That portion of Perry Co. in Hazard	X			
That portion of Pike Co. in Pikeville	X			
That portion of Whitley Co. in Corbin				X
Rest of State				

Kentucky—SO_x

Designated area	Does not meet primary standards	Does not meet secondary standards	Cannot be classified	Better than national standards
That portion of Boyd County south of UTM northing line 4251 km	X			
Jefferson County	X	X		
Muhlenberg County	X	X		
Rest of State				X

Kentucky—O_x

Designated area	Does not meet primary standards	Cannot be classified or better than national standards
Boyd County	X	
Cincinnati Area—Boone, Kenton, and Campbell Counties	X	
Fayette County	X	
Jefferson County	X	
Rest of State		X

Kentucky—CO

Designated area	Does not meet primary standards	Cannot be classified or better than national standards
Jefferson County	X	
Rest of State		X

APPENDIX B
Statistical Evaluation of Trends

The trend evaluation procedure used in the air quality evaluation is based on the Sen non-parametric statistic. The procedure was recommended by Vector Research, Incorporated, in a study performed under contract with the U.S. Environmental Protection Agency. It was selected over other candidate methods as the method which gives the highest probability of detecting real trends. Essential advantages of the method include the following:

1. It takes the seasonality of data into account.

2. It deals with autocorrelation effects in data collected at frequent intervals e.g., hourly. (Autocorrelation is the tendency for data measured at nearby times to be more similar than data measured at more distant times).

3. It does not assume that the data are normally distributed.

4. It identifies continuing trends, even if there is some oscillation around the trend line.

The latest draft report of the study, "Methods for Classifying Changes in Environmental Conditions" [VRI-EPA 7.4-FR80-1(R)] describes in more detail the other candidate methods and the advantages of the Sen statistical test.

A step-by-step summary of the trend evaluation procedure is given in the following paragraphs, which were adapted from the above report.

1. Compute one data value for each month of each year. For high-frequency data series in which autocorrelation may be present (e.g., continuous monitor data), a monthly average will correct for that autocorrelation. Alternatively, if trends in high pollutant concentrations at a site are of greater interest, the 90th percentile concentration for each month is used. (The 90th percentile concentration produces a more stable statistical estimate than would the maximum concentration.)

2. Compute the seasonal average of the data for each calendar month, (i.e., compute the average of all January values, the average of all February values, etc.). Subtract the appropriate seasonal average from the value for each month to obtain seasonally adjusted data.

3. Rank the seasonally adjusted data. Replace each adjusted datum with its rank. (This step makes the procedure non-parametric. It eliminates the requirement for different statistical methods for different series of data with different distributional laws governing their random behavior. It also limits the potential error-producing effects of outliers.)

4. Compute the Sen test statistic, S, from the formula

$$S = \sqrt{\frac{12\,T^2}{Y(Y+1)\sum_{y=1}^{Y}\sum_{t=1}^{T}(R_{yt} - R_{.t})^2}} \sum_{y=1}^{Y}\left(y - \frac{Y+1}{2}\right)\left(R_{y.} - \frac{TY+1}{2}\right)$$

where

Y = number of years
y = the index of the year (the index of first year is 1, of the second year, 2, etc.)
T = number of periods per year (12)
t = the index of the month (the index for January is 1, for February 2, etc.)
R_{yt} = the rank of the seasonally adjusted value for month t of year y
$R_{.t}$ = the mean rank for month t over all the years
$R_{y.}$ = the mean rank over all months for year y

The significance of the individual parts of that formula is described as follows.

a) For each year, $R_{y.}$ is computed by averaging the ranks of the seasonally adjusted data for that year. This will be large if the data in that year are higher than that in other years, small if the data are smaller. Thus, an increasing trend in this mean rank indicates an increasing trend in the data through the years. Likewise, a decreasing trend in the mean ranks indicates a decreasing trend in the data.

b) The term

$$\sum_{y=1}^{Y} \left(y - \frac{Y+1}{2}\right)\left(R_{y.} - \frac{TY+1}{2}\right)$$

represents the covariance between the mean rank for a year and the index of that year. When large annual mean ranks ($R_{y.}$ - (TY + 1)/2 positive) occur in late years (y-(Y+1)/2 positive) or small annual mean ranks ($R_{y.}$ - (TY + 1)/2 negative) occur in early years (y-(Y+1)/2 negative) a positive product will result. Thus, an accumulation of positive products, and therefore, a large positive result, is associated with a positive trend. Similarly, an accumulation of negative products, and a large negative result, is associated with a negative trend.

c) The first term of the equation is a scale factor which normalizes the covariance calculated above. It is a data-based estimate of the expected standard deviation of the covariance statistic if there were no trend. The scaling adjusts the covariance statistic so that it may be compared with tabulated percentile values of the normal probability distribution, rather than requiring the generation of special tables uniquely applicable to this statistic.

5. If the statistic exceeds (in either direction) the appropriate percentile values of the tabulated normal probability distribution, a statistically significant trend is present. If it does not exceed those values, no statistically significant trend is present.

Specifically, if the Sen statistic exceeds ± 1.645 (the 90th percentile values of the normal distribution for a two-tailed test), we conclude that the data show a trend. If the statistic does not exceed those limits, but does exceed ±1.28 (the 80th percentile values), we conclude that the data show a probable trend. Otherwise, we conclude that no statistically significant trend is shown by the data.

The following example illustrates the above process. While the trend calculations are usually performed by a computer, and include five years of data, the example shows how the calculations can be done manually. The example uses only three years of data, so that the calculation can be more easily followed.

Monthly geometric mean TSP data provide the starting point for the calculation. The monthly values and the seasonal averages are:

Year	Jan	Feb	Mar	Apr	May	Jun
1	102	126	142	150	92	112
2	136	107	144	68	80	100
3	70	67	84	125	112	83
Monthly (Seasonal) Average	102.67	100.0	123.33	114.33	94.67	98.33

Year	Jul	Aug	Sep	Oct	Nov	Dec
1	124	122	126	117	93	136
2	90	104	125	125	102	63
3	95	105	107	101	68	98
Monthly (Seasonal) Average	103.0	110.33	119.33	114.33	87.67	99.0

The seasonally adjusted data are obtained by subtracting the appropriate seasonal average from each monthly value.

Year	Jan	Feb	Mar	Apr	May	Jun
1	-.67	26	18.67	35.67	-2.67	13.67
2	33.33	7	20.67	-46.33	-14.67	1.67
3	-32.67	-33.0	-39.33	10.67	17.33	-15.33

Year	Jul	Aug	Sep	Oct	Nov	Dec
1	21.0	11.67	6.67	2.67	5.33	37.0
2	-13.0	-6.33	5.67	10.67	14.33	-36.0
3	-8.0	-5.33	-12.33	-13.33	-19.67	-1.0

The seasonally adjusted data are ranked from lowest to highest and replaced by the ranks R_{yt}, as shown in the next table. Ties are handled by assigning the same average rank to each of the tied values. (Ranks 24 and 25 are tied, so both months are ranked as 24.5). The mean rank for each season ($R_{.t}$) and the mean rank for each year ($R_{y.}$) are also shown.

Year	Jan	Feb	Mar	Apr	May	Jun
1	17	33	30	35	15	27
2	34	23	31	1	8	18
3	5	4	2	24.5	29	7
$R_{.t}$	18.67	20	21	20.17	17.33	17.33

Year	Jul	Aug	Sep	Oct	Nov	Dec	$R_{y.}$
1	32	26	22	19	20	36	26.0
2	10	13	21	24.5	28	3	17.875
3	12	14	11	9	6	16	11.625
$R_{.t}$	18	17.67	18	17.5	18	18.33	

The individual terms $(R_{yt}-R_{.t})^2$ in the summation of the scale factor are listed in the following table. The summation over all three years for each individual month, is shown in the last line of the table.

Year	Jan	Feb	Mar	Apr	May	Jun
1	2.8	169	81	219.9	5.4	93.5
2	235.1	9	100	367.5	87.0	0.4
3	186.8	256	361	18.7	136.2	106.7
$\sum_{y=1}^{3}(R_{yt}-R_{.t})^2$	424.7	434	542	606.1	228.7	200.6

Year	Jul	Aug	Sep	Oct	Nov	Dec
1	196	69.4	16	2.25	4	312.2
2	64	21.8	9	49.	100	235.0
3	36	13.5	49	72.25	144	5.4
$\sum_{y=1}^{3}(R_{yt}-R_{.t})^2$	296	104.7	74	123.5	248	552.6

Summing across the last line of the table, we have

$$\sum_{t=1}^{12} \sum_{y=1}^{3} (R_{yt} - R_{.t})^2 = 3834.9$$

Substituting into the formula for the Sen statistic, we have

$$S = \sqrt{\frac{12\ (12)^2}{3(4)\ (3834.9)}} \left[(1 - \tfrac{4}{2})\ (26.0 - \tfrac{37}{2}) + (2 - \tfrac{4}{2})\ (17.875 - \tfrac{37}{2}) + (3 - \tfrac{4}{2})\ (11.65 - \tfrac{37}{2}) \right]$$

$$= .1938\ [\ -7.50 + 0 - 6.85\ ] = -2.78$$

Since the test statistic is below the range $\pm$ 1.645 (the 90th percentile values of the normal distribution), we conclude (with greater than 90% confidence) that the data show a decreasing trend.

APPENDIX C
Population Exposure Estimates

As Section XIV of this report described, previous estimates of population exposure to elevated concentrations have focused on county-level populations in areas where all or portions of a county had been designated as not meeting the NAAQS's for specific pollutants. Those approximations tend to overestimate, and sometimes greatly so, the population exposure. In order to refine those estimates, populations within the designated non-attainment areas were desired. Systems Applications, Inc. (SAI), of San Rafael, California has written the software necessary to compute population estimates within any arbitrary closed polygon at any location in the United States. The procedure used is based in part on the high resolution population gridding program used in the SHEAR model for estimating population exposure to air pollutants (Anderson and Lundberg, 1983). Robert G. Ireson was the SAI project manager for the current study. Funding for the project came through EPA Headquarters. Tim Matzke (Environmental Results Branch, OMSE) provided the necessary coordination. The assistance of both of those individuals is gratefully acknowledged.

This Appendix gives a general description of the software, and provides copies of the program outputs, including population density maps. Since those maps show approximate population densities by square kilometer, they may be useful as a reference for other analyses, in addition to the population exposure estimates. The abbreviations PNA and SNA in the map titles stand for "Primary Non-Attainment Area" and "Secondary Non-Attainment Area," respectively.

The starting point for the population estimation is a set of points which define a closed polygon (the non-attainment area). These points were initially obtained by digitizing the outline of each non-attainment area from appropriate maps. Those points were used both in constructing the non-attainment area boundaries shown in the body of the report, and as input to the population estimation software.

The SAI software checks each polygon to verify closure, and selects a cell size which is appropriate to the size of the non-attainment area of interest. Map scale is also adjusted according to the size of the area. Comparison of the Kansas City O_3 map (2 km x 2 km cells) with the Topeka TSP map (1 km x 1 km cells) illustrates both effects. Maps are plotted with Universal Transverse Mercator coordinate axes, and include a border extending four cell widths beyond the boundary of the area of interest.

The program searches the population data file, which contains the locations of the centroids of all census block groups and enumeration districts (BG/ED's), and the population of each BG/ED. It assigns each centroid to the appropriate cell in the final grid, and distributes the population for each BG/ED according to the density of centroids and the size of the cells. It then calculates the population density for each cell. Individual cells are classified as being inside the polygon, outside the polygon, or divided by the polygon. The population within the

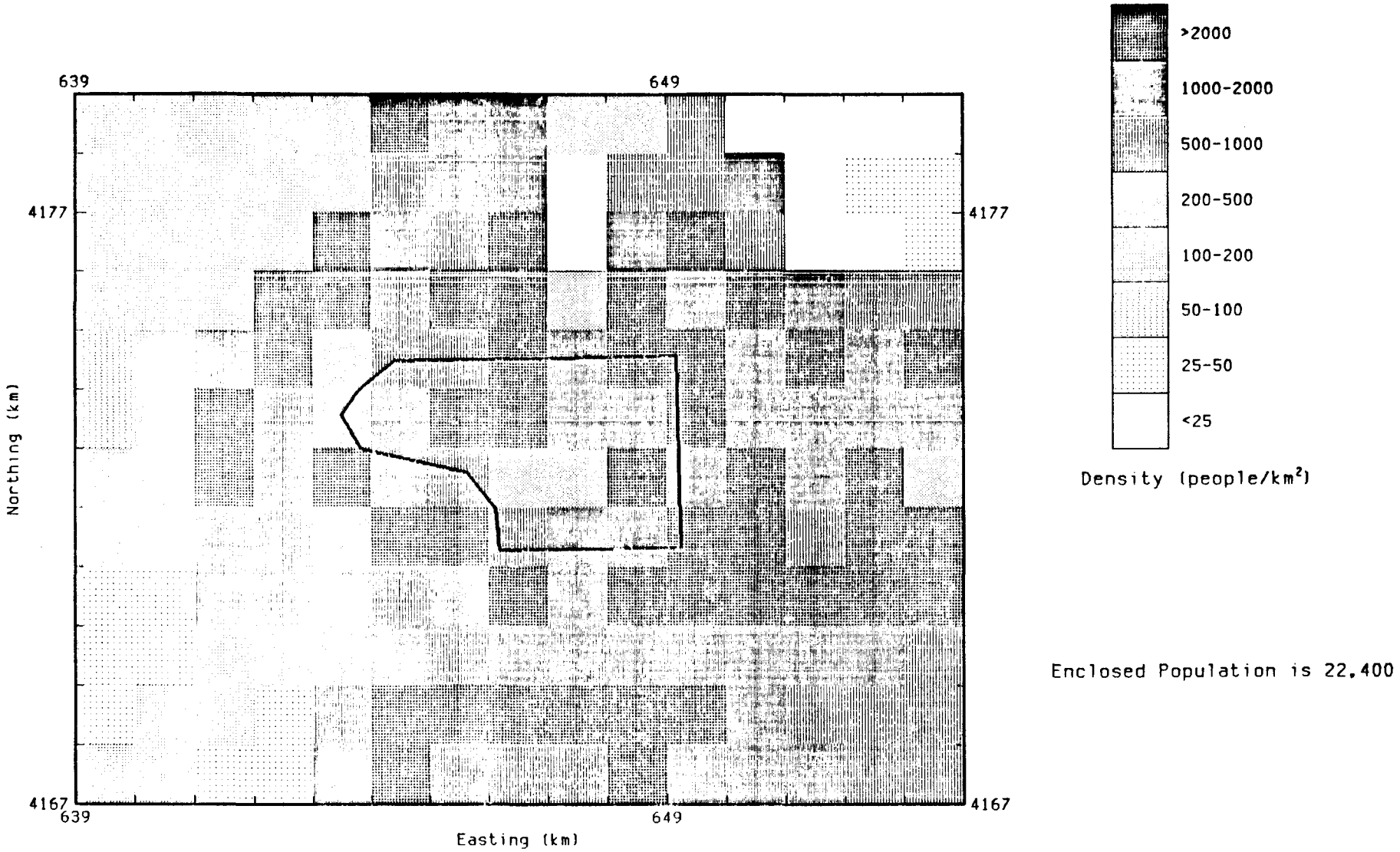
polygon is estimated by adding up the populations of all cells in the polygon. For cells divided by the polygon, the relative areas inside and outside are used to estimate the population inside.

The population extraction and gridding program produces a listing, by county, of the number and total population of the BG/ED's extracted for the grid. For completeness, those listings are also included. Where the geographical density of the BG/ED's centroids is low, the populations may be spread over a large number of cells, especially near the edges of the final grid. In those cases, (which appear on the map as large areas with uniform low density), population density estimates may be shifted into or out of the polygon. If the total population is small, that effect may significantly change the estimate for population within the polygon.

Because of the approximations discussed above, the population estimates in the text were rounded to the nearest 1000. Where total population is low, and the non-attainment area boundary coincides with the city limits, the city population from census tables was used, rather than the estimate from the computer-produced population density map.

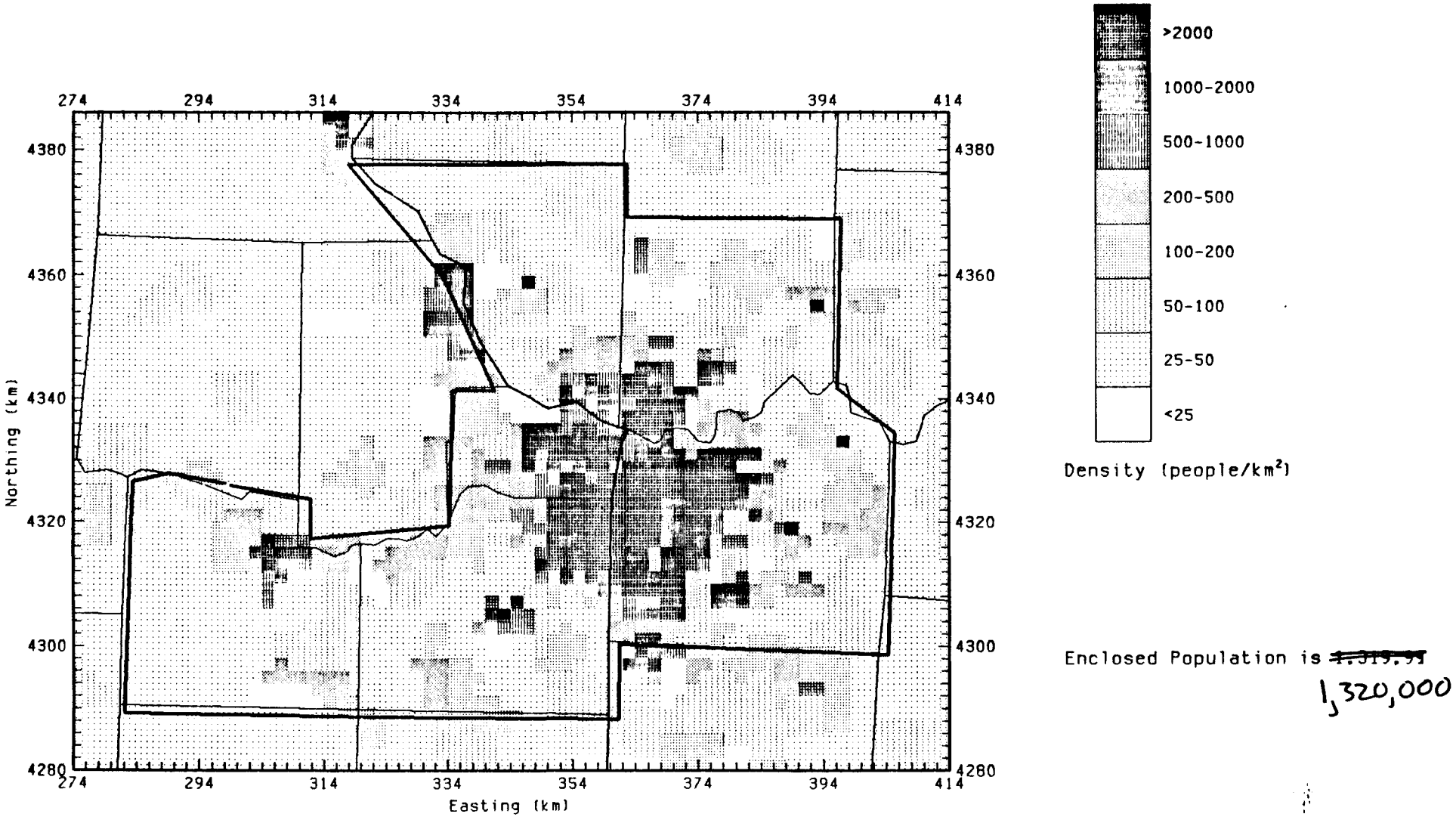
Reference

Anderson, Gerald E., and Lundberg, Gary W. 1983. User's Manual for SHEAR. A Computer Code for Modeling Human Exposure and Risk from Multiple Hazardous Air Pollutants in Selected Regions. Report SYSAPP-83/124, Systems Applications, Inc., San Rafael, California.



Enclosed Population is 22,400

Population Density Map for Polygon 1
Wichita CO PNA



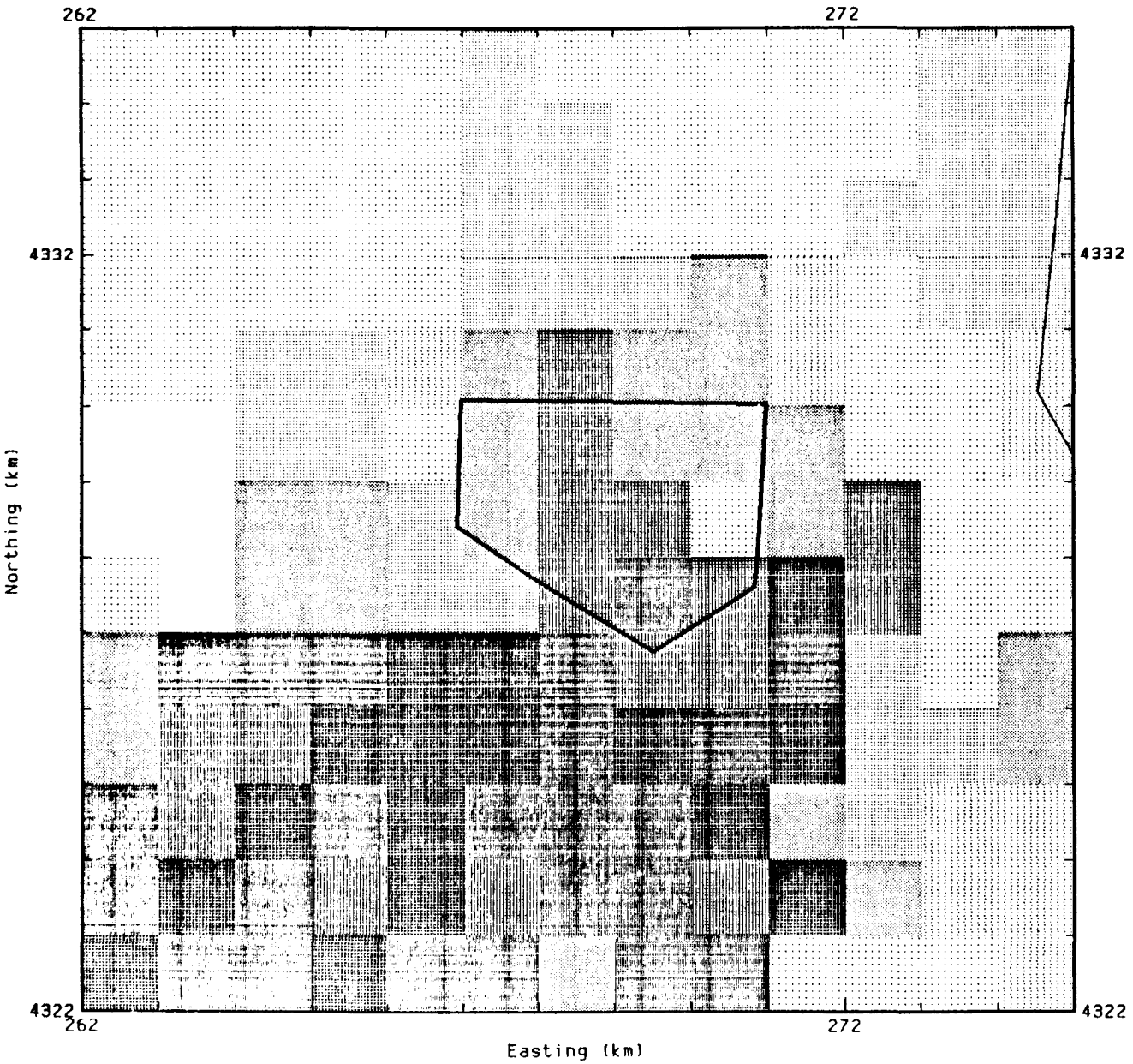
Enclosed Population is ~~1,319,99~~ 1,320,000

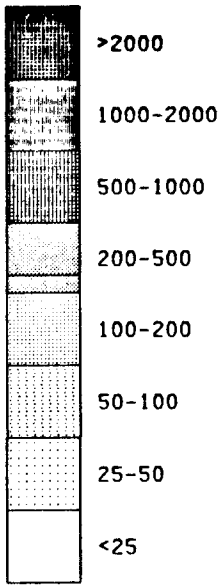
87

613

Population Density Map for Polygon 42

Kansas City and Lawrence Oc PNA's

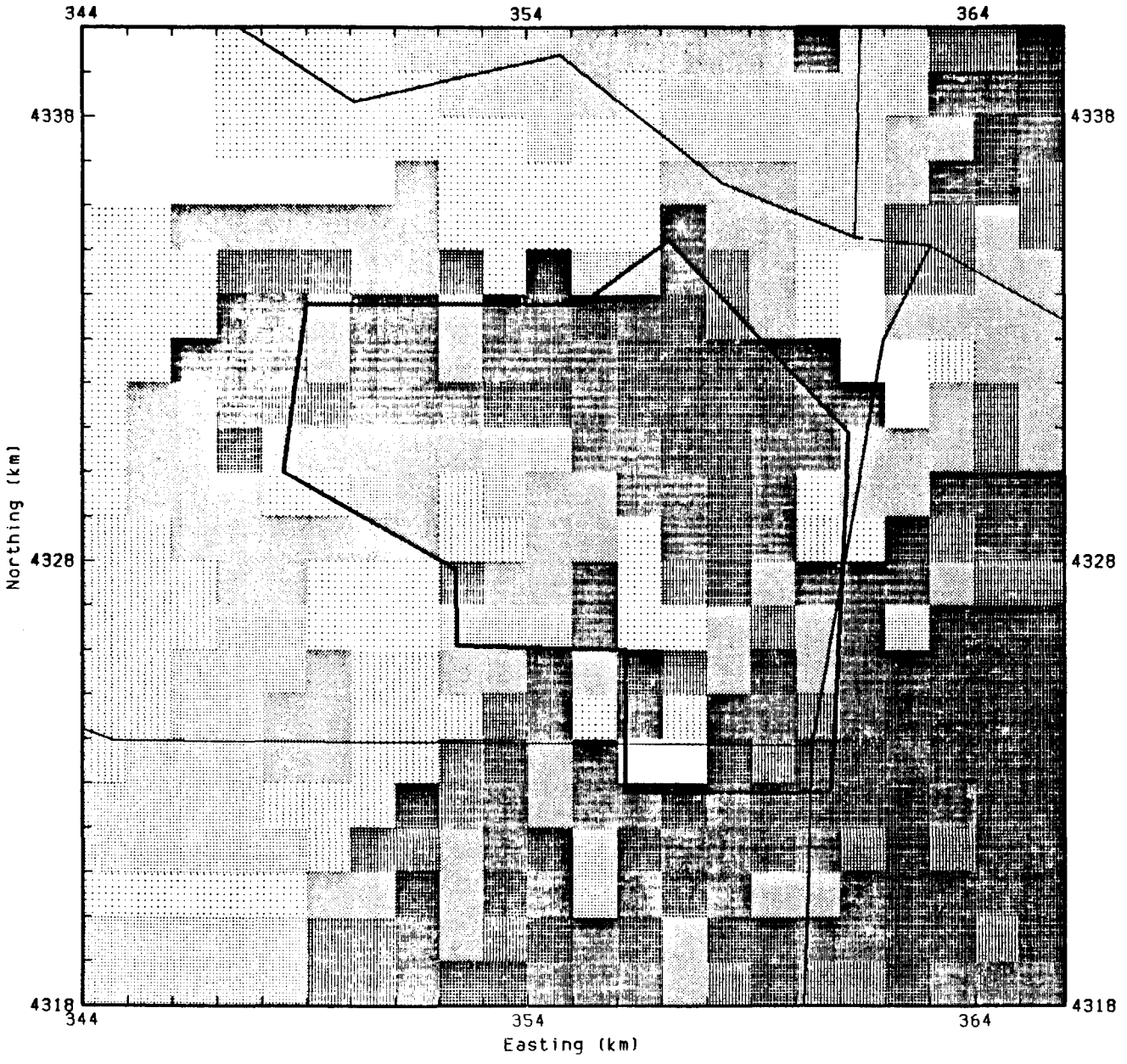


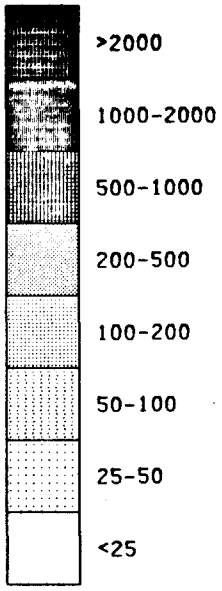


Density (people/km^2)

Enclosed Population is 6,550

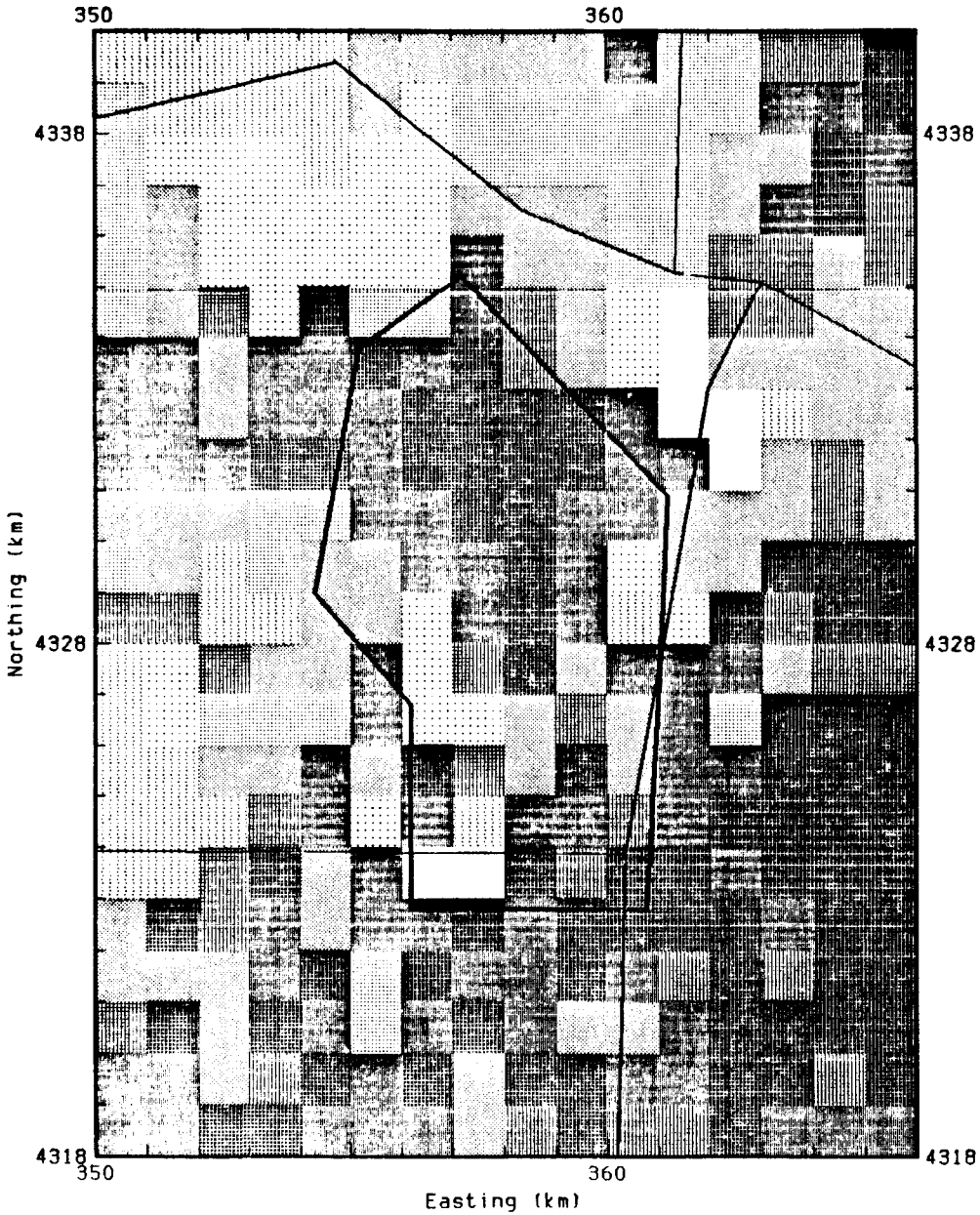
Population Density Map for Polygon 43
Topeka TSP SNA

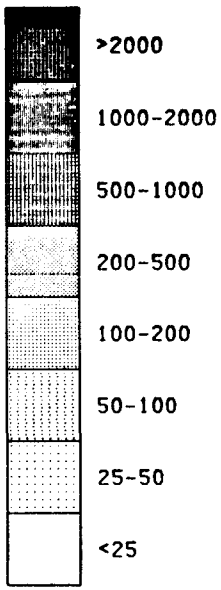




Enclosed Population is 117,000

Population Density Map for Polygon 67
Kansas City TSP SNA





Enclosed Population is 90,200

Population Density Map for Polygon 68
Kansas City TSP PNA

1

SAI/MEDX POPULATION GRIDDING PROGRAM

REGION - /
REGION ORIGIN (UTM COORDINATES/METERS)
EASTING - 639000.
NORTHING - 4167000.
ZONE - 14
REGION SIZE (METERS)
EAST-WEST - 15000.
NORTH-SOUTH - 12000.

POPULATION YEAR - 1978

51 STATES FOUND ON POPULATION-FILE INDEX,
3141 COUNTIES,
232567 BG/ED'S,
1000 BG/ED'S PER PAGE IN POPFILE.

283 BG/ED-S WITH A TOTAL POPULATION OF 230270 EXTRACTED FROM COUNTY 20173

283 BG/ED-S WITH A TOTAL POPULATION OF 230270 EXTRACTED

303 BG/ED-S WITH A TOTAL POPULATION OF 277500 EXTRACTED

REGION - 42

REGION ORIGIN (UTM COORDINATES/METERS)

EASTING -	274000
NORTHING -	4280000
ZONE -	15

REGION SIZE (METERS)

EAST-WEST -	140000
NORTH-SOUTH -	106000

1 PA

POPULATION YEAR - 1978

51 STATES FOUND ON POPULATION-FILE INDEX.
3141 COUNTIES.
232567 BG/ED'S.
1000 BG/ED'S PER PAGE IN POPFILE.

26	BG/ED-S WITH A TOTAL POPULATION OF	16124 EXTRACTED FROM COUNTY 20005
51	BG/ED-S WITH A TOTAL POPULATION OF	66790 EXTRACTED FROM COUNTY 20045
5	BG/ED-S WITH A TOTAL POPULATION OF	2886 EXTRACTED FROM COUNTY 20059
2	BG/ED-S WITH A TOTAL POPULATION OF	559 EXTRACTED FROM COUNTY 20085
20	BG/ED-S WITH A TOTAL POPULATION OF	14479 EXTRACTED FROM COUNTY 20087
293	BG/ED-S WITH A TOTAL POPULATION OF	256977 EXTRACTED FROM COUNTY 20091
49	BG/ED-S WITH A TOTAL POPULATION OF	57106 EXTRACTED FROM COUNTY 20103
3	BG/ED-S WITH A TOTAL POPULATION OF	2950 EXTRACTED FROM COUNTY 20121
3	BG/ED-S WITH A TOTAL POPULATION OF	1753 EXTRACTED FROM COUNTY 20139
5	BG/ED-S WITH A TOTAL POPULATION OF	4688 EXTRACTED FROM COUNTY 20177
241	BG/ED-S WITH A TOTAL POPULATION OF	176666 EXTRACTED FROM COUNTY 20209
8	BG/ED-S WITH A TOTAL POPULATION OF	3288 EXTRACTED FROM COUNTY 29021
3	BG/ED-S WITH A TOTAL POPULATION OF	1285 EXTRACTED FROM COUNTY 29025
38	BG/ED-S WITH A TOTAL POPULATION OF	32506 EXTRACTED FROM COUNTY 29037
190	BG/ED-S WITH A TOTAL POPULATION OF	137056 EXTRACTED FROM COUNTY 29047
12	BG/ED-S WITH A TOTAL POPULATION OF	7483 EXTRACTED FROM COUNTY 29049
830	BG/ED-S WITH A TOTAL POPULATION OF	624447 EXTRACTED FROM COUNTY 29095
4	BG/ED-S WITH A TOTAL POPULATION OF	2316 EXTRACTED FROM COUNTY 29101
6	BG/ED-S WITH A TOTAL POPULATION OF	2834 EXTRACTED FROM COUNTY 29107
69	BG/ED-S WITH A TOTAL POPULATION OF	42332 EXTRACTED FROM COUNTY 29165
16	BG/ED-S WITH A TOTAL POPULATION OF	9488 EXTRACTED FROM COUNTY 29177

92

```
  1874 BG/ED-S WITH A TOTAL POPULATION OF  1464013 EXTRACTED
REGION - 43
REGION ORIGIN (UTM COORDINATES/METERS)
        EASTING -                262000.
        NORTHING -              4322000.
        ZONE -                       15
REGION SIZE (METERS)
        EAST-WEST -              13000
        NORTH-SOUTH -            13000.

POPULATION YEAR - 1978
```

```
    51 STATES FOUND ON POPULATION-FILE INDEX.
  3141 COUNTIES.
232567 BG/ED'S.
  1000 BG/ED'S PER PAGE IN POPFILE.
```

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   146 BG/ED-S WITH A TOTAL POPULATION OF   103773 EXTRACTED FROM COUNTY 20177
```

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    63 BG/ED-S WITH A TOTAL POPULATION OF     25081 EXTRACTED
REGION - 67
REGION ORIGIN (UTM COORDINATES/METERS)
         EASTING -                344000.
         NORTHING -              4318000.
         ZONE -                       15
REGION SIZE (METERS)
         EAST-WEST -              22000.
         NORTH-SOUTH -            22000.

POPULATION YEAR - 1978

    51 STATES FOUND ON POPULATION-FILE INDEX.
  3141 COUNTIES.
232567 BG/ED'S.
  1000 BG/ED'S PER PAGE IN POPFILE.

   121 BG/ED-S WITH A TOTAL POPULATION OF     87877 EXTRACTED FROM COUNTY 20091
   227 BG/ED-S WITH A TOTAL POPULATION OF    167503 EXTRACTED FROM COUNTY 20209
    30 BG/ED-S WITH A TOTAL POPULATION OF     24436 EXTRACTED FROM COUNTY 29047
   244 BG/ED-S WITH A TOTAL POPULATION OF    179433 EXTRACTED FROM COUNTY 29095
    11 BG/ED-S WITH A TOTAL POPULATION OF      8658 EXTRACTED FROM COUNTY 29165
```

```
   633 BG/ED-S WITH A TOTAL POPULATION OF    467907 EXTRACTED
REGION - 69
REGION ORIGIN (UTM COORDINATES/METERS)
         EASTING -                  350000.
         NORTHING -                4318000.
         ZONE -                         15
REGION SIZE (METERS)
         EAST-WEST -                 16000.
         NORTH-SOUTH -               22000.
```

1

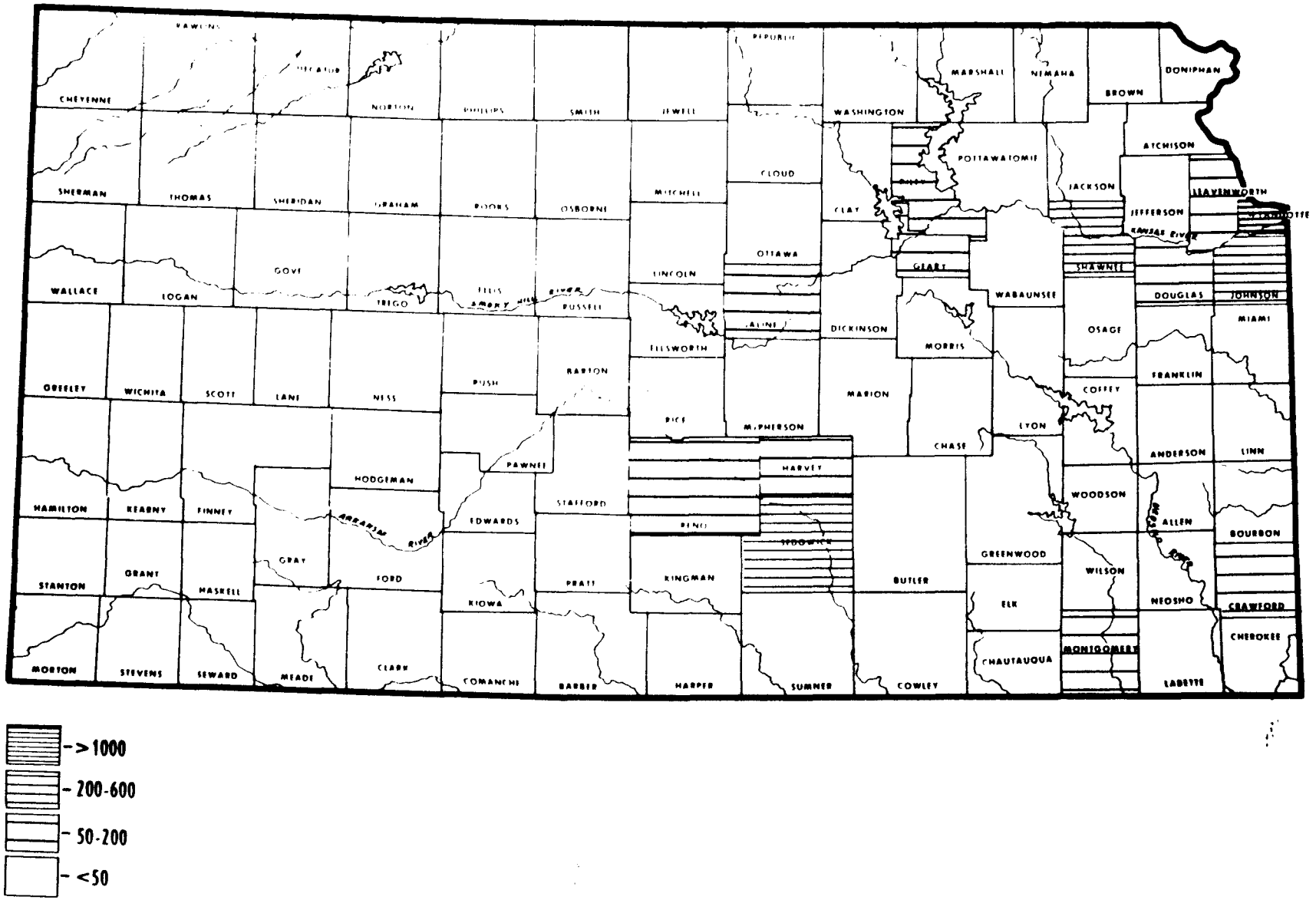
POPULATION YEAR - 1978

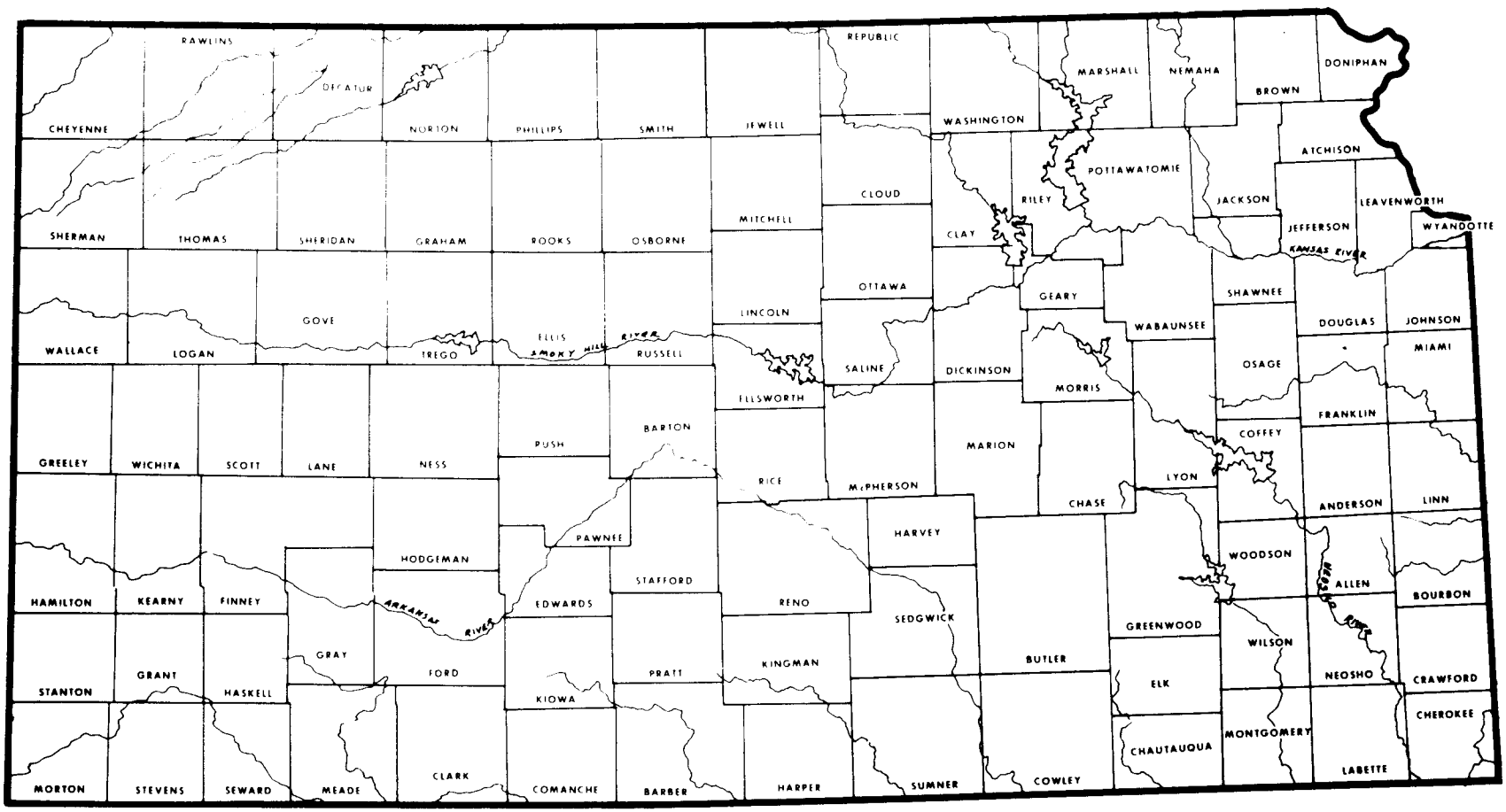
```
    51 STATES FOUND ON POPULATION-FILE INDEX.
  3141 COUNTIES.
232567 BG/ED'S.
  1000 BG/ED'S PER PAGE IN POPFILE.
```

```
   114 BG/ED-S WITH A TOTAL POPULATION OF     84399 EXTRACTED FROM COUNTY 20091
   201 BG/ED-S WITH A TOTAL POPULATION OF    142265 EXTRACTED FROM COUNTY 20209
    30 BG/ED-S WITH A TOTAL POPULATION OF     24436 EXTRACTED FROM COUNTY 29047
   244 BG/ED-S WITH A TOTAL POPULATION OF    179433 EXTRACTED FROM COUNTY 29095
    10 BG/ED-S WITH A TOTAL POPULATION OF      8568 EXTRACTED FROM COUNTY 29165
```

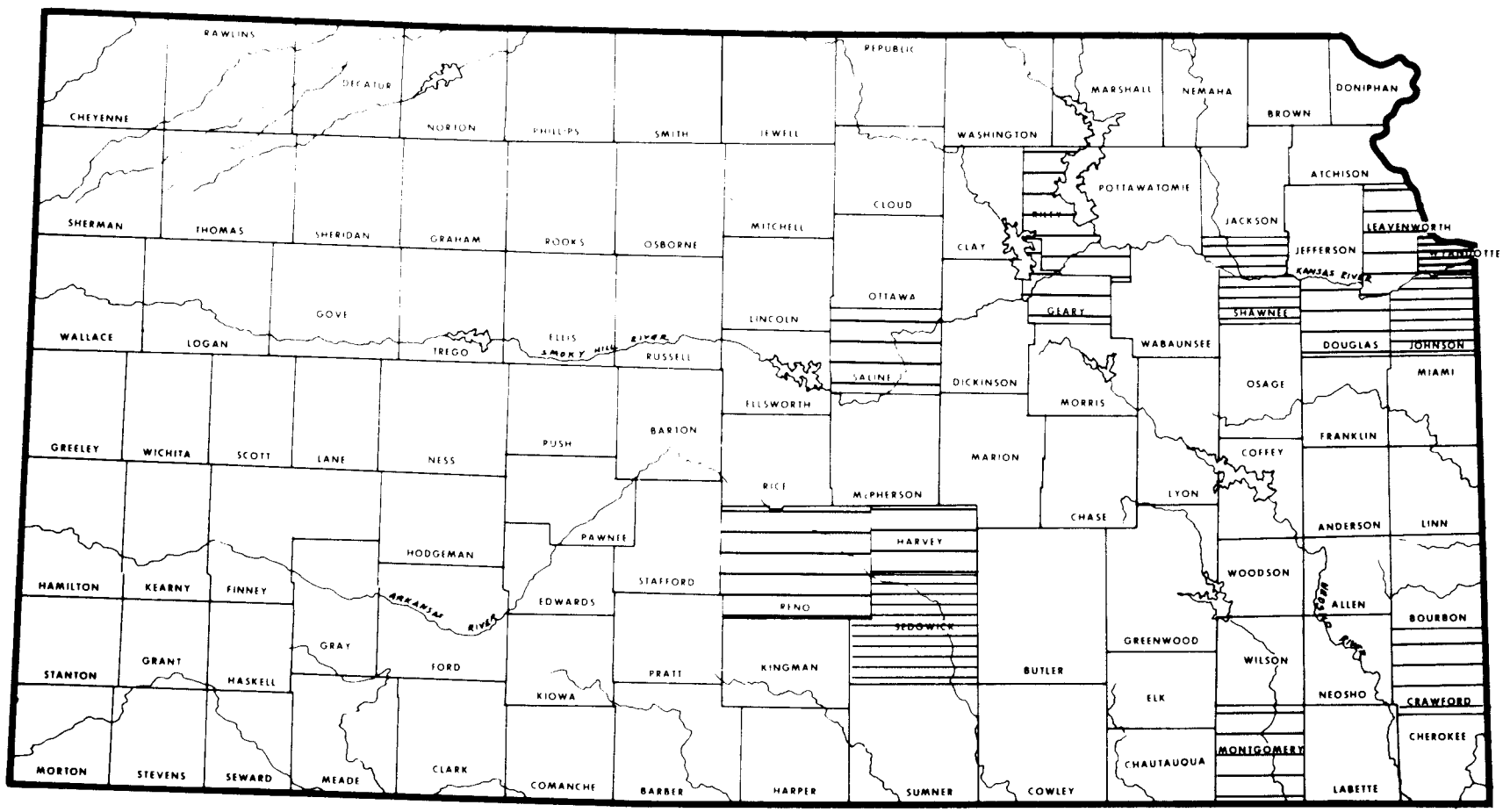
Figure 1

Population Density (People/mi²)




RAWLINS
DECATUR
CHEYENNE
NORTON
PHILLIPS
SMITH
JEWELL
REPUBLIC
WASHINGTON
MARSHALL
NEMAHA
BROWN
DONIPHAN
ATCHISON
POTTAWATOMIE
JACKSON
LEAVENWORTH
WYANDOTTE
JEFFERSON
KANSAS RIVER
SHERMAN
THOMAS
SHERIDAN
GRAHAM
ROOKS
OSBORNE
MITCHELL
CLOUD
RILEY
CLAY
OTTAWA
GEARY
SHAWNEE
DOUGLAS
JOHNSON
WABAUNSEE
MIAMI
WALLACE
LOGAN
GOVE
TREGO
ELLIS
SMOKY HILL RIVER
RUSSELL
LINCOLN
SALINE
DICKINSON
OSAGE
MORRIS
ELLSWORTH
FRANKLIN
COFFEY
GREELEY
WICHITA
SCOTT
LANE
NESS
PUSH
BARTON
RICE
McPHERSON
MARION
CHASE
LYON
ANDERSON
LINN
PAWNEE
HARVEY
WOODSON
HODGEMAN
STAFFORD
RENO
ALLEN
HAMILTON
KEARNY
FINNEY
ARKANSAS RIVER
EDWARDS
SEDGWICK
BUTLER
GREENWOOD
NEOSHO RIVER
BOURBON
GRAY
WILSON
STANTON
GRANT
HASKELL
FORD
PRATT
KINGMAN
ELK
NEOSHO
CRAWFORD
KIOWA
CHAUTAUQUA
MONTGOMERY
CHEROKEE
MORTON
STEVENS
SEWARD
MEADE
CLARK
COMANCHE
BARBER
HARPER
SUMNER
COWLEY
LABETTE

Population Density (People/mi²)

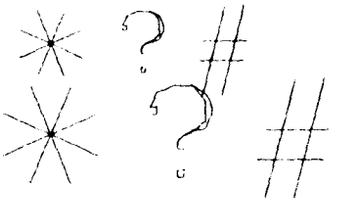


- >1000
- 200-600
- 50-200
- <50

TABLE 3

LEGEND FOR EMISSIONS DATA MAPS

POINT SOURCE SYMBOL SIZE -- EMISSIONS (TONS/YEAR)



	NON--LEAD	LEAD
? #	100 - 1000	5 - 25
	1001 - 5000	26 - 100
	OVER 5000	OVER 100

POINT SOURCE SYMBOL COLOR -- STACK HEIGHT (METERS)

?	UNKNOWN
	1 - 45
	46 - 120
	OVER 120

AMBIENT MONITOR SYMBOLS

	NAMS
	SLAMS
	SPMS

TABLE 2

LEGEND FOR AMBIENT MONITORING DATA MAPS

Boundaries

Primary Nonattainment Area

Secondary Nonattainment Area

Unclassified Area

Monitor Symbol Colors and Flag

No Violation of Standard

Violation of Secondary Standard

Violation of Primary Standard

Exceedance of Alert Level

Annotation for Standards Violated

A Annual Primary Standard

Q Quarterly Primary Standard

24 24-hour Primary Standard

24 24-hour Secondary Standard

8 8-hour Primary Standard

3 3-hour Secondary Standard

1 1-hour Primary Standard

Annotation for Trends

↑ Increasing Trend

∧ Probable Increasing Trend

– No Trend

∨ Probable Decreasing Trend

↓ Decreasing Trend

(Where two trend symbols are shown, the first is for long-term averages, the second for 24-hour observations.)

Monitor Symbol Sizes

Microscale

Middle Scale

Neighborhood Scale

Urban Scale

Regional Scale

Data Completeness

Data met completeness criteria each year.

Data did not meet completeness criteria one or more years.