UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

AUG 13 1997

Ref: 8P2-A

Daniel E. Harman, Manager
Air Quality Monitoring
Division of Environmental Engineering
P.O. Box 5520
Bismarck, North Dakota 58506-5520

Dear Mr. Harman:

This letter is in reply to your submittal by e-mail to Joe Delwiche on May 27, 1997, of the report, "Ambient Air Quality Monitoring, Annual Network Review, 1996." The review of North Dakota's ambient air monitoring network was conducted by the Division of Environmental Engineering. We have assessed the report and found that it met the requirements of the State-EPA Agreement. Our comments are presented below.

Sections 2.4.3 and 2.8.3 say that all of the monitoring stations for particulate matter and sulfate except for the Sharon station are population-oriented, urban scale stations. The Aerometric Information Retrieval System, Air Quality Subsystem (AIRS-AQS) shows the following PM_{10} stations as urban scale stations:

Site Name	AIRS-AQS Identification Number
Beulah Residential	38-057-0001
Fargo Residential	38-017-1003
Grand Forks Commercial	38-035-0001

With the exception of the regional scale station at Sharon (AIRS identification number 38-091-0001), the remainder of the PM_{10} stations are shown as neighborhood scale stations both in Table 1, AAQM Network Description, of the report and in AIRS-AQS.

Table 18 of the report includes marks in the column labeled "new site needed" for the Grand Forks Commercial and Williston Commercial PM_{10} stations, and "8/16" was entered in the "date deleted" column for the Williston Commercial station. The report did not explain the meaning of the information in Table 18.

Please consider adding the identification number from AIRS to the network description table (Table 1) or similar tabulation in future versions of this report. Usually, the reader can readily determine exactly which station in the AIRS data base corresponds to a site name. In cases where questions such as those above arise, particularly where more than one station operates or has operated in a city, having a positive correlation between the AIRS identification number and the site name could help to resolve the questions.

We appreciate the information on $PM_{2.5}$ monitoring that was included in the report. With the promulgation of the new standard for $PM_{2.5}$, we anticipate that the network review for the current year will build upon this information.

Thank you for submitting this report. If you have any questions or further comments on the network review, please call Joe Delwiche at (303) 312-6448.

Sincerely,

Dean Gillam

Dean Gillam
Technical Assistance Unit Leader

Author: Dan E. Harman at ~NDHDEHS
Date: 5/27/97 1:56 PM
Priority: Normal
TO: delwiche.joseph@epamail.epa.gov at SMTPMAIL
Subject: 1996 Network Review

Reference: FY 96-'97 Air Quality Media Workplan, Monitoring, Item C

Attached is the file containing the 1996 network review for State operated s as required by the reference. The attached zipped file, NW_ND.ZIP' contain the actual network review file NWREV96.WP6.' A separate document, Network Modification Plan,' contains the projected 1997 network modifications for bo State and industry operated sites.

If you have any questions about the network review, please call me at 701-328-5188.

NORTH DAKOTA DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL ENGINEERING

AMBIENT AIR QUALITY MONITORING
ANNUAL NETWORK REVIEW
1996

May 1997

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1.0 INTRODUCTION

The North Dakota Department of Health, Division of Environmental Engineering, has the primary responsibility of protecting the health and welfare of North Dakotans from the detrimental effects of air pollution. Toward that end, the Division of Environmental Engineering ensures that the ambient air quality in North Dakota is maintained in accordance with the levels established by the State and Federal Ambient Air Quality Standards (AAQS) and the Prevention of Significant Deterioration of Air Quality (PSD) Rules. To carry out this responsibility, the Division of Environmental Engineering operates and maintains a network of ambient air quality monitors and requires five major industrial pollution sources to conduct source specific ambient air quality monitoring.

To evaluate the effectiveness of the State's air quality monitoring effort, the U.S. Environmental Protection Agency (EPA) requires the Division of Environmental Engineering to conduct an annual review of the State's ambient air quality monitoring (AAQM) network. EPA's requirements, as set forth in 40 CFR 58.20, are to (1) determine if the system meets the monitoring objectives defined in 40 CFR 58, Appendix D, and (2) identify network modifications such as termination or relocation of unnecessary sites or establishment of new sites which are necessary. 40 CFR 58.25 requires the State to annually develop and implement a schedule to modify the AAQM network to eliminate any unnecessary sites or correct any inadequacies indicated as a result of the annual review required by 40 CFR 58.20(d). This document and subsequent revisions satisfy those annual requirements.

1.1 Network Review Process

The locations of sites in a monitoring program are established to meet certain objectives. The May 10, 1979, Federal Register (40 CFR 58), "Air Quality Monitoring, Data Reporting, and Surveillance Provisions," as amended, has specified a minimum of four basic monitoring objectives. These objectives are as follows:

1. To determine the highest pollutant concentrations expected to occur in an area covered by the network.

2. To determine representative concentrations in areas of high population density.

3. To determine the impact on ambient pollution levels by a significant source or class of sources.

4. To determine the general/background concentration levels.

The link between basic monitoring objectives and the physical location of a particular monitoring site involves the concept of spatial scale of representativeness. This spatial scale is determined by the physical dimensions of the air parcel nearest a monitoring site throughout which actual pollutant concentrations are reasonably similar. The goal in locating sites is to match the spatial scale represented by the sample of monitored air with a spatial scale most appropriate for the monitoring objective. Spatial scales of representativeness, as specified by EPA, are described as follows:

Microscale - dimensions ranging from several meters up to about 100 meters.

Middle Scale - areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 km.

Neighborhood Scale - city areas of relatively uniform land use with dimensions of 0.5 to 4.0 km.

Urban Scale - overall, city-wide dimensions on the order of 4.0 to 50.0 km. (Usually requires more than one site for definition.)

Regional Scale - rural areas of reasonably homogeneous geography covering from 50 km to hundreds of km.

The relationships between monitoring objectives and spatial scales of representativeness, as specified by EPA, are as follows:

Monitoring Objective	Appropriate Siting Scales
Highest Concentration	Micro, middle, neighborhood
Population Exposure	Neighborhood, urban
Source Impact	Micro, middle, neighborhood
General/Background	Urban, regional

Recommended scales of representativeness appropriate to the criteria pollutants monitored in North Dakota are shown below:

Criteria Pollutant	Spatial Scales
Inhalable Particulate (PM_{10})	micro, middle, neighborhood, urban, regional
Sulfur Dioxide (SO_2)	middle, neighborhood, urban, regional
Ozone (O_3)	middle, neighborhood, urban, regional
Nitrogen Dioxide (NO_2)	middle, neighborhood, urban
Carbon Monoxide (CO)	micro, middle, neighborhood

Using this physical basis to locate sites allows for an objective approach, ensures compatibility among sites, and provides a common basis for data interpretation and application. The annual review process involves an examination of existing sites to evaluate their monitoring objectives and spatial scale with sites deleted, added, or modified accordingly. Further details on network design can be found in 40 CFR 58, Appendix D.

1.2 General Monitoring Needs

As can be gathered from the prior discussion, each air pollutant has certain characteristics which must be considered when establishing a monitoring site. These characteristics may result from 1) variations in the number and types of sources and emissions in question; 2) reactivity of a particular pollutant with other constituents in the air; 3) local site influences such as terrain and land use; and 4) climatology. The State AAQM network is designed to monitor air quality data for three basic conditions: 1) background monitoring; 2) population exposure; and 3) highest concentration. The industrial AAQM network sites are designed to monitor air quality data for source specific highest concentration impacts on a neighborhood scale.

The primary function of the department operated continuous sites is to collect background data to determine if and when there is any change in background concentrations. Beulah and Fargo Residential are exceptions to this primary function. Beulah is population exposure because of the major sources in the vicinity. Fargo Residential is also population orintiented because Fargo is a major population center with PSD sources in the Fargo-Moorhead area. The data from this site will be used as input to dispersion models to evaluate permits-to-construct and permits-to-operate for projects located in or near population centers in the eastern part of the state. PM_{10} sites, except for Sharon, are population exposure sites: Sharon collects background data for the eastern part of the state.

Background sites are chosen to determine concentrations of air contaminants in areas remote from urban sources and generally are sited using the regional spatial scale. This is true for NO_2 despite the fact that the regional spatial scale is not normally used for NO_2 monitoring. Once general locations are established, all monitoring sites are established in accordance with the specific probe siting criteria specified in 40 CFR 58, Appendix E.

Since all industrial AAQM network sites are source specific, all the pollutants at industry sites are source oriented on a neighborhood scale. Industrial sites are selected using dispersion modeling results and meteorological data. These sites are the most likely locations to have elevated ambient concentrations. The data collected at the industry-operated sites is included in the data summaries for comparison but not included in any discusion of the State ambient monitoring network needs or analysis. Each industry network is an entity unto itself and does not influence the placement of State operated sites.

1.3 Monitoring Objectives

The monitoring objectives of the Department are to track those pollutants that are judged to have the potential for violating either State or Federal Ambient Air Quality Standards and to ensure that those pollutants do not cause significant deterioration of our existing air quality. To accomplish these objectives, the Department operated 15 AAQM sites around the State. Thirteen were SLAMS/NAMS sites, and two were special purpose monitoring (SPM) sites. There were five industries that reported ambient air quality data to this Department. Table 1 lists each site's type and the parameters monitored. Figure 1 shows the approximate site locations. For the industry networks, each network is represented by a single circle whether there is a single site or multiple sites.

The numbers in the Site Name/Company column in Table 1 and in the '#' column in Tables 2, 5, 7, 9, and 12 correspond to the numbers on the figures. The numbers in the circles correspond to the monitoring site monitoring that pollutant and the squares correspond to the major sources for that particular pollutant.

TABLE 1

AAQM Network Description

Site Name	Type Station	Parameter Monitored[1]	Operating Schedule	Monitoring Objective[2]	Spatial Scale[2]	Date Site Began
1 Beulah Residential	SLAMS	PM_{10} SO_2, NO_2, O_3, MET	6th Day cont.	Population Exposure Population Exposure	Neighborhood Urban	12/95 04/80
2 Bismarck Residential	SLAMS	PM_{10}, $PM_{2.5}$	6th Day	Population Exposure	Neighborhood	07/95
3 Dickinson Residential	SLAMS	PM_{10}	6th Day	Population Exposure	Neighborhood	07/89
4 Dunn Center	SLAMS	SO_2, MET	cont.	General Background	Regional	10/79
5 Fargo Residential	SLAMS	PM_{10} PM_{10} SO_2, NO_2, O_3, MET	6th Day 6th Day cont.	Population Exposure Collocated SSI Population Exposure	Neighborhood N/A Regional	08/95 08/95
6 Grand Forks Commercial	SLAMS	PM_{10}	6th Day	Population Exposure	Neighborhood	07/89
7 Hannover	SLAMS	SO_2, NO_2, O_3, MET	cont.	General Background	Regional	10/84
8 Mandan Refinery - SPM	SPM	SO2, MET	cont.	Source Impact	Neighborhood	12/95
9 Sharon	SLAMS	SO_2, NO_X O_3, MET PM_{10}	cont. 6th Day	General Background	Regional	07/94
10 TRNP - NU	SLAMS	SO_2, O_3, H_2S, MET	cont.	General Background	Regional	02/80
11 Whiskey Joe - SPM	SPM	SO2, H2S, MET	cont.	Source Impact	Neighborhood	07/95
12 Williston Residential	SLAMS	PM_{10}	6th Day	Population Exposure	Neighborhood	08/95
Company	**Site Name**					
13 Amerada Hess Corporation	TIOGA #1 TIOGA #2 TIOGA #3	SO_2 H_2S, MET SO_2	cont. cont. cont.	Source Source Source	Neighborhood Neighborhood Neighborhood	07/87 07/87 11/87
14 Dakota Gasification Company	DGC #12 DGC #14 DGC #16 DGC #17	SO_2, NO_2, MET SO_2 SO_2 SO_2, NO_2	cont. cont. cont. cont.	Source Source Source Source	Neighborhood Neighborhood Neighborhood Neighborhood	01/80 01/89 10/95 10/95
15 Koch Hydrocarbon Company	KOCH #3 KOCH #4	SO_2, MET H_2S, MET	cont. cont.	Source Source	Neighborhood Neighborhood	11/94 05/94
16 W. H. Hunt Estate	HUNT #5	SO_2, H_2S, MET	cont.	Source	Neighborhood	11/92

1. MET refers to meteorological and indicates wind speed and wind direction monitoring equipment.
2. Not applicable to MET.

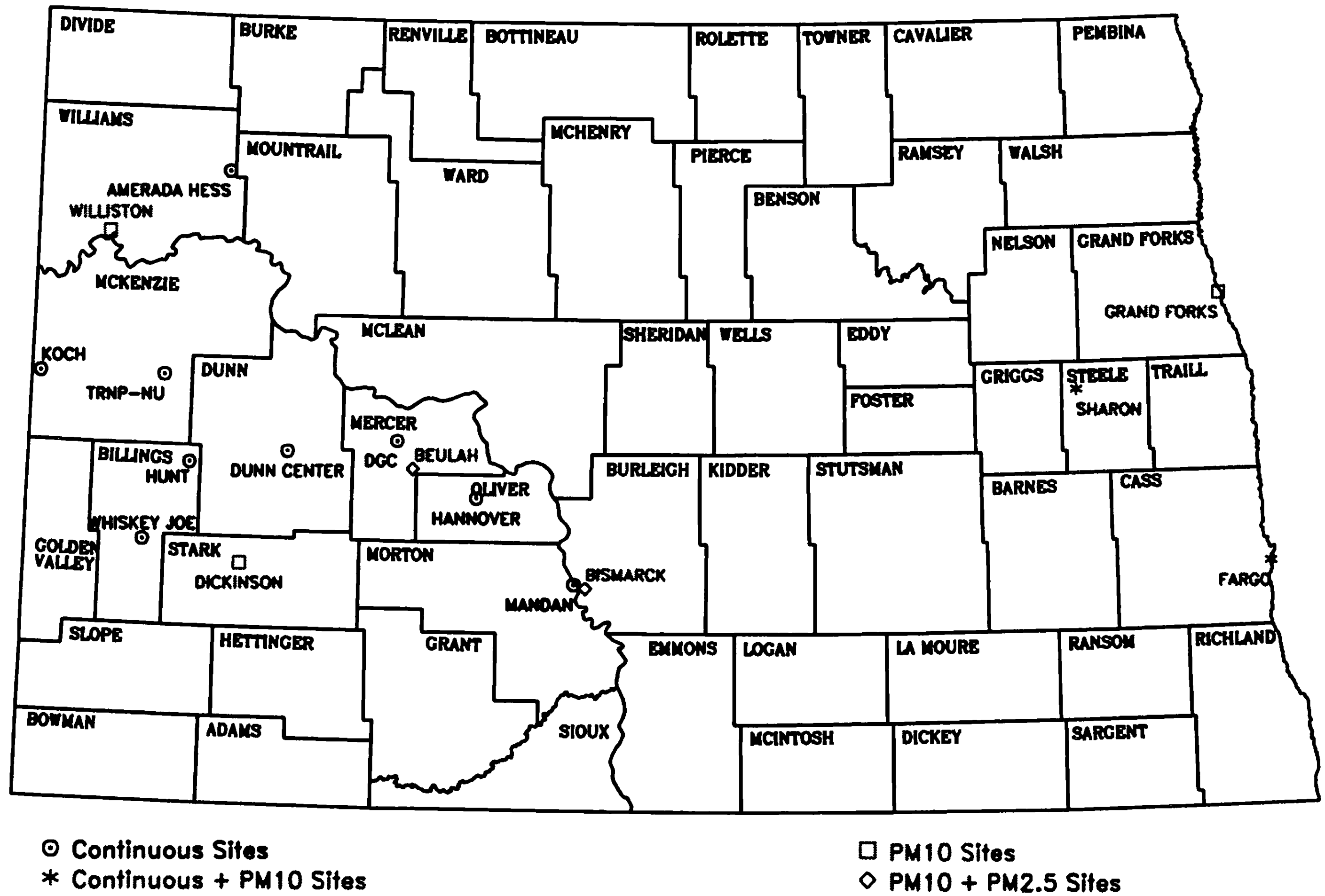

Figure 1 North Dakota Ambient Air Quality Monitoring Sites

2.0 AMBIENT AIR MONITORING NETWORK COVERAGE

The State of North Dakota is attainment for all criteria pollutants. As such, there are no "problem areas" in the general sense of the term. However, there are areas of concern where the Department has established monitoring sites to track the emissions of specific pollutants from area sources. Also, four major sources maintained monitoring networks in the vicinity of their plants (see Table 1 and Figure 1).

2.1 Sulfur Dioxide

Energy development in the west and west-central portions of North Dakota has produced a number of sources of sulfur dioxide (SO_2). These sources include coal-fired steam-powered electrical generating facilities, a coal gasification plant, natural gas processing plants, an oil refinery, and flaring at oil/gas well sites. As a result, SO_2 is one of the Department's major concerns in regard to ambient air quality monitoring.

2.1.1 Point Sources

The major SO_2 point sources (>100 TPY) are listed in Table 2 along with their emissions from the emissions inventories reported to the department. Figure 2 shows the approximate locations of these facilities (the numbers correspond to the respective positions in the site and source tables).

2.1.2 Other Sources

The western part of the State has a number of potential SO_2 sources associated with the development of oil and gas. These sources include individual oil/gas wells, oil storage facilities, and compressor stations. Emissions from such sources can create two problems. First, these sources may directly emit significant amounts of hydrogen sulfide (H_2S) to the ambient air (see Section 2.7). Second, flaring the H_2S from these sources can create significant concentrations of SO_2 in the ambient air. The primary counties for these sources in western North Dakota are outlined in green on Figure 2.

TABLE 2

Major SO_2 Sources
(>100 TPY)

1996

#	Name of Company	Type of Source	Location	County	SO_2 Emissions Ton/Yr
1	Dakota Gasification Co.	Synthetic Fuel Plant	Beulah	Mercer	48781
2	CPA/UPA (Coal Creek)	Steam Electric Gen. Facility	Underwood	Mc Lean	46459
3	Minnkota Power Coop.	Steam Electric Gen. Facility	Center	Oliver	45502
4	Basin Electric Power Cooperative (Leland Olds)	Steam Electric Gen. Facility	Stanton	Mercer	39339
5	Montana Dakota Utilities (Coyote Station)	Steam Electric Gen. Facility	Beulah	Mercer	17924
6	Basin Electric Power Cooperative (AVS)	Steam Electric Gen. Facility	Beulah	Mercer	14890
7	United Power Association	Steam Electric Gen. Facility	Stanton	Mercer	7816
8	Amoco Oil Company	Oil Refinery	Mandan	Morton	6402
9	Montana Dakota Utilities (Heskett)	Steam Electric Gen. Facility	Mandan	Morton	2066
10	Koch Hydrocarbon - MGP	Natural Gas Processing Plant	---	McKenzie	981
11	Amerada-Hess Corporation (Tioga Gas Plant)	Natural Gas Processing Plant	Tioga	Williams	956
12	American Crystal Sugar	Sugar Beet Processing Plant	Drayton	Pembina	839
13	W. H. Hunt Trust Estate	Natural Gas Processing Plant	---	Billings	787
14	Univ. of North Dakota	Steam Heat	Grand Forks	Grand Forks	619

TABLE 2 (cont.)

Major SO_2 Sources
(>100 TPY)

1996

#	Name of Company	Type of Source	Location	County	SO_2 Emissions Ton/Yr
15	American Crystal Sugar	Sugar Beet Processing Plant	Hillsboro	Traill	476
16	Interenergy Sheffield	Natural Gas Processing Plant	Lignite	Burke	299
17	North Dakota State	Steam Heat	Fargo	Cass	232
18	Archer-Daniels-Midland	Corn Processing	Walhalla	Pembina	129
19	Amerada Hess - Cherry Creek	Compressor Station	---	McKenzie	119
20	Minn-Dak Farmers Cooperative	Sugar Beet Processing Plant	Wahpeton	Richland	112

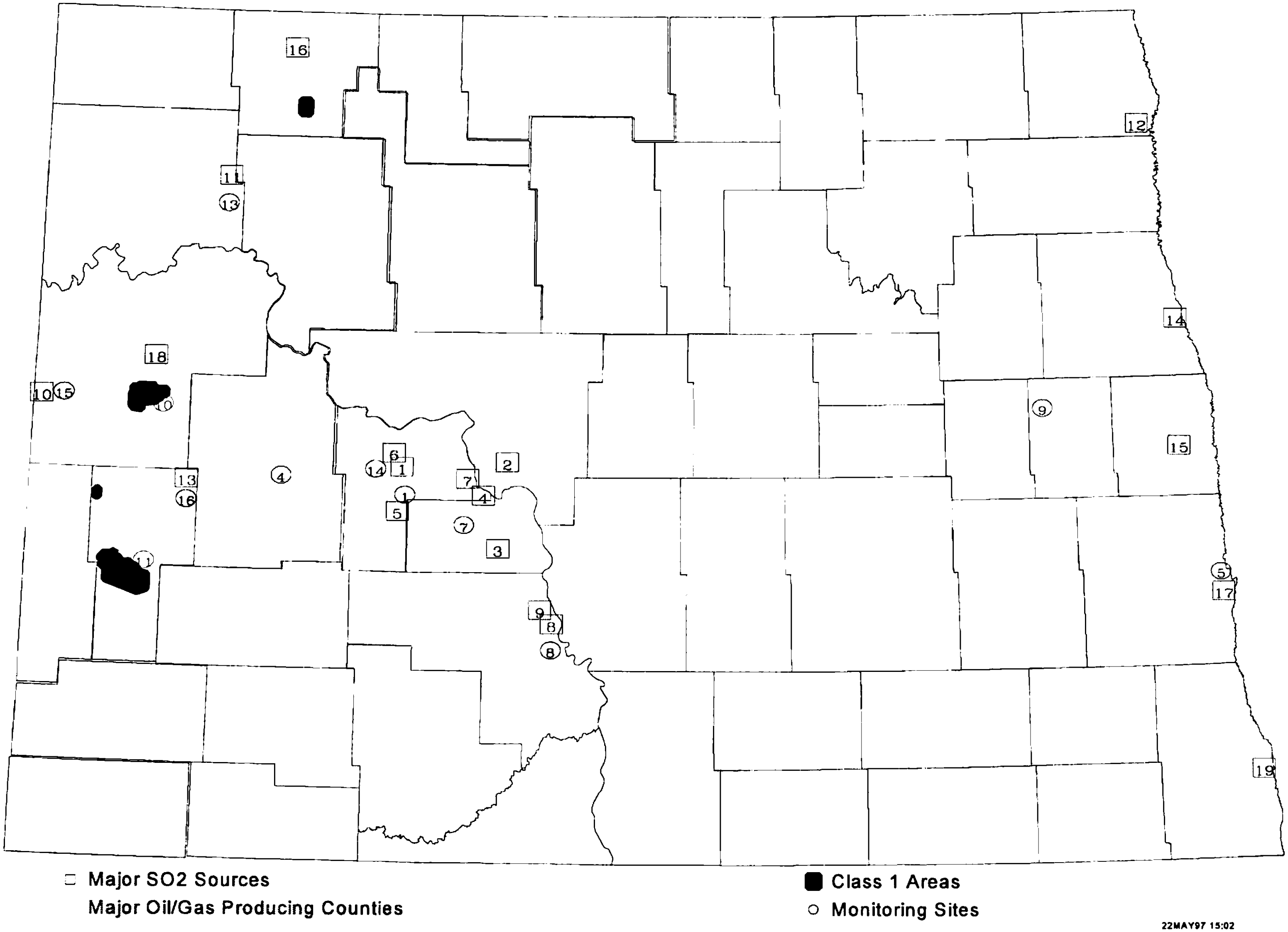

Figure 2 Major Sulfur Dioxide Sources

2.1.3 Monitoring Network

The SO_2 monitoring sites are shown on Figure 2. As can be seen, these monitoring sites are concentrated in the vicinity of the oil and gas development in the west and the coal-fired steam electrical generating plants in the central part of the State. Table 3 shows the 1996 annual SO_2 data summaries; Table 4 shows the 5-minute data summary. There were no exceedances of either State or Federal SO_2 standards.

2.1.4 Network Analysis

The nine largest SO_2 sources in the state are within 45 miles of both the Beulah and Hannover sites. This makes these two sites very important in tracking the impact of these nine sources on the ambient air . In Beulah, many homes and businesses use coal as a heat source during the heating season. This local influence could be as much an influence on the data as the major sources in the vicinity. One would expect that as these large sources came on line, beginning in 1980, a noticeable change would be seen on the ambient air quality. This has not been the case. There have been possible short term influences, but no significant long term impact by these nine sources combined. Figures 3, 4, 5, and 6, present a 17 year view of the percentage of data greater than the minimum detectable value (MDV), 1-hour maximums, 3-hour maximums, and 24-hour maximums, for the state operated sites. Because the industry sites are sited specifically for maximum expected concentrations (primarily as predicted by dispersion models and secondarily in a downwind direction), the industry sites are not reviewed for particular long term trends.

The best long term indicator of the change in the amount of SO_2 in the ambient air is seen by reviewing the MDV. Figure 3 presents this data for the active state sites from 1980 through 1996. With the exception the three new sites (Fargo Res, Mandan Ref, and Whiskey Joe), the remaining sites fit into two distinct groupings: near major sources (Beulah and Hannover) and sites remote to major sources (Dunn Center, Sharon, and TRNP - NU). To calculate valid annual statistics, at least 75% of the data must be grater than the MDV. Therefore, the annual mean is not a valid indicator and, consequently, not addressed.

TABLE 3

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : Sulfur Dioxide (PPB)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MAXIMA 1 - HOUR 1ST MM/DD/HH	1 - HOUR 2ND MM/DD/HH	3 - HOUR 1ST MM/DD/HH	3 - HOUR 2ND MM/DD/HH	24 - HOUR 1ST MM/DD	24 - HOUR 2ND MM/DD	ARITH MEAN	1HR #>273	24HR #>99	% >MDV
AMERADA HESS - TIOGA #1	1996	JAN-DEC	8674	108 07/25/10	88 07/25/09	81 07/25/11	34 12/19/17	13 07/25	10 12/02	1.5			15.3
AMERADA HESS - TIOGA #3	1996	JAN-DEC	8633	50 07/24/10	45 07/23/16	40 07/24/11	37 07/23/17	15 04/19	13 12/16	2.3			23.4
BEULAH	1996	JAN-DEC	8736	104 08/14/09	82 08/14/08	51 08/14/11	41 11/04/17	17 11/04	16 08/14	2.9			41.6
DGC #12	1996	JAN-DEC	8715	122 08/13/07	108 04/14/10	84 04/14/11	67 08/13/08	21 12/16	15 03/16	3.2			41.1
DGC #14	1996	JAN-DEC	8574	209 08/16/10	125 06/20/09	99 08/16/11	83 10/14/20	25 10/14	21 11/04	3.7			50.0
DGC #16	1996	JAN-DEC	8604	206 02/20/13	182 08/26/20	110 08/20/08	99 02/20/14	28 08/20	26 09/15	5.0			72.3
DGC #17	1996	JAN-DEC	8644	229 09/14/03	225 06/11/09	170 09/14/05	125 09/14/20	56 09/14	33 09/18	3.5			47.9
DUNN CENTER	1996	JAN-DEC	8728	49 12/22/06	43 12/22/07	43 12/22/08	19 03/28/14	10 12/22	7 01/19	1.5			13.6
FARGO RESIDENTIAL	1996	JAN-DEC	8394	29 02/19/10	28 01/06/08	24 01/06/08	21 12/26/14	10 12/26	8 01/06	1.5			21.8
HANNOVER	1996	JAN-DEC	8649	75 05/31/07	72 09/03/12	40 08/24/23	40 10/13/11	14 11/04	12 10/13	2.4			27.7
KOCH - MGP #3	1996	JAN-DEC	5456 ***	72 05/15/06	17 01/05/13	25 05/15/08	14 03/05/08	6 03/05	5 01/27	1.4			13.6
LITTLE KNIFE #5	1996	JAN-DEC	8732	41 12/22/06	32 12/22/07	28 12/22/08	26 11/22/14	12 12/22	7 11/22	1.5			17.7
MANDAN REFINERY - SPM	1996	JAN-DEC	8727	162 10/29/19	160 12/17/18	148 12/17/20	142 10/30/23	79 12/17	56 04/19	6.7			36.1
SHARON	1996	JAN-DEC	8724	23 11/27/02	19 11/27/01	19 11/27/02	14 11/27/05	8 12/25	6 01/30	1.3			17.1
TRNP - NU	1996	JAN-DEC	8559	65 01/19/17	29 01/19/18	34 01/19/17	19 01/19/20	11 01/19	8 10/03	1.4			15.1
WHISKEY JOE - SPM	1996	JAN-DEC	8690	26 11/18/10	25 03/08/18	18 11/18/11	17 03/28/11	7 12/22	6 01/25	1.5			20.4

The maximum 1-hour concentration is 229 ppb at DGC #17 on 09/14/03
The maximum 3-hour concentration is 170 ppb at DGC #17 on 09/14/05
The maximum 24-hour concentration is 79 ppb at MANDAN REFINERY - SPM on 12/17

* The air quality standards are:
STATE Standards -
1) 273 ppb maximum 1-hour average concentration.
2) 99 ppb maximum 24-hour average concentration.
3) 23 ppb maximum annual arithmetic mean concentration.

FEDERAL Standards -
1) 500 ppb maximum 3-hour concentration not to be exceeded more than once per year.
2) 140 ppb maximum 24-hour concentration not to be exceeded more than once per year.
3) 30 ppb annual arithmetic mean.

*** Less than 80% of the possible samples (data) were collected.

TABLE 4

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : SO2 5-Minute Averages (ppb)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	5 - MINUTE MAXIMA 1ST	DATE MM/DD/HH	2ND	DATE MM/DD/HH	3RD	DATE MM/DD/HH	# HOURS >600	% >MDV
MANDAN REFINERY - SPM	1996	JAN-DEC	7853	398	1/ 9/14	396	1/ 9/13	381	3/30/ 5	0	43.2

The maximum 5-minute concentration is 398 ppb at MANDAN REFINERY - SPM on 1/ 9/14

* The proposed air quality standards for SO2 5-minute averages are:

STATE - 600 ppb not to be exceeded.

FEDERAL - 600 ppb not to be exceeded.

Beginning in 1980, major events are easily traceable. In 1980, the oil industry was expanding. In 1981, MDU's Coyote Power Station began operation. In 1982 the oil industry in western North Dakota hit its peak activity. 1983, 1984, and 1985 were startup years for Basin Electric's Antelope Valley Unit #1, the synthetic natural gas plant (aka, Dakota Gasification Company), and Antelope Valley Unit #2, respectively. From 1987 through 1995, for the Beulah and Hannover sites, there has been a steady increasing trend in the percentage of data greater than the MDV. However, Hannover has shown a decrease the last two years while Beulah has continued to increase. In contrast, the Dunn Center and TRNP - NU sites have remained consistently between 5% and 10% since 1988.

The same patterns seen in Figure 3 are discernable in the 1-hour, 3-hour, and 24-hour maximum concentration graphs (see Figures 4, 5, and 6, respectively). As can be seen from the graphs, none of the maximum concentrations approached the applicable standards.

Because the newer sites (Fargo Residential, Mandan Refinery - SPM, Sharon, and Whiskey Joe - SPM) have limited amount of data, no attempt is made to evaluate the results other than no standards were exceeded.

At DGC (Table 2, Source #3), sites DGC #11 and DGC #15 were terminated and the equipment moved to new locations. DGC is building a new stack and dispersion modeling for the new stack emissions indicate the locations of the maximum concentrations occurring northwest of the stack are in new locations.

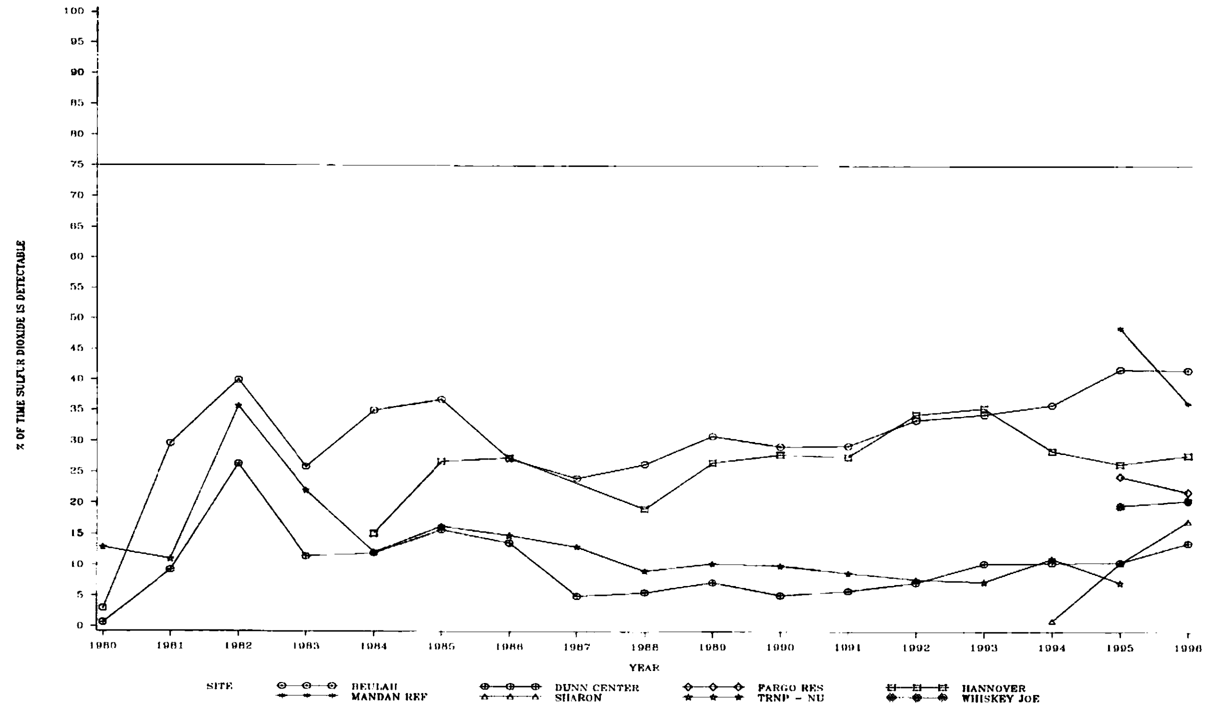

Figure 3. Percentage of Time SO_2 Detectable

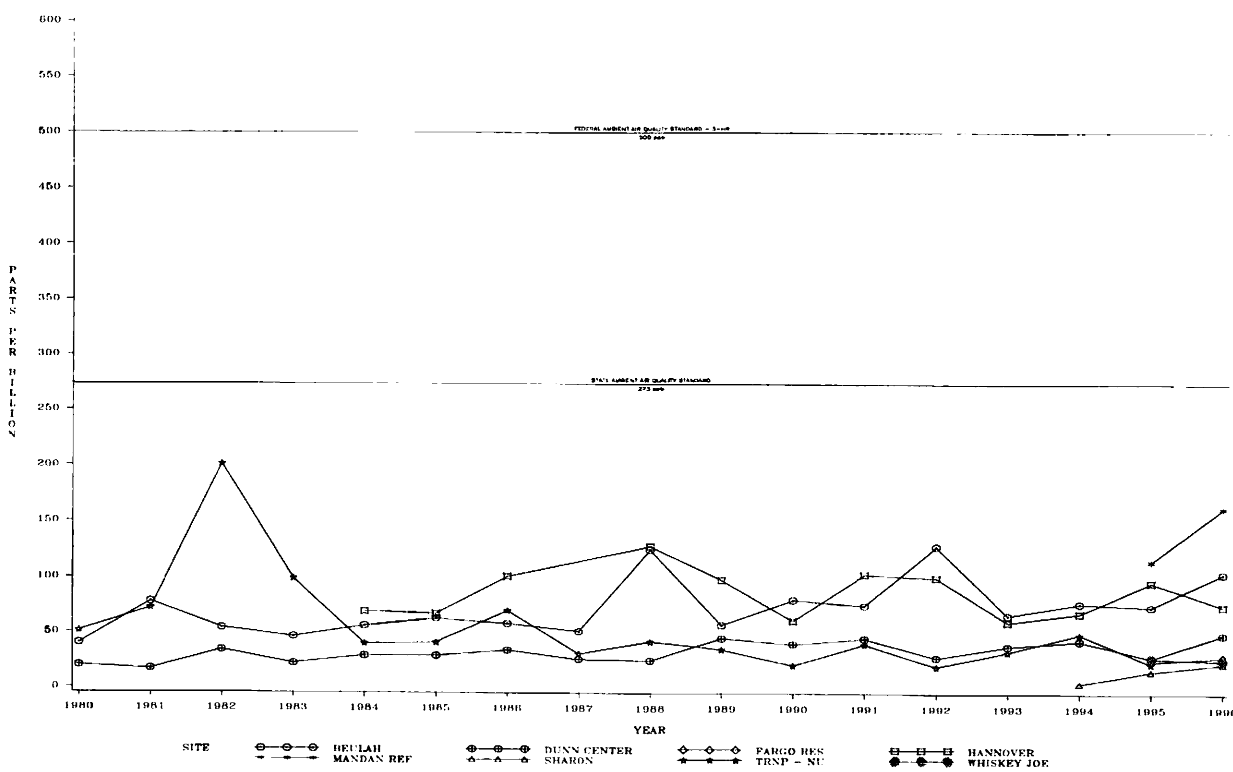

Figure 4. SO_2 Maximum 1-Hour Concentrations

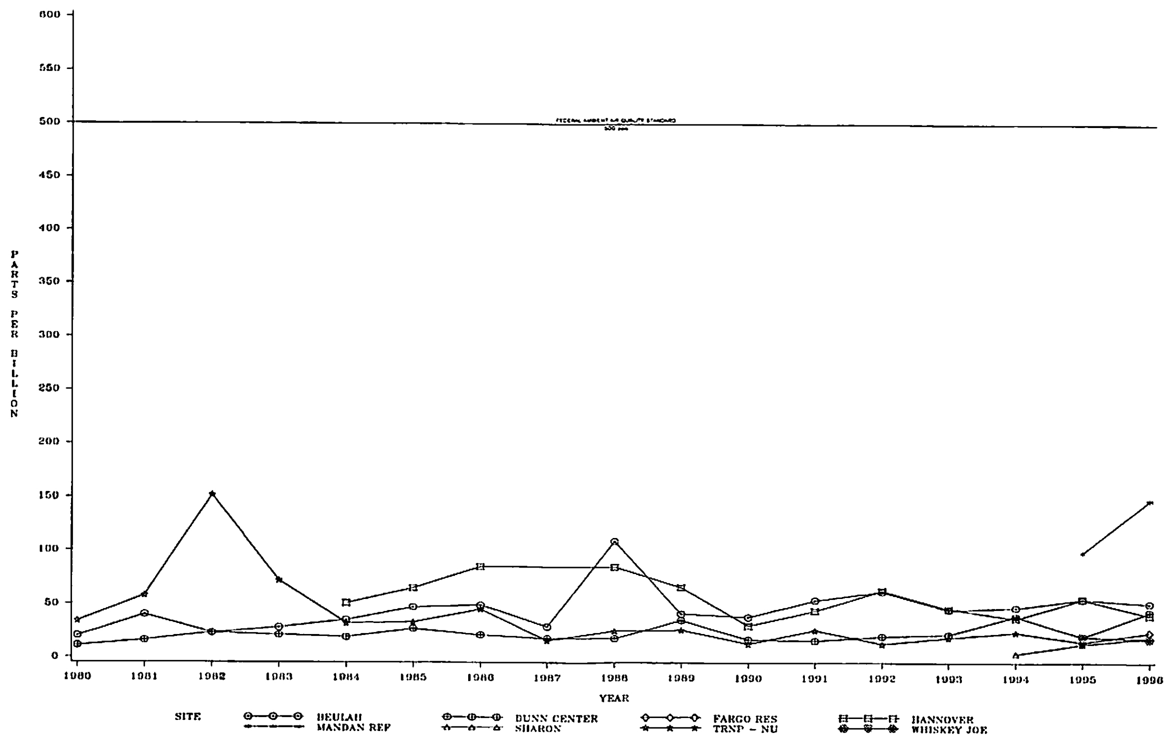

Figure 5. SO_2 Maximum 3-Hour Concentrations

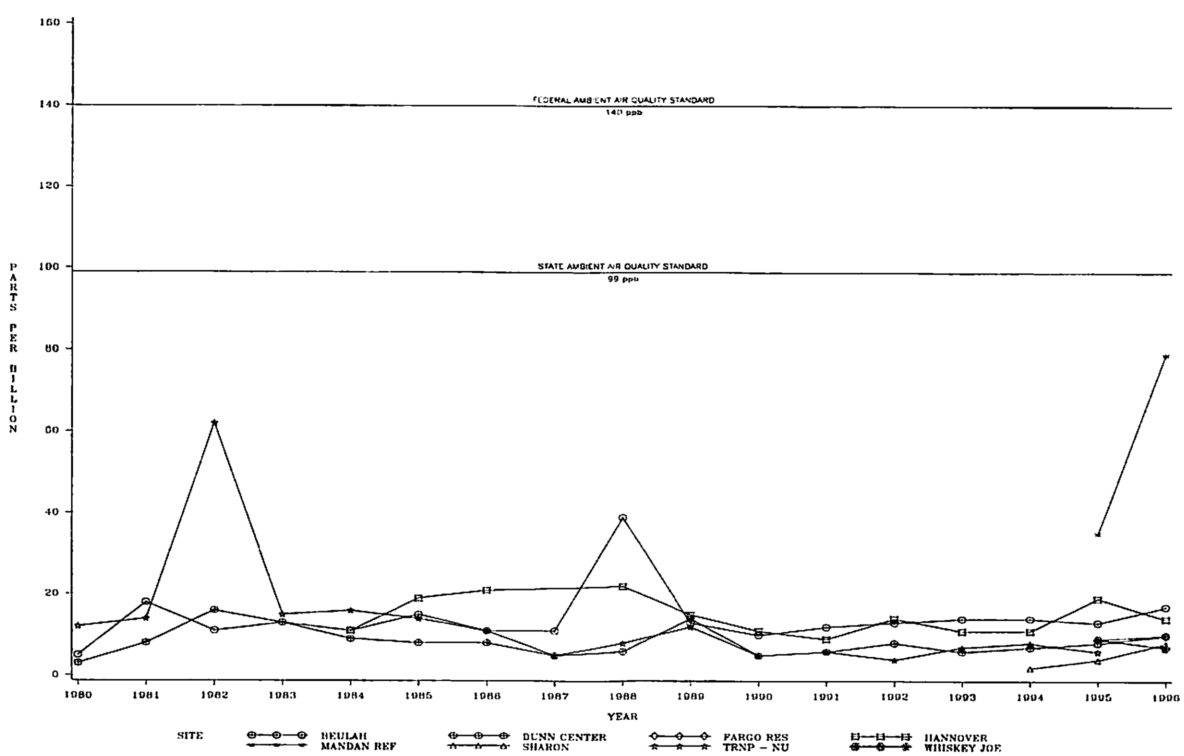

Figure 6 SO_2 Maximum 24-Hour Concentrations

2.2 Oxides of Nitrogen

Oxides of Nitrogen (NO_x) is the term used to represent both nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is formed when NO is oxidized in the ambient air. There are no ambient air quality standards for NO.

2.2.1 Point Sources

The major NO_x stationary point sources (>100 TPY) are listed in Table 5 along with their emissions as calculated from the most recent emission inventories reported to the department. Figure 7 shows the approximate locations of these facilities (the numbers correspond to the respective positions in the site and source tables). The larger NO_x point sources in North Dakota are associated with coal-fired steam-powered electrical generating plants in the west-central portion of the State and large internal combustion compressor engines in the natural gas fields in the western part of the State.

2.2.2 Area Sources

Another source of NO_X is automobile emissions. North Dakota has no significant urbanized areas with regard to oxides of nitrogen; the entire population of the State is less than the 1,000,000 population figure that EPA specifies in the NO_2 requirement for NAMS monitoring.

2.2.3 Monitoring Network

The Department currently operates four $NO/NO_2/NO_x$ analyzers. These are located at Beulah, Fargo, Hannover, and Sharon. The Dakota Gasification Company (DGC) network also operated analyzers at sites DGC #12 and DGC #17. Table 6 shows the 1996 NO_2 data summaries. The measured NO_2 values are quite low, particularly the annual means. From Figure 7 it can be seen that $NO/NO_2/NO_x$ analyzers, except for Sharon, are well placed with respect to the major NO_x sources: Sharon is a background site.

TABLE 5

Major NO_x Sources
(> 100 TPY)

1996

#	Name of Company	Type of Source	Location	County	NO_x Emissions Ton/Yr
1	Minnkota Power Coop.	Steam Electric Gen. Facility	Center	Oliver	29958
2	CPA/UPA (Coal Creek)	Steam Electric Gen. Facility	Underwood	McLean	26543
3	Basin Electric Power Cooperative (Leland Olds)	Steam Electric Gen. Facility	Stanton	Mercer	16128
4	Montana Dakota Utilities (Coyote Station)	Steam Electric Gen. Facility	Beulah	Mercer	13378
5	Basin Electric Power Cooperative (AVS)	Steam Electric Gen. Facility	Beulah	Mercer	11497
6	United Power Association	Steam Electric Gen. Facility	Stanton	Mercer	5101
7	Dakota Gasification Co.	Synthetic Fuel Plant	Beulah	Mercer	3211
8	Amoco Oil Company	Oil Refinery	Mandan	Morton	1986
9	Amerada Hess Corporation (Tioga Gas Plant)	Natural Gas Processing Plant	Tioga	Williams	1608
10	American Crystal - Drayton	Sugar Beet Processing	Drayton	Pembina	884
11	MDU - Heskett	Steam Electric Gen. Facility	Mandan	Morton	874
12	MINN-DAK Farmers	Sugar Beet Processing	Wahpeton	Richland	492
13	American Crystal - Hillsboro	Sugar Beet Processing	Hillsboro	Traill	460
14	University of North Dakota	Heating Plant	Grand Forks	Grand Forks	348
15	Amerada Hess - Antelope #2	Compressor Station	---	McKenzie	324

TABLE 5 (cont.)

Major NO_x Sources
(> 100 TPY)

1996

#	Name of Company	Type of Source	Location	County	NO_x Emissions Ton/Yr
16	Amerada Hess - Hawkeye	Compressor Station	---	McKenzie	238
17	Williston Basin IPC	Compressor Station	Dickinson	Stark	208
18	Northern Border Pipeline - CS #8	Compressor Station	---	McIntosh	206
19	Amerada Hess - Antelope #1	Compressor Station	---	McKenzie	192
20	Interenergy Sheffield Processing Co.	Natural Gas Processing	Lignite	Burke	188
21	Northern Border Pipeline - CS #6	Compressor Station	Glen Ullin	Morton	181
22	Northern Border Pipeline - CS #4	Compressor Station	---	McKenzie	177
23	Amerada Hess-Cherry Creek	Compressor Station	---	McKenzie	153
24	Koch Hydrocarbon - Alexander	Compressor Station	---	McKenzie	148
25	True Oil - Red Wing Gas Plant	Compressor Station	---	McKenzie	141
26	Koch Hydrocarbon-Tree Top	Compressor Station	---	Billings	140
27	Koch Hydrocarbon - Cow Creek	Compressor Station	---	Williams	136
28	ND State University	Heating Plant	Fargo	Cass	119
29	Cavalier Air Station	Power Plant	Concrete	Pembina	119
30	Koch Hydrocarbon - Beaver Creek	Compressor Station	---	McKenzie	118

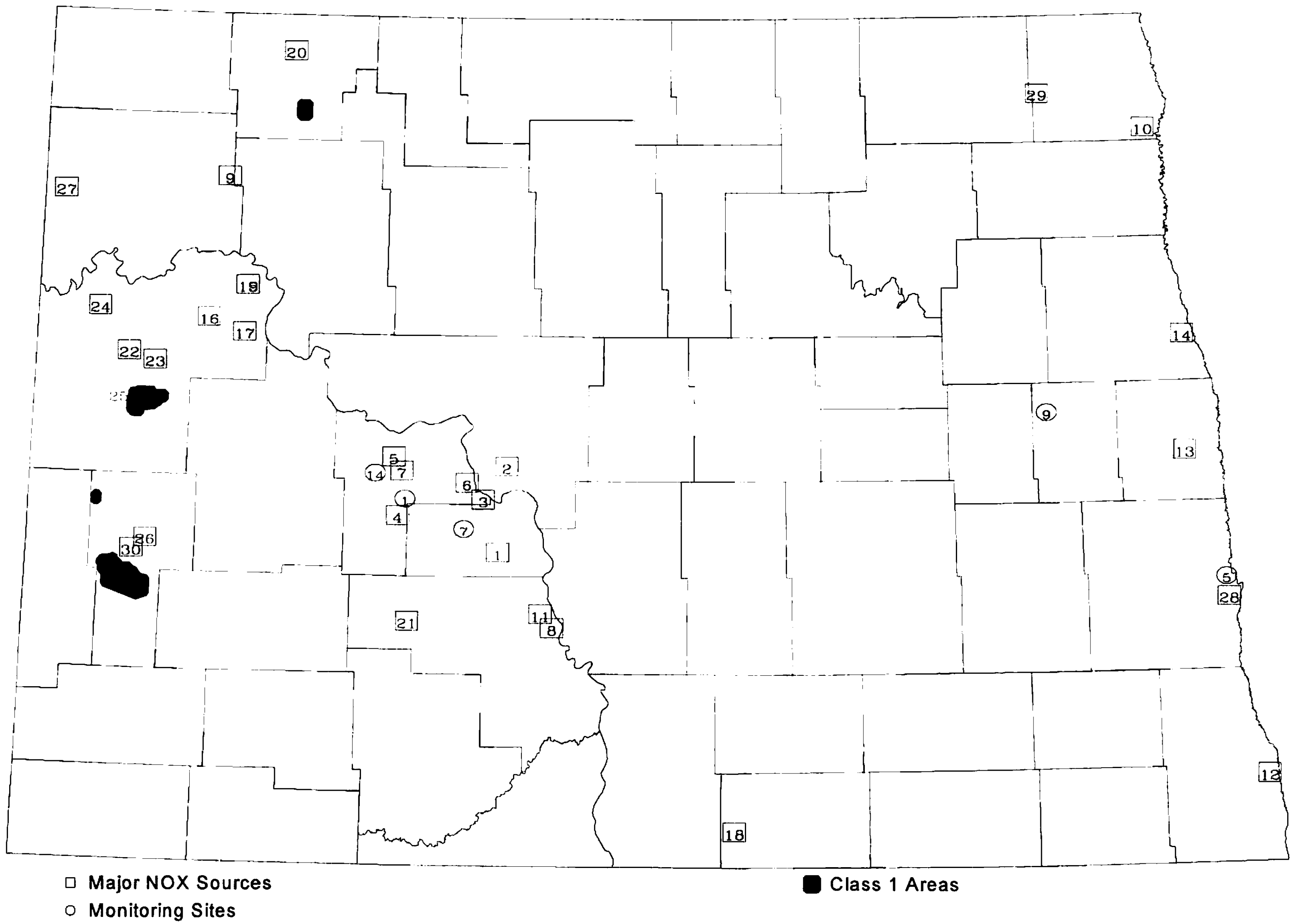

Figure 7 Major Nitrogen Dioxide Sources

TABLE 6

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : Nitrogen Dioxide (PPB)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MAXIMA 1 - HOUR 1ST MM/DD/HH	MAXIMA 1 - HOUR 2ND MM/DD/HH	ARITH MEAN	% >MDV
BEULAH	1996	JAN-DEC	8721	47 03/09/20	47 03/09/22	4.0	69.6
DGC #12	1996	JAN-DEC	8283	70 02/10/03	67 10/30/17	3.8	95.4
DGC #17	1996	JAN-DEC	8633	88 09/04/17	77 05/26/02	3.7	86.6
FARGO RESIDENTIAL	1996	JAN-DEC	8722	57 01/26/08	51 01/24/21	7.9	84.4
HANNOVER	1996	JAN-DEC	8706	31 08/24/22	26 09/13/21	2.0	35.8
SHARON	1996	JAN-DEC	8409	18 11/27/02	16 11/27/01	1.8	36.8

The maximum 1-hour concentration is 88 ppb at DGC #17 on 09/04/17

* The air quality standards are:
  STATE - 53 ppb maximum annual arithmetic mean.

  FEDERAL - 53 ppb annual arithmetic mean.

2.2.4 Network Analysis

Nine of the eleven largest NO_2 sources in the state are within 45 miles of the Beulah and Hannover monitoring sites. Figures 8 and 9 show the trends for the state operated sites for the last 17 years. Since the industry operated sites are placed for maximum concentrations, trends are not considered.

With the exception of Beulah in 1981, the percentage of data greater than the MDV, shown in Figure 8, was reasonably stable until 1993. The significant increase in the percentage of detectable concentrations is contrary to the quantity of NO_2 emitted. In 1992 these nine sources emitted 119,213 tons; in 1993, 103,673 tons; in 1994, 97,583 tons; in 1995, 96,098 tons; and, in 1996, 108676 tons. A possible explanation for Hannover is the analyzer was changed in March 1992 from a Meloy 8101C to a TECO 42. However, the analyzer change did not produce a discreet jump: the increase was seen at both the Beulah and Hannover sites. The conclusion is the increase in detectable NO_2 concentrations is real and not the result of an analyzer change. Since 1994, both Beulah and Hannover have had a decrease, greater at Hannover, in the percentage of detectable NO_2 concentrations. It appears that Fargo Res may be the only State site with more then 75% of the possible values greater then the MDV.

If the 1-hour maximum concentrations had followed a pattern similar to the one shown in Figure 8, the equipment change could have accounted for the increase in the percentage of data greater than the MDV. However, the 1-hour maximums, shown in Figure 9, have shown an overall decrease. Since Fargo Res and Sharon are relatively new sites, no valid trending is possible.

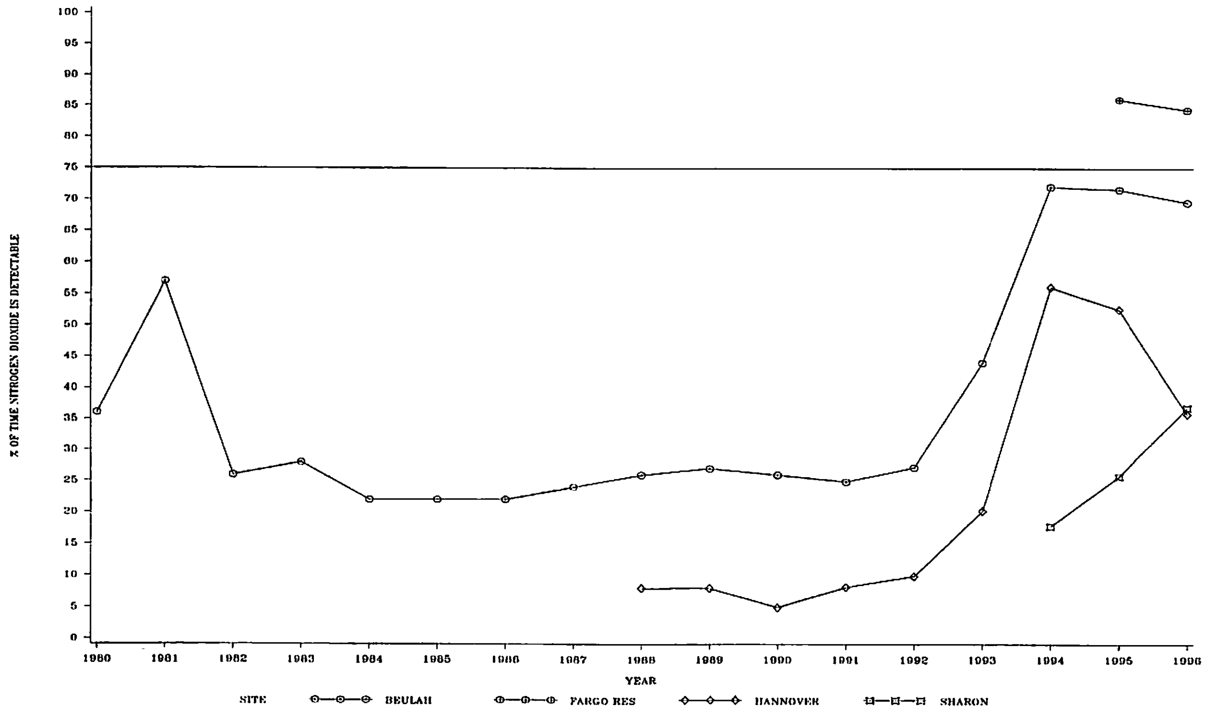

Figure 8. Percentage of Time NO_2 Detectable

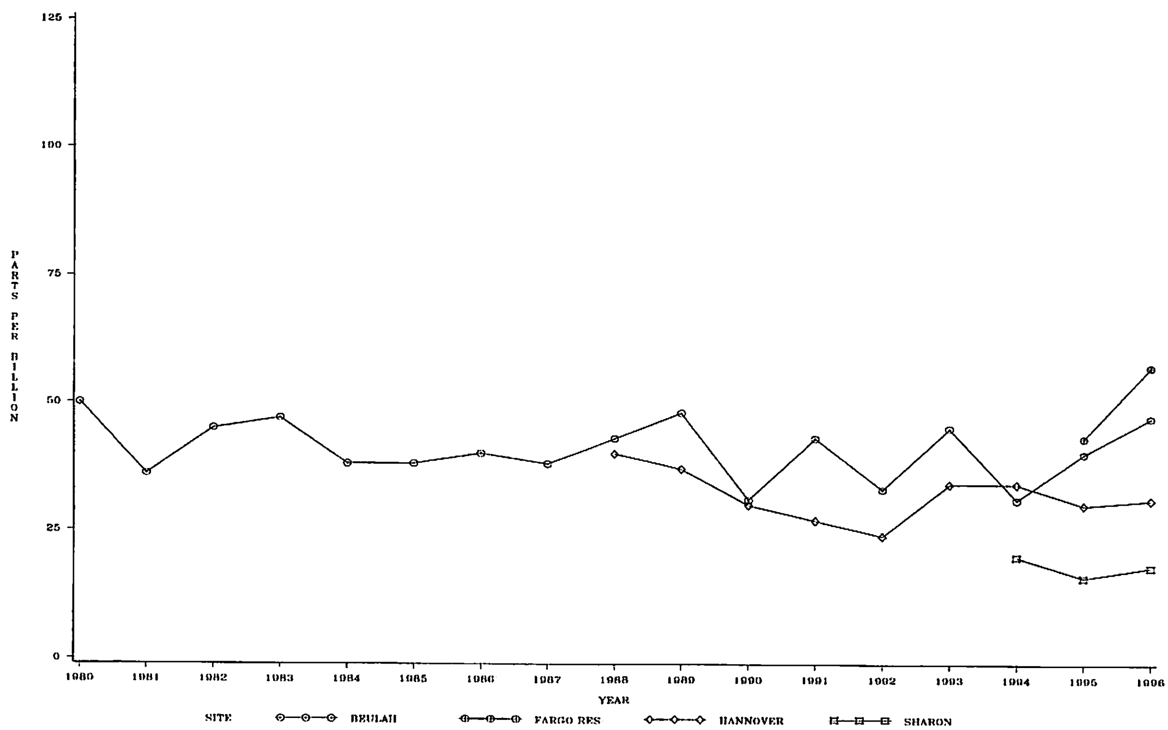

Figure 9. NO_2 Maximum 1-Hour Concentrations

2.3 Ozone

Unlike most other pollutants, ozone (O_3) is not emitted directly into the atmosphere but results from a complex photochemical reaction between volatile organic compounds (VOC), oxides of nitrogen (NO_x), and solar radiation. Both VOC and NO_x are emitted directly into the atmosphere from sources within the State. Since solar radiation is a major factor in O_3 production, O_3 concentrations are known to peak in summer months. 40 CFR 58 defines the O_3 monitoring season for North Dakota as May 1 through September 30. However, at Beulah and TRNP - NU the O_3 analyzers are operated from April 1 through September 30 to collect two full quarters of data. The O_3 analyzers at Fargo, Hannover and Sharon collect data year round for use in the CALPUFF dispersion model.

2.3.1 Point Sources

The major stationary point sources (> 100 TPY) of VOC, as calculated from the most recent emission inventories reported to the department, are listed in Table 7. Figure 10 shows the approximate locations of these facilities.

2.3.2 Area Sources

Point sources contribute only part of the total VOC and NO_x emissions. The remaining emissions are attributed to mobile sources in urban areas. The EPA has specified a design criteria for selecting NAMS locations for O_3 as any urbanized area having a population of more than 200,000. North Dakota has no urbanized areas large enough to warrant monitoring for ozone.

2.3.3 Monitoring Network

The state currently has five continuous ozone analyzers in operation. These are at Beulah, Fargo, Hannover, Sharon, and Theodore Roosevelt National Park - North Unit. Table 8 presents 1996 1-hour and 8-hour data summaries. The most interesting aspect of the data is the similarity between the 1-hour and 8-hour averages. The greatest difference between any two pairs is eight parts per billion or about 22 percent. This indicates the O_3 concentrations are reasonably uniform across the State for both the 1-hour and 8-hour averages. Also, this indicates the ozone is unrelated to the major sources. Figure 11 shows the maximum 1-hour average by month with the two sites in the East producing the higher concentration in May, June, and September.

TABLE 7

Major VOC Sources
(> 100 TPY)

1996

#	Name of Company	Type of Source	Location	County	VOC Emissions Ton/Year
1	Dakota Gasification Co.	Synthetic Fuel Plant	Beulah	Mercer	289
2	Minnkota Power Coop.	Steam Electric Gen. Facility	Center	Oliver	243
3	CPA/UPA (Coal Creek)	Steam Electric Gen. Facility	Underwood	Mc Lean	215
4	Basin Electric Power Cooperative (AVS)	Steam Electric Gen. Facility	Beulah	Mercer	156
5	Basin Electric Power Cooperative (Leland Olds)	Steam Electric Gen. Facility	Stanton	Mercer	148
6	Montana-Dakota Utilities (Coyote Station)	Steam Electric Gen. Facility	Beulah	Mercer	126
7	Amoco Oil Company	Oil Refinery	Mandan	Morton	121

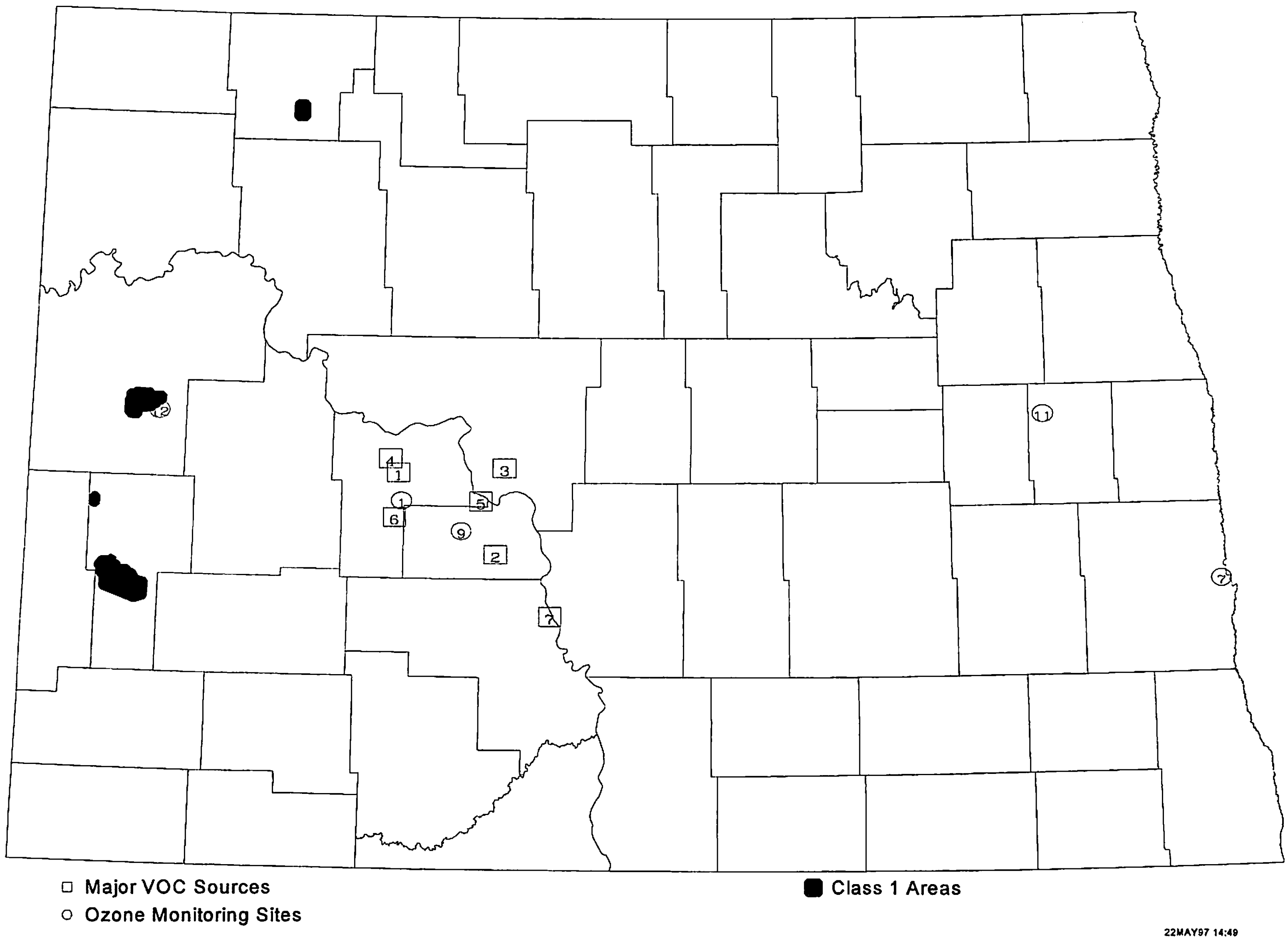

Figure 10 Major VOC Sources

TABLE 8

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : Ozone (PPB)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MAXIMA 1 - HOUR 1ST MM/DD/HH	1 - HOUR 2ND MM/DD/HH	1 - HOUR 3RD MM/DD/HH	8 - HOUR 1ST MM/DD/HH	8 - HOUR 2ND MM/DD/HH	8 - HOUR 3RD MM/DD/HH	1HR #>120	8HR #>80
BEULAH	1996	APR-SEP	4169 ***	62 07/15/16	62 08/24/12	62 05/28/16	60 08/31/18	59 08/31/17	59 08/31/16		
FARGO RESIDENTIAL	1996	JAN-DEC	8727	76 06/09/15	75 06/15/18	74 06/09/14	73 06/09/18	69 06/09/19	69 06/09/17		
HANNOVER	1996	JAN-DEC	8716	68 08/24/16	65 08/24/15	63 06/11/12	62 08/24/18	58 08/24/17	58 08/24/16		
SHARON	1996	JAN-DEC	8733	71 06/15/16	70 06/15/15	70 06/15/13	69 06/15/17	62 06/15/19	62 06/15/18		
TRNP - NU	1996	APR-SEP	3651 ***	64 08/28/15	63 08/24/16	62 05/28/15	61 08/31/18	60 08/31/17	60 08/31/20		

The maximum 1-hour concentration is 76 ppb at FARGO RESIDENTIAL on 06/09/15
The maximum 8-hour concentration is 73 ppb at FARGO RESIDENTIAL on 06/09/18

* The air quality standards for ozone are:
STATE - 120 ppb not to be exceeded more than once per year.

FEDERAL - 120 ppb with no more than one expected exceedance per year.

The two sites in the vicinity of the major VOC sources are not significantly differerent from the TRNP-NU site which is in a Class 1 area. However, the VOCs from the oil fields may have some effect on the O_3 levels at the TRNP - NU site.

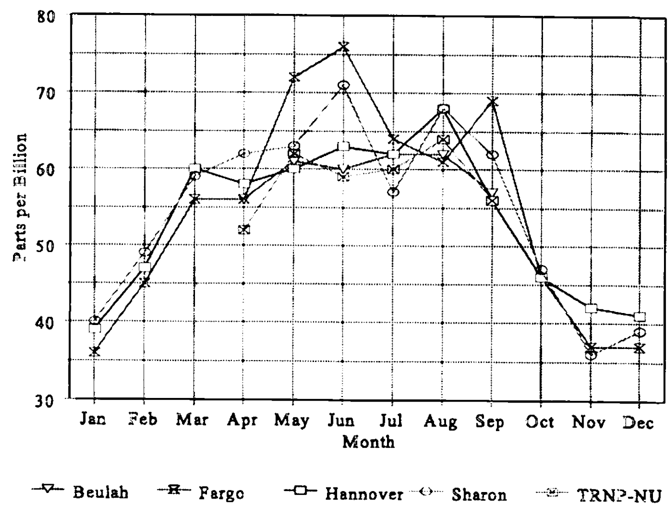

Figure 11 Maximum Ozone Concentrations

2.3.4 Network Analysis

Only one of the five state ozone monitoring sites is in an area not significantly influenced by VOC sources (see Figure 10). Beulah and Hannover are within 45 miles of all seven of the major VOC sources in the state. TRNP- NU is located in a Class I area surrounded by oil fields. Fargo Residential is located in Fargo and influenced by city traffic. Sharon is located in a rural community surrounded by crop land. With this diversity of site locations and influences, it would be expected to see a diversity of ozone concentrations. On the contrary, Figure 12 shows a significant similarity among the maximum 1-hour concentrations. Since 1980, there have been only two hours of data collect higher than 80 ppb and neither of these exceeded 100 ppb.

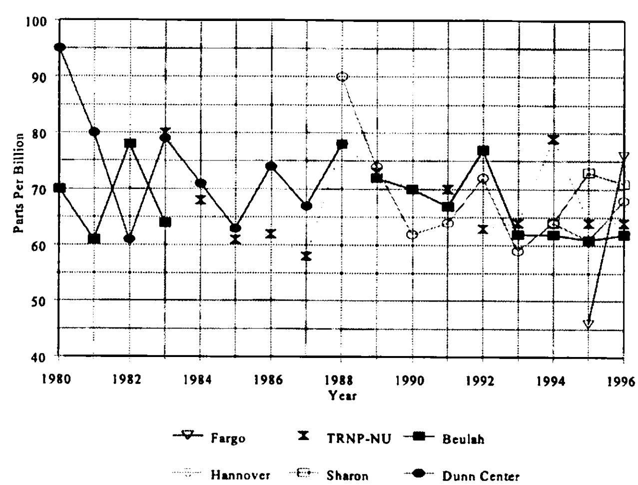

Figure 12. Maximum Ozone Concentrations

2.4 Inhalable Particulates

The inhalable particulate standard is designed to protect against those particulates that can be inhaled deep into the lungs and cause respiratory problems. These particulates have an aerodynamic diameter less than or equal to a nominal 10 microns and are designated as PM_{10}. Also, this section addresses the $PM_{2.5}$ data the department began collecting. A second $PM_{2.5}$ sampler was activated January 4 at Beulah.

2.4.1 Sources

The major PM_{10} point sources (>100 TPY) are listed in Table 9 along with their emissions as calculated from the most recent emissions inventories reported to the department. Figure 13 shows the approximate locations of these facilities (the numbers correspond to the respective positions in the site and source tables). Most of these sources are large coal-fired facilities, and the PM_{10} particles are part of the boiler stack emissions; however, some of the emissions are the result of processing operations. Not included in this table are sources of fugitive dust such as coal mines, gravel pits, agricultural fields, and unpaved roads

2.4.2 Monitoring Network

The State operates seven PM_{10} samplers at six sites and two $PM_{2.5}$ samplers; the Fargo site has collocated PM_{10} samplers. Since PM_{10} and smaller particles are of concern mainly because of their effects on people, monitoring efforts are concentrated in the state's population centers. Table 10 shows the inhalable PM_{10} particulate data summary and Table 11 shows the $PM_{2.5}$ particulate data summary.

Graseby Andersen Model 231-F $PM_{2.5}$ impactors are used on a PM_{10} sampler at the Bismarck and Beulah sites to collect $PM_{2.5}$ data. The first FRM $PM_{2.5}$ samplers will be colocated with the existing $PM_{2.5}$ samplers. This is necessary because the current samplers are from two different manufacturers: Grasebey-Anderson and Wedding. This side-by-side comparison will help validate the existing $PM_{2.5}$ data. The continuous $PM_{2.5}$ analyzer the Department expects to purchase this fall will most likely be placed at a site located in TRNP-SU. The details will be worked out with the U.S Park Service.

TABLE 9

Major PM_{10} Sources
(> 100 TPY)

1996

#	Name of Company	Type of Source	Location	County	PM_{10} Emissions Ton/Year
1	CPA/UPA (Coal Creek)	Steam Electric Gen. Facility	Underwood	Mc Lean	1282
2	Basin Electric Power Cooperative (AVS)	Steam Electric Gen. Facility	Beulah	Mercer	964
3	Amoco Oil Company	Oil Refinery	Mandan	Morton	604
4	Minnkota Power Coop.	Steam Electric Gen. Facility	Center	Oliver	594
5	Montana Dakota Utilities (Coyote Station)	Steam Electric Gen. Facility	Beulah	Mercer	558
6	Basin Electric Power Cooperative (Leland Olds)	Steam Electric Gen. Facility	Stanton	Mercer	544
7	Minn-Dak Farmers Coop.	Sugar Beet Processing Plant	Wahpeton	Richland	391
8	Dakota Gasification Co.	Synthetic Fuel Plant	Beulah	Mercer	246
9	American Crystal Sugar Co.	Sugar Beet Processing Plant	Drayton	Pembina	166
10	ND State University	Steam Heating Plant	Fargo	Cass	134

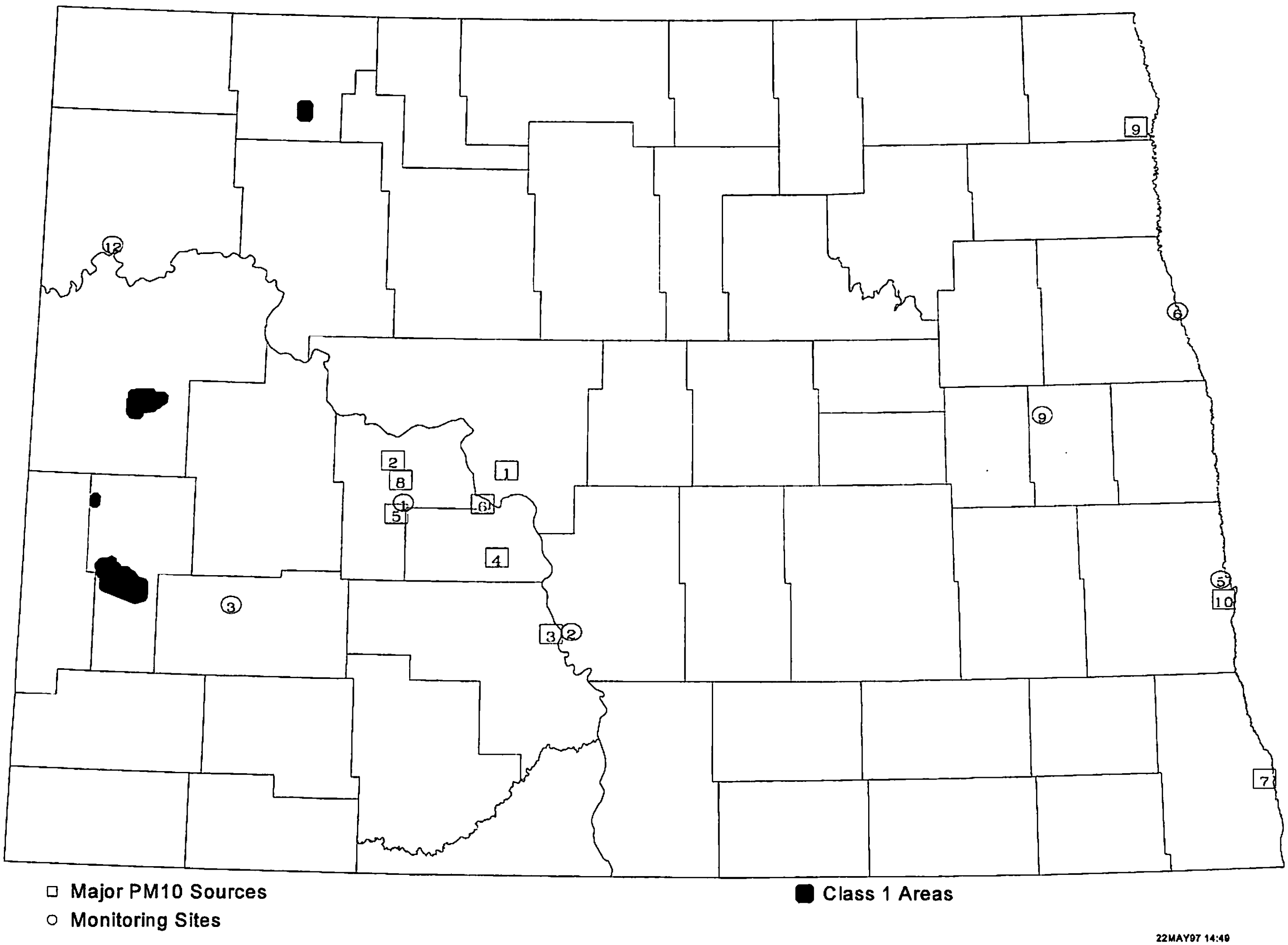

Figure 13. Major PM Sources$_{10}$

TABLE 10

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : Inhalable PM_{10} Particulates ($\mu g/m^3$)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAXIMA 24 - HOUR 1ST MM/DD	2ND MM/DD	3RD MM/DD	ARITH MEAN	#>150	AM>50	% >MDV
BEULAH	1996	JAN-DEC	61	4.4	79.3 06/08	45.3 11/05	23.2 04/09	15.2			100.0
BISMARCK RESIDENTIAL	1996	JAN-DEC	58	4.7	28.2 10/12	27.2 08/13	22.9 04/09	12.4			100.0
DICKINSON RESIDENTIAL	1996	JAN-DEC	58	0.0	51.2 12/29	23.3 10/12	23.2 08/13	8.8			81.0
FARGO RESIDENTIAL	1996	JAN-DEC	59	4.0	56.0 10/12	53.5 06/14	43.2 09/06	17.0			100.0
GRAND FORKS	1996	JAN-JUN	30 ***	7.7	40.9 06/14	27.6 06/26	23.7 01/04	15.2			100.0
GRAND FORKS - NORTH	1996	JUL-DEC	29 ***	4.2	96.3 10/12	52.8 08/31	49.0 09/06	23.6			100.0
SHARON	1996	JAN-DEC	61	0.2	57.9 05/27	37.7 05/03	37.4 10/12	13.4			86.8
WILLISTON RESIDENTIAL	1996	JAN-DEC	56	0.4	22.7 11/05	22.5 04/09	22.3 06/14	11.2			96.4

The maximum 24-hour concentration is 96.3 $\mu g/m^3$ at GRAND FORKS - NORTH on 10/12

* The STATE and FEDERAL air quality standards are:
1) 150 µg/m3 maximum averaged over a 24-hour period with no more than one expected exceedance per year.
2) 50 µg/m3 expected annual arithmetic mean.

*** Less than 80% of the possible samples (data) were collected.

TABLE 11

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : Inhalable $PM_{2.5}$ Particulates ($\mu g/m^3$)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAXIMA 24 - HOUR 1ST MM/DD	2ND MM/DD	3RD MM/DD	ARITH MEAN	% >MDV
BEULAH	1996	JAN-DEC	61	3.5	27.4 11/05	16.8 04/09	15.3 08/31	9.6	96.7
BISMARCK RESIDENTIAL	1996	JAN-DEC	57	3.3	20.1 08/13	17.1 04/09	16.9 08/31	9.8	98.2

The maximum 24-hour concentration is 27.4 µg/m3 at Beulah on 11/05

* Their is no standard in effect.

2.4.3 Network Analysis

All sites, with the exception of Sharon, are population oriented urban scale sites: Sharon is a background regional scale site. Each site is located within the city limits of the respective cities. The population of the cities range from 119 (Sharon) to over 100,00 in the Fargo, ND-Moorhead, MN area. With this population range, it would be expected to see a wide range in both 24-hour and annual averages as well as a stratification following city population. Figures 14and 15 show this is not the case. Figure 14 shows that Fargo maximums are about midrange while Bismarck, the third largest city, ranges from the highest ('87, '92, '93) to the lowest maximum ('96).

The annual means do demonstrate some stratification. Dickinson, Sharon and Williston are lower than Bismarck, Grand Forks, and Fargo. This stratification could be for two reasons. First, Dickinson, Sharon, and Williston are in predominatly farmland areas. Second, the reason for the higher average concentrations in Bismarck, Grand Forks, and Fargo is primarily due to anthropogenic activities like furnaces, gasoline engines, and fine dust particles from roadway surfaces. To help resolve this question, a PM_{10} sampler was added to the Beulah site which is a small city (pop. 3363) with three major sources within 10 miles. Also, many of the houses in town use coal for either primary or supplemental heat. If elevated concentrations are found in Beulah, it would be a good indication that combustion sources are the dominant source for fine particulates. Based on one year of data, combustion sources appear to be the major source of fine patriculates. However, North Dakota has had three exceptional events since 1987, and all three have been associated with higher than normal winds. Since the PM_{10} heads are not efficient at rejecting particulates larger than 10 microns in aerodynamic diameter, these events were most likely caused by loading the filters with oversized particles.

Figures 16 thrugh 19 present the Beulah and Bismark PM_{10}, $PM_{2.5}$, and $PM_{10}/PM_{2.5}$ ratios. In Figure 16, the 79.8 $\mu g/m^3$ on June 8 may be an anomly, but after the filters are cut for sulfate analysis, there is no way to recheck the weights. In Figures 17 and 19, ratios greater than 100% were set to 100%. Most of these occurrances are when the concentrations are less than 10 $\mu g/m^3$. The dark line in these graphs represent the average percentage difference. It is interesting the ratio averages are within 10% of each other.

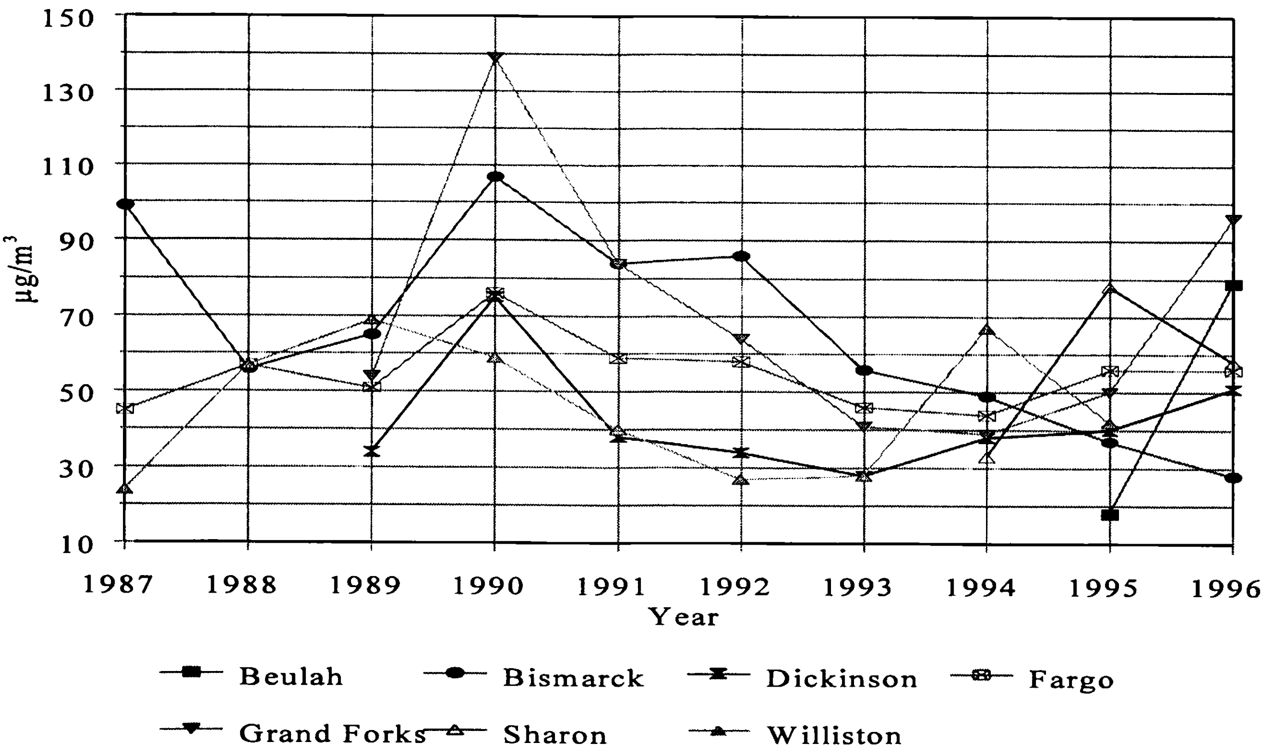

Figure 14 PM_{10} Maximum Concentrations

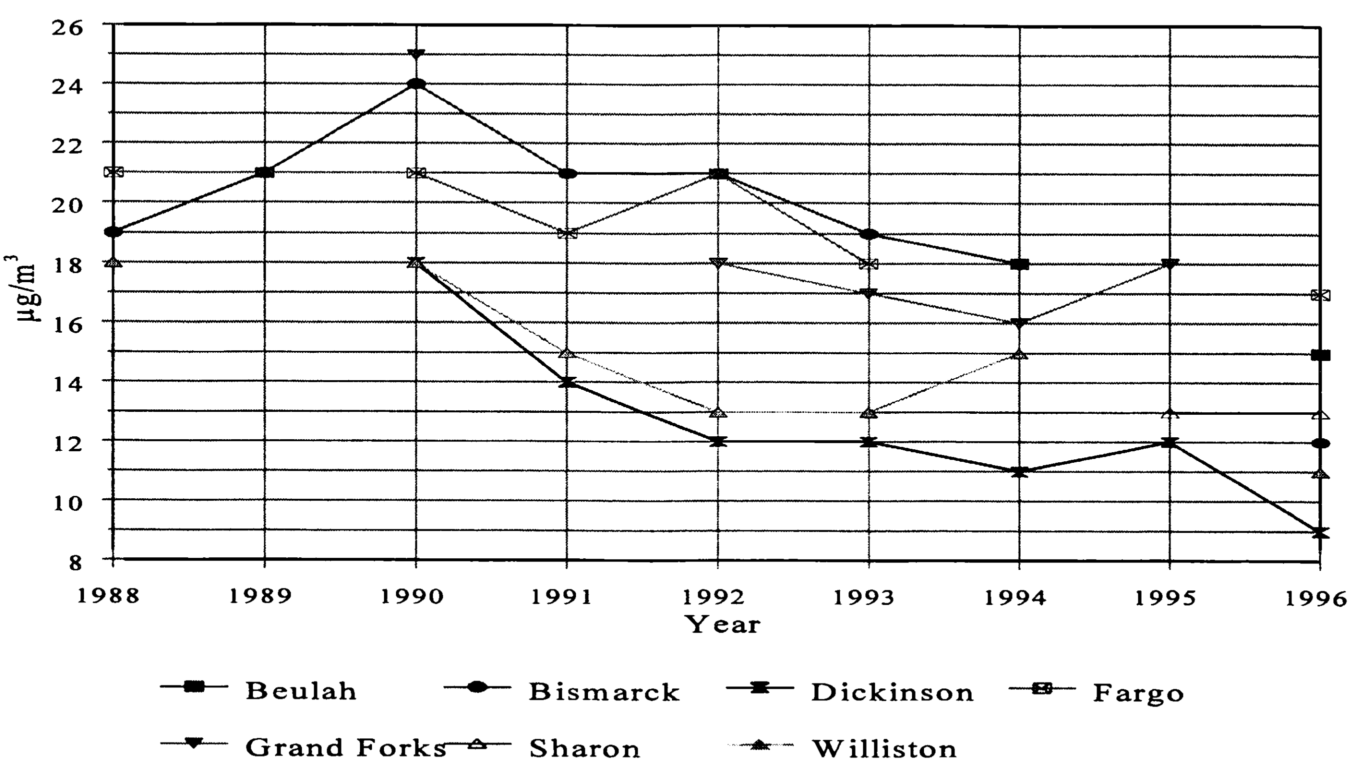

Figure 15 PM_{10} Annual Means

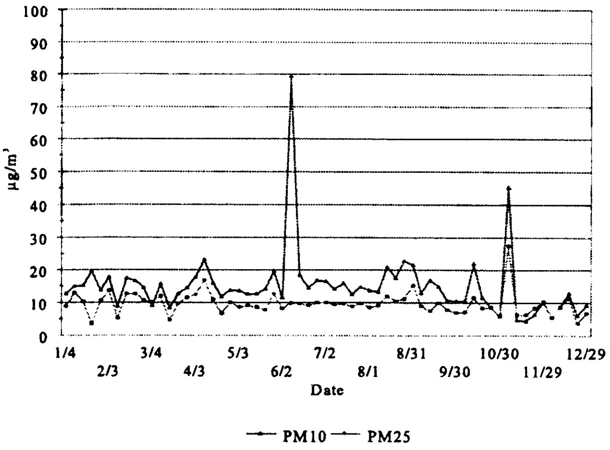

Figure 16 Beulah PM_{10} and $PM_{2.5}$ Data

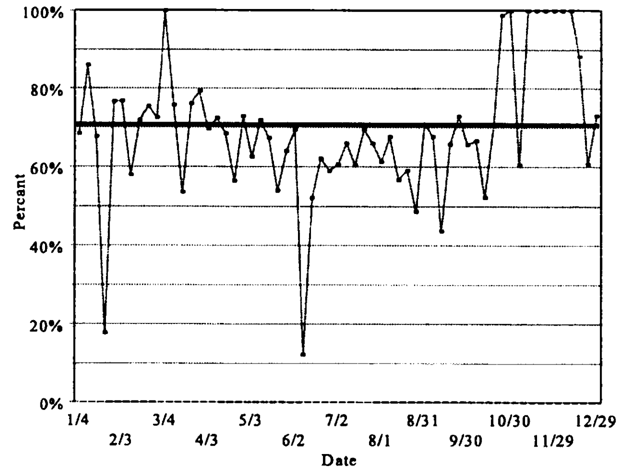

Figure 17 Beulah PM Ratio

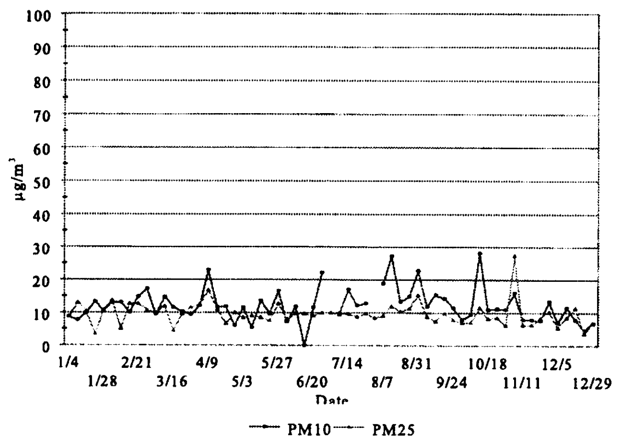

Figure 18 Bismarck PM_{10} and $PM_{2.5}$ Data

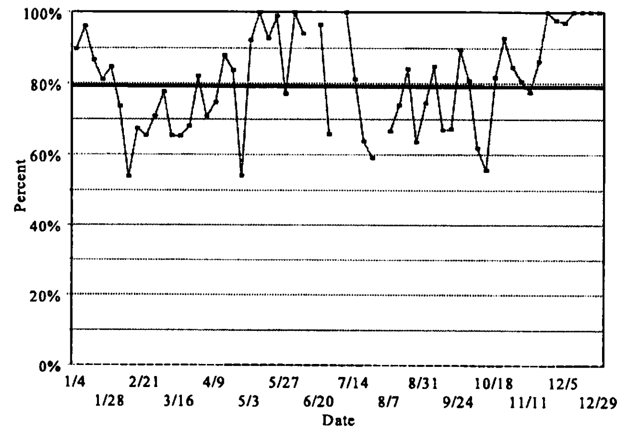

Figure 19 Bismarck PM Ratios

2.5 Carbon Monoxide

Many large urban areas in the United States have problems attaining the AAQS for carbon monoxide (CO) where the primary source of CO is automobiles. North Dakota does not have sufficient population with the corresponding traffic congestion and geographical/meteorological conditions to create significant CO emission problems. However, there are several stationary sources in the State that emit more than 100 TPY of CO.

2.5.1 Sources

The major stationary CO sources (>100 TPY) are listed in Table 12 along with their emissions as calculated from the most recent emissions inventories reported to the department. Figure 17 shows the approximate locations of these facilities (the numbers correspond to the respective positions in the site and source tables). Most of these sources are the same sources that are the major emitters of SO_2 and NO_x. However, the corresponding levels of CO from these sources are considerably lower.

2.5.2 Monitoring Network

Carbon monoxide monitoring in North Dakota was terminated March 31, 1994, after 5 years of operation. The conclusion drawn from the data was that North Dakota did not have a CO problem. A summary report was drafted for the Fargo-Moorhead Council of Governments for use in their traffic planning program.

TABLE 12

Major CO Sources
(> 100 TPY)

1996

#	Name of Company	Type of Source	Location	County	CO Emissions Ton/Year
1	Dakota Gasification Co.	Synthetic Fuel Gen. Plant	Beulah	Mercer	2124
2	Montana Dakota Utilities (Heskett Plant)	Steam Electric Gen. Plant	Mandan	Morton	1926
3	CPA/UPA (Coal Creek)	Steam Electric Gen. Facility	Underwood	Mc Lean	1818
4	Basin Electric Power Cooperative (AVS)	Steam Electric Gen. Facility	Beulah	Mercer	1294
5	Northern Sun	Oil Seed Processing	Enderlin	Ransom	1167
6	MINN-DAK Farmers	Sugar Beet Processing Plant	Wahpeton	Richland	1023
7	Minnkota Power Coop.	Steam Electric Gen. Facility	Center	Oliver	991
8	Montana Dakota Utilities (Coyote Station)	Steam Electric Gen. Plant	Beulah	Mercer	595
9	American Crystal Sugar Co.	Sugar Beet Processing Plant	Drayton	Pembina	369
10	American Crystal Sugar Co.	Sugar Beet Processing Plant	Hillsboro	Pembina	349
11	Basin Electric Power Coop. (Leland Olds)	Steam Electric Gen. Plant	Stanton	Mercer	348
12	Amerada Hess	Natural Gas Processing	Tioga	Williams	286
13	True Oil - Red Wing	Compressor Station	---	McKenzie	223

TABLE 12 (Cont.)

Major CO Sources
(> 100 TPY)

1996

#	Name of Company	Type of Source	Location	County	CO Emissions Ton/Year
14	Western Gas Resources - Temple Gas Plant	Natural Gas Processing Plant	McGregor	Williams	149
15	Interenergy Sheffield	Natural Gas Processing Plant	Lignite	Burke	139
16	Amoco Oil Co.	Oil refinery	Mandan	Morton	134
17	Koch Hydrocarbon - Tree Top	Compressor Station	---	Billings	130
18	University of North Dakota	Steam Heat	Grand Forks	Grand Forks	126
19	Koch Hydrocarbon - Demmik Lake	Compressor Station	---	McKenzie	123
20	Amerada Hess - Hawkeye Station	Compressor station	---	McKenzie	123
21	United Power Association	Steam Electric Gen. Facility	Stanton	Mercer	118
22	Koch Hydrocarbon - Alexander	Compressor Station	---	Billings	116
23	Koch Hydrocarbon - Mystry Creek	Compressor Station	---	Billings	107

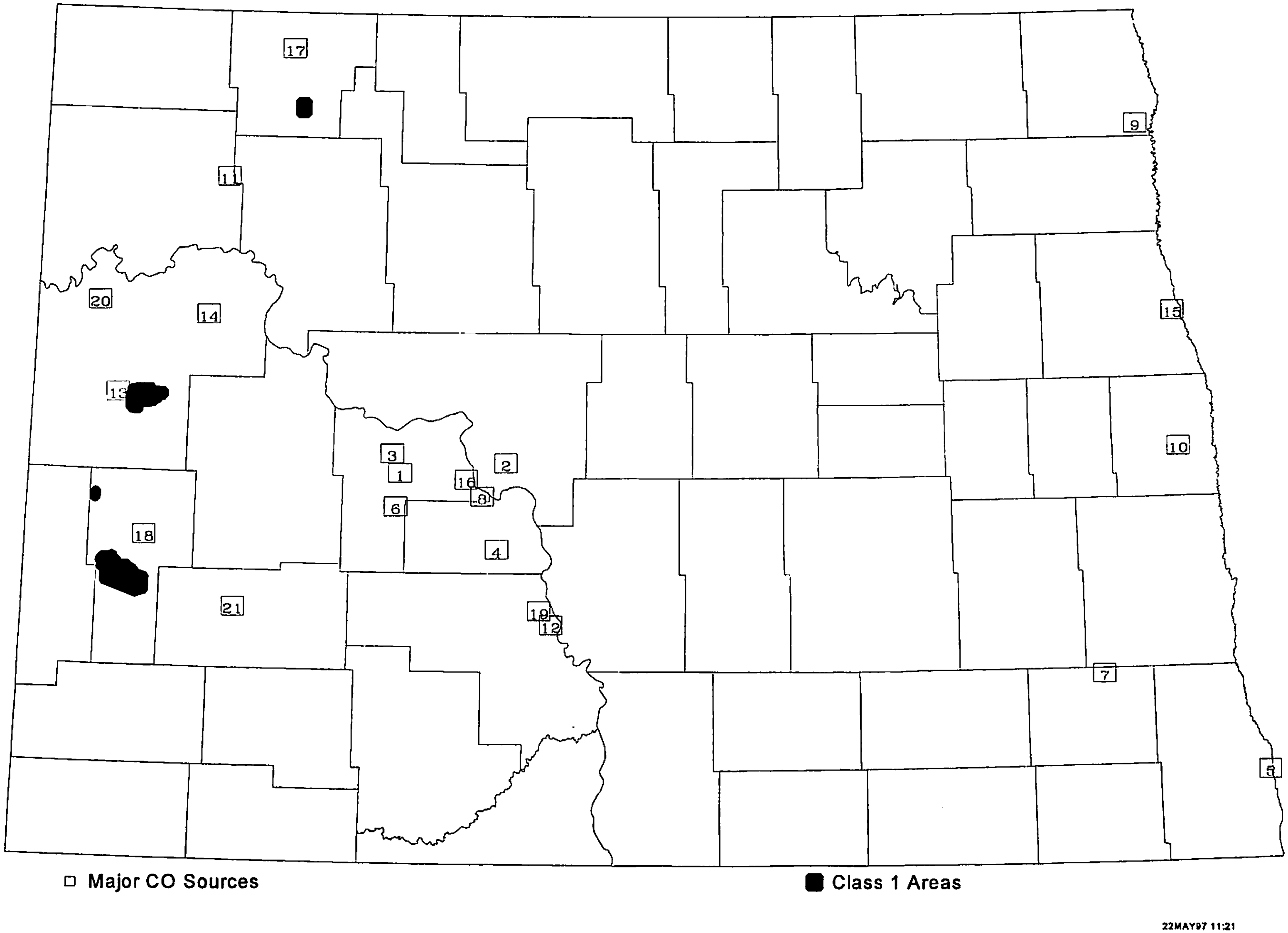

Figure 17. Major CO Sources

2.6 Lead

Through prior sampling efforts, the Department has determined that the State has low lead concentrations (38.6% of the standard) and no significant lead sources. This determination, coupled with the Federal requirement for a NAMS network only in urbanized areas with populations greater than 500,000, resulted in terminating the lead monitoring program effective December 31, 1983. Along with the low monitored concentrations, lead has been completely removed from gasoline since lead monitoring began in 1979.

2.7 Hydrogen Sulfide

Although no Federal Ambient Air Quality Standard exists for hydrogen sulfide (H_2S), the State of North Dakota has developed H_2S standards.

2.7.1 Sources

H_2S emissions of concern stems almost totally from the oil and gas operations in the western part of the State; principally from the green outlined area on Figure 2. Flares and treater stacks associated with oil/gas wells, oil storage tanks, compressor stations, pipeline risers, and natural gas processing plants are potential sources of H_2S emissions.

2.7.2 Monitoring Network

Currently two State-operated sites, TRNP-NU and Whiskey Joe - SPM, are monitoring for H_2S emissions. There are five industry-operated H_2S monitoring sites. Table 13 shows the 1996 H_2S data summaries.

TABLE 13

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : Hydrogen Sulfide (PPB)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MAXIMA 1 - HOUR 1ST MM/DD/HH	1 - HOUR 2ND MM/DD/HH	24 - HOUR 1ST MM/DD	24 - HOUR 2ND MM/DD	3 - MONTH 1ST MM	3 - MONTH 2ND MM	ARITH MEAN	1HR #>200	24HR #>100	% MDV
AMERADA HESS - TIOGA #2	1996	JAN-DEC	8645	378 08/26/09	209 08/26/10	34 08/26	12 04/16	2 02	2 11	1.8	2		17.5
KOCH - MGP #4	1996	JAN-DEC	5107 ***	124 04/23/09	56 04/23/10	9 04/23	7 01/06	2 01	2 11	2.0			25.4
LITTLE KNIFE #5	1996	JAN-DEC	8125	152 03/06/18	142 03/07/04	47 03/06	45 03/07	6 01	6 03	3.9			48.1
TRNP - NU	1996	JAN-DEC	8570	32 01/19/17	27 09/07/02	7 09/07	4 12/19	2 01	1 12	1.1			4.2
WHISKEY JOE - SPM	1996	JAN-DEC	6974 ***	300 10/17/01	295 05/12/23	54 06/03	49 11/01	14 09	12 11	11.4	16		39.5

The maximum 1-hour concentration is 378 ppb at AMERADA HESS - TIOGA #2 on 08/26/09
the maximum 24-hour concentration is 54 ppb at WHISKEY JOE - SPM on 06/03
The maximum 3-month concentration is 14 ppb at WHISKEY JOE - SPM on 09

* The State air quality standards are:
1) 10 ppm maximum instantaneous (ceiling) concentration not to be exceeded.
2) 200 ppb maximum 1-hour average concentration not to be exceeded more than once per month.
3) 100 ppb maximum 24-hour average concentration not to be exceeded more than once per year.
4) 20 ppb maximum arithmetic mean concentration averaged over three consecutive months.

*** Less than 80% of the possible samples (data) were collected.

Since there are four oil fields with relatively sour gas (1 - 8 % H_2S) just north of the park with some sour gas flaring, and considering some of the problems the department has encountered in these four oil fields, it was decided that a monitoring site was justified along the north boundary of the park. This H_2S data will aid in identifying sources emitting elevated H_2S concentrations. This site is expected to be terminated as soon as the Notice of Violation filed for the Federal 1-7 well owned by Slawson Exploration, Inc., is satisfied.

2.8 Inhalable Particulate Sulfates

Sulfates are any of a group of compounds that contain the sulfate ($SO_4^=$) ion. Sulfates are generally found as a fine partiulate with an aerometric diameter of 2.5 microns or less ($PM_{2.5}$).

2.8.1 Sources

Most sulfates are a secondary particulate, not directly emitted from a source, but created by oxidation of SO_2. Sulfur dioxide can be transformed to $SO_4^=$ by several atmospheric chemical reactions. These various reactions involve water vapor, ozone, hydrocarbons, peroxides or free radicals. Sulfates can be directly emitted from application of fertilizers and some industral sources. Atmospheric sulfates usually exist as sulfuric acid or ammonium sulfate.

2.8.2 Monitoring Network

The State operates seven PM_{10} and two $PM_{2.5}$ samplers at six sites; the Fargo site has collocated samplers. Since sulfates have health effects such as decreased lung function in excercising adolescent asthmatics, efforts are concentrated in the state's population centers. Also, fine particulate sulfate is efficient at scattering light: thus a factor in visibility degradation. Even at concentrations as low as 3 $\mu g/m^3$, sulfate will affect visibility. Tables 14 and 15 show the inhalable particulate sulfate data summaries with Tables 16 and 17 showing the ratios of sulfates to total mass for each sample.

2.8.3 Network Analysis

All sites, with the exception of Sharon, are population oriented urban scale sites: Sharon is a backgrpound regional scale site. Each site is located within the city limits of the respective cities. The population of the cities range from 119 (Sharon) to over 100,000 in the Fargo-Moorhead, MN area. The pattern seen in both averaging periods for the four highest concentrations for the PM_{10} and $PM_{2.5}$ samples closely follows the proximity of major sources/high-sulfur fuel usage sources. For the PM_{10} sulfates, only three of the sites met the 75% data recovery criteria for calculating unbiased statistics and all three of these sites are in the top four sites for both 24-hour and annual averages. For the $PM_{2.5}$ sulfates, both sites met the 75% data recovery for calculating statisitcs. The samplers at Beulah are within eight miles of three major point sources and 32 miles of eight major point sources. Also, many homes in Beulah use coal as either primary or supplemental heat during the heating season.

Ratios were calculated for data pairs only when both samples were greater than the minimum detectable for the analysis method. The ratios for the 24-hour PM_{10} sulfates to PM_{10} total mass range from 87.2% to 1.9%. The averages for all samples collected range from to 13.1% to 20.7%. The highest 24-hour and annual average ratio for sites collecting at least 75% of possible samples is at Beulah. The $PM_{2.5}$ sulfates to $PM_{2.5}$ total mass appears to reflect the proximity to major sources. The Bismarck site is within seven miles, East-southeast of two major SO_2 point sources. A factor that is not considered is the effect of the combinations of chemical reactions that may occur in the sulfate formation process. Because the necessary information to quanitify the speed of transformation from SO_2 to $SO_4^{=}$, this process is not addressed.

With the limited amount of data avialable, the most suprising information is the average sulfate concentrations for the Beulah and Bismarck PM_{10} and $PM_{2.5}$ samplers are similar. With that similarity, one would expect the ratios for the $PM_{2.5}$ samplers to be much higher. The Bismarck site appears to exhibit this trait, however, less than 75% of the possible data is available, making a valid comparison impossible.

Table 14

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : PM_{10} Sulfate (µg/m3)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAXIMA 1ST MM/DD	MAXIMA 2ND MM/DD	MAXIMA 3RD MM/DD	ARITH MEAN	#>15.	AM>5.	% >MDV
BEULAH	1996	JAN-DEC	51	0.3	39.5 11/05	8.0 12/17	7.5 04/09	2.8	1		98.0
BISMARCK RESIDENTIAL	1996	APR-DEC	37 ***	0.4	4.3 08/31	4.1 11/29	3.4 12/11	1.5			94.5
DICKINSON RESIDENTIAL	1996	MAR-DEC	38 ***	0.3	3.4 12/23	3.3 03/22	3.3 04/03	1.4			94.7
FARGO RESIDENTIAL	1996	MAR-DEC	47	0.3	11.7 09/06	8.0 08/31	5.2 08/19	1.9			95.7
GRAND FORKS	1996	MAR-MAY	11 ***	0.5	2.9 04/09	2.3 04/21	2.1 03/22	1.7			100.0
GRAND FORKS - NORTH	1996	JUL-DEC	29 ***	0.3	9.9 09/06	6.8 08/31	4.4 08/19	2.0			86.2
SHARON	1996	JAN-DEC	51	0.1	9.1 08/31	5.1 12/11	4.0 09/06	1.7			92.1
WILLISTON RESIDENTIAL	1996	JAN-DEC	36 ***	0.3	5.0 11/05	2.6 11/14	2.3 09/18	1.3			94.4

The maximum 24-hour concentration is 39.5 µg/m3 at BEULAH on 11/05

* No standard is currently in effect.

*** Less than 80% of the possible samples (data) were collected.

Table 15

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : $PM_{2.5}$ Sulfate (µg/m3)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAXIMA 1ST MM/DD	MAXIMA 2ND MM/DD	MAXIMA 3RD MM/DD	ARITH MEAN	#>15.	AM>5.	% >MDV
BEULAH	1996	JAN-DEC	49	0.3	15.5 11/05	7.5 12/17	6.5 04/09	2.3	1		97.9
BISMARCK RESIDENTIAL	1996	JAN-DEC	49	0.0	9.5 11/29	4.1 12/29	3.9 12/05	1.7			89.8

The maximum 24-hour concentration is 15.5 µg/m3 at BEULAH on 11/05

* No standard is currently in effect.

Table 16

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : PM_{10} Sulfate/PM_{10} Total Mass Ratio (PERCENTAGE)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAXIMA 1ST MM/DD	MAXIMA 2ND MM/DD	MAXIMA 3RD MM/DD	ARITH MEAN	#>15.	% >MDV
BEULAH	1996	JAN-DEC	50	2.2	87.2 11/05	62.0 12/17	41.9 12/11	18.6		0.0
BISMARCK RESIDENTIAL	1996	APR-DEC	35 ***	2.9	30.6 11/29	29.3 12/11	26.5 12/29	14.7		0.0
DICKINSON RESIDENTIAL	1996	MAR-DEC	28 ***	2.9	66.7 12/23	57.5 11/29	56.9 04/03	20.7		0.0
FARGO RESIDENTIAL	1996	MAR-DEC	45	1.9	35.8 04/03	34.3 03/28	32.7 12/11	13.1		0.0
GRAND FORKS	1996	MAR-MAY	11 ***	4.6	24.2 04/21	23.6 04/03	21.9 03/22	13.7		0.0
GRAND FORKS - NORTH	1996	JUL-DEC	25 ***	2.1	39.7 12/17	26.2 12/23	25.3 12/11	12.2		0.0
SHARON	1996	JAN-DEC	42 ***	2.2	46.0 04/15	40.5 12/11	39.0 01/10	16.9		0.0
WILLISTON RESIDENTIAL	1996	JAN-DEC	31 ***	2.5	31.3 02/21	29.8 01/04	29.3 12/18	16.0		0.0

The maximum 24-hour ratio is 87.2 percent at BEULAH on 11/05

* No standard is currently in effect.

*** Less than 80% of the possible samples (data) were available.

Table 17

COMPARISON OF AIR QUALITY DATA WITH
THE NORTH DAKOTA AMBIENT AIR QUALITY STANDARDS *

POLLUTANT : $PM_{2.5}$ Sulfate/PM_{25} Total Mass Ratio (PERCENTAGE)

LOCATION	YEAR	SAMPLING PERIOD	NUM OBS	MIN	MAXIMA 1ST MM/DD	MAXIMA 2ND MM/DD	MAXIMA 3RD MM/DD	ARITH MEAN	#>15..	% >MDV
BEULAH	1996	JAN-DEC	46	4.5	65.8 12/17	56.6 11/05	38.7 04/09	21.8		0.0
BISMARCK RESIDENTIAL	1996	JAN-DEC	43 ***	3.9	72.5 11/29	57.4 12/05	55.4 12/29	20.2		0.0

The maximum 24-hour ratio is 72.5 percent at BISMARCK RESIDENTIAL on 11/29

* No standard is currently in effect.

*** Less than 80% of the possible samples (data) were available.

3.0 SUMMARY AND CONCLUSIONS

The North Dakota Ambient Air Quality Monitoring Network is designed to monitor those air pollutants which demonstrate the greatest potential for deteriorating the air quality of North Dakota. Due to a greater number of pollution producing sources in the western part of the State (primarily associated with the energy producing industries) the greatest percentage of the network is located in the western part of the State.

3.1 Sulfur Dioxide (SO_2)

Neither the State nor Federal standards were not exceeded at any monitoring site. The maximum concentrations and the maximum concentrations expressed as a percentage of the applicable standard are as follows: 1-hour - 229 ppb (83.9%); 3-hour - 170 ppb (34.0%); 24-hour - 79 ppb (79.8%); annual (partial year) - 1.4 ppb (6.4%); annual (full year) - 6.7 ppb (29.1%).

There is no SO_2 5-minute standard currently in effect. The maximum 5-minute average was 398 ppb.

3.2 Nitrogen Dioxide (NO_2)

Neither the State nor Federal standards were exceeded at any of the monitoring sites. The maximum concentrations and the maximum concentrations expressed as a percentage of the applicable standard are as follows: annual (partial year) - 7.4 ppb (14.0%); annual (full year) - 7.9 ppb (14.9.0%).

3.3 Ozone (O_3)

Neither the State nor Federal standard was exceeded during the year. The maximum concentration and the maximum concentration expressed as a percentage of the applicable standard is 76 ppb (63.3%).

3.4 Inhalable Particulates

Neither the State nor Federal PM_{10} standards were exceeded during the year. The maximum concentrations and the maximum concentrations expressed as a percentage of the applicable PM_{10} standard are as follows: 24-hour - 96.3 $\mu g/m^3$ (64.6%); annual (partial year) - 23.6 $\mu g/m^3$ (47.2%); annual (full year) - 15.2 $\mu g/m^3$ (30.4%).

There is no $PM_{2.5}$ standard currently in effect. The maximum 24-hour average $PM_{2.5}$ concentration was 27.4 $\mu g/m^3$.

3.5 Carbon Monoxide (CO)

No monitoring was conducted.

3.6 Lead

No monitoring was conducted.

3.7 Hydrogen Sulfide

There were no exceedances of any of the standards. The maximum concentrations and the maximum concentrations expressed as a percentage of the applicable standard are as follows: 1-hour - 378 ppb (189%); 24-hour - 54 ppb (54%); 3-month - 14 ppb (70%).

3.8 Inhalable Particulate Sulfates

Thare are no inhalable particulate sulfate standards. The maximum PM_{10} 24-hour and annual concentrations are 39.5 $\mu g/m^3$ and 2.8 $\mu g/m^3$, respectively The maximum $PM_{2.5}$ 24-hour and annual concentrations are 15.5 $\mu g/m^3$ and 2.4 $\mu g/m^3$, respectively.

Table 18 summarizes the evaluations for each of the sites in the State network. The justification for each site is contained in the AIRS-AQS data subsystem on the site level records. Justification for each parameter at each site is contained in the monitor level records.

TABLE 18
Monitoring Site Evaluation

Site	Parameter*	Meets Needs	Modification Needed	New Site Needed	Parameter Not Needed	Date Deleted
Beulah Residential	SO_2	X				
	NO_2	X				
	O_3	X				
	$PM_{2.5}$	X				
	PM_{10}	X				
	MET	X				
Bismarck Residential	PM_{25}	X				
	PM_{10}	X				
Dickinson Residential	PM_{10}	X				
Dunn Center Rural	SO_2	X				
	MET	X				
Fargo Residential	PM_{10}	X				
	SO_2	X				
	NO_2	X				
	O_3	X				
	MET	X				
Sharon	SO_2	X				
	NO_2	X				
	O_3	X				
	MET	X				
	PM_{10}	X				
Grand Forks Commercial	PM_{10}			X		
Hannover Rural	SO_2	X				
	NO_2	X				
	O_3	X				
	MET	X				
Mandan Refinery (SPM)	SO_2	X				
	SO_2 (5-min)	X				
	MET	X				
TRNP-NU	SO_2	X				
	O_3	X				
	H_2S	X				
	MET	X				
TRNP-SU (Whiskey Joe - SPM)	SO_2	X				
	H_2S	X				
	MET	X				
Williston Commercial	PM_{10}			X		08/16
Williston Residential	PM_{10}	X				

* MET refers to meteorology and indicates wind speed and wind direction data are available from those sites.