Annual Report

North Dakota
Ambient Air Quality Monitoring Program

Network Plan/Assessment
with
Data Summary

2024

NORTH Dakota Be Legendary.™

Environmental Quality

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Ambient Monitoring
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DRAFT

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Environmental Quality

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ACRONYMS AND ABBREVIATIONS

- AQM – Ambient Air Quality Monitoring
- AQS – Air Quality System
- BAM – Beta Attenuation Particulate Monitor
- BART – Best Available Retrofit Technology
- CFR – Code of Federal Regulations
- CO – Carbon Monoxide
- CSN – Chemical Speciation Network
- DRR – Data Requirements Rule
- EPA – United States Environmental Protection Agency
- FEM – Federal Equivalent Method
- FRM – Federal Reference Method
- GIS – Geographic Information System
- H_2S – Hydrogen sulfide
- H_2SO_3 – Sulfurous acid
- H_2SO_4 – Sulfuric acid
- HAP – Hazardous Air Pollutant
- IMPROVE – Interagency Monitoring of Protected Visual Environments
- MSA – Metropolitan Statistical Area
- NAAMS – National Ambient Air Monitoring Strategy
- NAAQS – National (also North Dakota) Ambient Air Quality Standards
- NCore – National Core Monitoring Network
- NH_3 – Ammonia
- NO – Nitric oxide
- NO_2 – Nitrogen dioxide
- NO_x – Oxides of Nitrogen
- NO_y – Total Reactive Nitrogen
- NPS – National Park Service
- NTN – National Trends Network
- NWR – National Wildlife Refuge
- O_3 – Ozone
- PM – Particulate Matter
- PM_{10} – Particulate Matter less than 10 microns in diameter
- $PM_{2.5}$ – Particulate Matter less than 2.5 microns in diameter (fine particulate matter)
- $PM_{10-2.5}$ - Particulate Matter between 2.5 and 10 microns in diameter (coarse particulate matter)
- ppb – parts per billion
- PSD – Prevention of Significant Deterioration
- SLAMS – State and Local Air Monitoring Stations
- SO_2 – Sulfur dioxide
- SPM – Special Purpose Monitoring
- STN – Speciation Trends Network
- TAD – Technical Assistance Document
- Teledyne T640 – Light Sensing PM Monitor
- TEOM – Tapered Element Oscillating Microbalance
- TRNP – Theodore Roosevelt National Park (NU – North Unit; SU – South Unit at Painted Canyon)
- TPY – Tons Per Year
- UV - Ultraviolet
- VOC – Volatile Organic Compound

1.0 INTRODUCTION

The North Dakota Department of Environmental Quality (Department), Division of Air Quality (Division)[1], 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 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 (NAAQS)[2] and the Prevention of Significant Deterioration of Air Quality (PSD) Rules.

To carry out this responsibility, the Division operates and maintains a network of ambient air quality monitoring (AQM) sites throughout the state[3].

The Division conducts an annual review of the network to determine if all federal monitoring requirements as set forth in 40 CFR 58[4] are being met. This document is an account of the review and demonstrates that siting and operation of each monitor in the network meets the requirements of appendices A, B, C, D, and E of the part, where applicable. The annual review also serves to identify any network modifications that are necessary to meet federal requirements. Modifications could include the establishment of new sites, relocation of sites to more appropriate areas, or the removal of sites where the original justification for the site no longer exists. Modifications described in this report are proposed for a period within 18 months of report publication.

Additionally, every five years the Division completes a longer-range assessment to assure that the network has and will continue to meet all its monitoring obligations. The five-year assessment allows for the evaluation of future possible expansions or retractions of the network and the possible incorporation of new technologies.

Each year, the Division completes a data summary report for the previous 12-month calendar year data collection season. In the past, this report was issued as a separate document from the network review. Upon inspection, it was found that much of the information included in the data summary report duplicates what was included in the network review. To avoid duplication of effort, beginning in 2015, the data summary for state run AQM sites was combined with the network review resulting in one single comprehensive annual report document[5].

[1] See Appendix A of this report for an organizational chart for the Division.
[2] See Appendix B of this report for a summary table of all applicable federal and state ambient air quality standards.
[3] See Appendix C of this report for a full description for each site, site photographs, and a site map.
[4] The Code of Federal Regulations - 40 CFR 58 was promulgated by the Environmental Protection Agency (EPA) on October 17, 2006, and includes subsequent updates.
[5] This report is subject to 30 days of public comment before finalization. See Appendix F of this report for applicable public comments received.

1.1 Site Selection

1.1.1 Monitoring Objectives

The AQM network consists of a number of individual sites located throughout North Dakota which host the equipment needed to measure pollution concentrations in the air. The process of selecting a monitoring site begins by identifying a monitoring objective. Appendix D of 40 CFR 58 defines the six basic monitoring objectives used to choose the locations of sites in a monitoring program:

- To determine the highest pollutant concentrations expected to occur in an area covered by the network.
- To determine representative concentrations of pollutants in areas of high population density.
- To determine the impact on ambient pollution levels by a significant source or source categories[6].
- To determine the general/background concentration levels of a given pollutant.
- To determine the impact on air quality by regional transport[7] of pollutants.
- To determine the welfare-related impacts (such as impacts on visibility and vegetation) of pollution.

1.1.2 Spatial Scale

Once an objective for a site has been identified, a spatial scale is chosen. EPA has defined a set of spatial scales based on physical dimensions that, given a particular objective, would be likely to have similar pollutant concentrations throughout. These are:

- **Micro-scale**
  – 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 kilometers (km).
- **Neighborhood Scale**
  – City areas of relatively uniform land use with dimensions of 0.5 to 4.0 km.

[6] Sources of interest could be point sources (a major industrial facility), area sources (a number of smaller emissions sources that collectively impact ambient air quality), or mobile sources (automobiles on a busy roadway or non-road sources including aircraft, construction vehicles, farm equipment, etc.)
[7] In this case, regional transport refers to the movement of air pollutants that originate from sources outside the borders of North Dakota into areas within the state.

- **Urban Scale**
  – Overall, city-wide dimensions on the order of 4 to 50 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.
- **National or Global Scale**
  – The entire nation or greater.

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

Monitoring Objective	Appropriate Siting Scales
Highest Concentration	Micro, middle, neighborhood, (sometimes urban or regional for secondarily formed pollutants).
Population Oriented	Neighborhood, urban.
Source Impact	Micro, middle, neighborhood.
General/Background	Urban, regional.
Regional Transport	Urban, regional.
Welfare-related Impacts	Urban, regional.

Spatial scales appropriate to the criteria pollutants monitored in North Dakota are shown below[8]:

Criteria Pollutant	Spatial Scales
Inhalable Particulate	Micro, middle, neighborhood, urban, Regional.
Sulfur Dioxide	Middle, neighborhood, urban, regional.

[8] Carbon monoxide (CO) is also monitored at the North Dakota National Core (NCore) site in order to meet federal requirements. Appendix D to 40 CFR 58 does not identify an urban spatial scale (4 to 50 kilometers) for Carbon Monoxide because this pollutant is primarily associated with automobile traffic on a neighborhood or smaller scale. However, because the CO monitor is present to satisfy NCore specific requirements, it has historically been considered by the Department to be an urban scale monitor in alignment with the other monitors at the site.

Ozone	Middle, neighborhood, urban, regional.
Nitrogen Dioxide	Middle, neighborhood, urban.

A good understanding of the appropriate monitoring objective and spatial scale permits a site location to be chosen. Using these criteria 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 assessing each site and associated monitors to confirm that all still meet their intended purpose. Sites and/or monitors that no longer satisfy the intended purpose are either discontinued or modified accordingly.

1.2 General Monitoring Needs

Each air pollutant has certain characteristics that must be considered when establishing a monitoring site. These characteristics may result from:

(A) Variations in the number and types of sources and emissions in question;
(B) Reactivity of a particular pollutant with other constituents in the air;
(C) Local site influences such as terrain and land use; and
(D) Climatology.

The Department's AQM network is designed to monitor air quality data for six basic objectives:

(1) Monitoring of criteria pollutant background concentrations;
(2) Quantifying population exposure to pollutants;
(3) Monitoring significant sources of pollutants or class category;
(4) Long-range transport of pollutants;
(5) Regional haze; and
(6) Air quality characterization for attainment designations.

The 2008 National Ambient Air Monitoring Strategy (NAAMS[9]) establishes a monitoring site classification system for the national AQM network. State and Local Monitoring Stations (SLAMS) make up the primary component for determining criteria pollutant NAAQS compliance. The Department operates eight ambient air quality monitoring sites in North Dakota (Figure 1). A ninth site, the Theodore Roosevelt National Park – South Unit site at Painted Canyon (TRNP – SU), is operated by the Department in partnership with the National Park Service (NPS). All of the state operated sites and the partnership site at Painted Canyon have been designated SLAMS sites[10].

[9] U.S. EPA (2008). Ambient Air Monitoring Strategy for State, Local, and Tribal Air Agencies. Available via link at: Ambient Air Monitoring Strategy for State, Local, and Tribal Air Agencies | US EPA.
[10] See Appendix C of this report for specific information on the location of each monitoring site.

Additionally, one site (Hess Tioga Station B - Northeast) has been established as a SLAMS-like site[11] in order to characterize air quality in Williams County in response to the Data Requirements Rule (DRR) for the 2010 1-hour SO_2 NAAQS. This site is operated by industry and overseen by the Department.

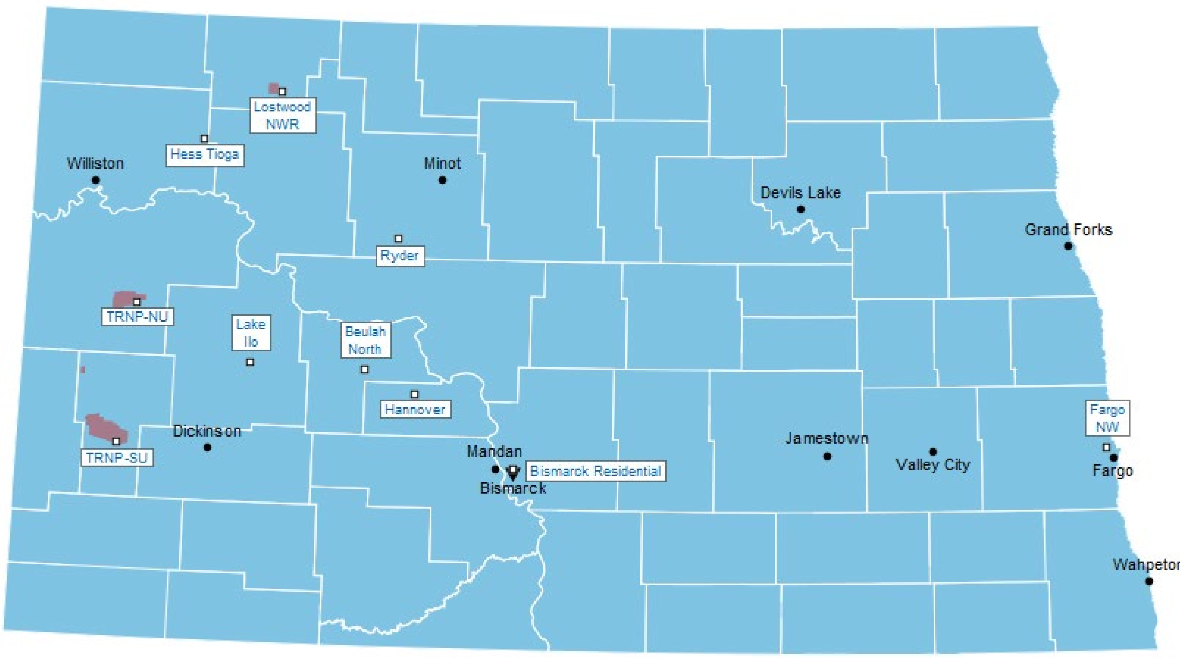


Figure 1. North Dakota Ambient Air Quality Monitoring Sites
(Indicated with White Labels)

A National Core (NCore) site is one in a network of approximately 80 multi-pollutant monitoring sites throughout the United States designed to support specific EPA core monitoring objectives in public reporting, emissions trends tracking, and NAAQS compliance evaluation. Each state is required to have one or more NCore designated sites. In addition to being a SLAMS site, EPA has approved the Department's moving of the NCore site in 2017 and has designated the Bismarck Residential site as the required NCore site in North Dakota[12].

[11] Monitors operated in a manner equivalent to SLAMS as to meet all applicable requirements of 40 CFR 58, appendices A, C, and E, and subject to the data certification and reporting requirements of 40 CFR 58.15 and 58.16.
[12] Previously the Fargo NW site was the North Dakota designated NCore site.

The Bismarck site is also a part of EPA's Chemical Speciation Network (CSN) as a trends site. The Speciation Trends Network (STN; a subset of the CSN) was established to monitor long term trends in concentration of selected particulate matter constituents. The NAAMS document provides additional information regarding these national networks.

1.3 Network Monitoring Objectives

As described in section 1.1, each monitoring site is selected to satisfy certain monitoring objectives. Additionally, 40 CFR 58 outlines certain conditions whereby EPA has determined a particular type of monitor is required to satisfy a given monitoring objective. The monitoring sites in North Dakota can be divided into three categories: 40 CFR 58 required (3 sites), supplemental (6 sites), and 40 CFR 51 DRR required (1 site). The Department's three required Part 58 sites are:

> The **Bismarck** monitoring site lies in the second largest metropolitan area in North Dakota. Bismarck is the designated NCore and Chemical Speciation Trends site. This site is designed to satisfy the requirements of 40 CFR 58 Appendix D 3.0 – Design Criteria for NCore Sites, and 4.7 – Fine Particulate Matter ($PM_{2.5}$) Design Criteria.
>
> The **Fargo NW** site has been designated a population orientated site because the city of Fargo is the largest population center in North Dakota and several major emissions sources are located in the area. The data from the Fargo site are used in dispersion modeling to evaluate construction and operating permit applications for projects located in the eastern part of the state. Additionally, Fargo monitors meet the requirement of 40 CFR 58 Appendix D 4.4 – Sulfur Dioxide (SO_2) Design Criteria.
>
> The **Theodore Roosevelt National Park North Unit (TRNP-NU)** site is used to evaluate background concentrations, long-range transport, and welfare-related impacts of pollutants. Monitors at this site help to meet the requirements of 40 CFR 58 Appendix D 4.7 – Fine Particulate Matter ($PM_{2.5}$) Design Criteria.

The six supplemental sites are used to support air dispersion model calibration and/or validation and to supplement data collected at the required sites. Monitoring objectives for the entire network are outlined in Table 1.

The Department is in the process of establishing a new Ambient Air Quality Monitoring Station sited in the northeast portion of North Dakota. This new site will help evaluate background concentrations, long-range transport, and welfare-related impacts of pollutants.

Background, welfare-related and long-range transport sites are chosen to determine concentrations of air contaminants in areas remote from urban sources. These are generally sited using the regional spatial scale. Once a specific location is selected for a site, the site is established in accordance with the specific sitting criteria specified in 40 CFR 58, Appendices A, C, D and E.

The Department evaluates any monitoring requirements and site changes needed to support the visibility regulations in 40 CFR 51.300, 40 CFR 51.308 (visibility and regional haze rules) and 40 CFR 51, Appendix Y (Best Available Retrofit Technology, BART).

Table 1. Ambient Air Quality Monitoring Network Description

Site Name AQS* Site Number	Parameter Monitored										Monitoring Objective
	CO	NO_2	O_3	Manual $PM_{2.5}$	Continuous $PM_{2.5}$	Continuous PM_{10}	SO_2	PM_{fine} Speciation	NO_y	Wind Speed & Direction	
1 Beulah North 380570004		★	★		★	★	★			★	Population Exposure & Significant Source
2 Bismarck Residential 380150003	★	★	★	★	★	★	★	★	★	★	Population Exposure (NCore)
3 Lake Ilo 380250004		★	★		★	★	★			★	General Background
4 Fargo NW 380171004		★	★		★	★	★			★	Population Exposure
5 Hannover 380650002		★	★		★	★	★			★	Source Impact
6 Lostwood NWR 380130004		★	★		★	★	★			★	General Background & Significant Source
7 Painted Canyon 380070002			★		★		★			★	General Background
8 Ryder 381010003		★	★		★	★	★			★	Population Exposure & Long-range Transport
9 TRNP – NU 380530002		★	★		★	★	★			★	General Background, Long-range Transport, & Welfare-related
10 Hess Tioga B – NE 381050106							★			★	Source Specific, DRR air quality characterization

* Air Quality System – EPA's computer database and information system of ambient air quality data.

2.0 AMBIENT AIR MONITORING NETWORK COVERAGE

The ambient air quality monitoring sites in the state are positioned to satisfy the monitoring objectives (described in Section 1.3 of this report), to collect data to support dispersion modeling activities relating to visibility/regional haze and source permit evaluation, and to compare to the State and Federal ambient air quality standards.

The NAAQS[13] are established by EPA in order to meet the requirements of the Clean Air Act and address concentrations of six criteria pollutants in the ambient air. The following sections describe the pollutants and outline state monitoring efforts with respect to each pollutant. Monitoring results in relation to the NAAQS are presented in each section. Additionally, Appendix D of this report includes wind and pollution roses for each monitoring site.

2.1 Carbon Monoxide

Carbon monoxide (CO) is an odorless, colorless, and toxic gas. Worn or poorly adjusted and maintained combustion devices (e.g., boilers and furnaces), or those with improperly sized, blocked, disconnected, or leaking flues, can be significant sources of CO. Auto, truck, or bus exhaust can also be a source of CO. Many large urban areas in the United States have problems attaining the NAAQS for CO where the primary source of CO is automobiles. To date, North Dakota does not have large population centers with the corresponding traffic congestion and geographical/meteorological conditions to create significant CO emissions issues. However, there are several stationary sources in the state that emit more than 100 tons per year (TPY) of CO.

The effects of CO exposure can vary greatly from person to person depending on age, overall health and the concentration and length of exposure. At lower levels of exposure, CO causes mild effects that are often mistaken for a cold or the flu virus. These symptoms include headaches, dizziness, disorientation, nausea, and fatigue. In individuals with heart disease, chest pain may be a symptom. At moderate concentrations, angina, impaired vision, and reduced brain function may result. At very high concentrations, CO exposure can be fatal. Acute effects are due to the formation of carboxyhemoglobin in the blood, which inhibits oxygen intake.

2.1.1 Point Sources

The major stationary CO sources (>100 TPY) are listed in Table 2. Figure 2 shows the approximate locations of these facilities (the numbers correspond to the site and source tables and some labels may overlap). Most of these sources are the same sources that are the major emitters of sulfur dioxide and oxides of nitrogen. However, the corresponding CO emission levels from these sources are considerably lower.

[13] See Appendix B of this report.

2.1.2 Monitoring Network & Network Analysis

A five-year CO monitoring study concluded in 1994. The data produced by this study led the Department to determine that ambient concentrations of CO within the state were well below the NAAQS and exceedances were unlikely. Based on this, CO monitoring in North Dakota was suspended. Between 2009 and early 2016, the Department operated a Trace Level CO analyzer at the Fargo NW site in order to comply with the NCore requirements. Trace Level CO analysis began in Bismarck upon relocation of the NCore site from Fargo to Bismarck. The 2017 monitoring season was the first full year of CO data for the Bismarck NCore site.

Figure 3 shows 2023 CO concentrations at Bismarck in comparison to the 1- and 8-hour NAAQS. Numbers above the bars indicate monitored concentrations.

2.1.3 Network Changes

There were no significant changes made to the CO monitoring network in 2023. There are no changes planned for 2024.

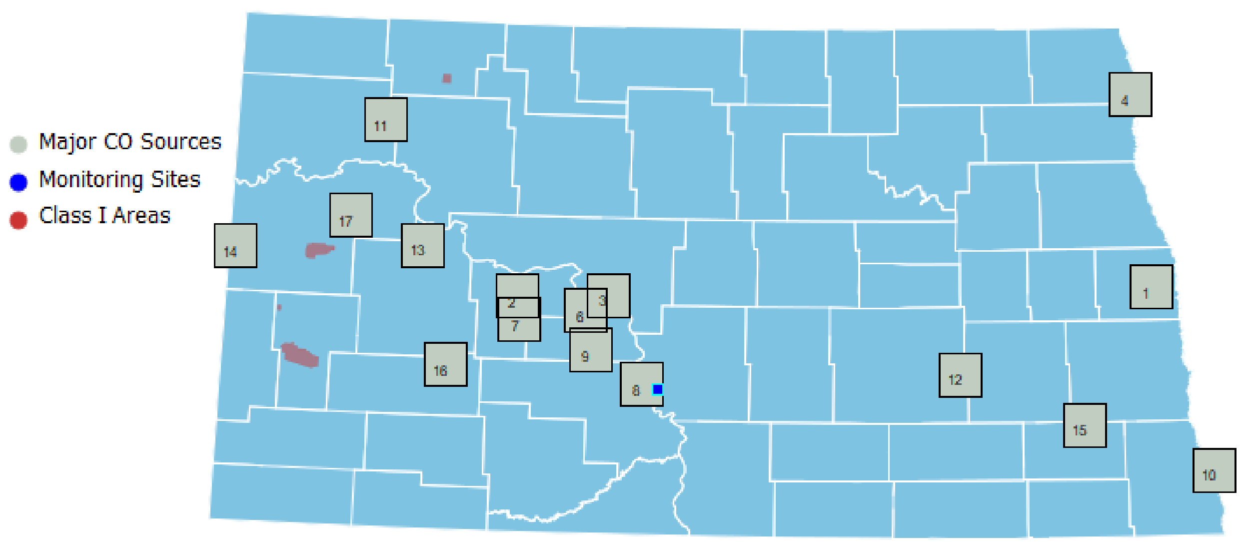


Figure 2. Major CO Sources in 2023

Table 2. Major CO Sources (≥ 100 TPY) in 2023

#	COMPANY	SOURCE
1	American Crystal Sugar Company	Hillsboro Plant
2	Dakota Gasification Company	Great Plains Synfuels Plant
3	Rainbow Energy Center, LLC	Coal Creek Station
4	American Crystal Sugar Company	Drayton Plant
5	Basin Electric Power Cooperative	Antelope Valley Station
6	Basin Electric Power Cooperative	Leland Olds Station
7	Otter Tail Power Company	Coyote Station
8	Tesoro Refining & Marketing Company LLC	Mandan Refinery
9	Minnkota Power Cooperative, Inc	Milton R. Young Station
10	Minn-Dak Farmers Cooperative	Wahpeton Plant
11	Hess Tioga Gas Plant LLC	Tioga Gas Plant
12	Great River Energy	Spiritwood Station
13	ONEOK Rockies Midstream, L.L.C.	Demicks Lake Gas Plant
14	ONEOK Rockies Midstream, L.L.C.	Grasslands Gas Plant
15	Archer Daniels Midland Company (ADM)	Enderlin Facility
16	Red Trail Energy, LLC	Richardton Ethanol Plant
17	Rough Rider Operating, LLC	Wild Basin Gas Processing
18	Hiland Partners Holdings LLC	Watford City Gas Plant

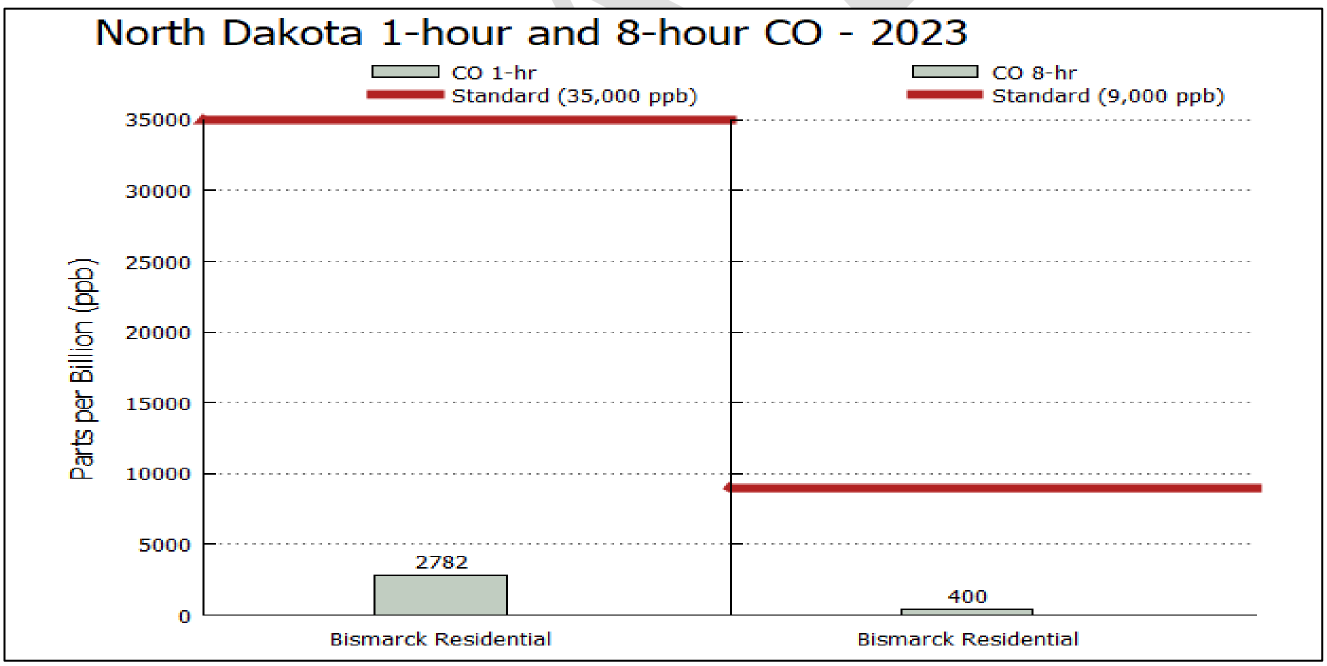


Figure 3. CO Concentrations (2nd high) Compared to the 1-hour and 8-hour Standards (2023)

2.2 Lead

Lead is a heavy metal that can be emitted through some heavy industrial manufacturing processes, including metals processing. Lead is also used as a fuel additive to increase engine performance and reduce valve wear. Although phased out of general use in the United States for on-road automobile and truck fuel in the 1970s, lead additive is still used in some aviation fuels.

High lead levels in the body can affect the nervous system, kidneys, and the immune system. Reproductive and cardiovascular health can also be impacted.

Through prior sampling efforts, the Department has determined that the state has low lead concentrations and no significant lead sources. This determination, coupled with the federal lead monitoring requirements, resulted in the state lead monitoring program ending effective December 31, 1983.

2.2.1 Monitoring Network

Currently there are no state Lead monitoring sites.

2.2.2 Network Changes

There were no significant changes made to the lead monitoring network in 2023. There are no changes planned for 2024.

2.3 Oxides of Nitrogen

Oxides of Nitrogen (NO_x) is the term used to represent nitric oxide (NO) plus nitrogen dioxide (NO_2). NO and NO_2 are formed when the nitrogen and oxygen in the air are combined in high-temperature combustion. Major NO_x sources in North Dakota are coal conversion processes, natural gas processing plants, and natural gas compressor stations.

In its pure state, NO_2 is a reddish-orangish-brown gas with a characteristic pungent odor. As a pollutant in ambient air, however, NO_2 is virtually odorless – although it may be an irritant to the eyes and throat. NO_2 is corrosive and a strong oxidizing agent. The dark orangish-brown colored plume that can sometimes be seen downwind from a major combustion emissions source is most likely the result of NO_2 or the conversion of NO to NO_2.

There is no ambient air quality standard for NO, a colorless gas. NO released into ambient air combines with excess oxygen to form NO_2. The speed with which this conversion occurs is dependent on several factors, including the relative concentrations of NO and ozone, the amount of ultraviolet light available, and meteorological conditions.

NO_x exposure can result in respiratory distress, including airway inflammation and aggravation of asthmatic symptoms. Ozone, with its own health concerns, is a byproduct of the chemical reaction of NO_x and volatile organic compounds with heat and sunlight. In the form of the corrosive species nitrous and nitric acid, NO_x can result in impacts on vegetation and materials. In combination with ammonia and water vapor, NO_x can form small particulates, impairing visibility and impacting health.

NO_y, or "total reactive nitrogen", consists of oxidized compounds of nitrogen (i.e. NO_x + nitric acid and organic nitrates). A NO_y monitor works by converting all reactive species to NO. Non-NO_x species concentrations can be determined by subtracting monitored ambient NO and NO_2 concentrations from the resultant total concentration of converted NO. There is no ambient air quality standard for NO_y.

2.3.1 Point Sources

The major NO_x stationary point sources (>100 TPY) are listed in Table 3.

Figure 4 shows the approximate locations of these facilities (the numbers correspond to the site and source tables and some labels may overlap). Some of 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, large internal combustion compressor engines in the natural gas fields in the western part of the state, and manufacturing facilities in the eastern part of the state.

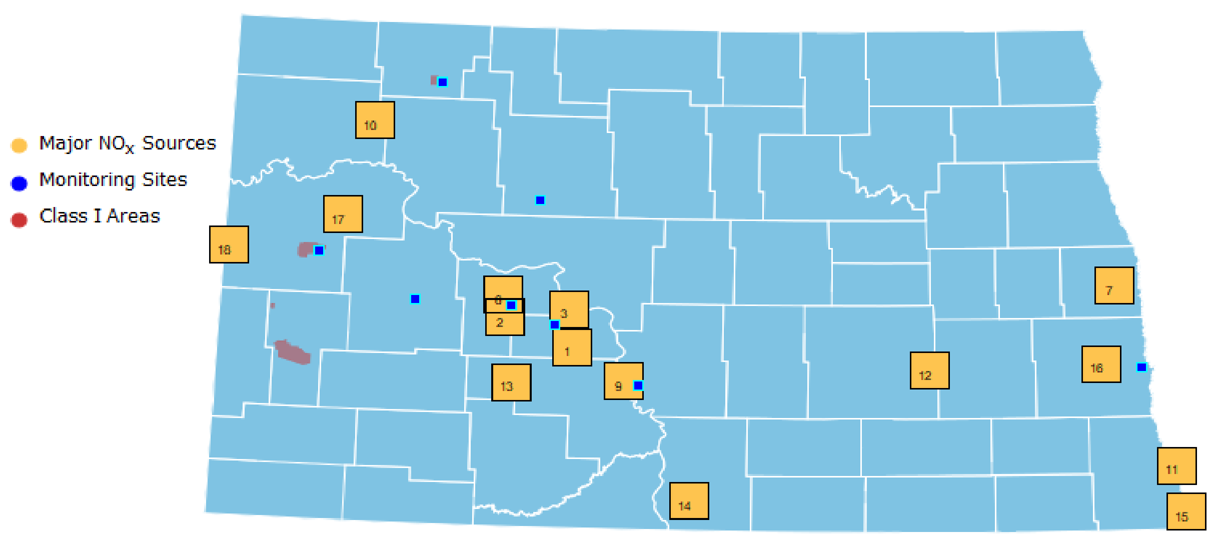


Figure 4. Major Oxides of Nitrogen (NO_x) Sources in 2023

Table 3. Major NO_x Sources (≥ 100 TPY) in 2023

#	Company	Source
1	Minnkota Power Cooperative, Inc.	Milton R. Young Station
2	Otter Tail Power Company	Coyote Station
3	Basin Electric Power Cooperative	Leland Olds Station
4	Rainbow Energy Center, LLC	Coal Creek Station
5	Basin Electric Power Cooperative	Antelope Valley Station
6	Dakota Gasification Company	Great Plains Synfuels Plant
7	American Crystal Sugar Company	Hillsboro Plant
8	American Crystal Sugar Company	Drayton Plant
9	Tesoro Refining & Marketing Company LLC	Mandan Refinery
10	Hess Tioga Gas Plant LLC	Tioga Gas Plant
11	Minn-Dak Farmers Cooperative	Wahpeton Plant
12	Great River Energy	Spiritwood Station
13	Northern Border Pipeline Company	Glen Ulin Compressor Station
14	Northern Border Pipeline Company	Zeeland Compressor Station
15	Guardian Hankinson, LLC	Hankinson Renewable Energy, LLC
16	Tharaldson Ethanol Plant I, LLC	Tharaldson Ethanol Plant I, LLC
17	Rough Rider Operating, LLC	Wild Basin Gas Processing
18	ONEOK Rockies Midstream, L.L.C.	Grasslands Gas Plant

2.3.2 Area Sources

Another source of NO_x is automobile emissions. North Dakota has no significant urbanized areas with respect to oxides of nitrogen; the entire population of the state is less than 1,000,000 people and the largest Metropolitan Statistical Area (MSA; includes Fargo) has a population of 248,591 (2020 estimate[14]).

2.3.3 Monitoring Network

The Department operated eight $NO/NO_2/NO_x$ analyzers in 2023. From Figure 4 it can be seen that the $NO/NO_2/NO_x$ analyzers are well placed with respect to the major NO_x sources. Additionally, as part of the NCore network site at Bismarck, the Department operates a NO_y monitor.

[14] US Census Bureau. Annual Estimates of the Resident Population: July 1, 2022 – United States – Metropolitan and Micropolitan Statistical Area 2022 Population Estimates.

2.3.4 Network Analysis

Several of the largest NO_x sources in the state are within 45 miles of the Beulah and Hannover monitoring sites. This makes these two sites very important in tracking the impact of these sources on the ambient air. Figures 5 and 6 show the NO_2 monitoring concentrations in comparison to the 1-hour and annual NO_2 NAAQS, respectively. Numbers above the bars indicate monitored concentrations. Figures 7 and 8 show the 1-hour and annual average concentrations for the Department-operated sites for 1982 – 2023, respectively.

2.3.5 Network Changes

There were no significant changes made to the NO_2 network in 2023. The Department is in the process of updating the aged fleet of NO_2 analyzers. The aged fleet will be replaced with an alternate EPA approved method. This process will take effect over the 2023 - 2024 monitoring seasons. The Department has purchased enough analyzers to replace 80% of the NO_2 network. The remaining 20% will be replaced as funding becomes available.

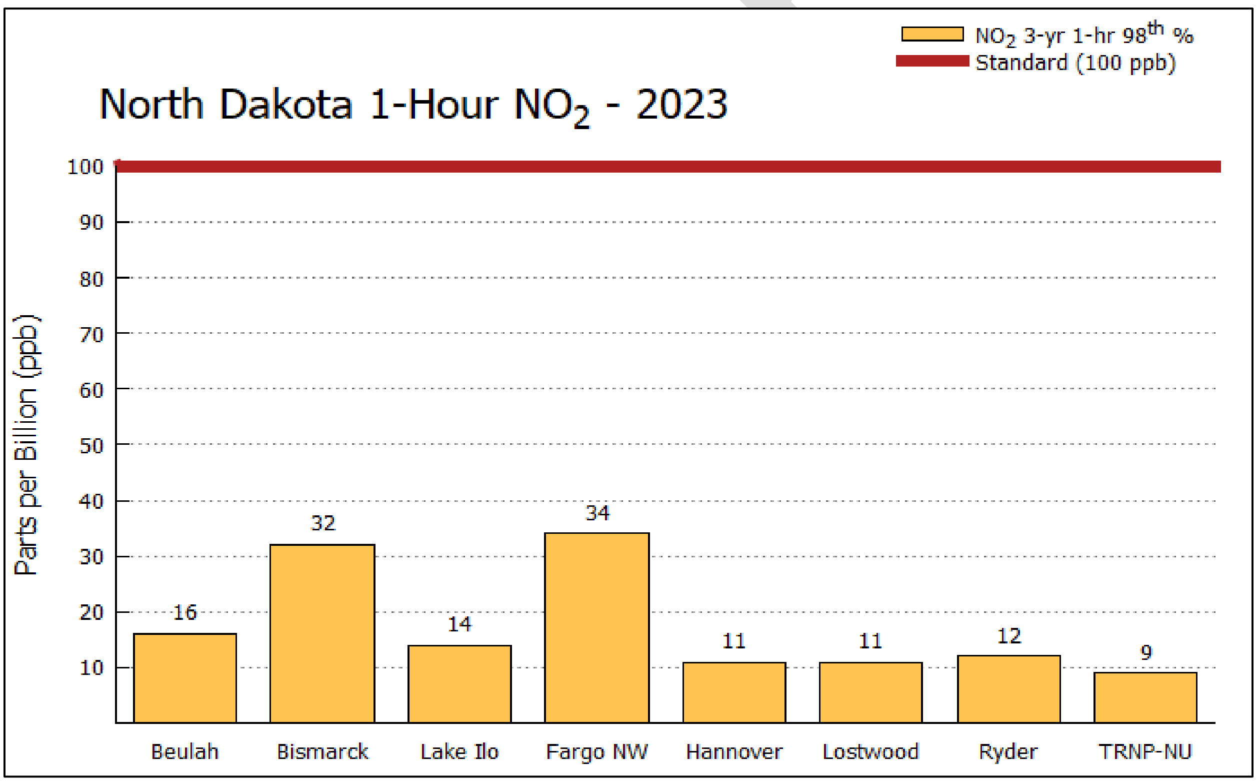


Figure 5. NO_2 Concentrations Compared to the 1-hour Standard (2021-2023)

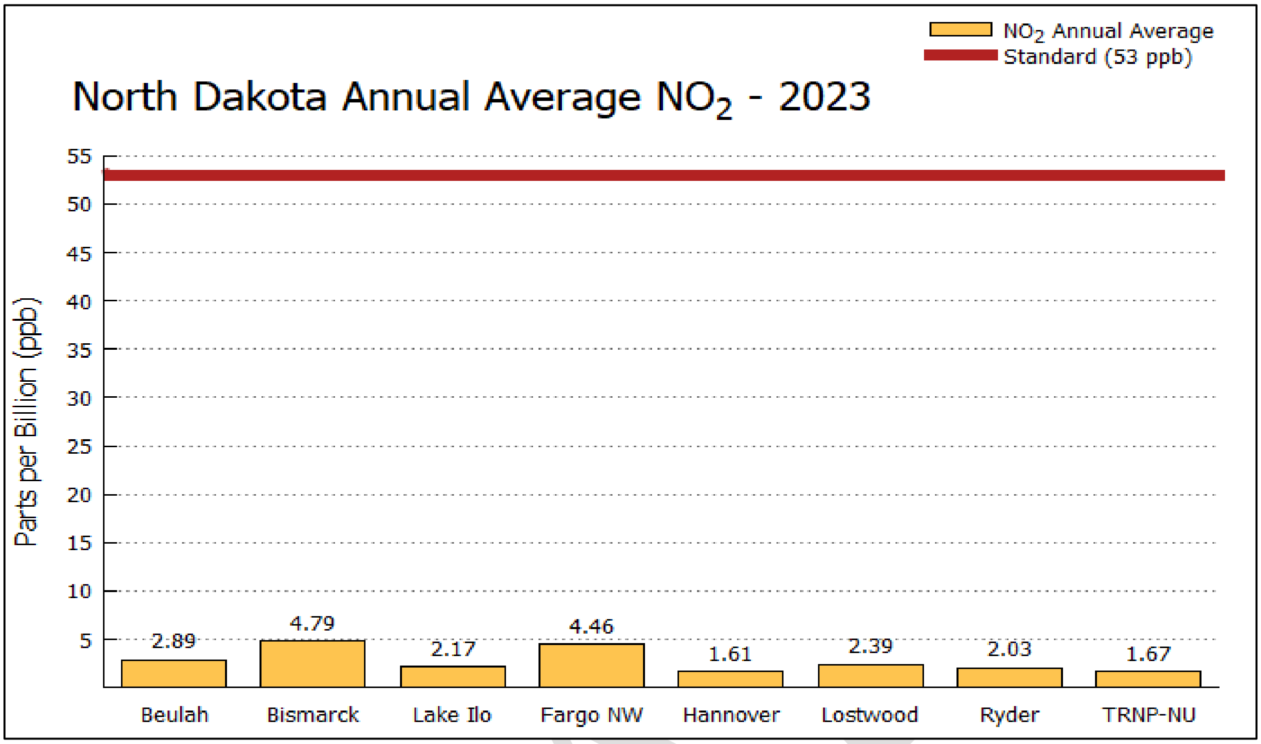


Figure 6. NO_2 Concentrations Compared to the Annual Standard (2023)

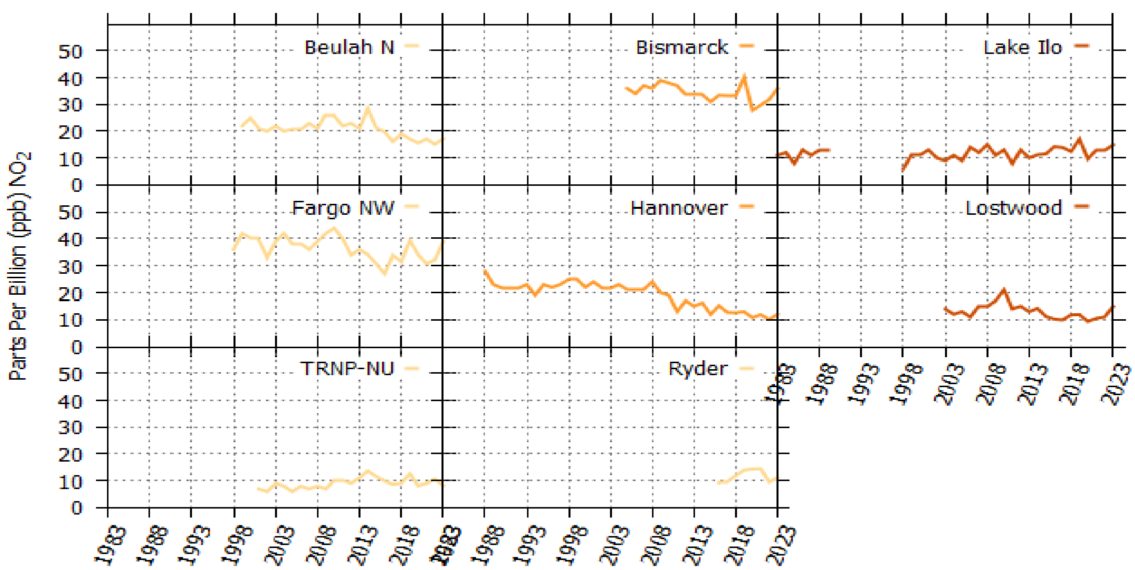


Figure 7. NO_2 98th Percentile 1-Hour Concentrations

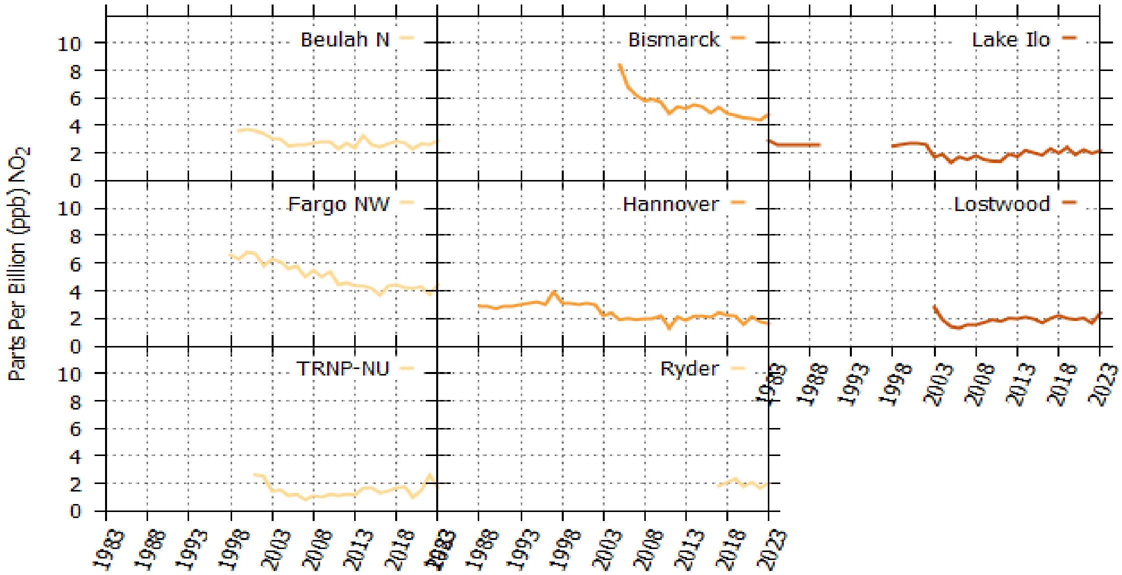


Figure 8. NO_2 Annual Average Concentrations

2.4 Ozone

Ozone (O_3) is a highly reactive form of oxygen. At very high concentrations, it is a blue, unstable gas with a characteristic pungent odor. It can often be detected around an arcing electric motor, lightning storms, or other electrical discharges. However, at ambient concentrations, O_3 is colorless and odorless.

Unlike most other pollutants, O_3 is not emitted directly into the atmosphere, but results from a complex photochemical reaction between volatile organic compounds (VOC), NO_x, and solar radiation. Both VOC and NO_x are emitted directly into the atmosphere. Sources of VOC include automobile exhaust, gasoline and oil storage and transfer, industrial paint solvents, degreasing agents, cleaning fluids, and ink solvents. Some vegetation can also emit VOC (e.g., terpene from pine trees). See Sections 2.3.1 and 2.3.2 for discussion of NO_x sources.

Production of O_3 is a year-round phenomenon. However, the highest O_3 levels generally occur during the summer months when sunlight is stronger and stagnant meteorological conditions can cause reactive pollutants to remain in an area for several days. Ozone produced under these conditions can be transported many miles. 40 CFR 58 defines the O_3 monitoring season for North Dakota as March 1 through September 30[15].

[15] The required O_3 monitoring season for NCore stations is January through December. The Department typically

At ground level where it can be breathed, O_3 is a pollutant. However, ground-level O_3 should not be confused with the stratospheric O_3 located between 12 and 20 miles above the earth's surface. The stratospheric O_3 layer shields the earth from intense cancer-causing ultraviolet radiation. Concentrations of O_3 in this layer are approximately 10,000 to 12,000 ppb, or 100 times the state's ambient air quality standard. Occasionally, meteorological conditions can result in stratospheric O_3 being brought to ground level. This can increase ambient air concentrations by 50 to 100 ppb.

Short-term exposure to O_3 in the range of 150 to 250 ppb may impair mechanical functions of the lungs and may induce respiratory difficulties and related symptoms in sensitive individuals (those who have asthma, emphysema, or reduced lung function). Symptoms and effects of O_3 exposure are more readily induced in people who are exercising.

O_3 is the major component of photochemical "smog", although the haziness and odors of the smog are caused by other components. The deterioration and degradation of material, especially the splitting and cracking of rubber tires and windshield wiper blades, is associated with O_3. Many plants, such as soybeans and alfalfa, are sensitive to O_3 and can be damaged by extended exposure to low levels.

2.4.1 Point Sources

The major NO_x stationary point sources (>100 TPY) are listed in Table 3 and Figure 4 shows the approximate locations of these facilities. The major stationary point sources (> 100 TPY) of VOC as determined from the most recent emission inventories reported to the Department are listed in Table 4. Figure 9 shows the approximate locations of these facilities (the numbers correspond to the site and source tables and some labels may overlap).

2.4.2 Area Sources

Point sources contribute only part of the total VOC and NO_x emissions. The remaining emissions can generally be attributed to oilfield-related activities and mobile sources in urban areas.

collects O_3 monitoring data year-round at all ozone monitoring sites.

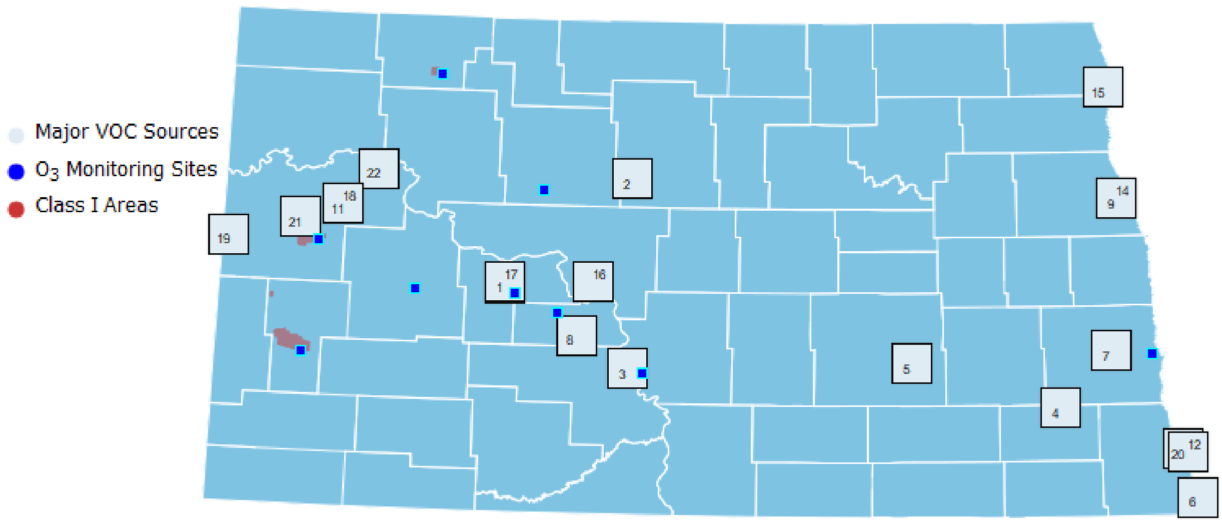


Figure 9. VOC Sources > 100 TPY in 2023

Table 4. VOC Sources (≥ 100 TPY) in 2023

#	Company	Source
1	Dakota Gasification Company	Great Plains Synfuels Plant
2	ADM Processing	Velva Facility
3	Tesoro Refining & Marketing Company LLC	Mandan Refinery
4	Archer Daniels Midland Company (ADM)	Enderlin Facility
5	City of Jamestown	Jamestown Sanitary Landfill
6	Guardian Hankinson, LLC	Hankinson Renewable Energy, LLC
7	Tharaldson Ethanol Plant I, LLC	Tharaldson Ethanol Plant I, LLC
8	Minnkota Power Cooperative, Inc.	Milton R. Young Station
9	LM Wind Power Blades	Grand Forks Facility
10	Andeavor Field Services LLC	Robinson Lake Gas Plant
11	Rough Rider Operating, LLC	Wild Basin Gas Processing
12	Minn-Dak Farmers Cooperative	Wahpeton Plant
13	ONEOK Rockies Midstream, L.L.C.	Demicks Lake Gas Plant
14	J.R. Simplot Company	Grand Forks Facility
15	American Crystal Sugar Company	Drayton Plant

16	Rainbow Energy Center, LLC	Coal Creek Station
17	Basin Electric Power Cooperative	Antelope Valley Station
18	Hiland Partners Holdings LLC	Watford City Gas Plant
19	ONEOK Rockies Midstream, L.L.C.	Grasslands Gas Plant
20	Cargill Corn Milling	Cargill Corn Milling
21	Targa Badlands, LLC	Little Missouri Gas Plant and Smokey Compressor Station
22	Hess North Dakota Pipelines LLC	Hawkeye Gas Facility

2.4.3 Monitoring Network

The EPA has specified design criteria for selecting locations for population oriented O_3 monitoring as any urbanized area having a population of 50,000 to less than 350,000. North Dakota has three urbanized areas (Bismarck; Fargo, ND-Moorhead, MN; and Grand Forks) that meet these criteria. However, to require monitoring, the 4th highest 8-hour average concentration must be at least 68 parts per billion. As can be seen from Figure 10, which presents the three-year (2021-2023) average of the maximum 4th highest 8-hour concentrations with the numbers above the bars indicating concentrations, none of the O_3 monitors at SLAMS sites reach this threshold.

The Department operated nine continuous ultraviolet (UV) photometric ozone analyzers in 2023 (see Figure 9).

2.4.4 Network Analysis

Only a few of the O_3 monitoring sites are in an area not significantly influenced by VOC sources (see Figure 9). Beulah and Hannover are within 45 miles of several major VOC sources in the state. Lostwood National Wildlife Refuge (NWR) and TRNP - NU are located in Class I areas[16] surrounded by oil fields. Bismarck Residential and Fargo NW are located in population centers and influenced by city traffic. Lake Ilo is located in a rural area surrounded by crop land but has seen major oil development over the last few years.

With this diversity of site locations and influences, one would expect to see a diversity of ozone concentrations. On the contrary, Figure 10 shows a striking similarity among the three-year (2021-2023) average of the maximum 4th highest 8-hour concentrations in comparison to the NAAQS. Numbers above the bars indicate monitored concentrations. Another, even stronger, indication of a uniform ozone distribution is the 8-hour concentrations: for all sites, the difference among the three-year (2021-2023) average of the maximum 4th highest 8-hour concentrations is 6 ppb (see Figure 10). Figure 11 shows the annual 4th highest concentrations for the Department-operated sites for 1995 - 2023.

[16] A Class I area is one of 156 parks and wilderness areas given special protection under the Clean Air Act for the purpose of visibility protection.

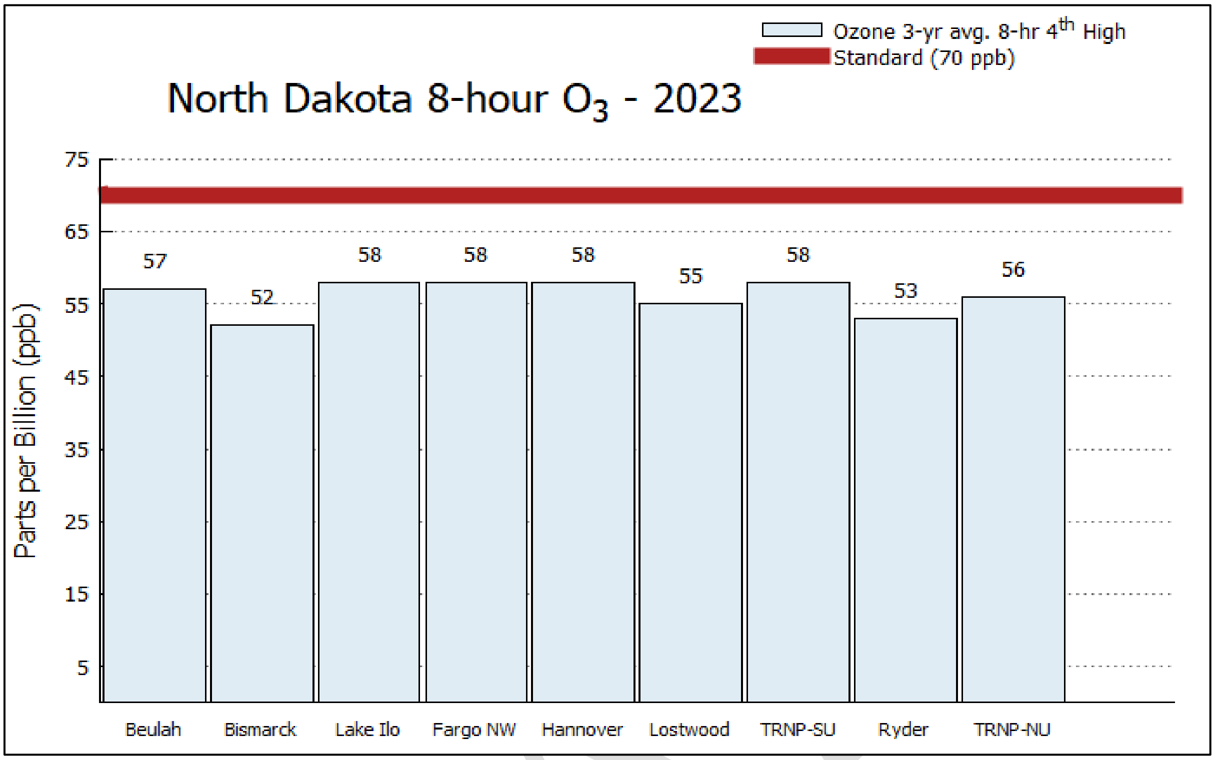


Figure 10. Ozone Concentrations* compared to the 8-hour Standard (2021-2023)
* Dataset includes all values (wildfire smoke data qualified events included).

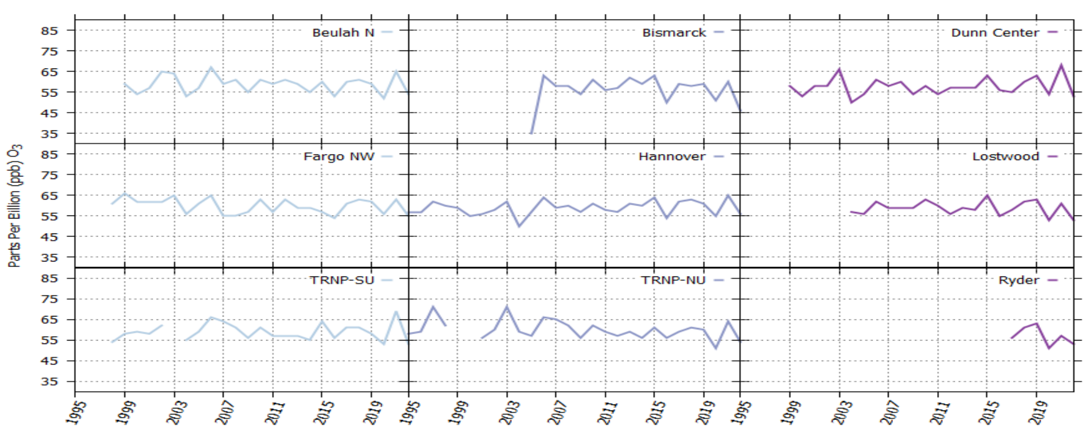


Figure 11. Annual 4th Highest 8-hour Ozone Concentrations*
* Dataset includes all values (wildfire smoke data qualified events included).

2.4.5 Wildfire Smoke Impacts

From mid-May through mid-September of 2023, smoke from wildfires across Canada directly affected the air quality in North Dakota, including O_3 concentrations. The Division has applied data qualifiers in AQS associated with the elevated O_3 concentrations. The Department considers all sites in North Dakota to be demonstrating attainment of the O_3 8-hour NAAQS.

2.4.6 Network Changes

There were no significant changes made to the O_3 network in 2023. The Department is in the process of updating the aged fleet of O_3 analyzers. The aged fleet will be replaced with an alternate EPA approved method. This process will take effect over the 2023 - 2024 monitoring seasons. The Department has purchased enough analyzers to replace 80% of the O_3 network. The remaining 20% will be replaced as funding becomes available.

2.5 Particle Pollution

Particulate matter (PM) is the term given to the tiny particles of solid or semi-solid material found in the atmosphere. The inhalable PM standards are designed to protect against those particulates that can be inhaled deep into the lungs and cause respiratory problems.

Particles larger than 10 micrometers are usually due to "fugitive dust" (windblown sand and dirt from roadways, fields, and constructions sites) and contain large amounts of silica (sand-like) materials. The majority of anthropogenic (man-made) PM is in the 0.1 to 10 micrometer particle diameter range. Within the NAAQS, there are two subgroups of PM identified: PM_{10} and $PM_{2.5}$. The PM_{10} particles have an aerodynamic diameter less than or equal to a nominal 10 microns, while the $PM_{2.5}$ particles have an aerodynamic diameter less than or equal to a nominal 2.5 microns.

PM_{10} is generally created during a burning process and includes fly ash (from power plants), carbon black (from automobiles and diesel engines), and soot (from fireplaces and wood-burning stoves); or industrial processes including grinding, crushing, or agricultural processing. PM_{10} from these sources contain a large percentage of elemental and organic carbon, which play a role in both visual haze and health issues. $PM_{2.5}$ can also form directly through combustion processes but can also be the result of indirect formation through chemical reactions between various other compounds and meteorological factors in the atmosphere. The EPA has also defined PM subgroup of particles called "coarse fraction," designated $PM_{10-2.5}$, with an aerodynamic diameter between 10 and 2.5 microns.

The health risk from an inhaled dose of PM depends on the size and concentration of the particulate. Size determines how deeply the inhaled particulate will penetrate into the respiratory tract, where it can persist and do damage. Particles less than 10 micrometers in diameter are easily inhaled deeply into the lungs. $PM_{2.5}$ (also called fine particulate pollution) affects the health of certain subgroups (e.g., people with heart or lung diseases, children, and older adults), which can be identified as potentially at risk of adverse health effects from airborne pollutants. There is very strong evidence that asthmatics are much more sensitive (i.e., respond with symptoms at relatively low concentrations) to the effects of particulates than is the general healthy population.

The effects of PM exposure may be the most widespread of all pollutants. Because of the potential for extremely long-range transport of $PM_{2.5}$ particles and because of the chemical reactions that occur, no place on earth has been spared from the particulate generated by urban and rural sources. The effects of PM range from visibility degradation to nutrient changes in soil and water to vegetation damage. General soiling can have long-term effects on paint and other materials.

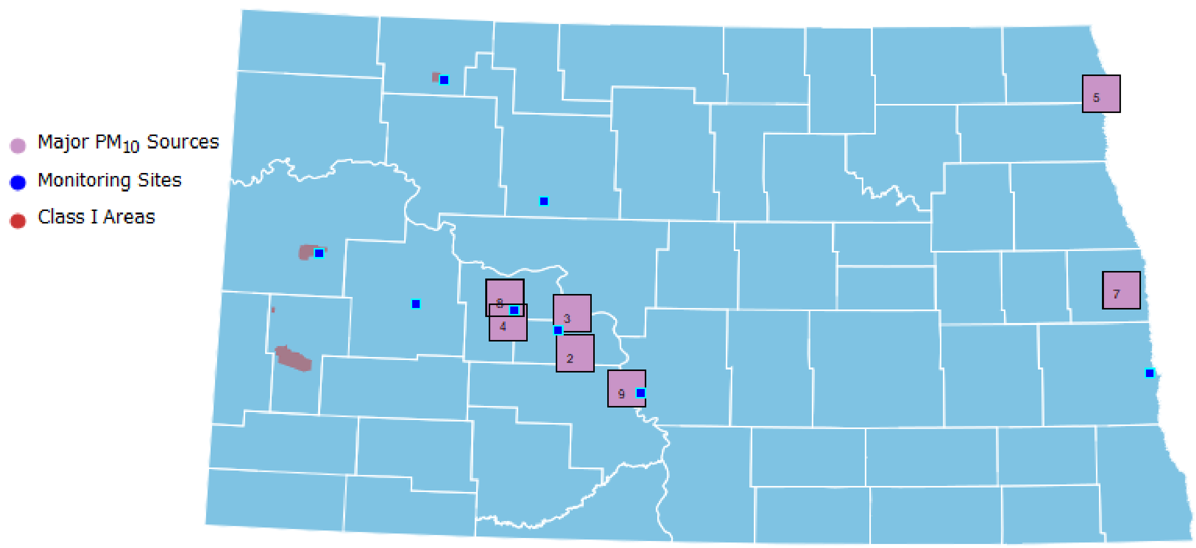


Figure 12. Major PM_{10} Sources in 2023

Table 5. Major PM_{10} Sources (≥ 100 TPY)* in 2023

#	COMPANY	SOURCE
1	Rainbow Energy Center, LLC	Coal Creek Station
2	Minnkota Power Cooperative, Inc.	Milton R. Young Station
3	Basin Electric Power Cooperative	Leland Olds Station
4	Otter Tail Power Company	Coyote Station
5	American Crystal Sugar Company	Drayton Plant
6	Basin Electric Power Cooperative	Antelope Valley Station
7	American Crystal Sugar Company	Hillsboro Plant
8	Dakota Gasification Company	Great Plains Synfuels Plant
9	Tesoro Refining & Marketing Company LLC	Mandan Refinery

* Total PM_{10}-Filterable + PM-Condensable as reported.

2.5.1 Point Sources

The major PM_{10} point sources (>100 TPY of PM_{10}-Filterable + PM-Condensable) are listed in Table 5 and the $PM_{2.5}$ point sources (>50 TPY of $PM_{2.5}$-Filterable + PM-Condensable) are shown in Table 6. Figures 12 and 14 show the approximate locations of these facilities, respectively (the numbers correspond to the site and source tables and some labels may overlap). Most of these sources are large coal-fired facilities, and the particles are part of the boiler stack emissions; however, some of the emissions are the result of processing operations. Not included in these tables are sources of fugitive dust such as coal mines, gravel pits, agricultural fields, and unpaved roads.

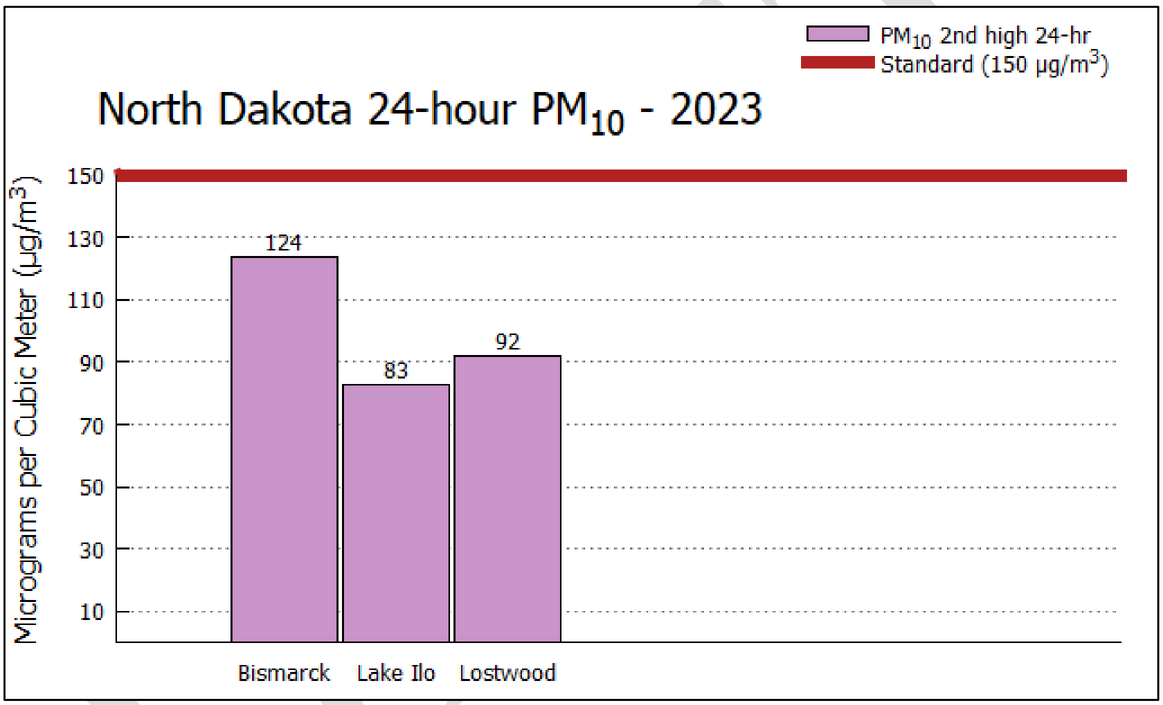


Figure 13. PM_{10} Concentrations* Compared to the 24-hour Standard (2023)[17]
* Dataset includes all values (wildfire smoke data qualified events included).

2.5.2 Monitoring Network

The Department operated eight continuous PM_{10} analyzer sites (Figure 12), one Federal Reference Method (FRM) manual $PM_{2.5}$ site (at the Bismarck NCore site), nine Federal Equivalent Method (FEM) continuous $PM_{2.5}$ analyzer sites (Figure 14), and one speciation sampler site (also at the Bismarck site) in 2023. The manual $PM_{2.5}$ samplers at Bismarck operate on a 1-in-3-day schedule. FEM continuous $PM_{2.5}$ analyzers have been installed at all sites in the network (Figure 14).

[17] Values shown represent the maximum yearly second high value for 2023.

Continuous PM_{10} analyzers are used with the continuous $PM_{2.5}$ analyzers to determine the $PM_{10-2.5}$ fraction. As can be seen in Figures 12 and 14, the majority of the sites are concentrated in the west and west-central part of the state. The sites are well placed with respect to major sources as well as in Class I areas and in population centers.

2.5.3 PM_{10} Network Analysis

Only PM_{10} analyzers operated at standard temperature and pressure are directly comparable to the PM_{10} NAAQS. Figure 13 shows the 2023 PM_{10} particulate monitoring results in comparison to the 24-hour NAAQS. Numbers above the bars indicate monitored concentrations.

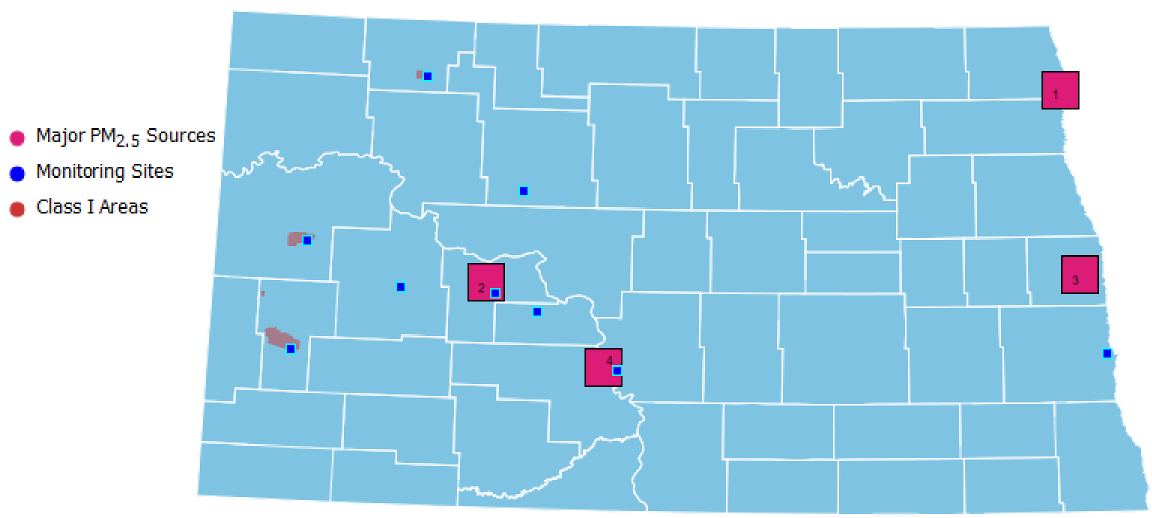


Figure 14 $PM_{2.5}$ Sources in 2023

Table 6. $PM_{2.5}$ Sources (≥ 50 TPY)* in 2023

#	COMPANY	SOURCE
1	American Crystal Sugar Company	Drayton Plant
2	Dakota Gasification Company	Great Plains Synfuels Plant
3	American Crystal Sugar Company	Hillsboro Plant
4	Tesoro Refining & Marketing Company LLC	Mandan Refinery

* Total $PM_{2.5}$-Filterable + PM-Condensable as reported.

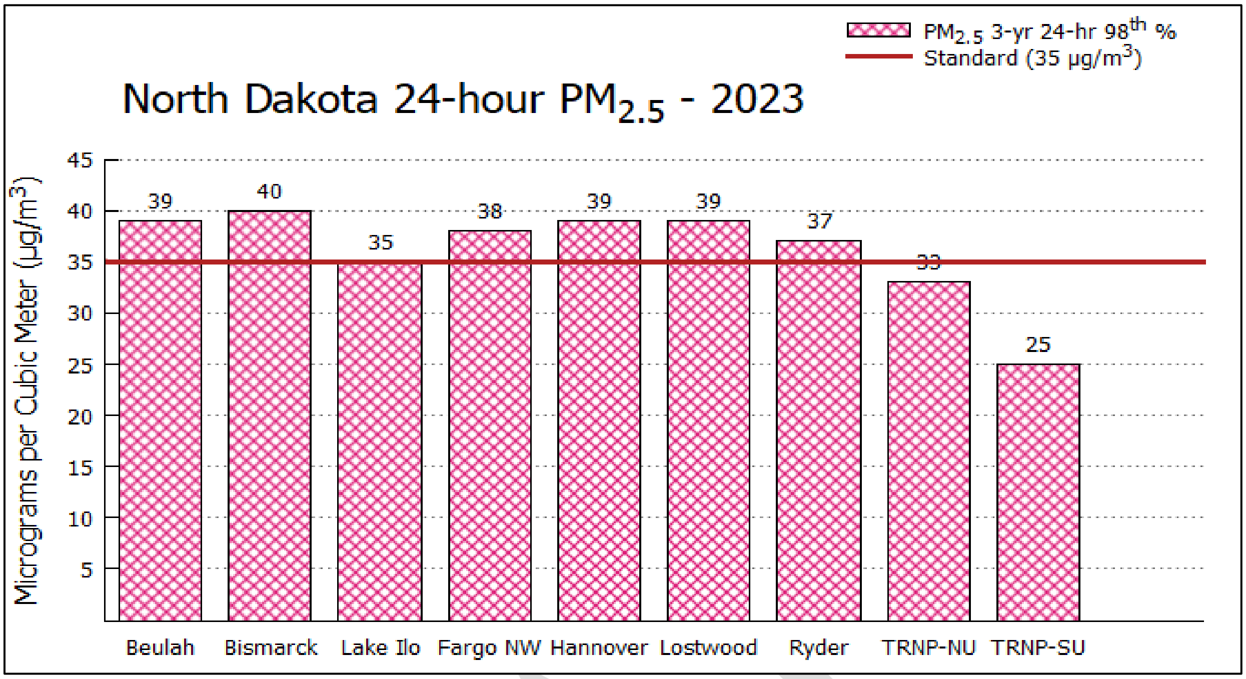


Figure 15. $PM_{2.5}$ Concentrations* Compared to the 24-hour Standard (2021-2023)
* Dataset includes all values (wildfire smoke data qualified events included).

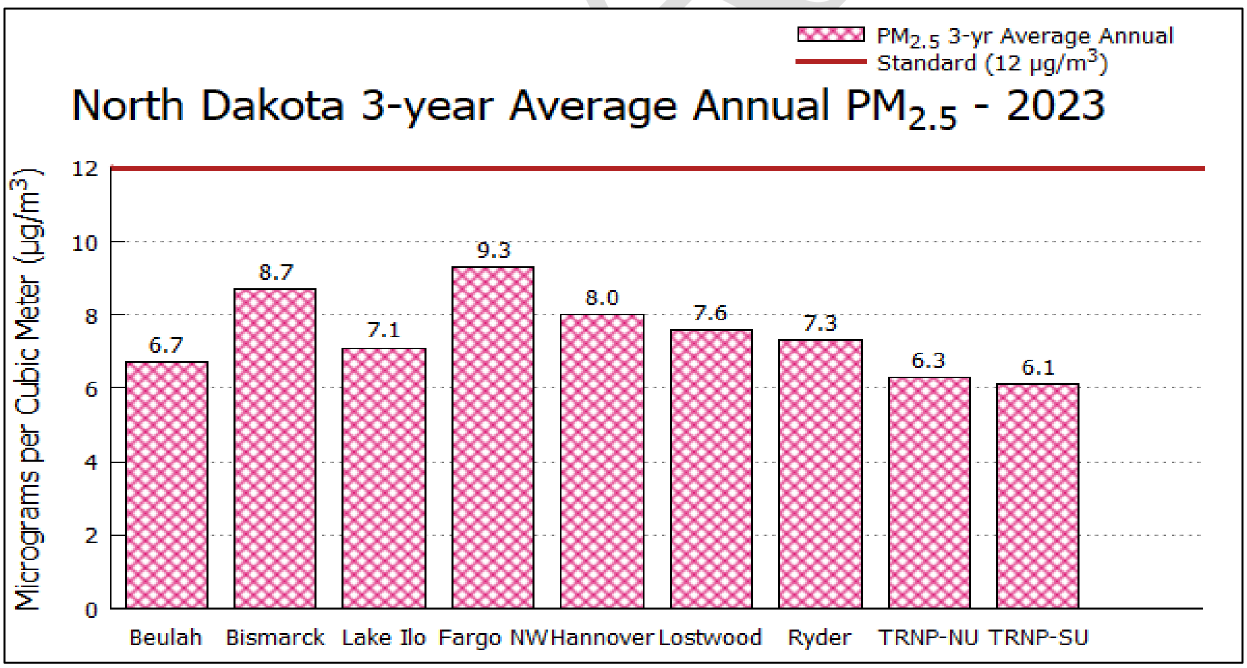


Figure 16. $PM_{2.5}$ Concentrations* Compared to the Annual Standard (2021-2023)
* Dataset includes all values (wildfire smoke data qualified events included).

2.5.4 $PM_{2.5}$ Network Analysis

Figures 15 and 16 show the $PM_{2.5}$ particulate monitoring results for the three-year period 2021-2023 in comparison to the 24-hour and annual NAAQS, respectively. Numbers above the bars indicate monitored concentrations.

In the 2023 Annual Ambient Air Monitoring Data Certification letter to U.S. EPA, North Dakota acknowledged EPA's implementation of an alignment algorithm to update previously collected $PM_{2.5}$ T640/T640X FEM monitor data in EPA's AQS. Within this Annual Report, the $PM_{2.5}$ data at Lostwood NWR, Bismarck NCORE, Fargo NW, Lake Ilo, TRNP-NU, Beulah North, Hannover, and Ryder reflect the alignment algorithm developed by Teledyne and implemented in the Teledyne firmware update July of 2023, as well as implemented by EPA in AQS.

2.5.5 Wildfire Smoke Impacts

From mid-May through mid-September of 2023, smoke from wildfires across Canada directly affected the air quality in North Dakota, causing elevated particulate matter (PM_{10} and $PM_{2.5}$) concentrations. The Division has applied data qualifiers in AQS associated with the elevated PM_{10} and $PM_{2.5}$ concentrations. The Department will request exclusion of PM_{10} and $PM_{2.5}$ data recorded at all monitoring stations from the data record due to wildfire smoke in accordance with the U.S. EPA's Treatment of Data Influenced by Exceptional Events (Exceptional Event Rule). The Department considers all sites in North Dakota to be demonstrating attainment of the PM_{10} 24-hour NAAQS as well as the $PM_{2.5}$ 24-hour and annual NAAQS.

2.5.6 Speciation Network

One speciation sampler is installed as a National Trends Network sampler in Bismarck. The data collected by this sampler are added to the Air Quality System (AQS) database by an EPA contractor[18].

2.5.7 Network Changes

Only major modification to $PM_{2.5}$ network in 2023, was at the Painted Canyon site. The MetOne BAM PM monitor was replace with a Teledyne T640 late December 2023. In July 2023, the alignment algorithm developed by Teledyne was implemented in the Teledyne firmware update for the T640/T640x monitors. No major modifications are planned for the 2024 monitoring season.

[18] RTI International

2.6 Sulfur Dioxide

Sulfur dioxide (SO_2) is a colorless gas with a pungent odor detectable by the human nose at concentrations of 500 to 800 ppb. It is highly soluble in water where it forms sulfurous acid (H_2SO_3). In the atmosphere, sulfurous acid is easily converted to sulfuric acid (H_2SO_4), the major acidic component of “acid rain”, which then may convert again to form particulate sulfate compounds. On a worldwide basis, sulfur dioxide is considered to be a major pollutant. It is emitted mainly from stationary sources that burn coal and oil. Energy development in the west and west-central portions of North Dakota has produced a number of sources of SO_2. These sources include coal-fired steam-powered electrical generating facilities, a coal gasification plant, natural gas processing plants, oil refineries, and flaring at oil/gas well sites.

Sulfuric acid aerosols and particulate sulfate compounds, the result of conversions of SO_2 in the atmosphere, are corrosive and potentially carcinogenic (cancer-causing). The major health effects of SO_2 appear when it is associated with high levels of other pollutants, such as particulate. SO_2 also may play an important role in the aggravation of chronic illnesses, such as asthma. The incidence and intensity of asthma attacks have increased when asthmatics are exposed to higher levels of sulfur dioxide and particulate matter sulfates[19].

Particulate matter sulfates resulting from SO_2 emissions can also affect visibility. In combination with high humidity, sulfates can develop to sizes that are effective at scattering sunlight, thus resulting in reduced visibility through haze formation. SO_2 is one of the Department's primary interests with respect to visibility: first, to aid in establishing the visibility baseline, then to track visibility improvement over time.

2.6.1 Point Sources

The major SO_2 point sources (>100 TPY) based on 2023 emissions are listed in Table 7. Figure 17 shows the approximate locations of these facilities (the numbers correspond to the site and source tables and some labels may overlap). Some of the larger SO_2 point sources in North Dakota are associated with coal-fired steam-powered electrical generating plants, natural gas plants, and manufacturing facilities in the west-central, western, and eastern portions of the state, respectively.

2.6.2 Other Sources

The western part of the state has a number of potential SO_2 sources including oil wells, oil storage facilities, and natural gas compressor stations. These sources may directly emit amounts of hydrogen sulfide to the ambient air (see Section 2.7 for hydrogen sulfide discussion) or they may flare the hydrogen sulfide creating SO_2 and contributing to concentrations of this pollutant.

[19] U.S. EPA (2008). Integrated Science Assessment (ISA) for Sulfur Oxides – Health Criteria (Final Report). Available at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=198843.

2.6.3 Monitoring Network

In 2023 there were nine SO_2 monitoring sites in the state. As can be seen in Figure 17, the majority of the 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 west-central part of the state.

2.6.4 Network Analysis

Figure 18 shows the SO_2 monitoring results for the three-year period 2021-2023 in comparison to the 1-hour SO_2 NAAQS. Numbers above the bars indicate monitored concentrations.

Several major SO_2 sources are within 45 miles of both the Beulah and Hannover sites. This makes these two sites very important in tracking the impact of these sources on the ambient air. Also, Lostwood NWR is within 45 miles of several major sources, including two power plants located near Estevan, Saskatchewan, approximately 40 miles to the northwest.

One would expect that as the large sources in Oliver and Mercer counties came online beginning in 1980, a noticeable change would be seen on the ambient air quality. This has not been the case. The data has demonstrated possible short-term influences, but no significant long-term impacts by the combined sources. Figure 19 presents 1-hour maximums for the Department-operated sites for 1991 - 2023.

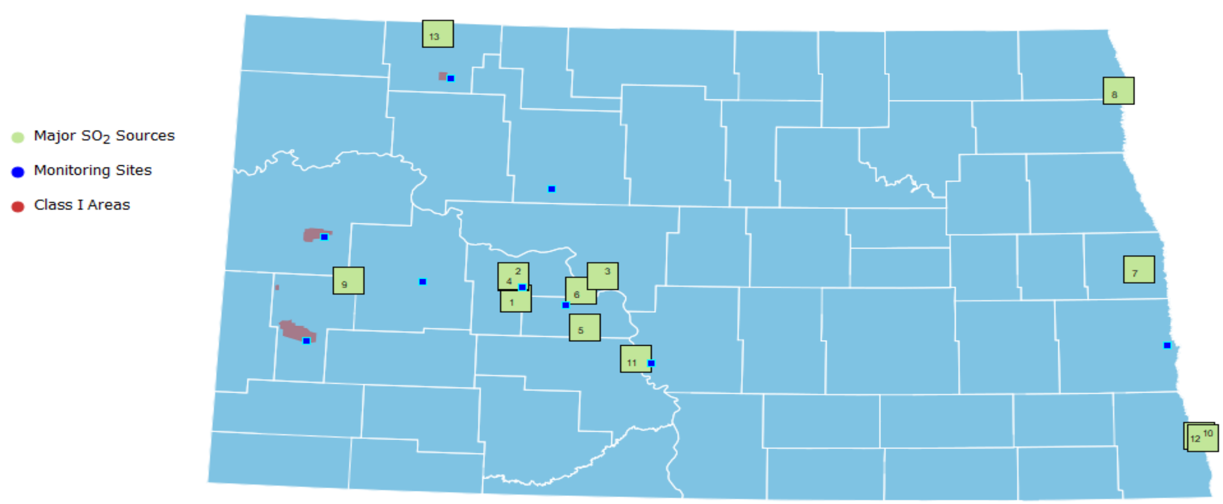


Figure 17. Major Sulfur Dioxide (SO_2) Sources in 2023

Table 7. Major SO_2 Sources (≥100 TPY) in 2023

#	Company Name	Source
1	Otter Tail Power Company	Coyote Station
2	Basin Electric Power Cooperative	Antelope Valley Station
3	Rainbow Energy Center, LLC	Coal Creek Station
4	Dakota Gasification Company	Great Plains Synfuels Plant
5	Minnkota Power Cooperative, Inc.	Milton R. Young Station
6	Basin Electric Power Cooperative	Leland Olds Station
7	American Crystal Sugar Company	Hillsboro Plant
8	American Crystal Sugar Company	Drayton Plant
9	Petro-Hunt, L.L.C.	Little Knife Gas Plant
10	Minn-Dak Farmers Cooperative	Wahpeton Plant
11	Tesoro Refining & Marketing Company LLC	Mandan Refinery
12	Cargill Corn Milling	Wahpeton Facility
13	Steel Reef Burke LLC	Lignite Gas Plant

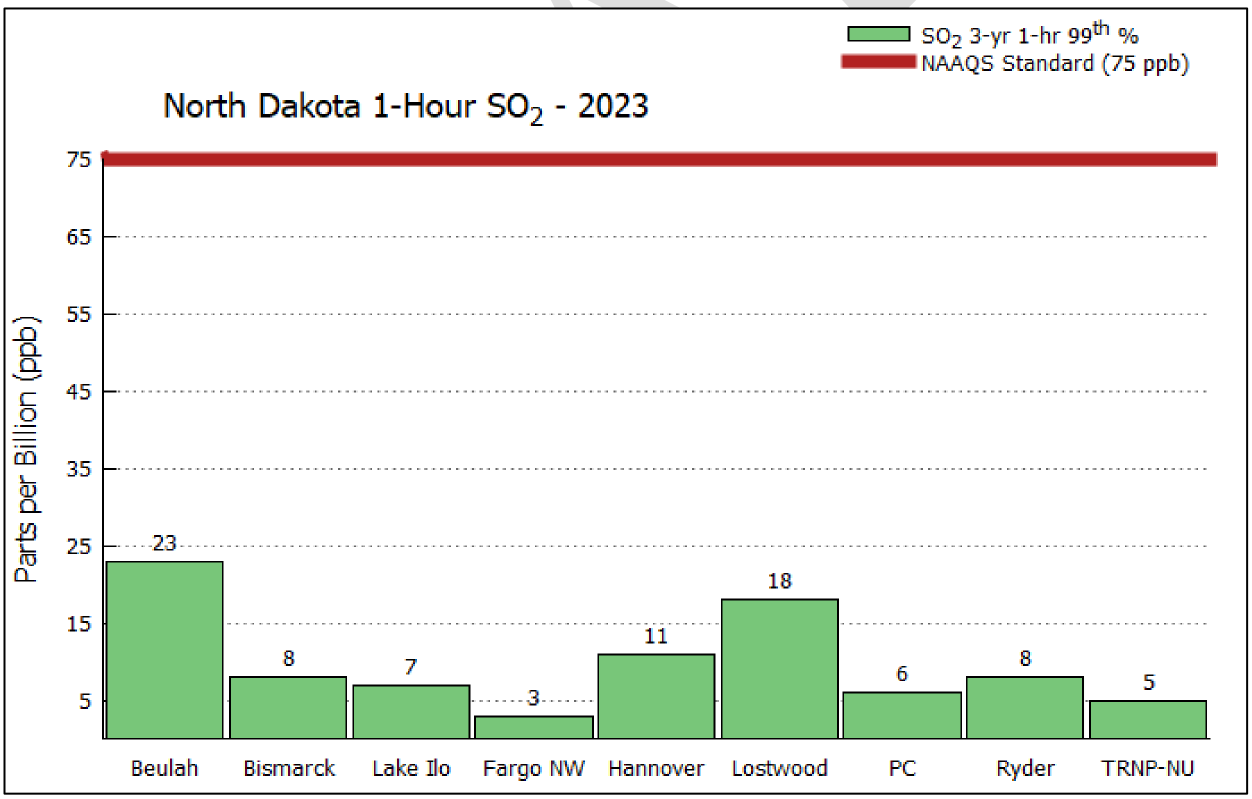


Figure 18. SO_2 Concentrations Compared to the 1-hour Standard (2021-2023)

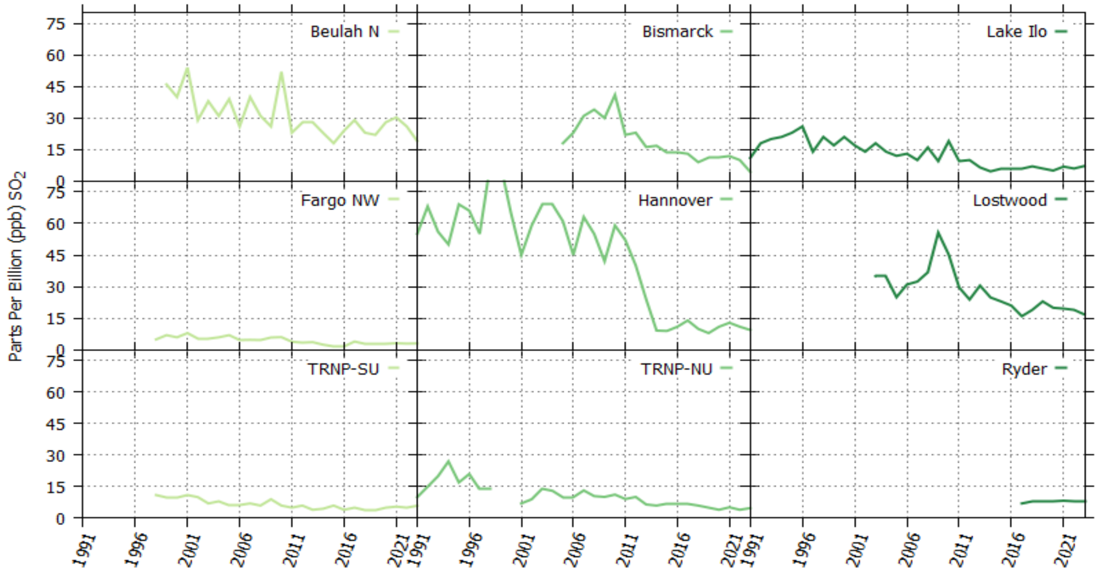


Figure 19 SO_2 99th Percentile 1-Hour Concentrations

Beginning in 1980, major events are traceable. In 1980, the oil industry was expanding and in 1982 the oil industry in western North Dakota hit a peak in activity prior to the most recent increase. Dunn Center/Lake Ilo and TRNP – NU show the influence from the oil field activity as the oil fields expanded and flared the gas. As pipelines were built and wells were tied into the pipelines, the amount of hydrogen sulfide gas flared decreased, reducing the amount of sulfur dioxide emitted. Once the wells were tied into pipelines, the predominant influence at these two sites has been long-range transport from major point sources.

Dunn Center/Lake Ilo and TRNP – NU are indicators of the "oil patch" activity and tracked the activity very well. Since TRNP – NU is more centrally located in the "oil patch," it is the stronger indicator. Dunn Center/Lake Ilo, which is on the eastern edge of the oil development area, demonstrates influences from both the "oil patch" and the coal conversion facilities to the east.

2.6.5 Network Changes

There were no significant changes made to the SO_2 network in 2023. The Department is looking into changing to an alternate EPA approved method of SO_2 analyzers in the foreseeable future.

In response to the requirement of 40 CFR 51.1203 (b) concerning characterization of 1-hour SO_2 concentrations for the Tioga area, a SLAMS-like monitoring site was established in Williams County for operation in 2017. See Appendix E of this report for more information.

2.7 Hydrogen Sulfide

Hydrogen sulfide (H_2S) is a colorless gas with a rotten egg odor. It is incompatible with strong oxidizers and reacts violently with metal oxides. It will attack many metals, forming sulfides.

Exposure to low concentrations may cause irritation to the eyes, nose, or throat. It may also cause headaches, poor memory, tiredness, and dizziness Brief exposure to high concentrations can cause respiratory distress or loss of consciousness. Although the odor is detectable at very low concentrations, it rapidly causes olfactory fatigue at higher levels, and, therefore, is not considered to have adequate warning. To reduce potential exposure, people should avoid industrial and natural sources where high concentrations of hydrogen sulfide may be found.

Although no Federal Ambient Air Quality Standard exists for H_2S, the state of North Dakota has developed H_2S standards in response to historically high petroleum sulfur content (during the 1980s in particular) and associated high H_2S. The major source of H_2S in North Dakota is legacy oil wells. Other sources are natural gas processing plants, lagoons, and sloughs. Emissions have been reduced significantly over time as production from these older sites has declined. The Bakken formation, the focus of the most recent oil and gas activity in the state, has been found to result in very low H_2S emissions when compared to legacy (non-Bakken) operations.

2.7.1 Point Sources

H_2S emissions of concern stems almost totally from the legacy oil and gas well operations in the western part of the state. Flares and treater stacks associated with oil/gas wells, oil storage tanks, compressor stations, pipeline risers, and natural gas processing plants are potential H_2S emission sources.

2.7.2 Monitoring Network

Currently there are no state H_2S monitoring sites.

2.7.3 Network Changes

There were no significant changes made to the H_2S network in 2023. There are no changes planned for 2024.

2.8 Air Toxics

The term 'air toxics' refers to Hazardous Air Pollutants (HAP) - air contaminants, other than those listed above, that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. HAPs are regulated at the federal and state level through National Emission Standards for Hazardous Air Pollutants (NESHAPs) rather than ambient air quality standards. NESHAPs undergo direct review of the specific HAP they regulate and all sources operating in North Dakota must comply with the applicable NESHAPs.

The historic raw monitoring data and associated summaries are available in EPA's AQS system.

2.8.1 Point Sources

The air toxics sources (>40 TPY) are listed in Table 8 and Figure 20 shows the approximate locations of these facilities (the numbers correspond to the source table and some labels may overlap).

2.8.2 Monitoring Network

Currently there are no state air toxics monitoring sites.

2.8.3 Network Changes

There were no significant changes made to the Air Toxics network in 2023. There are no changes planned for 2024.

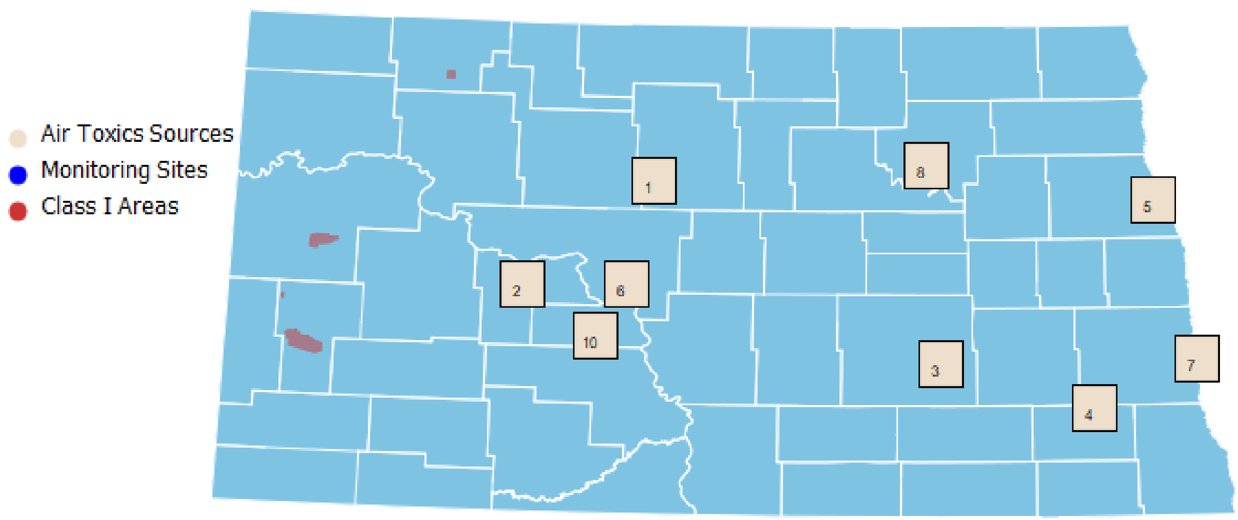


Figure 20. Air Toxics Sources in 2023

Table 8. Air Toxics Sources in 2023
(≥ 40 TPY of a single HAP or ≥ 40 TPY aggregate HAPS)

#	COMPANY	SOURCE
1	ADM Processing	Velva Facility
2	Dakota Gasification Company	Great Plains Synfuels Plant
3	City of Jamestown	Jamestown Sanitary Landfill
4	Archer Daniels Midland Company (ADM)	Enderlin Facility
5	LM Wind Power Blades	Grand Forks Facility
6	Rainbow Energy Center, LLC	Coal Creek Station
7	Cargill, Inc.	Cargill Oilseeds Processing
8	Nordic Fiberglass, Inc.	Devils Lake Plant
9	Basin Electric Power Cooperative	Antelope Valley Station
10	Minnkota Power Cooperative, Inc.	Milton R. Young Station

3.0 NETWORK SITE CHANGES

There were no Network Site Changes during the 2023 monitoring season.

The Department is in the process of establishing a new Ambient Air Quality Monitoring station sited in the northeast portion of North Dakota. In addition, the Department is in the process of updating aged analyzers, equipment, and a shelter in the existing Monitoring Network.

4.0 SUMMARY AND CONCLUSIONS

The North Dakota Ambient Air Quality Monitoring Network is designed to monitor those air pollutants that 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.

4.1 Carbon Monoxide (CO)

Neither the state nor federal CO standards of 35,000 ppb (1-hour) or 9,000 ppb (8-hour) were exceeded at the monitoring site. The 2023 maximum concentrations are as follows: 1-hour – 2782ppb; 8-hour – 400 ppb.

4.2 Lead

No lead monitoring was conducted. No changes to the network were identified.

4.3 Nitrogen Dioxide (NO_2)

Neither the state nor federal NO_2 standards of 100 ppb (1-hour) or 53 ppb (annual) were exceeded at any of the monitoring sites. The maximum concentrations were as follows: three-year (2021-2023) average of the 98th percentile 1-hour average concentrations – 34 ppb; and 2023 annual average concentration – 4.79 ppb.

4.4 Ozone (O_3)

Neither the state nor federal O_3 standard of 70 ppb was exceeded during the year. The three-year (2021-2023) average of the maximum fourth-highest 8-hour concentration was 58 ppb.

4.5 • Particulate Matter (PM_{10}, $PM_{2.5}$)

The federal PM_{10} 24-hour standard states that the concentration of PM_{10} in the ambient air should not go over 150 $\mu g/m^3$ more than once per year on average over a three-year period. Neither the state nor federal PM_{10} standard was exceeded during the year. The 2nd highest value over three years (2021-2023) was 135 $\mu g/m^3$.

Only the state and federal $PM_{2.5}$ 24-hour standard of 35 $\mu g/m^3$ was exceeded during the year. The state and federal $PM_{2.5}$ annual standard of 12 $\mu g/m^3$ was not exceeded during the year. The maximum concentrations for the three-year period 2021-2023 are as follows: 24-hour – 40 $\mu g/m^3$; annual – 9.3 $\mu g/m^3$. All but two of the nine sites in North Dakota exceeded the 24-hour $PM_{2.5}$ NAAQS of 35 $\mu g/m^3$ in for the three-year period 2021-2023.

As described in Section 2.5.5, from mid-May through mid-September 2023 the smoke from wildfires across Canada directly affected the air quality in North Dakota, including particulate matter (PM_{10} and $PM_{2.5}$) concentrations. The Department will request exclusion of PM_{10} and $PM_{2.5}$ data recorded at all monitoring stations from the data record due to wildfire smoke in accordance with the U.S. EPA's Treatment of Data Influenced by Exceptional Events (Exceptional Event Rule). The Department is in the process of preparing an Exceptional Event demonstration, to address the Exceptional Event Rule requirements in showing that the smoke from the 2023 Canadian wildfires caused the PM_{10} and $PM_{2.5}$ event concentrations throughout North Dakota.

4.6 • Sulfur Dioxide (SO_2)

Neither the state nor federal SO_2 standard of 75 ppb (1-hour) was exceeded at any state operated monitoring site. The maximum concentration measured was: three-year (2021-2023) average 1-hour 99th percentile – 23 ppb.

4.7 • Hydrogen Sulfide (H_2S)

No H_2S monitoring was conducted. No changes to the network were identified.

4.8 • Air Toxics (HAP)

No Air Toxics monitoring was conducted. No changes to the network were identified.

Appendix A Air Quality Personnel Organizational Chart

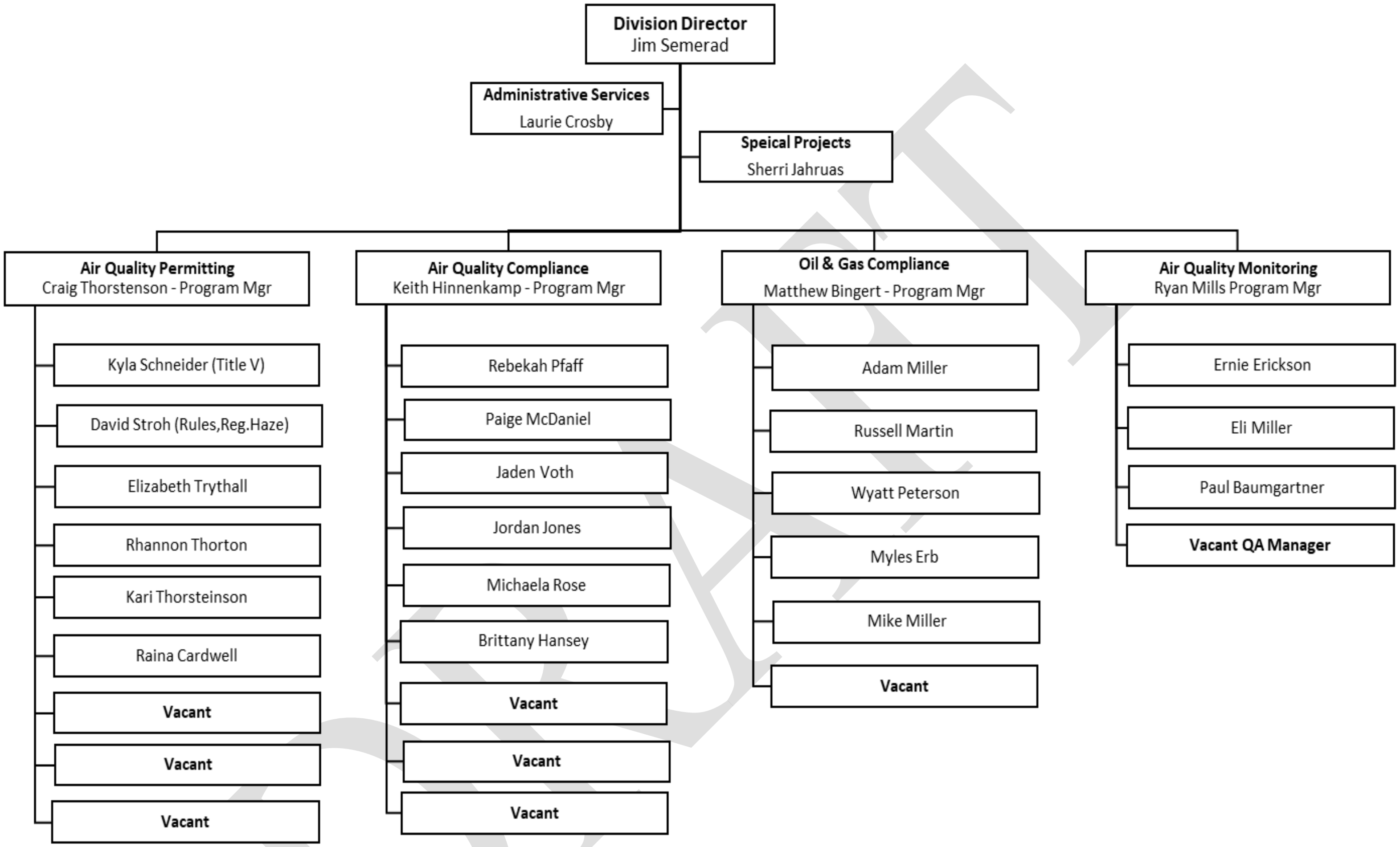


Figure 21. Organizational Chart June 2023

Appendix B Ambient Air Quality Standards

Table 9. National and North Dakota Ambient Air Quality Standards

National and North Dakota Ambient Air Quality Standards

Pollutant	Averaging Period	North Dakota		Federal	
		$\mu g/m^3$	ppb	$\mu g/m^3$	ppb
Carbon Monoxide (CO)	1-hour [a]	40,000	35,000	40,000	35,000
	8-hour [a]	10,000	9,000	10,000	9,000
Lead	3-month [b]	0.15	--	0.15	--
Nitrogen Dioxide (NO_2)	Annual [c]	100	53	100	53
	1-hour [d]	188	100	188	100
Ozone (O_3)	8-hour [e]	147	70	147	70
Particulate Matter – PM_{10}	24-hour [f]	150	--	150	--
Particulate Matter – $PM_{2.5}$	24-hour [g]	35	--	35	--
	Annual [h]	12	--	12	--
Sulfur Dioxide (SO_2)	1-hour [i]	196	75	196	75
	3-hour [a]	1309	500	1309	500
	24-hour [a]*	--	--	365	140
	Annual [c]*	--	--	80	30
Hydrogen Sulfide (H_2S)	Instantaneous	14,000	10,000	--	--
	1-hour [j]	280	200	--	--
	24-hour [a]	140	100	--	--
	Quarter	28	20	--	--

[a] Not to be exceeded more than once per calendar year.
[b] Not to be exceeded by a rolling three-month arithmetic mean.
[c] Annual arithmetic mean.
[d] Three-year average of 98th percentile of 1-hour daily maximum concentrations.
[e] Three-year average of the annual fourth-highest daily maximum 8-hour concentrations.
[f] Not to be exceeded more than once per year on average over a 3-year period.
[g] Three-year average of the annual 98th percentile values.
[h] Three-year average of annual concentrations.
[i] Three-year average of 99th percentile of 1-hour daily maximum concentrations.
[j] Not to be exceeded more than once per month.

* The 24-hour and Annual SO_2 standards were revoked per the 2010 rulemaking. However, these standards will remain in effect until one year after attainment status designations for the 2010 1-hour SO_2 standard are complete for a given area.

Appendix C AAQM Site Descriptions

This appendix includes site descriptions and information relating to State operated analyzers and samplers onsite. Please note that all sites meet the siting criteria specified in 40 CFR 58, Appendices A, C, D, and E. When selecting a site, five factors are considered: modeling results, landowner permission, power availability, year-round access to the site, and prevailing wind direction.

The sites addressed in this report are only the current active sites. A complete list of sites and all monitoring that has been conducted at each site can be found in the AQS system at https://www.epa.gov/outdoor-air-quality-data. Also available at this site are air quality summary data and emissions data.

Map images in this appendix are from the North Dakota Geographic Information Systems (GIS) Hub site at http://www.nd.gov/gis.

Site Name: Beulah – North

Station Type: SLAMS (required)
AQS#: 38-057-0004 **MSA:** 0000
Address: 6024 Highway 200
Beulah, ND
Latitude: +47.298611 **Longitude:** -101.766944

Site Description: This is one of three key sites in the Department's ambient monitoring network to meet the six required monitoring objectives. When this site was established, it was decided to enhance the site to include ammonia, solar radiation, and delta temperature to support air quality dispersion modeling. This site is one of the required $PM_{2.5}$ monitoring sites for North Dakota. This site also acts as a collocated $PM_{2.5}$ site for meeting EPA Collocation requirements.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Population Exposure	Urban
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	Urban
Ozone	Instrumental Ultraviolet	Continuous	Population Exposure	Urban
$PM_{2.5}$	$PM_{2.5}$ scattered light spectrometry	Continuous	Population Exposure	Urban
PM_{10}	PM_{10} Local Condition scattered light spectrometry	Continuous	Population Exposure	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Delta Temperature	Elec. or Mach Avg.	Continuous	10 - 2 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban
Solar Radiation	Pyranometer	Continuous	2 meters	Urban

Site Pictures: **Beulah North**

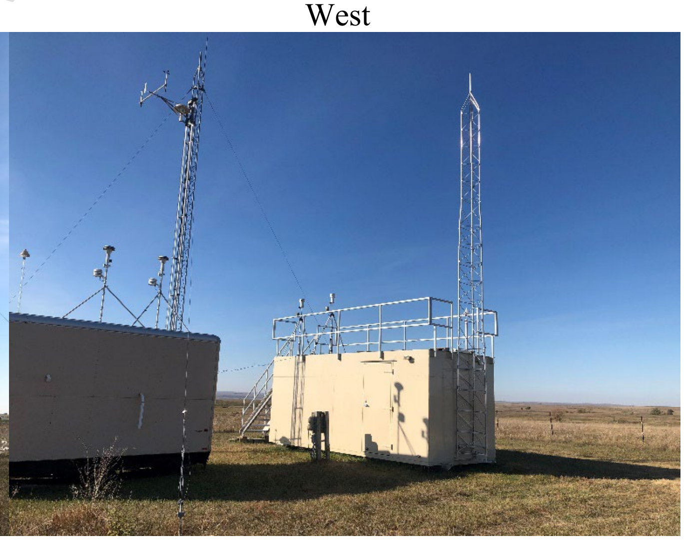
North

South

East

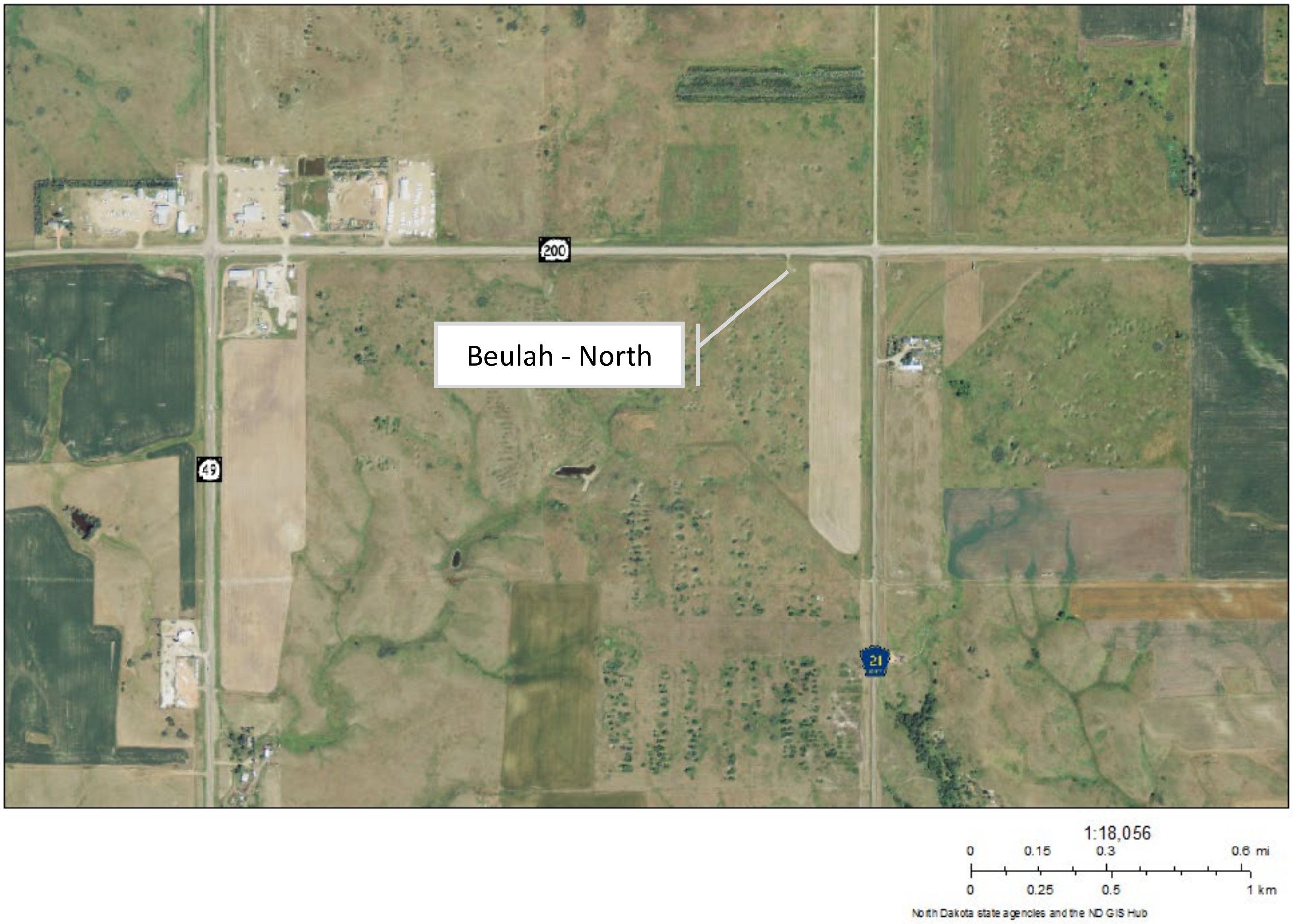
West

Looking Northeast



Looking Southwest

Beulah - North



Site Name: Bismarck Residential

Station Type: SLAMS, NCore
AQS#: 38-015-0003 **MSA:** 1010
Address: 1810 N 16th Street
Bismarck, ND
Latitude: +46.825425 **Longitude:** -100.768210

Site Description: This site is located in the second largest metropolitan area in the state and is the designated NCore site in North Dakota. This site also serves as a field test location for new types of equipment and procedures.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Population Exposure	Urban
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	Urban
Carbon Monoxide	Instrumental Gas Filter Correlation	Continuous	Population Exposure	Urban
NO_y	Instrumental Chemiluminescence	Continuous	Population Exposure	Urban
Ozone	Instrumental Ultraviolet	Continuous	Population Exposure	Urban
$PM_{2.5}$	24-hour Gravimetric	1/3	Population Exposure	Urban
$PM_{2.5}$	$PM_{2.5}$ scattered light spectrometry	Continuous	Population Exposure	Urban
$PM_{10\ STP}$	PM_{10} scattered light spectrometry	Continuous	Population Exposure	Urban
$PM_{2.5}$ Speciation	24-hour Gravimetric	1/3	Population Exposure	Urban

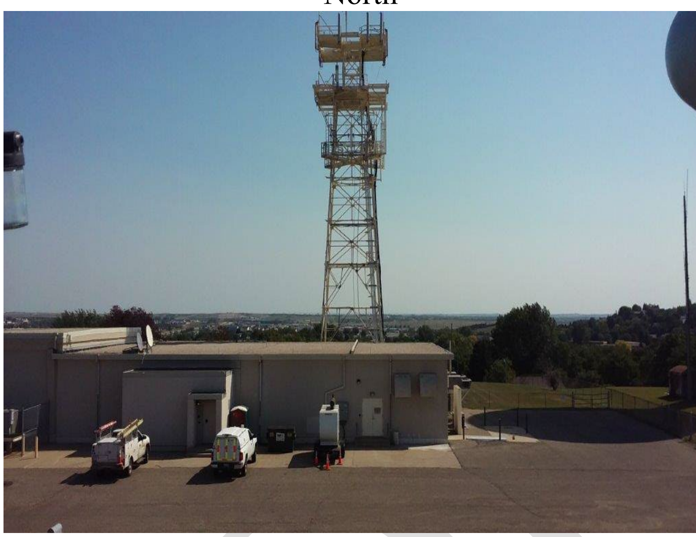
Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Delta Temperature	Elec. or Mach Avg.	Continuous	10 - 2 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban
Relative Humidity	Hygroscopic Plastic Film	Continuous	10 meters	Urban
Solar Radiation	Pyranometer	Continuous	2 meters	Urban

Site Pictures: **Bismarck Residential**


North

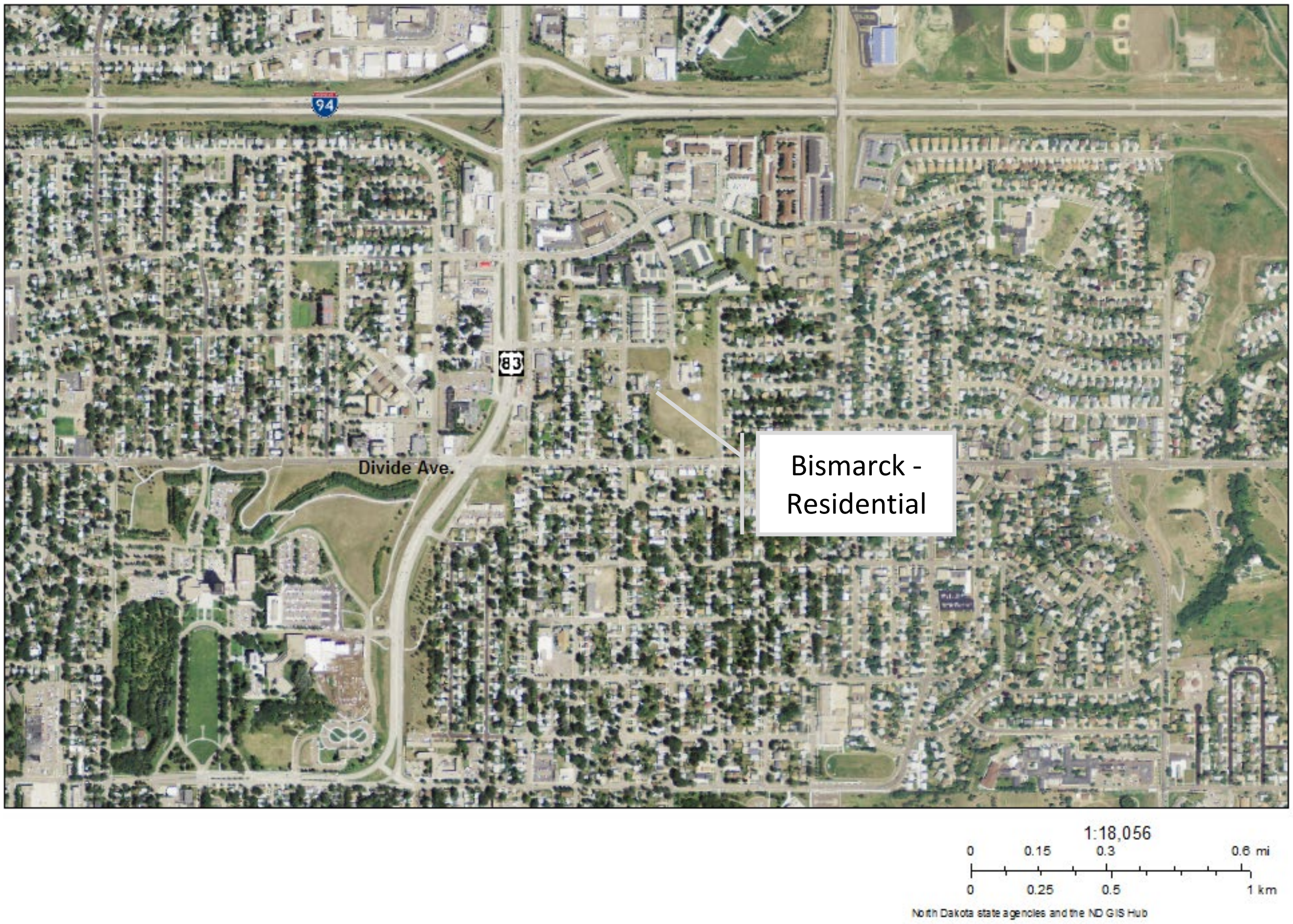

South


East


West


Shelter

Bismarck Residential



Site Name: Lake Ilo

Station Type: SLAMS
AQS#: 38-025-0004 **MSA:** 0000
Address: 101st Avenue SW
Dunn Center, ND
Latitude: +47.342442 **Longitude:** -102.645839

Site Description: This site is located about midway between the oil development all along the North Dakota – Montana border and the seven coal conversion facilities to the east. The importance lies in the ability to monitor the transport of sulfur dioxide, nitrogen dioxide, and $PM_{2.5}$ between these two areas. Also, this is a key site used in dispersion model calibration and validation.

Gas/Particulate parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	General/Background	Urban
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	General/Background	Urban
Ozone	Instrumental Ultraviolet	Continuous	General/Background	Urban
$PM_{2.5}$	$PM_{2.5}$ scattered light spectrometry	Continuous	General/Background	Urban
PM_{10}	PM_{10} scattered light spectrometry	Continuous	General/Background	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Delta Temperature	Elec. or Mach Avg.	Continuous	10 - 2 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban
Solar Radiation	Pyranometer	Continuous	2 meters	Urban

Site Pictures: **Lake Ilo**

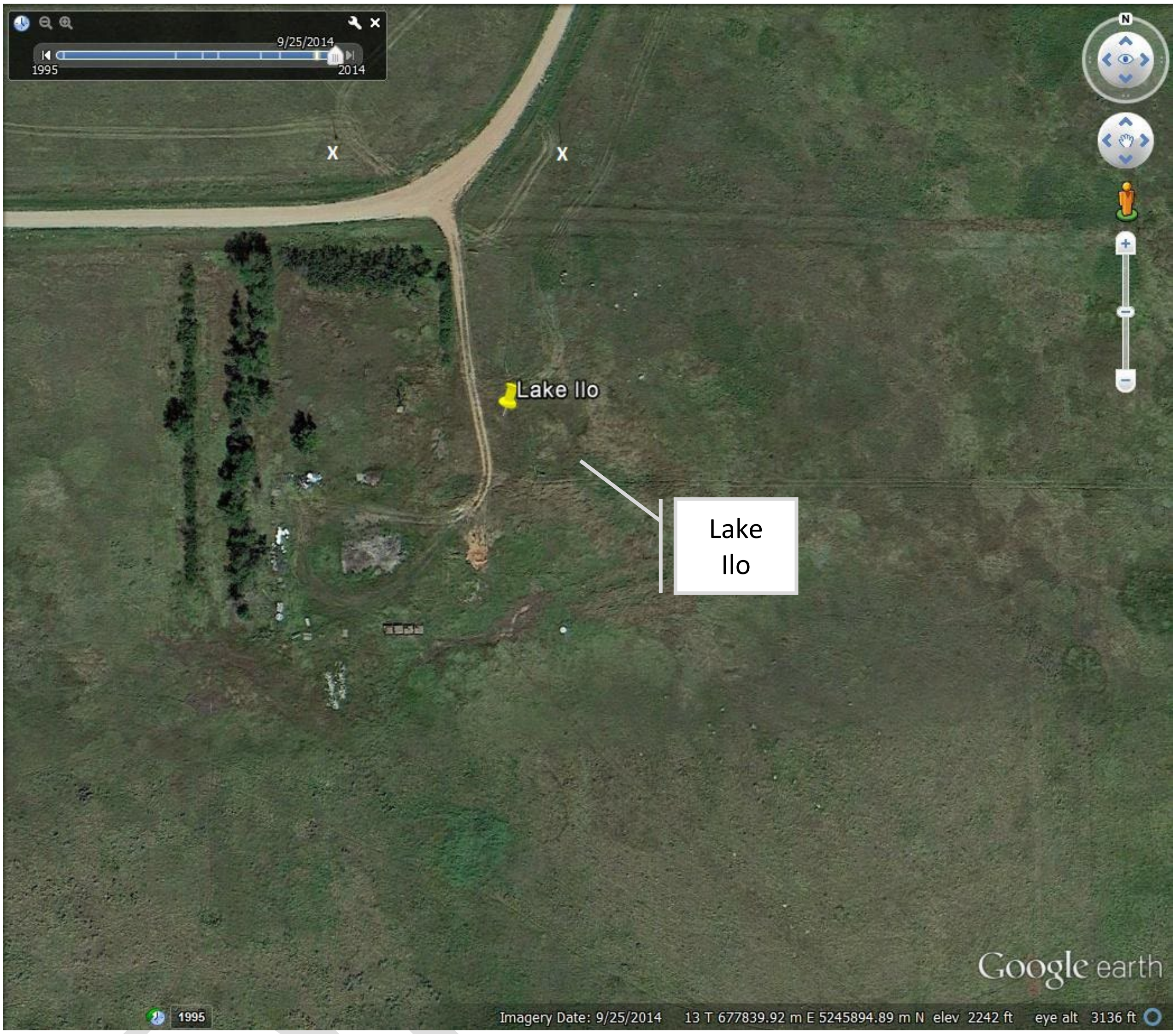
North

West

East

South

Looking Southeast



9/25/2014
1995
2014
X
X
Lake Ilo
Lake
Ilo
Google earth
1995
Imagery Date: 9/25/2014 13 T 677839.92 m E 5245894.89 m N elev 2242 ft eye alt 3136 ft

Site Name: Fargo NW

Station Type: SLAMS (required)
AQS#: 38-017-1004 **MSA:** 2520
Address: 4266 40th Avenue North
Fargo, ND
Latitude: +46.933754 **Longitude:** -96.855350

Site Description: This site is located in the largest metropolitan area in North Dakota. The data collected at this site are used in dispersion modeling for input, calibration, and validation.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Population Exposure	Urban
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	Urban
Ozone	Instrumental Ultraviolet	Continuous	Population Exposure	Urban
$PM_{2.5}$	$PM_{2.5}$ scattered light spectrometry	Continuous	Population Exposure	Urban
PM_{10}	PM_{10} scattered light spectrometry	Continuous	Population Exposure	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Delta Temperature	Elec. or Mach Avg.	Continuous	10 - 2 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban
Relative Humidity	Hygroscopic Plastic Film	Continuous	10 meters	Urban
Solar Radiation	Pyranometer	Continuous	2 meters	Urban

Site Pictures: **Fargo NW**

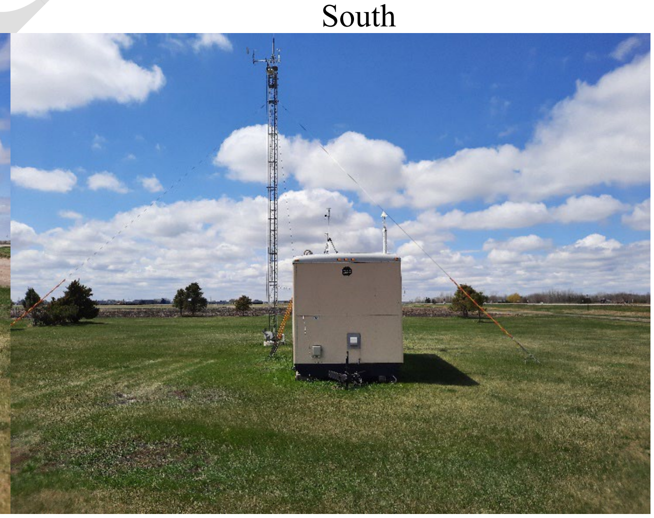
North

West

East

South

Looking Northeast



Looking West

Fargo NW


45th St.
40th Ave N
29
29
1:18,056
0
0.15
0.3
0.6 mi
0
0.25
0.5
1 km
North Dakota state agencies and the ND GIS Hub

Site Name: Hannover

Station Type: SLAMS
AQS#: 38-065-0002 **MSA:** 0000
Address: 1575 Highway 31
Stanton, ND
Latitude: +47.185833 **Longitude:** -101.428056

Site Description: This site is centrally located to the power plants in the Oliver-Mercer-McLean County area. The data collected here are used to supplement ambient data collected at Beulah – North and TRNP – NU.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Source Oriented	Urban
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Source Oriented	Urban
Ozone	Instrumental Ultraviolet	Continuous	Source Oriented	Urban
$PM_{2.5}$	$PM_{2.5}$ scattered light spectrometry	Continuous	Source Oriented	Urban
PM_{10}	PM_{10} scattered light spectrometry	Continuous	Source Oriented	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban

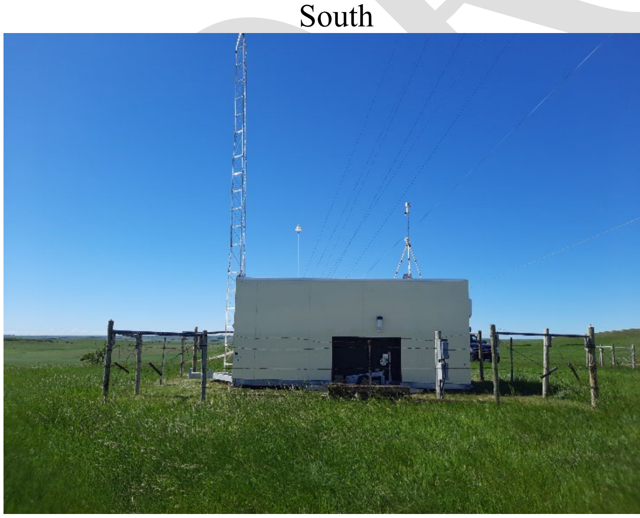
Site Pictures: **Hannover**

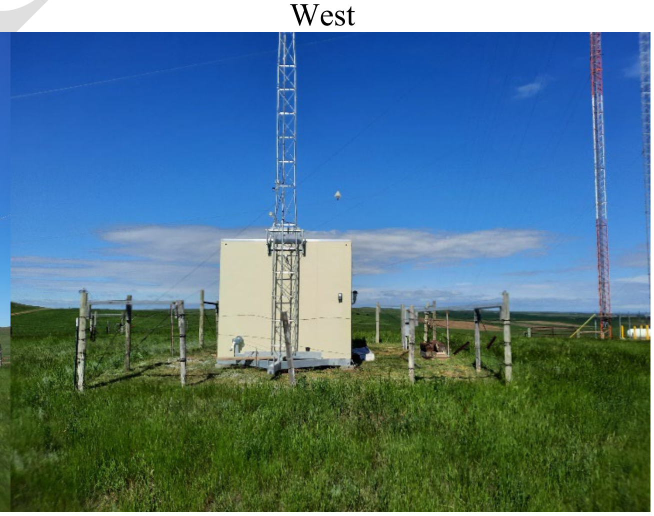

North


East


South


West


Looking Southwest


Looking West

Hannover


Hannover
31
16th St.
1:9,028
0 0.075 0.15 0.3 mi
0 0.1 0.2 0.4 km
North Dakota state agencies and the ND GIS Hub

Site Name: Lostwood NWR

Station Type: SLAMS
AQS#: 38-013-0004 **MSA:** 0000
Address: 8315 Highway 8
Kenmare, ND
Latitude: +48.641930 **Longitude:** -102.401800

Site Description: This site is located in a PSD Class I area. This site is downwind of two power plants near Estevan, SK, and located in the Souris River Airshed.

The site has an IMPROVE sampler operated by the US Fish and Wildlife Service. These data will be used with the other ambient data collected here to evaluate long-range transport of aerosols affecting regional haze/visibility.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Regional Transport	Regional
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Regional Transport	Regional
Ozone	Instrumental Ultraviolet	Continuous	Regional Transport	Regional
Ozone	Instrumental Chemiluminescence	Continuous	Regional Transport	Regional
$PM_{2.5}$	$PM_{2.5}$ scattered light spectrometry	Continuous	Regional Transport	Regional
PM_{10}	PM_{10} Beta Attenuation	Continuous	Regional Transport	Regional

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Delta Temperature	Elec. or Mach Avg.	Continuous	10 - 2 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban
Solar Radiation	Pyranometer	Continuous	2 meters	Urban
Relative Humidity	Hygroscopic Plastic Film	Continuous	10 meters	Urban

Site Pictures: **Lostwood NWR**

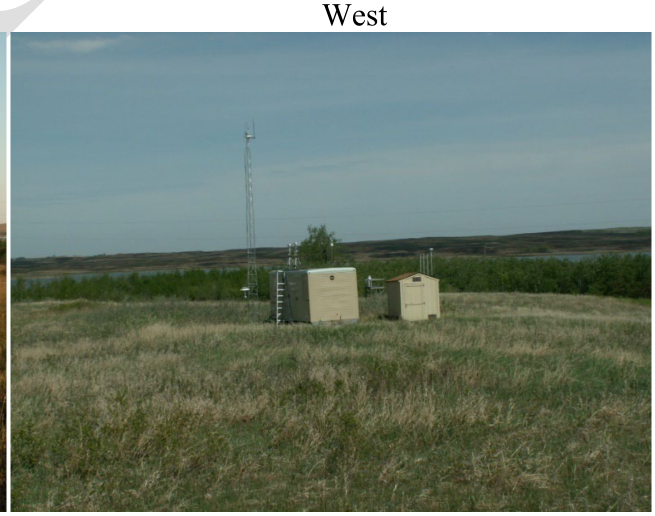
North

South

East

West

Looking Northwest



Looking North

Lostwood NWR

Site Name: Painted Canyon (TRNP – SU)

Station Type: SLAMS
AQS#: 38-007-0002 **MSA:** 0000
Address: Theodore Roosevelt National Park – South Unit
13881 I94 East
Latitude: +46.894300 **Longitude:** -103.378530

Site Description: Located in the South Unit of Theodore Roosevelt National Park, this PSD Class I area site is operated in partnership with the National Park Service. As it is positioned south of the majority of oil and gas activity in the state, this station plays a key role in monitoring general background conditions and providing data for dispersion modeling input, calibration, and validation.

The site has an IMPROVE sampler operated by the National Park Service. These data will be used with the other ambient data collected here to evaluate long-range transport of aerosols affecting regional haze/visibility.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	General/Background	Urban
Ozone	Instrumental Ultraviolet	Continuous	General/Background	Urban
$PM_{2.5}$	$PM_{2.5}$ Beta Attenuation	Continuous	General/Background	Urban

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
*	*	*	*	*

* All meteorological parameters are monitored as part of the NPS network.

Site Pictures: **Painted Canyon**

North

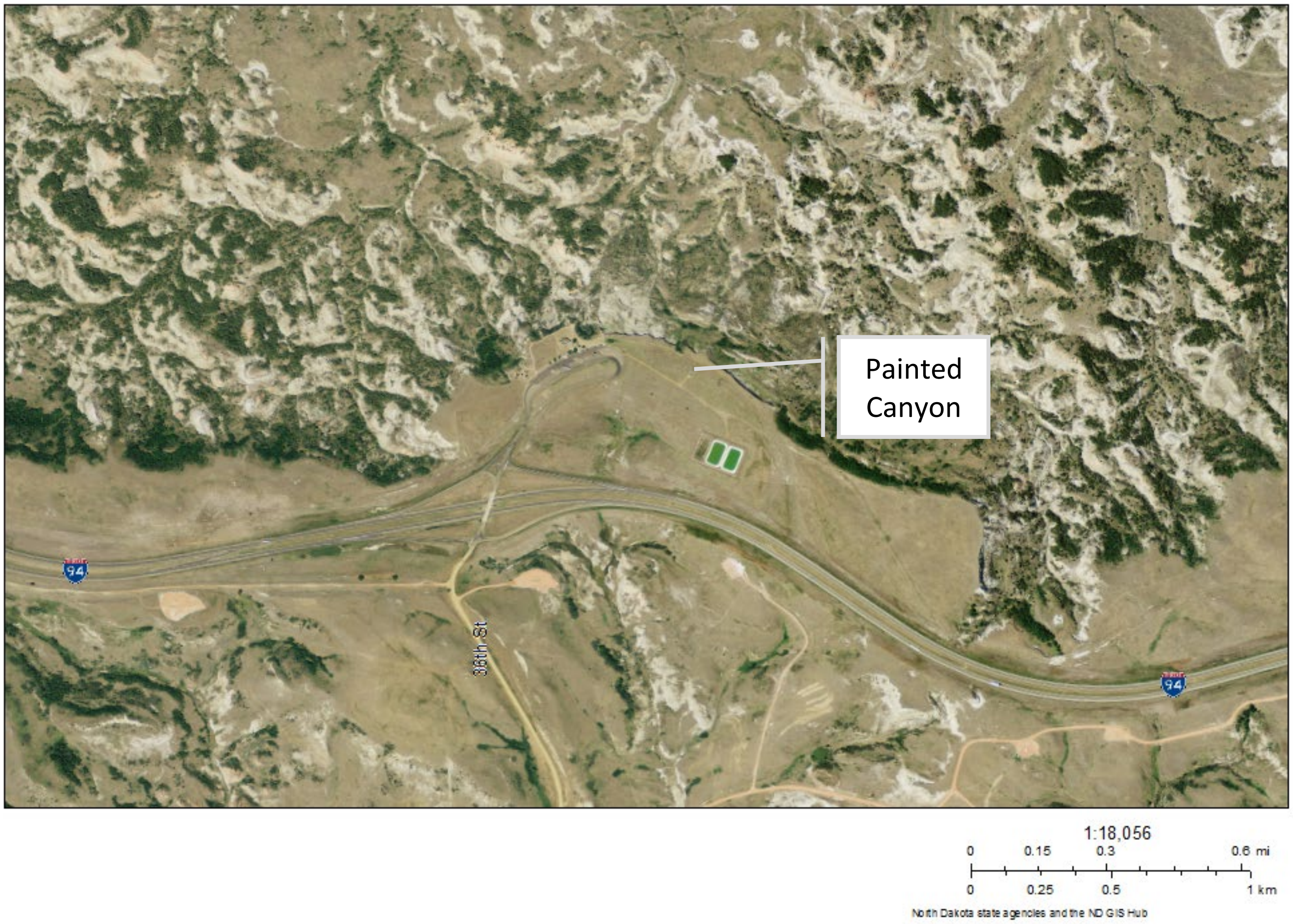
East

South

West

Looking Southwest

Painted Canyon



Site Name: Ryder

Station Type: SLAMS
AQS#: 38-101-0003 **MSA:** 0000
Address: 184th St. SW
Ryder, ND
Latitude: +47.940861 **Longitude:** -101.571583

Site Description: This site is located at the eastern edge of the major oil and gas production area of the state. Located in Ward County, it is approximately 20 miles southwest of the city of Minot. This station is intended to provide data on regional pollutant transport and population impacts.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Regional Transport / Population Exposure	Regional
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Regional Transport / Population Exposure	Regional
Ozone	Instrumental Ultraviolet	Continuous	Regional Transport / Population Exposure	Regional
$PM_{2.5}$	$PM_{2.5}$ scattered light spectrometry	Continuous	Regional Transport / Population Exposure	Regional
PM_{10}	PM_{10} scattered light spectrometry	Continuous	Regional Transport / Population Exposure	Regional

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban

Site Pictures: **Ryder**

North

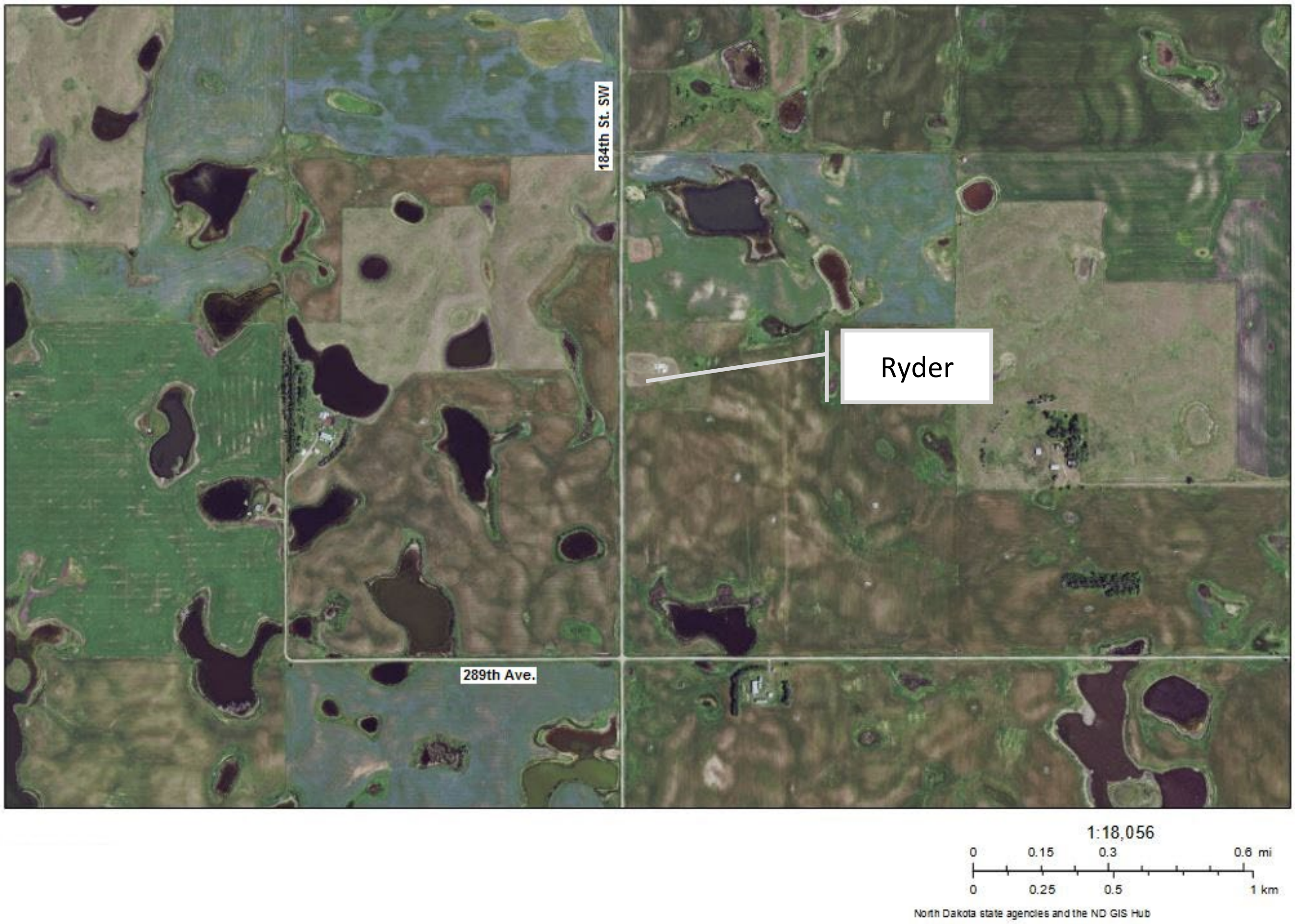
East

South

West

Looking Northeast

Ryder


184th St. SW
Ryder
289th Ave.
1:18,056
0 0.15 0.3 0.6 mi
0 0.25 0.5 1 km
North Dakota state agencies and the ND GIS Hub

Site Name: TRNP-NU

Station Type: SLAMS (required)
AQS#: 38-053-0002 **MSA:** 0000
Address: 229 Service Road
Watford City, ND
Latitude: +47.581200 **Longitude:** -103.299500

Site Description: This site is located in Theodore Roosevelt National Park – North Unit, a PSD Class I area, and is one of three key sites in the Department's ambient monitoring network to meet the six required monitoring objectives. The data collected are used for model calibration/validation.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	General/Background	Regional
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	General/Background	Regional
Ozone	Instrumental Ultraviolet	Continuous	General/Background	Regional
$PM_{2.5}$	$PM_{2.5}$ scattered light spectrometry	Continuous	General/Background Regional Transport	Regional
PM_{10}	PM_{10} scattered light spectrometry	Continuous	General/Background Regional Transport	Regional

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. or Mach Avg.	Continuous	10 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	6 meters	Urban
Relative Humidity	Hygroscopic Plastic Film	Continuous	10 meters	Urban

Site Pictures: **TRNP-NU**

North

South

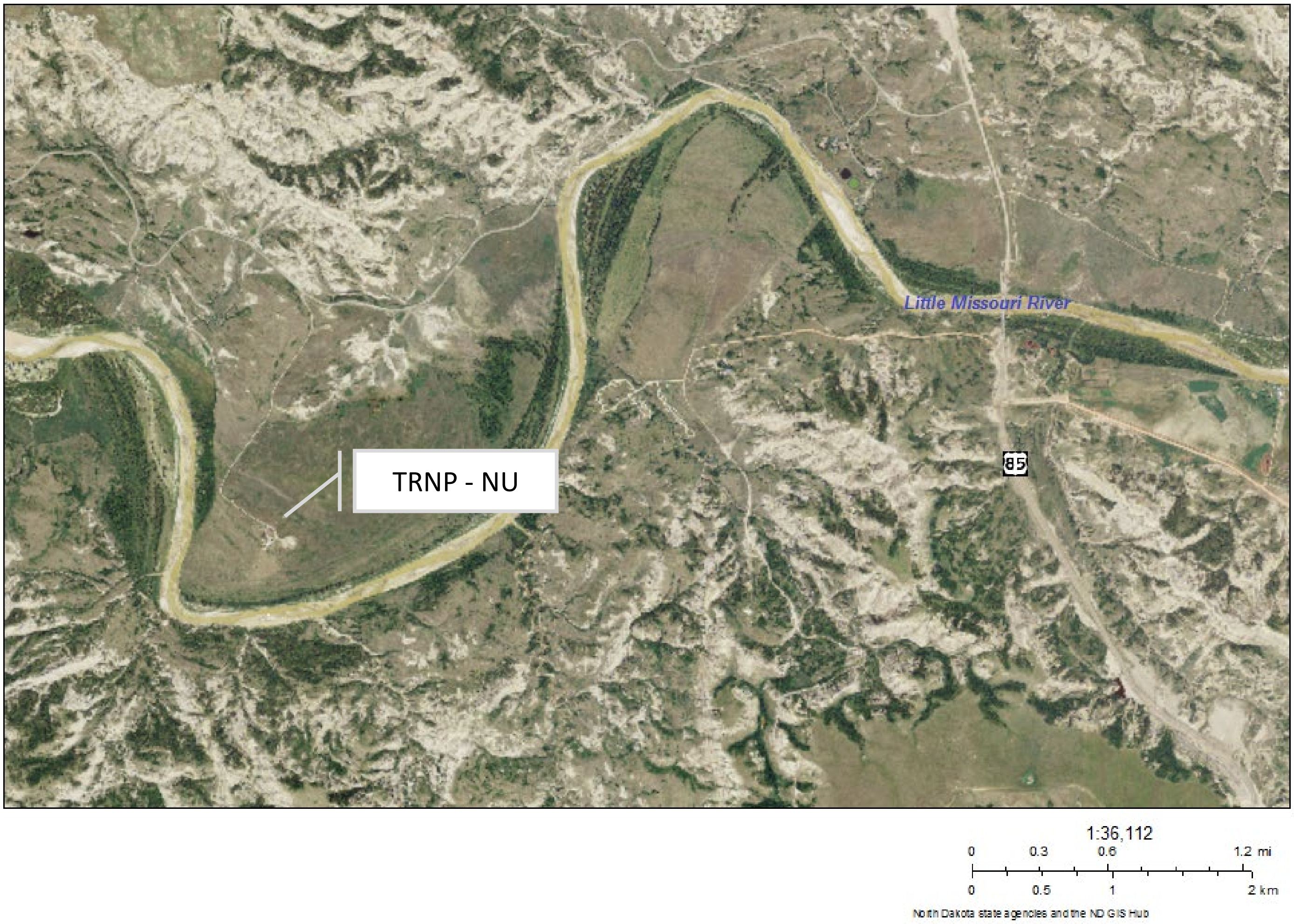
East

West

Looking Southwest

Looking Northeast

Theodore Roosevelt National Park - North Unit



Appendix D Wind and Pollution Roses

The figures in this appendix are organized with the site's wind rose presented at the top, criteria pollutant roses follow in alphabetical order, monitored pollutant roses.

The pollution roses show the percentage of time a pollutant is detected when the wind is from a given direction and provide a total summary of detected concentrations in the legend.

From mid-May through mid-September of 2023, smoke from wildfires across Canada directly affected the air quality in North Dakota, causing elevated concentrations of particulate matter ($PM_{2.5}$ and PM_{10}) and ozone (O_3). The Division has applied data qualifiers in AQS associated with the elevated concentrations. The pollution roses in this appendix include wildfire smoke events.

Site Name: Beulah – North

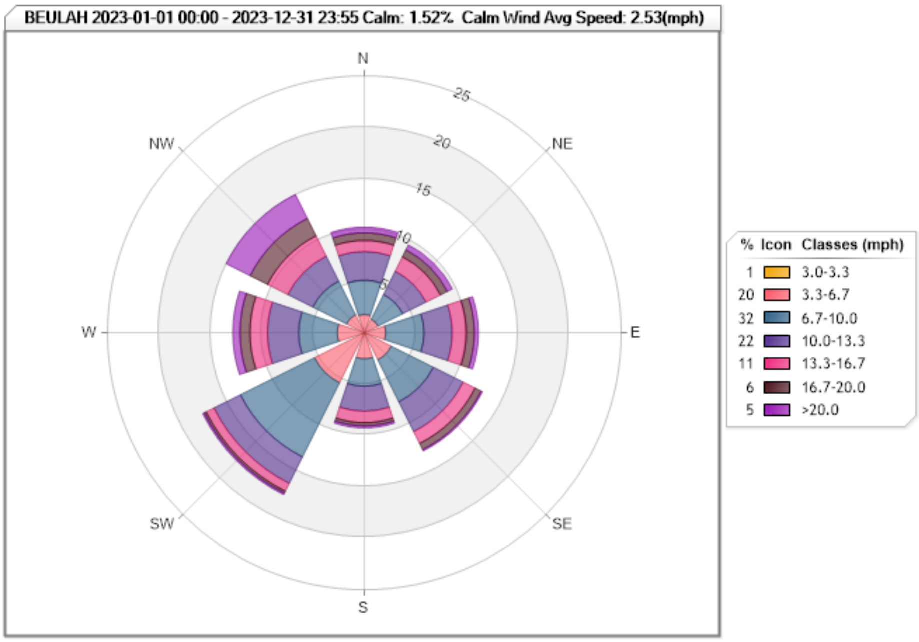


Figure 22. Beulah Wind Rose for 2023

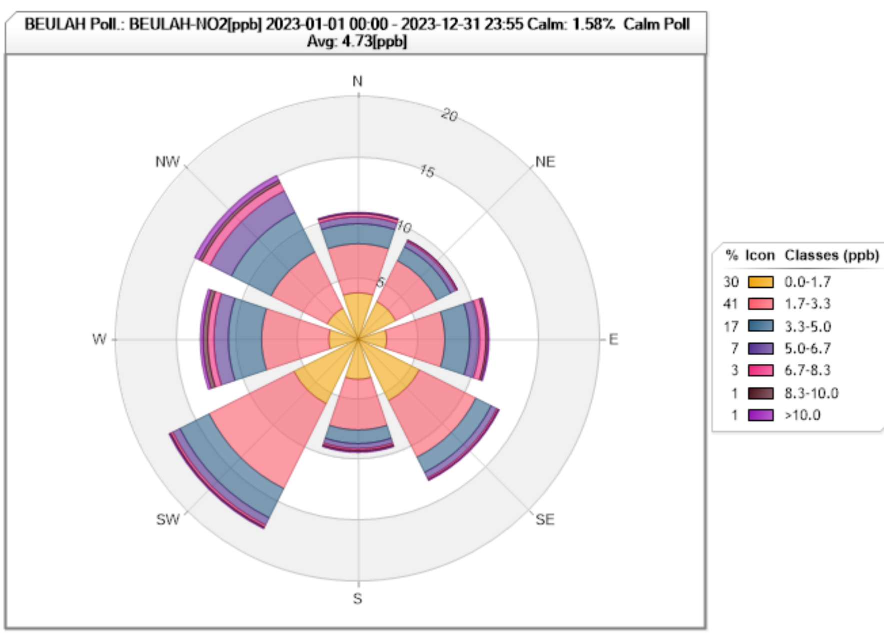


Figure 23. Beulah NO_2 Pollution Rose for 2023

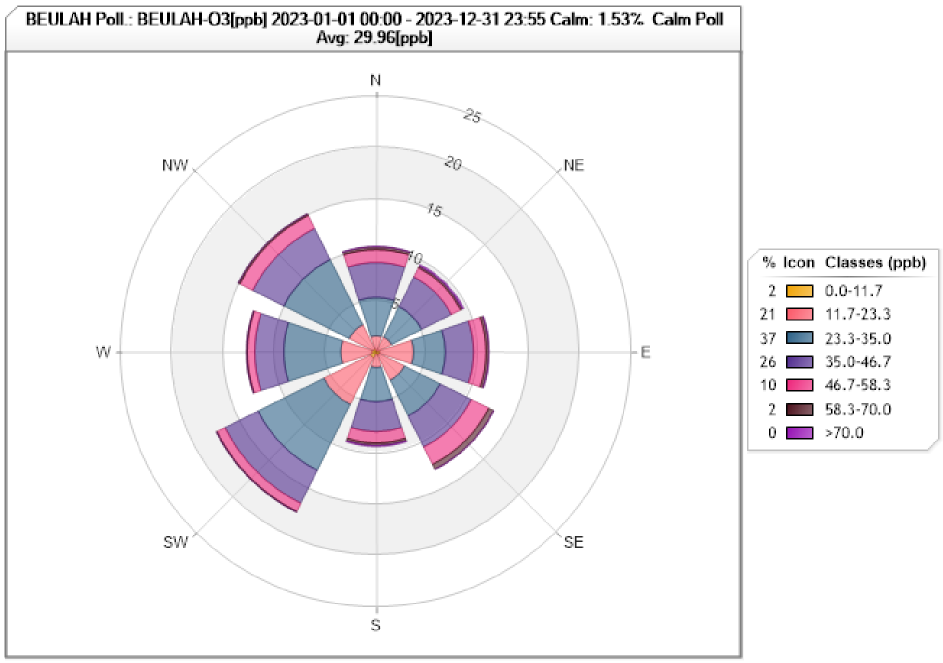


Figure 24. Beulah O_3 Pollution Rose for 2023

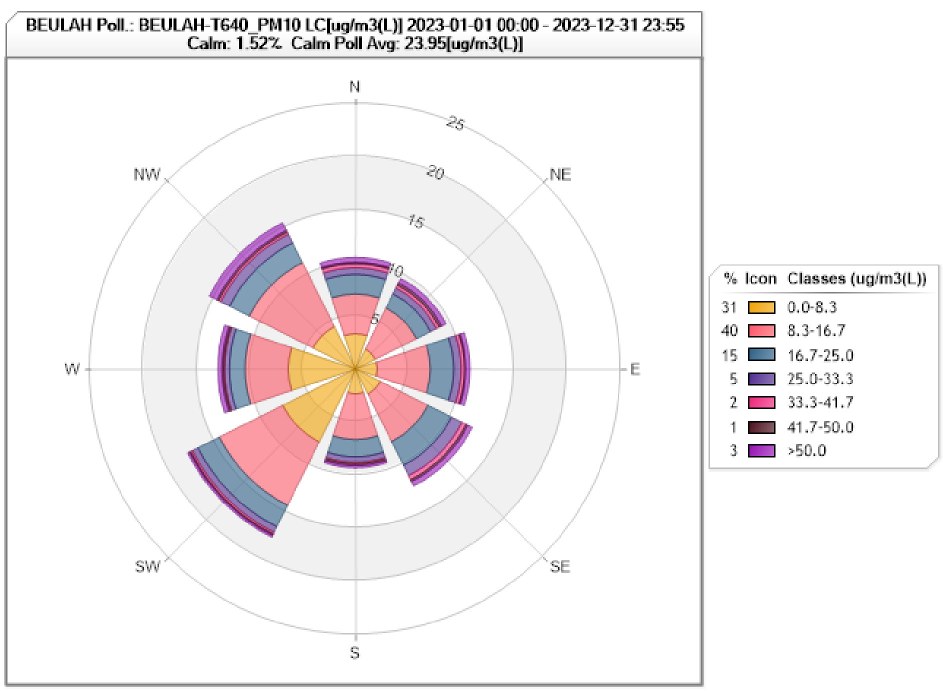


Figure 25. Beulah PM_{10} Pollution Rose for 2023

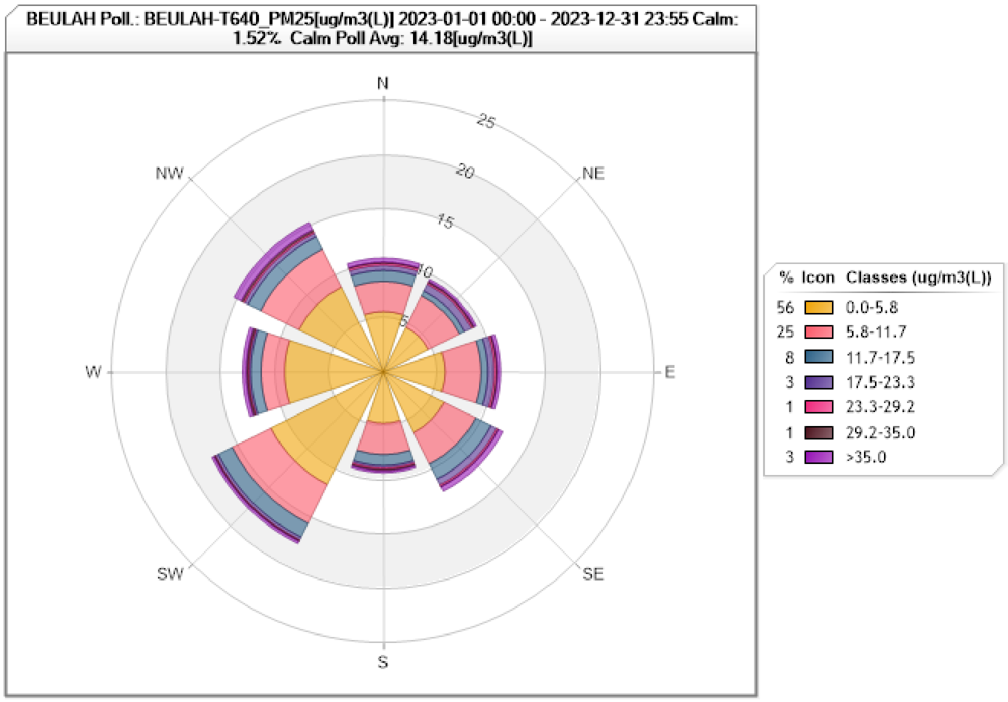


Figure 26. Beulah $PM_{2.5}$ Pollution Rose for 2023

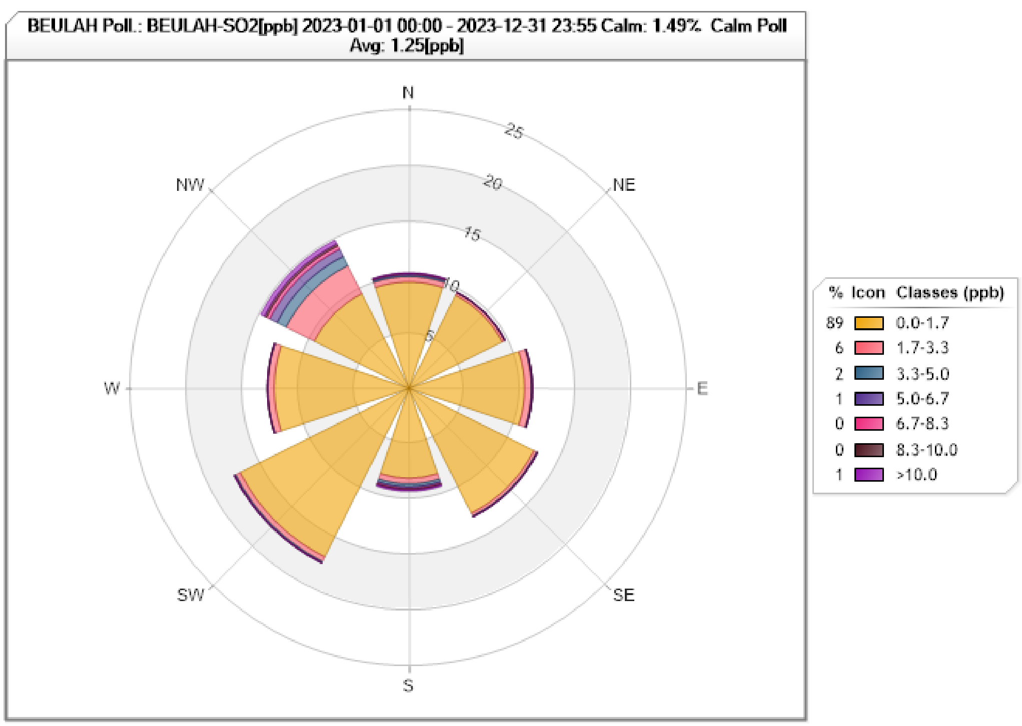


Figure 27. Beulah SO_2 Pollution Rose for 2023

Site Name: Bismarck Residential

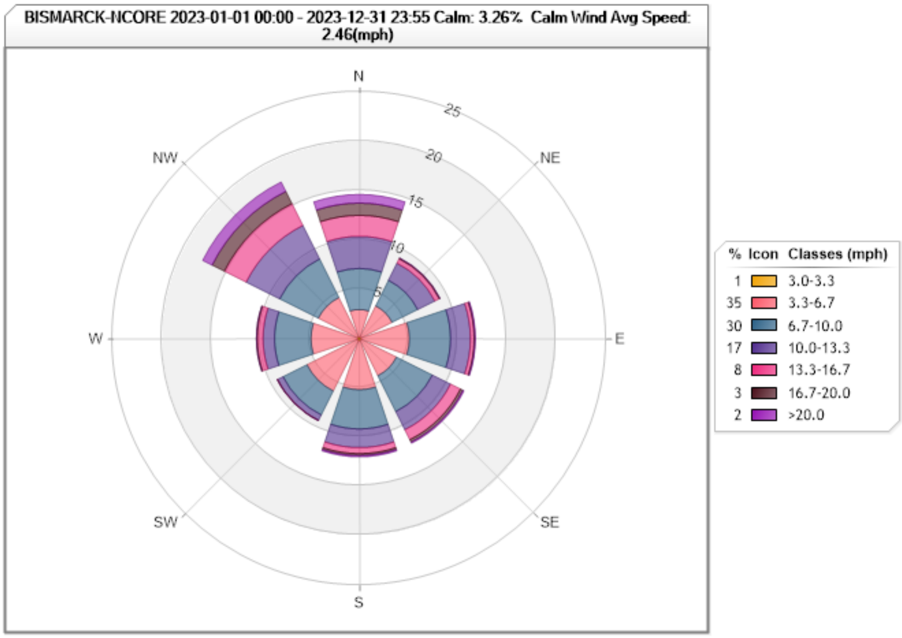


Figure 28. Bismarck Wind Rose for 2023

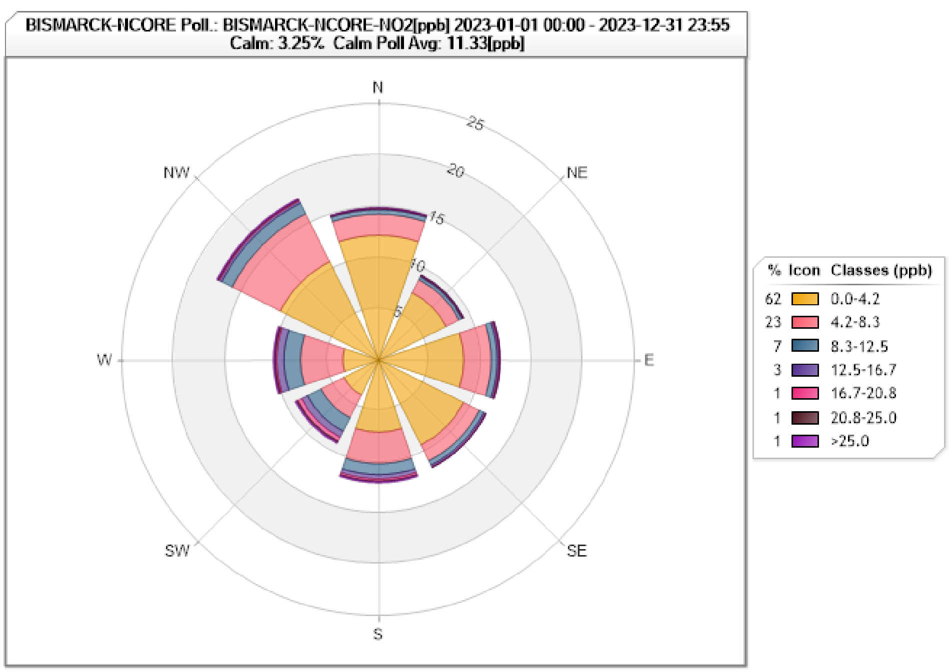


Figure 29. Bismarck NO_2 Pollution Rose for 2023

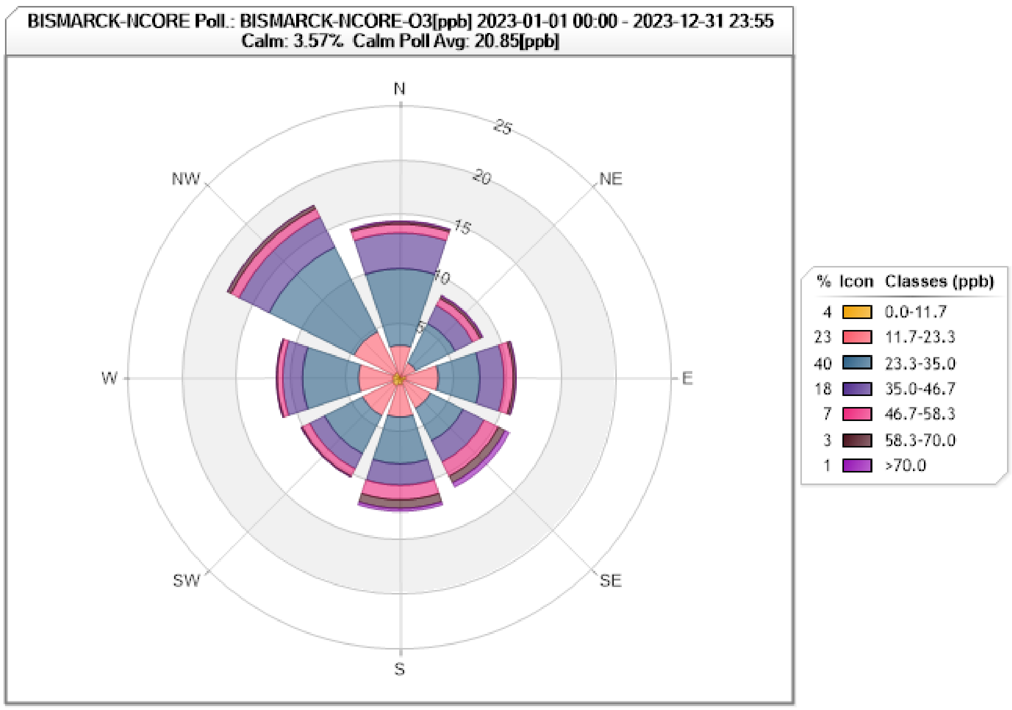


Figure 30. Bismarck O_3 Pollution Rose for 2023

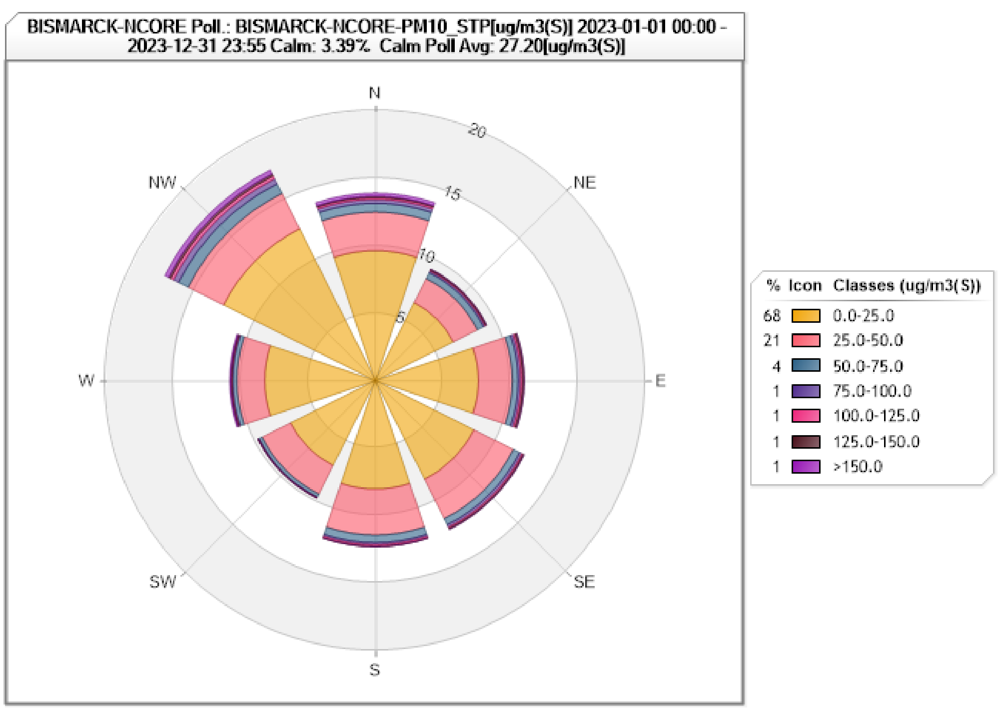


Figure 31. Bismarck PM_{10} Pollution Rose for 2023

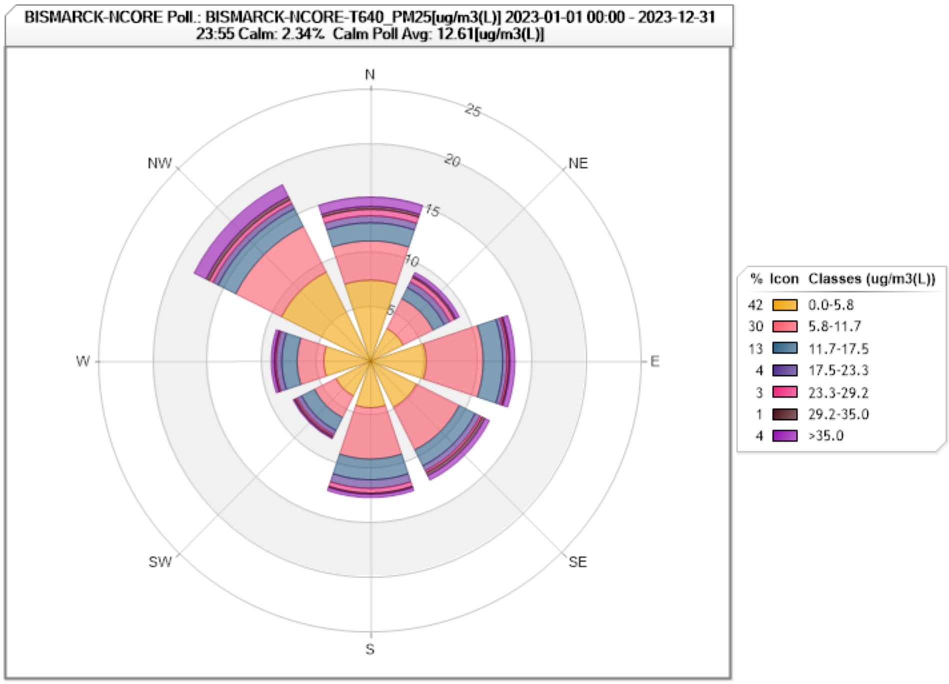


Figure 32. Bismarck $PM_{2.5}$ Pollution Rose for 2023

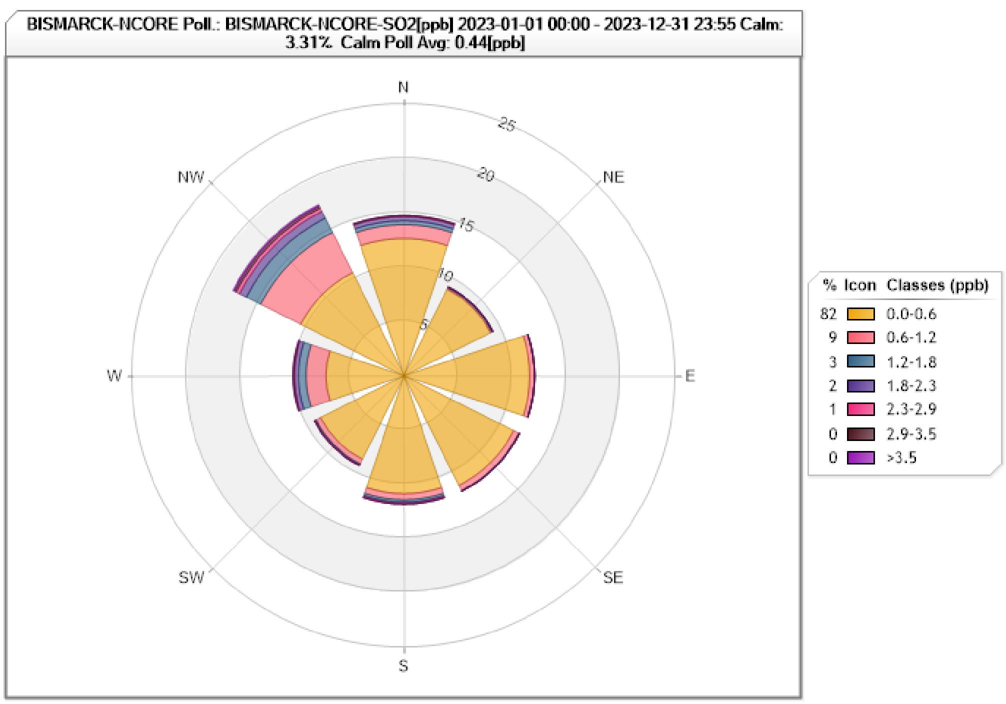


Figure 33. Bismarck SO_2 Pollution Rose for 2023

Site Name: Lake Ilo

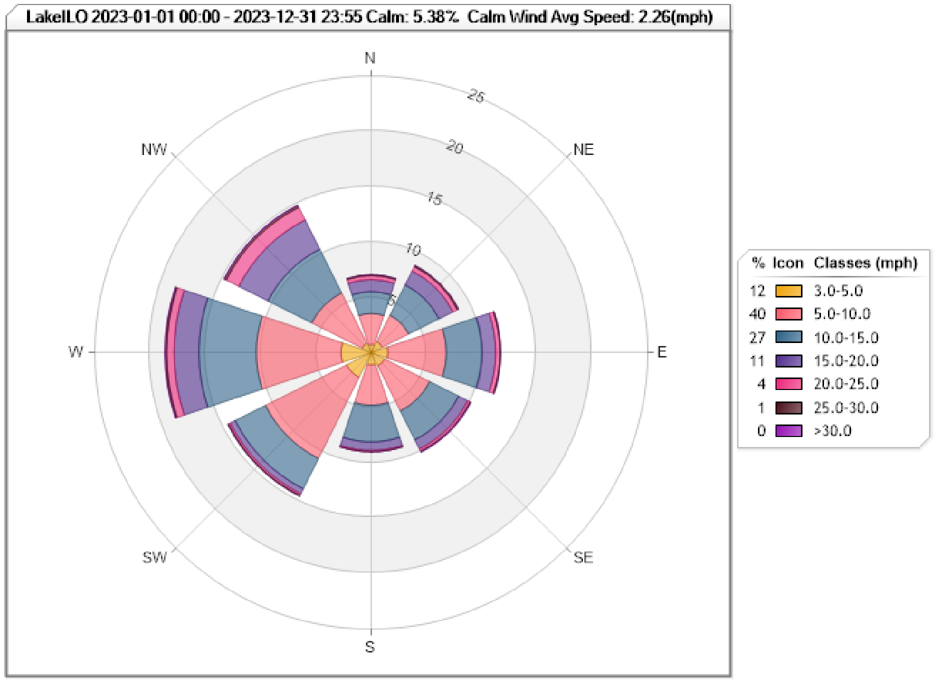


Figure 34. Lake Ilo Wind Rose for 2023

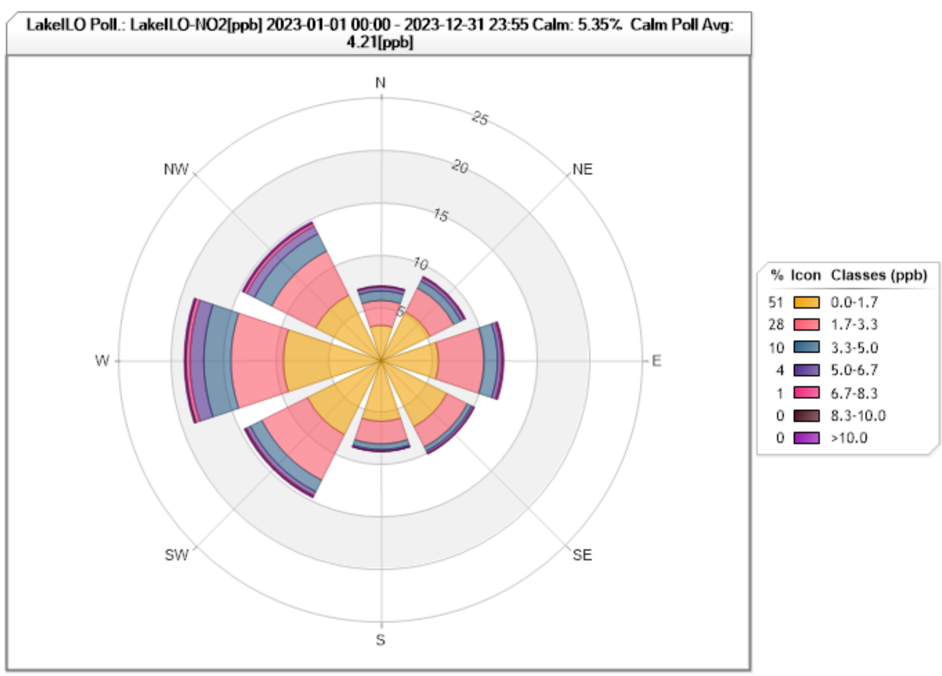


Figure 35. Lake Ilo NO_2 Pollution Rose for 2023

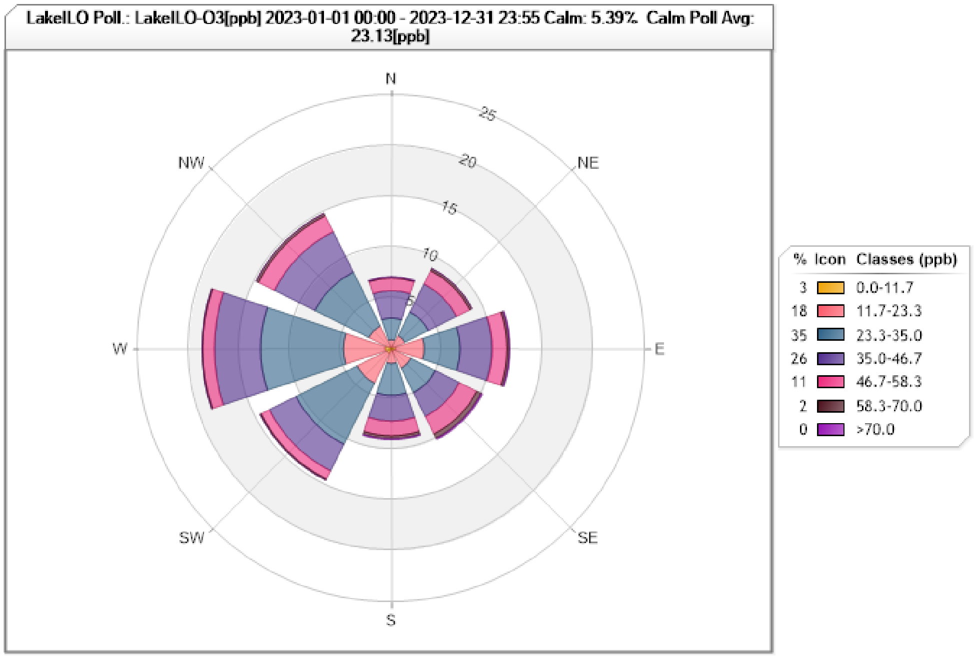


Figure 36. Lake Ilo O_3 Pollution Rose for 2023

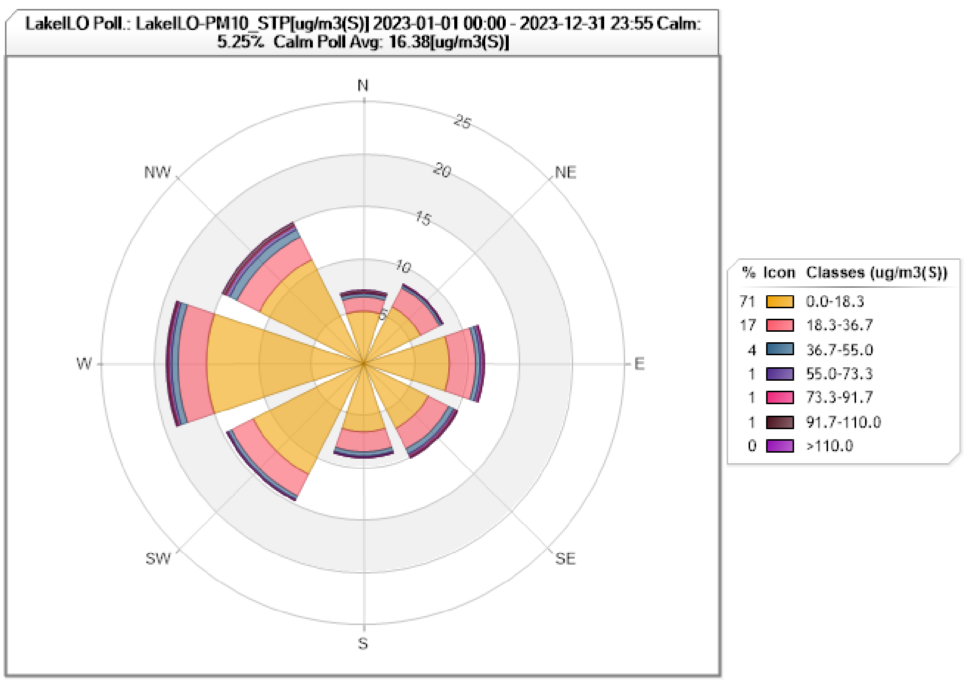


Figure 37. Lake Ilo PM_{10} Pollution Rose for 2023

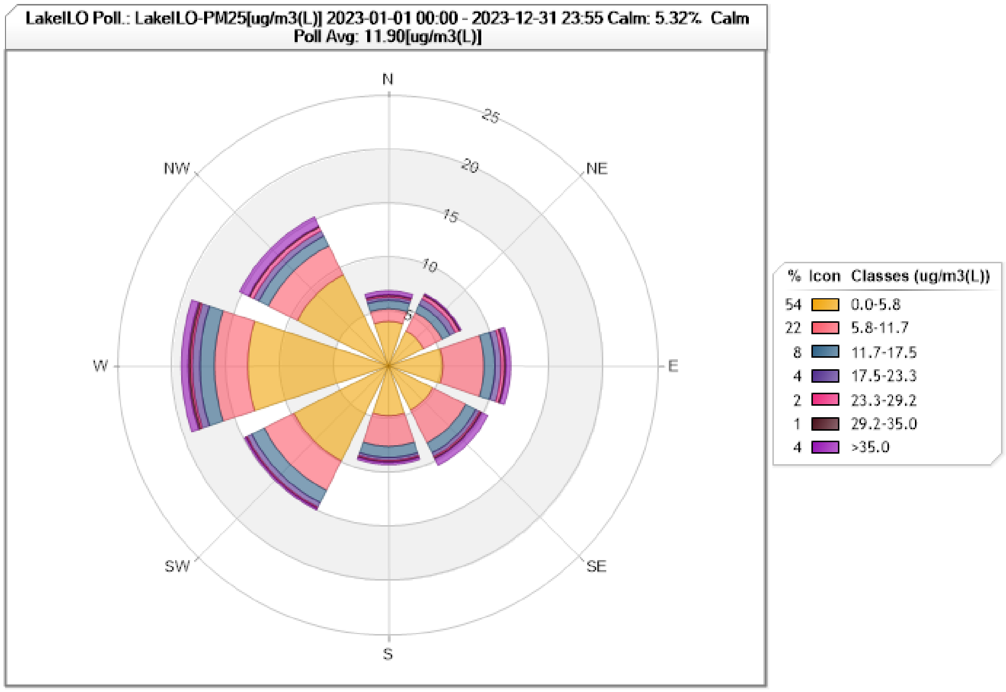


Figure 38. Lake Ilo $PM_{2.5}$ Pollution Rose for 2023

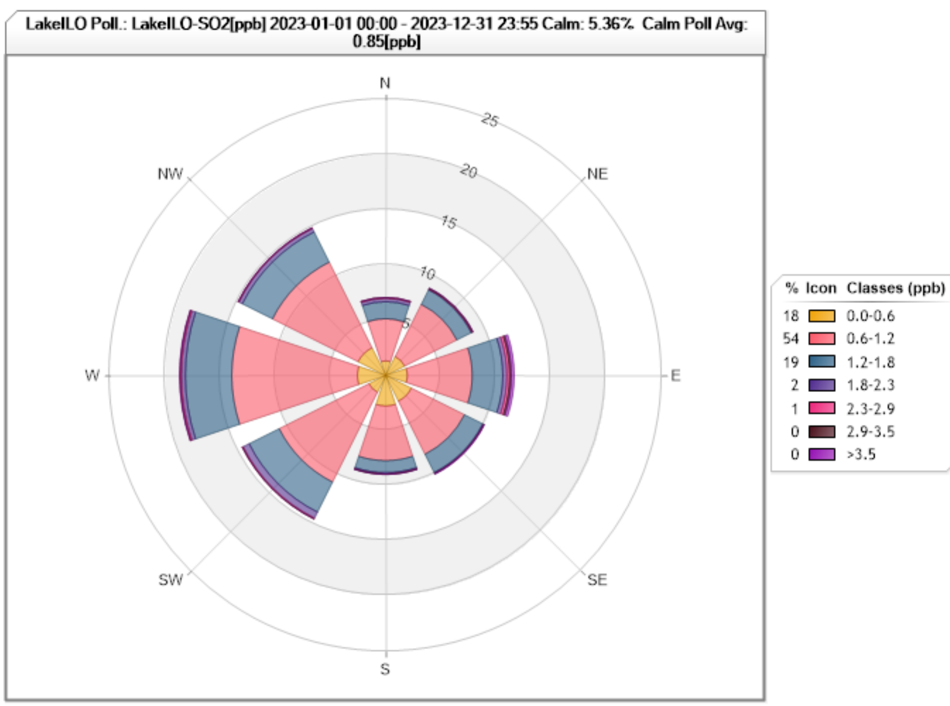


Figure 39. Lake Ilo SO_2 Pollution Rose for 2023

Site Name: Fargo NW

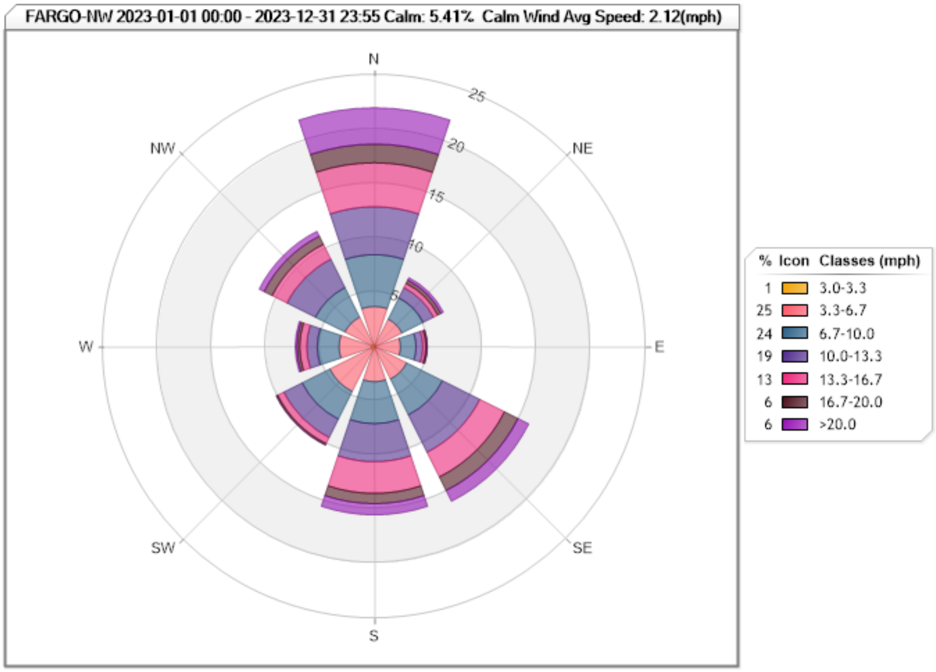


Figure 40. Fargo Wind Rose for 2023

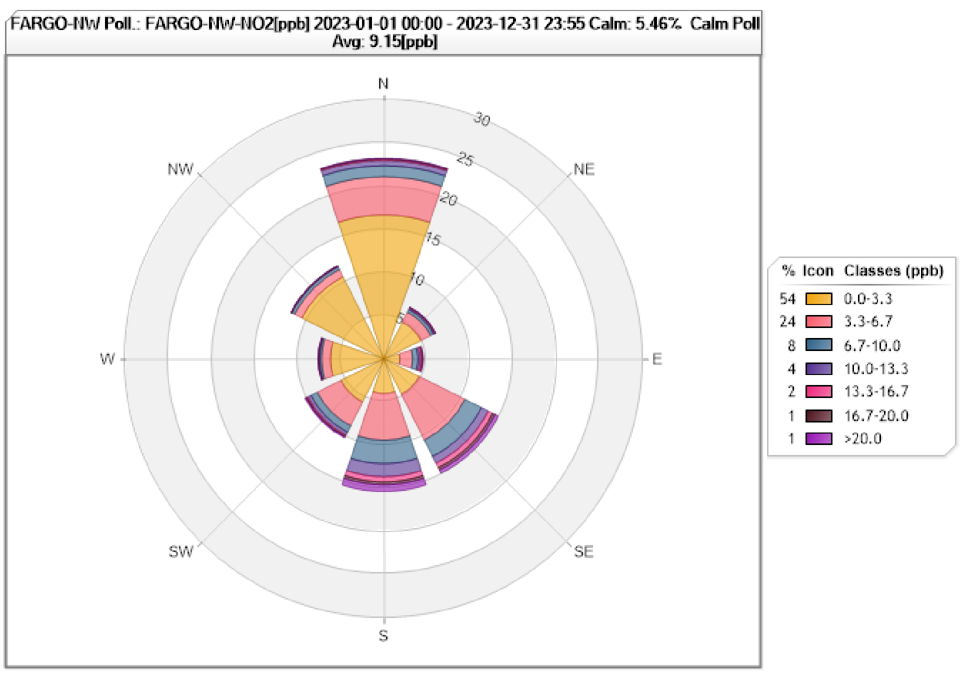


Figure 41. Fargo NO_2 Pollution Rose for 2023

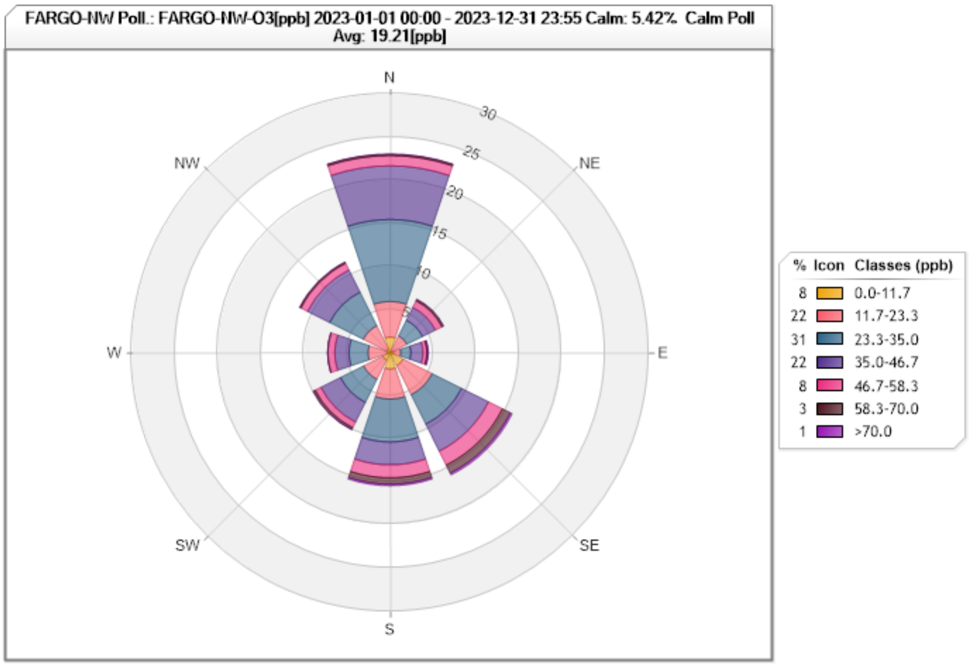


Figure 42. Fargo O_3 Pollution Rose for 2023

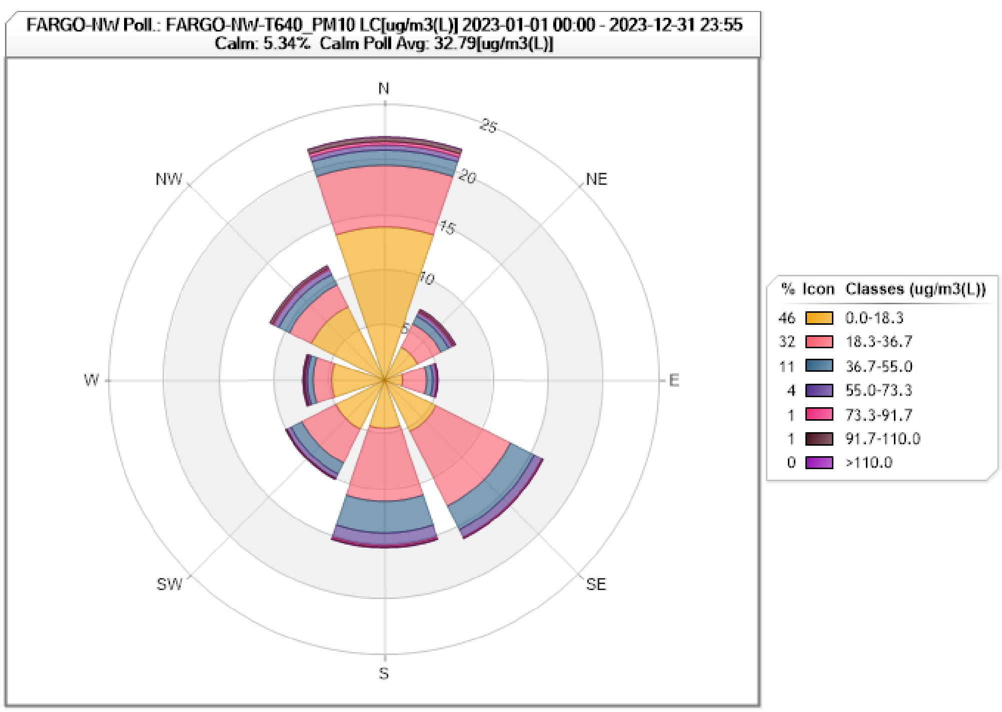


Figure 43. Fargo PM_{10} Pollution Rose for 2023

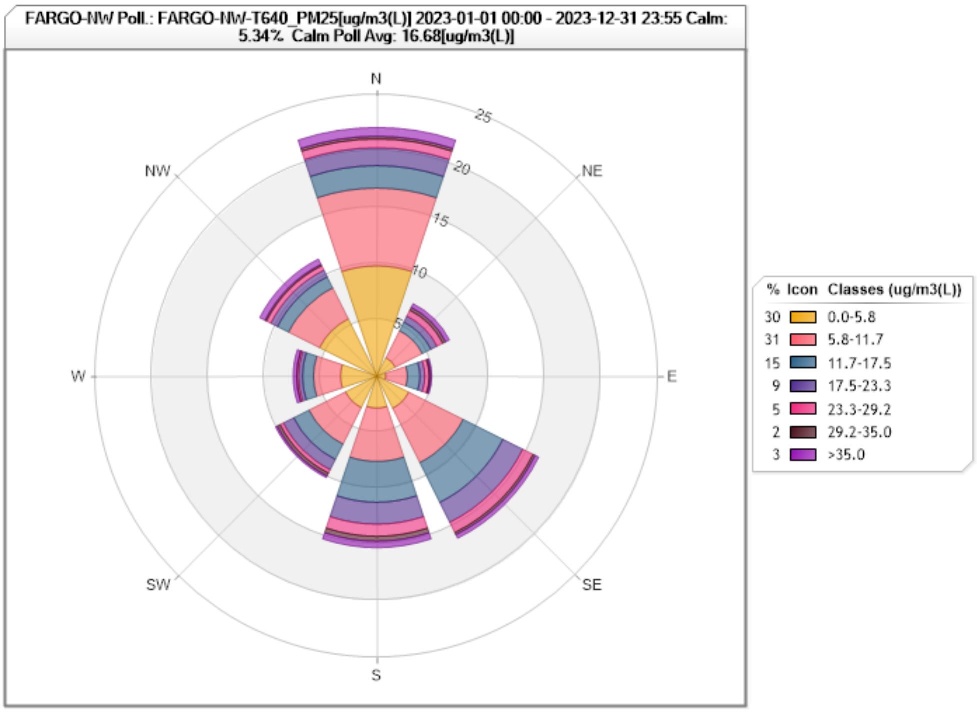


Figure 44. Fargo $PM_{2.5}$ Pollution Rose for 2023

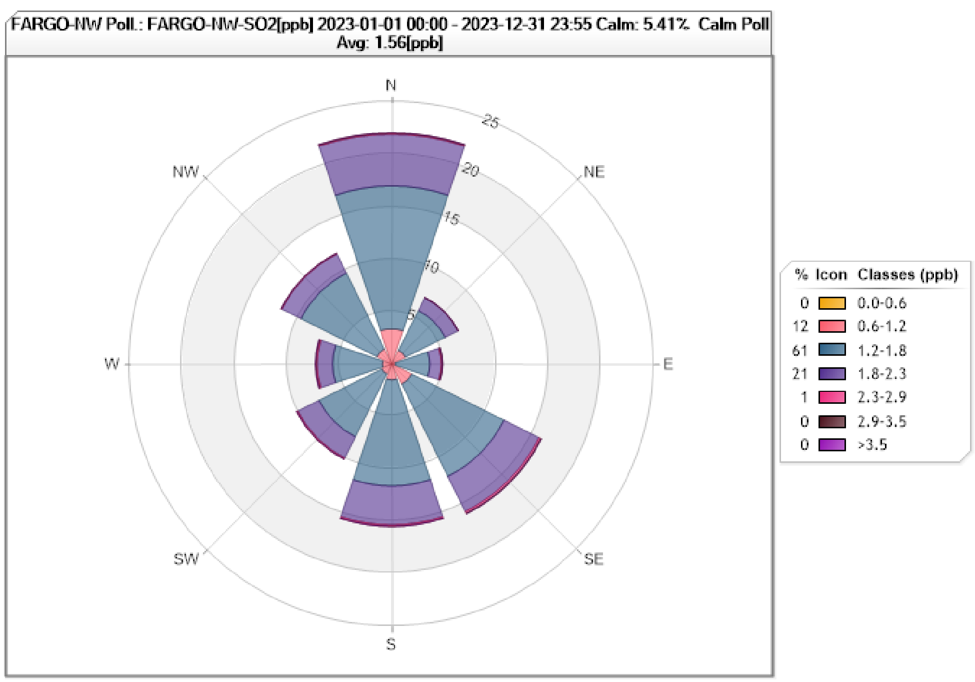


Figure 45. Fargo SO_2 Pollution Rose for 2023

Site Name: Hannover

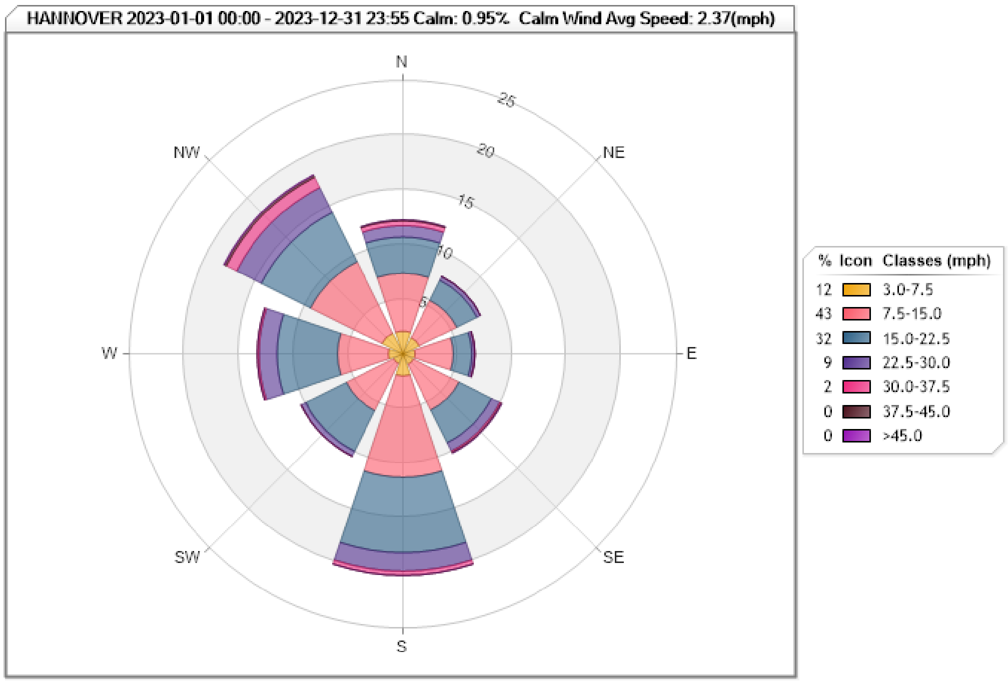


Figure 46. Hannover Wind Rose for 2023

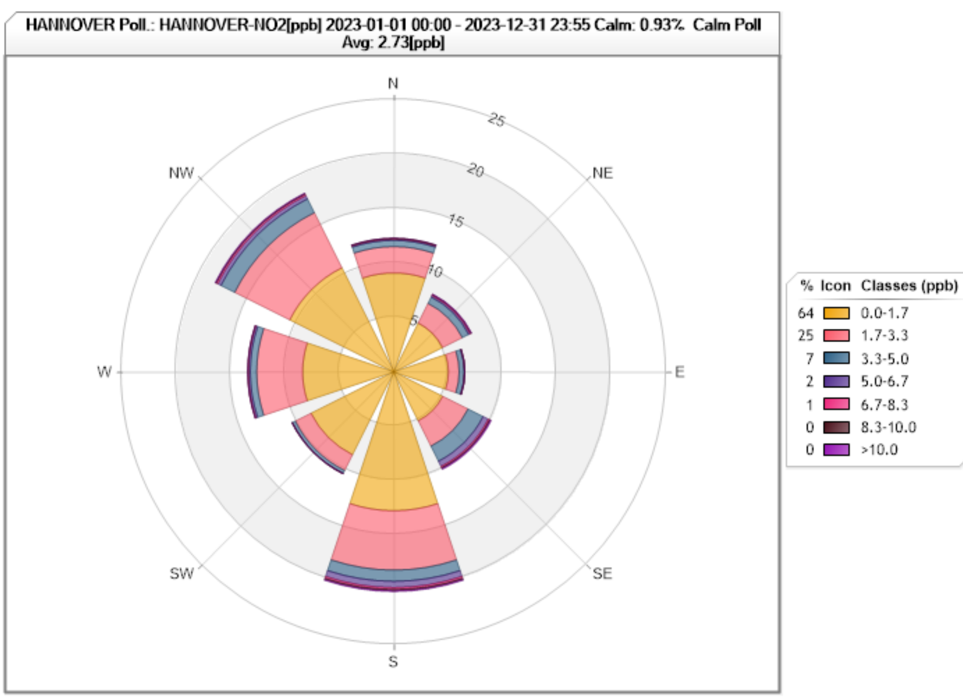


Figure 47. Hannover NO_2 Pollution Rose for 2023

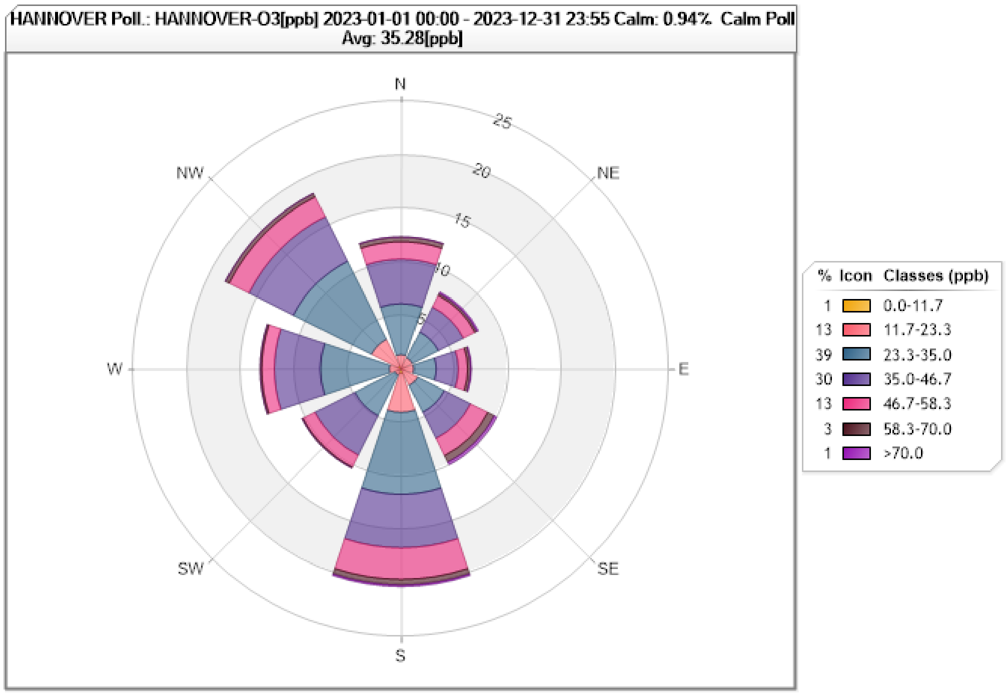


Figure 48. Hannover O_3 Pollution Rose for 2023

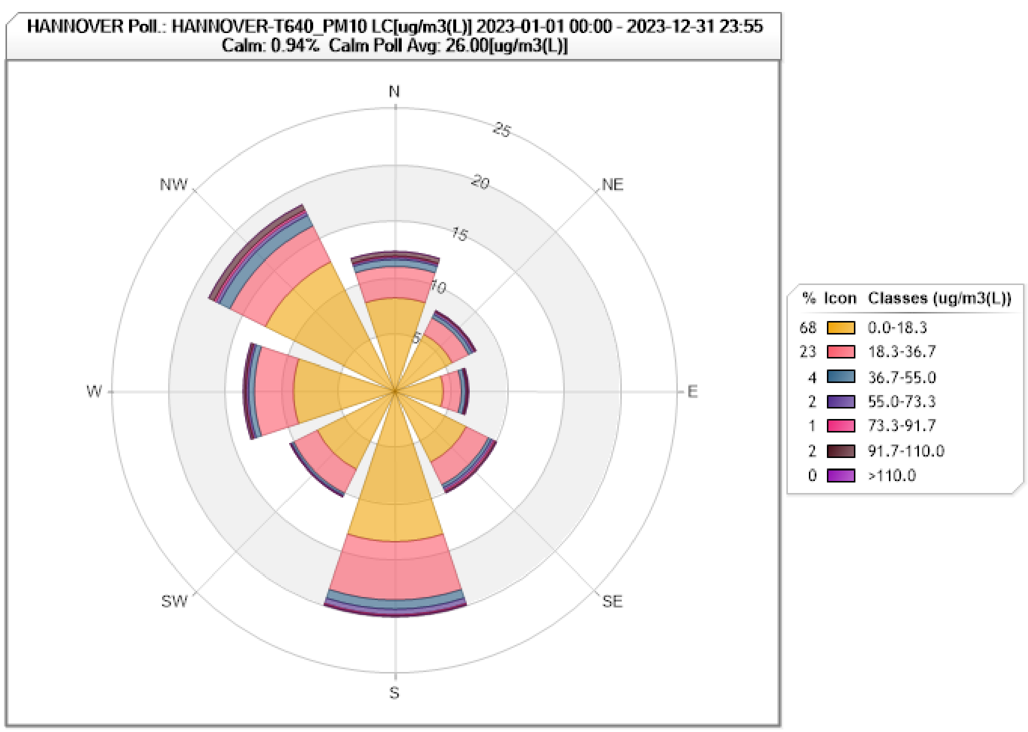


Figure 49. Hannover PM_{10} Pollution Rose for 2023

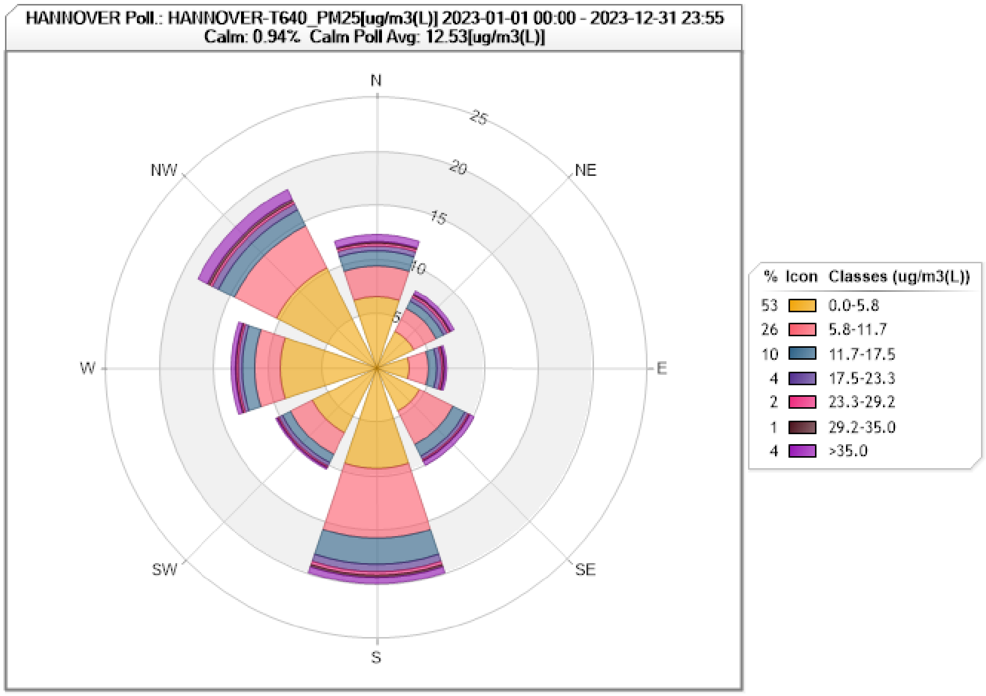


Figure 50. Hannover $PM_{2.5}$ Pollution Rose for 2023

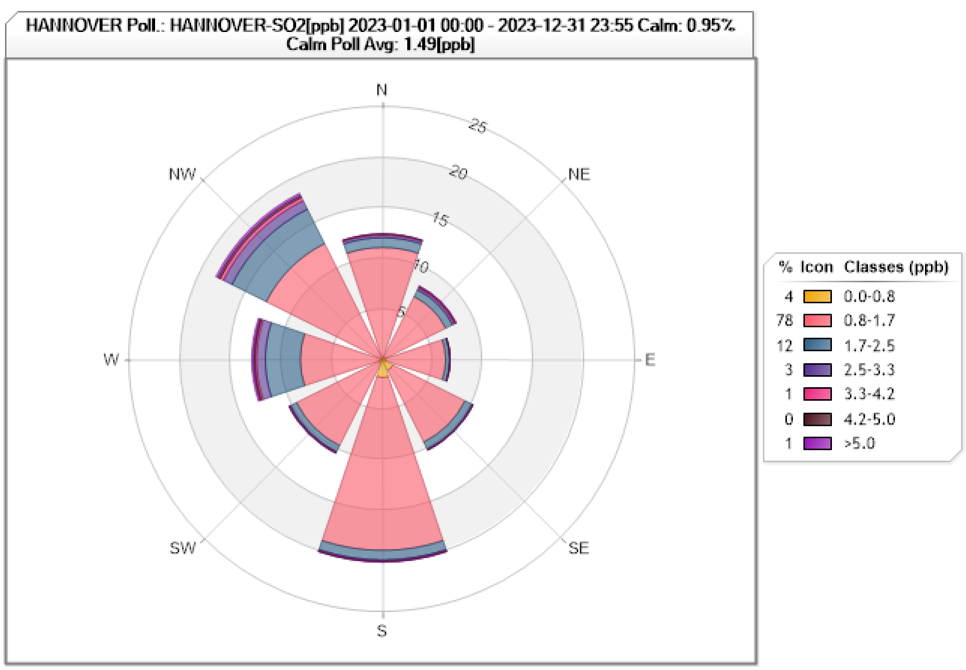


Figure 51. Hannover SO_2 Pollution Rose for 2023

Site Name: Ryder

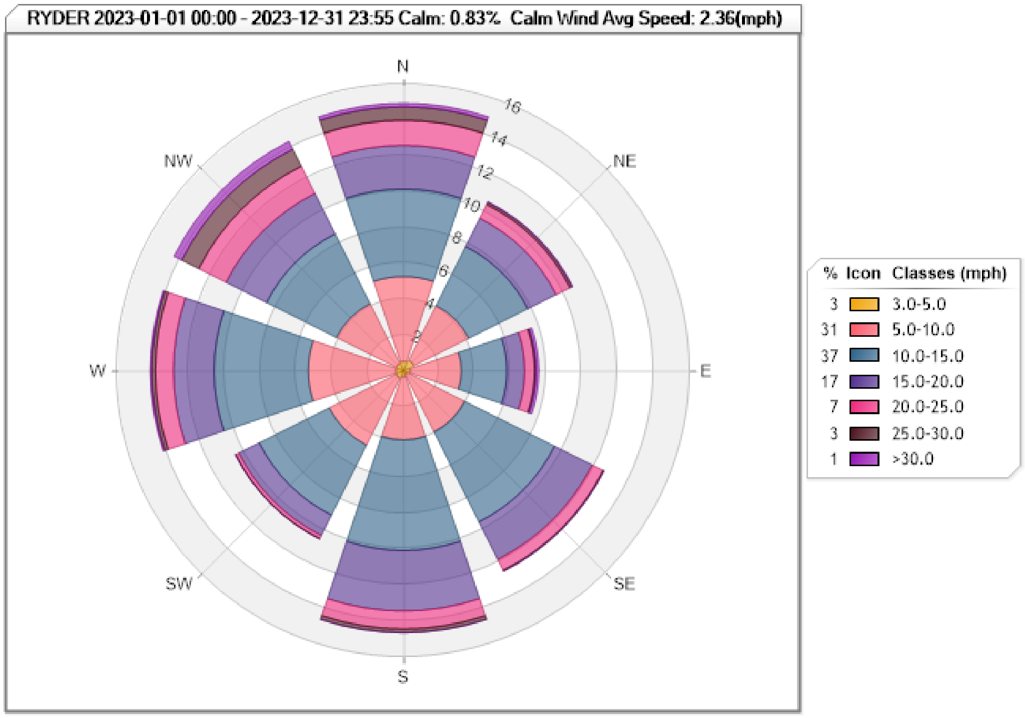


Figure 52. Ryder Wind Rose for 2023

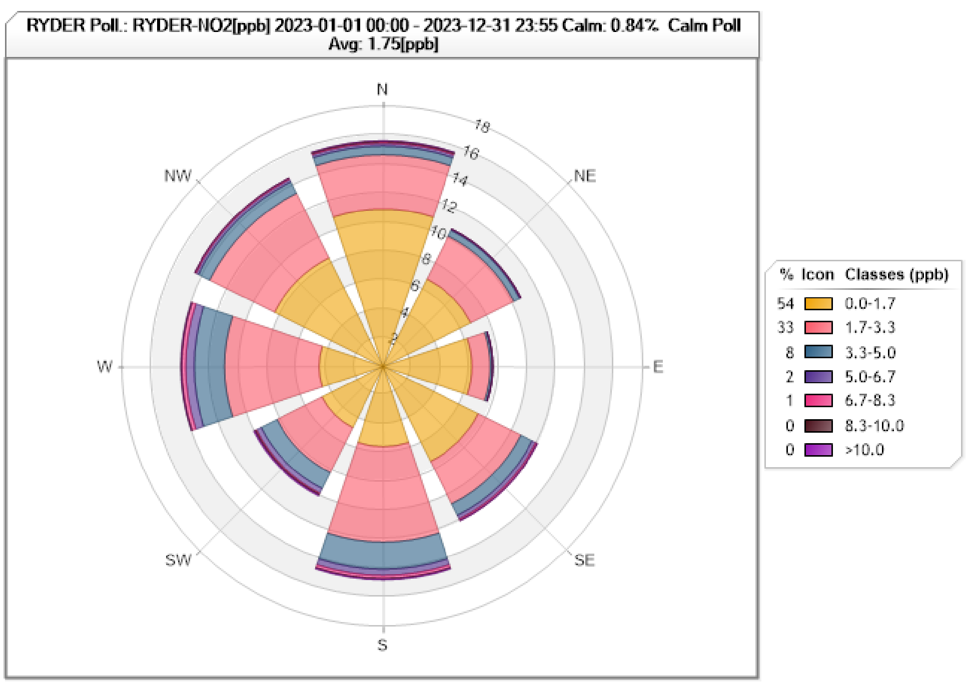


Figure 53. Ryder NO_2 Pollution Rose for 2023

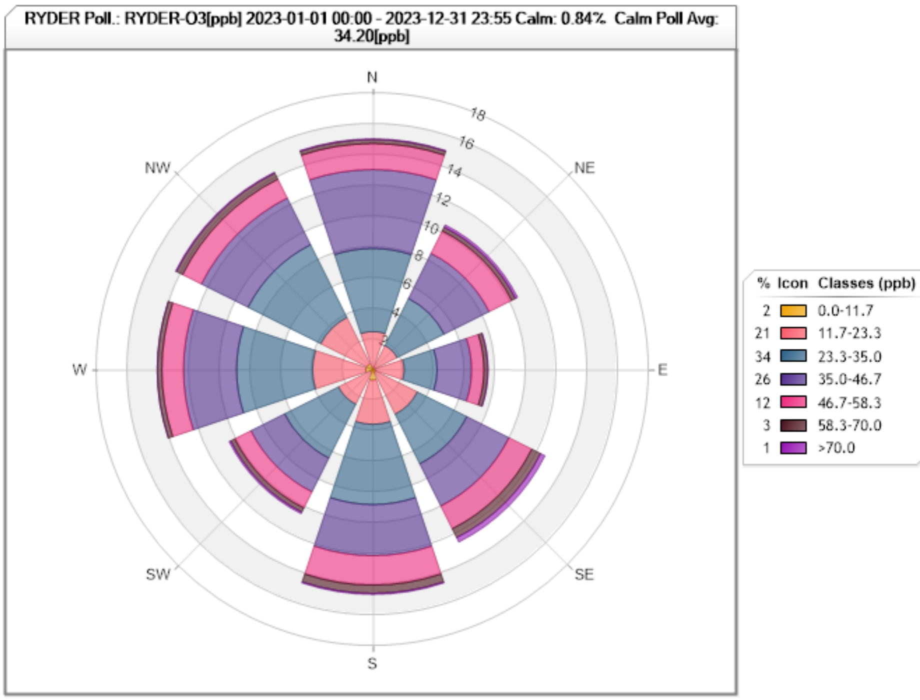


Figure 54. Ryder O_3 Pollution Rose for 2023

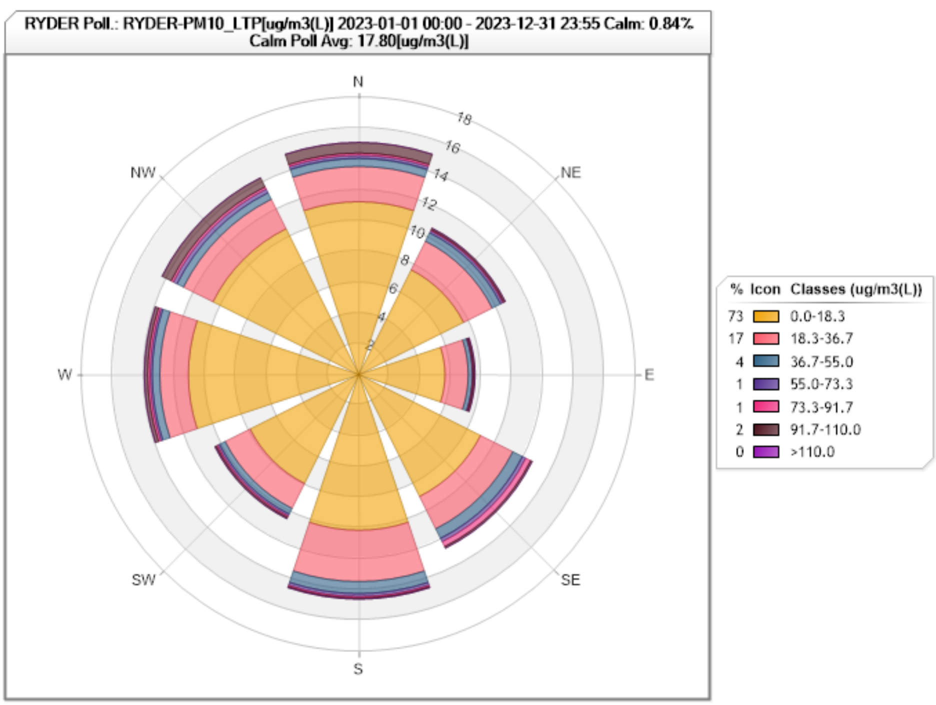


Figure 55. Ryder PM_{10} Pollution Rose for 2023

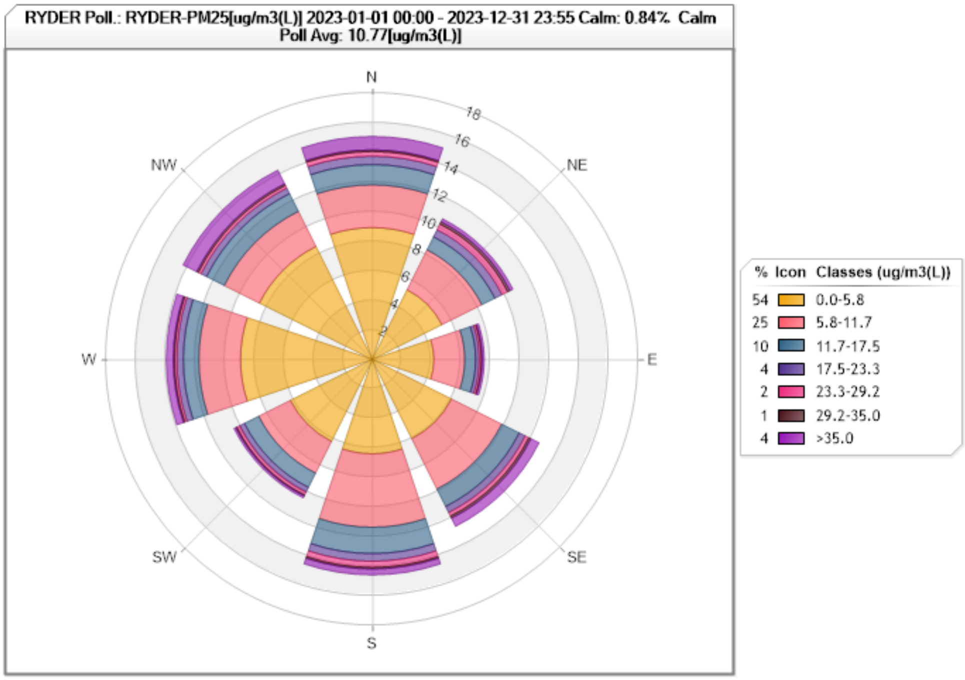


Figure 56. Ryder $PM_{2.5}$ Pollution Rose for 2023

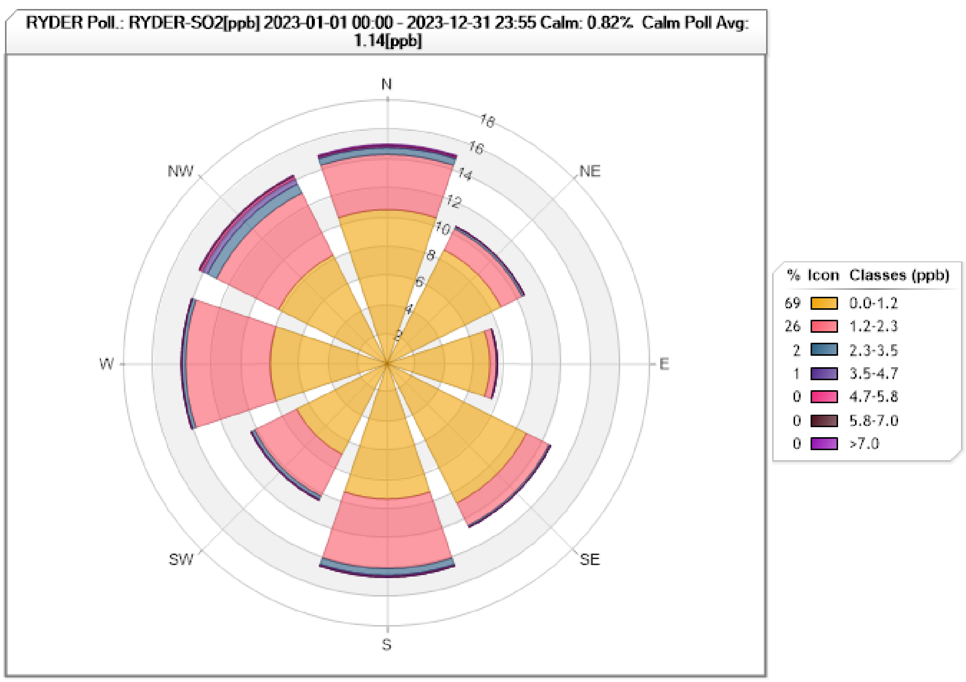


Figure 57. Ryder SO_2 Pollution Rose for 2023

Site Name: Lostwood NWR

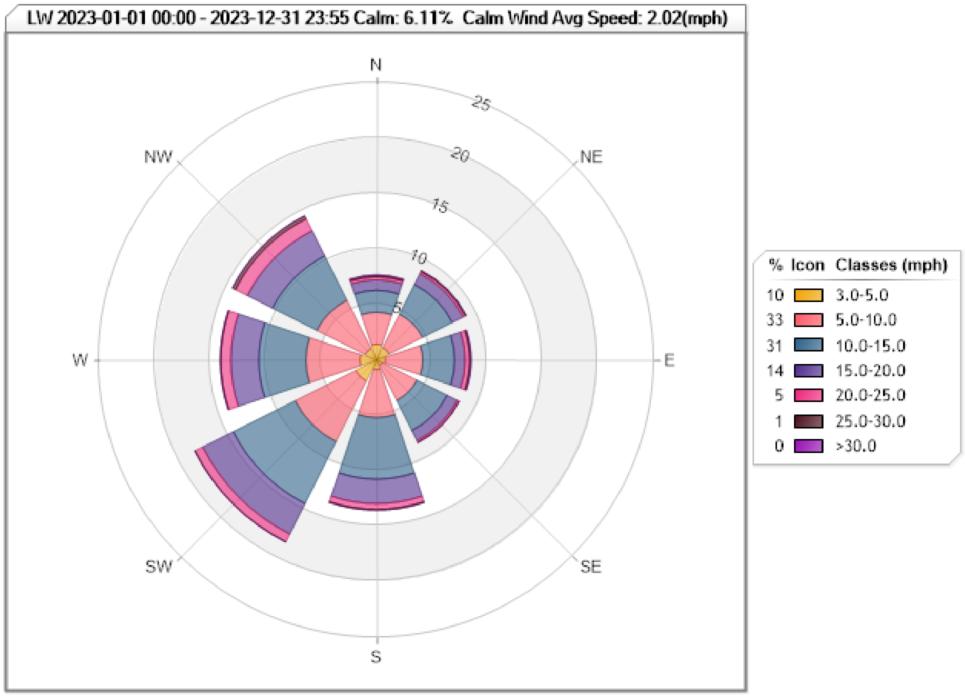


Figure 58. Lostwood Wind Rose for 2023

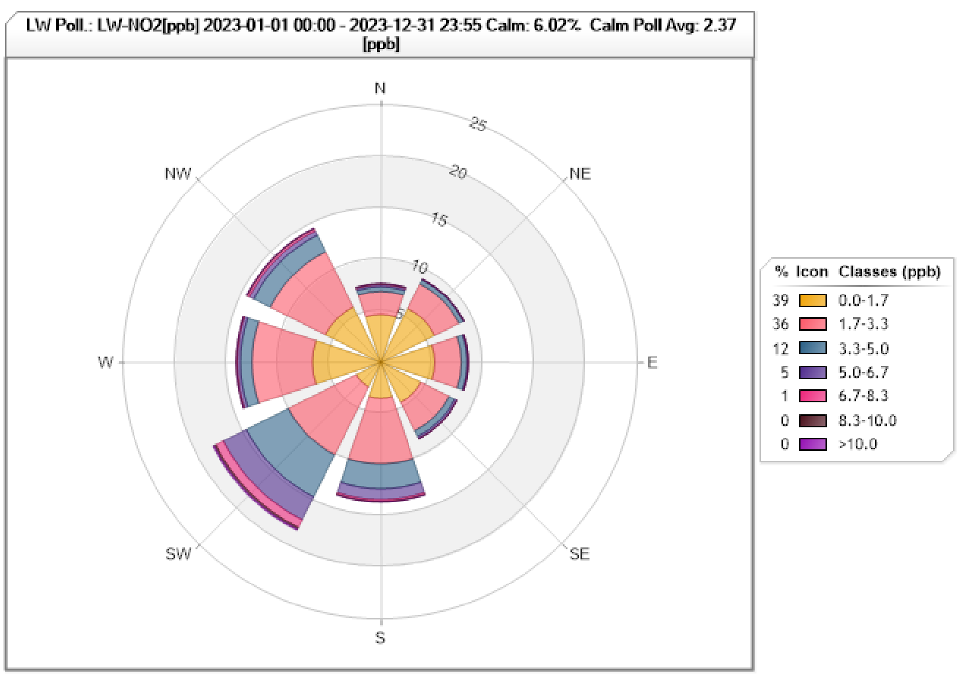


Figure 59. Lostwood NO_2 Pollution Rose for 2023

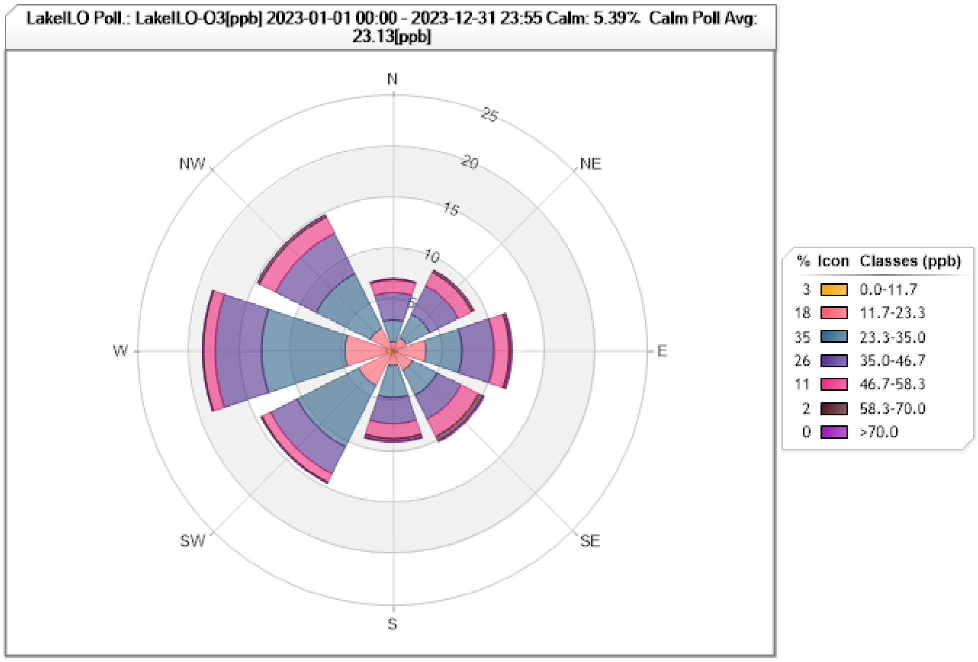


Figure 60. Lostwood O_3 Pollution Rose for 2023

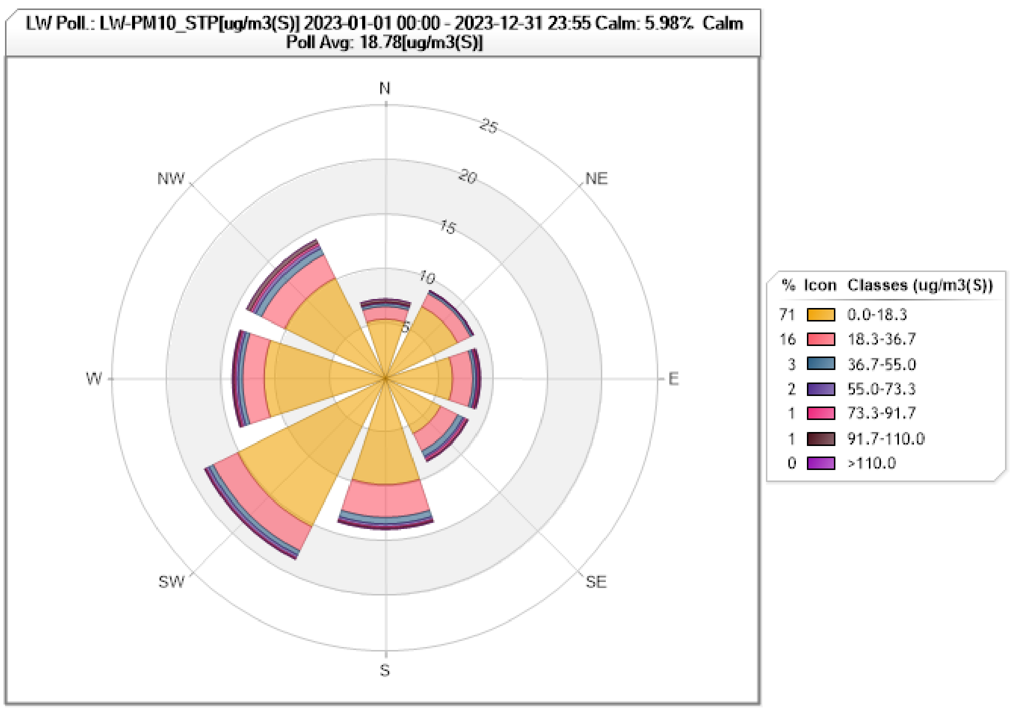


Figure 61. Lostwood PM_{10} Pollution Rose for 2023

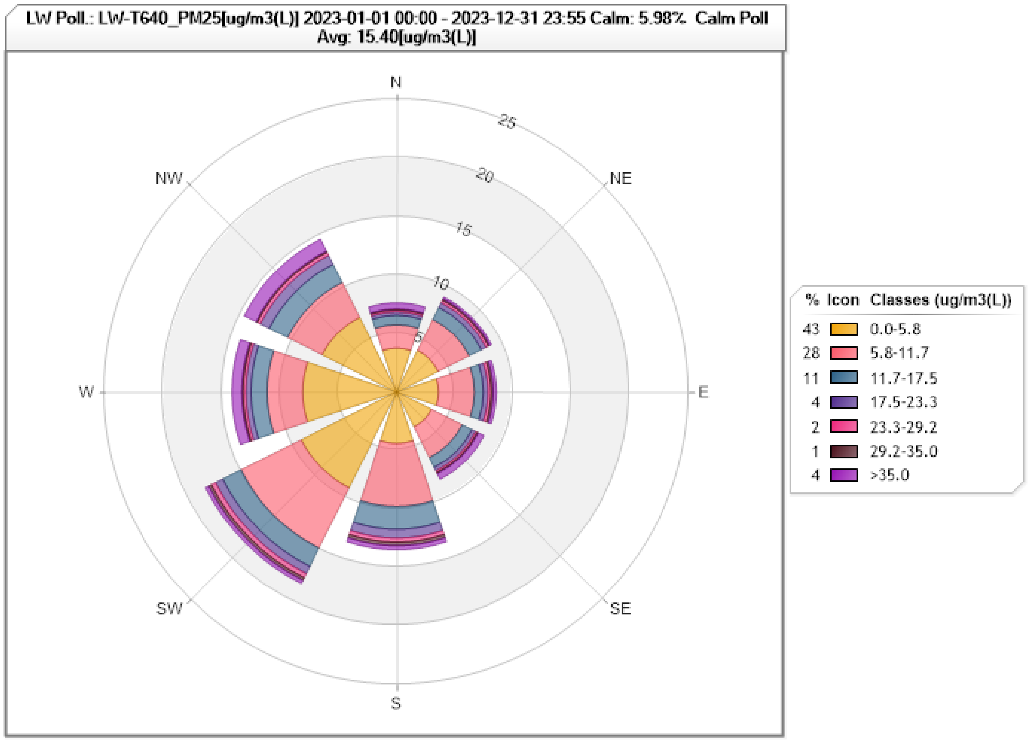


Figure 62. Lostwood $PM_{2.5}$ Pollution Rose for 2023

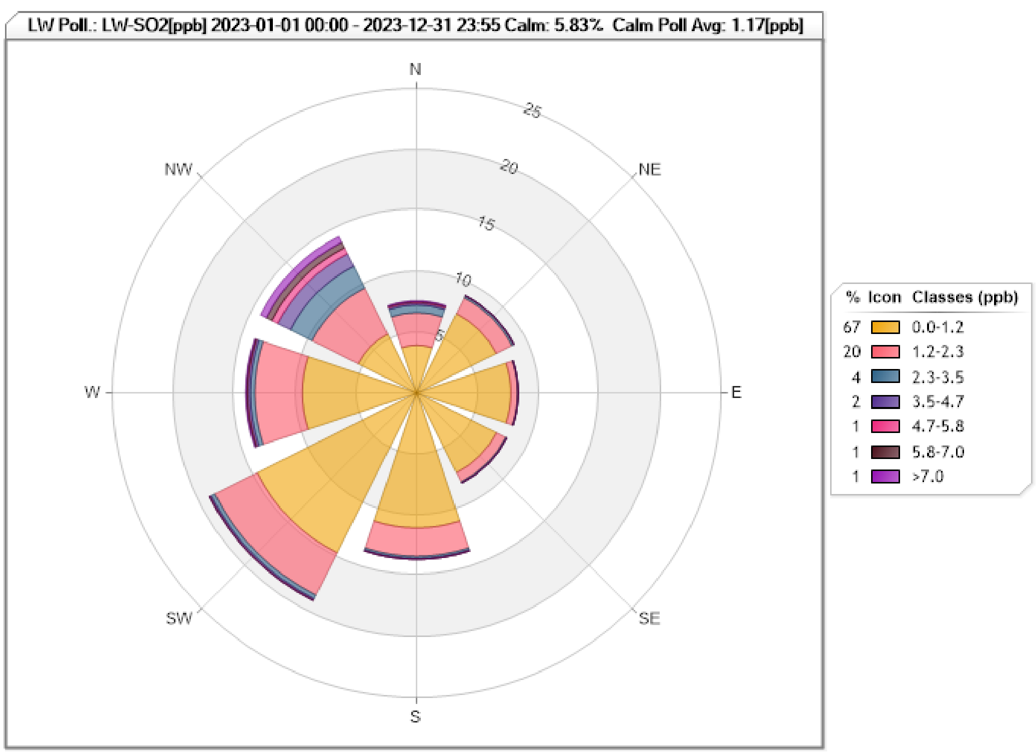


Figure 63. Lostwood SO_2 Pollution Rose for 2023

Site Name: Painted Canyon (TRNP - SU)

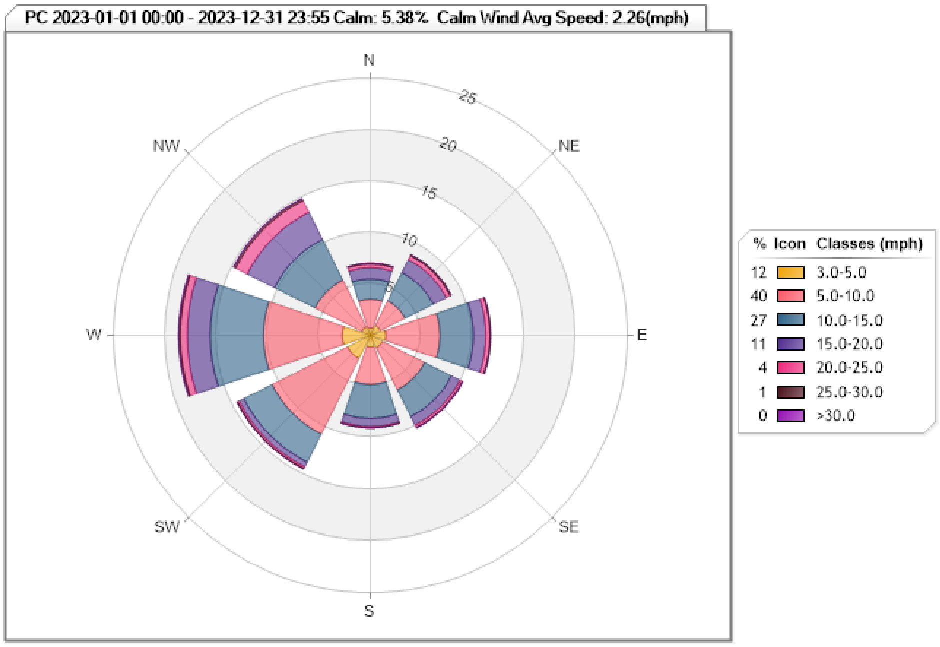


Figure 64. Painted Canyon Wind Rose for 2023

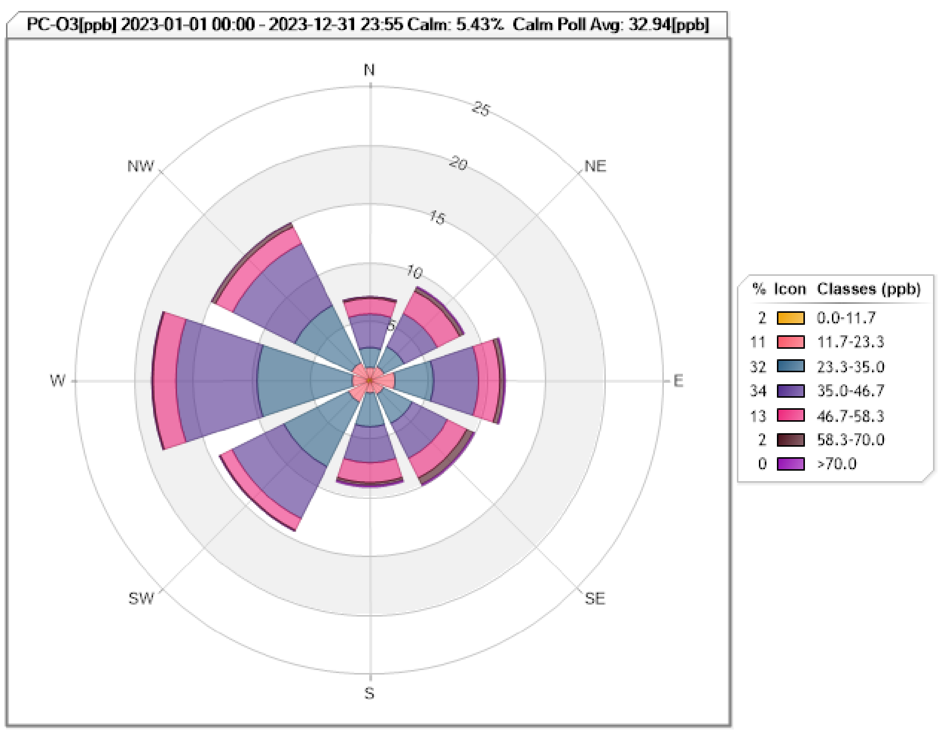


Figure 65. Painted Canyon O_3 Pollution Rose for 2023

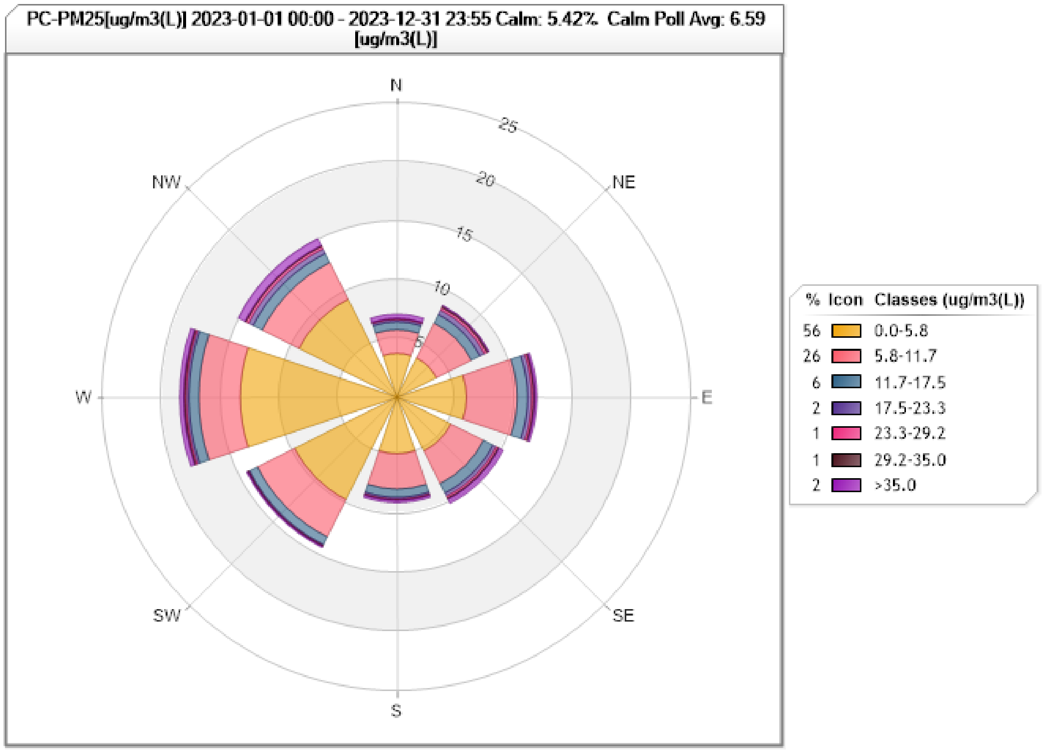


Figure 66. Painted Canyon $PM_{2.5}$ Pollution Rose for 2023

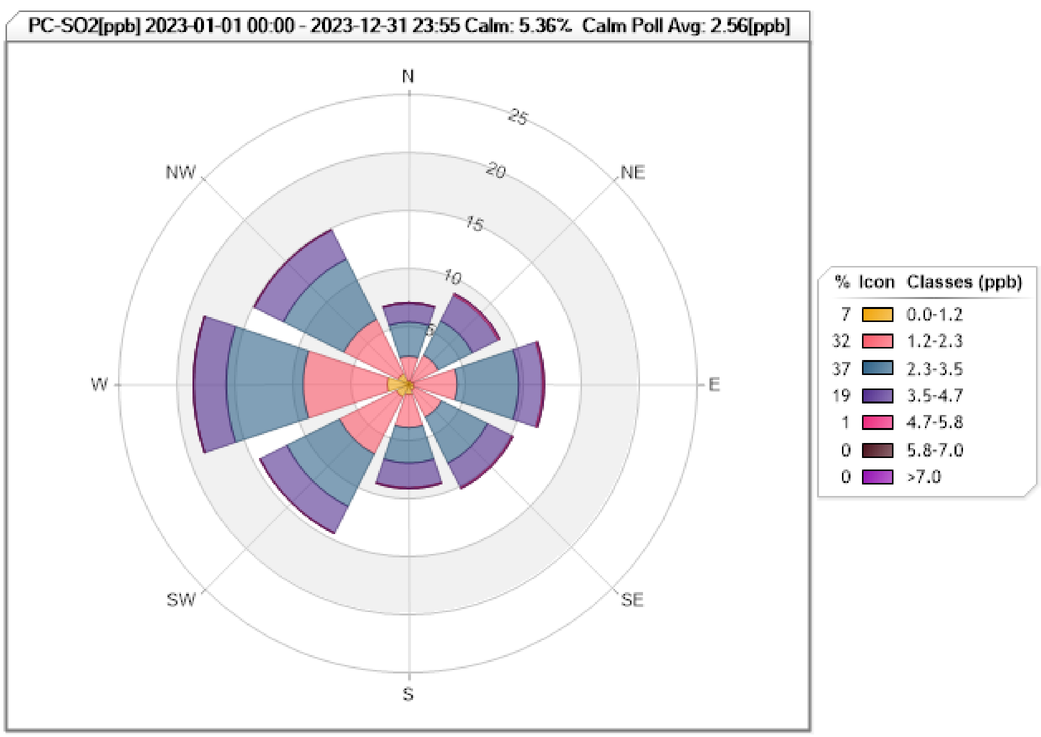


Figure 67. Painted Canyon SO_2 Pollution Rose for 2023

Site Name: TRNP-NU

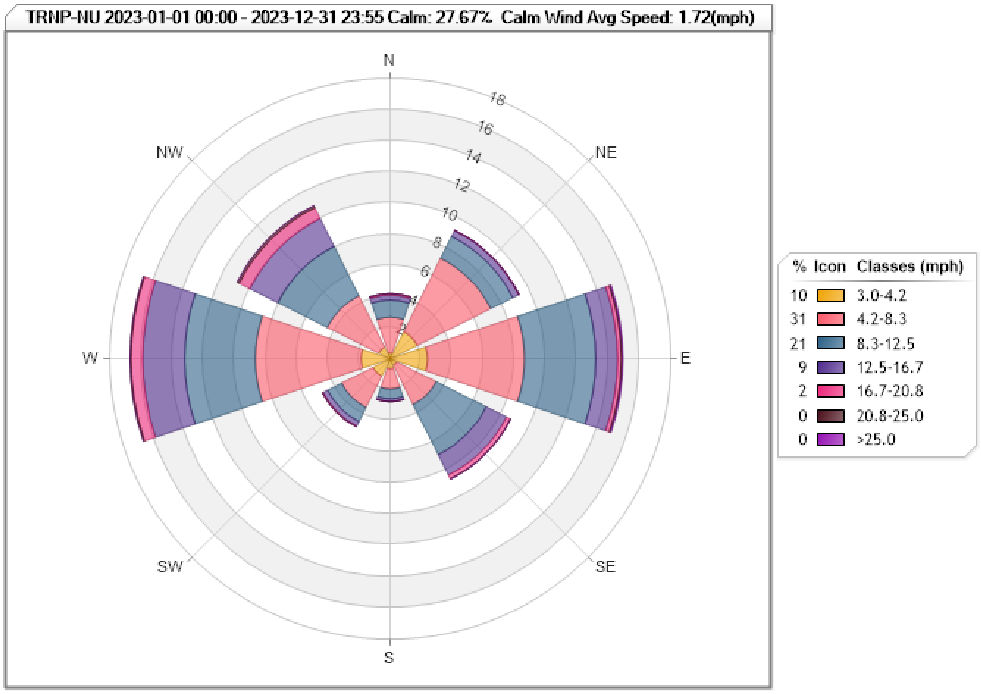


Figure 68. TRNP – North Unit Wind Rose for 2023

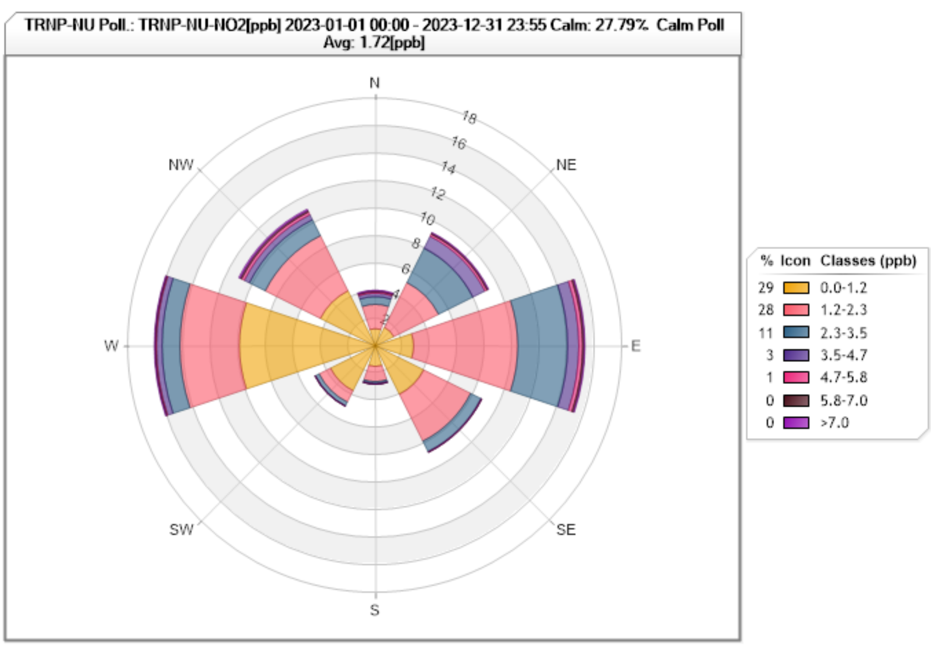


Figure 69. TRNP – North Unit NO_2 Pollution Rose for 2023

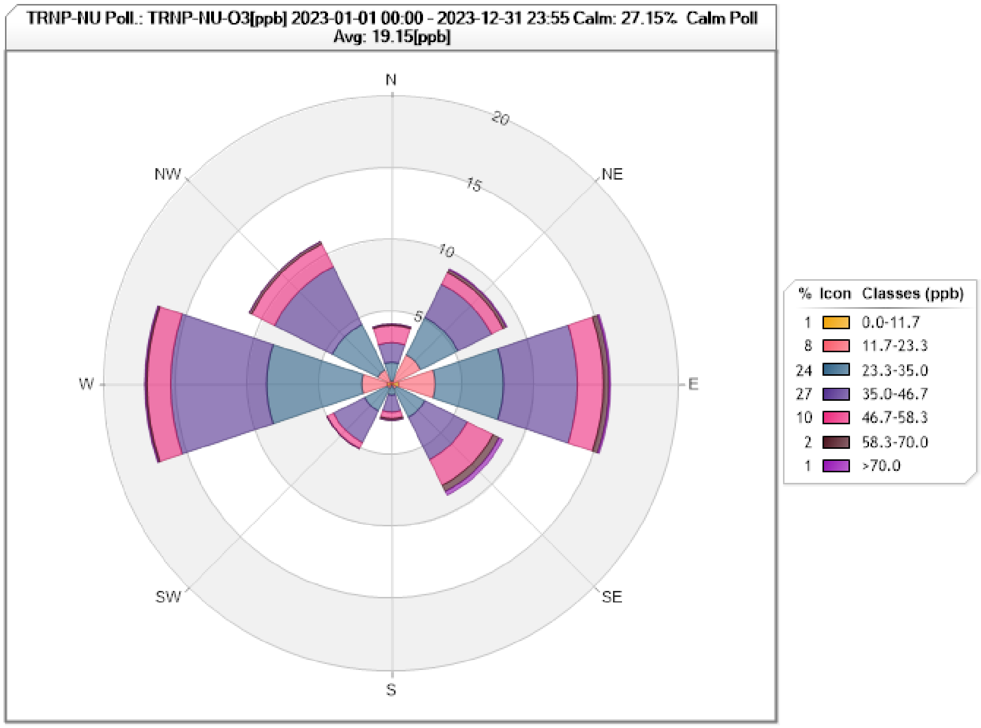


Figure 70. TRNP – North Unit O_3 Pollution Rose for 2023

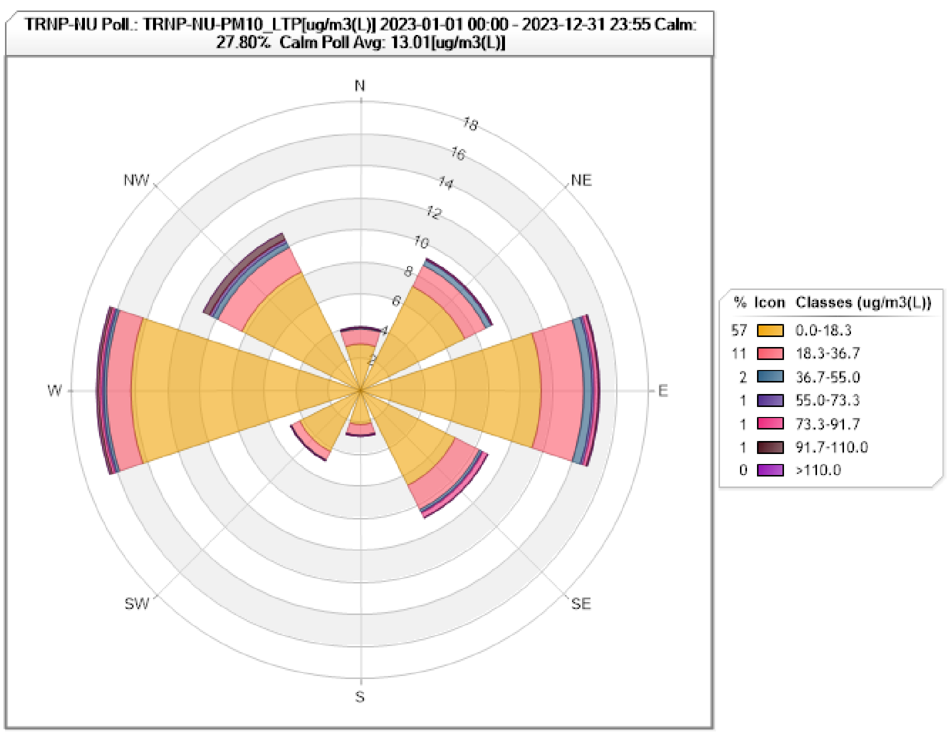


Figure 71. TRNP – North Unit PM_{10} Pollution Rose for 2023

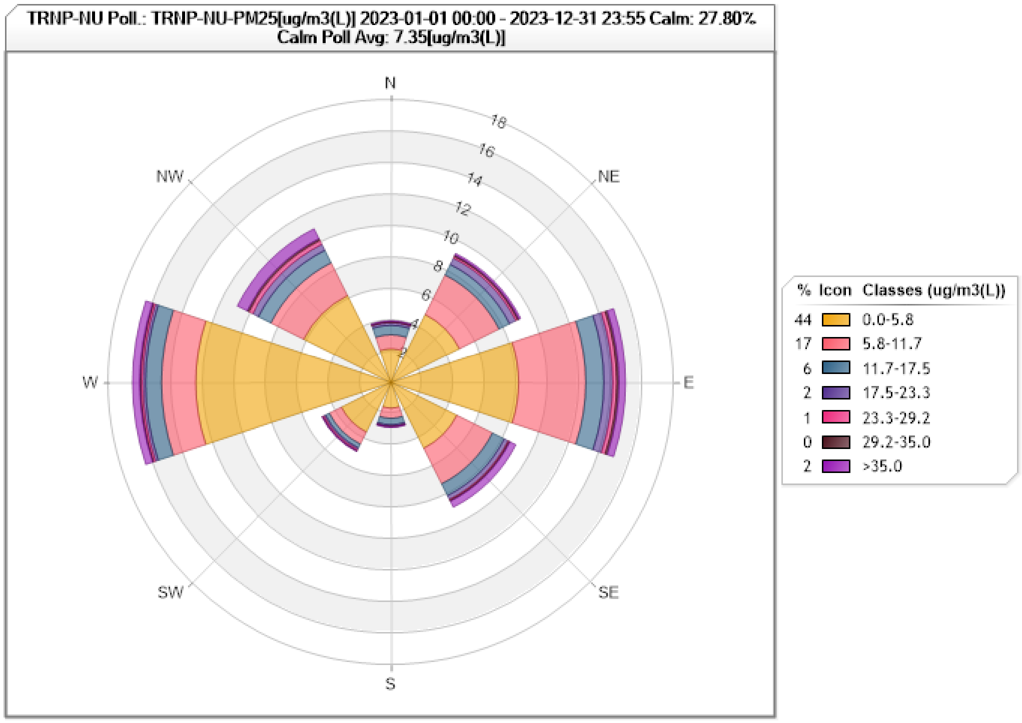


Figure 72. TRNP – North Unit $PM_{2.5}$ Pollution Rose for 2023

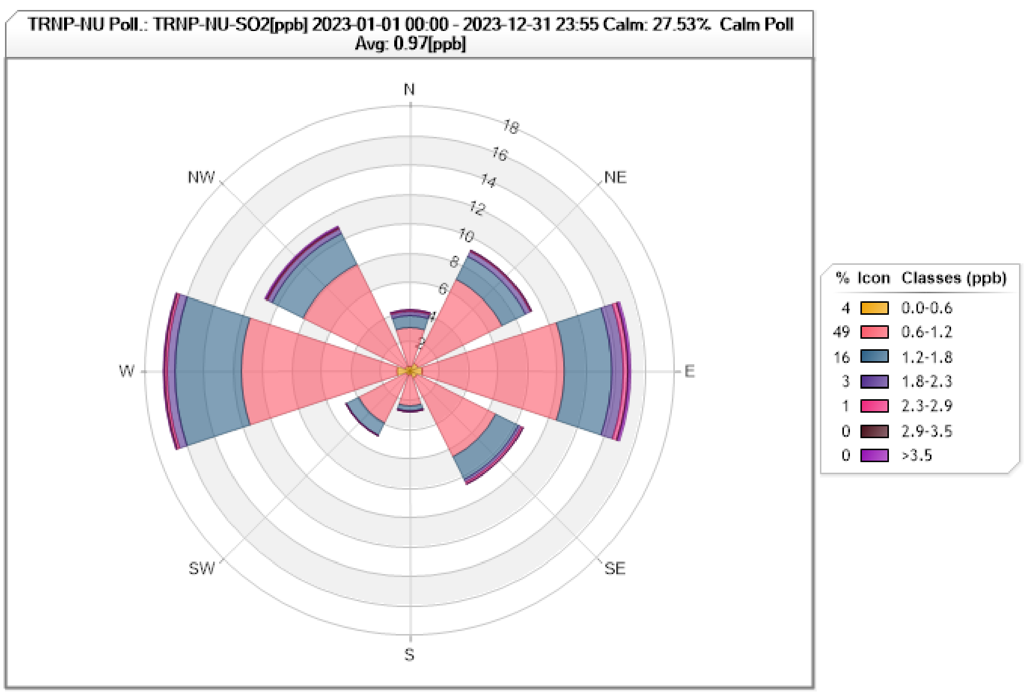


Figure 73. TRNP – North Unit SO_2 Pollution Rose for 2023

Appendix E SO₂ Monitors for the Data Requirements Rule

Effective September 21, 2015, EPA promulgated the Data Requirements Rule (DRR) for the 2010 1-hour SO_2 standard which requires state air agencies to characterize air quality in areas with large sources of SO_2 emissions. The Hess Corporation's Tioga Gas Plant in Williams County is subject to this rule as an applicable source due to a non-regulatory monitor in the area suggesting excessive ambient concentrations of SO_2. This applicability is outlined in the March 18, 2016, DRR Response letter from EPA[20].

One of the pathways for a state agency to characterize air quality is to use ambient air quality monitoring by use of SLAMS or SLAMS-like monitors. The Department chose to use SLAMS-like monitors to meet this requirement. In this case a SLAMS-like monitor is operated by the regulated entity but is audited by the Department and must meet all the requirements of a SLAMS monitor as specified in 40 CFR 58[21].

After a comprehensive computer air dispersion modeling analysis, the Department determined that two monitors will be used to characterize ambient air quality around the Hess Tioga Gas Plant: one in the general area identified via the modeling analysis as the location of peak SO_2 concentration (Station B – Northeast), and one at the current location of the non-regulatory monitor that collected data that resulted in the facility being subject to the DRR (Station A - South). The following pages provide information on the Station B – Northeast regulatory monitor.

[20] Available at https://www.epa.gov/so2-pollution
[21] Monitors operated in a manner equivalent to SLAMS as to meet all applicable requirements of 40 CFR 58, appendices A, C, and E, and subject to the data certification and reporting requirements of 40 CFR 58.15 and 58.16.

Site Name: Hess Tioga Gas Plant - Station B Northeast

Station Type: SLAMS – Like
AQS#: 38-105-0106 **MSA:** 0000
Address: Tioga, ND
Latitude: +48.465253 **Longitude:** -102.894086

Site Description: This site is located in the area where maximum modeled SO_2 concentrations were seen. The modeling was conducted in response to the requirements of the Data Requirements Rule for the 2010 1-hour SO_2 Standard.

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous	Data Requirements Rule SO_2 Characterization	Source Specific

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Wind Speed	Elec. or Mach Avg. Level 1	Continuous	10 meters	Source Specific
Wind Direction	Elec. or Mach Avg. Level 1	Continuous	10 meters	Source Specific
Ambient Temperature	Elec. or Mach Avg.	Continuous	4 meters	Source Specific

Site Pictures: **Hess Tioga Gas Plant – Station B Northeast**

North

South

East

West

Hess Tioga Gas Plant - Station B North

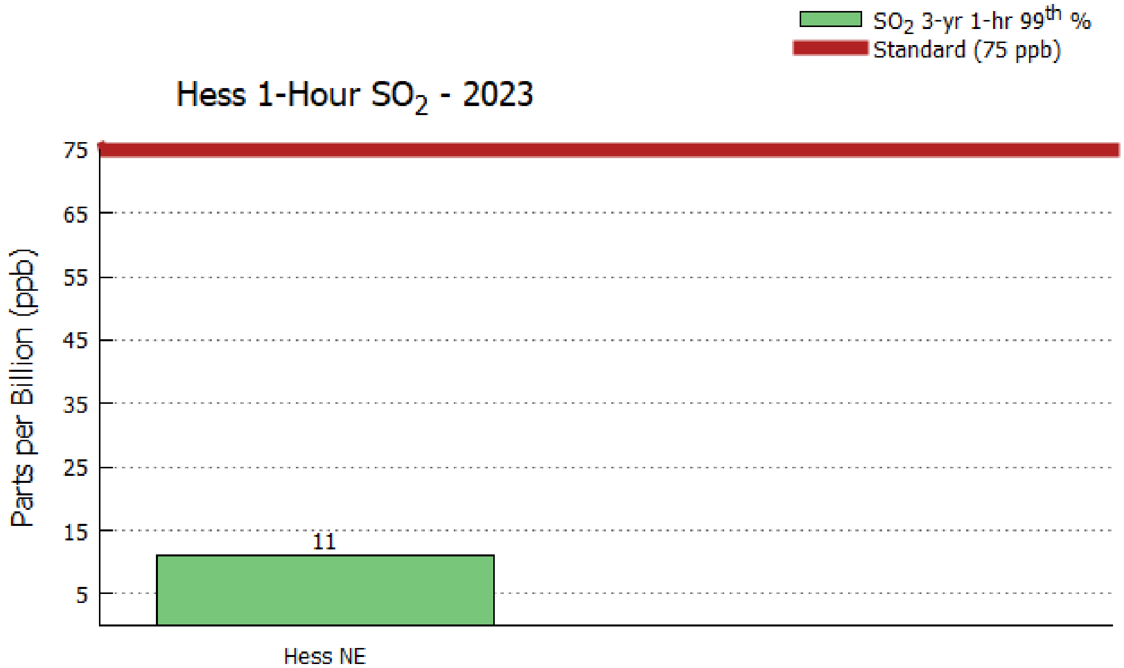


Figure 74. Tioga Gas Plant SO_2 Concentrations Compared to the 1-hour Standard (2021-2023)

Appendix F Public Comments

This report is subject to 30 days of public comment before finalization. This appendix will be populated with applicable public comments before finalization.