Environment

Submitted to:
ConocoPhillips Alaska, Inc.
Anchorage, Alaska

Submitted by:
AECOM
Fort Collins, Colorado
60147490.400
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Nuiqsut Ambient Air Quality Monitoring Program 2010 Monitoring Year Data Summary January 1, 2010 through December 31, 2010

Final

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Executive Summary

Since April 9, 1999 (prior to construction of the Alpine Central Processing Facility), ConocoPhillips Alaska, Inc. has operated an air quality and dispersion meteorology monitoring station in Nuiqsut, Alaska, (Nuiqsut Station) which is located on the Alaskan North Slope. This station is part of the Nuiqsut Ambient Air Quality and Meteorological Monitoring Program (Monitoring Program), which primarily is designed to characterize ambient air in Nuiqsut as regional oil field development continues. Currently, the Monitoring Program is being conducted on a voluntary basis to document air quality in Nuiqsut. Monitoring Program data also are used to support various ambient air quality impact analyses conducted for oil field development in the Colville Delta region. The Monitoring Program has been administered according to United States Environmental Protection Agency (USEPA) Prevention of Significant Deterioration (PSD) protocols; therefore, data collected are considered PSD quality. This report summarizes data collected at the Nuiqsut Station during the 2010 monitoring year (January 1, 2010 through December 31, 2010).

The Nuiqsut Station is equipped to continuously measure ambient air quality (oxides of nitrogen [NO_X], sulfur dioxide [SO_2], carbon monoxide [CO], particulate matter with an aerodynamic diameter of 10 micrometers or less [PM_{10}], particulate matter with an aerodynamic diameter of 2.5 micrometers or less [$PM_{2.5}$], and ozone [O_3]) and dispersion meteorology parameters. Air quality and meteorology data collected at the Nuiqsut Station meet strict Quality Assurance (QA) and data capture requirements of the USEPA PSD Program as administered by the Alaska Department of Environmental Conservation (ADEC) and other specific ADEC ambient monitoring QA requirements (ADEC 1996). Protocols used to collect data at the Nuiqsut Station are fully described in the project Monitoring Program Quality Assurance Project Plan (QAPP). There were no deviations from the QAPP during this reporting period.

As shown in **Table ES-1**, the percent data capture for each air quality parameter exceeded the QAPP goal of 80 percent each quarter. The data capture goal of 90 percent was achieved for all meteorological parameters in the third quarter. In the first, second, and fourth quarters, the data capture goal was achieved for most, but not all meteorological parameters. In the first quarter, the data capture goal for the 10 to 2 meter (m) temperature difference (delta temperature) was not achieved due to a failed as found first quarter calibration check. A successful as left calibration check was performed following a delta temperature calibration adjustment. Prior to the as found calibration check, delta temperature data collected during the first quarter were invalidated. In the second quarter, the data capture goal was not achieved for horizontal wind speed, wind direction, and associated parameters. This resulted from a damaged wind anemometer that was inoperable for a couple of weeks during the monitoring period. Data collection resumed following repairs on April 14, 2010. As noted in the QAPP, vertical wind speed is an optional parameter for the AERMOD dispersion model and it is of limited utility for meeting other project objectives. Therefore, meeting the data capture goal is not critical. In the fourth quarter, the data capture goal was not achieved for the optional parameters vertical wind speed and vertical wind speed standard deviation (sigma-w). The data capture goal was not achieved because the sensor froze on many occasions during the monitoring quarter.

Tables ES-2 through **ES-7** summarize average nitrogen dioxide (NO_2), SO_2, PM_{10}, O_3, CO, and $PM_{2.5}$ concentrations measured during the monitoring year. Measured concentrations of NO_2, SO_2, O_3, and CO were well below Alaska Ambient Air Quality Standards (AAAQS), which are the same as the national standards for the pollutants measured.

The typical hourly NO_2 concentrations were just above instrument detection, and the annual average was well below applicable AAAQS. Concentrations measured this monitoring year generally were lower than historical measurements.

Table ES-1 Recovery Statistics, 2010 Annual Data Summary

Parameter	1st Quarter 2010 (%)	2nd Quarter 2010 (%)	3rd Quarter 2010 (%)	4th Quarter 2010 (%)	Required Capture Rate (%)
Meteorological					
10-m Horizontal Wind Speed	91.4	**84.9**	99.5	98.0	90
10-m Horizontal Sigma-u (σ_u)	91.4	**84.9**	99.5	98.0	
10-m Horizontal Wind Direction	91.4	**84.9**	99.5	98.0	
10-m Sigma-Theta (σ_θ)	91.4	**84.9**	99.5	98.0	
10-m Vertical Wind Speed	91.9	90.2	99.0	**59.0**	
10-m Vertical Sigma-w (σ_w)	91.9	90.2	99.0	**59.0**	
10-m Temperature	99.5	99.2	99.5	99.6	
2-m Temperature	99.5	99.2	99.5	99.6	
10-2 m Temperature Difference	**8.1**	99.2	99.5	99.6	
Total Solar Radiation	99.9	99.1	100	99.8	
Air Quality					
NO_2	95.9	96.7	89.6	81.1	80
SO_2	95.9	96.7	97.3	88.3	
O_3	95.4	95.1	97.4	93.5	
CO	95.9	96.7	97.4	88.3	
$PM_{2.5}$ (BAM)	95.2	98.9	98.0	86.9	
PM_{10} (TEOM)	94.7	99.2	98.1	97.4	

Measured SO_2 concentrations were at or below instrument detection the entire year. The low concentrations measured are consistent with an airshed containing relatively few and widely dispersed SO_2 sources. This trend has been typical of SO_2 measurements since monitoring began.

O_3 concentrations measured during this monitoring year were typical of seasonal averages measured on the Alaskan North Slope (Prudhoe Bay, Kuparuk River Unit, and Barrow). In the absence of large combustion sources, frontal boundaries and high incoming solar radiation, ambient O_3 levels will be spatially homogeneous and representative of a regional background.

CO measurements were below applicable AAAQS standards. Low concentrations measured are consistent with an airshed containing relatively few and widely dispersed CO sources.

Table ES-4 shows that the measured PM_{10} concentrations were well below the AAAQS for nearly the entire year with the exception of one exceedance of the 24-hour standard. PM_{10} concentration was higher than the 24-hour PM_{10} standard on October 2, 2010. The on-site technician noted that sediment was transported by wind from the banks of the Nechelik channel of the Colville River Delta to the monitoring site. The $PM_{2.5}$ to PM_{10} ratio was quite low indicating that most of the mass was in the coarse mode, consistent with windblown dust. During this time, the ground was snow free and winds were high (9 to 11 m/s), favorable for dust production. These observations suggest that the source of the high PM_{10} values was local fugitive dust.

$PM_{2.5}$ concentrations were below applicable AAAQS throughout 2010 on both a 24 hour and annual basis.

Table ES-2 Measured Nitrogen Dioxide, 2010 Annual Summary

Monitoring Period	Year	1-hour (ppm)		Period Mean (ppm)[1]	Number of Exceedances
		1st high	98th percentile		
1st Quarter	2010	0.028	0.021	0.002	None
2nd Quarter	2010	0.023	0.016	0.001	None
3rd Quarter	2010	0.012	0.012	0.001	None
4th Quarter	2010	0.022	0.021	0.001	None
Annual	2010	0.028	0.020	0.001	None

[1]Annual or quarterly average.
NAAQS/AAAQS:
1-hour – 0.1 parts per million (ppm) – Compared to the 3-year average of the 98th percentile of the daily maximum 1-hour average.
Annual – 0.053 ppm (100 micrograms per cubic meter [µg/m^3]) – Compared to the annual arithmetic mean.

Table ES-3 Measured Sulfur Dioxide, 2010 Annual Summary

Monitoring Period	Year	1-hour (ppm)		3-hour (ppm)[1]		24-hour (ppm)[2]		Period Mean (ppm)[3]	Number of Exceedances
		1st high	99th percentile	1st high	2nd high	1st high	2nd high		
1st Quarter	2010	0.002	0.002	0.001	0.001	0.000	0.000	0.000	None
2nd Quarter	2010	0.001	0.001	0.001	0.001	0.000	0.000	0.000	None
3rd Quarter	2010	0.002	0.002	0.002	0.002	0.001	0.001	0.000	None
4th Quarter	2010	0.003	0.003	0.002	0.001	0.001	0.001	0.000	None
Annual	2010	0.003	0.002	0.002	0.002	0.001	0.001	0.000	None

[1] Rolling 3-hour average.
[2] Midnight to midnight 24-hour average.
[3] Annual or quarterly average.
NAAQS/AAAQS:
1-hour – 0.075 ppm – Compared to the 3-year average of the 99th percentile of the daily maximum 1-hour average.
3-hour - 0.5 ppm (1,300 µg/m^3) – Non-overlapping block averages starting at midnight not to be exceeded more than once per year.
24-hour - 0.14 ppm – Midnight to midnight average not to be exceeded more than once per year.
Annual - 0.03 ppm – Compared to the annual arithmetic mean.

Table ES-4 Measured PM_{10} Data, 2010 Annual Data Summary

Monitoring Period	Year	24-hour (µg/m^3)[1]		Period Mean (µg/m^3)[2]	Number of Exceedances
		1st high	2nd high		
1st Quarter	2010	21.1	18.0	6.0	None
2nd Quarter	2010	21.0	17.7	6.4	None
3rd Quarter	2010	48.2	41.7	10.1	None
4th Quarter	2010	**167.2**[3]	21.1	8.1	1
Annual	2010	**167.2**[3]	48.2	7.7	1

[1]Midnight to midnight 24-hour average.
[2]Annual or quarterly average.
[3]Measured on October 2, 2010.
NAAQS/AAAQS:
24-hour – 150 µg/m^3 – Not to be exceeded more than once per year measured from midnight to midnight.
Annual – 50 µg/m^3 – Compared to the 3-year average of the weighted annual arithmetic mean concentration measured at USEPA Standard Conditions.

Table ES-5 Measured Ozone Data, 2010 Annual Data Summary

Monitoring Period	Year	8-hour (ppm)[1]			Period Mean (ppm)[2]	Number of Exceedances
		1st high	2nd high	4th high		
1st Quarter	2010	0.043	0.043	0.043	0.023	None
2nd Quarter	2010	0.043	0.043	0.042	0.021	None
3rd Quarter	2010	0.032	0.032	0.032	0.015	None
4th Quarter	2010	0.039	0.039	0.039	0.032	None
Annual	2010	0.043	0.043	0.043	0.023	None

[1] Rolling 8-hour average.
[2] Annual or quarterly average.
NAAQS/AAAQS:
8-hour - 0.08 ppm – Compared to the 3-year average of the fourth-highest daily maximum rolling 8-hour average concentrations.

Table ES-6 Measured Carbon Monoxide, 2010 Annual Data Summary

Monitoring Period	Year	1-hour (ppm)		8-hour (ppm)[1]		Period Mean[2] (ppm)	Number of Exceedances
		1st high	2nd high	1st high	2nd high		
1st Quarter	2010	0.5	0.5	0.3	0.3	0.1	None
2nd Quarter	2010	0.4	0.4	0.3	0.3	0.2	None
3rd Quarter	2010	0.4	0.4	0.4	0.4	0.2	None
4th Quarter	2010	0.5	0.5	0.4	0.4	0.1	None
Annual	2010	0.5	0.5	0.4	0.4	0.2	None

[1] Rolling 8-hour average.
[2]Annual or quarterly average.
NAAQS/AAAQS:
1-hour – 35 ppm (40 mg/m^3) – Not to be exceeded more than once per year.
8-hour – 9 ppm (10 mg/m^3) – Non-overlapping block averages starting at midnight not to be exceeded more than once per year.

Table ES-7 Measured $PM_{2.5}$ Data, 2010 Annual Data Summary

Monitoring Period	Year	24-hour (µg/m^3)[1]		Period Mean (µg/m^3)[2]	Number of Exceedances
		1st high	98th percentile		
1st Quarter	2010	9	8	4	None
2nd Quarter	2010	8	7	3	None
3rd Quarter	2010	12	9	4	None
4th Quarter	2010	15	12	3	None
Annual	2010	15	9	3	None

[1]Midnight to midnight 24-hour average.
[2]Annual or quarterly average.
NAAQS/AAAQS:
24-hour – 35 µg/m^3 – Compared to the 3-year average of the 98th percentile of 24-hour concentrations measured from midnight to midnight.
Annual – 15 µg/m^3 – Compared to the 3-year average of the weighted annual arithmetic mean concentration.

1.0 Introduction

1.1 Project Summary

Since April 9, 1999 (prior to Alpine Central Processing Facility startup), ConocoPhillips Alaska, Inc. (CPAI) has operated an air quality and dispersion meteorology monitoring station in Nuiqsut, Alaska (Nuiqsut Station), which is located on the Alaskan North Slope. This station is part of the Nuiqsut Ambient Air Quality Monitoring Program (Monitoring Program), which primarily is designed to characterize ambient air in Nuiqsut as regional oilfield development continues. This Monitoring Program has been administered according to United States Environmental Protection Agency (USEPA) Prevention of Significant Deterioration (PSD) protocols; therefore, data collected are considered PSD quality. This report summarizes data collected at the Nuiqsut Station during the 2010 monitoring year (January 1, 2010 through December 31, 2010).

Currently, the Monitoring Program is being conducted on a voluntary basis to document air quality in Nuiqsut. Monitoring Program data are also used to support various ambient air quality impact analyses conducted for oilfield development in the Colville Delta region.

Since the beginning, the Monitoring Program has been modified to enhance Quality Assurance (QA) and Quality Control (QC) and increase program utility through the addition of monitored parameters. Major Monitoring Program modifications include:

- Collocated Federal Reference Method (FRM) particulate matter with an aerodynamic diameter of 10 micrometers or less (PM_{10}) sampling initiated to evaluate the Monitoring Program Federal Equivalent Method sampling methodology (July 14, 2000). Collocated FRM PM_{10} sampling was discontinued in fall 2002.
- Enhanced dispersion meteorology characterization through the addition of 10-meter (m) temperature, vertical wind speed, and solar radiation monitoring (July 24, 2001).
- Expanded background air quality evaluation through the addition of ozone (O_3) monitoring (November 19, 2004).
- Expanded background air quality evaluations through the addition of carbon monoxide (CO) and particulate matter with an aerodynamic diameter of 2.5 micrometers or less ($PM_{2.5}$) measurement systems (July 2009).

Since inception, the specific technical objectives of the Monitoring Program are to:

- Collect data meeting QA and data capture requirements of the USEPA PSD Program and other specific Alaska Department of Environmental Conservation (ADEC) ambient monitoring QA requirements (ADEC 1996);
- Document preconstruction air quality impacts at Nuiqsut prior to operation of Alpine (fulfilled);
- Document air quality conditions after Alpine is operational;
- Meet air quality and meteorological monitoring requirements listed in Alpine Permit No. 0073-AC060 (fulfilled); and
- Document dispersion meteorology conditions in Nuiqsut to support refined modeling of potential impacts in the region.

1.2 Measurement Methods

To meet project technical objectives, the Nuiqsut Station is instrumented and equipped to continuously measure the parameters listed in **Table 1-1**. **Table 1-1** details the methods and instruments used for measurement. A complete description of the Monitoring Program is contained in the ADEC approved Quality Assurance Project Plan (QAPP) (AECOM 2010).

1.3 Variations from Quality Assurance Project Plan

There were no deviations from the QAPP during this reporting period.

Table 1-1 Measurement Methods, 2010 Annual Data Summary

Parameter	Measurement Level (m)	Manufacturer/ Model	Sample Frequency	Averaging Period	Measurement Range	Detection Limit	Measurement Method
Wind speed (scalar)	10	RM Young 05305-AQ	Continuous	1-hour	0.4 to 50 m/s	0.4 m/s	Propeller anemometer/magnetically induced AC
Wind direction (scalar)	10	RM Young 05305-AQ	Continuous	1-hour	0 to 360º	0.5 m/s at 10º displacement	Lightweight vane and precision potentiometer
Wind speed standard deviation	10	Campbell Scientific 23X	Continuous	1-hour	N/A	N/A	Computed by data logger
Wind direction standard deviation	10	Campbell Scientific 23X	Continuous	1-hour	0 to 104º	N/A	Yamartino Method (Yamartino 1984), computed by data logger
Vertical wind speed	10	RM Young 27106	Continuous	1-hour	-25 to 25 m/s	N/A	Propeller anemometer/photochopper
Vertical wind speed standard deviation	10	Campbell Scientific 23X	Continuous	1-hour	N/A	N/A	Computed by data logger
Ambient temperature	2, 10	YSI 44020	Continuous	1-hour	-50 to 50ºC	N/A	Motor aspirated triple element thermistor
Vertical temperature difference	10-2	Campbell Scientific 23X	Continuous	1-hour	-40 to 40	N/A	Computed by data logger
Total solar radiation	~2	Eppley 8-48	Continuous	1-hour	0 to 1,400 W/m^2	N/A	Black and white pyranometer with a differential thermopile
Nitrogen Oxides	3-4	Thermo Electron TECO 42C	Continuous	1-hour	0 to 0.5 ppm	0.40 ppb	USEPA Reference Method RFNA-1289-074
Sulfur Dioxide	3-4	Thermo Electron TECO 43C	Continuous	1-hour	0 to 0.5 ppm	1.0 ppb	USEPA Equivalent Method EQSA-0486-060
Carbon Monoxide	3-4	Thermo Electron TECO 48i	Continuous	1-hour	0 to 50 ppm	0.04 ppm	USEPA Reference Method RFCA-0981-054
Ozone	3-4	Thermo Electron TECO 49	Continuous	1-hour	0 to 0.5 ppm	0.50 ppb	USEPA Equivalent Method EQOA-0880-047
PM_{10}	3-4	Rupprecht & Patashnick (R&P) Model 1400ab TEOM	Continuous	1-hour	<5 micrograms per cubic meter (µg/m^3) to several g/m^3	<5 µg/m^3	USEPA Equivalent Method EQPM-1090-079
$PM_{2.5}$	3-4	Met One BAM-1020	Continuous	1-hour	0 to 1,000 µg/m^3	<4.8 µg/m^3 for 1-hour averages; and <1.0 µg/m^3 for 24-hour averages	USEPA Equivalent Method EQPM-0308-170

2.0 Station Performance Summary

2.1 Significant Project Events

Table 2-1 summarizes calibration and audit visits, as well as non-routine trips to the monitoring station during the year. Detailed discussions of project events affecting data capture are presented in **Table 2-2**.

Table 2-1 Calibrations, Audits, and Non-routine Trips to the Station

Date	Reason For Visit
3/22/10 through 3/25/10	First quarter calibration and quarterly audit.[1]
4/14/10	Replace damaged wind vane and propeller.[2]
6/15/10 through 6/16/10	Second quarter calibration and quarterly audit.
9/16/10 through 9/17/10	Third quarter calibration and quarterly audit.
12/1/10 through 12/3/10	Fourth quarter calibration and quarterly audit.
12/27/10 through 12/28/10	Install and calibrate replacement NO_X analyzer.[3]

[1]AECOM staff performed all quarterly calibrations. Air Monitoring Services and Technology (AMSTech) performed all quarterly audits.

[2]AECOM staff completed the repair.

[3]SLR Consulting installed and calibrated the replacement NO_X analyzer.

Table 2-2 Significant Project Events, 2010 Annual Data Summary

Date	Event/Comment
1/1/10 through 12/31/10	All air quality data (sulfur dioxide [SO_2], oxides of nitrogen [NO_X], nitrogen dioxide [NO_2], nitric oxide [NO], O_3, and CO) were corrected for zero drift according to the procedure outlined in the USEPA Quality Assurance Handbook for Air Pollution Measurement Systems Volume II: Part 1 (USEPA 1998), which is presented in **Appendix A**, Section A.3. All negative air quality data (except $PM_{2.5}$ and PM_{10}) were adjusted to 0.0 following adjustments and corrections.
1/1/10 through 3/24/10	1/1/10 0100 through 3/24/10 1200 – The 10 to 2 m temperature difference data were invalidated due to a failed calibration during the first quarter calibration visit.
1/07/10	0300 through 0500 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor. 0200 through 1100 – $PM_{2.5}$ data were invalidated because maintenance was performed and the filter tape was changed.
1/09/10 through 1/10/10	1/09/10 2200 through 1/10/10 0200 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor. 1/09/10 0800 through 1/10/10 0300 – $PM_{2.5}$ data were invalidated due to cold temperatures (-40ºC) and high atmospheric pressure (<777 mm Hg). It appears that the mass flow controller and/or pump were operating at its extreme limits. Therefore, the instrument could not establish a steady set point. This resulted in high flow variability.
1/10/10	0800 and 1300 through 1600 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
1/13/10	1400 – NO_X, NO, NO_2, SO_2, O_3, and CO data were invalidated due to a manual CO adjustment.

Table 2-2 Significant Project Events, 2010 Annual Data Summary

Date	Event/Comment
1/19/10 through 1/20/10	01/19/10 1500 through 01/20/10 0300 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor. 01/20/10 1100 through 1900 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
1/20/10	1300 – Horizontal wind speed, sigma-u, horizontal wind direction, and sigma-theta data were invalidated due to a frozen sensor.
1/21/10	0300 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
1/22/10	1000 and 1100 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
1/23/10	0600 and 0700 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
1/24/10	1100 through 1600 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor. 0700, 1800, and 2400 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
1/25/10	0100 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
1/28/10 through 1/29/10	1/28/10 1800 through 1/29/10 800 – NO_X, NO, NO_2, SO_2, O_3, CO, $PM_{2.5}$, and PM_{10} data were invalidated due to a power failure. 1/29/10 1500 – NO_X, NO, NO_2, SO_2, O_3, CO, $PM_{2.5}$, and PM_{10} data were invalidated due to a power failure.
2/1/10	1600 – NO_X, NO, NO_2, SO_2, CO, and O_3 data were invalidated due to a manual precision check.
2/3/10	1100 and1500 through 1700 – NO_X, NO, NO_2, SO_2, CO, and O_3 data were invalidated due to a manual precision check.
2/3/10 through 2/4/10	2/03/10 1800 through 2/04/10 0200 – O_3 data were invalidated because zero air was left on following a manual precision check.
2/6/10 through 2/9/10	2/06/10 1300 through 2/09/10 2400 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
2/7/10	0300 through 0600 – Horizontal wind speed, sigma-u, horizontal wind direction, and sigma-theta data were invalidated due to a frozen sensor.
2/9/10	1600 – Horizontal wind speed, sigma-u, horizontal wind direction, and sigma-theta data were invalidated due to a frozen sensor.
2/20/10	0200 through 1900 – NO_X, NO, NO_2, SO_2, O_3, CO, $PM_{2.5}$, and PM_{10} data were invalidated due to a power failure. 2000 – PM_{10} 1-hour average was invalidated due to instrument stabilization following the power failure. 2000 and 2100 – $PM_{2.5}$ data were invalidated due to instrument stabilization following the power failure.
2/22/10 through 2/23/10	2/22/10 0200 through 2/23/10 0300 – PM_{10} data were invalidated due to instrument stabilization following the power failure.
2/23/10	1100 and 1200 – $PM_{2.5}$ data were invalidated due to a filter tape change.
2/23/10	0700 and 1000 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
2/24/10	1800 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.

Table 2-2 Significant Project Events, 2010 Annual Data Summary

Date	Event/Comment
2/25/10	0700 and 0900 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
2/27/10	0700 and 0900 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
2/28/10	1700 through 2100 – Horizontal wind speed, sigma-u, horizontal wind direction, sigma-theta, vertical wind speed, and sigma-w data were invalidated due to frozen sensors.
3/10/10	0600 through 0800 – PM_{10} data were invalidated because one hour mass concentration values were outside of validation criteria as specified in the project QAPP.
3/12/10	1500 – NO_X, NO, NO_2, SO_2, O_3, CO, $PM_{2.5}$, and PM_{10} data were invalidated due to a power failure. 1600 – PM_{10} and $PM_{2.5}$ data were invalidated due to instrument stabilization following the power failure. 2400 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
3/15/10	1900 and 2300 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
3/16/10	0100 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
3/22/10	2400 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
3/22/10 through 3/23/10	3/22/10 1200 through 1700 – SO_2, NO_X, NO, NO_2, and CO data were invalidated due to the quarterly calibration. 3/22/10 1200 through 1900 – O_3 data were invalidated due to the quarterly calibration. 3/22/10 0100 through 03/23/10 0400 – PM_{10} data were invalidated due to the quarterly calibration. 3/23/10 0700 through 1200 – PM_{10} data were invalidated due to the quarterly calibration. 3/23/10 1500 through 1700 – SO_2, NO_X, NO, NO_2, O_3, CO, horizontal wind speed, sigma-u, wind direction, sigma-theta, 2-m temperature, and 10-m temperature data were invalidated due to the quarterly calibration.
3/23/10 through 3/24/10	3/23/10 0900 through 3/24/10 1800 – $PM_{2.5}$ data were invalidated due to the quarterly calibration. 3/23/10 1500 through 3/24/10 1200 – Vertical wind speed and sigma-w data were invalidated due to the semi-annual calibration.
3/24/10	0800 through 1300 – SO_2, NO_X, NO, NO_2, O_3, and CO data were invalidated due to the quarterly audit. 0700 through 2100 – PM_{10} data were invalidated due to the quarterly calibration and instrument stabilization following the filter change. 1200 through 1800 – 2-m temperature, 10-m temperature, and 10 to 2 m temperature difference data were invalidated due to the semi-annual calibration. 1600 and 1700 – NO_X, NO, NO_2, SO_2, CO, and O_3 data were invalidated due to a manual precision check.
3/24/10 through 3/31/10	3/24/10 2100 through 3/31/10 2400 – Horizontal wind speed, sigma-u, wind direction, and sigma-theta data were invalidated due to an inoperable wind vane and propeller.
3/25/10	0900 and 1000 – Solar radiation data were invalidated due to the semi-annual calibration. 1100 – NO_X, NO, NO_2, SO_2, CO, and O_3 data were invalidated due to a manual precision check.

Table 2-2 Significant Project Events, 2010 Annual Data Summary

Date	Event/Comment
3/28/10	0300 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
3/30/10	2000 and 2400 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
4/1/10 through 4/14/10	4/1/10 0100 through 4/14/10 1100 – Horizontal wind speed, sigma-u, wind direction, and sigma-theta data were invalidated due to an inoperable wind vane and propeller.
4/5/10	0200 and 2100 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
4/10/10	0400 through 0500 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
4/11/10	2300 through 2400 – SO_2, NO_X, NO, NO_2, CO, O_3, $PM_{2.5}$, and PM_{10} data were invalidated due to a power failure.
4/15/10	2000 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
4/19/10	0500 through 0600 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
4/22/10	0200 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
4/24/10 through 4/26/10	4/24/10 0800 through 4/26/10 0800 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
4/27/10 through 4/30/10	4/27/10 0600 through 4/30/10 1100 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
4/28/10	0600 and 0700 – Horizontal wind speed, sigma-u, horizontal wind direction, and sigma-theta data were invalidated due to a frozen sensor.
5/6/10	1200 through 1400 – $PM_{2.5}$ data were invalidated due to a tape change and instrument stabilization.
5/8/10	1100 – $PM_{2.5}$ 1-hour average concentration seemed unreasonably high based on surrounding values. Based on professional judgment, the high concentration was attributed to lint on the filter tape and invalidated.
5/12/10	1200 – PM_{10} 1-hour average was invalidated due to a power failure. 1300 – SO_2, NO_X, NO_2, NO, CO, O_3, $PM_{2.5}$, and PM_{10} data were invalidated due to a power failure.
5/20/10 through 5/21/10	5/20/2010 1600 through 5/21/10 0900 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
5/27/10	0300 through 1100 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
5/29/10 through 5/30/10	5/29/10 2400 through 5/30/10 0900 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
5/30/10 through 5/31/10	5/30/10 2200 through 5/31/10 1000 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
6/6/10	1000 – $PM_{2.5}$ 1-hour average was invalidated because the nozzle punched a hole in the filter tape, which resulted in an erroneous negative value.
6/15/10	1300 through 1900 – PM_{10} and $PM_{2.5}$ data were invalidated due to the quarterly calibration.
6/15/10 through 6/16/10	6/15/10 1100 through 6/16/10 1600 – NO_X, NO, NO_2, SO_2, CO, and O_3 data were invalidated due to the quarterly calibration. 6/15/10 1900 through 6/16/10 1100 – 2-m temperature, 10-m temperature, 10 to 2 m temperature difference, and solar radiation data were invalidated due to the quarterly audit.

Table 2-2 Significant Project Events, 2010 Annual Data Summary

Date	Event/Comment
6/16/10	0800 through 1100 – Horizontal wind speed, sigma-u, wind direction, sigma theta, vertical wind speed, and sigma-w data were invalidated due to the quarterly audit. 1400 through 1500 – Solar radiation data were invalidated due to the quarterly audit. 1200 through 1500 – PM_{10} data were invalidated due to the quarterly audit. 1200 through 1700 – $PM_{2.5}$ data were invalidated due to the quarterly audit.
6/16/10 through 6/17/10	6/16/10 1200 through 6/17/10 0800 – Vertical wind speed and sigma-w data were invalidated due to the quarterly audit. 6/16/10 1700 through 6/17/10 0500 – O_3 data were invalidated due to an issue with the zero air supply.
6/17/10	0600 through 1300 – NO_X, NO, NO_2, SO_2, CO, and O_3 data were invalidated due to manual precision checks. 1200 – $PM_{2.5}$ data were invalidated due to the quarterly audit.
6/17/10 through 6/18/10	6/17/10 1400 through 6/18/10 1100 – O_3 data were invalidated due to an issue with the zero air supply.
6/19/10	1000 – NO_X, NO, NO_2, SO_2, O_3, CO, $PM_{2.5}$, and PM_{10} data were invalidated due to a power failure. 1100 – NO_X, NO, NO_2, SO_2, O_3, CO, and PM_{10} data were invalidated due to instrument stabilization following a power failure.
6/20/10	0300 through 0700 – Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
6/26/10	1000 – $PM_{2.5}$ 1-hour average was invalidated because the nozzle punched a hole in the filter tape, which resulted in an erroneous negative value.
7/6/10	1500 – The $PM_{2.5}$ concentration seemed unreasonably high based on surrounding values. Based on professional judgment, the high concentration was attributed to lint on the filter tape and invalidated. 1600 – $PM_{2.5}$ negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the $PM_{2.5}$ 1-hour average was invalidated.
7/10/10	0200 – PM_{10} negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} 1-hour average was invalidated.
7/12/10	0900 – SO_2, NO_X, NO_2, NO, CO, and O_3 data were invalidated due to a manual precision check.
7/13/10	1200 and 1300 – SO_2, NO_X, NO_2, NO, CO, and O_3 data were invalidated due to a manual precision check.
7/15/10	0900 – SO_2, NO_X, NO_2, NO, CO, and O_3 data were invalidated due to a manual precision check.
7/16/10	1200 – SO_2, NO_X, NO_2, NO, CO, and O_3 data were invalidated due to a manual precision check.
7/17/10	2200 and 2300 – PM_{10} negative concentrations were outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the data were invalidated. 1100 – $PM_{2.5}$ negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the $PM_{2.5}$ 1-hour average was invalidated.
7/20/10	0800 – PM_{10} negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} 1-hour average was invalidated.
7/21/10	1300 through 1500 – $PM_{2.5}$ data were invalidated due to routine analyzer maintenance.

Table 2-2 Significant Project Events, 2010 Annual Data Summary

Date	Event/Comment
7/22/10	2100 – PM_{10} negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} 1-hour average was invalidated.
7/28/10	1300 and 1400 – PM_{10} negative concentrations were outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the data were invalidated.
8/2/10	2200 – PM_{10} 1-hour average was invalidated due to a power failure. 2300 – SO_2, NO_X, NO, NO_2, CO, O_3, PM_{10}, and $PM_{2.5}$ data were invalidated due to a power failure. 2400 – PM_{10} 1-hour average was invalidated due to instrument stabilization following the power failure.
8/3/10	1500 and 1600 – $PM_{2.5}$ negative concentrations were outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the data were invalidated. 2300 and 2400 – PM_{10} negative concentrations were outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} data were invalidated.
8/14/10	0100 and 1100 – PM_{10} negative concentrations were outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} data were invalidated. 1200 – The $PM_{2.5}$ concentration seemed unreasonably high based on surrounding values. Based on professional judgment, the high concentration was attributed to lint on the filter tape and invalidated.
8/16/10	1100 and 1200 – PM_{10} negative concentrations were outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the data were invalidated. 1900 through 2200 – PM_{10} negative concentrations were outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the data were invalidated.
8/17/10	1300 – $PM_{2.5}$ negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the $PM_{2.5}$ 1-hour average was invalidated.
8/21/10	1100 – PM_{10} negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} 1- hr average was invalidated. 1800 – The $PM_{2.5}$ concentration seemed unreasonably high based on surrounding values. Based on professional judgment, the high concentration was attributed to lint on the filter tape and invalidated.
8/22/10	0400 and 0700 – $PM_{2.5}$ negative concentrations were outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the data were invalidated. 1100 and 1300 – The $PM_{2.5}$ concentrations seemed unreasonably high based on surrounding values. Based on professional judgment, the high concentrations were attributed to lint on the filter tape and invalidated.
8/23/10	0600 through 0800 – $PM_{2.5}$ data were invalidated due to quarterly data download. 1100 and 2000 – $PM_{2.5}$ negative concentrations were outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the data were invalidated.
8/29/10	0900 – The $PM_{2.5}$ concentration seemed unreasonably high based on surrounding values. Based on professional judgment, the high concentration was attributed to lint on the filter tape and invalidated. 1500 – $PM_{2.5}$ negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the $PM_{2.5}$ 1-hour average was invalidated.

Table 2-2 Significant Project Events, 2010 Annual Data Summary

Date	Event/Comment
8/30/10	2300 – $PM_{2.5}$ negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the $PM_{2.5}$ 1-hour average was invalidated.
8/31/10	1800 – The $PM_{2.5}$ concentration seemed unreasonably high based on surrounding values. Based on professional judgment, the high concentration was attributed to lint on the filter tape and invalidated.
9/2/10	1400 – $PM_{2.5}$ negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the $PM_{2.5}$ 1-hour average was invalidated. 1300 and 2300 – The $PM_{2.5}$ concentrations seemed unreasonably high based on surrounding values. Based on professional judgment, the high concentrations were attributed to lint on the filter tape and invalidated.
9/8/10	2000 – PM_{10} negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} 1-hour average was invalidated.
9/9/10	2200 – PM_{10} negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} 1-hour average was invalidated.
9/10/10	2200 – PM_{10} negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} 1-hour average was invalidated.
9/11/10	1100 – $PM_{2.5}$ negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the $PM_{2.5}$ 1-hour average was invalidated.
9/16/10	1400 and 2100 – NO_X, NO, NO_2, SO_2, CO, and O_3 data were invalidated due to non-routine automatic precision checks. 2200 through 2400 – The elevated NO_X, NO_2, NO, SO_2, and CO concentrations following the non-routine automatic precision checks were due to residual gas in the lines. Therefore, the data were invalidated. 2200 through 2400 – O_3 data were invalidated due to the quarterly calibration. 1400 through 2300 – Horizontal wind speed, sigma-u, wind direction, sigma-theta, vertical wind speed, sigma-w, 2-m temperature, 10-m temperature, and 10-2 m temperature difference data were invalidated due to the quarterly calibration.
9/16/10 through 9/17/10	9/16/10 1700 through 9/17/10 0300 – PM_{10} data were invalidated due to the quarterly calibration.
9/17/10	0900 through 2300 – NO_X, NO, NO_2, SO_2, CO, and O_3 data were invalidated due to the quarterly calibration. 1400 through 2100 – PM_{10} data were invalidated due to the quarterly audit. 700 through 2100 – $PM_{2.5}$ data were invalidated due to the quarterly calibration.
9/21/10	0200 through 1100 - Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
9/23/10 through 10/06/10	9/23/10 1700 through 10/6/10 1300 – NO_X, NO, and NO_2 data were not collected during this period because the Thermo Electron NO-NO_2-NO_X analyzer malfunctioned and was removed from service. The analyzer was transported to the AECOM office in Fort Collins, CO, where the problem was diagnosed. The analyzer's cooler had failed and needed to be replaced. After repairs were completed, the analyzer was returned to the monitoring station and reinstalled. Data collection resumed on October 6, 2010 following calibration and a series of instrument checks.

Table 2-2 Significant Project Events, 2010 Annual Data Summary

Date	Event/Comment
9/24/10	0800 and 1100 – SO_2, CO, and O_3 data were invalidated due to non-routine automatic precision/GPT checks. 1200 – The elevated SO_2 concentration following the precision check was due to residual gas in the line. Therefore, the SO_2 1-hour average was invalidated.
9/30/10	0800 - Vertical wind speed and sigma-w data were invalidated due to a frozen sensor.
10/01/10 through 10/06/10	10/01/10 1000 through 10/06/10 1300 – All SO_2, and CO data were invalidated due to operations related to the removal and installation of the replacement NO_X analyzer. Unsupported failed precision checks confirmed that on-site activities were affecting the performance of each system. However, it was unclear how and when each system was impacted by the activities. After the replacement NO_X analyzer was properly installed, calibration adjustments and as left calibration checks were performed. The results confirmed that all systems were operating within tolerance limits. For each system, data were invalidated until the as left calibration check was performed.
10/04/10 through 10/08/10	10/04/10 1500 through 10/08/10 1200 – Vertical wind speed and sigma-w data were invalidated because the sensor was frozen.
10/04/10	1200 through 1500 – O_3 data were invalidated due to a series of manual precision checks related to the installation of the NO_X analyzer.
10/06/10	1100 through 1300 – O_3 data were invalidated due to the calibration of the NO_X analyzer.
10/12/10 through 10/13/10	10/12/10 1200 through 10/13/10 1200 – PM_{10} data were invalidated because the instrument's mass transducer wasn't closed following a routine site visit.
10/13/10 through 10/15/10	10/13/10 0100 through 10/15/10 1400 - Vertical wind speed and sigma-w data were invalidated because the sensor was frozen.
10/19/10	1000 – PM_{10} and $PM_{2.5}$ data were invalidated due to a power failure. 1100 – NO_X, NO, NO_2, SO_2, O_3, CO, $PM_{2.5}$, and PM_{10} data were invalidated due to a power failure.
10/20/10	0400 – Vertical wind speed and sigma-w data were invalidated because the sensor was frozen.
10/24/10 through 10/31/10	10/24/10 1700 through 10/31/10 2400 – Vertical wind speed and sigma-w data were invalidated because the sensor was frozen.
10/27/10	1600 – PM_{10} negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} 1- hr average was invalidated.
10/28/10	0100 – $PM_{2.5}$ negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the $PM_{2.5}$ 1-hour average was invalidated.
11/01/10	0500 – PM_{10} negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} 1- hr average was invalidated.
11/03/10	0800 and 0900 – $PM_{2.5}$ data were invalidated due to on-site maintenance.
11/01/10 through 11/04/10	11/01/10 0100 through 11/04/10 0900 – Vertical wind speed and sigma-w data were invalidated because the sensor was frozen.
11/07/10 through 11/16/10	11/07/10 0300 through 11/16/10 2200 – Vertical wind speed and sigma-w data were invalidated because the sensor was frozen.
11/8/10	2200 – PM_{10} negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the PM_{10} 1- hr average was invalidated.

Table 2-2 Significant Project Events, 2010 Annual Data Summary

Date	Event/Comment
11/9/10	0800 – The $PM_{2.5}$ concentration seemed unreasonably high based on surrounding values. Based on professional judgment, the high concentration was attributed to lint on the filter tape and invalidated. 0900 – $PM_{2.5}$ negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the $PM_{2.5}$ 1-hour average was invalidated.
11/19/10	0300 – Vertical wind speed and sigma-w data were invalidated because the sensor was frozen.
11/22/10	0100 – PM_{10} data were invalidated due to a power failure. 0200 – NO_X, NO, NO_2, SO_2, O_3, CO, and PM_{10} data were invalidated due to a power failure. 0600 through 0900 – NO_X, NO, NO_2, SO_2, O_3, and CO data were invalidated due to a power failure. 0600 through 1000 – PM_{10} data were invalidated due to a power failure and instrument stabilization following the power failure. 0100 through 1200 – $PM_{2.5}$ data were invalidated due to a power failure and instrument stabilization following the power failure. 0800 and 0900 – Vertical wind speed and sigma-w data were invalidated because the sensor was frozen.
11/23/10 through 11/30/10	11/23/10 0800 through 11/30/10 2400 – Vertical wind speed and sigma-w data were invalidated because the sensor was frozen.
11/26/10	1600 – $PM_{2.5}$ negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the $PM_{2.5}$ 1-hour average was invalidated. 1700 – The $PM_{2.5}$ concentration seemed unreasonably high based on surrounding values. Based on professional judgment, the high concentration was attributed to lint on the filter tape and invalidated.
11/28/10	1100 and 1200 – Horizontal wind speed, sigma-u, horizontal wind direction, and sigma-theta data were invalidated because the sensor was frozen.
11/29/10 through 11/30/10	11/29/10 1100 through 11/30/10 2100 – Horizontal wind speed, sigma-u, horizontal wind direction, and sigma-theta data were invalidated because the sensor was frozen.
12/1/10	1700 through 2300 – NO_X, NO, NO_2, SO_2, O_3, and CO data were invalidated due to the quarterly calibration.
12/2/10	1100 through 1400 and 1900 through 2300 – PM_{10} data were invalidated due to the quarterly calibration.
12/1/10 through 12/3/10	12/1/10 0100 through 12/3/10 1200 – Vertical wind speed and sigma-w data were invalidated because the sensor was frozen. 12/2/10 0700 through 12/3/10 2200 – $PM_{2.5}$ data were invalidated due to the quarterly calibration.
12/3/10	1300 through 1500 – Horizontal wind speed, sigma-u, wind direction, sigma-theta, vertical wind speed, sigma-w, 2-m temperature, 10-m temperature, and 10-2 m temperature difference data were invalidated due to the quarterly audit. 1600 through 2100 – PM_{10} data were invalidated due to the quarterly calibration.

Table 2-2 Significant Project Events, 2010 Annual Data Summary

Date	Event/Comment
12/2/10 through 12/4/10	12/2/10 0800 through 12/4/10 1100 – NO_X, NO, NO_2, SO_2, O_3, and CO data were invalidated due to the quarterly audit.
12/3/10 through 12/9/10	12/3/10 2300 through 12/9/10 1600 – $PM_{2.5}$ data were invalidated due to the manufacturer's recommended zero filter test.
12/9/10 through 12/10/10	12/9/10 1700 through 12/10/10 2000 – $PM_{2.5}$ data were invalidated due to filter tape tracking issues.
12/8/10	1800 – NO_X, NO, NO_2, SO_2, O_3, CO, and PM_{10} data were invalidated due to a power failure. 1900 – PM_{10} 1-hour average was invalidated due to instrument stabilization issues following the power failure.
12/14/10	0900 – NO_X, NO, NO_2, SO_2, O_3, and CO data were invalidated due to a manual precision check being conducted. 1200 – $PM_{2.5}$ data were invalidated due to on-site activity.
12/14/10 through 12/15/10	12/14/10 1000 through 12/15/10 0200 – NO_X, NO, NO_2, SO_2, O_3, and CO data were invalidated due to zero air being left on following the manual precision check.
12/17/10	0100 – $PM_{2.5}$ negative concentration was outside of acceptable limits that were developed in collaboration with the manufacturer. As a result, the $PM_{2.5}$ 1-hour average was invalidated.
12/18/10	1400 – $PM_{2.5}$ 1-hour average was invalidated because the filter tape was changed.
12/20/10	1900 – The $PM_{2.5}$ concentration seemed unreasonably high based on surrounding values. Based on professional judgment, the high concentration was attributed to lint on the filter tape and invalidated.
12/21/10	1700 and 1800 – Anomalous PM_{10} and $PM_{2.5}$ concentrations. It is believed that power fluctuations affected the measurement systems. Therefore, NO_X, NO, NO_2, SO_2, O_3, CO, PM_{10} and $PM_{2.5}$ data were invalidated.
12/21/10 through 12/28/10	12/21/10 1900 through 12/28/10 1100 – NO_X, NO, and NO_2 data were not collected during this period because the analyzer malfunctioned and was removed from service. Data collection resumed on December 28, 2010 following the installation of the replacement analyzer.
12/27/10	1400 through 2100 – SO_2, O_3, and CO data were invalidated due to on-site activity by SLR Consulting. SLR was on-site installing the replacement NO_X analyzer. 2000 and 2100 – Horizontal wind speed, sigma-u, wind direction, sigma-theta, vertical wind speed, sigma-w, 2-m temperature, 10-m temperature, 10-2 m temperature difference, and solar radiation data were invalidated due to on-site activity by SLR Consulting.
12/27/10 through 12/29/10	12/27/10 0200 through 12/29/10 0500 – The $PM_{2.5}$ instrument's temperature sensor is limited to - 40ºC. The ambient temperature was below - 40ºC during this period. Therefore, the data were invalidated.
12/28/10	0300, 1200, and 1300 – Horizontal wind speed, sigma-u, wind direction, sigma-theta, vertical wind speed, sigma-w, 2-m temperature, 10-m temperature, 10-2 m temperature difference, and solar radiation data were invalidated due to on-site activity by SLR Consulting. 1200 through 2000 – NO_X, NO, NO_2, SO_2, O_3, and CO data were invalidated because SLR Consulting was calibrating the replacement NO_X analyzer. 1100 and 1900 – PM_{10} data were invalidated due to flow rate issues associated with the cold temperatures.

Table 2-2 Significant Project Events, 2010 Annual Data Summary

Date	Event/Comment
12/29/10	0700 and 0800 – NO_X, NO, NO_2, SO_2, O_3, and CO data were invalidated because manual precision checks were being conducted.
12/30/10	0500 through 0900 – The $PM_{2.5}$ instrument's temperature sensor is limited to - 40ºC. The ambient temperature was below - 40ºC during this period. Therefore, the data were invalidated.
12/30/10	0700 – NO_X, NO, NO_2, SO_2, O_3, and CO data were invalidated because a manual precision check was being conducted.

2.2 Missing, Invalid and Adjusted Data

All hourly NO_X, SO_2, O_3, and CO data were routinely adjusted for instrument zero drift according to the procedure outlined in the USEPA Quality Assurance Handbook for Air Pollution Measurement Systems Vol. II: Part 1 (USEPA 1998) as presented in **Appendix A**, Section A.3. After instrument zero drift corrections were applied, all hourly NO_X, SO_2, O_3, and CO data less than 0.000 parts per million (ppm) were investigated and then set to 0.000 ppm to conservatively remove any remaining negative bias.

Details pertaining to all invalidated data were provided in the previous section (Section 2.1) in **Table 2-2**.

2.3 Network Data Completeness

Table 2-3 provides a summary of quarterly data capture rates for each parameter during the monitoring year. Data capture rates for each air quality and meteorological parameter were calculated using the procedure described in **Appendix A**, Section A.1. Quarterly network data capture rates for the year achieved QAPP goals for all parameters except horizontal wind speed, horizontal wind speed standard deviation, horizontal wind direction, horizontal wind direction standard deviation, vertical wind speed, vertical wind speed standard deviation, and 10 to 2 m temperature difference.

Table 2-3 Data Recovery Statistics, 2010 Annual Data Summary

Parameter	1st Quarter 2010 (%)	2nd Quarter 2010 (%)	3rd Quarter 2010 (%)	4th Quarter 2010 (%)	Required Capture Rate (%)
Meteorological					
10-m Horizontal Wind Speed	91.4	**84.9**	99.5	98.0	90
10-m Horizontal Sigma-u (σ_u)	91.4	**84.9**	99.5	98.0	
10-m Horizontal Wind Direction	91.4	**84.9**	99.5	98.0	
10-m Sigma-Theta (σ_θ)	91.4	**84.9**	99.5	98.0	
10-m Vertical Wind Speed	91.9	90.2	99.0	**59.0**	
10-m Vertical Sigma-w (σ_w)	91.9	90.2	99.0	**59.0**	
10-m Temperature	99.5	99.2	99.5	99.6	
2-m Temperature	99.5	99.2	99.5	99.6	
10-2 m Temperature Difference	**8.1**	99.2	99.5	99.6	
Total Solar Radiation	99.9	99.1	100	99.8	

Table 2-3 Data Recovery Statistics, 2010 Annual Data Summary

Parameter	1st Quarter 2010 (%)	2nd Quarter 2010 (%)	3rd Quarter 2010 (%)	4th Quarter 2010 (%)	Required Capture Rate (%)
Air Quality					
NO_2	95.9	96.7	89.6	81.1	80
SO_2	95.9	96.7	97.3	88.3	
O_3	95.4	95.1	97.4	93.5	
CO	95.9	96.7	97.4	88.3	
$PM_{2.5}$ (BAM)	95.2	98.9	98.0	86.9	
PM_{10} (TEOM)	94.7	99.2	98.1	97.4	

All data losses were thoroughly detailed in Section 2.1, **Table 2-2**. In summary, the following events resulted in data capture rates below QAPP goals:

- First quarter 10 to 2 m temperature difference (delta temperature) losses were due to a failed as found calibration check. A successful as left calibration check was performed following a delta temperature calibration adjustment.
- Horizontal wind speed, wind direction, and associated data were lost during the second quarter because the propeller and vane were damaged and inoperable for a couple of weeks. Data collection resumed following repairs on April 14, 2010.
- Fourth quarter vertical wind speed and vertical wind speed standard deviation (sigma-w) data losses occurred because the sensor froze on many occasions during the monitoring period. As noted in the QAPP, vertical wind speed is an optional parameter for the AERMOD dispersion model and it is of limited utility for meeting other project objectives. Therefore, meeting the data capture goal is not critical.

2.4 Precision Statistics

2.4.1 Monitoring Network Precision Statistics

A summary of the 2010 NO_2, NO, SO_2, O_3, and CO precision check statistics shown in **Table 2-4** indicates all air quality systems were reporting measurements to within QAPP established tolerances. Precision statistics have been calculated for NO_2, NO, SO_2, O_3, and CO instruments based on USEPA methods, which are summarized in **Appendix A**, Section A.2. Individual results from each precision check conducted are listed in **Appendix B**, **Tables B-1** through **B-4**.

2.5 Accuracy Statistics

Meteorological and ambient air quality measurement systems are subjected to periodic calibrations/QC checks and independent QA performance audits to document measurement system accuracy. All calibration/QC check and audit equipment relies on NIST or other traceable standards. The purpose of calibration/QC and audit checks is to challenge measurement systems with known inputs, verifying that the response of each system is accurate to within USEPA established tolerances listed in the QAPP. A complete copy of all calibration/QC check data, independent QA performance audits, and technical systems audits is included in **Appendix C** and summarized below.

Table 2-4 Annual Precision and Bias Statistics Summary January through December 2010

Precision and Bias Estimates	Analyzer					Goal[1]
	NO	NO_2	SO_2	O_3	CO	
Number of Precision Checks (N)	120	118	125	125	128	24
Coefficient of Variation (CV)	3.4	5.5	2.2	2.2	2.5	±10 / ±7[2]
Bias (BA)	± 3.2	+ 5.24	- 3.83	- 3.36	± 2.4	±10 / ±7[2]

[1] Precision goal is based on the number of precision checks possible per quarter in accordance with *40 CFR* 58 App. A Section 3.2.1.

[2] The project goal for O_3 is ±7 for CV and BA and ±10 for CV and BA for all other analyzers. CV and BA are evaluated on an annual basis for comparison to project goals.

[3] The ± symbol indicates that per the methodology provided in *40 CFR* 58 App. A Section 4.1.3.1 that a sign could not be assigned to the bias estimate.

Remarks:
At least one valid precision check was conducted every 2 weeks for all gaseous pollutant measurement systems in accordance with *40 CFR 58 App. A Section 3.2.1*.
Six valid precision checks are required per quarter by the QAPP; 140 were performed during 2010 and the valid number is indicated in the table.

2.5.1 Instrument Calibration Statistics

A description of quarterly calibration/QC checks is presented below by quarter. These quarterly calibration/QC check descriptions are summarized in **Tables 2-5** through **2-8** for each measurement parameter during the monitoring year. The results in these summary tables characterize an as left instrument state. If as found results were significantly different or failed QA criteria, they are discussed before the summary table.

2.5.1.1 First Quarter 2010

The first quarter calibration of the air quality measurement systems and the semi-annual calibration of the meteorological measurement systems were conducted by AECOM on March 22 through March 25, 2010. The as found delta temperature calibration check data failed to meet accuracy criteria. Delta temperature data collected during the first quarter prior to the as found calibration check were invalidated. A successful as left calibration check was performed following a delta temperature calibration adjustment. All other meteorological and air quality measurement systems were found and left reporting measurements to within acceptable limits. The results (as left measurements) are summarized in **Table 2-6**.

Table 2-5 shows that all calibrated systems were left reporting measurements to within acceptable limits.

2.5.1.2 Second Quarter 2010

The second quarter calibration of the air quality measurement systems was conducted by AECOM on June 15th and 16th, 2010. All calibrated air quality measurement systems were found and left reporting measurements to within acceptable limits. The results (as left measurements) are summarized in **Table 2-6**.

2.5.1.3 Third Quarter 2010

The third quarter calibration of the air quality measurement systems and the semi-annual calibration of the meteorological measurement systems were conducted by AECOM on September 16th and 17th, 2010. All calibrated measurement systems were found and left reporting measurements to within acceptable limits. The results (as left measurements) are summarized in **Table 2-7**.

2.5.1.4 Fourth Quarter 2010

The fourth quarter calibration of the air quality measurement systems was conducted by AECOM on December 1 through December 3, 2010. All calibrated air quality measurement systems were found and left reporting measurements to within acceptable limits. The results (as left measurements) are summarized in **Table 2-8**.

Table 2-5 First Quarter 2010 Calibration Results

Parameter	QC Check Category	QC Check Criteria	Measured Response[1]	Results (Pass/Fail)	Comments
Air Quality Systems Calibration (March 22 through March 25)					
SO_2	Span	0.075 ppm	0.000 ppm	Pass	The calibration confirmed that air quality systems were reporting measurements to within acceptable limits.
	Zero	0.015 ppm	0.002 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_X	Span	0.075 ppm	0.002 ppm	Pass	
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO	Span	0.075 ppm	0.000 ppm	Pass	
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_2	Converter Eff.	≥ 96%	100%	Pass	
O_3	Span	0.075 ppm	-0.007 ppm	Pass	
	Zero	0.015 ppm	-0.001 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
CO	Span	7.5 ppm	0.040 ppm	Pass	
	Zero	1.5 ppm	-0.046 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
PM_{10}	Flow Compared to Nominal	16.67 lpm	16.24 lpm	Pass	
	Temperature	±1°C	0.70°C	Pass	
	Pressure	±1.5%	0.2%	Pass	
$PM_{2.5}$	Flow Compared to Nominal	16.67 lpm	16.75 lpm	Pass	
	Temperature	±2°C	0.20°C	Pass	
	Pressure	±10 mm Hg	0.3 mm Hg	Pass	
Meteorological Systems Calibration (March 22 through March 25)					
10-m Horizontal Wind Speed	Accuracy	±(0.2 m/s + 5% of actual)	0.0 m/s	Pass	The calibration confirmed that meteorological systems were reporting measurements to within acceptable limits.
	Starting Torque	≤ 0.5 m/s	0.16 m/s CW, 0.16 m/s CCW	Pass	
10-m Horizontal Wind Direction	Alignment	≤ ±5 deg	-0.5 deg	Pass	
	Linearity	≤ ±3 deg	0.0 deg CW, 0.0 deg CCW	Pass	
	Starting Torque	≤ 0.5 m/s	0.4 m/s CW, 0.4 m/s CCW	Pass	
10-m Vertical Wind Speed	Accuracy	±(0.2 m/s + 5% of actual)	0.26 m/s CW, -0.26 m/s CCW	Pass	
	Starting Torque	0.3 g-cm	0.2 g-cm CW, 0.2 g-cm CCW	Pass	
10-m Temperature	Accuracy	≤ ±0.5°C	-0.07°C	Pass	
2-m Temperature	Accuracy	≤ ±0.5°C	-0.06°C	Pass	
10-2 m Temperature Difference	Accuracy	≤ ±0.1°C	-0.01°C	Pass	
Solar Radiation	Accuracy	≤ ±5% of observed	2.5 W/m^2	Pass	

[1] If multiple checks were performed, the measured response was estimated by averaging all measured values.

Table 2-6 Second Quarter 2010 Calibration Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Systems Calibration (June 15th and 16th)					
SO_2	Span	0.075 ppm	0.000 ppm	Pass	The calibration confirmed that air quality systems were reporting measurements to within acceptable limits.
	Zero	0.015 ppm	0.004 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_X	Span	0.075 ppm	0.009 ppm	Pass	
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO	Span	0.075 ppm	0.008 ppm	Pass	
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_2	Converter Eff.	≥ 96%	100.2%	Pass	
O_3	Span	0.075 ppm	0.000 ppm	Pass	
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
CO	Span	7.5 ppm	0.000 ppm	Pass	
	Zero	1.5 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
PM_{10}	Flow Compared to Nominal	16.67 lpm	16.56 lpm	Pass	
	Temperature	±1°C	0°C	Pass	
	Pressure	±1.5%	-0.1%	Pass	
$PM_{2.5}$	Flow Compared to Nominal	16.67 lpm	16.75 lpm	Pass	
	Temperature	±2°C	0°C	Pass	
	Pressure	±10 mm Hg	2.0 mm Hg	Pass	

Table 2-7 Third Quarter 2010 Calibration Results

Parameter	QC Check Category	QC Check Criteria	Measured Response[1]	Results (Pass/Fail)	Comments
Air Quality Systems Calibration (September 16th and 17th)					
SO_2	Span	0.075 ppm	0.003 ppm	Pass	The calibration confirmed that air quality systems were reporting measurements to within acceptable limits.
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_X	Span	0.075 ppm	0.004 ppm	Pass	
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO	Span	0.075 ppm	0.004 ppm	Pass	
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_2	Converter Eff.	≥ 96%	100.5%	Pass	
O_3	Span	0.075 ppm	0.001 ppm	Pass	
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
CO	Span	7.5 ppm	0.700 ppm	Pass	
	Zero	1.5 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
PM_{10}	Flow Compared to Nominal	16.67 lpm	16.77 lpm	Pass	
	Temperature	±1°C	-0.24°C	Pass	
	Pressure	±1.5%	0.3%	Pass	
$PM_{2.5}$	Flow Compared to Nominal	16.67 lpm	16.70 lpm	Pass	
	Temperature	±2°C	0.10°C	Pass	
	Pressure	±10 mm Hg	0.0 mm Hg	Pass	
Meteorological Systems Calibration (September 16th and 17th)					
10-m Horizontal Wind Speed	Accuracy	±(0.2 m/s + 5% of actual)	0.0 m/s	Pass	The calibration confirmed that meteorological measurement systems were reporting measurements to within acceptable limits.
	Starting Torque	≤ 0.5 m/s	0.16 m/s CW, 0.20 m/s CCW	Pass	
10-m Horizontal Wind Direction	Alignment	≤ ±5 deg	-0.1 deg	Pass	
	Linearity	≤ ±3 deg	0.0 deg CW, 0.0 deg CCW	Pass	
	Starting Torque	≤ 0.5 m/s	0.4 m/s CW, 0.4 m/s CCW	Pass	
10-m Vertical Wind Speed	Accuracy	±(0.2 m/s + 5% of actual)	0.24 m/s CW, -0.27 m/s CCW	Pass	
	Starting Torque	≤ 0.25 m/s	0.14 m/s CW, 0.17 m/s CCW	Pass	
10-m Temperature	Accuracy	≤ ±0.5°C	-0.01°C	Pass	
2-m Temperature	Accuracy	≤ ±0.5°C	0.02°C	Pass	
10-2 m Temperature Difference	Accuracy	≤ ±0.1°C	-0.01°C	Pass	
Solar Radiation	Accuracy	≤ ±5% of observed	3.0 W/m^2	Pass	

[1] If multiple checks were performed, the measured response was estimated by averaging all measured values.

Table 2-8 Fourth Quarter 2010 Calibration Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Systems Calibration (December 1 through December 3)					
SO_2	Span	0.075 ppm	-0.001 ppm	Pass	The calibration confirmed that air quality systems were reporting measurements to within acceptable limits.
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_X	Span	0.075 ppm	-0.002 ppm	Pass	
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO	Span	0.075 ppm	-0.006 ppm	Pass	
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
NO_2	Converter Eff.	≥ 96%	100%	Pass	
O_3	Span	0.075 ppm	-0.007 ppm	Pass	
	Zero	0.015 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
CO	Span	7.5 ppm	0.310 ppm	Pass	
	Zero	1.5 ppm	0.000 ppm	Pass	
	Linearity Check	±2% of Span	< ±2% of Span	Pass	
PM_{10}	Flow Compared to Nominal	16.67 lpm	16.64 lpm	Pass	
	Temperature	±1°C	-0.29°C	Pass	
	Pressure	±1.5%	0.2%	Pass	
$PM_{2.5}$	Flow Compared to Nominal	16.67 lpm	16.54 lpm	Pass	
	Temperature	±2°C	-0.10°C	Pass	
	Pressure	±10 mm Hg	5.0 mm Hg	Pass	

2.5.2 Deviations from the QAPP

There were no deviations from the QAPP during this reporting period.

2.5.3 Independent Quality Assurance Audits

A written description of quarterly independent QA performance audits and the technical systems audit is presented below. Quarterly performance audit results are also summarized in **Tables 2-9** through **Table 2-12** for each measurement parameter.

2.5.3.1 First Quarter 2010

The first quarter performance audit of the air quality measurement systems was conducted by AMSTech on March 24, 2010. Results of this QA activity are summarized in **Table 2-9**, which shows that all audited systems were reporting measurements to within acceptable limits. Conducting a meteorological performance audit is only required semi-annually and was conducted during the second and fourth quarters of 2010.

2.5.3.2 Second Quarter 2010

The second quarter air quality and meteorological measurement systems performance audit was conducted by AMSTech on June 16, 2010. Results of this QA activity are summarized in **Table 2-10**, which shows that all audited systems were reporting measurements to within acceptable limits.

2.5.3.3 Third Quarter 2010

The third quarter performance audit of the air quality measurement systems was conducted by AMSTech on September 17, 2010. Results of this QA activity are summarized in **Table 2-11**, which shows that all audited systems were reporting measurements to within acceptable limits.

2.5.3.4 Fourth Quarter 2010

The fourth quarter air quality and meteorological measurement systems performance audit was conducted by AMSTech on December 3, 2010. Results of this QA activity are summarized in **Table 2-12**, which shows that all audited systems were reporting measurements to within acceptable limits.

2.5.3.5 Technical Systems Audit

The annual Technical Systems Audit (TSA) of data handling, validation, processing, reporting procedures, and monitoring station siting and operation was conducted during August and September 2010 at the Nuiqsut Station and at the AECOM Air Resources Laboratory in Fort Collins, Colorado. TSA results showed the monitoring station has been installed and is operating in accordance with the QAPP and USEPA recommended guidelines. The audit also showed AECOM has the necessary organization, practical field experience, work facilities, and data processing procedures in place to accurately collect and report project ambient air quality and meteorological data.

Table 2-9 First Quarter 2010 Audit Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Audit March 24, 2010					
SO_2	Accuracy	≤15%	2.1%	Pass	The audit confirmed the air quality analyzers were reporting measurements to within acceptable limits.
NO_X	Accuracy	≤15%	1.7%	Pass	
NO	Accuracy	≤15%	3.2%	Pass	
NO_2	Accuracy	≤15%	2.5%	Pass	
O_3	Accuracy	≤15%	0.7%	Pass	
CO	Accuracy	≤15%	1.1%	Pass	
PM_{10}	Flow Rate Accuracy	±4%	-2.0%	Pass	
	Inlet Flow Rate Test	±5%	0.1%	Pass	
	Mass Determination	±2.5% mean	2.03%	Pass	
$PM_{2.5}$	Flow Accuracy	±4%	0.0%	Pass	
	Inlet Flow Rate Test	±5%	0.0%	Pass	

Table 2-10 Second Quarter 2010 Audit Results

Parameter	QC Check Category	QC Check Criteria	Measured Response[1]	Results (Pass/Fail)	Comments
Air Quality Audit June 16, 2010					
SO_2	Accuracy	≤15%	2.2%	Pass	The audit confirmed the air quality analyzers were reporting measurements to within acceptable limits.
NO_X	Accuracy	≤15%	3.2%	Pass	
NO	Accuracy	≤15%	2.8%	Pass	
NO_2	Accuracy	≤15%	3.6%	Pass	
O_3	Accuracy	≤15%	2.0%	Pass	
CO	Accuracy	≤15%	0.9%	Pass	
PM_{10}	Flow Rate Accuracy	±4%	-0.7%	Pass	
	Inlet Flow Rate Test	±5%	-0.7%	Pass	
	Mass Determination	±2.5% mean	1.60%	Pass	
$PM_{2.5}$	Flow Accuracy	±4%	1.8%	Pass	
	Inlet Flow Rate Test	±5%	-1.6%	Pass	
Meteorological Audit June 16, 2010					
10-m Horizontal Wind Speed	Accuracy	≤ ±(0.20 mps + 5% of known input)	0.0 mps	Pass	The semi-annual audit of the meteorological measurement systems was conducted during this quarter. All systems were reporting measurements to within acceptable limits.
	Starting Torque	≤ 0.5 mps	0.16 mps	Pass	
10-m Horizontal Wind Direction	Accuracy	≤ ±5 deg	-0.5 deg	Pass	
	Linearity	≤ ±3 deg	-0.3 deg	Pass	
	Starting Torque	≤ 0.5 mps	0.46 mps	Pass	
10-m Vertical Wind Speed	Accuracy	≤ ±(0.20 mps + 5% of known input)	0.11 mps	Pass	
	Starting Torque	≤ 0.25 mps	0.14 mps	Pass	
10-m Temperature	Accuracy	≤ ±0.5°C	0.05°C	Pass	
2-m Temperature	Accuracy	≤ ±0.5°C	0.04°C	Pass	
10-2 m Temperature Difference	Accuracy	≤ ±0.1°C	0.01°C	Pass	
Total Solar Radiation	Accuracy	≤ ±5%	0.1%	Pass	

[1] If multiple checks were performed, the measured response was estimated by averaging all measured values.

Table 2-11 Third Quarter 2010 Audit Results

Parameter	QC Check Category	QC Check Criteria	Measured Response	Results (Pass/Fail)	Comments
Air Quality Audit September 17, 2010					
SO_2	Accuracy	≤15%	3.1%	Pass	The audit confirmed the air quality analyzers were reporting measurements to within acceptable limits.
NO_X	Accuracy	≤15%	1.0%	Pass	
NO	Accuracy	≤15%	1.4%	Pass	
NO_2	Accuracy	≤15%	2.1%	Pass	
O_3	Accuracy	≤15%	1.9%	Pass	
CO	Accuracy	≤15%	0.6%	Pass	
PM_{10}	Flow Rate Accuracy	±4%	-1.0%	Pass	
	Inlet Flow Rate Test	±5%	0.1%	Pass	
	Mass Determination	±2.5% mean	1.60%	Pass	
$PM_{2.5}$	Flow Accuracy	±4%	1.2%	Pass	
	Inlet Flow Rate Test	±5%	-1.0%	Pass	

Table 2-12 Fourth Quarter 2010 Audit Results

	QC Check Category	QC Check Criteria	Measured Response[1]	Results (Pass/Fail)	Comments
Air Quality Audit December 3, 2010					
SO_2	Accuracy	≤15%	0.7%	Pass	The audit confirmed the air quality analyzers were reporting measurements to within acceptable limits.
NO_X	Accuracy	≤15%	3.2%	Pass	
NO	Accuracy	≤15%	3.0%	Pass	
NO_2	Accuracy	≤15%	4.5%	Pass	
O_3	Accuracy	≤15%	1.4%	Pass	
CO	Accuracy	≤15%	1.3%	Pass	
PM_{10}	Flow Rate Accuracy	±4%	-1.0%	Pass	
	Inlet Flow Rate Test	±5%	-0.1%	Pass	
	Mass Determination	±2.5% mean	1.47%	Pass	
$PM_{2.5}$	Flow Accuracy	±4%	1.8%	Pass	
	Inlet Flow Rate Test	±5%	-1.6%	Pass	
Meteorological Audit December 3, 2010					
10-m Horizontal Wind Speed	Accuracy	≤ ±(0.20 mps + 5% of known input)	0.0 mps	Pass	The audit confirmed the meteorological measurement systems were reporting measurements to within acceptable limits. Solar radiation values were too low to effectively measure during that time of year and at that latitude.
	Starting Torque	≤ 0.5 mps	0.23 mps	Pass	
10-m Horizontal Wind Direction	Accuracy	≤ ±5 deg	-0.25 deg	Pass	
	Linearity	≤ ±3 deg	-0.4 deg	Pass	
	Starting Torque	≤ 0.5 mps	0.46 mps	Pass	
10-m Vertical Wind Speed	Accuracy	≤ ±(0.20 mps + 5% of known input)	0.12 mps	Pass	
	Starting Torque	≤ 0.25 mps	0.24 mps	Pass	
10-m Temperature	Accuracy	≤ ±0.5°C	0.04°C	Pass	
2-m Temperature	Accuracy	≤ ±0.5°C	0.04°C	Pass	
10-2 m Temperature Difference	Accuracy	≤ ±0.1°C	0.01°C	Pass	
Total Solar Radiation	Accuracy	≤ ±10 W/m^2	N/A	N/A	

[1] If multiple checks were performed, the measured response was estimated by averaging all measured values.

3.0 Monitoring Data Network Summary

3.1 Air Quality Data Summary

Criteria pollutants monitored as part of the Monitoring Program are NO_2, SO_2, O_3, respirable PM_{10}, CO, and respirable $PM_{2.5}$. Criteria pollutants are those air pollutants for which ADEC and USEPA have established standards that provide a threshold above which risk to public health and welfare becomes an issue. These standards are referred to as the Alaska Ambient Air Quality Standards (AAAQS) or National Ambient Air Quality Standards (NAAQS). Applicable AAAQS or NAAQS, along with ambient concentrations measured at the Nuiqsut Station, are presented in **Tables 3-1** through **3-6** and summarized by pollutant below.

3.1.1 Nitrogen Dioxide

Table 3-1 lists the measured maximum 1-hour, 98^{th} percentile 1-hour, and the annual average NO_2 concentrations measured this monitoring year. The annual average NO_2 concentration was 0.001 ppm, which is less than 2 percent of the annual NO_2 AAAQS of 0.053 ppm. The annual average measured this year was lower than last year's annual average and the historical Nuiqsut Station average of 0.003 ppm. Typical hourly NO_2 concentrations were just above the instrument detection level and well below the 1-hour NAAQS.

Table 3-1 Measured Nitrogen Dioxide, 2010 Annual Summary

Monitoring Period	Year	1-hour (ppm)		Period Mean (ppm)[1]	Number of Exceedances
		1st high	98th percentile		
1st Quarter	2010	0.028	0.021	0.002	None
2nd Quarter	2010	0.023	0.016	0.001	None
3rd Quarter	2010	0.012	0.012	0.001	None
4th Quarter	2010	0.022	0.021	0.001	None
Annual	2010	0.028	0.020	0.001	None

[1]Annual or quarterly average.
NAAQS/AAAQS:
1-hour – 0.1 parts per million (ppm) – Compared to the 3-year average of the 98^{th} percentile of the daily maximum 1-hour average.
Annual – 0.053 ppm (100 micrograms per cubic meter [$\mu g/m^3$]) – Compared to the annual arithmetic mean.

The distribution of average hourly NO_2 concentration by wind direction this year was typical of past years with the magnitude of the highest values lower than the historical average (**Figure 3-1**). This difference in magnitude is consistent with the difference between the historical and current year's annual average of the hourly concentrations. As shown in **Figure 3-1**, historically, the lowest concentrations are measured when winds transport background air to the Nuiqsut Station (west-southwest clockwise through east-southeast). Slightly higher concentrations occur for wind directions that place the station downwind of Nuiqsut (southeast clockwise through southwest wind directions). In general, measured NO_2 concentrations at Nuiqsut are extremely low.

Monthly average NO_2 concentrations are presented in **Figure 3-2**. Historically, it is typical to observe increases in monthly averaged NO_2 concentrations in January and December, and this trend repeated in 2010 as shown in **Figure 3-2**. The pattern of higher measured concentrations in winter has been attributed to differences in atmospheric dispersion characteristics between winter and summer, and potential changes in local emissions. Seasonal differences in atmospheric dispersion characteristics arise because in winter, there is an increase in stable and neutral atmospheric conditions. With the sun up in summer, solar radiation and heating of the surface induces more vertical mixing of the lower atmosphere than in winter, thereby increasing air pollution dispersion. In winter, without the benefit of solar energy, the atmosphere remains relatively stable reducing vertical pollution dispersion. In addition, the increased local use of heating systems and idling vehicles in winter contribute to the NO_2 load.

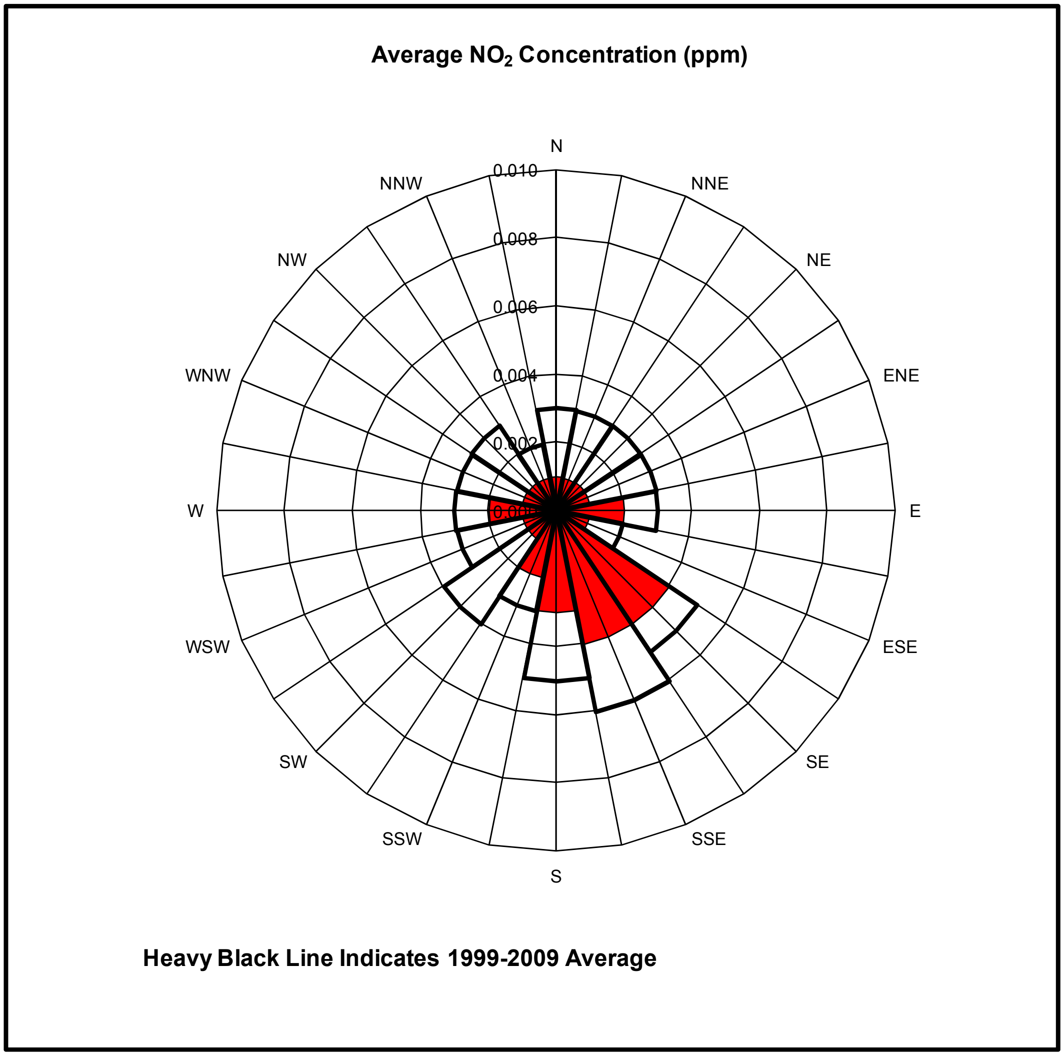


Figure 3-1 Average NO_2 Concentration by Wind Direction, 2010 Annual Data Summary

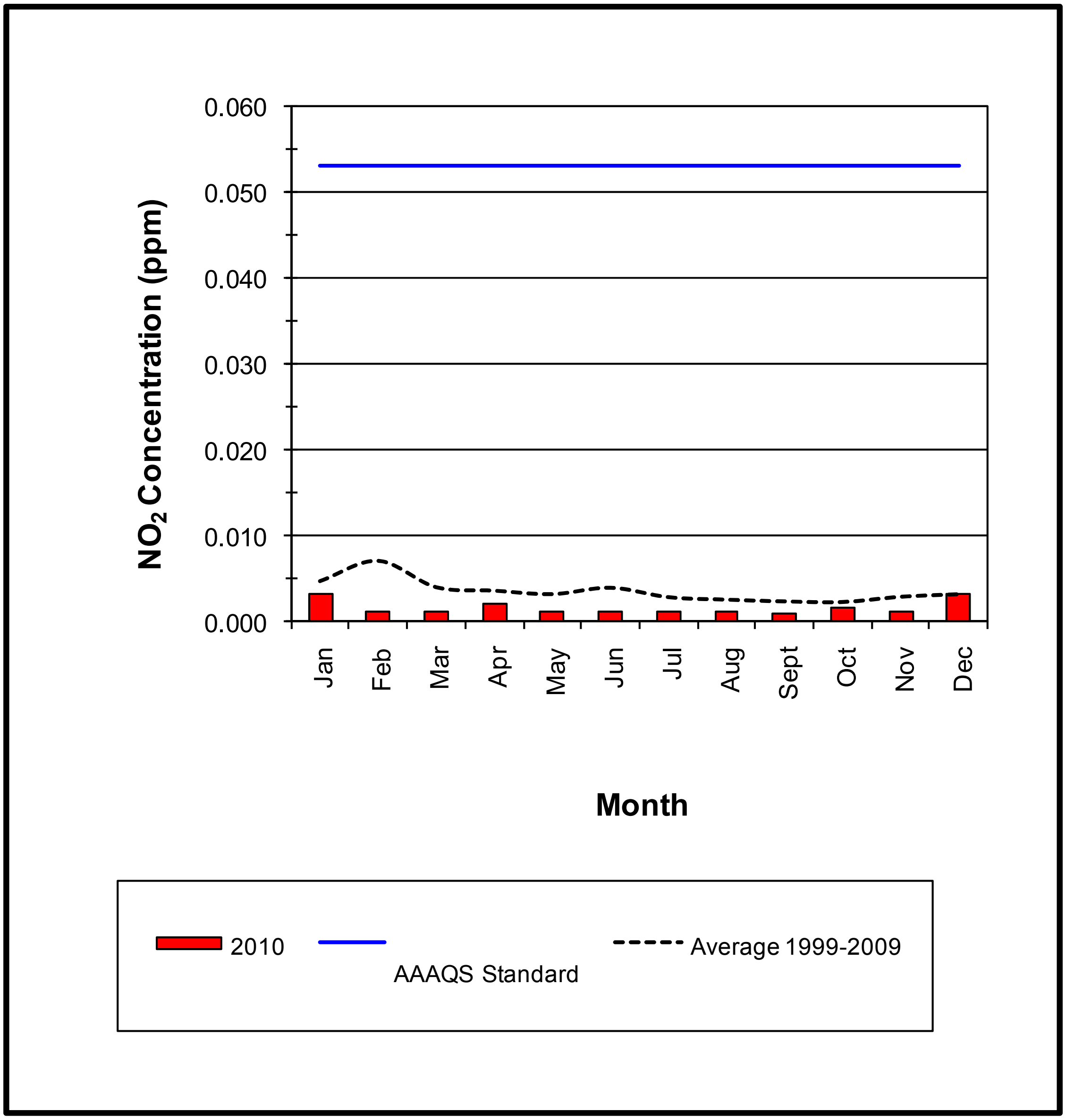


Figure 3-2 Average NO_2 Concentration by Month, 2010 Annual Data Summary

3.1.2 Sulfur Dioxide

Table 3-2 lists the measured maximum 1-hour, 99th percentile 1-hour, maximum 3-hour (running), maximum 24-hour (midnight to midnight), and the annual average hourly SO_2 concentrations measured this monitoring year. Concentrations for all averaging periods were near or below instrument detection limit and well below applicable AAAQS. Measured SO_2 concentrations were typical of historical (1999-2009) values.

Table 3-2 Measured Sulfur Dioxide, 2010 Annual Summary

Monitoring Period	Year	1-hour (ppm)		3-hour (ppm)[1]		24-hour (ppm)[2]		Period Mean (ppm)[3]	Number of Exceedances
		1st high	99th percentile	1st high	2nd high	1st high	2nd high		
1st Quarter	2010	0.002	0.002	0.001	0.001	0.000	0.000	0.000	None
2nd Quarter	2010	0.001	0.001	0.001	0.001	0.000	0.000	0.000	None
3rd Quarter	2010	0.002	0.002	0.002	0.002	0.001	0.001	0.000	None
4th Quarter	2010	0.003	0.003	0.002	0.001	0.001	0.001	0.000	None
Annual	2010	0.003	0.002	0.002	0.002	0.001	0.001	0.000	None

[1] Rolling 3-hour average.
[2] Midnight to midnight 24-hour average.
[3] Annual or quarterly average.
NAAQS/AAAQS:
1-hour – 0.075 ppm – Compared to the 3-year average of the 99th percentile of the daily maximum 1-hour average.
3-hour - 0.5 ppm (1,300 μg/m^3) – Non-overlapping block averages starting at midnight not to be exceeded more than once per year.
24-hour - 0.14 ppm – Midnight to midnight average not to be exceeded more than once per year.
Annual - 0.03 ppm – Compared to the annual arithmetic mean.

Measured 3-hour average SO_2 concentrations were less than 0.003 ppm throughout the monitoring year. The majority of measured SO_2 concentrations were just above the instrument detection limit making it difficult to discuss significant trends. Simply, there was no single near-field or far-field measurable SO_2 source observed in the data collected this year. Without identifiable sources, measured concentrations are representative of a regional or global background signature. The low average concentrations measured are consistent with an airshed containing relatively few and widely distributed sources. This trend has been typical of SO_2 measurements since monitoring began.

3.1.3 Respirable Particulate Matter (PM_{10})

Throughout the monitoring project history, the majority of elevated measured PM_{10} concentrations appear to result from naturally occurring windblown fugitive dust from exposed or disturbed areas local to the Nuiqsut Station. Exposed areas identified in the program are:

- The exposed bank of the Nechelik Channel north-northeast clockwise through east-southeast of the station;
- The exposed gravel mining area southeast of the station;
- Disturbed ground due to residential construction along the utility right-of-way and road southeast clockwise through south-southeast of the station; and
- To a lesser degree, disturbed ground associated with dirt roads within Nuiqsut south clockwise through west-southwest of the station.

In addition to these local fugitive sources, elevated particulate concentrations have also been measured from wild fires. This year plumes from extremely large forest fires burning in eastern Siberia contributed to the elevated PM_{10} concentrations measured in the beginning of August. The effect of these forest fires is documented in text and photos on the NASA earth observatory web site (http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=44997) which said:

"Intense fires continued to burn in the boreal forests of eastern Siberia on August 1, 2010. The fires are outlined in red in this image, acquired by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite. The fires span the borders of Russia's Chukotskiy, Magadan, and Koryakskiy provinces.

Burning in coniferous (evergreen) forests, the fires blanketed northeastern Siberia with thick brown smoke. The smoke hugs the ground near the fires, filling valleys, and soars over clouds farther away from the flames. On August 1, the smoke flowed north from the fires and over the Arctic Ocean. A wide view of the Arctic shows the smoke crossing the Bering Strait and clouding skies over northern Alaska."

Additional discussions of the smoke plume that impacted the area are found in the NOAA Satellite Support Services Division Smoke Text product daily narratives during this time frame which can be found at http://www.ssd.noaa.gov/PS/FIRE/DATA/SMOKE/. For example, the summary on August 1, 2010 read:

"Alaska/Yukon Territory:
An area of thin smoke was seen across central AK from Nome to central Yukon Territory and to Big Bear Lake in NW Northwest Territories. This smoke is remaining north of the spine of the Rockies and Alaska Range...likely as it is low to mid level smoke. Origins of the smoke are from fires in E Siberia that have drifted over the Arctic Ocean and is shearing out E to W across AK but is moving SE across Yukon and NW Territories."

Though a considerable amount of evidence indicates that plumes from wild land fires were likely contributing to elevated PM_{10} concentrations in the beginning of August, it must also be noted that from late in the day on August 1 through August 2, 2010 conditions were favorable to suggest that fugitive dust from local sources may have also been contributing to elevated particulate measurements during that period.

Respirable PM_{10} measured at USEPA standard temperature and pressure, has a 24-hour and annual AAAQS of 150 µg/m^3 and 50 µg/m^3, respectively. As shown in **Table 3-3**, the annual average PM_{10} concentration was 7.7 µg/m^3. This is well below the annual AAAQS of 50 µg/m^3 and also less than the historical Nuiqsut Station average of 8.4 µg/m^3. The maximum 24-hour PM_{10} concentration measured during the monitoring year was 167.2 µg/m^3, which is higher than the standard. This value was measured on October 2, 2010. On this date, there was no snow on the ground and winds were high (9 to 11 m/s). The on-site technician noted that sediment was transported by wind from the banks of the Nechelik channel of the Colville River Delta to the monitoring site. The $PM_{2.5}$ to PM_{10} ratio was quite low indicating that most of the mass was in the coarse mode. All observations suggest that the source of the high PM_{10} values was local fugitive dust.

Table 3-3 Measured PM_{10} Data, 2010 Annual Summary

Monitoring Period	Year	24-hour (µg/m^3)[1]		Period Mean (µg/m^3)[2]	Number of Exceedances
		1st high	2nd high		
1st Quarter	2010	21.1	18.0	6.0	None
2nd Quarter	2010	21.0	17.7	6.4	None
3rd Quarter	2010	48.2	41.7	10.1	None
4th Quarter	2010	**167.2**[3]	21.1	8.1	1
Annual	2010	**167.2**[3]	48.2	7.7	1

[1]Midnight to midnight 24-hour average.
[2]Annual or quarterly average.
[3]Measured on October 2, 2010.
NAAQS/AAAQS:
24-hour – 150 µg/m^3 – Not to be exceeded more than once per year measured from midnight to midnight.
Annual – 50 µg/m^3 – Compared to the 3-year average of the weighted annual arithmetic mean concentration measured at USEPA Standard Conditions.

Figure 3-3 shows annual average hourly PM_{10} concentrations by wind direction measured this year compared to the historical trend. Concentrations associated with easterly winds were lower than historical annual averages. Concentrations associated with all other wind directions were similar to historical concentrations.

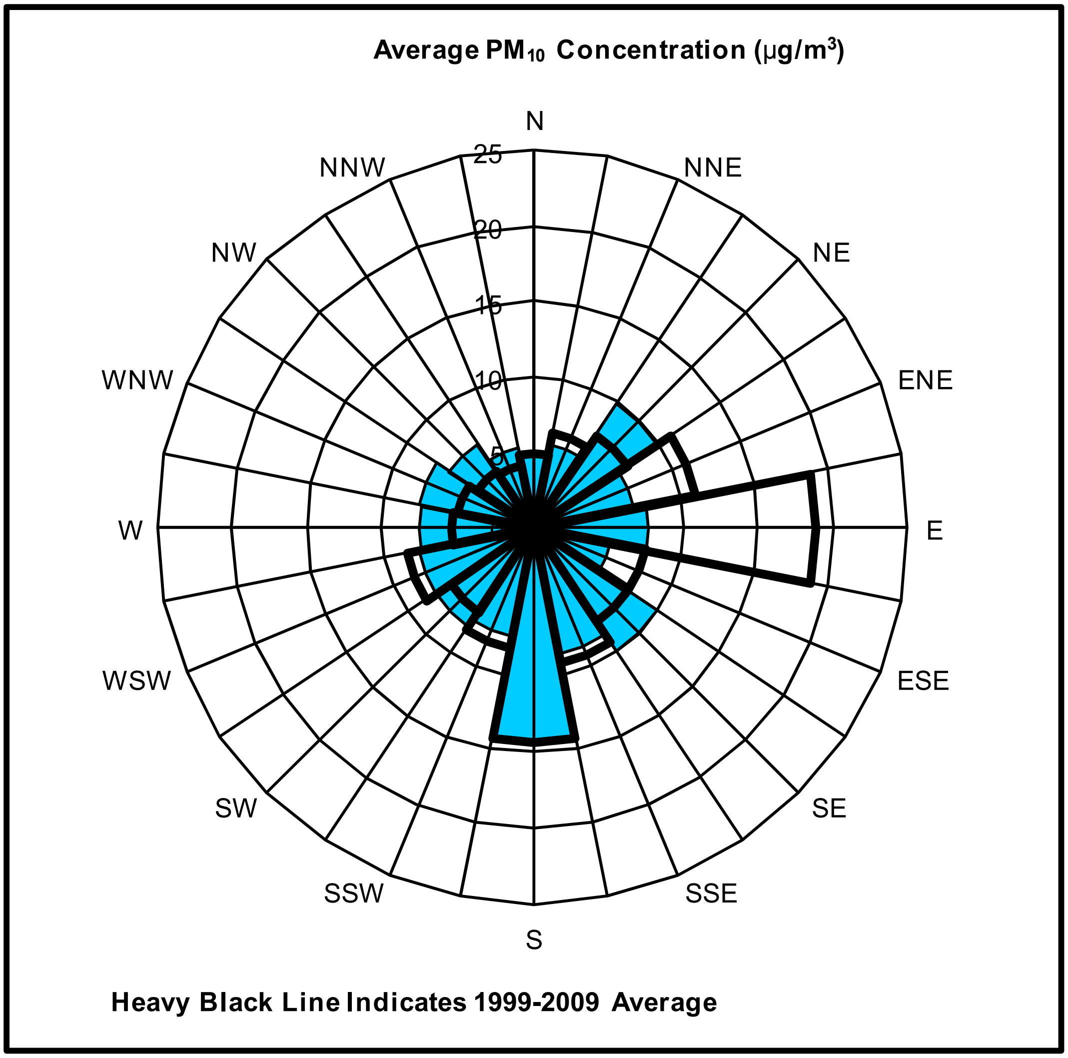
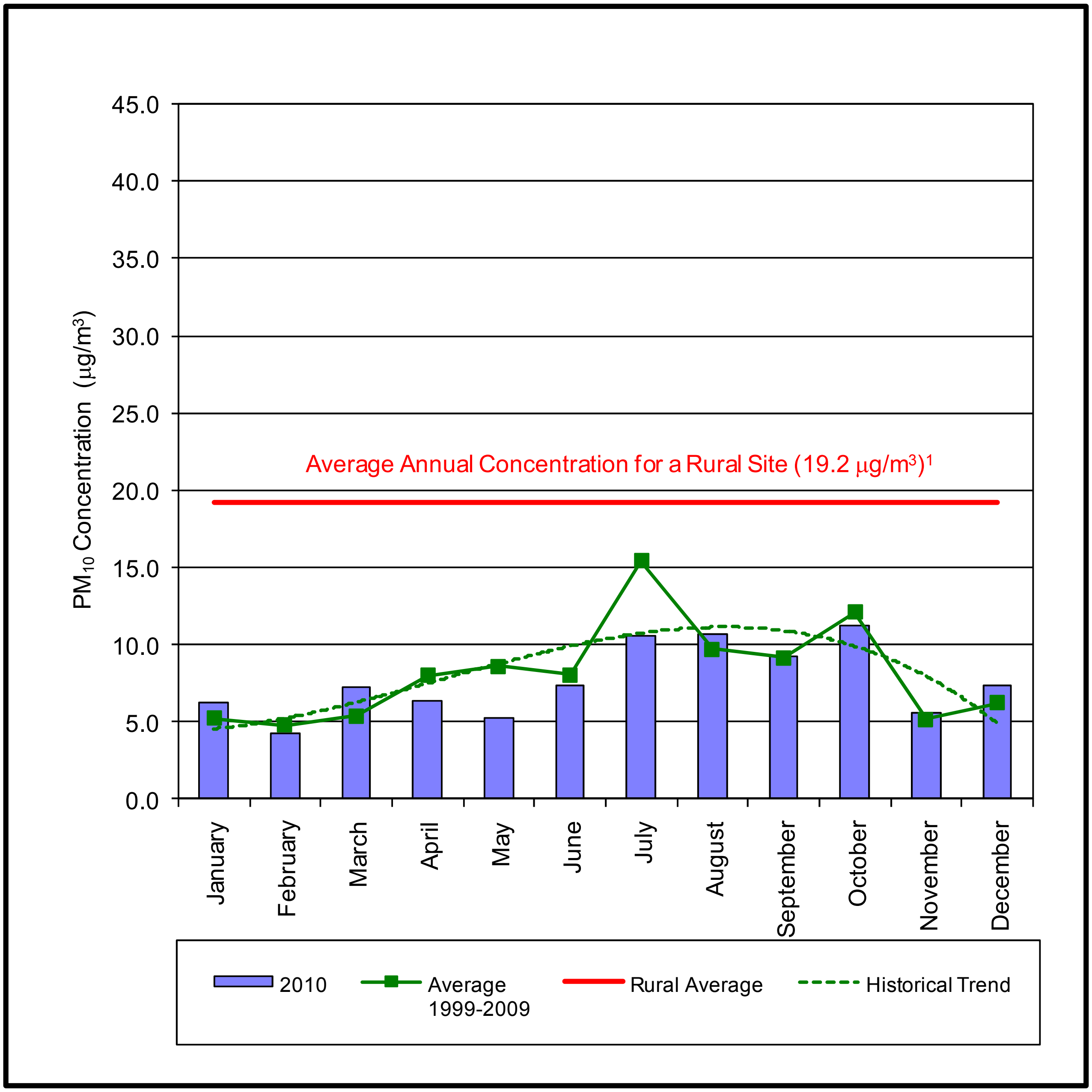


Figure 3-3 Average PM_{10} Concentration by Wind Direction, 2010 Annual Data Summary

Figure 3-4 compares the monthly average hourly PM_{10} concentrations measured this year to Nuiqsut Station historical monthly average PM_{10} concentrations. Historical trends show the fourth and first calendar quarters (October through March) typically experience the lowest average hourly PM_{10} concentrations reflecting snow covered conditions that suppress fugitive dust. In contrast, the second and third calendar quarters (April through September) record higher average hourly concentrations as fugitive dust sources become exposed and active. During the first quarter of 2010, average hourly concentrations were low and followed the historical trend. Average hourly concentrations measured during the second quarter of 2010 were lower than historical measurements. Average hourly concentrations were elevated from the beginning of the third quarter (July) through the first month of the fourth quarter (October), which is consistent with the historical trend. As mentioned previously, local fugitive sources contributed to the elevated concentrations measured during this period. The elevated concentrations measured in August were also attributed to the wild fires in Siberia. The variability seen throughout this year and compared to previous years is expected considering PM_{10} concentrations are highly dependent on the interplay of many meteorological characteristics such as wind speed and frequency, precipitation, and temperature.



[1]Average annual concentration obtained from 153 rural sites in the contiguous United States as summarized in the National Air Quality and Emissions Trends Report, 1999 (USEPA 2001).

Figure 3-4 Average PM_{10} Concentration by Month, 2010 Annual Data Summary

3.1.4 Ozone

Table 3-4 lists 8-hour and annual average hourly O_3 concentrations measured during the monitoring year. The AAAQS for O_3 is based on the 3-year average of the fourth highest measured daily maximum 8-hour average O_3 concentration. Since the maximum 8-hour average O_3 concentration measured was just over half the AAAQS, it is anticipated that concentrations measured at the Nuiqsut Station will remain well below the AAAQS.

Table 3-4 Measured Ozone Data, 2010 Annual Summary

Monitoring Period	Year	8-hour (ppm)[1]			Period Mean (ppm)[2]	Number of Exceedances
		1st high	2nd high	4th high		
1st Quarter	2010	0.043	0.043	0.043	0.023	None
2nd Quarter	2010	0.043	0.043	0.042	0.021	None
3rd Quarter	2010	0.032	0.032	0.032	0.015	None
4th Quarter	2010	0.039	0.039	0.039	0.032	None
Annual	2010	0.043	0.043	0.043	0.023	None

[1] Rolling 8-hour average.
[2] Annual or quarterly average.
NAAQS/AAAQS:
8-hour - 0.08 ppm – Compared to the 3-year average of the fourth-highest daily maximum rolling 8-hour average concentrations.

O_3 concentrations measured this year are typical of seasonal averages measured on the Alaskan North Slope (Prudhoe Bay, Kuparuk River Unit, and Barrow). In the absence of large combustion sources, strong frontal passages and high solar radiation, ambient O_3 levels are spatially homogenous and representative of a regional background.

3.1.5 CO

Table 3-5 lists 1-hour, 8-hour (rolling average), and annual average concentrations of CO measured during the monitoring year. Concentrations for all averaging periods were near or below the instrument detection limit and well below applicable AAAQS.

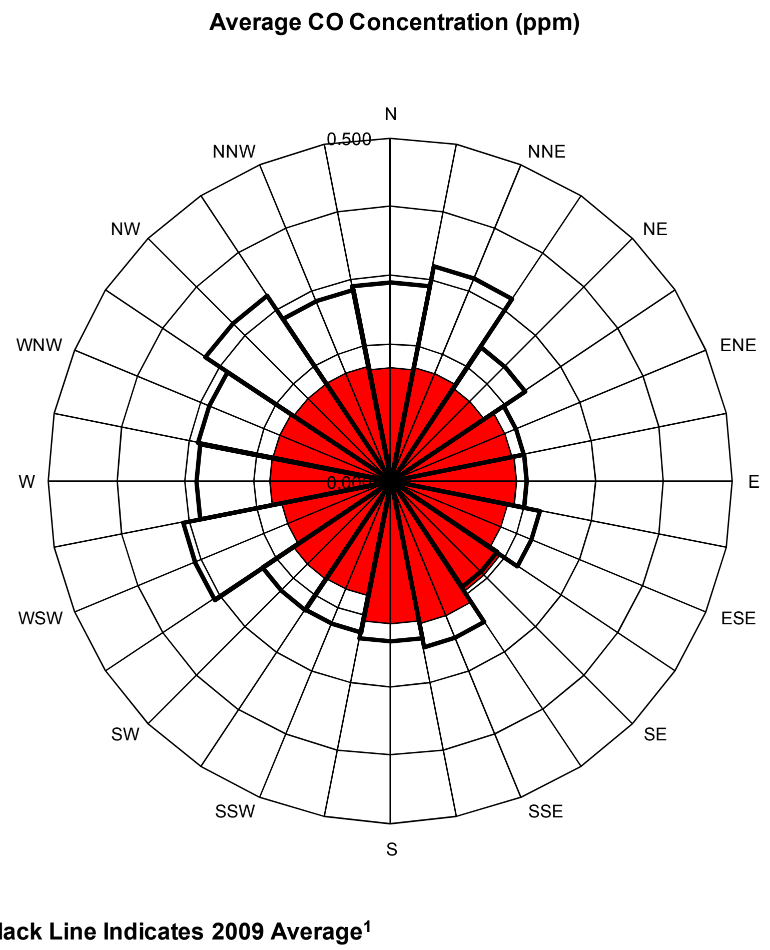
Table 3-5 Measured Carbon Monoxide, 2010 Annual Data Summary

Monitoring Period	Year	1-hour (ppm)		8-hour (ppm)[1]		Period Mean[2] (ppm)	Number of Exceedances
		1st high	2nd high	1st high	2nd high		
1st Quarter	2010	0.5	0.5	0.3	0.3	0.1	None
2nd Quarter	2010	0.4	0.4	0.3	0.3	0.2	None
3rd Quarter	2010	0.4	0.4	0.4	0.4	0.2	None
4th Quarter	2010	0.5	0.5	0.4	0.4	0.1	None
Annual	2010	0.5	0.5	0.4	0.4	0.2	None

[1] Rolling 8-hour average.
[2] Annual or quarterly average.
NAAQS/AAAQS:
1-hour – 35 ppm (40 mg/m^3) – Not to be exceeded more than once per year.
8-hour – 9 ppm (10 mg/m^3) – Non-overlapping block averages starting at midnight not to be exceeded more than once per year.

Measured period averages for CO concentrations were less than 0.3 ppm throughout the monitoring year. The majority of measured CO concentrations were just above the instrument detection limit making it difficult to discuss significant trends. Simply, there was no single near-field or far-field measurable CO source observed in the data collected this year. Without identifiable sources, measured concentrations are representative of a regional or global background signature. The low average concentrations measured are consistent with an airshed containing relatively few and widely distributed sources.

Figure 3-5 shows annual 2010 average hourly CO concentrations by wind direction measured this year compared to 2009. The 2009 concentrations shown in **Figure 3-5** are averages of third and fourth quarter data that were collected after the CO analyzer was installed. In 2010, average hourly CO concentrations for all wind directions were similar to or lower than 2009 concentrations.



[1]2009 concentrations are averages of third and fourth quarter data that were collected after the CO analyzer was installed on July 14, 2009.

Figure 3-5 Average CO Concentration by Wind Direction, 2010 Annual Data

Figure 3-6 compares monthly average hourly CO concentrations measured at the Nuiqsut Station to the AAAQS for CO.

3.1.6 Respirable Particulate Matter ($PM_{2.5}$)

Respirable $PM_{2.5}$ has a 24-hour and annual AAAQS of 35 μg/m^3 and 15 μg/m^3, respectively. As shown in **Table 3-6**, the maximum 24-hour $PM_{2.5}$ concentration measured during the monitoring year was 15 μg/m^3, which is lower than the standard. The annual average $PM_{2.5}$ concentration was 3 μg/m^3. This is well below the annual standard and the same as last year's average. Last year's average was computed using third and fourth quarter data that were collected after the analyzer was installed.

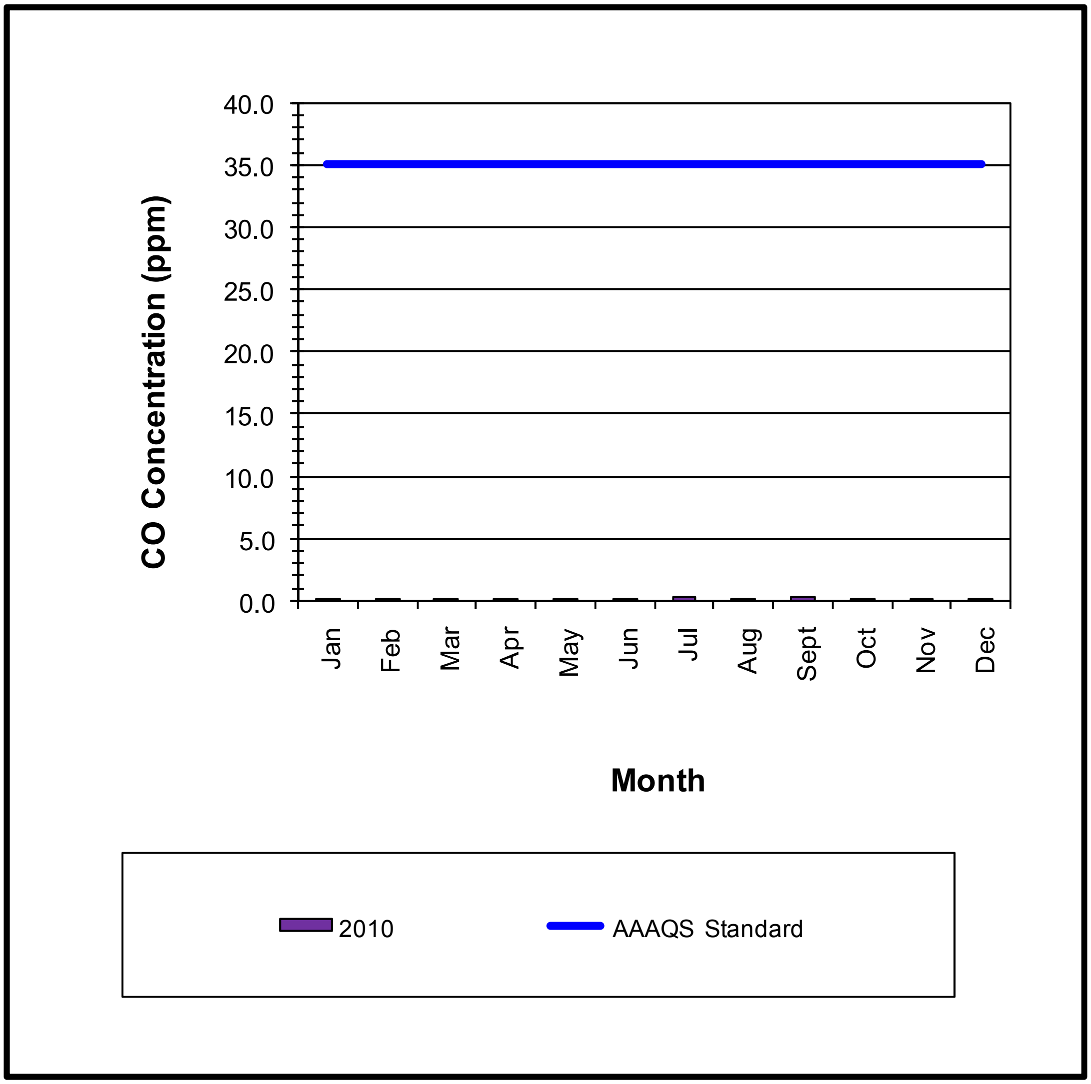


Figure 3-6 Average CO Concentration by Month, 2010 Annual Data Summary

Table 3-6 Measured $PM_{2.5}$ Data, 2010 Annual Data Summary

Monitoring Period	Year	24-hour ($\mu g/m^3$)[1]		Period Mean ($\mu g/m^3$)[2]	Number of Exceedances
		1st high	98th percentile		
1st Quarter	2010	9	8	4	None
2nd Quarter	2010	8	7	3	None
3rd Quarter	2010	12	9	4	None
4th Quarter	2010	15	12	3	None
Annual	2010	15	9	3	None

[1]Midnight to midnight 24-hour average.
[2]Annual or quarterly average.
NAAQS/AAAQS:
24-hour – 35 $\mu g/m^3$ – Compared to the 3-year average of the 98th percentile of 24-hour concentrations measured midnight to midnight.
Annual – 15 $\mu g/m^3$ – Compared to the 3-year average of the weighted annual arithmetic mean concentration.

Elevated particulate concentrations were measured during the third quarter from July 31 through August 2, 2010. During this period, plumes from extremely large forest fires burning in eastern Siberia were documented to be impacting the Nuiqsut area. The effect of these forest fires is documented in text and photos on the NASA earth observatory web site (http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=44997) which said:

> "Intense fires continued to burn in the boreal forests of eastern Siberia on August 1, 2010. The fires are outlined in red in this image, acquired by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite. The fires span the borders of Russia's Chukotskiy, Magadan, and Koryakskiy provinces.
>
> Burning in coniferous (evergreen) forests, the fires blanketed northeastern Siberia with thick brown smoke. The smoke hugs the ground near the fires, filling valleys, and soars over clouds farther away from the flames. On August 1, the smoke flowed north from the fires and over the Arctic Ocean. A wide view of the Arctic shows the smoke crossing the Bering Strait and clouding skies over northern Alaska."

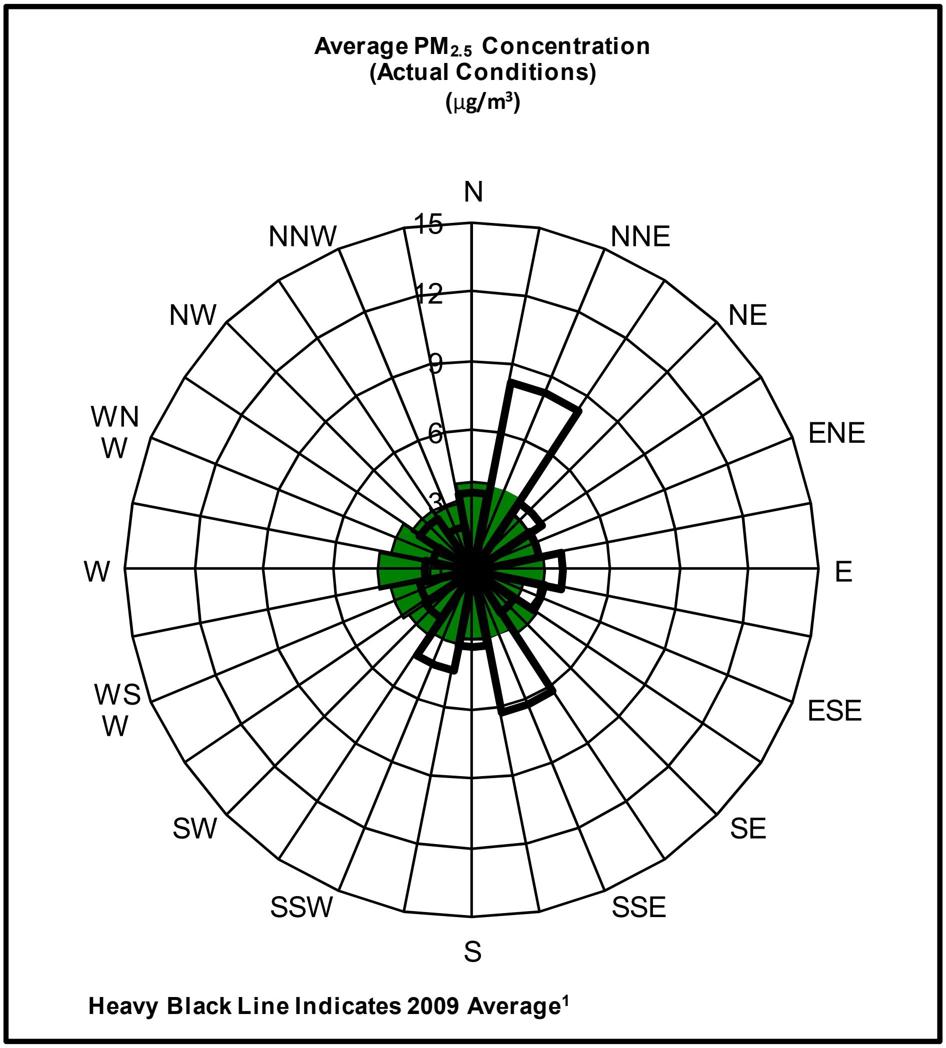
Additional discussions of the smoke plume that impacted the area are found in the NOAA Satellite Support Services Division Smoke Text product daily narratives during this time frame which can be found at http://www.ssd.noaa.gov/PS/FIRE/DATA/SMOKE/. For example, the summary on August 1, 2010 read:

> "Alaska/Yukon Territory:
> An area of thin smoke was seen across central AK from Nome to central Yukon Territory and to Big Bear Lake in NW Northwest Territories. This smoke is remaining north of the spine of the Rockies and Alaska Range...likely as it is low to mid level smoke. Origins the smoke are from fires in E Siberia that have drifted over the Arctic Ocean and is shearing out E to W across AK but is moving SE across Yukon and NW Territories."

Though a considerable amount of evidence indicates that plumes from wild land fires likely were contributing to elevated particulate concentrations during this period, it also must be noted that from late in the day on August 1 through August 2, 2010, conditions were favorable to suggest that fugitive dust from local sources may have also been contributing to elevated particulate measurements during that period.

Figure 3-7 shows annual average hourly $PM_{2.5}$ concentrations by wind direction measured this year compared to last year's concentrations. $PM_{2.5}$ concentrations this year for all wind directions were similar to 2009. The elevated concentrations associated with north-northeasterly and south-southeasterly wind directions seen last year were not observed in 2010. A pervasive influence from a stationary source located to the north-northeast or south-southeast of Nuiqsut is thus unlikely. It is important to note that the elevated concentrations associated with the north-northeasterly and south-southeasterly wind directions in 2009 represented less than 6 percent of the total valid hours for the year combined. Also, since data collection began in July, the 2009 concentrations shown in **Figure 3-7** are averages of third and fourth quarter data. Since only a limited amount of data is available, it is not yet possible to establish trends.

Figure 3-8 compares the monthly average hourly $PM_{2.5}$ concentrations measured at the Nuiqsut Station to the $PM_{2.5}$ AAAQS.



[1]2009 concentrations are averages of third and fourth quarter data that were collected after the monitor was installed.

Figure 3-7 Average $PM_{2.5}$ Concentration by Wind Direction, 2010 Annual Data Summary

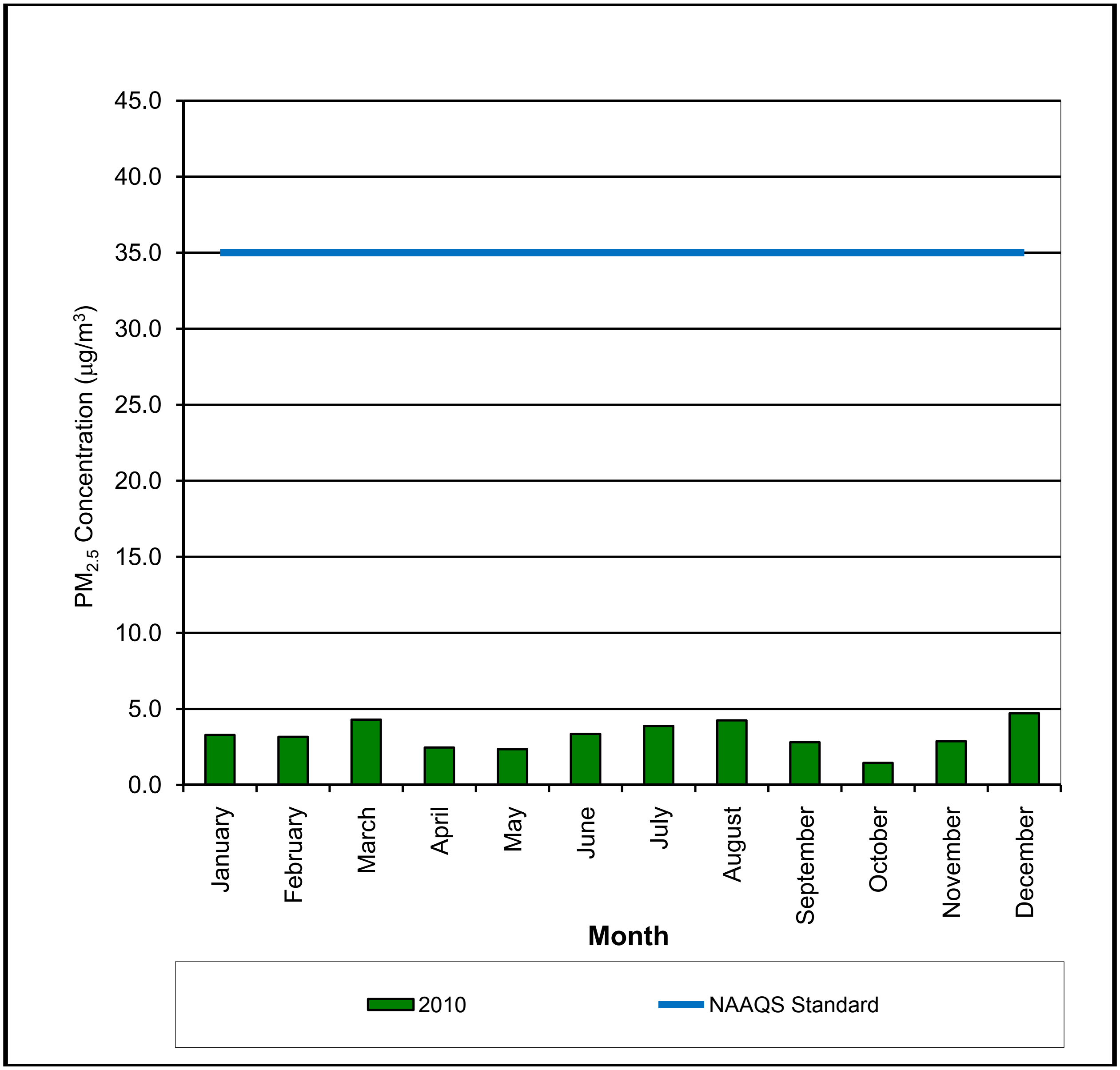


Figure 3-8 Average $PM_{2.5}$ Concentration by Month, 2010 Annual Data Summary

3.2 Meteorological Data Summary

Temperature, wind speed, and wind direction data collected at the Nuiqsut Station during the monitoring year are summarized in the following subsections. Vertical wind speed and solar radiation data are also collected at the Nuiqsut Station, but are not specifically discussed in this section.

3.2.1 Wind Speed and Direction Climatology

The annual Nuiqsut bivariate wind frequency distribution (wind rose) is presented in **Figure 3-9**. Data presented in this figure are consistent with the established North Slope wind climatology and typical of the Nuiqsut bimodal wind direction distribution demonstrated every year since monitoring began. This figure shows winds during the monitoring year were dominated by northeast clockwise through easterly (NE-E) and to a lesser degree south-southwest clockwise through westerly (SSW-W). Winds from these 2 sectors occurred approximately 80 percent of the total hours this year and are caused by persistent regional weather patterns.

Without respect to direction, the mean 10-m wind speed for the monitoring year was 5.21 m/s and the maximum was 20.6 m/s.

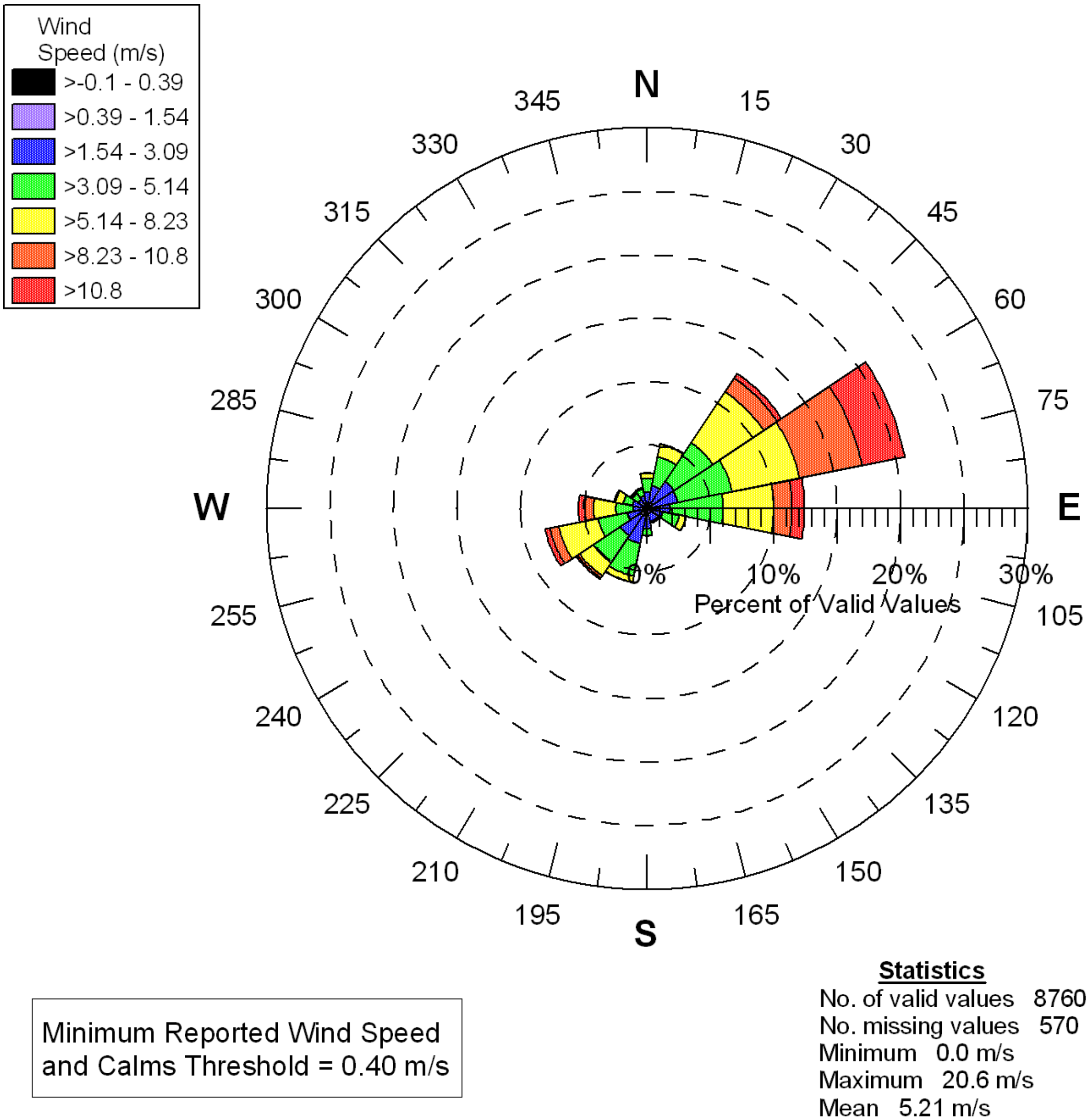


Figure 3-9 2010 Annual Nuiqsut Wind Rose

The persistence of weather patterns season to season can be inferred from **Figures 3-10** through **3-13**, which present wind roses by quarter. Typical of the Nuiqsut Station wind climatology, the quarterly wind roses collected this year indicate there is a general persistence of NE-E all year long. SSW-W winds are present all year long, but only become a significant part of the climatology during the winter months. Mean and maximum wind speeds remain fairly constant over all quarters. The quarterly wind rose depictions are augmented by **Tables 3-7** through **3-10**, which present quarterly wind rose data as a percent of valid hours.

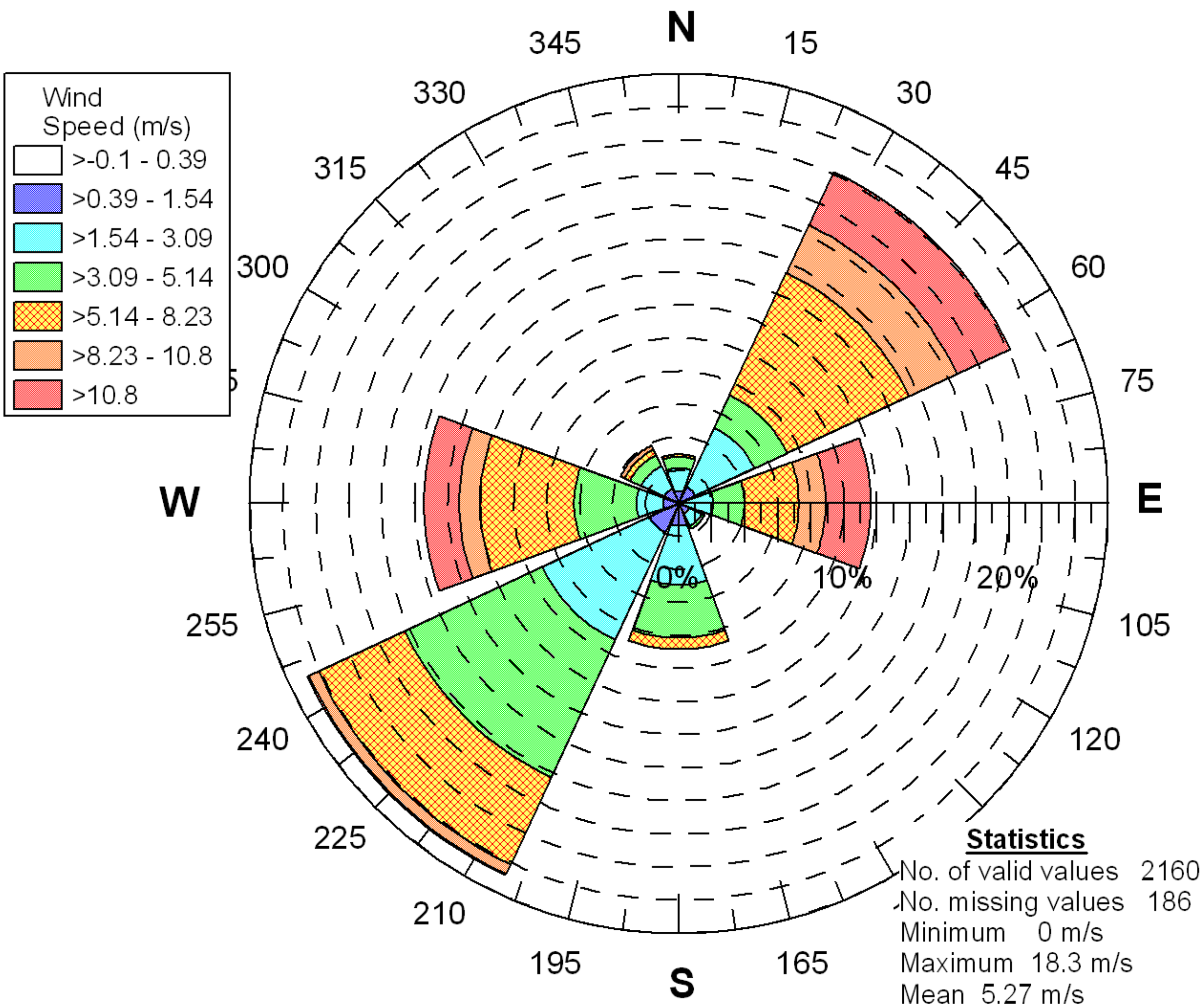


Figure 3-10 First Quarter 2010 Nuiqsut Wind Rose

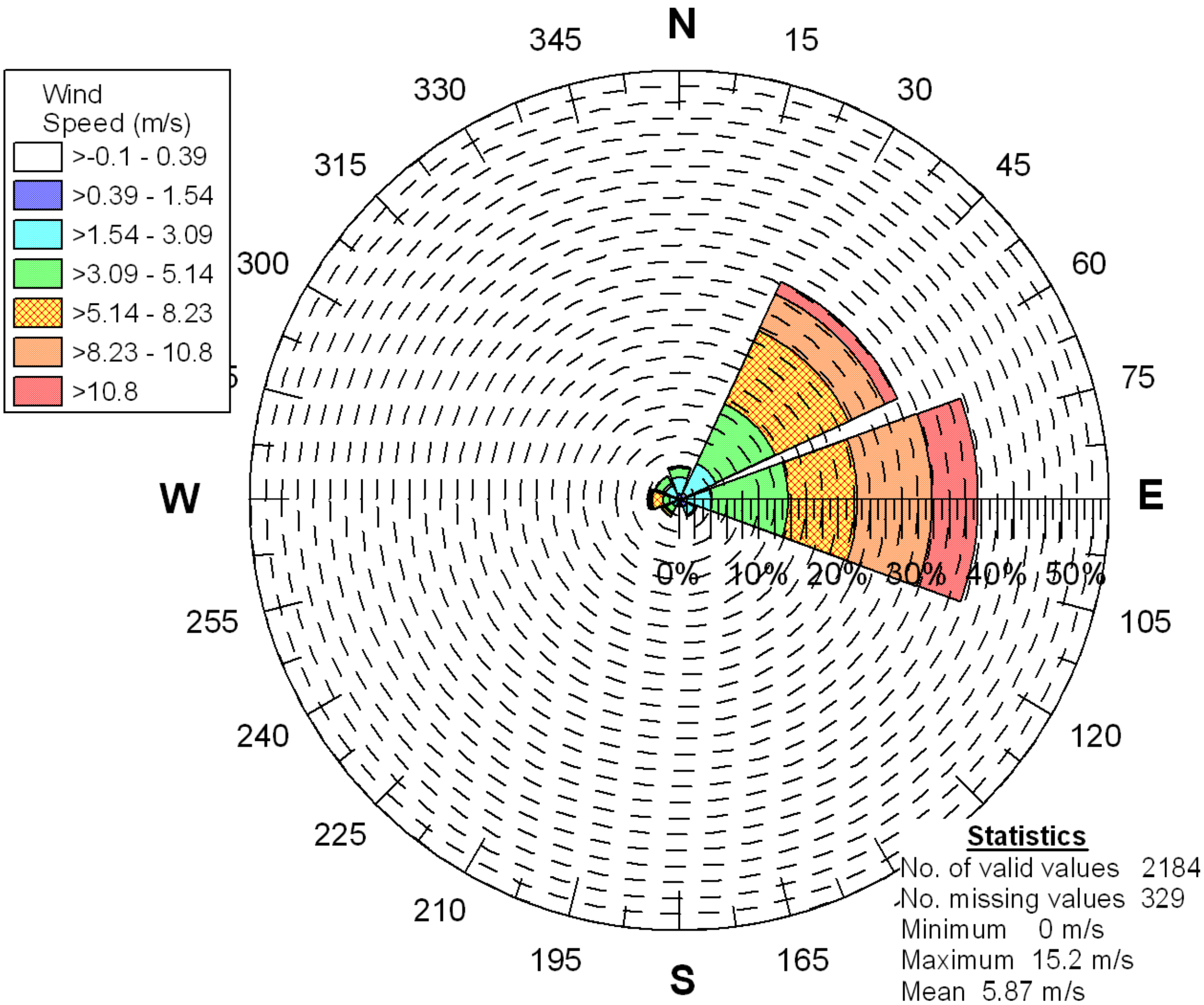


Figure 3-11 Second Quarter 2010 Nuiqsut Wind Rose

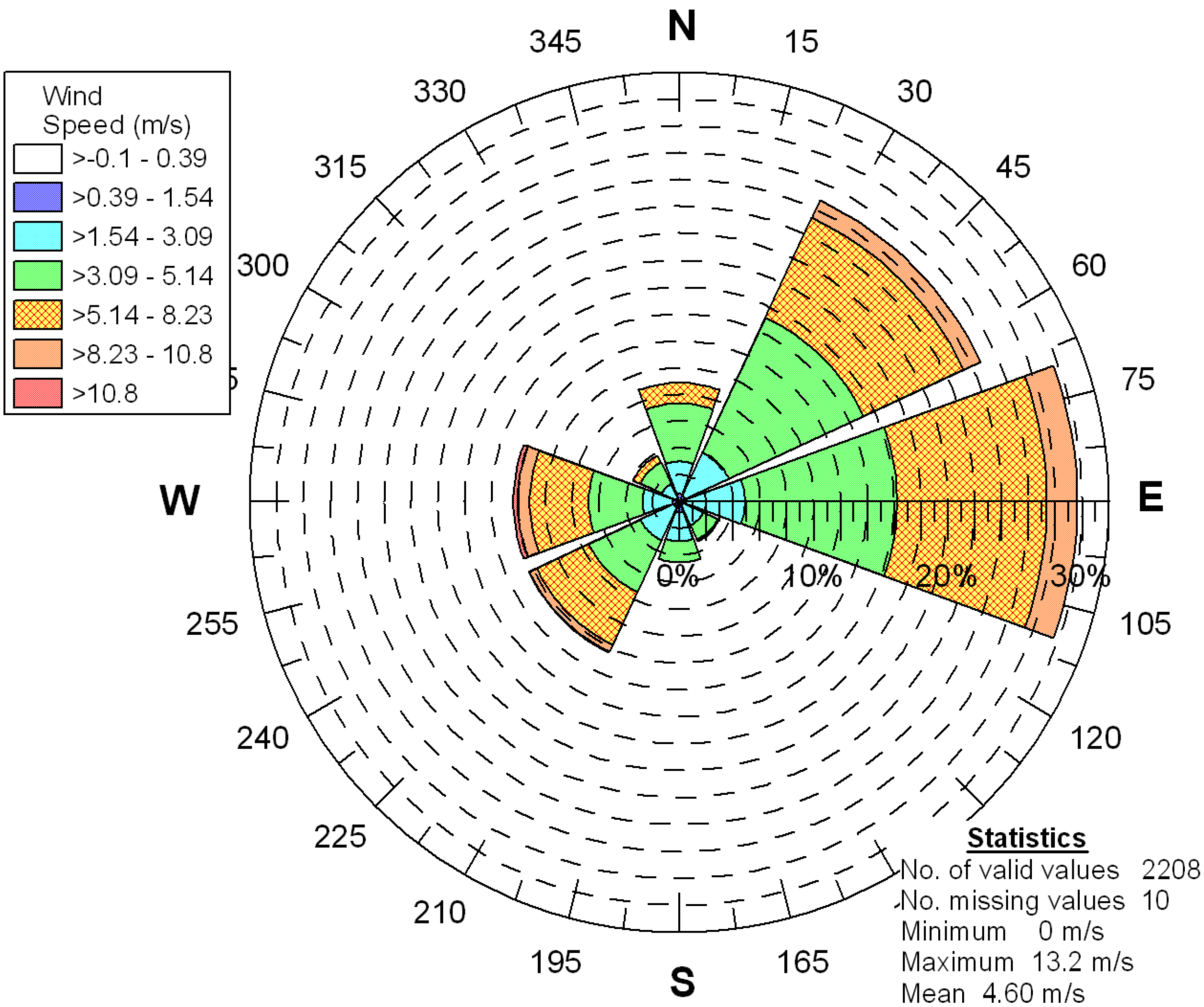


Figure 3-12 Third Quarter 2010 Nuiqsut Wind Rose

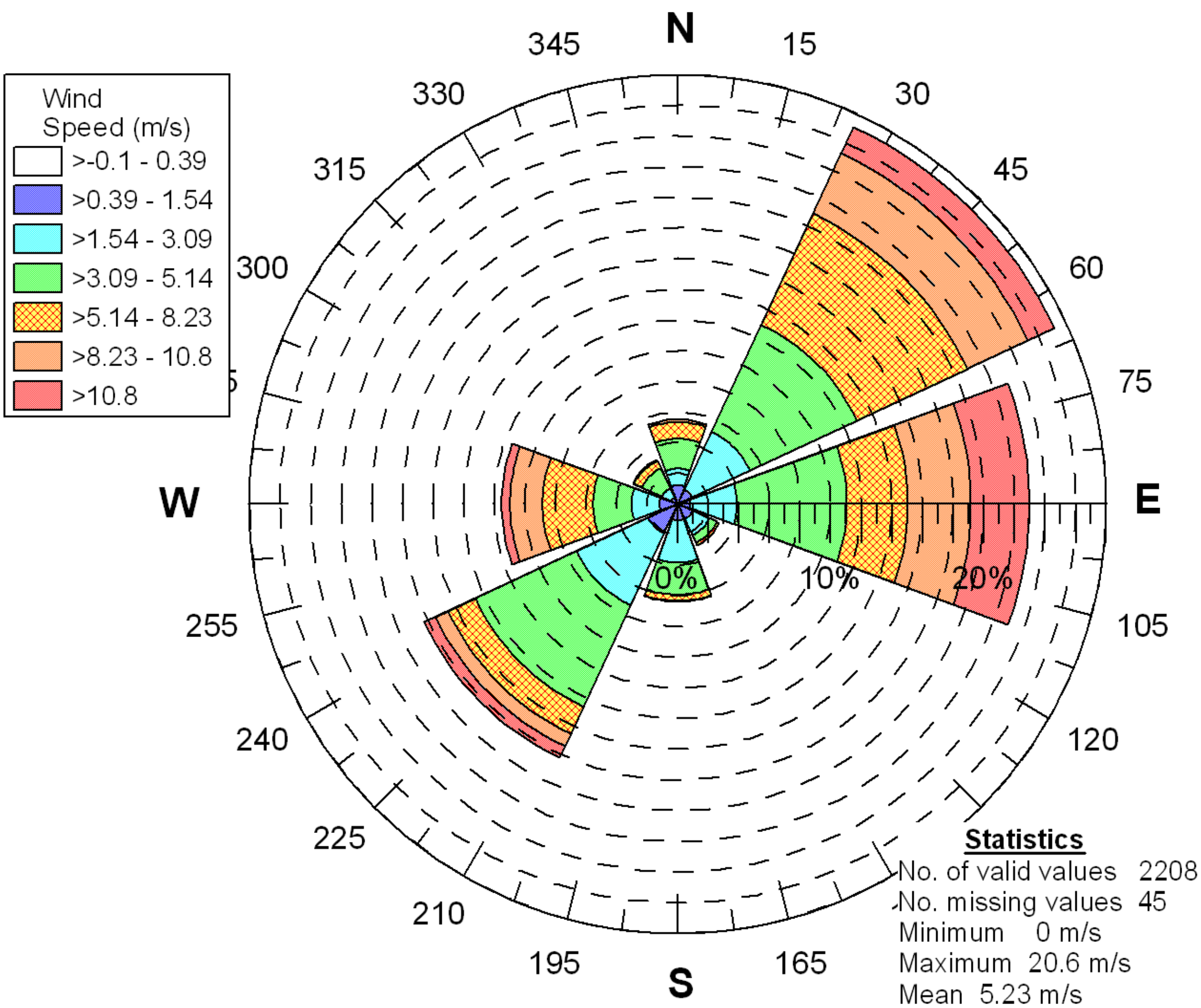


Figure 3-13 Fourth Quarter 2010 Nuiqsut Wind Rose

Table 3-7 First Quarter 2010 Wind Direction/Speed Frequency Analysis

Wind Rose Analysis – Percent of Valid Hourly Values (All Valid Hours)									
Wind Direction	Wind Speed – m/s								Average Speed
	≤ 0.39	≤ 1.54	≤ 3.09	≤ 5.14	≤ 8.23	≤ 10.8	> 10.8	Total	
N		0.65	1.39	0.69	0.14	0.00	0.00	2.91	2.63
NE		1.11	3.94	2.18	8.15	3.19	3.56	22.16	6.41
E		0.32	1.76	1.90	3.29	1.62	2.73	11.66	6.77
SE		0.65	0.83	0.19	0.00	0.00	0.00	1.70	1.97
S		1.34	3.56	3.19	0.69	0.00	0.00	8.83	3.09
SW		1.90	7.18	9.17	5.79	0.65	0.09	24.80	4.10
W		0.88	1.62	3.80	5.69	1.25	2.13	15.41	6.03
NW		0.97	1.53	0.74	0.37	0.28	0.00	3.92	3.22
CALM	0.28								
TOTAL	0.28	7.82	21.81	21.85	24.12	6.99	8.52	91	

Table 3-8 Second Quarter 2010 Wind Direction/Speed Frequency Analysis

Wind Rose Analysis – Percent of Valid Hourly Values (All Valid Hours)									
Wind Direction	Wind Speed – m/s								Average Speed
	≤ 0.39	≤ 1.54	≤ 3.09	≤ 5.14	≤ 8.23	≤ 10.8	> 10.8	Total	
N		0.69	2.06	1.28	0.14	0.00	0.00	4.18	2.77
NE		1.01	4.08	8.24	10.16	5.04	1.69	30.23	5.88
E		0.96	3.16	9.52	8.70	9.34	5.82	37.51	6.84
SE		1.05	1.10	0.23	0.00	0.00	0.00	2.39	1.87
S		0.46	0.41	0.09	0.00	0.00	0.00	0.97	1.83
SW		0.27	0.69	0.87	0.55	0.05	0.00	2.44	3.90
W		0.46	0.73	0.82	1.37	0.18	0.27	3.86	5.02
NW		0.46	1.83	1.01	0.05	0.00	0.00	3.35	2.71
CALM	0.09								
TOTAL	0.09	5.36	14.06	22.07	20.97	14.61	7.78	85	

Table 3-9 Third Quarter 2010 Wind Direction/Speed Frequency Analysis

Wind Rose Analysis – Percent of Valid Hourly Values (0 Valid Hours Used)									
Wind Direction	Wind Speed – m/s								Average Speed
	≤ 0.39	≤ 1.54	≤ 3.09	≤ 5.14	≤ 8.23	≤ 10.8	> 10.8	Total	
N		0.59	2.40	4.35	1.54	0.00	0.00	8.88	3.85
NE		0.50	3.58	11.05	8.20	1.40	0.00	24.73	4.93
E		0.54	4.35	11.32	11.14	2.26	0.00	29.62	5.15
SE		0.32	1.63	1.18	0.14	0.00	0.00	3.26	3.00
S		0.86	2.13	1.54	0.00	0.00	0.00	4.53	2.66
SW		0.45	2.72	4.26	4.30	0.59	0.05	12.36	4.76
W		0.50	2.22	4.03	4.39	0.91	0.32	12.36	5.12
NW		0.32	1.13	1.77	0.59	0.00	0.00	3.80	3.70
CALM	0.00								
TOTAL	0.00	4.08	20.15	39.49	30.30	5.16	0.36	100	

Table 3-10 Fourth Quarter 2010 Wind Direction/Speed Frequency Analysis

Wind Rose Analysis – Percent of Valid Hourly Values (2,145 Valid Hours Used)									
Wind Direction	Wind Speed – m/s								Average Speed
	≤ 0.39	≤ 1.54	≤ 3.09	≤ 5.14	≤ 8.23	≤ 10.8	> 10.8	Total	
N		1.22	1.09	1.95	1.09	0.18	0.00	5.58	3.71
NE		1.00	4.17	7.70	7.97	4.35	1.90	27.14	5.79
E		0.68	3.08	7.16	3.99	4.12	3.80	22.88	6.29
SE		1.04	1.18	0.54	0.18	0.00	0.00	3.00	2.41
S		1.04	2.76	2.08	0.41	0.05	0.00	6.40	2.99
SW		1.95	5.16	7.29	1.95	0.91	0.82	18.13	4.09
W		1.18	1.81	2.54	3.31	2.13	0.54	11.56	5.52
NW		0.45	0.68	1.45	0.54	0.09	0.00	3.27	3.82
CALM	0.45								
TOTAL	0.45	8.56	19.93	30.71	19.43	11.82	7.07	98	

3.2.2 Temperature Climatology

During the monitoring year, the hourly averaged 2-m ambient temperature reached a maximum of 23.7°C (74.7 °F) on August 3, 2010 and a minimum of -45.0°C (-49.0°F) on December 27, 2010. **Table 3-11** shows the monthly hourly minimum and the hourly maximum.

Table 3-11 Nuiqsut Temperature Climate Summary, 2010 Annual Data Summary

2-Meter Temperature (°C)									
	Mean			Extreme					
Month	Maximum Daily (Monthly Average)	Minimum Daily (Monthly Average)	Monthly	Record Highest (Hourly Average)	Year	Day	Record Lowest (Hourly Average)	Year	Day
January 2010	-15.1	-42.6	-29.0	0.8	2008	20	-46.3	2008	13
February 2010	-14.7	-41.5	-25.6	1.8	2006	16	-45.9	2004	19
March 2010	-19.8	-36.1	-26.4	-3.1	2004	21	-44.5	2008	19
April 2010	-5.1	-23.3	-12.6	6.1	2009	29	-35.8	2004	2,3
May 2010	-0.4	-16.7	-6.4	18.5	2002	24	-28.7	2001	1
June 2010	12.4	-0.2	3.9	27.3	2003	29	-5.5	2000	5
July 2010	16.8	3.9	9.9	28.6	2009	13	-1.6	2002	26
August 2010	19.7	3.8	8.8	27.8	1999	5	-3.3	2000	27
September 2010	11.9	-4.9	3.7	23.4	2007	30	-13.6	1999	30
October 2010	-0.3	-12.4	-5.5	9.8	2006	10	-27.2	1999/ 2004	31/31
November 2010	-2.0	-29.1	-11.0	0.8	2010	22	-35.5	1999	5
December 2010	-13.0	-44.4	-27.0	-1.6	2006	2	-45.0	2010	27
1st Quarter 2010	-16.6	-40.0	-27.0	-	-	-	-	-	-
2nd Quarter 2010	2.3	-13.4	-5.1	-	-	-	-	-	-
3rd Quarter 2010	16.2	1.0	7.5	-	-	-	-	-	-
4th Quarter 2010	-5.1	-28.6	-14.6	-	-	-	-	-	-
Monitoring Year	-0.7	-20.2	-9.7	28.6	2009	13	-46.3	2008	13

Figure 3-14 compares average hourly temperatures by month measured at Nuiqsut during the current monitoring year to historical data collected at Barrow and the Nuiqsut Station. Comparisons are made to Barrow data because that data, collected over a 49-year period, is less likely influenced by interannual variability.

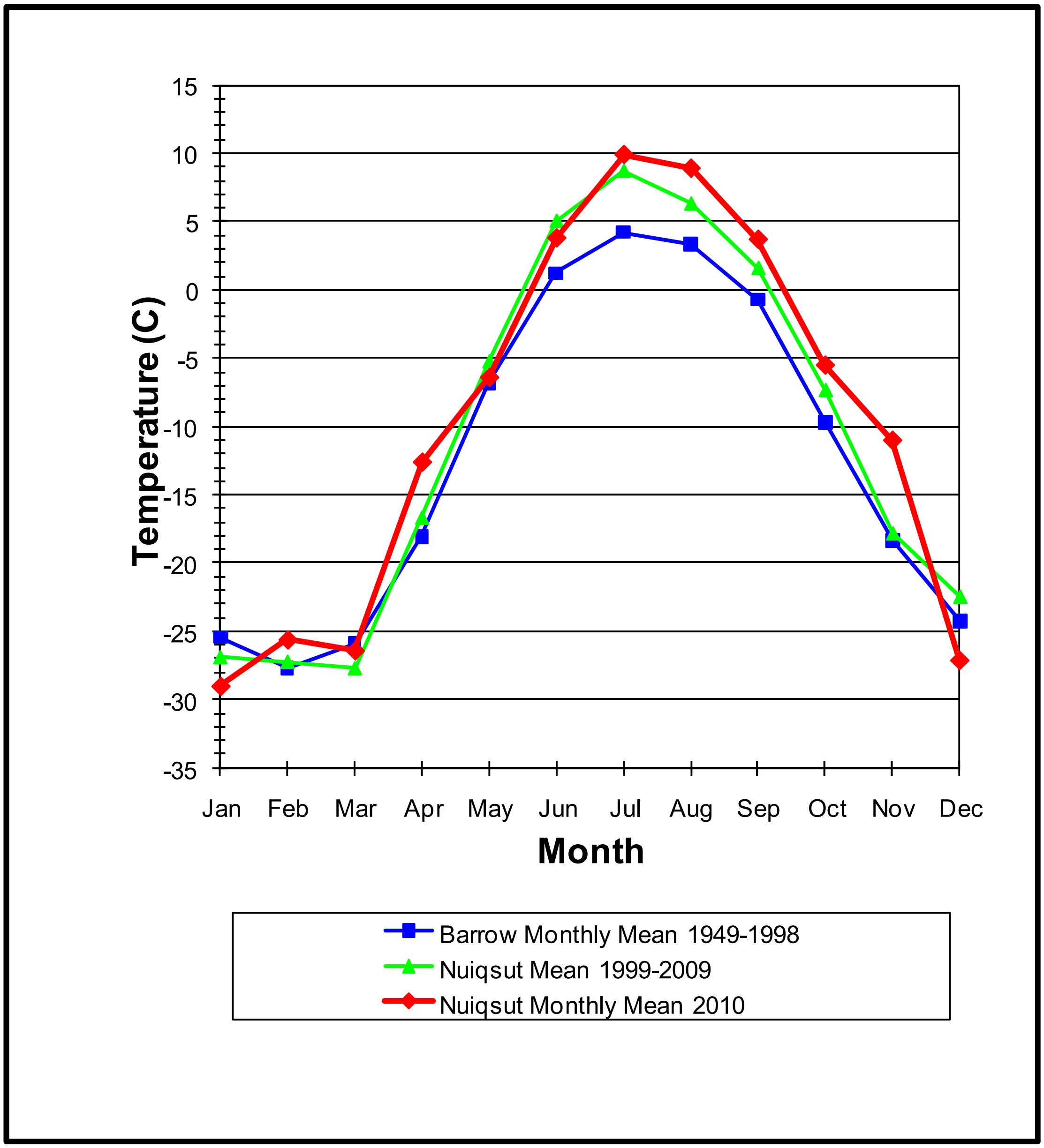


Figure 3-14 Nuiqsut Station Temperature Climatology, 2010 Annual Data Summary

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