2012 Annual Data Report
Nuiqsut Ambient Air Quality and Meteorological Monitoring Program

January 1, 2012 – December 31, 2012

ConocoPhillips Alaska, Inc.
Nuiqsut, Alaska

February 2013

AKreports@SLRconsulting.com
(907) 563-2137

2012 Annual Data Report

Prepared for:

ConocoPhillips Alaska, Inc.
700 G St.
Anchorage, AK 99501

This document has been prepared by SLR International Corp. The material and data in this report were prepared under the supervision and direction of the undersigned.

K. Steven Mackey
SLR Project Manager

Gregg Malinky
SLR Project QA Officer

CONTENTS

TABLES

CONTENTS (continued)

FIGURES

APPENDICES

EXECUTIVE SUMMARY

On behalf of ConocoPhillips Alaska, Inc. (CPAI), SLR International Corp (SLR) has been collecting ambient air and meteorological data in the village of Nuiqsut, Alaska. Since April 9, 1999 (prior to construction of the Alpine Central Processing Facility), CPAI has operated an ambient air quality and dispersion meteorology monitoring station in Nuiqsut, Alaska, which is located on the Alaskan North Slope. The Nuiqsut Ambient Air Quality and Meteorological Monitoring Program is comprised of one station located at the northern edge of Nuiqsut approximately 400 meters north-northwest of the community electrical generators. Currently, the Nuiqsut Monitoring Program is being conducted on a voluntary basis to document air quality in Nuiqsut. The data may also be used to support various ambient air quality impact analyses conducted for oil field development in the Colville Delta region.

On January 1, 2011, SLR assumed responsibility for the operation and management of the Nuiqsut monitoring station, which is one of five independent ambient air and meteorological monitoring programs operated by CPAI on the North Slope of Alaska. The Nuiqsut monitoring program is designed and operated in accordance with applicable EPA PSD regulations and guidance documents. This report provides details of ambient air and meteorological measurements collected from the 2012 monitoring year, spanning from January 1, 2012, to December 31, 2012, at the Nuiqsut monitoring station.

Table E-1 details Quality Assurance Project Plan (QAPP) variations documented for this project during the monitoring year. Any QAPP variations are explained in more detail in Section 1. The Nuiqsut QAPP Revision 2.1 was approved by the Alaska Department of Conservation (ADEC) in September 2012. Table E-2 provides a summary of quarterly and annual measured data for the monitored pollutants and the respective ratios of measured pollutants to National Ambient Air Quality Standards and Alaska Ambient Air Quality Standards (NAAQS/AAAQS). Tables E-3 and E-4 provide monthly, quarterly, and annual valid hours and percent data capture for the Nuiqsut meteorological monitoring station. Data not meeting QAPP and PSD precision and accuracy criteria were invalidated and are discussed in Section 2.

Table E-1: QAPP Variation Table

Item / Procedure	Summary of QAPP Variation	Reason for Variation
Monthly BAM QC checks	June BAM QC checks were not performed due to delayed certificate of calibration instrument. Extra QC checks were performed in early July 2012 to make up for the missed June QC checks.	Due to the need for recertification, the availability of the calibration instrument used for BAM QC checks was delayed by travel logistics.
Meteorological tower moved	The meteorological tower is no longer mounted directly to the air quality monitoring structure.	The meteorological tower was moved several feet from the air quality monitoring structure as part of a station rebuild that occurred in September 2012.
Meteorological parameters measured	In the Nuiqsut QAPP approved by ADEC in September 2012 it is stated that meteorological parameters to be measured would include relative humidity and barometric pressure. Meteorological data was not collected for these parameters during the 2012 monitoring year.	The Nuiqsut station was not configured with relative humidity and barometric pressure sensors during the 2012 monitoring year. These parameters are not required for dispersion modeling.

Table E-2: Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Carbon Monoxide (**CO**)	35 ppm (40,000 µg/m^3)	1-Hour[1]	1st Highest, 1-Hour Average	1	1	1	1	**1**	**2.9%**
			2nd Highest, 1-Hour Average	1	1	1	1	**1**	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour[1]	1st Highest, 8-Hour Average	1	1	1	1	**1**	**11.1%**
			2nd Highest, 8-Hour Average	1	1	1	1	**1**	**11.1%**
Nitrogen Dioxide (**NO_2**)	100.0 ppb (190 µg/m^3)	1-Hour[2]	Daily Max 1-Hour Averages (98th Percentile)	-	-	-	-	**18.2**	**18.2%**
			1st Highest, 1-Hour Average	33.5	14.4	16.8	31.6	**33.5**	**33.5%**
			2nd Highest, 1-Hour Average	33.4	13.6	14.6	28.0	**33.4**	**33.4%**
	53 ppb (100 µg/m^3)	Annual	Average of Period	2	1	1	1	**1**	**1.9%**
Ozone (**O_3**)	0.075 ppm (150 µg/m^3)	8-Hour[3]	4th Highest, 8-Hour Average	0.039	0.044	0.037	0.041	**0.044**	**58.7%**
			1st Highest, 8-Hour Average	0.039	0.045	0.038	0.041	**0.045**	**60.0%**
			2nd Highest, 8-Hour Average	0.039	0.045	0.038	0.041	**0.045**	**60.0%**

[1] Not to be exceeded more than once each year.
[2] To attain this standard, the 3-year average of the 98th percentile of the annual daily maximum 1-hour average must not exceed 100 ppb. The 1-hour daily standard is a federal standard (NAAQS), but has not been incorporated into the Alaska Ambient Air Quality Standards (AAAQS) yet.
[3] To attain this standard, the 3-year average of the annual fourth-highest daily maximum 8-hour average must not exceed 0.075 ppm.

Table E-2 (Continued): Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Sulfur Dioxide (SO_2)	75.0 ppb (196 μg/m^3)	1-Hour[4]	Daily Max 1-Hour Averages (99th Percentile)	-	-	-	-	**1.9**	**2.5%**
			1st Highest, 1-Hour Average	2.2	4.2	1.3	1.5	**4.2**	**5.6%**
			2nd Highest, 1-Hour Average	2.1	2.5	1.3	1.5	**2.5**	**3.3%**
	500.0 ppb (1,300 μg/m^3)	3-Hour[5]	1st Highest, 3-Hour Average	1.7	2.4	1.3	1.5	**2.4**	**0.5%**
			2nd Highest, 3-Hour Average	1.6	1.6	1.2	1.4	**1.7**	**0.3%**
	140.0 ppb (365 μg/m^3)	24-Hour[5]	1st Highest, 24-Hour Average	1.3	1.1	1.2	1.4	**1.4**	**1.0%**
			2nd Highest, 24-Hour Average	1.2	0.9	1.1	1.4	**1.4**	**1.0%**
	30.0 ppb (80 μg/m^3)	Annual	Average of Period	0.0	0.0	0.4	0.2	**0.0**	**0.0%**

[4] To attain this standard, the 3-year average of the 99th percentile of the annual daily maximum 1-hour average must not exceed 75.0 ppb.
[5] Not to be exceeded more than once each year.

Table E-2 (Continued): Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Particulate Matter <2.5 microns ($PM_{2.5}$)	35.0 μg/m^3	24-Hour[6]	98th Percentile, 24-Hour Average	-	-	-	-	**5.9**	**16.9%**
			1st Highest, 24-Hour Average	5.2	6.5	7.1	9.6	**9.6**	**27.4%**
			2nd Highest, 24-Hour Average	5.0	6.0	5.9	9.0	**9.0**	**25.7%**
	15.0 μg/m^3	Annual[7]	Average of Period	2.0	2.2	1.9	2.0	**2.0**	**13.3%**
Particulate Matter <10 microns (PM_{10})	150 μg/m^3	24-Hour[8, 9]	1st Highest, 24-Hour Average	10	20	40	10	**40**	**26.7%**
			2nd Highest, 24-Hour Average	10	10	40	10	**40**	**26.7%**

[6] To attain this standard, the 3-year average of the 98th percentile of the 24-hour concentration must not exceed 35.0 μg/m^3.
[7] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentration must not exceed 15.0 μg/m^3.
[8] Not to be exceeded more than once per year on average over three years.
[9] 40 CFR Appendix K requires that reportable concentrations of PM_{10} be rounded to the nearest 10 μg/m^3; actual measurement results are within Appendix C.

Table E-3: Meteorological Data Capture – Valid Hours per Month

Period	Meteorological Parameters – Data Recovery[1]								
	Horizontal Wind Speed	Horizontal Wind Direction	Wind Direction Std. Dev. (Sigma Theta)	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January 2012	740	734	734	726	726	740	740	740	742
February 2012	617(1)	615(1)	615(1)	686	686	691	691	691	695
March 2012	742	723	723	742	742	742	742	742	742
1st Quarter	**2,099**	**2,072**	**2,072**	**2,154**	**2,154**	**2,173**	**2,173**	**2,173**	**2,179**
April 2012	717	712	712	717	717	717	717	717	717
May 2012	735	733	733	661(2)	661(2)	735	735	735	742
June 2012	717	715	715	690	690	717	717	717	720
2nd Quarter	**2,169**	**2,160**	**2,160**	**2,068**	**2,068**	**2,169**	**2,169**	**2,169**	**2,179**
July 2012	744	744	744	744	744	744	744	744	744
August 2012	744	744	744	744	744	744	744	744	744
September 2012	587(3)	586(3)	586(3)	587(3)	587(3)	587(3)	587(3)	587(3)	601(3)
3rd Quarter	**2,075**	**2,074**	**2,074**	**2,075**	**2,075**	**2,075**	**2,075**	**2,075**	**2,089**
October 2012	721	717	717	701	701	721	721	721	726
November 2012	720	720	720	720	720	720	720	720	713
December 2012	551(1)	551(1)	551(1)	740	740	743	743	743	743
4th Quarter	**1,992**	**1,988**	**1,988**	**2,161**	**2,161**	**2,184**	**2,184**	**2,184**	**2,182**
Year to Date	**8,335**	**8,294**	**8,294**	**8,458**	**8,458**	**8,601**	**8,601**	**8,601**	**8,629**

[1] Horizontal wind speed, wind direction, and wind sigma theta failed to achieve 90 percent data recovery for the months of March and December due to periodic rime ice build-up on the sensors. The quarterly 90 percent data capture objective was still achieved for both the first and fourth quarters.

[2] Vertical wind speed and wind sigma omega failed to achieve 90 percent data recovery for the month of May due to periodic rime ice build-up on the sensors. The quarterly 90 percent data capture objective was still achieved for the second quarter.

[3] All parameters failed to achieve 90 percent data recovery for the month of September due to the station rebuild. The quarterly 90 percent data capture objective was still achieved for the third quarter.

Table E-4: Meteorological Data Capture – Percent Data Capture

Period	Meteorological Parameters – Data Recovery[1]								
	Horizontal Wind Speed	Horizontal Wind Direction	Wind Direction Std. Dev. (Sigma Theta)	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January 2012	99	99	99	98	98	99	99	99	100
February 2012	89[(2)]	88[(2)]	88[(2)]	99	99	99	99	99	100
March 2012	100	97	97	100	100	100	100	100	100
1st Quarter	**96**	**95**	**95**	**99**	**99**	**99**	**99**	**99**	**100**
April 2012	100	99	99	100	100	100	100	100	100
May 2012	99	99	99	89[(3)]	89[(3)]	99	99	99	100
June 2012	100	99	99	96	96	100	100	100	100
2nd Quarter	**99**	**99**	**99**	**95**	**95**	**99**	**99**	**99**	**100**
July 2012	100	100	100	100	100	100	100	100	100
August 2012	100	100	100	100	100	100	100	100	100
September 2012	82[(4)]	81[(4)]	81[(4)]	82[(4)]	82[(4)]	82[(4)]	82[(4)]	82[(4)]	83[(4)]
3rd Quarter	**94**	**94**	**94**	**94**	**94**	**94**	**94**	**94**	**95**
October 2012	97	96	96	94	94	97	97	97	98
November 2012	100	100	100	100	100	100	100	100	99
December 2012	74[(2)]	74[(2)]	74[(2)]	99	99	100	100	100	100
4th Quarter	**90**	**90**	**90**	**98**	**98**	**99**	**99**	**99**	**99**
Year to Date	**95**	**94**	**94**	**96**	**96**	**98**	**98**	**98**	**98**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Horizontal wind speed, wind direction, and wind sigma theta failed to achieve 90 percent data recovery for the months of March and December due to periodic rime ice build-up on the sensors. The quarterly 90 percent data capture objective was still achieved for both the first and fourth quarters.
[3] Vertical wind speed and wind sigma omega failed to achieve 90 percent data recovery for the month of May due to periodic rime ice build-up on the sensors. The quarterly 90 percent data capture objective was still achieved for the second quarter.
[4] All parameters failed to achieve 90 percent data recovery for the month of September due to the station rebuild. The quarterly 90 percent data capture objective was still achieved for the third quarter.

1. INTRODUCTION

1.1 PROJECT SUMMARY

Since April 9, 1999 (prior to construction of the Alpine Central Processing Facility), CPAI has operated an ambient air quality and meteorology monitoring station in Nuiqsut, Alaska, which is located on the Alaska North Slope. The Nuiqsut monitoring station is one of five independent ambient air and meteorological monitoring programs operated by CPAI on the North Slope of Alaska. The Nuiqsut Ambient Air Quality and Meteorological Monitoring Program is comprised of one station located at the northern edge of Nuiqsut approximately 400 meters north-northwest of the community electrical generators. Currently, the Nuiqsut Monitoring Program is being conducted on a voluntary basis to document air quality in Nuiqsut. The data may also be used to support various ambient air quality impact analyses conducted for oil field development in the Colville Delta region.

The monitoring program consists of an ambient air quality monitoring station and a meteorological monitoring tower mounted near the air quality monitoring structure. The program is designed and operated in accordance with applicable Prevention of Significant Deterioration (PSD) regulations and guidance documents. The specific project objectives of the Monitoring Program are to:

- Collect data to document Nuiqsut air quality and address community concerns related to regional oilfield development.
- Establish a monitoring system to measure, with known accuracy and precision, meteorological parameters at the project site from ground level up to 10 meters.
- Provide required and relevant optional meteorological data for American Meteorological Society/EPA Regulatory Model Improvement Committee Model (AERMOD) modeling system.
- Establish a monitoring system to measure, with known bias and precision, the ambient concentrations of the criteria air quality pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), and particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$) to establish National Ambient Air Quality Standards (NAAQS) compliance status for the monitoring location.

The Nuiqsut station collects the following ambient air data:

- Carbon monoxide (CO)
- Oxides of nitrogen (NO_2, NO_X, and NO)
- Ozone (O_3)
- Sulfur dioxide (SO_2)
- Inhalable particulate matter less than 2.5 microns ($PM_{2.5}$)

- Inhalable particulate matter less than 10 microns (PM_{10})

The Nuiqsut station measures the following meteorological parameters:

- Horizontal wind speed (meters per second [m/s])
- Horizontal wind direction (degrees [°])
- Vertical wind speed (meters per second [m/s])
- Air temperature, two and ten meters above ground level (degrees Celsius [°C])
- Solar radiation (Watts per square meter [W/m^2])

The Nuiqsut station calculates the following meteorological parameters:

- Horizontal wind direction standard deviation (Sigma Theta [σ_θ])
- Vertical wind speed standard deviation (Sigma Omega [σ_ω])
- Temperature difference ((ΔT, "Delta T" (degrees Celsius [°C]), is calculated as temperature at 10 meters minus temperature at 2 meters)

Data review and validation procedures and monitoring program data and measurement quality objectives (MQO's) are provided in the Nuiqsut Ambient Air Quality and Meteorological Monitoring Station Quality Assurance Project Plans prepared by AECOM (August 2010), which was later superseded by the Nuiqsut QAPP Revision 2.1 approved by ADEC in September 2012.

The community of Nuiqsut is located in the Colville River Delta region of the North Slope of Alaska. Figure 1-1 shows a detailed map of Nuiqsut while Figure 1-2 provides an aerial view of the Nuiqsut village and depicts the location of the monitoring station. Figure 1-3 depicts the general location of the project area.

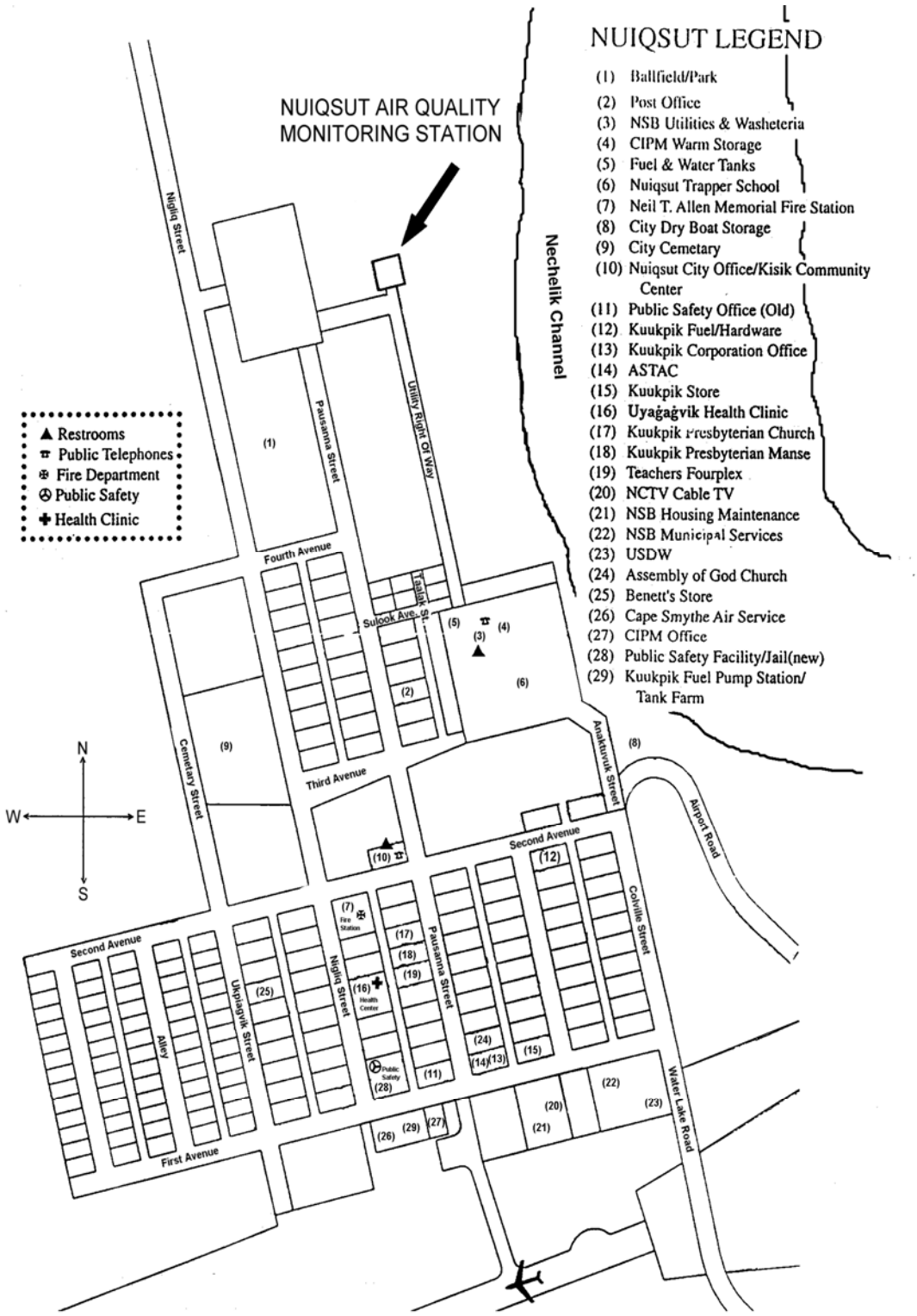


Figure 1-1: Local Map of Nuiqsut

Figure 1-2: Aerial Photo Showing Site Location

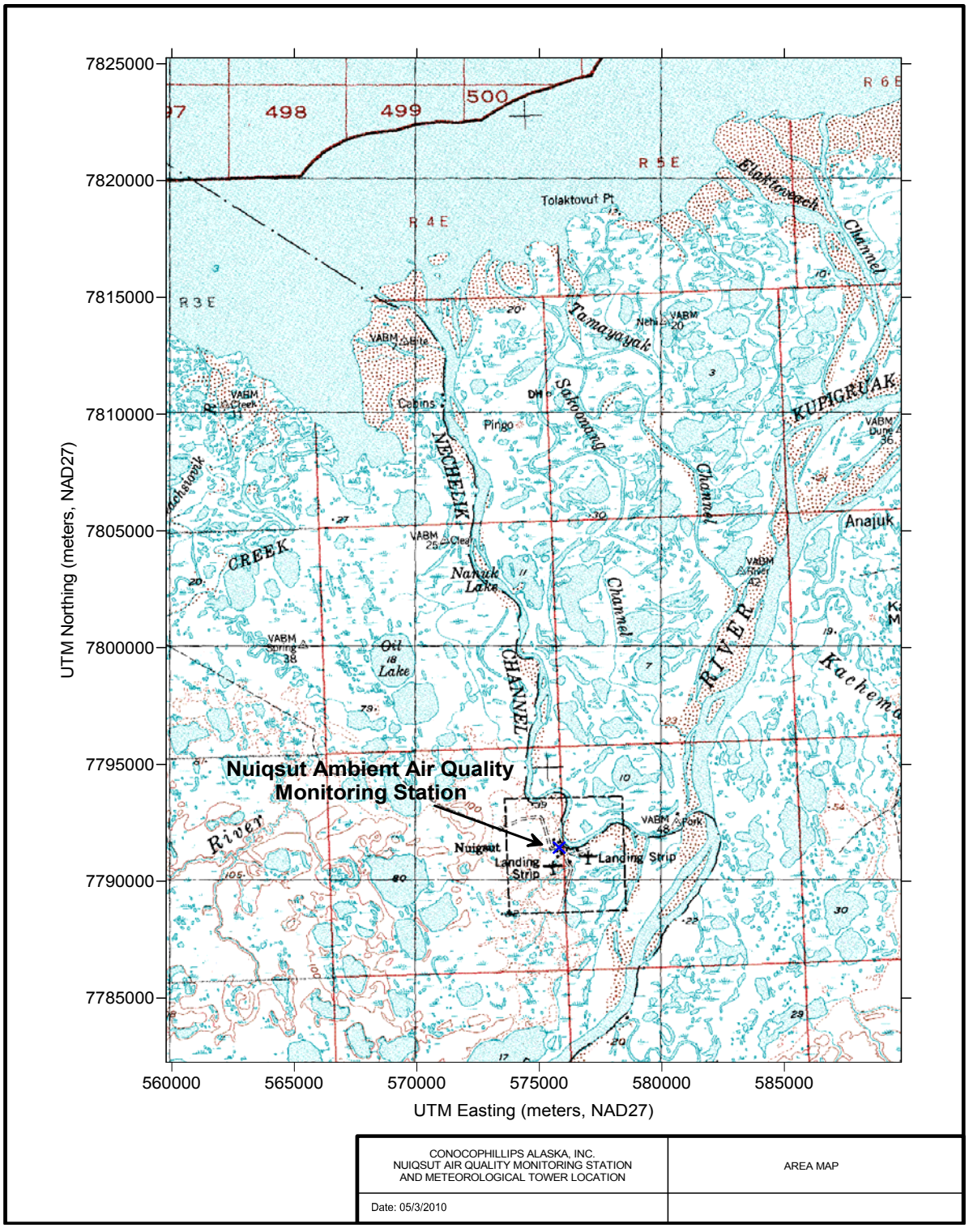


Figure 1-3: Map of Nuiqsut Project Area

1.2 MEASUREMENT METHODS TABLE

All instruments meet or exceed the U.S. Environmental Protection Agency (EPA) PSD requirements for range accuracies, thresholds, response times, resolutions, damping ratios, and other measures of instrument performance.

1.2.1 CONTINUOUS NO_2, O_3, CO AND SO_2 MONITORING

The gas analyzers used for the Nuiqsut Air Monitoring Station have been designated by EPA as either a Federal Equivalent Method (FEM) or Federal Reference Method (FRM) as defined in 40 CFR 53. Table 1-1 provides a summary of the measurement methods and parameters used for the Nuiqsut Ambient Air Monitoring Program.

Table 1-1: Gaseous Pollutant Measurement Parameters

Parameter	Instrument	References	Units	Sampling Frequency	Sample Averaging
Carbon Monoxide (CO)	Thermo 48i Gas filter correlation analyzer	EPA equivalent method RFCA-0981-054	Parts per million (ppm)	Continuous	1-hour
Ozone (O_3)	T-API T400 UV Photometric Ozone analyzer	EPA equivalent method EQOA-0992-087	Parts per billion (ppb)	Continuous	1-hour
Nitrogen Dioxide (NO_2)[1]	Thermo 42i Chemiluminescent NO_X gas analyzer	EPA reference method RFNA-1289-074	Parts per billion (ppb)	Continuous	1-hour
Sulfur Dioxide (SO_2)	Thermo 43i Pulsed fluorescence SO_2 gas analyzer	EPA equivalent method EQSA-0486-060	Parts per billion (ppb)	Continuous	1-hour

[1] Total oxides of nitrogen (NO_X) and nitrogen Oxide (NO) are also measured.

1.2.2 CONTINUOUS PM_{10} AND $PM_{2.5}$ MONITORING

Monitoring for PM_{10}/$PM_{2.5}$ data was conducted in accordance with the requirements and guidance in 40 CFR Parts 50, 53, and 58. Both PM_{10} and $PM_{2.5}$ monitoring were conducted using the Met One Instruments, Inc. Model BAM-1020 Beta Attenuation Mass Monitors, which continuously measure ambient particulate concentrations using beta ray attenuation. The US EPA designations for these units are PM_{10}: FEM EQPM-0798-122 and $PM_{2.5}$ Class III FEM EQPM-0308-170. For EPA reference method sampling, the $PM_{2.5}$ sampler inlet system was configured with a BGI VSCC™ (Very Sharp Cut Cyclone) particle size separator.

CPAI participates in the North Slope air monitoring network that contains a $PM_{2.5}$ collocation station in Deadhorse, Alaska. As such, filter-based samplers for assessing precision were not run at Nuiqsut. Network precision statistics were evaluated using samples collocated at Deadhorse.

Block daily averages (24-hours) were obtained from the hourly measurements with the BAM-1020 samplers. Table 1-2 lists the particulate matter parameters measured and the frequency at which samples collected and recorded.

Table 1-2: PM Monitoring Measurement Parameters

Parameter	Units	Sampling Schedule	Sample Period	Averaging Time
PM_{10}	Micrograms per cubic meter ($\mu g/m^3$)	Continuous	1-Hour[1]	24-Hour (Average)[1]
$PM_{2.5}$	Micrograms per cubic meter ($\mu g/m^3$)	Continuous	1-Hour[1]	24-Hour (Average)[1]
Sample Volume	Cubic meters (m^3)	Every sampling event	Continuously up to 30 days (hourly checks)	Total volume over sample period
Flow Rate	Liters per min (LPM)			Average over sampling period
Ambient Temperature	Degrees Celsius (°C)			
Barometric Pressure	Millimeters of mercury (mm Hg)			

[1] 24-hour averages are obtained from the 1-hour measurements each day. A minimum of 18 hours must be available for a valid 24-hr average to be calculated.

1.2.3 METEOROLOGICAL MONITORING

The meteorological monitoring (wind speed, wind direction, vertical wind speed, ambient air temperature, and solar radiation) were conducted in a manner consistent with PSD criteria for surface meteorological data collection. The meteorological sensors meet or exceed the performance specifications stated in *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (EPA-454/R-99-005). Table 1-3 lists the parameters measured, their reported units, sampling frequency, and sample averaging time.

Table 1-3: Meteorological Measurement Methods

Parameter	Sensor Manufacturer/ Model Number	Measurement Method	Range	Accuracy	Sampling Frequency	Averaging Period
Ambient Temperature	Climatronics Model 100093-2	Triple element thermistor	-50 to +50°C	± 0.1°C	1 second	1 hour
Horizontal Wind Speed	RM Young Co. 05305-AQ	Propeller, magnetically induced AC sine wave	0 to 50 m/s	±(0.2 m/s + 5% of actual)	1 second	1 hour
Wind Direction	RM Young Co. 05305-AQ	Light-weight vane, Low torque potentiometer	0 to 360°	± 3°	1 second	1 hour
Vertical Wind Speed[1]	RM Young Co. 27106	Propeller anemometer	0 to 25 m/s	±(0.2 m/s + 5% of actual)	1 second	1 hour
Vertical Wind Speed[1]	Climatronics Model 102236-G0	Propeller anemometer	0 to 49 m/s	±(0.2 m/s + 5% of actual)	1 second	1 hour
Solar Radiation	Eppley Black and White	Precision thermopile pyranometer	0 to 2,800 W/m^2	± 2%	1 second	1 hour

[1] The RM Young Model 27106 vertical wind speed sensor was replaced on October 2, 2012, with a Climatronics model 102236-G0 vertical wind speed sensor.

1.3 VARIATIONS FROM THE QAPP

During the 2012 monitoring year, the following variations from the approved Nuiqsut Ambient Air Quality and Meteorological Monitoring Quality Assurance Project Plan (QAPP) occurred:

Table 1-4: QAPP Variation Table

Item / Procedure	Summary of QAPP Variation	Reason for Variation
Monthly BAM QC checks	June BAM QC checks were not performed.	The availability of the calibration instrument used for BAM QC checks was delayed by travel logistics.
Meteorological tower moved	The meteorological tower is no longer mounted directly to the air quality monitoring structure.	The meteorological tower was moved several feet from the air quality monitoring structure as part of a station rebuild that occurred in September 2012.
Meteorological parameters measured	Meteorological data was not collected for relative humidity and barometric pressure during the 2012 monitoring year.	The Nuiqsut station was not configured with relative humidity and barometric pressure sensors.

In June the monthly QC checks were not performed on the PM samplers. The QC checks were not performed because the recertification of the calibration instrument was delayed as a result of travel logistics. Extra QC checks were performed in July to make up for the missed June QC checks and the samplers passed all critical criteria.

In September 2012 the Nuiqsut station underwent a rebuild which included replacing the monitoring shelter, moving the meteorological tower several feet from the air monitoring shelter, adding redundant wind, temperature, and solar sensors, replacing the vertical wind speed sensor, replacing the station data logger, and replacing cables as necessary. The shelter, data logger, and cables were replaced because the existing equipment was showing signs of wear. The vertical wind speed sensor was replaced with a model with a lower starting threshold to improve the quality of data collected. Redundant sensors were added to act as a backup in case a primary sensor fails to meet PSD-quality criteria.

In the Nuiqsut QAPP approved by ADEC in September 2012 it is stated that meteorological parameters to be measured would include relative humidity and barometric pressure. Meteorological data was not collected for these parameters during the 2012 monitoring year because the Nuiqsut station was not configured with relative humidity and barometric pressure sensors. These parameters are not required for dispersion modeling.

2. STATION PERFORMANCE SUMMARY

2.1 SIGNIFICANT PROJECT EVENTS

Table 2-1 summarizes the significant events that occurred at the Nuiqsut station relevant to the 2012 ambient air and meteorological monitoring year.

Table 2-1: Chronology of Significant Events

Date	Event
January 1, 2012	Start of monitoring year.
January 2, 2012	Multipoint calibrations performed on all ambient air analyzers; all passed.
January 3, 2012	Monthly QC checks and multipoint calibrations performed on PM samplers; all passed. NO_X and SO_2 ambient air analyzers replaced. Multipoint calibrations performed on new ambient air analyzers and CO analyzer; all passed.
January 6 – 10, 2012	All ambient air data were invalidated as a result of shelter temperature standard deviation exceeding daily 2 degrees Celsius limit.
January 21, 2012	Multipoint calibration conducted on SO_2 analyzer due to span drift; did not pass. SO_2 data invalidated back to last valid precision calibration resulting in approximately 30 hours of lost data. SO_2 analyzer recalibrated and passed multipoint calibration.
January 23 – 26, 2012	$PM_{2.5}$ data flagged as invalid due to temperatures below the acceptable range of the instrument. PM_{10} data flagged as invalid due to concentrations below the acceptable range of the instrument.
January 28, 2012	PM_{10} data flagged as invalid due to a 24-hour average of less than 2 $\mu g/m^3$.
January 31 – February 1, 2012	$PM_{2.5}$ data flagged as invalid due to temperatures below the acceptable range of the instrument.
February 9, 2012	Several hours of ambient air data flagged as invalid as a result of the shelter temperature falling below the acceptable range.
February 9 – 12, 2012	Horizontal wind speed data indicated episodes of rime ice build-up on sensor; 75 hours of horizontal wind speed data flagged invalid.
February 14 – 16, 2012	Monthly QC check performed on PM samplers; all passed. Multipoint calibrations performed on all ambient air analyzers; all passed. Maintenance performed on ambient air analyzers and meteorological monitoring sensors.
February 23, 2012	Independent performance audit of ambient air analyzers and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits.
February 28 – March 6, 2012	A pump failure on the ozone analyzer resulted in approximately 145 hours of data flagged as invalid. The pump was replaced and the analyzer recalibrated.
March 2, 2012	Monthly QC checks performed on PM samplers; all passed.
March 6 – 7, 2012	Ambient air data flagged as invalid as a result of the shelter temperature falling outside of the acceptable range.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
March 9, 2012	Multipoint calibrations performed on CO and SO_2 ambient air analyzers; all passed. The CO analyzer failed a precision check resulting in all data being invalidated to back to most recently passed precision check (3/5/12). The CO analyzer was recalibrated and passed.
March 12 – 14, 2012	Ambient air data flagged as invalid as a result of the shelter temperature falling outside of the acceptable range.
April 2, 2012	Monthly QC checks performed on PM samplers; all passed.
April 19, 2012	Calibration conducted on CO analyzer; passed.
April 26 – May 8, 2012	Ozone transfer standard out for recertification; recertification took place on May 3, 2012.
May 1, 2012	Monthly QC checks performed on PM samplers; all passed.
May 9,13, 21-24, 31 and June 1, 5, 8, 13	Vertical wind speed data indicated episodes of rime ice build-up on sensor; vertical wind speed and vertical wind sigma omega data flagged invalid.
May 17 – 31, 2012	Ozone analyzer pump broken, resulting in all ozone data flagged as invalid for this period. Repaired and calibrated on May 31, 2012.
May 31, 2012	Maintenance performed on tower and meteorological instruments. Wind, solar, and temperature sensors deiced. Calibrations conducted on all meteorological sensors and ambient air analyzers; all passed.
June 8 – 9, 2012	Independent performance audit of meteorological sensors, PM samplers, and ambient air analyzers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits.
July 2, 2012	Makeup June monthly QC checks performed on PM samplers. Leak checks on the $PM_{2.5}$ sampler and ambient temperature checks on both the $PM_{2.5}$ and PM_{10} samplers did not pass but an additional QC check on July 17 before any corrective action was taken indicated that these apparently failing QC checks were due to operator error. See Section 2.5.1 for further details.
July 17, 2012	Monthly QC checks performed on PM samplers; all passed.
August 4, 2012	Monthly QC checks performed on PM samplers; all passed.
September 3, 2012	Monthly QC checks performed on PM samplers; all passed.
September 19 – 20, 2012	Independent performance audit of ambient air analyzers and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits.
September 24 – 25, 2012	Calibrations conducted on all meteorological sensors and ambient gas analyzers; all passed.
September 26 – October 2, 2012	All station sensors offline for station rebuild. Meteorological tower separated from station shelter, shelter replaced, redundant wind, temperature, and solar sensors installed, and vertical wind sensor replaced. CR1000 data logger and all cables replaced.
October 1, 2012	Calibrations conducted on all meteorological sensors and ambient gas analyzers and QC checks performed on PM samplers; all passed.
October 6, 2012	Monthly QC checks performed on PM samplers; all passed.
October 8 and 24, 2012	Vertical wind speed data indicated episodes of rime ice build-up on sensor; vertical wind speed and vertical wind sigma omega data flagged invalid.

Table 2-1 Continued: Chronology of Significant Events

Date	Event
October 19 – 20, 2012	Independent performance audit of meteorological sensors, PM samplers, and ambient air analyzers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits.
October 25 – November 3, 2012	Ozone transfer standard out for recertification; recertification took place on October 31, 2012.
November 3 – November 10, 2012	Ozone transfer standard reinstalled incorrectly resulting in zero air entering the ozone sampling system. Data flagged as invalid
October 26 – 27, 2012	All ambient air and particulate matter data were invalidated as a result of shelter temperature standard deviation exceeding daily 2 degrees Celsius limit.
November 2, 2012	Monthly QC checks performed on PM samplers; all passed.
November 3 – 10, 2012	Local station operator reinstalled the ozone transfer standard incorrectly resulting in 170 hours of invalid O_3 data.
December 3, 2012	Monthly QC checks performed on PM samplers; all passed.
December 3 – 5, 2012	PM_{10} data not collected due to a system communication error.
December 19 – 31, 2012	Local station operator installed new bypass flow pump incorrectly resulting in 297 hours of invalid data for all gases.
December 24 – 31, 2012	Horizontal wind speed, direction, and sigma theta data indicated episodes of rime ice build-up on sensor; 193 hours of horizontal wind data flagged invalid.
December 28, 2012	Technical systems audit completed by AMS Tech, LLC. All aspects of the monitoring program were found to be in order.
December 31, 2012	End of monitoring year.

2.2 MISSING, INVALID AND ADJUSTED DATA

Table 2-2 lists the quantities of data that were flagged according to EPA criteria, yet not removed from the refined final data set. All flagged data were carefully examined, but generally remained in the reduced data unless dictated by certain circumstances, including: values outside the normal range of variation; consecutive repetitive values recorded for an unidentified reason; maintenance activity at the site, and impairing damage to sensors.

Table 2-2: Percentage of Final Data Set Flagged

Parameter	Flagging Criteria[1]	Percent Flagged
Wind Speed	Value is < 0 m/s	0.0%
	Value is > 25 m/s	0.0%
	< 0.1 m/s variation for 3 consecutive hours	2.1%
	< 0.5 m/s variation for 12 consecutive hours	0.3%
Wind Direction	Value is < 0°, > 360°	0.0%
	< 1° variation over 3 consecutive hours	0.0%
	< 10° variation over 18 consecutive hours	0.8%
Temperature (2 meters)	> 5°C variation from previous hour	0.2%
	< 0.5°C variation for 12 consecutive hours	0.6%
	Value is > record high, < record low	0.0%
Temperature (10 meters)	> 5°C variation from previous hour	0.2%
	< 0.5°C variation for 12 consecutive hours	1.0%
	Value is > record high, < record low	0.0%
Temperature Difference, ΔT	Value is > 0.8°C during the daytime	0.8%
	Value is < -0.8°C during the night	0.1%
	Value is > 5°C, < -3°C	0.8%
Solar Radiation	> 0 w/m^2 at night	0.0%
	Greater than the maximum possible value for date and latitude	0.1%

[1] Based upon Table 8-4: Suggested Data Screening Criteria in *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (EPA-454/R-99-005).

2.3 NETWORK DATA COMPLETENESS

Data completeness is a measure of the amount of data actually collected compared to the amount of data that could have been collected. Data completeness was calculated by dividing the number of valid hours of data by the total number of hours during the monitoring period. The data quality objective (DQO) for data completeness for air quality data is 80 percent per calendar quarter, and 90 percent for meteorological data per calendar quarter.

The Nuiqsut ambient air and meteorological monitoring station met all PSD requirements during the monitoring year with the following notable exceptions:

- Fourth quarter data recovery for O_3 was less than eighty percent due to the local operator reinstalling the zero air line into the ozone transfer standard incorrectly on 11/3/12 (data invalidated 11/3 – 11/10) and due to the local operator installing the bypass flow pump incorrectly on 12/19/12 (data invalidated 12/19 – 12/31).

Annual and quarterly data completeness for ambient air and meteorological parameters are provided in Tables 2-3 and 2-4, respectively. Calculations for determining data completeness are provided in Appendix A. Fully validated data for all parameters are provided in Appendix D.

Table 2-3: Ambient Air Quality Data Capture Percent

Period	Pollutants – Data Recovery[1]					
	NO_2	SO_2	CO	O_3	$PM_{2.5}$	PM_{10}
January 2012	82	78[(2)]	82	81	81	81
February 2012	95	93	95	88	97	100
March 2012	89	89	78[(3)]	72[(4)]	100	97
1st Quarter	**88**	**86**	**85**	**80**	**92**	**92**
April 2012	98	98	98	98	97	97
May 2012	98	98	98	54[(4)]	97	100
June 2012	99	98	99	98	100	100
2nd Quarter	**98**	**98**	**98**	**83**	**98**	**99**
July 2012	99	99	99	99	97	100
August 2012	99	99	99	99	94	100
September 2012	80	80	80	80	80	80
3rd Quarter	**93**	**93**	**93**	**93**	**90**	**93**
October 2012	94	94	94	94	90	90
November 2012	99	99	99	76[(5)]	100	100
December 2012	60[(5)]	60[(5)]	60[(5)]	60[(5)]	100	90
4th Quarter	**84**	**84**	**84**	**76[(5)]**	**97**	**93**
Monitoring Year	**91**	**90**	**90**	**83**	**94**	**95**

[1] EPA PSD-quality ambient air monitoring standards require data capture of 80 percent or greater per quarter for four consecutive quarters.
[2] SO_2 failed to achieve 80 percent data recovery for the month of January due to a failed multipoint calibration on 1/21/12. The quarterly 80 percent data capture objective was still achieved for the first quarter.
[3] CO failed to achieve 80 percent data recovery for the month of March due to a failed precision check on 3/9/12. The quarterly 80 percent data capture objective was still achieved for the first quarter.
[4] O_3 failed to achieve 80 percent data recovery for the months of March and May due to pump failures. The quarterly 80 percent data capture objectives were still achieved for the first and second quarters.
[5] Quarterly data recovery for O_3 was less than 80 percent during the fourth quarter due to the local operator reinstalling the zero air line into the ozone transfer standard incorrectly on 11/3/12 (data invalidated 11/3 – 11/10) and due to the local operator installing bypass pump incorrectly on 12/19/12 (data invalidated 12/19 – 12/31). All ambient air data was invalidated from 12/19 – 12/31 resulting in December data capture for all parameters below 80 percent, though only O_3 failed to achieve the 80 percent data capture objective for the quarter.

Table 2-4: Meteorological Data Capture Percent

Period	Meteorological Parameters – Data Recovery[1]								
	Horizontal Wind Speed	Horizontal Wind Direction	Wind Direction Std. Dev. (Sigma Theta)	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	2-M Temp	10-M Temp	Delta-T	Solar Radiation
January 2012	99	99	99	98	98	99	99	99	100
February 2012	89[(2)]	88[(2)]	88[(2)]	99	99	99	99	99	100
March 2012	100	97	97	100	100	100	100	100	100
1st Quarter	**96**	**95**	**95**	**99**	**99**	**99**	**99**	**99**	**100**
April 2012	100	99	99	100	100	100	100	100	100
May 2012	99	99	99	89[(3)]	89[(3)]	99	99	99	100
June 2012	100	99	99	96	96	100	100	100	100
2nd Quarter	**99**	**99**	**99**	**95**	**95**	**99**	**99**	**99**	**100**
July 2012	100	100	100	100	100	100	100	100	100
August 2012	100	100	100	100	100	100	100	100	100
September 2012	82[(4)]	81[(4)]	81[(4)]	82[(4)]	82[(4)]	82[(4)]	82[(4)]	82[(4)]	83[(4)]
3rd Quarter	**94**	**94**	**94**	**94**	**94**	**94**	**94**	**94**	**95**
October 2012	97	96	96	94	94	97	97	97	98
November 2012	100	100	100	100	100	100	100	100	99
December 2012	74[(2)]	74[(2)]	74[(2)]	99	99	100	100	100	100
4th Quarter	**90**	**90**	**90**	**98**	**98**	**99**	**99**	**99**	**99**
Year to Date	**95**	**94**	**94**	**96**	**96**	**98**	**98**	**98**	**98**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Horizontal wind speed, wind direction, and wind sigma theta failed to achieve 90 percent data recovery for the months of March and December due to periodic rime ice build-up on the sensors. The quarterly 90 percent data capture objective was still achieved for both the first and fourth quarters.
[3] Vertical wind speed and wind sigma omega failed to achieve 90 percent data recovery for the month of May due to periodic rime ice build-up on the sensors. The quarterly 90 percent data capture objective was still achieved for the second quarter.
[4] All parameters failed to achieve 90 percent data recovery for the month of September due to the station rebuild. The quarterly 90 percent data capture objective was still achieved for the third quarter.

2.4 PRECISION STATISTICS

2.4.1 MONITORING NETWORK PRECISION STATISTICS

Precision statistics were determined using the methods outlined in Title 40 Code of Federal Regulations, Part 58 (40 CFR 58), Appendix A. Valid precision data for ambient air monitors (CO, NO_2, O_3, and SO_2) were collected at least once every two weeks, meeting the critical validation criteria outlined in the monitoring program QAPP. Quarterly precision statistics for each criteria pollutant are provided in Tables 2-5 through 2-20.

Continuous PM_{10} monitors are not required to have collocated precision comparisons. Precision statistics for the continuous $PM_{2.5}$ monitor were determined using the monitoring network QA station located in Deadhorse, Alaska. EPA recommends that precision statistics for $PM_{2.5}$ should only be calculated for collocated samples if both the collocated and the primary sample concentrations are greater than or equal to 3 $\mu g/m^3$. As proposed in the Deadhorse $PM_{2.5}$ Monitoring Program QAPP, precision statistics for this monitoring project were calculated for collocated samples if both the collocated and the primary sample concentrations were greater than or equal to 2 $\mu g/m^3$. Quarterly network PM precision statistics are presented in Table 2-21.

Table 2-5: 1st Quarter CO Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Jan-12	auto	8.2	8.2	0.00							
12-Jan-12	auto	8.2	8.2	0.00							
19-Jan-12	auto	8.4	7.9	6.33							
26-Jan-12	auto	8.4	7.9	6.33							
30-Jan-12	auto	8.1	7.9	2.53							
2-Feb-12	auto	8.1	7.9	2.53							
6-Feb-12	auto	8.1	7.9	2.53							
9-Feb-12	auto	8.2	7.9	3.80							
13-Feb-12	auto	8.2	7.9	3.80							
16-Feb-12	auto	7.6	7.9	-3.80							
20-Feb-12	auto	7.8	7.9	-1.27	21	-0.65	4.92	9.00	-10.30	6.24	±4.82
23-Feb-12	auto	7.8	7.9	-1.27							
27-Feb-12	auto	7.5	7.9	-5.06							
1-Mar-12	auto	7.4	7.9	-6.33							
5-Mar-12	auto	7.2	7.9	-8.86							
8-Mar-12	auto	6.8	7.9	-13.92[(3)]							
9-Mar-12	Manual	7.8	8.0	-2.25							
12-Mar-12	auto	7.8	7.9	-1.27							
15-Mar-12	auto	8.0	7.9	1.27							
22-Mar-12	auto	7.9	7.9	0.00							
29-Mar-12	auto	8.0	7.9	1.27							

[1] Acceptance criteria: ≤ 10%
[2] Acceptance criteria: ≤ ±10%
[3] Data invalidated back to the most recently passed precision check (3/5/12).

Table 2-6: 2nd Quarter CO Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Apr-12	auto	8.1	7.9	2.53	15	3.21	3.02	9.13	-2.71	4.05	+4.72
12-Apr-12	auto	8.3	7.9	5.06							
19-Apr-12	auto	8.6	7.9	8.86							
19-Apr-12	manual	7.8	8.0	-2.56							
26-Apr-12	auto	7.9	7.9	0.00							
3-May-12	auto	8.0	7.9	1.27							
10-May-12	auto	8.2	7.9	3.80							
17-May-12	auto	8.3	7.9	5.06							
24-May-12	auto	8.4	7.9	6.33							
31-May-12	auto	8.5	7.9	7.59							
7-Jun-12	auto	8.0	7.9	1.27							
10-Jun-12	auto	8.0	7.9	1.27							
14-Jun-12	auto	8.0	7.9	1.27							
21-Jun-12	auto	8.1	7.9	2.53							
28-Jun-12	auto	8.2	7.9	3.80							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-7: 3rd Quarter CO Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Jul-12	auto	8.2	7.9	3.80	12	-0.32	3.33	6.22	-6.84	4.68	±3.62
12-Jul-12	auto	8.3	7.9	5.06							
19-Jul-12	auto	8.3	7.9	5.06							
26-Jul-12	auto	7.6	7.9	-3.80							
2-Aug-12	auto	7.7	7.9	-2.53							
9-Aug-12	auto	7.7	7.9	-2.53							
16-Aug-12	auto	7.8	7.9	-1.27							
23-Aug-12	auto	7.9	7.9	0.00							
30-Aug-12	auto	7.9	7.9	0.00							
6-Sep-12	auto	7.9	7.9	0.00							
13-Sep-12	auto	7.6	7.9	-3.80							
20-Sep-12	auto	7.6	7.9	-3.80							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-8: 4th Quarter CO Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Oct-12	auto	7.6	7.9	-3.8	13	1.17	3.16	7.36	-5.03	4.36	+/-3.59
11-Oct-12	auto	7.7	7.9	-2.5							
18-Oct-12	auto	7.9	7.9	0.0							
25-Oct-12	auto	7.8	7.9	-1.3							
1-Nov-12	auto	7.9	7.9	0.0							
8-Nov-12	auto	7.9	7.9	0.0							
15-Nov-12	auto	8.1	7.9	2.5							
22-Nov-12	auto	8.0	7.9	1.3							
29-Nov-12	auto	8.2	7.9	3.8							
6-Dec-12	auto	8.3	7.9	5.1							
13-Dec-12	auto	8.3	7.9	5.1							
20-Dec-12	auto	8.4	7.9	6.3							
27-Dec-12	auto	7.8	7.9	-1.3							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-9: 1st Quarter NO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Jan-12	auto	80.1	79.3	1.01	20	2.21	2.44	6.99	-2.56	3.11	+3.24
12-Jan-12	auto	81.9	80.5	1.69							
19-Jan-12	auto	82.5	83.1	-0.68							
26-Jan-12	auto	82.6	80.2	3.03							
30-Jan-12	auto	82.5	80.6	2.35							
2-Feb-12	auto	84.2	79.3	6.24							
6-Feb-12	auto	82.6	78.5	5.24							
9-Feb-12	auto	82.2	78.6	4.58							
13-Feb-12	auto	82.3	77.9	5.65							
16-Feb-12	auto	80.7	80.4	0.41							
20-Feb-12	auto	75.8	74.2	2.14							
23-Feb-12	auto	75.6	75.9	-0.35							
27-Feb-12	auto	76.4	76.6	-0.22							
1-Mar-12	auto	77.7	77.1	0.82							
5-Mar-12	auto	79.3	75.7	4.76							
8-Mar-12	auto	79.5	74.6	6.54							
12-Mar-12	auto	80.8	79.9	1.09							
15-Mar-12	auto	80.0	79.9	0.14							
22-Mar-12	auto	80.5	80.6	-0.14							
29-Mar-12	auto	80.3	80.3	-0.04							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-10: 2nd Quarter NO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Apr-12	auto	80.1	79.7	0.50	13	-1.34	1.79	2.17	-4.85	2.47	-2.31
12-Apr-12	auto	80.1	80.2	-0.09							
19-Apr-12	auto	79.7	80.5	-1.00							
26-Apr-12	auto	80.0	79.9	0.18							
3-May-12	auto	79.9	79.7	0.26							
10-May-12	auto	78.6	78.8	-0.27							
17-May-12	auto	79.6	80.1	-0.65							
24-May-12	auto	78.8	79.8	-1.31							
31-May-12	auto	78.3	78.7	-0.45							
10-Jun-12	auto	73.1	75.3	-2.89							
14-Jun-12	auto	73.1	77.3	-5.45							
21-Jun-12	auto	73.2	75.2	-2.65							
28-Jun-12	auto	74.8	77.6	-3.61							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-11: 3rd Quarter NO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Jul-12	auto	76.0	77.7	-2.16	12	-2.47	1.23	-0.06	-4.88	1.73	-3.10
12-Jul-12	auto	76.6	76.4	0.25							
19-Jul-12	auto	76.5	78.4	-2.41							
26-Jul-12	auto	76.7	77.8	-1.37							
2-Aug-12	auto	75.9	79.4	-4.42							
9-Aug-12	auto	76.9	78.4	-1.87							
16-Aug-12	auto	76.1	78.6	-3.12							
23-Aug-12	auto	76.1	78.4	-2.97							
30-Aug-12	auto	76.2	78.4	-2.80							
6-Sep-12	auto	76.0	77.3	-1.73							
13-Sep-12	auto	76.1	79.2	-3.92							
20-Sep-12	auto	75.7	78.1	-3.09							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-12: 4th Quarter NO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Oct-12	auto	81.3	78.9	3.1	13	1.75	0.85	3.41	0.08	1.17	+2.17
11-Oct-12	auto	81.4	81.2	0.3							
18-Oct-12	auto	80.9	79.3	2.0							
25-Oct-12	auto	83.0	82.5	0.6							
1-Nov-12	auto	82.0	80.4	2.0							
8-Nov-12	auto	82.5	81.3	1.5							
15-Nov-12	auto	81.7	80.3	1.8							
22-Nov-12	auto	82.5	81.5	1.2							
29-Nov-12	auto	82.3	81.6	0.8							
6-Dec-12	auto	83.2	81.0	2.7							
13-Dec-12	auto	82.1	80.1	2.5							
20-Dec-12	auto	83.6	82.0	1.9							
27-Dec-12	auto	82.6	80.7	2.4							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-13: 1st Quarter O_3 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Jan-12	auto	87.2	90.0	-3.11	18	1.24	3.35	7.81	-5.33	4.35	±3.77
12-Jan-12	auto	92.8	90.0	3.11							
19-Jan-12	auto	94.3	90.0	4.78							
26-Jan-12	auto	95.0	90.0	5.56							
30-Jan-12	auto	87.5	90.0	-2.78							
2-Feb-12	auto	86.0	90.0	-4.44							
6-Feb-12	auto	93.5	90.0	3.89							
9-Feb-12	auto	92.3	90.0	2.56							
13-Feb-12	auto	85.9	90.0	-4.56							
16-Feb-12	auto	95.5	90.0	6.11							
20-Feb-12	auto	93.0	90.0	3.33							
23-Feb-12	auto	92.6	90.0	2.89							
27-Feb-12	auto	92.0	90.0	2.22							
1-Mar-12[3]	auto	-	-	-							
5-Mar-12[3]	auto	-	-	-							
8-Mar-12	auto	90.8	90.0	0.89							
12-Mar-12	auto	90.4	90.0	0.44							
15-Mar-12	auto	93.0	90.0	3.33							
22-Mar-12	auto	88.8	90.0	-1.33							
29-Mar-12	auto	89.5	90.0	-0.56							

[1] Acceptance criteria: ≤ 7%
[2] Acceptance criteria: ≤ ±7%
[3] Ozone pump failure resulted in invalid precision checks.

Table 2-14: 2nd Quarter O_3 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Apr-12	auto	0.0893	0.0900	-0.78	12	0.53	2.18	4.80	-3.75	3.06	±2.21
12-Apr-12	auto	0.0917	0.0900	1.89							
19-Apr-12	auto	0.0904	0.0900	0.44							
26-Apr-12	auto	0.0961	0.0900	6.78							
3-May-12[3]	-	-	-	-							
8-May-12	auto	0.0886	0.0900	-1.56							
10-May-12	auto	0.0890	0.0900	-1.11							
17-May-12	auto	0.0897	0.0900	-0.33							
24-May-12[4]	-	-	-	-							
1-Jun-12	manual	0.0800	0.0800	0.00							
7-Jun-12	auto	0.0894	0.0900	-0.67							
14-Jun-12	auto	0.0905	0.0900	0.56							
21-Jun-12	auto	0.0907	0.0900	0.78							
28-Jun-12	auto	0.0903	0.0900	0.33							

[1]Acceptance criteria: ≤ 7%
[2]Acceptance criteria: ≤ ±7%
[3] Ozone transfer standard out for recertification
[4] Unable to perform precision check due to broken ozone analyzer pump.

Table 2-15: 3rd Quarter O_3 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Jul-12	auto	0.0908	0.0900	0.89	12	0.70	0.52	1.72	-0.32	0.74	+0.98
12-Jul-12	auto	0.0900	0.0900	0.00							
19-Jul-12	auto	0.0904	0.0900	0.44							
26-Jul-12	auto	0.0908	0.0900	0.89							
2-Aug-12	auto	0.0904	0.0900	0.44							
9-Aug-12	auto	0.0906	0.0900	0.67							
16-Aug-12	auto	0.0917	0.0900	1.89							
23-Aug-12	auto	0.0905	0.0900	0.56							
30-Aug-12	auto	0.0904	0.0900	0.44							
6-Sep-12	auto	0.0900	0.0900	0.00							
13-Sep-12	auto	0.0910	0.0900	1.11							
20-Sep-12	auto	0.0910	0.0900	1.11							

[1]Acceptance criteria: ≤ 7%
[2]Acceptance criteria: ≤ ±7%

Table 2-16: 4th Quarter O_3 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppm)	Precision Gas Concentration (ppm)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Oct-12	auto	91.7	90.0	1.9	12	1.15	0.58	2.29	0.01	0.81	+1.45
11-Oct-12	auto	91.1	90.0	1.2							
18-Oct-12	auto	91.5	90.0	1.7							
25-Oct-12	auto	92.0	90.0	2.2							
1-Nov-12[3]	-	-	-	-							
8-Nov-12	auto	91.2	90.0	1.3							
15-Nov-12	auto	90.6	90.0	0.7							
22-Nov-12	auto	90.4	90.0	0.4							
29-Nov-12	auto	91.3	90.0	1.4							
6-Dec-12	auto	90.9	90.0	1.0							
13-Dec-12	auto	90.6	90.0	0.7							
20-Dec-12	auto	90.5	90.0	0.6							
27-Dec-12	auto	90.6	90.0	0.7							

[1]Acceptance criteria: ≤ 7%
[2]Acceptance criteria: ≤ ±7%
[3] Ozone transfer standard out for recertification.

Table 2-17: 1st Quarter SO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Jan-12	auto	77.5	81.0	-4.32	21	-0.89	1.71	2.46	-4.24	2.17	-1.90
12-Jan-12	auto	78.4	81.0	-3.21							
19-Jan-12	auto	78.6	78.0	0.77							
26-Jan-12	auto	77.8	78.0	-0.26							
30-Jan-12	auto	78.2	78.0	0.26							
2-Feb-12	auto	80.2	78.0	2.82							
6-Feb-12	auto	76.5	78.0	-1.92							
9-Feb-12	auto	77.8	78.0	-0.26							
13-Feb-12	auto	79.3	78.0	1.67							
16-Feb-12	auto	77.6	78.0	-0.51							
20-Feb-12	auto	76.6	78.0	-1.79							
23-Feb-12	auto	76.7	78.0	-1.67							
27-Feb-12	auto	77.6	78.0	-0.51							
1-Mar-12	auto	78.0	78.0	0.00							
5-Mar-12	auto	75.2	78.0	-3.59							
8-Mar-12	auto	75.7	78.0	-2.95							
9-Mar-12	Manual	78.3	79.2	-1.14							
12-Mar-12	auto	77.4	78.0	-0.77							
15-Mar-12	auto	77.7	78.0	-0.38							
22-Mar-12	auto	77.7	78.0	-0.38							
29-Mar-12	auto	77.6	78.0	-0.51							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-18: 2nd Quarter SO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Apr-12	auto	77.5	78	-0.64	14	-1.11	0.95	0.75	-2.97	1.29	-1.58
12-Apr-12	auto	77.7	78	-0.38							
19-Apr-12	auto	77.2	78.0	-1.03							
26-Apr-12	auto	76.6	78.0	-1.79							
3-May-12	auto	76.5	78.0	-1.92							
10-May-12	auto	77.3	78.0	-0.90							
17-May-12	auto	78.4	78.0	0.51							
24-May-12	auto	77.4	78.0	-0.77							
31-May-12	auto	78.0	78.0	0.00							
7-Jun-12	auto	77.7	78.0	-0.38							
10-Jun-12	auto	77.0	78.0	-1.28							
14-Jun-12	auto	76.3	78.0	-2.18							
21-Jun-12	auto	76.7	78.0	-1.67							
28-Jun-12	auto	75.6	78.0	-3.08							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-19: 3rd Quarter SO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
5-Jul-12	auto	77.7	78.0	-0.38	12	-1.26	0.66	0.03	-2.56	0.93	-1.60
12-Jul-12	auto	76.7	78.0	-1.67							
19-Jul-12	auto	76.2	78.0	-2.31							
26-Jul-12	auto	76.2	78.0	-2.31							
2-Aug-12	auto	77.4	78.0	-0.77							
9-Aug-12	auto	77.0	78.0	-1.28							
16-Aug-12	auto	77.0	78.0	-1.28							
23-Aug-12	auto	77.3	78.0	-0.90							
30-Aug-12	auto	77.8	78.0	-0.26							
6-Sep-12	auto	77.0	78.0	-1.28							
13-Sep-12	auto	76.7	78.0	-1.67							
20-Sep-12	auto	77.2	78.0	-1.03							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-20: 4th Quarter SO_2 Precision Statistics Summary

Period	Type of Precision Check	Analyzer Response (ppb)	Precision Gas Concentration (ppb)	Percent Difference (%)	Number of Checks	Average Percent Difference	Standard Deviation	Upper 95% Limit	Lower 95% Limit	CV Upper Bound[1]	Bias Estimate[2]
4-Oct-12	auto	77.1	78.0	-1.2	13	-0.33	0.96	1.56	-2.21	1.32	+/-1.06
11-Oct-12	auto	78.9	78.0	1.2							
18-Oct-12	auto	78.5	78.0	0.6							
25-Oct-12	auto	78.1	78.0	0.1							
1-Nov-12	auto	77.0	78.0	-1.3							
8-Nov-12	auto	76.1	78.0	-2.4							
15-Nov-12	auto	78.0	78.0	0.0							
22-Nov-12	auto	77.8	78.0	-0.3							
29-Nov-12	auto	77.1	78.0	-1.2							
6-Dec-12	auto	78.3	78.0	0.4							
13-Dec-12	auto	77.6	78.0	-0.5							
20-Dec-12	auto	78.0	78.0	0.0							
27-Dec-12	auto	78.2	78.0	0.3							

[1]Acceptance criteria: ≤ 10%
[2]Acceptance criteria: ≤ ±10%

Table 2-21: Network $PM_{2.5}$ Monitoring Precision Statistics

Period	Samplers	Number of Collocated Samples[1]	Concentration Levels	Average Percent Difference	Standard Deviation[2] (µg/m³)	Precision[3] (µg/m³)	Bias[4] (µg/m³)
1st Quarter (January 1 – March 31, 2012)	Primary FEM against Collocated FEM	61	≥ 2 µg/m³	12.6%	1.17	0.59	1.31
		75	All	-15.9%	1.22	0.61	1.36
	Primary FEM against Collocated FRM	10	≥ 2 µg/m³	14.3%	1.04	0.52	1.24
		10	All	14.3%	1.04	0.52	1.24
2nd Quarter (April 1 – June 30, 2012)	Primary FEM against Collocated FEM	11	≥2 µg/m³	15.1%	0.56	0.28	0.73
		15	All	33.3%	0.74	0.37	0.96
	Primary FEM against Collocated FRM	10	≥2 µg/m³	10.1%	1.82	0.91	1.63
		14	All	-182.4%	1.65	0.83	1.71
3rd Quarter (July 1 – September 30, 2012)	Primary FEM against Collocated FEM	24	≥2 µg/m³	-21.3%	0.68	0.34	1.03
		76	All	-45.5%	0.93	0.47	1.24
	Primary FEM against Collocated FRM	2	≥2 µg/m³	-34.6%	2.97	1.48	2.70
		14	All	-70.1%	1.16	0.58	1.56
4th Quarter (October 1 – December 31, 2012)	Primary FEM against Collocated FEM	77	≥2 µg/m³	-33.0%	1.09	0.54	1.98
		90	All	-43.9%	1.11	0.55	2.00
	Primary FEM against Collocated FRM	13	≥2 µg/m³	30.7%	1.81	0.90	1.39
		15	All	15.5%	1.69	0.85	1.48
Annual (January 1 – December 31, 2012)	Primary FEM against Collocated FEM	**173**	**≥2 µg/m³**	**-12.3%**	**1.12**	**0.56**	**1.53**
		256	All	-31.6%	1.13	0.56	1.52
	Primary FEM against Collocated FRM	**35**	**≥2 µg/m³**	**16.4%**	**1.64**	**0.82**	**1.49**
		53	All	-59.6%	1.42	0.71	1.52

[1] $PM_{2.5}$ network precision statistics represent data from the Deadhorse monitoring station samplers.
[2] Standard deviation of the absolute concentration differences for the population.
[3] Standard deviation of the absolute concentration difference for the population divided by 2 with a goal of ≤ 3 µg/m³ per quarter.
[4] Average over the population of the absolute value of the individual pair concentration difference with a goal of ≤ 4 µg/m³ per quarter.

2.4.2 ANALYTICAL LABORATORY PRECISION STATISTICS

Not applicable.

2.4.3 ANALYTICAL LABORATORY PRECISION STATISTICS FOR LEAD ANALYSIS OF PARTICULATE SAMPLES

Not applicable.

2.5 ACCURACY STATISTICS

The ambient air and meteorological monitoring systems are subjected to periodic calibrations and independent quality assurance performance audits. All calibration and audit equipment are documented as traceable to authoritative standards. The purpose of these calibration and audit checks is to challenge the monitoring systems with known inputs or collocated traceable authoritative standards with them to verify that each instrument response is accurate to within established tolerances.

Tables 2-22 through 2-39 summarize the accuracy statistics obtained during the project.

2.5.1 INSTRUMENT CALIBRATION STATISTICS

Single-point calibrations were performed on a daily basis on all gas pollutant analyzers throughout the monitoring year. The single-point calibrations consisted of challenging each instrument response with air scrubbed of all pollutants ("zero air") and air containing a National Institute of Standards and Technology (NIST) traceable standard gas concentration equal to 80 percent of the instrument's upper range limit (URL). If a single-point calibration zero or span drift limits are exceeded, ambient measurements are invalidated back to the most recent point in time where such measurements were known to be valid. Single-point calibration data for each parameter and parameter quality control (QC) performance statistics are provided in Appendix C.

Multi-point calibrations were performed on a biannual basis as recommended by the EPA (EPA-454/R-98-004). Additionally, multi-point calibrations were conducted under specific circumstances including: indication of analyzer malfunction, repairs or service that affected its calibration, and following significant interruptions in station operations. Multi-point calibrations consisted of challenging each instrument response with air scrubbed of all pollutants ("zero air") and at least four concentrations spanning 80 to 90 percent of the URL. The NO_2 converter efficiency was determined following the guidelines provided in the 40 CFR 50 – Appendix F. Tables 2-22 through 2-25 include calibration statistical summaries for CO, NO_2, O_3, and SO_2 analyzers, respectively.

Tables 2-26 and 2-27 summarize the quarterly quality control checks of the particulate samplers. These manual QC checks are conducted by SLR or on-site personnel and the data are transmitted to the SLR Anchorage office.

Meteorological calibrations are assessed semi-annually. Each sensor is assessed by collocating calibration sensors of NIST-traceable accuracy. Calibration results are presented in Tables 2-28 through 2-30. Refer to Appendix C for detailed calibration records for meteorological sensors.

If calibration checks reveal a sampler is operating outside of established quality control criteria, data is invalidated as far back as the most recently passed calibration. Refer to Section 2 for a discussion of any data that was invalidated due to failing accuracy.

Table 2-22: Calibration Summary – CO

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope[3]	Y-Intercept[4]	R^2	Pass/Fail[1]
January 2, 2012	0.0	0.4	-	4.3	1.0214	0.4172	0.99997	Pass
	8.0	8.5	6.4					
	17.4	18.2	4.7					
	29.8	31.1	4.4					
	39.7	40.9	3.0					
	44.6	45.8	2.8					
January 3, 2012	0.0	0.0	-	1.1	1.0051	0.0997	0.99994	Pass
	8.0	8.1	1.5					
	17.4	17.6	1.1					
	29.7	30.3	2.0					
	39.7	40.0	0.8					
	44.7	44.7	0.2					
February 15, 2012	0.0	0.3	-	1.4	0.9881	0.4031	0.99995	Pass
	7.9	8.3	3.9					
	17.4	17.6	1.2					
	29.8	30.1	1.1					
	39.7	39.7	0.0					
	44.7	44.3	-0.8					
March 9, 2012	0.0	-0.7	-	6.8	0.9758	-0.7908	0.99999	Pass
	8.0	7.0	-12.9[2]					
	17.4	16.1	-7.6					
	29.8	28.4	-4.7					
	39.7	38.0	-4.3					
	44.7	42.7	-4.3					
March 9, 2012	0.0	0.0	-	0.8	1.0043	-0.1479	0.99998	Pass
	8.0	7.8	-2.2					
	17.4	17.1	-1.6					
	29.8	29.8	0.1					
	39.7	39.7	0.1					
	44.7	44.8	0.2					

Table 2-22 Continued: Calibration Summary – CO

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope[3]	Y-Intercept[4]	R^2	Pass/Fail[1]
April 19, 2012	0.0	0.7	-	4.8	1.0337	0.3922	0.99994	Pass
	8.0	8.5	6.4					
	17.4	18.1	4.0					
	29.8	31.2	4.8					
	39.7	41.5	4.4					
	44.7	46.7	4.5					
May 31, 2012	0.0	0.0	-	2.6	0.9835	-0.1245	0.99999	Pass
	8.0	7.7	-3.9					
	17.4	16.8	-3.1					
	29.8	29.2	-2.2					
	39.8	39.1	-1.8					
	44.8	43.9	-1.9					
September 24, 2012	0.0	-0.1	-	2.9	0.9852	-0.2034	0.99997	Pass
	8.0	7.6	-5.2					
	17.4	16.8	-3.7					
	29.8	29.3	-1.8					
	39.7	39.0	-1.8					
	44.7	43.8	-2.0					
October 1, 2012	0.0	0.0	-	1.1	1.0028	-0.1625	0.99997	Pass
	8.0	7.7	-3.2					
	17.4	17.1	-1.6					
	29.8	29.8	0.1					
	39.8	39.7	-0.4					
	44.7	44.8	0.1					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±15%
2. $R^2 \geq 0.9950$
3. Slope ≥ 0.90 and ≤ 1.10
4. Y-intercept ≤ ±3% of full scale

[2]Multipoint calibration was in response to failed precision check on March 8th

Table 2-23: Calibration Summary – NO_2

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Converter Efficiency	Pass/Fail[1]
January 2, 2012	0	0	-	5.2	1.0475	0.0005	0.99999	100.2%	Pass
	75	80	6.1						
	163	172	5.4						
	286	300	4.8						
	371	389	4.8						
	401	421	5.0						
January 3, 2012	0	0	-	1.2	1.0040	0.0010	0.99999	99.9%	Pass
	77	79	3.1						
	165	167	1.1						
	288	290	0.8						
	371	374	0.7						
	402	404	0.5						
February 15, 2012	0	0	-	4.0	1.0294	0.0012	0.99998	100.1%	Pass
	77	82	6.6						
	164	169	3.5						
	288	298	3.6						
	375	387	3.3						
	405	417	3.1						
May 31, 2012	0	0	-	2.0	0.9763	0.0005	0.99998	100.0%	Pass
	78	77	-2.0						
	165	162	-1.7						
	290	285	-1.7						
	378	369	-2.5						
	408	399	-2.4						
September 24, 2012	0	0	-	3.6	0.9566	0.0009	0.99999	99.3%	Pass
	77	75	-2.1						
	162	156	-3.4						
	289	277	-4.1						
	377	360	-4.4						
	406	390	-3.9						

Table 2-23: Calibration Summary – NO_2

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Converter Efficiency	Pass/Fail[1]
October 1, 2012	0	0	-	0.3	1.0001	-0.0001	0.99999	100.1%	Pass
	80	80	0.5						
	169	168	-0.3						
	299	298	-0.4						
	374	375	0.2						
	405	305	0.0						

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.90 and ≤ 1.10
3. R^2 ≥ 0.9950
4. Y-intercept ≤ ±3% of full scale
5. Converter efficiency ≥ 96.0%

Table 2-24: Calibration Summary – O_3

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
January 2, 2012	0.000	0.000	-	2.1	0.9929	-0.0017	0.99996	Pass
	0.080	0.076	-4.6					
	0.176	0.171	-2.7					
	0.299	0.296	-1.0					
	0.399	0.394	-1.3					
	0.449	0.445	-0.9					
February 15, 2012	0.001	0.009	-	0.7	0.9801	0.0042	0.99989	Pass
	0.083	0.083	-0.5					
	0.179	0.177	-1.0					
	0.301	0.300	-0.6					
	0.402	0.398	-1.0					
	0.452	0.449	-0.7					
May 31, 2012	0.001	0.000	-	0.8	0.9880	0.0009	1.00000	Pass
	0.081	0.081	0.1					
	0.176	0.175	-0.9					
	0.302	0.299	-1.0					
	0.403	0.399	-1.0					
	0.454	0.450	-0.9					
September 24, 2012	0.000	0.002	-	0.7	0.9878	0.0012	0.99999	Pass
	0.081	0.081	-0.5					
	0.177	0.176	-0.7					
	0.303	0.302	-0.4					
	0.404	0.401	-0.8					
	0.456	0.451	-1.1					
October 1, 2012	-0.001	0.000	-	0.6	0.9897	0.0015	0.99999	Pass
	0.080	0.081	0.9					
	0.176	0.176	0.1					
	0.303	0.303	-0.3					
	0.403	0.400	-0.8					
	0.454	0.451	-0.8					

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.93 and ≤ 1.07
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale

Table 2-25: Calibration Summary – SO_2

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
January 2, 2012	0	1	-	1.7	1.0224	-0.0003	0.99989	Pass
	79	79	0.0					
	172	174	1.2					
	294	304	3.4					
	392	397	1.3					
	439	450	2.5					
January 3, 2012	0	0	-	0.5	1.0038	-0.0004	0.99999	Pass
	78	78	-1.3					
	172	173	0.6					
	293	294	0.3					
	391	391	0.0					
	440	442	0.5					
January 21, 2012	0.0	-1.0	-	30.7	1.2968	0.0013	0.99992	Fail[2]
	78.6	104.0	32.3					
	171.3	224.0	30.8					
	293.5	385.0	31.2					
	391.4	511.0	30.6					
	440.4	568.0	29.0					
January 21, 2012	0.0	0.0	-	1.0	1.0107	-0.0001	0.99999	Pass
	78.6	80.0	1.7					
	171.3	172.0	0.4					
	293.5	296.0	0.9					
	391.4	396.0	1.2					
	440.4	445.0	1.0					
February 15, 2012	0.0	0.1	-	0.3	1.0014	-0.0001	0.99999	Pass
	78.5	78.0	-0.6					
	171.6	171.9	0.2					
	293.5	294.0	0.2					
	391.5	391.0	-0.1					
	439.9	441.0	0.3					

Table 2-25 Continued: Calibration Summary – SO_2

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail[1]
March 9, 2012	0.0	1.5	-	0.6	0.9961	-0.0005	0.99995	Pass
	79.2	78.3	-1.2					
	172.0	171.4	-0.3					
	293.7	293.6	0.0					
	391.5	391.3	0.0					
	440.4	435.3	-1.2					
May 31, 2012	0.0	-0.3	-	1.5	0.9872	-0.0005	0.99997	Pass
	78.7	78.3	-0.5					
	171.2	167.6	-2.1					
	294.0	287.9	-2.1					
	392.0	386.3	-1.5					
	441.4	436.7	-1.1					
September 24, 2012	0.0	2.0	-	2.1	0.9865	-0.0010	0.99997	Pass
	79.0	76.0	-3.4					
	172.0	168.0	-2.3					
	294.0	289.0	-1.7					
	392.0	384.0	-2.0					
	441.0	436.0	-1.1					
October 1, 2012	0.0	0.0	-	0.5	0.9970	-0.0002	0.99999	Pass
	78.5	77.3	-1.6					
	171.5	171.1	-0.2					
	293.5	293.0	-0.2					
	392.9	392.0	-0.2					
	441.3	439.0	-0.5					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.90 and ≤ 1.10
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale

[2] Data invalidated back to last valid precision calibration; analyzer recalibrated and passed.

Table 2-26: Quality Control Checks $PM_{2.5}$

Date	Ambient Temperature[1] (˚C)			Barometric Pressure[2] (mm Hg)			Time (hh:mm:ss)			Flow Rate[3] (L/min)		
	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff
3-Jan-12[4]	-26.9	-26.9	0.0	753	753	0	15:11:13	15:09:00	00:02:13	16.7	16.66	0.2%
15-Feb-12	-19.9	-18.9	-1.0	751	751	0	13:26:45	13:25:15	00:01:30	16.7	16.80	-0.6%
2-Mar-12	-38.0	-38.1	0.1	750	750	0	-[5]	-[5]	-[5]	16.7	16.70	0.0%
2-Apr-12	-22.9	-23.1	0.2	765	765	0	11:31:00	11:32:19	-00:01:19	16.7	16.70	0.0%
1-May-12	-9.9	-9.1	-0.8	755	757	-2	09:47:00	09:49:41	-00:02:41	16.7	16.70	0.0%
2-Jul-12[6]	0.2	7.0	-6.8	755	755	0	08:14:30	08:13:49	00:00:41	16.7	16.70	0.0%
17-Jul-12	10.2	10.5	-0.3	760	756	4	08:26:00	08:25:17	00:00:43	16.7	16.70	0.0%
4-Aug-12	9.9	10.8	-0.9	759	755	4	08:50:30	08:50:52	-00:00:22	16.7	16.70	0.0%
3-Sep-12	6.3	7.0	-0.7	754	749	5	13:48:30	13:48:27	00:00:03	16.7	16.70	0.0%
1-Oct-12	3.1	3.1	0.0	765	765	0	17:09:00	17:09:00	00:00:00	16.7	16.78	-0.5%
6-Oct-12	2.5	2.0	0.5	755	758	-3	10:32:00	10:33:28	-00:01:28	16.7	16.70	0.0%
2-Nov-12	-11.8	-11.1	-0.7	764	761	3	12:28:15	12:26:21	00:01:54	16.7	16.70	0.0%
3-Dec-12	-2.0	-1.0	-1.0	764	761	3	09:54:00	09:53:06	00:00:54	16.7	16.70	0.0%

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] Multi-point calibration performed
[5] Non-critical check
[6] An inexperienced operator performed July 2 QC checks and thus they were not performed correctly. The apparently failing ambient temperature check and leak check were not true failures. An additional QC check on July 17, prior to any further calibrations, confirmed that the sampler was operating within reference criteria.

Table 2-27: Quality Control Checks PM_{10}

Date	Ambient Temperature[1] (˚C)			Barometric Pressure[2] (mm Hg)			Time (hh:mm:ss)			Flow Rate[3] (L/min)		
	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff
3-Jan-12[4]	-26.4	-26.4	0.0	754	753	1	15:13:12	15:11:00	00:2:12	16.7	16.86	-0.9%
15-Feb-12	-19.9	-19.3	-0.6	750	751	-1	13:24:25	13:22:45	00:01:40	16.7	16.94	-1.4%
2-Mar-12	-41.3	-41.1	-0.2	750	750	0	-[5]	-[5]	-[5]	16.7	16.70	0.0%
2-Apr-12	-23.0	-22.4	-0.6	765	765	0	11:30:00	11:31:44	-00:01:44	16.7	16.70	0.0%
1-May-12	-9.1	-8.7	-0.4	755	757	-2	09:46:00	09:48:23	-00:02:23	16.7	16.70	0.0%
2-Jul-12[6]	-2.0	6.8	-8.8	755	755	0	08:15:00	08:12:47	00:02:13	16.7	16.70	0.0%
17-Jul-12	11.0	10.0	1.0	753	756	-3	08:27:30	08:24:46	00:02:44	16.7	16.70	0.0%
4-Aug-12	10.7	10.5	0.2	752	755	-3	08:49:45	08:52:42	-00:02:57	16.7	16.70	0.0%
3-Sep-12	7.0	7.0	0.0	752	749	3	13:50:00	12:47:35	00:02:25	16.7	16.70	0.0%
1-Oct-12	2.6	2.7	-0.1	762	762	0	17:19:00	17:19:00	00:00:00	16.7	16.70	0.0%
6-Oct-12	2.5	2.2	0.3	755	755	0	10:32:30	10:32:58	-00:00:28	16.7	16.70	0.0%
2-Nov-12	-11.3	-11.1	-0.2	765	761	4	12:27:45	12:25:39	00:02:06	16.7	16.70	0.0%
3-Dec-12	-3.0	-2.0	-1.0	764	762	2	09:51:30	09:51:52	-00:00:22	16.7	16.70	0.0%

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] Multi-point calibration performed
[5] Non-critical check
[6] An inexperienced operator performed July 2 QC checks and thus they were not performed correctly. The apparently failing ambient temperature check and leak check were not true failures. An additional QC check on July 17, prior to any further calibrations, confirmed that the sampler was operating within reference criteria.

Table 2-28: May 31, 2012 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
Time	≤ ±5	mm:ss	-00:12	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	-0.11	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.11	Pass
Air Temperature Difference	≤ ±0.10	°C	0.00	Pass
Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 1.0	g-cm	0.2	Pass
Wind Direction Alignment	≤ ±5	Degree	2.2	Pass
Wind Direction Accuracy	≤ ±5	Degree	0.8	Pass
Wind Direction Linearity	≤ ±3	Degree	0.4	Pass
Wind Direction Torque	≤ 11.0	g-cm	10.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.04	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.300	Pass
Solar Radiation Accuracy	≤ ±5	%	3.2	Pass

Table 2-29: September 25, 2012 Meteorological Calibration Summary

Parameter	Limit	Units	Error	Status
Time	≤ ±5	mm:ss	00:15	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	0.08	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.08	Pass
Air Temperature Difference	≤ ±0.10	°C	0.00	Pass
Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 1.0	g-cm	0.3	Pass
Wind Direction Alignment	≤ ±5	Degree	-2.6	Pass
Wind Direction Accuracy	≤ ±5	Degree	1.5	Pass
Wind Direction Linearity	≤ ±3	Degree	0.5	Pass
Wind Direction Torque	≤ 11.0	g-cm	6.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.14	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass
Solar Radiation Accuracy	≤ ±10	W/m^2	5.6	Pass

Table 2-30: October 1, 2012 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
Time	≤ ±5	mm:ss	00:00	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	0.08	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.07	Pass
Air Temperature Difference	≤ ±0.10	°C	0.06	Pass
Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 1.0	g-cm	0.4	Pass
Wind Direction Alignment	≤ ±5	Degree	1.8	Pass
Wind Direction Accuracy	≤ ±5	Degree	3.0	Pass
Wind Direction Linearity	≤ ±3	Degree	2.0	Pass
Wind Direction Torque	≤ 11.0	g-cm	5.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.20	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass

2.5.2 INDEPENDENT QUALITY ASSURANCE AUDITS

Gas analyzer performance audits involve challenging the analyzer with known concentrations of pollutants. For each concentration challenge, the difference between the audit gas concentration and analyzer response is assessed and compared to PSD limits. Results of the gas analyzer audits conducted during the monitoring year are presented in Tables 2-31 to 2-34. The gas analyzers performance audit acceptance criterion for an individual analyzer is that the mean absolute difference between the audit gas concentration and analyzer response is equal to or less than 15 percent for CO, NO_2, and SO_2 and equal to or less than 10 percent for O_3. Linear regression acceptance criteria of the best-fit line of individual pollutant parameter audit points are: a) the slope is greater than or equal to 0.85 and less than or equal to 1.15, b) the y-intercept is less than or equal to 3 percent of the full scale of the analyzer, and c) the R-squared value is greater than or equal to 0.995.

The performance audits of $PM_{2.5}$ and PM_{10} samplers challenge the flow rate of the monitors against independent instruments that are calibrated and traceable to National Institute of Standards and Technology (NIST) transfer standards. Audits of the $PM_{2.5}$ and PM_{10} are conducted using an audit orifice transfer standard (BGI Delta Cal or equivalent). Results of the PM sampler audits are presented in Tables 2-35 and 2-36.

Meteorological performance audits involve challenging the sensors with known inputs or by using calibrated instruments collocated with the sensor. For each reading, the difference between the station value and the expected value is compared with established PSD limits to assess the accuracy of the sensor. Results of the meteorological audits conducted throughout the monitoring year are presented in Tables 2-37 to 2-38.

AMS Tech LLC. completed performance audits on all station monitors. All meteorological sensors and ambient air analyzers were found to be operating within acceptable criteria throughout the monitoring year. Complete performance audit findings and details are provided in Appendix C.

In order to satisfy the $PM_{2.5}$ Performance Evaluation Program (PEP) audit requirements specified in Title 40 CFR Part 58, Appendix A, Section 3.2.7, the Nuiqsut station is associated with the ConocoPhillips North Slope air monitoring network. Within that network, special $PM_{2.5}$ quality assurance requirements such as $PM_{2.5}$ collocation sampling and PEP audits are satisfied at an alternate location. During the 2012 monitoring year this audit occurred at the Deadhorse monitoring station. This “PEP-like” audit is designed to satisfy the intent of the requirements to obtain an independent assessment of system bias and is a comparable program to that of the PEP audit program. Results of the PEP audit at Deadhorse station are summarized in Table 2-39 and the full audit report is available in Appendix C.

EPA recommends that a technical systems audit (TSA) be conducted to serve as a qualitative review of all aspects of a monitoring program. The systems audit includes a review of the program plan, station site, facilities, equipment, personnel, procedures, record keeping, data validation and data reporting. An annual TSA was performed in December 2012 at the Nuiqsut monitoring station. The audit indicated that the monitoring project is staffed with experienced personnel with a defined organization, and that the station is well-planned and properly sited according to criteria recommended by the EPA. Appendix C contains the complete technical systems audit report.

Table 2-31: Performance Audit Summary – CO

Period	Audit Point	Audit Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Pass/Fail[1]
						Slope	Y-Intercept	R^2	
February 23, 2012	0	0.00	0.29	-	3.0	0.9722	0.085	0.9998	Pass
	1	2.06	2.01	-2.4					
	2	6.77	6.47	-4.5					
	3	21.66	21.21	-2.1					
June 8, 2012	0	0.00	0.29	-	2.1	0.9855	0.221	1.0000	Pass
	1	2.07	2.14	3.4					
	2	6.92	7.09	2.5					
	3	22.21	22.10	-0.5					
September 19, 2012	0	0.00	0.29	-	2.1	0.9556	0.182	1.0000	Pass
	1	2.06	2.05	-0.5					
	2	6.86	6.71	-2.2					
	3	22.08	21.30	-3.5					
October 20, 2012	0	0.00	0.29	-	0.6	1.0027	0.095	0.9999	Pass
	1	2.06	2.05	-0.5					
	2	6.87	6.84	-0.4					
	3	21.99	22.20	1.0					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.90 and ≤ 1.10
3. R^2 ≥ 0.9950
4. Y-intercept ≤ ±3% of full scale

Table 2-32: Performance Audit Summary – NO_2

Period	Audit Point	Audit Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Converter Efficiency	Pass/Fail[1]
						Slope	Y-Intercept	R^2		
February 23, 2012	0	0	0	-	5.4	0.9367	0.732	1.0000	98.5%	Pass
	1	45	43	-4.4						
	2	209	198	-5.3						
	3	361	338	-6.4						
June 8, 2012	0	0	0	-	4.9	0.9488	0.316	1.0000	100.0%	Pass
	1	78	74	-4.7						
	2	252	240	-4.7						
	3	379	359	-5.2						
September 19, 2012	0	0	0	-	4.8	0.9536	-0.016	1.0000	100.0%	Pass
	1	38	36	-5.3						
	2	63	60	-4.3						
	3	253	241	-4.7						
October 20, 2012	0	0	0	-	4.6	0.9423	0.424	1.0000	100.0	Pass
	1	40	39	-2.5						
	2	69	65	-5.8						
	3	267	252	-5.6						

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.90 and ≤ 1.10
3. R^2 ≥ 0.9950
4. Y-intercept ≤ ±3% of full scale
5. Converter efficiency ≥ 96.0%

Table 2-33: Performance Audit Summary – O_3

Period	Audit Point	Audit Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Pass/Fail[1]
						Slope	Y-Intercept	R^2	
February 23, 2012	0	0.000	-0.001	-	0.6	1.0068	-1.247	1.0000	Pass
	1	0.075	0.074	-1.3					
	2	0.148	0.148	0.0					
	3	0.249	0.249	0.0					
	4	0.450	0.452	0.4					
June 8, 2012	0	0.000	0.000	-	0.2	0.9977	0.810	1.0000	Pass
	1	0.075	0.075	0.0					
	2	0.147	0.149	1.4					
	3	0.244	0.245	0.4					
	4	0.437	0.436	-0.2					
September 19, 2012	0	0.000	0.000	-	1.9	1.0148	0.098	1.0000	Pass
	1	0.035	0.036	2.9					
	2	0.067	0.068	1.5					
	3	0.147	0.149	1.4					
	4	0.392	0.398	1.5					
October 20, 2012	0	0.000	0.000	-	3.6	1.0212	0.917	1.0000	Pass
	1	0.035	0.037	5.7					
	2	0.065	0.068	4.6					
	3	0.144	0.148	2.8					
	4	0.389	0.398	2.3					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale

Table 2-34: Performance Audit Summary – SO_2

Period	Audit Point	Audit Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Pass/Fail[1]
						Slope	Y-Intercept	R^2	
February 23, 2012	0	0	0	-	5.6	0.9485	-0.556	1.0000	Pass
	1	73	69	-5.9					
	2	241	227	-5.9					
	3	434	412	-5.1					
June 8, 2012	0	0	0	-	1.4	0.9784	0.858	1.0000	Pass
	1	74	74	0.4					
	2	246	242	-1.8					
	3	443	434	-2.0					
September 19, 2012	0	0	0	-	1.9	0.9729	0.381	1.0000	Pass
	1	49	48	-1.4					
	2	73	72	-1.8					
	3	244	238	-2.6					
October 20, 2012	0	0	0	-	0.3	0.9910	0.328	1.0000	Pass
	1	50	50	0.0					
	2	73	73	0.0					
	3	245	243	-0.8					

[1]Acceptance criteria:
1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.9 and ≤ 1.10
3. R^2 ≥ 0.9950
4. Y-intercept ≤ ±3% of full scale

Table 2-35: Performance Audit Summary – $PM_{2.5}$

Period	External Leak Check Error (LPM)	Ambient Temperature Error (°C)	Ambient Pressure Error (mmHg)	Flow Rate		Pass/Fail[1]
				Flow Rate Accuracy Percent Error (%)	Design Flow Test Percent Error (%)	
February 23, 2012	0.0	1.4	-5	-1.1	1.1	Pass
June 8, 2012	0.1	-0.1	2	2.5	-2.4	Pass
September 20, 2012	0.2	0.4	-4	0.6	-0.6	Pass
October 19, 2012	0.1	0.0	4	0.6	-0.6	Pass

[1] Acceptance criteria:
1. Leak check ≤ ±1.0 LPM
2. Temperature ≤ ±2.0 °C
3. Pressure ≤ ± 10 mmHg
4. Flow rate error ≤ ± 4% audit standard
5. Design flow test ≤ ± 5% design flow rate

Table 2-36: Performance Audit Summary – PM_{10}

Period	External Leak Check Error (LPM)	Ambient Temperature Error (°C)	Ambient Pressure Error (mmHg)	Flow Rate		Pass/Fail[1]
				Flow Rate Accuracy Percent Error (%)	Design Flow Test Percent Error (%)	
February 23, 2012	0.0	1.3	-5	2.4	-2.3	Pass
June 8, 2012	0.2	0.3	-4	0.6	-0.6	Pass
September 20, 2012	0.2	-0.4	3	0.6	-0.6	Pass
October 19, 2012	0.0	0.2	1	-1.2	1.2	Pass

[1] Acceptance criteria:
1. Leak check ≤ ±1.0 LPM
2. Temperature ≤ ±2.0 °C
3. Pressure ≤ ± 10 mmHg
4. Flow rate error ≤ ± 4% audit standard
5. Design flow test ≤ ± 5% design flow rate

Table 2-37: June 8, 2012 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 0.5	m/s	0.16	Pass
Wind Direction Accuracy	≤ ±5	Degree	-2	Pass
Wind Direction Linearity	≤ ±3	Degree	1	Pass
Wind Direction Torque	≤ 0.5	m/s	0.35	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.63	Pass
Vertical Wind Speed Torque	≤ 0.25	m/s	0.16	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	-0.06	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.06	Pass
Air Temperature Difference	≤ ±0.10	°C	0.04	Pass
Solar Radiation Accuracy < 200 W/m^2	≤ ±10	W/m^2	2.0	Pass
Solar Radiation Accuracy ≥ 200 W/m^2	≤ ±5	Mean % error	1.2	Pass

Table 2-38: October 20, 2012 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 0.50	m/s	0.16	Pass
Wind Direction Accuracy	≤ ±5	Degree	2	Pass
Wind Direction Linearity	≤ ±3	Degree	1	Pass
Wind Direction Torque	≤ 0.50	m/s	0.32	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	-0.07	Pass
Vertical Wind Speed Torque	≤ 0.25	m/s	0.14	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	0.18	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.21	Pass
Air Temperature Difference	≤ ±0.10	°C	0.03	Pass
Solar Radiation Accuracy ≤ 200 W/m^2	≤ ±10	W/m^2	3.6	Pass

Table 2-39: Deadhorse $PM_{2.5}$ PEP Audit Results

Date	BAM 1020 Results ($\mu g/m^3$)	PEP Audit Results ($\mu g/m^3$)	Difference ($\mu g/m^3$)	Bias[1] ($\mu g/m^3$)
10-Jul-2012	2.3	3.53	-1.23	0.47
12-Jul-2012	1.7	1.77	-0.07	
13-Jul-2012	1.2	2.57	-1.37	
14-Jul-2012	3.5	2.44	1.06	
15-Jul-2012	2.9	1.68	1.22	
16-Jul-2012	2.2	0.04	2.16	
17-Jul-2012	1.1	1.47	-0.37	
18-Jul-2012	0.9	1.52	-0.62	
19-Jul-2012	4.1	0.67	3.43	

[1] Average over the population of the absolute value of the individual pair concentration differences with a goal of ≤ 4 $\mu g/m^3$ per quarter.

3. MONITORING DATA NETWORK SUMMARY

3.1 AIR QUALITY DATA SUMMARY

Table 3-1 provides quarterly and annual averages of the criteria pollutant concentrations measured from January 1, 2012, through December 31, 2012, and compared to National and Alaska Air Quality Standards (NAAQS/AAAQS). The highest and second highest critical pollutant concentrations are also provided in Table 3-1 and compared to the respective primary and secondary air quality standards. Figures 3-1 through 3-9 provide plots of annual averages of the criteria pollutant concentrations at the Nuiqsut station along with respective NAAQS/AAAQS standards for comparison.

Table 3-1: Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Carbon Monoxide (**CO**)	35 ppm (40,000 µg/m^3)	1-Hour[1]	1st Highest, 1-Hour Average	1	1	1	1	**1**	**2.9%**
			2nd Highest, 1-Hour Average	1	1	1	1	**1**	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour[1]	1st Highest, 8-Hour Average	1	1	1	1	**1**	**11.1%**
			2nd Highest, 8-Hour Average	1	1	1	1	**1**	**11.1%**
Nitrogen Dioxide (**NO_2**)	100.0 ppb (190 µg/m^3)	1-Hour[2]	Daily Max 1-Hour Averages (98th Percentile)	-	-	-	-	**18.2**	**18.2%**
			1st Highest, 1-Hour Average	33.5	14.4	16.8	31.6	**33.5**	**33.5%**
			2nd Highest, 1-Hour Average	33.4	13.6	14.6	28.0	**33.4**	**33.4%**
	53 ppb (100 µg/m^3)	Annual	Average of Period	2	1	1	1	**1**	**1.9%**
Ozone (**O_3**)	0.075 ppm (150 µg/m^3)	8-Hour[3]	4th Highest, 8-Hour Average	0.039	0.044	0.037	0.041	**0.044**	**58.7%**
			1st Highest, 8-Hour Average	0.039	0.045	0.038	0.041	**0.045**	**60.0%**
			2nd Highest, 8-Hour Average	0.039	0.045	0.038	0.041	**0.045**	**60.0%**

[1] Not to be exceeded more than once each year.
[2] To attain this standard, the 3-year average of the 98th percentile of the annual daily maximum 1-hour average must not exceed 100 ppb. The 1-hour daily standard is a federal standard (NAAQS), but has not been incorporated into the Alaska Ambient Air Quality Standards (AAAQS) yet.
[3] To attain this standard, the 3-year average of the annual fourth-highest daily maximum 8-hour average must not exceed 0.075 ppm.

Table 3-1 Continued: Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Sulfur Dioxide (SO_2)	75.0 ppb (196 μg/m^3)	1-Hour[4]	Daily Max 1-Hour Averages (99th Percentile)	-	-	-	-	**1.9**	**2.5%**
			1st Highest, 1-Hour Average	2.2	4.2	1.3	1.5	**4.2**	**5.6%**
			2nd Highest, 1-Hour Average	2.1	2.5	1.3	1.5	**2.5**	**3.3%**
	500.0 ppb (1,300 μg/m^3)	3-Hour[5]	1st Highest, 3-Hour Average	1.7	2.4	1.3	1.5	**2.4**	**0.5%**
			2nd Highest, 3-Hour Average	1.6	1.6	1.2	1.4	**1.7**	**0.3%**
	140.0 ppb (365 μg/m^3)	24-Hour[5]	1st Highest, 24-Hour Average	1.3	1.1	1.2	1.4	**1.4**	**1.0%**
			2nd Highest, 24-Hour Average	1.2	0.9	1.1	1.4	**1.4**	**1.0%**
	30.0 ppb (80 μg/m^3)	Annual	Average of Period	0.0	0.0	0.4	0.2	**0.0**	**0.0%**

[4] To attain this standard, the 3-year average of the 99th percentile of the annual daily maximum 1-hour average must not exceed 75.0 ppb.
[5] Not to be exceeded more than once each year.

Table 3-1 Continued: Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Particulate Matter <2.5 microns (**$PM_{2.5}$**)	35.0 μg/m^3	24-Hour[6]	98th Percentile, 24-Hour Average	-	-	-	-	**5.9**	**16.9%**
			1st Highest, 24-Hour Average	5.2	6.5	7.1	9.6	**9.6**	**27.4%**
			2nd Highest, 24-Hour Average	5.0	6.0	5.9	9.0	**9.0**	**25.7%**
	15.0 μg/m^3	Annual[7]	Average of Period	2.0	2.2	1.9	2.0	**2.0**	**13.3%**
Particulate Matter <10 microns[1] (**PM_{10}**)	150 μg/m^3	24-Hour[8,9]	1st Highest, 24-Hour Average	10	20	40	10	**40**	**26.7%**
			2nd Highest, 24-Hour Average	10	10	40	10	**40**	**26.7%**

[6] To attain this standard, the 3-year average of the 98th percentile of the 24-hour concentration must not exceed 35.0 μg/m^3.
[7] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentration must not exceed 15.0 μg/m^3.
[8] Not to be exceeded more than once per year on average over three years.
[9] 40 CFR Appendix K requires that reportable concentrations of PM_{10} be rounded to the nearest 10 μg/m^3; actual measurement results are within Appendix C.

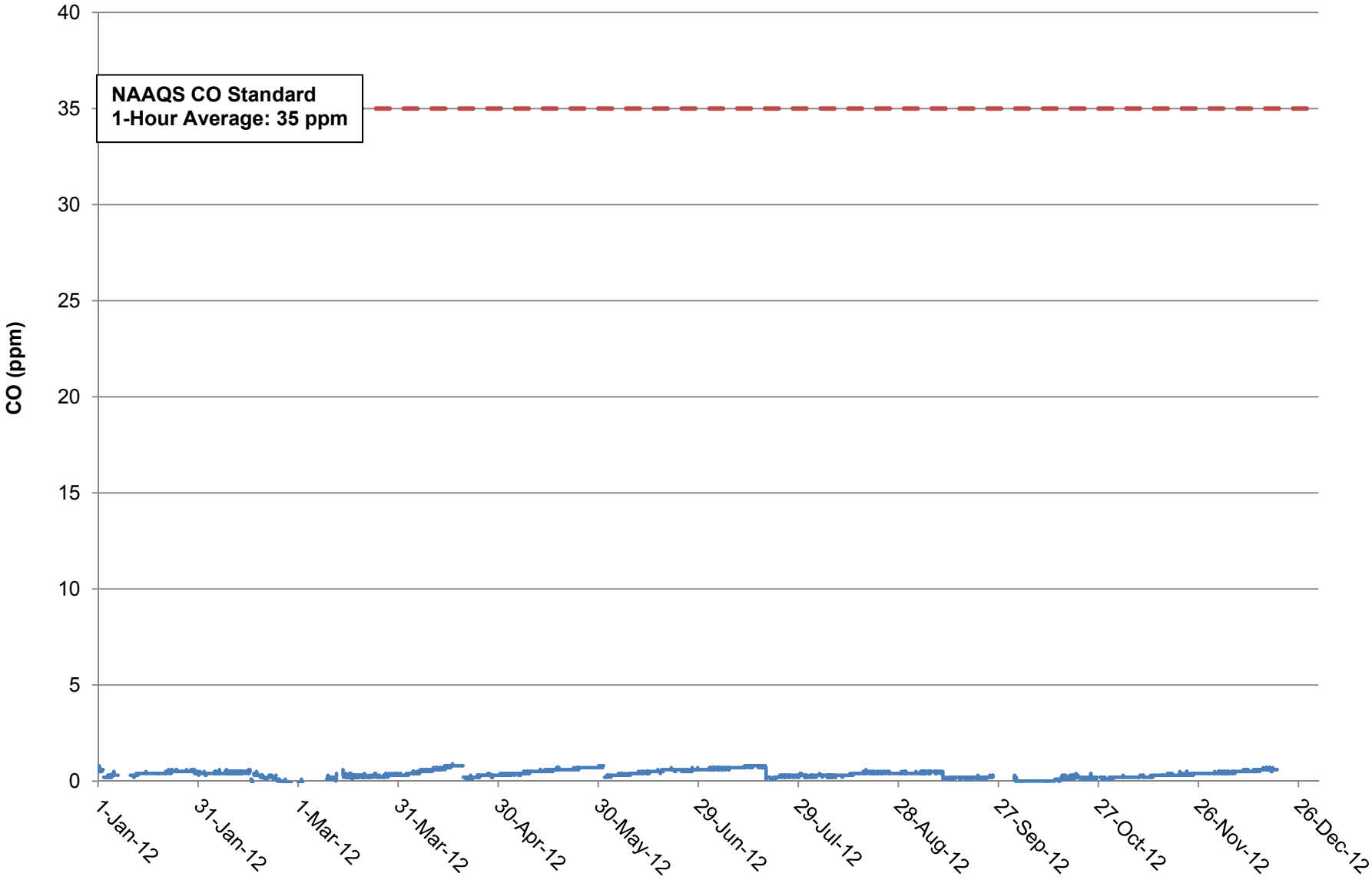


Figure 3-1: 1-Hour Average CO and NAAQS/AAAQS Standard

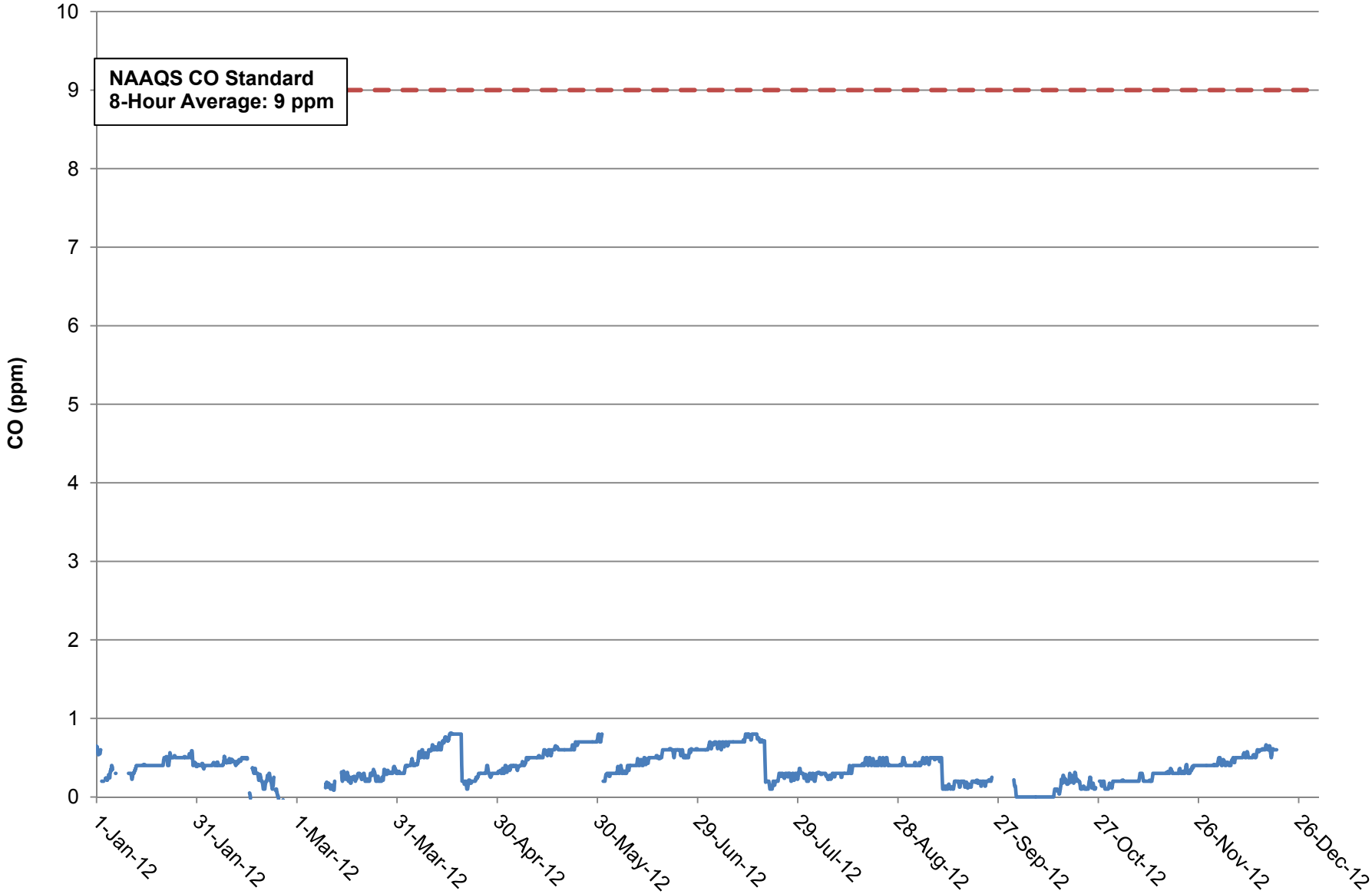


Figure 3-2: 8-Hour Average CO and NAAQS/AAAQS Standard

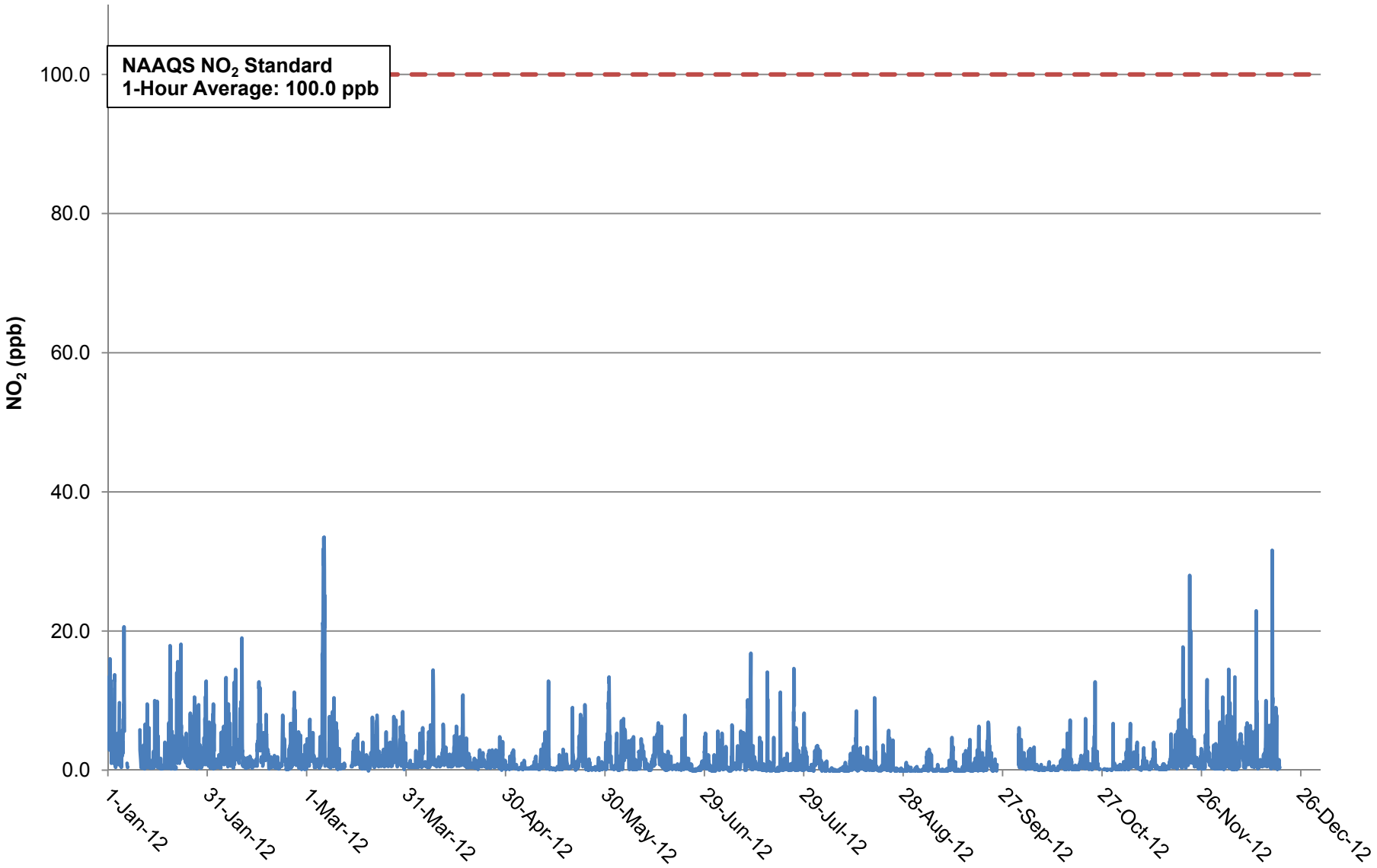


Figure 3-3: 1-Hour Average NO_2 and NAAQS Standard

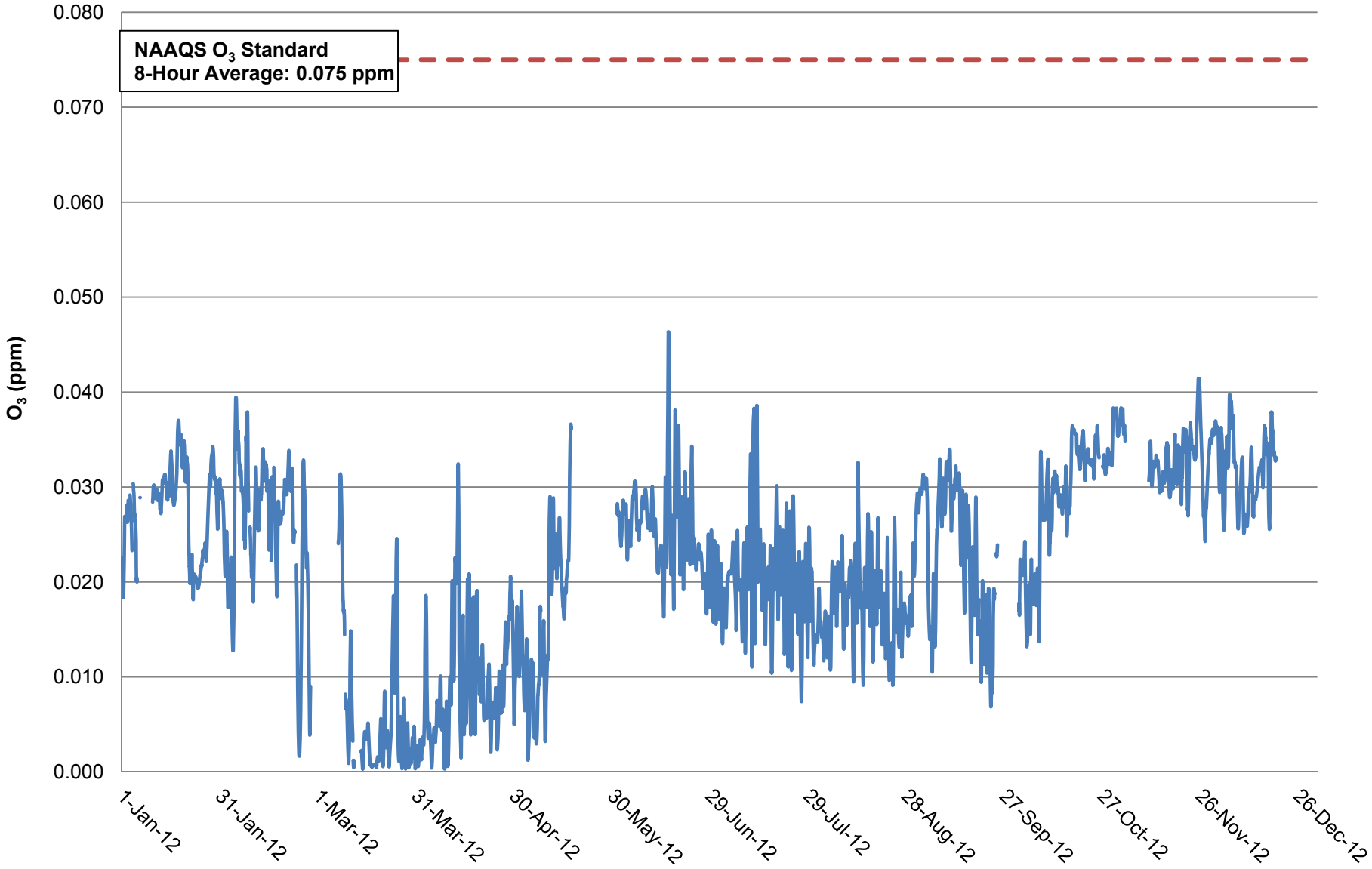


Figure 3-4: 8-Hour Average O_3 and NAAQS/AAAQS Standard

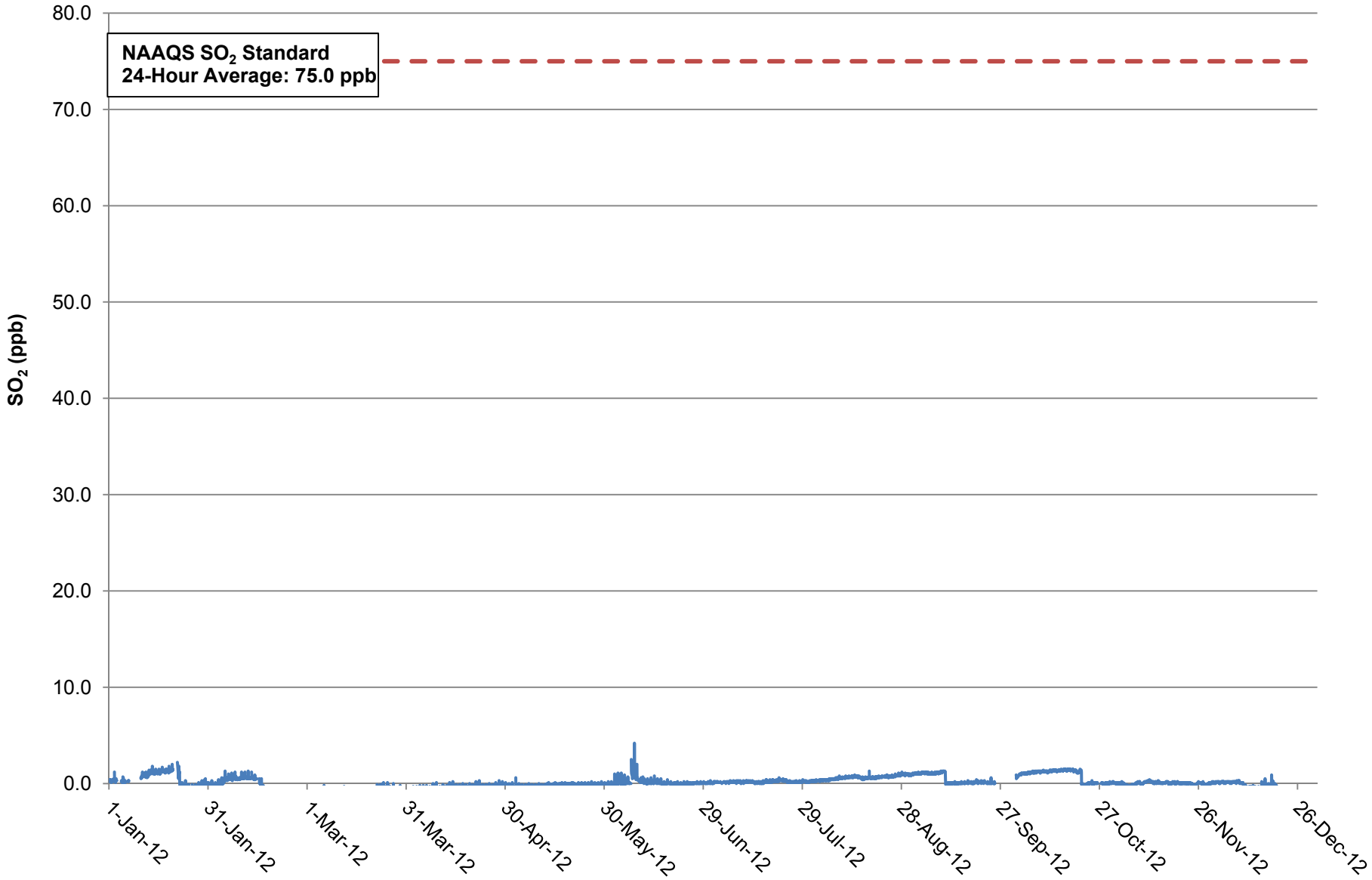


Figure 3-5: 1-Hour Average SO_2 and NAAQS/AAAQS Standard

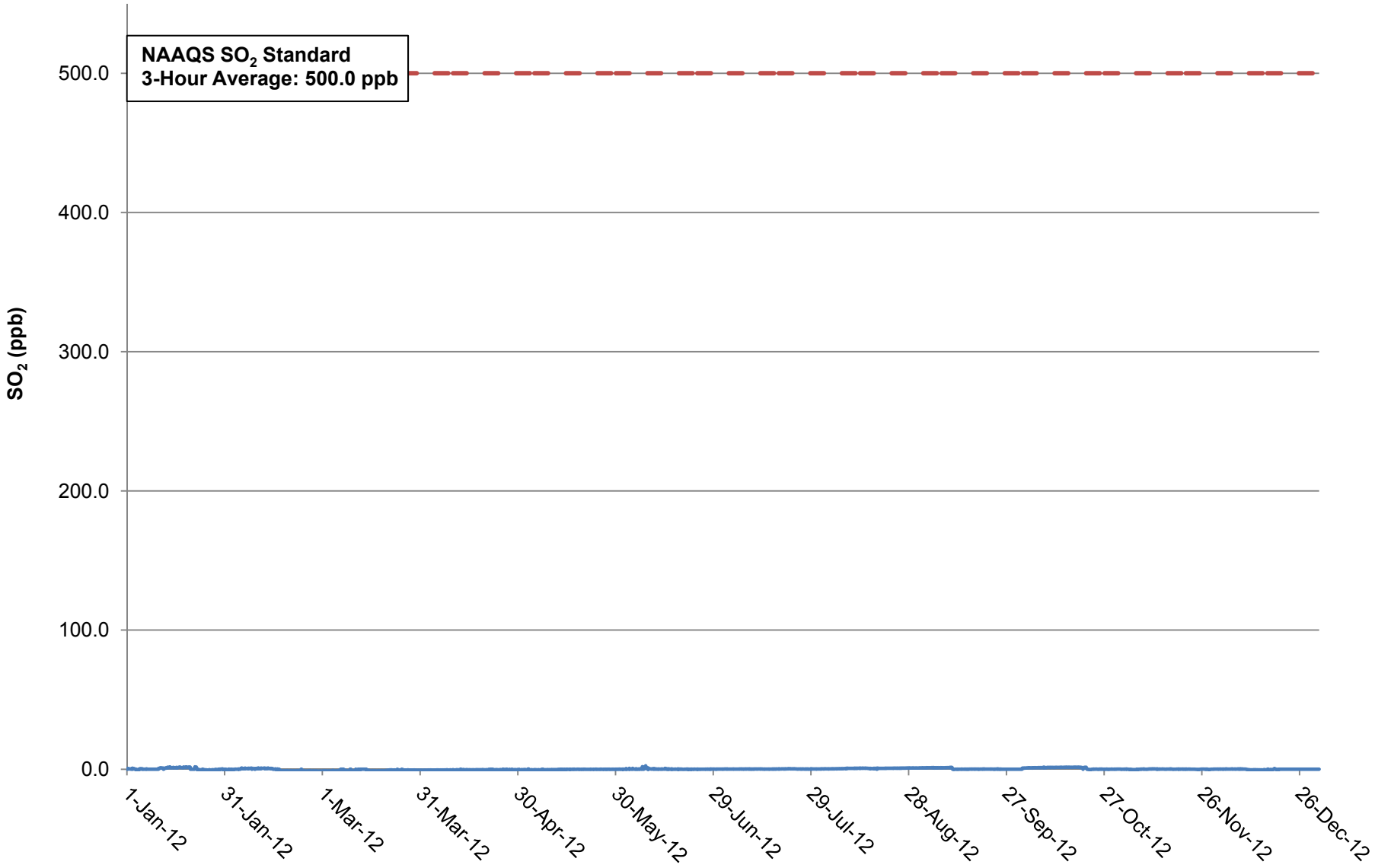


Figure 3-6: 3-Hour Average SO_2 and NAAQS/AAAQS Standard

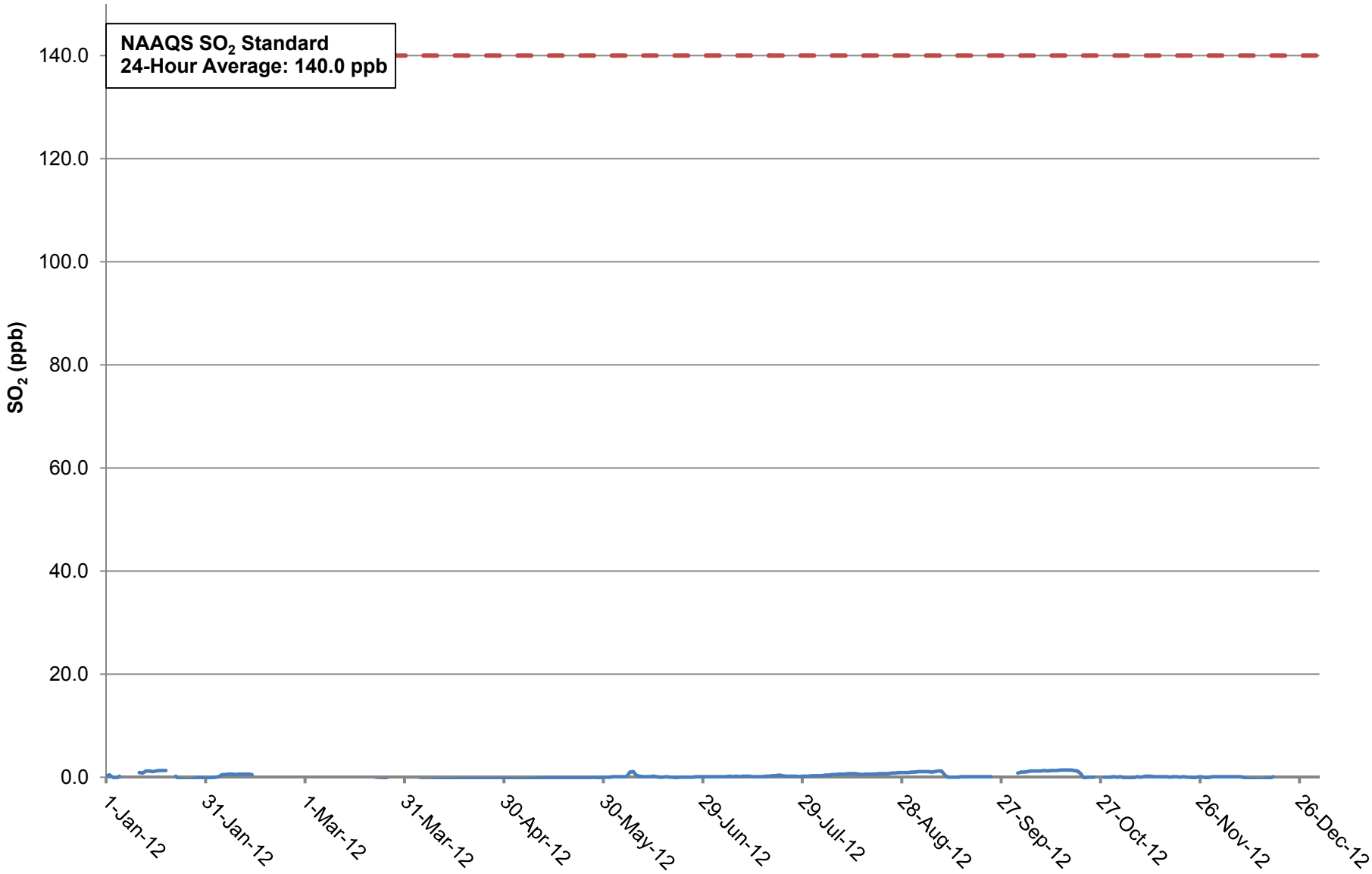


Figure 3-7: 24-Hour Average SO_2 and NAAQS/AAAQS Standard

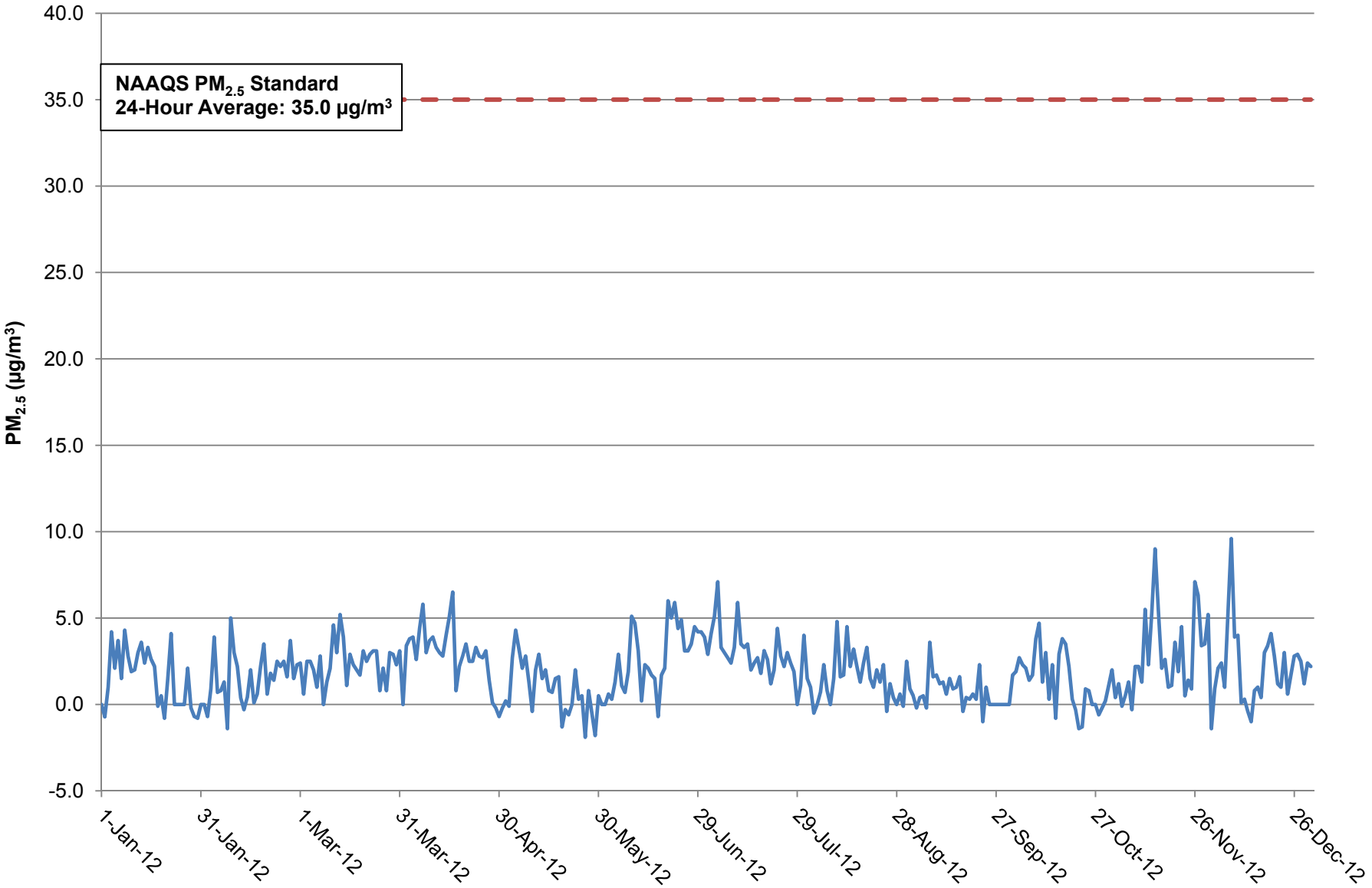


Figure 3-8: 24-Hour Average $PM_{2.5}$ and NAAQS/AAAQS Standard

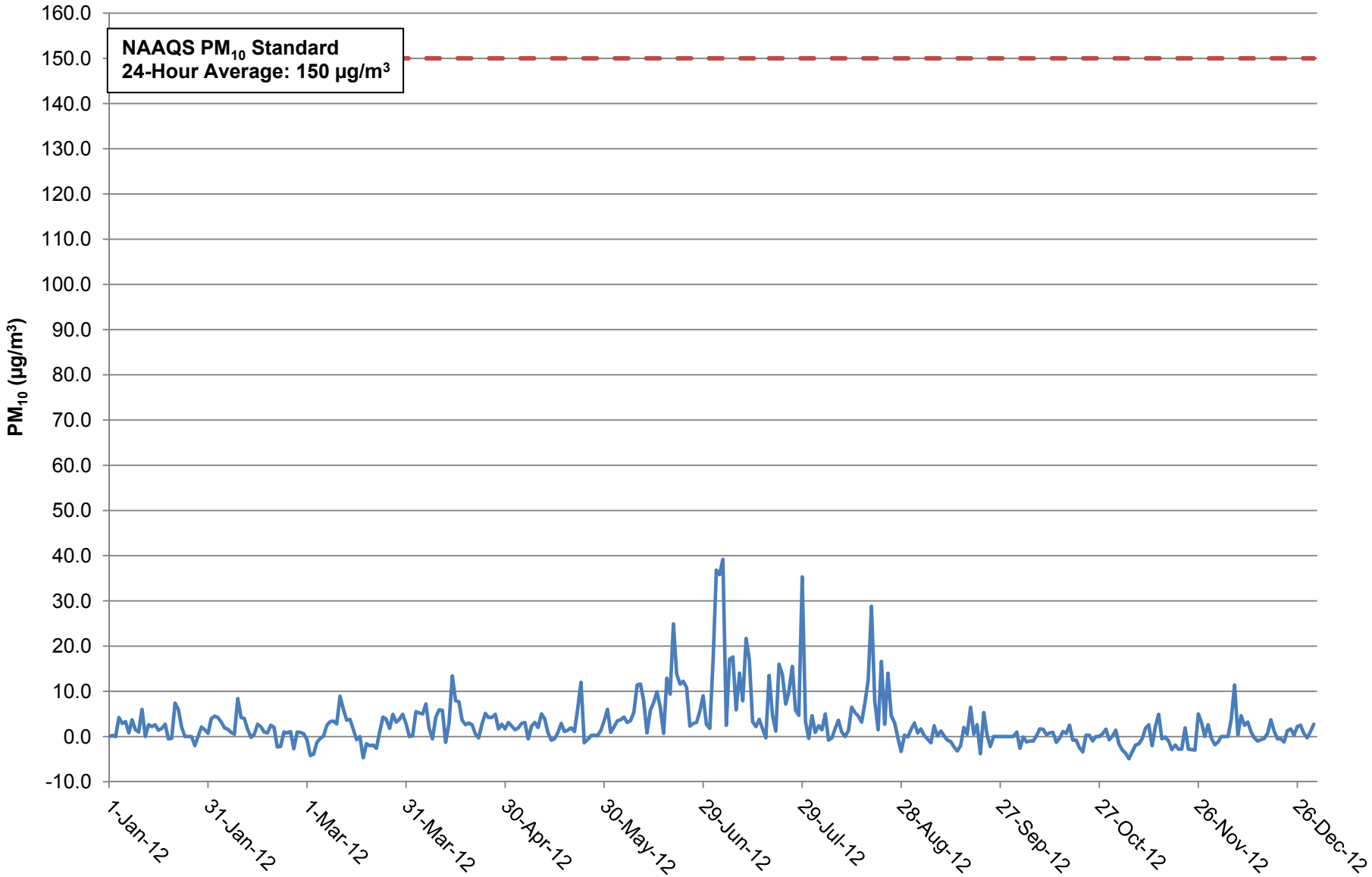


Figure 3-9: 24-Hour Average PM_{10} and NAAQS/AAAQS Standard

3.2 METEOROLOGICAL DATA SUMMARY

3.2.1 WIND SPEED (WS) AND WIND DIRECTION (WD) CLIMATOLOGY

Table 3-2 provides the mean and maximum hourly wind speeds at the nearby Nuiqsut Airport meteorological station, operated by the National Weather Service and located approximately one mile southwest of Nuiqsut meteorological monitoring station. The summary in Table 3-2 is for comparison purposes and can be contrasted with Table 3-3, which is a statistical summary of horizontal and vertical wind speed measurements during the meteorological monitoring year at the Nuiqsut station.

Figure 3-10 provides an annual wind rose for the Nuiqsut station and Figure 3-11 provides quarterly wind roses. Winds were predominantly from the east-northeast with other minor wind components. Table 3-4 is the annual wind analysis table and Tables 3-5 to 3-8 are the quarterly wind analysis tables. Figure 3-12 provides the annual wind rose superimposed over a Nuiqsut area map, centered at the approximate location of the monitoring station.

Table 3-2: Average and Maximum Wind Speeds at the Nuiqsut Airport

Monitoring Period	Mean Hourly Average Wind Speed (m/s)	Maximum Hourly Average Wind Speed (m/s)
1st Quarter	4.1	12.9
2nd Quarter	4.6	13.9
3rd Quarter	4.0	12.3
4th Quarter	4.6	18.5
Monitoring Year	**4.3**	**18.5**

Table 3-3: Average and Maximum Wind Speeds at Nuiqsut Station

Monitoring Period	Mean Hourly Average Horizontal Wind Speed (m/s)	Mean Hourly Average Vertical Wind Speed (m/s)	Maximum Hourly Average Horizontal Wind Speed (m/s)	Maximum Hourly Average Vertical Wind Speed (m/s)
1st Quarter	4.14	0.20	12.74	1.25
2nd Quarter	4.72	0.31	12.99	1.24
3rd Quarter	4.34	0.20	11.96	1.06
4th Quarter	4.27	0.21	16.04	1.05
Monitoring Year	**4.37**	**0.23**	**16.04**	**1.25**

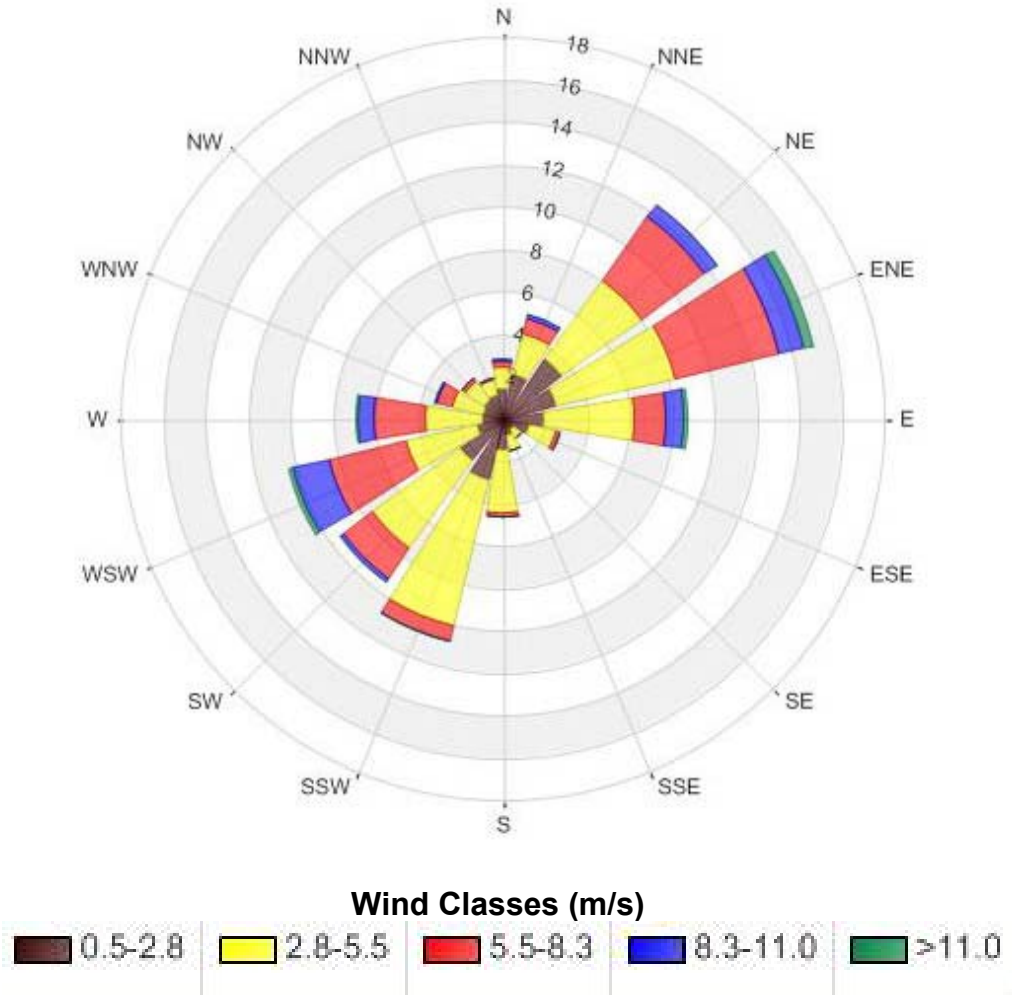
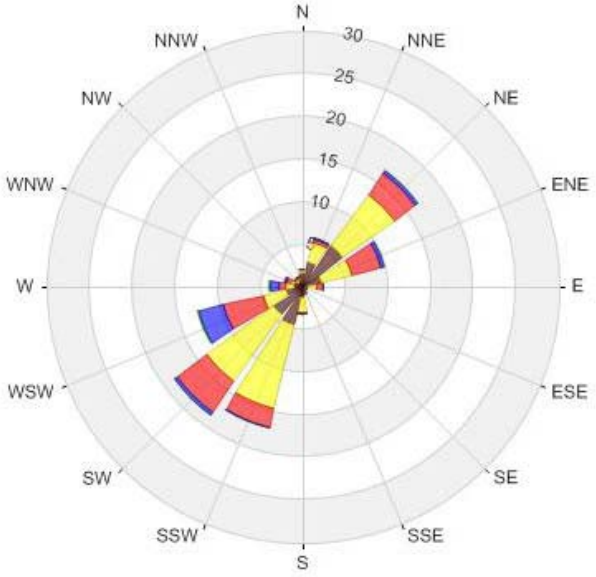
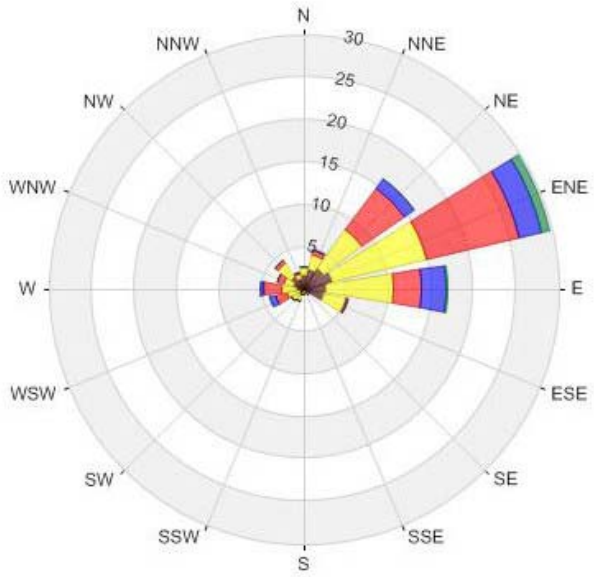


Figure 3-10: Nuiqsut Annual Wind Rose

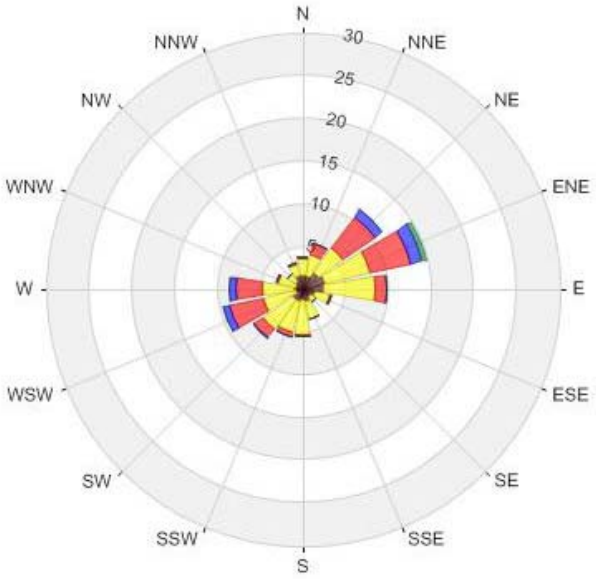
1st Quarter (1/1/12 – 3/31/12)



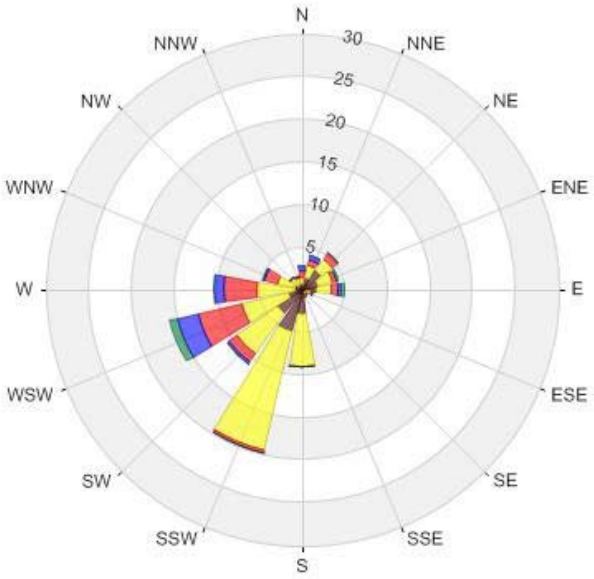
2nd Quarter (4/1/12 – 6/30/12)



3rd Quarter (7/1/12 – 9/30/12)



4th Quarter (10/1/12 – 12/31/12)



Wind Classes (m/s)

Figure 3-11: Nuiqsut Quarterly Wind Roses

Table 3-4: Annual Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	Speed (m/s)					
	0.5-2.8	2.8-5.5	5.5-8.3	8.3-11.0	>11.0	Total
N	1.41	1.04	0.25	0.10	0.00	**2.80**
NNE	2.17	2.01	0.72	0.17	0.00	**5.07**
NE	3.47	4.59	3.68	0.71	0.00	**12.45**
ENE	2.64	5.69	5.10	1.18	0.42	**15.03**
E	1.94	4.27	1.51	0.84	0.16	**8.72**
ESE	1.30	1.35	0.12	0.00	0.00	**2.77**
SE	0.69	0.40	0.00	0.00	0.00	**1.09**
SSE	0.86	0.72	0.01	0.00	0.00	**1.59**
S	1.50	3.01	0.14	0.00	0.00	**4.65**
SSW	2.94	7.11	0.77	0.01	0.00	**10.83**
SW	2.46	5.11	1.70	0.19	0.01	**9.47**
WSW	1.27	3.42	3.77	1.71	0.23	**10.40**
W	1.00	2.65	2.40	0.83	0.05	**6.93**
WNW	1.02	1.40	0.78	0.13	0.00	**3.33**
NW	1.05	1.17	0.18	0.00	0.00	**2.40**
NNW	1.13	0.75	0.13	0.00	0.00	**2.01**
Summary	**26.85**	**44.69**	**21.26**	**5.87**	**0.87**	**100.00**

Table 3-5: First Quarter Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	Speed (m/s)					
	0.5-2.8	2.8-5.5	5.5-8.3	8.3-11.0	>11.0	Total
N	1.64	0.39	0.00	0.00	0.00	**2.03**
NNE	2.99	2.41	0.39	0.05	0.00	**5.84**
NE	5.89	7.38	3.04	0.39	0.00	**16.70**
ENE	2.32	3.67	3.52	0.39	0.00	**9.90**
E	0.63	1.06	0.77	0.05	0.00	**2.51**
ESE	0.39	0.19	0.05	0.00	0.00	**0.63**
SE	0.43	0.19	0.00	0.00	0.00	**0.62**
SSE	0.77	0.24	0.05	0.00	0.00	**1.06**
S	1.40	1.64	0.34	0.00	0.00	**3.38**
SSW	4.58	10.14	2.27	0.05	0.00	**17.04**
SW	4.15	9.60	4.44	0.34	0.00	**18.53**
WSW	1.98	2.85	4.68	3.04	0.10	**12.65**
W	1.11	0.92	0.72	0.97	0.19	**3.91**
WNW	1.01	0.39	0.72	0.19	0.00	**2.31**
NW	0.68	0.48	0.14	0.00	0.00	**1.30**
NNW	0.87	0.24	0.14	0.00	0.00	**1.25**
Summary	**30.84**	**41.79**	**21.27**	**5.47**	**0.29**	**100.00**

Table 3-6: Second Quarter Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	**Speed (m/s)**					
	0.5-2.8	**2.8-5.5**	**5.5-8.3**	**8.3-11.0**	**>11.0**	**Total**
N	1.67	0.97	0.05	0.00	0.00	**2.69**
NNE	2.45	1.76	0.46	0.14	0.00	**4.81**
NE	2.92	5.60	6.16	1.30	0.00	**15.98**
ENE	3.56	11.39	11.25	2.73	0.93	**29.86**
E	2.78	7.96	3.24	2.82	0.19	**16.99**
ESE	2.45	2.82	0.19	0.00	0.00	**5.46**
SE	0.69	0.28	0.00	0.00	0.00	**0.97**
SSE	0.42	0.09	0.00	0.00	0.00	**0.51**
S	0.32	0.46	0.05	0.00	0.00	**0.83**
SSW	0.79	0.74	0.05	0.00	0.00	**1.58**
SW	0.74	0.97	0.09	0.00	0.00	**1.80**
WSW	0.56	1.53	1.30	0.69	0.00	**4.08**
W	0.88	1.76	2.04	0.46	0.00	**5.14**
WNW	1.25	1.11	0.74	0.00	0.00	**3.10**
NW	1.90	1.90	0.28	0.00	0.00	**4.08**
NNW	1.25	0.65	0.05	0.00	0.00	**1.95**
Summary	**24.63**	**39.99**	**25.95**	**8.14**	**1.12**	**100.00**

Table 3-7: Third Quarter Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	**Speed (m/s)**					
	0.5-2.8	**2.8-5.5**	**5.5-8.3**	**8.3-11.0**	**>11.0**	**Total**
N	1.69	1.98	0.10	0.00	0.00	**3.77**
NNE	1.69	2.46	1.30	0.05	0.00	**5.50**
NE	2.36	3.52	4.48	1.11	0.00	**11.47**
ENE	2.75	5.45	4.73	1.45	0.48	**14.86**
E	2.60	5.93	1.30	0.00	0.00	**9.83**
ESE	1.64	1.69	0.19	0.00	0.00	**3.52**
SE	1.16	0.87	0.00	0.00	0.00	**2.03**
SSE	1.54	2.22	0.00	0.00	0.00	**3.76**
S	1.45	4.05	0.10	0.00	0.00	**5.60**
SSW	1.49	3.81	0.48	0.00	0.00	**5.78**
SW	1.49	4.29	1.21	0.14	0.00	**7.13**
WSW	0.87	3.91	4.00	0.72	0.00	**9.50**
W	1.11	3.62	3.09	0.82	0.00	**8.64**
WNW	0.96	1.98	0.24	0.00	0.00	**3.18**
NW	1.01	1.25	0.00	0.00	0.00	**2.26**
NNW	1.74	1.25	0.14	0.00	0.00	**3.13**
Summary	**25.55**	**48.28**	**21.36**	**4.29**	**0.48**	**100.00**

Table 3-8: Fourth Quarter Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	**Speed (m/s)**					
	0.5-2.8	**2.8-5.5**	**5.5-8.3**	**8.3-11.0**	**>11.0**	**Total**
N	0.60	0.80	0.91	0.40	0.00	**2.71**
NNE	1.51	1.41	0.75	0.45	0.00	**4.12**
NE	2.72	1.71	0.80	0.00	0.00	**5.23**
ENE	1.86	1.86	0.45	0.05	0.25	**4.47**
E	1.71	1.86	0.60	0.40	0.45	**5.02**
ESE	0.65	0.60	0.05	0.00	0.00	**1.30**
SE	0.45	0.25	0.00	0.00	0.00	**0.70**
SSE	0.70	0.35	0.00	0.00	0.00	**1.05**
S	2.92	6.14	0.10	0.00	0.00	**9.16**
SSW	5.08	14.34	0.30	0.00	0.00	**19.72**
SW	3.57	5.78	1.11	0.30	0.05	**10.81**
WSW	1.71	5.58	5.28	2.46	0.86	**15.89**
W	0.91	4.43	3.82	1.11	0.00	**10.27**
WNW	0.86	2.16	1.46	0.35	0.00	**4.83**
NW	0.55	1.01	0.30	0.00	0.00	**1.86**
NNW	0.65	0.86	0.20	0.00	0.00	**1.71**
Summary	**26.45**	**49.14**	**16.13**	**5.52**	**1.61**	**98.85**

[1] The remaining 1.15 percent of data were calms (below 0.5 m/s).

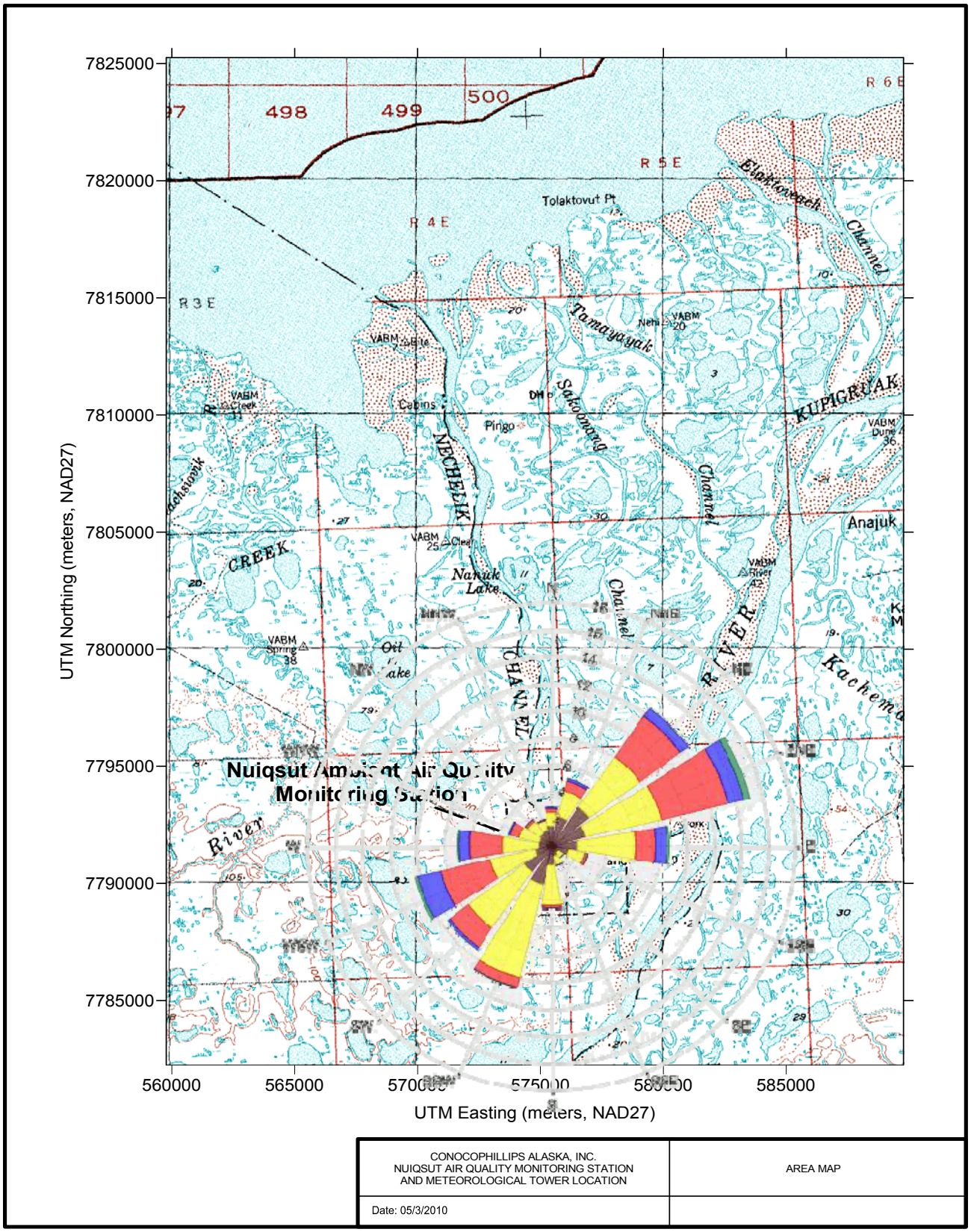


Figure 3-12: Annual Wind Rose Superimposed on Site Map

3.2.2 TEMPERATURE CLIMATOLOGY

Tables 3-9 and 3-10 give the maximum and minimum daily mean temperatures, monthly mean temperatures, and maximum and minimum hourly average temperatures for the 2-meter and 10-meter temperature measurements, respectively. Figure 3-13 provides a graph of the 2-meter and 10-meter hourly average temperatures as well as hourly average temperatures at the nearby Nuiqsut Airport station. Figure 3-13 shows a plot of vertical temperature difference (the difference between 10-meter and 2-meter temperature values) during the monitoring year.

Table 3-9: 2-Meter Temperature Summary

Period	Maximum Daily Mean Temperature (°C)	Minimum Daily Mean Temperature (°C)	Mean Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)
January 2012	-19.6	-48.3	-33.6	-13.0	-49.5
February 2012	-14.1	-47.7	-26.1	-10.8	-48.4
March 2012	-24.5	-41.6	-34.7	-20.4	-45.9
1st Quarter	**-14.1**	**-48.3**	**-31.6**	**-10.8**	**-49.5**
April 2012	-9.5	-25.1	-15.6	-6.8	-30.5
May 2012	2.3	-15.5	-4.7	6.2	-19.9
June 2012	18.6	0.7	6.8	24.2	-2.4
2nd Quarter	**18.6**	**-25.1**	**-4.5**	**24.2**	**-30.5**
July 2012	19.6	6.7	12.1	26.4	2.4
August 2012	15.3	4.5	10.1	20.6	1.9
September 2012	8.4	0.3	3.6	14.1	-2.2
3rd Quarter	**19.6**	**0.3**	**9.0**	**26.4**	**-2.2**
October 2012	3.1	-17.5	-4.2	6.8	-21.6
November 2012	-8.0	-28.6	-18.2	-5.4	-30.8
December 2012	-17.6	-39.9	-27.8	-15.7	-40.5
4th Quarter	**3.1**	**-39.9**	**-16.8**	**6.8**	**-40.5**
Monitoring Year	**19.6**	**-48.3**	**-11.2**	**26.4**	**-49.5**

Table 3-10: 10-Meter Temperature Summary

Period	Maximum Daily Mean Temperature (°C)	Minimum Daily Mean Temperature (°C)	Mean Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)
January 2012	-19.3	-47.9	-33.0	-12.8	-48.7
February 2012	-13.7	-46.8	-25.8	-9.7	-47.5
March 2012	-24.8	-41.4	-34.7	-20.4	-45.5
1st Quarter	**-13.7**	**-47.9**	**-31.3**	**-9.7**	**-48.7**
April 2012	-9.7	-25.1	-16.1	-8.4	-30.0
May 2012	1.5	-16.1	-5.5	3.8	-19.5
June 2012	17.7	0.2	6.2	23.4	-2.7
2nd Quarter	**17.7**	**-25.1**	**-5.1**	**23.4**	**-30.0**
July 2012	19.7	6.5	11.7	25.9	2.3
August 2012	15.2	4.5	10.0	19.7	2.7
September 2012	8.3	0.3	3.7	13.9	-1.4
3rd Quarter	**19.7**	**0.3**	**8.8**	**25.9**	**-1.4**
October 2012	3.2	-17.1	-4.0	6.8	-21.4
November 2012	-7.9	-28.5	-18.0	-5.3	-30.1
December 2012	-17.4	-39.6	-27.3	-15.7	-40.3
4th Quarter	**3.2**	**-39.6**	**-16.5**	**6.8**	**-40.3**
Monitoring Year	**19.7**	**-47.9**	**-11.3**	**25.9**	**-48.7**

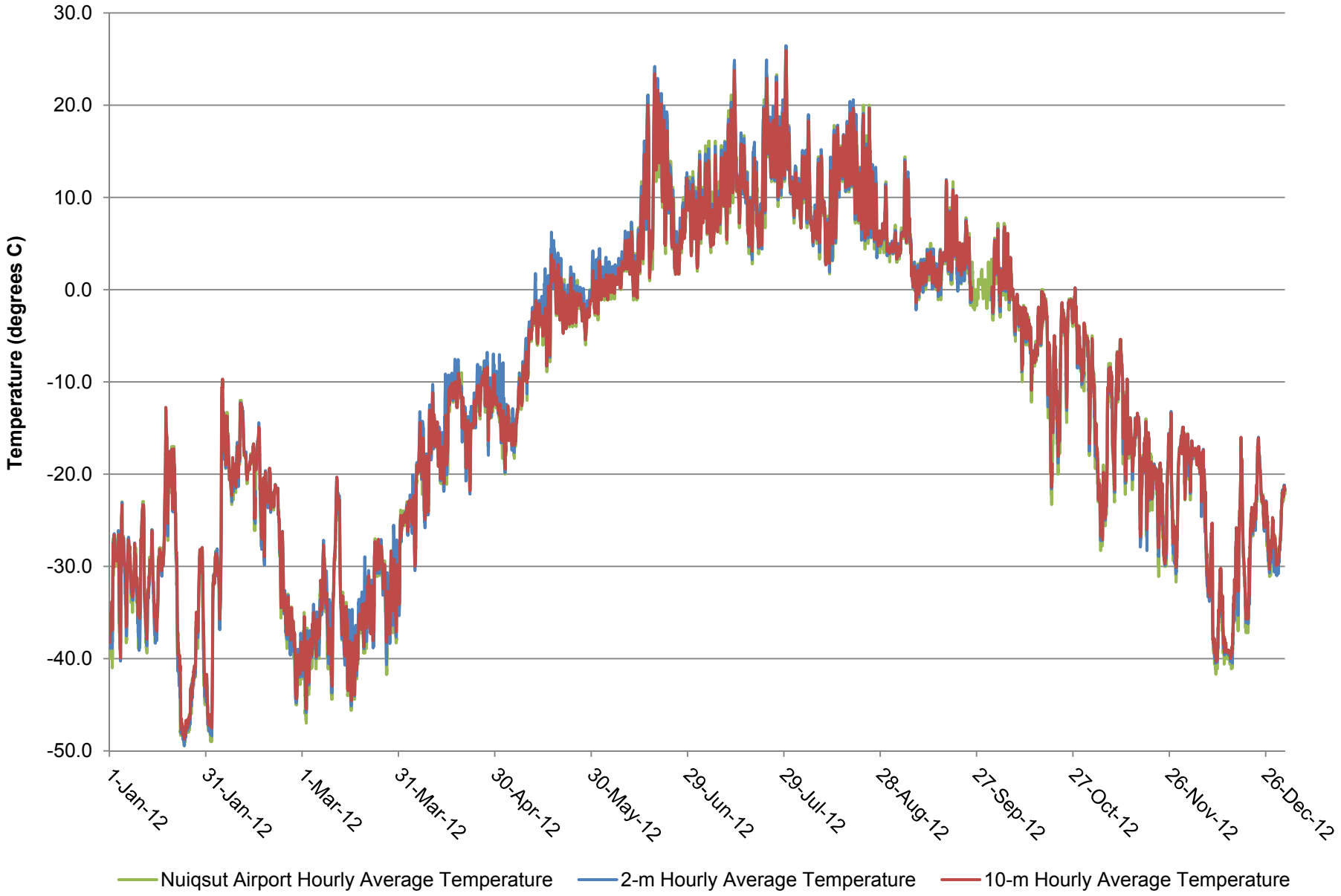


Figure 3-13: Hourly Average 2-Meter and 10-Meter Temperatures

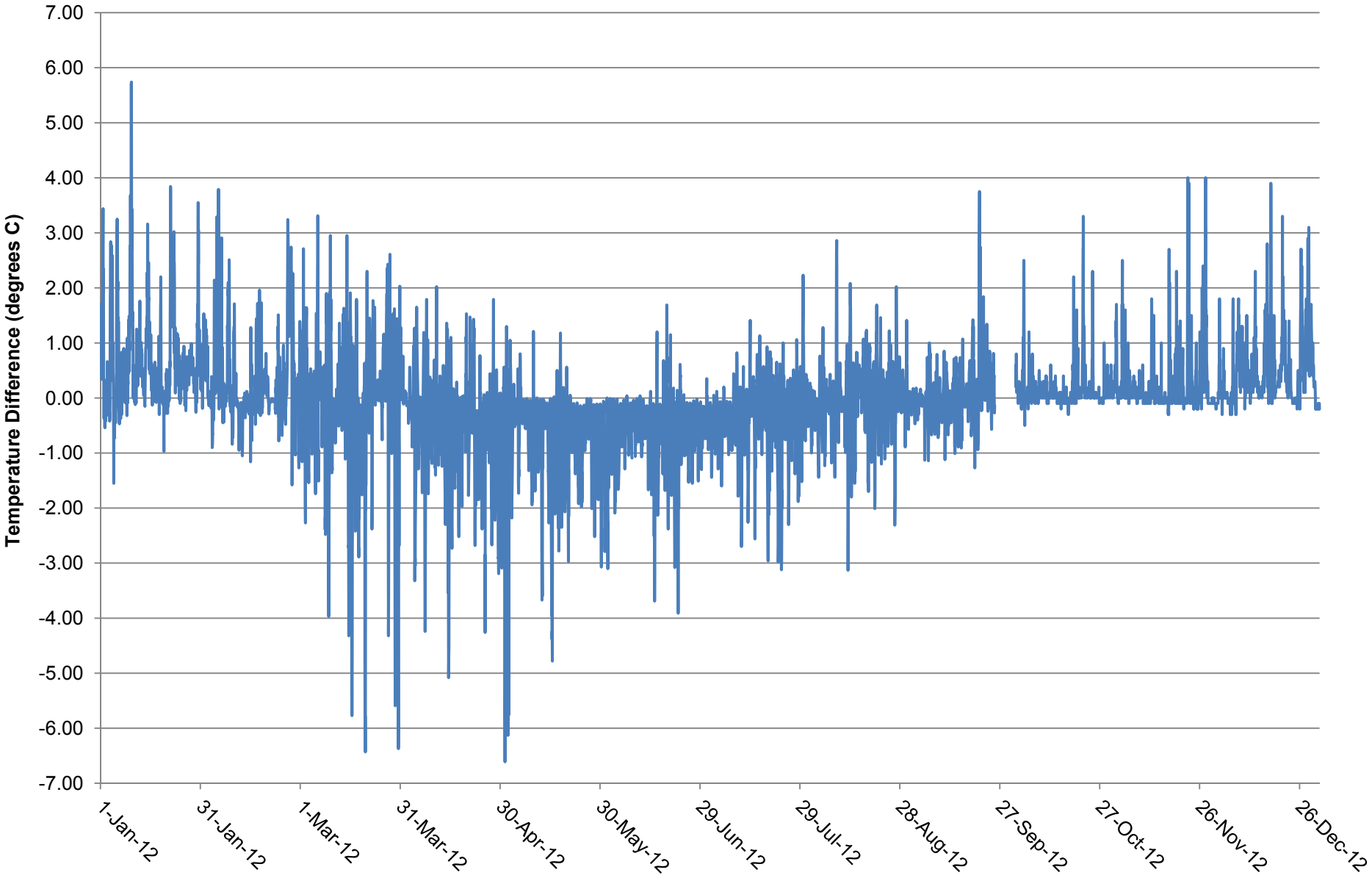


Figure 3-14: Hourly Average Vertical Temperature Difference

3.2.3 OTHER METEOROLOGICAL PARAMETERS

The other meteorological parameter measured at the Nuiqsut station is solar radiation. Table 3-11 provides a summary of this parameter for the 2012 monitoring year. Figure 3-15 is a plot of annual hourly average solar radiation. The solar radiation data are available in monthly tabular format in Appendix D.

Table 3-11: Solar Radiation Summary

Period	Mean Solar Radiation (W/m^2)	Maximum Solar Radiation (W/m^2)
January 2012	1	24
February 2012	19	227
March 2012	104	512
1st Quarter	**42**	**512**
April 2012	171	640
May 2012	242	760
June 2012	240	721
2nd Quarter	**218**	**760**
July 2012	221	725
August 2012	121	584
September 2012	65	429
3rd Quarter	**140**	**725**
October 2012	23	244
November 2012	2	52
December 2012	0	2
4th Quarter	**9**	**244**
Monitoring Year	**102**	**760**

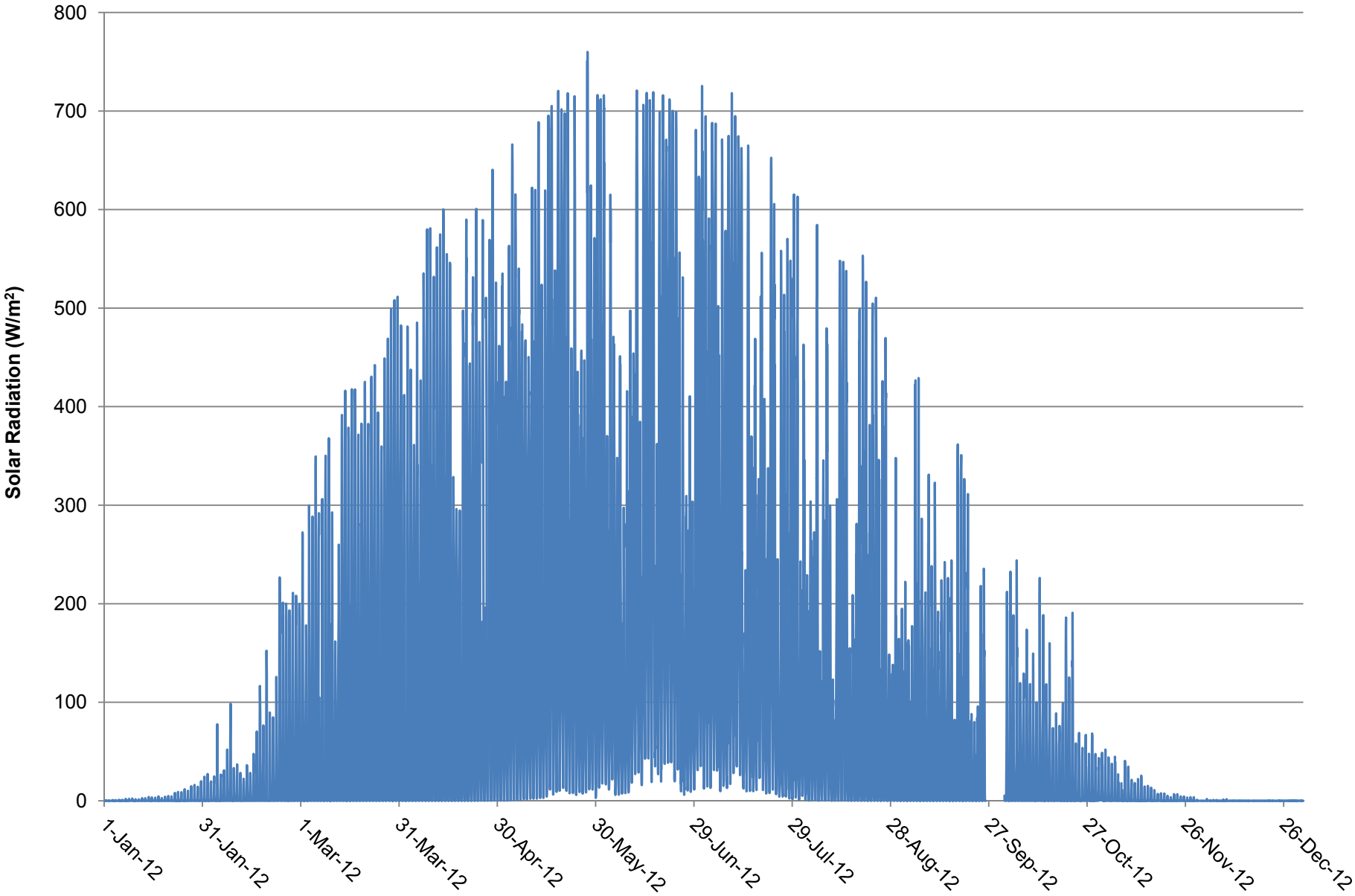


Figure 3-15: Hourly Average Solar Radiation

4. REFERENCES

U.S. Environmental Protection Agency (EPA), *On-Site Meteorological Program Guidance for Regulatory Modeling Applications*, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, EPA-450/4-87-013, Revised August 1995.

EPA, *Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD).* Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, EPA-450/4-87-007, 1987.

EPA, *Meteorological Monitoring Guidance for Regulatory Modeling Applications*, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, EPA-454/R-99-005, 2000.

U.S. Department of Commerce, National Climatic Data Center, Asheville, North Carolina, *http://www.ncdc.noaa.gov*.

Western Regional Climate Center, Desert Research Institute, Reno Nevada, *http://www.wrcc.dri.edu/summary/climsmak.html.*

Yamartino, R.J., *A Comparison of Several "Single-Pass" Estimators of the Standard Deviation of Wind Direction*, J. Climate Appl. Meteor., Vol. 23, pp. 1362-1366, 1984.