NUIQSUT AMBIENT AIR AND METEOROLOGICAL MONITORING PROGRAM

2019 Annual Report

Prepared for:

ConocoPhillips Alaska, Inc.

February 2020

global **environmental** and **advisory** solutions

SLR

2019 Annual Report

Prepared for:
ConocoPhillips Alaska, Inc.
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This document has has been prepared by SLR International Corporation (SLR). The material and data in this report were prepared under the supervision and direction of the undersigned.

Vincent Fricaud
SLR Project Manager

CONTENTS

FIGURES

TABLES

APPENDICES

ACRONYMS

AAC	Alaska Administrative Code
AAAQS	Alaska Ambient Air Quality Standards
ADEC	Alaska Department of Environmental Conservation
AERMOD	American Meteorological Society/EPA Regulatory Model Improvement Committee Model
CFR	Code of Federal Regulations
CPAI	ConocoPhillips Alaska, Inc.
DQO	data quality objective
mg/L	milligrams per liter
MQO	measurement quality objectives
NAAQS	National Ambient Air Quality Standards
NIST	National Institute of Standards and Technology
PM	Particulate Matter
ppb	parts per billion
PEP	Performance Evaluation Program
ppm	parts per million
PSD	Prevention of Significant Deterioration
QA	quality assurance
QAPP	Quality Assurance Project Plan
QAR	quality assurance review
QC	quality control
SLR	SLR International Corporation
TSA	Technical Systems Audit
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
$\mu g/m^3$	microcgrams per meter cubed
URL	upper range limit
USEPA	U.S. Environmental Protection Agency

SUMMARY

On behalf of ConocoPhillips Alaska, Inc. (CPAI), SLR International Corporation (SLR) is 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. The Nuiqsut Monitoring Program is being conducted to document air quality in Nuiqsut and data may also be used to support various ambient air quality impact analyses conducted for oil field development in the Colville Delta region.

The Nuiqsut monitoring program is designed and operated in accordance with applicable U.S. Environmental Protection Agency (USEPA) Prevention of Significant Deterioration (PSD) regulations and guidance documents. This report provides details of ambient air and meteorological measurements collected during the 2019 monitoring year, spanning from January 1, 2019, to December 31, 2019, at the Nuiqsut monitoring station.

Table E-1-1 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 Environmental 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). Table E-3 and Table 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
During the monitoring period there were no variations from the approved procedures and criteria specified in the Nuiqsut Ambient Air Quality and Meteorological Monitoring Program Quality Assurance Project Plan.		

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
Nitrogen Dioxide (NO_2)	53 ppb (100 µg/m³)	Annual	Average of Period	4	1	1	2	2	**3.8%**
	100.0 ppb (190 µg/m³)	1-Hour [2]	Daily Max 1-Hour Averages (98th Percentile)	--	--	--	--	31.8	**31.8%**
			1st Highest, 1-Hour Average	55.6	27.6	20.0	36.4	55.6	**55.6%**
			2nd Highest, 1-Hour Average	46.0	20.8	16.4	27.5	46.0	**46.0%**
Ozone (O_3)	0.070 ppm (150 µg/m³)	8-Hour [3]	4th Highest, 8-Hour Average	0.046	0.043	0.031	0.037	0.046	**65.7%**
			1st Highest, 8-Hour Average	0.049	0.046	0.033	0.039	0.049	**70.0%**
			2nd Highest, 8-Hour Average	0.046	0.044	0.032	0.038	0.046	**65.7%**
Carbon Monoxide (CO)	35 ppm (40,000 µg/m³)	1-Hour [1]	1st Highest, 1-Hour Average	1	0	1	1	1	**2.9%**
			2nd Highest, 1-Hour Average	0	0	1	1	1	**2.9%**
	9 ppm (10,000 µg/m³)	8-Hour [1]	1st Highest, 8-Hour Average	0	0	1	1	1	**11.1%**
			2nd Highest, 8-Hour Average	0	0	1	1	1	**11.1%**

[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.
[3] To attain this standard, the 3-year average of the annual fourth-highest daily maximum 8-hour average must not exceed 0.070 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)	0.030 ppm (80 µg/m³)	Annual	Average of Period	0.000	0.001	0.000	0.000	0.000	**0.0%**
	0.14 ppm (365 µg/m³)	24-Hour [5]	1st Highest, 1-Hour Average	0.00	0.00	0.00	0.00	0.00	**0.0%**
			2nd Highest, 1-Hour Average	0.00	0.00	0.00	0.00	0.00	**0.0%**
	0.5 ppm (1,300 µg/m³)	3-Hour [5]	1st Highest, 3-Hour Average	0.0	0.0	0.0	0.0	0.0	**0.0%**
			2nd Highest, 3-Hour Average	0.0	0.0	0.0	0.0	0.0	**0.0%**
	75.0 ppb (196 µg/m³)	1-Hour [4]	Daily Max 1-Hour Averages (99th Percentile)	--	--	--	--	3.5	**4.7%**
			1st Highest, 1-Hour Average	2.1	5.1	1.6	0.8	5.1	**6.8%**
			2nd Highest, 1-Hour Average	1.8	3.6	1.2	0.7	3.6	**4.8%**

[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 ($PM_{2.5}$)	12.0 µg/m³	Annual [7]	Average of Period	2.5	2.2	1.6	0.6	1.7	**14.2%**
	35 µg/m³	24-Hour [6]	98th Percentile, 24-Hour Average	--	--	--	--	7	**20.0%**
			1st Highest, 24-Hour Average	8	8	9	8	9	**25.7%**
			2nd Highest, 24-Hour Average	7	6	8	6	8	**22.9%**
Particulate Matter <10 microns (PM_{10})	150 µg/m³	24-Hour [8,9]	1st Highest, 24-Hour Average	20	80	130	**200** [10]	**200** [10]	**133.3%** [10]
			2nd Highest, 24-Hour Average	10	70	40	70	130	**86.7%**

[6] To attain this standard, the 3-year average of the 98th percentile of the 24-hour concentration must not exceed 35.0 µg/m³.
[7] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentration must not exceed 12.0 µg/m³.
[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/m³.
[10] The daily average for PM_{10} exceeded the NAAQS standard of 150 µg/m³ on October 27, 2019. Winds at the time were strong and from an easterly direction, which indicates possible interference from wind-blown dust and silt from the nearby Colville River channel banks. The single measurement exceeding the 150 µg/m³ does not constitute a violation of the NAAQS as the NAAQS criterion is based on an average of exceedances over three years and there were no exceedances in 2017 and 2018.

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

Period	Meteorological Parameters – Valid Hours per Month [1]								
	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	Horizontal Wind Speed	Horizontal Wind Direction	Wind Direction Std. Dev. (Sigma Theta)	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January	744	744	668 [2]	668 [2]	668 [2]	744	744	744	744
February	669	669	669 [2]	669 [2]	669 [2]	669	669	669	662
March	742	742	742 [2]	742 [2]	742 [2]	742	742	742	742
1st Quarter	**2155**	**2155**	**2079 [2]**	**2079 [2]**	**2079 [2]**	**2155**	**2155**	**2155**	**2148**
April	718	718	718	718	718	718 [3]	718 [3]	718 [3]	717
May	729	729	728	728	728	729 [3]	728 [3]	728 [3]	732
June	715	715	715	715	715	715 [3]	715 [3]	715 [3]	718
2nd Quarter	**2162**	**2162**	**2161**	**2161**	**2161**	**2162 [3]**	**2161 [3]**	**2161 [3]**	**2167**
July	727	727	727	727	727	733	724	724	739
August	744	744	744	744	744	744	744	744	744
September	720	720	720	720	720	720	720	720	720
3rd Quarter	**2191**	**2191**	**2191**	**2191**	**2191**	**2197**	**2188**	**2188**	**2203**
October	742	742	742	742	742	742	742	742	742
November	694	694	694	694	694	694	694	694	695
December	740	740	559 [4]	559 [4]	559 [4]	740	740	740	740
4th Quarter	**2176**	**2176**	**1995 [2]**	**1995 [2]**	**1995 [2]**	**2176**	**2176**	**2176**	**2177**
Annual	**8684**	**8684**	**8426**	**8426**	**8426**	**8690**	**8680**	**8680**	**8695**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Data from the secondary horizontal wind sensor were used during the first and fourth quarters.
[3] A combination of data from the primary and secondary temperature sensors were used during the second quarter. See Section 2.2 for more information.
[4] Horizontal wind data were invalidated during December 2019 due to snow and ice buildup on the sensors. Despite the data loss, DQOs were met for the fourth quarter.

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

Period	Meteorological Parameters – Data Recovery [1]								
	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	Horizontal Wind Speed	Horizontal Wind Direction	Wind Direction Std. Dev. (Sigma Theta)	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January	100%	100%	90% [2]	90% [2]	90% [2]	100%	100%	100%	100%
February	100%	100%	100% [2]	100% [2]	100% [2]	100%	100%	100%	99%
March	100%	100%	100% [2]	100% [2]	100% [2]	100%	100%	100%	100%
1st Quarter	**100%**	**100%**	**96% [2]**	**96% [2]**	**96% [2]**	**100%**	**100%**	**100%**	**99%**
April	100%	100%	100%	100%	100%	100% [3]	100% [3]	100% [3]	100%
May	98%	98%	98%	98%	98%	98% [3]	98% [3]	98% [3]	98%
June	99%	99%	99%	99%	99%	99% [3]	99% [3]	99% [3]	100%
2nd Quarter	**99%**	**99%**	**99%**	**99%**	**99%**	**99% [3]**	**99% [3]**	**99% [3]**	**99%**
July	98%	98%	98%	98%	98%	99%	97%	97%	99%
August	100%	100%	100%	100%	100%	100%	100%	100%	100%
September	100%	100%	100%	100%	100%	100%	100%	100%	100%
3rd Quarter	**99%**	**99%**	**99%**	**99%**	**99%**	**100%**	**99%**	**99%**	**100%**
October	100%	100%	100% [2]	100% [2]	100% [2]	100%	100%	100%	100%
November	96%	96%	96% [2]	96% [2]	96% [2]	96%	96%	96%	97%
December	99%	99%	**75% [2,4]**	**75% [2,4]**	**75% [2,4]**	99%	99%	99%	99%
4th Quarter	**99%**	**99%**	**90% [2]**	**90% [2]**	**90% [2]**	**99%**	**99%**	**99%**	**99%**
Annual	**99%**	**99%**	**96%**	**96%**	**96%**	**99%**	**99%**	**99%**	**99%**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Data from the secondary horizontal wind sensor were used during the first and fourth quarters.
[3] A combination of data from the primary and secondary temperature sensors were used during the second quarter. See Section 2.2 for more information.
[4] Horizontal wind data were invalidated during December 2019 due to snow and ice buildup on the sensors. Despite the data loss, DQOs were met for the fourth 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. One station located at the northern edge of Nuiqsut, approximately 400 meters north-northwest of the community electrical generators, comprises the Nuiqsut Ambient Air Quality and Meteorological Monitoring Program. Currently, the Nuiqsut Monitoring Program is being conducted to document air quality in Nuiqsut and 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 directly mounted to the air quality monitoring structure. The program is designed and operated in accordance with applicable 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 Plan 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.

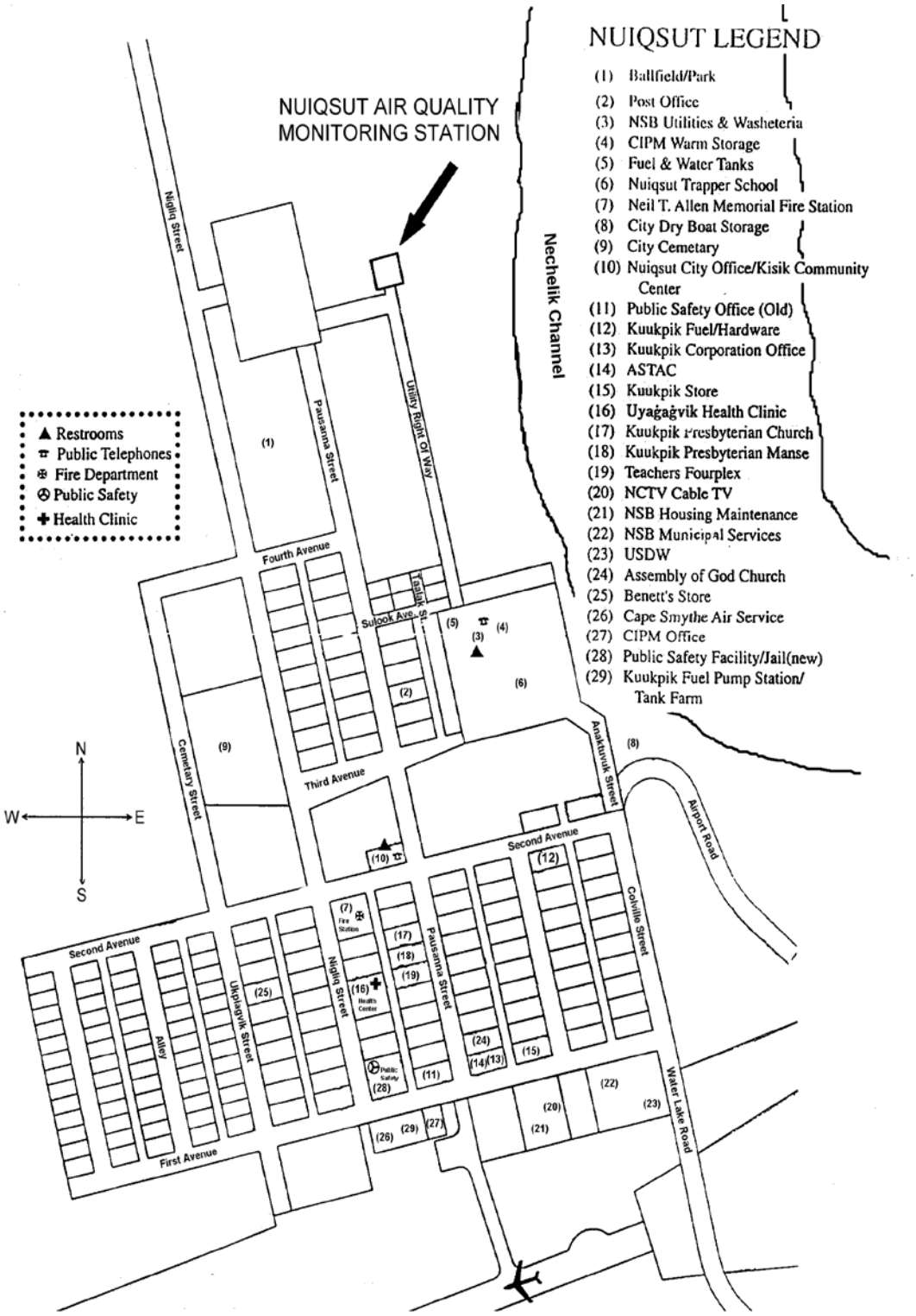


Figure 1-1: Local Map of Nuiqsut

Figure 1-2: Aerial Photo Showing Site Location

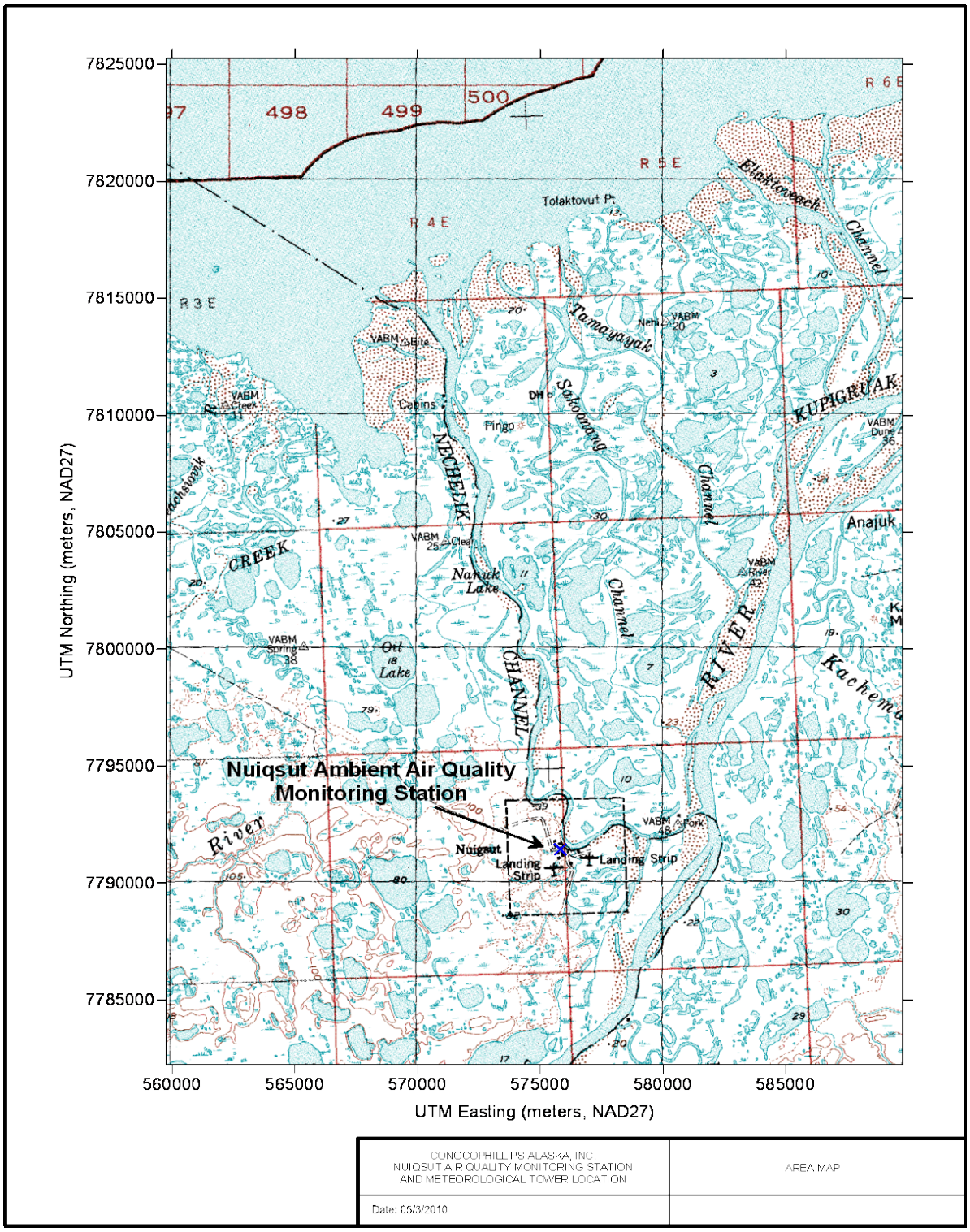


Figure 1-3: Map of Nuiqsut Project Area

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) [1]	API T300 Non-dispersive Infrared (NDIR) absorbance spectroscopy	Reference method RFCA-1093-093 40 CFR 53	Parts per million (ppm)	Continuous	1-hour
	Thermo 48i Gas filter correlation analyzer	EPA reference method RFCA-0981-054			
Nitrogen Dioxide (NO_2) [2, 3]	Thermo Scientific 42i Chemiluminescent NO_X gas analyzer	EPA reference method RFNA-1289-074	Parts per billion (ppb)		
	API T200U Chemiluminescent NO_X gas analyzer	EPA reference method RFNA-1194-099			
Ozone (O_3)	API T400 UV Photometric Ozone analyzer	EPA equivalent method EQOA-0992-087			
Sulfur Dioxide (SO_2) [4]	Thermo 43i Pulsed fluorescence SO_2 gas analyzer	EPA equivalent method EQSA-0486-060			
	API T100U Pulsed fluorescence SO_2 gas analyzer	EPA equivalent method EQSA-0495-100			

[1] API instrument was used January 1 – October 22, 2019. Thermo instrument was installed October 22, 2019.
[2] Total oxides of nitrogen (NO_X) and nitrogen oxide (NO) are also measured.
[3] Thermo instrument was used January 1 – January 31, 2019. API instrument was installed February 1, 2019.
[4] Thermo instrument was used January 1 – October 22, 2019. API instrument was installed October 22, 2019.

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. PM_{10} and $PM_{2.5}$ monitoring were conducted using 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 at the nearby Alpine CD1 pad. As such, filter-based samplers for assessing precision were not run at Nuiqsut. Network $PM_{2.5}$ precision statistics were evaluated using collocated sampling at CD1.

Block daily averages (24-hours) were obtained from the hourly measurements with the Met-one 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
$PM_{2.5}$	Micrograms per cubic meter ($\mu g/m^3$)	Continuous	1-Hour [1]	24-Hour (Average) [1]
PM_{10}	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	Measurement Method	Sensor Manufacturer/ Model Number	Range	Accuracy	Resolution	Sampling Frequency	Averaging Period
Ambient Temperature	Triple element thermistor	Climatronics Model 100093-2	-50 to +50°C	± 0.10°C	0.01°C	1 second	1 hour
Horizontal Wind Speed	Propeller, magnetically induced AC sine wave	RM Young Co. 05305-AQ	0 to 50 m/s	0.2 m/s and three upscale points over sensor range, ±(0.2 m/s + 5% of actual), Starting torque ≤0.25 m/s	0.1 m/s	1 second	1 hour
Wind Direction	Light-weight vane, Low torque potentiometer	RM Young Co. 05305-AQ	0 to 360°	Alignment within ±5°, Starting torque ≤0.5 m/s, Normalized linearity within ±3° (every 30 or 45 degrees)	1.0°	1 second	1 hour
Vertical Wind Speed	Propeller anemometer	Climatronics Model 102236-G0	0 to 49 m/s	±(0.2 m/s + 5% of actual), Starting torque ≤0.25 m/s	0.1 m/s	1 second	1 hour
Solar Radiation	Thermopile sensing element	Kipp & Zonen CMP 11	0 to 2,800 W/m^2	± 2%	10 W/m^2	1 second	1 hour

1.3 VARIATIONS FROM THE QAPP

Any QAPP variations that have occurred throughout the monitoring period are discussed in Table 1-4 and below.

Table 1-4: QAPP Variation Table

Item / Procedure	Summary of QAPP Variation	Reason for Variation
During the monitoring period there were no variations from the approved procedures and criteria specified in the Nuiqsut Ambient Air Quality and Meteorological Monitoring Program Quality Assurance Project Plan.		

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 2019 ambient air and meteorological monitoring year.

Table 2-1: Chronology of Significant Events

Date	Event
January 1, 2019	Start of the monitoring year.
January 2, 2019	Multipoint calibrations performed on the ozone analyzer; analyzer passed.
January 2 – 3, 2019	Snow and ice buildup on the horizontal wind sensor. 23 hours of horizontal wind data invalidated.
January 7, 2019	Multipoint calibrations performed on the CO analyzer; analyzer passed.
January 8, 2019	Multipoint calibrations performed on the NO_X analyzer; analyzer passed. Maintenance and leak checks performed on PM samplers; all passed. 15 hours of $PM_{2.5}$ data invalidated during maintenance and QC checks.
January 9 – 10, 2019	Snow and ice buildup on the horizontal wind sensor. Six hours of horizontal wind data invalidated.
January 12, 2019	Snow and ice buildup on the horizontal wind sensor. Four hours of horizontal wind data invalidated.
January 16 – 18, 2019	Snow and ice buildup on the horizontal wind sensor. 38 hours of horizontal wind data invalidated in total.
January 29, 2019	The $PM_{2.5}$ sampler experienced periodic flow errors. 13 hours of $PM_{2.5}$ data invalidated in total.
January 31 – February 1, 2019	Multipoint calibrations performed on NO_X, SO_2, and CO analyzers; all passed. The Thermo Scientific 42i NOX analyzer (serial number: 0705820942) was replaced with an API Teledyne T200U analyzer (serial number: 194) on February 1, 2019. As-left calibrations passed. Monthly maintenance, QC checks and multipoint calibrations performed on PM samplers; all passed. 31 hours of NO_X data, 10 hours of $PM_{2.5}$ data, and 27 hours of PM_{10} data invalidated between the two days.
February 6, 2019	Daily average PM_{10} concentration less than -2 µg/m^3. 24 hours of BAM PM_{10} data invalidated.
February 7, 2019	Multipoint calibrations performed on the ozone analyzer; analyzer passed.
February 8 – 16, 2019	PM_{10} analyzer experienced water damage. The analyzer was repaired on February 15, and multipoint calibrations were performed on February 16; all passed. 187 hours of PM_{10} data invalidated.
February 14, 2019	Multipoint calibrations performed on the ozone analyzer; analyzer passed. Four hours of all gas data invalidated.
February 15 – 16, 2019	Quarterly calibrations performed on all gas analyzers; all passed. Monthly QC checks, maintenance, and multipoint calibrations performed on PM samplers; all passed. 11 hours of $PM_{2.5}$ data invalidated over two separate periods.

Date	Event
February 20, 2019	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.
March 15, 2019	Monthly QC checks performed on PM samplers; all passed.
March 20, 2019	Multipoint calibrations performed on the CO analyzer; analyzer passed.
April 16, 2019	$PM_{2.5}$ sampler (Met-one BAM 1020 serial number: J3243) replaced with Met-one BAM 1020 serial number J6249. Monthly QC checks performed on PM samplers and multipoint calibration performed on $PM_{2.5}$ sampler; all passed.
May 8, 2019	Monthly QC checks performed on PM samplers; all passed. Multipoint calibrations performed on NO_X, SO_2, and CO, and all meteorological analyzers; all passed. Independent performance audit of ambient air analyzers, meteorological monitors, and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits. Four hours of all gas data, six hours of PM data, eight hours of vertical wind data, nine hours of horizontal wind and temperature data invalidated during calibrations and audit. Six hours of solar data unavailable during audit due to operator error.
May 21, 2019	Multipoint calibrations performed on all gas analyzers; all passed. Seven hours of all gas data were invalidated during calibrations.
May 9 – June 19, 2019	Primary 2-meter temperature sensor malfunction. A total of 986 hours of primary 2-meter and delta temperature data invalidated. Secondary temperature sensor data are reported for the period from May 1 through June 20, 2019.
June 19, 2019	Monthly maintenance and QC checks performed on PM samplers; all passed. 11 hours of PM data invalidated. Maintenance conducted on ozone analyzer; 11 hours ozone invalid.
June 20 – 23, 2019	Shelter temperature standard deviation greater than 2° C or above 30° C. 96 hours of gas data invalidated in total.
June 21 – 30, 2019	Secondary 2-meter temperature sensor malfunction. 227 hours of secondary 2-meter and delta temperature data invalidated. Reporting of primary temperature sensor data resumes on June 21, 2019.
July 1, 2019	BAM and meteorology communication error. 1 hour of data on $PM_{2.5}$, PM_{10}, and meteorological fields missing.
July 2 – 8, 2019	Shelter temperature above 30° C or standard deviation greater than 2° C. 144 hours of gas data invalidated in total.
July 7, 2019	Raw BAM data values recorded below the lower detectable and reporting limits of -5 $\mu g/m^3$. 1 hour of data on $PM_{2.5}$ and PM_{10} invalidated.
July 10, 2019	Extra QC checks conducted on gas analyzers. 2 hours of gas data invalidated.
July 11, 2019	Raw PM_{10} BAM data values recorded below the lower detectable and reporting limits of -5 $\mu g/m^3$. 1 hour of data on PM_{10} invalidated.
July 13 – 16, 2019	Shelter temperature above 30° C or standard deviation greater than 2° C. 96 hours of gas data invalidated in total.
July 15, 2019	Temporary flow error on $PM_{2.5}$ and PM_{10} BAMs. 1 hour of data on $PM_{2.5}$ and PM_{10} invalidated.
July 15, 2019	Raw PM_{10} BAM data values recorded below the lower detectable and reporting limits of -5 $\mu g/m^3$. 1 hour of data on PM_{10} invalidated.

Date	Event
July 17, 2019	Tower maintenance and repair of secondary temperature sensors. Eight hours of wind data, seven hours of primary 2-meter temperature data, and 11 hours of primary 10-meter and Delta-T data invalidated. An hour of data from other fields was invalid because of a temporary communication outage during the maintenance. Monthly QC checks performed on PM samplers; all passed. 2 hours of BAM data invalidated. Maintenance on gas analyzers; 2 hours invalidated.
July 18, 2019	Tower maintenance. Five hours of all non-solar meteorological data invalidated. Multipoint calibrations performed on all gas analyzers; all passed. 13 hours of SO_2 data and 6 hours of data from other gases invalidated during calibrations. Training QC checks performed on PM_{10} sampler; sampler passed.
July 18, 2019	Temporary flow error on $PM_{2.5}$ and PM_{10} BAMs. 1 hour of data on $PM_{2.5}$ and PM_{10} invalidated.
July 30, 2019	Communication error. 3 hours gas and meteorology data and 2 hours of BAM data missing.
August 27 – 29, 2019	Station maintenance and multipoint calibrations performed on NO_X, SO_2, and CO analyzers; all passed. 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. Ozone transfer standard (API Teledyne Model 703E serial number 86) removed and replaced with API Teledyne Model T703 serial number 170. 41 hours of SO_2 data, 45 hours CO data, 29 hours of NO_X data, and 34 hours of O_3 data invalidated in total.
August 28, 2019	Monthly QC checks performed on PM samplers; all passed. 2 hours of data on $PM_{2.5}$ and 3 hours of data on PM_{10} invalidated.
August 28, 2019	Temporary flow error on $PM_{2.5}$ and PM_{10} BAMs. 1 hour of data on $PM_{2.5}$ and PM_{10} invalidated.
August 30-31, 2019	Adjustments made to gas analyzers and recently installed EPA protocol gas cylinder. 3 hours gases invalid.
September 2-3, 2019	Adjustments made to gas analyzers and recently installed EPA protocol gas cylinder. 2 hours gases invalid.
September 6, 2019	Adjustments made to gas analyzers and recently installed EPA protocol gas cylinder. 1 hour gases invalid.
September 8, 2019	Adjustments made to gas analyzers and recently installed EPA protocol gas cylinder. 1 hour gases invalid.
September 10-11, 2019	Adjustments made to gas analyzers and recently installed EPA protocol gas cylinder. 2 hours gases invalid.
September 17, 2019	Adjustments made to gas analyzers and recently installed EPA protocol gas cylinder. 1 hour gases invalid.
September 18, 2019	Monthly QC checks performed on PM samplers; all passed. Four hours of PM data invalidated during checks. Multipoint calibrations performed on NO_X, SO_2, and CO analyzers; some as-found checks were unstable due to malfunctioning calibration system. All analyzers passed as-left calibrations. 8 hours gases invalid.
September 28, 2019	Temporary flow error on $PM_{2.5}$ and PM_{10} BAMs. 1 hour of data on $PM_{2.5}$ and PM_{10} invalidated.
September 29, 2019	Additional precision check run on gases. 1 hour gases invalid.
October 17, 2019	Multipoint calibrations performed on the CO analyzer; analyzer passed. 3 hours of gas data invalidated.

Date	Event
October 22, 2019	Station maintenance and multipoint calibrations performed on all gas analyzers; all passed. Monthly QC checks performed on PM samplers; all passed. The CO analyzer (API Teledyne Model T300, serial number: 3956) was removed and replaced with Thermo Scientific Model 48i, serial number: 1008241341. The SO_2 analyzer (Thermo Scientific Model 43i, serial number: 09200039) was removed and replaced with API Teledyne Model T100U, serial number: 338. Nine hours of gas data and one hour of BAM data invalidated.
October 24, 2019	Temporary loss of software service resulted in loss of one hour of gas and meteorological data.
October 25, 2019	Multipoint calibrations performed on SO_2 and CO analyzers; all passed. Four hours of gas data invalidated.
October 27, 2019	PM_{10} values exceeded the NAAQS daily average standard of 70 µg/m^3 with a daily average of 196 µg/m^3. Winds at the time were relatively strong and from an easterly direction, which may have caused dust interference with the PM_{10} sampler. No data were invalidated.
October 30, 2019	Power outage resulted in the loss of one hour of PM and meteorological data. The power outage caused zero air to flow through the gas sampling system until the precision check began on October 31. Seven hours of gas data invalidated.
November 2, 2019	Temporary PM flow error. One hour of BAM data invalidated.
November 2 – 3, 2019	Gas flow error. 16 hours of gas data invalidated.
November 5 – 6, 2019	Monthly QC checks and multipoint calibrations performed on PM samplers; all passed. Multipoint calibrations performed on all meteorological analyzers; all passed. Independent performance audit of ambient air analyzers, meteorological monitors, and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits. 7 hours of $PM_{2.5}$, six hours of PM_{10}, 25 hours of gas data, and 22 hours of meteorological data (21 of solar data) were invalidated in total.
November 6 & 8, 2019	Temporary PM flow error. One hour of BAM data invalidated each day.
November 8, 2019	SO_2 and O_3 sampling error. One hour of data invalidated.
November 9, 2019	Communication error. Three hours of meteorological and BAM data and four hours of gas data missing.
November 10, 2019	Station power loss resulted in two hours of invalidated gas data.
November 11 &13, 2019	SO_2 sampling error. One hour of SO_2 data invalidated each day.
November 15, 2019	Station power loss resulted in two hours of BAM, and one hour of gas and met data invalidated.
November 25 & 26, 2019	Multipoint calibrations performed on CO analyzer; all passed. Two hours of gas data invalidated each day (three hours SO_2 on the 25th).
December 2, 2019	PM_{10} concentrations less than -5 µg/m^3. Two hours of PM_{10} data invalidated.
December 9, 2019	SO_2 sampling error. One hour of SO_2 data invalidated.
December 11, 2019	Multipoint calibration performed on NO_x, SO_2, and CO analyzers; all passed. Five hours of gas data invalidated in total.
December 14 – 15, 2019	Daily average $PM_{2.5}$ and PM_{10} concentration less than -2 µg/m^3. 48 hours of BAM $PM_{2.5}$ and PM_{10} data invalidated.

Date	Event
December 15, 2019	Station sampling error. One hour of gas and met data invalidated.
December 18, 2019	Monthly QC checks and multipoint calibrations performed on PM samplers; all passed. One hour of BAM data invalidated.
December 19, 2019	Station sampling error. Two hours of gas and met data invalidated.
December 20, 2019	Station sampling error. One hour of gas, PM, and met data invalidated.
December 21, 2019	$PM_{2.5}$ and PM_{10} concentrations less than -5 µg/m^3. One hour of $PM_{2.5}$ and two hours of PM_{10} data invalidated.
December 21 – 31, 2019	CO analyzer pump malfunction. 261 hours of CO data invalidated. The analyzer was repaired in January 2020.
December 23, 2019	$PM_{2.5}$ and PM_{10} concentrations less than -5 µg/m^3. Two hours of $PM_{2.5}$ and four hours of PM_{10} data invalidated.
December 23 – 30, 2019	Snow and ice buildup on the horizontal wind sensor. 181 hours of horizontal wind data invalidated.
December 24, 2019	PM_{10} concentrations less than -5 µg/m^3. Five hours of PM_{10} data invalidated.
December 28, 2019	$PM_{2.5}$ concentrations less than -5 µg/m^3. Three hours of $PM_{2.5}$ data invalidated.
December 29, 2019	PM_{10} concentrations less than -5 µg/m^3. One hour of PM_{10} data invalidated.
December 31, 2019	$PM_{2.5}$ concentrations less than -5 µg/m^3. Three hours of $PM_{2.5}$ data invalidated.
December 31, 2019	End of the monitoring year.

2.2 MISSING, INVALID AND ADJUSTED DATA

The data collected at the Nuiqsut station were carefully reviewed during the quality assurance process. Some data were removed as a result of planned site activities, including data collected during station system and performance audits and calibrations. Data known or suspected to be invalid have been removed from the data set after verifying that the removed data values do not represent actual ambient air quality conditions at the sampling station.

Historically, periods of 4 or fewer records that were invalidated were considered to be due to routine operations and maintenance activities and were generally not described in detail. Events impacting larger periods of time during the first and second quarters have been described above in Table 2-1: Chronology of Significant Events.

Following discussion between SLR and CPAI, it was agreed that any event resulting in an at least one hourly record being invalidated would be tracked and discussed specifically in Table 2-1. Consequently, beginning with the third quarter of 2019, all events resulting in an invalidation of data are listed in Table 2-1.

The gas analyzers routinely undergo a precision check during the hour ending at 4 a.m. on Thursday morning. Since 45 minutes of valid data are required to report an hour as valid, and the duration of the precision checks requires more than 15 minutes of data to be invalidated, gas data from 4 a.m. on Thursday morning are routinely invalidated. Additional invalidations occurring during the monitoring year are as follows:

Data from the secondary horizontal wind sensor were used during the first quarter. The horizontal wind sensor experienced periodic snow and ice buildup during the first monitoring quarter. Horizontal wind data were periodically invalidated January 2 – 3, January 9 – 10, January 12, and January 16 – 18, 2019. A total of 71 hours of horizontal wind data were invalidated during the first quarter.

15 hours of $PM_{2.5}$ data were invalidated January 8, 2019 during routine maintenance and QC checks. The $PM_{2.5}$ sampler experienced periodic flow errors on January 29, 2019. A total of 13 hours of $PM_{2.5}$ data were invalidated as a result.

The Thermo 42i NO_X analyzer (serial number: 0705820942) was replaced with an API T200U analyzer (serial number: 194) January 31 – February 1, 2019. As-left calibrations passed. 31 hours of NO_X data were invalidated between the two days. Multipoint calibrations were also performed on the SO_2 and CO analyzers; all passed.

Routine maintenance, monthly QC checks, and multipoint calibrations were performed on the PM analyzers January 31 – February 1, 2019; all passed. 10 hours of $PM_{2.5}$ and 27 hours of PM_{10} data were invalidated in total.

Manufacturer specifications for PM_{10} measurements indicate that the uncertainty for 24-hour average concentrations is +/- 2 µg/m^3. Accordingly, 24-hour average concentrations less than -2 µg/m^3 resulted in the invalidation of PM_{10} data for the entire day on February 6, 2019. A total of 24 hours of PM_{10} data were invalidated during the first quarter.

The PM_{10} analyzer was damaged by water intrusion on February 8, 2019 and repaired on February 15, 2019. Multipoint calibrations were performed on the $PM_{2.5}$ and PM_{10} analyzers on February 16, 2019; all passed. 11 hours of $PM_{2.5}$ data and 187 hours of PM_{10} data were invalidated in total.

Multipoint calibrations were performed on the ozone analyzer on February 14, 2019; analyzer passed. Four hours of all gas data invalidated during calibrations.

The primary and secondary 2-meter temperature sensors experienced periodic malfunctions throughout the second monitoring quarter. As a result, data from both the primary and secondary temperature sensors are used throughout this report. Data from the primary temperature sensors are used for the entire month of April 2019. Data from the secondary temperature sensors are used for the entire month of May 2019 through June 20, 2019. Data from the primary temperature sensors are used for the period of June 21 through June 30, 2019. A total of 986 hours of primary 2-meter and delta temperature data and 227 hours of secondary 2-meter and delta temperature data were invalidated in total during the second monitoring quarter as a result of malfunctions. However; at all times during the quarter, at least one of the primary or secondary temperature sensor sets was functioning properly.

Four hours of all gas data, six hours of PM data, eight hours of vertical wind data, nine hours of horizontal wind and temperature data were invalidated during quarterly calibrations and independent performance audit on May 8, 2019. Additionally, six hours of solar data were not collected during the audit due to operator error. Semi-annual solar audit and calibration results show that both primary and secondary sensors passed.

Seven hours of all gas data were invalidated during multipoint calibrations on May 21, 2019.

Eleven hours of particulate matter data were invalidated June 19, 2019 during monthly maintenance and QC checks. Ozone analyzer maintenance on June 19, 2019 also resulted in 11 invalidated hours of ozone data.

The shelter temperature standard deviation exceeded 2° C or hourly shelter temperature exceeded 30° C from June 20 – 23, 2019. As a result, 96 hours of gas data were invalidated during this time period.

A communication error resulted in the loss of one hour of BAM and meteorology data on July 1, 2019 and three hours of BAM and gas data and two hours of PM data on July 30, 2019.

The lower detectible limit and reporting limit of the BAM analyzers are -5 µg/m^3. One hour of $PM_{2.5}$ data on July 7, 2019 was invalidated for recording a concentration below this limit. One hour of PM_{10} data from each of July 7, July 11, and July 15, 2019 were similarly invalidated.

Additional QC checks were conducted on the gas analyzers on July 10, 2019. Two hours of gas data were invalidated.

Temporary BAM flow errors occurred on July 15, 2019, July 18, 2019, August 28, 2019, and September 28, 2019. One hour of data from each BAM on each day was invalidated.

The shelter temperature standard deviation exceeded 2° C or hourly shelter temperature exceeded 30° C from July 2 through 8 and July 13 through 16, 2019. As a result, a total of 240 hours of gas data were invalidated during this time period.

Maintenance was performed on the meteorological tower on July 17, 2019. Eight hours of wind data, seven hours of primary 2-meter temperature data, and 11 hours of primary 10-meter and Delta-T data invalidated. An hour of data on other fields was not recorded as a result of a temporary communication outage during the maintenance. An additional five hours of all non-solar meteorological data were invalidated on July 18, 2019 during continued tower maintenance.

Monthly QC checks of the BAMs and maintenance on the gas analyzers were also performed on July 17, 2019; two hours of gas and BAM data were invalidated.

Thirteen hours of SO_2 data and six hours of other gas data were invalidated during multipoint calibrations on all gas analyzers on July 18, 2019; all analyzers passed.

Station maintenance, multipoint calibrations, and independent performance audit of ambient air analyzers and PM samplers performed August 27 through 29, 2019. Ozone transfer standard serial number 86 was removed and replaced with serial number 170. As-found and as-left calibrations passed. 41 hours of SO_2 data, 45 hours of CO data, 29 hours of NO_X data, and 34 hours of O_3 data invalidated in total during this time period.

Two hours of $PM_{2.5}$ and three hours of PM_{10} data were invalidated August 28, 2019 during monthly maintenance and QC checks.

During the August 27-29, 2019 station visit, the EPA protocol cylinder was swapped. Occasional adjustments to the gas analyzers and protocol cylinder were made in late August and early September during the new protocol cylinder's normal adjustment period. 10 hours of gas data were invalidated during this period as a result of these adjustments.

Four hours of particulate matter data were invalidated September 18, 2019 during monthly maintenance and QC checks. Multipoint calibrations on the gas analyzers were performed at the same time, resulting in the invalidation of eight hours of gas data.

The regularly scheduled precision checks for Thursday, September 26 did not complete automatically (except for ozone). A make-up precision check was conducted on September 29, 2019. One hour of gas data was invalidated during the makeup precision check.

Multipoint calibrations were performed on the carbon monoxide analyzer on October 17, 2019; analyzer passed. Three hours of all gas data invalidated during calibrations.

Multipoint calibrations and maintenance were performed on all gas analyzers on October 22, 2019; all instruments passed. The CO and SO_2 analyzers were replaced at this time. Nine hours of gas data were invalidated. Monthly QC checks were also performed on the PM BAMs on this date, resulting in the invalidation of one hour of PM data.

A temporary loss of software service on October 24, 2019 resulted in the loss of one hour of gas and meteorological data.

Multipoint calibrations were performed on the carbon monoxide and sulfur dioxide analyzers on October 25, 2019; analyzers passed. Four hours of all gas data invalidated during calibrations.

A power outage on October 30, 2019 resulted in the loss of one hour of meteorological and particulate data. The power loss caused zero air to flow through the gas sampling system until the precision check the next morning. As a result, seven hours of gas data were invalidated.

PM flow errors occurred on November 2, November 6, and November 8, 2019. One hour of BAM data was invalidated each day.

A gas flow error on November 2-3, 2019 resulted in the invalidation of 16 hours of data.

25 hours of all gas data, seven hours of $PM_{2.5}$ data, six hours of PM_{10} data, 21 hours of solar data, and 22 hours of other meteorological data were invalidated during quarterly calibrations and independent performance audit on November 5-6, 2019.

A sampling error on November 8, 2019 resulted in the invalidation of one hour of sulfur dioxide and ozone data. Further sampling errors on November 11 and 13, 2019 and December 9, 2019 resulted in the additional loss of one hour of sulfur dioxide data each day.

A communication error occurred on November 9, 2019, resulting in the loss of three hours of meteorological and BAM data, and four hours of gas data.

Station power losses resulted in the invalidation of two hours of gas data on November 10, 2019 and two hours of BAM data and one hour of meteorological and gas data on November 15, 2019.

Multipoint calibrations were performed on the carbon monoxide analyzer on November 25 and 26, 2019; analyzer passed. Two hours of all gas data invalidated during each calibration, except three hours of sulfur dioxide data were invalidated on the 25th.

The lower detectible limit and reporting limit of the BAM analyzers are -5 $\mu g/m^3$. Two hours of PM_{10} data on December 2, 2019 were invalidated for recording a concentration below this limit. One hour of $PM_{2.5}$ data and two hours of PM_{10} data from December 21, 2019; two hours of $PM_{2.5}$ data and four hours of PM_{10}

data from December 23, 2019; five hours of PM_{10} data from December 24, 2019; three hours of $PM_{2.5}$ data from December 28, 2019; one of PM_{10} data from December 29, 2019; and three hours of $PM_{2.5}$ data from December 31, 2019 were similarly invalidated.

Multipoint calibrations were performed on the carbon monoxide, nitrogen oxides, and sulfur dioxide analyzers on December 11, 2019; analyzers passed. Five hours of all gas data invalidated on this day.

Manufacturer specifications for $PM_{2.5}$ and PM_{10} measurements indicate that the uncertainty for 24-hour average concentrations is +/- 2 $\mu g/m^3$. Accordingly, 24-hour average concentrations less than -2 $\mu g/m^3$ resulted in the invalidation of both PM species for the entire days on December 14 and December 15, 2019. A total of 48 hours of data from each BAM was invalidated during the first quarter.

One hour of gas and met data were invalidated on December 15, 2019; two hours of gas and met data on December 19, 2019; and one hour of all data on December 20, 2019 were invalidated as a result of station sampling errors.

One hour of $PM_{2.5}$ and PM_{10} data were invalidated December 18, 2019 during monthly maintenance and QC checks.

The CO analyzer pulp malfunctioned on December 21, 2019. The pump was repaired in January 2020. 261 hours of CO data were invalidated from December 21, 2019 through the end of the year.

Data from the secondary wind sensors were reported in the fourth quarter of 2019. Snow and ice buildup on the sensors occurred from December 23-30, 2019. 181 hours of wind data were invalidated during this period.

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	2.7%
	< 0.5 m/s variation for 12 consecutive hours	1.3%
Wind Direction	Value is < 0°, > 360°	0.0%
	< 1° variation over 3 consecutive hours	0.0%
	< 10° variation over 18 consecutive hours	1.3%
Temperature (2 meters)	> 5°C variation from previous hour	0.2%
	< 0.5°C variation for 12 consecutive hours	0.4%
	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	0.7%
	Value is > record high, < record low	0.0%
Temperature Difference, ΔT	Value is > 0.8°C during the daytime	0.7%
	Value is < -0.8°C during the night	0.0%
	Value is > 5°C, < -3°C	0.0%
Solar Radiation	> 0 w/m^2 at night	0.0%
	Greater than the maximum possible value for date and latitude	0.2%

[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.

Quarterly and annual data completeness for ambient air and meteorological parameters are provided in, Table 2-3 and Table 2-4 respectively. Calculations for determining data completeness are provided in Appendix A.

Table 2-3: Ambient Air Quality Data Capture Percent

Period	Pollutants – Data Recovery [1]					
	NO_2	SO_2	O_3	CO	$PM_{2.5}$ [2]	PM_{10} [2]
January	97%	98%	98%	98%	90%	97%
February	94%	97%	97%	97%	100%	64% [3]
March	98%	98%	97%	98%	100%	100%
1st Quarter	**96%**	**98%**	**97%**	**98%**	**97%**	**88%**
April	99%	99%	99%	99%	100%	100%
May	97%	97%	97%	97%	97%	97%
June	86%	85%	84%	86%	97%	97%
2nd Quarter	**94%**	**94%**	**93%**	**94%**	**98%**	**98%**
July	65% [4]	65% [4]	65% [4]	65% [4]	100%	100%
August	95%	93%	94%	93%	100%	100%
September	97%	97%	97%	97%	100%	100%
3rd Quarter	**86%**	**85%**	**86%**	**85%**	**100%**	**100%**
October	96%	96%	96%	96%	100%	100%
November	92%	92%	92%	92%	97%	100%
December	98%	98%	98%	63% [5]	93%	93%
4th Quarter	**96%**	**95%**	**96%**	**84%**	**97%**	**98%**
Annual	**93%**	**93%**	**93%**	**90%**	**98%**	**96%**

[1] EPA PSD-quality ambient air monitoring standards require data capture of 80 percent or greater per quarter for four consecutive quarters.
[2] Data recovery for PM monitors is based on the number of valid 24-hour average particulate matter samples collected divided by the total number of 24-hour periods during the sampling period.
[3] PM_{10} data were invalidated in February 2019 due to sampler damage. Despite the data loss, DQOs were met for the monitoring quarter.
[4] Unstable shelter temperatures led to the invalidation of NO_2, SO_2, O_3, and CO data July 2019. Despite the data loss, DQOs were met for the monitoring quarter.
[5] The CO analyzer experienced a pump malfunction in December 2019. Despite the data loss, DQOs were met for the fourth monitoring quarter.

Table 2-4: Meteorological Data Capture Percent

Period	Meteorological Parameters – Data Recovery [1]								
	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	Horizontal Wind Speed	Horizontal Wind Direction	Wind Direction Std. Dev. (Sigma Theta)	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January	100%	100%	90% [2]	90% [2]	90% [2]	100%	100%	100%	100%
February	100%	100%	100% [2]	100% [2]	100% [2]	100%	100%	100%	99%
March	100%	100%	100% [2]	100% [2]	100% [2]	100%	100%	100%	100%
1st Quarter	**100%**	**100%**	**96% [2]**	**96% [2]**	**96% [2]**	**100%**	**100%**	**100%**	**99%**
April	100%	100%	100%	100%	100%	100% [3]	100% [3]	100% [3]	100%
May	98%	98%	98%	98%	98%	98% [3]	98% [3]	98% [3]	98%
June	99%	99%	99%	99%	99%	99% [3]	99% [3]	99% [3]	100%
2nd Quarter	**99%**	**99%**	**99%**	**99%**	**99%**	**99% [3]**	**99% [3]**	**99% [3]**	**99%**
July	98%	98%	98%	98%	98%	99%	97%	97%	99%
August	100%	100%	100%	100%	100%	100%	100%	100%	100%
September	100%	100%	100%	100%	100%	100%	100%	100%	100%
3rd Quarter	**99%**	**99%**	**99%**	**99%**	**99%**	**100%**	**99%**	**99%**	**100%**
October	100%	100%	100% [2]	100% [2]	100% [2]	100%	100%	100%	100%
November	96%	96%	96% [2]	96% [2]	96% [2]	96%	96%	96%	97%
December	99%	99%	**75% [2,4]**	**75% [2,4]**	**75% [2,4]**	99%	99%	99%	99%
4th Quarter	**99%**	**99%**	**90% [2]**	**90% [2]**	**90% [2]**	**99%**	**99%**	**99%**	**99%**
Annual	**99%**	**99%**	**96%**	**96%**	**96%**	**99%**	**99%**	**99%**	**99%**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Data from the secondary horizontal wind sensor were used during the first and fourth quarters.
[3] A combination of data from the primary and secondary temperature sensors were used during the second quarter. See Section 2.2 for more information.
[4] Horizontal wind data were invalidated during December 2019 due to snow and ice buildup on the sensors. Despite the data loss, DQOs were met during the fourth 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, NO2, O3, and SO2) 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 Table 2-20.

Precision statistics for the continuous $PM_{2.5}$ monitor were determined using the monitoring network QA station, located at the Alpine CD1 monitoring station. 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 µg/m^3. As proposed in the CD1 $PM_{2.5}$ Monitoring Program QAPP, PM2.5 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 3 µg/m^3. Secondary precision statistics were used when collocated samples did not meet the minimum concentration threshold. Quarterly network $PM_{2.5}$ precision statistics are presented in Table 2-21.

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

Period	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]
1/3/2019	7.6	8.0	-5.6	23	-3.53	1.75	-0.10	-6.96	2.19
1/7/2019 [2]	7.5	8.0	-6.8						
1/7/2019 [3]	7.9	8.0	-1.7						
1/8/2019	7.9	8.0	-1.5						
1/10/2019	7.8	8.0	-2.1						
1/17/2019	7.8	8.0	-2.5						
1/24/2019	7.7	8.0	-3.9						
1/31/2019 [2]	7.8	8.0	-2.5						
1/31/2019 [3]	7.9	8.0	-1.2						
2/1/2019	7.7	8.0	-3.2						
2/7/2019	7.7	8.0	-4.1						
2/14/2019	7.6	8.0	-5.3						
2/16/2019 [2]	7.7	8.0	-4.0						
2/16/2019 [3]	7.7	8.0	-3.7						
2/21/2019	7.9	8.0	-1.7						
2/28/2019	7.6	8.0	-5.2						
3/4/2019	7.6	8.0	-5.6						
3/7/2019	7.6	8.0	-5.0						
3/14/2019	7.6	8.0	-5.2						
3/20/2019 [2]	7.6	8.0	-5.5						
3/20/2019 [3]	7.9	8.0	-0.8						
3/21/2019	7.9	8.0	-1.8						
3/28/2019	7.8	8.0	-2.3						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

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

Period	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]
4/4/2019	7.8	8.0	-3.1	17	-3.20	0.96	-1.31	-5.09	1.26
4/11/2019	7.7	8.0	-4.0						
4/18/2019	7.6	8.0	-4.9						
4/25/2019	7.7	8.0	-3.8						
5/2/2019	7.8	8.0	-2.8						
5/8/2019	7.7	8.0	-3.4						
5/9/2019	7.7	8.0	-4.0						
5/16/2019	7.7	8.0	-3.9						
5/21/2019 [2]	7.6	8.0	-4.7						
5/21/2019 [3]	7.9	8.0	-1.8						
5/23/2019	7.8	8.0	-2.2						
5/30/2019	7.8	8.0	-2.9						
6/6/2019	7.8	8.0	-2.6						
6/13/2019	7.8	8.0	-2.3						
6/19/2019	7.8	8.0	-2.5						
6/20/2019	7.9	8.0	-1.8						
6/27/2019	7.7	8.0	-3.8						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

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

Period	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]
7/4/2019	7.6	8.0	-4.8	22	-2.10	3.32	4.41	-8.60	4.18
7/11/2019	7.6	8.0	-5.3						
7/16/2019 [2]	7.3	8.0	-8.5						
7/16/2019 [3]	7.9	8.0	-0.7						
7/17/2019	7.9	8.0	-0.7						
7/18/2019	7.9	8.0	-1.4						
7/18/2019	7.8	8.0	-2.2						
7/25/2019	7.8	8.0	-2.0						
8/1/2019	7.6	8.0	-5.2						
8/8/2019	7.6	8.0	-4.9						
8/15/2019	7.6	8.0	-5.3						
8/22/2019	7.5	8.0	-5.8						
8/27/2019	7.5	8.0	-6.8						
8/28/2019	8.0	7.7	3.9						
8/29/2019 [2]	8.0	7.7	3.4						
8/29/2019 [3]	7.7	7.7	0.1						
9/5/2019	7.8	7.7	1.5						
9/12/2019	7.6	7.7	-0.8						
9/18/2019 [2]	7.6	7.7	-1.8						
9/18/2019 [3]	7.8	7.7	1.5						
9/19/2019	7.7	7.7	-0.4						
9/29/2019	7.7	7.7	-0.2						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

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

Period	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]
10/3/2019	7.9	7.7	2.0	20	-2.08	2.93	3.67	-7.83	3.75
10/10/2019	7.3	7.7	-5.3						
10/17/2019	7.8	7.7	1.2						
10/22/2019 [2]	7.6	7.7	-1.9						
10/22/2019 [3]	7.5	7.7	-2.6						
10/24/2019	7.3	7.7	-5.8						
10/25/2019 [2]	7.2	7.7	-6.6						
10/25/2019 [3]	7.6	7.7	-1.4						
10/31/2019	7.5	7.7	-3.1						
11/7/2019	7.4	7.7	-3.5						
11/14/2019	7.6	7.7	-1.9						
11/21/2019	7.7	7.7	0.3						
11/25/2019	7.8	7.7	1.7						
11/26/2019	7.6	7.7	-1.5						
11/28/2019	7.6	7.7	-1.6						
12/5/2019	7.8	7.7	0.8						
12/11/2019 [2]	7.9	7.7	3.1						
12/11/2019 [3]	7.2	7.7	-6.0						
12/12/2019	7.2	7.7	-5.9						
12/19/2019	7.4	7.7	-3.7						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration
[3] As-left; post calibration.

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

Period	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]
1/3/2019	82.0	80.0	2.5	16	-0.95	5.54	9.91	-11.82	7.34
1/8/2019	85.6	80.0	7.0						
1/10/2019	86.9	80.0	8.6						
1/17/2019	83.6	80.0	4.5						
1/24/2019	82.7	80.0	3.4						
1/31/2019	84.4	80.0	5.5						
2/1/2019 [2]	80.9	80.0	1.1						
2/7/2019	78.1	80.0	-2.4						
2/14/2019 [3]	-	-	-						
2/16/2019 [4]	75.8	80.0	-5.3						
2/16/2019 [5]	76.4	80.0	-4.5						
2/21/2019	77.0	80.0	-3.8						
3/4/2019	75.8	80.0	-5.3						
3/7/2019	74.0	80.0	-7.5						
3/14/2019	73.7	80.0	-7.9						
3/21/2019	76.6	80.0	-4.3						
3/28/2019	74.3	80.0	-7.1						

[1] Acceptance criteria: ≤ 15%
[2] The Thermo 42i NOX analyzer (serial number: 0705820942) was replaced with an API T200U analyzer (serial number: 194) on February 1, 2019.
[3] No precision check run during calibrations on ozone analyzer.
[4] As-found; pre-calibration.
[5] As-left; post calibration.

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

Period	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]
4/4/2019	75.1	80.0	-6.1	17	-6.11	0.85	-4.44	-7.79	1.12
4/11/2019	74.7	80.0	-6.6						
4/18/2019	74.6	80.0	-6.8						
4/25/2019	75.9	80.0	-5.1						
5/2/2019	75.2	80.0	-6.0						
5/8/2019	75.7	80.0	-5.4						
5/9/2019	75.5	80.0	-5.6						
5/16/2019	74.4	80.0	-7.0						
5/21/2019 [2]	74.3	80.0	-7.1						
5/21/2019 [3]	75.8	80.0	-5.3						
5/23/2019	74.8	80.0	-6.5						
5/30/2019	75.6	80.0	-5.5						
6/6/2019	75.0	80.0	-6.3						
6/13/2019	74.2	80.0	-7.3						
6/19/2019	75.5	80.0	-5.6						
6/20/2019	74.1	80.0	-7.4						
6/27/2019	76.5	80.0	-4.4						

[1] Acceptance criteria: ≤ 15%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

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

Period	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]
7/4/2019	71.7	80.0	-10.4	17	-3.34	3.60	3.72	-10.39	4.72
7/11/2019	74.4	80.0	-7.0						
7/17/2019	74.3	80.0	-7.1						
7/18/2019 [2]	73.6	80.0	-8.0						
7/18/2019 [3]	74.6	80.0	-6.8						
7/25/2019	75.8	80.0	-5.3						
8/1/2019	75.8	80.0	-5.3						
8/8/2019	79.5	80.0	-0.6						
8/15/2019	79.4	80.0	-0.8						
8/22/2019	78.5	80.0	-1.9						
8/27/2019	80.1	80.0	0.1						
8/29/2019	81.3	80.0	1.6						
9/12/2019	79.2	80.0	-1.0						
9/18/2019 [2]	79.8	80.0	-0.3						
9/18/2019 [3]	77.4	80.0	-3.3						
9/19/2019	78.3	80.0	-2.1						
9/29/2019	80.9	80.0	1.1						

[1] Acceptance criteria: ≤ 15%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

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

Period	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]
10/3/2019	79.8	80.0	-0.3	14	3.10	3.01	9.00	-2.80	4.09
10/10/2019	80.2	80.0	0.3						
10/17/2019	80.3	80.0	0.4						
10/24/2019	80.9	80.0	1.1						
10/31/2019	82.8	80.0	3.5						
11/7/2019	87.3	80.0	9.1						
11/14/2019	84.8	80.0	6.0						
11/21/2019	79.0	80.0	-1.3						
11/28/2019	80.8	80.0	1.0						
12/5/2019	84.7	80.0	5.9						
12/11/2019	83.4	80.0	4.3						
12/12/2019	84.9	80.0	6.1						
12/19/2019	82.9	80.0	3.6						
12/26/2019	82.9	80.0	3.6						

[1] Acceptance criteria: ≤ 15%

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

Period	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]
1/2/2019 [2]	83.1	80.0	3.9	18	0.83	1.94	4.63	-2.96	2.51
1/2/2019 [3]	80.8	80.0	1.0						
1/3/2019	80.6	80.0	0.7						
1/10/2019	79.0	80.0	-1.3						
1/17/2019	80.9	80.0	1.1						
1/24/2019	83.6	80.0	4.4						
1/31/2019	82.6	80.0	3.3						
2/7/2019	79.5	80.0	-0.7						
2/14/2019 [2]	77.5	80.0	-3.2						
2/14/2019 [3]	79.4	80.0	-0.7						
2/16/2019	81.4	80.0	1.8						
2/21/2019	81.3	80.0	1.6						
2/28/2019	81.4	80.0	1.7						
3/1/2019	79.6	80.0	-0.5						
3/7/2019	79.7	80.0	-0.4						
3/14/2019	80.5	80.0	0.6						
3/24/2019	81.9	80.0	2.4						
3/28/2019	79.3	80.0	-0.8						

[1] Acceptance criteria: ≤ 7%
[2] As-found; pre-calibration
[3] As-left; post calibration.

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

Period	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)
4/4/2019	78.8	80.0	-1.5	14	-2.00	1.48	0.89	-4.89	2.00
4/11/2019	79.0	80.0	-1.2						
4/18/2019	79.1	80.0	-1.1						
4/25/2019	79.6	80.0	-0.6						
5/2/2019	77.4	80.0	-3.3						
5/9/2019	77.5	80.0	-3.2						
5/16/2019	78.0	80.0	-2.5						
5/23/2019	77.8	80.0	-2.7						
5/30/2019	76.1	80.0	-4.9						
6/6/2019	77.9	80.0	-2.6						
6/13/2019	78.3	80.0	-2.2						
6/19/2019	77.7	80.0	-2.9						
6/20/2019	79.7	80.0	-0.4						
6/27/2019	80.8	80.0	1.0						

[1] Acceptance criteria: ≤ 7%

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

Period	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)
7/4/2019	80.9	80.0	1.1	15	-0.18	0.88	1.54	-1.90	1.18
7/11/2019	80.4	80.0	0.5						
7/18/2019	80.8	80.0	1.0						
7/25/2019	79.4	80.0	-0.7						
8/1/2019	80.1	80.0	0.2						
8/8/2019	80.3	80.0	0.4						
8/15/2019	80.1	80.0	0.1						
8/22/2019	80.2	80.0	0.3						
8/27/2019	80.1	80.0	0.1						
8/29/2019	80.0	80.0	0.0						
9/5/2019	79.3	80.0	-0.8						
9/12/2019	79.8	80.0	-0.3						
9/19/2019	79.0	80.0	-1.3						
9/26/2019	78.4	80.0	-2.0						
9/29/2019	79.0	80.0	-1.3						

[1] Acceptance criteria: ≤ 7%

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

Period	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]
10/3/2019	77.7	80.0	-2.9	15	-0.82	1.58	2.28	-3.91	2.12
10/10/2019	78.3	80.0	-2.1						
10/17/2019	80.6	80.0	0.7						
10/22/2019 [2]	77.0	80.0	-3.7						
10/22/2019 [3]	78.7	80.0	-1.6						
10/24/2019	78.1	80.0	-2.3						
10/31/2019	79.0	80.0	-1.2						
11/7/2019	80.9	80.0	1.2						
11/14/2019	80.0	80.0	0.0						
11/21/2019	78.1	80.0	-2.4						
11/28/2019	80.5	80.0	0.6						
12/5/2019	80.7	80.0	0.9						
12/12/2019	80.2	80.0	0.2						
12/19/2019	80.4	80.0	0.5						
12/26/2019	79.8	80.0	-0.2						

[1] Acceptance criteria: ≤ 7%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

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

Period	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)
1/3/2019	76.8	78.0	-1.5	21	0.92	1.66	4.18	-2.34	2.11
1/7/2019	77.9	78.0	-0.1						
1/8/2019	76.7	78.0	-1.7						
1/10/2019	76.9	78.0	-1.5						
1/17/2019	78.5	78.0	0.7						
1/24/2019	78.5	78.0	0.6						
1/31/2019 (2)	79.1	78.0	1.4						
1/31/2019 (3)	77.8	78.0	-0.2						
2/1/2019	76.9	78.0	-1.4						
2/7/2019	78.0	78.0	0.0						
2/14/2019	77.9	78.0	-0.2						
2/16/2019 (2)	78.4	78.0	0.5						
2/16/2019 (3)	79.3	78.0	1.7						
2/21/2019	79.5	78.0	2.0						
2/28/2019	79.9	78.0	2.4						
3/4/2019	80.7	78.0	3.4						
3/7/2019	80.0	78.0	2.5						
3/14/2019	80.6	78.0	3.3						
3/20/2019	80.4	78.0	3.0						
3/21/2019	79.5	78.0	1.9						
3/28/2019	80.0	78.0	2.5						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

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

Period	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]
4/4/2019	80.1	78.0	2.7	17	2.90	2.29	7.39	-1.60	3.01
4/11/2019	79.3	78.0	1.7						
4/18/2019	80.3	78.0	3.0						
4/25/2019	80.5	78.0	3.2						
5/2/2019	80.7	78.0	3.5						
5/8/2019	80.4	78.0	3.1						
5/9/2019	83.6	78.0	7.1						
5/16/2019	83.4	78.0	6.9						
5/21/2019 [2]	84.0	78.0	7.7						
5/21/2019 [3]	78.7	78.0	0.9						
5/23/2019	78.7	78.0	0.8						
5/30/2019	79.2	78.0	1.6						
6/6/2019	79.3	78.0	1.7						
6/13/2019	79.3	78.0	1.6						
6/19/2019	79.7	78.0	2.2						
6/20/2019	77.7	78.0	-0.4						
6/27/2019	79.6	78.0	2.0						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

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

Period	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)
7/4/2019	79.6	78.0	2.1	20	2.10	2.38	6.76	-2.56	3.04
7/11/2019	79.0	78.0	1.3						
7/16/2019 (2)	80.2	78.0	2.8						
7/16/2019 (3)	78.7	78.0	0.8						
7/17/2019	79.2	78.0	1.6						
7/18/2019 (2)	79.2	78.0	1.5						
7/18/2019 (3)	79.5	78.0	1.9						
7/25/2019	78.0	78.0	-0.1						
8/1/2019	77.6	78.0	-0.5						
8/8/2019	79.2	78.0	1.6						
8/15/2019	79.8	78.0	2.3						
8/22/2019	79.3	78.0	1.7						
8/27/2019	81.2	78.0	4.1						
8/28/2019	78.3	74.9	4.5						
9/5/2019	77.3	74.9	3.1						
9/12/2019	79.4	74.9	6.0						
9/18/2019 (2)	81.5	74.9	8.8						
9/18/2019 (3)	74.9	74.9	0.0						
9/19/2019	74.8	74.9	-0.2						
9/29/2019	73.9	74.9	-1.3						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

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

Period	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]
10/3/2019	75.4	74.9	0.6	21	-1.63	1.96	2.21	-5.48	2.49
10/10/2019	74.9	74.9	0.1						
10/17/2019	75.5	74.9	0.8						
10/22/2019 [2]	75.5	74.9	0.9						
10/22/2019 [3]	74.8	74.9	-0.2						
10/24/2019	74.0	74.9	-1.1						
10/25/2019 [2]	73.8	74.9	-1.5						
10/25/2019 [3]	75.3	74.9	0.5						
10/31/2019	74.8	74.9	-0.1						
11/7/2019	73.6	74.9	-1.8						
11/14/2019	72.1	74.9	-3.8						
11/21/2019	73.1	74.9	-2.4						
11/25/2019	71.6	74.9	-4.5						
11/26/2019	72.8	74.9	-2.8						
11/28/2019	72.7	74.9	-2.9						
12/5/2019	70.7	74.9	-5.7						
12/11/2019 [2]	71.6	74.9	-4.5						
12/11/2019 [3]	75.2	74.9	0.4						
12/12/2019	74.2	74.9	-1.0						
12/19/2019	73.0	74.9	-2.5						
12/26/2019	72.7	74.9	-3.0						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

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

Period	Samplers [1]	Concentration Levels	Number of Collocated Samples	Average Percent Difference	Standard Deviation [2] (µg/m³)	Precision [3] (%CV)
1st Quarter (January 1 – March 31)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 µg/m³	57	-38.3	20.9	16.9
2nd Quarter (April 1 – June 30)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 µg/m³	29	-20.0	36.3	31.2
3rd Quarter (July 1 – September 30)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 µg/m³	8	16.4	25.1	27.9
4th Quarter (October 1 – December 31)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 µg/m³	26	-30.0	41.4	36.1
Year to Date	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 µg/m³	120	-28.4	33.4	25.8

[1] $PM_{2.5}$ network precision statistics represent data from the CD1 monitoring station $PM_{2.5}$ 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 ≤ 10%CV per quarter. If the precision estimate exceeds 10%CV, alternate precision statistics of ±3 µg/m3 apply. See CD1 summary report for additional information

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 collocate traceable authoritative standards with them to verify that each instrument response is accurate to within established tolerances.

Tables 2-22 through Table 2-38 summarize the accuracy statistics obtained during the project.

2.5.1 INSTRUMENT CALIBRATION STATISTICS

Single-point calibration verifications were performed on a daily basis on all gas pollutant analyzers throughout the monitoring year. The single-point calibration verifications 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 (span check) of the instrument's upper range limit (URL). If 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.

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 Table 2-25 include calibration statistical summaries for CO, NO_2, O_3, and SO_2 analyzers, respectively. Table 2-26 and Table 2-27 summarize the monthly 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 calibration is assessed at least semi-annually. Each sensor is assessed by collocating calibration sensors of NIST-traceable accuracy. Calibration results are presented in Table 2-28 through Table 2-29.

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	Y-Intercept	R^2	Pass/Fail [1]
1/7/2019	0.0	0.0	-	0.44%	1.0016	-0.0749	1.0000	PASS
	8.0	7.9	-1.5%					
	17.5	17.4	-0.5%					
	30.0	30.0	-0.2%					
	40.0	40.1	0.0%					
	45.0	45.1	0.0%					
1/31/2019	0.0	-0.1	-	1.29%	1.0032	-0.2337	1.0000	PASS
	8.1	7.7	-4.5%					
	17.5	17.3	-1.2%					
	30.0	29.9	-0.3%					
	40.0	39.9	-0.3%					
	45.1	45.0	-0.1%					
2/16/2019	0.0	0.1	-	0.15%	0.9982	0.0284	1.0000	PASS
	8.0	8.0	-0.4%					
	17.5	17.5	-0.1%					
	30.0	30.0	-0.1%					
	40.0	40.0	0.0%					
	45.0	44.9	-0.2%					
3/20/2019	0.0	0.0	-	0.61%	1.0053	-0.1072	0.9999	PASS
	8.0	7.9	-0.6%					
	17.5	17.4	-0.4%					
	30.0	29.7	-0.9%					
	40.0	40.1	0.4%					
	45.0	45.3	0.8%					
5/8/2019	0.0	-0.1	-	1.35%	0.9959	-0.1460	1.0000	PASS
	8.0	7.7	-3.3%					
	17.5	17.3	-0.9%					
	30.0	29.6	-1.2%					
	40.0	39.8	-0.6%					
	45.0	44.7	-0.8%					

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. R2 ≥ 0.9955
4. Y-intercept ≤ ±2% of full scale

Table 2-22 (Continued): Calibration Summary – CO

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R^2	Pass/Fail [1]
12/11/2019	0.0	0.0	-	0.73%	0.9985	-0.0427	1.0000	PASS
	7.4	7.2	-1.6%					
	16.1	15.9	-1.1%					
	27.6	27.6	0.3%					
	36.8	36.8	-0.1%					
	41.5	41.3	-0.5%					

[1] Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. R2 ≥ 0.9955
4. Y-intercept ≤ ±2% of full scale

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]
1/8/2019	0.0	0.1	-	4.08%	1.0417	-0.0299	1.0000	100.3%	PASS
	82.6	85.6	3.6%						
	174.4	181.8	4.2%						
	304.5	317.7	4.3%						
	408.5	425.5	4.2%						
	436.4	454.3	4.1%						
1/31/2019 [2]	0.0	0.0	-	0.90%	0.9986	0.9618	0.9999	98.6%	PASS
	78.3	81.0	3.4%						
	174.8	175.2	0.2%						
	303.5	303.2	-0.1%						
	405.1	404.2	-0.2%						
	432.4	434.4	0.5%						
2/16/2019	0.0	0.2	-	2.99%	0.9710	-0.0337	1.0000	98.0%	PASS
	78.4	75.8	-3.3%						
	170.6	165.7	-2.9%						
	296.0	286.8	-3.1%						
	390.4	380.3	-2.6%						
	416.4	403.5	-3.1%						
5/8/2019	0.0	-0.1	-	0.80%	1.0080	0.0395	1.0000	99.9%	PASS
	79.4	79.6	0.2%						
	170.2	172.8	1.5%						
	296.1	298.0	0.6%						
	393.8	397.1	0.8%						
	420.6	423.9	0.8%						

[1] Acceptance criteria:

1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.9 and ≤ 1.10
3. $R^2 \geq 0.9950$
4. Y-intercept ≤ ±3% of full scale
5. Converter efficiency ≥ 96.0%

[2] The Thermo 42i NO_x analyzer (serial number: 0705820942) was replaced with an API T200U analyzer (serial number: 194) on February 1, 2019. As-Found NO_2 calibrations were not performed. As-Left calibration performed on 2/1/2019.

Table 2-23 (Continued): 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]
5/21/2019	-0.3	-0.3	-	3.02%	0.9638	0.6501	1.0000	96.9%	PASS
	76.7	75.6	-1.4%						
	160.9	155.5	-3.3%						
	275.0	265.4	-3.5%						
	387.2	373.5	-3.5%						
	362.1	350.1	-3.3%						
7/18/2019	0.0	0.1	-	2.80%	0.9638	1.2839	0.9995	96.6%	PASS
	76.5	74.4	-2.8%						
	152.7	148.3	-2.9%						
	253.9	252.1	-0.7%						
	343.8	330.9	-3.7%						
	365.3	350.9	-3.9%						
8/27/2019	0.0	0.1	-	1.01%	0.9881	0.2160	1.0000	97.6%	PASS
	80.5	80.0	-0.7%						
	155.9	154.7	-0.8%						
	269.2	265.2	-1.5%						
	351.6	347.4	-1.2%						
	373.3	369.8	-0.9%						
9/18/2019	0.0	0.0	-	2.49%	0.9683	0.7961	0.9999	96.4%	PASS
	78.1	77.4	-0.9%						
	154.1	149.3	-3.1%						
	262.6	256.8	-2.2%						
	348.0	336.3	-3.4%						
	372.1	361.3	-2.9%						
12/11/2019	0.0	-0.1	-	2.35%	0.9715	0.3483	0.9998	99.0%	PASS
	83.5	83.4	-0.1%						
	170.8	166.5	-2.5%						
	297.9	285.6	-4.1%						
	392.2	381.2	-2.8%						
	418.5	409.6	-2.1%						

[1] Acceptance criteria:

1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.9 and ≤ 1.10
3. $R^2 \geq 0.9950$
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]
1/2/2019	0.000	-0.001	-	0.30%	1.0001	-0.0001	1.0000	PASS
	0.080	0.081	1.1%					
	0.175	0.175	0.0%					
	0.300	0.300	0.2%					
	0.399	0.398	-0.2%					
	0.450	0.450	0.0%					
2/7/2019	0.000	-0.001	-	0.43%	1.0066	-0.0010	1.0000	PASS
	0.080	0.080	-0.5%					
	0.175	0.176	0.6%					
	0.299	0.300	0.2%					
	0.399	0.401	0.5%					
	0.449	0.451	0.4%					
2/14/2019	0.000	0.001	-	0.23%	0.9995	0.0002	1.0000	PASS
	0.080	0.079	-0.6%					
	0.175	0.175	0.3%					
	0.299	0.300	0.1%					
	0.399	0.400	0.1%					
	0.449	0.449	-0.1%					
2/16/2019	-0.001	0.001	-	0.61%	0.9980	0.0015	1.0000	PASS
	0.080	0.081	1.9%					
	0.175	0.176	0.5%					
	0.299	0.301	0.5%					
	0.400	0.400	0.1%					
	0.450	0.450	0.2%					

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±7%
2. Slope ≥ 0.93 and ≤ 1.07
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale

Table 2-24 (Continued): 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]
5/21/2019	0.002	0.000	-	0.95%	1.0065	-0.0026	1.0000	PASS
	0.081	0.079	-3.1%					
	0.175	0.173	-1.2%					
	0.300	0.299	-0.2%					
	0.400	0.400	-0.1%					
	0.449	0.450	0.2%					
8/27/2019 – As Found [2]	0.000	0.002	-	0.52%	0.9965	0.0017	1.0000	PASS
	0.080	0.081	1.2%					
	0.173	0.175	1.2%					
	0.300	0.300	-0.1%					
	0.399	0.399	0.1%					
	0.449	0.449	0.1%					
8/27/2019 – As Left [2]	0.001	0.001	-	0.90%	0.9974	0.0010	0.9998	PASS
	0.080	0.081	1.4%					
	0.174	0.175	0.9%					
	0.300	0.297	-1.0%					
	0.395	0.399	0.9%					
	0.450	0.448	-0.4%					
10/22/2019	0.002	0.000	-	2.24%	0.9879	0.0021	1.0000	PASS
	0.081	0.079	-2.8%					
	0.177	0.172	-3.0%					
	0.301	0.295	-1.9%					
	0.399	0.391	-2.1%					
	0.449	0.443	-1.3%					

[1] Acceptance criteria:

1. Measured and audit point difference ≤ ±7%
2. Slope ≥ 0.93 and ≤ 1.07
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale

[2] Ozone transfer standard (serial number 86) replaced with serial number 170 on August 27, 2019.

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]
1/31/2019	0.0	-1.5	-	0.93%	1.0116	-1.6586	1.0000	PASS
	78.6	77.1	-1.9%					
	170.6	171.8	0.7%					
	292.4	294.5	0.7%					
	390.3	391.7	0.4%					
	439.2	443.5	1.0%					
2/16/2019	0.0	0.3	-	0.69%	1.0064	0.1062	0.9999	PASS
	78.6	79.3	0.9%					
	171.0	171.8	0.5%					
	292.4	295.0	0.9%					
	390.1	390.3	0.1%					
	438.6	443.4	1.1%					
5/8/2019	0.0	0.2	-	5.56%	1.0582	-0.1185	1.0000	PASS
	78.0	81.2	4.2%					
	169.4	179.9	6.2%					
	289.8	307.0	5.9%					
	387.0	409.4	5.8%					
	435.2	460.0	5.7%					
5/21/2019	0.0	0.4	-	0.32%	0.9996	0.6236	1.0000	PASS
	77.8	78.4	0.7%					
	171.9	172.2	0.2%					
	292.2	293.8	0.5%					
	389.9	390.5	0.2%					
	474.2	474.0	0.0%					

[1]Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale

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]
7/18/2019	0.0	1.0	-	1.27%	0.9962	1.9792	0.9996	PASS
	78.5	79.1	0.7%					
	170.4	173.5	1.8%					
	292.1	297.5	1.9%					
	389.7	384.1	-1.4%					
	438.6	440.9	0.5%					
8/27/2019	0.0	1.6	-	2.94%	1.0249	1.0572	1.0000	PASS
	78.5	81.4	3.7%					
	170.4	174.7	2.5%					
	292.1	301.1	3.1%					
	389.8	400.2	2.7%					
	438.6	450.8	2.8%					
8/28/2019	0.0	0.1	-	0.24%	1.0015	0.0988	1.0000	PASS
	77.8	78.3	0.6%					
	170.4	170.6	0.1%					
	292.1	292.5	0.1%					
	389.8	390.1	0.1%					
	438.6	439.9	0.3%					
9/18/2019	0.0	-0.2	-	0.21%	1.0023	-0.0999	1.0000	PASS
	74.8	75.0	0.3%					
	163.5	163.6	0.1%					
	280.1	281.1	0.4%					
	373.9	374.1	0.1%					
	420.9	422.0	0.3%					

[1] Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale

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]
10/22/19 – As Found (2)	0.0	0.8	-	0.91%	0.9984	1.6882	0.9999	PASS
	74.7	75.7	1.4%					
	163.5	166.4	1.8%					
	280.2	282.6	0.9%					
	374.1	375.6	0.4%					
	420.8	420.2	-0.1%					
10/22/19 – As Left (2)	0.0	1.0	-	0.21%	0.9950	0.7545	1.0000	PASS
	74.7	74.8	0.2%					
	163.4	163.4	0.0%					
	280.1	279.5	-0.2%					
	374.2	372.5	-0.4%					
	420.7	419.9	-0.2%					
10/25/2019	0.0	0.2	-	1.45%	0.9828	0.4533	1.0000	PASS
	74.8	73.8	-1.4%					
	163.5	161.7	-1.1%					
	280.2	276.2	-1.4%					
	375.3	369.0	-1.7%					
	420.5	413.5	-1.7%					
12/11/2019	0.0	0.5	-	0.39%	0.9990	0.7349	1.0000	PASS
	74.4	75.2	1.1%					
	162.6	162.6	0.0%					
	278.5	280.1	0.6%					
	371.8	372.2	0.1%					
	419.2	418.8	-0.1%					

[1] Acceptance criteria:

1. Measured and audit point difference ≤ ±10%
2. Slope ≥ 0.90 and ≤ 1.10
3. $R^2 \geq 0.9955$
4. Y-intercept ≤ ±2% of full scale

[2] The Thermo 43i SO_2 analyzer (serial number 09200039) was replaced with an API T100U analyzer (serial number 338) on October 22, 2019.

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

Date	Ambient Temperature [1] (˚C)			Barometric Pressure [2] (mmHg)			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
1/8/2019 [4]	-	-	-	-	-	-	14:29:07	14:27:07	0:01:57	-	-	-
1/31/2019 [5]	-33.3	-32.0	-1.3	777	769	8	- [6]	- [6]	- [6]	16.7	17.27	-3.3%
2/16/2019 [5]	-32.7	-31.3	-1.4	766	756	10	- [6]	- [6]	- [6]	16.7	17.11	-2.4%
3/15/2019	-15.9	-15.0	-0.9	754	751	4	17:44:30	17:42:46	0:01:44	16.7	16.77	-0.4%
4/16/2019 [5]	-12.6	-12.8	0.2	752	750	2	18:53:30	18:51:35	0:01:55	16.7	16.87	-1.0%
5/8/2019	-6.4	-6.7	0.3	754	757	-3	- [6]	- [6]	- [6]	16.7	16.67	0.2%
6/19/2019	14.1	13.7	0.4	761	763	-2	- [6]	- [6]	- [6]	16.7	16.88	-1.1%
7/17/2019	10.0	10.0	0.0	752	752	0	- [6]	- [6]	- [6]	16.7	16.91	-1.1%
8/28/2019	1.7	1.8	-0.1	761	761	0	17:36:50	17:34:40	0:02:10	16.7	16.82	-0.8%
9/18/2019	4.7	4.6	0.1	747	747	1	16:24:00	16:21:50	0:02:10	16.7	16.85	-0.9%
10/22/2019	-6.0	-5.9	-0.1	757	755	2	11:45:00	11:44:00	0:01:00	16.7	16.88	-1.1%
11/5/2019	-12.1	-11.5	-0.6	769	766	3	10:06:00	10:04:00	0:02:00	16.7	16.99	-1.9%
12/18/2019	-19.4	-19.0	-0.4	757	754	3	16:43:00	16:40:40	0:02:20	16.7	16.47	1.4%

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] Only leak-check performed on 1/08/2019.
[5] Multipoint calibration performed.
[6] Time verification is an operational criterion, not a critical criterion.

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

Date	Ambient Temperature [1] (˚C)			Barometric Pressure [2] (mmHg)			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
1/8/2019 [4]	-	-	-	-	-	-	14:30:05	14:28:05	0:02:00	-	-	-
1/31/2019 [5]	-33.2	-31.2	-2.0	776	769	7	- [6]	- [6]	- [6]	16.7	16.75	-0.3%
2/16/2019 [5]	-	-	-	-	-	-	-	-	-	-	-	-
3/15/2019	-16.0	-15.0	-1.0	753	751	3	17:49:20	17:47:15	0:02:05	16.7	16.85	-0.9%
4/16/2019	-10.8	-11.0	0.2	755	754	1	18:54:23	18:52:20	0:02:03	16.7	16.85	-0.9%
5/8/2019	-6.6	-6.6	0.0	757	757	0	- [6]	- [6]	- [6]	16.7	16.79	-0.5%
6/19/2019	13.0	12.5	0.5	761	763	-2	- [6]	- [6]	- [6]	16.7	16.83	-0.8%
7/17/2019	9.9	10.0	-0.1	752	752	1	- [6]	- [6]	- [6]	16.7	16.83	-0.8%
7/18/2019	17.5	18.5	-1.0	752	752	1	17:03:23	17:01:30	0:01:53	16.7	16.84	-0.9%
8/28/2019	1.4	1.7	-0.3	762	761	1	17:32:00	17:29:50	0:02:10	16.7	16.82	-0.7%
9/18/2019	4.6	4.6	0.0	747	747	1	16:24:00	16:21:50	0:02:10	16.7	16.87	-1.2%
10/22/2019	-6.0	-5.5	-0.5	757	755	2	11:45:00	11:44:00	0:01:00	16.7	16.88	-1.0%
11/5/2019	-12.3	-11.6	-0.7	769	766	3	10:06:00	10:04:00	0:02:00	16.7	17.00	-1.8%
12/18/2019	-18.7	-19.0	0.3	758	754	4	16:41:50	16:39:26	0:02:24	16.7	16.82	-0.8%

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] Only leak-check performed on 1/08/2019.
[5] Multipoint calibration performed.
[6] Time verification is an operational criterion, not a critical criterion.

Table 2-28: May 8, 2019 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
2-m Temperature Accuracy – Primary Sensor (1)	≤ ±0.50	°C	0.48	Pass
2-m Temperature Accuracy – Secondary Sensor (1)	≤ ±0.50	°C	0.37	Pass
10-m Temperature Accuracy – Primary Sensor (1)	≤ ±0.50	°C	0.39	Pass
10-m Temperature Accuracy – Secondary Sensor (1)	≤ ±0.50	°C	0.30	Pass
Temperature Difference (ΔT) – Primary Sensors (1)	≤ ±0.10	°C	0.09	Pass
Temperature Difference (ΔT) – Secondary Sensors (1)	≤ ±0.10	°C	0.08	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.09	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass
Solar Radiation Accuracy	≤ ±10 W/m2	W/m2	1.7	Pass
Horizontal Wind Primary Sensor – As Found (2)				
Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 1.0	g-cm	1	Pass
Wind Direction Alignment	≤ ±5	Degree	2	Pass
Wind Direction Accuracy	≤ ±5	Degree	3.5	Pass
Wind Direction Linearity	≤ ±3	Degree	2.0	Pass
Wind Direction Torque	≤ 11.0	g-cm	8	Pass
Horizontal Wind Primary Sensor – As Left (2)				
Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 1.0	g-cm	1	Pass
Wind Direction Alignment	≤ ±5	Degree	2	Pass
Wind Direction Accuracy	≤ ±5	Degree	1.6	Pass
Wind Direction Linearity	≤ ±3	Degree	1.1	Pass
Wind Direction Torque	≤ 11.0	g-cm	6	Pass

Horizontal Wind Secondary Sensor – As Found [2]				
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	3	Pass
Wind Direction Accuracy	≤ ±5	Degree	4.0	Pass
Wind Direction Linearity	≤ ±3	Degree	3.0	Pass
Wind Direction Torque	≤ 11.0	g-cm	8	Pass
Horizontal Wind Secondary Sensor – As Left [2]				
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	3	Pass
Wind Direction Accuracy	≤ ±5	Degree	1.3	Pass
Wind Direction Linearity	≤ ±3	Degree	1.1	Pass
Wind Direction Torque	≤ 11.0	g-cm	5	Pass

[1] A combination of data from the primary and secondary temperature sensors were used during the second monitoring quarter. See Section 2.2 for more information.
[2] The horizontal wind sensor mounting post and nose-cone assemblies were replaced. Data from the secondary horizontal wind sensor were used during the first quarter.

Table 2-29: November 5, 2019 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
2-m Temperature Accuracy – Primary Sensor [1]	≤ ±0.50	°C	0.26	Pass
2-m Temperature Accuracy – Secondary Sensor [1]	≤ ±0.50	°C	0.19	Pass
10-m Temperature Accuracy – Primary Sensor [1]	≤ ±0.50	°C	0.21	Pass
10-m Temperature Accuracy – Secondary Sensor [1]	≤ ±0.50	°C	0.18	Pass
Temperature Difference (ΔT) – Primary Sensor [1]	≤ ±0.10	°C	0.06	Pass
Temperature Difference (ΔT) – Secondary Sensor [1]	≤ ±0.10	°C	0.07	Pass
Wind Speed Accuracy – Primary Sensor [2]	≤ ±0.20 ± 5% known input	m/s	0.01	Pass
Wind Speed Torque – Primary Sensor [2]	≤ 1.0	g-cm	0.1	Pass
Wind Direction Alignment – Primary Sensor [2]	≤ ±5	Degree	1.8	Pass
Wind Direction Accuracy – Primary Sensor [2]	≤ ±5	Degree	1.6	Pass
Wind Direction Linearity – Primary Sensor [2]	≤ ±3	Degree	2.1	Pass
Wind Direction Torque – Primary Sensor [2]	≤ 11.0	g-cm	9.0	Pass
Wind Speed Accuracy – Secondary Sensor [2]	≤ ±0.20 ± 5% known input	m/s	0.00	Pass
Wind Speed Torque – Secondary Sensor [2]	≤ 1.0	g-cm	0.2	Pass
Wind Direction Alignment – Secondary Sensor [2]	≤ ±5	Degree	1.8	Pass
Wind Direction Accuracy – Secondary Sensor [2]	≤ ±5	Degree	1.6	Pass
Wind Direction Linearity – Secondary Sensor [2]	≤ ±3	Degree	1.2	Pass
Wind Direction Torque – Secondary Sensor [2]	≤ 11.0	g-cm	5.0	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.03	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass

[1] Temperature data in the second quarter of 2019 was partially from the primary sensor and partially from the secondary sensor. Secondary sensor calibration results shown to bracket validity of secondary sensor data. All reported data from the third and fourth quarter is from the primary temperature sensors.

2 Data from the secondary horizontal wind sensor were used during the fourth quarter.

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 2-30 through Table 2-33.

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.

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} samplers are conducted using an audit orifice transfer standard (BGI Delta Cal or equivalent). Results of the PM sampler audits are presented in Tables 2-34 and Table 2-35.

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 2-36 to Table 2-37.

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.

Conoco requested and was granted a waiver from ADEC to reduce the network frequency of $PM_{2.5}$ Performance Evaluation Program (PEP) audits to one every three years. The last PEP-like audit was conducted in monitoring year 2017 at the CD1 station. Accordingly, no PEP audit was conducted during the reporting period. Data from the 2017 $PM_{2.5}$ PEP audit are provided in Table 2-38.

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 September 2019 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.

Table 2-30: 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	
2/20/2019	0	0.00	0.040	-	3.4	1.0110	0.101	1.0000	Pass
	1	2.080	2.17	4.3					
	2	6.890	7.20	4.5					
	3	21.61	21.91	1.4					
5/08/2019	0	0.00	-0.130	-	4.9	1.0024	-0.215	1.0000	Pass
	1	1.87	1.71	-8.6					
	2	6.72	6.34	-5.7					
	3	24.80	24.69	-0.4					
8/28/2019	0	0.00	0.000	-	3.2	1.0149	-0.099	1.0000	Pass
	1	2.130	1.95	-8.5					
	2	7.040	7.05	0.1					
	3	22.12	22.36	1.1					
11/05/2019	0	0.00	-0.110	-	2.4	0.9683	0.025	1.0000	Pass
	1	2.040	2.01	-1.5					
	2	6.890	6.72	-2.5					
	3	21.67	21.00	-3.1					

[1] Acceptance criteria: Measured and audit point difference ≤ ±15%

Table 2-31: 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		
2/20/2019	0	0	0	-	7.7	1.0288	2.121	0.9999	100.0%	Pass
	1	34.0	37.0	8.8						
	2	64.0	71.0	10.9						
	3	233	241	3.4						
5/08/2019	0	0	0	-	7.7	0.8901	1.583	0.9999	99.2%	Pass
	1	30.0	27.9	-7.0						
	2	75.0	71.0	-5.3						
	3	272	243	-10.7						
8/28/2019	0	0	0.4	-	2.2	0.9679	0.559	1.0000	100.0%	Pass
	1	41.0	40.7	-0.7						
	2	70.0	68.0	-2.9						
	3	205	199	-2.9						
11/05/2019	0	0	0.4	-	1.2	0.9816	0.629	1.0000	99.6%	Pass
	1	38.0	38.3	0.8						
	2	71.0	70.2	-1.1						
	3	250	246	-1.6						

[1] Acceptance criteria: Measured and audit point difference ≤ ±15%

Table 2-32: Performance Audit Summary – O_3

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	
2/20/2019	0	0	0.8	-	4.2	0.9874	-0.662	1.0000	Pass
	1	32.0	28.7	-10.3					
	2	77.0	74.9	-2.7					
	3	150	149	-0.7					
	4	398	392	-1.5					
5/08/2019	0	0	0.8	-	3.4	1.0155	-2.035	1.0000	Pass
	1	30.0	27.5	-8.3					
	2	75.4	73.1	-3.1					
	3	150	149	-0.7					
	4	400	405	1.3					
8/28/2019	0	0	0.8	-	11.5	0.8752	0.808	1.0000	Pass
	1	32.0	28.7	-10.3					
	2	77.0	68.4	-11.2					
	3	150	132	-12.0					
	4	399	350	-12.3					
11/05/2019	0	0	0.0	-	3.9	1.0688	-2.750	1.0000	Pass
	1	30.0	29.4	-2.0					
	2	75.0	75.9	1.2					
	3	150	155	3.3					
	4	400	426	6.5					

[1] Acceptance criteria: Measured and audit point difference ≤ ±15%

Table 2-33: 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	
2/20/2019	0	0.0	0.0	-	2.5	1.0377	-0.568	1.0000	Pass
	1	40.0	40.4	1.0					
	2	75.0	77.1	2.8					
	3	250	259	3.6					
5/08/2019	0	0.0	3.0	-	5.3	0.9320	1.637	1.0000	Pass
	1	29.8	26.6	-4.0					
	2	71.1	67.0	-5.8					
	3	250	235	-6.0					
8/28/2019	0	0.0	1.0	-	1.6	1.0237	-0.464	1.0000	Pass
	1	41.0	40.4	-1.5					
	2	77.0	77.6	0.8					
	3	255	261	2.4					
11/05/2019	0	0.0	0.0	-	1.0	1.0016	-0.475	1.0000	Pass
	1	39.0	37.9	-2.8					
	2	74.0	73.8	-0.3					
	3	250	250	0.0					

[1] Acceptance criteria: Measured and audit point difference ≤ ±15%

Table 2-34: 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 (%)	
2/20/2019	0.5	0.7	-3	3.1	-3.0	Pass
5/08/2019	0.4	0.4	-4	1.2	-1.2	Pass
8/28/2019	0.37	-1.2	0	0.0	0.0	Pass
11/05/2019	0.4	-0.3	-3	2.5	-2.4	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 2-35: 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 (%)	
2/20/2019	0.6	0.8	-4	2.5	-2.4	Pass
5/08/2019	0.5	-0.1	-1	0.0	0.0	Pass
8/28/2019	0.03	-0.9	0	0.6	-0.6	Pass
11/05/2019	0.3	0.5	0	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: May 8, 2019 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy – Primary Sensor [1]	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque – Primary Sensor [1]	≤ 0.5	m/s	0.23	Pass
Wind Direction Accuracy – Primary Sensor [1]	≤ ±5	Degree	2.0	Pass
Wind Direction Linearity – Primary Sensor [1]	≤ ±3	Degree	2	Pass
Wind Direction Torque – Primary Sensor [1]	≤ 0.5	m/s	0.33	Pass
Wind Speed Accuracy – Secondary Sensor [1]	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque – Secondary Sensor [1]	≤ 0.5	m/s	0.32	Pass
Wind Direction Accuracy – Secondary Sensor [1]	≤ ±5	Degree	-2	Pass
Wind Direction Linearity – Secondary Sensor [1]	≤ ±3	Degree	1	Pass
Wind Direction Torque – Secondary Sensor [1]	≤ 0.5	m/s	0.49	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.09	Pass
Vertical Wind Speed Torque	≤ 0.25	m/s	0.20	Pass
2-m Temperature Accuracy – Primary Sensor [2]	≤ ±0.50	°C	-0.36	Pass
2-m Temperature Accuracy – Secondary Sensor [2	≤ ±0.50	°C	-0.15	Pass
10-m Temperature Accuracy – Primary Sensor [2]	≤ ±0.50	°C	-0.27	Pass
10-m Temperature Accuracy – Secondary Sensor [2]	≤ ±0.50	°C	-0.08	Pass
Temperature Difference (ΔT) – Primary Sensors [2]	≤ ±0.10	°C	0.09	Pass
Temperature Difference (ΔT) – Secondary Sensors [2]	≤ ±0.10	°C	0.07	Pass
Solar Radiation Accuracy < 200 W/m^2	≤ ±10	W/m^2	2	Pass

[1] Data from the secondary horizontal wind sensor were used during the first quarter.
[2] A combination of data from the primary and secondary temperature sensors were used during the second quarter. See Section 2.2 for more information.

Table 2-37: November 5, 2019 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy – Primary Sensor [1]	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque – Primary Sensor [1]	≤ 0.5	m/s	0.16	Pass
Wind Direction Accuracy – Primary Sensor [1]	≤ ±5	Degree	-2	Pass
Wind Direction Linearity – Primary Sensor [1]	≤ ±3	Degree	3	Pass
Wind Direction Torque – Primary Sensor [1]	≤ 0.5	m/s	0.49	Pass
Wind Speed Accuracy – Secondary Sensor [1]	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque – Secondary Sensor [1]	≤ 0.5	m/s	0.23	Pass
Wind Direction Accuracy – Secondary Sensor [1]	≤ ±5	Degree	2	Pass
Wind Direction Linearity – Secondary Sensor [1]	≤ ±3	Degree	2	Pass
Wind Direction Torque – Secondary Sensor [1]	≤ 0.5	m/s	0.37	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	-0.06	Pass
Vertical Wind Speed Torque	≤ 0.25	m/s	0.14	Pass
2-m Temperature Accuracy Accuracy – Primary Sensor [2]	≤ ±0.50	°C	-0.25	Pass
2-m Temperature Accuracy Accuracy – Secondary Sensor [2]	≤ ±0.50	°C	-0.18	Pass
10-m Temperature Accuracy Accuracy – Primary Sensor [2]	≤ ±0.50	°C	-0.20	Pass
10-m Temperature Accuracy Accuracy – Secondary Sensor [2]	≤ ±0.50	°C	-0.17	Pass
Air Temperature Difference – Primary Sensor [2]	≤ ±0.10	°C	0.06	Pass
Air Temperature Difference – Secondary Sensor [2]	≤ ±0.10	°C	0.07	Pass
Solar Radiation Accuracy < 200 W/m^2	≤ ±10	W/m^2	0	Pass

[1] Data from the secondary horizontal wind sensor were used during the fourth quarter.
[2] Temperature data in the second quarter of 2019 was partially from the primary sensor and partially from the secondary sensor. Secondary sensor calibration results shown to bracket validity of secondary sensor data. All reported data from the third and fourth quarter is from the primary temperature sensors.

Table 2-38: 2017 $PM_{2.5}$ PEP Audit Results

Date	PEP Audit Results ($\mu g/m^3$)	BAM 1020 Results ($\mu g/m^3$)	Difference ($\mu g/m^3$)	Bias [1] ($\mu g/m^3$)
7/14/2017 – 7/15/2017	5.07	2.1	2.97	1.91
7/15/2017 – 7/16/2017	3.21	0.4	2.81	
7/16/2017 – 7/17/2017	3.43	1.7	1.08	
12/12/2017 – 12/13/2017	2.96	4.0	1.04	
12/13/2017 – 12/14/2017	7.64	6.0	1.64	

[1] Average over the population of the absolute value of the individual pair concentration differences with a goal of ≤ 4 µg/m3 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, 2019, through December 31, 2019, 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. Figure 3-1 through Figure 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
Nitrogen Dioxide (NO_2)	53 ppb (100 µg/m³)	Annual	Average of Period	4	1	1	2	2	**3.8%**
	100.0 ppb (190 µg/m³)	1-Hour [2]	Daily Max 1-Hour Averages (98th Percentile)	--	--	--	--	31.8	**31.8%**
			1st Highest, 1-Hour Average	55.6	27.6	20.0	36.4	55.6	**55.6%**
			2nd Highest, 1-Hour Average	46.0	20.8	16.4	27.5	46.0	**46.0%**
Ozone (O_3)	0.075 ppm (150 µg/m³)	8-Hour [3]	4th Highest, 8-Hour Average	0.046	0.043	0.031	0.037	0.046	**65.7%**
			1st Highest, 8-Hour Average	0.049	0.046	0.033	0.039	0.049	**70.0%**
			2nd Highest, 8-Hour Average	0.046	0.044	0.032	0.038	0.046	**65.7%**
Carbon Monoxide (CO)	35 ppm (40,000 µg/m³)	1-Hour [1]	1st Highest, 1-Hour Average	1	0	1	1	1	**2.9%**
			2nd Highest, 1-Hour Average	0	0	1	1	1	**2.9%**
	9 ppm (10,000 µg/m³)	8-Hour [1]	1st Highest, 8-Hour Average	0	0	1	1	1	**11.1%**
			2nd Highest, 8-Hour Average	0	0	1	1	1	**11.1%**

[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. 3 To attain this standard, the 3-year average of the annual fourth-highest daily maximum 8-hour average must not exceed 0.070 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)	0.030 ppm (80 µg/m³)	Annual	Average of Period	0.000	0.001	0.000	0.000	0.000	0.0%
	0.14 ppm (365 µg/m³)	24-Hour [5]	1st Highest, 1-Hour Average	0.00	0.00	0.00	0.00	0.00	0.0%
			2nd Highest, 1-Hour Average	0.00	0.00	0.00	0.00	0.00	0.0%
	0.5 ppm (1,300 µg/m³)	3-Hour [5]	1st Highest, 3-Hour Average	0.0	0.0	0.0	0.0	0.0	0.0%
			2nd Highest, 3-Hour Average	0.0	0.0	0.0	0.0	0.0	0.0%
	75.0 ppb (196 µg/m³)	1-Hour [4]	Daily Max 1-Hour Averages (99th Percentile)	--	--	--	--	3.5	4.7%
			1st Highest, 1-Hour Average	2.1	5.1	1.6	0.8	5.1	6.8%
			2nd Highest, 1-Hour Average	1.8	3.6	1.2	0.7	3.6	4.8%

[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 ($PM_{2.5}$)	12.0 µg/m³	Annual [7]	Average of Period	2.5	2.2	1.6	0.6	1.7	**14.2%**
	35 µg/m³	24-Hour [6]	98th Percentile, 24-Hour Average	--	--	--	--	7	**20.0%**
			1st Highest, 24-Hour Average	8	8	9	8	9	**25.7%**
			2nd Highest, 24-Hour Average	7	6	8	6	8	**22.9%**
Particulate Matter <10 microns (PM_{10})	150 µg/m³	24-Hour [8,9]	1st Highest, 24-Hour Average	20	80	130	**200** [10]	**200** [10]	**133.3%** [10]
			2nd Highest, 24-Hour Average	10	70	40	70	130	**86.7%**

[6] To attain this standard, the 3-year average of the 98th percentile of the 24-hour concentration must not exceed 35.0 µg/m3.
[7] To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentration must not exceed 12.0 µg/m3.
[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/m3.
[10] The daily average for PM10 exceeded the NAAQS standard of 150 µg/m3 on October 27, 2019. Winds at the time were strong and from an easterly direction, which indicates possible interference from wind-blown dust. The single measurement exceeding the 150 µg/m³ does not constitute a violation of the NAAQS as the NAAQS criterion is based on an average of exceedances over three years and there were no exceedances in 2017 and 2018.

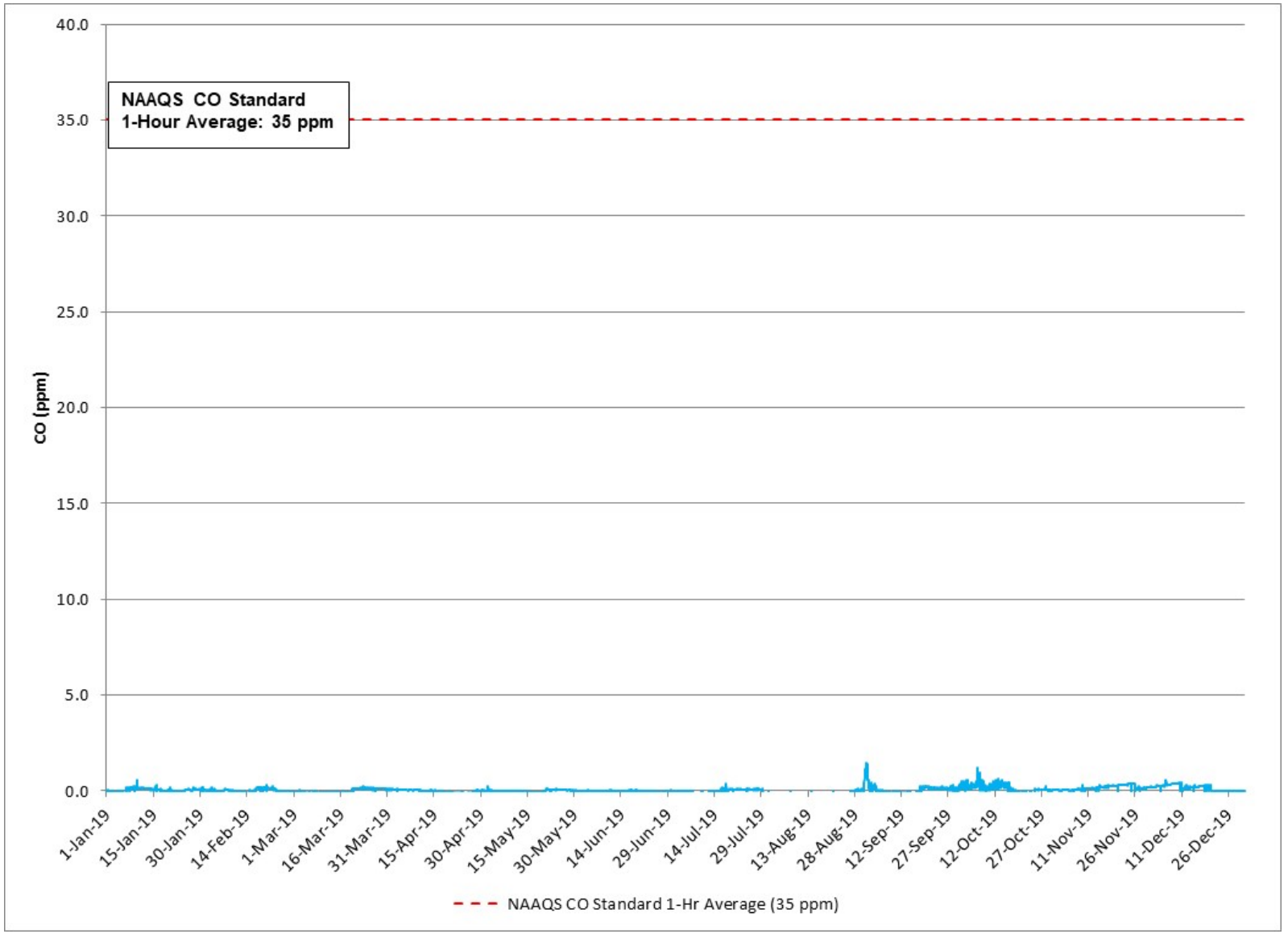


Figure 3-1: 1-Hour Average CO and NAAQS/AAAQS Standard

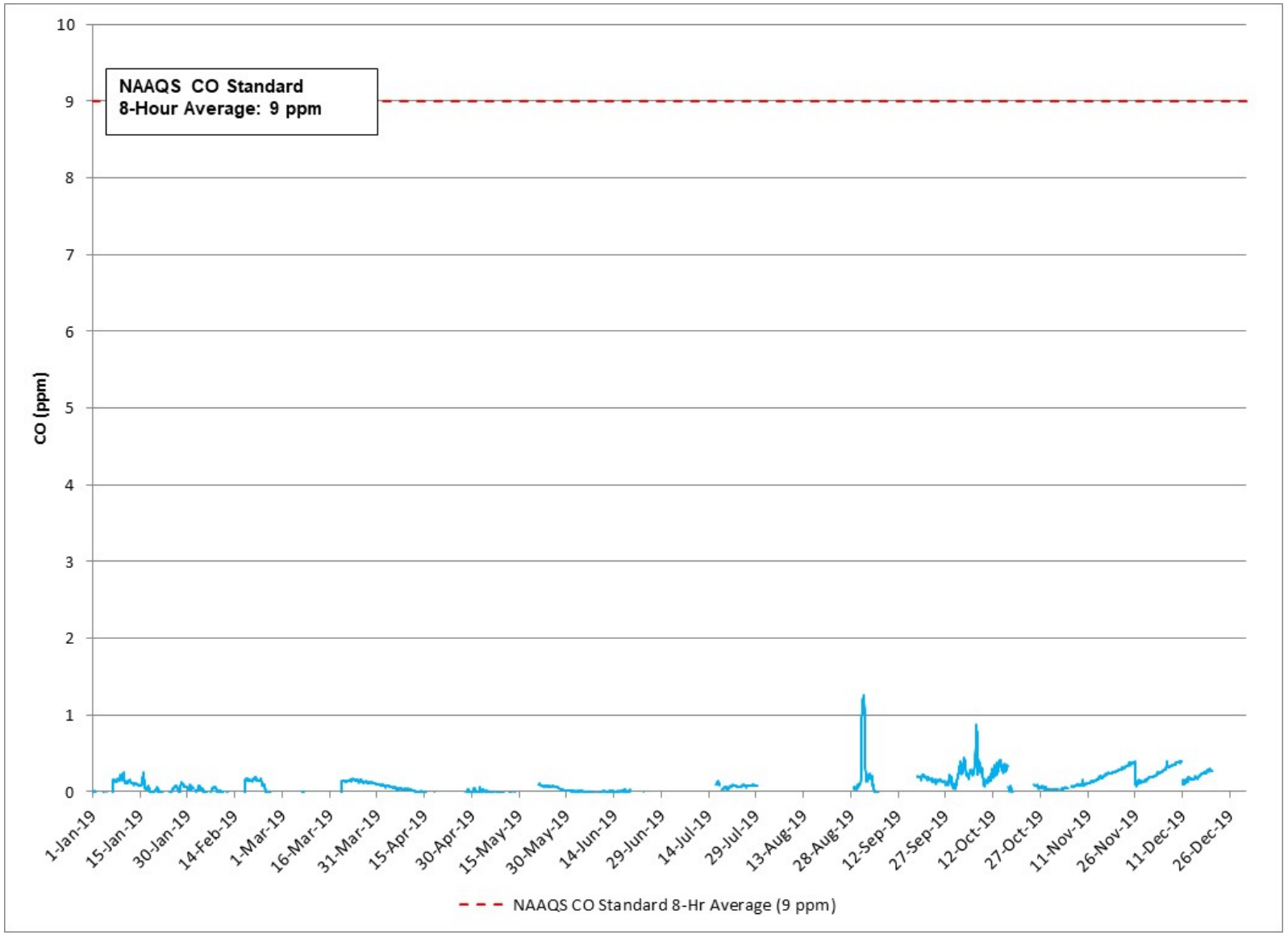


Figure 3-2: 8-Hour Average CO and NAAQS/AAAQS Standard

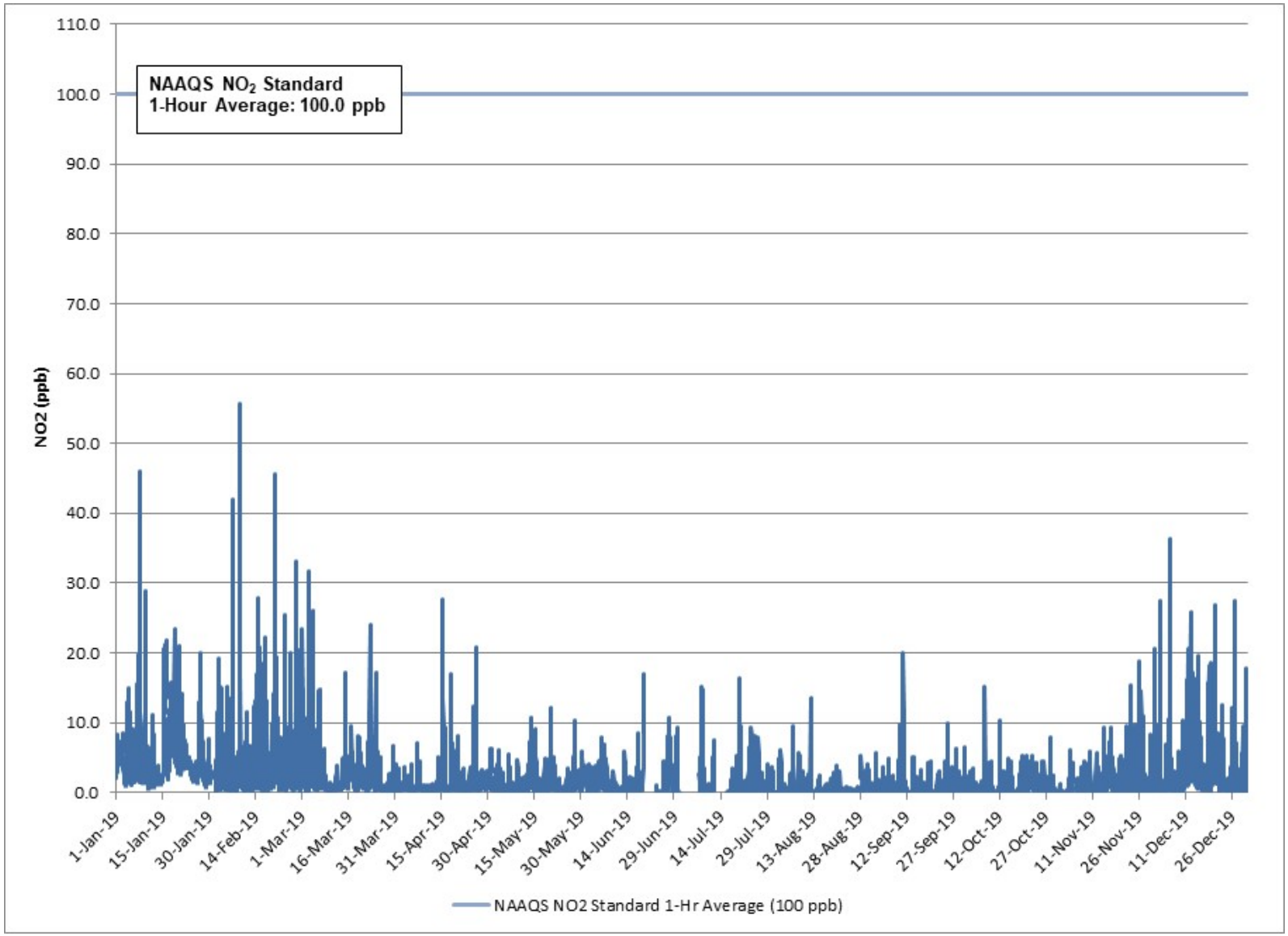


Figure 3-3: 1-Hour Average NO_2 and NAAQS Standard

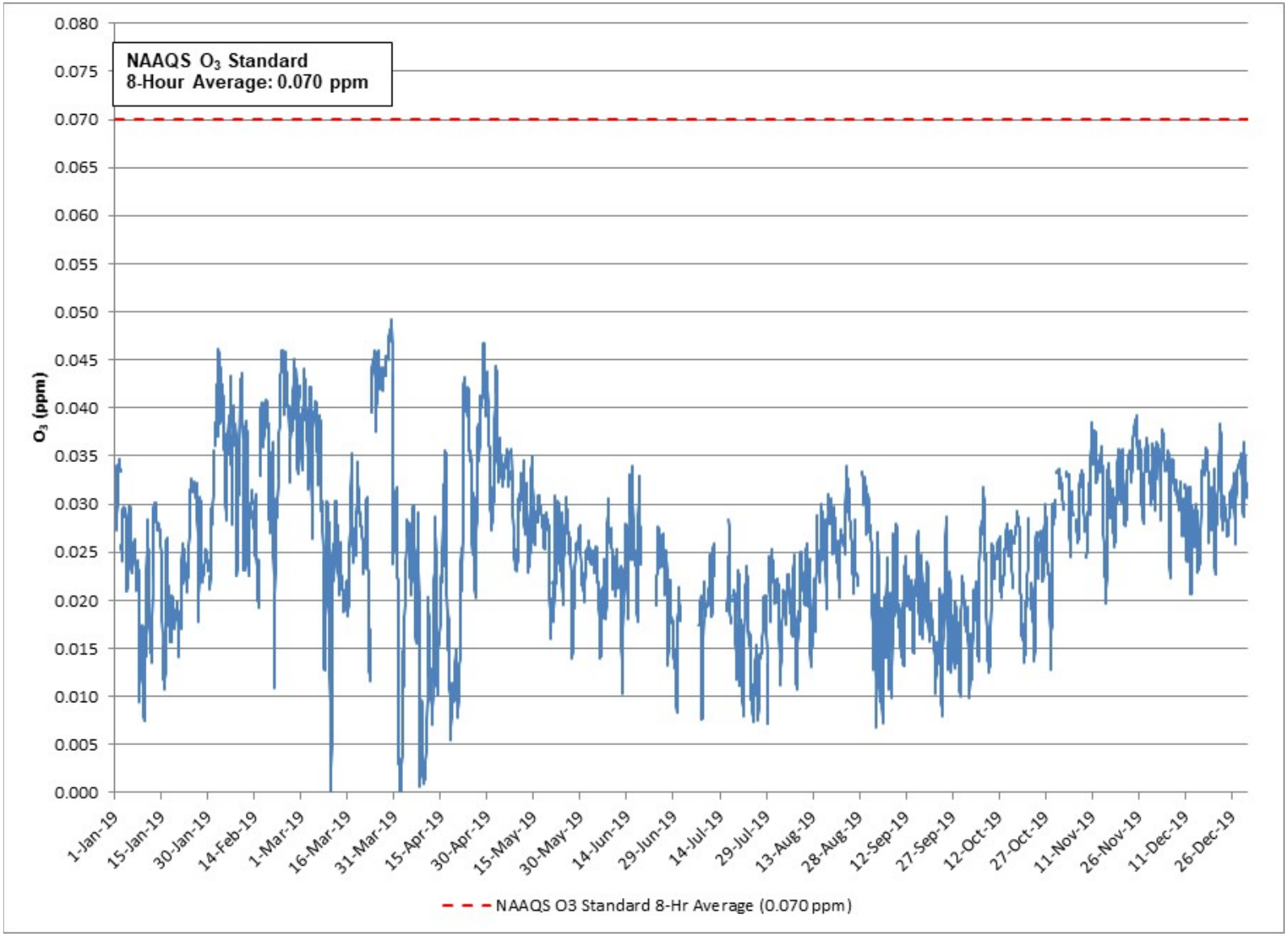


Figure 3-4: 8-Hour Average O_3 and NAAQS/AAAQS Standard

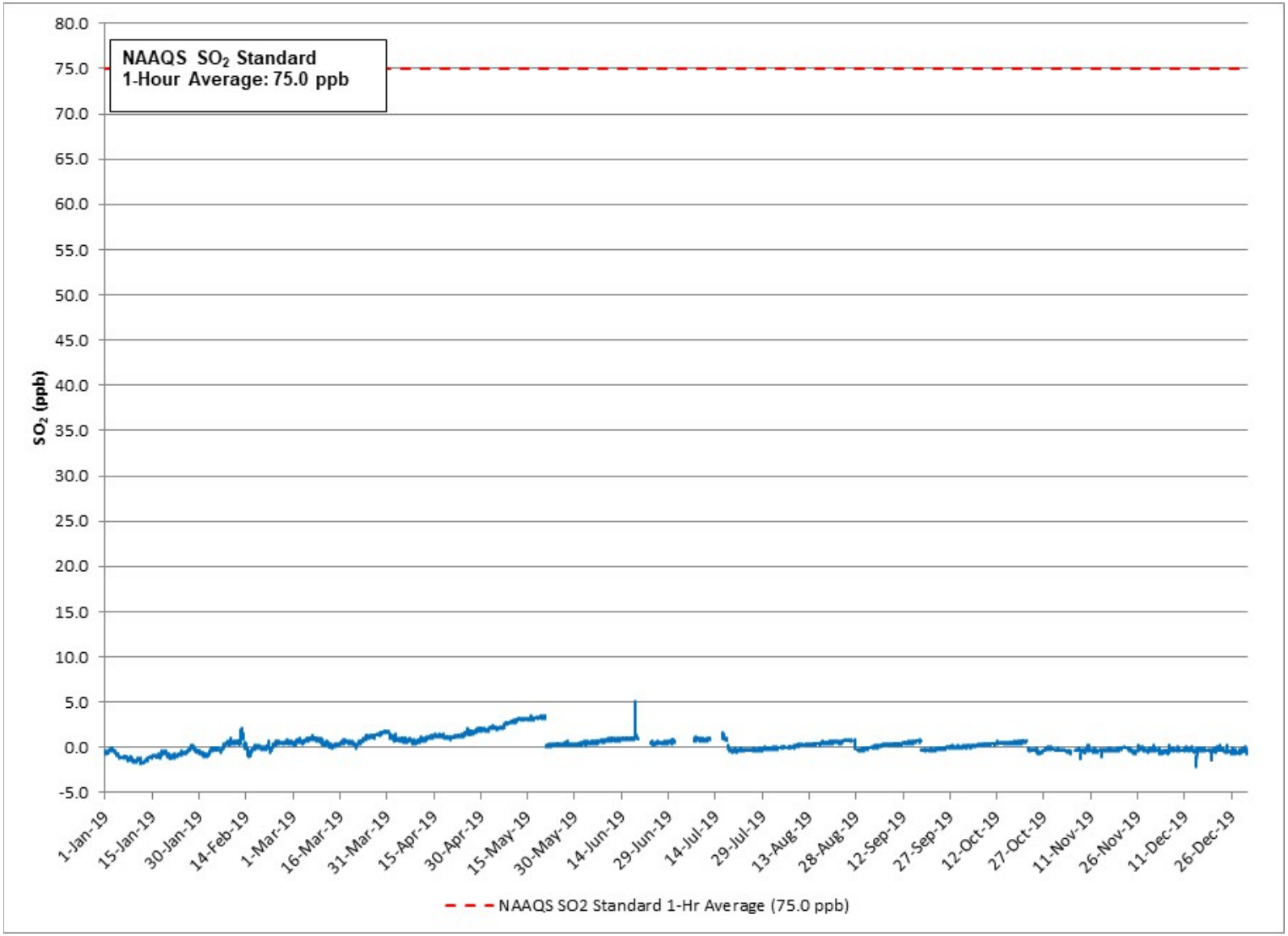


Figure 3-5: 1-Hour Average SO_2 and NAAQS/AAAQS Standard

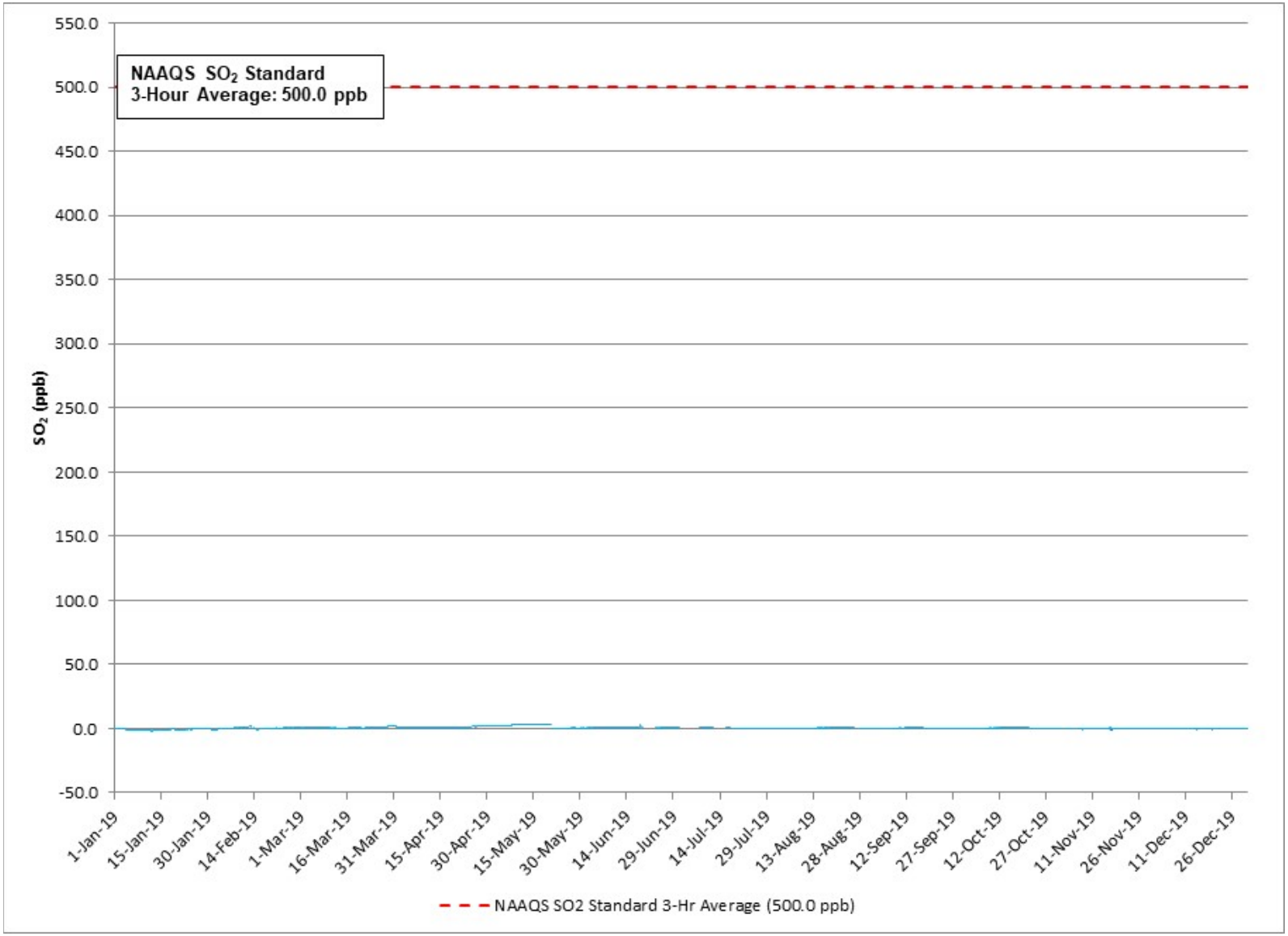


Figure 3-6: 3-Hour Average SO_2 and NAAQS/AAAQS Standard

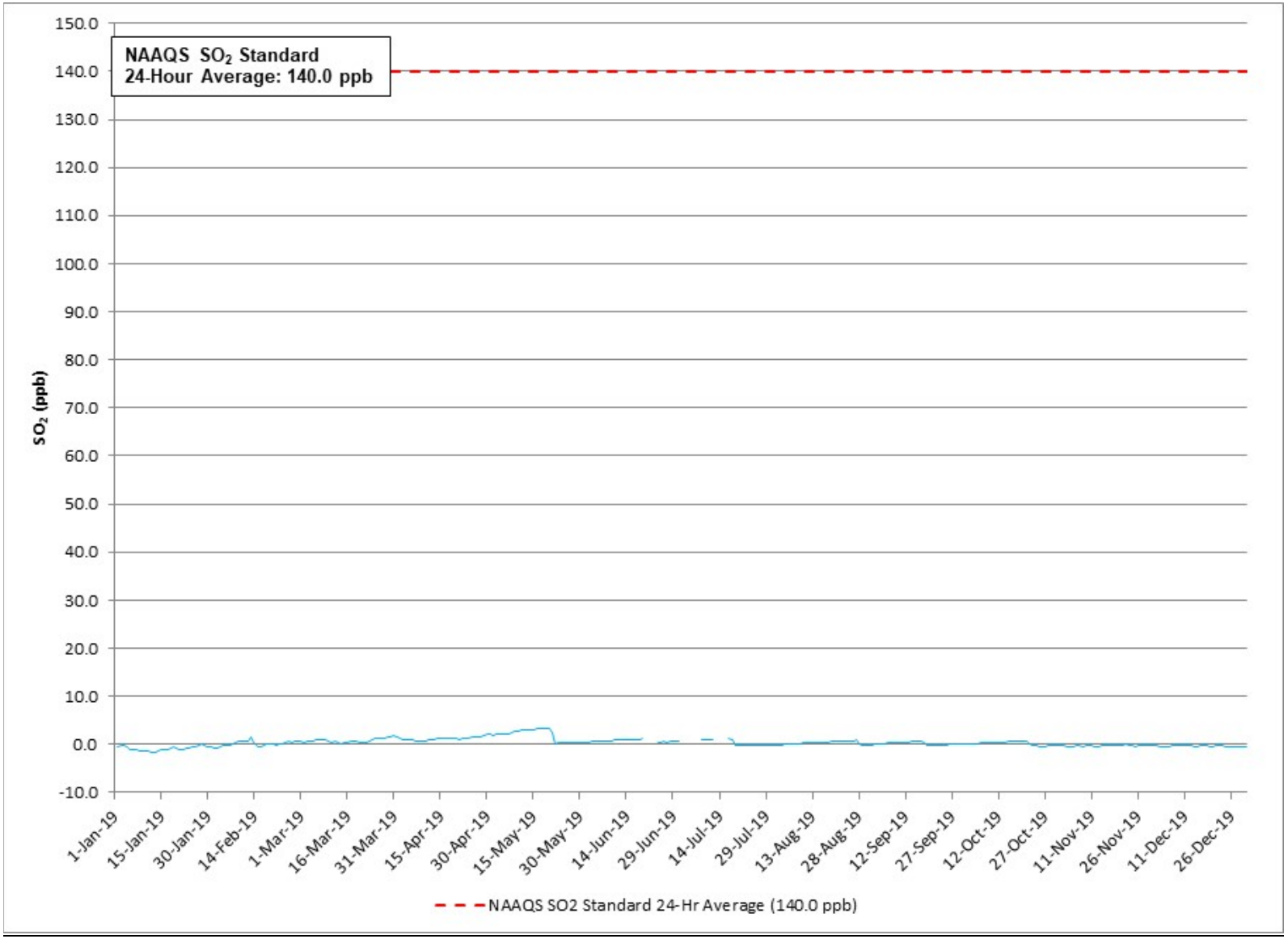


Figure 3-7: 24-Hour Average SO_2 and NAAQS/AAAQS Standard

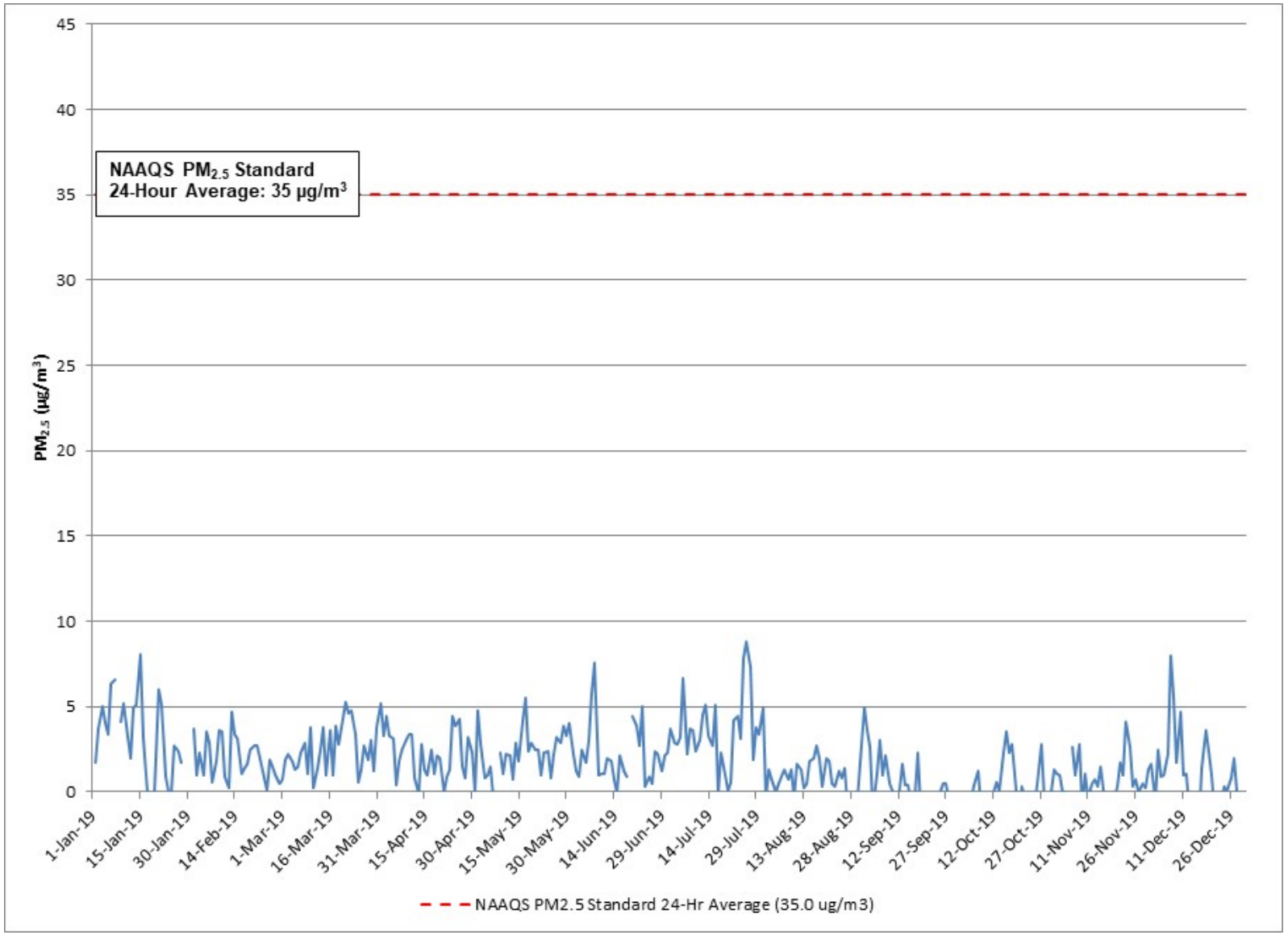


Figure 3-8: 24-Hour Average $PM_{2.5}$ and NAAQS/AAAQS Standard

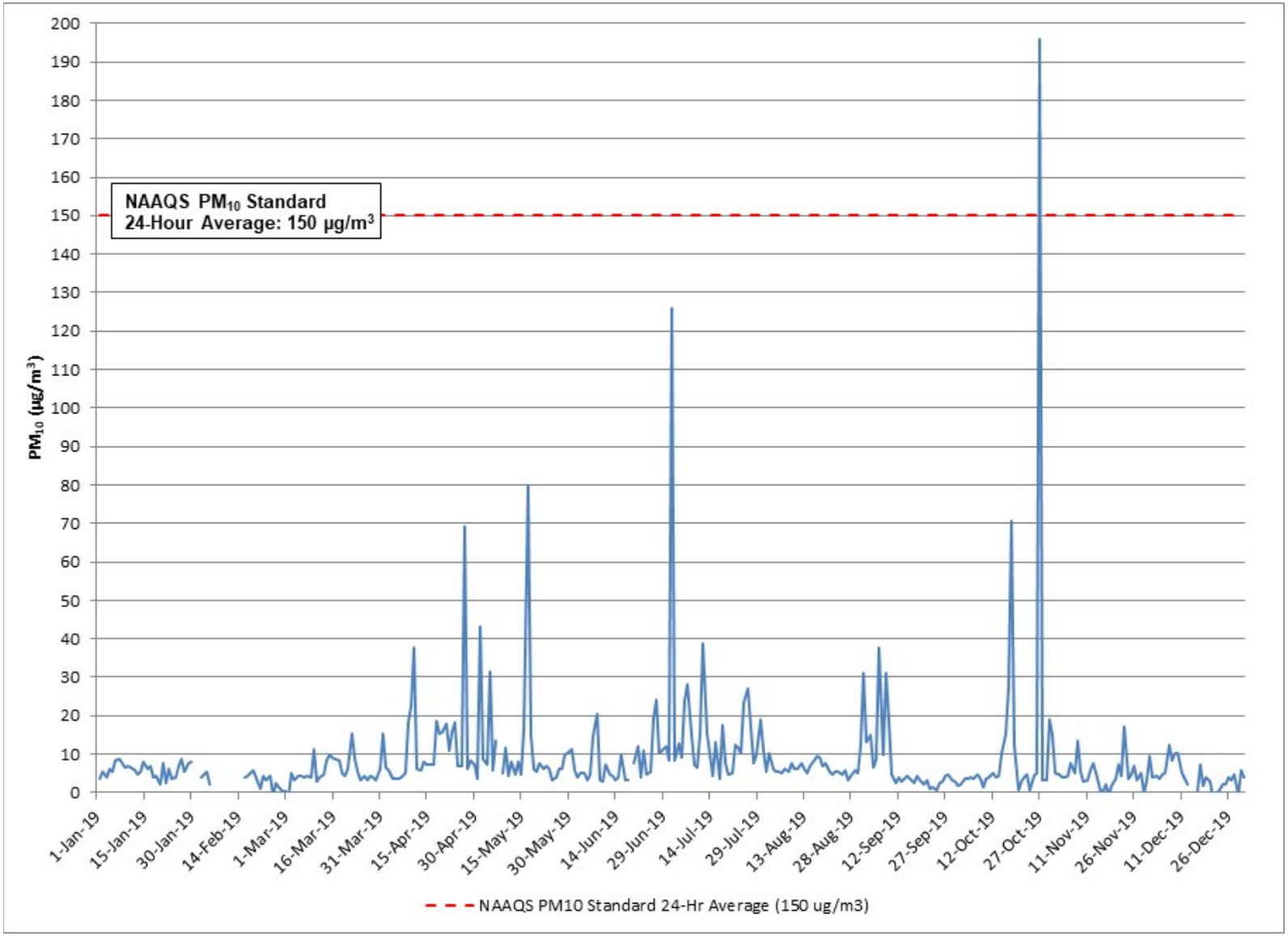


Figure 3-9: 24-Hour Average PM_{10} and NAAQS/AAAQS Standard

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 the Nuiqsut meteorological monitoring station. The summary in Table 3-2 provides summary statistics for data collected at the Nuiqsut airport. Table 3-3 provides a statistical summary of measurements obtained at the Nuiqsut station.

Figure 3-10 provides an annual wind rose for the Nuiqsut station and Figure 3-11 provides quarterly wind roses. Table 3-4 is the annual wind analysis table and Table 3-5 through Table 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	5.08	21.09
2nd Quarter	5.21	18.01
3rd Quarter	4.04	18.01
4th Quarter	4.54	19.03
Monitoring Year	**4.70**	**21.09**

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

Monitoring Period	Mean Hourly Average Horizontal Wind Speed (m/s)	Maximum Hourly Average Horizontal Wind Speed (m/s)	Mean Hourly Average Vertical Wind Speed (m/s)	Maximum Hourly Average Vertical Wind Speed (m/s)
1st Quarter	4.63	19.23	0.31	1.92
2nd Quarter	5.17	17.32	0.48	1.86
3rd Quarter	4.04	15.28	0.31	1.60
4th Quarter	4.28	16.25	0.36	1.77
Monitoring Year	**4.53**	**19.23**	**0.37**	**1.92**

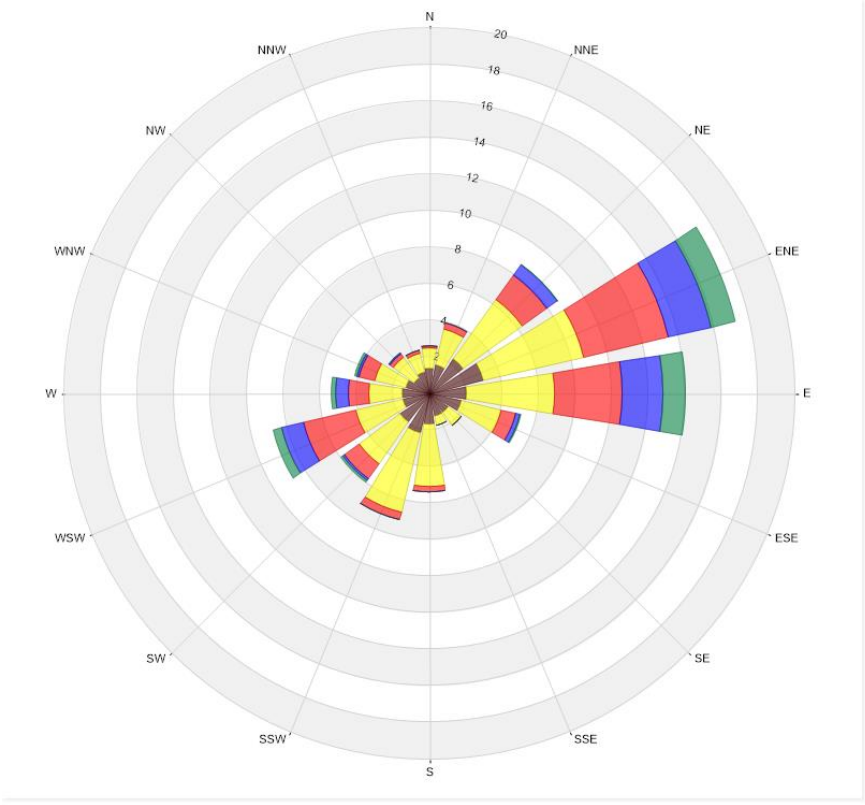
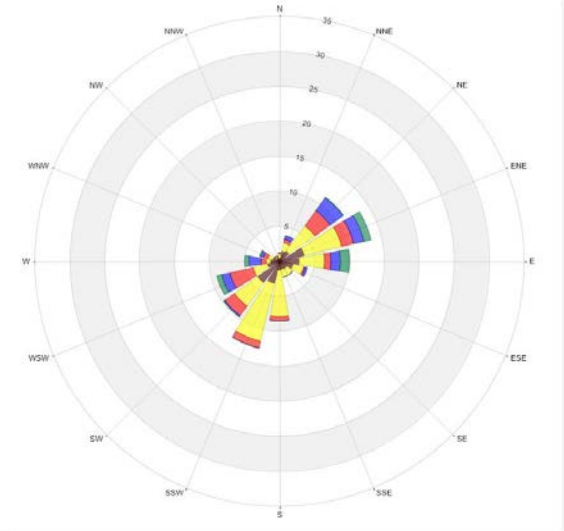
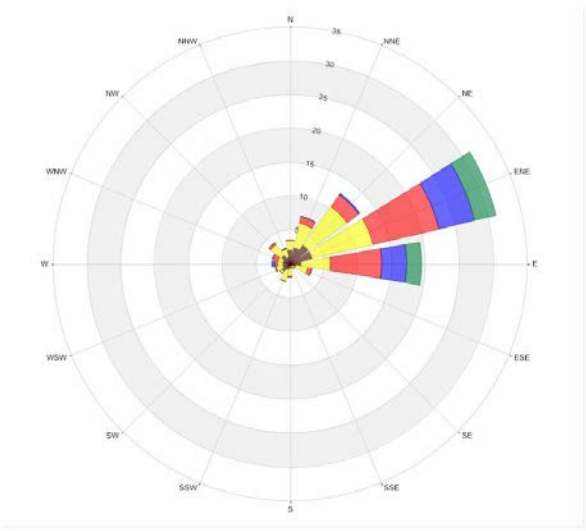


Figure 3-10: Nuiqsut Annual Wind Rose

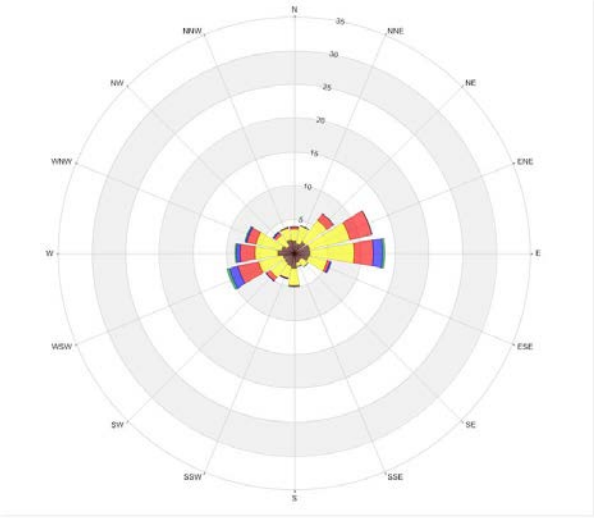
1st Quarter (1/1/19 – 3/31/19)



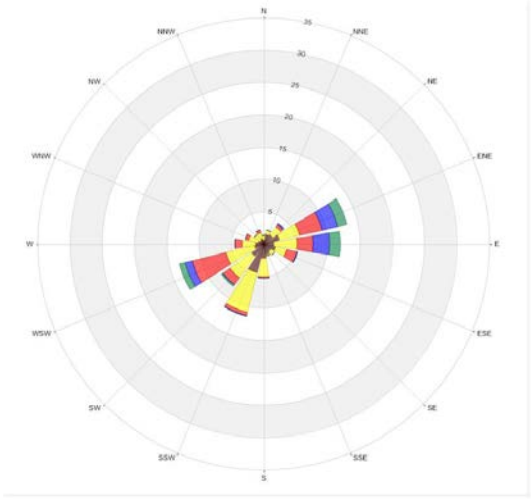
2nd Quarter (4/1/19 – 6/30/19)



3rd Quarter (7/1/19 – 9/30/19)



4th Quarter (10/1/19 – 12/31/19)



Wind Classes (m/s)

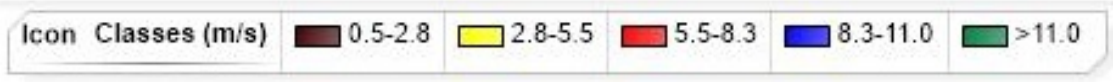


Figure 3-11: Nuiqsut Quarterly Wind Roses

Table 3-4: Annual Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	Direction					
	0.5-2.8	2.8-5.5	5.5-8.3	8.3-11.0	>11.0	Total
N	1.28	1.17	0.11	0.00	0.00	**2.56**
NNE	1.79	2.04	0.42	0.14	0.00	**4.39**
NE	2.28	4.26	1.65	0.66	0.02	**8.87**
ENE	2.99	6.05	4.76	2.35	1.44	**17.59**
E	2.10	4.60	3.50	2.27	1.34	**13.81**
ESE	1.79	1.99	0.71	0.15	0.01	**4.65**
SE	1.19	0.82	0.00	0.00	0.00	**2.01**
SSE	1.23	0.56	0.01	0.00	0.00	**1.80**
S	1.65	3.29	0.23	0.00	0.00	**5.17**
SSW	2.66	4.53	0.38	0.02	0.00	**7.59**
SW	2.33	2.75	0.91	0.07	0.08	**6.14**
WSW	1.52	2.82	2.92	0.94	0.50	**8.70**
W	1.55	1.71	1.13	0.68	0.21	**5.28**
WNW	1.23	1.76	0.83	0.14	0.08	**4.04**
NW	1.02	1.34	0.24	0.02	0.02	**2.64**
NNW	1.15	1.03	0.17	0.00	0.00	**2.35**
Summary	**27.76**	**40.72**	**17.97**	**7.44**	**3.70**	**97.59** [(1)]

[1] The remaining 2.41 percent of data were calms (below 0.5 m/s).

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	0.48	0.63	0.10	0.00	0.00	**1.21**
NNE	1.54	1.20	0.48	0.58	0.00	**3.80**
NE	1.78	4.47	2.69	2.26	0.10	**11.30**
ENE	3.70	5.48	1.78	1.49	1.01	**13.46**
E	2.84	3.66	0.91	1.39	1.35	**10.15**
ESE	2.07	1.54	0.24	0.24	0.05	**4.14**
SE	1.39	0.96	0.00	0.00	0.00	**2.35**
SSE	1.25	1.11	0.00	0.00	0.00	**2.36**
S	1.39	6.54	0.58	0.00	0.00	**8.51**
SSW	3.27	8.51	0.96	0.00	0.00	**12.74**
SW	3.85	4.04	1.73	0.14	0.05	**9.81**
WSW	1.78	2.12	3.37	1.20	0.72	**9.19**
W	1.30	0.63	0.72	1.73	0.63	**5.01**
WNW	1.01	0.72	0.58	0.38	0.29	**2.98**
NW	0.43	0.24	0.19	0.00	0.00	**0.86**
NNW	0.63	0.10	0.00	0.00	0.00	**0.73**
Summary	**28.71**	**41.95**	**14.33**	**9.41**	**4.20**	**98.60** [(1)]

[1] The remaining 1.40 percent of data were calms (below 0.5 m/s).

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	2.04	1.53	0.00	0.00	0.00	**3.57**
NNE	2.50	3.66	1.02	0.00	0.00	**7.18**
NE	3.38	7.03	2.13	0.23	0.00	**12.77**
ENE	3.38	9.21	10.04	5.41	3.24	**31.28**
E	1.67	4.30	7.64	3.70	2.13	**19.44**
ESE	0.97	1.76	0.65	0.00	0.00	**3.38**
SE	0.51	0.46	0.00	0.00	0.00	**0.97**
SSE	0.46	0.28	0.00	0.00	0.00	**0.74**
S	0.69	1.20	0.14	0.00	0.00	**2.03**
SSW	0.97	1.76	0.00	0.00	0.00	**2.73**
SW	1.48	0.32	0.00	0.00	0.00	**1.80**
WSW	1.11	1.02	0.09	0.00	0.00	**2.22**
W	1.06	0.79	0.42	0.46	0.00	**2.73**
WNW	1.11	0.74	0.79	0.00	0.00	**2.64**
NW	1.57	1.99	0.23	0.00	0.00	**3.79**
NNW	1.02	1.25	0.14	0.00	0.00	**2.41**
Summary	**23.92**	**37.30**	**23.29**	**9.80**	**5.37**	**100**

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	1.83	1.83	0.32	0.00	0.00	**3.98**
NNE	1.55	2.60	0.05	0.00	0.00	**4.20**
NE	2.15	3.88	1.19	0.00	0.00	**7.22**
ENE	2.42	6.12	3.38	0.00	0.00	**11.92**
E	2.37	6.62	2.83	1.32	0.37	**13.51**
ESE	2.19	2.88	0.41	0.23	0.00	**5.71**
SE	1.41	1.14	0.00	0.00	0.00	**2.55**
SSE	1.51	0.64	0.00	0.00	0.00	**2.15**
S	2.33	2.56	0.05	0.00	0.00	**4.94**
SSW	1.96	1.87	0.09	0.05	0.00	**3.97**
SW	1.78	2.60	0.68	0.09	0.00	**5.15**
WSW	1.69	3.74	3.10	1.32	0.41	**10.26**
W	2.46	3.38	2.19	0.50	0.23	**8.76**
WNW	1.96	3.88	1.41	0.18	0.05	**7.48**
NW	1.32	2.01	0.41	0.09	0.09	**3.92**
NNW	2.10	1.73	0.14	0.00	0.00	**3.97**
Summary	**31.03**	**47.48**	**16.25**	**3.78**	**1.15**	**100**

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	0.70	0.65	0.00	0.00	0.00	**1.35**
NNE	1.55	0.65	0.00	0.00	0.00	**2.20**
NE	1.75	1.50	0.50	0.20	0.00	**3.95**
ENE	2.61	3.16	3.56	2.46	1.50	**13.29**
E	1.60	3.66	2.41	2.66	1.55	**11.88**
ESE	1.95	1.75	1.60	0.15	0.00	**5.45**
SE	1.45	0.70	0.00	0.00	0.00	**2.15**
SSE	1.75	0.20	0.05	0.00	0.00	**2.00**
S	2.26	2.91	0.15	0.00	0.00	**5.32**
SSW	4.61	6.32	0.50	0.05	0.00	**11.48**
SW	2.36	4.11	1.30	0.05	0.30	**8.12**
WSW	1.45	4.56	5.36	1.15	0.90	**13.42**
W	1.30	2.01	1.15	0.00	0.00	**4.46**
WNW	0.85	1.55	0.50	0.00	0.00	**2.90**
NW	0.70	1.05	0.10	0.00	0.00	**1.85**
NNW	0.85	0.95	0.40	0.00	0.00	**2.20**
Summary	**27.74**	**35.73**	**17.58**	**6.72**	**4.25**	**92.02** [(1)]

[1] The remaining 7.98 percent of data were calms (below 0.5 m/s).

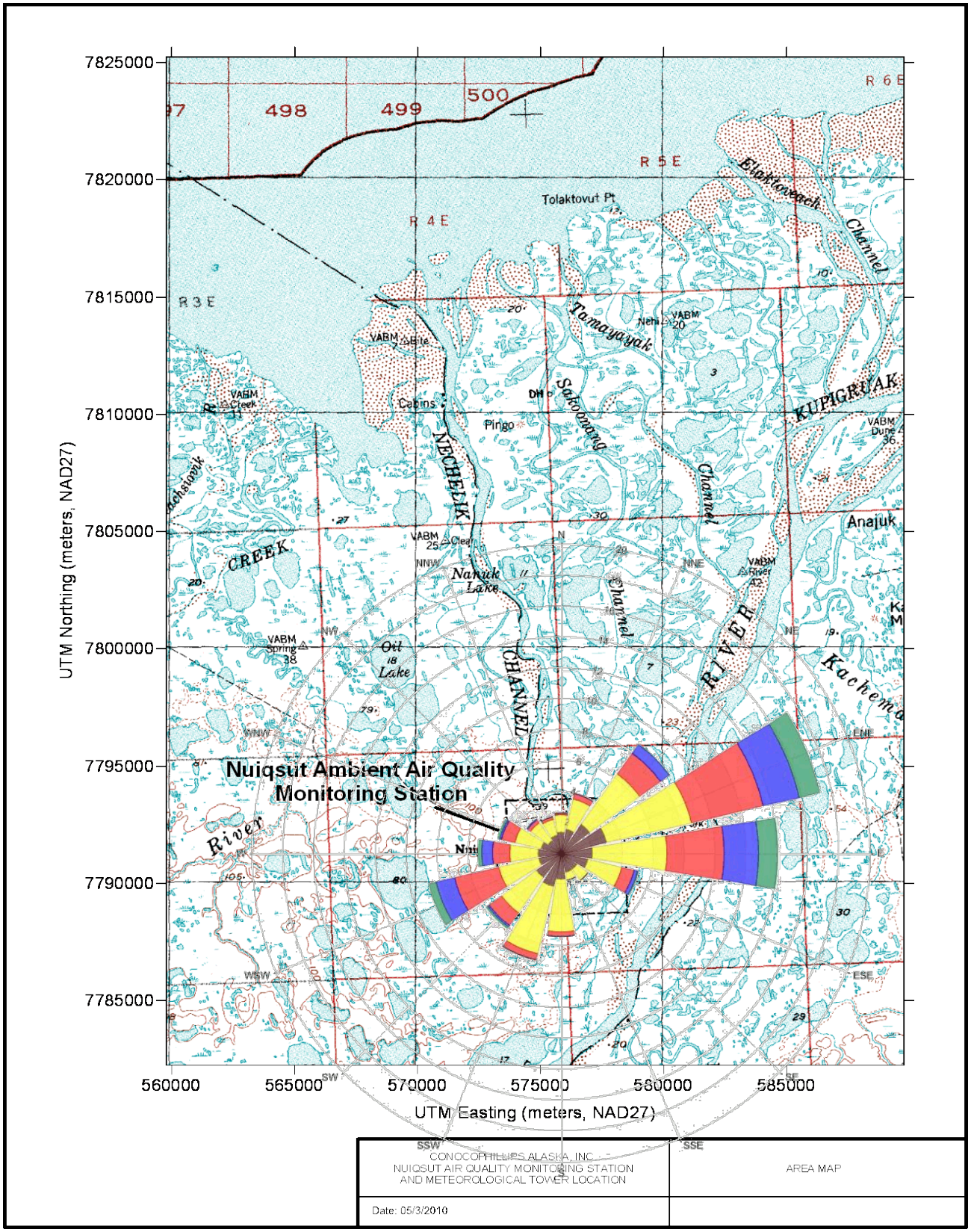


Figure 3-12: Annual Wind Rose Superimposed on Site Map

3.2.2 TEMPERATURE CLIMATOLOGY

Table 3-9 and Table 3-10 provide 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 at the Nuiqsut station, as well as temperature data from the Nuiqsut Airport for comparative purposes only. Figure 3-14 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	-8.1	-39.7	-25.8	-4.0	-41.9
February	-1.9	-35.8	-17.2	0.4	-37.7
March	-0.9	-28.1	-13.7	1.5	-31.1
1st Quarter	**-0.9**	**-39.7**	**-19.0**	**1.5**	**-41.9**
April	-2.8	-22.2	-14.5	1.6	-28.2
May	4.5	-8.0	-1.6	9.7	-12.3
June	15.6	0.0	5.1	22.8	-1.6
2nd Quarter	**15.6**	**-22.2**	**-3.7**	**22.8**	**-28.2**
July	16.1	6.0	11.8	23.6	3.4
August	11.8	3.1	6.4	15.4	1.0
September	12.8	-0.5	4.8	18.9	-4.0
3rd Quarter	**16.1**	**-0.5**	**7.6**	**23.6**	**-4.0**
October	3.4	-12.1	-3.5	5.4	-16.3
November	-4.9	-17.8	-12.1	-2.7	-22.8
December	-9.1	-41.3	-23.4	-7.8	-41.9
4th Quarter	**3.4**	**-41.3**	**-13.0**	**5.4**	**-41.9**
Monitoring Year	**16.1**	**-41.3**	**-6.9**	**23.6** [1]	**-41.9** [2]

[1] The maximum hourly average temperature occurred on July 13, 2019.

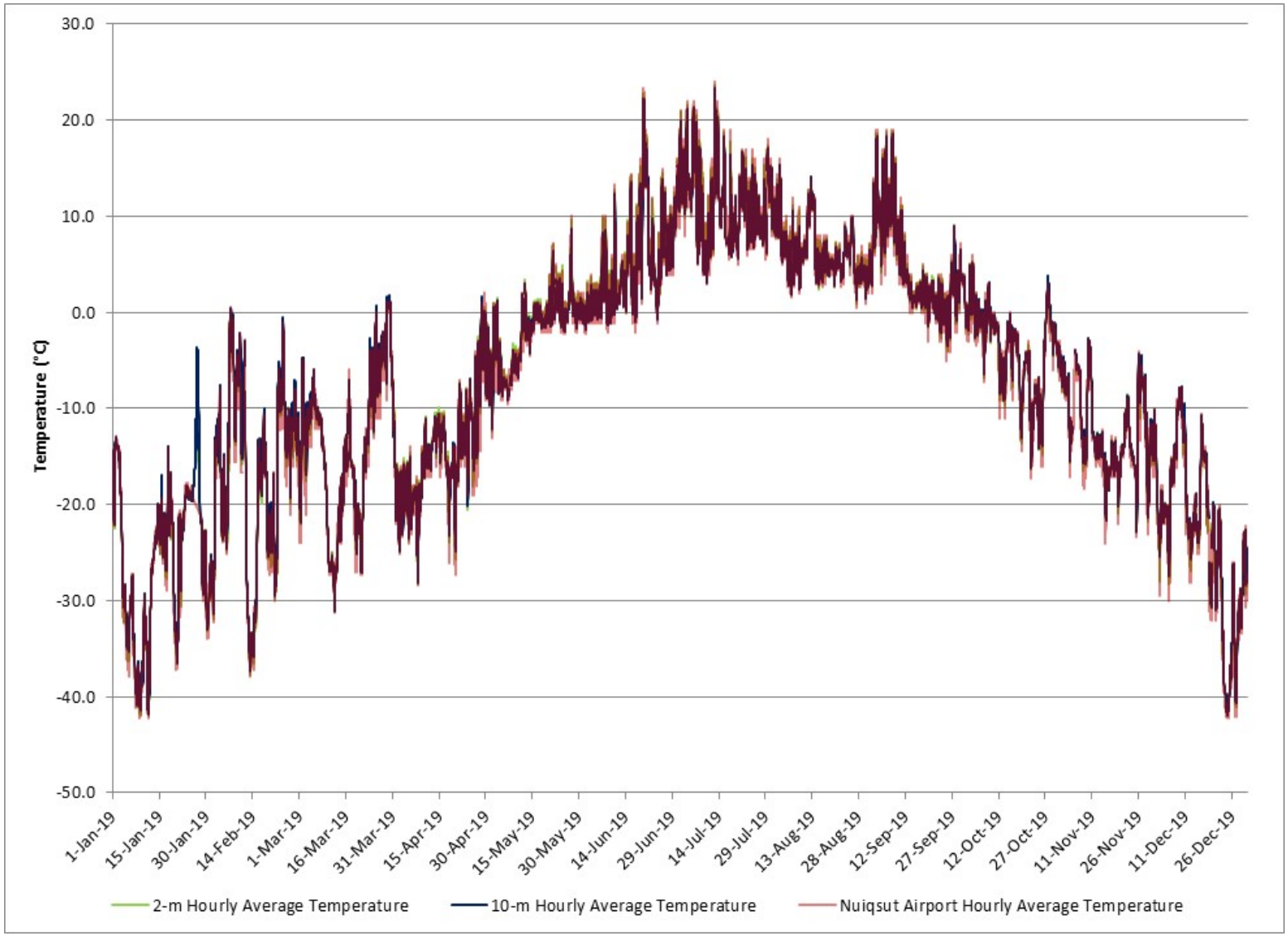
[2] The minimum hourly average temperature occurred on January 12, 2019.

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	-7.9	-39.6	-25.5	-3.7	-41.8
February	-1.7	-35.4	-16.8	0.5	-37.3
March	-0.8	-28.2	-13.5	1.8	-31.1
1st Quarter	**-0.8**	**-39.6**	**-18.7**	**1.8**	**-41.8**
April	-2.6	-22.3	-14.6	1.7	-28.0
May	4.1	-8.2	-1.9	8.7	-12.0
June	15.3	-0.2	4.7	22.3	-1.7
2nd Quarter	**15.3**	**-22.3**	**-3.9**	**22.3**	**-28.0**
July	15.9	5.4	11.5	23.3	3.2
August	11.8	2.9	6.2	15.4	1.4
September	13.1	-0.2	4.8	18.6	-3.4
3rd Quarter	**15.9**	**-0.2**	**7.5**	**23.3**	**-3.4**
October	3.4	-12.0	-3.3	5.2	-16.2
November	-4.8	-17.6	-12.0	-2.7	-22.7
December	-9.2	-41.3	-23.0	-7.8	-41.9
4th Quarter	**3.4**	**-41.3**	**-12.8**	**5.2**	**-41.9**
Monitoring Year	**15.9**	**-41.3**	**-6.9**	**23.3** [(1)]	**-41.9** [(2)]

[1] The maximum hourly average temperature occurred on July 13, 2019.

[2] The minimum hourly average temperature occurred on December 25, 2019.



[1] Nuiqsut airport data is presented as available through the mesowest.utah.edu website.

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

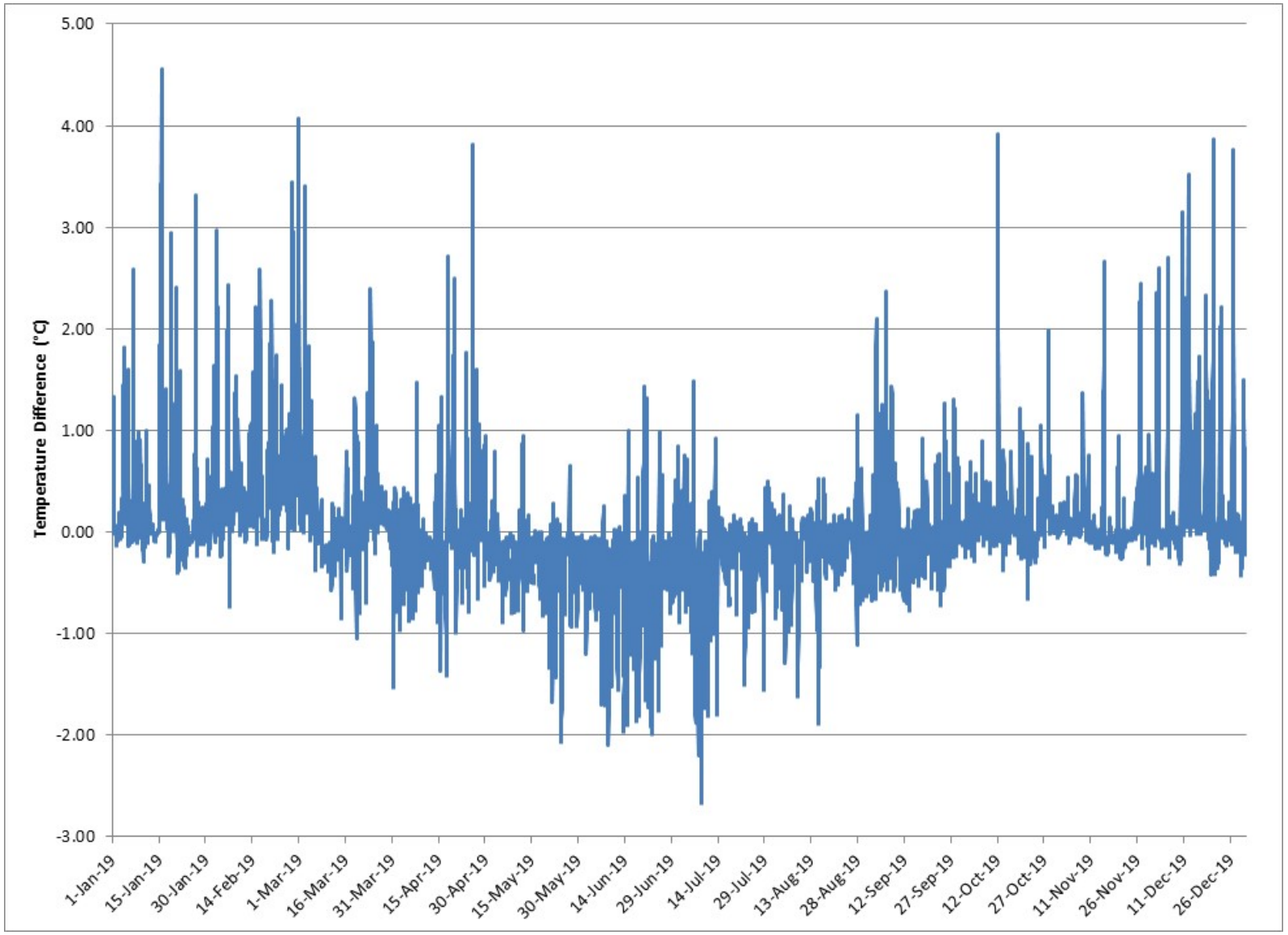


Figure 3-14: Hourly Average Vertical Temperature Difference

3.2.3 OTHER METEOROLOGICAL PARAMETERS

Table 3-11 provides a summary of solar radiation measurements obtained for the 2019 monitoring year. Figure 3-15 is a plot of annual hourly average solar radiation.

Table 3-11: Solar Radiation Summary

Period	Mean Solar Radiation (W/m^2)	Maximum Solar Radiation (W/m^2)
January	1	43
February	20	262
March	79	508
1st Quarter	**34**	**508**
April	179	761
May	185	699
June	222	731
2nd Quarter	**195**	**761**
July	185	690
August	100	623
September	75	488
3rd Quarter	**120**	**690**
October	26	284
November	3	108
December	0	2
4th Quarter	**10**	**284**
Monitoring Year	**90**	**761**

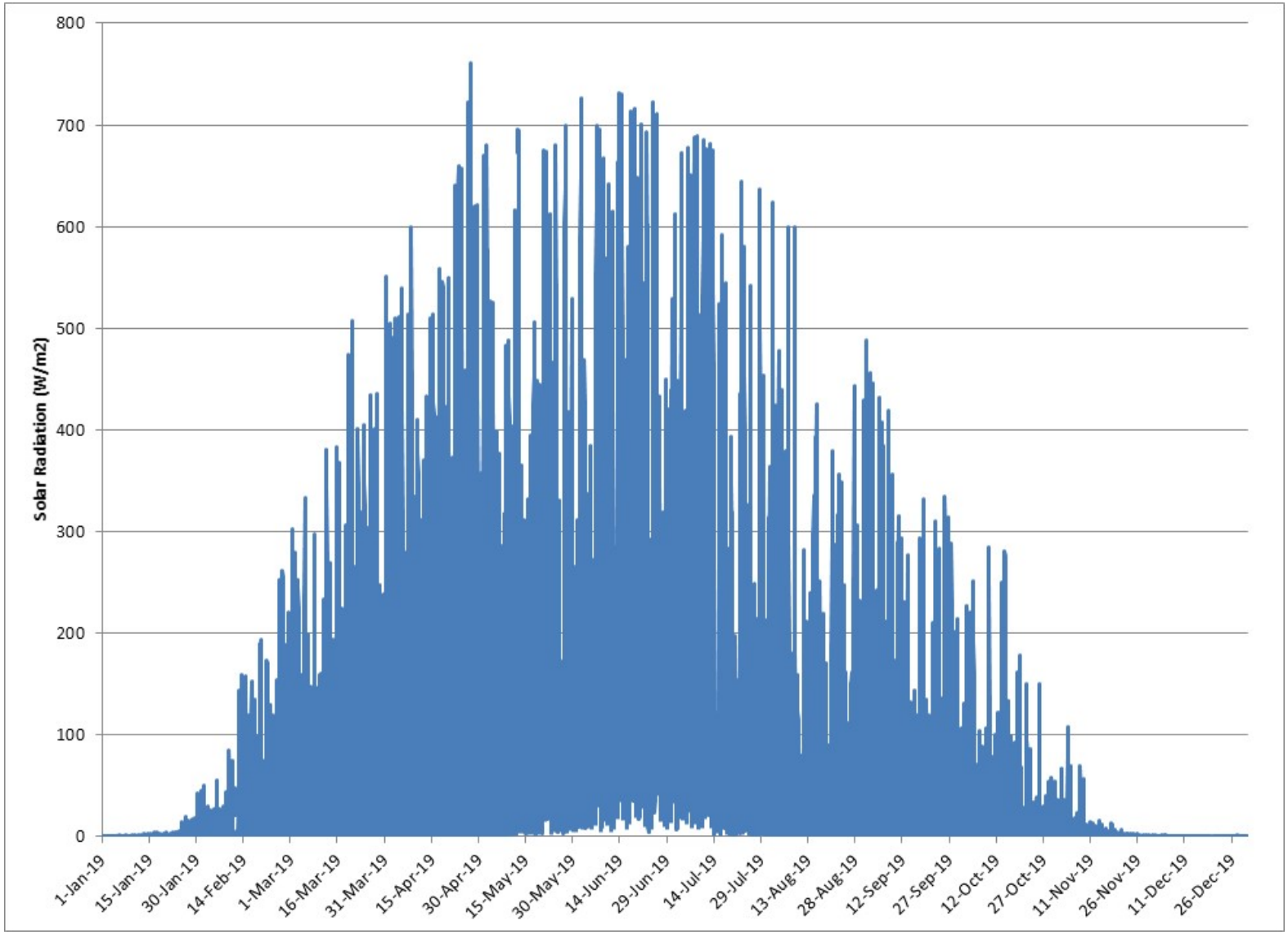


Figure 3-15: Hourly Average Solar Radiation

4. REFERENCES

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APPENDIX A

DATA PROCESSING SPECIFICATIONS AND STATISTICAL FORMULAE

A.1 Data Recovery Percentage

Data completeness for ambient air and meteorological monitoring methods was calculated assuming:

- Minimum of 75% valid hourly average data to calculate 1-hour, 3-hour, 8-hour, and 24-hour averages;
- Minimum of 90% valid hourly averages to calculate quarterly average data completeness for meteorological parameters;
- Minimum of 80% valid hourly averages to calculate quarterly average data completeness for air quality criteria pollutants; and
- Minimum of 90% quarterly data completeness for 4 consecutive monitoring quarters (before any data substitution).

Quarterly data completeness (DC_i) was determined using the following equation:

$$DC_i = h_v/h_i \times 100$$

Where: h_v = number of hours of valid data actually collected
h_i = number of possible valid hours of data collection during the monitoring period

A.2 Data Bias Correction Using Calibration Information

Not Applicable.

A.3 Estimation of Pasquill-Gifford Stability Categories

Not Applicable.

Table A-1: Ambient Air Quality Data Capture Percent

Period	Pollutants – Data Recovery [1]					
	NO_2	SO_2	O_3	CO	$PM_{2.5}$ [2]	PM_{10} [2]
January	97%	98%	98%	98%	90%	97%
February	94%	97%	97%	97%	100%	**64%** [3]
March	98%	98%	97%	98%	100%	100%
1st Quarter	**96%**	**98%**	**97%**	**98%**	**97%**	**88%**
April	99%	99%	99%	99%	100%	100%
May	97%	97%	97%	97%	97%	97%
June	86%	85%	84%	86%	97%	97%
2nd Quarter	**94%**	**94%**	**93%**	**94%**	**98%**	**98%**
July	**65%** [4]	**65%** [4]	**65%** [4]	**65%** [4]	100%	100%
August	95%	93%	94%	93%	100%	100%
September	97%	97%	97%	97%	100%	100%
3rd Quarter	**86%**	**85%**	**86%**	**85%**	**100%**	**100%**
October	96%	96%	96%	96%	100%	100%
November	92%	92%	92%	92%	97%	100%
December	98%	98%	98%	**63%** [5]	93%	93%
4th Quarter	**96%**	**95%**	**96%**	**84%**	**97%**	**98%**
Annual	**93%**	**93%**	**93%**	**90%**	**98%**	**96%**

[1] EPA PSD-quality ambient air monitoring standards require data capture of 80 percent or greater per quarter for four consecutive quarters.
[2] Data recovery for PM monitors is based on the number of valid 24-hour average particulate matter samples collected divided by the total number of 24-hour periods during the sampling period.
[3] PM_{10} data were invalidated in February 2019 due to sampler damage. Despite the data loss, DQOs were met for the monitoring quarter.
[4] Unstable shelter temperatures led to the invalidation of NO_2, SO_2, O_3, and CO data July 2019. Despite the data loss, DQOs were met for the monitoring quarter.
[5] The CO analyzer experienced a pump malfunction in December 2019. Despite the data loss, DQOs were met for the fourth monitoring quarter.

Table A-2: Meteorological Data Capture Percent

Period	Meteorological Parameters – Data Recovery [1]								
	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	Horizontal Wind Speed	Horizontal Wind Direction	Wind Direction Std. Dev. (Sigma Theta)	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January	100%	100%	90% [2]	90% [2]	90% [2]	100%	100%	100%	100%
February	100%	100%	100% [2]	100% [2]	100% [2]	100%	100%	100%	99%
March	100%	100%	100% [2]	100% [2]	100% [2]	100%	100%	100%	100%
1st Quarter	**100%**	**100%**	**96% [2]**	**96% [2]**	**96% [2]**	**100%**	**100%**	**100%**	**99%**
April	100%	100%	100%	100%	100%	100% [3]	100% [3]	100% [3]	100%
May	98%	98%	98%	98%	98%	98% [3]	98% [3]	98% [3]	98%
June	99%	99%	99%	99%	99%	99% [3]	99% [3]	99% [3]	100%
2nd Quarter	**99%**	**99%**	**99%**	**99%**	**99%**	**99% [3]**	**99% [3]**	**99% [3]**	**99%**
July	98%	98%	98%	98%	98%	99%	97%	97%	99%
August	100%	100%	100%	100%	100%	100%	100%	100%	100%
September	100%	100%	100%	100%	100%	100%	100%	100%	100%
3rd Quarter	**99%**	**99%**	**99%**	**99%**	**99%**	**100%**	**99%**	**99%**	**100%**
October	100%	100%	100% [2]	100% [2]	100% [2]	100%	100%	100%	100%
November	96%	96%	96% [2]	96% [2]	96% [2]	96%	96%	96%	97%
December	99%	99%	**75% [2,4]**	**75% [2,4]**	**75% [2,4]**	99%	99%	99%	99%
4th Quarter	**99%**	**99%**	**90% [2]**	**90% [2]**	**90% [2]**	**99%**	**99%**	**99%**	**99%**
Annual	**99%**	**99%**	**96%**	**96%**	**96%**	**99%**	**99%**	**99%**	**99%**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Data from the secondary horizontal wind sensor were used during the first and fourth quarters.
[3] A combination of data from the primary and secondary temperature sensors were used during the second quarter. See Section 2.2 for more information.
[4] Horizontal wind data were invalidated during December 2019 due to snow and ice buildup on the sensors. Despite the data loss, DQOs were met during the fourth quarter.

APPENDIX B

PRECISION DATA

Appendix B Table of Contents

Table B-1: 1st Quarter CO Precision Statistics Summary

Period	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]
1/3/2019	7.6	8.0	-5.6	23	-3.53	1.75	-0.10	-6.96	2.19
1/7/2019 [2]	7.5	8.0	-6.8						
1/7/2019 [3]	7.9	8.0	-1.7						
1/8/2019	7.9	8.0	-1.5						
1/10/2019	7.8	8.0	-2.1						
1/17/2019	7.8	8.0	-2.5						
1/24/2019	7.7	8.0	-3.9						
1/31/2019 [2]	7.8	8.0	-2.5						
1/31/2019 [3]	7.9	8.0	-1.2						
2/1/2019	7.7	8.0	-3.2						
2/7/2019	7.7	8.0	-4.1						
2/14/2019	7.6	8.0	-5.3						
2/16/2019 [2]	7.7	8.0	-4.0						
2/16/2019 [3]	7.7	8.0	-3.7						
2/21/2019	7.9	8.0	-1.7						
2/28/2019	7.6	8.0	-5.2						
3/4/2019	7.6	8.0	-5.6						
3/7/2019	7.6	8.0	-5.0						
3/14/2019	7.6	8.0	-5.2						
3/20/2019 [2]	7.6	8.0	-5.5						
3/20/2019 [3]	7.9	8.0	-0.8						
3/21/2019	7.9	8.0	-1.8						
3/28/2019	7.8	8.0	-2.3						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

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

Period	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]
4/4/2019	7.8	8.0	-3.1						
4/11/2019	7.7	8.0	-4.0						
4/18/2019	7.6	8.0	-4.9						
4/25/2019	7.7	8.0	-3.8						
5/2/2019	7.8	8.0	-2.8						
5/8/2019	7.7	8.0	-3.4						
5/9/2019	7.7	8.0	-4.0						
5/16/2019	7.7	8.0	-3.9						
5/21/2019 [2]	7.6	8.0	-4.7	17	-3.20	0.96	-1.31	-5.09	1.26
5/21/2019 [3]	7.9	8.0	-1.8						
5/23/2019	7.8	8.0	-2.2						
5/30/2019	7.8	8.0	-2.9						
6/6/2019	7.8	8.0	-2.6						
6/13/2019	7.8	8.0	-2.3						
6/19/2019	7.8	8.0	-2.5						
6/20/2019	7.9	8.0	-1.8						
6/27/2019	7.7	8.0	-3.8						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

Table B-3: 3rd Quarter CO Precision Statistics Summary

Period	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]
7/4/2019	7.6	8.0	-4.8	22	-2.10	3.32	4.41	-8.60	4.18
7/11/2019	7.6	8.0	-5.3						
7/16/2019 [2]	7.3	8.0	-8.5						
7/16/2019 [3]	7.9	8.0	-0.7						
7/17/2019	7.9	8.0	-0.7						
7/18/2019	7.9	8.0	-1.4						
7/18/2019	7.8	8.0	-2.2						
7/25/2019	7.8	8.0	-2.0						
8/1/2019	7.6	8.0	-5.2						
8/8/2019	7.6	8.0	-4.9						
8/15/2019	7.6	8.0	-5.3						
8/22/2019	7.5	8.0	-5.8						
8/27/2019	7.5	8.0	-6.8						
8/28/2019	8.0	7.7	3.9						
8/29/2019 [2]	8.0	7.7	3.4						
8/29/2019 [3]	7.7	7.7	0.1						
9/5/2019	7.8	7.7	1.5						
9/12/2019	7.6	7.7	-0.8						
9/18/2019 [2]	7.6	7.7	-1.8						
9/18/2019 [3]	7.8	7.7	1.5						
9/19/2019	7.7	7.7	-0.4						
9/29/2019	7.7	7.7	-0.2						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

Table B-4: 4th Quarter CO Precision Statistics Summary

Period	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]
10/3/2019	7.9	7.7	2.0	20	-2.08	2.93	3.67	-7.83	3.75
10/10/2019	7.3	7.7	-5.3						
10/17/2019	7.8	7.7	1.2						
10/22/2019 [2]	7.6	7.7	-1.9						
10/22/2019 [3]	7.5	7.7	-2.6						
10/24/2019	7.3	7.7	-5.8						
10/25/2019 [2]	7.2	7.7	-6.6						
10/25/2019 [3]	7.6	7.7	-1.4						
10/31/2019	7.5	7.7	-3.1						
11/7/2019	7.4	7.7	-3.5						
11/14/2019	7.6	7.7	-1.9						
11/21/2019	7.7	7.7	0.3						
11/25/2019	7.8	7.7	1.7						
11/26/2019	7.6	7.7	-1.5						
11/28/2019	7.6	7.7	-1.6						
12/5/2019	7.8	7.7	0.8						
12/11/2019 [2]	7.9	7.7	3.1						
12/11/2019 [3]	7.2	7.7	-6.0						
12/12/2019	7.2	7.7	-5.9						
12/19/2019	7.4	7.7	-3.7						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration
[3] As-left; post calibration.

Table B-5: 1st Quarter NO_2 Precision Statistics Summary

Period	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]
1/3/2019	82.0	80.0	2.5	16	-0.95	5.54	9.91	-11.82	7.34
1/8/2019	85.6	80.0	7.0						
1/10/2019	86.9	80.0	8.6						
1/17/2019	83.6	80.0	4.5						
1/24/2019	82.7	80.0	3.4						
1/31/2019	84.4	80.0	5.5						
2/1/2019 [2]	80.9	80.0	1.1						
2/7/2019	78.1	80.0	-2.4						
2/14/2019 [3]	-	-	-						
2/16/2019 [4]	75.8	80.0	-5.3						
2/16/2019 [5]	76.4	80.0	-4.5						
2/21/2019	77.0	80.0	-3.8						
3/4/2019	75.8	80.0	-5.3						
3/7/2019	74.0	80.0	-7.5						
3/14/2019	73.7	80.0	-7.9						
3/21/2019	76.6	80.0	-4.3						
3/28/2019	74.3	80.0	-7.1						

[1] Acceptance criteria: ≤ 15%
[2] The Thermo 42i NOX analyzer (serial number: 0705820942) was replaced with an API T200U analyzer (serial number: 194) on February 1, 2019.
[3] No precision check run during calibrations on ozone analyzer.
[4] As-found; pre-calibration.
[5] As-left; post calibration.

Table B-6: 2nd Quarter NO_2 Precision Statistics Summary

Period	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]
4/4/2019	75.1	80.0	-6.1	17	-6.11	0.85	-4.44	-7.79	1.12
4/11/2019	74.7	80.0	-6.6						
4/18/2019	74.6	80.0	-6.8						
4/25/2019	75.9	80.0	-5.1						
5/2/2019	75.2	80.0	-6.0						
5/8/2019	75.7	80.0	-5.4						
5/9/2019	75.5	80.0	-5.6						
5/16/2019	74.4	80.0	-7.0						
5/21/2019 [2]	74.3	80.0	-7.1						
5/21/2019 [3]	75.8	80.0	-5.3						
5/23/2019	74.8	80.0	-6.5						
5/30/2019	75.6	80.0	-5.5						
6/6/2019	75.0	80.0	-6.3						
6/13/2019	74.2	80.0	-7.3						
6/19/2019	75.5	80.0	-5.6						
6/20/2019	74.1	80.0	-7.4						
6/27/2019	76.5	80.0	-4.4						

[1] Acceptance criteria: ≤ 15%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

Table B-7: 3rd Quarter NO_2 Precision Statistics Summary

Period	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]
7/4/2019	71.7	80.0	-10.4	17	-3.34	3.60	3.72	-10.39	4.72
7/11/2019	74.4	80.0	-7.0						
7/17/2019	74.3	80.0	-7.1						
7/18/2019 [2]	73.6	80.0	-8.0						
7/18/2019 [3]	74.6	80.0	-6.8						
7/25/2019	75.8	80.0	-5.3						
8/1/2019	75.8	80.0	-5.3						
8/8/2019	79.5	80.0	-0.6						
8/15/2019	79.4	80.0	-0.8						
8/22/2019	78.5	80.0	-1.9						
8/27/2019	80.1	80.0	0.1						
8/29/2019	81.3	80.0	1.6						
9/12/2019	79.2	80.0	-1.0						
9/18/2019 [2]	79.8	80.0	-0.3						
9/18/2019 [3]	77.4	80.0	-3.3						
9/19/2019	78.3	80.0	-2.1						
9/29/2019	80.9	80.0	1.1						

[1] Acceptance criteria: ≤ 15%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

Table B-8: 4th Quarter NO_2 Precision Statistics Summary

Period	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]
10/3/2019	79.8	80.0	-0.3	14	3.10	3.01	9.00	-2.80	4.09
10/10/2019	80.2	80.0	0.3						
10/17/2019	80.3	80.0	0.4						
10/24/2019	80.9	80.0	1.1						
10/31/2019	82.8	80.0	3.5						
11/7/2019	87.3	80.0	9.1						
11/14/2019	84.8	80.0	6.0						
11/21/2019	79.0	80.0	-1.3						
11/28/2019	80.8	80.0	1.0						
12/5/2019	84.7	80.0	5.9						
12/11/2019	83.4	80.0	4.3						
12/12/2019	84.9	80.0	6.1						
12/19/2019	82.9	80.0	3.6						
12/26/2019	82.9	80.0	3.6						

[1] Acceptance criteria: ≤ 15%

Table B-9: 1st Quarter O_3 Precision Statistics Summary

Period	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]
1/2/2019 [2]	83.1	80.0	3.9	18	0.83	1.94	4.63	-2.96	2.51
1/2/2019 [3]	80.8	80.0	1.0						
1/3/2019	80.6	80.0	0.7						
1/10/2019	79.0	80.0	-1.3						
1/17/2019	80.9	80.0	1.1						
1/24/2019	83.6	80.0	4.4						
1/31/2019	82.6	80.0	3.3						
2/7/2019	79.5	80.0	-0.7						
2/14/2019 [2]	77.5	80.0	-3.2						
2/14/2019 [3]	79.4	80.0	-0.7						
2/16/2019	81.4	80.0	1.8						
2/21/2019	81.3	80.0	1.6						
2/28/2019	81.4	80.0	1.7						
3/1/2019	79.6	80.0	-0.5						
3/7/2019	79.7	80.0	-0.4						
3/14/2019	80.5	80.0	0.6						
3/24/2019	81.9	80.0	2.4						
3/28/2019	79.3	80.0	-0.8						

[1] Acceptance criteria: ≤ 7%
[2] As-found; pre-calibration
[3] As-left; post calibration.

Table B-10: 2nd Quarter O_3 Precision Statistics Summary

Period	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]
4/4/2019	78.8	80.0	-1.5	14	-2.00	1.48	0.89	-4.89	2.00
4/11/2019	79.0	80.0	-1.2						
4/18/2019	79.1	80.0	-1.1						
4/25/2019	79.6	80.0	-0.6						
5/2/2019	77.4	80.0	-3.3						
5/9/2019	77.5	80.0	-3.2						
5/16/2019	78.0	80.0	-2.5						
5/23/2019	77.8	80.0	-2.7						
5/30/2019	76.1	80.0	-4.9						
6/6/2019	77.9	80.0	-2.6						
6/13/2019	78.3	80.0	-2.2						
6/19/2019	77.7	80.0	-2.9						
6/20/2019	79.7	80.0	-0.4						
6/27/2019	80.8	80.0	1.0						

[1] Acceptance criteria: ≤ 7%

Table B-11: 3rd Quarter O_3 Precision Statistics Summary

Period	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]
7/4/2019	80.9	80.0	1.1	15	-0.18	0.88	1.54	-1.90	1.18
7/11/2019	80.4	80.0	0.5						
7/18/2019	80.8	80.0	1.0						
7/25/2019	79.4	80.0	-0.7						
8/1/2019	80.1	80.0	0.2						
8/8/2019	80.3	80.0	0.4						
8/15/2019	80.1	80.0	0.1						
8/22/2019	80.2	80.0	0.3						
8/27/2019	80.1	80.0	0.1						
8/29/2019	80.0	80.0	0.0						
9/5/2019	79.3	80.0	-0.8						
9/12/2019	79.8	80.0	-0.3						
9/19/2019	79.0	80.0	-1.3						
9/26/2019	78.4	80.0	-2.0						
9/29/2019	79.0	80.0	-1.3						

[1] Acceptance criteria: ≤ 7%

Table B-12: 4th Quarter O_3 Precision Statistics Summary

Period	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]
10/3/2019	77.7	80.0	-2.9	15	-0.82	1.58	2.28	-3.91	2.12
10/10/2019	78.3	80.0	-2.1						
10/17/2019	80.6	80.0	0.7						
10/22/2019 [2]	77.0	80.0	-3.7						
10/22/2019 [3]	78.7	80.0	-1.6						
10/24/2019	78.1	80.0	-2.3						
10/31/2019	79.0	80.0	-1.2						
11/7/2019	80.9	80.0	1.2						
11/14/2019	80.0	80.0	0.0						
11/21/2019	78.1	80.0	-2.4						
11/28/2019	80.5	80.0	0.6						
12/5/2019	80.7	80.0	0.9						
12/12/2019	80.2	80.0	0.2						
12/19/2019	80.4	80.0	0.5						
12/26/2019	79.8	80.0	-0.2						

[1] Acceptance criteria: ≤ 7%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

Table B-13: 1st Quarter SO_2 Precision Statistics Summary

Period	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]
1/3/2019	76.8	78.0	-1.5						
1/7/2019	77.9	78.0	-0.1						
1/8/2019	76.7	78.0	-1.7						
1/10/2019	76.9	78.0	-1.5						
1/17/2019	78.5	78.0	0.7						
1/24/2019	78.5	78.0	0.6						
1/31/2019 [2]	79.1	78.0	1.4						
1/31/2019 [3]	77.8	78.0	-0.2						
2/1/2019	76.9	78.0	-1.4						
2/7/2019	78.0	78.0	0.0						
2/14/2019	77.9	78.0	-0.2	21	0.92	1.66	4.18	-2.34	2.11
2/16/2019 [2]	78.4	78.0	0.5						
2/16/2019 [3]	79.3	78.0	1.7						
2/21/2019	79.5	78.0	2.0						
2/28/2019	79.9	78.0	2.4						
3/4/2019	80.7	78.0	3.4						
3/7/2019	80.0	78.0	2.5						
3/14/2019	80.6	78.0	3.3						
3/20/2019	80.4	78.0	3.0						
3/21/2019	79.5	78.0	1.9						
3/28/2019	80.0	78.0	2.5						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

Table B-14: 2nd Quarter SO_2 Precision Statistics Summary

Period	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]
4/4/2019	80.1	78.0	2.7						
4/11/2019	79.3	78.0	1.7						
4/18/2019	80.3	78.0	3.0						
4/25/2019	80.5	78.0	3.2						
5/2/2019	80.7	78.0	3.5						
5/8/2019	80.4	78.0	3.1						
5/9/2019	83.6	78.0	7.1						
5/16/2019	83.4	78.0	6.9						
5/21/2019 [2]	84.0	78.0	7.7	17	2.90	2.29	7.39	-1.60	3.01
5/21/2019 [3]	78.7	78.0	0.9						
5/23/2019	78.7	78.0	0.8						
5/30/2019	79.2	78.0	1.6						
6/6/2019	79.3	78.0	1.7						
6/13/2019	79.3	78.0	1.6						
6/19/2019	79.7	78.0	2.2						
6/20/2019	77.7	78.0	-0.4						
6/27/2019	79.6	78.0	2.0						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

Table B-15: 3rd Quarter SO_2 Precision Statistics Summary

Period	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]
7/4/2019	79.6	78.0	2.1	20	2.10	2.38	6.76	-2.56	3.04
7/11/2019	79.0	78.0	1.3						
7/16/2019 [2]	80.2	78.0	2.8						
7/16/2019 [3]	78.7	78.0	0.8						
7/17/2019	79.2	78.0	1.6						
7/18/2019 [2]	79.2	78.0	1.5						
7/18/2019 [3]	79.5	78.0	1.9						
7/25/2019	78.0	78.0	-0.1						
8/1/2019	77.6	78.0	-0.5						
8/8/2019	79.2	78.0	1.6						
8/15/2019	79.8	78.0	2.3						
8/22/2019	79.3	78.0	1.7						
8/27/2019	81.2	78.0	4.1						
8/28/2019	78.3	74.9	4.5						
9/5/2019	77.3	74.9	3.1						
9/12/2019	79.4	74.9	6.0						
9/18/2019 [2]	81.5	74.9	8.8						
9/18/2019 [3]	74.9	74.9	0.0						
9/19/2019	74.8	74.9	-0.2						
9/29/2019	73.9	74.9	-1.3						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

Table B-16: 4th Quarter SO_2 Precision Statistics Summary

Period	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]
10/3/2019	75.4	74.9	0.6	21	-1.63	1.96	2.21	-5.48	2.49
10/10/2019	74.9	74.9	0.1						
10/17/2019	75.5	74.9	0.8						
10/22/2019 [2]	75.5	74.9	0.9						
10/22/2019 [3]	74.8	74.9	-0.2						
10/24/2019	74.0	74.9	-1.1						
10/25/2019 [2]	73.8	74.9	-1.5						
10/25/2019 [3]	75.3	74.9	0.5						
10/31/2019	74.8	74.9	-0.1						
11/7/2019	73.6	74.9	-1.8						
11/14/2019	72.1	74.9	-3.8						
11/21/2019	73.1	74.9	-2.4						
11/25/2019	71.6	74.9	-4.5						
11/26/2019	72.8	74.9	-2.8						
11/28/2019	72.7	74.9	-2.9						
12/5/2019	70.7	74.9	-5.7						
12/11/2019 [2]	71.6	74.9	-4.5						
12/11/2019 [3]	75.2	74.9	0.4						
12/12/2019	74.2	74.9	-1.0						
12/19/2019	73.0	74.9	-2.5						
12/26/2019	72.7	74.9	-3.0						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.

Table B-17: Network $PM_{2.5}$ Monitoring Precision

Period	Samplers [1]	Concentration Levels	Number of Collocated Samples	Average Percent Difference	Standard Deviation [2] ($\mu g/m^3$)	Precision [3] (%CV)
1st Quarter (January 1 – March 31)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	57	-38.3	20.9	16.9
2nd Quarter (April 1 – June 30)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	29	-20.0	36.3	31.2
3rd Quarter (July 1 – September 30)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	8	16.4	25.1	27.9
4th Quarter (October 1 – December 31)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	26	-30.0	41.4	36.1
Year to Date	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	120	-28.4	33.4	25.8

[1] $PM_{2.5}$ network precision statistics represent data from the CD1 monitoring station $PM_{2.5}$ 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 ≤ 10%CV per quarter. If the precision estimate exceeds 10%CV, alternate precision statistics of ±3 µg/m3 apply. See CD1 summary report for additional information.