Nuiqsut Ambient Air Quality and Meteorological Monitoring Program

January 1, 2018 – December 31, 2018

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Nuiqsut, Alaska

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2018 Annual Data Report

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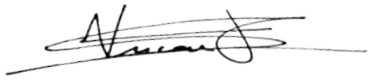
This document has been prepared by SLR International Corporation (SLR). The material and data in this report were prepared under the supervision and direction of the undersigned.



Vincent Fricaud
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EXECUTIVE 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 Environmental Protection Agency (EPA) Prevention of Significant Deterioration (PSD) regulations and guidance documents. This report provides details of ambient air and meteorological measurements collected during the 2018 monitoring year, spanning from January 1, 2018, to December 31, 2018, at the Nuiqsut monitoring station.

Table E-1 details Quality Assurance Project Plan (QAPP) variations documented for this project during the monitoring year. Any QAPP variations are explained in more detail in Section 1. The Nuiqsut QAPP Revision 2.1 was approved by the Alaska Department of 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). Tables E-3 and E-4 provide monthly, quarterly, and annual valid hours and percent data capture for the Nuiqsut meteorological monitoring station. Data not meeting QAPP and PSD precision and accuracy criteria were invalidated and are discussed in Section 2.

Table E-1-1: QAPP Variation Table

Item / Procedure	Summary of QAPP Variation	Reason for Variation
Ozone transfer standard certification Ozone precision and span checks performed by certified transfer standard	Span and precision checks conducted between April 3, 2018 and June 12, 2018 were conducted using an expired ozone transfer standard.	Certification of the SLR-owned primary standard used to certify field transfer standards was delayed after submittal to EPA. After it was re-certified, a replacement field transfer standard was certified and sent to the field to verify instrument calibration accuracy. No changes were made to the instrument during the time the expired standard was in use and all checks, including that conducted with the certified transfer standard were within specification. Data accuracy was determined to be unaffected by the procedural deviation.

Table E-1-2: 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/m^3)	Annual	Average of Period	3	1	1	2	2	**3.8%**
	100.0 ppb (190 µg/m^3)	1-Hour (2)	Daily Max 1-Hour Averages (98th Percentile)	--	--	--	--	23.9	**23.9%**
			1st Highest, 1-Hour Average	30.0	14.9	12.6	37.9	37.9	**37.9%**
			2nd Highest, 1-Hour Average	24.9	14.5	11.6	33.9	33.9	**33.9%**
Ozone (O_3)	0.070 ppm (150 µg/m^3)	8-Hour (3)	4th Highest, 8-Hour Average	0.044	0.041	0.030	0.038	0.046	**65.7%**
			1st Highest, 8-Hour Average	0.047	0.047	0.031	0.041	0.047	**67.1%**
			2nd Highest, 8-Hour Average	0.046	0.044	0.030	0.040	0.047	**67.1%**
Carbon Monoxide (CO)	35 ppm (40,000 µg/m^3)	1-Hour (1)	1st Highest, 1-Hour Average	1	1	1	1	1	**2.9%**
			2nd Highest, 1-Hour Average	1	1	1	1	1	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour (1)	1st Highest, 8-Hour Average	1	1	1	1	1	**11.1%**
			2nd Highest, 8-Hour Average	1	1	1	1	1	**11.1%**

[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/m^3)	Annual	Average of Period	0.001	0.001	0.001	0.000	0.001	**3.3%**
	0.14 ppm (365 μg/m^3)	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/m^3)	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/m^3)	1-Hour [4]	Daily Max 1-Hour Averages (99th Percentile)	--	--	--	--	2.6	**3.5%**
			1st Highest, 1-Hour Average	2.6	2.6	2.0	1.6	2.6	**3.5%**
			2nd Highest, 1-Hour Average	2.6	2.5	1.9	1.5	2.6	**3.5%**

[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/m^3	Annual [7]	Average of Period	1.9	1.6	1.4	2.7	1.9	**15.8%**
	35 μg/m^3	24-Hour [6]	98th Percentile, 24-Hour Average	--	--	--	--	8	**22.9%**
			1st Highest, 24-Hour Average	9	11	5	12	12	**34.3%**
			2nd Highest, 24-Hour Average	8	8	5	11	11	**31.4%**
Particulate Matter <10 microns (PM_{10})	150 μg/m^3	24-Hour [8,9]	1st Highest, 24-Hour Average	20	50	20	140	140	**93.3%**
			2nd Highest, 24-Hour Average	10	50	20	140	140	**93.3%**

[6] To attain this standard, the 3-year average of the 98th percentile of the 24-hour concentration must not exceed 35.0 μg/m^3.
[7] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentration must not exceed 12.0 μg/m^3.
[8] Not to be exceeded more than once per year on average over three years.
[9] 40 CFR Appendix K requires that reportable concentrations of PM_{10} be rounded to the nearest 10 μg/m^3.

Table E-1-3: 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	730	730	691	691	691	743	743	743	743
February	588 [2]	588 [2]	540 [2]	540 [2]	540 [2]	672	672	672	672
March	744	744	744	744	744	744	744	744	739
1st Quarter	**2062**	**2062**	**1975**	**1975**	**1975**	**2159**	**2159**	**2159**	**2154**
April	715	715	715	715	715	715	715	715	715
May	735	735	742	742	742	743	743	743	743
June	710	710	720	720	720	720	720	720	720
2nd Quarter	**2160**	**2160**	**2177**	**2177**	**2177**	**2178**	**2178**	**2178**	**2178**
July	741	741	741	741	741	741	741	741	741
August	744	744	744	744	744	744	744	744	744
September	679	679	719	719	719	719	719	719	719
3rd Quarter	**2164**	**2164**	**2204**	**2204**	**2204**	**2204**	**2204**	**2204**	**2204**
October	722	722	721	721	721	743	743	743	744
November	717	717	701	701	701	717	717	717	713
December	738	738	660 [3]	660 [3]	660 [3]	738	738	738	742
4th Quarter	**2177**	**2177**	**2082**	**2082**	**2082**	**2198**	**2198**	**2198**	**2199**
Annual	**8563**	**8563**	**8438**	**8438**	**8438**	**8739**	**8739**	**8739**	**8735**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Horizontal and vertical wind speed data invalidated due to snow and ice buildup on the sensors February 2018. Despite the data loss, DQOs were met for the first quarter.
[3] Horizontal wind data invalidated due to snow and ice buildup on the sensors December 2018. Despite the data loss, DQOs were met for the fourth quarter.

Table E-1-4: 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	98%	98%	93%	93%	93%	100%	100%	100%	100%
February	88% [2]	88% [2]	80% [2]	80% [2]	80% [2]	100%	100%	100%	100%
March	100%	100%	100%	100%	100%	100%	100%	100%	99%
1st Quarter	**95%**	**95%**	**91%**	**91%**	**91%**	**100%**	**100%**	**100%**	**100%**
April	99%	99%	99%	99%	99%	99%	99%	99%	99%
May	99%	99%	100%	100%	100%	100%	100%	100%	100%
June	99%	99%	100%	100%	100%	100%	100%	100%	100%
2nd Quarter	**99%**	**99%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
July	100%	100%	100%	100%	100%	100%	100%	100%	100%
August	100%	100%	100%	100%	100%	100%	100%	100%	100%
September	94%	94%	100%	100%	100%	100%	100%	100%	100%
3rd Quarter	**98%**	**98%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
October	97%	97%	97%	97%	97%	100%	100%	100%	100%
November	100%	100%	97%	97%	97%	100%	100%	100%	99%
December	99%	99%	89% [3]	89% [3]	89% [3]	99%	99%	99%	100%
4th Quarter	**99%**	**99%**	**94%**	**94%**	**94%**	**100%**	**100%**	**100%**	**100%**
Annual	**98%**	**98%**	**96%**	**96%**	**96%**	**100%**	**100%**	**100%**	**100%**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Horizontal and vertical wind speed data invalidated due to snow and ice buildup on the sensors February 2018. Despite the data loss, DQOs were met for the first quarter.
[3] Horizontal wind speed data invalidated due to snow and ice buildup on the sensors December 2018. 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.

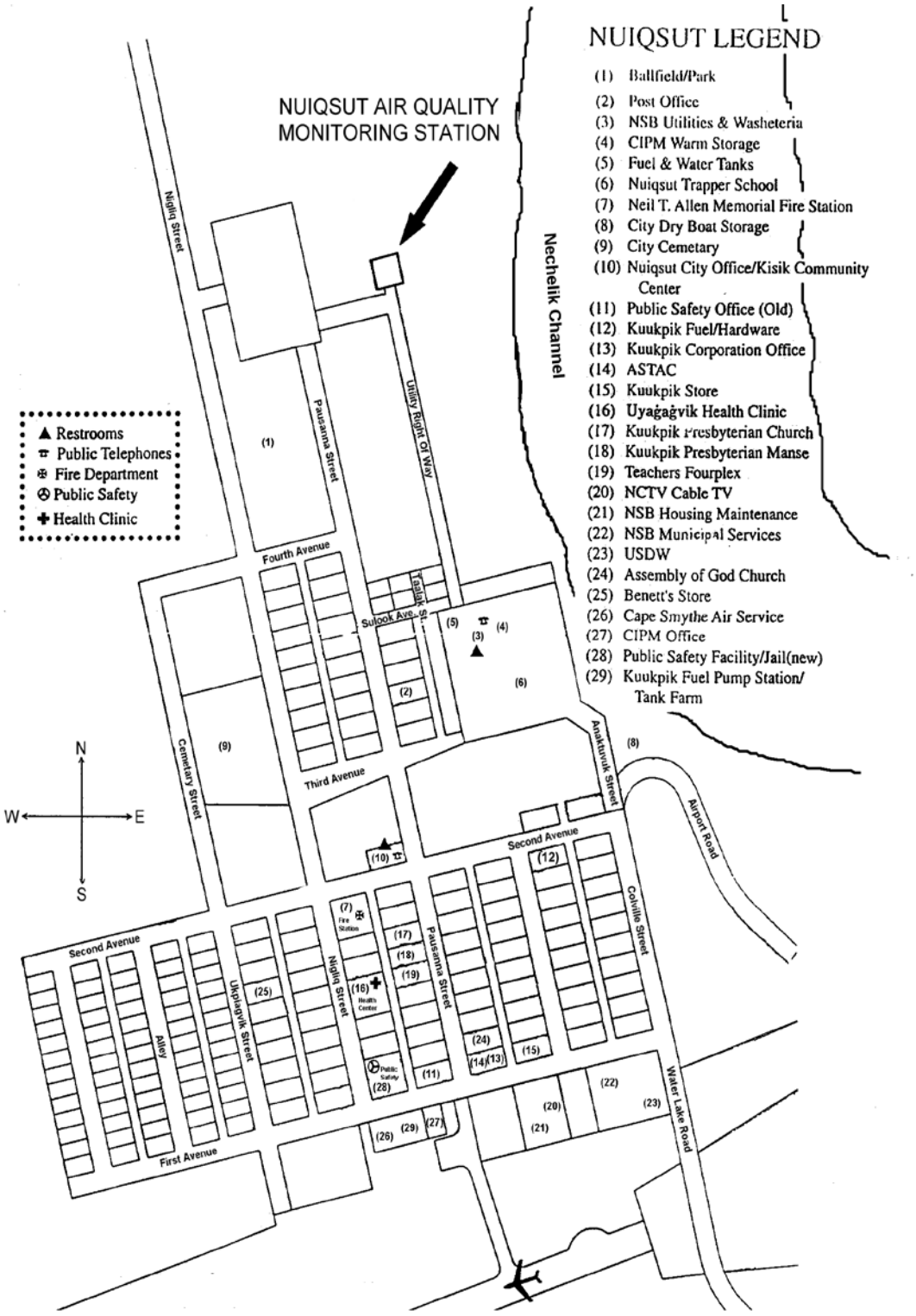


Figure 1-1: Local Map of Nuiqsut

Figure 1-2: Aerial Photo Showing Site Location

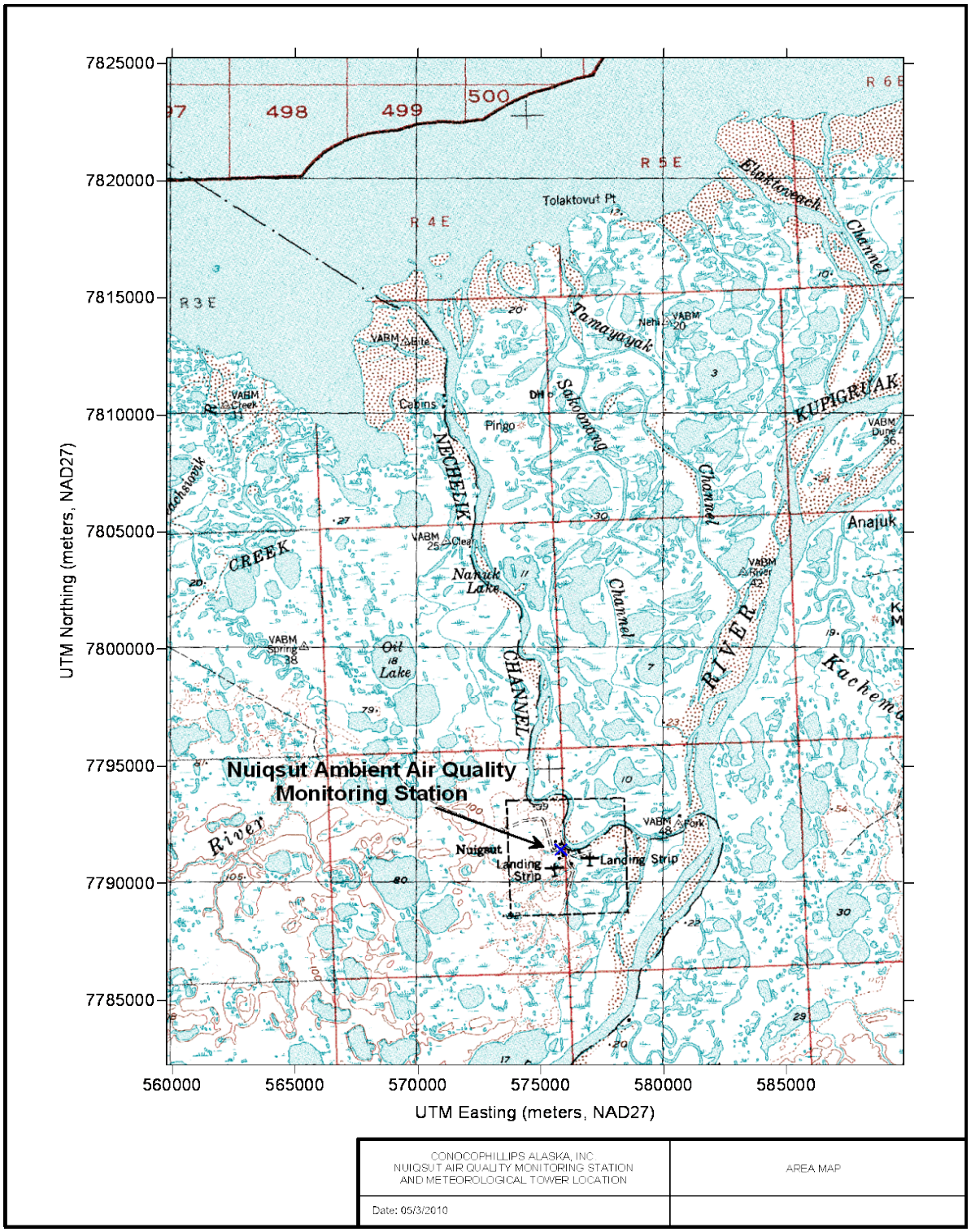


Figure 1-3: Map of Nuiqsut Project Area

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

[1] Total oxides of nitrogen (NO_X) and nitrogen oxide (NO) are also measured.
[2] Thermo instrument was used January 1-November 13, 2018. API instrument was used November 14-December 31, 2018.
[3] API instrument was used January 1-December 6, 2018. Thermo instrument was used December 6-December 31, 2018.

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 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
Ozone transfer standard certification Ozone precision and span checks performed by certified transfer standard	Span and precision checks conducted between April 3, 2018 and June 12, 2018 were conducted using an expired ozone transfer standard.	Certification of the SLR-owned primary standard used to certify field transfer standards was delayed after submittal to EPA. After it was re-certified, a replacement field transfer standard was certified and sent to the field to verify instrument calibration accuracy. No changes were made to the instrument during the time the expired standard was in use and all checks, including that conducted with the certified transfer standard were within specification. Data accuracy was determined to be unaffected by the procedural deviation.

During the second quarter, there was a procedural deviation from the approved Nuiqsut Ambient Air Quality and Meteorological Monitoring Quality Assurance Project Plan (QAPP). Certification of the SLR-owned primary standard used to certify field transfer standards was delayed. EPA took longer to certify the instrument and return it to SLR than expected. As a result, the field transfer standard in use at the station expired and a certified replacement was not immediately available. After the SLR-owned primary standard was re-certified and returned to SLR, a replacement field transfer standard was quickly certified and sent to the field to verify instrument calibration accuracy. Upon installation, multipoint calibration verification demonstrated that the instrument was still within acceptable accuracy limits. No changes were made to the ozone sampler during the time the expired transfer standard was in use. All checks, including that conducted with the newly certified transfer standard, were within acceptable limits at all times. As a result, data accuracy was determined to be unaffected by the procedural deviation and data were determined valid.

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 2018 ambient air and meteorological monitoring year.

Table 2-1: Chronology of Significant Events

Date	Event
January 1, 2018	Start of the monitoring year.
January 9, 2018	Snow and ice buildup on horizontal wind speed sensor. 4 hours of horizontal wind data invalidated.
January 11, 2018	Daily average PM_{10} concentration less than -2 µg/m^3. 24 hours of BAM PM_{10} data invalidated.
January 11 – 12, 2018	Snow and ice buildup on vertical wind speed sensor. 13 hours of vertical wind data invalidated.
January 11 – 13, 2018	Snow and ice buildup on horizontal wind speed sensor. 48 hours of horizontal wind data invalidated.
January 13 – 24, 2018	$PM_{2.5}$ analyzer communication and flow errors. 277 hours of $PM_{2.5}$ BAM data invalidated in total.
January 24, 2018	Routine maintenance and monthly QC checks performed on PM samplers. PM_{10} analyzer passed as-found. $PM_{2.5}$ did not pass as-found with known flow issues since January 13. The analyzer was repaired and recalibrated; as-left QC check passed. 10 hours of $PM_{2.5}$ and 4 hours of PM_{10} BAM data invalidated during maintenance.
January 25, 2018	Quarterly calibration performed on MFC calibrator; instrument passed.
January 31, 2018	Quarterly calibrations performed on all gas analyzers; all instruments passed. Six hours of gas data invalidated during calibrations.
February 2 – 7, 2018	Snow and ice buildup on horizontal wind speed sensor. 113 hours of horizontal wind data invalidated.
February 3 – 7, 2018	Snow and ice buildup on vertical wind speed sensor. 84 hours of vertical wind data invalidated.
February 7, 2018	Daily average PM_{10} concentration less than -2 µg/m^3. 24 hours of BAM PM_{10} data invalidated.
February 14, 2018	Monthly QC checks performed on PM samplers. All instruments passed.
February 14 – 15, 2018	BAM communication problems. 16 hours of $PM_{2.5}$ and PM_{10} BAM data invalidated.
February 16 – 17, 2018	Snow and ice buildup on horizontal wind speed sensor. 19 hours of horizontal wind data invalidated.
February 18, 2018	$PM_{2.5}$ analyzer error. 11 hours of $PM_{2.5}$ BAM data invalidated.
March 14, 2018	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. Monthly QC checks performed on PM samplers. All instruments passed. 4 hours of $PM_{2.5}$ and PM_{10} BAM data invalidated during audit.

Date	Event
April 3, 2018	Station ozone transfer standard certification expired. Replacement certified transfer standard not available due to delays in recertification of SLR-owned primary standard.
April 7, 2018	Calibrations performed on the CO and SO_2 analyzers; all passed.
April 11, 2018	Independent performance audit of meteorological sensors, ambient air analyzers and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits. Monthly QC checks performed on PM samplers. All instruments passed. 7 hours of gas data, 4 hours of $PM_{2.5}$ and PM_{10} BAM data, and 5 hours of wind and temperature data invalidated during audit.
April 11-12, 2018	Quarterly calibrations performed on all gas and meteorological analyzers; all instruments passed.
May 14, 2018	Snow and ice buildup on vertical wind speed sensor. 8 hours of vertical wind data invalidated.
May 16, 2018	Monthly QC checks performed on PM samplers. All instruments passed.
May 26, 2018	Calibrations performed on the CO and SO_2 analyzers; all passed.
June 4, 2018	Snow and ice buildup on vertical wind speed sensor. 9 hours of vertical wind data invalidated.
June 5, 2018	SLR-owned primary ozone transfer standard received back from EPA certification. Replacement field transfer standard certified and sent to field to replace expired unit in service.
June 9, 2018	Calibrations performed on NO_X analyzer; analyzer passed. 5 hours of gas data invalidated during calibration.
June 12, 2018	Ozone transfer standard (serial number: 85) replaced (new serial number: 170). As found calibration verification performed on the O_3 analyzer; analyzer passed.
June 20, 2018	Calibrations performed on CO analyzer; analyzer passed. Monthly QC checks performed on PM samplers. All instruments passed.
June 28 – July 5, 2018	CO analyzer failure (serial number: 9130050). Analyzer replaced (serial number: CM09200034) on July 5, 2018. 166 hours of CO data lost and four hours of all other gas data invalidated July 5, 2018 during repair.
July 4, 2018	Monthly QC checks performed on PM samplers. All instruments passed. Four hours of $PM_{2.5}$ data invalidated during QC checks.
July 13 – 14, 2018	Shelter temperature standard deviation exceeded 2° C for the day. 48 hours of all gas data invalidated.
July 14 – 15, 2018	Shelter temperature exceeded 30° C. 27 hours of all gas data invalidated.
July 14 – 25, 2018	PM_{10} tape breakage. 274 hours of PM_{10} data invalidated.
July 18 – 25, 2018	$PM_{2.5}$ tape breakage. 173 hours of $PM_{2.5}$ data invalidated.
July 19 – August 1, 2018	The CO and NO_X analyzers failed precision checks on July 26, 2018. CO and NO_X data were invalidated back to the last passing check on July 19, 2018. The CO and NO_X analyzers were re-calibrated on August 1, 2018. 329 hours of CO and NO_X data invalidated in total. Four hours of SO_2 data invalidated July 26, 2018 and seven hours of SO_2 data invalidated August 1, 2018 during repairs to the CO and NO_X analyzers.

Date	Event
July 21 – 22, 2018	Shelter temperature standard deviation exceeded 2° C for the day. 48 hours of all gas data invalidated.
July 23, 2018	Shelter temperature exceeded 30° C. 18 hours of all gas data invalidated.
July 24 – 25, 2018	Shelter temperature standard deviation exceeded 2° C for the day. 48 hours of all gas data invalidated.
July 26, 2018	Shelter temperature exceeded 30° C. Four hours of all gas data invalidated.
July 26 – 27, 2018	PM_{10} tape breakage. 21 hours of PM_{10} data invalidated.
July 29 – 31, 2018	Shelter temperature exceeded 30° C. 72 hours of all gas data invalidated.
August 1, 2018	Leak checks performed on PM samplers; all passed.
August 2 – 3, 2018	PM_{10} tape breakage. 30 hours of PM_{10} data invalidated.
August 5 – 6, 2018	PM_{10} tape breakage. 25 hours of PM_{10} data invalidated.
August 6 – 9, 2018	PM_{10} tape breakage. 66 hours of PM_{10} data invalidated.
August 15, 2018	Calibrations performed on the CO analyzer; analyzer passed.
August 29, 2018	Monthly QC checks performed on PM samplers. All instruments passed.
September 19, 2018	Quarterly calibrations performed on all gas analyzers; all passed. Monthly QC checks performed on PM samplers. All instruments passed. Four hours of $PM_{2.5}$ data invalidated during checks.
September 21 – 22, 2018	Snow and ice buildup on the vertical wind sensor. 40 hours of vertical wind data invalidated.
September 22, 2018	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.
October 2, 2018	Calibrations performed on the CO and SO_2 analyzers; all passed.
October 3 – 4, 2018	Strong and dry conditions contributed to elevated PM_{10} concentrations from October 3rd, 2018 to October 4th, 2018 that did not exceed the NAAQS. No data were invalidated during this time.
October 16, 2018	Snow and ice buildup on the horizontal wind sensor. Seven hours of horizontal wind data invalidated.
October 23, 2018	Snow and ice buildup on the horizontal and vertical wind sensor. 18 hours of vertical wind data and 12 hours of horizontal wind data invalidated.
October 24, 2018	Monthly QC checks performed on PM samplers. All instruments passed.
October 30, 2018	Calibrations performed on all gas analyzers; all passed. Five hours of gas data invalidated during calibration.
October 31 – November 14, 2018	The 10m temperature aspirator fan failed following tower maintenance on October 31, 2018. The fan was replaced on November 14, 2018. No temperature data were invalidated during this time period. See Section 2.2 for more details.
November 9 – 10, 2018	Snow and ice buildup on the horizontal wind sensor. 16 hours of horizontal wind data invalidated.

Date	Event
November 14, 2018	Thermo 48i CO analyzer (serial number 9200034) replaced with API T300 analyzer (serial number 3956) and calibrated; analyzer passed. Six hours of CO data and four hours of other gas data invalidated during replacement. Shelter temperature check was performed and passed. Monthly QC checks performed on PM samplers. All instruments passed.
November 17, 2018	Calibrations performed on the CO analyzer; analyzer passed.
November 25, 2018	Calibrations performed on the NO_X, SO_2, and CO analyzers; all passed. Five hours of gas data invalidated during calibration.
December 4, 2018	Monthly QC checks performed on PM samplers. All instruments passed.
December 6, 2018	Quarterly calibrations performed by SLR and independent performance audit of meteorological sensors, ambient air analyzers and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits. Monthly QC checks performed on PM samplers. All instruments passed. 16 hours of gas data and six hours of wind and temperature data invalidated during audit. API 200U NO_X analyzer (serial number 194) replaced with Thermo 42i analyzer (serial number 0705820942) and calibrated; analyzer passed.
December 7 – 9, 2018	Snow and ice buildup on the horizontal wind sensor. 52 hours of horizontal wind data invalidated.
December 8, 2018	Calibrations performed on the NO_X analyzer; analyzer passed. Five hours of gas data invalidated during calibration.
December 13, 2018	Calibrations performed on the NO_X analyzer; analyzer passed.
December 18, 2018	Calibrations performed on the NO_X and CO analyzers; analyzers passed.
December 23 – 24, 2018	Snow and ice buildup on the horizontal wind sensor. 26 hours of horizontal wind data invalidated.
December 26, 2018	Daily average PM_{10} concentration less than -2 µg/m^3. 24 hours of BAM PM_{10} data invalidated.
December 31, 2018	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.

Periods of 4 or fewer records that were invalidated are considered to be due to routine operations and maintenance activities and are generally not described in detail. Events impacting larger periods of time are described above in Table 2-1: Chronology of Significant Events. Additionally, those events meriting more detailed explanation of data validation decisions are as follows:

The horizontal wind speed data were periodically invalidated due to ice accumulation January 9, January 11 – 13, February 2 – 7, and February 16 – 17, 2018. A total of 184 hours of horizontal wind data were invalidated during the first quarter.

Vertical wind speed data were periodically invalidated due to ice accumulation on the sensor January 11 – 12, and February 3 – 7, 2018. A total of 97 hours of vertical wind data were invalidated during the first quarter.

Manufacturer specifications for $PM_{2.5}$ and 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 January 11 and February 7, 2018. A total of 48 hours of PM_{10} data were invalidated during the first quarter.

The $PM_{2.5}$ BAM analyzer experienced periodic communication and flow errors January 13 through January 24, 2018. The analyzer was repaired and recalibrated on January 24, 2018; calibrations passed. A total of 277 hours of $PM_{2.5}$ BAM data were invalidated January 13 – 24, 2018. Ten hours of $PM_{2.5}$ BAM data and four hours of PM_{10} BAM data were invalidated during the maintenance on January 24, 2018.

Quarterly calibrations were performed on all gas analyzers January 31, 2018; all instruments passed. Six hours of gas data were invalidated during calibrations.

The $PM_{2.5}$ and PM_{10} BAM analyzers experienced communication problems February 14 – 15, 2018. 16 hours of $PM_{2.5}$ and PM_{10} BAM data were invalidated.

11 hours of $PM_{2.5}$ BAM data were invalidated February 18, 2018 due to an analyzer error.

Independent performance audit of ambient air analyzers and PM samplers was conducted by AMS Tech, LLC on March 14, 2018. All instruments were found to be operating within EPA PSD measurement quality limits. Four hours of $PM_{2.5}$ and PM_{10} BAM data were invalidated during the audit.

An independent performance audit of ambient air analyzers, PM samplers, and meteorological sensors was conducted by AMS Tech, LLC on April 11, 2018. All instruments were found to be operating within EPA PSD measurement quality limits. Seven hours of gas data, four hours of $PM_{2.5}$ and PM_{10} BAM data, and five hours of wind and temperature data invalidated during the audit.

Vertical wind speed data were periodically invalidated due to ice accumulation on the sensor May 14, and June 4, 2018. A total of 17 hours of vertical wind data were invalidated during the second quarter.

Five hours of gas data were invalidated June 9, 2018 during calibrations on the NO_X analyzer; calibration passed.

The CO analyzer failed on June 28, 2018 and was replaced on July 5, 2018. 166 hours of CO data lost from June 28 – July 5, 2018 and four hours of all other gas data invalidated July 5, 2018 during analyzer repair.

Four hours of $PM_{2.5}$ data were invalidated during QC checks on July 4, 2018 and four hours were invalidated during QC checks on September 19, 2018.

The shelter temperature standard deviation exceeded 2° C for the day on July 13, 14, 21, 22, 24, and 25, 2018. A total of 144 hours of all gas data invalidated.

The shelter temperature exceeded 30° C periodically on July 14 – 15, 23, 26, and July 29 – 31, 2018. A total of 121 hours of all gas data invalidated.

The $PM_{2.5}$ and PM_{10} BAM analyzers experienced frequent tape breakage errors during the third quarter. $PM_{2.5}$ data were invalidated July 18 – 25, 2018 and the PM_{10} data were invalidated July 14 – 25, July 26 – 27, August 2 – 3, August 5 – 6, and August 6 – 9, 2018 due to tape errors. A total of 173 hours of $PM_{2.5}$ data and hours of 416 hours of PM_{10} data lost during the third quarter. Due to the data loss, DQOs were not met for PM_{10} for the third quarter.

The CO and NO_X analyzers failed precision checks on July 26, 2018. CO and NO_X data were invalidated back to the last passing check on July 19, 2018. The CO and NO_X analyzers were re-calibrated on August 1, 2018. 329 hours of CO and NO_X data invalidated in total. Seven hours of SO_2 data invalidated August 1, 2018 during repairs to the CO and NO_X analyzers. Due to the data loss, CO did not meet DQOs during the third quarter.

Vertical wind speed data were periodically invalidated due to ice accumulation on the sensor September 21 – 22, 2018. A total of 40 hours of vertical wind data invalidated during the third quarter.

Horizontal wind speed data were periodically invalidated due to ice accumulation October 16, October 23, November 9 – 10, December 7 – 9, and December 23 – 24, 2018. A total of 113 hours of horizontal wind data were invalidated during the fourth quarter. Despite the data loss, DQOs for horizontal wind were met during the fourth quarter.

Vertical wind speed data were periodically invalidated due to ice accumulation on the sensor October 23, 2018. A total of 18 hours of vertical wind data invalidated during the fourth quarter.

Five hours of gas data were invalidated October 30, 2018 during NO_X, SO_2, and CO calibrations.

The 10-meter temperature aspirator fan failed after tower maintenance to remove ice on October 31, 2018 at 1400. The proper working of the aspirator fan is an operational criterion. According to EPA's "QA Handbook for Air Pollution Measurement Systems: Volume II" (EPA-454/B-17-001), data that fail to meet one or more operational criteria are suspect unless other quality control information demonstrates otherwise and is documented. Therefore, further tests were performed and documented to determine whether temperature data were affected in any way due to the failure of the aspirator fan. On November 14, 2018, an SLR technician brought the 10-meter elevator down to 2 meters so that the temperature sensors were at the same level and placed a calibration temperature probe inside the 10-meter aspirator casing. Temperatures from the 2-meter, 10-meter, and calibration probes were recorded at 15-minute intervals over a 2-hour period during maximum sunlight. The maximum absolute difference between the 2-meter and 10-meter temperature sensors was 0.48°C and the maximum absolute difference between the 10-meter sensors and the calibration probe was 0.07°C. These results are well within the 0.50°C calibration and audit standard. It was concluded that, since solar radiation is near a minimum during this time of the year (maximum solar radiation was 67 w/m^2 during the October 31 – November 14, 2018 time period), aspiration does not cause an appreciable effect on temperature during the brief daylight hours. This quality control test indicated that data within acceptable parameters of error were still being collected and as a result, no temperature data were invalidated during this time period.

Thermo 48i CO analyzer (serial number 9200034) replaced with API T300 analyzer (serial number 3956) and calibrated on November 14, 2018; analyzer passed. Six hours of CO data and four hours of other gas data invalidated during replacement.

Quarterly calibrations performed by SLR and independent performance audit of meteorological sensors, ambient air analyzers and PM samplers conducted by AMS Tech, LLC on December 6, 2018. All instruments were found to be operating within EPA PSD measurement quality limits. The API 200U NO_X analyzer (serial number 194) was replaced with Thermo 42i analyzer (serial number 0705820942) and calibrated; analyzer passed.16 hours of gas data and six hours of wind and temperature data invalidated during maintenance and audit.

Five hours of gas data were invalidated December 8, 2018 during NO_X calibrations.

24 hours of PM_{10} data invalidated December 26, 2018 due to 24-hour average concentrations less than -2 µg/m^3.

Table 2-2: Percentage of Final Data Set Flagged

Parameter	Flagging Criteria[(1)]	Percent Flagged
Wind Speed	Value is < 0 m/s	0.0%
	Value is > 25 m/s	0.0%
	< 0.1 m/s variation for 3 consecutive hours	2.1%
	< 0.5 m/s variation for 12 consecutive hours	0.8%
Wind Direction	Value is < 0°, > 360°	0.0%
	< 1° variation over 3 consecutive hours	0.0%
	< 10° variation over 18 consecutive hours	3.1%
Temperature (2 meters)	> 5°C variation from previous hour	0.1%
	< 0.5°C variation for 12 consecutive hours	0.5%
	Value is > record high, < record low	0.0%
Temperature (10 meters)	> 5°C variation from previous hour	0.1%
	< 0.5°C variation for 12 consecutive hours	0.6%
	Value is > record high, < record low	0.0%
Temperature Difference, ΔT	Value is > 0.8°C during the daytime	0.4%
	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	1.4%
	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 with the exception of CO and PM_{10} during the third quarter.

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

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	98%	98%	98%	98%	61% [3]	97%
February	99%	99%	99%	99%	89%	89%
March	98%	98%	98%	98%	100%	100%
1st Quarter	**99%**	**99%**	**99%**	**99%**	**83%**	**96%**
April	98%	98%	98%	98%	100%	100%
May	99%	99%	99%	99%	100%	100%
June	98%	98%	98%	90%	100%	100%
2nd Quarter	**98%**	**98%**	**98%**	**95%**	**100%**	**100%**
July	48% [4]	63% [5]	63% [5]	34% [6]	74% [7]	55% [8]
August	96%	98%	99%	96%	100%	77% [8]
September	98%	98%	98%	98%	100%	100%
3rd Quarter	**80%**	**86%**	**86%**	76% [6]	**91%**	77% [8]
October	98%	98%	98%	98%	100%	100%
November	98%	98%	98%	97%	100%	100%
December	95%	95%	95%	95%	100%	97%
4th Quarter	**97%**	**97%**	**97%**	**97%**	**100%**	**99%**
Annual	**94%**	**95%**	**95%**	**92%**	**94%**	**93%**

[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] $PM_{2.5}$ data invalidated in January 2018 due to communication and sampler flow errors. Despite the data loss, DQOs were met for the first quarter.
[4] The NO_X analyzer failed its precision check on July 26, 2018. NO_X data were invalidated back to the last passing calibration on July 19, 2018 and the analyzer was recalibrated August 1, 2018. Despite the data loss, DQOs were met for the quarter.
[5] All gas data were invalidated for occasional shelter temperatures that exceeded 30° C or deviated by more than 2°C over 24 hours during the month of July 2018.
[6] The CO analyzer experienced a failure at the end of June 2018 and was repaired July 5, 2018. In addition, the CO analyzer failed its precision check on July 26, 2018. CO data were invalidated back to the last passing calibration on July 19, 2018 and the analyzer was recalibrated August 1, 2018. Due to the combined data loss, DQOs for CO were not met for the third monitoring quarter.
[7] $PM_{2.5}$ data were invalidated in July 2018 due to tape break errors.
[8] PM_{10} data were invalidated frequently in July and August 2018 due to tape break errors. Due to the data loss, DQOs for PM_{10} were not met for the third 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	98%	98%	93%	93%	93%	100%	100%	100%	100%
February	88% [2]	88% [2]	80% [2]	80% [2]	80% [2]	100%	100%	100%	100%
March	100%	100%	100%	100%	100%	100%	100%	100%	99%
1st Quarter	**95%**	**95%**	**91%**	**91%**	**91%**	**100%**	**100%**	**100%**	**100%**
April	99%	99%	99%	99%	99%	99%	99%	99%	99%
May	99%	99%	100%	100%	100%	100%	100%	100%	100%
June	99%	99%	100%	100%	100%	100%	100%	100%	100%
2nd Quarter	**99%**	**99%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
July	100%	100%	100%	100%	100%	100%	100%	100%	100%
August	100%	100%	100%	100%	100%	100%	100%	100%	100%
September	94%	94%	100%	100%	100%	100%	100%	100%	100%
3rd Quarter	**98%**	**98%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
October	97%	97%	97%	97%	97%	100%	100%	100%	100%
November	100%	100%	97%	97%	97%	100%	100%	100%	99%
December	99%	99%	89% [3]	89% [3]	89% [3]	99%	99%	99%	100%
4th Quarter	**99%**	**99%**	**94%**	**94%**	**94%**	**100%**	**100%**	**100%**	**100%**
Annual	**98%**	**98%**	**96%**	**96%**	**96%**	**100%**	**100%**	**100%**	**100%**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Horizontal and vertical wind speed data invalidated due to snow and ice buildup on the sensors February 2018. Despite the data loss, DQOs were met for the first quarter.
[3] Horizontal wind data invalidated due to snow and ice buildup on the sensors December 2018. Despite the data loss, DQOs were met for 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, NO_2, O_3, and SO_2) were collected at least once every two weeks, meeting the critical validation criteria outlined in the monitoring program QAPP. Quarterly precision statistics for each criteria pollutant are provided in Tables 2-5 through 2-20.

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, $PM_{2.5}$ 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]
1/4/2018	8.2	8.0	2.4	15	1.78	2.05	5.80	-2.24	2.75
1/11/2018	8.2	8.0	3.0						
1/18/2018	8.3	8.0	3.6						
1/25/2018	8.3	8.0	4.2						
1/31/2018 [2]	8.3	8.0	3.6						
1/31/2018 [3]	7.9	8.0	-1.6						
2/1/2018	7.9	8.0	-0.7						
2/8/2018	8.0	8.0	0.3						
2/15/2018	7.9	8.0	-0.9						
2/22/2018	7.9	8.0	-1.3						
3/1/2018	8.1	8.0	1.8						
3/13/2018	8.2	8.0	2.9						
3/15/2018	8.2	8.0	2.4						
3/22/2018	8.3	8.0	4.1						
3/29/2018	8.2	8.0	2.8						

[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]
4/5/2018	8.4	8.0	4.7	22	1.23	1.77	4.71	-2.24	2.23
4/7/2018 [2]	8.3	8.0	3.8						
4/7/2018 [3]	7.9	8.0	-0.8						
4/12/2018	8.0	8.0	0.4						
4/12/2018	8.0	8.0	0.2						
4/19/2018	8.1	8.0	0.8						
4/26/2018	8.1	8.0	0.9						
5/3/2018	8.1	8.0	1.4						
5/10/2018	8.1	8.0	1.6						
5/17/2018	8.1	8.0	1.6						
5/24/2018	8.2	8.0	2.2						
5/26/2018 [2]	8.2	8.0	2.6						
5/26/2018 [3]	8.0	8.0	0.4						
5/31/2018	8.0	8.0	-0.2						
6/7/2018	8.0	8.0	-0.3						
6/9/2018 [2]	8.0	8.0	-0.4						
6/9/2018 [3]	8.0	8.0	-0.4						
6/14/2018	8.0	8.0	0.0						
6/20/2018 [2]	7.9	8.0	-1.3						
6/20/2018 [3]	8.2	8.0	2.1						
6/21/2018	8.2	8.0	2.7						
6/28/2018	8.4	8.0	5.3						

[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]
7/4/2018	7.4	8.0	-7.0	20	1.82	4.25	10.15	-6.51	5.43
7/5/2018 [2]	- [4]	- [4]	- [4]						
7/5/2018 [3]	7.9	8.0	-1.4						
7/12/2018	8.2	8.0	2.7						
7/19/2018	8.7	8.0	8.5						
7/26/2018	8.9 [5]	8.0 [5]	11.7 [5]						
8/1/2018 [2]	7.9	8.0	-1.3						
8/1/2018 [3]	7.9	8.0	-1.1						
8/2/2018	8.0	8.0	-0.1						
8/9/2018	8.3	8.0	4.0						
8/15/2018 [2]	8.6	8.0	7.7						
8/15/2018 [3]	7.9	8.0	-1.9						
8/16/2018	7.9	8.0	-1.6						
8/23/2018	8.1	8.0	1.1						
8/30/2018	8.3	8.0	3.6						
9/6/2018	8.4	8.0	4.5						
9/10/2018	8.0	8.0	-0.5						
9/13/2018	8.0	8.0	-0.1						
9/18/2018	8.1	8.0	1.1						
9/20/2018	8.2	8.0	2.2						
9/27/2018	8.3	8.0	4.3						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.
[4] The CO analyzer (serial number: 9130050) failed on June 28, 2018 and was replaced with serial number: CM09200034. Valid data collection began on July 5, 2018. The July 4 precision check was collected using CM0920034.
[5] The CO analyzer failed the precision check on July 26, 2018. CO data invalidated back to last passing calibration on July 19, 2018 and the analyzer was recalibrated August 1, 2018. See Section 2.2 for more information.

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]
10/2/2018 [2]	8.5	8.0	5.7	30	-1.36	3.05	4.62	-7.34	3.69
10/2/2018 [3]	8.0	8.0	-0.1						
10/4/2018	8.0	8.0	0.4						
10/11/2018	8.2	8.0	2.0						
10/18/2018	8.2	8.0	3.0						
10/25/2018	8.4	8.0	4.7						
10/30/2018 [2]	8.5	8.0	6.0						
10/30/2018 [3]	7.9	8.0	-1.6						
11/1/2018	7.9	8.0	-1.4						
11/8/2018	8.0	8.0	-0.3						
11/14/2018 [2]	8.1	8.0	1.6						
11/14/2018 [3]	7.7	8.0	-3.4						
11/15/2018	7.6	8.0	-5.0						
11/17/2018 [2]	7.5	8.0	-6.0						
11/17/2018 [3]	7.9	8.0	-1.8						
11/22/2018	7.8	8.0	-2.8						
11/25/2018 [2]	7.7	8.0	-3.3						
11/25/2018 [3]	7.9	8.0	-1.7						
11/29/2018	7.8	8.0	-2.7						
12/6/2018	7.7	8.0	-3.5						
12/6/2018 [2]	7.7	8.0	-3.7						
12/6/2018 [3]	7.8	8.0	-2.3						
12/8/2018 [2]	7.8	8.0	-2.3						
12/8/2018 [3]	7.8	8.0	-2.8						
12/13/2018 [2]	7.8	8.0	-3.0						
12/13/2018 [3]	7.7	8.0	-3.3						
12/18/2018 [2]	7.7	8.0	-4.0						
12/18/2018 [3]	7.8	8.0	-3.0						
12/20/2018	7.7	8.0	-3.3						
12/27/2018	7.8	8.0	-3.1						

[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]
1/4/2018	78.5	80.0	-1.9	15	0.70	2.21	5.04	-3.64	2.97
1/11/2018	78.8	80.0	-1.5						
1/18/2018	77.8	80.0	-2.8						
1/25/2018	81.1	80.0	1.4						
1/31/2018 [2]	79.1	80.0	-1.1						
1/31/2018 [3]	82.3	80.0	2.9						
2/1/2018	83.8	80.0	4.8						
2/8/2018	83.5	80.0	4.4						
2/15/2018	81.2	80.0	1.5						
2/22/2018	80.2	80.0	0.3						
3/1/2018	81.4	80.0	1.8						
3/13/2018	79.2	80.0	-1.0						
3/15/2018	80.9	80.0	1.1						
3/22/2018	79.6	80.0	-0.5						
3/29/2018	81.0	80.0	1.3						

[1] Acceptance criteria: ≤ 15%
[2] As-found; pre-calibration.
[3] 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]
4/5/2018	78.5	80.0	-1.9	16	-2.83	2.08	1.26	-6.91	2.76
4/12/2018	78.8	80.0	-1.5						
4/12/2018	78.2	80.0	-2.3						
4/19/2018	79.4	80.0	-0.8						
4/26/2018	76.7	80.0	-4.1						
5/3/2018	77.9	80.0	-2.6						
5/10/2018	77.2	80.0	-3.5						
5/17/2018	76.2	80.0	-4.8						
5/24/2018	76.4	80.0	-4.5						
5/31/2018	75.7	80.0	-5.4						
6/7/2018	75.4	80.0	-5.8						
6/9/2018 [2]	75.1	80.0	-6.1						
6/9/2018 [3]	79.0	80.0	-1.3						
6/14/2018	80.3	80.0	0.4						
6/21/2018	80.0	80.0	0.0						
6/28/2018	79.0	80.0	-1.3						

[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]
7/5/2018	78.8	80.0	-1.5	15	-0.51	4.17	7.66	-8.67	5.58
7/12/2018	76.6	80.0	-4.3						
7/19/2018	74.0	80.0	-7.5						
7/26/2018	**70.8** [4]	**80.0** [4]	**-11.5** [4]						
8/1/2018 [2]	**-** [4]	**-** [4]	**-** [4]						
8/1/2018 [3]	80.2	80.0	0.3						
8/2/2018	81.5	80.0	1.9						
8/9/2018	81.2	80.0	1.5						
8/16/2018	80.6	80.0	0.8						
8/23/2018	81.0	80.0	1.3						
8/30/2018	81.2	80.0	1.5						
9/6/2018	80.7	80.0	0.9						
9/13/2018	80.7	80.0	0.9						
9/18/2018	81.7	80.0	2.1						
9/20/2018	83.4	80.0	4.3						
9/27/2018	81.5	80.0	1.9						

[1] Acceptance criteria: ≤ 15%
[2] As-found; pre-calibration.
[3] As-left; post calibration.
[4] The NO_X analyzer failed the precision check on July 26, 2018. NO_X data invalidated back to last passing calibration on July 19, 2018 and the analyzer was recalibrated August 1, 2018. See Section 2.2 for more information.

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]
10/4/2018	82.2	80.0	2.8	24	2.80	4.63	11.87	-6.27	5.76
10/11/2018	83.2	80.0	4.0						
10/18/2018	83.8	80.0	4.8						
10/25/2018	83.3	80.0	4.1						
10/30/2018 [2]	87.3	80.0	9.1						
10/30/2018 [3]	81.6	80.0	2.0						
11/1/2018	81.1	80.0	1.4						
11/8/2018	80.9	80.0	1.1						
11/15/2018	85.9	80.0	7.4						
11/22/2018	84.4	80.0	5.5						
11/25/2018 [2]	86.4	80.0	8.0						
11/25/2018 [3]	81.2	80.0	1.5						
11/29/2018	80.4	80.0	0.5						
12/6/2018	79.7	80.0	-0.4						
12/6/2018 [2]	79.2	80.0	-1.0						
12/6/2018 [3]	78.5	80.0	-1.9						
12/8/2018 [2]	70.4	80.0	-12.0						
12/8/2018 [3]	79.2	80.0	-1.0						
12/13/2018 [2]	85.5	80.0	6.9						
12/13/2018 [3]	85.4	80.0	6.8						
12/18/2018 [2]	88.4	80.0	10.5						
12/18/2018 [3]	80.6	80.0	0.8						
12/20/2018	81.9	80.0	2.4						
12/27/2018	83.3	80.0	4.1						

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

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]
1/4/2018	83.9	80.0	4.9	15	2.55	2.05	6.57	-1.47	2.75
1/11/2018	84.4	80.0	5.5						
1/18/2018	84.2	80.0	5.2						
1/25/2018	84.3	80.0	5.4						
1/31/2018 [2]	84.3	80.0	5.4						
1/31/2018 [3]	81.0	80.0	1.2						
2/1/2018	81.2	80.0	1.5						
2/8/2018	80.5	80.0	0.6						
2/15/2018	80.8	80.0	1.0						
2/22/2018	81.5	80.0	1.9						
3/1/2018	80.1	80.0	0.1						
3/13/2018	81.2	80.0	1.5						
3/15/2018	81.3	80.0	1.7						
3/22/2018	81.0	80.0	1.2						
3/29/2018	80.9	80.0	1.1						

[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]
4/5/2018 [2]	80.8	80.0	1.0	15	1.62	0.75	3.10	0.15	1.01
4/12/2018 [2]	81.6	80.0	2.0						
4/12/2018 [2]	81.8	80.0	2.2						
4/19/2018 [2]	81.7	80.0	2.1						
4/26/2018 [2]	80.9	80.0	1.2						
5/3/2018 [2]	81.5	80.0	1.9						
5/10/2018 [2]	80.7	80.0	0.9						
5/17/2018 [2]	81.5	80.0	1.8						
5/24/2018 [2]	80.6	80.0	0.8						
5/31/2018 [2]	81.9	80.0	2.4						
6/7/2018 [2]	81.5	80.0	1.9						
6/12/2018	82.0	80.0	2.5						
6/14/2018	81.9	80.0	2.4						
6/21/2018	81.3	80.0	1.6						
6/28/2018	79.8	80.0	-0.2						

[1] Acceptance criteria: ≤ 7%

[2] Precision verification conducted with expired ozone transfer standard due to delay in receiving primary ozone reference standard from EPA. "As-found" calibration verification conducted on 6/12/2018 demonstrated that instrument accuracy was unaffected despite the transfer standard certification being expired. Data were determined to remain valid despite the procedural deviation.

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]
7/5/2018	80.3	80.0	0.4	15	2.86	1.34	5.48	0.24	1.79
7/12/2018	82.6	80.0	3.3						
7/19/2018	80.9	80.0	1.2						
7/26/2018	81.8	80.0	2.3						
8/2/2018 [2]	80.8	80.0	1.0						
8/2/2018 [3]	82.8	80.0	3.5						
8/9/2018	83.8	80.0	4.7						
8/16/2018	84.0	80.0	5.0						
8/23/2018	83.3	80.0	4.1						
8/30/2018	82.2	80.0	2.8						
9/6/2018	82.6	80.0	3.3						
9/13/2018	83.0	80.0	3.8						
9/19/2018	82.4	80.0	3.0						
9/20/2018	81.5	80.0	1.9						
9/27/2018	82.3	80.0	2.8						

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

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]
10/4/2018	83.7	80.0	4.6	16	3.84	0.96	5.72	1.95	1.28
10/11/2018	82.8	80.0	3.5						
10/18/2018	82.8	80.0	3.5						
10/25/2018	82.8	80.0	3.5						
10/30/2018	83.5	80.0	4.4						
11/1/2018	82.8	80.0	3.5						
11/8/2018	82.6	80.0	3.2						
11/15/2018	82.2	80.0	2.7						
11/22/2018	84.0	80.0	5.0						
11/29/2018	81.6	80.0	1.9						
12/6/2018 [2]	83.7	80.0	4.6						
12/6/2018 [3]	82.7	80.0	3.3						
12/8/2018	83.8	80.0	4.8						
12/13/2018	82.9	80.0	3.7						
12/20/2018	82.7	80.0	3.3						
12/27/2018	84.7	80.0	5.9						

[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]
1/4/2018	80.3	78.0	2.9	15	0.72	1.02	2.72	-1.29	1.37
1/11/2018	78.9	78.0	1.2						
1/18/2018	78.2	78.0	0.3						
1/25/2018	78.2	78.0	0.3						
1/31/2018 [2]	79.7	78.2	1.9						
1/31/2018 [3]	77.9	78.4	-0.6						
2/1/2018	78.1	78.0	0.1						
2/8/2018	77.1	78.0	-1.1						
2/15/2018	78.0	78.0	0.1						
2/22/2018	78.8	78.0	1.0						
3/1/2018	78.5	78.0	0.6						
3/13/2018	79.2	78.0	1.6						
3/15/2018	78.1	78.0	0.2						
3/22/2018	78.8	78.0	1.1						
3/29/2018	79.1	78.0	1.4						

[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]
4/5/2018	78.8	78.0	1.1	22	0.19	1.11	2.37	-1.99	1.40
4/7/2018 [2]	78.5	78.0	0.6						
4/7/2018 [3]	78.0	78.0	0.0						
4/12/2018	77.7	78.0	-0.4						
4/12/2018	78.8	78.2	0.8						
4/19/2018	77.9	78.0	-0.1						
4/26/2018	78.9	78.0	1.1						
5/3/2018	78.3	78.0	0.4						
5/10/2018	77.8	78.0	-0.2						
5/17/2018	79.6	78.0	2.1						
5/24/2018	78.9	78.0	1.1						
5/26/2018 [2]	79.2	78.0	1.5						
5/26/2018 [3]	78.1	78.0	0.1						
5/31/2018	76.8	78.0	-1.5						
6/7/2018	77.6	78.0	-0.5						
6/9/2018 [2]	76.4	78.2	-2.2						
6/9/2018 [3]	77.7	78.2	-0.7						
6/14/2018	77.0	78.0	-1.3						
6/20/2018 [2]	77.8	78.0	-0.2						
6/20/2018 [3]	78.3	78.0	0.4						
6/21/2018	77.9	78.0	-0.2						
6/28/2018	79.8	78.0	2.3						

[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]
7/4/2018	79.0	78.0	1.3	21	1.13	1.38	3.83	-1.58	1.75
7/5/2018	78.5	78.0	0.6						
7/12/2018	78.6	78.0	0.8						
7/19/2018	80.3	78.0	3.0						
7/26/2018 [2]	80.4	78.0	3.1						
7/26/2018 [3]	79.8	78.5	1.6						
8/1/2018 [2]	75.9	78.3	-3.0						
8/1/2018 [3]	79.0	78.3	0.8						
8/2/2018	77.4	78.0	-0.8						
8/9/2018	78.6	78.0	0.7						
8/15/2018 [2]	79.0	78.0	1.3						
8/15/2018 [3]	77.9	78.0	-0.1						
8/16/2018	79.5	78.0	1.9						
8/23/2018	78.6	78.0	0.7						
8/30/2018	78.6	78.0	0.7						
9/6/2018	79.4	78.0	1.8						
9/10/2018	79.9	78.0	2.4						
9/13/2018	80.2	78.0	2.8						
9/18/2018	78.9	78.4	0.7						
9/20/2018	78.9	78.0	1.1						
9/27/2018	79.7	78.0	2.2						

[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]
10/2/2018 [2]	80.6	78.0	3.3	30	0.50	1.11	2.93	-1.93	1.50
10/2/2018 [3]	79.2	78.0	1.5						
10/4/2018	78.4	78.0	0.5						
10/11/2018	78.3	78.0	0.4						
10/18/2018	79.6	78.0	2.1						
10/25/2018	79.5	78.0	1.9						
10/30/2018 [2]	79.4	78.0	1.8						
10/30/2018 [3]	79.2	78.0	1.5						
11/1/2018	78.4	78.0	0.5						
11/8/2018	78.6	78.0	0.8						
11/14/2018 [2]	77.8	78.0	-0.2						
11/14/2018 [3]	77.8	78.0	-0.2						
11/15/2018	77.7	78.0	-0.4						
11/17/2018 [2]	78.4	78.0	0.5						
11/17/2018 [3]	78.1	78.0	0.2						
11/22/2018	78.8	78.0	1.1						
11/25/2018 [2]	77.0	78.0	-1.3						
11/25/2018 [3]	77.5	78.0	-0.6						
11/29/2018	78.3	78.0	0.4						
12/6/2018	79.1	78.0	1.4						
12/6/2018 [2]	78.0	78.0	0.0						
12/6/2018 [3]	79.7	78.0	2.2						
12/8/2018 [2]	78.6	78.0	0.8						
12/8/2018 [3]	78.3	78.0	0.4						
12/13/2018 [2]	77.5	78.0	-0.6						
12/13/2018 [3]	77.9	78.0	-0.2						
12/18/2018 [2]	76.8	78.0	-1.5						
12/18/2018 [3]	77.6	78.0	-0.5						
12/20/2018	77.3	78.0	-0.9						
12/27/2018	78.2	78.0	0.2						

[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] ($\mu g/m^3$)	Precision [3] (%CV)
1st Quarter (January 1 – March 31)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	54	-9.3	18.9	15.3
2nd Quarter (April 1 – June 30)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	61	15.4	20.0	16.1
3rd Quarter (July 1 – September 30)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	7	-0.2	23.2	27.0
4th Quarter (October 1 – December 31)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	44	-33.0	17.1	14.1
Year to Date	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	166	-6.1	26.90	20.49

[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 2-39 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 2-25 include calibration statistical summaries for CO, NO_2, O_3, and SO_2 analyzers, respectively. Tables 2-26 and 2-27 summarize the 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 Tables 2-28 through 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]
1/31/2018	0.0	0.0	-	2.01%	0.9725	0.1185	0.9999	PASS
	8.1	7.9	-1.8%					
	17.5	17.3	-1.4%					
	30.0	29.6	-1.2%					
	40.0	39.0	-2.5%					
	45.0	43.6	-3.0%					
4/7/2018	0.0	0.0	-	1.75%	0.9726	0.1386	0.9999	PASS
	8.0	7.9	-0.6%					
	17.5	17.3	-1.5%					
	30.0	29.6	-1.4%					
	40.0	39.1	-2.4%					
	45.0	43.7	-2.9%					
4/12/2018	0.0	0.1	-	1.00%	0.9774	0.2289	0.9998	PASS
	8.0	8.0	0.1%					
	17.5	17.4	-0.6%					
	30.0	29.9	-0.3%					
	40.0	39.4	-1.6%					
	45.0	43.9	-2.4%					
5/26/2018	0.0	0.0	-	0.97%	0.9801	0.1749	0.9998	PASS
	8.0	8.0	0.5%					
	17.5	17.5	-0.2%					
	30.0	29.9	-0.3%					
	40.0	39.3	-1.7%					
	45.0	44.1	-2.1%					
6/20/2018	0.0	0.1	-	1.05%	1.0003	0.1862	0.9999	PASS
	8.1	8.2	1.3%					
	17.5	17.8	1.7%					
	30.0	30.5	1.7%					
	40.0	40.2	0.5%					
	45.0	45.0	-0.1%					

[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)]
7/5/2018	0.0	0.2	-	5.67%	0.9479	0.0180	0.9999	PASS
	8.1	7.4	-7.6%					
	17.5	16.5	-5.8%					
	30.0	28.6	-4.6%					
	40.0	38.0	-4.9%					
	45.0	42.6	-5.4%					
7/26/2018	0.0	0.8	-	5.77%	1.0184	0.7822	0.9999	PASS
	8.1	8.9	10.4%					
	17.5	18.6	6.1%					
	30.0	31.6	5.3%					
	40.0	41.5	3.7%					
	45.0	46.5	3.3%					
8/1/2018	0.0	0.1	-	1.17%	0.9800	0.1543	0.9999	PASS
	8.0	8.0	-0.3%					
	17.5	17.3	-1.2%					
	30.0	29.8	-0.6%					
	40.0	39.3	-1.7%					
	45.0	44.1	-2.0%					
8/15/2018	0.0	0.1	-	2.19%	0.9743	0.0743	0.9999	PASS
	8.1	8.2	1.3%					
	17.5	17.8	1.7%					
	30.0	30.5	1.7%					
	40.0	40.2	0.5%					
	45.0	45.0	-0.1%					
9/19/2018	0.0	0.0	-	0.67%	0.9969	0.1180	0.9999	PASS
	8.0	8.1	1.2%					
	17.5	17.6	0.6%					
	30.0	30.3	1.0%					
	40.0	40.0	-0.1%					
	45.0	44.8	-0.4%					

[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]
10/2/2018	0.0	0.0	-	0.65%	0.9895	0.1001	0.9999	PASS
	8.1	8.0	-0.8%					
	17.5	17.5	-0.1%					
	30.0	30.1	0.2%					
	40.0	39.7	-0.7%					
	45.0	44.4	-1.3%					
10/30/2018	0.0	0.0	-	1.34%	0.9805	0.1018	0.9999	PASS
	8.0	7.9	-1.1%					
	17.5	17.3	-1.1%					
	30.0	29.8	-0.6%					
	39.9	39.3	-1.6%					
	45.0	44.0	-2.3%					
11/14/2018 – As Found [2]	0.0	0.1	-	0.88%	0.9856	0.2500	0.9999	PASS
	8.0	8.1	1.3%					
	17.5	17.6	0.4%					
	30.0	30.1	0.5%					
	40.0	39.6	-0.9%					
	45.0	44.4	-1.3%					
11/14/2018 – As Left [2]	0.0	-0.1	-	0.99%	1.0061	-0.2172	1.0000	PASS
	8.0	7.7	-3.2%					
	17.5	17.3	-1.0%					
	30.0	30.0	-0.1%					
	40.0	39.9	-0.1%					
	45.0	45.2	0.4%					
11/17/2018	0.0	0.0	-	0.68%	1.0035	-0.1272	1.0000	PASS
	8.0	7.9	-1.6%					
	17.5	17.3	-1.0%					
	30.0	29.9	-0.4%					
	40.0	40.0	0.0%					
	45.0	45.2	0.3%					

[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

[2] Thermo 48i CO analyzer serial number 9200034 replaced with API T300 serial number 3956 on November 14, 2018.

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]
11/25/2018	0.0	0.0	-	0.56%	1.0051	-0.1119	1.0000	PASS
	8.0	7.9	-1.1%					
	17.5	17.4	-0.6%					
	30.0	29.9	-0.3%					
	40.0	40.1	0.2%					
	45.0	45.3	0.6%					
12/6/2018	0.0	0.0	-	1.01%	0.9985	-0.1048	1.0000	PASS
	8.1	7.8	-3.2%					
	17.5	17.4	-0.6%					
	30.0	29.8	-0.6%					
	40.0	39.9	-0.3%					
	45.0	44.8	-0.4%					
12/18/2018	0.0	0.0	-	1.46%	0.9929	-0.0916	1.0000	PASS
	8.1	7.8	-3.3%					
	17.5	17.3	-1.2%					
	30.0	29.7	-1.0%					
	40.0	39.6	-1.1%					
	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 2-23: 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]
1/31/2018	0.0	0.1	-	1.11%	0.9812	1.6918	1.0000	99.3%	PASS
	81.5	82.4	1.1%						
	172.1	171.8	-0.2%						
	270.8	268.1	-1.0%						
	382.1	375.9	-1.6%						
	455.7	448.3	-1.6%						
4/12/2018	0.0	0.0	-	2.21%	0.9788	-0.3075	0.9999	99.9%	PASS
	79.5	78.2	-1.6%						
	170.7	166.9	-2.2%						
	296.6	286.5	-3.4%						
	392.2	383.6	-2.2%						
	419.4	412.4	-1.7%						
6/9/2018	0.0	-0.1	-	0.55%	0.9946	0.5797	1.0000	98.8%	PASS
	77.9	79.0	1.4%						
	168.3	168.1	-0.1%						
	289.3	287.9	-0.5%						
	388.6	386.7	-0.5%						
	416.2	415.0	-0.3%						
7/26/2018	0.0	0.1	-	**11.28%**	**0.8879**	-0.1786	0.9999	100.0%	**FAIL** [2]
	79.8	71.0	-11.0%						
	169.0	150.0	-11.3%						
	294.1	258.7	-12.0%						
	387.8	344.7	-11.1%						
	413.5	368.0	-11.0%						
8/1/2018	0.0	0.0	-	0.58%	1.0034	0.2202	1.0000	99.5%	PASS
	78.9	80.2	1.6%						
	167.8	168.0	0.1%						
	290.3	291.2	0.3%						
	385.9	387.4	0.4%						
	413.7	415.7	0.5%						

[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] Analyzer not adjusted and recalibrated until 8/1/2018 due to loss of communications and computer problems.

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]
9/19/2018	0.0	0.0	-	0.85%	1.0119	-0.7040	0.9999	100.1%	PASS
	80.5	81.7	1.5%						
	172.1	172.4	0.2%						
	299.2	299.3	0.0%						
	425.1	432.2	1.7%						
	398.6	402.1	0.9%						
10/30/2018	0.0	0.0	-	1.12%	0.9913	1.1120	0.9999	98.4%	PASS
	79.1	81.6	3.1%						
	171.5	170.2	-0.7%						
	295.7	294.6	-0.4%						
	394.2	389.7	-1.1%						
	423.2	422.4	-0.2%						
11/25/2018	0.0	0.0	-	1.95%	0.9764	2.6974	0.9998	96.6%	PASS
	77.7	81.2	4.4%						
	169.0	169.1	0.0%						
	297.0	291.5	-1.9%						
	399.0	393.9	-1.3%						
	428.6	419.5	-2.1%						
12/6/2018 – As Found	0.0	0.1	-	1.88%	0.9725	2.8951	0.9997	99.0%	PASS
	77.0	79.2	2.8%						
	167.3	168.2	0.5%						
	294.5	290.6	-1.3%						
	394.4	382.0	-3.1%						
	421.0	414.3	-1.6%						
12/6/2018 – As Left	0.0	-0.4	-	2.93%	0.9749	-0.7483	1.0000	100.5%	PASS
	81.2	78.6	-3.2%						
	168.6	163.4	-3.1%						
	291.9	282.3	-3.3%						
	388.2	378.7	-2.4%						
	414.4	403.4	-2.7%						

[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] API 200U NOX analyzer serial number 194 replaced with Thermo 42i serial number 0705820942 on December 6, 2018.

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]
12/8/2018	0.0	0.2	-	2.53%	1.0160	1.4292	0.9999	99.9%	PASS
	76.8	79.2	3.1%						
	166.4	172.2	3.5%						
	291.3	298.9	2.6%						
	392.4	399.5	1.8%						
	416.0	422.9	1.7%						
12/13/2018	0.0	0.1	-	7.63%	1.0779	-0.3397	1.0000	100.8%	PASS
	78.8	85.6	8.6%						
	170.1	180.8	6.3%						
	295.0	318.1	7.8%						
	397.6	428.1	7.7%						
	425.3	458.6	7.8%						
12/18/2018	0.0	0.1	-	1.16%	1.0085	-0.1496	0.9999	100.1%	PASS
	78.9	80.6	2.2%						
	171.6	170.3	-0.8%						
	293.3	296.7	1.2%						
	394.0	397.0	0.8%						
	421.9	425.6	0.9%						

[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]
1/31/2018	-0.001	0.000	-	0.43%	0.9980	0.0011	1.0000	PASS
	0.080	0.081	1.4%					
	0.175	0.176	0.3%					
	0.300	0.301	0.2%					
	0.399	0.400	0.2%					
	0.450	0.450	0.0%					
4/12/2018	0.000	0.001	-	0.77%	0.9950	0.0017	1.0000	PASS
	0.080	0.082	2.4%					
	0.175	0.176	0.9%					
	0.300	0.301	0.2%					
	0.401	0.401	0.0%					
	0.451	0.450	-0.3%					
6/12/2018	0.000	0.001	-	0.91%	0.9882	0.0018	1.0000	PASS
	0.080	0.082	2.5%					
	0.175	0.175	-0.1%					
	0.300	0.299	-0.3%					
	0.400	0.397	-0.7%					
	0.450	0.446	-0.9%					
8/1/2018	0.000	0.001	-	1.55%	1.0030	0.0021	1.0000	PASS
	0.080	0.083	3.4%					
	0.175	0.178	1.7%					
	0.300	0.303	1.2%					
	0.400	0.404	1.1%					
	0.450	0.452	0.4%					
9/19/2018	0.000	0.002	-	1.24%	0.9814	0.0036	0.9999	PASS
	0.080	0.082	3.0%					
	0.175	0.177	0.9%					
	0.300	0.300	0.0%					
	0.400	0.397	-0.8%					
	0.450	0.443	-1.6%					

[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]
10/30/2018	0.000	0.000	-	2.18%	1.0120	0.0011	1.0000	PASS
	0.080	0.084	4.5%					
	0.176	0.179	1.8%					
	0.299	0.304	1.9%					
	0.400	0.405	1.4%					
	0.450	0.456	1.4%					
12/6/2018 – As Found [2]	0.000	0.000	-	0.75%	1.0034	0.0007	0.9999	PASS
	0.081	0.080	-1.5%					
	0.177	0.177	0.2%					
	0.298	0.302	1.1%					
	0.398	0.401	0.6%					
	0.450	0.452	0.4%					
12/6/2018 – As-Left [2]	0.000	0.000	-	2.58%	1.0167	0.0017	1.0000	PASS
	0.080	0.083	3.5%					
	0.175	0.180	2.8%					
	0.300	0.308	2.6%					
	0.400	0.408	2.1%					
	0.452	0.460	1.8%					

[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 replaced on December 6, 2018.

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]
1/31/2018	0.0	0.6	-	0.74%	0.9907	0.5038	1.0000	PASS
	78.6	77.9	-0.9%					
	170.6	169.7	-0.5%					
	292.5	291.2	-0.4%					
	390.3	386.2	-1.0%					
	438.4	435.1	-0.8%					
4/7/2018	0.0	-0.2	-	0.88%	0.9884	0.2976	1.0000	PASS
	77.9	78.0	0.1%					
	170.6	169.1	-0.9%					
	292.5	289.0	-1.2%					
	390.2	385.4	-1.2%					
	438.4	434.2	-1.0%					
4/12/2018	0.0	0.9	-	0.72%	0.9883	1.0606	1.0000	PASS
	77.9	78.2	0.4%					
	170.6	169.4	-0.7%					
	292.4	290.7	-0.6%					
	390.3	386.6	-0.9%					
	438.4	434.1	-1.0%					
5/26/2018	0.0	-0.6	-	0.23%	0.9974	0.2268	1.0000	PASS
	77.9	78.1	0.3%					
	170.6	171.0	0.3%					
	292.2	292.3	0.0%					
	390.0	389.6	-0.1%					
	438.8	436.9	-0.4%					
7/26/2018	0.0	1.4	-	1.17%	1.0073	1.0376	1.0000	PASS
	78.6	79.8	1.5%					
	171.0	173.0	1.2%					
	292.4	295.2	1.0%					
	390.1	396.1	1.5%					
	438.6	441.4	0.6%					

[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]
8/1/2018	0.0	-0.5	-	1.10%	1.0147	-0.7362	1.0000	PASS
	78.2	79.0	1.0%					
	170.7	172.3	0.9%					
	292.4	294.7	0.8%					
	389.6	394.8	1.3%					
	438.5	444.9	1.5%					
9/19/2018	0.0	0.4	-	1.68%	1.0180	0.0493	1.0000	PASS
	78.2	78.9	0.9%					
	170.7	174.4	2.1%					
	292.3	297.2	1.7%					
	390.0	397.8	2.0%					
	438.7	446.1	1.7%					
10/2/2018	0.0	0.8	-	1.58%	1.0207	-0.4460	1.0000	PASS
	78.5	79.2	0.8%					
	170.5	172.8	1.4%					
	292.2	296.6	1.5%					
	390.0	398.1	2.1%					
	438.7	448.1	2.1%					
10/30/2018	0.0	-1.0	-	1.59%	1.0179	-0.6243	1.0000	PASS
	77.9	79.2	1.7%					
	170.6	173.1	1.5%					
	292.3	296.6	1.5%					
	389.2	395.1	1.5%					
	438.9	446.6	1.7%					
11/25/2018	0.0	-0.6	-	0.81%	1.0104	-0.6343	1.0000	PASS
	77.9	77.5	-0.5%					
	170.6	171.9	0.8%					
	292.4	296.1	1.3%					
	390.2	392.8	0.7%					
	439.0	442.9	0.9%					

[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]
12/6/2018	0.0	1.0	-	1.25%	1.0060	1.2675	1.0000	PASS
	78.5	79.7	1.5%					
	170.6	173.9	1.9%					
	292.4	295.9	1.2%					
	390.1	393.0	0.8%					
	438.4	442.2	0.9%					

[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 2-26: 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
1/24/2018 – As Found	-33.6	-33.0	-0.6	771	768	3	12:34:08	12:32:09	0:01:59	17.3	19.30	**-10.4%** [5]
1/24/2018 – As Left [4]	-32.8	-32.6	-0.2	769	770	-1	17:57:25	17:55:24	0:02:01	16.7	16.73	-0.2%
1/25/2018	-27.9	-28.1	0.2	772	769	3	14:20:03	14:20:00	00:00:03	16.7	16.60	0.6%
2/14/2018	-8.0	-7.8	-0.2	752	757	-5	5:22:00	5:20:00	0:02:00	16.7	16.88	-1.1%
3/14/2018	-17.6	-17.4	-0.2	759	758	1	9:51:00	9:50:00	0:01:00	16.7	16.70	0.0%
4/11/2018	-13.1	-13.2	0.1	744	745	-1	13:47:16	13:45:16	0:02:00	16.7	16.80	-0.6%
5/16/2018	-3.4	-4.2	0.8	758	764	-6	10:10:12	10:08:12	0:02:00	16.8	16.80	0.0%
6/20/2018	7.4	5.6	1.8	755	761	-6	12:50:57	12:49:10	0:01:47	16.7	16.85	-0.9%
7/4/2018 – As Found	4.6	6.4	-1.8	761	759	2	10:35:45	10:33:48	0:01:57	16.7	17.10	-2.3%
7/4/2018 – As Left	6.4	6.4	0.0	759	759	0	10:35:45	10:33:48	0:01:57	16.7	17.10	-2.3%
8/1/2018 [6]	-	-	-	-	-	-	-	-	-	-	-	-
8/29/2018	5.6	7.2	-1.6	755	752	3	11:33:18	11:31:18	0:02:00	16.7	16.40	1.8%
9/19/2018	2.0	3.3	-1.3	764	761	4	18:46:08	18:44:00	0:02:08	16.6	17.11	-3.0%
10/24/2018	-2.5	-1.7	-0.8	743	740	3	14:24:00	14:22:17	0:01:43	16.7	16.82	-0.7%
11/14/2018	-27.8	-27.1	-0.7	763	763	0	17:11:09	17:11:00	0:00:09	17.4	17.26	0.8%
12/6/2018	-14.1	-12.2	-1.9	755	748	7	8:47:10	8:45:10	0:02:00	16.7	17.00	-1.8%

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] QC check and multipoint calibration performed.
[5] The $PM_{2.5}$ analyzer experienced flow issues starting January 13, 2018. The analyzer was repaired and recalibrated on January 24, 2018; as-left QC check passed.
[6] Only leak-check performed on 08/01/2018.

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
1/24/2018	-33.7	-33.0	-0.7	770	767	3	12:13:10	12:11:08	0:02:02	16.7	16.62	0.5%
2/14/2018	-8.6	-7.8	-0.8	758	757	1	5:28:00	5:26:00	0:02:00	16.7	16.90	-1.2%
3/14/2018	-19.1	-19.3	0.2	755	755	0	9:24:56	9:23:56	0:01:00	16.7	16.40	1.8%
4/11/2018	-14.4	-13.9	-0.5	749	748	1	13:47:16	13:45:16	0:02:00	16.7	16.70	0.0%
5/16/2018	-4.0	-4.2	0.2	765	764	1	10:11:00	10:09:00	0:02:00	16.7	16.70	0.0%
6/20/2018	6.8	7.1	-0.3	759	761	-2	12:46:29	12:44:29	0:02:00	16.9	16.89	0.1%
7/4/2018 - As Found	4.2	6.4	**-2.2** [4]	761	759	2	11:16:44	11:16:44	0:00:00	16.7	16.70	0.0%
7/4/2018 - As Left	6.4	6.4	0.0	759.0	759.0	0	11:16:44	11:16:44	0:00:00	16.7	16.70	0.0%
8/1/2018 [5]	-	-	-	-	-	-	-	-	-	-	-	-
8/29/2018	6.1	7.5	-1.4	754	752	2	12:28:51	12:26:51	0:02:00	16.7	16.40	1.8%
9/19/2018	2.1	3.3	-1.2	764	761	4	18:48:31	18:46:00	0:02:31	16.7	16.89	-1.1%
10/24/2018	-2.6	-1.7	-0.9	742	740	2	14:19:00	14:17:37	0:01:23	16.7	16.79	-0.5%
11/14/2018	-27.8	-27.1	-0.7	761	763	-2	17:11:14	17:11:00	0:00:14	16.8	17.00	-1.2%
12/6/2018	-14.0	-12.2	-1.8	754	748	6	8:46:45	8:44:45	0:02:00	16.7	16.90	-1.2%

[1] Acceptable criteria ±2°C
[2] Acceptable criteria ±10 mmHg
[3] Acceptable criteria ±4% of reference
[4] One-point temperature verification is an operational criterion, not a critical criterion. Review of data collected at the time indicate concentrations were in line with historical behavior and concentrations recorded at other stations. In addition, other quality control checks performed at this time passed. Therefore, no PM_{10} data were invalidated as a result of this check. Temperature and BP were recalibrated and analyzer passed the As-Left QC check.
[5] Only leak-check performed 08/01/2018.

Table 2-28: April 11, 2018 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
Time	≤ ±05:00	mm:ss	01:24	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	0.03	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.06	Pass
Temperature Difference (ΔT)	≤ ±0.10	°C	0.05	Pass
Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 1.0	g-cm	0.1	Pass
Wind Direction Alignment	≤ ±5	Degree	2	Pass
Wind Direction Accuracy	≤ ±5	Degree	1.8	Pass
Wind Direction Linearity	≤ ±3	Degree	1.6	Pass
Wind Direction Torque	≤ 11.0	g-cm	9	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.20	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass
Solar Radiation Accuracy	≤ ±10 W/m^2	W/m^2	8.0	Pass

Table 2-29: December 6, 2018 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
Time	≤ ±05:00	mm:ss	01:00	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	0.07	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	0.04	Pass
Temperature Difference (ΔT)	≤ ±0.10	°C	0.07	Pass
Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.10	Pass
Wind Speed Torque	≤ 1.0	g-cm	0.1	Pass
Wind Direction Alignment	≤ ±5	Degree	2	Pass
Wind Direction Accuracy	≤ ±5	Degree	3.5	Pass
Wind Direction Linearity	≤ ±3	Degree	2.7	Pass
Wind Direction Torque	≤ 11.0	g-cm	8	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 ± 5% known input	m/s	0.14	Pass
Vertical Wind Speed Torque	≤ 0.310	g-cm	0.100	Pass
Solar Radiation Accuracy	≤ ±10 W/m^2	W/m^2	0.0 (1)	Pass

[1] CP flight schedule did not allow for 24 hour collection of solar radiation data.

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 to 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 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 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 December 2018 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	R2	
03/14/2018	0	0.00	0.264	-	3.2	1.0290	0.105	0.9998	Pass
	1	2.197	2.26	2.9					
	2	7.010	7.23	3.1					
	3	24.50	25.35	3.5					
04/11/2018	0	0.00	-0.080	-	0.2	1.0062	-0.046	1.0000	Pass
	1	2.218	2.22	0.1					
	2	6.920	6.92	0.0					
	3	24.40	24.50	0.4					
9/22/2018	0	0.00	0.266	-	5.3	1.0211	0.175	1.0000	Pass
	1	2.305	2.54	10.2					
	2	6.969	7.15	2.6					
	3	24.40	25.13	3.0					
12/06/2018	0	0.00	-0.110	-	4.2	0.9976	-0.170	1.0000	Pass
	1	2.426	2.23	-8.0					
	2	7.035	6.79	-3.5					
	3	24.40	24.19	-0.9					

[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	R2		
03/14/2018	0	0	0	-	3.5	0.9618	0.145	1.0000	99.2%	Pass
	1	45.0	43.5	-3.3						
	2	86.0	83.0	-3.5						
	3	238	229	-3.8						
04/11/2018	0	0	0	-	2.7	0.9818	-0.441	1.0000	99.3%	Pass
	1	47.0	45.2	-3.8						
	2	83.0	81.0	-2.4						
	3	256	251	-2.0						
9/22/2018	0	0	0	-	2.8	1.0181	0.325	1.0000	99.1%	Pass
	1	41.0	43.1	5.1						
	2	81.0	82.0	1.2						
	3	253	258	2.0						
12/06/2018	0	0	0	-	1.4	1.0068	0.350	1.0000	99.6%	Pass
	1	44.0	45.0	2.3						
	2	82.0	83.0	1.2						
	3	255	257	0.8						

[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	R2	
03/14/2018	0	0	0	-	1.5	0.9988	-0.639	1.0000	Pass
	1	30.2	29.1	-3.6					
	2	75.7	74.8	-1.2					
	3	151	150	-0.7					
	4	401	400	-0.2					
04/11/2018	0	0	0	-	0.4	0.9976	0.097	1.0000	Pass
	1	30.1	29.8	-1.0					
	2	74.8	75.0	0.3					
	3	150	150	0.0					
	4	400	399	-0.3					
9/22/2018	0	0	1	-	2.3	1.0127	1.001	1.0000	Pass
	1	30.2	31.2	3.3					
	2	74.5	76.8	3.1					
	3	148	151	2.0					
	4	399	405	1.5					
12/06/2018	0	0	0.6	-	3.1	1.0319	-0.122	1.0000	Pass
	1	29.6	30.6	3.4					
	2	75.0	76.7	2.3					
	3	150	154	2.7					
	4	400	413	3.3					

[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	R2	
03/14/2018	0	0.0	2	-	1.2	0.9782	1.279	1.0000	Pass
	1	30.0	30.2	0.7					
	2	76.8	75.9	-1.2					
	3	251	247	-1.6					
04/11/2018	0	0.0	0	-	2.1	0.9847	-0.173	1.0000	Pass
	1	30.1	29.2	-3.0					
	2	80.0	76.7	-1.6					
	3	251	247	-1.6					
9/22/2018	0	0.0	1	-	3.9	0.9605	2.052	1.0000	Pass
	1	35.2	37.5	6.5					
	2	83.8	82.0	-2.1					
	3	253	245	-3.2					
12/06/2018	0	0.0	0	-	1.3	0.9902	0.537	1.0000	Pass
	1	39.7	40.7	2.5					
	2	87.7	87.1	-0.7					
	3	255	253	-0.8					

[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 (%)	
03/14/2018	0.3	0.1	-5	0.6	-0.6	Pass
04/11/2018	0.3	-0.1	-4	-0.6	0.6	Pass
9/22/2018	0.3	-0.8	2	-1.8	1.8	Pass
12/06/2018	0.3	-1.0	3	0.0	0.0	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 (%)	
03/14/2018	0.0	-0.8	1	0.0	0.0	Pass
04/11/2018	0.4	-0.8	1	0.6	-0.6	Pass
9/22/2018	0.4	-0.6	2	0.0	0.0	Pass
12/06/2018	0.4	-0.9	2	-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: April 11, 2018 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 0.5	m/s	0.23	Pass
Wind Direction Accuracy	≤ ±5	Degree	2	Pass
Wind Direction Linearity	≤ ±3	Degree	2	Pass
Wind Direction Torque	≤ 0.5	m/s	0.46	Pass
Vertical Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.05	Pass
Vertical Wind Speed Torque	≤ 0.25	m/s	0.14	Pass
2-m Temperature Accuracy	≤ ±0.50	°C	-0.08	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.12	Pass
Temperature Difference (ΔT)	≤ ±0.10	°C	-0.05	Pass
Solar Radiation Accuracy < 200 W/m^2	≤ ±10	W/m^2	-3	Pass

Table 2-37: December 6, 2018 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy	≤ ±0.20 + 5% known input	m/s	0.00	Pass
Wind Speed Torque	≤ 0.5	m/s	0.28	Pass
Wind Direction Accuracy	≤ ±5	Degree	1.3	Pass
Wind Direction Linearity	≤ ±3	Degree	2	Pass
Wind Direction Torque	≤ 0.5	m/s	0.49	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	≤ ±0.50	°C	-0.10	Pass
10-m Temperature Accuracy	≤ ±0.50	°C	-0.10	Pass
Air Temperature Difference	≤ ±0.10	°C	0.06	Pass
Solar Radiation Accuracy < 200 W/m^2	≤ ±10	W/m^2	0 (1)	Pass

[1] CP flight schedule did not allow for 24 hour collection of solar radiation data.

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, 2018, through December 31, 2018, and compared to national and Alaska air quality standards (NAAQS/AAAQS). The highest and second highest critical pollutant concentrations are also provided in Table 3-1 and compared to the respective primary and secondary air quality standards. Figures 3-1 through 3-9 provide plots of annual averages of the criteria pollutant concentrations at the Nuiqsut station along with respective NAAQS/AAAQS standards for comparison.

Table 3-1: Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/ AAAQS
Nitrogen Dioxide (NO_2)	53 ppb (100 µg/m^3)	Annual	Average of Period	3	1	1	2	2	**3.8%**
	100.0 ppb (190 µg/m^3)	1-Hour [2]	Daily Max 1-Hour Averages (98th Percentile)	--	--	--	--	23.9	**23.9%**
			1st Highest, 1-Hour Average	30.0	14.9	12.6	37.9	37.9	**37.9%**
			2nd Highest, 1-Hour Average	24.9	14.5	11.6	33.9	33.9	**33.9%**
Ozone (O_3)	0.075 ppm (150 µg/m^3)	8-Hour [3]	4th Highest, 8-Hour Average	0.044	0.041	0.030	0.038	0.046	**65.7%**
			1st Highest, 8-Hour Average	0.047	0.047	0.031	0.041	0.047	**67.1%**
			2nd Highest, 8-Hour Average	0.046	0.044	0.030	0.040	0.047	**67.1%**
Carbon Monoxide (CO)	35 ppm (40,000 µg/m^3)	1-Hour [1]	1st Highest, 1-Hour Average	1	1	1	1	1	**2.9%**
			2nd Highest, 1-Hour Average	1	1	1	1	1	**2.9%**
	9 ppm (10,000 µg/m^3)	8-Hour [1]	1st Highest, 8-Hour Average	1	1	1	1	1	**11.1%**
			2nd Highest, 8-Hour Average	1	1	1	1	1	**11.1%**

[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/m^3)	Annual	Average of Period	0.001	0.001	0.001	0.000	0.001	**3.3%**
	0.14 ppm (365 μg/m^3)	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/m^3)	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/m^3)	1-Hour [4]	Daily Max 1-Hour Averages (99th Percentile)	--	--	--	--	2.6	**3.5%**
			1st Highest, 1-Hour Average	2.6	2.6	2.0	1.6	2.6	**3.5%**
			2nd Highest, 1-Hour Average	2.6	2.5	1.9	1.5	2.6	**3.5%**

[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/m^3	Annual [7]	Average of Period	1.9	1.6	1.4	2.7	1.9	**15.8%**
	35 μg/m^3	24-Hour [6]	98th Percentile, 24-Hour Average	--	--	--	--	8	**22.9%**
			1st Highest, 24-Hour Average	9	11	5	12	12	**34.3%**
			2nd Highest, 24-Hour Average	8	8	5	11	11	**31.4%**
Particulate Matter <10 microns (PM_{10})	150 μg/m^3	24-Hour [8,9]	1st Highest, 24-Hour Average	20	50	20	140	140	**93.3%**
			2nd Highest, 24-Hour Average	10	50	20	140	140	**93.3%**

[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.

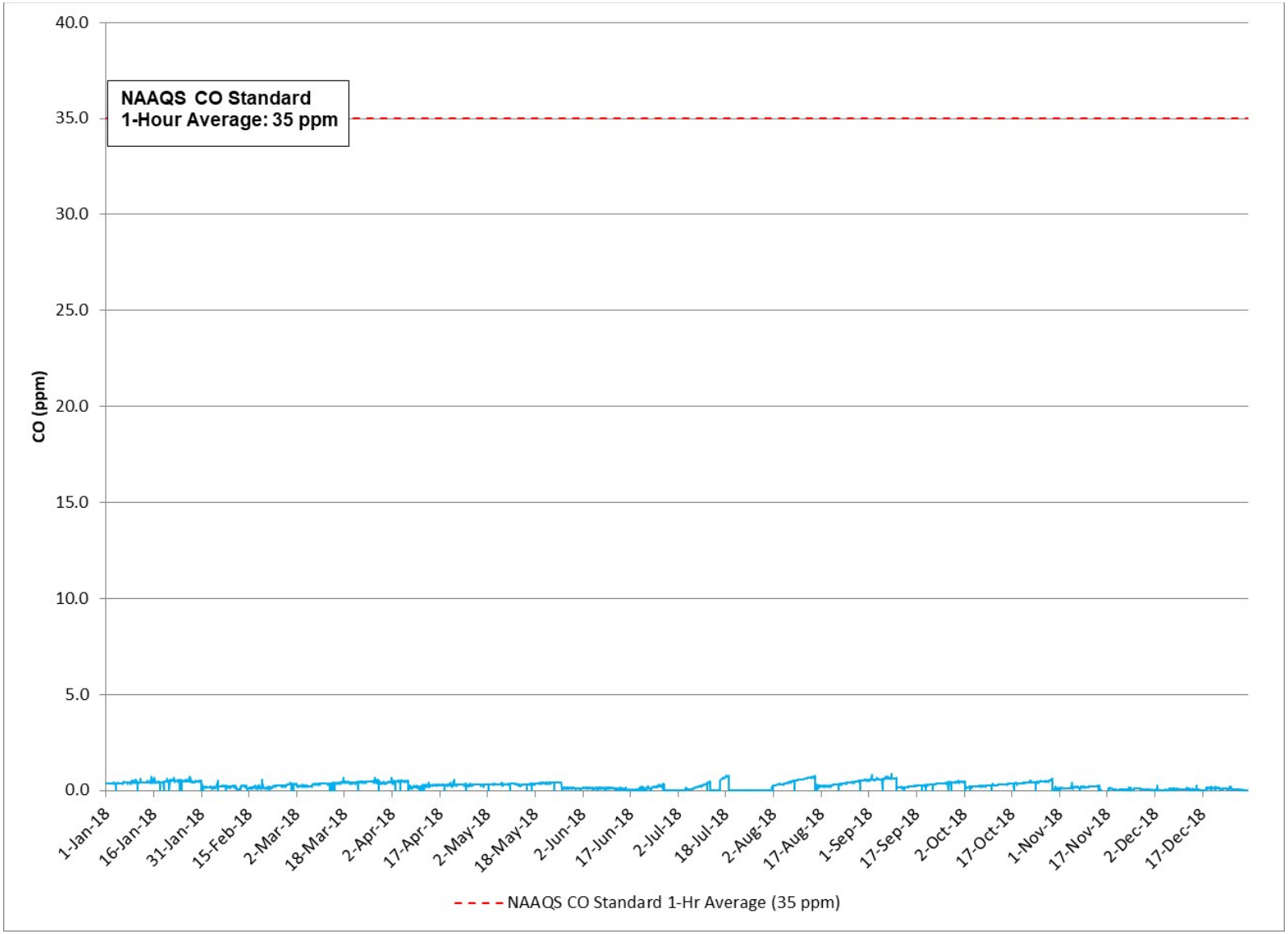


Figure 3-1: 1-Hour Average CO and NAAQS/AAAQS Standard

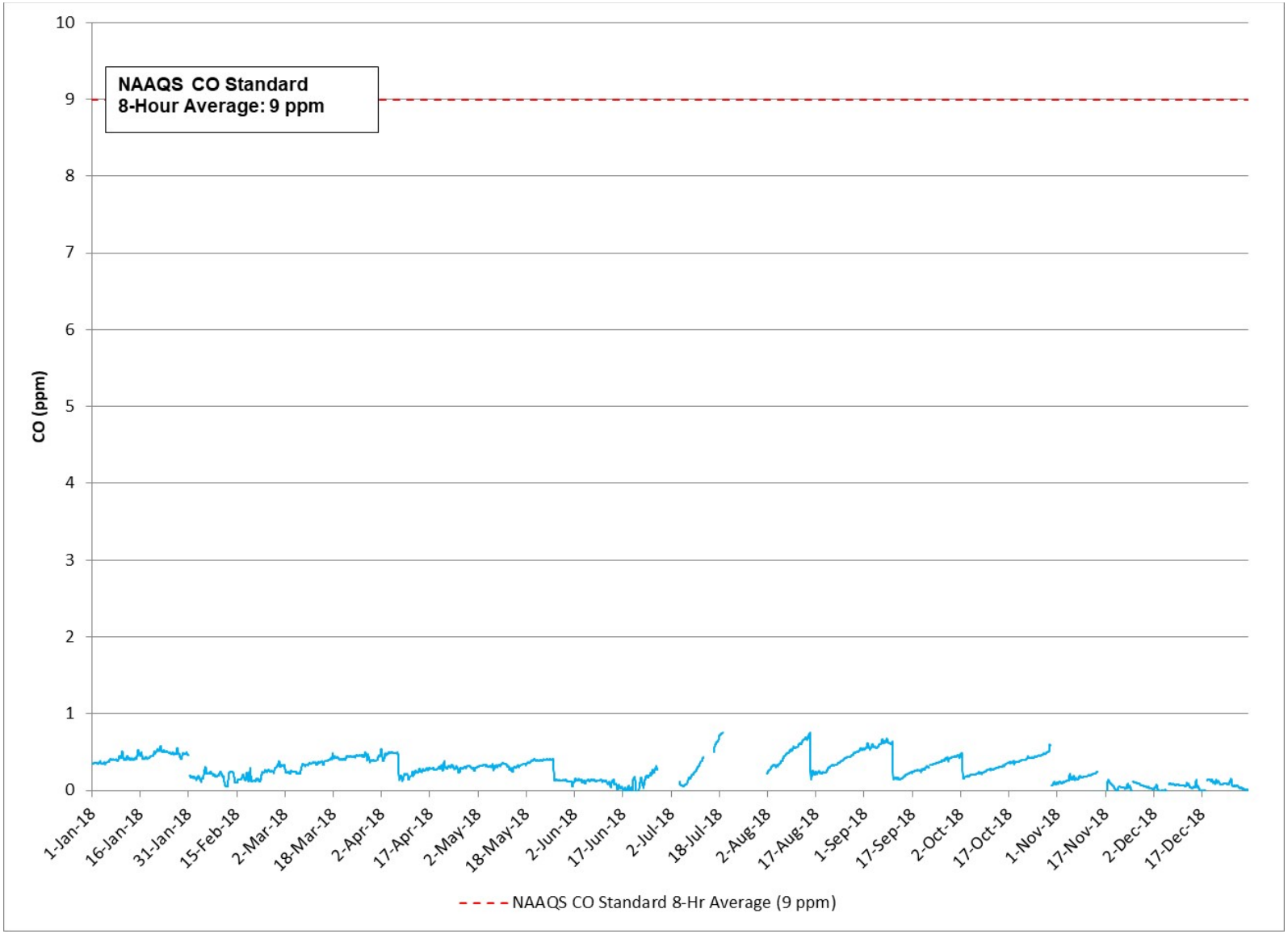


Figure 3-2: 8-Hour Average CO and NAAQS/AAAQS Standard

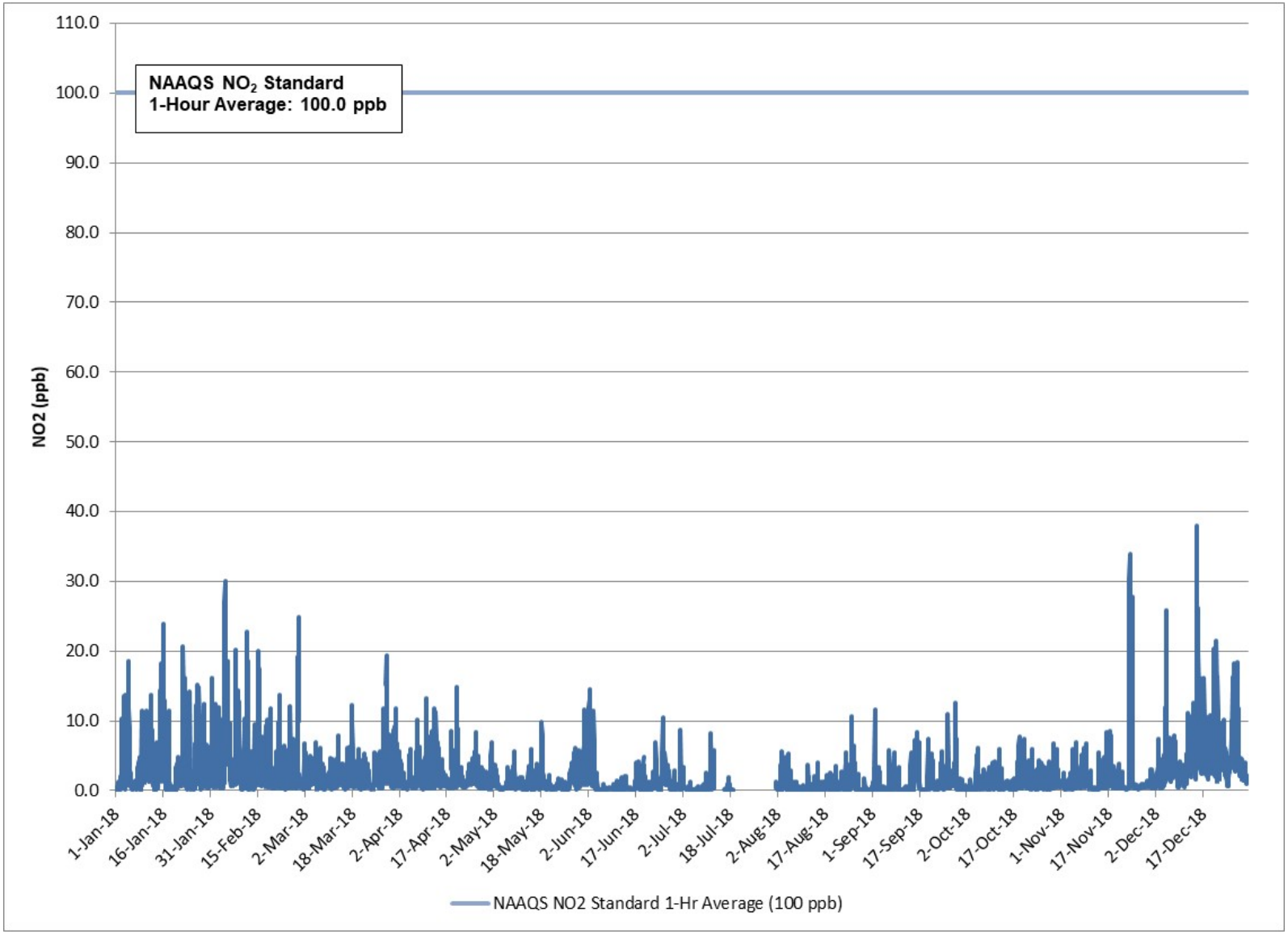


Figure 3-3: 1-Hour Average NO_2 and NAAQS Standard

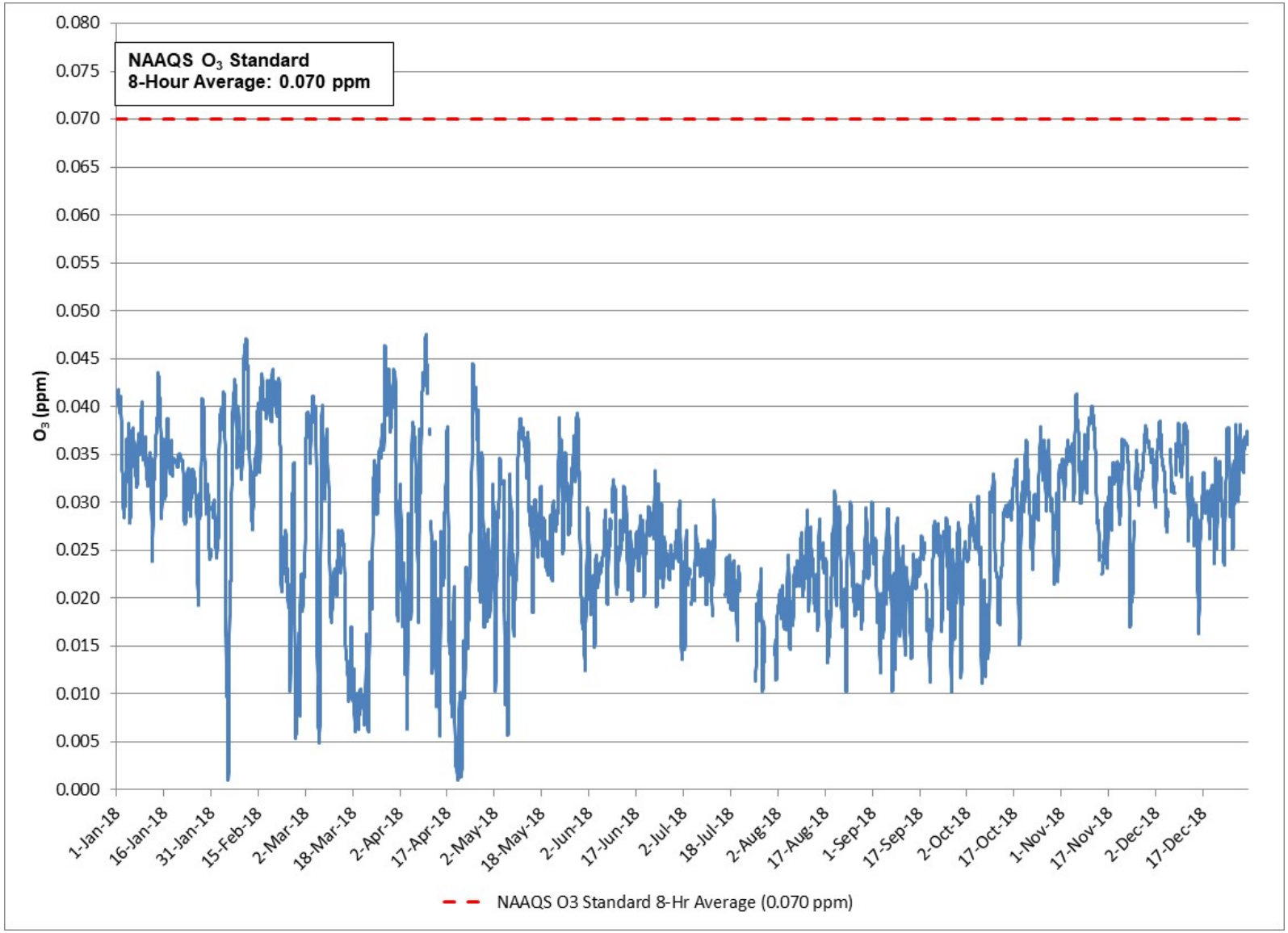


Figure 3-4: 8-Hour Average O_3 and NAAQS/AAAQS Standard

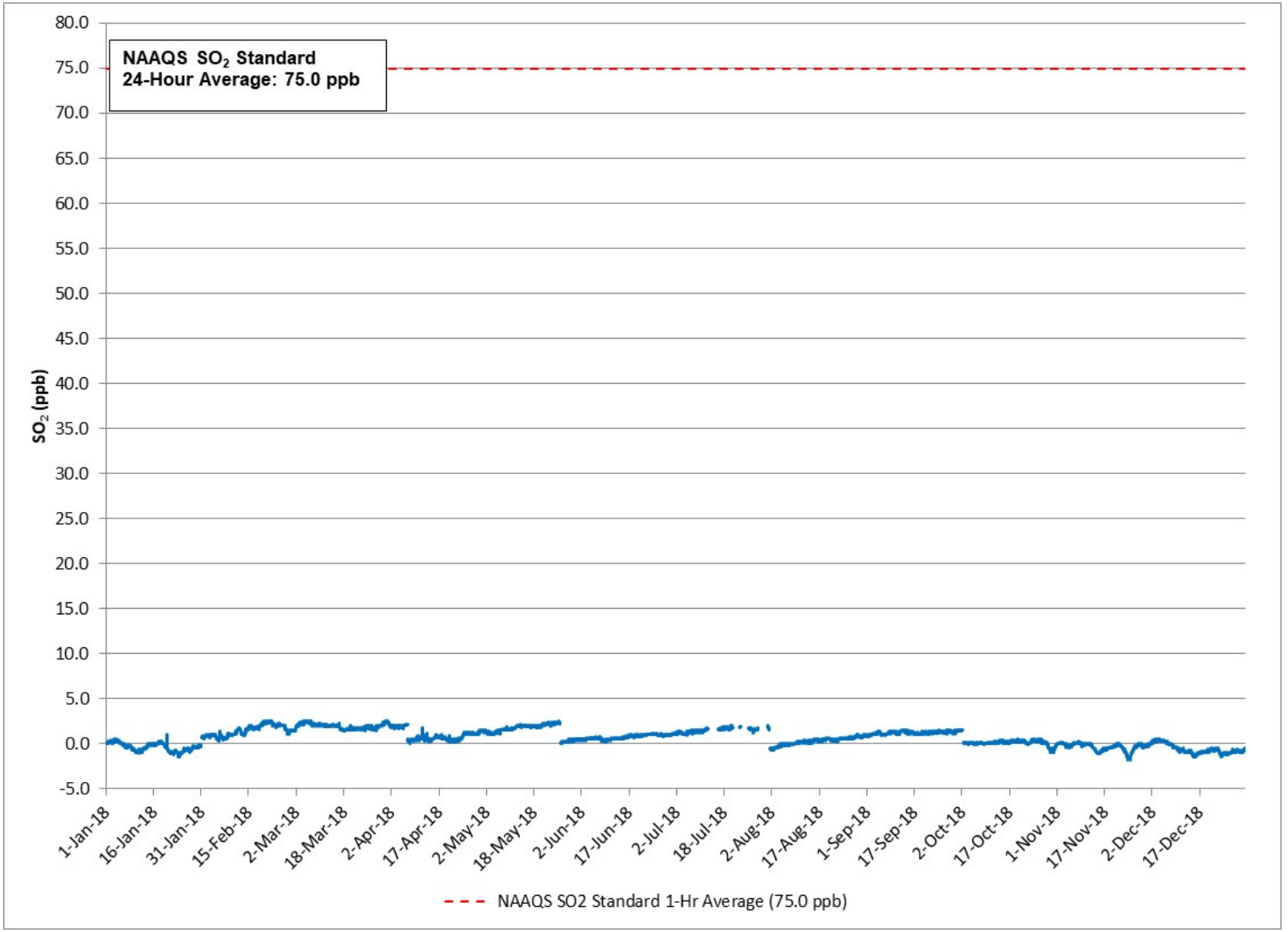


Figure 3-5: 1-Hour Average SO_2 and NAAQS/AAAQS Standard

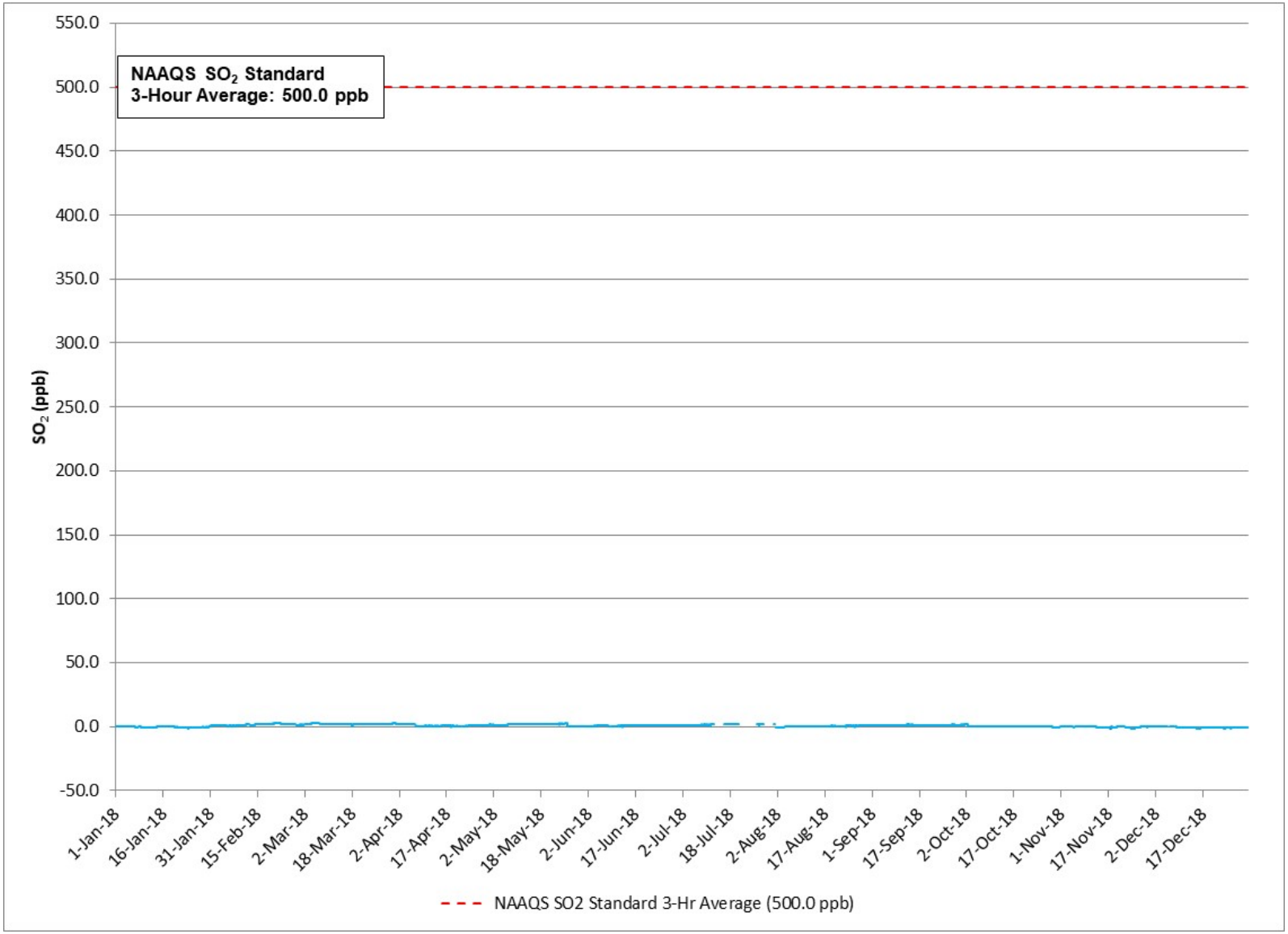


Figure 3-6: 3-Hour Average SO_2 and NAAQS/AAAQS Standard

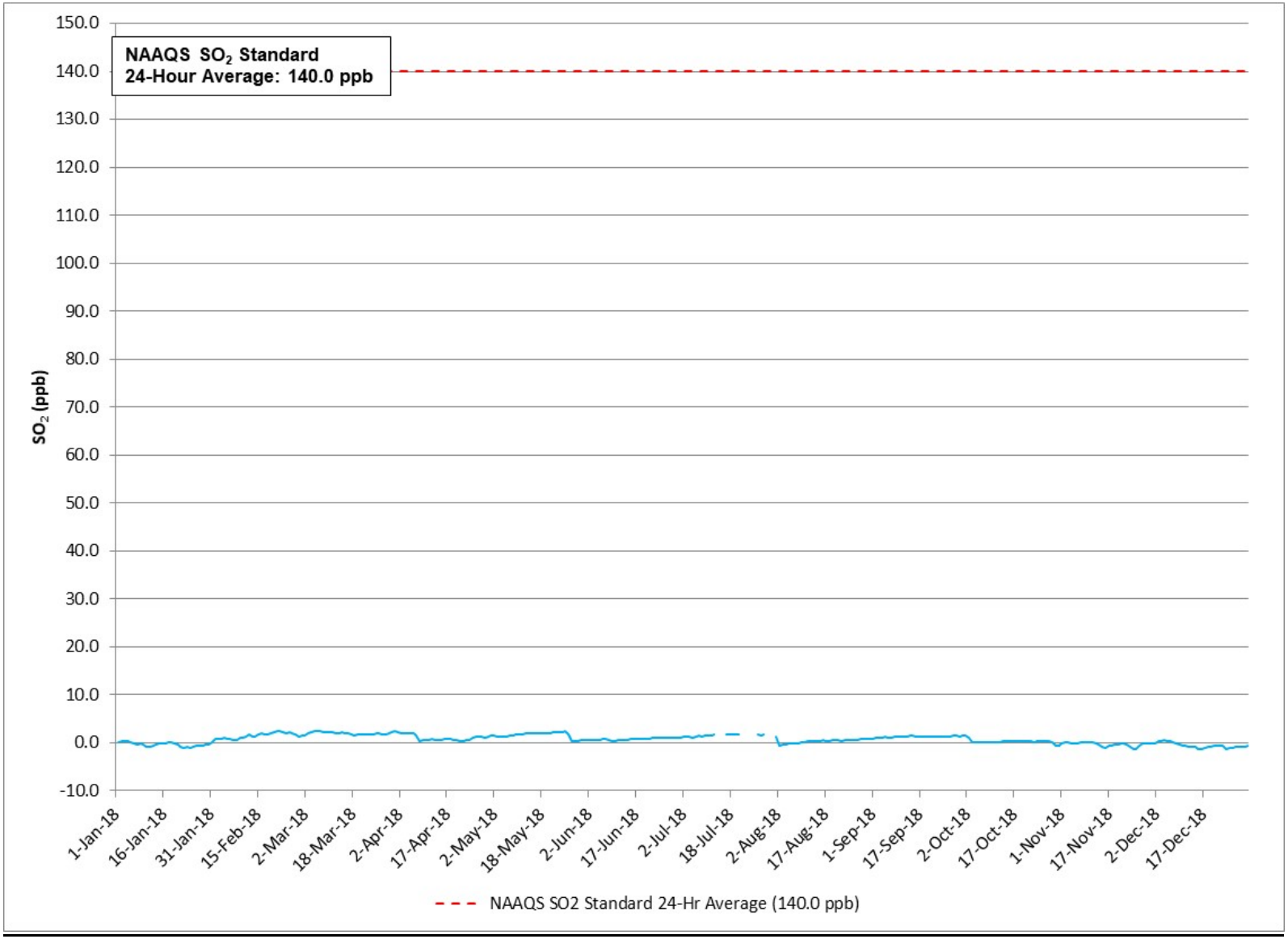


Figure 3-7: 24-Hour Average SO_2 and NAAQS/AAAQS Standard

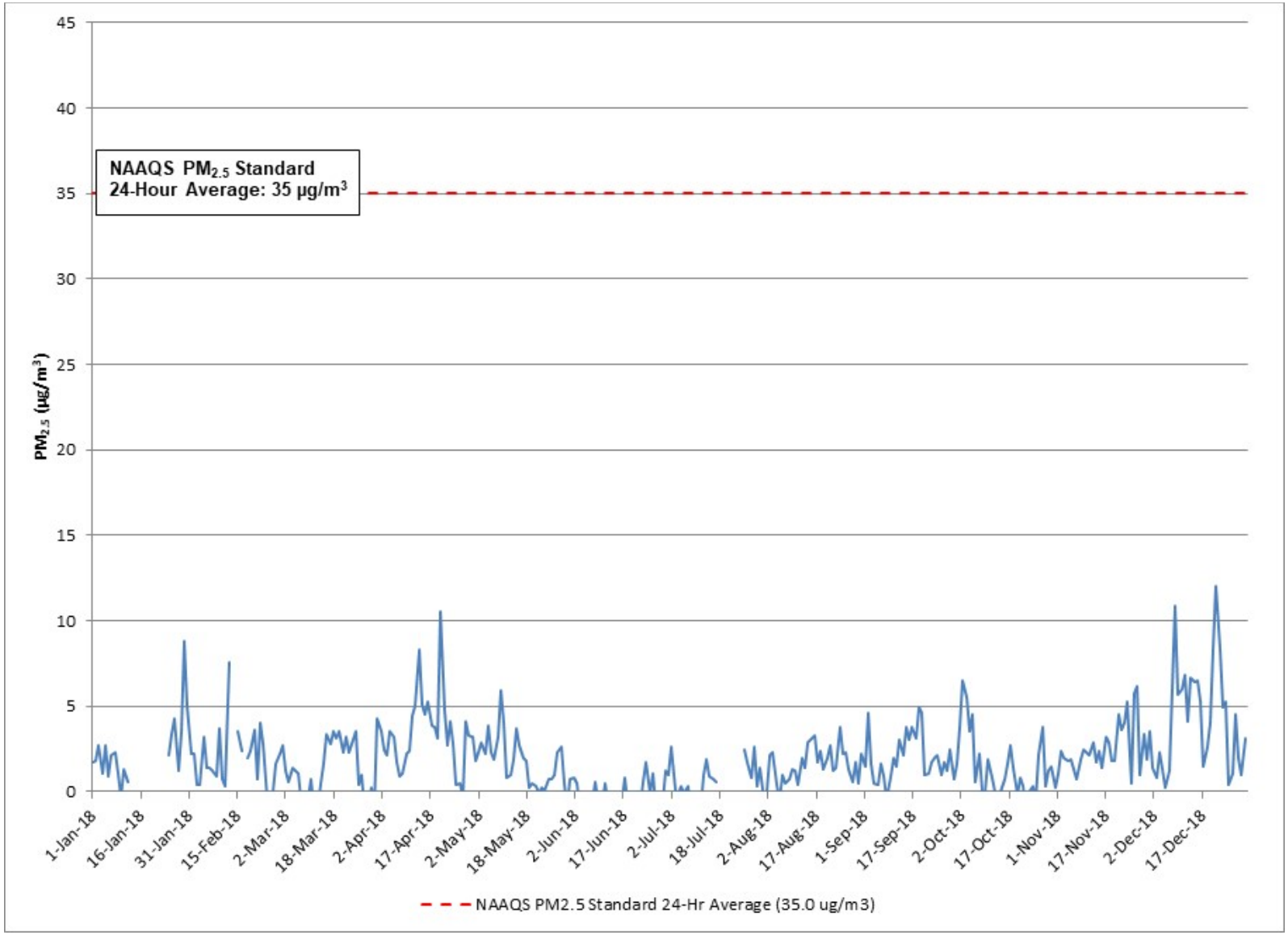


Figure 3-8: 24-Hour Average $PM_{2.5}$ and NAAQS/AAAQS Standard

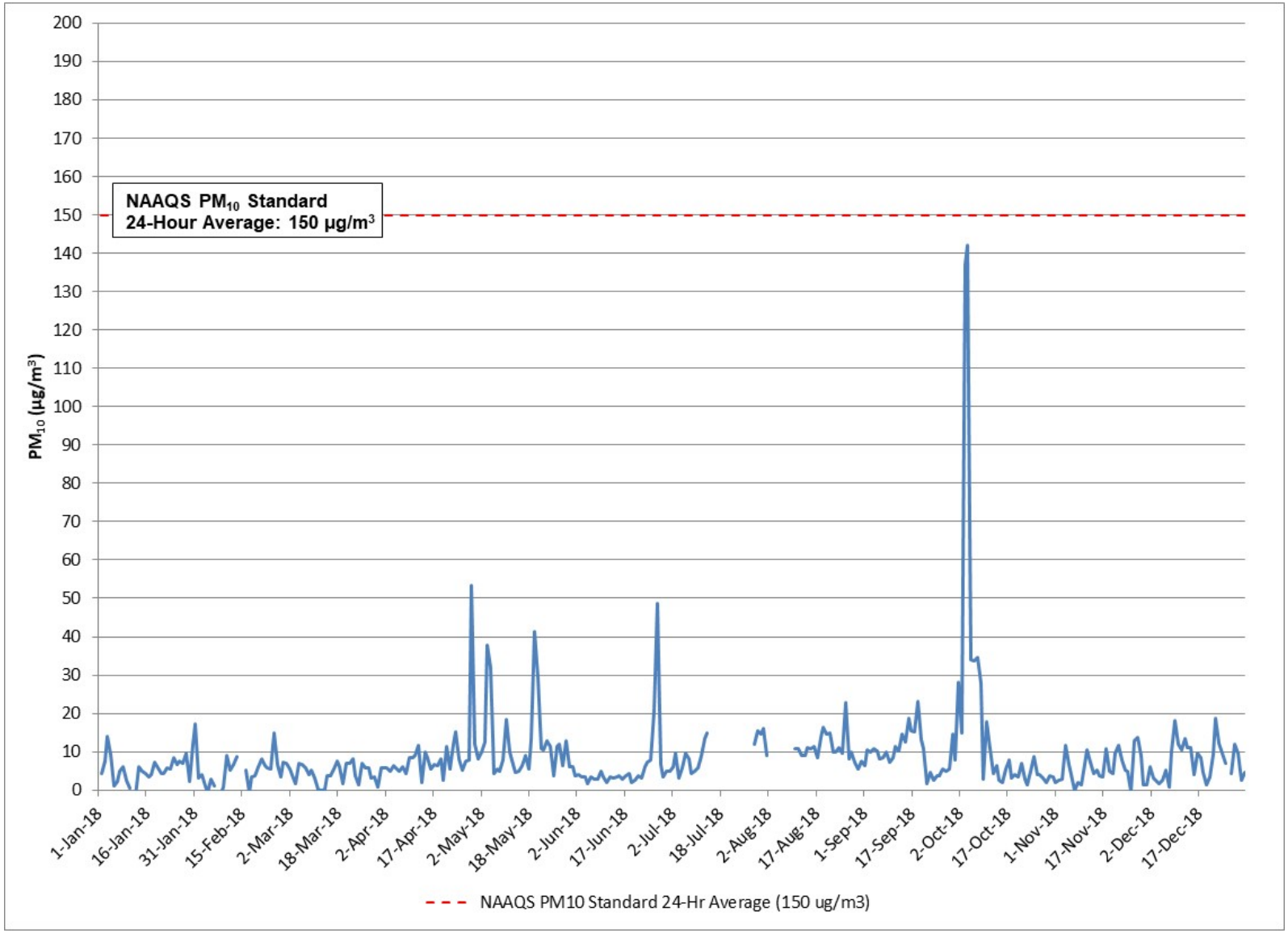


Figure 3-9: 24-Hour Average PM_{10} and NAAQS/AAAQS Standard

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 Tables 3-5 to 3-8 are the quarterly wind analysis tables. Figure 3-12 provides the annual wind rose superimposed over a Nuiqsut area map, centered at the approximate location of the monitoring station.

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

Monitoring Period	Mean Hourly Average Wind Speed (m/s)	Maximum Hourly Average Wind Speed (m/s)
1st Quarter	5.70	18.52
2nd Quarter	5.62	15.95
3rd Quarter	4.27	15.95
4th Quarter	4.88	15.95
Monitoring Year	**5.06**	**18.52**

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	5.53	18.87	0.26	1.45
2nd Quarter	5.68	14.56	0.36	0.97
3rd Quarter	4.41	13.77	0.26	0.70
4th Quarter	4.62	14.00	0.31	1.54
Monitoring Year	**5.05**	**18.87**	**0.30**	**1.54**

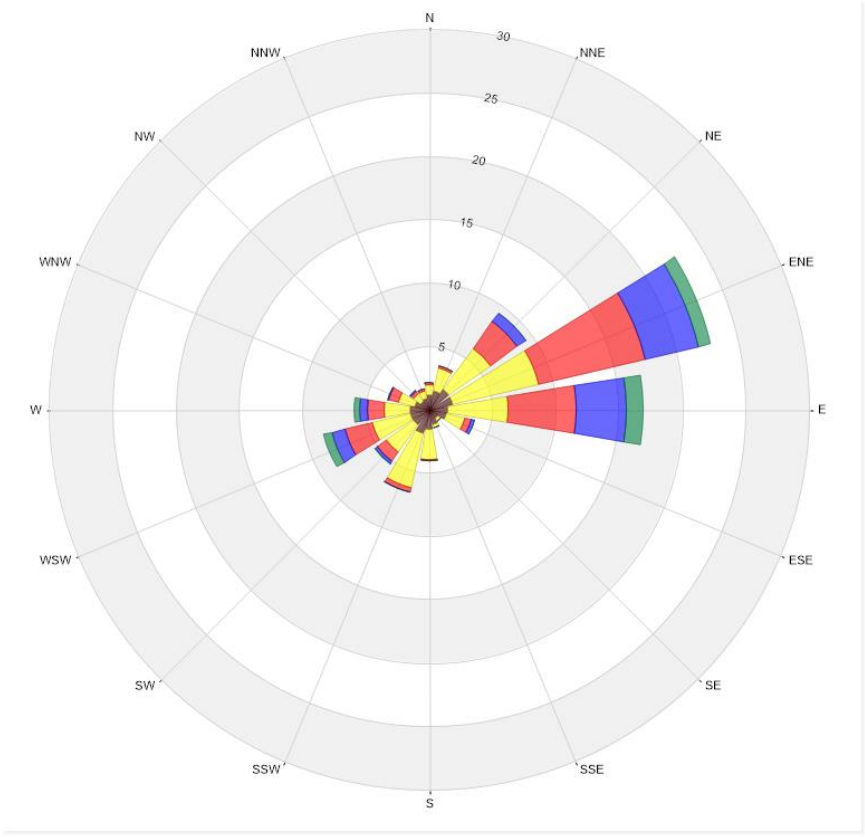
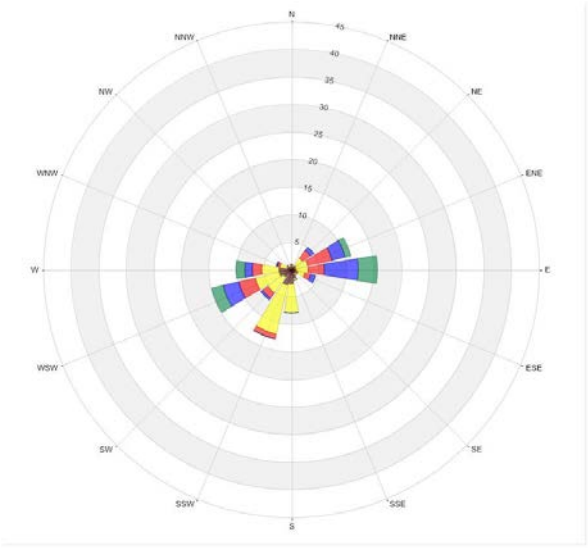
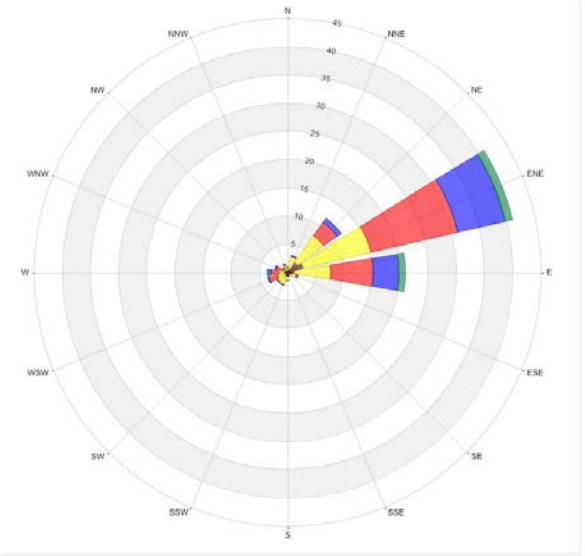


Figure 3-10: Nuiqsut Annual Wind Rose

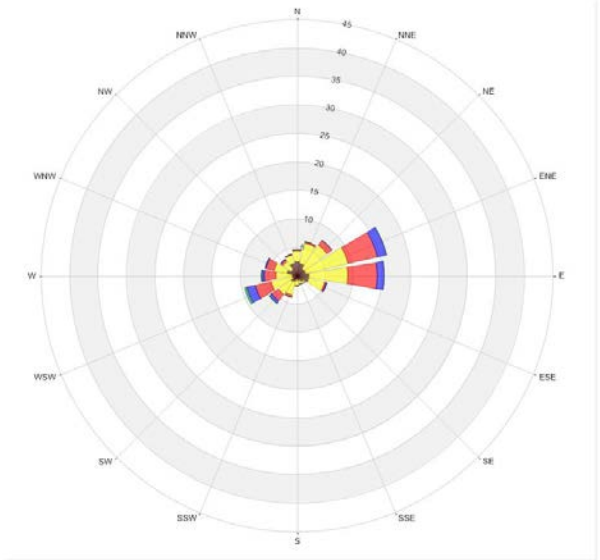
1st Quarter (1/1/18 – 3/31/18)



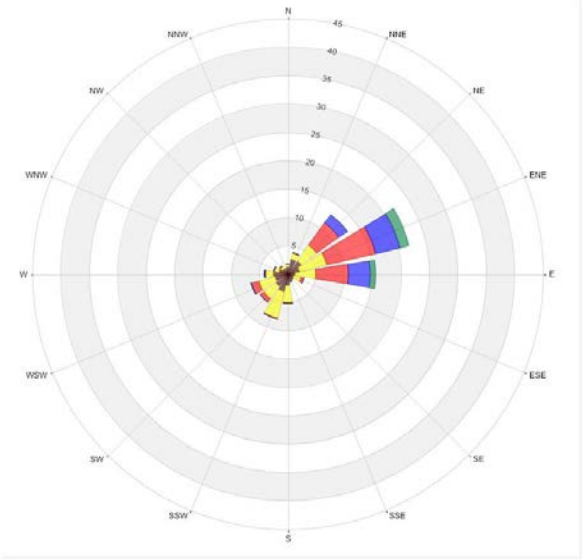
2nd Quarter (4/1/18 – 6/30/18)



3rd Quarter (7/1/18 – 9/30/18)



4th Quarter (10/1/18 – 12/31/18)



Wind Classes (m/s)

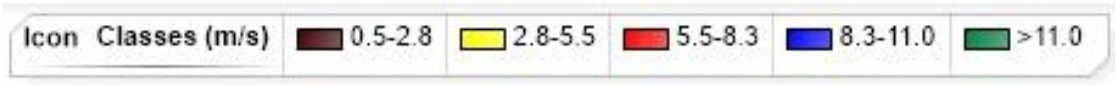


Figure 3-11: Nuiqsut Quarterly Wind Roses

Table 3-4: Annual Wind Rose Frequency Distribution Table

Frequency Distribution (Percent)						
Direction	**Speed (m/s)**					
	0.5-2.8	**2.8-5.5**	**5.5-8.3**	**8.3-11.0**	**>11.0**	**Total**
N	1.20	0.81	0.12	0.01	0.00	**2.14**
NNE	1.56	1.80	0.18	0.01	0.00	**3.55**
NE	1.97	3.98	2.63	0.84	0.00	**9.42**
ENE	1.91	6.96	8.66	4.29	1.01	**22.83**
E	1.46	4.82	5.39	3.90	1.34	**16.91**
ESE	1.37	1.52	0.55	0.27	0.00	**3.71**
SE	0.92	0.24	0.00	0.00	0.00	**1.16**
SSE	1.21	0.26	0.00	0.00	0.00	**1.47**
S	1.59	2.41	0.05	0.00	0.00	**4.05**
SSW	1.98	4.35	0.34	0.04	0.00	**6.71**
SW	1.54	2.63	0.88	0.23	0.05	**5.33**
WSW	1.51	3.11	2.18	1.11	0.66	**8.57**
W	1.54	2.06	1.30	0.65	0.44	**5.99**
WNW	1.21	1.26	0.81	0.15	0.00	**3.43**
NW	0.87	0.70	0.26	0.04	0.00	**1.87**
NNW	0.90	0.68	0.17	0.01	0.00	**1.76**
Summary	**22.74**	**37.59**	**23.52**	**11.55**	**3.50**	**98.90 (1)**

[1] The remaining 1.10 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	0.71	0.15	0.15	0.00	0.00	**1.01**
NNE	0.51	0.15	0.10	0.00	0.00	**0.76**
NE	1.06	1.52	1.72	0.76	0.00	**5.06**
ENE	0.76	2.38	4.46	2.43	1.01	**11.04**
E	0.91	2.13	2.99	6.18	3.44	**15.65**
ESE	1.37	1.16	1.06	0.91	0.00	**4.50**
SE	0.96	0.20	0.00	0.00	0.00	**1.16**
SSE	1.77	0.20	0.00	0.00	0.00	**1.97**
S	2.73	5.16	0.05	0.00	0.00	**7.94**
SSW	2.99	9.06	0.91	0.05	0.00	**13.01**
SW	1.77	3.49	1.22	0.35	0.00	**6.83**
WSW	2.33	4.46	2.99	2.94	2.18	**14.90**
W	2.33	3.04	1.72	1.42	1.57	**10.08**
WNW	0.91	1.32	0.35	0.30	0.00	**2.88**
NW	0.71	0.10	0.15	0.00	0.00	**0.96**
NNW	0.25	0.05	0.15	0.00	0.00	**0.45**
Summary	**22.07**	**34.57**	**18.02**	**15.34**	**8.20**	**98.20 (1)**

[1] The remaining 1.80 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	0.23	0.60	0.18	0.05	0.00	**1.06**
NNE	0.73	2.11	0.18	0.05	0.00	**3.07**
NE	2.20	5.83	2.89	0.87	0.00	**11.79**
ENE	2.99	12.31	15.85	8.54	1.38	**41.07**
E	1.29	6.43	7.53	4.55	1.19	**20.99**
ESE	0.92	0.69	0.37	0.00	0.00	**1.98**
SE	0.32	0.14	0.00	0.00	0.00	**0.46**
SSE	0.83	0.00	0.00	0.00	0.00	**0.83**
S	0.83	0.73	0.00	0.00	0.00	**1.56**
SSW	0.78	1.52	0.09	0.00	0.00	**2.39**
SW	0.46	1.70	0.14	0.09	0.00	**2.39**
WSW	0.55	1.29	1.56	0.18	0.09	**3.67**
W	0.55	1.01	1.24	0.64	0.18	**3.62**
WNW	0.41	0.41	1.29	0.18	0.00	**2.29**
NW	0.32	0.28	0.32	0.05	0.00	**0.97**
NNW	0.37	0.83	0.32	0.05	0.00	**1.57**
Summary	**13.78**	**35.88**	**31.96**	**15.25**	**2.84**	**99.71** [(1)]

[1] The remaining 0.29 percent of data were calms (below 0.5 m/s).

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	2.54	1.86	0.14	0.00	0.00	**4.54**
NNE	2.27	3.68	0.27	0.00	0.00	**6.22**
NE	1.63	4.95	1.09	0.00	0.00	**7.67**
ENE	1.68	7.62	5.26	1.63	0.00	**16.19**
E	2.18	6.81	5.13	1.27	0.00	**15.39**
ESE	2.13	2.86	0.27	0.14	0.00	**5.40**
SE	1.36	0.41	0.00	0.00	0.00	**1.77**
SSE	0.91	0.68	0.00	0.00	0.00	**1.59**
S	0.86	0.95	0.09	0.00	0.00	**1.90**
SSW	1.13	2.45	0.32	0.09	0.00	**3.99**
SW	1.36	2.72	1.41	0.45	0.18	**6.12**
WSW	0.95	3.77	2.86	1.41	0.50	**9.49**
W	0.82	2.90	2.09	0.45	0.09	**6.35**
WNW	1.81	2.40	1.50	0.05	0.00	**5.76**
NW	1.23	1.81	0.50	0.09	0.00	**3.63**
NNW	2.18	1.50	0.14	0.00	0.00	**3.82**
Summary	**25.04**	**47.37**	**21.07**	**5.58**	**0.77**	**99.83** [(1)]

[1] The remaining 0.17 percent of data were calms (below 0.5 m/s).

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	1.25	0.53	0.00	0.00	0.00	**1.78**
NNE	2.69	1.06	0.14	0.00	0.00	**3.89**
NE	2.93	3.36	4.85	1.78	0.00	**12.92**
ENE	2.11	5.00	8.74	4.42	1.68	**21.95**
E	1.39	3.60	5.72	3.84	0.91	**15.46**
ESE	1.06	1.30	0.53	0.10	0.00	**2.99**
SE	1.06	0.19	0.00	0.00	0.00	**1.25**
SSE	1.39	0.14	0.00	0.00	0.00	**1.53**
S	2.07	3.07	0.05	0.00	0.00	**5.19**
SSW	3.17	4.85	0.10	0.00	0.00	**8.12**
SW	2.64	2.69	0.77	0.00	0.00	**6.10**
WSW	2.31	3.03	1.34	0.05	0.00	**6.73**
W	2.59	1.34	0.14	0.14	0.00	**4.21**
WNW	1.68	0.86	0.00	0.10	0.00	**2.64**
NW	1.20	0.53	0.05	0.00	0.00	**1.78**
NNW	0.72	0.24	0.05	0.00	0.00	**1.01**
Summary	**30.26**	**31.79**	**22.48**	**10.43**	**2.59**	**97.55** [(1)]

[1] The remaining 2.45 percent of data were calms (below 0.5 m/s).

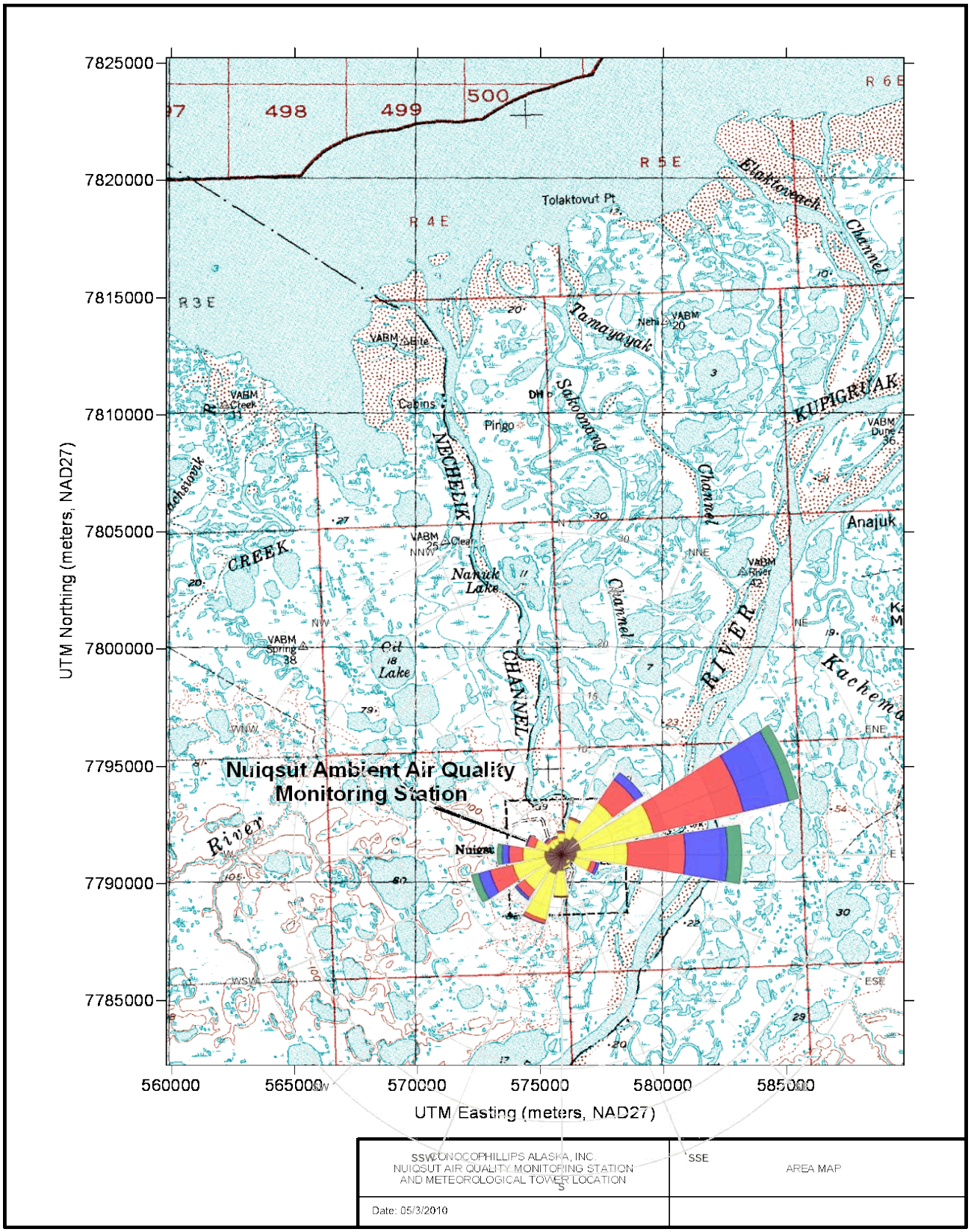


Figure 3-12: Annual Wind Rose Superimposed on Site Map

3.2.2 TEMPERATURE CLIMATOLOGY

Tables 3-9 and 3-10 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

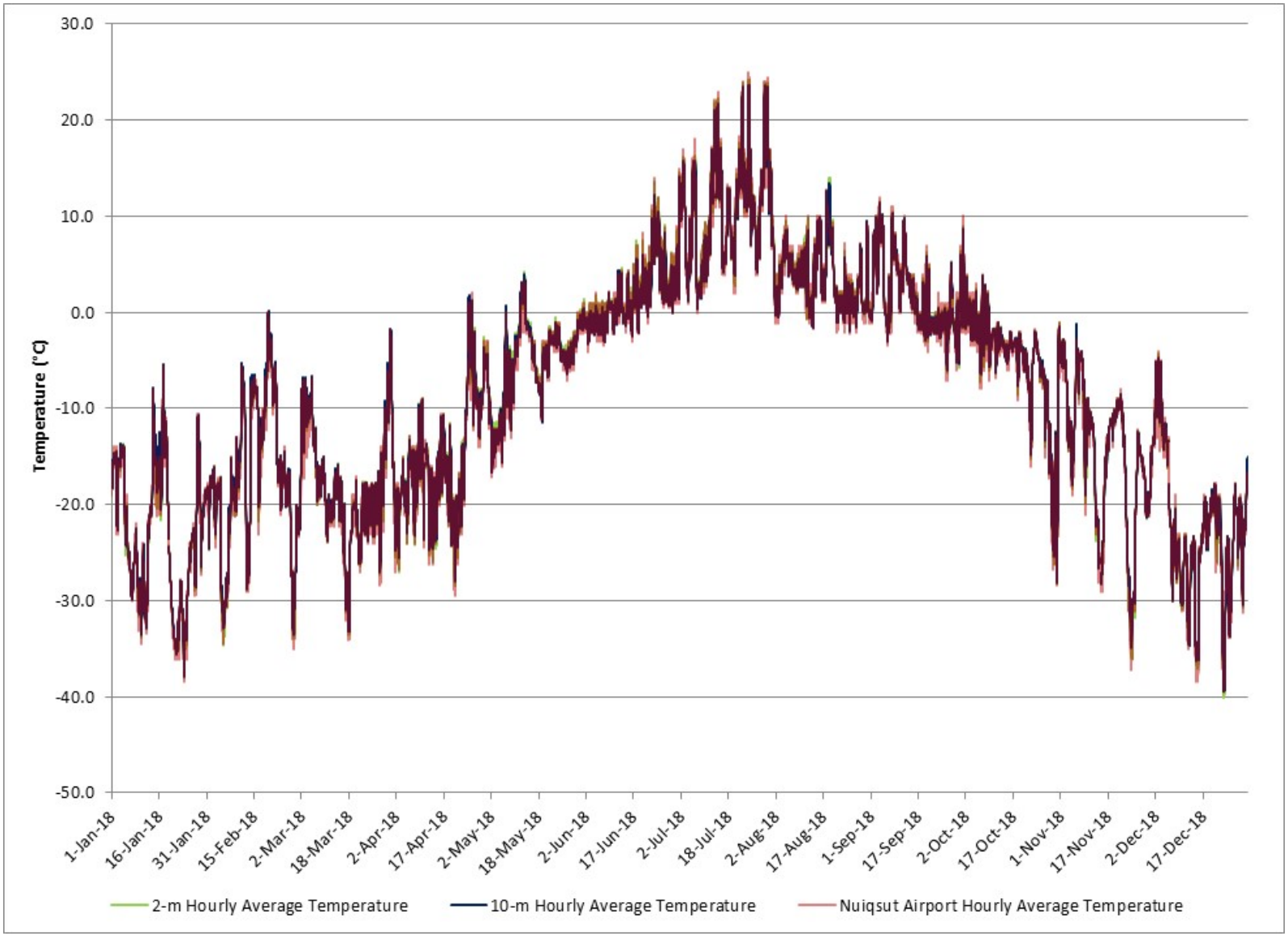
Period	Maximum Daily Mean Temperature (°C)	Minimum Daily Mean Temperature (°C)	Mean Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)
January	-11.0	-34.7	-23.2	-5.5	-37.9
February	-3.0	-31.9	-16.9	0.0	-34.5
March	-5.9	-29.2	-18.3	-1.7	-33.5
1st Quarter	**-3.0**	**-34.7**	**-19.6**	**0.0**	**-37.9**
April	-2.9	-23.7	-15.8	1.5	-28.4
May	2.3	-13.7	-5.0	4.2	-16.3
June	9.3	-0.9	2.0	13.6	-3.1
2nd Quarter	**9.3**	**-23.7**	**-6.2**	**13.6**	**-28.4**
July	19.1	2.4	10.8	24.2	0.5
August	10.1	0.4	3.9	14.0	-1.9
September	8.7	-3.0	1.6	11.6	-6.3
3rd Quarter	**19.1**	**-3.0**	**5.5**	**24.2**	**-6.3**
October	1.5	-22.8	-5.1	8.9	-28.2
November	-3.7	-33.3	-14.7	-1.0	-36.0
December	-7.7	-35.9	-22.7	-4.3	-40.1
4th Quarter	**1.5**	**-35.9**	**-14.1**	**8.9**	**-40.1**
Monitoring Year	**19.1**	**-35.9**	**-8.6**	**24.2 (1)**	**-40.1 (2)**

[1] The maximum hourly average temperature occurred on July 24, 2018.
[2] The minimum hourly average temperature occurred on December 24, 2018.

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	-11.0	-34.6	-23.0	-5.5	-37.8
February	-2.7	-31.3	-16.6	0.1	-33.5
March	-5.9	-28.8	-18.2	-1.7	-33.2
1st Quarter	**-2.7**	**-34.6**	**-19.4**	**0.1**	**-37.8**
April	-2.4	-22.9	-15.6	1.8	-27.9
May	2.3	-14.1	-5.3	4.0	-16.6
June	8.5	-1.4	1.5	12.2	-3.2
2nd Quarter	**8.5**	**-22.9**	**-6.5**	**12.2**	**-27.9**
July	19.3	2.0	10.6	23.7	0.4
August	9.9	0.3	3.6	13.5	-1.9
September	8.8	-2.9	1.6	11.5	-6.0
3rd Quarter	**19.3**	**-2.9**	**5.3**	**23.7**	**-6.0**
October	1.5	-22.3	-5.0	8.7	-28.1
November	-4.0	-32.1	-14.5	-1.2	-34.8
December	-7.6	-35.0	-22.5	-4.7	-39.5
4th Quarter	**1.5**	**-35.0**	**-14.0**	**8.7**	**-39.5**
Monitoring Year	**19.3**	**-35.0**	**-8.6**	**23.7 (1)**	**-39.5 (2)**

[1] The maximum hourly average temperature occurred on July 29, 2018.
[2] The minimum hourly average temperature occurred on December 24, 2018.



[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

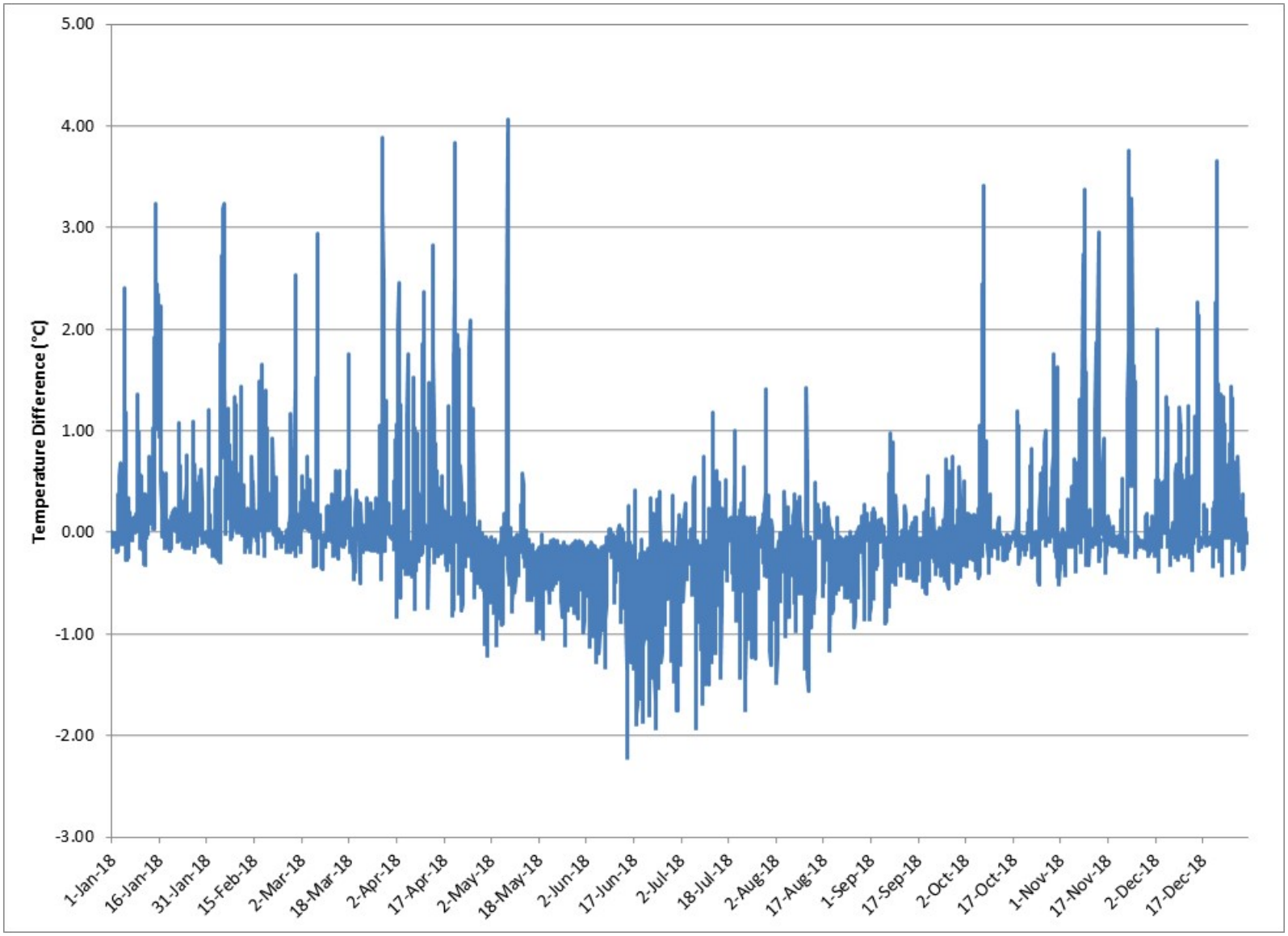


Figure 3-14: Hourly Average Vertical Temperature Difference

3.2.3 OTHER METEOROLOGICAL PARAMETERS

Table 3-11 provides a summary of solar radiation measurements obtained for the 2018 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	21
February	16	286
March	86	492
1st Quarter	**35**	**492**
April	198	761
May	197	794
June	212	769
2nd Quarter	**202**	**794**
July	190	730
August	97	587
September	67	473
3rd Quarter	**118**	**730**
October	25	285
November	2	68
December	0	1
4th Quarter	**9**	**285**
Monitoring Year	**91**	**794**

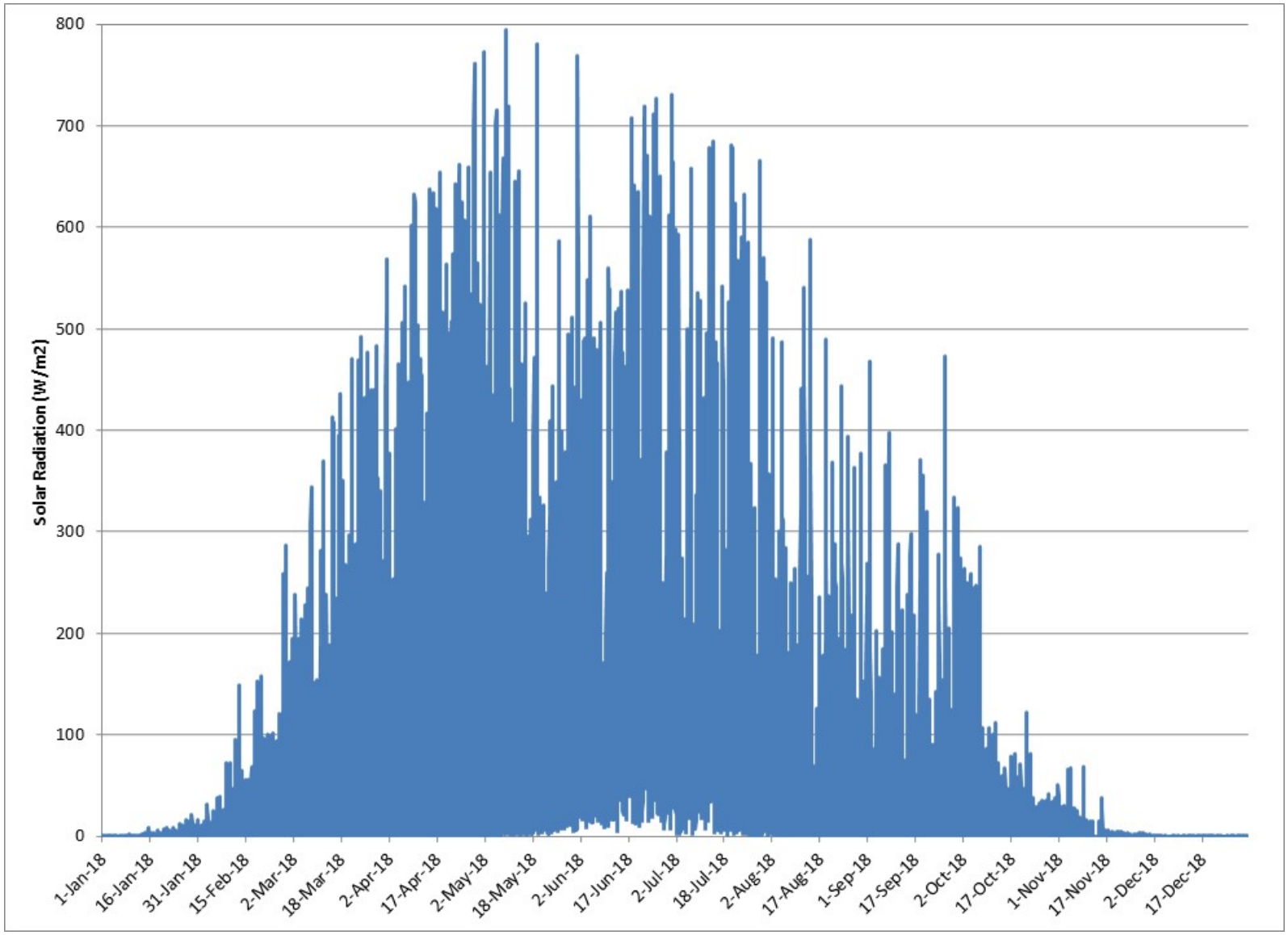


Figure 3-15: Hourly Average Solar Radiation

4. REFERENCES

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

APPENDIX A

DATA PROCESSING SPECIFICATIONS AND STATISTICAL FORMULAE

APPENDIX B

PRECISION DATA

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	98%	98%	98%	98%	61% [3]	97%
February	99%	99%	99%	99%	89%	89%
March	98%	98%	98%	98%	100%	100%
1st Quarter	**99%**	**99%**	**99%**	**99%**	**83%**	**96%**
April	98%	98%	98%	98%	100%	100%
May	99%	99%	99%	99%	100%	100%
June	98%	98%	98%	90%	100%	100%
2nd Quarter	**98%**	**98%**	**98%**	**95%**	**100%**	**100%**
July	48% [4]	63% [5]	63% [5]	34% [6]	74% [7]	55% [8]
August	96%	98%	99%	96%	100%	77% [8]
September	98%	98%	98%	98%	100%	100%
3rd Quarter	**80%**	**86%**	**86%**	76% [6]	**91%**	77% [8]
October	98%	98%	98%	98%	100%	100%
November	98%	98%	98%	97%	100%	100%
December	95%	95%	95%	95%	100%	97%
4th Quarter	**97%**	**97%**	**97%**	**97%**	**100%**	**99%**
Annual	**94%**	**95%**	**95%**	**92%**	**94%**	**93%**

[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] $PM_{2.5}$ data invalidated in January 2018 due to communication and sampler flow errors. Despite the data loss, DQOs were met for the first quarter.
[4] The NO_X analyzer failed its precision check on July 26, 2018. NO_X data were invalidated back to the last passing calibration on July 19, 2018 and the analyzer was recalibrated August 1, 2018. Despite the data loss, DQOs were met for the quarter.
[5] All gas data were invalidated for occasional shelter temperatures that exceeded 30° C or deviated by more than 2°C over 24 hours during the month of July 2018.
[6] The CO analyzer experienced a failure at the end of June 2018 and was repaired July 5, 2018. In addition, the CO analyzer failed its precision check on July 26, 2018. CO data were invalidated back to the last passing calibration on July 19, 2018 and the analyzer was recalibrated August 1, 2018. Due to the combined data loss, DQOs for CO were not met for the third monitoring quarter.
[7] $PM_{2.5}$ data were invalidated in July 2018 due to tape break errors.
[8] PM_{10} data were invalidated frequently in July and August 2018 due to tape break errors. Due to the data loss, DQOs for PM_{10} were not met for the third 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	98%	98%	93%	93%	93%	100%	100%	100%	100%
February	88% [2]	88% [2]	80% [2]	80% [2]	80% [2]	100%	100%	100%	100%
March	100%	100%	100%	100%	100%	100%	100%	100%	99%
1st Quarter	**95%**	**95%**	**91%**	**91%**	**91%**	**100%**	**100%**	**100%**	**100%**
April	99%	99%	99%	99%	99%	99%	99%	99%	99%
May	99%	99%	100%	100%	100%	100%	100%	100%	100%
June	99%	99%	100%	100%	100%	100%	100%	100%	100%
2nd Quarter	**99%**	**99%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
July	100%	100%	100%	100%	100%	100%	100%	100%	100%
August	100%	100%	100%	100%	100%	100%	100%	100%	100%
September	94%	94%	100%	100%	100%	100%	100%	100%	100%
3rd Quarter	**98%**	**98%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
October	97%	97%	97%	97%	97%	100%	100%	100%	100%
November	100%	100%	97%	97%	97%	100%	100%	100%	99%
December	99%	99%	89% [3]	89% [3]	89% [3]	99%	99%	99%	100%
4th Quarter	**99%**	**99%**	**94%**	**94%**	**94%**	**100%**	**100%**	**100%**	**100%**
Annual	**98%**	**98%**	**96%**	**96%**	**96%**	**100%**	**100%**	**100%**	**100%**

[1] EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.
[2] Horizontal and vertical wind speed data invalidated due to snow and ice buildup on the sensors February 2018. Despite the data loss, DQOs were met for the first quarter.
[3] Horizontal wind data invalidated due to snow and ice buildup on the sensors December 2018. Despite the data loss, DQOs were met for 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]
1/4/2018	8.2	8.0	2.4	15	1.78	2.05	5.80	-2.24	2.75
1/11/2018	8.2	8.0	3.0						
1/18/2018	8.3	8.0	3.6						
1/25/2018	8.3	8.0	4.2						
1/31/2018 [2]	8.3	8.0	3.6						
1/31/2018 [3]	7.9	8.0	-1.6						
2/1/2018	7.9	8.0	-0.7						
2/8/2018	8.0	8.0	0.3						
2/15/2018	7.9	8.0	-0.9						
2/22/2018	7.9	8.0	-1.3						
3/1/2018	8.1	8.0	1.8						
3/13/2018	8.2	8.0	2.9						
3/15/2018	8.2	8.0	2.4						
3/22/2018	8.3	8.0	4.1						
3/29/2018	8.2	8.0	2.8						

[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]
4/5/2018	8.4	8.0	4.7	22	1.23	1.77	4.71	-2.24	2.23
4/7/2018 [2]	8.3	8.0	3.8						
4/7/2018 [3]	7.9	8.0	-0.8						
4/12/2018	8.0	8.0	0.4						
4/12/2018	8.0	8.0	0.2						
4/19/2018	8.1	8.0	0.8						
4/26/2018	8.1	8.0	0.9						
5/3/2018	8.1	8.0	1.4						
5/10/2018	8.1	8.0	1.6						
5/17/2018	8.1	8.0	1.6						
5/24/2018	8.2	8.0	2.2						
5/26/2018 [2]	8.2	8.0	2.6						
5/26/2018 [3]	8.0	8.0	0.4						
5/31/2018	8.0	8.0	-0.2						
6/7/2018	8.0	8.0	-0.3						
6/9/2018 [2]	8.0	8.0	-0.4						
6/9/2018 [3]	8.0	8.0	-0.4						
6/14/2018	8.0	8.0	0.0						
6/20/2018 [2]	7.9	8.0	-1.3						
6/20/2018 [3]	8.2	8.0	2.1						
6/21/2018	8.2	8.0	2.7						
6/28/2018	8.4	8.0	5.3						

[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]
7/4/2018	7.4	8.0	-7.0	20	1.82	4.25	10.15	-6.51	5.43
7/5/2018 [2]	- [4]	- [4]	- [4]						
7/5/2018 [3]	7.9	8.0	-1.4						
7/12/2018	8.2	8.0	2.7						
7/19/2018	8.7	8.0	8.5						
7/26/2018	8.9 [5]	8.0 [5]	11.7 [5]						
8/1/2018 [2]	7.9	8.0	-1.3						
8/1/2018 [3]	7.9	8.0	-1.1						
8/2/2018	8.0	8.0	-0.1						
8/9/2018	8.3	8.0	4.0						
8/15/2018 [2]	8.6	8.0	7.7						
8/15/2018 [3]	7.9	8.0	-1.9						
8/16/2018	7.9	8.0	-1.6						
8/23/2018	8.1	8.0	1.1						
8/30/2018	8.3	8.0	3.6						
9/6/2018	8.4	8.0	4.5						
9/10/2018	8.0	8.0	-0.5						
9/13/2018	8.0	8.0	-0.1						
9/18/2018	8.1	8.0	1.1						
9/20/2018	8.2	8.0	2.2						
9/27/2018	8.3	8.0	4.3						

[1] Acceptance criteria: ≤ 10%
[2] As-found; pre-calibration.
[3] As-left; post calibration.
[4] The CO analyzer (serial number: 9130050) failed on June 28, 2018 and was replaced with serial number: CM09200034. Valid data collection began on July 5, 2018. The July 4 precision check was collected using CM0920034.
[5] The CO analyzer failed the precision check on July 26, 2018. CO data invalidated back to last passing calibration on July 19, 2018 and the analyzer was recalibrated August 1, 2018. See Section 2.2 for more information.

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]
10/2/2018 [2]	8.5	8.0	5.7	30	-1.36	3.05	4.62	-7.34	3.69
10/2/2018 [3]	8.0	8.0	-0.1						
10/4/2018	8.0	8.0	0.4						
10/11/2018	8.2	8.0	2.0						
10/18/2018	8.2	8.0	3.0						
10/25/2018	8.4	8.0	4.7						
10/30/2018 [2]	8.5	8.0	6.0						
10/30/2018 [3]	7.9	8.0	-1.6						
11/1/2018	7.9	8.0	-1.4						
11/8/2018	8.0	8.0	-0.3						
11/14/2018 [2]	8.1	8.0	1.6						
11/14/2018 [3]	7.7	8.0	-3.4						
11/15/2018	7.6	8.0	-5.0						
11/17/2018 [2]	7.5	8.0	-6.0						
11/17/2018 [3]	7.9	8.0	-1.8						
11/22/2018	7.8	8.0	-2.8						
11/25/2018 [2]	7.7	8.0	-3.3						
11/25/2018 [3]	7.9	8.0	-1.7						
11/29/2018	7.8	8.0	-2.7						
12/6/2018	7.7	8.0	-3.5						
12/6/2018 [2]	7.7	8.0	-3.7						
12/6/2018 [3]	7.8	8.0	-2.3						
12/8/2018 [2]	7.8	8.0	-2.3						
12/8/2018 [3]	7.8	8.0	-2.8						
12/13/2018 [2]	7.8	8.0	-3.0						
12/13/2018 [3]	7.7	8.0	-3.3						
12/18/2018 [2]	7.7	8.0	-4.0						
12/18/2018 [3]	7.8	8.0	-3.0						
12/20/2018	7.7	8.0	-3.3						
12/27/2018	7.8	8.0	-3.1						

[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]
1/4/2018	78.5	80.0	-1.9	15	0.70	2.21	5.04	-3.64	2.97
1/11/2018	78.8	80.0	-1.5						
1/18/2018	77.8	80.0	-2.8						
1/25/2018	81.1	80.0	1.4						
1/31/2018 [2]	79.1	80.0	-1.1						
1/31/2018 [3]	82.3	80.0	2.9						
2/1/2018	83.8	80.0	4.8						
2/8/2018	83.5	80.0	4.4						
2/15/2018	81.2	80.0	1.5						
2/22/2018	80.2	80.0	0.3						
3/1/2018	81.4	80.0	1.8						
3/13/2018	79.2	80.0	-1.0						
3/15/2018	80.9	80.0	1.1						
3/22/2018	79.6	80.0	-0.5						
3/29/2018	81.0	80.0	1.3						

[1] Acceptance criteria: ≤ 15%
[2] As-found; pre-calibration.
[3] 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]
4/5/2018	78.5	80.0	-1.9	16	-2.83	2.08	1.26	-6.91	2.76
4/12/2018	78.8	80.0	-1.5						
4/12/2018	78.2	80.0	-2.3						
4/19/2018	79.4	80.0	-0.8						
4/26/2018	76.7	80.0	-4.1						
5/3/2018	77.9	80.0	-2.6						
5/10/2018	77.2	80.0	-3.5						
5/17/2018	76.2	80.0	-4.8						
5/24/2018	76.4	80.0	-4.5						
5/31/2018	75.7	80.0	-5.4						
6/7/2018	75.4	80.0	-5.8						
6/9/2018 [2]	75.1	80.0	-6.1						
6/9/2018 [3]	79.0	80.0	-1.3						
6/14/2018	80.3	80.0	0.4						
6/21/2018	80.0	80.0	0.0						
6/28/2018	79.0	80.0	-1.3						

[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]
7/5/2018	78.8	80.0	-1.5	15	-0.51	4.17	7.66	-8.67	5.58
7/12/2018	76.6	80.0	-4.3						
7/19/2018	74.0	80.0	-7.5						
7/26/2018	**70.8** [4]	**80.0** [4]	**-11.5** [4]						
8/1/2018 [2]	**-** [4]	**-** [4]	**-** [4]						
8/1/2018 [3]	80.2	80.0	0.3						
8/2/2018	81.5	80.0	1.9						
8/9/2018	81.2	80.0	1.5						
8/16/2018	80.6	80.0	0.8						
8/23/2018	81.0	80.0	1.3						
8/30/2018	81.2	80.0	1.5						
9/6/2018	80.7	80.0	0.9						
9/13/2018	80.7	80.0	0.9						
9/18/2018	81.7	80.0	2.1						
9/20/2018	83.4	80.0	4.3						
9/27/2018	81.5	80.0	1.9						

[1] Acceptance criteria: ≤ 15%
[2] As-found; pre-calibration.
[3] As-left; post calibration.
[4] The NO_X analyzer failed the precision check on July 26, 2018. NO_X data invalidated back to last passing calibration on July 19, 2018 and the analyzer was recalibrated August 1, 2018. See Section 2.2 for more information.

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]
10/4/2018	82.2	80.0	2.8	24	2.80	4.63	11.87	-6.27	5.76
10/11/2018	83.2	80.0	4.0						
10/18/2018	83.8	80.0	4.8						
10/25/2018	83.3	80.0	4.1						
10/30/2018 [2]	87.3	80.0	9.1						
10/30/2018 [3]	81.6	80.0	2.0						
11/1/2018	81.1	80.0	1.4						
11/8/2018	80.9	80.0	1.1						
11/15/2018	85.9	80.0	7.4						
11/22/2018	84.4	80.0	5.5						
11/25/2018 [2]	86.4	80.0	8.0						
11/25/2018 [3]	81.2	80.0	1.5						
11/29/2018	80.4	80.0	0.5						
12/6/2018	79.7	80.0	-0.4						
12/6/2018 [2]	79.2	80.0	-1.0						
12/6/2018 [3]	78.5	80.0	-1.9						
12/8/2018 [2]	70.4	80.0	-12.0						
12/8/2018 [3]	79.2	80.0	-1.0						
12/13/2018 [2]	85.5	80.0	6.9						
12/13/2018 [3]	85.4	80.0	6.8						
12/18/2018 [2]	88.4	80.0	10.5						
12/18/2018 [3]	80.6	80.0	0.8						
12/20/2018	81.9	80.0	2.4						
12/27/2018	83.3	80.0	4.1						

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

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]
1/4/2018	83.9	80.0	4.9	15	2.55	2.05	6.57	-1.47	2.75
1/11/2018	84.4	80.0	5.5						
1/18/2018	84.2	80.0	5.2						
1/25/2018	84.3	80.0	5.4						
1/31/2018 [2]	84.3	80.0	5.4						
1/31/2018 [3]	81.0	80.0	1.2						
2/1/2018	81.2	80.0	1.5						
2/8/2018	80.5	80.0	0.6						
2/15/2018	80.8	80.0	1.0						
2/22/2018	81.5	80.0	1.9						
3/1/2018	80.1	80.0	0.1						
3/13/2018	81.2	80.0	1.5						
3/15/2018	81.3	80.0	1.7						
3/22/2018	81.0	80.0	1.2						
3/29/2018	80.9	80.0	1.1						

[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]
4/5/2018 [2]	80.8	80.0	1.0	15	1.62	0.75	3.10	0.15	1.01
4/12/2018 [2]	81.6	80.0	2.0						
4/12/2018 [2]	81.8	80.0	2.2						
4/19/2018 [2]	81.7	80.0	2.1						
4/26/2018 [2]	80.9	80.0	1.2						
5/3/2018 [2]	81.5	80.0	1.9						
5/10/2018 [2]	80.7	80.0	0.9						
5/17/2018 [2]	81.5	80.0	1.8						
5/24/2018 [2]	80.6	80.0	0.8						
5/31/2018 [2]	81.9	80.0	2.4						
6/7/2018 [2]	81.5	80.0	1.9						
6/12/2018	82.0	80.0	2.5						
6/14/2018	81.9	80.0	2.4						
6/21/2018	81.3	80.0	1.6						
6/28/2018	79.8	80.0	-0.2						

[1] Acceptance criteria: ≤ 7%

[2] Precision verification conducted with expired ozone transfer standard due to delay in receiving primary ozone reference standard from EPA. "As-found" calibration verification conducted on 6/12/2018 demonstrated that instrument accuracy was unaffected despite the transfer standard certification being expired. Data were determined to remain valid despite the procedural deviation.

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]
7/5/2018	80.3	80.0	0.4	15	2.86	1.34	5.48	0.24	1.79
7/12/2018	82.6	80.0	3.3						
7/19/2018	80.9	80.0	1.2						
7/26/2018	81.8	80.0	2.3						
8/2/2018 [2]	80.8	80.0	1.0						
8/2/2018 [3]	82.8	80.0	3.5						
8/9/2018	83.8	80.0	4.7						
8/16/2018	84.0	80.0	5.0						
8/23/2018	83.3	80.0	4.1						
8/30/2018	82.2	80.0	2.8						
9/6/2018	82.6	80.0	3.3						
9/13/2018	83.0	80.0	3.8						
9/19/2018	82.4	80.0	3.0						
9/20/2018	81.5	80.0	1.9						
9/27/2018	82.3	80.0	2.8						

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

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]
10/4/2018	83.7	80.0	4.6	16	3.84	0.96	5.72	1.95	1.28
10/11/2018	82.8	80.0	3.5						
10/18/2018	82.8	80.0	3.5						
10/25/2018	82.8	80.0	3.5						
10/30/2018	83.5	80.0	4.4						
11/1/2018	82.8	80.0	3.5						
11/8/2018	82.6	80.0	3.2						
11/15/2018	82.2	80.0	2.7						
11/22/2018	84.0	80.0	5.0						
11/29/2018	81.6	80.0	1.9						
12/6/2018 [2]	83.7	80.0	4.6						
12/6/2018 [3]	82.7	80.0	3.3						
12/8/2018	83.8	80.0	4.8						
12/13/2018	82.9	80.0	3.7						
12/20/2018	82.7	80.0	3.3						
12/27/2018	84.7	80.0	5.9						

[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]
1/4/2018	80.3	78.0	2.9	15	0.72	1.02	2.72	-1.29	1.37
1/11/2018	78.9	78.0	1.2						
1/18/2018	78.2	78.0	0.3						
1/25/2018	78.2	78.0	0.3						
1/31/2018 [2]	79.7	78.2	1.9						
1/31/2018 [3]	77.9	78.4	-0.6						
2/1/2018	78.1	78.0	0.1						
2/8/2018	77.1	78.0	-1.1						
2/15/2018	78.0	78.0	0.1						
2/22/2018	78.8	78.0	1.0						
3/1/2018	78.5	78.0	0.6						
3/13/2018	79.2	78.0	1.6						
3/15/2018	78.1	78.0	0.2						
3/22/2018	78.8	78.0	1.1						
3/29/2018	79.1	78.0	1.4						

[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]
4/5/2018	78.8	78.0	1.1	22	0.19	1.11	2.37	-1.99	1.40
4/7/2018 [2]	78.5	78.0	0.6						
4/7/2018 [3]	78.0	78.0	0.0						
4/12/2018	77.7	78.0	-0.4						
4/12/2018	78.8	78.2	0.8						
4/19/2018	77.9	78.0	-0.1						
4/26/2018	78.9	78.0	1.1						
5/3/2018	78.3	78.0	0.4						
5/10/2018	77.8	78.0	-0.2						
5/17/2018	79.6	78.0	2.1						
5/24/2018	78.9	78.0	1.1						
5/26/2018 [2]	79.2	78.0	1.5						
5/26/2018 [3]	78.1	78.0	0.1						
5/31/2018	76.8	78.0	-1.5						
6/7/2018	77.6	78.0	-0.5						
6/9/2018 [2]	76.4	78.2	-2.2						
6/9/2018 [3]	77.7	78.2	-0.7						
6/14/2018	77.0	78.0	-1.3						
6/20/2018 [2]	77.8	78.0	-0.2						
6/20/2018 [3]	78.3	78.0	0.4						
6/21/2018	77.9	78.0	-0.2						
6/28/2018	79.8	78.0	2.3						

[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]
7/4/2018	79.0	78.0	1.3	21	1.13	1.38	3.83	-1.58	1.75
7/5/2018	78.5	78.0	0.6						
7/12/2018	78.6	78.0	0.8						
7/19/2018	80.3	78.0	3.0						
7/26/2018 [2]	80.4	78.0	3.1						
7/26/2018 [3]	79.8	78.5	1.6						
8/1/2018 [2]	75.9	78.3	-3.0						
8/1/2018 [3]	79.0	78.3	0.8						
8/2/2018	77.4	78.0	-0.8						
8/9/2018	78.6	78.0	0.7						
8/15/2018 [2]	79.0	78.0	1.3						
8/15/2018 [3]	77.9	78.0	-0.1						
8/16/2018	79.5	78.0	1.9						
8/23/2018	78.6	78.0	0.7						
8/30/2018	78.6	78.0	0.7						
9/6/2018	79.4	78.0	1.8						
9/10/2018	79.9	78.0	2.4						
9/13/2018	80.2	78.0	2.8						
9/18/2018	78.9	78.4	0.7						
9/20/2018	78.9	78.0	1.1						
9/27/2018	79.7	78.0	2.2						

[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]
10/2/2018 [2]	80.6	78.0	3.3	30	0.50	1.11	2.93	-1.93	1.50
10/2/2018 [3]	79.2	78.0	1.5						
10/4/2018	78.4	78.0	0.5						
10/11/2018	78.3	78.0	0.4						
10/18/2018	79.6	78.0	2.1						
10/25/2018	79.5	78.0	1.9						
10/30/2018 [2]	79.4	78.0	1.8						
10/30/2018 [3]	79.2	78.0	1.5						
11/1/2018	78.4	78.0	0.5						
11/8/2018	78.6	78.0	0.8						
11/14/2018 [2]	77.8	78.0	-0.2						
11/14/2018 [3]	77.8	78.0	-0.2						
11/15/2018	77.7	78.0	-0.4						
11/17/2018 [2]	78.4	78.0	0.5						
11/17/2018 [3]	78.1	78.0	0.2						
11/22/2018	78.8	78.0	1.1						
11/25/2018 [2]	77.0	78.0	-1.3						
11/25/2018 [3]	77.5	78.0	-0.6						
11/29/2018	78.3	78.0	0.4						
12/6/2018	79.1	78.0	1.4						
12/6/2018 [2]	78.0	78.0	0.0						
12/6/2018 [3]	79.7	78.0	2.2						
12/8/2018 [2]	78.6	78.0	0.8						
12/8/2018 [3]	78.3	78.0	0.4						
12/13/2018 [2]	77.5	78.0	-0.6						
12/13/2018 [3]	77.9	78.0	-0.2						
12/18/2018 [2]	76.8	78.0	-1.5						
12/18/2018 [3]	77.6	78.0	-0.5						
12/20/2018	77.3	78.0	-0.9						
12/27/2018	78.2	78.0	0.2						

[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 $\mu g/m^3$	54	-9.3	18.9	15.3
2nd Quarter (April 1 – June 30)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	61	15.4	20.0	16.1
3rd Quarter (July 1 – September 30)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	7	-0.2	23.2	27.0
4th Quarter (October 1 – December 31)	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	44	-33.0	17.1	14.1
Year to Date	BAM $PM_{2.5}$ Primary against BAM $PM_{2.5}$ Collocated	≥3 $\mu g/m^3$	166	-6.1	26.90	20.49

[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.