

# NUIQSUT AMBIENT AIR AND METEOROLOGICAL MONITORING PROGRAM

**2020 Annual Report**

Prepared for:  
ConocoPhillips Alaska, Inc.

May 2021

# 2020 Annual Report

Prepared for:  
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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.



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## REVISIONS

March 2021	Original
May 2021	Formatting Corrections

## ACRONYMS

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

## SUMMARY

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

The Nuiqsut monitoring program is designed and operated in accordance with applicable U.S. Environmental Protection Agency (USEPA) Prevention of Significant Deterioration (PSD) regulations and guidance documents. This report provides details of ambient air and meteorological measurements collected during the 2020 monitoring year, spanning from January 1, 2020, to December 31, 2020, 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/AAQs). Table E-3 and Table E-4 provide monthly, quarterly, and annual valid hours and percent data capture for the Nuiqsut meteorological monitoring station. Data not meeting QAPP and PSD precision and accuracy criteria were invalidated and are discussed in Section 2.

Table E-1: QAPP Variation Table

Item / Procedure	Summary of QAPP Variation	Reason for Variation
Performance Audit	A performance audit was not completed during the second monitoring quarter.	Travel restrictions in place during COVID-19 pandemic.
Meteorological Calibration	A meteorological calibration was not completed during the second monitoring quarter.	
Monthly Particulate QC checks	Monthly BAM PM <sub>2.5</sub> /PM <sub>10</sub> quality control checks were not completed in April, May, July, August, and November 2020.	
Mass Flow Controller (MFC) calibration	A gas calibrator MFC calibration was not completed during the third monitoring quarter.	



Table E-2: Nuiqsut Ambient Air Monitoring Summary Data

Pollutant	National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/AAAQS
Nitrogen Dioxide (NO <sub>2</sub> )	53 ppb (100 µg/m <sup>3</sup> )	Annual	Average of Period	4	2	1	1	2	3.8%
	100.0 ppb (190 µg/m <sup>3</sup> )	1-Hour <sup>(2)</sup>	Daily Max 1-Hour Averages (98 <sup>th</sup> Percentile)	--	--	--	--	32.4	32.4%
			1 <sup>st</sup> Highest, 1-Hour Average	46.5	34.4	14.9	25.1	46.5	46.5%
			2 <sup>nd</sup> Highest, 1-Hour Average	35.4	29.9	13.9	18.8	35.4	35.4%
Ozone (O <sub>3</sub> )	0.070 ppm (150 µg/m <sup>3</sup> )	8-Hour <sup>(3)</sup>	4 <sup>th</sup> Highest, 8-Hour Average	0.039	0.041	0.030	0.036	0.041	58.6%
			1 <sup>st</sup> Highest, 8-Hour Average	0.045	0.041	0.033	0.042	0.045	64.3%
			2 <sup>nd</sup> Highest, 8-Hour Average	0.041	0.041	0.033	0.039	0.042	60.0%
Carbon Monoxide (CO)	35 ppm (40,000 µg/m <sup>3</sup> )	1-Hour <sup>(1)</sup>	1 <sup>st</sup> Highest, 1-Hour Average	0	0	9	1	9	25.7%
			2 <sup>nd</sup> Highest, 1-Hour Average	0	0	9	1	9	25.7%
	9 ppm (10,000 µg/m <sup>3</sup> )	8-Hour <sup>(1)</sup>	1 <sup>st</sup> Highest, 8-Hour Average	0	0	4	1	4	44.4%
			2 <sup>nd</sup> Highest, 8-Hour Average	0	0	3	1	3	33.3%

<sup>1</sup> Not to be exceeded more than once each year.

<sup>2</sup> To attain this standard, the 3-year average of the 98<sup>th</sup> percentile of the annual daily maximum 1-hour average must not exceed 100 ppb.

<sup>3</sup> 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	1 <sup>st</sup> Quarter	2 <sup>nd</sup> Quarter	3 <sup>rd</sup> Quarter	4 <sup>th</sup> Quarter	Annual	YTD % of NAAQS/AAAQS
Sulfur Dioxide (SO <sub>2</sub> )	0.030 ppm (80 µg/m <sup>3</sup> )	Annual	Average of Period	0.000	0.000	0.000	0.000	0.000	0.0%
	0.14 ppm (365 µg/m <sup>3</sup> )	24-Hour <sup>(5)</sup>	1 <sup>st</sup> Highest, 1-Hour Average	0.00	0.00	0.00	0.00	0.00	0.0%
			2 <sup>nd</sup> Highest, 1-Hour Average	0.00	0.00	0.00	0.00	0.00	0.0%
	0.5 ppm (1,300 µg/m <sup>3</sup> )	3-Hour <sup>(5)</sup>	1 <sup>st</sup> Highest, 3-Hour Average	0.0	0.0	0.0	0.0	0.0	0.0%
			2 <sup>nd</sup> Highest, 3-Hour Average	0.0	0.0	0.0	0.0	0.0	0.0%
	75.0 ppb (196 µg/m <sup>3</sup> )	1-Hour <sup>(4)</sup>	Daily Max 1-Hour Averages (99 <sup>th</sup> Percentile)	--	--	--	--	4.2	5.6%
			1 <sup>st</sup> Highest, 1-Hour Average	5.0	2.1	1.8	0.0	5.0	6.7%
			2 <sup>nd</sup> Highest, 1-Hour Average	4.8	1.3	1.2	0.0	4.8	6.4%

<sup>4</sup> To attain this standard, the 3-year average of the 99<sup>th</sup> percentile of the annual daily maximum 1-hour average must not exceed 75.0 ppb.

<sup>5</sup> 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/AAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1 <sup>st</sup> Quarter	2 <sup>nd</sup> Quarter	3 <sup>rd</sup> Quarter	4 <sup>th</sup> Quarter	Annual	YTD % of NAAQS/AAQS
Particulate Matter <2.5 microns (PM <sub>2.5</sub> )	12.0 µg/m <sup>3</sup>	Annual <sup>(7)</sup>	Average of Period	1.3	1.5	0.9	1.0	1.2	10.0%
	35 µg/m <sup>3</sup>	24-Hour <sup>(6)</sup>	98 <sup>th</sup> Percentile, 24-Hour Average	--	--	--	--	6	17.1%
			1 <sup>st</sup> Highest, 24-Hour Average	5	6	6	8	8	22.9%
			2 <sup>nd</sup> Highest, 24-Hour Average	5	6	6	7	7	20.0%
Particulate Matter <10 microns (PM <sub>10</sub> )	150 µg/m <sup>3</sup>	24-Hour <sup>(8,9)</sup>	1 <sup>st</sup> Highest, 24-Hour Average	10	110	30	30	110	73.3%
			2 <sup>nd</sup> Highest, 24-Hour Average	10	60	30	20	60	40.0%

<sup>6</sup>To attain this standard, the 3-year average of the 98<sup>th</sup> percentile of the 24-hour concentration must not exceed 35.0 µg/m<sup>3</sup>.

<sup>7</sup>To attain this standard, the 3-year average of the weighted annual mean PM<sub>2.5</sub> concentration must not exceed 12.0 µg/m<sup>3</sup>.

<sup>8</sup>Not to be exceeded more than once per year on average over three years.

<sup>9</sup>40 CFR Appendix K requires that reportable concentrations of PM<sub>10</sub> be rounded to the nearest 10 µg/m<sup>3</sup>; actual measurement results are within Appendix D.

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

Period	Meteorological Parameters – Valid Hours per Month <sup>(1)</sup>								
	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	Horizontal Wind Speed <sup>(2)</sup>	Horizontal Wind Direction <sup>(2)</sup>	Wind Direction Std. Dev. (Sigma Theta) <sup>(2)</sup>	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January	743	743	743	743	743	743	743	743	743
February	696	696	696	696	696	696	696	696	696
March	743	743	743	743	743	743	743	743	743
<b>1<sup>st</sup> Quarter</b>	<b>2182</b>	<b>2182</b>	<b>2182</b>	<b>2182</b>	<b>2182</b>	<b>2182</b>	<b>2182</b>	<b>2182</b>	<b>2182</b>
April	701	701	720	720	720	720	720	720	703
May	744	744	744	744	744	744	744	744	744
June	719	719	719	719	719	719	719	719	719
<b>2<sup>nd</sup> Quarter</b>	<b>2164</b>	<b>2164</b>	<b>2183</b>	<b>2183</b>	<b>2183</b>	<b>2183</b>	<b>2183</b>	<b>2183</b>	<b>2166</b>
July	743	743	743	743	743	743	743	743	743
August	741	741	741	741	741	741	741	741	741
September	718	718	718	718	718	718	718	718	718
<b>3<sup>rd</sup> Quarter</b>	<b>2202</b>	<b>2202</b>	<b>2202</b>	<b>2202</b>	<b>2202</b>	<b>2202</b>	<b>2202</b>	<b>2202</b>	<b>2202</b>
October	737	737	737	737	737	736	637 <sup>(4)</sup>	637 <sup>(4)</sup>	739
November	720	720	720	720	720	720	720	720	720
December	739	739	589 <sup>(3)</sup>	589 <sup>(3)</sup>	589 <sup>(3)</sup>	739	739	739	742
<b>4<sup>th</sup> Quarter</b>	<b>2196</b>	<b>2196</b>	<b>2046</b>	<b>2046</b>	<b>2046</b>	<b>2195</b>	<b>2096</b>	<b>2096</b>	<b>2201</b>
<b>Annual</b>	<b>8744</b>	<b>8744</b>	<b>8613</b>	<b>8613</b>	<b>8613</b>	<b>8762</b>	<b>8663</b>	<b>8663</b>	<b>8751</b>

<sup>1</sup> EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.

<sup>2</sup> Data from the secondary horizontal wind sensor were used during the monitoring year.

<sup>3</sup> Horizontal wind data were invalidated during December 2020 due to snow and ice buildup on the sensors. Despite the data loss, DQOs were met during the fourth quarter.

<sup>4</sup> 10m temperature and Delta-T data were invalidated during October 2020 due to malfunctioning sensors. Despite the data loss, DQOs were met during the fourth quarter.

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

Period	Meteorological Parameters – Data Recovery <sup>(1)</sup>								
	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	Horizontal Wind Speed <sup>(2)</sup>	Horizontal Wind Direction <sup>(2)</sup>	Wind Direction Std. Dev. (Sigma Theta) <sup>(2)</sup>	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January	100%	100%	100%	100%	100%	100%	100%	100%	100%
February	100%	100%	100%	100%	100%	100%	100%	100%	100%
March	100%	100%	100%	100%	100%	100%	100%	100%	100%
<b>1<sup>st</sup> Quarter</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>
April	97%	97%	100%	100%	100%	100%	100%	100%	98%
May	100%	100%	100%	100%	100%	100%	100%	100%	100%
June	100%	100%	100%	100%	100%	100%	100%	100%	100%
<b>2<sup>nd</sup> Quarter</b>	<b>99%</b>	<b>99%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>99%</b>
July	100%	100%	100%	100%	100%	100%	100%	100%	100%
August	100%	100%	100%	100%	100%	100%	100%	100%	100%
September	100%	100%	100%	100%	100%	100%	100%	100%	100%
<b>3<sup>rd</sup> Quarter</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>
October	99%	99%	99%	99%	99%	99%	86% <sup>(4)</sup>	86% <sup>(4)</sup>	99%
November	100%	100%	100%	100%	100%	100%	100%	100%	100%
December	99%	99%	79% <sup>(3)</sup>	79% <sup>(3)</sup>	79% <sup>(3)</sup>	99%	99%	99%	100%
<b>4<sup>th</sup> Quarter</b>	<b>99%</b>	<b>99%</b>	<b>93%</b>	<b>93%</b>	<b>93%</b>	<b>99%</b>	<b>95%</b>	<b>95%</b>	<b>100%</b>
<b>Annual</b>	<b>100%</b>	<b>100%</b>	<b>98%</b>	<b>98%</b>	<b>98%</b>	<b>100%</b>	<b>99%</b>	<b>99%</b>	<b>100%</b>

<sup>1</sup> EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.

<sup>2</sup> Data from the secondary horizontal wind sensor were used during the monitoring year.

<sup>3</sup> Horizontal wind data were invalidated during December 2020 due to snow and ice buildup on the sensors. Despite the data loss, DQOs were met during the fourth quarter.

<sup>4</sup> 10m temperature and Delta-T data were invalidated during October 2020 due to malfunctioning sensors. Despite the data loss, DQOs were met during 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<sub>3</sub>), carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), particulate matter with an aerodynamic diameter of 10 microns or less (PM<sub>10</sub>), and particulate matter with an aerodynamic diameter of 2.5 microns or less (PM<sub>2.5</sub>) 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<sub>2</sub>, NO<sub>x</sub>, and NO)
- Ozone (O<sub>3</sub>)
- Sulfur dioxide (SO<sub>2</sub>)
- Inhalable particulate matter less than 2.5 microns (PM<sub>2.5</sub>)
- Inhalable particulate matter less than 10 microns (PM<sub>10</sub>)

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<sup>2</sup>])

The Nuiqsut station calculates the following meteorological parameters:

- Horizontal wind direction standard deviation (Sigma Theta [ $\sigma_\theta$ ])
- Vertical wind speed standard deviation (Sigma Omega [ $\sigma_\omega$ ])
- Temperature difference ( $\Delta T$ , “Delta T” (degrees Celsius [ $^{\circ}\text{C}$ ]), 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.

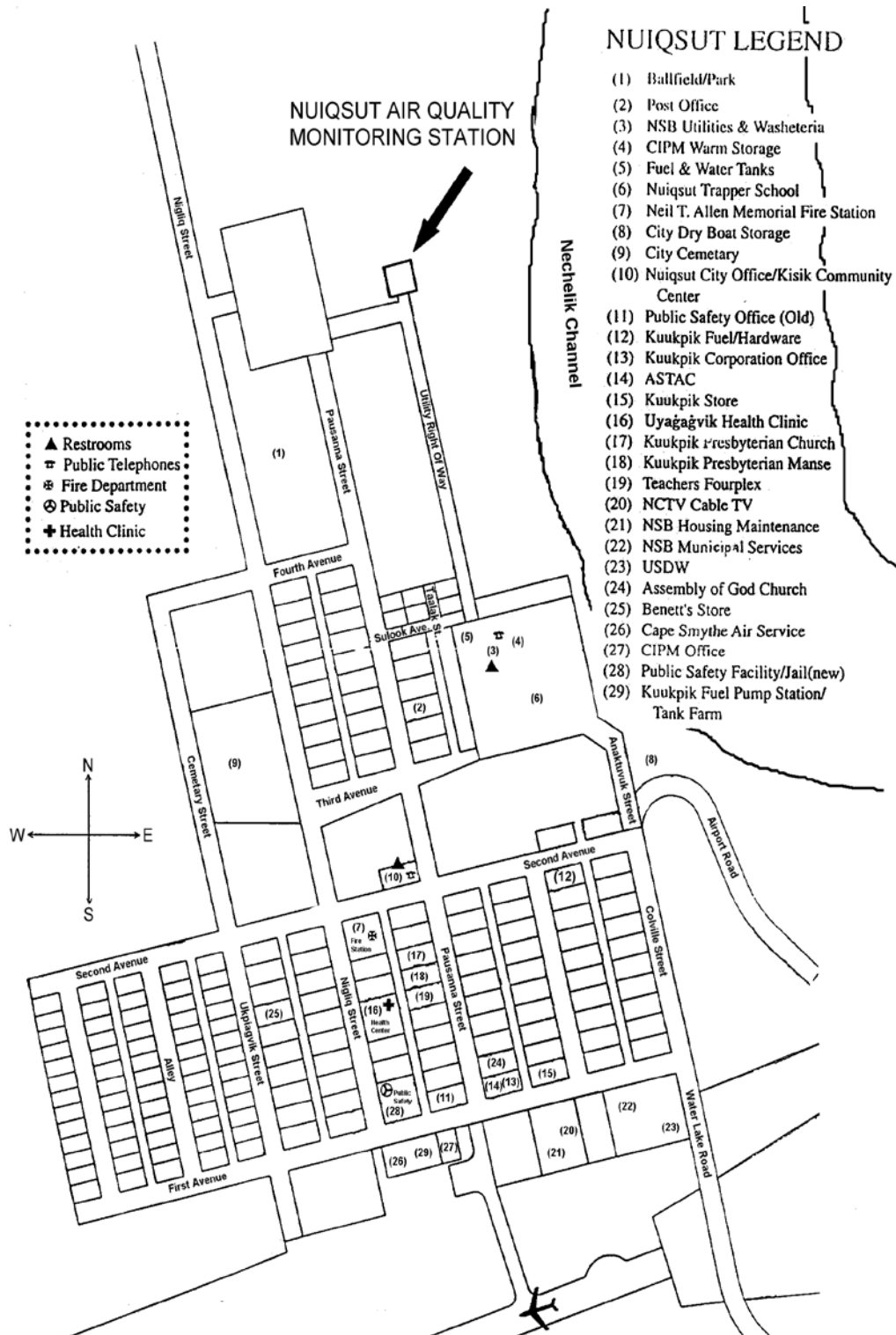


Figure 1-1: Local Map of Nuiqsut





Figure 1-2: Aerial Photo Showing Site Location



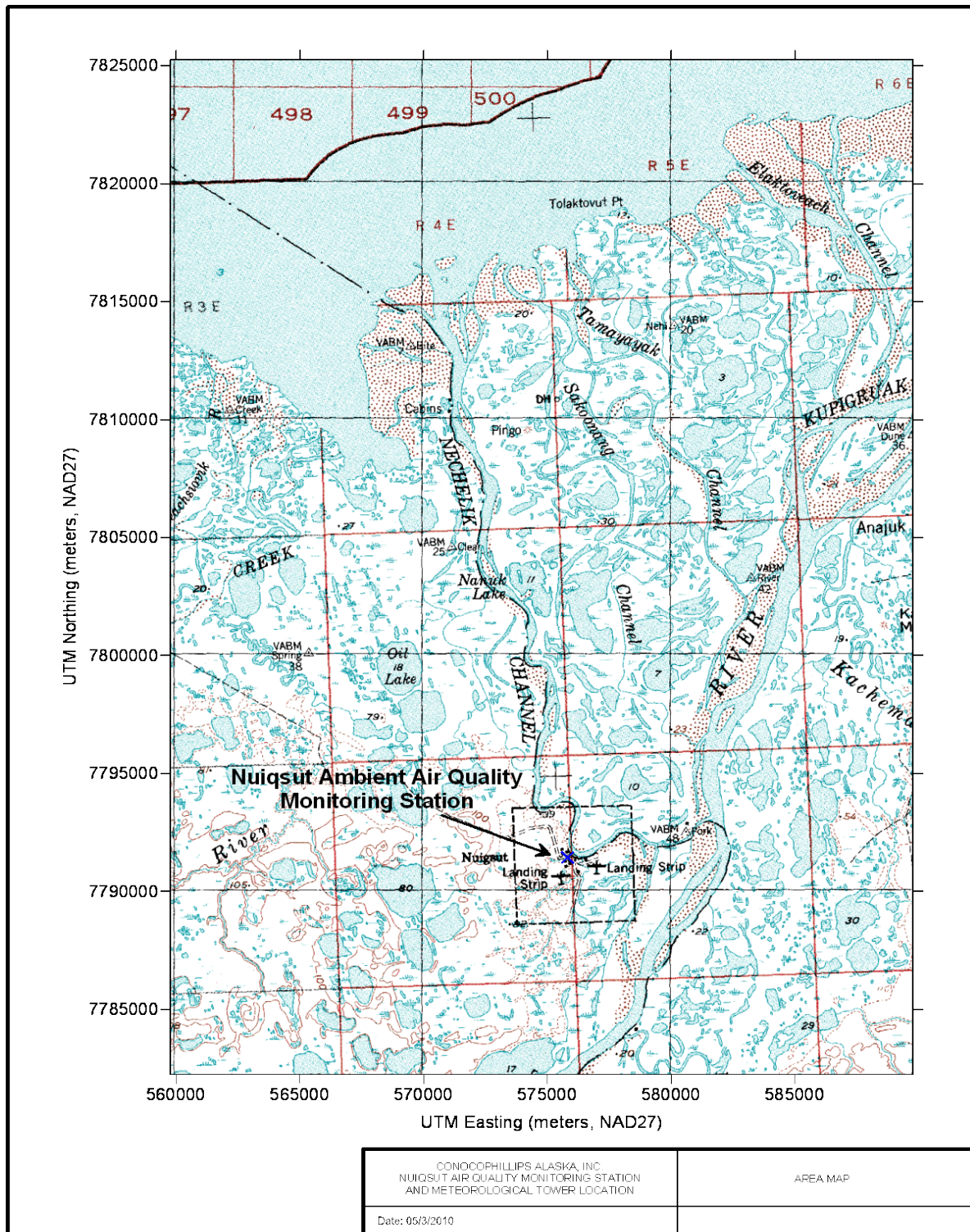


Figure 1-3: Map of Nuiqsut Project Area

## 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<sub>2</sub>, O<sub>3</sub>, CO AND SO<sub>2</sub> 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) <sup>(1)</sup>	API T300 Non-dispersive Infrared (NDIR) absorbance spectroscopy	Reference method RFCA-1093-093 40 CFR 53	Parts per million (ppm)	Continuous	1-hour
	Thermo 48i Gas filter correlation analyzer	EPA reference method RFCA-0981-054			
Nitrogen Dioxide (NO <sub>2</sub> ) <sup>(2, 3)</sup>	Thermo Scientific 42i Chemiluminescent NO <sub>x</sub> gas analyzer	EPA reference method RFNA-1289-074	Parts per billion (ppb)		
	API T200U Chemiluminescent NO <sub>x</sub> gas analyzer	EPA reference method RFNA-1194-099			
Ozone (O <sub>3</sub> )	API T400 UV Photometric Ozone analyzer	EPA equivalent method EQOA-0992-087			
Sulfur Dioxide (SO <sub>2</sub> ) <sup>(4)</sup>	Thermo 43i Pulsed fluorescence SO <sub>2</sub> gas analyzer	EPA equivalent method EQSA-0486-060			
	API T100U Pulsed fluorescence SO <sub>2</sub> gas analyzer	EPA equivalent method EQSA-0495-100			

<sup>1</sup> API analyzer was switched for the Thermo analyzer on August 24, 2020.

<sup>2</sup> Total oxides of nitrogen (NO<sub>x</sub>) and nitrogen oxide (NO) are also measured.

<sup>3</sup> API instrument was used January 1 – October 20, 2020. Thermo instrument was installed October 20, 2020.

<sup>4</sup> Thermo instrument was used January 1 – March 31, 2020. API instrument was installed January 22, 2020 and reported beginning April 1, 2020.

## 1.2.2 CONTINUOUS PM<sub>10</sub> AND PM<sub>2.5</sub> MONITORING

Monitoring for PM<sub>10</sub>/PM<sub>2.5</sub> data was conducted in accordance with the requirements and guidance in 40 CFR Parts 50, 53, and 58. PM<sub>10</sub> and PM<sub>2.5</sub> 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<sub>10</sub>: FEM EQPM-0798-122 and PM<sub>2.5</sub> Class III FEM EQPM-0308-170. For EPA reference method sampling, the PM<sub>2.5</sub> 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<sub>2.5</sub> collocation station at the nearby Alpine CD1 pad. As such, filter-based samplers for assessing precision were not run at Nuiqsut. Network PM<sub>2.5</sub> precision statistics were evaluated using collocated sampling at CD1.

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

**Table 1-2: PM Monitoring Measurement Parameters**

Parameter	Units	Sampling Schedule	Sample Period	Averaging Time
PM <sub>2.5</sub>	Micrograms per cubic meter (µg/m <sup>3</sup> )	Continuous	1-Hour <sup>(1)</sup>	24-Hour (Average) <sup>(1)</sup>
PM <sub>10</sub>	Micrograms per cubic meter (µg/m <sup>3</sup> )	Continuous	1-Hour <sup>(1)</sup>	24-Hour (Average) <sup>(1)</sup>
Sample Volume	Cubic meters (m <sup>3</sup> )	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)			

<sup>1</sup> 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 <sup>2</sup>	± 2%	10 W/m <sup>2</sup>	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.

The project QAPP specifies that QC checks of the particulate samplers should be performed on a monthly basis. These checks were not performed in April, May, July, August, and November of 2020. The April, May, July, August, and November QC checks were not performed as COVID-19 related travel restrictions prevented project personnel from reaching the site to perform the checks in those months. In addition, the project QAPP specifies that an independent performance audit of the pollutant analyzers should be performed at a quarterly frequency and that a calibration and an independent performance audit of the meteorological sensors be performed semiannually. These calibrations and audits were not performed in the second quarter of 2020. The scheduled calibrations and audits were not performed as travel restrictions put in place to prevent the spread of COVID-19 prevented project personnel and the independent QA auditor from traveling to the North Slope of Alaska, and therefore the scheduled performance audit and meteorological calibration were not performed during this quarter. The project QAPP also specifies that mass flow controller (MFC) calibrations should be performed on a quarterly frequency. However, during the third quarter of 2020, travel restrictions put in place to prevent the spread of COVID-19 prevented the station operator from traveling to the North Slope of Alaska, and therefore the scheduled MFC calibration was not performed during this quarter.

**Table 1-4: QAPP Variation Table**

Item / Procedure	Summary of QAPP Variation	Reason for Variation
Performance Audit	A performance audit was not completed during the second monitoring quarter.	Travel restrictions in place during COVID-19 pandemic.
Meteorological Calibration	A meteorological calibration was not completed during the second monitoring quarter.	
Monthly Particulate QC checks	Monthly BAM PM <sub>2.5</sub> /PM <sub>10</sub> quality control checks were not completed in April, May, July, August, and November 2020.	
Mass Flow Controller (MFC) calibration	A gas calibrator MFC calibration was not completed during the third monitoring quarter.	



## 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 2020 ambient air and meteorological monitoring year.

**Table 2-1: Chronology of Significant Events**

Date	Event
January 1, 2020	Start of the monitoring year.
January 1 – 3, 2020	The CO pump malfunctioned December 21, 2019. CO analyzer (serial number: 1008241341) was removed and replaced with serial number 1527 on January 3, 2020. 61 hours of CO data invalid January 1 – 3, 2020. Three hours of NO <sub>x</sub> and O <sub>3</sub> data, and four hours of SO <sub>2</sub> data invalidated January 3, 2020 during installation of new analyzer.
January 2, 2020	Monthly QC checks performed on PM samplers; all passed. Three hours of PM <sub>2.5</sub> data and two hours of PM <sub>10</sub> data invalidated. An additional precision check was performed on the NO <sub>x</sub> , SO <sub>2</sub> , and O <sub>3</sub> analyzers; two hours of NO <sub>x</sub> , SO <sub>2</sub> , and O <sub>3</sub> data invalidated.
January 6, 2020	Station power outage. One hour of all gas and meteorological data and two hours of PM data missing.
January 6 – 9, 2020	Daily average PM <sub>2.5</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>2.5</sub> data invalidated each day. A total of 96 hours of PM <sub>2.5</sub> data invalidated.
January 6 – 21, 2020	SO <sub>2</sub> analyzer failure. The analyzer (serial number: 9200039) was removed and replaced with serial number: 10020059 on January 21, 2020. 364 hours of SO <sub>2</sub> data were invalidated in total. Two hours of all other gas data were invalidated January 20, 2020 and one additional hour of all gas data was invalidated January 21, 2020 during calibrations and maintenance on the SO <sub>2</sub> analyzer.
January 16, 2020	Additional precision check run on gases. Two hours of all gas data invalidated
January 22, 2020	SO <sub>2</sub> sampling error; two hours of data invalidated.
January 23, 2020	Raw PM <sub>10</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . One hour of PM <sub>10</sub> data invalidated.
January 29, 2020	Raw PM <sub>2.5</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . One hour of PM <sub>2.5</sub> data invalidated.
January 29, 2020	Daily average PM <sub>10</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>10</sub> data invalidated.
January 30, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. One hour of PM <sub>2.5</sub> and PM <sub>10</sub> data invalidated.
February 1, 2020	Raw PM <sub>10</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . Four hours of PM <sub>10</sub> data invalidated. Daily average PM <sub>2.5</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>2.5</sub> data invalidated.
February 2, 2020	Raw PM <sub>2.5</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . One hour of PM <sub>10</sub> data invalidated.
February 2 – 3, 2020	Daily average PM <sub>10</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>10</sub> data invalidated each day. A total of 48 hours of PM <sub>10</sub> data invalidated.
February 5, 2020	Raw PM <sub>2.5</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . One hour of PM <sub>2.5</sub> data invalidated. Multipoint calibrations performed on the SO <sub>2</sub> analyzer; analyzer passed. One hour of all gas data invalidated during calibration.
February 7, 2020	Daily average PM <sub>10</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>10</sub> data invalidated.



Date	Event
February 10, 2020	Raw PM <sub>10</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . Two hours of PM <sub>10</sub> data invalidated.
February 10 – 13, 2020	O <sub>3</sub> analyzer failed a precision check on February 13, 2020. The ozone transfer standard (serial number 172) was removed and replaced with transfer standard serial number 87. O <sub>3</sub> data were invalidated back to the last passing check on February 10, 2020. 61 hours of data invalidated.
February 11, 2020	Daily average PM <sub>2.5</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>2.5</sub> data invalidated. NO <sub>x</sub> sampling error; one hour of NO <sub>x</sub> data invalidated.
February 11 – March 12, 2020	The PM <sub>10</sub> BAM analyzer failed the QC check on March 12, 2020. PM <sub>10</sub> data were invalidated back to the last passing QC check on February 11, 2020 and the pump was rebuilt on March 12, 2020. A total of 719 hours of PM <sub>10</sub> data invalidated. As a result of the data loss, DQOs for PM <sub>10</sub> were not met for the monitoring quarter.
February 11 – 12, 2020	Monthly QC checks performed on PM samplers; all passed. One hour of PM <sub>2.5</sub> data invalidated.
February 12 – 19, 2020	Additional precision checks run on gases. 1 hour of all gases invalidated each day.
February 13, 2020	Raw PM <sub>2.5</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . One hour of PM <sub>2.5</sub> data invalidated.
February 13 – 21 & 24 – 26, 2020	The O <sub>3</sub> analyzer failed precision checks and calibrations. In each case, O <sub>3</sub> data were invalidated back to the last passing check. 202 hours of data invalidated February 13 – 21, 2020, and 48 hours invalidated February 24 – 26, 2020.
February 22, 2020	Raw PM <sub>2.5</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . One hour of PM <sub>2.5</sub> data invalidated.
February 24, 2020	Additional precision check run on gases. One hour of all gas data invalidated
February 28, 2020	Multipoint calibrations performed on O <sub>3</sub> analyzer; analyzer passed. One hour of O <sub>3</sub> data invalidated.
March 3, 2020	Multipoint calibrations performed on O <sub>3</sub> analyzer; analyzer passed. Four hours of O <sub>3</sub> data invalidated.
March 10, 2020	Raw PM <sub>2.5</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . Two hours of PM <sub>2.5</sub> data invalidated.
March 11, 2020	Station maintenance and multipoint calibrations performed on all gas analyzers; all passed. Independent performance audit of ambient air analyzers and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits. Three hours of all gas data and five hours of PM <sub>2.5</sub> data invalidated during calibrations and audit.
March 11 – 13, 2020	The O <sub>3</sub> analyzer failed precision checks on March 13, 2020. O <sub>3</sub> data were invalidated back to the last passing check on March 11, 2020. The ozone transfer standard (serial number 87) was removed and replaced with transfer standard serial number 172. A total of 57 hours of data invalidated.
March 16, 2020	Multipoint calibrations performed on SO <sub>2</sub> analyzer; analyzer passed. One hour of SO <sub>2</sub> , NO <sub>x</sub> , and CO data invalidated.
March 24, 2020	Station communication error led to the loss of one hour of all gas, PM, and meteorological data.
April 3, 2020	Additional precision check run on gases. One hour of all gas data were invalidated.
April 3 – 9, 2020	A data acquisition system error resulted in the failure to achieve the required upscale calibration measurement points for CO and SO <sub>2</sub> and consequently 136 hours of data were invalidated between valid precision checks, April 3, 2020 to April 9, 2020. Three hours of NO <sub>2</sub> data were also invalidated during the attempted CO and SO <sub>2</sub> checks on April 8.
April 8, 2020	Solar sensor records values greater than the theoretical maximum value based on station latitude and day of year. 17 hours invalidated.

Date	Event
April 15 – 16, 2020	Snow and ice buildup on the vertical wind sensor. 19 hours of vertical wind data invalidated.
April 16, 2020	Multipoint calibrations performed on SO <sub>2</sub> analyzer; analyzer passed. One hour of non-ozone gas data were invalidated.
April 23, 2020	Two hours of non-ozone gas data were invalidated during data acquisition system maintenance.
April 27 – 29, 2020	Tape errors in the PM <sub>10</sub> and PM <sub>2.5</sub> BAMs caused the invalidation of 23 hours of PM <sub>2.5</sub> data and 42 hours of PM <sub>10</sub> data.
May 1, 2020	Raw PM <sub>10</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . Two hours of PM <sub>10</sub> data invalidated.
May 5, 2020	Raw PM <sub>10</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . One hour of PM <sub>10</sub> data invalidated.
May 12, 2020	Multipoint calibrations were performed on the SO <sub>2</sub> , NO <sub>2</sub> , and CO analyzers; all analyzers passed. Five hours of ozone and 6 hours of SO <sub>2</sub> , NO <sub>x</sub> , and CO data were invalidated.
May 27, 2020	Multipoint calibration performed on CO analyzer; analyzer passed. Three hours of ozone and 4 hours of SO <sub>2</sub> , NO <sub>x</sub> , and CO data were invalidated.
June 1, 2020	Station communication error led to the loss of one hour of all gas, PM, and meteorological data.
June 10, 2020	Multipoint calibrations were performed on ozone, SO <sub>2</sub> , NO <sub>2</sub> , and CO analyzers; all analyzers passed. Eight hours of ozone and SO <sub>2</sub> were invalidated, and seven hours of NO <sub>x</sub> and CO data were invalidated. Monthly QC checks performed on PM samplers; all passed. Two hours of PM <sub>2.5</sub> and three hours of PM <sub>10</sub> data were invalidated.
June 11 – 14, 2020	Shelter temperature standard deviation greater than 2° C or shelter temperature above 30° C. 96 hours of gas data invalidated in total.
June 12 – 13, 2020	Raw PM <sub>2.5</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . Four hours total of PM <sub>2.5</sub> data were invalidated.
June 16, 2020	Shelter temperature under 20° C. One hour of gas data were invalidated.
June 18, 2020	Multipoint calibration performed on NO <sub>2</sub> analyzer; analyzer passed. Seven hours of all gas data were invalidated.
June 18 – 21, 2020	Ozone analyzer failed a precision check on June 21, 2020. Ozone data were invalidated back to the last passing check on June 18, 2020. 79 hours of data were invalidated.
June 21 – 22, 2020	Additional ozone multipoint calibration verifications were performed. Three hours of ozone data were invalidated.
June 24, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. One hour of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
July 22, 2020	Station communication error led to the loss of one hour of all gas, PM, and meteorological data.
August 5, 2020	Multipoint calibrations were performed on the SO <sub>2</sub> and CO analyzers; all analyzers passed. One hour of ozone and five hours of SO <sub>2</sub> , NO <sub>x</sub> , and CO data were invalidated.
August 10-11, 2020	CO analyzer malfunction required invalidation of 34 hours of CO data. 3 hours of gas data invalidated during maintenance.
August 11-12, 2020	CO analyzer malfunction required invalidation of 26 hours of CO data.
August 13-14, 2020	CO analyzer malfunction required invalidation of 24 hours of CO data.
August 15, 2020	CO analyzer malfunction required invalidation of two hours of CO data.
August 17-19, 2020	CO analyzer malfunction required invalidation of 44 hours of CO data.
August 19, 2020	Multipoint calibrations were performed on ozone analyzer; analyzer passed. Two hours of ozone data were invalidated.
August 19-23, 2020	CO analyzer malfunction required invalidation of 94 hours of CO data.

Date	Event
August 23, 2020	Station communication error led to the loss of two hours of PM, three hours of all gas and meteorological data.
August 24-25, 2020	CO analyzer replaced, 25 hours of CO, 3 hours of other gases, and 1 hour of PM invalidated.
August 26, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. One hour of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
August 27, 2020	Temporary flow errors on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. Three hours of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
August 27, 2020	Nightly precision check purge error required invalidation of one additional hour of gas data.
September 1, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. One hour of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
September 7, 2020	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 passed. Seven hours of SO <sub>2</sub> , five hours of other gases, and three hours of PM <sub>2.5</sub> and four hours of PM <sub>10</sub> data were invalidated.
September 11-13, 200	NO/NO <sub>x</sub> analyzer failed a quality control check on September 12, 2020. NO/NO <sub>x</sub> data were invalidated between passing checks, September 11 to September 13, 2020. 48 hours of data were invalidated.
September 14-16, 2020	NO/NO <sub>x</sub> analyzer failed a quality control check on September 15, 2020. NO/NO <sub>x</sub> data were invalidated between passing checks, September 14 to September 16, 2020. 48 hours of data were invalidated.
September 20, 2020	Station communication error led to the loss of two hours of all gas and meteorological data, one hour of PM <sub>10</sub> and PM <sub>2.5</sub> data.
September 20-22, 2020	NO/NO <sub>x</sub> analyzer failed a quality control check on September 21, 2020. NO/NO <sub>x</sub> data were invalidated between passing checks on September 20 and calibration on September 22, 2020. 58 hours of data were invalidated.
September 21, 2020	Multipoint calibration performed on NO <sub>x</sub> analyzer; passed. Four hours of other gas data invalidated.
September 22, 2020	Multipoint calibration performed on NO <sub>x</sub> analyzer; passed. Three hours of other gas data invalidated.
October 4, 2020	Nightly precision check purge error required invalidation of one additional hour of gas data.
October 4-6, 2020	Intermittent brief power outages caused 4 hours of invalid SO <sub>2</sub> and PM.
October 6-12, 2020	CO analyzer malfunction required invalidation of 158 hours of CO data and three hours of SO <sub>2</sub> data during calibrations on October 12.
October 8, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. One hour of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
October 10-13, 2020	NO <sub>x</sub> analyzer malfunction required invalidation of 83 hours of NO <sub>x</sub> data and four hours of gas data during calibrations.
October 19-20, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. Four hours of PM <sub>2.5</sub> and three hours of PM <sub>10</sub> data were invalidated.
October 19-21, 2020	Data acquisition system error communicating with NO <sub>x</sub> analyzer required the invalidation of 34 hours of NO <sub>x</sub> data.
October 20, 2020	Replacement and calibration of NO <sub>x</sub> analyzer, installation of gas cylinders resulted in two hours of invalid CO and SO <sub>2</sub> and one hour of ozone.

Date	Event
October 21, 2020	Monthly QC checks performed on PM samplers; all passed. Multipoint calibrations performed on PM and all meteorological analyzers; all passed. Independent performance audit of ambient air analyzers, meteorological monitors, and PM samplers conducted by AMS Tech, LLC. All instruments found to be operating within EPA PSD measurement quality limits. Ten hours of NO <sub>x</sub> and CO, eleven hours of ozone and SO <sub>2</sub> gas data, seven hours of PM data, seven hours of vertical wind and horizontal wind data, eight hours of temperature data, and five hours of solar data were invalidated during calibrations and audit.
October 21-25, 2020	10-meter temperature sensor malfunction required 107 hours of 10-meter temperature and deltaT to be invalidated.
November 3, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. Two hours of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
November 5, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. One hour of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
November 13, 2020	Daily average PM <sub>2.5</sub> and PM <sub>10</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>2.5</sub> and PM <sub>10</sub> data invalidated.
November 18, 2020	Daily average PM <sub>2.5</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>2.5</sub> data invalidated. Temporary flow error on PM <sub>10</sub> BAM. One hour of PM <sub>10</sub> data were invalidated.
November 19, 2020	Daily average PM <sub>2.5</sub> and PM <sub>10</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>2.5</sub> and PM <sub>10</sub> data invalidated.
November 20, 2020	Daily average PM <sub>10</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>10</sub> data invalidated.
November 23, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. Two hours of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
December 1, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. One hour of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
December 3, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. One hour of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
December 6, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. Two hours of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
December 8, 2020	Multipoint calibrations were performed on the SO <sub>2</sub> and CO analyzers; all analyzers passed. Three hours of gas data were invalidated. Raw PM <sub>10</sub> BAM data values recorded below the lower detectable and reporting limits of -5 µg/m <sup>3</sup> . Two hours of PM <sub>10</sub> data invalidated.
December 10-11, 2020	Station communication errors led to the loss of one hour of all gas, PM, and meteorological data each day.
December 15, 2020	Temporary flow error on PM <sub>2.5</sub> and PM <sub>10</sub> BAMs. One hour of PM <sub>2.5</sub> and PM <sub>10</sub> data were invalidated.
December 16, 2020	Shelter temperature standard deviation greater than 2° C. 24 hours of gas data invalidated in total.
December 16-18, 2020	Monthly QC checks performed on all PM <sub>2.5</sub> samplers; all instruments passed. Annual zero background check initiated on December 16, 2020 and completed on December 18, 2020. 43 hours of PM <sub>2.5</sub> and 47 hours of PM <sub>10</sub> data were invalidated.
December 17, 2020	Multipoint calibrations were performed on all gas analyzers; all analyzers passed. Three hours of CO and 2 hours of SO <sub>2</sub> , NO <sub>x</sub> , and ozone data were invalidated.
December 17, 2020	Communication error resulted in the loss of 3 hours of meteorological data.
December 21, 2020	Daily average PM <sub>10</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>2.5</sub> data invalidated.
December 25-31, 2020	Snow and ice buildup on the horizontal wind sensor. 150 hours of horizontal wind data invalidated.
December 28, 2020	Daily average PM <sub>2.5</sub> concentration less than -2 µg/m <sup>3</sup> . 24 hours of BAM PM <sub>2.5</sub> data invalidated.

Date	Event
December 31, 2020	Data acquisition system error required the invalidation of one hour of gas and PM data.
December 31, 2020	End of the monitoring year.

## 2.2 MISSING, INVALID AND ADJUSTED DATA

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

Historically, periods of 4 or fewer records that were invalidated were considered to be due to routine operations and maintenance activities and were generally not described in detail. Starting in the third quarter of 2019 and forward, any record invalidated is discussed in detail for transparency.

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

The CO pump malfunctioned December 21, 2019. CO analyzer (serial number: 1008241341) was removed and replaced with serial number 1527 on January 3, 2020. 61 hours of CO data invalid January 1 – 3, 2020. Three hours of NO<sub>x</sub> and O<sub>3</sub> data, and four hours of SO<sub>2</sub> data invalidated January 3, 2020 during installation of new analyzer.

Three hours of PM<sub>2.5</sub> data and two hours of PM<sub>10</sub> data invalidated January 2, 2020 during monthly QC checks; all passed.

An additional precision check was performed on the NO<sub>x</sub>, SO<sub>2</sub>, and O<sub>3</sub> analyzers on January 2, 2020; two hours of NO<sub>x</sub>, SO<sub>2</sub>, and O<sub>3</sub> data invalidated.

A station power outage on January 6, 2020 resulted in the loss of one hour of all gas and meteorological data and two hours of PM data.

Manufacturer specifications for PM<sub>2.5</sub> and PM<sub>10</sub> measurements indicate that the uncertainty for 24-hour average concentrations is +/- 2 µg/m<sup>3</sup>. Accordingly, 24-hour average concentrations less than -2 µg/m<sup>3</sup> resulted in the invalidation of PM<sub>2.5</sub> data for the entire day on January 6 through 9, February 1, and February 11, 2020 and PM<sub>10</sub> data on January 29, February 2 through 3, and February 7, 2020. A total of 144 hours of PM<sub>2.5</sub> data and 96 hours of PM<sub>10</sub> data were invalidated during the first quarter.

The SO<sub>2</sub> analyzer failed on January 6, 2020. The analyzer (serial number: 9200039) was removed and replaced with serial number: 10020059 on January 21, 2020. 364 hours of SO<sub>2</sub> data were invalidated in total. Two hours of all other gas data were invalidated January 20, 2020 and one additional hour of all gas data was invalidated January 21, 2020 during work on the SO<sub>2</sub> analyzer.

An additional precision check was run on all gases on January 16, 2020. Two hours of all gas data invalidated.

A sampling error on January 22, 2020 led to the invalidation of two hours of SO<sub>2</sub> data.

The lower detectable limit and reporting limit of the BAM analyzers are -5 µg/m<sup>3</sup>. PM<sub>2.5</sub> data were invalidated as a result as follows: one hour on January 29, one hour on February 2, one hour on February 5, one hour on February 13, one hour on February 22, and two hours on March 10, 2020. PM<sub>10</sub> data were invalidated as follows: one hour on January 23, four hours on February 1, and two hours on February 10, 2020. A total of seven hours of PM<sub>2.5</sub> data and seven hours of PM<sub>10</sub> data were invalidated in total during the first monitoring quarter.

A temporary BAM flow error occurred on January 30, 2020. One hour of data from each BAM was invalidated.

Multipoint calibrations performed on the SO<sub>2</sub> analyzer on February 5, 2020; instrument passed. One hour of all gas data invalidated during calibrations.

The O<sub>3</sub> analyzer failed precision checks or calibrations on February 13 through February 21, February 24, and March 13, 2020. In each instance, O<sub>3</sub> data were invalidated back to the last passing check. A total of 368 hours of O<sub>3</sub> data invalidated. Despite the data loss, DQOs were still met for the first quarter.

A sampling error on February 11, 2020 led to the invalidation of one hour of NO<sub>x</sub> data.

The PM<sub>10</sub> BAM analyzer failed the QC check on March 12, 2020. PM<sub>10</sub> data were invalidated back to the last passing QC check on February 11, 2020 and the pump was rebuilt on March 12, 2020. A total of 719 hours of PM<sub>10</sub> data invalidated. As a result of the data loss, DQOs for PM<sub>10</sub> were not met for the first monitoring quarter.

One hour of PM<sub>2.5</sub> data were invalidated February 12, 2020 during monthly QC checks.

Additional precision checks were run on all gases on February 12 through 19, 2020 instead of zero/span checks. One hour of all gas data invalidated each day.

An additional precision check was run on all gases on February 24, 2020. One hour of all gas data invalidated.

Multipoint calibrations were performed on the O<sub>3</sub> analyzer on February 28 and March 3, 2020; analyzer passed all calibrations. One hour of O<sub>3</sub> data invalidated February 28 and four hours invalidated March 3, 2020.

Station maintenance and multipoint calibrations performed on all gas analyzers and an independent performance audit of ambient air analyzers and PM samplers conducted by AMS Tech, LLC on March 11, 2020. All instruments found to be operating within EPA PSD measurement quality limits. Three hours of all gas data and five hours of PM<sub>2.5</sub> data invalidated during calibrations and audit.

Multipoint calibrations performed on SO<sub>2</sub> analyzer on March 16, 2020; analyzer passed. One hour of SO<sub>2</sub>, NO<sub>x</sub>, and CO data invalidated.

A Station communication error led to the loss of one hour of all gas, PM, and meteorological data on March 24, 2020.

An additional precision check was performed on the NO<sub>2</sub>, CO, SO<sub>2</sub>, and O<sub>3</sub> analyzers on April 3, 2020. One hour of NO<sub>2</sub>, CO, SO<sub>2</sub>, and O<sub>3</sub> data were invalidated.

A data acquisition system error on April 8, 2020 resulted in the failure to achieve the required upscale calibration measurement points for CO and SO<sub>2</sub> and 136 hours of data were invalidated between valid precision checks from April 3, 2020 to April 9, 2020.

Seventeen hours of solar data were invalidated on April 8, 2020 as the result of the sensor reporting values higher than the theoretical maximum value based on the station latitude and day of year.

Nineteen hours of vertical wind data were invalidated on April 15-16, 2020 because of snow and ice buildup on the sensor.

A multipoint calibration was performed on the SO<sub>2</sub> analyzer on April 16, 2020; the analyzer passed. One hour of non-ozone gas data were invalidated.

Two hours of non-ozone gas data were invalidated on April 23, 2020 during data acquisition system maintenance.

Tape errors in the PM<sub>10</sub> and PM<sub>2.5</sub> BAMs caused the invalidation of 23 hours of PM<sub>2.5</sub> data and 42 hours of PM<sub>10</sub> data from April 27, 2020 to April 29, 2020.

The lower detectible limit and reporting limit of the BAM analyzers are -5 µg/m<sup>3</sup>. Two hours of PM<sub>10</sub> data were invalidated on May 1, 2020 and one hour was invalidated on May 5, 2020 as a result of reporting raw concentrations below this limit. Four hours of PM<sub>2.5</sub> data were invalidated as a result on June 12 and 13, 2020 for the same reason.

Multipoint calibrations were performed on the SO<sub>2</sub>, NO<sub>2</sub>, and CO analyzers on May 12, 2020; all analyzers passed. Five hours of ozone and 6 hours of SO<sub>2</sub>, NO<sub>x</sub>, and CO data were invalidated.

A multipoint calibration was performed on the CO analyzer on May 27, 2020; analyzer passed. Three hours of ozone and 4 hours of SO<sub>2</sub>, NO<sub>x</sub>, and CO data were invalidated.

A station communication error on June 1, 2020 led to the loss of one hour of all gas, PM, and meteorological data.

Multipoint calibrations were performed on June 10, 2020 on the ozone, SO<sub>2</sub>, NO<sub>2</sub>, and CO analyzers; all analyzers passed. Eight hours of ozone and SO<sub>2</sub> were invalidated, and seven hours of NO<sub>x</sub> and CO data were invalidated.

Three hours of PM<sub>2.5</sub> data and two hours of PM<sub>10</sub> data invalidated June 10, 2020 during monthly QC checks; all passed.

The shelter temperature standard deviation exceeded 2° C or hourly shelter temperature exceeded 30° C from June 11 – 14, 2020. As a result, 96 hours of gas data were invalidated during this time period.

The hourly shelter temperature dropped below 20° C on June 16, 2020. As a result, one hour of gas data were invalidated during this time period.

A multipoint calibration was performed on the NO<sub>2</sub> analyzer on June 18, 2020; analyzer passed. Seven hours of all gas data were invalidated.



The ozone analyzer failed a precision check on June 21, 2020. Ozone data were invalidated back to the last passing check on June 18, 2020. 79 hours of data were invalidated.

Additional ozone multipoint calibration verifications were performed on June 21-22, 2020. Three hours of ozone data were invalidated.

A temporary BAM flow error occurred on June 24, 2020. One hour of data from each BAM were invalidated.

A station communication error on July 22, 2020 led to the loss of one hour of all gas, PM, and meteorological data.

A multipoint calibration was performed on the SO<sub>2</sub> and CO analyzers on August 5, 2020; the analyzers passed. One hour of ozone, and five hours of other gas data were invalidated.

A CO analyzer malfunction on August 10 and 11, 2020 required invalidation of 34 hours of CO data. 3 hours of gas data were invalidated during maintenance.

A CO analyzer malfunction from August 11, 2020 to August 12, 2020 required invalidation of 26 hours of CO data.

A CO analyzer malfunction from August 13, 2020 to August 14, 2020 required invalidation of 24 hours of CO data.

A CO analyzer malfunction on August 15, 2020 required invalidation of two hours of CO data.

A CO analyzer malfunction from August 17, 2020 to August 19, 2020 required invalidation of 44 hours of CO data.

A multipoint calibration was performed on the ozone analyzer on August 19, 2020; the analyzer passed. Two hours of ozone gas data were invalidated.

A CO analyzer malfunction from August 19, 2020 to August 23, 2020 required invalidation of 94 hours of CO data.

A communication error on August 23, 2020 resulted in the loss of two hours of PM data and three hours of all gas and meteorological data.

The CO analyzer was replaced on August 24 and 25, 2020 requiring invalidation of 25 hours of CO data, 3 hours of other gases, and 1 hour of PM<sub>10</sub> and PM<sub>2.5</sub> data.

A temporary BAM flow error occurred on August 26, 2020. One hour of data from each BAM were invalidated.

Temporary BAM flow errors occurred on August 27, 2020. Three hours of data from each BAM were invalidated.

An extended calibration gas purge required an extra hour of all gas data to be invalidated on August 27, 2020.

A temporary BAM flow error occurred on September 1, 2020. One hour of data from each BAM were invalidated.

An independent performance audit of ambient air analyzers and PM samplers was conducted by AMS Tech, LLC on September 7, 2020. All instruments found to be operating within EPA PSD measurement



quality limits. Monthly QC checks were performed on PM samplers; all passed. Seven hours of SO<sub>2</sub>, five hours of other gases, and three hours of PM<sub>2.5</sub> and four hours of PM<sub>10</sub> data were invalidated.

NO/NO<sub>x</sub> analyzer failed a quality control check on September 12, 2020. NO/NO<sub>x</sub> data were invalidated between passing checks, September 11 to September 13, 2020. 48 hours of data were invalidated.

NO/NO<sub>x</sub> analyzer failed a quality control check on September 15, 2020. NO/NO<sub>x</sub> data were invalidated between passing checks, September 14 to September 16, 2020. 48 hours of data were invalidated.

A station communication error on September 20, 2020 led to the loss of two hours of all gas and meteorological data, one hour of PM<sub>10</sub> and PM<sub>2.5</sub> data.

NO/NO<sub>x</sub> analyzer failed a quality control check on September 21, 2020. NO/NO<sub>x</sub> data were invalidated between passing check on September 20 and calibration on September 22, 2020. 58 hours of data were invalidated.

A multipoint calibration was performed on the NO/NO<sub>x</sub> analyzer on September 21, 2020; the analyzer passed. Four hours of gas data were invalidated.

A multipoint calibration was performed on the NO/NO<sub>x</sub> analyzer on September 22, 2020; the analyzer passed. Three hours of gas data were invalidated.

Nightly precision check purge error on October 4, 2020 required invalidation of one additional hour of gas data.

Intermittent brief power outages caused from October 4, 2020 to October 6, 2020 resulted in 4 hours of invalid SO<sub>2</sub> and PM

The CO analyzer malfunctioned from October 6, 2020 to October 12, 2020 requiring invalidation of 158 hours of CO data and three hours of SO<sub>2</sub> data during calibrations on October 12.

A temporary PM BAM flow error on October 8, 2020 resulted in one hour of invalid PM<sub>2.5</sub> and PM<sub>10</sub> data.

The NO<sub>x</sub> analyzer malfunctioned from October 10, 2020 to October 13, 2020 requiring invalidation of 83 hours of NO<sub>x</sub> data and four hours of other gas data during calibrations.

Temporary PM BAM flow errors on October 19 and 20, 2020 resulted in four hours of invalid PM<sub>2.5</sub> and three hours of invalid PM<sub>10</sub> data.

A data acquisition system error communicating with the NO<sub>x</sub> analyzer on October 19, 2020 to October 21, 2020 required the invalidation of 34 hours of NO<sub>x</sub> data.

Replacement and calibration of the NO<sub>x</sub> analyzer and installation of gas cylinders on October 20, 2020 resulted in two hours of invalid CO and SO<sub>2</sub> and one hour of ozone.

On October 21, 2020, monthly QC checks were performed on PM samplers; all passed. Multipoint calibrations were performed on PM and all meteorological analyzers; all passed. An Independent performance audit of ambient air analyzers, meteorological monitors, and PM samplers was conducted by AMS Tech, LLC. All instruments were found to be operating within EPA PSD measurement quality limits. Ten hours of NO<sub>x</sub> and CO, eleven hours of ozone and SO<sub>2</sub> gas data, seven hours of PM data, seven hours of vertical wind and horizontal wind data, eight hours of temperature data, and five hours of solar data were invalidated during QC checks, calibrations, and audit.

The 10-meter temperature sensor malfunctioned on October 21, 2020 to October 25, 2020 and required 107 hours of 10-meter temperature and deltaT to be invalidated.

A temporary PM BAM flow error on November 3, 2020 resulted in two hours of invalid PM<sub>2.5</sub> and PM<sub>10</sub> data.

A temporary PM BAM flow error on November 5, 2020 resulted in one hour of invalid PM<sub>2.5</sub> and PM<sub>10</sub> data.

24 hours of PM<sub>2.5</sub> and PM<sub>10</sub> data were invalidated on November 13, 2020 due to a daily average PM<sub>2.5</sub> and PM<sub>10</sub> concentration of less than  $-2.0 \mu\text{g}/\text{m}^3$ .

24 hours of PM<sub>2.5</sub> data were invalidated on November 18, 2020 due to a daily average PM<sub>2.5</sub> concentration of less than  $-2.0 \mu\text{g}/\text{m}^3$ .

A temporary PM BAM flow error on November 18, 2020 resulted in one hour of invalid PM<sub>10</sub> data.

24 hours of PM<sub>2.5</sub> and PM<sub>10</sub> data were invalidated on November 19, 2020 due to a daily average PM<sub>2.5</sub> and PM<sub>10</sub> concentration of less than  $-2.0 \mu\text{g}/\text{m}^3$ .

24 hours of PM<sub>10</sub> data were invalidated on November 20, 2020 due to a daily average PM<sub>10</sub> concentration of less than  $-2.0 \mu\text{g}/\text{m}^3$ .

A temporary PM BAM flow error on November 23, 2020 resulted in two hours of invalid PM<sub>2.5</sub> and PM<sub>10</sub> data.

A temporary PM BAM flow error on December 1, 2020 resulted in one hour of invalid PM<sub>2.5</sub> and PM<sub>10</sub> data.

A temporary PM BAM flow error on December 6, 2020 resulted in two hours of invalid PM<sub>2.5</sub> and PM<sub>10</sub> data.

On December 8, 2020, multipoint calibrations were performed on the SO<sub>2</sub> and CO analyzers; all analyzers passed. Three hours of gas data were invalidated. Raw PM<sub>10</sub> BAM data values recorded below the lower detectable and reporting limits of  $-5 \mu\text{g}/\text{m}^3$ . Two hours of PM<sub>10</sub> data invalidated.

Station communication errors on December 10 and 11, 2020 led to the loss of one hour of all gas, PM, and meteorological data each day.

A temporary PM BAM flow error on December 15, 2020 resulted in one hour of invalid PM<sub>2.5</sub> and PM<sub>10</sub> data.

Shelter temperature standard deviation greater than 2° C. required the invalidation of 24 hours of gas data on December 16, 2020.

Monthly QC checks were performed on all PM samplers on December 16, 2020; all instruments passed. Annual zero background check initiated On December 16, 2020 and completed on December 18, 2020. 43 hours of PM<sub>2.5</sub> and 47 hours of PM<sub>10</sub> data were invalidated.

Multipoint calibrations were performed on all gas analyzers on December 17, 2020; all analyzers passed. Three hours of CO and 2 hours of SO<sub>2</sub>, NO<sub>x</sub>, and ozone data were invalidated.

A communication error resulted in the loss of 3 hours of meteorological data on December 17, 2020.

24 hours of PM<sub>10</sub> data were invalidated on December 21, 2020 due to a daily average PM<sub>2.5</sub> concentration of less than  $-2.0 \mu\text{g}/\text{m}^3$ .

Snow and ice buildup occurred on the horizontal wind sensor on December 25, 2020 to December 31, 2020. 150 hours of horizontal wind data were invalidated.

24 hours of PM<sub>2.5</sub> data were invalidated on December 28, 2020 due to a daily average PM<sub>2.5</sub> concentration of less than  $-2.0 \mu\text{g}/\text{m}^3$ .

A data acquisition system error on December 31, 2020 required the invalidation of one hour of gas and PM data.

**Table 2-2: Percentage of Final Data Set Flagged**

Parameter	Flagging Criteria <sup>(1)</sup>	Percent Flagged
Wind Speed	Value is $< 0 \text{ m/s}$	0.0%
	Value is $> 25 \text{ m/s}$	0.0%
	$< 0.1 \text{ m/s}$ variation for 3 consecutive hours	2.0%
	$< 0.5 \text{ m/s}$ variation for 12 consecutive hours	0.3%
Wind Direction	Value is $< 0^\circ$ , $> 360^\circ$	0.0%
	$< 1^\circ$ variation over 3 consecutive hours	0.0%
	$< 10^\circ$ variation over 18 consecutive hours	2.1%
Temperature (2 meters)	$> 5^\circ\text{C}$ variation from previous hour	0.1%
	$< 0.5^\circ\text{C}$ variation for 12 consecutive hours	1.1%
	Value is $>$ record high, $<$ record low	0.0%
Temperature (10 meters)	$> 5^\circ\text{C}$ variation from previous hour	0.1%
	$< 0.5^\circ\text{C}$ variation for 12 consecutive hours	1.3%
	Value is $>$ record high, $<$ record low	0.0%
Temperature Difference, $\Delta T$	Value is $> 0.8^\circ\text{C}$ during the daytime	1.0%
	Value is $< -0.8^\circ\text{C}$ during the night	0.0%
	Value is $> 5^\circ\text{C}$ , $< -3^\circ\text{C}$	0.0%
Solar Radiation	$> 0 \text{ w/m}^2$ at night	0.0%
	Greater than the maximum possible value for date and latitude	0.2%

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

## 2.3 NETWORK DATA COMPLETENESS

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

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

Table 2-3: Ambient Air Quality Data Capture Percent

Period	Pollutants – Data Recovery <sup>(1)</sup>					
	NO <sub>2</sub>	SO <sub>2</sub>	O <sub>3</sub>	CO	PM <sub>2.5</sub> <sup>(2)</sup>	PM <sub>10</sub> <sup>(2)</sup>
January	98%	50% <sup>(3)</sup>	98%	90%	87%	97%
February	98%	98%	55% <sup>(4)</sup>	98%	93%	24% <sup>(5)</sup>
March	99%	99%	91%	99%	100%	64% <sup>(5)</sup>
<b>1<sup>st</sup> Quarter</b>	<b>98%</b>	<b>82%</b>	<b>82%</b>	<b>96%</b>	<b>93%</b>	<b>63% <sup>(5)</sup></b>
April	99%	80%	99%	80%	93%	93%
May	98%	98%	98%	98%	100%	100%
June	84%	84%	72% <sup>(6)</sup>	84%	100%	100%
<b>2<sup>nd</sup> Quarter</b>	<b>94%</b>	<b>88%</b>	<b>90%</b>	<b>88%</b>	<b>98%</b>	<b>98%</b>
July	99%	99%	99%	99%	100%	100%
August	97%	97%	98%	65% <sup>(7)</sup>	100%	100%
September	77% <sup>(8)</sup>	97%	97%	97%	100%	100%
<b>3<sup>rd</sup> Quarter</b>	<b>91%</b>	<b>98%</b>	<b>98%</b>	<b>87%</b>	<b>100%</b>	<b>100%</b>
October	82%	96%	97%	76% <sup>(9)</sup>	97%	97%
November	99%	99%	99%	99%	90%	90%
December	95%	95%	95%	95%	87%	87%
<b>4<sup>th</sup> Quarter</b>	<b>92%</b>	<b>97%</b>	<b>97%</b>	<b>90%</b>	<b>91%</b>	<b>91%</b>
<b>Annual</b>	<b>94%</b>	<b>91%</b>	<b>92%</b>	<b>90%</b>	<b>96%</b>	<b>88%</b>

<sup>1</sup> EPA PSD-quality ambient air monitoring standards require data capture of 80 percent or greater per quarter for four consecutive quarters.

<sup>2</sup> 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. A minimum of 18 valid hourly averages are required to calculate a valid 24-hour average concentration. 24-hour average data recovery percentages in Table 2-2 differ from the 1-hour average data recovery percentage summaries presented in Appendix C.

<sup>3</sup> SO<sub>2</sub> data were invalidated due to an analyzer failure January 6 – 20, 2020. Despite the data loss, DQOs were met for the monitoring quarter.

<sup>4</sup> O<sub>3</sub> data were invalidated periodically in February 2020 as a result of failed precision checks and calibrations. Despite the data loss, DQOs were met for the monitoring quarter.

<sup>5</sup> The PM<sub>10</sub> analyzer failed the flow check on March 10, 2020. PM<sub>10</sub> data were invalidated back to the last passing check on February 11, 2020. Due to the data loss, DQOs were not met for the first monitoring quarter.

<sup>6</sup> O<sub>3</sub> data were invalidated periodically in June 2020 as a result of a failed precision check and shelter temperature variation. Despite the data loss, DQOs were met for the monitoring quarter.

<sup>7</sup> CO data were invalidated periodically in August 2020 as a result multiple analyzer malfunctions, which required installation of a backup CO analyzer on August 24 and 25, 2020. Despite the data loss, DQOs were met for the monitoring quarter.

<sup>8</sup> NO<sub>2</sub> data were invalidated periodically in September 2020 as a result of failed quality control checks. Despite the data loss, DQOs were met for the monitoring quarter.

<sup>9</sup> CO data were invalidated in October 2020 due to an analyzer malfunction. Despite the data loss, DQOs were met for the monitoring quarter.

Table 2-4: Meteorological Data Capture Percent

Period	Meteorological Parameters – Data Recovery <sup>(1)</sup>								
	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	Horizontal Wind Speed <sup>(2)</sup>	Horizontal Wind Direction <sup>(2)</sup>	Wind Direction Std. Dev. (Sigma Theta) <sup>(2)</sup>	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January	100%	100%	100%	100%	100%	100%	100%	100%	100%
February	100%	100%	100%	100%	100%	100%	100%	100%	100%
March	100%	100%	100%	100%	100%	100%	100%	100%	100%
1 <sup>st</sup> Quarter	100%	100%	100%	100%	100%	100%	100%	100%	100%
April	97%	97%	100%	100%	100%	100%	100%	100%	98%
May	100%	100%	100%	100%	100%	100%	100%	100%	100%
June	100%	100%	100%	100%	100%	100%	100%	100%	100%
2 <sup>nd</sup> Quarter	99%	99%	100%	100%	100%	100%	100%	100%	99%
July	100%	100%	100%	100%	100%	100%	100%	100%	100%
August	100%	100%	100%	100%	100%	100%	100%	100%	100%
September	100%	100%	100%	100%	100%	100%	100%	100%	100%
3 <sup>rd</sup> Quarter	100%	100%	100%	100%	100%	100%	100%	100%	100%
October	99%	99%	99%	99%	99%	99%	86% <sup>(4)</sup>	86% <sup>(4)</sup>	99%
November	100%	100%	100%	100%	100%	100%	100%	100%	100%
December	99%	99%	79% <sup>(3)</sup>	79% <sup>(3)</sup>	79% <sup>(3)</sup>	99%	99%	99%	100%
4 <sup>th</sup> Quarter	99%	99%	93%	93%	93%	99%	95%	95%	100%
Annual	100%	100%	98%	98%	98%	100%	99%	99%	100%

<sup>1</sup> EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.

<sup>2</sup> Data from the secondary horizontal wind sensor were used during the monitoring year.

<sup>3</sup> Horizontal wind data were invalidated during December 2020 due to snow and ice buildup on the sensors. Despite the data loss, DQOs were met during the fourth quarter.

<sup>4</sup> 10m temperature and Delta-T data were invalidated during October 2020 due to malfunctioning sensors. Despite the data loss, DQOs were met during the fourth quarter.

## 2.4 PRECISION STATISTICS

### 2.4.1 MONITORING NETWORK PRECISION STATISTICS

Precision statistics were determined using the methods outlined in Title 40 Code of Federal Regulations, Part 58 (40 CFR 58), Appendix A. Valid precision data for ambient air monitors (CO, NO<sub>2</sub>, O<sub>3</sub>, and SO<sub>2</sub>) 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 Table 2-5 through Table 2-20.

Precision statistics for the continuous PM<sub>2.5</sub> monitor were determined using the monitoring network QA station, located at the Alpine CD1 monitoring station. EPA recommends that precision statistics for PM<sub>2.5</sub> 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<sup>3</sup>. As proposed in the CD1 PM<sub>2.5</sub> Monitoring Program QAPP, PM<sub>2.5</sub> 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<sup>3</sup>. Secondary precision statistics were used when collocated samples did not meet the minimum concentration threshold. Quarterly network PM<sub>2.5</sub> precision statistics are presented in Table 2-21.

Table 2-5: 1<sup>st</sup> 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 <sup>(1)</sup>
1/3/2020 <sup>(2)</sup>	7.1	7.7	-7.3	22	0.23	3.15	6.41	-5.95	3.97
1/3/2020	7.7	7.7	0.2						
1/9/2020	7.5	7.7	-2.7						
1/16/2020	7.4	7.7	-4.2						
1/16/2020	7.5	7.7	-3.2						
1/23/2020	7.4	7.7	-3.6						
1/30/2020	7.4	7.7	-3.8						
2/6/2020	7.9	7.7	2.1						
2/12/2020	7.8	7.7	0.8						
2/13/2020	7.8	7.7	1.3						
2/14/2020	7.8	7.7	1.1						
2/15/2020	7.8	7.7	1.8						
2/16/2020	7.8	7.7	1.7						
2/17/2020	7.9	7.7	2.1						
2/18/2020	7.8	7.7	1.8						
2/19/2020	7.9	7.7	2.0						
2/27/2020	7.7	7.7	-0.3						
3/10/2020	7.8	7.7	1.6						
3/11/2020	7.8	7.4	6.0						
3/16/2020	8.0	7.7	3.7						
3/18/2020	8.0	7.7	4.1						
3/30/2020	7.7	7.7	-0.1						

<sup>1</sup> Acceptance criteria: ≤ 10%<sup>2</sup> Previous instrument (SN 1008241341) replaced by SN 1527.



Table 2-6: 2<sup>nd</sup> 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 <sup>(1)</sup>
3-Apr-20 <sup>(2)</sup>	7.8	7.7	0.7	22	0.02	1.29	2.55	-2.51	1.63
9-Apr-20	7.8	7.7	0.8						
16-Apr-20	7.9	7.7	2.2						
23-Apr-20	7.8	7.7	1.0						
23-Apr-20 <sup>(3)</sup>	7.8	7.7	0.9						
30-Apr-20	7.8	7.7	0.9						
7-May-20	7.7	7.7	0.6						
12-May-20 <sup>(4)</sup>	7.8	7.7	0.7						
12-May-20 <sup>(5)</sup>	7.7	7.7	0.3						
14-May-20	7.8	7.7	0.8						
21-May-20	7.8	7.7	0.9						
27-May-20 <sup>(4)</sup>	7.8	7.7	1.9						
27-May-20 <sup>(5)</sup>	7.6	7.7	-0.9						
28-May-20	7.5	7.7	-2.0						
4-Jun-20	7.5	7.7	-2.3						
10-Jun-20 <sup>(4)</sup>	7.5	7.7	-2.1						
10-Jun-20 <sup>(5)</sup>	7.6	7.7	-1.1						
11-Jun-20	7.6	7.7	-1.0						
18-Jun-20	7.7	7.7	0.0						
18-Jun-20 <sup>(4)</sup>	7.7	7.7	0.5						
18-Jun-20 <sup>(5)</sup>	7.7	7.7	-0.6						
25-Jun-20	7.6	7.7	-1.8						

<sup>1</sup> Acceptance criteria:  $\leq 10\%$

<sup>2</sup> Manual precision check completed due to errors in auto precision check on April 2, 2020 for non-ozone gases.

<sup>3</sup> Manual precision check completed to test changes to data acquisition system

<sup>4</sup> As-found; pre-calibration.

<sup>5</sup> As-left; post calibration.

Table 2-7: 3<sup>rd</sup> 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 <sup>(1)</sup>
7/2/2020	7.4	7.7	-3.8	16	-1.18	3.33	5.35	-7.70	4.41
7/9/2020	7.4	7.7	-4.2						
7/16/2020	7.3	7.7	-4.9						
7/23/2020	7.6	7.7	-1.9						
7/30/2020	7.4	7.7	-4.4						
8/5/2020 <sup>(3)</sup>	7.0	7.7	-8.7						
8/5/2020 <sup>(4)</sup>	7.7	7.7	-0.2						
8/6/2020	7.9	7.7	2.2						
8/13/2020	7.6	7.7	-2.0						
8/27/2020	7.7	7.7	0.1						
9/3/2020	7.7	7.7	-0.6						
9/10/2020	7.8	7.7	0.8						
9/17/2020	7.7	7.7	0.6						
9/21/2020 <sup>(2)</sup>	8.0	7.7	3.6						
9/22/2020 <sup>(2)</sup>	7.9	7.7	2.9						
9/24/2020	7.8	7.7	1.6						

<sup>1</sup> Acceptance criteria: ≤ 10%

<sup>2</sup> Manual precision check completed alongside NO<sub>2</sub> calibration

<sup>3</sup> As-found; pre-calibration.

<sup>4</sup> As-left; post calibration.

Table 2-8: 4<sup>th</sup> 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 <sup>(1)</sup>
10/1/2020	7.7	7.7	0.0	18	0.14	3.14	6.29	-6.01	4.07
10/12/2020 <sup>(2)</sup>	7.3	7.7	-4.9						
10/13/2020 <sup>(2)</sup>	7.3	7.7	-5.6						
10/15/2020	7.3	7.7	-4.7						
10/22/2020	7.6	7.7	-1.6						
10/29/2020	7.6	7.7	-1.6						
11/5/2020	7.6	7.7	-1.0						
11/12/2020	7.7	7.7	0.5						
11/19/2020	7.8	7.7	1.2						
11/26/2020	8.0	7.7	3.4						
12/3/2020	8.0	7.7	4.2						
12/8/2020 <sup>(2)</sup>	8.1	7.7	5.3						
12/8/2020 <sup>(2)</sup>	7.7	7.7	-0.6						
12/10/2020	7.6	7.7	-0.9						
12/17/2020	7.8	7.7	0.9						
12/17/2020	7.8	7.7	0.9						
12/24/2020	7.9	7.7	3.1						
12/31/2020	8.0	7.7	3.8						

<sup>1</sup> Acceptance criteria: ≤ 10%<sup>2</sup> As-found; pre-calibration

Table 2-9: 1<sup>st</sup> Quarter NO<sub>2</sub> 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 <sup>(1)</sup>
1/2/2020	82.5	80.0	3.1	16	1.42	3.05	7.40	-4.57	4.04
1/9/2020	84.6	80.0	5.8						
1/16/2020	83.2	80.0	4.0						
1/23/2020	79.2	80.0	-1.0						
1/30/2020	80.2	80.0	0.3						
2/6/2020	79.9	80.0	-0.1						
2/17/2020	80.3	80.0	0.4						
2/17/2020	82.8	80.0	3.5						
2/24/2020	79.0	80.0	-1.3						
2/25/2020	79.9	80.0	-0.1						
2/27/2020	83.4	80.0	4.3						
3/11/2020	85.7	80.0	7.1						
3/11/2020	76.1	80.0	-4.9						
3/18/2020	79.4	80.0	-0.8						
3/18/2020	80.2	80.0	0.3						
3/30/2020	81.7	80.0	2.1						

<sup>1</sup> Acceptance criteria: ≤ 15%

Table 2-10: 2<sup>nd</sup> Quarter NO<sub>2</sub> 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 <sup>(1)</sup>
3-Apr-20 <sup>(2)</sup>	80.6	80.0	0.7	19	0.66	4.84	10.15	-8.82	6.23
9-Apr-20	82.7	80.0	3.3						
16-Apr-20	78.2	80.0	-2.3						
23-Apr-20	79.2	80.0	-1.0						
30-Apr-20	79.9	80.0	-0.1						
7-May-20	79.4	80.0	-0.7						
12-May-20 <sup>(3)</sup>	77.5	80.0	-3.1						
12-May-20 <sup>(4)</sup>	85.1	80.0	6.4						
14-May-20	85.9	80.0	7.4						
21-May-20	84.2	80.0	5.2						
28-May-20	84.0	80.0	5.0						
4-Jun-20	82.6	80.0	3.3						
10-Jun-20 <sup>(3)</sup>	82.7	80.0	3.4						
10-Jun-20 <sup>(4)</sup>	80.3	80.0	0.3						
11-Jun-20	81.7	80.0	2.1						
18-Jun-20	70.3	80.0	-12.1						
18-Jun-20 <sup>(3)</sup>	73.2	80.0	-8.5						
18-Jun-20 <sup>(4)</sup>	80.3	80.0	0.4						
25-Jun-20	82.3	80.0	2.9						

<sup>1</sup> Acceptance criteria: ≤ 15%

<sup>2</sup> Manual precision check completed due to errors in auto precision check on April 2, 2020 for non-ozone gases.

<sup>3</sup> As-found; pre-calibration.

<sup>4</sup> As-left; post calibration.

Table 2-11: 3<sup>rd</sup> Quarter NO<sub>2</sub> 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 <sup>(1)</sup>
7/2/2020	84.9	80.0	6.1	15	5.06	1.95	8.88	1.24	2.61
7/9/2020	84.1	80.0	5.1						
7/16/2020	83.0	80.0	3.8						
7/23/2020	83.5	80.0	4.4						
7/30/2020	82.8	80.0	3.5						
8/6/2020	83.4	80.0	4.3						
8/13/2020	84.6	80.0	5.8						
8/20/2020	86.3	80.0	7.9						
8/27/2020	84.9	80.0	6.1						
9/3/2020	84.6	80.0	5.8						
9/10/2020	86.6	80.0	8.3						
9/17/2020	85.8	80.0	7.3						
9/21/2020 <sup>(2)</sup>	81.2	80.0	1.5						
9/22/2020 <sup>(2)</sup>	81.8	80.0	2.3						
9/24/2020	83.2	80.0	4.0						

<sup>1</sup> Acceptance criteria: ≤ 15%<sup>2</sup> As-left; post calibration.

Table 2-12: 4<sup>th</sup> Quarter NO<sub>2</sub> 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 <sup>(1)</sup>
10/1/2020	80.2	80.0	0.3	16	0.92	1.58	4.01	-2.17	2.09
10/8/2020	81.1	80.0	1.4						
10/13/2020 <sup>(2)</sup>	83.6	80.0	4.5						
10/15/2020	83.2	80.0	4.0						
10/22/2020	80.0	80.0	0.0						
10/29/2020	80.7	80.0	0.9						
11/5/2020	79.7	80.0	-0.4						
11/12/2020	80.0	80.0	0.0						
11/19/2020	80.6	80.0	0.8						
11/26/2020	79.4	80.0	-0.8						
12/3/2020	79.6	80.0	-0.5						
12/10/2020	81.1	80.0	1.4						
12/17/2020	81.6	80.0	2.0						
12/17/2020 <sup>(2)</sup>	80.6	80.0	0.8						
12/24/2020	79.1	80.0	-1.1						
12/31/2020	81.3	80.0	1.6						

<sup>1</sup> Acceptance criteria: ≤ 15%<sup>2</sup> As-left; post calibration.

Table 2-13: 1<sup>st</sup> Quarter O<sub>3</sub> 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 <sup>(1)</sup>
1/2/2020	80.6	80.0	0.8	41	4.65	4.15	12.78	-3.48	4.87
1/9/2020	77.5	80.0	-3.1						
1/16/2020	79.3	80.0	-0.9						
1/23/2020	79.9	80.0	-0.1						
1/27/2020 <sup>(2)</sup>	79.2	81.0	-2.2						
1/27/2020 <sup>(3)</sup>	83.3	81.0	2.8						
1/30/2020	81.9	80.0	2.4						
2/6/2020	80.8	80.0	1.0						
2/10/2020	84.3	83.2	1.3						
<b>2/12/2020 <sup>(4)</sup></b>	<b>85.7</b>	<b>80.0</b>	<b>7.1</b>						
2/13/2020	84.6	80.0	5.8						
2/13/2020 <sup>(2)</sup>	83.8	79.0	6.1						
2/13/2020 <sup>(3)</sup>	84.2	79.0	6.6						
<b>2/13/2020 <sup>(5)</sup></b>	<b>85.7</b>	<b>80.0</b>	<b>7.1</b>						
2/13/2020	84.0	80.0	5.0						
<b>2/14/2020 <sup>(5)</sup></b>	<b>86.4</b>	<b>80.0</b>	<b>8.0</b>						
<b>2/15/2020 <sup>(5)</sup></b>	<b>89.2</b>	<b>80.0</b>	<b>11.5</b>						
<b>2/16/2020 <sup>(5)</sup></b>	<b>88.2</b>	<b>80.0</b>	<b>10.3</b>						
<b>2/17/2020 <sup>(5)</sup></b>	<b>87.4</b>	<b>80.0</b>	<b>9.3</b>						
<b>2/18/2020 <sup>(5)</sup></b>	<b>87.4</b>	<b>80.0</b>	<b>9.3</b>						
<b>2/19/2020 <sup>(5)</sup></b>	<b>89.7</b>	<b>80.0</b>	<b>12.1</b>						
<b>2/21/2020 <sup>(2,5)</sup></b>	<b>90.3</b>	<b>79.0</b>	<b>14.3</b>						
2/21/2020 <sup>(3)</sup>	82.5	79.0	4.4						
2/21/2020	82.5	80.0	3.1						
2/24/2020 <sup>(2)</sup>	83.7	79.0	6.0						
2/24/2020 <sup>(3)</sup>	87.4	81.7	7.0						
<b>2/26/2020 <sup>(2,6)</sup></b>	<b>84.8</b>	<b>78.5</b>	<b>8.0</b>						



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 <sup>(1)</sup>
2/26/2020 <sup>(3)</sup>	84.2	79.4	6.1						
2/28/2020 <sup>(2)</sup>	86.5	81.8	5.8						
2/28/2020 <sup>(3)</sup>	83.5	80.9	3.2						
3/3/2020 <sup>(7)</sup>	83.1	79.9	4.0						
3/3/2020 <sup>(8)</sup>	77.2	80.0	-3.5						
3/3/2020 <sup>(9)</sup>	82.8	80.0	3.5						
3/11/2020 <sup>(2)</sup>	85.2	79.8	6.8						
3/11/2020 <sup>(3)</sup>	82.8	79.0	4.8						
3/11/2020	85.2	81.2	4.9						
<b>3/13/2020 <sup>(2,10)</sup></b>	<b>88.1</b>	<b>80.7</b>	<b>9.2</b>						
3/13/2020 <sup>(3)</sup>	81.1	80.0	1.4						
3/18/2020	80.9	80.7	0.3						
3/19/2020	80.6	80.0	0.8						
3/26/2020	80.7	80.0	0.9						

<sup>1</sup> Acceptance criteria:  $\leq 7\%$

<sup>2</sup> As-found; pre-calibration.

<sup>3</sup> As-left; post calibration.

<sup>4</sup> Analyzer failed precision check on February 12, 2020. Data invalidated from the last passing check on February 10, 2020 to the next passing check on February 13, 2020.

<sup>5</sup> Analyzer fails several precision checks in the February 13 to February 21 period. Data invalidated during this period.

<sup>6</sup> Analyzer failed precision check on February 26, 2020. Data invalidated to the last passing check on February 24, 2020.

<sup>7</sup> As-found precision check using transfer standard serial number 87.

<sup>8</sup> Check performed immediately after swapping transfer standard serial number 87 for transfer standard serial number 170.

<sup>9</sup> As-left precision check using transfer standard serial number 170.

<sup>10</sup> Analyzer failed precision check on March 13, 2020. Data invalidated to the last passing check on March 11, 2020.

Table 2-14: 2<sup>nd</sup> Quarter O<sub>3</sub> 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 <sup>(1)</sup>
2-Apr-20	80.1	80.0	0.1	22	1.22	2.24	5.61	-3.17	2.82
3-Apr-20 <sup>(2)</sup>	80.2	80.0	0.2						
9-Apr-20	79.8	80.0	-0.2						
11-Apr-20	85.2	81.2	4.9						
16-Apr-20	79.9	80.0	-0.1						
23-Apr-20	79.2	80.0	-1.0						
30-Apr-20	79.6	80.0	-0.6						
7-May-20	79.7	80.0	-0.4						
14-May-20	79.8	80.0	-0.3						
21-May-20	79.8	80.0	-0.2						
27-May-20 <sup>(3)</sup>	78.9	80.0	-1.4						
27-May-20 <sup>(4)</sup>	80.6	80.0	0.8						
28-May-20	81.7	80.0	2.1						
4-Jun-20	81.4	80.0	1.7						
10-Jun-20 <sup>(3)</sup>	81.3	80.0	1.6						
10-Jun-20 <sup>(4)</sup>	80.6	80.0	0.7						
11-Jun-20	80.9	80.0	1.1						
12-Jun-20	82.4	80.0	3.0						
18-Jun-20	82.6	80.0	3.2						
<b>21-Jun-20 <sup>(5)</sup></b>	<b>86.9</b>	<b>80.0</b>	<b>8.6</b>						
22-Jun-20 <sup>(4)</sup>	81.1	80.0	1.4						
25-Jun-20	81.4	80.0	1.7						

<sup>1</sup> Acceptance criteria: ≤ 7%

<sup>2</sup> Manual precision check completed due to errors in auto precision check on April 2, 2020 for non-ozone gases.

<sup>3</sup> As-found; pre-calibration.

<sup>4</sup> As-left; post calibration.

<sup>5</sup> Analyzer failed precision check on June 21, 2020. Data invalidated from the last passing check on June 18, 2020 to the next passing check on June 22, 2020.

Table 2-15: 3<sup>rd</sup> Quarter O<sub>3</sub> 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 <sup>(1)</sup>
7/2/2020	79.7	80.0	-0.4	15	1.51	0.70	2.89	0.13	0.94
7/9/2020	81.2	80.0	1.5						
7/16/2020	81.6	80.0	2.0						
7/23/2020	81.7	80.0	2.2						
7/30/2020	81.3	80.0	1.6						
8/6/2020	82.0	80.0	2.5						
8/13/2020	81.4	80.0	1.7						
8/19/2020 <sup>(2)</sup>	81.1	80.0	1.4						
8/20/2020	81.6	80.0	2.0						
8/24/2020 <sup>(2)</sup>	80.8	80.0	0.9						
8/27/2020	81.4	80.0	1.8						
9/3/2020	80.8	80.0	1.0						
9/10/2020	81.5	80.0	1.9						
9/17/2020	80.7	80.0	0.8						
9/24/2020	81.3	80.0	1.6						

<sup>1</sup> Acceptance criteria: ≤ 7%<sup>2</sup> Manual precision check completed

Table 2-16: 4<sup>th</sup> Quarter O<sub>3</sub> 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 <sup>(1)</sup>
10/1/2020	82.1	80.0	2.6	14	1.14	1.32	3.73	-1.46	1.80
10/8/2020	81.0	80.0	1.3						
10/15/2020	81.4	80.0	1.8						
10/22/2020	80.3	80.0	0.4						
10/29/2020	81.3	80.0	1.6						
11/5/2020	82.0	80.0	2.5						
11/12/2020	81.9	80.0	2.4						
11/19/2020	81.7	80.0	2.1						
11/26/2020	81.9	80.0	2.4						
12/3/2020	80.8	80.0	1.0						
12/10/2020	80.6	80.0	0.7						
12/17/2020	79.3	80.0	-0.8						
12/24/2020	78.8	80.0	-1.4						
12/31/2020	79.6	80.0	-0.6						

<sup>1</sup> Acceptance criteria:  $\leq 7\%$

Table 2-17: 1<sup>st</sup> Quarter SO<sub>2</sub> 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 <sup>(1)</sup>
1/2/2020	71.1	74.9	-5.1	28	0.03	3.62	6.93	-6.86	4.30
1/3/2020	71.2	74.9	-4.9						
1/3/2020	80.4	74.9	7.3						
1/21/2020 <sup>(2)</sup>	72.5	74.2	-2.3						
1/23/2020	71.4	74.9	-4.7						
1/24/2020 <sup>(3)</sup>	69.8	74.4	-6.2						
1/24/2020 <sup>(4)</sup>	75.8	74.3	2.0						
1/30/2020	73.5	74.9	-1.9						
2/5/2020 <sup>(3)</sup>	70.8	74.4	-4.8						
2/5/2020 <sup>(4)</sup>	75.1	73.3	2.5						
2/6/2020	76.0	74.9	1.5						
2/12/2020	74.4	74.9	-0.7						
2/13/2020	74.5	74.9	-0.5						
2/14/2020	74.6	74.9	-0.4						
2/15/2020	74.9	74.9	0.0						
2/16/2020	74.4	74.9	-0.7						
2/17/2020	74.0	74.9	-1.2						
2/18/2020	75.3	74.9	0.5						
2/19/2020	75.8	74.9	1.2						
2/24/2020	76.3	74.9	1.9						
2/27/2020	72.4	74.9	-3.3						
3/10/2020	73.9	74.9	-1.3						
3/11/2020	73.9	74.4	-0.7						
3/16/2020 <sup>(3)</sup>	79.1	74.9	5.6						
3/16/2020 <sup>(4)</sup>	80.7	74.8	7.9						
3/16/2020	77.8	74.9	3.9						

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 <sup>(1)</sup>
3/18/2020	77.6	74.9	3.6						
3/30/2020	76.2	74.9	1.7						

<sup>1</sup> Acceptance criteria:  $\leq 10\%$

<sup>2</sup> Previous instrument (SN 9200039) replaced by SN 10020059.

<sup>3</sup> As-found; pre-calibration.

<sup>4</sup> As-left; post calibration.

Table 2-18: 2<sup>nd</sup> Quarter SO<sub>2</sub> 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 <sup>(1)</sup>
3-Apr-20	74.3	74.9	-0.7	22	1.07	1.27	3.56	-1.42	1.61
9-Apr-20	75.6	74.9	0.9						
16-Apr-20	75.9	74.9	1.3						
23-Apr-20	75.1	74.9	0.3						
23-Apr-20 <sup>(2)</sup>	75.2	74.9	0.3						
30-Apr-20	75.2	74.9	0.4						
7-May-20	74.4	74.9	-0.7						
12-May-20 <sup>(3)</sup>	75.4	74.9	0.7						
12-May-20 <sup>(4)</sup>	75.2	74.9	0.4						
14-May-20	74.8	74.9	-0.1						
21-May-20	75.2	74.9	0.5						
27-May-20 <sup>(3)</sup>	75.7	74.9	1.0						
27-May-20 <sup>(4)</sup>	75.5	74.9	0.7						
28-May-20	74.8	74.9	-0.1						
4-Jun-20	75.4	74.9	0.6						
10-Jun-20 <sup>(3)</sup>	75.5	74.9	0.8						
10-Jun-20 <sup>(4)</sup>	76.4	74.9	2.1						
11-Jun-20	76.6	74.9	2.3						
18-Jun-20	77.7	74.9	3.8						
18-Jun-20 <sup>(3)</sup>	77.7	74.9	3.7						
18-Jun-20 <sup>(4)</sup>	77.1	74.9	2.9						
25-Jun-20	76.7	74.9	2.4						

<sup>1</sup> Acceptance criteria: ≤ 10%

<sup>2</sup> Manual precision check completed to test changes to data acquisition system.

<sup>3</sup> As-found; pre calibration.

<sup>4</sup> As-left; post calibration.

Table 2-19: 3<sup>rd</sup> Quarter SO<sub>2</sub> 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 <sup>(1)</sup>
7/2/2020	75.7	74.9	1.0	17	1.42	1.33	4.04	-1.19	1.75
7/9/2020	76.5	74.9	2.2						
7/16/2020	76.8	74.9	2.5						
7/23/2020	77.4	74.9	3.4						
7/30/2020	77.2	74.9	3.1						
8/5/2020 <sup>(3)</sup>	78.0	74.9	4.2						
8/5/2020 <sup>(4)</sup>	75.1	74.9	0.3						
8/6/2020	75.4	74.9	0.6						
8/13/2020	74.8	74.9	-0.2						
8/20/2020	74.8	74.9	-0.2						
8/27/2020	74.7	74.9	-0.3						
9/3/2020	75.9	74.9	1.4						
9/10/2020	74.9	74.9	0.0						
9/17/2020	75.8	74.9	1.2						
9/21/2020 <sup>(2)</sup>	76.1	74.9	1.6						
9/22/2020 <sup>(2)</sup>	76.4	74.9	2.0						
9/24/2020	76.0	74.9	1.4						

<sup>1</sup> Acceptance criteria: ≤ 10%

<sup>2</sup> Manual precision check completed alongside NO<sub>2</sub> calibration

<sup>3</sup> As-found; pre calibration.

<sup>4</sup> As-left; post calibration.



Table 2-20: 4<sup>th</sup> Quarter SO<sub>2</sub> 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 <sup>(1)</sup>
10/1/2020	76.1	74.9	1.6	19	1.55	1.39	4.28	-1.19	1.79
10/8/2020	76.5	74.9	2.1						
10/12/2020 <sup>(2)</sup>	75.8	74.9	1.2						
10/13/2020 <sup>(2)</sup>	76.1	74.9	1.6						
10/15/2020	75.5	74.9	0.8						
10/22/2020	75.6	74.9	0.9						
10/29/2020	76.2	74.9	1.7						
11/5/2020	76.4	74.9	2.0						
11/12/2020	77.1	74.9	2.9						
11/19/2020	76.9	74.9	2.7						
11/26/2020	77.7	74.9	3.8						
12/3/2020	77.8	74.9	3.9						
12/8/2020 <sup>(2)</sup>	77.6	74.9	3.6						
12/8/2020 <sup>(3)</sup>	75.1	74.9	0.3						
12/10/2020	74.3	74.9	-0.8						
12/17/2020	74.9	74.9	0.0						
12/17/2020 <sup>(2)</sup>	75.3	74.9	0.5						
12/24/2020	75.8	74.9	1.3						
12/31/2020	74.4	74.9	-0.6						

<sup>1</sup> Acceptance criteria: ≤ 10%<sup>2</sup> As-found; pre-calibration.<sup>3</sup> As-left; post calibration.

Table 2-21: Network PM<sub>2.5</sub> Monitoring Precision

Period	Samplers <sup>(1)</sup>	Concentration Levels	Number of Collocated Samples	Average Percent Difference	Standard Deviation <sup>(2)</sup> (µg/m <sup>3</sup> )	Precision <sup>(3)</sup> (%CV)
1 <sup>st</sup> Quarter (January 1 – March 31)	BAM PM <sub>2.5</sub> Primary against BAM PM <sub>2.5</sub> Collocated	≥3 µg/m <sup>3</sup>	61	-38.3	29.9	24.0
2 <sup>nd</sup> Quarter (April 1 – June 30)	BAM PM <sub>2.5</sub> Primary against BAM PM <sub>2.5</sub> Collocated	≥3 µg/m <sup>3</sup>	18	-21.8	23.5	21.5
3 <sup>rd</sup> Quarter (July 1 – September 30)	BAM PM <sub>2.5</sub> Primary against BAM PM <sub>2.5</sub> Collocated	≥3 µg/m <sup>3</sup>	1	-2.2	NA <sup>(4)</sup>	NA <sup>(4)</sup>
4 <sup>th</sup> Quarter (October 1 – December 31)	BAM PM <sub>2.5</sub> Primary against BAM PM <sub>2.5</sub> Collocated	≥3 µg/m <sup>3</sup>	9	12.3	48.7	52.1
Year to Date	BAM PM <sub>2.5</sub> Primary against BAM PM <sub>2.5</sub> Collocated	≥3 µg/m <sup>3</sup>	89	-29.5	34.4	27.0

<sup>1</sup> PM<sub>2.5</sub> network precision statistics represent data from the CD1 monitoring station PM<sub>2.5</sub> samplers.

<sup>2</sup> Standard deviation of the absolute concentration differences for the population.

<sup>3</sup> Precision is calculated as the coefficient of variation upper bound with a goal of ≤ 10%CV per quarter. Because of the very low PM<sub>2.5</sub> concentrations routinely observed on the North Slope of Alaska, 10%CV is often exceeded because of the exaggeration associated in the relative percent difference for very low concentration sample pairs. Because the precision estimate exceeds 10%CV, alternate precision statistics of ±3 µg/m<sup>3</sup> per collocated pair were applied according to the approved CD1 project quality assurance project plan (QAPP). See CD1 summary report and QAPP for additional information.

<sup>4</sup> NA indicates insufficient number of paired samples with both measurements >3µg/m<sup>3</sup> to calculate.

#### 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.

Table 2-22 through Table 2-36 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. Single-point calibration verification data for each parameter are provided in Appendix C.

Multi-point calibrations were performed on a biannual basis as recommended by the EPA (EPA-454/R-98-004). Additionally, multi-point calibrations were conducted under specific circumstances including: indication of analyzer malfunction, repairs or service that affected its calibration, and following significant interruptions in station operations. Multi-point calibrations consisted of challenging each instrument response with air scrubbed of all pollutants (“zero air”) and at least four concentrations spanning 80 to 90 percent of the URL. The NO<sub>2</sub> converter efficiency was determined following the guidelines provided in the 40 CFR 50 – Appendix F.

Table 2-22 through Table 2-25 include calibration statistical summaries for CO, NO<sub>2</sub>, O<sub>3</sub>, and SO<sub>2</sub> analyzers, respectively. Table 2-26 and Table 2-27 summarize the monthly quality control checks of the particulate samplers. These manual QC checks are conducted by SLR or on-site personnel and the data are transmitted to the SLR Anchorage office.

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

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

Table 2-22: Calibration Summary – CO

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Pass/Fail <sup>(1)</sup>
1/3/2020 <sup>(2)</sup>	0.0	0.0		0.80%	1.0035	0.0771	1.0000	PASS
	7.7	7.7	0.6%					
	16.8	17.0	1.5%					
	28.7	28.9	0.7%					
	38.4	38.7	0.8%					
	43.1	43.2	0.2%					
2/5/2020	0.0	0.0		1.10%	0.9995	0.1563	0.9999	PASS
	7.7	7.9	2.6%					
	16.8	17.1	2.0%					
	28.7	28.8	0.3%					
	38.4	38.6	0.5%					
	43.1	43.1	0.1%					
2/24/2020	0.0	0.1	-	1.86%	1.0037	0.2588	0.9998	PASS
	7.7	7.8	2.2%					
	16.8	17.3	3.3%					
	28.7	29.4	2.3%					
	38.3	38.8	1.3%					
	46.9	47.0	0.2%					
3/10/2020	0.0	0.0	-	5.29%	1.0351	0.2598	0.9996	PASS
	7.4	7.8	6.3%					
	16.1	17.2	7.1%					
	27.6	29.0	5.2%					
	36.8	38.6	5.0%					
	41.3	42.5	2.9%					

<sup>1</sup>Acceptance criteria:

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

<sup>2</sup> The CO analyzer pump failed on December 21, 2019. The CO analyzer (serial number 1008241341) was removed and replaced with serial number 1527 on January 3, 2020.

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 <sup>2</sup>	Pass/Fail <sup>(1)</sup>
4/8/2020 <sup>(2)</sup>	0.0	0.0		4.63%	1.0366	0.0984	0.9999	PASS <sup>(2)</sup>
	7.4	7.8	4.7%					
	16.2	17.1	5.5%					
	37.1	38.5	3.7%					
5/12/2020	0.0	0.0	-	4.14%	1.0355	0.0853	1.0000	PASS
	7.4	7.7	4.3%					
	16.2	17.0	5.0%					
	27.8	28.9	4.1%					
	41.7	43.2	3.6%					
	45.4	47.1	3.7%					
5/27/2020	0.0	-0.2	-	3.96%	1.0433	-0.0872	0.9999	PASS
	7.4	7.6	2.4%					
	16.2	17.0	5.2%					
	27.8	28.9	4.2%					
	37.0	38.6	4.1%					
	41.7	43.3	3.8%					
6/10/2020	0.0	0.0	-	3.96%	1.0412	-0.0473	1.0000	PASS
	7.5	7.6	1.9%					
	16.2	16.9	4.6%					
	27.7	28.9	4.1%					
	37.0	38.5	4.0%					
	41.7	43.3	3.9%					

<sup>1</sup> Acceptance criteria:

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

<sup>2</sup> Calibration was unstable and unable to produce the usual number of upscale measurement points. Although the average percent error and linear regression statistics are within acceptable boundaries, they are based on fewer upscale calibration points than normal. Precision check runs on April 3, 2020 and April 9, 2020 were stable and upscale points tested at the same time of the precision check were also stable on those dates. Data were invalidated between the valid precision checks on April 3, 2020 and April 9, 2020.

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 <sup>2</sup>	Pass/Fail <sup>(1)</sup>
8/5/2020	0.0	-0.1	-	0.61%	0.9958	0.0399	0.9999	PASS
	7.7	7.8	0.9%					
	16.9	17.0	1.1%					
	28.9	28.9	0.0%					
	38.6	38.3	-0.8%					
	43.4	43.3	-0.3%					
8/24/2020	0.0	-0.1	-	0.61%	0.9958	0.0399	0.9999	PASS
	7.7	7.7	-0.3%					
	16.9	16.8	-0.4%					
	28.9	28.8	-0.3%					
	38.6	38.3	-0.6%					
	43.4	43.4	0.0%					
10/12/2020	0.0	-0.3	-	2.10%	0.9987	-0.3377	1.0000	PASS
	7.7	7.3	-5.1%					
	16.9	16.5	-2.5%					
	29.0	28.7	-1.0%					
	38.6	38.3	-0.9%					
	43.4	43.0	-1.0%					
10/13/2020	0.0	-0.3	-	2.97%	0.9879	-0.3075	1.0000	PASS
	7.7	7.3	-5.8%					
	16.9	16.3	-3.3%					
	29.0	28.5	-1.7%					
	38.6	37.9	-1.9%					
	43.4	42.5	-2.2%					
10/20/2020	0.0	-0.3	-	1.78%	0.9849	-0.1177	0.9999	PASS
	7.3	7.3	0.5%					
	16.9	16.3	-3.3%					
	28.9	28.5	-1.3%					
	38.6	37.9	-1.8%					
	43.4	42.5	-2.0%					

<sup>1</sup> Acceptance criteria:

1. Measured and audit point difference  $\leq \pm 10\%$
2. Slope  $\geq 0.90$  and  $\leq 1.10$
3.  $R^2 \geq 0.9955$
4. Y-intercept  $\leq \pm 2\%$  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 <sup>2</sup>	Pass/Fail <sup>(1)</sup>
12/8/2020 (as found)	0.0	0.4	-	3.35%	1.0175	0.3257	1.0000	PASS
	7.7	8.1	5.2%					
	16.9	17.4	3.1%					
	29.0	30.0	3.6%					
	38.6	39.6	2.6%					
	43.5	44.4	2.3%					
12/8/2020 (as-left)	0.0	0.2	-	0.51	0.9953	0.1102	0.9999	PASS
	7.7	7.7	-0.9%					
	16.9	16.8	-0.5%					
	28.9	29.1	0.6%					
	38.6	38.5	-0.2%					
	43.4	43.2	-0.4%					
12/17/2020	0.0	0.1	-	0.43%	0.9999	0.0985	1.0000	PASS
	7.7	7.8	0.7%					
	16.9	16.9	0.3%					
	28.9	29.2	1.0%					
	38.6	38.6	0.0%					
	43.4	43.4	0.1%					

<sup>1</sup> Acceptance criteria:

1. Measured and audit point difference  $\leq \pm 10\%$
2. Slope  $\geq 0.90$  and  $\leq 1.10$
3. R<sup>2</sup>  $\geq 0.9955$
4. Y-intercept  $\leq \pm 2\%$  of full scale



Table 2-23: Calibration Summary – NO<sub>2</sub>

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Converter Efficiency	Pass/Fail <sup>(1)</sup>
2/24/2020	0.0	0.0	-	4.56%	0.9613	-0.9101	0.9998	98.3%	PASS
	85.2	79.9	-6.3%						
	180.4	174.3	-3.4%						
	304.9	289.9	-4.9%						
	302.1	287.8	-4.7%						
	402.9	388.8	-3.5%						
3/10/2020	0.0	0.2	-	2.46%	0.9980	1.8952	0.9991	99.5%	PASS
	81.3	85.7	5.4%						
	175.8	179.9	2.4%						
	318.0	309.9	-2.5%						
	391.6	397.7	1.5%						
	419.3	421.3	0.5%						
5/12/2020	0.0	0.2	-	3.02%	0.9787	4.690	0.9994	96.0%	PASS
	78.5	85.1	8.4%						
	169.9	175.0	3.0%						
	304.9	299.1	-1.9%						
	402.8	402.7	0.0%						
	434.2	426.7	-1.7%						
6/10/2020	0.0	-0.1	-	0.44%	0.9966	-0.1497	1.0000	100.2%	PASS
	80.8	80.3	-0.7%						
	171.7	171.8	0.0%						
	297.8	295.2	-0.9%						
	398.2	396.4	-0.4%						
	425.7	425.0	-0.2%						
6/18/2020	0.0	0.2	-	1.26%	0.9810	1.3680	1.0000	97.8%	PASS
	79.6	80.4	1.0%						
	167.8	166.3	-0.9%						
	283.8	280.7	-1.1%						
	373.4	366.9	-1.7%						
	398.3	391.8	-1.6%						

<sup>1</sup> Acceptance criteria:

1. Measured and audit point difference ≤ ±15%
2. Slope ≥ 0.9 and ≤ 1.10
3. R<sup>2</sup> ≥ 0.9950
4. Y-intercept ≤ ±3% of full scale
5. Converter efficiency ≥ 96.0%

Table 2-23 (Continued): Calibration Summary – NO<sub>2</sub>

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Converter Efficiency	Pass/Fail <sup>(1)</sup>
9/21/2020	0.0	0.0	-	0.35%	0.9957	0.3551	1.0000	99.4%	PASS
	81.6	81.3	-0.3%						
	173.9	173.6	-0.2%						
	298.0	298.8	0.3%						
	401.4	400.0	-0.3%						
	428.1	425.5	-0.6%						
9/22/2020	0.0	0.0	-	0.90%	0.9970	1.3410	0.9999	99.2%	PASS
	80.0	81.8	2.2%						
	171.0	172.6	0.9%						
	298.1	300.1	0.7%						
	402.4	400.3	-0.5%						
	430.0	430.6	0.1%						
10/13/2020	0.000	0.000	-	1.21%	0.9949	1.5376	0.9998	99.3%	PASS
	80.936	83.600	3.3%						
	174.073	175.100	0.6%						
	303.313	304.400	0.4%						
	406.864	401.700	-1.3%						
	432.454	434.900	0.6%						
10/21/2021 <sup>(2)</sup>	0.0	-0.2	-	0.30%	1.0045	0.2552	1.0000	100.1%	PASS
	80.1	80.2	0.1%						
	178.4	178.9	0.3%						
	301.2	302.3	0.4%						
	404.2	405.6	0.4%						
	418.3	420.1	0.4%						
12/17/2020	0.000	-0.100	-	1.91%	1.0265	-1.0256	1.0000	100.7%	PASS
	80.351	81.000	0.8%						
	174.355	177.200	1.6%						
	302.248	308.600	2.1%						
	400.083	410.600	2.6%						
	427.194	437.400	2.4%						

<sup>1</sup> Acceptance criteria:

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

<sup>2</sup> No as-found performed due to instrument malfunction.

Table 2-24: Calibration Summary – O<sub>3</sub>

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Pass/Fail <sup>(1)</sup>
1/27/2020	-0.001	0.000	-	1.59%	0.9791	0.0033	0.9999	PASS
	0.081	0.083	2.8%					
	0.175	0.177	1.3%					
	0.299	0.297	-0.8%					
	0.400	0.394	-1.5%					
	0.451	0.444	-1.5%					
2/10/2020	0.001	0.000	-	1.44%	0.9916	0.0022	0.9992	PASS
	0.083	0.084	1.3%					
	0.180	0.182	0.8%					
	0.299	0.308	3.0%					
	0.401	0.398	-0.7%					
	0.457	0.450	-1.4%					
2/13/2020 <sup>(2, 4)</sup>	0.000	0.000	-	2.60%	0.9692	0.0044	0.9997	PASS
	0.079	0.084	6.1%					
	0.173	0.175	1.0%					
	0.297	0.293	-1.2%					
	0.397	0.388	-2.3%					
	0.448	0.437	-2.4%					
2/13/2020 <sup>(3, 4)</sup>	0.000	0.000	-	2.65%	0.9700	0.0047	0.9997	PASS
	0.079	0.084	6.6%					
	0.173	0.176	1.4%					
	0.297	0.294	-0.8%					
	0.396	0.389	-1.8%					
	0.446	0.435	-2.6%					

<sup>1</sup>Acceptance criteria:

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

<sup>2</sup> As-Found; pre-calibration.

<sup>3</sup> As-Left; post-calibration.

<sup>4</sup> Ozone transfer standard (serial number 170) replaced with serial number 87 on February 13, 2020.

Table 2-24 (Continued): Calibration Summary – O<sub>3</sub>

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Pass/Fail <sup>(1)</sup>
2/21/2020 <sup>(2)</sup>	0.000	0.000	-	8.78%	1.0705	-0.0043	0.9954	FAIL
	0.079	0.090	14.3%					
	0.190	0.173	-8.7%					
	0.298	0.320	7.4%					
	0.397	0.423	6.7%					
	0.448	0.478	6.7%					
2/21/2020	0.000	0.000	-	2.29%	0.9676	0.0036	0.9998	PASS
	0.079	0.083	4.4%					
	0.173	0.173	0.1%					
	0.297	0.292	-1.7%					
	0.397	0.387	-2.6%					
	0.446	0.434	-2.7%					
2/24/2020	0.000	0.000	-	3.48%	0.9770	0.0067	0.9985	PASS
	0.082	0.087	7.0%					
	0.173	0.183	5.8%					
	0.298	0.302	1.3%					
	0.399	0.400	0.4%					
	0.445	0.433	-2.9%					
2/26/2020	0.000	0.001	-	2.87%	0.9630	0.0045	0.9998	PASS
	0.079	0.084	6.0%					
	0.177	0.175	-1.1%					
	0.297	0.293	-1.4%					
	0.396	0.385	-2.9%					
	0.445	0.433	-2.9%					

<sup>1</sup> Acceptance criteria:

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

<sup>2</sup> The ozone analyzer failed the calibration on February 21, 2020. Ozone data were invalidated back to the last passing calibration on February 13, 2020.

Table 2-24 (Continued): Calibration Summary – O<sub>3</sub>

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Pass/Fail <sup>(1)</sup>
2/28/2020	0.000	0.000	-	3.10%	0.9502	0.0047	0.9996	PASS
	0.081	0.084	3.2%					
	0.172	0.173	0.8%					
	0.297	0.288	-3.1%					
	0.401	0.385	-3.9%					
	0.445	0.425	-4.5%					
3/3/2020 <sup>(2, 4)</sup>	-0.006	0.000	-	3.12%	0.9430	0.0072	0.9999	PASS
	0.080	0.083	4.0%					
	0.172	0.172	-0.3%					
	0.297	0.288	-2.9%					
	0.397	0.381	-4.0%					
	0.448	0.428	-4.4%					
3/3/2020 <sup>(3, 4)</sup>	-0.001	0.000	-	5.49%	0.9304	0.0022	0.9999	PASS
	0.080	0.077	-3.5%					
	0.175	0.167	-4.7%					
	0.300	0.281	-6.2%					
	0.400	0.375	-6.3%					
	0.450	0.420	-6.7%					
3/3/2020 <sup>(4)</sup>	-0.001	0.000	-	1.25%	0.9882	0.0024	0.9999	PASS
	0.080	0.083	3.5%					
	0.175	0.177	1.0%					
	0.300	0.298	-0.6%					
	0.400	0.399	-0.2%					
	0.450	0.446	-1.0%					

<sup>1</sup> Acceptance criteria:

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

<sup>2</sup> As-Found; pre-calibration.

<sup>3</sup> As-Left; post-calibration.

<sup>4</sup> Ozone transfer standard (serial number 87) replaced with serial number 170 on March 3, 2020. An additional calibration was performed after the As-Left calibration.

Table 2-24 (Continued): Calibration Summary – O<sub>3</sub>

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Pass/Fail <sup>(1)</sup>
3/10/2020	-0.002	0.000	-	2.19%	0.9739	0.0034	0.9998	PASS
	0.079	0.083	4.8%					
	0.174	0.173	-0.6%					
	0.299	0.292	-2.4%					
	0.401	0.398	-0.8%					
	0.451	0.440	-2.3%					
3/13/2020	0.000	0.000	-	0.27%	1.0003	0.0003	1.0000	PASS
	0.081	0.081	0.5%					
	0.176	0.176	0.3%					
	0.299	0.300	0.2%					
	0.399	0.398	-0.1%					
	0.449	0.450	0.2%					
5/27/2020	0.000	0.000	-	0.38%	1.0056	-0.0005	1.0000	PASS
	0.081	0.081	0.4%					
	0.175	0.176	0.4%					
	0.299	0.300	-0.1%					
	0.399	0.401	0.4%					
	0.449	0.452	0.6%					
6/10/2020	0.001	0.000	-	0.19%	1.0050	-0.0009	1.0000	PASS
	0.081	0.081	0.2%					
	0.175	0.175	0.0%					
	0.299	0.300	0.1%					
	0.399	0.400	0.3%					
	0.449	0.450	0.2%					

<sup>1</sup> Acceptance criteria:

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

Table 2-24 (Continued): Calibration Summary – O<sub>3</sub>

Period	Calibration Gas Concentration (ppm)	Analyzer Response (ppm)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Pass/Fail <sup>(1)</sup>
6/21/2020	0.000	0.000	-	0.19%	1.0016	-0.0001	0.9997	PASS
	0.082	0.083	0.5%					
	0.175	0.175	0.1%					
	0.299	0.299	0.0%					
	0.449	0.450	0.2%					
	0.399	0.400	0.2%					
9/10/2020	0.001	0.001	-	0.99%	1.0114	-0.0003	1.0000	PASS
	0.081	0.081	0.7%					
	0.175	0.177	0.9%					
	0.299	0.303	1.3%					
	0.399	0.403	1.1%					
	0.450	0.454	1.0%					
10/20/2020	0.000	0.000	-	1.09%	1.0024	-0.0014	0.9996	PASS
	0.081	0.081	-0.9%					
	0.177	0.175	-1.0%					
	0.303	0.299	-1.2%					
	0.405	0.400	-1.2%					
	0.450	0.455	1.3%					
12/17/2020	0.000	0.000	-	0.84%	0.9977	-0.0009	1.0000	PASS
	0.081	0.080	-1.5%					
	0.175	0.172	-1.4%					
	0.299	0.298	-0.6%					
	0.399	0.397	-0.5%					
	0.450	0.448	-0.2%					

<sup>1</sup> Acceptance criteria:

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

Table 2-25: Calibration Summary – SO<sub>2</sub>

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Pass/Fail <sup>(1)</sup>
1/20/2020 <sup>(2)</sup>	-	-	-	20.45%	1.0734	23.4180	0.9991	FAIL
	73.6	101.2	37.5%					
	162.4	198.4	22.1%					
	278.4	322.0	15.7%					
	371.6	429.0	15.5%					
	417.7	466.0	11.6%					
1/21/2020 <sup>(3)</sup>	0.0	-1.4	-	0.77%	1.0032	-1.1643	0.9999	PASS
	74.2	72.5	-2.3%					
	162.5	162.0	-0.3%					
	278.1	280.0	0.7%					
	371.8	372.4	0.2%					
	417.8	416.1	-0.4%					
1/24/2020	0.0	-0.9	-	2.03%	1.0161	0.4140	0.9997	PASS
	74.3	75.8	2.0%					
	162.6	167.1	2.8%					
	278.5	286.8	3.0%					
	417.6	426.7	2.2%					
	371.8	372.9	0.3%					
2/5/2020	0.0	-0.3	-	0.84%	1.0089	-0.2040	1.0000	PASS
	74.3	75.1	1.1%					
	162.7	163.8	0.7%					
	278.7	280.3	0.6%					
	372.0	376.0	1.1%					
	417.8	421.0	0.8%					

<sup>1</sup>Acceptance criteria:

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

<sup>2</sup> The SO<sub>2</sub> analyzer malfunctioned and failed its calibration on January 20, 2020. Analyzer serial number 9200039 was removed and replaced with serial number 10020059. SO<sub>2</sub> data were invalidated back to the last passing precision check on January 6, 2020.

<sup>3</sup> As-Left following analyzer replacement.



Table 2-25 (Continued): Calibration Summary – SO<sub>2</sub>

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Pass/Fail <sup>(1)</sup>
2/24/2020	0.0	1.1	-	0.84%	0.9865	2.3060	0.9998	PASS
	74.3	75.1	1.0%					
	162.7	163.0	0.2%					
	278.4	280.8	0.9%					
	371.7	368.9	-0.7%					
	454.8	448.6	-1.4%					
3/10/2020	0.0	-0.2	-	0.99%	0.9923	1.2022	0.9996	PASS
	74.4	73.9	-0.6%					
	162.7	165.5	1.7%					
	278.4	277.8	-0.2%					
	371.6	374.2	0.7%					
	417.5	410.6	-1.7%					
3/16/2020	0.0	-0.6	-	1.34%	0.9918	2.0488	0.9998	PASS
	74.9	77.8	3.9%					
	163.8	165.9	1.3%					
	280.5	281.5	0.4%					
	375.4	375.9	0.1%					
	420.7	416.3	-1.0%					
4/8/2020 <sup>(2)</sup>	0.0	-0.1	-	0.77%	0.9901	1.0209	0.9999	PASS <sup>(2)</sup>
	74.9	75.5	0.8%					
	163.7	164.6	0.5%					
	374.6	371.2	-0.9%					

<sup>1</sup> Acceptance criteria:

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

<sup>2</sup> Calibration was unstable and unable to produce the usual number of upscale measurement points. Although the average percent error and linear regression statistics are within acceptable boundaries, they are based on fewer upscale calibration points than normal. Precision check runs on April 3, 2020 and April 9, 2020 were stable and upscale points tested at the same time of the precision check were also stable on those dates. Data were invalidated between the valid precision checks on April 3, 2020 and April 9,

Table 2-25 (Continued): Calibration Summary – SO<sub>2</sub>

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Pass/Fail <sup>(1)</sup>
5/12/2020	0.0	0.5	-	1.06%	0.9865	2.1336	0.9995	PASS
	74.4	75.4	1.4%					
	162.7	164.1	0.9%					
	278.4	277.6	-0.3%					
	371.6	373.8	0.6%					
	417.5	408.4	-2.2%					
6/10/2020	0.0	1.4	-	0.97%	1.0024	1.4913	1.0000	PASS
	75.6	76.3	0.9%					
	163.6	166.9	2.0%					
	280.2	282.6	0.8%					
	374.0	376.1	0.5%					
	421.0	423.3	0.5%					
8/5/2020	0.000	-1.5	-	0.58%	1.0062	-0.4273	1.0000	PASS
	74.8	75.1	0.4%					
	163.4	164.9	0.9%					
	280.2	282.4	0.8%					
	374.2	376.2	0.5%					
	420.9	422.0	0.3%					
10/12/2020	0.0	0.2	-	1.27%	1.0116	0.2163	1.0000	PASS
	74.8	75.8	1.3%					
	163.6	166.0	1.4%					
	281.0	284.1	1.1%					
	374.3	379.8	1.5%					
	421.2	425.7	1.1%					
10/13/2020	0.0	0.3	-	1.51%	1.0111	0.6299	1.0000	PASS
	74.9	76.2	1.8%					
	163.6	166.8	1.9%					
	280.3	284.7	1.6%					
	374.3	377.0	0.7%					
	421.2	427.6	1.5%					

<sup>1</sup> Acceptance criteria:

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

Table 2-25 (Continued): Calibration Summary – SO<sub>2</sub>

Period	Calibration Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Slope	Y-Intercept	R <sup>2</sup>	Pass/Fail <sup>(1)</sup>
10/20/2020	0.0	0.2	-	1.09%	1.0043	1.0620	0.9999	PASS
	74.9	75.9	1.4%					
	163.7	165.9	1.3%					
	280.3	284.7	1.6%					
	374.4	378.7	1.1%					
	421.3	421.2	0.0%					
12/8/2020	0.0	0.6	-	0.40%	1.0016	0.5379	1.0000	PASS
	74.9	75.2	0.5%					
	163.7	164.6	0.6%					
	280.4	281.8	0.5%					
	374.2	375.2	0.3%					
	420.6	421.7	0.2%					
12/17/2020	0.0	0.1	-	0.37%	1.0022	0.2272	1.0000	PASS
	74.9	75.3	0.5%					
	163.8	164.7	0.6%					
	280.2	281.1	0.3%					
	374.3	374.5	0.1%					
	420.7	422.4	0.4%					

<sup>1</sup> Acceptance criteria:

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

Table 2-26: Quality Control Checks PM<sub>2.5</sub>

Date <sup>(4)</sup>	Ambient Temperature <sup>(1)</sup> (°C)			Barometric Pressure <sup>(2)</sup> (mmHg)			Time (hh:mm:ss)			Flow Rate <sup>(3)</sup> (L/min)		
	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff
1/2/2020	-27.0	-26.6	-0.4	767	762	5	17:14:24	17:12:25	0:01:59	16.7	16.63	0.5%
2/11/2020	-36.1	-35.4	-0.7	768	767	1	11:48:50	11:47:00	0:01:50	16.9	16.75	0.8%
3/10/2020	-35.7	-35.2	-0.5	773	766	7	22:53:00	22:51:00	0:02:00	16.7	16.85	-0.8%
6/10/2020	1.1	1.1	0.0	754	758	-4	9:32:36	9:30:00	0:02:36	16.7	16.47	1.5%
9/7/2020	2.8	2.7	0.1	752	755	-3	16:52:00	16:50:00	0:02:00	16.7	16.39	1.8%
10/21/2020	-1.9	-1.6	-0.3	769	771	-2	10:10:00	10:08:00	0:02:00	16.7	16.38	1.8%
12/16/2020	-23.1	-23.3	0.2	764	760	4	16:15:00	16:13:40	0:01:20	16.7	16.63	0.2%

<sup>1</sup> Acceptable criteria  $\pm 2^{\circ}\text{C}$

<sup>2</sup> Acceptable criteria  $\pm 10$  mmHg

<sup>3</sup> Acceptable criteria  $\pm 4\%$  of reference

<sup>4</sup> COVID-19 related travel restrictions into North Slope villages prevented qualified staff from traveling to the station and completing quality control checks in April, May, July, August, and November 2020.

Table 2-27: Quality Control Checks PM<sub>10</sub>

Date <sup>(4)</sup>	Ambient Temperature <sup>(1)</sup> (°C)			Barometric Pressure <sup>(2)</sup> (mmHg)			Time (hh:mm:ss)			Flow Rate <sup>(3)</sup> (L/min)		
	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff	Sampler	QC Check	Diff
1/2/2020	-26.2	-26.6	0.4	767	762	5	17:14:20	17:12:25	0:01:55	16.7	16.84	-1.1%
2/11/2020	-35.4	-35.4	0.0	768	767	1	11:48:20	11:46:30	0:01:50	16.5	16.62	-1.0%
3/10/2020	-35.7	-35.2	-0.5	773	767	7	22:53:00	22:51:00	0:02:00	16.7	OVER <sup>(4)</sup>	OVER <sup>(4)</sup>
6/10/2020	1.3	1.1	0.2	756	758	-2	9:32:48	9:30:00	0:02:48	16.7	16.55	0.7%
9/7/2020	3.4	2.7	0.7	754	755	-1	16:52:00	16:50:00	0:02:00	16.7	16.49	1.3%
10/21/2020	-1.4	-1.6	0.2	771	771	0	10:10:00	10:08:00	0:02:00	16.7	16.51	1.3%
12/16/2020	-22.9	-23.5	0.6	765	760	5	16:15:00	16:13:40	0:01:20	16.7	16.62	0.4%

<sup>1</sup> Acceptable criteria ±2°C

<sup>2</sup> Acceptable criteria ±10 mmHg

<sup>3</sup> Acceptable criteria ±4% of reference

<sup>4</sup> The PM<sub>10</sub> BAM analyzer failed its QC check on March 10, 2020 and the calibration standard reading exceeded the range of the equipment. The pump was replaced on March 12, 2020 and PM<sub>10</sub> data were invalidated back to the last passing QC check on February 11, 2020. Due to the data loss, DQOs were not met for the first quarter.

<sup>5</sup> COVID-19 related travel restrictions into North Slope villages prevented qualified staff from traveling to the station and completing quality control checks in April, May, July, August, and November 2020.

Table 2-28: October 21, 2020 Meteorological Calibration Summary

Parameter	Limit	Units	Max Error	Status
2-m Temperature Accuracy – Primary Sensor <sup>(1)</sup>	$\leq \pm 0.50$	°C	0.19	Pass
10-m Temperature Accuracy – Primary Sensor <sup>(1)</sup>	$\leq \pm 0.50$	°C	0.14	Pass
Temperature Difference ( $\Delta T$ ) – Primary Sensors <sup>(1)</sup>	$\leq \pm 0.10$	°C	0.06	Pass
Vertical Wind Speed Accuracy	$\leq \pm 0.20 \pm 5\%$ known input	m/s	0.15	Pass
Vertical Wind Speed Torque	$\leq 0.310$	g-cm	0.3	Pass
Solar Radiation Accuracy	$\leq \pm 10$ W/m <sup>2</sup>	W/m <sup>2</sup>	0.0	Pass
Horizontal Wind Primary Sensor – As Found <sup>(2)</sup>				
Wind Speed Accuracy	$\leq \pm 0.20 \pm 5\%$ known input	m/s	0.00	Pass
Wind Speed Torque	$\leq 1.0$	g-cm	0.4	Pass
Wind Direction Alignment	$\leq \pm 5$	Degree	--	--
Wind Direction Accuracy	$\leq \pm 5$	Degree	4.1	Pass
Wind Direction Linearity	$\leq \pm 3$	Degree	3.9	Fail
Wind Direction Torque	$\leq 11.0$	g-cm	20.0	Fail
Horizontal Wind Secondary Sensor – As Found <sup>(2)</sup>				
Wind Speed Accuracy	$\leq \pm 0.20 \pm 5\%$ known input	m/s	0.00	Pass
Wind Speed Torque	$\leq 1.0$	g-cm	0.4	Pass
Wind Direction Alignment	$\leq \pm 5$	Degree	1.2	Pass
Wind Direction Accuracy	$\leq \pm 5$	Degree	2.0	Pass
Wind Direction Linearity	$\leq \pm 3$	Degree	1.8	Pass
Wind Direction Torque	$\leq 11.0$	g-cm	8	Pass

<sup>1</sup> The primary sensor calibration failed in October 2020. Data from the secondary sensor was used for the monitoring year.

## 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 Table 2-29 through Table 2-32.

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<sub>2</sub>, and SO<sub>2</sub> and equal to or less than 10 percent for O<sub>3</sub>.

The performance audits of PM<sub>2.5</sub> and PM<sub>10</sub> 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<sub>2.5</sub> and PM<sub>10</sub> samplers are conducted using an audit orifice transfer standard (BGI Delta Cal or equivalent). Results of the PM sampler audits are presented in Table 2-33 and Table 2-34.

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 Table 2-35.

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

Conoco requested and was granted a waiver from ADEC to reduce the network frequency of PM<sub>2.5</sub> Performance Evaluation Program (PEP) audits to one every three years. A PEP-like audit was conducted at the CD1 PM<sub>2.5</sub> network QA station in October 2020. Data from the 2020 PM<sub>2.5</sub> PEP audit are provided in Table 2-36.

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 October 2020 at the Nuiqsut monitoring station. The audit indicated that the monitoring project is staffed with experienced personnel with a defined organization, and that the station is well-planned and properly sited according to criteria recommended by the EPA. Appendix C contains the complete technical systems audit report.

Table 2-29: 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 <sup>(1)</sup>
						Slope	Y-Intercept	R <sup>2</sup>	
3/11/2020	0	0.00	0.057	-	3.8	1.0142	0.088	1.0000	Pass
	1	2.060	2.20	6.8					
	2	6.900	7.10	2.9					
	3	21.81	22.20	1.8					
9/7/2020	0	0.00	-0.120	-	2.8	0.9800	-0.062	1.0000	Pass
	1	2.060	1.98	-3.9					
	2	7.590	7.43	-2.1					
	3	25.04	24.46	-2.3					
10/21/2020	0	0.00	-0.045	-	3.4	0.9718	-0.042	1.0000	Pass
	1	2.060	1.99	-3.4					
	2	7.590	7.30	-3.8					
	3	25.04	24.30	-3.0					

<sup>1</sup> Acceptance criteria: Measured and audit point difference  $\leq \pm 15\%$



Table 2-30: Performance Audit Summary – NO<sub>2</sub>

Period	Audit Point	Audit Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Converter Efficiency	Pass/Fail <sup>(1)</sup>
						Slope	Y-Intercept	R <sup>2</sup>		
3/11/2020	0	0	0.4	-	0.8	1.0118	-0.019	1.0000	100.1	Pass
	1	39.0	39.0	0.0						
	2	75.0	75.8	1.1						
	3	248	251	1.2						
9/7/2020	0	0	0.4	-	2.2	1.0173	0.461	1.0000	100.0	Pass
	1	34.0	34.5	1.5						
	2	84.0	86.7	3.2						
	3	272	277	1.8						
10/21/2020	0	0	0.0	-	3.7	0.9569	0.216	1.0000	100.0	Pass
	1	33.0	32.0	-3.0						
	2	85.0	81.6	-4.0						
	3	306	293	-4.2						

<sup>1</sup> Acceptance criteria: Measured and audit point difference  $\leq \pm 15\%$

Table 2-31: Performance Audit Summary – O<sub>3</sub>

Period	Audit Point	Audit Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Pass/Fail <sup>(1)</sup>
						Slope	Y-Intercept	R <sup>2</sup>	
3/11/2020	0	0	0.0	-	9.1	1.1133	-1.519	1.0000	Pass
	1	31.0	32.9	6.1					
	2	76.0	81.6	7.4					
	3	149	164	10.1					
	4	398	442	11.1					
9/7/2020	0	0	0.0	-	6.8	1.0825	-1.044	1.0000	Pass
	1	31.0	32.7	5.5					
	2	77.0	81.7	6.1					
	3	148	158	6.8					
	4	394	426	8.1					
10/21/2020	0	0	0.0	-	5.2	1.0805	-1.761	1.0000	Pass
	1	31.0	31.8	2.6					
	2	75.0	78.8	5.1					
	3	150	158	5.3					
	4	395	426	7.8					

<sup>1</sup> Acceptance criteria: Measured and audit point difference  $\leq \pm 15\%$

Table 2-32: Performance Audit Summary – SO<sub>2</sub>

Period	Audit Point	Audit Gas Concentration (ppb)	Analyzer Response (ppb)	Percent Difference (%)	Mean Absolute Percent Difference (%)	Linear Regression Statistics			Pass/Fail <sup>(1)</sup>
						Slope	Y-Intercept	R <sup>2</sup>	
3/11/2020	0	0.0	-0.6	-	2.8	1.0111	0.561	1.0000	Pass
	1	40.0	41.8	4.5					
	2	75.0	77.1	2.8					
	3	250	253	1.2					
9/7/2020	0	0.0	0.0	-	0.7	0.9927	0.020	1.0000	Pass
	1	30.0	29.8	-0.7					
	2	75.0	74.5	-0.7					
	3	275	273	-0.7					
10/21/2020	0	0.0	0.7	-	3.2	0.9739	0.002	1.0000	Pass
	1	30.0	28.8	-4.0					
	2	75.0	72.6	-3.2					
	3	275	268	-2.5					

<sup>1</sup> Acceptance criteria: Measured and audit point difference  $\leq \pm 15\%$

Table 2-33: Performance Audit Summary – PM<sub>2.5</sub>

Period	External Leak Check Error (LPM)	Ambient Temperature Error (°C)	Ambient Pressure Error (mmHg)	Flow Rate		Pass/Fail <sup>(1)</sup>
				Flow Rate Accuracy Percent Error (%)	Design Flow Test Percent Error (%)	
3/11/2020	0.2	0.1	-2	-0.6	0.6	Pass
9/7/2020	0.3	0.3	-3	3.1	-3.0	Pass
10/21/2020	0.2	0.4	-1	0.6	-0.6	Pass

<sup>1</sup> Acceptance criteria:

1. Leak check  $\leq \pm 1.0$  LPM
2. Temperature  $\leq \pm 2.0$  °C
3. Pressure  $\leq \pm 10$  mmHg
4. Flow rate error  $\leq \pm 4\%$  audit standard
5. Design flow test  $\leq \pm 5\%$  design flow rate

Table 2-34: Performance Audit Summary – PM<sub>10</sub>

Period	External Leak Check Error (LPM)	Ambient Temperature Error (°C)	Ambient Pressure Error (mmHg)	Flow Rate		Pass/Fail <sup>(1)</sup>
				Flow Rate Accuracy Percent Error (%)	Design Flow Test Percent Error (%)	
3/11/2020	0.1	0.8	-3	-3.6	1.2	Pass
9/7/2020	0.5	0.8	-1	-0.6	-1.8	Pass
10/21/2020	0.1	0.4	-1	-1.8	-0.6	Pass

<sup>1</sup> Acceptance criteria:

1. Leak check  $\leq \pm 1.0$  LPM
2. Temperature  $\leq \pm 2.0$  °C
3. Pressure  $\leq \pm 10$  mmHg
4. Flow rate error  $\leq \pm 4\%$  audit standard
5. Design flow test  $\leq \pm 5\%$  design flow rate

Table 2-35: October 21, 2020 Meteorological Performance Audit Summary

Parameter	Limit	Units	Max Error	Status
Wind Speed Accuracy – Primary Sensor <sup>(1)</sup>	$\leq \pm 0.20 + 5\%$ known input	m/s	0.00	Pass
Wind Speed Torque – Primary Sensor <sup>(1)</sup>	$\leq 0.5$	m/s	0.32	Pass
Wind Direction Accuracy – Primary Sensor <sup>(1)</sup>	$\leq \pm 5$	Degree	2	Pass
Wind Direction Linearity – Primary Sensor <sup>(1)</sup>	$\leq \pm 3$	Degree	6	FAIL
Wind Direction Torque – Primary Sensor <sup>(1)</sup>	$\leq 0.5$	m/s	0.46	Pass
Wind Speed Accuracy – Secondary Sensor <sup>(1)</sup>	$\leq \pm 0.20 + 5\%$ known input	m/s	0.00	Pass
Wind Speed Torque – Secondary Sensor <sup>(1)</sup>	$\leq 0.5$	m/s	0.28	Pass
Wind Direction Accuracy – Secondary Sensor <sup>(1)</sup>	$\leq \pm 5$	Degree	2	Pass
Wind Direction Linearity – Secondary Sensor <sup>(1)</sup>	$\leq \pm 3$	Degree	1	Pass
Wind Direction Torque – Secondary Sensor <sup>(1)</sup>	$\leq 0.5$	m/s	0.46	Pass
Vertical Wind Speed Accuracy	$\leq \pm 0.20 + 5\%$ known input	m/s	0.08	Pass
Vertical Wind Speed Torque	$\leq 0.25$	m/s	0.20	Pass
2-m Temperature Accuracy – Primary Sensor <sup>(2)</sup>	$\leq \pm 0.50$	°C	-0.15	Pass
10-m Temperature Accuracy – Primary Sensor <sup>(2)</sup>	$\leq \pm 0.50$	°C	-0.11	Pass
Temperature Difference ( $\Delta T$ ) – Primary Sensors <sup>(2)</sup>	$\leq \pm 0.10$	°C	0.05	Pass
Solar Radiation Accuracy < 200 W/m <sup>2</sup>	$\leq \pm 10$	W/m <sup>2</sup>	1	Pass

<sup>1</sup> Primary wind sensor failed calibration and audit in October 2020, but secondary sensor passed all QC checks. Data from the secondary horizontal wind sensor were used during the monitoring year.

**Table 2-36: 2020 PM<sub>2.5</sub> PEP Audit Results**

Date	PEP Audit Results (µg/m <sup>3</sup> )	BAM 1020 Results (µg/m <sup>3</sup> )	Difference (µg/m <sup>3</sup> )	Bias <sup>(1)</sup> (µg/m <sup>3</sup> )
10/20/2020 – 10/21/2020	0.87	-0.38	-1.25	-0.41
10/21/2020 – 10/22/2020	2.69	2.79	0.10	
10/22/2020 – 10/23/2020	2.30	1.26	-1.04	
10/23/2020 – 10/24/2020	1.69	3.13	1.46	
10/24/2020 – 10/25/2020	1.35	0.04	-1.31	

<sup>1</sup> Average over the population of the absolute value of the individual pair concentration differences with a goal of ≤ 4 µg/m<sup>3</sup> 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, 2020, through December 31, 2020, and compared to national and Alaska air quality standards (NAAQS/AAQS). The highest and second highest critical pollutant concentrations are also provided in Table 3-1 and compared to the respective primary and secondary air quality standards. Figure 3-1 through Figure 3-9 provide plots of annual averages of the criteria pollutant concentrations at the Nuiqsut station along with respective NAAQS/AAQS 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 <sub>2</sub> )	53 ppb (100 µg/m <sup>3</sup> )	Annual	Average of Period	4	2	1	1	2	3.8%
	100.0 ppb (190 µg/m <sup>3</sup> )	1-Hour <sup>(2)</sup>	Daily Max 1-Hour Averages (98th Percentile)	--	--	--	--	32.4	32.4%
			1st Highest, 1-Hour Average	46.5	34.4	14.9	25.1	46.5	46.5%
			2nd Highest, 1-Hour Average	35.4	29.9	13.9	18.8	35.4	35.4%
Ozone (O <sub>3</sub> )	0.075 ppm (150 µg/m <sup>3</sup> )	8-Hour <sup>(3)</sup>	4th Highest, 8-Hour Average	0.039	0.041	0.030	0.036	0.041	58.6%
			1st Highest, 8-Hour Average	0.045	0.041	0.033	0.042	0.045	64.3%
			2nd Highest, 8-Hour Average	0.041	0.041	0.033	0.039	0.042	60.0%
Carbon Monoxide (CO)	35 ppm (40,000 µg/m <sup>3</sup> )	1-Hour <sup>(1)</sup>	1st Highest, 1-Hour Average	0	0	9	1	9	25.7%
			2nd Highest, 1-Hour Average	0	0	9	1	9	25.7%
	9 ppm (10,000 µg/m <sup>3</sup> )	8-Hour <sup>(1)</sup>	1st Highest, 8-Hour Average	0	0	4	1	4	44.4%
			2nd Highest, 8-Hour Average	0	0	3	1	3	33.3%

<sup>1</sup> Not to be exceeded more than once each year.

<sup>2</sup> To attain this standard, the 3-year average of the 98<sup>th</sup> percentile of the annual daily maximum 1-hour average must not exceed 100 ppb.

<sup>3</sup> 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/AAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/AAQS
Sulfur Dioxide (SO <sub>2</sub> )	0.030 ppm (80 µg/m <sup>3</sup> )	Annual	Average of Period	0.000	0.000	0.000	0.000	0.000	0.0%
	0.14 ppm (365 µg/m <sup>3</sup> )	24-Hour <sup>(5)</sup>	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 <sup>3</sup> )	3-Hour <sup>(5)</sup>	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 <sup>3</sup> )	1-Hour <sup>(4)</sup>	Daily Max 1-Hour Averages (99th Percentile)	--	--	--	--	4.2	5.6%
			1st Highest, 1-Hour Average	5.0	2.1	1.8	0.0	5.0	6.7%
			2nd Highest, 1-Hour Average	4.8	1.3	1.2	0.0	4.8	6.4%

<sup>4</sup> 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.

<sup>5</sup> 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/AAQS)		Nuiqsut Ambient Air Monitoring – Pollutant Data						
	Concentration	Averaging Period	Averaging Period	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual	YTD % of NAAQS/AAQS
Particulate Matter <2.5 microns (PM <sub>2.5</sub> )	12.0 µg/m <sup>3</sup>	Annual <sup>(7)</sup>	Average of Period	1.3	1.5	0.9	1.0	1.2	10.0%
	35 µg/m <sup>3</sup>	24-Hour <sup>(6)</sup>	98th Percentile, 24-Hour Average	--	--	--	--	6	17.1%
			1st Highest, 24-Hour Average	5	6	6	8	8	22.9%
			2nd Highest, 24-Hour Average	5	6	6	7	7	20.0%
Particulate Matter <10 microns (PM <sub>10</sub> )	150 µg/m <sup>3</sup>	24-Hour <sup>(8,9)</sup>	1st Highest, 24-Hour Average	10	110	30	30	110	73.3%
			2nd Highest, 24-Hour Average	10	60	30	20	60	40.0%

<sup>6</sup>To attain this standard, the 3-year average of the 98<sup>th</sup> percentile of the 24-hour concentration must not exceed 35.0 µg/m<sup>3</sup>.

<sup>7</sup>To attain this standard, the 3-year average of the weighted annual mean PM<sub>2.5</sub> concentration must not exceed 12.0 µg/m<sup>3</sup>.

<sup>8</sup>Not to be exceeded more than once per year on average over three years.

<sup>9</sup>40 CFR Appendix K requires that reportable concentrations of PM<sub>10</sub> be rounded to the nearest 10 µg/m<sup>3</sup>; actual measurement results are within Appendix D.

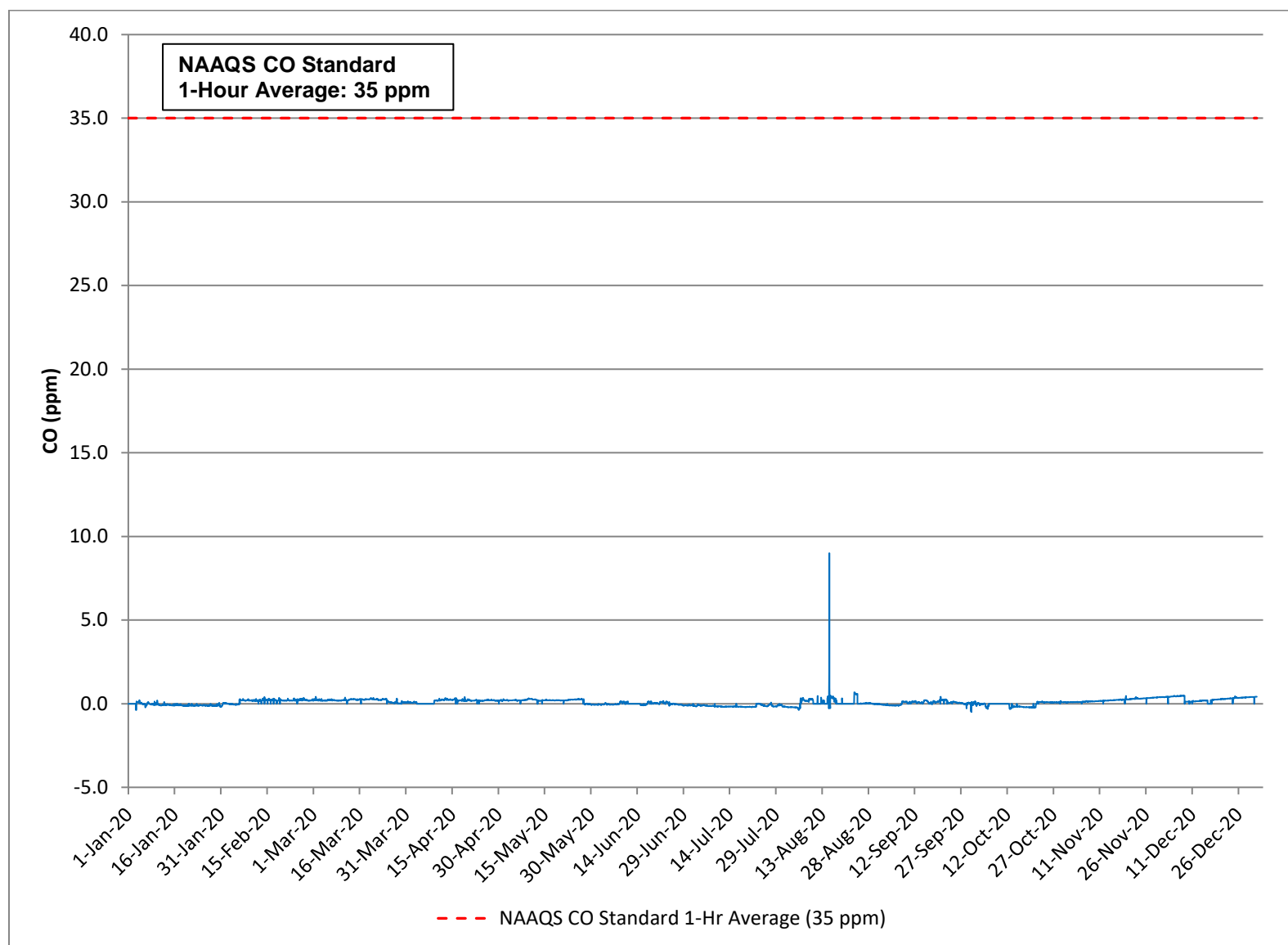


Figure 3-1: 1-Hour Average CO and NAAQS/AAAQS Standard

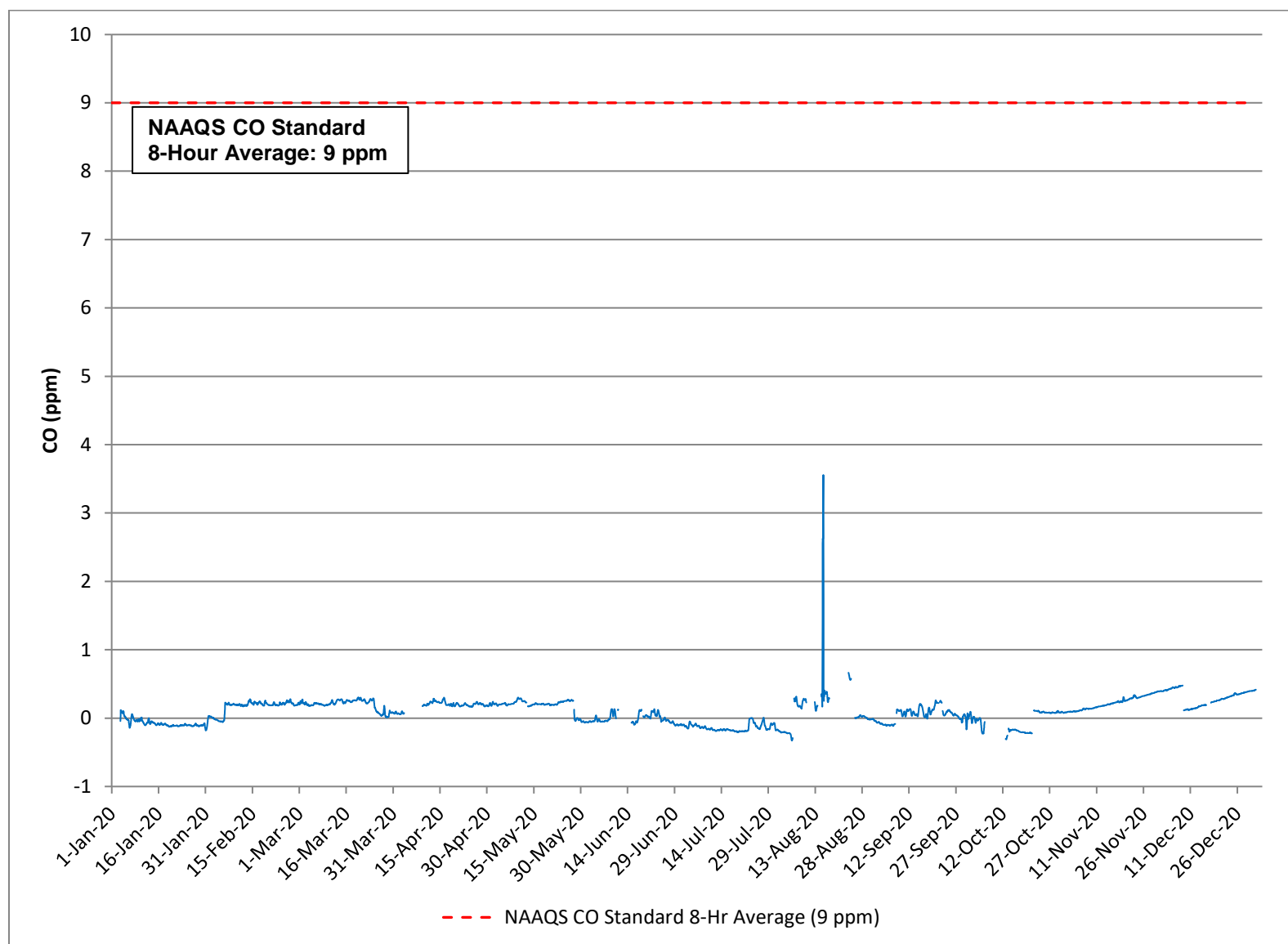


Figure 3-2: 8-Hour Average CO and NAAQS/AAAQS Standard

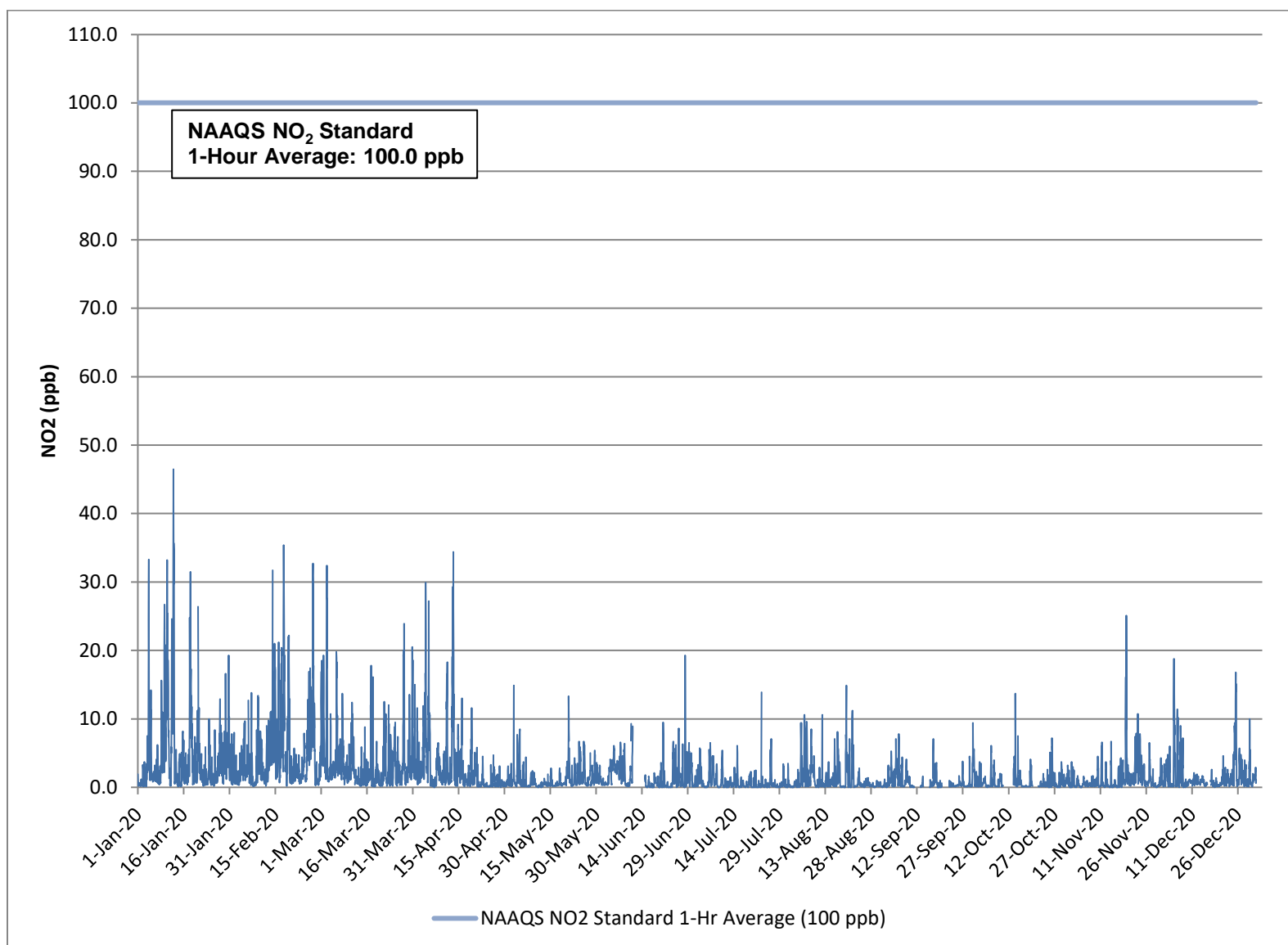


Figure 3-3: 1-Hour Average NO<sub>2</sub> and NAAQS Standard

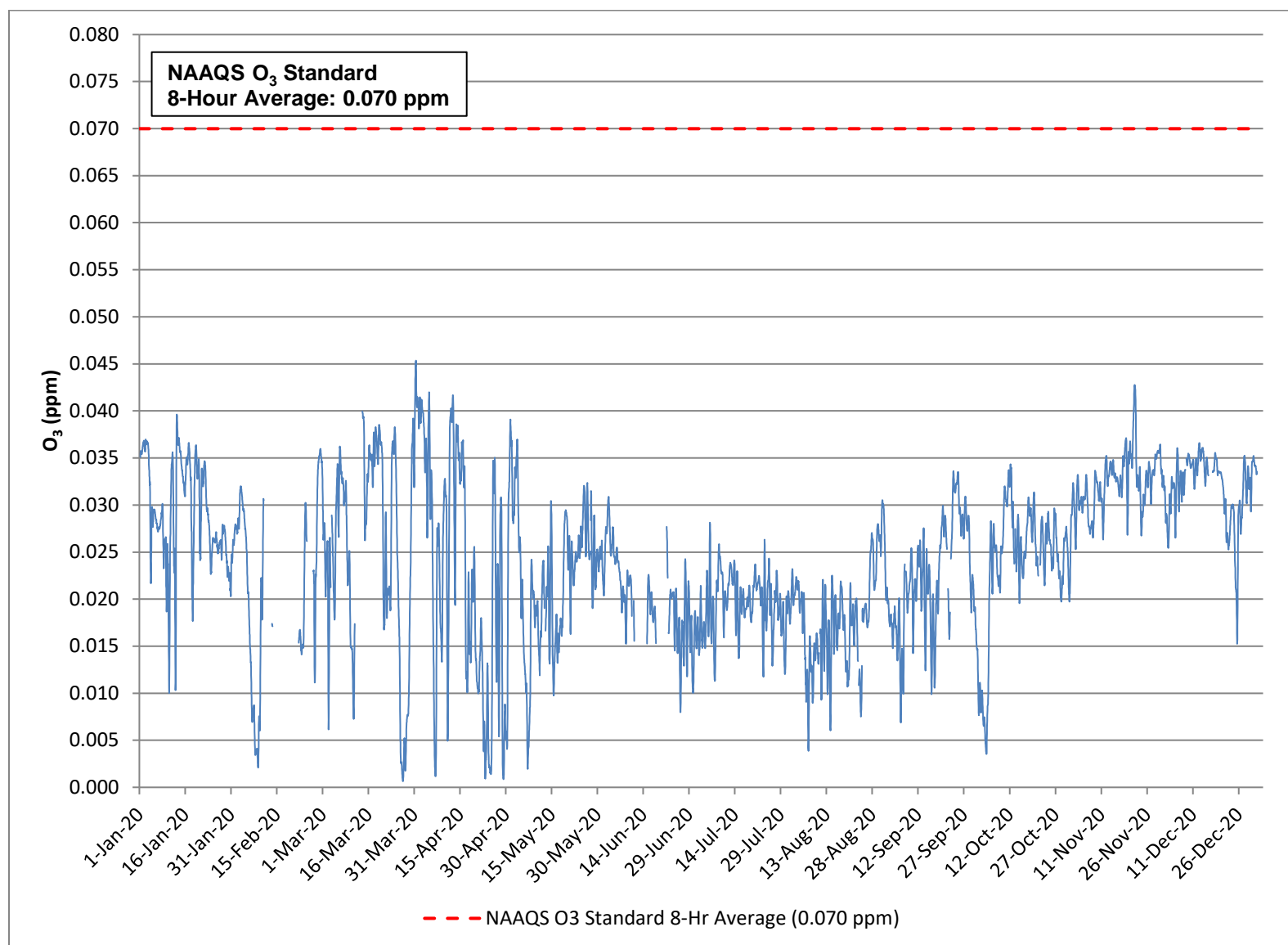


Figure 3-4: 8-Hour Average O<sub>3</sub> and NAAQS/AAAQS Standard

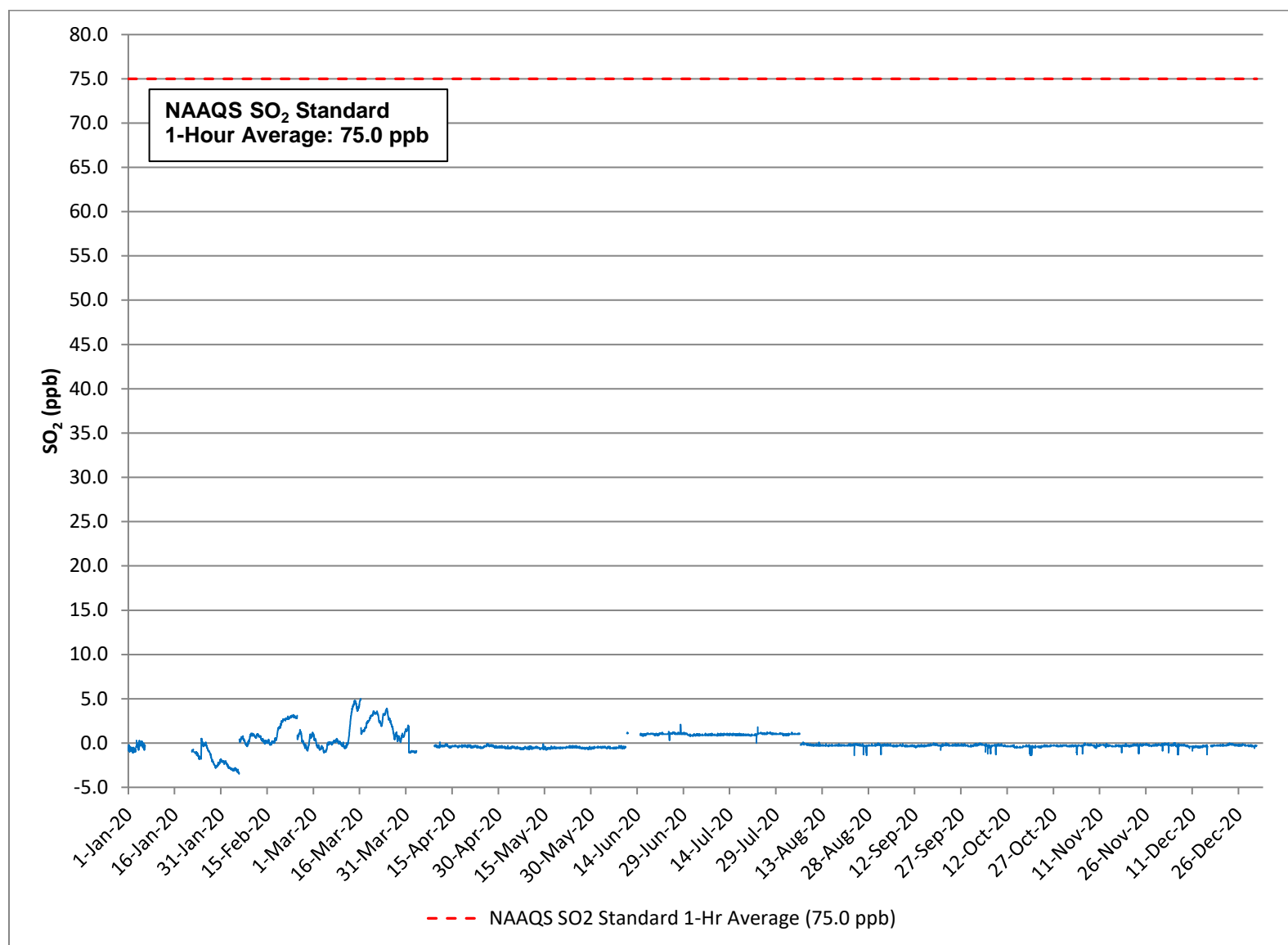


Figure 3-5: 1-Hour Average  $\text{SO}_2$  and NAAQS/AAAQS Standard

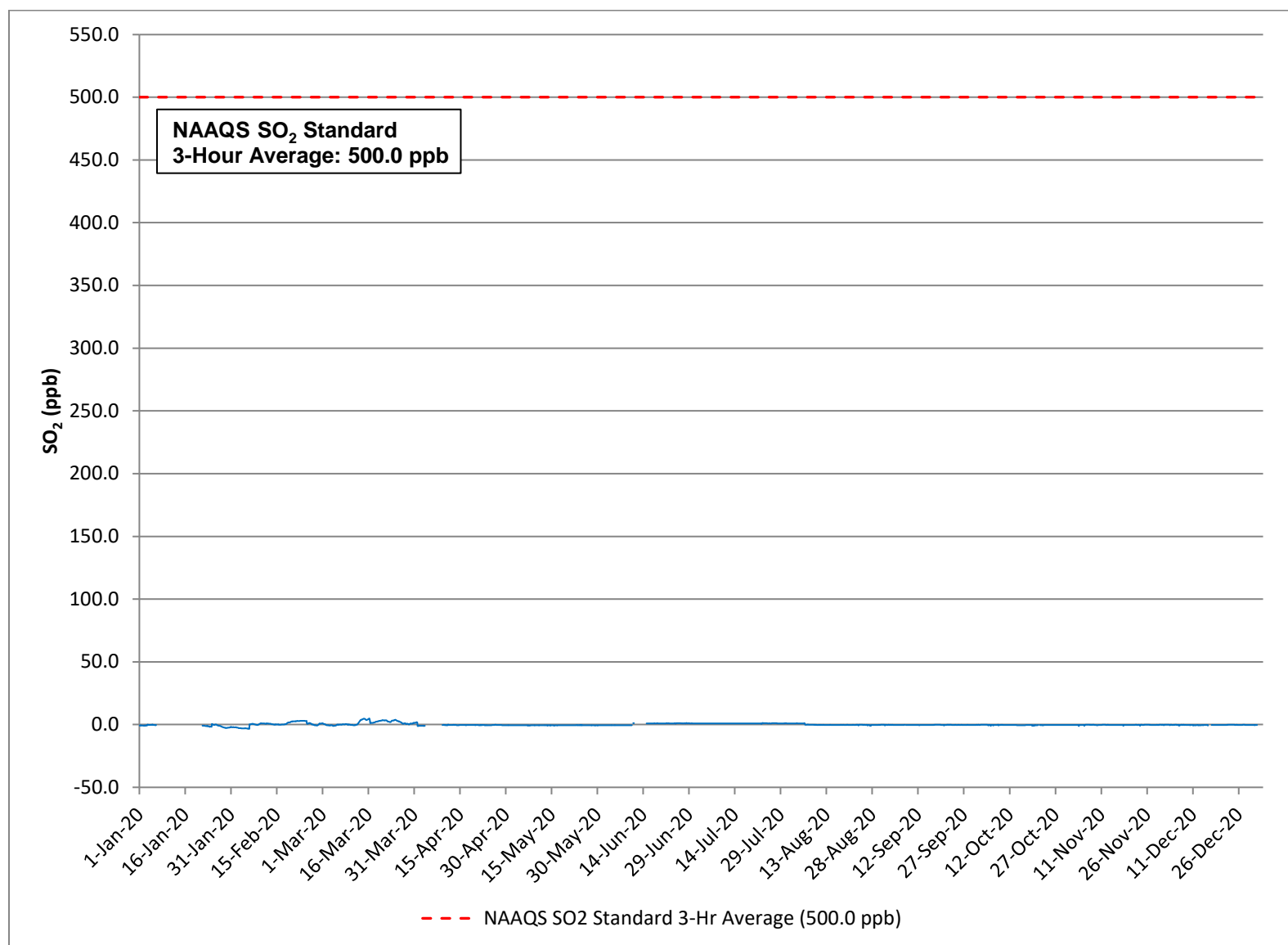


Figure 3-6: 3-Hour Average SO<sub>2</sub> and NAAQS/AAAQS Standard



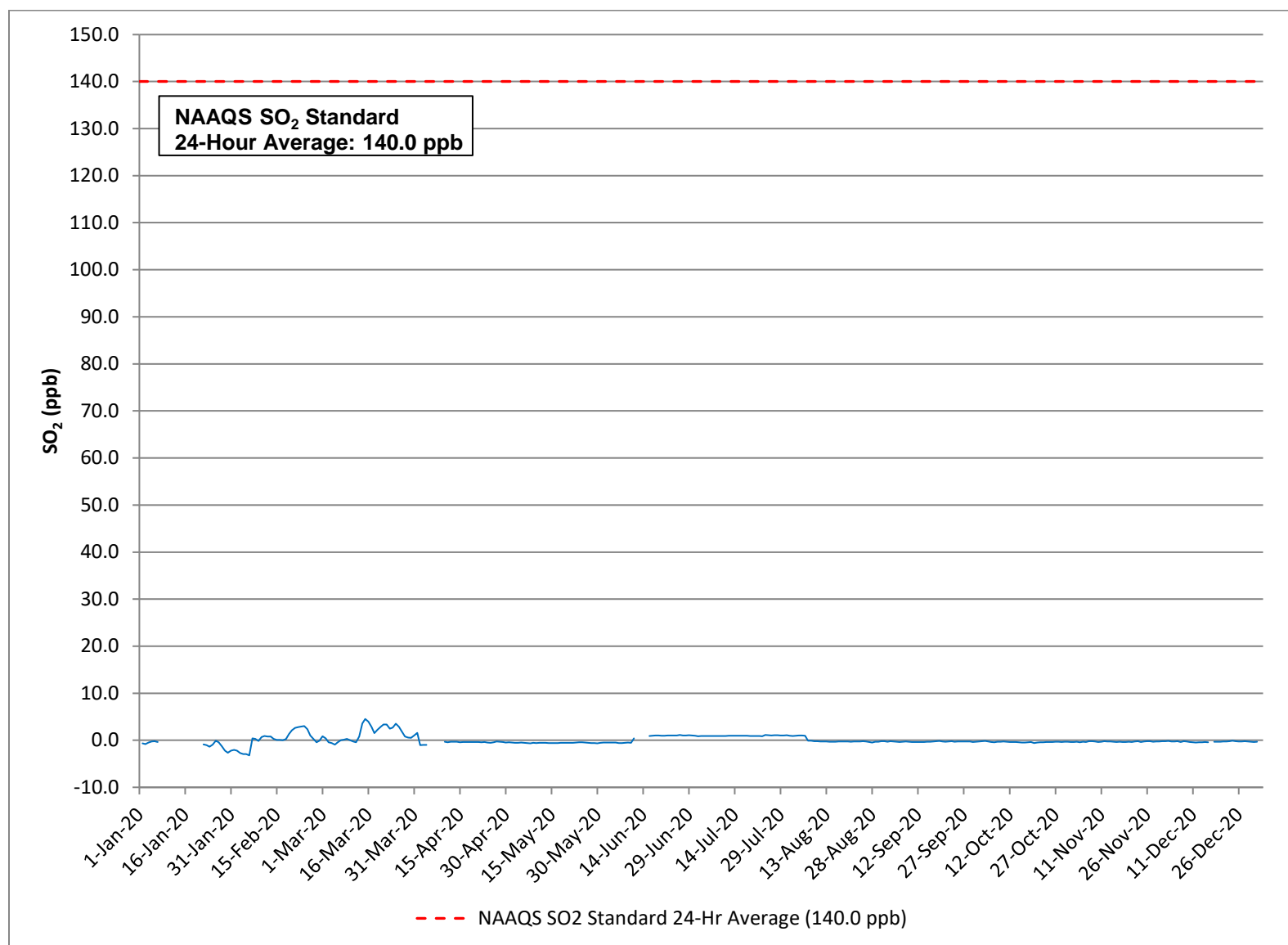
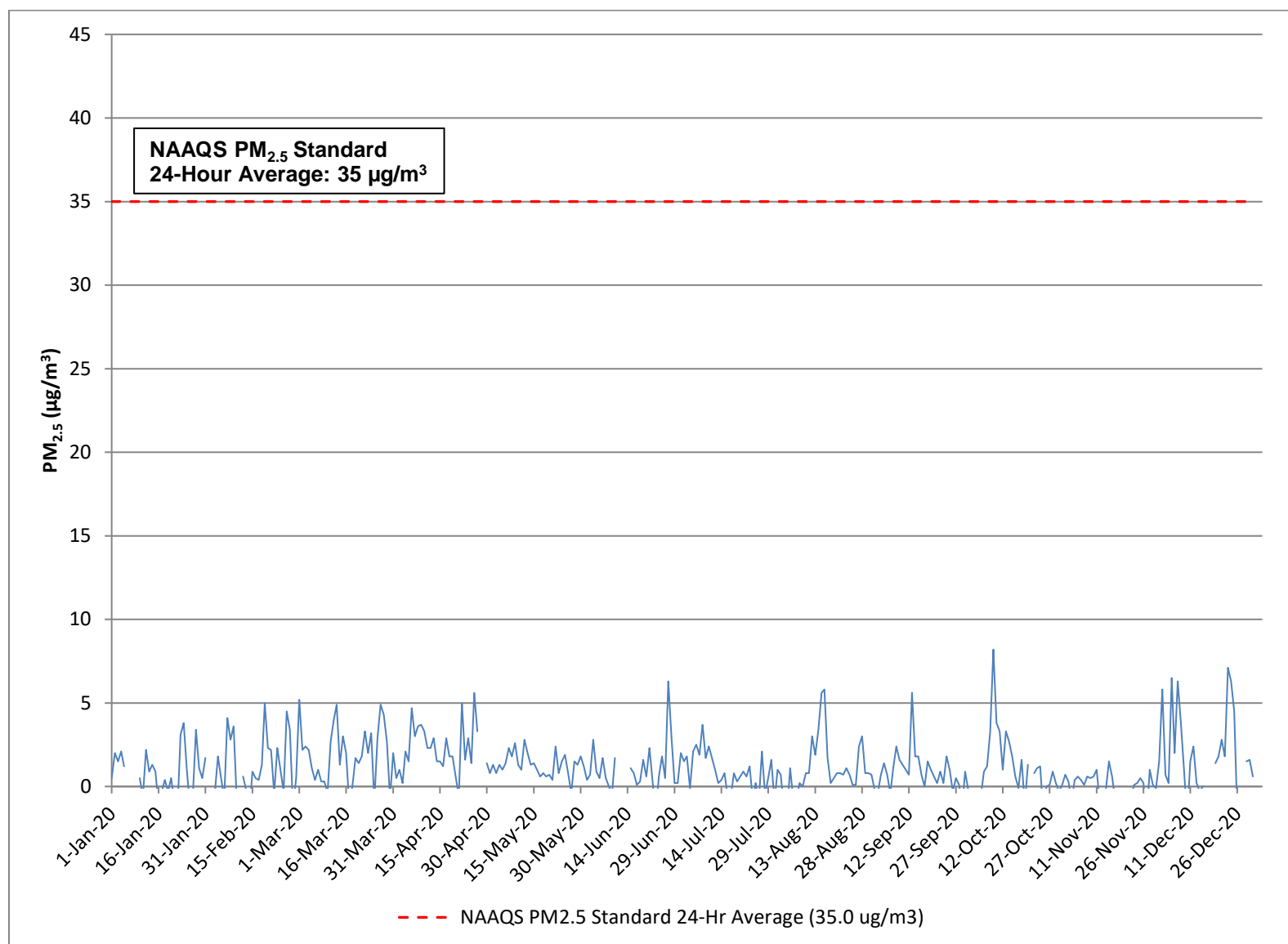
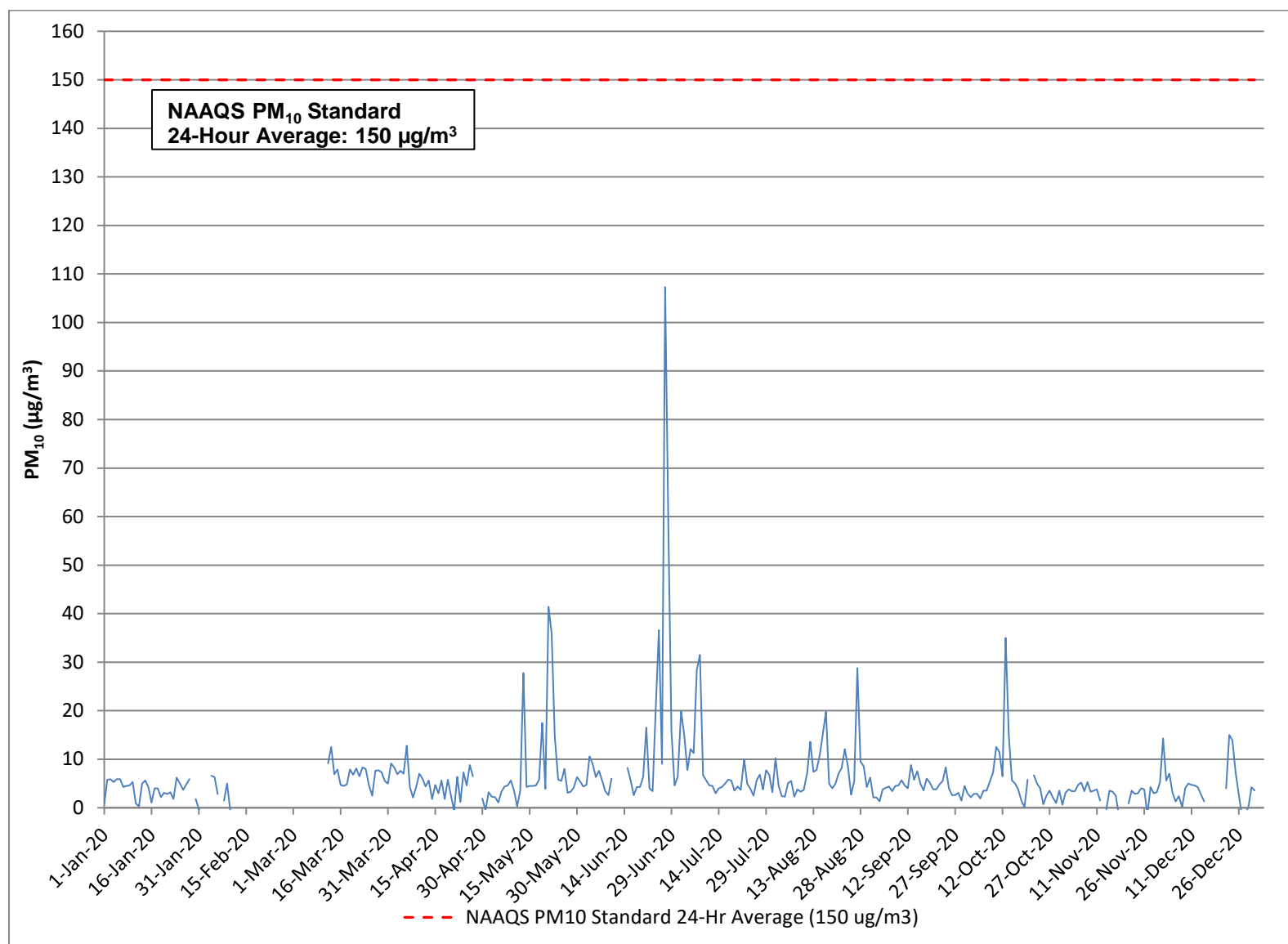


Figure 3-7: 24-Hour Average SO<sub>2</sub> and NAAQS/AAAQS Standard



**Figure 3-8: 24-Hour Average PM<sub>2.5</sub> and NAAQS/AAAQS Standard**



**Figure 3-9: 24-Hour Average PM<sub>10</sub> and NAAQS/AAAQS Standard**

## 3.2 METEOROLOGICAL DATA SUMMARY

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

Table 3-2 provides the mean and maximum hourly wind speeds at the nearby Nuiqsut Airport meteorological station, operated by the National Weather Service and located approximately one mile southwest of the Nuiqsut meteorological monitoring station. The summary in Table 3-2 provides summary statistics for data collected at the Nuiqsut airport. Table 3-3 provides a statistical summary of measurements obtained at the Nuiqsut station.

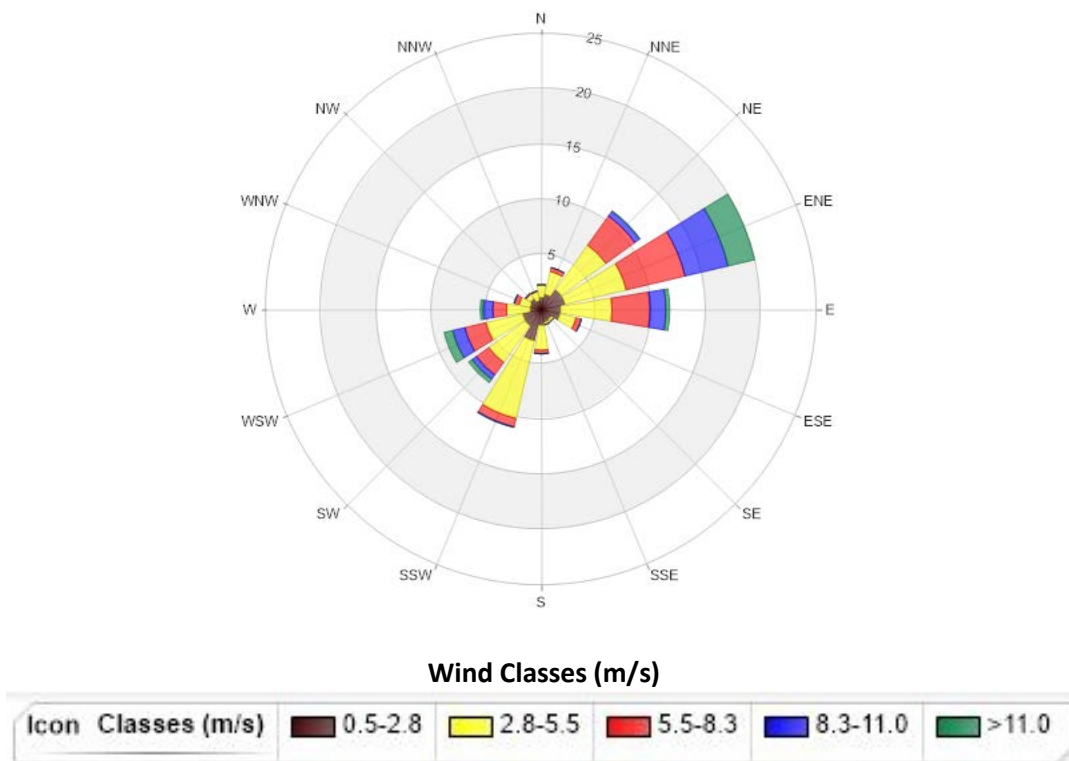
Figure 3-10 provides an annual wind rose for the Nuiqsut station and Figure 3-11 provides quarterly wind roses. Table 3-4 is the annual wind analysis table and Table 3-5 through Table 3-8 are the quarterly wind analysis tables. Figure 3-12 provides the annual wind rose superimposed over a Nuiqsut area map, centered at the approximate location of the monitoring station.

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

Monitoring Period	Mean Hourly Average Wind Speed (m/s)	Maximum Hourly Average Wind Speed (m/s)
1st Quarter	4.46	20.58
2nd Quarter	4.75	18.52
3rd Quarter	4.50	11.83
4th Quarter	5.46	16.98
<b>Monitoring Year</b>	<b>4.53</b>	<b>20.58</b>

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

Monitoring Period	Mean Hourly Average Horizontal Wind Speed (m/s)	Maximum Hourly Average Horizontal Wind Speed (m/s)	Mean Hourly Average Vertical Wind Speed (m/s)	Maximum Hourly Average Vertical Wind Speed (m/s)
1st Quarter	4.02	18.59	0.29	1.75
2nd Quarter	5.16	16.57	0.43	1.63
3rd Quarter	4.59	12.64	0.40	1.34
4th Quarter	5.55	16.86	0.48	1.76
<b>Monitoring Year</b>	<b>4.82</b>	<b>18.59</b>	<b>0.40</b>	<b>1.76</b>

**Figure 3-10: Nuiqsut Annual Wind Rose**

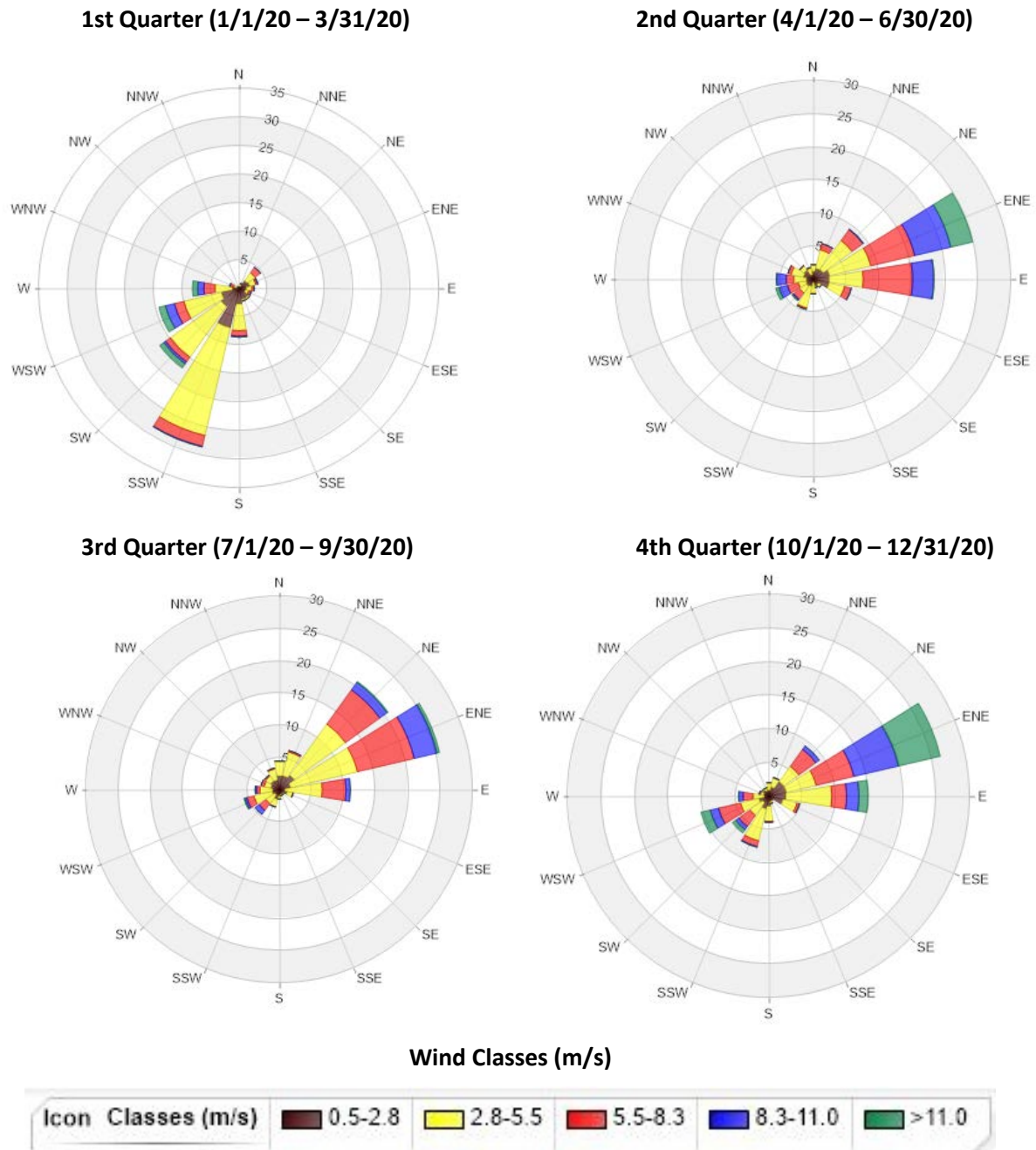


Figure 3-11: Nuiqsut Quarterly Wind Roses

**Table 3-4: Annual Wind Rose Frequency Distribution Table**

Direction	Frequency Distribution (Percent)					
	Direction					Total
	0.5-2.8	2.8-5.5	5.5-8.3	8.3-11.0	>11.0	
N	1.13	1.13	0.01	0.00	0.00	2.27
NNE	1.45	2.11	0.36	0.00	0.00	3.92
NE	2.22	4.98	3.24	0.53	0.05	11.02
ENE	2.19	5.71	5.49	4.01	2.48	19.88
E	1.75	4.66	3.45	1.44	0.34	11.64
ESE	1.73	1.50	0.48	0.02	0.00	3.73
SE	1.07	0.28	0.00	0.00	0.00	1.35
SSE	1.16	0.23	0.01	0.00	0.00	1.40
S	1.42	2.25	0.31	0.03	0.00	4.01
SSW	2.90	7.22	0.78	0.06	0.00	10.96
SW	1.79	4.09	1.39	0.49	0.39	8.15
WSW	1.76	3.43	1.95	1.13	0.80	9.07
W	1.03	2.15	1.25	0.87	0.26	5.56
WNW	1.06	1.01	0.45	0.03	0.01	2.56
NW	1.21	0.49	0.07	0.03	0.00	1.80
NNW	0.85	0.84	0.06	0.00	0.00	1.75
<b>Summary</b>	<b>24.72</b>	<b>42.08</b>	<b>19.30</b>	<b>8.64</b>	<b>4.33</b>	<b>99.07 <sup>(1)</sup></b>

<sup>1</sup> The remaining 0.93 percent of data were calms (below 0.5 m/s).

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

Direction	Frequency Distribution (Percent)					
	Speed (m/s)					Total
	0.5-2.8	2.8-5.5	5.5-8.3	8.3-11.0	>11.0	
N	0.18	0.05	0.00	0.00	0.00	0.23
NNE	0.41	0.32	0.18	0.00	0.00	0.91
NE	1.65	1.74	1.19	0.00	0.00	4.58
ENE	1.88	1.10	0.32	0.09	0.00	3.39
E	1.28	0.96	0.37	0.05	0.00	2.66
ESE	1.10	0.60	0.41	0.09	0.00	2.20
SE	1.97	0.32	0.00	0.00	0.00	2.29
SSE	1.97	0.32	0.00	0.00	0.00	2.29
S	2.75	4.63	1.01	0.14	0.00	8.53
SSW	7.06	19.39	1.97	0.09	0.00	28.51
SW	3.85	10.95	1.05	0.41	0.87	17.13
WSW	3.21	6.74	1.70	1.60	1.19	14.44
W	1.24	3.02	1.92	1.10	0.92	8.20
WNW	0.41	0.60	0.64	0.09	0.05	1.79
NW	0.32	0.00	0.00	0.09	0.00	0.41
NNW	0.18	0.05	0.00	0.00	0.00	0.23
<b>Summary</b>	<b>29.46</b>	<b>50.79</b>	<b>10.76</b>	<b>3.75</b>	<b>3.03</b>	<b>97.79 <sup>(1)</sup></b>

<sup>1</sup> The remaining 2.21 percent of data were calms (below 0.5 m/s).

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

Direction	Frequency Distribution (Percent)					
	Speed (m/s)					Total
	0.5-2.8	2.8-5.5	5.5-8.3	8.3-11.0	>11.0	
N	1.19	1.01	0.05	0.00	0.00	2.25
NNE	1.69	2.89	0.96	0.00	0.00	5.54
NE	1.79	5.41	2.06	0.09	0.00	9.35
ENE	2.52	6.41	6.83	5.63	3.39	24.78
E	2.43	5.13	7.47	3.21	0.05	18.29
ESE	2.47	2.38	1.05	0.00	0.00	5.90
SE	0.96	0.55	0.00	0.00	0.00	1.51
SSE	1.15	0.14	0.00	0.00	0.00	1.29
S	0.50	1.65	0.09	0.00	0.00	2.24
SSW	1.10	3.34	0.23	0.00	0.00	4.67
SW	1.24	1.28	1.19	0.18	0.14	4.03
WSW	1.15	1.19	1.69	1.33	0.5	5.86
W	1.05	1.92	1.15	1.47	0.05	5.64
WNW	1.56	1.88	0.50	0.00	0.00	3.94
NW	1.69	0.78	0.09	0.00	0.00	2.56
NNW	0.73	1.05	0.09	0.00	0.00	1.87
<b>Summary</b>	<b>23.22</b>	<b>37.01</b>	<b>23.45</b>	<b>11.91</b>	<b>4.13</b>	<b>99.72<sup>(1)</sup></b>

<sup>1</sup> The remaining 0.28 percent of data were calms (below 0.5 m/s).

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

Direction	Frequency Distribution (Percent)					
	Speed (m/s)					Total
	0.5-2.8	2.8-5.5	5.5-8.3	8.3-11.0	>11.0	
N	2.18	2.32	0.00	0.00	0.00	4.50
NNE	2.27	3.77	0.23	0.00	0.00	6.27
NE	2.77	9.81	6.54	1.41	0.18	20.71
ENE	1.73	10.67	9.04	3.63	0.41	25.48
E	0.82	5.81	3.68	0.68	0.00	10.99
ESE	1.23	0.91	0.05	0.00	0.00	2.19
SE	0.68	0.18	0.00	0.00	0.00	0.86
SSE	0.73	0.18	0.00	0.00	0.00	0.91
S	0.95	0.50	0.00	0.00	0.00	1.45
SSW	1.50	1.18	0.05	0.05	0.00	2.78
SW	0.91	1.68	1.32	0.77	0.00	4.68
WSW	1.18	2.91	1.14	0.32	0.14	5.69
W	1.09	1.95	0.50	0.27	0.00	3.81
WNW	1.41	1.04	0.50	0.00	0.00	2.95
NW	1.68	0.95	0.18	0.05	0.00	2.86
NNW	1.59	1.77	0.14	0.00	0.00	3.50
<b>Summary</b>	<b>22.72</b>	<b>45.63</b>	<b>23.37</b>	<b>7.18</b>	<b>0.73</b>	<b>99.63<sup>(1)</sup></b>

<sup>1</sup> The remaining 0.37 percent of data were calms (below 0.5 m/s).



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

Direction	Frequency Distribution (Percent)					
	Speed (m/s)					Total
	0.5-2.8	2.8-5.5	5.5-8.3	8.3-11.0	>11.0	
N	0.93	1.12	0.00	0.00	0.00	2.05
NNE	1.42	1.42	0.05	0.00	0.00	2.89
NE	2.69	2.79	3.13	0.64	0.00	9.25
ENE	2.69	4.55	5.77	6.84	6.40	26.25
E	2.54	6.84	2.20	1.86	1.37	14.81
ESE	2.15	2.15	0.39	0.00	0.00	4.69
SE	0.64	0.05	0.00	0.00	0.00	0.69
SSE	0.78	0.29	0.05	0.00	0.00	1.12
S	1.47	2.25	0.15	0.00	0.00	3.87
SSW	1.91	4.89	0.88	0.10	0.00	7.78
SW	1.12	2.35	2.05	0.59	0.59	6.70
WSW	1.52	2.83	3.37	1.27	1.42	10.41
W	0.73	1.66	1.47	0.64	0.05	4.55
WNW	0.83	0.49	0.15	0.05	0.00	1.52
NW	1.12	0.20	0.00	0.00	0.00	1.32
NNW	0.88	0.44	0.00	0.00	0.00	1.32
<b>Summary</b>	<b>23.42</b>	<b>34.32</b>	<b>19.66</b>	<b>11.99</b>	<b>9.83</b>	<b>99.22 <sup>(1)</sup></b>

<sup>1</sup> The remaining 0.78 percent of data were calms (below 0.5 m/s).

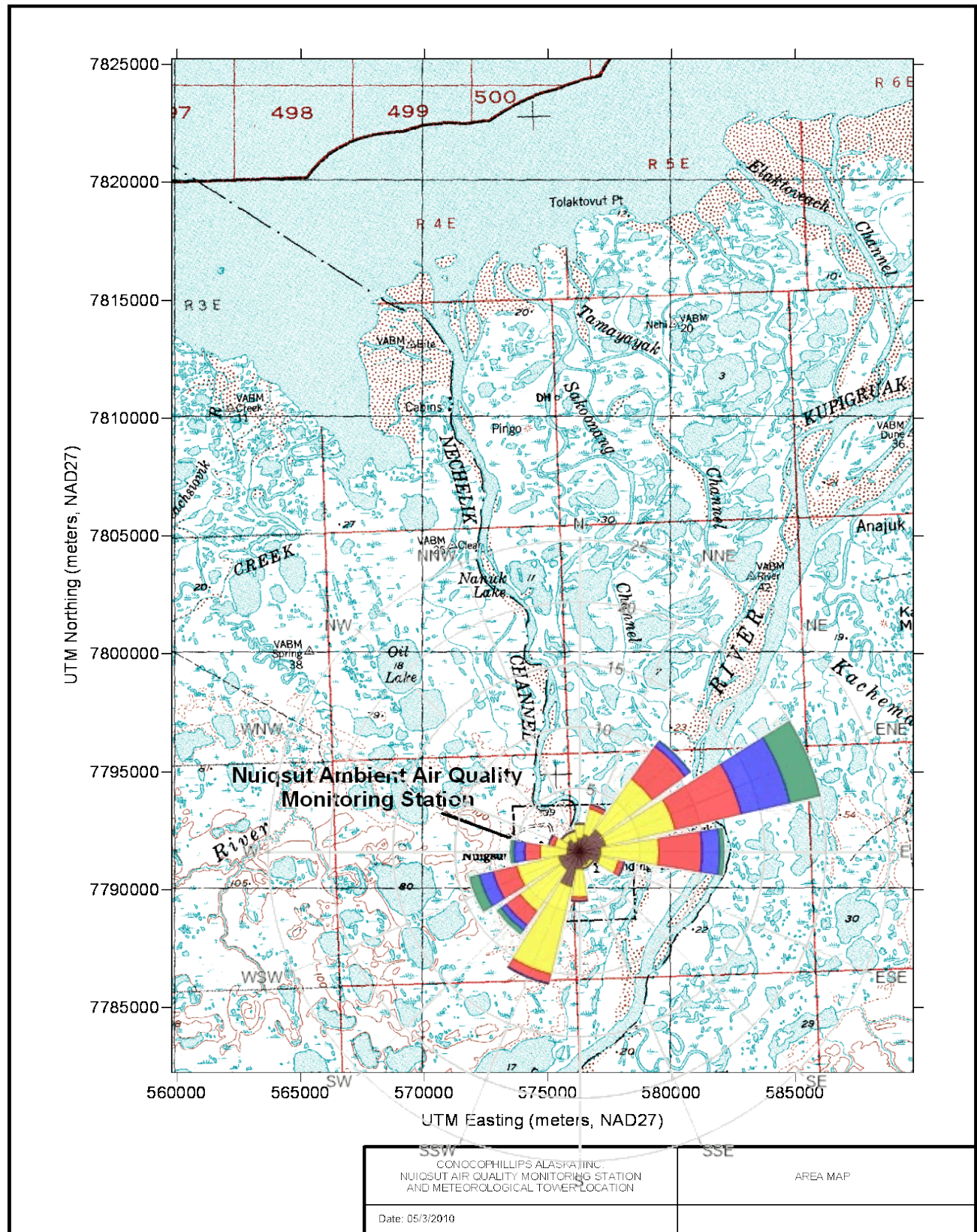


Figure 3-12: Annual Wind Rose Superimposed on Site Map

### 3.2.2 TEMPERATURE CLIMATOLOGY

Table 3-9 and Table 3-10 provide the maximum and minimum daily mean temperatures, monthly mean temperatures, and maximum and minimum hourly average temperatures for the 2-meter and 10-meter temperature measurements, respectively. Figure 3-13 provides a graph of the 2-meter and 10-meter hourly average temperatures at the Nuiqsut station, as well as temperature data from the Nuiqsut Airport for comparative purposes only. Figure 3-14 shows a plot of vertical temperature difference (the difference between 10-meter and 2-meter temperature values) during the monitoring year.

Table 3-9: 2-Meter Temperature Summary

Period	Maximum Daily Mean Temperature (°C)	Minimum Daily Mean Temperature (°C)	Mean Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)
January	-15.1	-43.8	-30.9	-8.3	-44.6
February	-22.1	-45.0	-35.0	-17.2	-47.5
March	-2.8	-40.6	-22.1	-0.4	-42.5
<b>1st Quarter</b>	<b>-2.8</b>	<b>-45.0</b>	<b>-29.2</b>	<b>-0.4</b>	<b>-47.5</b>
April	-3.9	-21.7	-12.9	0.0	-28.5
May	2.9	-15.1	-4.5	6.3	-22.9
June	13.3	0.1	5.8	20.1	-2.2
<b>2nd Quarter</b>	<b>13.3</b>	<b>-21.7</b>	<b>-3.9</b>	<b>20.1</b>	<b>-28.5</b>
July	12.0	3.3	6.4	16.5	0.3
August	11.8	1.5	7.3	20.2	-0.3
September	6.1	-2.0	1.5	12.6	-4.4
<b>3rd Quarter</b>	<b>12.0</b>	<b>-2.0</b>	<b>5.1</b>	<b>20.2</b>	<b>-4.4</b>
October	0.7	-13.1	-5.2	1.3	-16.5
November	-2.3	-21.2	-12.6	1.8	-23.7
December	-9.4	-34.8	-21.3	-8.5	-36.5
<b>4th Quarter</b>	<b>0.7</b>	<b>-34.8</b>	<b>-13.0</b>	<b>1.8</b>	<b>-36.5</b>
<b>Monitoring Year</b>	<b>13.3</b>	<b>-45.0</b>	<b>-10.2</b>	<b>20.2</b>	<b>-47.5</b>

<sup>1</sup> The maximum hourly average temperature occurred on June 27, 2020.

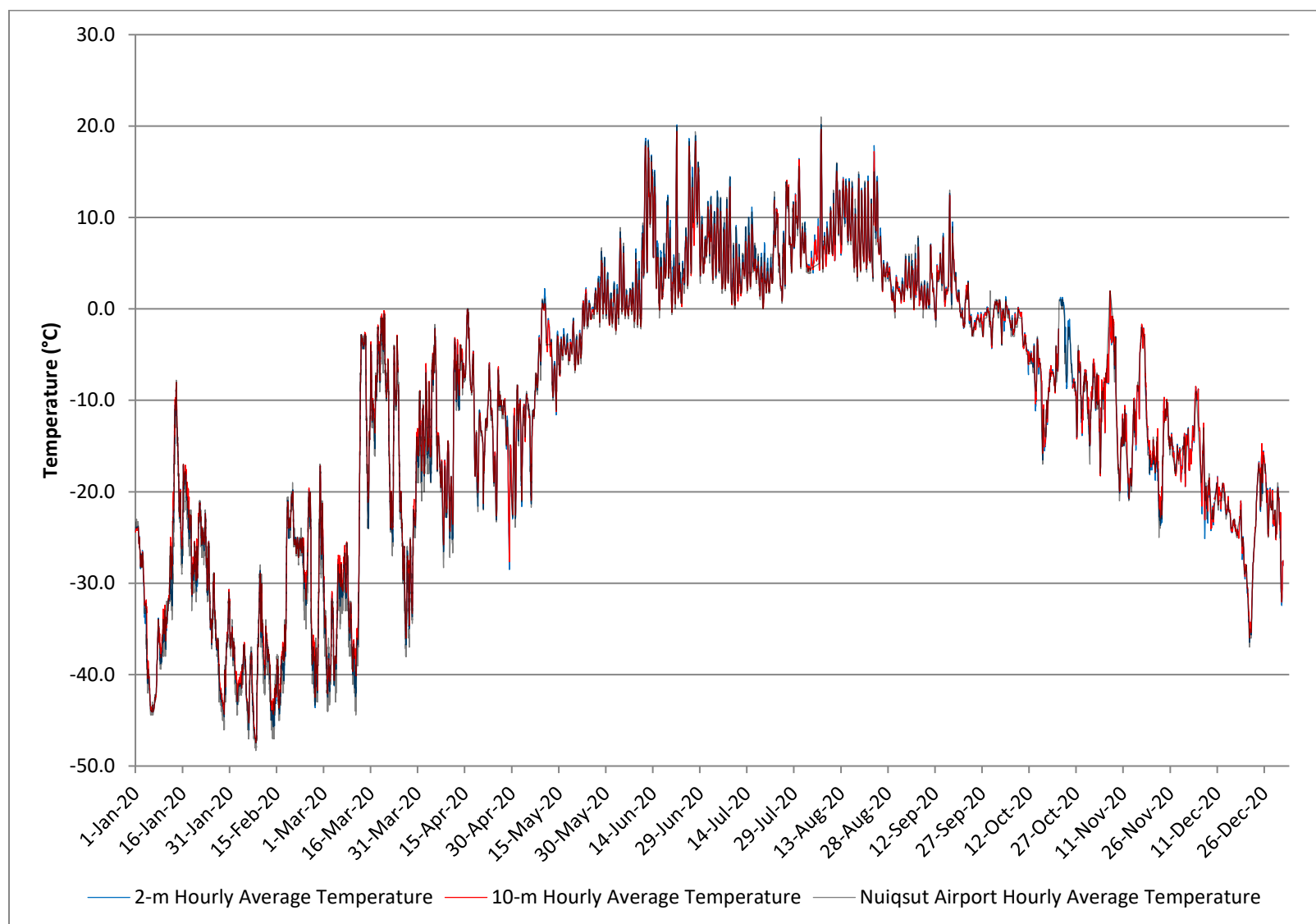
<sup>2</sup> The minimum hourly average temperature occurred on February 8, 2020

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	-14.4	-43.8	-30.4	-8.0	-44.3
February	-21.8	-45.0	-34.6	-17.1	-47.4
March	-2.5	-40.1	-21.6	-0.2	-42.1
<b>1st Quarter</b>	<b>-2.5</b>	<b>-45.0</b>	<b>-28.7</b>	<b>-0.2</b>	<b>-47.4</b>
April	-4.0	-21.1	-12.7	0.0	-27.7
May	2.5	-15.0	-4.7	5.3	-22.6
June	13.0	-0.5	5.2	19.4	-2.4
<b>2nd Quarter</b>	<b>13.0</b>	<b>-21.1</b>	<b>-4.0</b>	<b>19.4</b>	<b>-27.7</b>
July	12.0	2.4	5.9	16.3	0.0
August	11.7	1.2	7.1	19.7	-0.4
September	6.3	-2.1	1.4	12.4	-4.3
<b>3rd Quarter</b>	<b>12.0</b>	<b>-2.1</b>	<b>4.8</b>	<b>19.7</b>	<b>-4.3</b>
October	0.6	-12.7	-5.5	1.0	-15.8
November	-2.1	-20.1	-12.4	2.0	-22.8
December	-9.3	-34.5	-21.2	-8.5	-36.0
<b>4th Quarter</b>	<b>0.6</b>	<b>-34.5</b>	<b>-13.4</b>	<b>2.0</b>	<b>-36.0</b>
<b>Monitoring Year</b>	<b>13.0</b>	<b>-45.0</b>	<b>-10.3</b>	<b>19.7</b>	<b>-47.4</b>

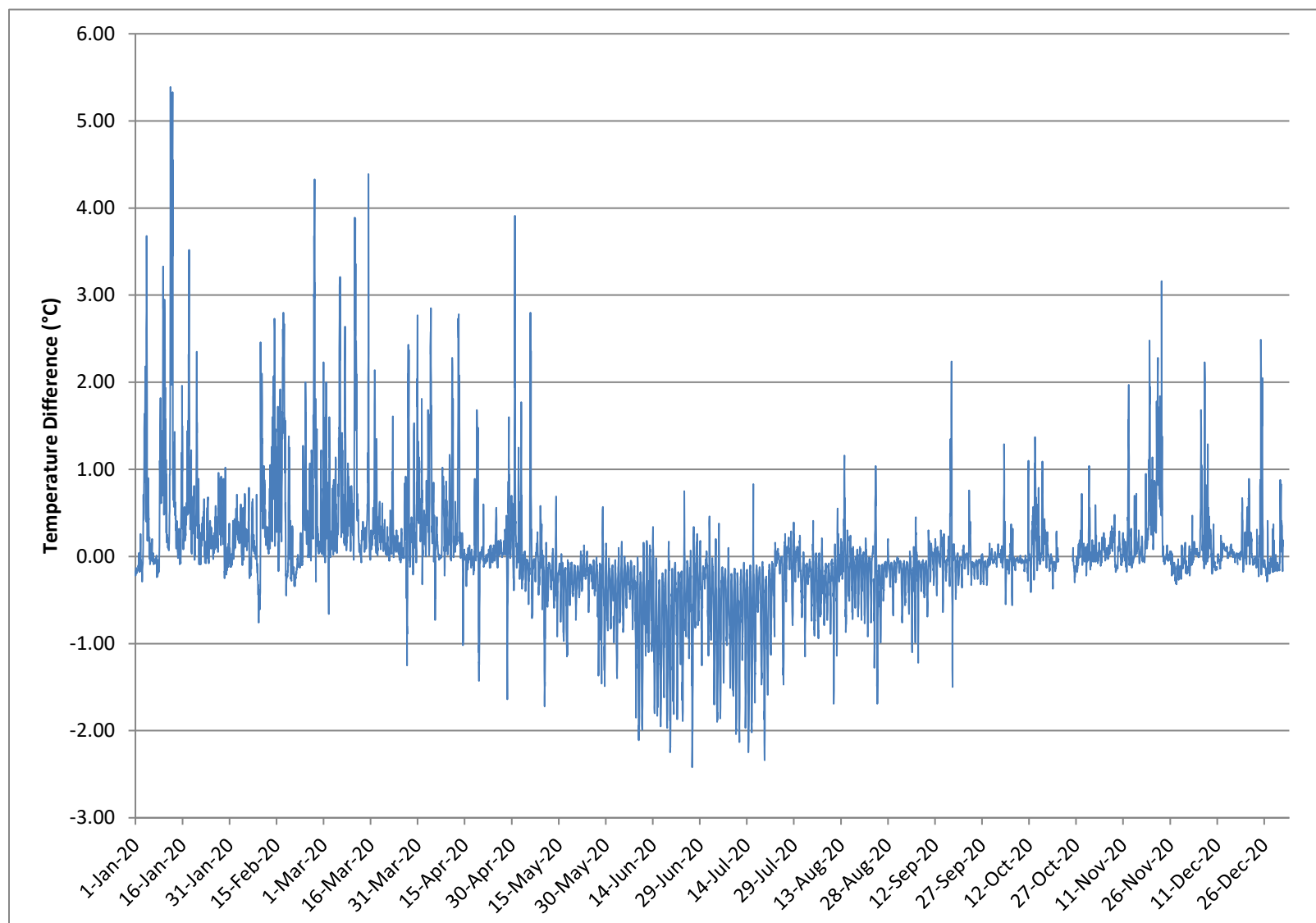
<sup>1</sup> The maximum hourly average temperature occurred on June 27, 2020.

<sup>2</sup> The minimum hourly average temperature occurred on February 8, 2020.



<sup>1</sup> 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 2020 monitoring year. Figure 3-15 is a plot of annual hourly average solar radiation. The solar radiation data are available in monthly tabular format in Appendix D.

**Table 3-11: Solar Radiation Summary**

Period	Mean Solar Radiation (W/m <sup>2</sup> )	Maximum Solar Radiation (W/m <sup>2</sup> )
January	1	18
February	16	259
March	94	505
<b>1st Quarter</b>	<b>37</b>	<b>505</b>
April	181	767
May	238	812
June	263	764
<b>2nd Quarter</b>	<b>228</b>	<b>812</b>
July	195	720
August	113	520
September	52	417
<b>3rd Quarter</b>	<b>121</b>	<b>720</b>
October	21	259
November	3	117
December	0	1
<b>4th Quarter</b>	<b>8</b>	<b>259</b>
<b>Monitoring Year</b>	<b>98</b>	<b>812</b>



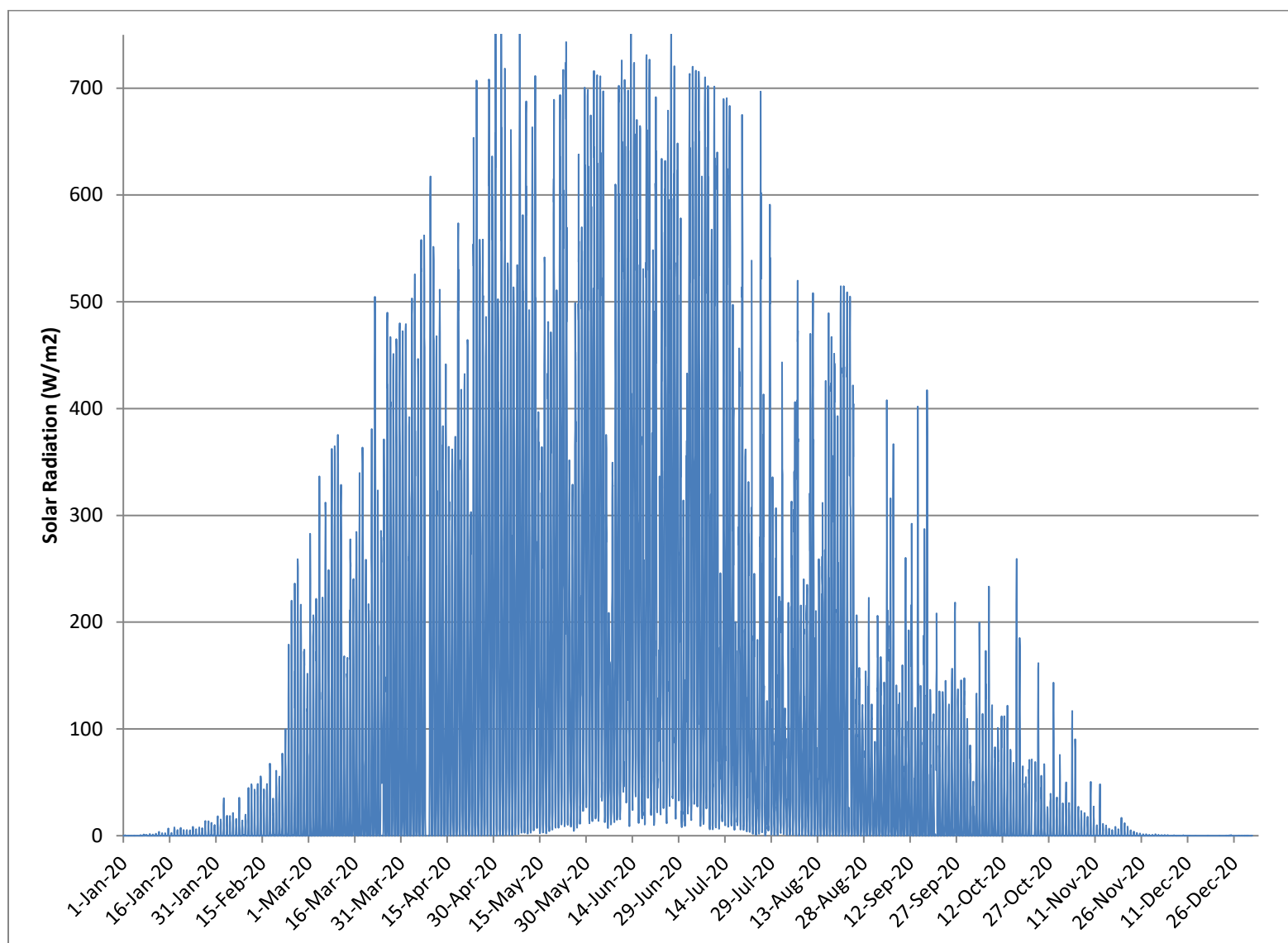


Figure 3-15: Hourly Average Solar Radiation

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## 4. REFERENCES

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## **APPENDIX A**

### **DATA PROCESSING SPECIFICATIONS AND STATISTICAL FORMULAE**

## **A.1 Data Recovery Percentage**

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

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

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

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

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

## **A.2 Data Bias Correction Using Calibration Information**

Not Applicable.

## **A.3 Estimation of Pasquill-Gifford Stability Categories**

Not Applicable.

**Table A-1: Ambient Air Quality Data Capture Percent**

Period	Pollutants – Data Recovery <sup>(1)</sup>					
	NO <sub>2</sub>	SO <sub>2</sub>	O <sub>3</sub>	CO	PM <sub>2.5</sub> <sup>(2)</sup>	PM <sub>10</sub> <sup>(2)</sup>
January	98%	50% <sup>(3)</sup>	98%	90%	87%	97%
February	98%	98%	55% <sup>(4)</sup>	98%	93%	24% <sup>(5)</sup>
March	99%	99%	91%	99%	100%	64% <sup>(5)</sup>
<b>1<sup>st</sup> Quarter</b>	<b>98%</b>	<b>82%</b>	<b>82%</b>	<b>96%</b>	<b>93%</b>	<b>63% <sup>(5)</sup></b>
April	99%	80%	99%	80%	93%	93%
May	98%	98%	98%	98%	100%	100%
June	84%	84%	72% <sup>(6)</sup>	84%	100%	100%
<b>2<sup>nd</sup> Quarter</b>	<b>94%</b>	<b>88%</b>	<b>90%</b>	<b>88%</b>	<b>98%</b>	<b>98%</b>
July	99%	99%	99%	99%	100%	100%
August	97%	97%	98%	65% <sup>(7)</sup>	100%	100%
September	77% <sup>(8)</sup>	97%	97%	97%	100%	100%
<b>3<sup>rd</sup> Quarter</b>	<b>91%</b>	<b>98%</b>	<b>98%</b>	<b>87%</b>	<b>100%</b>	<b>100%</b>
October	82%	96%	97%	76% <sup>(9)</sup>	97%	97%
November	99%	99%	99%	99%	90%	90%
December	95%	95%	95%	95%	87%	87%
<b>4<sup>th</sup> Quarter</b>	<b>92%</b>	<b>97%</b>	<b>97%</b>	<b>90%</b>	<b>91%</b>	<b>91%</b>
<b>Annual</b>	<b>94%</b>	<b>91%</b>	<b>92%</b>	<b>90%</b>	<b>96%</b>	<b>88%</b>

<sup>1</sup> EPA PSD-quality ambient air monitoring standards require data capture of 80 percent or greater per quarter for four consecutive quarters.

<sup>2</sup> 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. A minimum of 18 valid hourly averages are required to calculate a valid 24-hour average concentration. 24-hour average data recovery percentages in Table 2-2 differ from the 1-hour average data recovery percentage summaries presented in Appendix C.

<sup>3</sup> SO<sub>2</sub> data were invalidated due to an analyzer failure January 6 – 20, 2020. Despite the data loss, DQOs were met for the monitoring quarter.

<sup>4</sup> O<sub>3</sub> data were invalidated periodically in February 2020 as a result of failed precision checks and calibrations. Despite the data loss, DQOs were met for the monitoring quarter.

<sup>5</sup> The PM<sub>10</sub> analyzer failed the flow check on March 10, 2020. PM<sub>10</sub> data were invalidated back to the last passing check on February 11, 2020. Due to the data loss, DQOs were not met for the first monitoring quarter.

<sup>6</sup> O<sub>3</sub> data were invalidated periodically in June 2020 as a result of a failed precision check and shelter temperature variation. Despite the data loss, DQOs were met for the monitoring quarter.

<sup>7</sup> CO data were invalidated periodically in August 2020 as a result multiple analyzer malfunctions, which required installation of a backup CO analyzer on August 24 and 25, 2020. Despite the data loss, DQOs were met for the monitoring quarter.

<sup>8</sup> NO<sub>2</sub> data were invalidated periodically in September 2020 as a result of failed quality control checks. Despite the data loss, DQOs were met for the monitoring quarter.

<sup>9</sup> CO data were invalidated in October 2020 due to an analyzer malfunction. Despite the data loss, DQOs were met for the monitoring quarter.

**Table A-2: Meteorological Data Capture Percent**

Period	Meteorological Parameters – Data Recovery <sup>(1)</sup>								
	Vertical Wind Speed	Vertical Wind Speed Std. Dev. (Sigma Omega)	Horizontal Wind Speed <sup>(2)</sup>	Horizontal Wind Direction <sup>(2)</sup>	Wind Direction Std. Dev. (Sigma Theta) <sup>(2)</sup>	2-M Temp	10-M Temp	Delta-Temp	Solar Radiation
January	100%	100%	100%	100%	100%	100%	100%	100%	100%
February	100%	100%	100%	100%	100%	100%	100%	100%	100%
March	100%	100%	100%	100%	100%	100%	100%	100%	100%
<b>1<sup>st</sup> Quarter</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>
April	97%	97%	100%	100%	100%	100%	100%	100%	98%
May	100%	100%	100%	100%	100%	100%	100%	100%	100%
June	100%	100%	100%	100%	100%	100%	100%	100%	100%
<b>2<sup>nd</sup> Quarter</b>	<b>99%</b>	<b>99%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>99%</b>
July	100%	100%	100%	100%	100%	100%	100%	100%	100%
August	100%	100%	100%	100%	100%	100%	100%	100%	100%
September	100%	100%	100%	100%	100%	100%	100%	100%	100%
<b>3<sup>rd</sup> Quarter</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>
October	99%	99%	99%	99%	99%	99%	86% <sup>(4)</sup>	86% <sup>(4)</sup>	99%
November	100%	100%	100%	100%	100%	100%	100%	100%	100%
December	99%	99%	79% <sup>(3)</sup>	79% <sup>(3)</sup>	79% <sup>(3)</sup>	99%	99%	99%	100%
<b>4<sup>th</sup> Quarter</b>	<b>99%</b>	<b>99%</b>	<b>93%</b>	<b>93%</b>	<b>93%</b>	<b>99%</b>	<b>95%</b>	<b>95%</b>	<b>100%</b>
<b>Annual</b>	<b>100%</b>	<b>100%</b>	<b>98%</b>	<b>98%</b>	<b>98%</b>	<b>100%</b>	<b>99%</b>	<b>99%</b>	<b>100%</b>

<sup>1</sup> EPA PSD-quality meteorological monitoring standards require data capture of 90 percent or greater per quarter for four consecutive quarters.

<sup>2</sup> Data from the secondary horizontal wind sensor were used during the monitoring year..

<sup>3</sup> Horizontal wind data were invalidated during December 2020 due to snow and ice buildup on the sensors. Despite the data loss, DQOs were met during the fourth quarter.

<sup>4</sup> 10m temperature and Delta-T data were invalidated during October 2020 due to malfunctioning sensors. Despite the data loss, DQOs were met during the fourth quarter.

**APPENDIX B**

**PRECISION DATA**

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Table B-17: Annual PM<sub>2.5</sub> Precision Summary Statistics



**Table B-1: 1<sup>st</sup> 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 <sup>(1)</sup>
1/3/2020 <sup>(2)</sup>	7.1	7.7	-7.3	22	0.23	3.15	6.41	-5.95	3.97
1/3/2020	7.7	7.7	0.2						
1/9/2020	7.5	7.7	-2.7						
1/16/2020	7.4	7.7	-4.2						
1/16/2020	7.5	7.7	-3.2						
1/23/2020	7.4	7.7	-3.6						
1/30/2020	7.4	7.7	-3.8						
2/6/2020	7.9	7.7	2.1						
2/12/2020	7.8	7.7	0.8						
2/13/2020	7.8	7.7	1.3						
2/14/2020	7.8	7.7	1.1						
2/15/2020	7.8	7.7	1.8						
2/16/2020	7.8	7.7	1.7						
2/17/2020	7.9	7.7	2.1						
2/18/2020	7.8	7.7	1.8						
2/19/2020	7.9	7.7	2.0						
2/27/2020	7.7	7.7	-0.3						
3/10/2020	7.8	7.7	1.6						
3/11/2020	7.8	7.4	6.0						
3/16/2020	8.0	7.7	3.7						
3/18/2020	8.0	7.7	4.1						
3/30/2020	7.7	7.7	-0.1						

<sup>1</sup> Acceptance criteria: ≤ 10%

<sup>2</sup> Previous instrument (SN 1008241341) replaced by SN 1527.

**Table B-2: 2<sup>nd</sup> 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 <sup>(1)</sup>
3-Apr-20 <sup>(2)</sup>	7.8	7.7	0.7	22	0.02	1.29	2.55	-2.51	1.63
9-Apr-20	7.8	7.7	0.8						
16-Apr-20	7.9	7.7	2.2						
23-Apr-20	7.8	7.7	1.0						
23-Apr-20 <sup>(3)</sup>	7.8	7.7	0.9						
30-Apr-20	7.8	7.7	0.9						
7-May-20	7.7	7.7	0.6						
12-May-20 <sup>(4)</sup>	7.8	7.7	0.7						
12-May-20 <sup>(5)</sup>	7.7	7.7	0.3						
14-May-20	7.8	7.7	0.8						
21-May-20	7.8	7.7	0.9						
27-May-20 <sup>(4)</sup>	7.8	7.7	1.9						
27-May-20 <sup>(5)</sup>	7.6	7.7	-0.9						
28-May-20	7.5	7.7	-2.0						
4-Jun-20	7.5	7.7	-2.3						
10-Jun-20 <sup>(4)</sup>	7.5	7.7	-2.1						
10-Jun-20 <sup>(5)</sup>	7.6	7.7	-1.1						
11-Jun-20	7.6	7.7	-1.0						
18-Jun-20	7.7	7.7	0.0						
18-Jun-20 <sup>(4)</sup>	7.7	7.7	0.5						
18-Jun-20 <sup>(5)</sup>	7.7	7.7	-0.6						
25-Jun-20	7.6	7.7	-1.8						

<sup>1</sup> Acceptance criteria:  $\leq 10\%$

<sup>2</sup> Manual precision check completed due to errors in auto precision check on April 2, 2020 for non-ozone gases.

<sup>3</sup> Manual precision check completed to test changes to data acquisition system

<sup>4</sup> As-found; pre-calibration.

<sup>5</sup> As-left; post calibration.

**Table B-3: 3<sup>rd</sup> 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 <sup>(1)</sup>
7/2/2020	7.4	7.7	-3.8	16	-1.18	3.33	5.35	-7.70	4.41
7/9/2020	7.4	7.7	-4.2						
7/16/2020	7.3	7.7	-4.9						
7/23/2020	7.6	7.7	-1.9						
7/30/2020	7.4	7.7	-4.4						
8/5/2020 <sup>(3)</sup>	7.0	7.7	-8.7						
8/5/2020 <sup>(4)</sup>	7.7	7.7	-0.2						
8/6/2020	7.9	7.7	2.2						
8/13/2020	7.6	7.7	-2.0						
8/27/2020	7.7	7.7	0.1						
9/3/2020	7.7	7.7	-0.6						
9/10/2020	7.8	7.7	0.8						
9/17/2020	7.7	7.7	0.6						
9/21/2020 <sup>(2)</sup>	8.0	7.7	3.6						
9/22/2020 <sup>(2)</sup>	7.9	7.7	2.9						
9/24/2020	7.8	7.7	1.6						

<sup>1</sup> Acceptance criteria:  $\leq 10\%$

<sup>2</sup> Manual precision check completed alongside NO<sub>2</sub> calibration

<sup>3</sup> As-found; pre-calibration.

<sup>4</sup> As-left; post calibration.

**Table B-4: 4<sup>th</sup> 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 <sup>(1)</sup>
10/1/2020	7.7	7.7	0.0	18	0.14	3.14	6.29	-6.01	4.07
10/12/2020 <sup>(2)</sup>	7.3	7.7	-4.9						
10/13/2020 <sup>(2)</sup>	7.3	7.7	-5.6						
10/15/2020	7.3	7.7	-4.7						
10/22/2020	7.6	7.7	-1.6						
10/29/2020	7.6	7.7	-1.6						
11/5/2020	7.6	7.7	-1.0						
11/12/2020	7.7	7.7	0.5						
11/19/2020	7.8	7.7	1.2						
11/26/2020	8.0	7.7	3.4						
12/3/2020	8.0	7.7	4.2						
12/8/2020 <sup>(2)</sup>	8.1	7.7	5.3						
12/8/2020 <sup>(2)</sup>	7.7	7.7	-0.6						
12/10/2020	7.6	7.7	-0.9						
12/17/2020	7.8	7.7	0.9						
12/17/2020	7.8	7.7	0.9						
12/24/2020	7.9	7.7	3.1						
12/31/2020	8.0	7.7	3.8						

<sup>1</sup> Acceptance criteria:  $\leq 10\%$

<sup>2</sup> As-found; pre-calibration

**Table B-5: 1<sup>st</sup> Quarter NO<sub>2</sub> 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 <sup>(1)</sup>
1/2/2020	82.5	80.0	3.1	16	1.42	3.05	7.40	-4.57	4.04
1/9/2020	84.6	80.0	5.8						
1/16/2020	83.2	80.0	4.0						
1/23/2020	79.2	80.0	-1.0						
1/30/2020	80.2	80.0	0.3						
2/6/2020	79.9	80.0	-0.1						
2/17/2020	80.3	80.0	0.4						
2/17/2020	82.8	80.0	3.5						
2/24/2020	79.0	80.0	-1.3						
2/25/2020	79.9	80.0	-0.1						
2/27/2020	83.4	80.0	4.3						
3/11/2020	85.7	80.0	7.1						
3/11/2020	76.1	80.0	-4.9						
3/18/2020	79.4	80.0	-0.8						
3/18/2020	80.2	80.0	0.3						
3/30/2020	81.7	80.0	2.1						

<sup>1</sup> Acceptance criteria: ≤ 15%

**Table B-6: 2<sup>nd</sup> Quarter NO<sub>2</sub> 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 <sup>(1)</sup>
3-Apr-20 <sup>(2)</sup>	80.6	80.0	0.7	19	0.66	4.84	10.15	-8.82	6.23
9-Apr-20	82.7	80.0	3.3						
16-Apr-20	78.2	80.0	-2.3						
23-Apr-20	79.2	80.0	-1.0						
30-Apr-20	79.9	80.0	-0.1						
7-May-20	79.4	80.0	-0.7						
12-May-20 <sup>(3)</sup>	77.5	80.0	-3.1						
12-May-20 <sup>(4)</sup>	85.1	80.0	6.4						
14-May-20	85.9	80.0	7.4						
21-May-20	84.2	80.0	5.2						
28-May-20	84.0	80.0	5.0						
4-Jun-20	82.6	80.0	3.3						
10-Jun-20 <sup>(3)</sup>	82.7	80.0	3.4						
10-Jun-20 <sup>(4)</sup>	80.3	80.0	0.3						
11-Jun-20	81.7	80.0	2.1						
18-Jun-20	70.3	80.0	-12.1						
18-Jun-20 <sup>(3)</sup>	73.2	80.0	-8.5						
18-Jun-20 <sup>(4)</sup>	80.3	80.0	0.4						
25-Jun-20	82.3	80.0	2.9						

<sup>1</sup> Acceptance criteria:  $\leq 15\%$

<sup>2</sup> Manual precision check completed due to errors in auto precision check on April 2, 2020 for non-ozone gases.

<sup>3</sup> As-found; pre-calibration.

<sup>4</sup> As-left; post calibration.

**Table B-7: 3<sup>rd</sup> Quarter NO<sub>2</sub> 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 <sup>(1)</sup>
7/2/2020	84.9	80.0	6.1	15	5.06	1.95	8.88	1.24	2.61
7/9/2020	84.1	80.0	5.1						
7/16/2020	83.0	80.0	3.8						
7/23/2020	83.5	80.0	4.4						
7/30/2020	82.8	80.0	3.5						
8/6/2020	83.4	80.0	4.3						
8/13/2020	84.6	80.0	5.8						
8/20/2020	86.3	80.0	7.9						
8/27/2020	84.9	80.0	6.1						
9/3/2020	84.6	80.0	5.8						
9/10/2020	86.6	80.0	8.3						
9/17/2020	85.8	80.0	7.3						
9/21/2020 <sup>(2)</sup>	81.2	80.0	1.5						
9/22/2020 <sup>(2)</sup>	81.8	80.0	2.3						
9/24/2020	83.2	80.0	4.0						

<sup>1</sup> Acceptance criteria:  $\leq 15\%$

<sup>2</sup> As-left; post calibration.

**Table B-8: 4<sup>th</sup> Quarter NO<sub>2</sub> 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 <sup>(1)</sup>
10/1/2020	80.2	80.0	0.3	16	0.92	1.58	4.01	-2.17	2.09
10/8/2020	81.1	80.0	1.4						
10/13/2020 <sup>(2)</sup>	83.6	80.0	4.5						
10/15/2020	83.2	80.0	4.0						
10/22/2020	80.0	80.0	0.0						
10/29/2020	80.7	80.0	0.9						
11/5/2020	79.7	80.0	-0.4						
11/12/2020	80.0	80.0	0.0						
11/19/2020	80.6	80.0	0.8						
11/26/2020	79.4	80.0	-0.8						
12/3/2020	79.6	80.0	-0.5						
12/10/2020	81.1	80.0	1.4						
12/17/2020	81.6	80.0	2.0						
12/17/2020 <sup>(2)</sup>	80.6	80.0	0.8						
12/24/2020	79.1	80.0	-1.1						
12/31/2020	81.3	80.0	1.6						

<sup>1</sup> Acceptance criteria: ≤ 15%

<sup>2</sup> As-left; post calibration.



**Table B-9: 1<sup>st</sup> Quarter O<sub>3</sub> 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 <sup>(1)</sup>
1/2/2020	80.6	80.0	0.8	41	4.65	4.15	12.78	-3.48	4.87
1/9/2020	77.5	80.0	-3.1						
1/16/2020	79.3	80.0	-0.9						
1/23/2020	79.9	80.0	-0.1						
1/27/2020 <sup>(2)</sup>	79.2	81.0	-2.2						
1/27/2020 <sup>(3)</sup>	83.3	81.0	2.8						
1/30/2020	81.9	80.0	2.4						
2/6/2020	80.8	80.0	1.0						
2/10/2020	84.3	83.2	1.3						
<b>2/12/2020 <sup>(4)</sup></b>	<b>85.7</b>	<b>80.0</b>	<b>7.1</b>						
2/13/2020	84.6	80.0	5.8						
2/13/2020 <sup>(2)</sup>	83.8	79.0	6.1						
2/13/2020 <sup>(3)</sup>	84.2	79.0	6.6						
<b>2/13/2020 <sup>(5)</sup></b>	<b>85.7</b>	<b>80.0</b>	<b>7.1</b>						
2/13/2020	84.0	80.0	5.0						
<b>2/14/2020 <sup>(5)</sup></b>	<b>86.4</b>	<b>80.0</b>	<b>8.0</b>						
<b>2/15/2020 <sup>(5)</sup></b>	<b>89.2</b>	<b>80.0</b>	<b>11.5</b>						
<b>2/16/2020 <sup>(5)</sup></b>	<b>88.2</b>	<b>80.0</b>	<b>10.3</b>						
<b>2/17/2020 <sup>(5)</sup></b>	<b>87.4</b>	<b>80.0</b>	<b>9.3</b>						
<b>2/18/2020 <sup>(5)</sup></b>	<b>87.4</b>	<b>80.0</b>	<b>9.3</b>						
<b>2/19/2020 <sup>(5)</sup></b>	<b>89.7</b>	<b>80.0</b>	<b>12.1</b>						
<b>2/21/2020 <sup>(2,5)</sup></b>	<b>90.3</b>	<b>79.0</b>	<b>14.3</b>						
2/21/2020 <sup>(3)</sup>	82.5	79.0	4.4						
2/21/2020	82.5	80.0	3.1						
2/24/2020 <sup>(2)</sup>	83.7	79.0	6.0						

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 <sup>(1)</sup>
2/24/2020 <sup>(3)</sup>	87.4	81.7	7.0						
<b>2/26/2020 <sup>(2,6)</sup></b>	<b>84.8</b>	<b>78.5</b>	<b>8.0</b>						
2/26/2020 <sup>(3)</sup>	84.2	79.4	6.1						
2/28/2020 <sup>(2)</sup>	86.5	81.8	5.8						
2/28/2020 <sup>(3)</sup>	83.5	80.9	3.2						
3/3/2020 <sup>(7)</sup>	83.1	79.9	4.0						
3/3/2020 <sup>(8)</sup>	77.2	80.0	-3.5						
3/3/2020 <sup>(9)</sup>	82.8	80.0	3.5						
3/11/2020 <sup>(2)</sup>	85.2	79.8	6.8						
3/11/2020 <sup>(3)</sup>	82.8	79.0	4.8						
3/11/2020	85.2	81.2	4.9						
<b>3/13/2020 <sup>(2,10)</sup></b>	<b>88.1</b>	<b>80.7</b>	<b>9.2</b>						
3/13/2020 <sup>(3)</sup>	81.1	80.0	1.4						
3/18/2020	80.9	80.7	0.3						
3/19/2020	80.6	80.0	0.8						
3/26/2020	80.7	80.0	0.9						

<sup>1</sup> Acceptance criteria:  $\leq 7\%$

<sup>2</sup> As-found; pre-calibration.

<sup>3</sup> As-left; post calibration.

<sup>4</sup> Analyzer failed precision check on February 12, 2020. Data invalidated from the last passing check on February 10, 2020 to the next passing check on February 13, 2020.

<sup>5</sup> Analyzer fails several precision checks in the February 13 to February 21 period. Data invalidated during this period.

<sup>6</sup> Analyzer failed precision check on February 26, 2020. Data invalidated to the last passing check on February 24, 2020.

<sup>7</sup> As-found precision check using transfer standard serial number 87.

<sup>8</sup> Check performed immediately after swapping transfer standard serial number 87 for transfer standard serial number 170.

<sup>9</sup> As-left precision check using transfer standard serial number 170.

<sup>10</sup> Analyzer failed precision check on March 13, 2020. Data invalidated to the last passing check on March 11, 2020.

**Table B-10: 2<sup>nd</sup> Quarter O<sub>3</sub> 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 <sup>(1)</sup>
2-Apr-20	80.1	80.0	0.1	22	1.22	2.24	5.61	-3.17	2.82
3-Apr-20 <sup>(2)</sup>	80.2	80.0	0.2						
9-Apr-20	79.8	80.0	-0.2						
11-Apr-20	85.2	81.2	4.9						
16-Apr-20	79.9	80.0	-0.1						
23-Apr-20	79.2	80.0	-1.0						
30-Apr-20	79.6	80.0	-0.6						
7-May-20	79.7	80.0	-0.4						
14-May-20	79.8	80.0	-0.3						
21-May-20	79.8	80.0	-0.2						
27-May-20 <sup>(3)</sup>	78.9	80.0	-1.4						
27-May-20 <sup>(4)</sup>	80.6	80.0	0.8						
28-May-20	81.7	80.0	2.1						
4-Jun-20	81.4	80.0	1.7						
10-Jun-20 <sup>(3)</sup>	81.3	80.0	1.6						
10-Jun-20 <sup>(4)</sup>	80.6	80.0	0.7						
11-Jun-20	80.9	80.0	1.1						
12-Jun-20	82.4	80.0	3.0						
18-Jun-20	82.6	80.0	3.2						
<b>21-Jun-20 <sup>(5)</sup></b>	<b>86.9</b>	<b>80.0</b>	<b>8.6</b>						
22-Jun-20 <sup>(4)</sup>	81.1	80.0	1.4						
25-Jun-20	81.4	80.0	1.7						

<sup>1</sup> Acceptance criteria: ≤ 7%

<sup>2</sup> Manual precision check completed due to errors in auto precision check on April 2, 2020 for non-ozone gases.

<sup>3</sup> As-found; pre-calibration.

<sup>4</sup> As-left; post calibration.

<sup>5</sup> Analyzer failed precision check on June 21, 2020. Data invalidated from the last passing check on June 18, 2020 to the next passing check on June 22, 2020.

**Table B-11: 3<sup>rd</sup> Quarter O<sub>3</sub> 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 <sup>(1)</sup>
7/2/2020	79.7	80.0	-0.4	15	1.51	0.70	2.89	0.13	0.94
7/9/2020	81.2	80.0	1.5						
7/16/2020	81.6	80.0	2.0						
7/23/2020	81.7	80.0	2.2						
7/30/2020	81.3	80.0	1.6						
8/6/2020	82.0	80.0	2.5						
8/13/2020	81.4	80.0	1.7						
8/19/2020 <sup>(2)</sup>	81.1	80.0	1.4						
8/20/2020	81.6	80.0	2.0						
8/24/2020 <sup>(2)</sup>	80.8	80.0	0.9						
8/27/2020	81.4	80.0	1.8						
9/3/2020	80.8	80.0	1.0						
9/10/2020	81.5	80.0	1.9						
9/17/2020	80.7	80.0	0.8						
9/24/2020	81.3	80.0	1.6						

<sup>1</sup> Acceptance criteria:  $\leq 7\%$

<sup>2</sup> Manual precision check completed.

**Table B-12: 4<sup>th</sup> Quarter O<sub>3</sub> 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 <sup>(1)</sup>
10/1/2020	82.1	80.0	2.6	14	1.14	1.32	3.73	-1.46	1.80
10/8/2020	81.0	80.0	1.3						
10/15/2020	81.4	80.0	1.8						
10/22/2020	80.3	80.0	0.4						
10/29/2020	81.3	80.0	1.6						
11/5/2020	82.0	80.0	2.5						
11/12/2020	81.9	80.0	2.4						
11/19/2020	81.7	80.0	2.1						
11/26/2020	81.9	80.0	2.4						
12/3/2020	80.8	80.0	1.0						
12/10/2020	80.6	80.0	0.7						
12/17/2020	79.3	80.0	-0.8						
12/24/2020	78.8	80.0	-1.4						
12/31/2020	79.6	80.0	-0.6						

<sup>1</sup> Acceptance criteria:  $\leq 7\%$

**Table B-13: 1<sup>st</sup> Quarter SO<sub>2</sub> 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 <sup>(1)</sup>
1/2/2020	71.1	74.9	-5.1	28	0.03	3.62	6.93	-6.86	4.30
1/3/2020	71.2	74.9	-4.9						
1/3/2020	80.4	74.9	7.3						
1/21/2020 <sup>(2)</sup>	72.5	74.2	-2.3						
1/23/2020	71.4	74.9	-4.7						
1/24/2020 <sup>(3)</sup>	69.8	74.4	-6.2						
1/24/2020 <sup>(4)</sup>	75.8	74.3	2.0						
1/30/2020	73.5	74.9	-1.9						
2/5/2020 <sup>(3)</sup>	70.8	74.4	-4.8						
2/5/2020 <sup>(4)</sup>	75.1	73.3	2.5						
2/6/2020	76.0	74.9	1.5						
2/12/2020	74.4	74.9	-0.7						
2/13/2020	74.5	74.9	-0.5						
2/14/2020	74.6	74.9	-0.4						
2/15/2020	74.9	74.9	0.0						
2/16/2020	74.4	74.9	-0.7						
2/17/2020	74.0	74.9	-1.2						
2/18/2020	75.3	74.9	0.5						
2/19/2020	75.8	74.9	1.2						
2/24/2020	76.3	74.9	1.9						
2/27/2020	72.4	74.9	-3.3						
3/10/2020	73.9	74.9	-1.3						
3/11/2020	73.9	74.4	-0.7						
3/16/2020 <sup>(3)</sup>	79.1	74.9	5.6						
3/16/2020 <sup>(4)</sup>	80.7	74.8	7.9						

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 <sup>(1)</sup>
3/16/2020	77.8	74.9	3.9						
3/18/2020	77.6	74.9	3.6						
3/30/2020	76.2	74.9	1.7						

<sup>1</sup> Acceptance criteria:  $\leq 10\%$

<sup>2</sup> Previous instrument (SN 9200039) replaced by SN 10020059.

<sup>3</sup> As-found; pre calibration.

<sup>4</sup> As-left; post calibration.

**Table B-14: 2<sup>nd</sup> Quarter SO<sub>2</sub> 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 <sup>(1)</sup>
3-Apr-20	74.3	74.9	-0.7	22	1.07	1.27	3.56	-1.42	1.61
9-Apr-20	75.6	74.9	0.9						
16-Apr-20	75.9	74.9	1.3						
23-Apr-20	75.1	74.9	0.3						
23-Apr-20 <sup>(2)</sup>	75.2	74.9	0.3						
30-Apr-20	75.2	74.9	0.4						
7-May-20	74.4	74.9	-0.7						
12-May-20 <sup>(3)</sup>	75.4	74.9	0.7						
12-May-20 <sup>(4)</sup>	75.2	74.9	0.4						
14-May-20	74.8	74.9	-0.1						
21-May-20	75.2	74.9	0.5						
27-May-20 <sup>(3)</sup>	75.7	74.9	1.0						
27-May-20 <sup>(4)</sup>	75.5	74.9	0.7						
28-May-20	74.8	74.9	-0.1						
4-Jun-20	75.4	74.9	0.6						
10-Jun-20 <sup>(3)</sup>	75.5	74.9	0.8						
10-Jun-20 <sup>(4)</sup>	76.4	74.9	2.1						
11-Jun-20	76.6	74.9	2.3						
18-Jun-20	77.7	74.9	3.8						
18-Jun-20 <sup>(3)</sup>	77.7	74.9	3.7						
18-Jun-20 <sup>(4)</sup>	77.1	74.9	2.9						
25-Jun-20	76.7	74.9	2.4						

<sup>1</sup> Acceptance criteria:  $\leq 10\%$

<sup>2</sup> Manual precision check completed to test changes to data acquisition system.

<sup>3</sup> As-found; pre calibration.

<sup>4</sup> As-left; post calibration.



**Table B-15: 3<sup>rd</sup> Quarter SO<sub>2</sub> 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 <sup>(1)</sup>
7/2/2020	75.7	74.9	1.0	17	1.42	1.33	4.04	-1.19	1.75
7/9/2020	76.5	74.9	2.2						
7/16/2020	76.8	74.9	2.5						
7/23/2020	77.4	74.9	3.4						
7/30/2020	77.2	74.9	3.1						
8/5/2020 <sup>(3)</sup>	78.0	74.9	4.2						
8/5/2020 <sup>(4)</sup>	75.1	74.9	0.3						
8/6/2020	75.4	74.9	0.6						
8/13/2020	74.8	74.9	-0.2						
8/20/2020	74.8	74.9	-0.2						
8/27/2020	74.7	74.9	-0.3						
9/3/2020	75.9	74.9	1.4						
9/10/2020	74.9	74.9	0.0						
9/17/2020	75.8	74.9	1.2						
9/21/2020 <sup>(2)</sup>	76.1	74.9	1.6						
9/22/2020 <sup>(2)</sup>	76.4	74.9	2.0						
9/24/2020	76.0	74.9	1.4						

<sup>1</sup> Acceptance criteria:  $\leq 10\%$

<sup>2</sup> Manual precision check completed alongside NO<sub>2</sub> calibration

<sup>3</sup> As-found; pre calibration.

<sup>4</sup> As-left; post calibration.

**Table B-16: 4<sup>th</sup> Quarter SO<sub>2</sub> 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 <sup>(1)</sup>
10/1/2020	76.1	74.9	1.6	19	1.55	1.39	4.28	-1.19	1.79
10/8/2020	76.5	74.9	2.1						
10/12/2020 <sup>(2)</sup>	75.8	74.9	1.2						
10/13/2020 <sup>(2)</sup>	76.1	74.9	1.6						
10/15/2020	75.5	74.9	0.8						
10/22/2020	75.6	74.9	0.9						
10/29/2020	76.2	74.9	1.7						
11/5/2020	76.4	74.9	2.0						
11/12/2020	77.1	74.9	2.9						
11/19/2020	76.9	74.9	2.7						
11/26/2020	77.7	74.9	3.8						
12/3/2020	77.8	74.9	3.9						
12/8/2020 <sup>(2)</sup>	77.6	74.9	3.6						
12/8/2020 <sup>(3)</sup>	75.1	74.9	0.3						
12/10/2020	74.3	74.9	-0.8						
12/17/2020	74.9	74.9	0.0						
12/17/2020 <sup>(2)</sup>	75.3	74.9	0.5						
12/24/2020	75.8	74.9	1.3						
12/31/2020	74.4	74.9	-0.6						

<sup>1</sup> Acceptance criteria:  $\leq 10\%$

<sup>2</sup> As-found; pre-calibration.

<sup>3</sup> As-left; post calibration.

**Table B-17: Network PM<sub>2.5</sub> Monitoring Precision**

Period	Samplers <sup>(1)</sup>	Concentration Levels	Number of Collocated Samples	Average Percent Difference	Standard Deviation <sup>(2)</sup> (µg/m <sup>3</sup> )	Precision <sup>(3)</sup> (%CV)
1 <sup>st</sup> Quarter (January 1 – March 31)	BAM PM <sub>2.5</sub> Primary against BAM PM <sub>2.5</sub> Collocated	≥3 µg/m <sup>3</sup>	61	-38.3	29.9	24.0
2 <sup>nd</sup> Quarter (April 1 – June 30)	BAM PM <sub>2.5</sub> Primary against BAM PM <sub>2.5</sub> Collocated	≥3 µg/m <sup>3</sup>	18	-21.8	23.5	21.5
3 <sup>rd</sup> Quarter (July 1 – September 30)	BAM PM <sub>2.5</sub> Primary against BAM PM <sub>2.5</sub> Collocated	≥3 µg/m <sup>3</sup>	1	-2.2	NA <sup>(4)</sup>	NA <sup>(4)</sup>
4 <sup>th</sup> Quarter (October 1 – December 31)	BAM PM <sub>2.5</sub> Primary against BAM PM <sub>2.5</sub> Collocated	≥3 µg/m <sup>3</sup>	9	12.3	48.7	52.1
Year to Date	BAM PM <sub>2.5</sub> Primary against BAM PM <sub>2.5</sub> Collocated	≥3 µg/m <sup>3</sup>	89	-29.5	34.4	27.0

<sup>1</sup> PM<sub>2.5</sub> network precision statistics represent data from the CD1 monitoring station PM<sub>2.5</sub> samplers.

<sup>2</sup> Standard deviation of the absolute concentration differences for the population.

<sup>3</sup> Precision is calculated as the coefficient of variation upper bound with a goal of ≤ 10%CV per quarter. Because of the very low PM<sub>2.5</sub> concentrations routinely observed on the North Slope of Alaska, 10%CV is often exceeded because of the exaggeration associated in the relative percent difference for very low concentration sample pairs. Because the precision estimate exceeds 10%CV, alternate precision statistics of ±3 µg/m<sup>3</sup> per collocated pair were applied according to the approved CD1 project quality assurance project plan (QAPP). See CD1 summary report and QAPP for additional information.

<sup>4</sup> NA indicates insufficient number of paired samples with both measurements >3µg/m<sup>3</sup> to calculate.

## **APPENDIX C**

### **ACCURACY DATA**

***Not included because appendix contains  
confidential business information***

## **APPENDIX D**

### **VALIDATED CONTINUOUS DATA SUMMARIES**

***Not included because appendix contains  
confidential business information***