

## **2021 Q4 SENSOR REPORT COMMERCE CITY NORTH DENVER COMMUNITY AIR MONITORING NETWORK COMMERCE CITY, COLORADO**

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## Executive Summary

In response to feedback received by Suncor Energy (U.S.A.) Inc. (Suncor) through community engagement conducted in the fall of 2020, Suncor voluntarily committed to developing a continuous, near real-time air monitoring program to gain insight into air quality for neighborhoods in the vicinity of the Suncor refinery in Commerce City, Colorado. Montrose Environmental Group - Air Quality Services, LLC (Montrose) was contracted by Suncor to deploy, operate, and maintain the network in the Commerce City and North Denver (CCND) neighborhoods. Air monitoring was accomplished through three separate technical approaches: (1) continuous, near real-time monitoring for the following analytes<sup>1</sup>: carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), hydrogen sulfide (H<sub>2</sub>S), nitrogen oxide or nitric oxide (NO), nitrogen dioxide (NO<sub>2</sub>), particulate matter (PM<sub>2.5</sub>), and total volatile organic compounds (VOCs); (2) periodic collection and laboratory analysis for the presence of specific VOCs from 6-liter evacuated stainless steel (“Summa”) canisters; and (3) periodic real-time air monitoring throughout neighborhoods using a mobile monitoring van to detect the presence of specific VOCs. This report details approach number one, continuous near real-time air monitoring and a screening health risk analysis. Periodic collection and analysis of Summa canister air samples and mobile monitoring van data are presented in separate reports.

Continuous air monitoring sensors were operating at nine locations across the CCND neighborhoods. The fourth quarter of 2021 air monitoring preliminary data was made available in near real-time at [ccnd-air.com](http://ccnd-air.com) from October 1 – December 31, 2021, and final data is presented in this report. The sensors used in this program integrate different technologies including a photoionization detector for VOCs; an electrochemical sensor for CO, NO, NO<sub>2</sub>, H<sub>2</sub>S, and SO<sub>2</sub>; laser scattering for PM<sub>2.5</sub>; and a sonic anemometer for wind speed and direction. All sensor monitoring was conducted in accordance with the Quality Assurance Project Plan (QAPP) available at [ccnd-air.com/documents](http://ccnd-air.com/documents).

Health scientists from CTEH, LLC (CTEH®) (a subsidiary company of Montrose Environmental Group) evaluated the air monitoring data and compared them to air quality standards, health-based reference values, and previously published regional data to determine if the measured air quality may have the potential for adverse effects on community health.

The results of this assessment indicate the following:

- The analyte levels at each location were below their respective acute health-based reference levels, if available, or within the range of previously published regional data.
- The monitored analyte levels at locations within the CCND neighborhoods are lower than USEPA’s ambient air quality standards (which are provided for informational and not compliance purposes).

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<sup>1</sup> An “analyte” is a material that a measuring device is designed to detect and measure. It may be a chemical gas, an airborne particle, or other type of material.



## 1.0 INTRODUCTION

In response to feedback received by Suncor Energy (U.S.A.) Inc. (Suncor) through community engagement conducted in the fall of 2020, Suncor voluntarily committed to developing a continuous, near real-time air monitoring program to gain insight into air quality for neighborhoods in the vicinity of the Suncor refinery in Commerce City, Colorado. Montrose Environmental Group-Air Quality Services, LLC (Montrose) was contracted by Suncor to deploy, operate, and maintain the network in the Commerce City and North Denver (CCND) neighborhoods. Air monitoring was accomplished through three separate technical approaches: (1) continuous, near real-time monitoring for the following analytes: carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), hydrogen sulfide (H<sub>2</sub>S), nitric oxide (NO), nitrogen dioxide (NO<sub>2</sub>), particulate matter (PM<sub>2.5</sub>), and total volatile organic compounds (VOCs); (2) periodic collection and laboratory analysis for the presence of specific VOCs from Summa canisters; and (3) periodic real-time air monitoring throughout neighborhoods using a mobile monitoring van to detect presence of specific VOCs. An “analyte” is a material that a measuring device is designed to detect and measure. It may be a chemical gas, an airborne particle, or other type of material. This report details approach number one, the continuous, near real-time monitoring for the analytes listed. The Summa canister sampling and mobile monitoring van data are presented in separate reports. Air monitoring, sampling, and analysis from all three phases were conducted in accordance with the Quality Assurance Project Plan (QAPP) that can be found online at <https://www.ccnd-air.com/Documents/>.

### 1.1 Air Monitoring Site Description

Continuous air monitoring sensors were installed at eight locations across CCND neighborhoods within a three-mile radius of refinery operations in July 2021. An additional monitoring sensor was installed in December of 2021. The monitor locations are shown in Figure 1-1 and described in Table 1-1; and were selected based on the following criteria:

- Historical wind pattern data
- Proximity to the refinery and non-refinery sources
- Existing infrastructure, as well as site access and safety
- Community feedback

**FIGURE 1-1  
MAP OF CCND MONITOR LOCATIONS**



**TABLE 1-1  
CCND MONITORS AND SUMMA CANISTER SAMPLING LOCATIONS**

<b>Location ID</b>	<b>Secondary ID</b>	<b>GPS Coordinates</b>	<b>Distance from Refinery Center (miles)</b>	<b>Cross Streets</b>
CM1	Rose Hill Elementary School	39.80164, -104.90882	2.0	E. 58 <sup>th</sup> Ave. & Oneida St., Commerce City
CM2	Suncor Refinery Business Center	39.79599, -104.95603	0.70	Brighton Blvd. & York St., Commerce City
CM3	Adams City High School	39.82736, -104.90193	2.9	E. 72 <sup>nd</sup> Ave. & Quebec Pkwy, Commerce City
CM4	Adams City Middle School	39.82893, -104.93499	1.9	Birch St. & E. 72 <sup>nd</sup> Ave., Commerce City
CM5	Central Elementary School	39.81457, -104.91928	1.7	Holly St. & E. 64 <sup>th</sup> Ave., Commerce City
CM6	Focus Points Family Resource Center	39.78436, -104.95663	1.4	Columbine St. & 48 <sup>th</sup> Ave., Denver
CM7	Kearney Middle School	39.80888, -104.91545	1.7	E 62 <sup>nd</sup> Ave. & Kearney St., Commerce City
CM8	Monroe	39.8156, -104.94503	0.85	Monroe St. & E 64 <sup>th</sup> Ave., Denver
CM9	48 <sup>th</sup> and Race	39.78455, -104.96264	1.7	East 48 <sup>th</sup> Ave. & Race St., Denver

## 2.0 METHODS

### 2.1 Continuous Monitoring

The sensors used in the CCND network were manufactured by Lunar Outpost (Canary-S sensor), a Colorado-based company, and AQMesh (Pod), a United Kingdom-based company. The near-Federal Equivalency Method (FEM) AQM65 monitors used for quality assurance of the network were manufactured by Aeroqual, a New Zealand-based company. Each sensor is solar powered and transmits data to the data platform via Long Term Evolution, (LTE) cell technology. The monitoring in the community is being performed using a variety of technology, as described in Table 1-2.

**TABLE 1-2  
CCND MONITORING TECHNOLOGY**

<b>Air Pollutant/Parameter Category</b>	<b>Principle of Operation</b>	<b>Sensor Manufacturer</b>
Total VOC	Photoionization Detector	Lunar Outpost
SO <sub>2</sub>	Electrochemical Sensor	AQMesh
CO	Electrochemical Sensor	AQMesh
NO	Electrochemical Sensor	AQMesh
NO <sub>2</sub>	Electrochemical Sensor	AQMesh
H <sub>2</sub> S	Electrochemical Sensor	AQMesh
PM <sub>2.5</sub>	Laser Scattering	Lunar Outpost
Wind Speed, Wind Direction	Sonic Anemometer	Lunar Outpost
Temperature, Relative Humidity, Barometric Pressure	Solid State	Lunar Outpost

The sensors monitor the ambient air by allowing it to passively enter each sensor's exterior housing via small holes and pass over the surface of the sensor. The AQM65 monitors the ambient air via a pump that pulls the sample into the individual analyte specific gas modules for analysis. Each device used in this project is solar-powered and transmits data via cellular communication.

The Photoionization Detector (PID) sensors used to measure VOCs contains a lamp that produces photons that carry enough energy to break molecules into ions. The PID responds to molecules that have an ionization energy at or below the energy of the lamp; the PID used on this project employs a 10.6 electron-volt lamp. The produced ions then generate an electrical current that is measured as the output of the detector. PIDs are known to drift with ambient temperature and humidity variation. The PIDs used in this program mitigate the humidity issue by having a hydrophobic filter installed between the lamp and the ambient air. This deters water molecules

from entering the ion-producing chamber and absorbing radiation. The PIDs are also heated slightly above ambient temperature to improve stability of the detector.

Electrochemical sensors measure the concentration of a specific gas (SO<sub>2</sub>, CO, NO, NO<sub>2</sub>, and H<sub>2</sub>S) within an external circuit via oxidation or reduction reactions. These reactions generate the positive or negative current flow through the external circuit. An electrochemical sensor is made up of a working, counter, and reference electrode. All these components sit inside of a sensor housing along with a liquid electrolyte that is specific to the compound of interest. Temperature and relative humidity are known to affect the electrochemical sensors being used and could influence data quality. The AQMesh Pod collect sensor temperature and ambient relative humidity data and correct for these interferences via algorithms that were developed during extensive [global comparisons with reference data](#). Extreme temperature and humidity conditions can cause the liquid electrolyte to dry up and cause erratic readings on the monitors. The AQMesh Pod monitors conditions that can cause these erratic readings and automatically invalidates this data to improve the overall quality of the data the sensors are reporting.

Additionally, electrochemical sensors have known cross sensitivity to other compounds. Some significant cross sensitivities include ozone causing a response on the NO<sub>2</sub> sensor. This program mitigates this issue by using an ozone filter on the face of the NO<sub>2</sub> sensor. Similarly, the SO<sub>2</sub> sensor can have a response caused by the presence of H<sub>2</sub>S. Again, the SO<sub>2</sub> sensor has a built-in filter to mitigate the H<sub>2</sub>S interference. The SO<sub>2</sub> sensor has additional interference from NO<sub>2</sub>. The AQMesh data processing algorithms incorporate any data correction for these interferences.

The sensor data are intended to be used for informational purposes only and cannot be used for official compliance determination. The accuracy of sensors used in the program is not as high as certified ambient air monitoring equipment used by federal and local officials for National Ambient Air Quality Standard (NAAQS) compliance monitoring. State regulatory compliance data can be found on the CDPHE air quality website at <https://www.colorado.gov/airquality>.

The sampled particles are measured by the physical principle of light scattering. Each single particle is illuminated by a defined laser light and each scattering signal is detected at an angle of 90° by a photo diode. In accordance with the Mie theory, each measured pulse height is directly proportional to the particle size whereas each pulse is classified in an electronic register of 32 different size channels.

Sensors like the Lunar Outpost Canary-S and AQMesh Pod are also known to produce data that is noisier (lower signal-to-noise ratio) than traditional regulatory reference method quality ambient air monitoring equipment. To mitigate this issue, the data were averaged over one hour to improve the signal-to-noise of the instrument readings.

All sampling and quality assurance procedures were performed by Montrose.

## **2.2 Assessment of Community Health Implications**

Health scientists from CTEH, LLC (CTEH®) (a subsidiary company of Montrose) evaluated the air monitoring data collected by Montrose from October 1 through December 31, 2021. Results were compared to various standards, health-based reference levels, and previously published regional data to determine if the measured air quality may have the potential for adverse health effects within the surrounding communities.



The analytes CO, NO<sub>2</sub>, SO<sub>2</sub>, and PM<sub>2.5</sub> are all listed by the United States Environmental Protection Agency (USEPA) as “criteria pollutants”. These analytes were identified in the U.S. federal Clean Air Act as airborne pollutants that, at certain levels, may adversely impact public health and welfare and for which National Ambient Air Quality Standards (NAAQS) would be established and updated based on the periodically reviewed scientific data associating criteria pollutant levels and public health impacts. Unlike chemical-specific health reference values, the NAAQS provide air quality standards designed to protect public health at the regional level. The determination that a criteria pollutant is at a level legally required to be mitigated comes from evaluation of one year (CO) to three years (NO<sub>2</sub>, SO<sub>2</sub>, and PM<sub>2.5</sub>) of air monitoring data<sup>2</sup> collected by regulatory-grade instrumentation. If the maximum or average analyte levels in this report are higher than their respective NAAQS it does not necessarily indicate a violation of with the NAAQS or that adverse health effects are likely. For example, a 1-hour exceedance of the NO<sub>2</sub> standard would not constitute a violation of the NO<sub>2</sub> NAAQS, since it is not directly comparable as the 98<sup>th</sup> percentile of the 1-hour daily maximum concentration, averaged over 3 years. However, these data reported herein are used to determine if the potential may be identified for their values to negatively impact air quality and public health going forward.

H<sub>2</sub>S and NO are not criteria pollutants but were selected to be monitored because of the potential to produce reactive nitrogen compounds in the air (NO), or because of presence in some grades of crude oil and its refined products (H<sub>2</sub>S). Average and maximum NO levels for the Front Range region have been previously measured and reported by the Colorado Air Pollution Control Division (APCD)<sup>3</sup>. The maximum and average NO levels measured by Montrose from October through December 2021 are compared to the regional values reported by APCD. The health reference values for H<sub>2</sub>S were developed by the Agency for Toxic Substances and Disease Registry (ATSDR)<sup>4</sup>. The ATSDR acute health-based reference levels (one day to two weeks of continuous exposure) is a health reference value below which continuous exposure is likely to be without risk of developing adverse health effects, even in sensitive sub-populations. Maximum 1-hour rolling average H<sub>2</sub>S levels recorded in each CCND neighborhood were compared to an ATSDR acute-health-based reference level.

Finally, the USEPA has established values for use in emergency situations, termed Acute Exposure Guideline Levels (AEGLs). Unlike health-based reference levels that can be thousands of times below exposure levels where adverse effects are observed, AEGL values are levels at which different acute adverse health effects may be anticipated to occur. According to USEPA, “AEGL-1 represent exposure levels that could produce mild and progressively increasing but transient and non-disabling odor, taste, and sensory irritation or certain asymptomatic, non-sensory effects. With increasing airborne concentration above each AEGL, there is a progressive increase in the likelihood of occurrence and the severity of effects described for each corresponding AEGL [i.e., AEGL-2 or AEGL-3].” The AEGL-1 60-minute value, if available for the applicable compound, was also used for comparison purposes because it is more precautionary (than AEGL-2 or AEGL-3) as the AEGL-1 level reflects potential health impacts that are reversible upon cessation of exposure. The AEGL-1 60-minute values for H<sub>2</sub>S (510 ppb), NO<sub>2</sub> (500 ppb), and SO<sub>2</sub> (200 ppb) were also listed for comparison purposes. The USEPA did not derive an AEGL-1 value for CO, therefore an AEGL-2 (83 ppm) was selected.

<sup>2</sup> USEPA NAAQS Table, available online at <https://www.epa.gov/criteria-air-pollutants/naaqs-table>

<sup>3</sup> CO APCD 2019 Air Quality Data Report, available online at [https://www.colorado.gov/airquality/tech\\_doc\\_repository.aspx?action=open&file=2019AnnualDataReport.pdf](https://www.colorado.gov/airquality/tech_doc_repository.aspx?action=open&file=2019AnnualDataReport.pdf)

<sup>4</sup> ATSDR MRL List available online at <https://wwwn.cdc.gov/TSP/MRLS/mrlsListing.aspx>

## 2.3 Summary of Downtime or Equipment Malfunction

Data recovery is a percentage of the number of data points collected divided by the expected number of data points. For example, if we expect a data point every 5 minutes, we would expect a total of 12 data points over a 1-hour period. If only 11 data points were received, the data recovery for that hour would be 92%. The data recovery during the reporting period meets the QAPP targets and are presented in Table 1-3.

**TABLE 1-3**  
**CCND MONITORING DATA RECOVERY**

Location ID	AQMesh	AQMesh	Lunar Outpost
	(excludes periods of adverse atmospheric conditions)	(includes periods of adverse atmospheric conditions)	
CM1	97%	97%	98%
CM2	76% <sup>5</sup>	76% <sup>5</sup>	82% <sup>5</sup>
CM3	97%	97%	100%
CM4	97%	97%	99%
CM5	97%	97%	99%
CM6	97%	97%	97%
CM7	97%	97%	100%
CM8	97%	97%	98%
CM9	100%	100%	100%

Data recovery may be below 100% for several reasons including instrument malfunction, instrument communication issues, monitor downtime when performing quality assurance procedures, etc. In alignment with the QAPP, data recovery does not include downtime when adverse atmospheric conditions such as extreme humidity, extreme temperature, and other conditions can affect a monitor's ability to provide reliable data.

A data gap at CM2 occurred from October 1 through October 20, 2021 for the AQMesh Pod monitoring analytes (CO, NO, NO<sub>2</sub>, H<sub>2</sub>S, and SO<sub>2</sub>) and the Lunar Outpost monitoring analytes (PM<sub>2.5</sub> and VOC). The data during this time period was determined by Montrose to be invalid due to an event that occurred at the monitor's location on the roof of the Suncor Refinery Business Center. Both monitors were located in close proximity to the exhaust of a heater installed on the roof, and the off-gas was causing analyte spikes to the monitors. Once the issue was discovered, the monitors were moved (on 10/20/21) to a different corner of the roof, away from possible exposure of the off-gas. Additional testing, by simultaneously monitoring all analytes at the original and new location, verified the emission source was in fact coming from the roof exhaust.

The AQMesh Pod's internal quality assurance and procedures automatically invalidates this data to improve the overall quality of the data the sensors are reporting.

### 3.0 RESULTS

#### 3.1 Results Summary

The 1-hour rolling average results for CO, NO, NO<sub>2</sub>, PM<sub>2.5</sub>, H<sub>2</sub>S, SO<sub>2</sub>, and VOCs during this reporting period can be found in Table 1-4 and Figures 1-2 through 1-8. The gas (CO, NO, NO<sub>2</sub>, H<sub>2</sub>S, SO<sub>2</sub>, and VOC) data is reported on a 1-hour rolling average updated every 5 minutes. The PM<sub>2.5</sub> data presented on the website is a 1-hour block average to align with the other PM<sub>2.5</sub> sensor-based monitoring programs around the local community. The 24-hour block averages for PM<sub>2.5</sub> and H<sub>2</sub>S are also reported. Values reported as zero do not necessarily mean that the analyte is not present, but instead indicate that the analyte is present below the detectable level of the instrument.

The [Clean Air Act](#) requires USEPA to set NAAQS for pollutants considered harmful to public health and the environment. AEGLs are used by emergency planners and responders worldwide as guidance for emergency response situations. Minimal Risk Levels (MRLs), provided by the ATSDR, are intended to serve as a screening tool to help public health professionals determine where further evaluation may be needed. If the maximum or average analyte levels in this report are higher than their respective NAAQS it does not necessarily indicate a violation of with the NAAQS or that adverse health effects are likely. Table 1-4 and Figures 1-2 to 1-8 indicate readings for the monitoring period relative to the NAAQS and MRLs (if applicable).



**TABLE 1-4  
CCND MONITORS RESULTS SUMMARY**

Analyte	Sites with Exceedances	NAAQ Standard (duration)	Health-based Reference Value (Source)
CO	None	<b>35 ppm</b> (1-hour average not to be exceeded more than one per year)	<b>83 ppm</b> (1-hour USEPA AEGL-2)
NO	NA	NA	NA
NO <sub>2</sub>	None	<b>100 ppb</b> (98 <sup>th</sup> percentile of 1-hour daily maximum, averaged over 3 years)	<b>500 ppb</b> (1-hour USEPA AEGL-1)
SO <sub>2</sub>	None	<b>75 ppb</b> (99 <sup>th</sup> percentile of 1-hour daily maximum concentrations, averaged over 3 years)	<b>200 ppb</b> (1-hour USEPA AEGL-1)
H <sub>2</sub> S	None	NA	<b>70 ppb</b> (acute <sup>5</sup> ATSDR MRL) <b>510 ppb</b> (1-hour USEPA AEGL-1)
PM <sub>2.5</sub>	None	<b>35 µg/m<sup>3</sup></b> (98 <sup>th</sup> percentile of 24-hour daily average concentrations, averaged over 3 years)	NA
VOC	NA	NA	NA

<sup>5</sup> An acute exposure is defined by ATSDR as 1-14 days

### 3.2 Carbon Monoxide (CO)

Figure 1-2 shows the 1-hour rolling averages of CO from October 1, 2021, through December 31, 2021. The USEPA NAAQS for CO is 35 ppm as a 1-hour average not to be exceeded twice in one year. Figure 1-2 shows that all the measured 1-hour average CO values in all CCND neighborhoods were more than 22 times lower (maximum reading: 1.59 ppm) than the CO NAAQS concentration. Thus, CO levels such as those measured in the CCND neighborhoods would not contribute to an annual exceedance of the NAAQS. Further, the maximum measured CO values in the CCND neighborhoods are more than 52 times lower than the 1-hour USEPA AEGL-2 of 83 ppm.

### 3.3 Nitric Oxide (NO)

Figure 1-3 shows the 1-hour rolling averages of NO from October 1, 2021, through December 31, 2021. There are no established USEPA NAAQS, health-based reference level, or USEPA AEGL-1 value for NO since NO demonstrates low toxicity and is naturally occurring in the human body<sup>6</sup>. Thus, measured NO levels were compared to NO levels published by Air Pollution Control Division (APCD) in 2020<sup>7</sup>. The annual average NO levels reported by APCD for Denver (four locations), Jefferson County, and Weld County ranged from 0.7 to 29.2 ppb, (maximum levels ranged from 38 to 308 ppb), while the maximum 1-hour rolling average NO values measured by Montrose in the CCND neighborhoods concentration ranged from 137 - 243 ppb.

### 3.4 Nitrogen Dioxide (NO<sub>2</sub>)

Figure 1-4 shows the 1-hour rolling averages of NO<sub>2</sub> from October 1, 2021, through December 31, 2021. The USEPA NAAQS for NO<sub>2</sub> is 100 ppb as the 98th percentile of 1-hour daily maximum concentrations, averaged over three years. Figure 1-4 shows that all measured 1-hour average NO<sub>2</sub> values in all CCND neighborhoods (maximum 82.5 ppb) were at least 18% lower than the NO<sub>2</sub> NAAQS concentration. Thus, NO<sub>2</sub> levels such as those measured in the CCND neighborhoods would not contribute to an annual exceedance of the NAAQS. Further, the maximum measured 1-hour average NO<sub>2</sub> values in the CCND neighborhoods are more than six times lower than the 1-hour USEPA AEGL-1 for NO<sub>2</sub> of 500 ppb.

### 3.5 Sulfur Dioxide (SO<sub>2</sub>)

Figure 1-5 shows the 1-hour rolling averages of SO<sub>2</sub> from October 1, 2021, through December 31, 2021. The USEPA NAAQS for SO<sub>2</sub> is 75 ppb as 99th percentile of 1-hour daily maximum concentrations, averaged over three years. Figure 1-5 shows that all measured 1-hour average SO<sub>2</sub> values in all CCND neighborhoods were at or lower than 38 ppb. Thus, SO<sub>2</sub> levels such as those measured in the CCND neighborhoods would not contribute to an annual exceedance of the NAAQS. Further, the maximum measured 1-hour average SO<sub>2</sub> values in the CCND neighborhoods are more than five times lower than the 1-hour USEPA AEGL-1 for SO<sub>2</sub> of 200 ppb.

<sup>6</sup> [https://www.epa.gov/sites/default/files/2014-11/documents/nitrogen\\_oxides\\_volume\\_11.pdf](https://www.epa.gov/sites/default/files/2014-11/documents/nitrogen_oxides_volume_11.pdf)

<sup>7</sup> Colorado Air Pollution Control Division. 2020 Air Quality Data Report, dated November 2, 2021. Available online at: [https://www.colorado.gov/airquality/tech\\_doc\\_repository.aspx?action=open&file=2019AnnualDataReport.pdf](https://www.colorado.gov/airquality/tech_doc_repository.aspx?action=open&file=2019AnnualDataReport.pdf)

### 3.6 Hydrogen Sulfide (H<sub>2</sub>S)

Figures 1-6A and 1-6B show the 1-hour and 24-hour rolling averages of H<sub>2</sub>S, respectively, from October 1, 2021, through December 31, 2021. The maximum 1-hour average H<sub>2</sub>S value (65.3 ppb) and the maximum measure 24-hour average (11.7 ppb) in all CCND neighborhoods was below the ATSDR acute-duration MRL of 70 ppb. Thus, it is unlikely that H<sub>2</sub>S levels measured in the CCND neighborhoods would result in an increased risk of adverse acute duration health effects. Further, the maximum measured 1-hour average H<sub>2</sub>S values in the CCND neighborhoods are more than 7 times lower than the 1-hour USEPA AEGL-1 for H<sub>2</sub>S of 510 ppb.

### 3.7 Particulate Matter (PM<sub>2.5</sub>)

Figures 1-7A and 1-7B show the 1-hour and 24-hour block averages of PM<sub>2.5</sub>, respectively, from October 1, 2021, through December 31, 2021. The USEPA NAAQS for PM<sub>2.5</sub> is 35 µg/m<sup>3</sup> as 98th percentile of 24-hour daily (block) average concentrations, averaged over 3 years. The maximum measured 1-hour average of PM<sub>2.5</sub> (31.6 ug/m<sup>3</sup>) and the maximum measured 24-hour average (15.57 ug/m<sup>3</sup>) were below the NAAQS value and therefore it is unlikely that PM<sub>2.5</sub> levels measured in the CCND neighborhoods would result in an increased risk of adverse acute duration health effects.

### 3.8 Total Volatile Organic Compounds (VOC)

Figure 1-8 shows the 1-hour rolling averages of total VOCs from October 1, 2021, through December 31, 2021. There are no NAAQS or health-based reference values for total VOCs because this measurement may be made of one to thousands of different chemical compounds having various thresholds of toxic effects. VOC sensor-triggered samples were collected automatically when instantaneous total VOCs were detected at an airborne concentration of 1 part per million (ppm) or higher for 1 minute or longer. During the fourth quarter of 2021, total VOC levels exceeded 1 ppm on two separate occasions, which triggered the capture of two air samples. The results of those sensor-triggered events are presented in a separate report found [ccnd-air.com/Documents](https://ccnd-air.com/Documents).

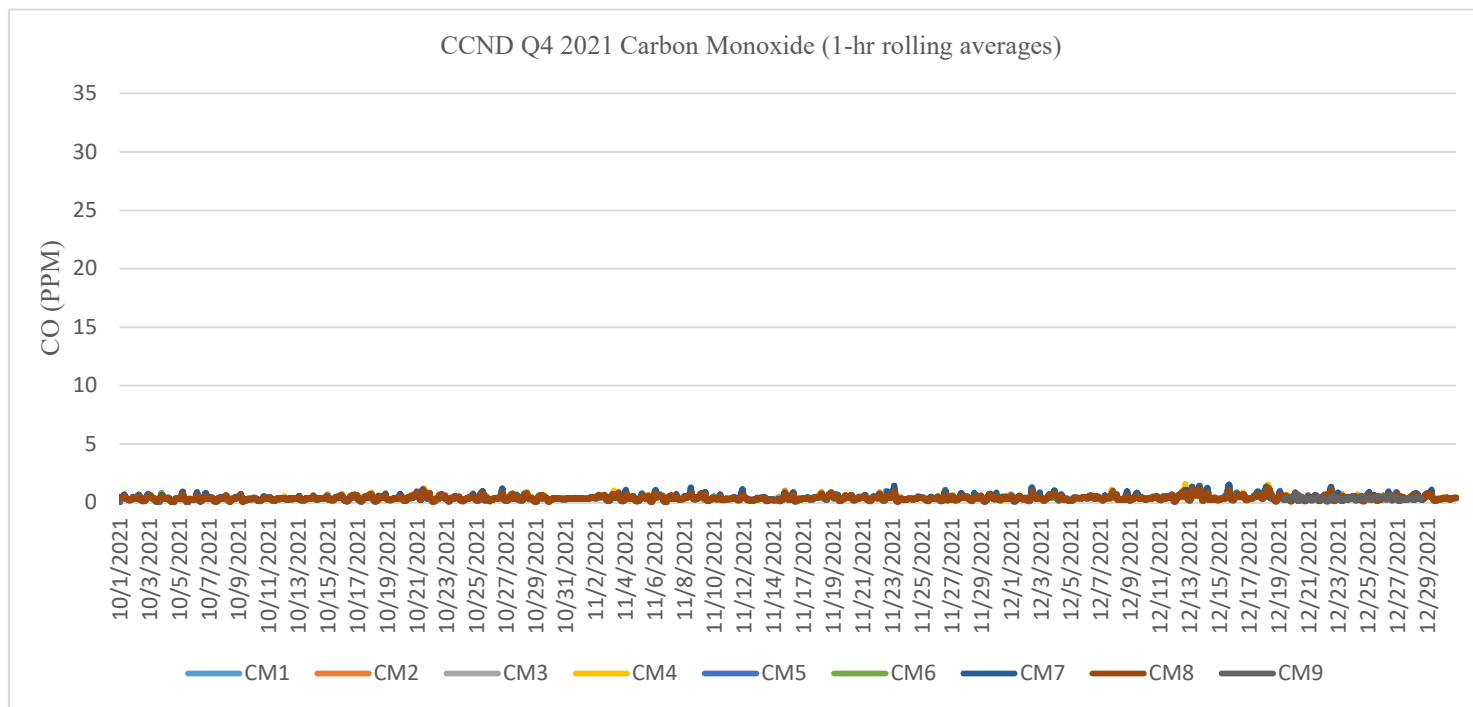
## 4.0 CONCLUSIONS

Continuous air monitoring sensors were operating at nine locations across the CCND neighborhoods. The air monitoring data from October – December 2021 was compared to air quality standards, health-based reference values, and previously published regional data to determine if the measured air quality may have the potential for adverse effects on community health.

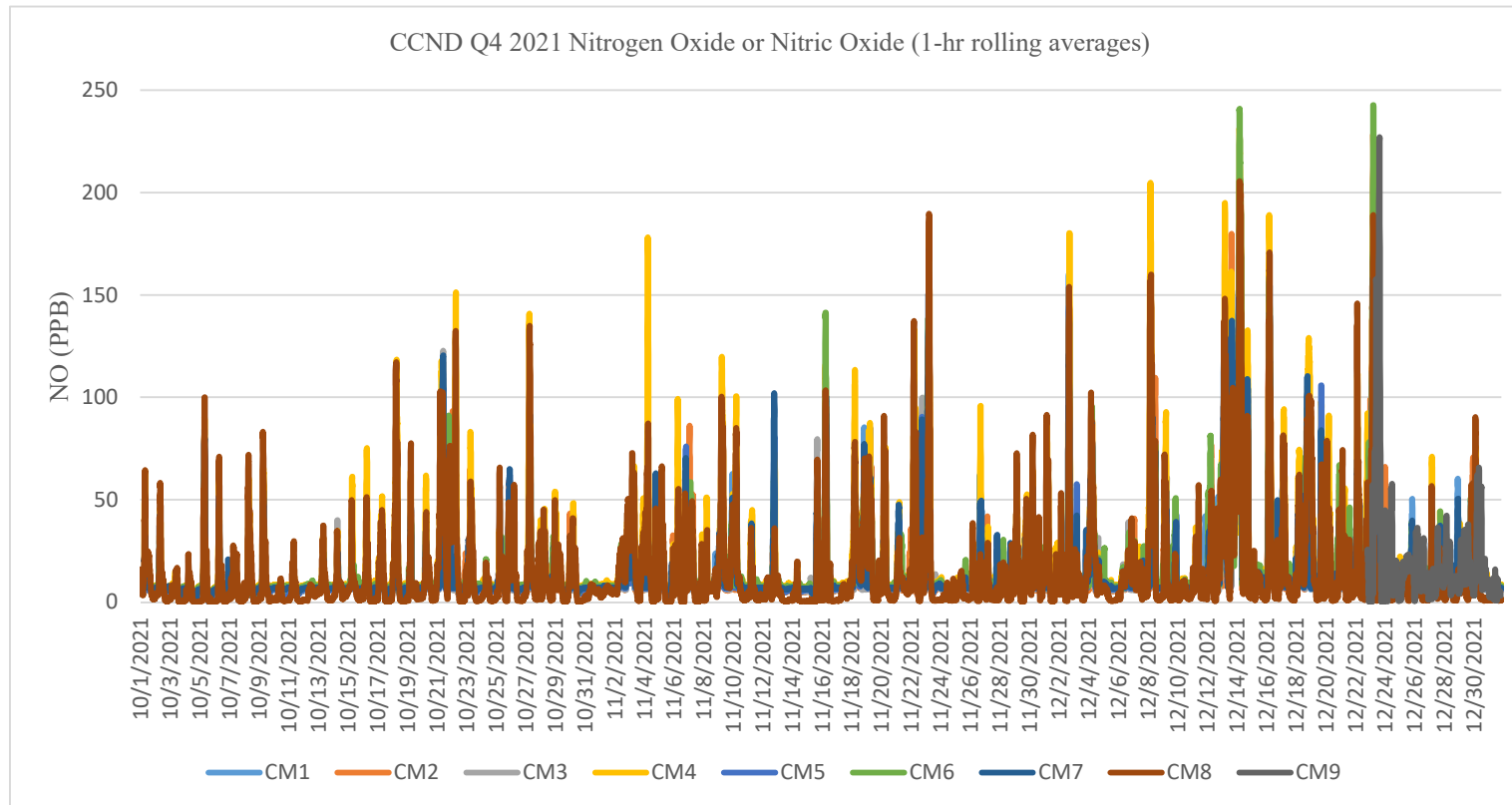
The results of this assessment indicate the following:

- The analyte levels at each location were below their respective acute health-based reference levels, if available, or within the range of previously published regional data.
- The monitored analyte levels at locations within the CCND neighborhoods are lower than USEPA's ambient air quality standards (which are provided for informational and not compliance purposes).

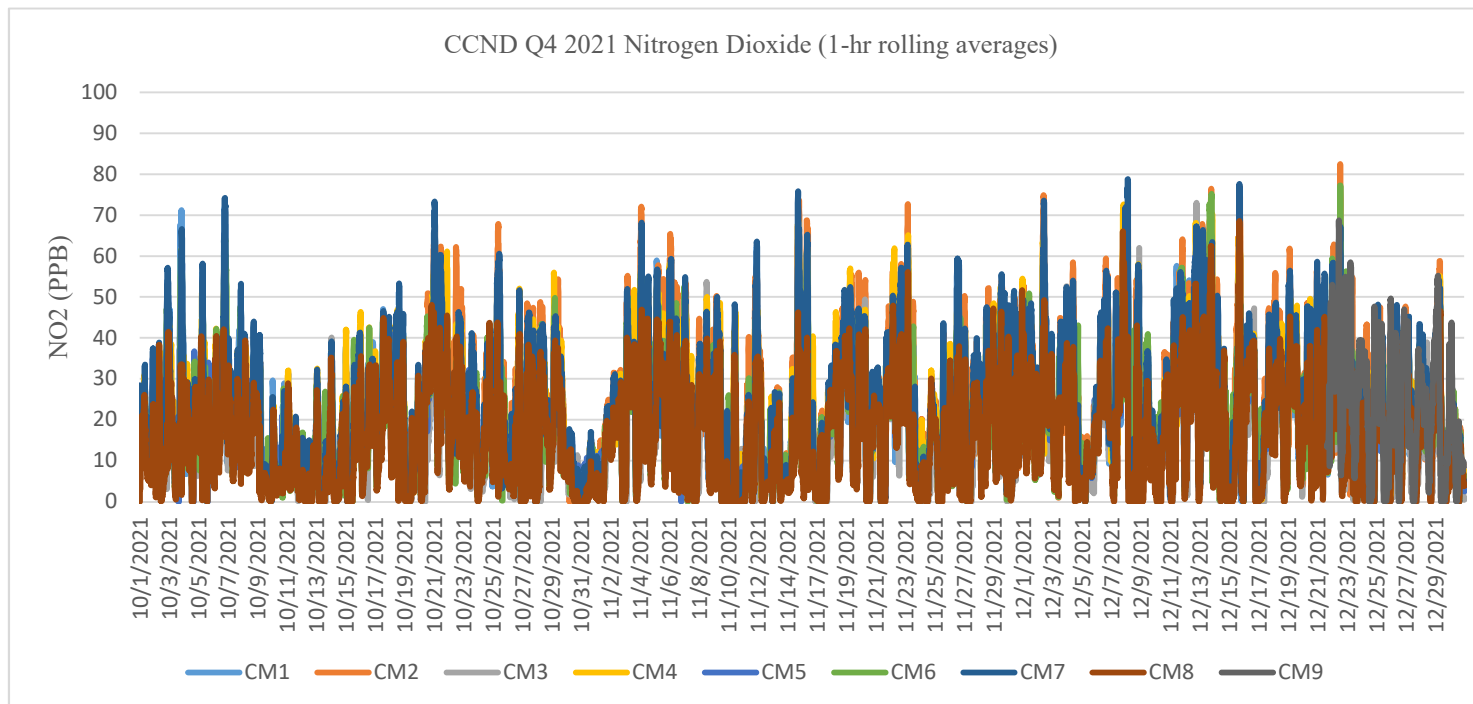
**FIGURE 1-2**  
**CCND COMMUNITY MONITORING CO DATA (1-HOUR ROLLING AVERAGES)**



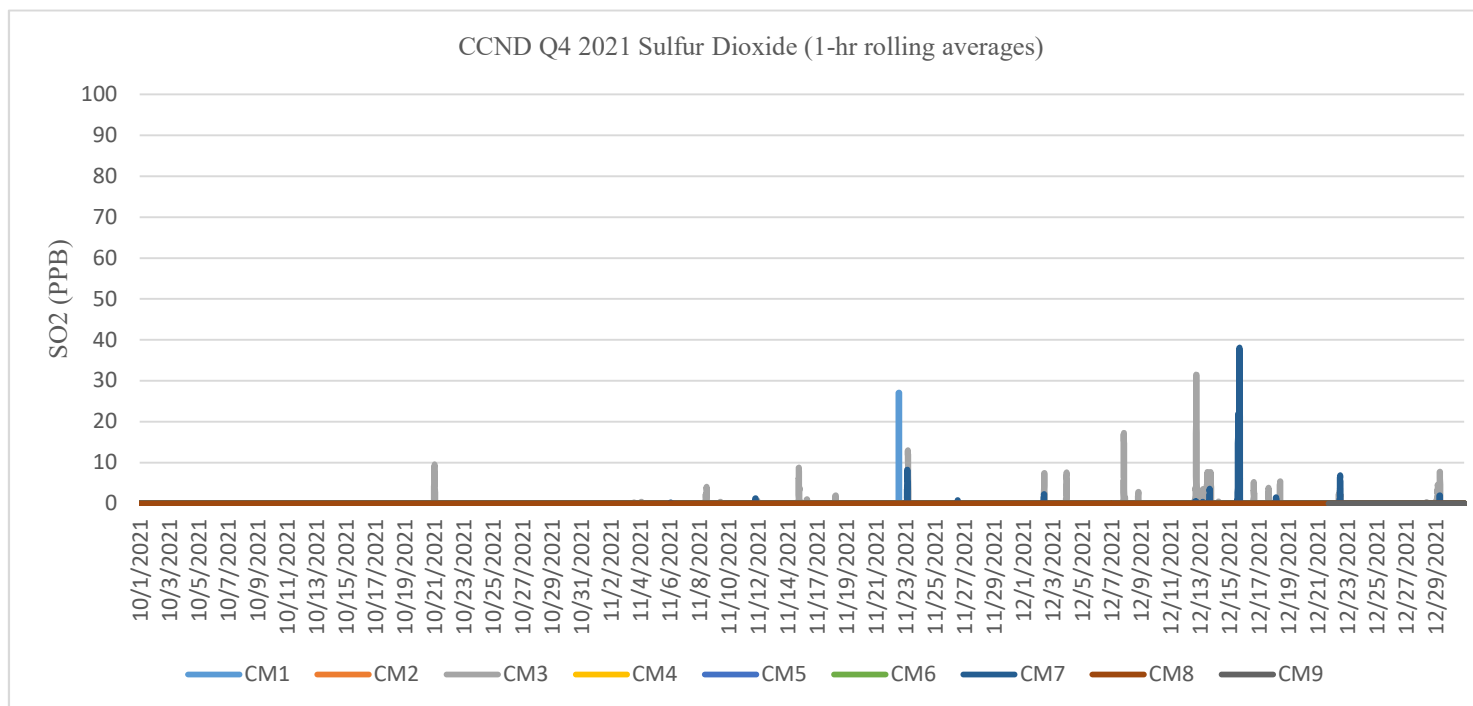
**FIGURE 1-3**  
**CCND COMMUNITY MONITORING NO DATA (1-HOUR ROLLING AVERAGES)**



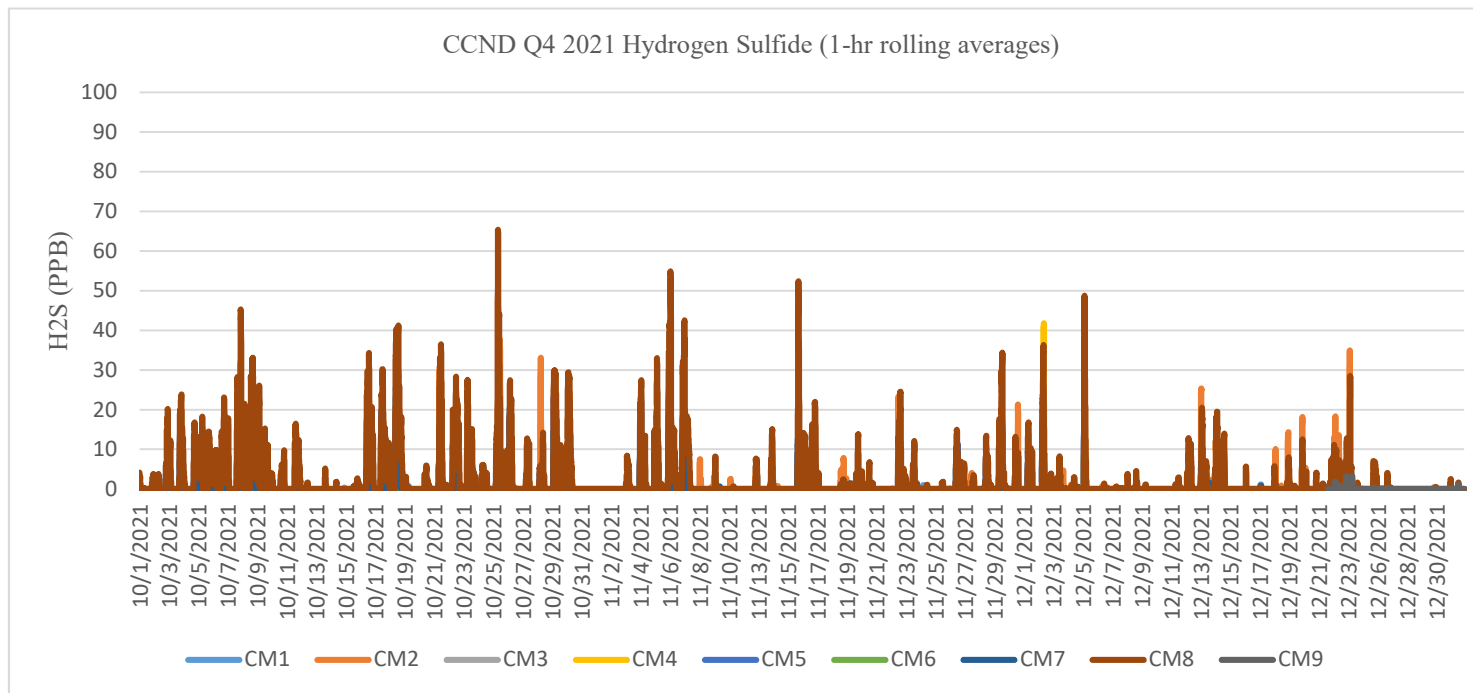
**FIGURE 1-4**  
**CCND COMMUNITY MONITORING NO<sub>2</sub> DATA (1-HOUR ROLLING AVERAGES)**



**FIGURE 1-5**  
**CCND COMMUNITY MONITORING SO<sub>2</sub> DATA (1-HOUR ROLLING AVERAGES)**

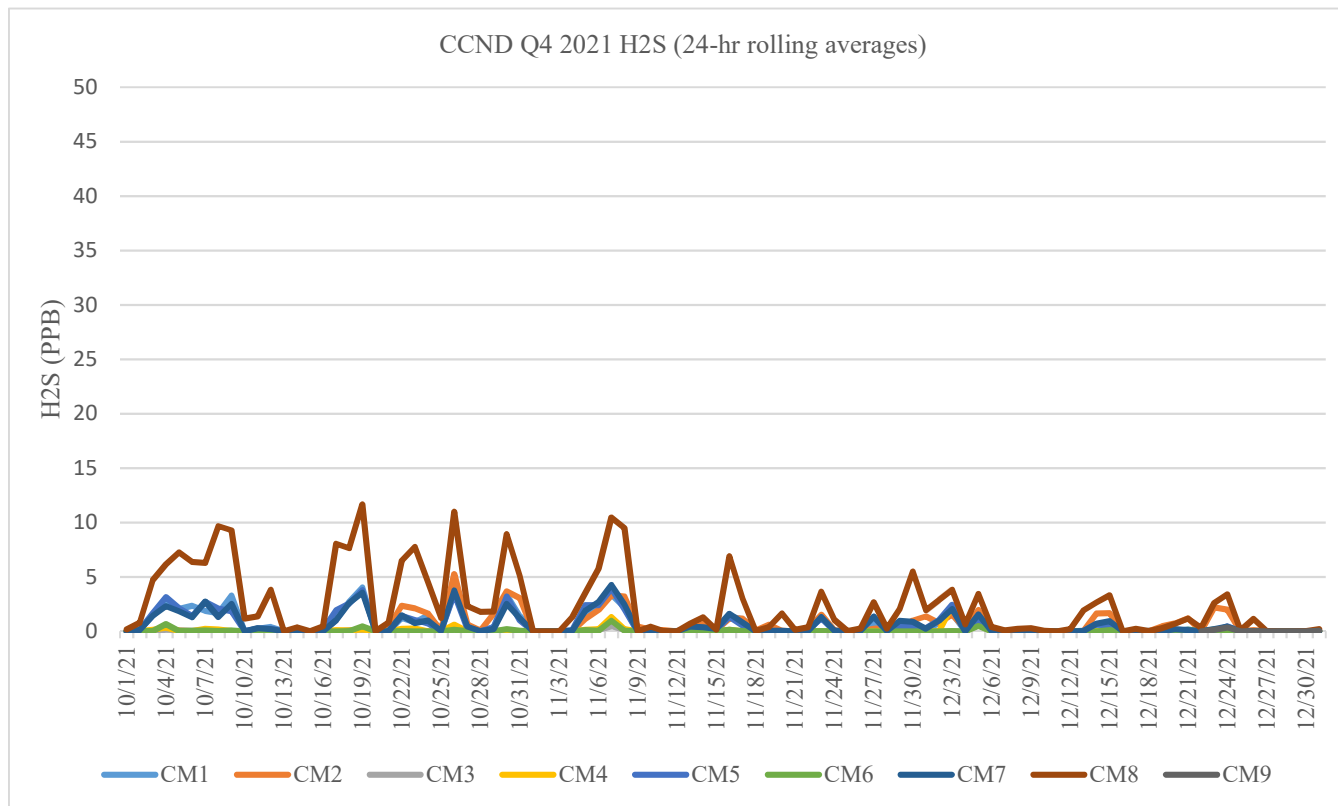


**FIGURE 1-6A**  
**CCND COMMUNITY MONITORING H<sub>2</sub>S DATA (1-HOUR ROLLING AVERAGES)**

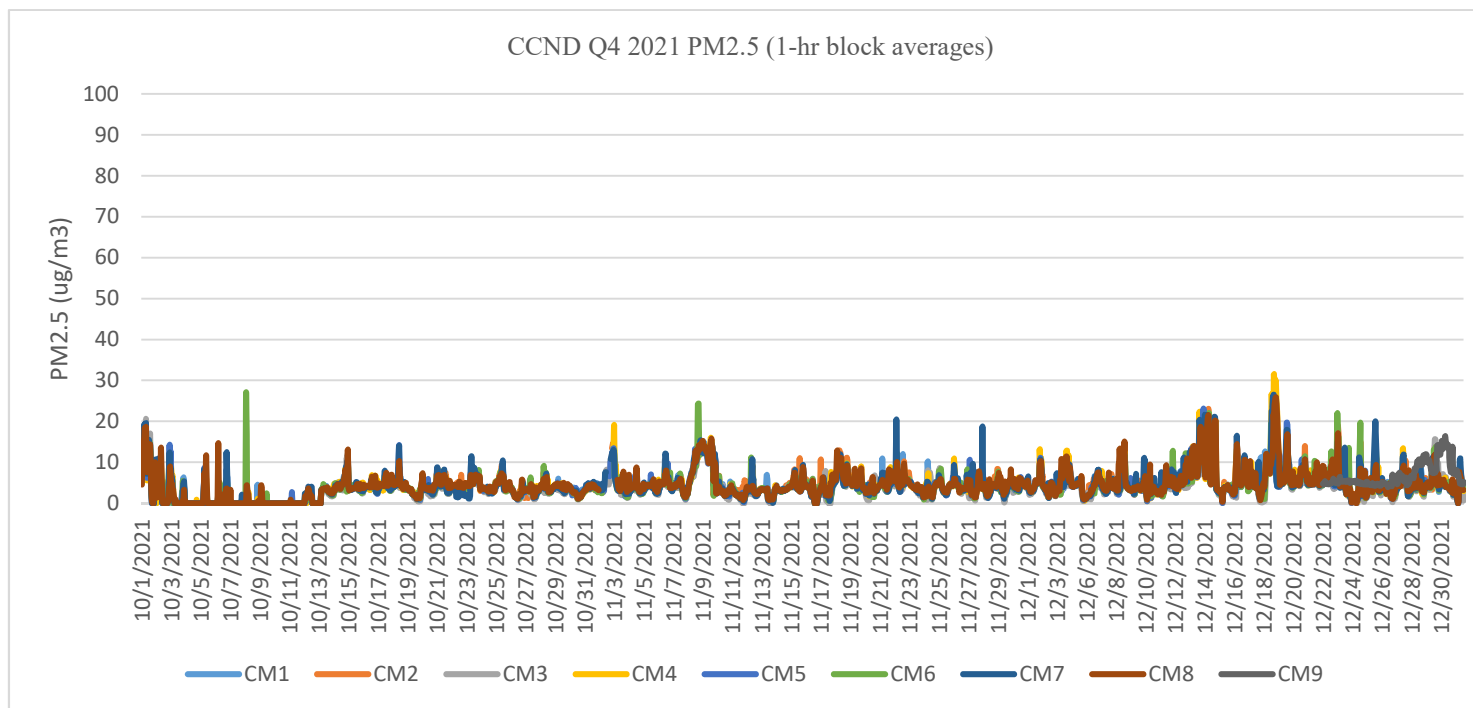




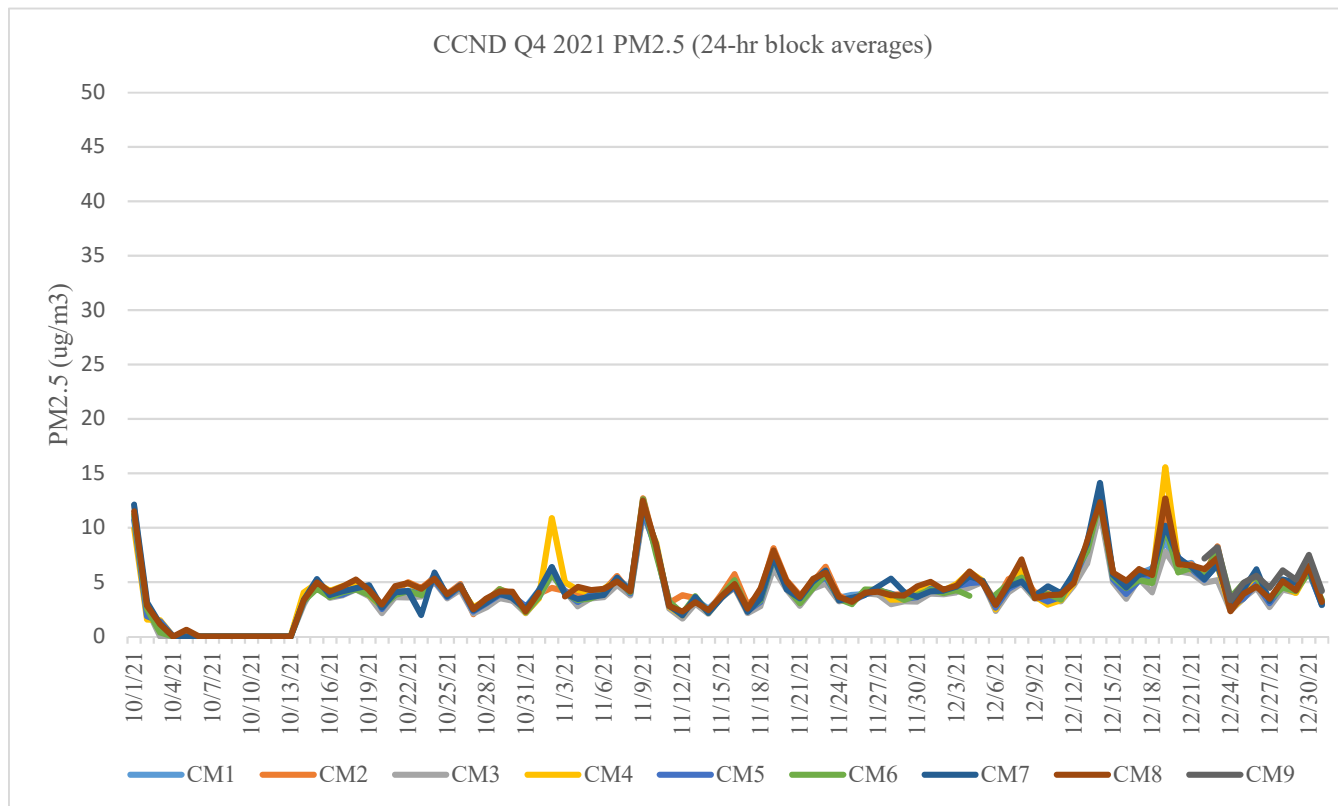
**FIGURE 1-6B**  
**CCND COMMUNITY MONITORING H<sub>2</sub>S DATA (24-HOUR ROLLING AVERAGES)**



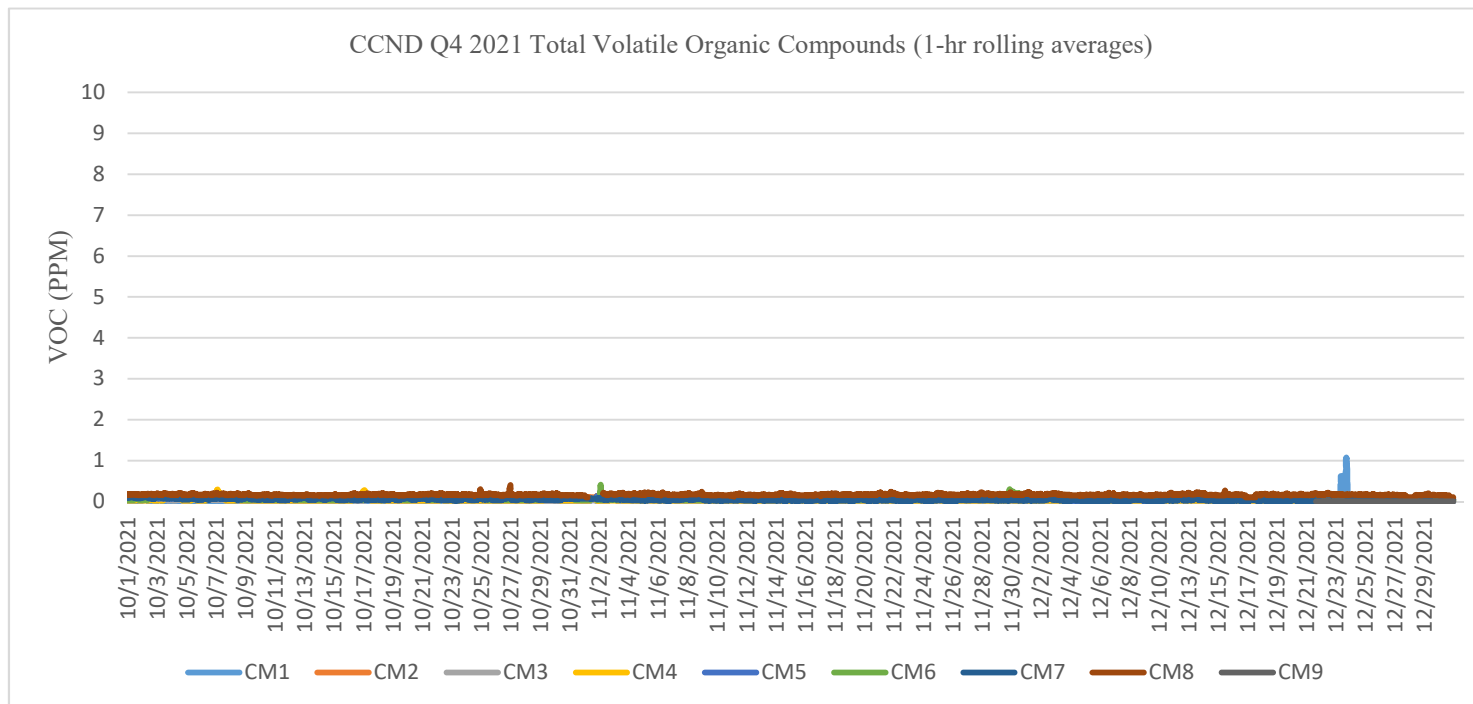
**FIGURE 1-7A**  
**CCND COMMUNITY MONITORING PM<sub>2.5</sub> DATA (1-HOUR BLOCK AVERAGES)**



**FIGURE 1-7B**  
**CCND COMMUNITY MONITORING PM<sub>2.5</sub> DATA (24-HOUR BLOCK AVERAGES)**



**FIGURE 1-8**  
**CCND COMMUNITY MONITORING VOC DATA (1-HOUR ROLLING AVERAGES)**



## 5.0 PROGRAM CHANGES

1. CM9 went online 12/22/21 and is now live on the ccnd-air.com website.
2. AQMesh provided a sensor software update during Q4, 2021 to improve data accuracy and help reduce instrumentation noise.
3. Various improvements to the ccnd-air.com website have been incorporated during Q4, 2021. These improvements were based on feedback received from the community.

Prepared by:



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Brendan Lawlor  
Project Manager - Emerging  
Technology  
Montrose Air Quality Services, LLC



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Michael Lumpkin, PhD, DABT  
Senior Toxicologist  
CTEH®, LLC

## **APPENDIX A CALIBRATION AND QA/QC DATA**

				Validation Results Table																	
				CO Error			NO Error			NO2 Error			SO2 Error			H2S Error			VOC Error		
AQMesh Monitor Serial Number	Lunar Outpost Monitor Serial Number	Community Monitor Location	Validation Date	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<25%)	Span (<25%)
2450728	Mon_Dutch_001	CM1	11/8/2021	2%	24%	47%	0%	33%	47%	0%	28%	48%	0%	45%	45%	0%	47%	46%	1%	18%	8%
2450728	Mon_Dutch_001	CM1	12/10/2021	1%	16%	34%	0%	39%	38%	0%	38%	38%	0%	45%	44%	0%	31%	21%	0%	16%	16%

				Validation Results Table																	
				CO Error			NO Error			NO2 Error			SO2 Error			H2S Error			VOC Error		
AQMesh Monitor Serial Number	Lunar Outpost Monitor Serial Number	Community Monitor Location	Validation Date	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<25%)	Span (<25%)
2450729	Mon_Dutch_002	CM2	11/9/2021	2%	27%	48%	0%	24%	36%	0%	20%	48%	0%	45%	43%	0%	46%	46%	6%	7%	6%
2450729	Mon_Dutch_002	CM2	1/5/2022	1%	13%	27%	0%	27%	24%	0%	10%	7%	0%	36%	47%	0%	18%	14%	5%	24%	15%



				Validation Results Table																	
				CO Error			NO Error			NO2 Error			SO2 Error			H2S Error			VOC Error		
AQMesh Monitor Serial Number	Lunar Outpost Monitor Serial Number	Community Monitor Location	Validation Date	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<25%)	Span (<25%)
2450730	Mon_Dutch_005	CM3	11/9/2021	2%	11%	49%	0%	33%	33%	1%	25%	37%	0%	45%	41%	0%	41%	47%	6%	6%	6%
2450730	Mon_Dutch_005	CM3	12/9/2021	1%	21%	2%	0%	24%	16%	0%	41%	44%	0%	40%	42%	0%	35%	22%	8%	20%	22%

				Validation Results Table																	
				CO Error			NO Error			NO2 Error			SO2 Error			H2S Error			VOC Error		
AQMesh Monitor Serial Number	Lunar Outpost Monitor Serial Number	Community Monitor Location	Validation Date	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<25%)	Span (<25%)
2450732	Mon_Dutch_006	CM4	11/10/2021	2%	19%	48%	0%	41%	27%	0%	42%	33%	0%	48%	43%	0%	44%	47%	6%	6%	7%
2450732	Mon_Dutch_006	CM4	12/15/2021	1%	27%	40%	0%	31%	14%	0%	27%	6%	0%	44%	44%	0%	43%	20%	0%	2%	8%

				Validation Results Table																	
				CO Error			NO Error			NO2 Error			SO2 Error			H2S Error			VOC Error		
AQMesh Monitor Serial Number	Lunar Outpost Monitor Serial Number	Community Monitor Location	Validation Date	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<25%)	Span (<25%)
2450733	Mon_Dutch_007	CM5	11/10/2021	2%	18%	47%	1%	25%	43%	0%	30%	40%	0%	45%	41%	0%	46%	46%	6%	7%	4%
2450733	Mon_Dutch_007	CM5	12/16/2021	2%	35%	41%	3%	43%	40%	0%	6%	9%	0%	49%	49%	0%	24%	15%	3%	2%	21%

				Validation Results Table																	
				CO Error			NO Error			NO2 Error			SO2 Error			H2S Error			VOC Error		
AQMesh Monitor Serial Number	Lunar Outpost Monitor Serial Number	Community Monitor Location	Validation Date	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<25%)	Span (<25%)
2450737	Mon_Dutch_009	CM6	11/11/2021	2%	19%	41%	0%	40%	39%	1%	36%	30%	0%	42%	43%	1%	44%	42%	8%	6%	1%
2450737	Mon_Dutch_009	CM6	12/6/2021	0%	21%	24%	0%	18%	34%	1%	30%	30%	0%	42%	42%	0%	34%	41%	5%	24%	3%

				Validation Results Table																	
				CO Error			NO Error			NO2 Error			SO2 Error			H2S Error			VOC Error		
AQMesh Monitor Serial Number	Lunar Outpost Monitor Serial Number	Community Monitor Location	Validation Date	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<25%)	Span (<25%)
2450735	Mon_Dutch_008	CM7	11/11/2021	2%	8%	48%	0%	29%	41%	0%	26%	46%	0%	41%	43%	0%	43%	43%	3%	10%	3%
2450735	Mon_Dutch_008	CM7	12/8/2021	3%	26%	1%	0%	28%	23%	0%	34%	31%	0%	38%	49%	0%	37%	20%	2%	10%	5%

				Validation Results Table																	
				CO Error			NO Error			NO2 Error			SO2 Error			H2S Error			VOC Error		
AQMesh Monitor Serial Number	Lunar Outpost Monitor Serial Number	Community Monitor Location	Validation Date	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<50%)	Span (<50%)	Zero (<10%)	Precision (<25%)	Span (<25%)
2450731	Mon_Dutch_010	CM8	11/12/2021	2%	26%	46%	0%	31%	35%	1%	25%	43%	0%	42%	46%	0%	40%	48%	3%	5%	1%
2450731	Mon_Dutch_010	CM8	12/7/2021	2%	27%	0%	0%	30%	36%	0%	0%	1%	0%	36%	21%	0%	17%	13%	8%	13%	16%

## **APPENDIX B FIELD DATA SHEETS**

AQM Serial Number	829	829	829
Community Monitor Location	2	2	2
Date	10/4/2021	11/1/2021	1/5/2022
Operator	AH	AH	BL

#### Gas Inlet

Gas Validation Checks (weekly) (Review Monthly)	Pass	Pass	Pass
Flow Rate (Quarterly)	NA	NA	Pass
Filter Change (Quarterly)	NA	NA	Pass
Field Calibration (Quarterly)	NA	NA	Pass

#### Particulate Monitor

Flow Rate (Quarterly)	NA	NA	Pass
Filter Change (Quarterly)	NA	NA	Pass
Check for Leaks (Quarterly)	NA	NA	Pass
Check Zero (Quarterly)	NA	NA	Pass
Check laser and detector (Quarterly)	NA	NA	Pass
Clean Cyclone (Quarterly)	NA	NA	Pass

Notes:



## **APPENDIX C**

# **CALIBRATION GAS CERTIFICATION SHEETS**



**GASCO AFFILIATES, LLC.**

320 Scarlet Blvd.  
Oldsmar, FL 34677  
(800) 910-0051  
fax: (866) 755-8920  
www.gascogas.com

## **CERTIFICATE OF ANALYSIS**

**Date:** June 8, 2021  
**Order Number:** 22039172  
**Lot Number:** 304-402132388-1

**Customer:** Cal Gas Direct Inc  
**Use Before:** 06/08/2022

<b><u>Component</u></b>	<b><u>Requested Concentration</u></b>	<b><u>Analytical Result (+/- 2%)</u></b>
Nitrogen Dioxide	100 PPM	99 PPM
Air	Balance	Balance

**Cylinder Size:** 2.0 Cu. Ft.  
**Contents:** 58 Liter

**Valve:** 5/8" -18UNF  
**Pressure:** 500 psig

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/ or N.I.S.T. Gas Mixture reference materials.

**Analyst:**

*Omar Reyes*  
Omar Reyes



**GASCO AFFILIATES, LLC.**

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Oldsmar, FL 34677  
(800) 910-0051  
fax: (866) 755-8920  
www.gascogas.com

## **CERTIFICATE OF ANALYSIS**

**Date:** June 8, 2021  
**Order Number:** 22039172  
**Lot Number:** 304-402132387-1

**Customer:** Cal Gas Direct Inc.

**Use Before:** 06/08/2022

<b><u>Component</u></b>	<b><u>Requested Concentration</u></b>	<b><u>Analytical Result (+/- 2%)</u></b>
Nitric Oxide	100 PPM	98 PPM
Nitrogen	Balance	Balance

**Cylinder Size:** 2.0 Cu. Ft.  
**Contents:** 58 Liter

**Valve:** 5/8" -18UNF  
**Pressure:** 500 psig

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

**Analyst:**

*Umar Reyes*

Umar Reyes



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fax: (866) 755-8920  
www.gascogas.com

## **CERTIFICATE OF ANALYSIS**

**Date:** June 8, 2021  
**Order Number:** 22039172  
**Lot Number:** 304-402132389-1

**Customer:** Cal Gas Direct Inc

**Use Before:** 06/08/2023

<u>Component</u>	<u>Requested Concentration</u>	<u>Analytical Result (+/-2%)</u>
Sulfur Dioxide	100 PPM	103 PPM
Air	Balance	Balance

**Cylinder Size:** 2.0 Cu. Ft.  
**Contents:** 58 Liter

**Valve:** 5/8" -18UNF  
**Pressure:** 500 psig

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

**Analyst:**

*Omar Reyes*

Omar Reyes



**GASCO AFFILIATES, LLC.**

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fax: (866) 755-8920  
www.gascogas.com

## **CERTIFICATE OF ANALYSIS**

**Date:** June 8, 2021  
**Order Number:** 22039172  
**Lot Number:** 304-402132385-1

**Customer:** Cal Gas Direct Inc  
**Use Before:** 06/08/2023

<b><u>Component</u></b>	<b><u>Requested Concentration</u></b>	<b><u>Analytical Result (+/- 2%)</u></b>
Hydrogen Sulfide	100 PPM	103 PPM
Air	Balance	Balance

**Cylinder Size:** 2.0 Cu. Ft.  
**Contents:** 58 Liter

**Valve:** 5/8" -18UNF  
**Pressure:** 500 psig

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

**Analyst:**

*Omar Reyes*

Omar Reyes



**GASCO AFFILIATES, LLC.**

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fax: (866) 755-8920  
www.gascogas.com

## **CERTIFICATE OF ANALYSIS**

**Date:** June 8, 2021  
**Order Number:** 22039172  
**Lot Number:** 304-402132384-1

**Customer:** Cal Gas Direct Inc  
**Use Before:** 06/08/2025

<u><b>Component</b></u>	<u><b>Requested Concentration</b></u>	<u><b>Analytical Result (+/- 2%)</b></u>
Carbon Monoxide	500 PPM	492 PPM
Air	Balance	Balance

**Cylinder Size:** 2.0 Cu. Ft.  
**Contents:** 58 Liter

**Valve:** 5/8" -18UNF  
**Pressure:** 500 psig

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/ or N.I.S.T. Gas Mixture reference materials.

**Analyst:**

*Omar Reyes*  
Omar Reyes



**GASCO AFFILIATES, LLC.**

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Oldsmar, FL 34677  
(800) 910-0051  
fax: (866) 755-8920  
www.gascogas.com

## **CERTIFICATE OF ANALYSIS**

**Date:** June 8, 2021  
**Order Number:** 22039172  
**Lot Number:** 304-402132386-1

**Customer:** Cal Gas Direct Inc

**Use Before:** 06/08/2025

<b><u>Component</u></b>	<b><u>Requested Concentration</u></b>	<b><u>Analytical Result (+/- 2%)</u></b>
Isobutylene	200 PPM	193 PPM
Air	Balance	Balance

**Cylinder Size:** 2.0 Cu. Ft.  
**Contents:** 58 Liter

**Valve:** 5/8" -18UNF  
**Pressure:** 500 psig

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

**Analyst:**

*Omar Reyes*

Omar Reyes



## CERTIFICATE OF ANALYSIS

Customer: AIRGAS USA, LLC  
PO Number: 4520349636  
Part Number: X02AI99CP58N009 / 58L-99-100  
Lot Number: 304-402274710-1  
Analysis Date: 11/05/2021

Cylinder Size: 2.0 Cu. Ft.  
Cylinder Volume: 58 Liter  
Cylinder Pressure: 500 psig  
Valve Outlet: 5/8"-18 UNF (C-10)  
Blend Tolerance: +/-5%

Use Before: 11/05/2023

### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
Hydrogen Sulfide	100 PPM	102.00 PPM	+/- 2 %
Air	Balance	Balance	

NIST Weight Certificate Number(s): L1114-1

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/ or N.I.S.T. Gas Mixture reference materials.

Analyst:

  
Glenn Velez



830  
Kear

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Part Number: E04NI99E80A0082 Reference Number: 153-402137965-1  
Cylinder Number: LL65270 Cylinder Volume: 83.5 CF  
Laboratory: 124 - Tooele (SAP) - UT Cylinder Pressure: 2216 PSIG  
PGVP Number: B72021 Valve Outlet: 660  
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	100.0 PPM	102.6 PPM	G1	+/- 1.1% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	100.0 PPM	102.5 PPM	G1	+/- 1.2% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	100.0 PPM	99.26 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	500.0 PPM	500.8 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061011	CC733024	98.61 PPM NITRIC OXIDE/NITROGEN	0.9%	Oct 06, 2026
PRM	12386	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	2.0%	Feb 20, 2020
GMIS	401648675102	CC500959	5.074 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Feb 01, 2023
NTRM	16010210	KAL003217	97.69 PPM SULFUR DIOXIDE/NITROGEN	0.8%	Dec 23, 2021
NTRM	16010223	KAL003822	97.69 PPM SULFUR DIOXIDE/NITROGEN	0.8%	Dec 23, 2021
NTRM	13010115	ND47957	495.4 PPM CARBON MONOXIDE/NITROGEN	0.6%	Jul 03, 2024

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 AUP2010228 CO MCO	FTIR	Jun 10, 2021
Nicolet iS50 AUP2010228 NO LNO	FTIR	Jun 10, 2021
Nicolet iS50 AUP2010228 NO2 impurity	FTIR NO2 impurity	Jun 10, 2021
Nicolet iS50 AUP2010228 SO2 MSO2	FTIR	Jun 16, 2021

Triad Data Available Upon Request



*[Signature]*  
Approved for Release

830  
Kear

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Customer: MONTROSE AIR QUALITY SERVICES  
Part Number: E02NI99E80A0614  
Cylinder Number: LL67806  
Laboratory: 124 - Pasadena (SG06) - TX  
PGVP Number: A32021  
Gas Code: H2S,BALN

Reference Number: 163-402136839-1  
Cylinder Volume: 83.4 CF  
Cylinder Pressure: 2215 PSIG  
Valve Outlet: 330  
Certification Date: Jun 29, 2021

Expiration Date: Jun 29, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
HYDROGEN SULFIDE	100.0 PPM	100.3 PPM	G1	+/- 1.8% NIST Traceable	06/22/2021, 06/29/2021
NITROGEN	Balance				

### CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010521	AAL073605	97.3 PPM HYDROGEN SULFIDE/NITROGEN	+/-1.2%	May 14, 2023
RGM	12345	CC157347	197.3 PPM HYDROGEN SULFIDE/NITROGEN	+/-0.5%	Nov 12, 2017
GMIS	124498495101	CC431119	201.9 PPM HYDROGEN SULFIDE/NITROGEN	+/-0.5%	Aug 21, 2022

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

### ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
AAI OMA-406H	NDUV	Jun 04, 2021

Triad Data Available Upon Request



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# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Part Number: E04NI99E80A0082  
Cylinder Number: LL47158  
Laboratory: 124 - Tooele (SAP) - UT  
PGVP Number: B72021  
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 153-402137965-1  
Cylinder Volume: 83.5 CF  
Cylinder Pressure: 2216 PSIG  
Valve Outlet: 660  
Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2029

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	100.0 PPM	102.9 PPM	G1	+/- 1.2% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	100.0 PPM	102.7 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	100.0 PPM	99.54 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	500.0 PPM	502.3 PPM	G1	+/- 0.8% NIST Traceable	06/14/2021
NITROGEN	Balance				

### CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061011	CC733024	98.61 PPM NITRIC OXIDE/NITROGEN	0.9%	Oct 06, 2026
PRM	12386	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	2.0%	Feb 20, 2020
GMIS	401648675102	CC500959	5.074 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Feb 01, 2023
NTRM	16010210	KAL003217	97.69 PPM SULFUR DIOXIDE/NITROGEN	0.8%	Dec 23, 2021
NTRM	16010223	KAL003822	97.69 PPM SULFUR DIOXIDE/NITROGEN	0.8%	Dec 23, 2021
NTRM	13010115	ND47957	495.4 PPM CARBON MONOXIDE/NITROGEN	0.6%	Jul 03, 2024

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

### ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 AUP2010228 CO MCO	FTIR	Jun 10, 2021
Nicolet iS50 AUP2010228 NO LNO	FTIR	Jun 10, 2021
Nicolet iS50 AUP2010228 NO2 impurity	FTIR NO2 impurity	Jun 10, 2021
Nicolet iS50 AUP2010228 SO2 MSO2	FTIR	Jun 16, 2021

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