Fenceline Monitoring Plan for HB 1189 Compliance
Goodrich Corporation
Wheels and Brakes, Carbon Operations
Pueblo, Colorado

Prepared For:

Goodrich Corporation
50 William White Blvd
Pueblo, CO 81001

Prepared By:

Montrose Air Quality Services, LLC
6270 Joyce Dr. Unit B,
Golden CO 80403

For Submission To:

Colorado Department of Public Health and Environment
4300 Cherry Creek S Dr.
Denver, Colorado 80246

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MONTROSE AIR QUALITY SERVICES

Review and Certification

I certify that, to the best of my knowledge, the information contained in this document is complete and accurate and conforms to the requirements of the Montrose Quality Management System.

Signature: **Date:** 6/30/2025

Name: Aikaterini (Katia) Liangou **Title:** Senior Project Manager

I have reviewed, technically and editorially, details and other appropriate written materials contained herein. I hereby certify that to the best of my knowledge the presented material is authentic and accurate and conforms to the requirements of the Montrose Quality Management System.

Signature: **Date:** 6/30/2025

Name: James Garrett **Title:** Operations Manager

Facility Certification

I have reviewed this document and agree that the information contained herein is true, accurate, and complete, to the best of my knowledge.

Signature: **Date:** 7/3/2025

Name: Matt Brandewie **Title:** Assoc. Dir of Operations

CDPHE Certification

I have reviewed this document and agree that the information contained herein is true, accurate, and complete, to the best of my knowledge.

Signature: **Date:** 8/19/2025

Name: Michael Ogletree **Title:** Director, Air Pollution Control Division

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1.0 Introduction

1.1 Summary of Monitoring Program

Goodrich Corporation (Goodrich) contracted Montrose Air Quality Services, LLC (Montrose) to install and operate a fenceline air monitoring program at the Goodrich facility located in Pueblo, Colorado. Montrose has created a monitoring plan to satisfy the requirements of House Bill (HB) 21-1189 and the monitoring plan guidelines provided by the Colorado Air Pollution Control Division (APCD). In accordance with these guidelines, this monitoring plan also will conform with the general project plan content requirements specified by the EPA.

HB21-1189 was signed into law on June 24, 2021 and requires covered facilities to conduct fenceline monitoring of three covered air toxics; benzene, hydrogen sulfide (H_2S)[1], and hydrogen cyanide (HCN). The monitoring must be conducted in near real time pursuant to a fenceline monitoring plan. The bill requires using optical remote sensing technology or other monitoring technology with the ability to provide real-time spatial and temporal data to understand the type and amount of emissions.

The specific objectives are to:

- Procure equipment and install a fenceline monitoring system to monitor for hydrogen cyanide, hydrogen sulfide, and benzene;
- Provide a public facing web site (in English and Spanish) to allow community members to see the Goodrich Pueblo facility's fenceline monitoring data, measured at a 5-minute resolution, in near real-time;
- Provide notifications to the public should pollutant concentrations exceed the thresholds defined in this monitoring plan;
- Perform quality assurance procedures on all monitoring equipment to ensure the collection of data that meets the objective of the program;
- Maintain all monitoring equipment to ensure the collection of data that meets the objective of the program;
- Provide periodic reports summarizing monitoring data and QA results and;
- Provide temporary backup measures to implement during equipment failures.

Montrose will provide the personnel and the necessary equipment to monitor potential emissions as outlined in this plan. Facility personnel will provide any required process or operational data to be included in the final reports. A summary of the monitoring program is presented in Table 1-1.

[1] Compound is not stored, produced or emitted by Goodrich.

Table 1-1. Summary of Test Program

Measurement Schedule	Activity/Parameters	EPA Test Method/Guidance
Continuous	Hydrogen sulfide[2], hydrogen cyanide	TO16
Continuous	Benzene	TO16
Continuous	Wind Speed	EPA-454/R-99-005
Continuous	Wind Direction	EPA-454/R-99-005
Continuous	Relative Humidity	EPA-454/R-99-005
Continuous	Barometric Pressure	EPA-454/R-99-005
Continuous	Temperature	EPA-454/R-99-005
Continuous	Oxygen (O2) and Ozone (O3)	Diagnostic

To simplify this monitoring plan, a list of Units and Abbreviations is included in Appendix B. Throughout this monitoring plan, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

1.2 Applicable Regulations and Notification Thresholds

Monitoring for Goodrich is set to begin on July 1, 2024.[3] HB21-1189 requires covered facilities to conduct real-time "fenceline" monitoring of their emissions of covered air toxics, one of which the Goodrich Pueblo facility neither stores nor emits, and release the data on a publicly accessible website. HB21-1189 also requires that a facility will communicate to the public via an emergency notification service following an exceedance of a notification threshold. HB21-1189 states that: "'Emergency notification service' has the meaning established in section 29-11-101(11). That statute subsection, in turn, provides:

> "Emergency notification service" means an informational service that, ***upon activation by a public agency***, rapidly notifies all telephone customers within a specified geographic area of hazardous conditions or emergent events that threaten their lives or property, including, without limitation, floods, fires, and hazardous materials incidents. (C.R.S. §29-11-101(11) (emphasis added)).

[2] Compound is not stored, produced or emitted by Goodrich.
[3] C.R. S. § 25-7-141(5)(a)(II).

Thus, the provisions of HB21-1189 that contemplate the use of an emergency notification service necessarily requires that covered facilities communicate to the applicable public agencies operating the emergency notification services in their locales.

The fenceline monitoring notification thresholds for the Goodrich Pueblo facility are presented in Table 1-2. These proposed thresholds are based on scientific research that is publicly available and peer-reviewed about the potential human health impacts of short-term exposures to pollutants and reflect EPA's Acute Exposure Guideline Levels.[4] See section 4.2 for a detailed discussion on the selection of the proposed fenceline notification threshold values.

Table 1-2. Target Compound Reporting Units and Emergency Notification Thresholds

Parameter	Reporting Units	Detection Limit	Alert Threshold
Hydrogen Sulfide[5]	ppm	<0.13 ppm[6]	0.36 ppm for a 60-minute exposure
Hydrogen Cyanide	ppm	<0.007 ppm[6]	1.3 ppm for a 60-minute exposure
Benzene	ppm	<0.003 ppm[7]	18 ppm for a 60-minute exposure

[4] C.R. S. § 25-7-141(5)(a)(III)(a)-(b).
[5] Compound is not stored or emitted by Goodrich.
[6] Based upon a 470-meter, monostatic system.
[7] Based upon a 455-meter, bistatic system.

1.3 Key Personnel

The personnel considered key to the successful operation of the monitoring program are listed in Figure 1-1. Figure 1-1 presents an organizational chart, including lines of responsibility and authority, for the monitoring program. The key project personnel will comprise the senior staff assigned to the project.

1.3.1 Organizational Chart

A list of project participants and an organizational chart is shown below:

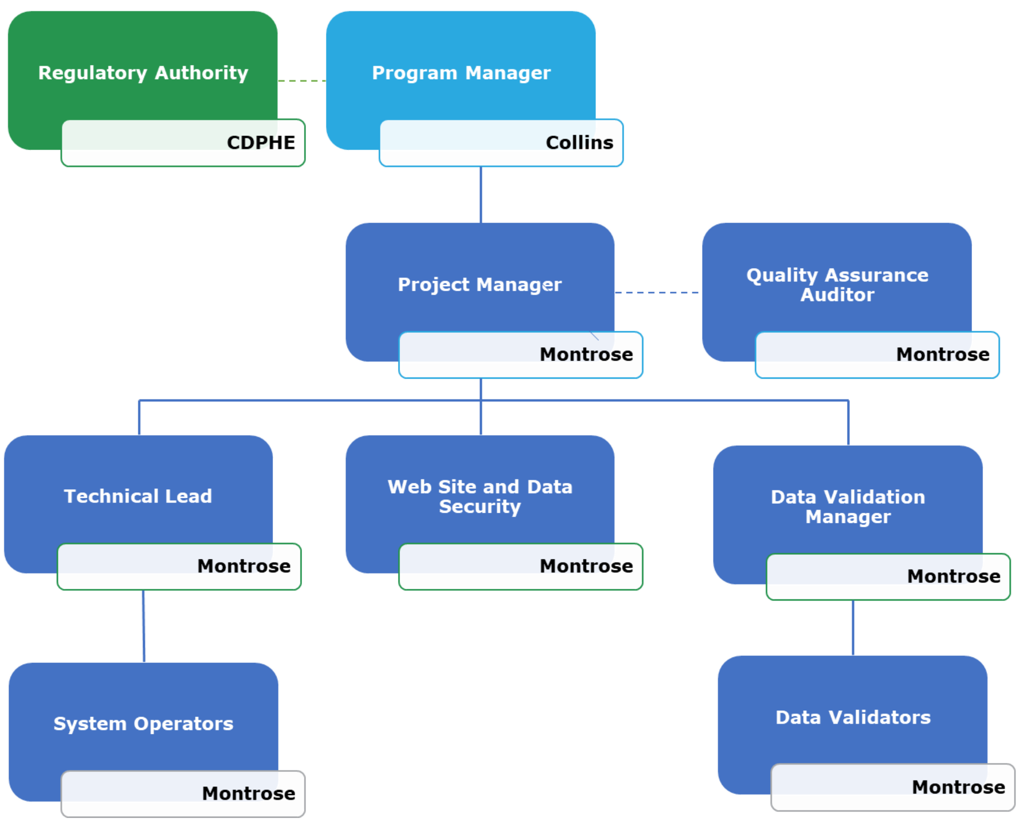


Figure 1-1. Key Personnel

1.3.2 Roles and Responsibilities

The Montrose management plan for the fenceline monitoring program is designed to satisfy all program requirements regarding quality and on-schedule performance. A brief description of each person's major responsibilities follows.

Project Manager: The specific responsibilities for the monitoring program will include:

- Directing, coordinating, and overseeing all project activities for the fenceline monitoring project;
- Preparation and submittal of the Monitoring Plan and Standard Operating Procedures (SOPs), ensure annual review of SOPs as required;
- Review performance of all project personnel with respect to established quality system work processes and goals. Provide/arrange for additional training for project personnel and staff as indicated;
- Ensure the availability of adequate resources for implanting and conducting the monitoring program in accordance with program goals and objectives;
- Mobilize personnel and equipment for the monitoring program, including acquisition of any standards or equipment needed for the monitoring program and ensure standards and equipment have current, documented, calibration and certification;
- Liaise with Goodrich regarding communications and information-sharing between project team members and stakeholders throughout the course of the project; and
- Provide administrative support for the project; and
- Develop and revise project schedules as-needed in consultation with Goodrich.

Technical Lead: The specific responsibilities for the monitoring program will include:

- Develop monitoring system engineering documentation and oversee monitoring system integration and initial factory acceptance testing;
- Oversee initial delivery, installation and commissioning of all monitoring instruments and equipment required for the project;
- Provide initial and on-going training for the locally-based monitoring system operators;
- Ensure appropriate stocks of spare parts and consumables are maintained in the network and replenished as necessary to ensure ready availability;
- Supervise and provide technical guidance and support to the local system operators on a routine and emergency basis to ensure all monitoring activities, investigative

and corrective actions are performed in accordance with the monitoring plan and SOPs; and

- Expedite emergency replacements parts and/or equipment delivery to the system operator on an as-needed basis.

Local System Operators: The system operator's specific responsibilities will include:

- Perform and document routine field operation, preventive maintenance, field calibrations, field QA/QC checks for the fenceline monitoring instruments;
- Receive, store and maintain shipments of supplies, parts and consumables for the monitoring program;
- Provide and maintain field documentation of all fenceline monitoring activities using designated forms and the site logbook;
- Maintain the overall integrity of the fenceline monitoring system and promptly report any problems or deficiencies to the Technical Lead or other senior project management staff as appropriate.

Data Validation Manager: The specific responsibilities for the monitoring program will include:

- Ensure the review and evaluation of the prior day's raw digital data each business day and notify appropriate program personnel for resolution of any problems;
- Receive and review all field documentation and project monitoring data submittals;
- Supervise and direct computer operations support for data processing and reporting functions;
- Ensure the proper reduction, processing, validation and reporting of all monitoring project data in accordance with the procedures outlined in the monitoring plan and SOPs; and
- Ensure a secure archival of all monitoring project data and documentation.

Quality Assurance Auditor The specific responsibilities will include:

- Supports monitoring plan and SOP development, periodic review and revision;
- Maintain audit standards and equipment;
- Ensure timely performance of periodic quality assurance audits on the analyzers and field measurement systems by trained and qualified personnel who are independent of day-to-day monitoring project operation, data collection, calibration and maintenance of the monitors; and

- Provide prompt transmittal of audit reports to the Montrose senior project manager. Audit reports will clearly indicate acceptable, marginally acceptable or unacceptable audit results so that corrective actions can be promptly initiated.

Web Site and Data Security Manager: The specific responsibilities for the monitoring program will include:

- Develops website with periodic review and revision;
- Develop and support automated QA functions;
- Support secure archival of all monitoring project data and documentation.

2.0 Facility Description and Safety

2.1 Facility Description, Operation, and Control Equipment

Goodrich operates an aircraft brakes manufacturing facility at 50 William White Blvd, Pueblo, CO 81001. The carbon brake manufacturing process is a series of seven operational steps: The textile of preforms, carbonization of preforms, chemical vapor deposition (CVD) of preforms, intermediate machining of preforms, an additional CVD cycle, final dimensional machining, and final assembly.

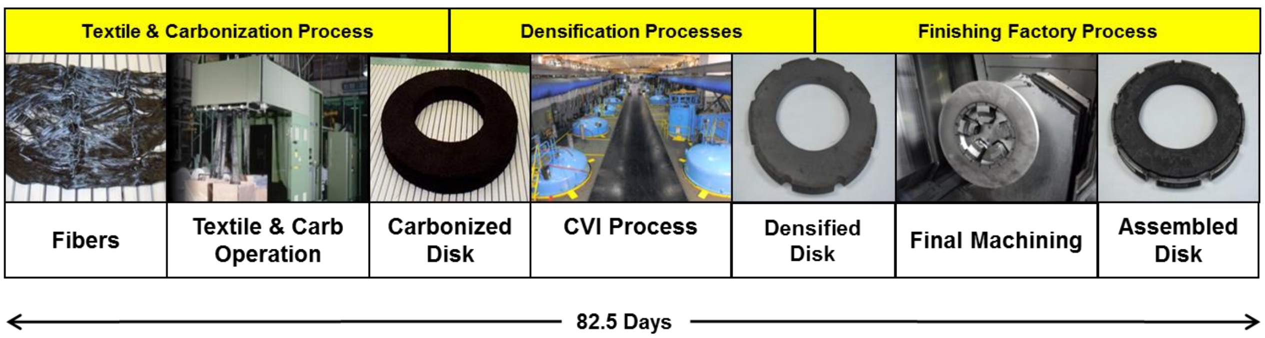


Figure 2-1. The Goodrich Carbon Brake Manufacturing Process

These specific processes can be more generally separated into four manufacturing areas; textile, furnace operations, machining, and finishing. The textile process transforms raw polyacrlyonitrile (PAN) fibers into a three-dimensional matrix or brake preform. Brake preforms are then batch processed in high-temperature, low-pressure reactors (furnaces). The two major processes completed are carbonization and densification. Carbonization converts the raw PAN preforms to a carbon fiber preform and removes impurities. The densification process cracks a feed hydrocarbon stream to infiltrate and sequester molecular carbon on the carbon fiber preform. The machining of preforms is completed at two stages; once in the middle of the densification and once following densification. After the final machining operations, the final assembly operations include application of an oxidation protection system and hardware installation. Additionally, the carbon brake manufacturing process requires extensive chemical process infrastructure including waste heat recovery, steam generation, cooling water systems, gas purification, and gas storage and delivery systems

The facility lies in a light industrial area approximately five miles east of downtown Pueblo. The predominant average wind direction in Pueblo is from the west. The nearest residential neighborhoods are two miles to the west and approximately 1.5 miles to the south. The closest sensitive receptors are Pueblo County High School 3.5 miles to the southeast, Baca Elementary 2.3 miles to the northwest and Pleasant View Middle School 2.4 miles to the southwest

A table of industrial sources in the vicinity of Goodrich is shown below (Table 2-1, Figure 2-2). The approximate property boundary of the Goodrich facility is shown in Figure 2-3.

Table 2-1. Other Industrial Facilities near Goodrich

Facility	Type of Facility	Location Relative to Goodrich
Pueblo Airport	Fuel Loading	0.5 miles to northeast
Sinclair	Gas Station	0.5 miles to southeast
Fuji Industrial Chemicals	Manufacturing Facility	0.5 miles to the west
Trane	Manufacturing Facility	0.25 miles to the north
City Wastewater Pump Station	City Wastewater Pump Station	0.1 miles to the south

Figure 2-2. Other Industrial Sources near the Goodrich Facility

Figure 2-3. Approximate Property Boundary of the Goodrich Facility

3.0 Monitoring Procedures

This section provides a summary of the fenceline air monitoring program that will be implemented to satisfy the requirements of HB21-1189. The monitoring system will be a permanent installation and provide continuous near real-time data for the three covered air toxics; benzene, hydrogen sulfide, and hydrogen cyanide. The monitoring program will use open path spectroscopy on path lengths along the Goodrich facility fenceline as described.

3.1 General

The parameters to be monitored, including the three target compounds, the two diagnostic compounds and meteorological variables, are listed in Table 3-1. The major components and features of the proposed fenceline air monitoring system are summarized in Table 3-2. Additional equipment specifications can be found in Appendix A.

Table 3-1. Target Compounds and Meteorological Parameters to be Monitored

Category	Parameters
Target compounds	Hydrogen Cyanide Hydrogen Sulfide Benzene
Meteorological parameters	Horizontal Wind Speed Vertical Wind Speed Wind Direction Temperature Relative Humidity Barometric Pressure
Diagnostic compounds	Ozone (O_3)[8] Oxygen (O_2)[9]

[8] Interferences with UVDOAS measurements
[9] Interferences with UVDOAS measurements

Table 3-2. Fenceline Air Monitoring System Equipment

Component	Make/Model	Quantity
Open-Path Measurement System		
Monostatic open-path TDLAS system	Unisearch LasIR TDL -OP	3
Monostatic open-path UVDOAS system	UV Sentry UVDOAS-OP	2
Bistatic open-path UVDOAS system	UV Sentry UVDOAS-OP	4
Alignment mechanism, Heavy Duty	UV Sentry PN282264	10
Fixed mount adapter	UV Sentry PN 88475	12
TDL Calibration materials	Unisearch Sealed LasIR™ Audit Module	NA
UVDOAS Calibration materials	GASCO gas cylinders	NA
27 Cube heated UV retroreflector array	UV Sentry PN 200812	2
45 Cube retroreflector array	Unisearch	6
Receiver open-path UVDOAS	UV Sentry UVDOAS-OP	4
12x12 Unit shelters	Kelly Klosure	6
Meteorological Tower System		
Wind speed	Met One 010C Cup Anemometer	1
Wind direction	Met One 020D Vane Sensor	1
Air temperature	Met One 065 Temperature Probe	
Relative humidity	Met One 083-E-0-35 RH Sensor	1
Barometric pressure	Met One 092 Barometric Pressure Sensor	1
Tower assembly	Universal Tower Model 35-30	1
Communications		
Cellular Modems	CISCO	3

3.2 System Description

The fenceline monitoring system will utilize three primary shelters to house the open path analyzers. Shelters 2 and 6 (Figure 3-1) will house one (1) monostatic open-path tunable diode laser (TDL) analyzer, one (1) monostatic open-path ultraviolet differential optical absorption (UV-DOAS) analyzer and one (1) bistatic open-path UV-DOAS receiver. Shelter 4 will house two (2) monostatic open-path TDL analyzers, and two (2) bistatic open-path UV-DOAS receivers.

Each open-path analyzer location will have multiple paths, where each path is measured continuously. At the end of each path there will be a retroreflector opposite the analyzer for the monostatic systems and a receiver opposite the analyzer for the bistatic systems. Each path ID consists of a number. Path numbers range from 1 to 6 (Figure 3-1, Table 3-3). Based on the path length some paths used monostatic and some paths used bistatic UV-DOAS. Table 3-3 shows the type of system used in each path. The specific locations for all open path equipment were selected in order to provide coverage of all facility emission sources within the constraints of the facility footprint.

This monitoring program also includes meteorological monitoring as required in HB21-1189. Meteorological monitoring is necessary to characterize wind patterns for understanding movement of the three target compounds and potential sources of emissions, whether they originate from the site or a neighboring facility. A meteorological tower will be installed near Shelter 6 (Figure 3-1) so that power can be shared.

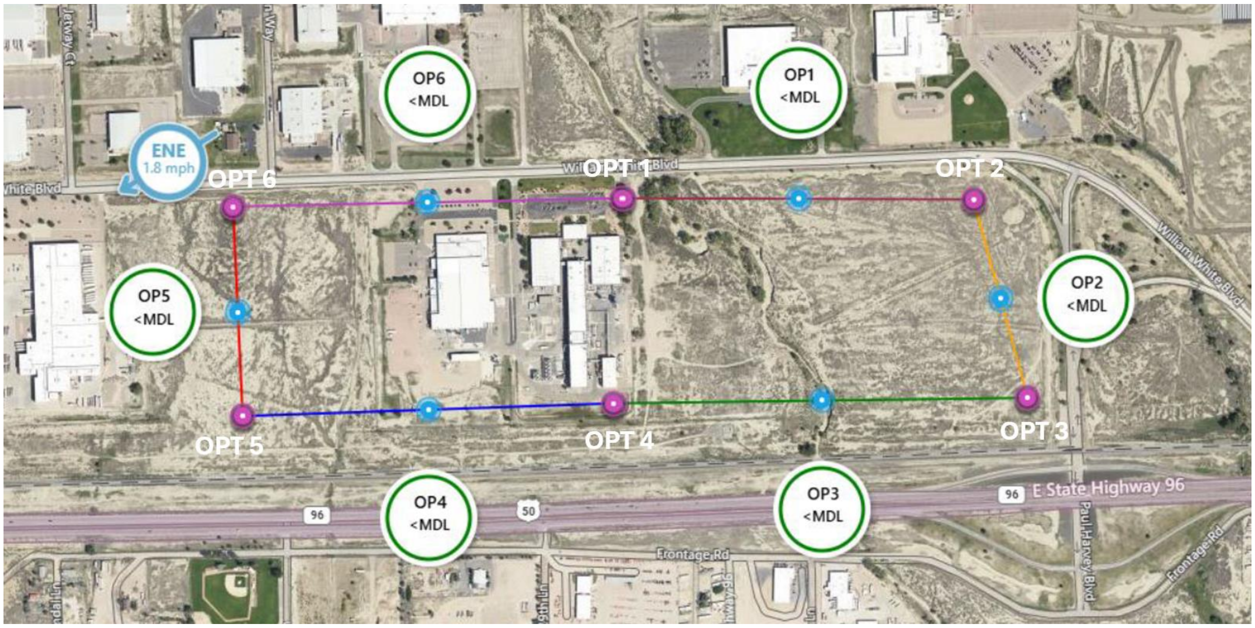


Figure 3-1. Approximate Layout of the Open-Path Analyzers, Retroreflector Locations, Receiver Locations and Meteorological Station.

Table 3-3. Individual Path Information

Path	Path Length	Compounds	Comments
1	558 meters	Hydrogen sulfide Hydrogen cyanide Benzene	UV-DOAS Bistatic and TDL Monostatic
2	283 meters	Hydrogen sulfide Hydrogen cyanide Benzene	UV-DOAS Monostatic and TDL Monostatic
3	613 meters	Hydrogen sulfide Hydrogen cyanide Benzene	UV-DOAS Bistatic and TDL Monostatic

4	566 meters	Hydrogen sulfide Hydrogen cyanide Benzene	UV-DOAS Bistatic and TDL Monostatic
5	297 meters	Hydrogen sulfide Hydrogen cyanide Benzene	UV-DOAS Monostatic and TDL Monostatic
6	569 meters	Hydrogen sulfide Hydrogen cyanide Benzene	UV-DOAS Bistatic and TDL Monostatic

3.3 Open Path Monitoring

The fenceline air monitoring system will include both open-path tunable diode laser spectrometers (TDLAS), and open-path ultra violet Doppler optical absorption spectrometers (UVDOAS). Open-path monitors operate by projecting a beam light through open air to retroreflectors that reflect the light back to the monitor where spectral absorption characteristics are measured. As the light travels along the path length a certain amount of this light will be absorbed by the various chemical species present in the air. Because all gasses absorb light differently according to their own unique spectral characteristics, it is possible to use measurements of absorption intensity at specific wavelengths as a proxy for measuring a target gasses concentration in the air. This is possible through a relationship known as the Beer-Lambert Law (Equation 1). Beer's Law describes the simple linear relationship between absorption intensity and concentration along a fixed path length.

Equation 1:

$$\boldsymbol{A} = \mathcal{E}\boldsymbol{lC}$$

Where:

A	=	absorption intensity
$\mathcal{E}$	=	absorptivity
l	=	path length
C	=	concentration

Therefore, along a known path length, an absorption measurement taken at the appropriate wavelength for the target molecule can easily be used to solve for its average concentration over the length of the beam.

The Goodrich open-path system will consist of both monostatic and bi-static systems at the locations shown in Figure 3-1 and outlined in Table 3-3. The monostatic systems operate by the light being transmitted to a retroreflector and back to a detector co-located with the transmitter. The bi-static system operates by transmitting light from one end of the path to a detector at the other end of the path. The analyzer software will provide five-minute averaged concentration measurements for each path.

Figure 3-2. Simple Open Path Monitoring System Diagram

3.3.1 Benzene

For the monitoring of benzene, Montrose will utilize Open Path (OP) Ultra Violet Differential Optical Absorption Spectroscopy (UVDOAS). This technology quantifies concentrations of gaseous compounds by measuring the absorption of ultraviolet light by chemical compounds in the air and applying the Beer-Lambert law. UVDOAS typically uses unique absorptions of specific wave lengths of ultraviolet light in a wavelength range of 245 to 380 nanometers (nm). Benzene peaks are found close to the 253 nm wavelength.

Open path UVDOAS instrumentation consists of a light source, transmitting and receiving optics (telescopes), a spectrometer, a reflector, a detector, and a data processing computer. A Xenon light source provides light, which is focused in a collimated beam before it is sent through a transmitting telescope and into the measurement path. A receiving telescope collects the light and directs it to the spectrometer which diffracts the light onto the detector. The detector is typically a solid-state array such as a charge-coupled device (CCD). This allows the detector to collect light of different wavelengths without moving parts. The spectra bands can be extracted from the spectrum and compared to reference spectra to determine which compounds were present along the path and at what concentrations.

Montrose has chosen the UV Sentry Open Path Multi-Gas Analyzer manufactured by Cerex Monitoring Solutions, LLC for the monitoring of benzene (Figure 3-3). The UV Sentry uses no moving parts to wear out, does not fail or require calibration, which keeps consumables and maintenance to a minimum. The UV Sentry has an on-board computer and saves raw spectral data independent of calibration. These spectra may be used at any time to verify real time measurements. Additionally, the UV Sentry records signal intensity and minimum detection limits for benzene in real time as data quality indicators. Real time MDL output supports both ASTM and USEPA methods. The UV Sentry also has a flow through calibration cell to allow for regular QA audits and bump tests.

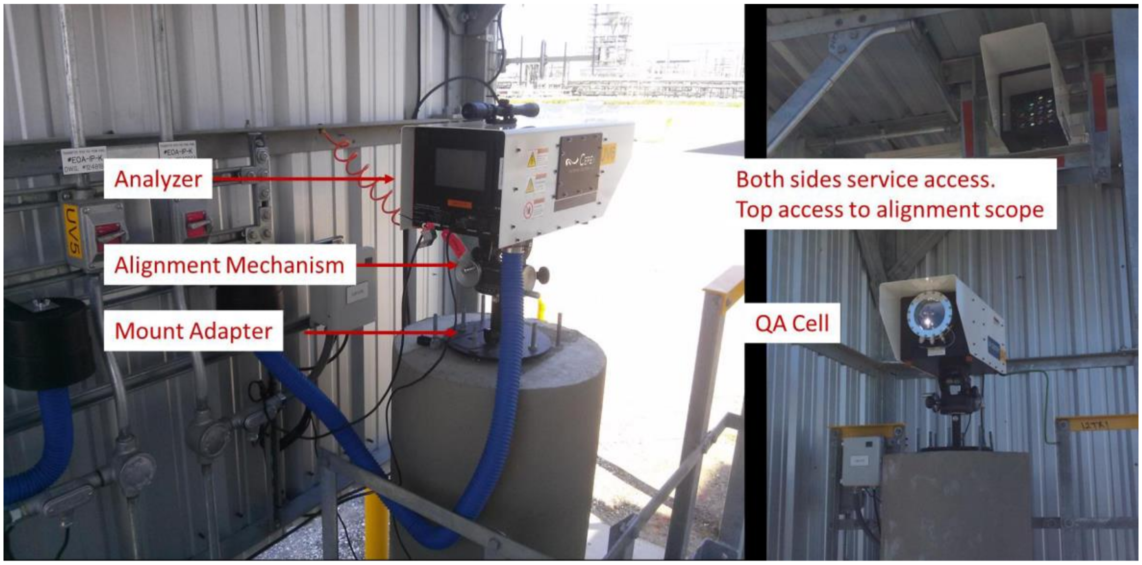


Figure 3-3. UV Sentry Open Path Multi Gas Analyzer

3.3.2 Hydrogen Sulfide and Hydrogen Cyanide

For the monitoring of Hydrogen Sulfide and Hydrogen Cyanide, Montrose will utilize Open Path (OP) Tunable Diode Laser Absorption Spectroscopy (TDLAS). OP-TDLAS offers some significant operational and cost advantages over other measurement technologies such as Fourier Transform Infrared Spectroscopy (FTIR). Tunable diode lasers (TDL) are designed to focus on single absorption wavelengths specific to a compound of concern in the gaseous form. They are capable of achieving low detection limits and are generally interferent-free. Similar to UVDOAS, quantitative measurements in direct gas phase laser absorption spectroscopy are based on Beer-Lambert law. A TDL uses a diode to generate light within a narrow frequency range that contains a relatively unique absorption wavelength of the chemical of interest. The laser frequency is "tuned" by changing the temperature of the diode or the current being fed to the diode or both so that it matches the spectral absorption line of interest.

Similar to the UVDOAS system, the OP-TDL system will consist of a light source, a spectrometer, a reflector, a photodiode detector, and a data processing computer. Monostatic (as opposed to bistatic) open path instruments have once again been selected to reduce the need for substantial power at the retroreflector sites, and improve detection limits by increasing effective path lengths.

Montrose has chosen the LasIR™ Fence Line Monitoring Gas Analyzer manufactured by Unisearch Associates Inc. for the monitoring of Hydrogen Sulfide (a compound that the

Goodrich Pueblo facility neither stores nor emits) and Hydrogen Cyanide. The LasIR™ allows one laser to send beams at two different wavelengths down each path length (one for each compound). Additionally, the beam can be split allowing it to monitor two path lengths with one laser. The controller uses a near infrared (NIR) Tunable Diode Laser Absorption Spectrometer System utilizing a single mode laser mounted in a thermoelectric cooler. A Windows based software package displays the data on a host laptop PC. The LasIR™ also has a flow through calibration cell to allow for regular QA audits and bump tests.

3.3.3 Limits of Detection

The Minimum Detection Limit is the minimum concentration of a compound that can be detected by an instrument with a given statistical probability. Usually, the detection limit is given as three (3) times the standard deviation of the noise in the system. In this case, the minimum concentration can be detected with a probability of 99.7%.

The detection limit of the open path systems is a dynamic quantity that will change as the atmospheric conditions change. The variability of the target gas, water vapor, and all of the other interfering species' concentrations can contribute to the variability of this measurement. The detection limit as determined is the result of a calculation using a set of 15 absorption spectra. 16 individual single beam spectra used for this determination are acquired in 5-min intervals and no time is allowed to elapse between them. The absorption spectra are then created by using the first and the second single beam spectra, the second and the third, and the third and the fourth, and so on until the 15 absorption spectra are obtained. These absorption spectra are analyzed in exactly the same way that all field spectra are to be analyzed and over the same wave number region.

The analysis will result in a set of numbers that are very close to zero because most of the effects of the gas variability have been removed. The numerical results will be both positive and negative and for a very large set of data should average to zero. Three times the standard deviation of this calculated set of concentrations is defined to be the detection limit. The specific procedure is as follows:

- Acquire a set of 16 single beam spectra in exactly the same manner that will be used for the field spectra
- Use the first spectrum as a background to create an absorbance spectrum from the second spectrum
- Use the second spectrum as the background and create an absorbance spectrum from the third spectrum
- Continue this process until all 15 absorbance spectra have been created
- Analyze each of the spectra for the target gas concentration

- Calculate the standard deviation of the set of concentration values
- Multiply the result of by three (3) to obtain the detection limit

The open-path monitor specifications conform to the general analyzer requirements indicated in EPA Method TO-16. Detailed equipment specifications are provided in Appendix A of this monitoring plan. The open-path analyzers will include a reference gas cell that can be placed in the beam path during quality assurance activities. This enables periodic quality assurance checks using reference gas mixtures containing known concentrations of a reference gas. Information on the frequency of QA checks on open-path instruments is also discussed in section 5.2. A minimum detection limit of at least 25% of the AEGL-1 4-hour values will be maintained for all systems, except for H_2S Paths 2 and 5 where detection limit should be 50% of the AEGL-1 4-hour values.

Table 3-4. Approximate Detection Levels for Open-path Monitors

Parameter	Manufacturer	Model	Reporting units	Approximate lower detection level (ppm)
Hydrogen sulfide[10]	Unisearch	LasIR	ppm	<0.13 ppm[11]
Hydrogen cyanide			ppm	<0.007 ppm[12]
Benzene	Cerex	UV Sentry	ppm	<0.003 ppm[12]

3.4 Meteorological Monitoring

The meteorological instrumentation will be installed on a heavy-duty aluminum tower. The 3-sided, open latticework tower is fabricated using a high-strength aluminum alloy in three, ten-foot sections and is engineered for the specified wind load per EIA RS-222G. The tower will not twist, rotate or sway, providing a rigid platform for mounting the sensors. It features hinged base leg brackets that permit the tower to be pivoted down into a horizontal position for easy servicing of the sensors. The tower will incorporate a lightning rod with a full height ground cable and ground rod.

[10] Compound is neither stored nor emitted by Goodrich.
[11] Based upon a 470-meter, monostatic system.
[12] Based upon a 455-meter, bistatic system.

The meteorological monitoring tower is located at the west end of the Goodrich property as shown in Figure 3-1. This tower will be outfitted with high quality meteorological instruments capable of making accurate near-real time measurements continuously. All sensors will be connected to a datalogger which will store the data, as well as broadcast it out to a cellular modem so that data can be viewed or downloaded at any time, from anywhere. The specific meteorological instruments chosen all meet EPA specifications for accuracy, range and resolution (Table 3-5) and have been deemed appropriate for use in the fenceline monitoring system. Data from these sensors will be used to calculate 1-hour rolling averages updated every five minutes.

Table 3-5. Performance Specifications for Installed Meteorological Sensors

Parameter	Sensor Make and Model	Reporting Units	Accuracy	Range
Horizontal wind speed	Met One 010C	Meters per second (m/s)	± 0.1	0 - 55
Horizontal wind direction	Met One 020D	Degrees (°)	± 3	0 to 360
Temperature	Met One 065	Degrees Celsius (°C)	± 0.15	-30 to 50
Relative Humidity	Met One 083-E-0-35	Percent (%)	± 2.0	0 to 100
Barometric Pressure	Met One 092	Millibars (mb)	± 0.35	600 to 1100

4.0 Public Website

4.1 Website and Community Interface

The purpose of the public facing website described in HB21-1189 is to disseminate to the public the current and historical air compound concentrations for benzene, hydrogen sulfide, and hydrogen cyanide, along the Goodrich Pueblo facility fenceline. The Montrose AirSense platform and public website are designed to monitor fenceline and meteorological data on a continuous basis. AirSense will also automatically flag erroneous or suspect measurements so that Montrose personnel can be made aware of, and address, any monitoring equipment issues quickly and effectively. The website will display one-hour rolling average data, measured at a 5-minute resolution.

4.1.1 Raw Data

The AirSense data platform does not allow for raw data to be edited or modified. Montrose project personnel can tag and invalidate data but not directly edit the raw data. The AirSense site gives users no direct access to the raw database. There may be times when data is corrected after the fact which will be noted in the summary reports. For a complete list of data qualifier codes and explanations see Table 4-1. For the program staff at Goodrich and Montrose, Air Sense's dashboard provides a summary of the operational status of the network. Montrose will have access to additional features that others may not, such as instrument settings, calibration and data correction features, and data invalidation. API data access will be provided to APCD for the same data streams that are made available to the public through this website.

When calibrating instruments, the data is saved to a new data point leaving both the raw and processed data points unmodified. All calibration or scaling adjustments are logged and date/time-stamped to identify when settings have changed. Even if changes are made, no actual data is modified. These settings allow for scaling and truncating, but the data is never directly modified, they are for viewing and alerting purposes only. All monitoring data is delivered to AirSense via cellular communication.

The instruments also have local data storage so in the event of a cell tower going down, all data collected during that time period can be recovered. All records and documents pertinent to the fenceline monitoring program, including raw spectral data, will be stored on back-up computer servers and backed up onto offsite disk storage for a period of five (5) years.

Table 4-1. Data qualifiers for fenceline air monitoring data

Flag	Flag Explanation ***(additional information added in parentheses)**	Type or Related Action
AB	Technician Unavailable. **(use if this affects scheduled QA/QC or*	Null Data Qualifier

	necessary maintenance)	
AD	Shelter Storm Damage.	Null Data Qualifier
AG	Sample Time out of Limits. **(e.g., use if integration time is out of manufacturer recommended range and signal intensity and MDL cannot meet the critical criteria mentioned in the FLMP)*	Null Data Qualifier
AI	Insufficient Data. (cannot calculate)	Null Data Qualifier
AL	Voided by Operator. **(e.g., Datum rejected by data validators)*	Null Data Qualifier
AM	Miscellaneous Void.	Null Data Qualifier
AN	Machine Malfunction **(can be used for issues such as an instrument being out of alignment, or an analyzer being offline due to connection problems or instrument failure)*	Null Data Qualifier
AO	Bad Weather. **(Use if weather impacts open-path instrument operation/function)*	Null Data Qualifier
AP	Vandalism. **(Use if vandalism impacts open-path instrument operation/function)*	Null Data Qualifier
AQ	Collection Error. **(use specifically for low analyzer signal events, or when a low analyzer signal prevents the reported data from meeting the critical criteria, while the calculated MDL is lower than the desired value)*	Null Data Qualifier
AT	Calibration.	Null Data Qualifier
AU	Monitoring Waived.	Null Data Qualifier
AV	Power Failure.	Null Data Qualifier
AW	Wildlife Damage. **(Use if damage impacts open-path instrument operation/function)*	Null Data Qualifier
AX	Precision Check.	Null Data Qualifier
AY	QC Control Points (zero/span).	Null Data Qualifier
AZ	QC Audit.	Null Data Qualifier
BA	Maintenance/Routine Repairs.	Null Data Qualifier
BD	Auto Calibration.	Null Data Qualifier
BH	Interference/co-elution/misidentification.	Null Data Qualifier
BJ	Operator Error.	Null Data Qualifier
BK	Site computer/data logger down.	Null Data Qualifier
BL	QA Audit.	Null Data Qualifier
BM	Accuracy check.	Null Data Qualifier
DA	Aberrant Data (Corrupt Files, Spikes, Shifts).	Null Data Qualifier
DL	Detection Limit Analyses.	Null Data Qualifier
EC	Exceeds Critical Criteria. **(use when data exceeds critical criteria, such as for MDL)*	Null Data Qualifier
IA	African Dust. **(use for any dust event)*	Informational

IT	Wildfire-U.S. *(use for any wildfire event)*	Informational
J	Construction/Repairs in Area.	Informational
LJ	Identification of Analyte Is Acceptable; Reported Value Is An Estimate.	Quality Assurance Qualifier
MD	Value less than MDL.	Quality Assurance Qualifier
NS	Influenced by nearby sources. *(e.g., in the event of emissions influenced by nearby sources)*	Quality Assurance Qualifier
QP	Pressure Sensor Questionable. *(e.g., use if cell pressure is out of range, indicating malfunction)*	Quality Assurance Qualifier
QT	Temperature Sensor Questionable. *(e.g., use if cell temperature is out of range, indicating malfunction)*	Quality Assurance Qualifier
QV	Quality Control Multi-point Verification.	Null Data Qualifier
QX	Does not meet QC criteria. *(e.g., data exceeds automatic criteria for rejection)*	Quality Assurance Qualifier
SC	Sampler Contamination.	Null Data Qualifier
ST	Calibration Verification Standard.	Null Data Qualifier
TC	Component Check & Retention Time Standard. *(use this code for additional instrument checks, e.g., a robustness tests)*	Null Data Qualifier

4.1.2 Website Description

All air monitoring equipment specified for the Goodrich Pueblo facility fenceline system will collect data on five-minute averages and be transmitted to an Internet website where the one-hour rolling averages can be viewed by the public. The website will be public facing, and users will be able to view the one-hour averages of all of the open path monitors and meteorological conditions in near real-time. Users will also be able to view historical data for a user defined time period, monitor, and/or parameters of their choosing.

The public facing site will be available in Spanish and English. The typical features of a public web site and an example dashboard are as follows:

- Near real time data displays, measured at a 5-minute resolution, in graphical form;
- Near real time data displays, measured at a 5-minute resolution, overlaid on a map;
- Data reported below detection limits is to be reported as less than detection limits or NaN, not zero. To calculate the data averages, the Limit of Detection (LOD)/$\sqrt{2}$ will be used for all values that are below detection limit;
- Ability to view data in graphical formats with notification thresholds indicated on the graphs;
- Public access to historical fenceline monitoring data since inception for all compounds (covered and diagnostic) and meteorological parameters, available for download at one-hour rolling averages updated every five-minutes for a user-defined time frame. The download functionality will be accomplished either a .txt, .xls tabular data file, associated with a given quarterly report, which will be posted at the same time the quarterly reports are posted to the Document Library;
- Description of monitoring techniques and pollutants;
- Contain pollutant information and their possible health effects as specified by the federal centers for disease control and prevention;
- Hyperlinks to related information;
- Two years of records of communications made through an emergency notification service, as defined by C.R.S. § 29-11-101 (11); and
- Document library including the monitoring plan, quarterly reports and quarterly data packets (see section 5.5.3).

Figure 4-1. Screenshot of the Public Website

4.1.3 Public Education and Feedback

The monitoring program and data to be collected are technically complex. Information will be written at a public-friendly level with hyperlinks to additional resources for members of the public who would like more detailed information. To provide context for the public, the following information will be included:

- Information about the pollutants measured and the measurement technology;
- Context of what fenceline measurements represent as compared to other local or regional air quality measurements;
- Discussion of levels of concern as well as links to third-party sources such as the EPA Acute Exposure Guideline Levels (AEGLs);
- Discussion of local sources other than the Goodrich Pueblo facility that could affect the measured concentrations;
- Definitions of abbreviations used;
- Discussion of data below MDL and;
- Definition of data quality flags and whether it justifies invalidating the data point.

4.2 Fenceline Monitoring Notification Thresholds

HB21-1189 requires that the Division establish notification thresholds for each covered air toxic.[13]

4.2.1 Regulatory and Scientific Evidence Supporting Target Compound Notification Thresholds

HB21-1189 specifies the criteria for developing the emergency notification thresholds that are used to trigger activation of the emergency notification service. The notification thresholds listed in Table 1-2 were selected according to the following criteria established in HB21-1189:

- Appropriate for comparison to air data averaged over one-hour[14]
- Represent emergency, acute (short -term) exposure scenarios[15]
- Based on publicly available and peer-reviewed scientific research about the potential human health impacts of short-term exposure to pollutants[16]
- Utilized by a federal agency or another state[17]

Based on the above criteria, the four-hour Acute Exposure Guideline Levels (AEGLs)[18] Level 1 values were selected as the appropriate emergency notification thresholds for this monitoring plan. AEGLs are developed by the US Environmental Protection Agency (EPA) using a formalized process that includes an extensive, rigorous review of the scientific data by a panel of scientific experts. AEGL values are specifically derived to address the needs of agencies such as the US Environmental Protection Agency (EPA), Agency for Toxic Substances and Disease Registry (ATSDR), Department of Energy (DOE), and Department of Defense (DOD) for acute exposure values that would be applicable to protecting public health in an emergency event[19]. "AEGLs are exposure guidelines designed to help responders deal with emergencies involving chemical spills or other catastrophic events where members of the general public are exposed to a hazardous airborne chemical[20]." AEGLs are exposure thresholds intended to protect the public from three levels of severity of symptoms: AEGL-1 is the threshold for mild, transient health effects that are reversible; AEGL-2 is the threshold

[13] C.R.S. §25-7-141(5)(a)(III).
[14] *Id.* § 25-7-141(2)(j).
[15] *Id.* § 25-7-141(5)(a)(III)(A)-(B).
[16] *Id.* § 25-7-141(5)(a)(III)(A)
[17] *Id.* § 25-7-141(5)(a)(III)(B).
[18] https://www.epa.gov/aegl
[19] https://www.epa.gov/sites/default/files/2015-09/documents/sop_final_standing_operating_procedures_2001.pdf
[20] https://response.restoration.noaa.gov/oil-and-chemical-spills/chemical-spills/resources/acute-exposure-guideline-levels-aegls.html

level for irreversible or other serious health effects or that could impair the ability to take protective action; and AEGL-3 is the threshold level for life-threatening health effects.

Using the AEGL-1 value as a threshold for comparison to data collected at the fenceline of the Goodrich Pueblo facility is an overly conservative approach as the fenceline data does not represent an exposure to a person in the nearby communities. Any potential exposure to a community member that lives further away from the facility is expected to be lower than the values measured at the fenceline due to known dispersion properties of these analytes. Additionally, using a 4-hour AEGL-1 threshold to compare to a 1-hour average measurement will provide the community advanced warning prior to being exposed to potential health effects.

4.2.1.1 Hydrogen Sulfide[21]

The AEGL-1 value for 4-hour exposure of 0.36 ppm (or 360 ppb) was selected as the emergency notification threshold for hydrogen sulfide (H_2S)[22]. According to the scientific literature used to derive this value, this AEGL-1 value would be protective for the general population, including sensitive individuals, from reversible adverse health effects.

4.2.1.2 Hydrogen Cyanide

The AEGL-1 value for 4-hour exposure of 1.3 ppm (1,300 ppb) was selected as the emergency notification threshold for hydrogen cyanide (HCN)[23]. According to the scientific literature used to derive this value, this AEGL-1 value would be protective for the general population, including sensitive individuals, from reversible adverse health effects.

4.2.1.3 Benzene

The AEGL-1 value for 4-hour of 18 ppm (18,000 ppb) was selected as the emergency notification threshold value for benzene, which is also based on protecting the general population, including sensitive individuals, from reversible or other serious adverse health effects[24].

4.2.2 Public Emergency Notification Service

The Integrated Public Alert & Warning System (IPAWS) is FEMA's national system for local alerting that provides authenticated emergency and life-saving information to the public through mobile phones using Wireless Emergency Alerts (WEA). It can also be used to alert

[21] Compound is not stored, produced or emitted by Goodrich.
[22] https://www.epa.gov/sites/default/files/2014-11/documents/hydrogen_sulfide_final_volume9_2010.pdf (page 173)
[23] https://www.epa.gov/sites/default/files/2014-09/documents/tsd6.pdf (page 211)
[24] https://www.epa.gov/sites/default/files/2014-08/documents/benzene_interim_dec_2008_v1.pdf

to radio and television via the Emergency Alert System, and on the National Oceanic and Atmospheric Administration's Weather Radio.

WEAs are short emergency messages from authorized federal, state, local, tribal and territorial public alerting authorities that can be broadcast from cell towers to any WEA-enabled mobile device in a locally targeted area. Wireless providers primarily use cell broadcast technology for WEA message delivery. WEA is a partnership among FEMA, the Federal Communications Commission (FCC) and wireless providers to enhance public safety. The messages are short and can provide immediate information. The alerts can contain information about a threat that may not be imminent or after an imminent threat has occurred. Public safety alerts are less severe than imminent threat alerts.

The use of IPAWS is restricted for use by alerting authorities that have been trained and approved by FEMA. The alerting authorities consist of federal agencies and state, local, tribal, and territorial authorities. For any Goodrich Pueblo facility IPAWS notifications, the alerting authorities are the Pueblo County Sheriff's Office. Before any message is sent via IPAWS, the alerting authorities for the appropriate jurisdiction must approve the message.

The IPAWS notifications system cannot be activated by any of the covered facilities. Only the relevant public safety authority has the power to activate IPAWS. These activation criteria are often specified in a memorandum of understanding, or similar governing document, between the alerting authorities and the public safety authorities. Any activation of IPAWS or WEA must comply with the applicable governing documents.

4.2.2.1 Threshold Exceedance Notification Plan

In the event of an exceedance of a notification threshold for one or more of the covered air toxics (benzene, hydrogen cyanide or hydrogen sulfide) averaged over a period of 30 minutes, Montrose personnel will be notified via an automated phone call, email, and text message from the AirSense data platform. A trained Montrose data expert will be available and on-call 24/7 to immediately review the monitoring data to validate whether the data quality indicators and automated quality control parameters described in Table 5.3 of this Monitoring Plan demonstrate the monitoring system was operating correctly during the 30-minute period in question, and prior to the monitored concentration reaching the 1-hour duration. If the 1-hour monitored concentration for one or more of the Covered Air Toxics thereafter exceed a notification threshold in Table 1-2 of this Monitoring Plan, the complete 1-hour data set will also be validated by the on-call Montrose data expert.

If the monitoring data does not meet the data quality requirements as specified in this Monitoring Plan, then the data will be invalidated, and a non-conformance/corrective action will be initiated. No further actions in regard to the threshold exceedance notification plan will be taken.

If the monitoring data does meet the data quality requirements identified in this Monitoring Plan thus confirming that an applicable notification threshold in Table 1-2 of this Monitoring Plan has been exceeded, Montrose will notify the Goodrich EH&S Department Manager (available 24/7), who will then notify Goodrich designated personnel. Goodrich personnel will promptly alert the CDPHE incident reporting hotline (1-877-518-5608) to the threshold exceedance notification, along with details about the location of the suspected source of the exceedance. Since no sources of hydrogen sulfide (H2S) exist on the Goodrich property, all detections of H2S at the fenceline originate from offsite and this information will be relayed by Goodrich personnel to the CDPHE hotline. The CDPHE incident command team will coordinate with the Pueblo County Sheriff's Office (the "alerting authority") and advise Goodrich on whether the authority will activate the Integrated Public Alert & Warning System (IPAWS). Goodrich will coordinate, as needed, with the CDPHE incident command team and undertake appropriate steps necessary to respond to the threshold exceedance notification.

In addition to monitoring data related to any exceedance of a notification threshold being posted in real time on the public fenceline monitoring website for Goodrich, within 24 hours of a valid threshold exceedance notification made by an alerting authority (i.e., any 1-hour measurement that is in exceedance of any AEGL-1 4-hr threshold in Table 1-2 of this Monitoring Plan for any Covered Air Toxic in which the data has been quality checked and the measurement is considered valid and accurate) relevant and pertinent information concerning the emergency notification will be posted to a dedicated webpage on the Goodrich fenceline monitoring plan public website. This information will include the measurement value that exceeded the AEGL-1 4-hr threshold, the time the event started, cause(s) of the event (explained if known, under investigation, or unknown if indeterminant), the monitoring path on which the exceedance was measured, the duration of the exceedance, and any corrective actions taken in response to the event. In addition to this information, plots will be reported on a map showing the location of the monitoring path that triggered the exceedance; a timeseries of the data (before, during and after the exceedance); and the wind direction measured (before, during and after the exceedance). Once a quarterly report that accounts for the event has been posted to the Goodrich fenceline monitoring website, the dedicated webpage used to initially communicate the exceedance to the public will be deleted. A permanent archive indicating the date of any valid exceedance of a notification threshold will remain on the website and it will refer to the appropriate quarterly report where the detailed information of the event will be preserved.

5.0 Quality Assurance and Reporting

This section summarizes the quality assurance (QA) and quality control (QC) program to be followed during the Goodrich fenceline monitoring program to ensure that data quality objectives (DQOs) established for the monitoring project are consistently met and that the reported measurement data are supported by defensible documentation. The QA/QC program has been developed in accordance with relevant requirements and guidance provided by EPA and consistent with what is conducted for similar fenceline monitoring programs.

5.1 Quality Objectives and Criteria

Measurement performance criteria are established as part of the monitoring program design to ensure the validity and accuracy of monitoring measurements. These criteria specify the data quality needed to minimize decision errors based on the quality of the data. Data quality is defined in terms of the degree of precision, accuracy, representativeness, comparability, and completeness. The definition of these terms is provided in EPA Guidance and is outlined below:

Table 5-1. Data Quality Indicators

Term	Definition
Precision	A measure of agreement among repeated measurements of the same parameter under identical or similar conditions
Bias	The systematic or persistent distortion of a measurement process that causes errors in one direction
Accuracy	A measure of overall agreement of a measurement to a known value
Representativeness	A qualitative term that expresses the degree to which data accurately and precisely represent a characteristic of a population
Comparability	A qualitative term that expresses the measure of confidence that one data set has when compared to another
Sensitivity	A measure of a method or instrument's ability to discriminate between measurement responses representing different levels of the variable of interest
Completeness	A measure of the amount of valid data obtained from a measurement system

Robustness	A qualitative term that expresses an open-path measurement system's ability to provide valid data under weather conditions that compromise signal strength (e.g., rain, fog, snow, etc.)

5.1.1 Completeness

The table below provides a list of relevant time intervals and the associated data recovery requirements for the monitoring parameters applicable to this monitoring program. The minimum valid data completeness objective for this program for fenceline air quality monitoring data is 75% per year. This minimum data completeness objective is consistent with EPA and Colorado minimum data completeness requirements for criteria pollutant ambient air compliance monitoring systems (e.g., the National Air Monitoring Stations (NAMS) and State and Local Air Monitoring Stations (SLAMS)).

Table 5-2. Completeness Summary

Completeness Requirement	Applicability
50% of scans (open path)	5 minute average data
75% of 5 minute data	1 hour average data
75% of daily data	Monthly, quarterly or yearly average data

Other factors that affect data availability include instrument bump tests (approximately every quarter for a few hours), annual maintenance, and other maintenance (e.g., replacement of UV bulbs for the UV-DOAS as needed). If actual or forecasted quarterly data completeness falls below 75%, corrective action will be initiated, which will include notifying APCD.

Additionally, adverse weather conditions can affect the measurements. Snow may block the signal from an open-path instrument and prevent data collection. Rain also can partially absorb the signal and interfere with measurements. Given the seasonal aspects of Colorado, snow is common during the fall, winter and spring months. Additionally, wildfires in the area can affect visibility and have the potential to impact measurements. The presence of weather events will be indicated by a loss of signal and verified by the local operators and notated as described in Section 5.5.

5.1.2 Calculations for the Assessment of Quality

Calculations of measurement uncertainty will be carried out following procedures like those used for ambient air monitoring networks, provided in the following subsections.

5.1.2. 1 Data Completeness, Hourly

$$\%\ \text{complete}_{\text{hourly}} = 100 \times \frac{n_{valid}}{\left(n_{\text{hour}} - n_{\text{excluded}}\right)}$$

Where:

% complete	=	amount of valid data (%)
n_{valid}	=	number of valid 5 minute measurements per hour
n_{hour}	=	number of 5 minute measurements within the hour
$n_{excluded}$	=	number of 5 minute measurements invalidated[25]
100	=	conversion factor (%)

5.1.2.2 Data Completeness, Daily

$$\%\ \text{complete}_{\text{daily}} = 100 \times \frac{h_{valid}}{\left(24 - h_{\text{excluded}}\right)}$$

Where:

% complete	=	amount of valid data (%)
h_{valid}	=	number of whole hours in a calendar day with complete/valid data
24	=	hours per day
$h_{excluded}$	=	number of whole hours during which all data are invalidated
100	=	conversion factor (%)

[25] Data that is invalidated due to adverse weather conditions or scheduled maintenance.

5.1.2.3 Data Completeness, Yearly

$$\%\ \text{complete}_{\text{yearly}} = 100 \times \frac{\text{d}_{valid}}{\left(\text{d}_{\text{yearly}} - \text{d}_{\text{excluded}}\right)}$$

Where:

% complete	=	amount of valid data (%)
d_{valid}	=	number of whole days in a calendar year with complete/valid data
d_{yearly}	=	number of contiguous whole days in that calendar year
$d_{excluded}$	=	number of whole days during which all data are invalidated
100	=	conversion factor (%)

5.1.2.4 Percent Difference

$$\text{d}_{\text{i}} = \frac{meas - audit}{audit}$$

Where:

d_i	=	difference (%)
measure	=	concentration indicated by the instrument
audit	=	certified concentration of the standard used in the QC check

5.1.2.5 Accuracy

$$A,\% = \frac{\left|\overline{C_{audit}} - \overline{C_{meas}}\right|}{\overline{C_{audit}}} \times 100$$

Where:

A,%	=	accuracy (%)
$\overline{C_{audit}}$	=	average value of the reference gas
$\overline{C_{meas}}$	=	average value of all measurements

5.1.2.6 Precision

$$CV,\% = \frac{\sigma_{meas}}{\overline{C}_{meas}} \times 100$$

$$\sigma_X = \sqrt{\frac{\sum (C_{meas} - \overline{C}_{meas})^2}{n-1}}$$

Where:

CV, %	=	coefficient of variation (%)
σ_{meas}	=	standard deviation of the measurements
$\overline{C}_{meas}$	=	average measured gas concentration
σ_{meas}	=	standard deviation of the measurements
C_{meas}	=	single measured gas concentration
n	=	number of measurements

5.1.2.7 Robustness

Robustness tests are typically performed to determine whether an instrument is operating correctly and providing valid quality data under extreme conditions. In open path monitoring systems, instrument robustness can be defined as what signal strength is needed for the instrument to collect data that are deemed to be valid.

Signal strength can be affected by factors such as weather, wildfires (smoke and/or ash), light source power (intensity), instrument alignment, etc. If signal strength is low, then the absorbance spectrum will be impacted, which can affect the collection of data that meets Data Quality Indicators (Table 4-1) and required minimum detection limits.

For open path monitoring instrumentation, there is no optimal signal strength or threshold that can be used as a criterion for checking instrument robustness. The target threshold for signal strength to provide quality data (a measure of robustness) is defined as the signal strength that is needed for the minimum detection limit of the monitored compounds to be lower than 25% of the corresponding notification threshold for all paths and compounds except for H_2S Paths 2 and 5 where the minimum detection limit should be 50% of the AEGL-1 4-hour values. If the signal strength cannot meet this performance criterion, then the corresponding measurements will be flagged automatically and invalidated as part of the Data

Invalidation Plan. A complete list of the data invalidation codes can be found in Table 4-1. Additionally, changes in signal intensity over time will also be monitored and evaluated to determine if corrective action is required to respond to a degrading signal (e.g., replace light source, instrument alignment, etc.).

5.2 Equipment Assembly, Installation and Initial Verification

Upon receipt of the various system components, the monitoring systems will be assembled and tested at the Montrose Denver office. Received instruments and materials will be visually inspected for integrity and conformance with specifications. Monitoring system assembly will be performed by Montrose trained and experienced fenceline monitoring group technical staff in accordance with approved technical documents. Monitoring equipment that satisfies visual inspection and conforms to purchase order specifications will be powered on and tested for correct operation, first as individual instruments and subsequently as integrated with other, related equipment, as applicable.

Data acquisition system software programming and configuration will be checked for conformance to defined functions, measurement ranges and other configuration parameters. Data acquisition functions and scaling accuracy will be confirmed using known, NIST-traceable electrical test signal inputs as surrogates for monitor measurement signals or actual monitoring signals, as applicable. Data transmission and acquisition functions between the specific equipment computers and AirSense data platform will be tested for proper operation.

Each instrument will be verified in accordance with the instrument manufacturers operating instructions as well as Standard Operating procedures (SOPs). Each instrument will be operated for several days under conditions that closely approximate actual field operating conditions. During this interval, comprehensive operating status and quality control (QC) checks will be performed and documented on each instrument undergoing testing. Data from the pollutant monitors will be continuously acquired and collected via the AirSense data platform.

Periodic calibration verification checks will be performed on all monitors and results documented. The recorded test data will be reviewed by the technical staff to confirm correct, stable operation and that instrument performance conforms to the manufacturers and engineering specifications.

After completion of the initial operations and quality control checks, Montrose will verify that all required infrastructure is in place (e.g., cements pads, electrical). Montrose will then commence installing the fenceline monitoring equipment in accordance with the plans and specifications provided by Montrose. Following installation of the fenceline monitoring systems in the field, the systems will be field-tested for proper operation and functional performance. The Montrose field staff will power-up the instruments and perform a documented check of component/systems operating functions to confirm the operational integrity of the installed monitoring systems. Operational integrity checks will include verifying:

- Correct functioning of each pollutant monitor;
- Correct functioning of the meteorological sensors;
- Confirmation of correct monitor input and output (I/O) electronic signal communications and acquisition and recording of monitor output signals by the AirSense data platform;
- Confirmation of automated and manual system control functions; and
- Comprehensive checks of data transmission functions via the installed wireless data modems. This will include:
    - Verifying correct automatic data transmission from the monitoring system
    - Receipt and recording of the data by the AirSense data platform
    - Correct transmission and receipt of alarm conditions by the AirSense data platform,
    - Correct transmittal of text and email messages, by the AirSense data platform

Upon confirming correct system functions and operating status, the fenceline monitoring system will be operated during a shakedown period where data will be collected and the overall system performance evaluated. No initial calibration of the open path instrumentation will occur because the instruments are factory calibrated to spectral reference libraries. A calibration is the process of adjusting the response of a measurement instrument to agree with the value of an applied standard within a specified accuracy. Calibration will be verified however by performing “bump tests” using a reference gas cell and a reference gas of known concentration.

Additionally, an initial audit of the meteorological sensors will be conducted to verify the accuracy of the meteorological sensors against calibrated equipment per EPA Quality Assurance Guidelines. The audit will be conducted by an experienced Montrose technician under the oversight of the Quality Assurance Coordinator. All sensors, electronic signal conditioning and data acquisition system equipment will be checked for proper electronic calibration and performance. The test methods utilized for conducting the initial calibration and performance audit on the meteorological monitoring systems will be identical to methods described for each type of meteorological monitor in Section 5.3 of this document except that adjustments may be made to the measurement system prior to or during the initial accuracy audit.

5.3 Quality Control

5.3.1 Automated Quality Control

Many Quality Control procedures for the fenceline monitoring network are integrated directly into AirSense data platform and are outlined as follows. These automated procedures allow for the ability to screen data not suitable for public display due to atmospheric or operational issues. These automated quality control checks include:

- Inspection of daily reports generated by the AirSense platform which summarize data recovery for each analyzer/sensor and suspect data flags;
- Monitoring of real time alerts and daily reports generated by the AirSense data platform that flag:
    - No data;
    - Data sticking – if values are repeated for a number of sampling intervals (does not apply to data below the detection limit);
    - Range exceedances – if values are outside a reasonable minimum or maximum value;
    - Data recovery;
    - Monitoring instrument parameters that may indicate equipment degradation / failure or a need for maintenance and / or cleaning;
    - Signal intensity (open path instruments);
    - Instrument or sensor alarms or error codes;
    - Analyzer and shelter temperatures; and
    - Laser parameters (TDL instruments)

Table 5-3. List of automated quality control parameters and corresponding evaluation criteria

Instrument	Automated Quality Control Parameter	Definition	Units	Evaluation criteria
UV-DOAS	MDL	Minimum detection limit	PPB	< 25% of alert threshold
	R^2	Percentage peak match	%	> 64
	Signal intensity	Signal intensity at full scale	%	> 40
	UV spectrometer temperature		°C	35
TDL	MDL	Minimum detection limit	PPB	< 25% of alert threshold for all compounds except for H2S Paths 2 and 5 where detection limit should be <50% of alert threshold
	Signal Power		mAmps	> 0.1
	Laser temperature stability	Absolute value of (laser temperature- laser temperature in long average) *100/ laser temperature in long average	%	< 5
	R	Peak correlation		> 0.8

5.3.2 Instrument Quality Control Checks

Both the UV-DOAS and TDL systems are designed to require only modest service and maintenance. Section 5.4 summarizes the UV-DOAS and TDL maintenance activities as recommended by the manufacturer. These activities will help ensure data integrity and maximize up-time.

5.3.2.1 UV-DOAS

For the UV-DOAS system, a calibration verification bump test will be performed on a quarterly basis using a flow through cell. The bump test simulates system-observed gas content at the required path average concentration and is used to verify that the system can detect concentrations at or below the levels of concern. The bump test serves as a quality control check in the presence of any spectral interferences present in the normal measurement path.

The measurement response is compared with the reference spectra (Table 5-4), and if values are within acceptable criteria (Table 5-5), the instrument calibration is verified.

The bump test is performed by measuring a known gas concentration of the target compounds in an enclosed cell placed into the normal measurement path, over a fixed path length and at a known temperature and pressure. For the UV-DOAS a cell path length of 0.047 meters and a volume of 0.37 liters will be used.

For the bump test, the test cell is purged with nitrogen to establish a baseline. The cell is then purged and filled with benzene reference gas, with data again collected for the operating instrument averaging interval. Certified calibration gas cylinders from GASCO will be used for the bump tests. The gas cylinders' concentration will be at or near the AEGL-1 alert threshold. The actual concentration to be used in the cell will be based upon the path length of the system being evaluated and the concentration of calibration commercially available. A second bump test will be conducted for each target compound at a lower level.

Table 5-4 outlines an example of what the desired path concentrations would be for a bump test based upon a 400-meter, monostatic, path length (800 meters total path length).

Table 5-4. UV DOAS Bump Test Concentrations

Compound	Desired Path Concentration Level 1	Desired Path Concentration Level 2
Benzene	18 ppm	9 ppm

For the UV-DOAS system, precision will be calculated by evaluating the variance of pollutant concentrations during a period of low atmospheric variability. Five-minute data will be selected when concentrations are well above the minimum detection limit (MDL) during periods of low variability. The precision can then be determined by calculating the coefficient of variation (CV). If there are no periods of low variability with concentrations above the minimum detection limit, bump test data will be used for the precision determination.

For the UV-DOAS, robustness can be determined by calculating the desired signal intensity in order for the benzene minimum detection limit to be lower than 25% of the notification threshold. If the measured signal intensity is found to be below the desired value, corrective action will be required (e.g., replace light source, instrument alignment, etc.). The QC checks for the UVDOAS are summarized in Table 5-5.

Table 5-5. UV DOAS QC Checks

QA/QC Check	Frequency	Acceptance Criteria
Accuracy and precision (Bump Test)	Quarterly	Accuracy: ≤ 30% of reference gas value Precision: ± 25%
Baseline Stability	Continuous	± 5%
Signal intensity	Continuous	>60%
Robustness	Continuous	Compound MDL lower than 25% of notification threshold

5.3.2.2 TDL

For the TDL system, a calibration verification bump test will be performed on a quarterly basis. The bump test simulates system-observed gas content at the required path average concentration and is used to verify that the system can detect concentrations at or below the levels of concern. The bump test serves as a quality control check in the presence of any spectral interferences present in the normal measurement path. The measurement response is compared with the reference spectra, and if values are within acceptable criteria, the instrument calibration is verified.

For the TDL, the bump test will be performed using an IR flow through external audit module manufactured by Unisearch Associates Inc. The external audit module allows the client to check the performance of the analyzers by inserting a module containing a flow-through cell and gas-in/gas-out ports. The gas-in port is meant to be connected to a gas cylinder containing known levels of the target gas. The audit module inserts into the fiber optic cabling (in series with the optics) at the analyzer. The user simply flows calibration gas from a standard source (cylinder, permeation device) though the cell and determines the equivalent concentration from the ratio of the measurement path length to the audit cell path length times the calibration gas concentration.

Table 5-6 outlines an example of what the desired path concentrations would be for a bump test based upon a 400-meter, monostatic, path length (800 meters total path length).

Table 5-6. TDL Bump Test Concentrations

Compound	Desired Path Concentration Level 1	Desired Path Concentration Level 2
Hydrogen Sulfide	0.36 ppm	90 ppb
Hydrogen Cyanide	1.3 ppm	325 ppb

For the TDL system, precision will be calculated by evaluating the variance of pollutant concentrations during a period of low atmospheric variability. Five-minute data will be selected when concentrations are well above the minimum detection limit during periods of low variability. The precision can then be determined by calculating the coefficient of variation (CV). If there are no periods of low variability with concentrations above the minimum detection limit (MDL), bump test data will be used for the precision determination.

For the TDL system, robustness can be determined by calculating the desired signal intensity for the hydrogen sulfide and hydrogen cyanide minimum detection limit to be lower than 25% of the corresponding notification thresholds for all paths and compounds, except for H_2S Paths 2 and 5 where detection limit should be 50% of the AEGL-1 4-hour values. If the measured signal intensity is found to be below the desired value, corrective action will be required (e.g., replace laser, instrument alignment, etc.). The QC checks for the TDL are summarized in Table 5-7 as follows.

Table 5-7. TDL QC Checks

QA/QC Check	Frequency	Acceptance Criteria
Accuracy and precision (Bump Test)	Quarterly	Accuracy: ≤ 30% of reference gas value Precision: ± 25%
Baseline Stability	Continuous	± 5%
Signal Power	Continuous	>0.1 mAmps

Robustness	Continuous	Compound MDL < 25% of notification threshold except for H2S Paths 2 and 5 where MDL< 50% of notification threshold.

5.3.2.3 Meteorological

Wind speed, wind direction, temperature, relative humidity and barometric pressure measurement systems will be aligned and tested at the time of installation and at three-month intervals thereafter using test equipment traceable to NIST or other authoritative standards and following standard operating procedures. Calibrations are performed immediately following scheduled semi-annual meteorological audits and performance of scheduled preventive and/or corrective maintenance for the monitoring instruments.

Following initial startup calibrations and continuing throughout the monitoring program, the field operator will routinely perform quarterly site checks on the meteorological monitoring systems. In the course of these checks, sensors will be observed for proper operation. The monitoring instruments and support equipment will be visually inspected to confirm operational integrity. The current data logger readings will be assessed for agreement with prevailing conditions.

Calibration of the wind speed measurement system will use the method described in Section 2.7.2 of Volume IV of the U.S. EPA Quality Assurance Handbook. This method consists of imparting a controlled rate of rotation on the impeller shaft via a calibrated direct-current motor to simulate selected wind speeds. The starting threshold of each anemometer will be assessed with a torque gauge.

Calibration of the wind direction measurement system will use the sensor control method described in Section 2.7.3 of Volume IV of the U.S. EPA Quality Assurance Handbook. This method describes the relative performance of the wind vane as a shaft-position transducer and the orientation of the transducer with respect to true north. The former is done with a calibration test fixture, part of which is mounted to the transducer body and another part mounted to the shaft in place of the vane. The latter assessment requires the determination of true north (MSI method SN008) and a setting of the transducer relative to the orientation. The azimuth response of the wind direction sensor will be tested at 12 different known headings spaced equally across the measurement range using the manufacturer's azimuth calibration test fixture. The starting threshold of each wind direction sensor will be assessed with a torque gauge.

Calibration of the temperature measurement system will use the method described in Section 3.4 of Volume IV of the U.S. EPA Quality Assurance Handbook. The method includes the comparison of the output of the device being calibrated to a known value, and determining if the difference is within acceptable tolerance limits. Most modern temperature measuring systems do not need adjusting to match known values if all components are working properly, so acceptance is pass or fail.

Calibration of the relative humidity measurement system will use the method described in Section 5.4 of Volume IV of the U.S. EPA Quality Assurance Handbook. Calibrating a relative humidity measurement system consists of comparing the output of the device being calibrated to a known value and determining if the difference is within acceptable tolerance limits. Modern relative humidity measurement systems may include software calibration adjustment capability.

Calibration of the barometric pressure measurement system will use the method described in Section 7.5 of Volume IV of the U.S. EPA Quality Assurance Handbook. Electronic barometers should be returned to a calibration facility annually for calibration. Upon receipt of a barometer at a meteorological station a comparison test should be run. Pressure readings from an electronic barometer should be compared to pressure readings from a Collocated Transfer System (CTS) over a period of several days. The readings should be taken with both barometers at the same height, when the wind is less than 12 m s^{-1}, and when the pressure is either steady or changing by less than 1 mb. An electronic barometer with a mean difference from the CTS that exceeds 0.5 mb should be regarded as unserviceable and returned to the calibration facility for recalibration. Every six months, readings from an electronic barometer collected over several consecutive hours should be compared to readings from a CTS under similar circumstances; a mean difference should be established. If the mean difference is more than 3 mb, the station barometer should be returned to the manufacturer for calibration.

Wind direction sensor orientation to true north will be verified using either a surveyors' transit or known benchmark. True north will be determined either by using either the true solar noon method or by use of a surveyor's transit, correcting for local magnetic declination.

All routine system operating checks and calibration data will be recorded on forms developed specifically for that purpose. The table at the end of this section summarizes and lists the QA and QC activities that will be performed for the meteorological monitoring systems.

Table 5-8. Meteorological QC Checks

QA/QC Check	Frequency	Acceptance Criteria
Wind direction	Quarterly	± 5 degrees
Wind speed	Quarterly	± 0.25 m/s below 5 m/s ± 5% above 5 m/s

Temperature	Quarterly	±0.5 degree of Celsius
Relative humidity	Quarterly	±7 %
Barometric pressure	Quarterly	±3.0 mb

5.4 Instrument Operations and Maintenance

Instrument operations and maintenance include various checks to ensure that data are flowing consistently, as well as monthly, quarterly, and annual maintenance activities. Equipment inspection, testing, and routine maintenance activities help make sure instruments are operating properly and generating monitoring data that meet the program objectives. Some evaluation activities are conducted remotely by the AirSense data platform and the instrument software while other activities are conducted by the local field operators manually.

Tables with a list of inspection, operations, and maintenance activities are presented for each instrument. The tables also present the minimum frequency for each task. The minimum frequencies assume routine operations without any significant instrument issues. Inspection, operations, and maintenance checks should also be performed "as needed" and more frequently if significant issues with instrument performance occur. Additionally, these activities will be performed after any major maintenance activities or after an instrument is replaced.

If an instrument inspection activity reveals a significant issue corrective action will be taken. APCD will be notified of any significant issue that impacts the data quality, and the provided plan for corrective action. A significant issue is defined as when any path is not measuring/recording data for a time period greater than 24-hours, or when anomalies are identified during calibration or data review that result in accuracy of instrumentation outside of acceptable parameters. A QC check will be performed before instrument repair/troubleshooting is conducted and any potential impact on data quality will be assessed as part of the data validation process.

The Technical Lead and System operator will be responsible for ensuring that critical spare parts are included with the field instruments to reduce potential downtime for repairs. The inventory will primarily contain parts that are subject to frequent failure, have limited useful lifetimes, and/or cannot be obtained in a timely manner. The spare parts inventory will be stored either on site at the Goodrich facility or at the local Montrose Denver office.

5.4.1 UV-DOAS

Open Path UV-DOAS systems are designed to require little service and maintenance. The table that follows summarizes the UV-DOAS maintenance activities as recommended by the manufacturer. The preventive maintenance frequency will depend on the operating environment and may be adjusted once the instruments are deployed in the field.

Table 5-9. UV-DOAS Operations and Maintenance Summary

Task	Frequency
Visually inspect the system	Monthly
Inspect and clean (if necessary) optics on detector and retroflector	Monthly
Inspect and replace (if necessary) filters	Monthly
Confirm alignment to verify absence of significant physical movement	Monthly
Download and archive data from hard drive and free space as needed	Monthly
Conform absence of obstructions between detector / light source and retroreflector (such as vegetation, equipment, etc.)	Monthly
Replace UV source	As Needed
Replace ventilation exit and intake filters	Quarterly
Clean optics on retroreflectors and detectors	Quarterly
Realign system after service (if necessary)	Quarterly
Check system performance indicators	Quarterly
Review and test light and signal levels to establish baseline for bulb change frequency	Quarterly
Verify system settings	Yearly

5.4.2 TDL

The open path TDL systems will require maintenance activities similar to those required for the UV-DOAS. The TDL systems are also designed to require little service and maintenance. The table that follows summarizes the TDL maintenance activities as recommended by the manufacturer. The preventive maintenance frequency will depend on the operating environment and may be adjusted once the instruments are deployed in the field.

Table 5-10. TDL Operations and Maintenance Summary

Task	Frequency
Visually inspect the system	Monthly
Confirm alignment to verify absence of significant physical movement	Monthly
Download and archive data from hard drive and free space as needed	Monthly
Conform absence of obstructions between detector / light source and retroreflector (such as vegetation, equipment, etc.)	Monthly
Replace ventilation exit and intake filters	Quarterly
Clean optics on retroreflectors and detectors	Quarterly
Realign system after service (if necessary)	Quarterly
Check system performance indicators	Quarterly
Review and test light and signal levels to establish baseline for bulb change frequency	Annually
Verify system settings	Annually
Replace laser source	Every 5 Years

5.4.3 Meteorological

The meteorological sensors will require maintenance activities similarly to lower the frequency of non-routine maintenance. The routine service tasks that will be performed on a regular basis are outlined in the table as follows.

Table 5-11. Meteorological Equipment Operations and Maintenance Summary

Task	Frequency
Check that tower is securely anchored to the cement pad	Monthly
Inspect all tower bolts at the base for signs of corrosion	Monthly
Inspect the tower for signs of damage or wear	Monthly
Check the tower’s vertical alignment	Monthly
Inspect the Temperature/RH Sensors hardware holding the assembly to the tower and repair as necessary	Monthly
Check that all temperature/ RH Sensors cable connections are secure	Monthly
Inspect all anemometer sensors for missing components or obvious damage	Monthly
Inspect that the whole anemometer sensor moves freely with changing wind direction and that the propeller rotates freely	Monthly

5.5 Data Management

5.5.1 Data Quality Objectives

This section identifies the data quality objectives (DQOs) established for the Goodrich fenceline monitoring program and summarizes the data processing and validation activities that will be implemented to meet these goals. These activities will work in tandem with the quality assurance and quality control program elements of this document to ensure that the reported data are consistent with the related program objectives. Quarterly reports of both monitoring results and quality assurance activities will be prepared and posted on the public web site. The contents of these reports and the disposition of related program documentation are summarized at the end of this section.

The fenceline Monitoring Plan data management will follow a standard procedure that will be part of the quality assurance plan (QAPP), which can be found in Appendix E. Goodrich collaborated with the Division to establish and finalize a fenceline monitoring system QAPP using the South Coast Air Quality District checklist as a template.

5.5.2 Data Quality Assurance

5.5.2.1 Data Retrieval and Review

All continuous data from the monitoring equipment will be transferred to the cloud based servers every five minutes. Each business day a data technician will check the data files to ensure that all data were successfully transmitted and stored in the database. If data are missing, they will be manually retrieved from the computers that control each piece of equipment or the on-site data logger for the meteorological equipment. This data is the raw data collected from the instrument computers or data logger and is considered “Level 1” data. These data are used to monitor instrument operations on a regular basis but are not used for reporting until subject to further review and validation. Level 1 (raw) data files are kept intact and unedited. These data are not subject to reduction or reformatting.

“Level 1” data are “raw” data; i.e., data obtained directly from the instrument computers or data logger that have not yet been subjected to quality assurance review. Electronic files of the raw data record are archived "as is"; no alteration is made to the raw data files. All data processing, editing and validation work is accomplished by working with copies of the raw data files produced by the data management system software upon request.

Following ingest into the cloud based server, Level 1 data will be manually reviewed for reasonableness and completeness. Initial (daily) review of the data will occur no more than four days after sample acquisition because of weekends and holidays. Daily data review includes checking for status or event flags, reasonableness of reported averaged data values (out-of-range, inconsistent or excessive transition values) and any missing data periods.

The operating status of each instrument is also reviewed (e.g., sample flow rates; other internal operating parameters). Meteorological data are reviewed for agreement with local seasonal and prevailing conditions and internal consistency. Suspect meteorological data will be compared against data reported from the nearest National Weather Service station. These daily reviews support "Level 2" validation of the data and provide a decision basis for investigative actions, instrument adjustment and calibration.

The data analyst will annotate the separate data processing file (i.e., an electronic copy of the original raw data file) and produce a summary report of any suspect data or out-of-tolerance operating conditions. Any situation requiring investigative and/or corrective action will be immediately brought to the attention of the Project Manager and Technical Lead. A "Non-Conformance / Corrective Action" (NC/CA) report documenting all pertinent information regarding suspect data, a non-conformance event or out-of-tolerance operating condition will be generated and updated with further information as it becomes available until the problem is fully resolved.

5.5.2.2 Data Processing

All data reporting forms and activity logs completed during the previous month will be stored in our local Denver office and will be reviewed against the electronic data record on a monthly basis in support of data processing and validation. Monthly review of the field monitoring documentation will include:

- All completed routine site check forms;
- Documentation of the two-point QC (bump) tests performed on the monitors during the previous month;
- Documentation of any maintenance activities performed on the monitors during the previous month;
- Documentation of any quality assurance audits performed on the meteorological sensors during the previous month; and
- Documentation of any Non-Conformance/Corrective Action (NC/CA) events that occurred during the previous month.

During "Level 2" data validation, the data file of each continuously-monitored parameter are processed at monthly intervals to develop an initial data report to be reviewed for completeness and correctness. Any corrections or additions to the raw "Level 1" data file are annotated in the processing data file with explanatory comments. Any hours incorporating a test, calibration or other quality control check, corrective or preventive maintenance, instrument malfunction, power failures, weather event, etc. are removed from the data set and annotated with the appropriate null data code (for details on null data codes and corresponding descriptions see Table 4-1). In all cases, any hour removed from the data set, for any reason, will be substantiated with a well-documented reason. For those instances where invalidation is needed but no defined reason is included in the invalidation plan, the facility will consult the Division to collaboratively decide if the data can be invalidated. If invalidation is agreed, then the data invalidation plan can be updated to include a new invalidation code, and justification.

Results of this review, including any data losses equal to or greater than one hourly block average, are documented and dated by the data technician in "Level 2" data files. The data technician will enter and annotate any null data codes or corrections required in the "Level 2" electronic data file. When all entries or corrections are complete, the data are designated as "Level 2 - Final" data, and are archived for subsequent final data validation review.

5.5.2.3 Data Validation

"Level 3" data validation review is performed by senior project personnel other than the data processing analyst. During the Level 3 data validation process, data losses due to activity or instrument malfunction are corroborated against documentation noted by the station field operators on completed field forms. The field form record identifying data affected by these activities and events are inter-compared with corresponding status flags entered by the operator in the digital data record.

Documented results of QA/QC checks performed on each analyzer are evaluated with respect to relevant acceptance and performance criteria outlined in this monitoring plan.

Reports documenting unacceptable operating conditions or non-conformance/corrective action (NC/CA) events that may have adversely impacted data quality are also reviewed. If discrepancies or questionable data values are identified during the validation process, the entire data record is reviewed (including all annotated corrections made for Level 2 data). Consultations with monitoring project personnel are made as necessary to obtain additional information relevant to questionable data. The objective of the validation review in these instances will be to establish a clear and defensible basis for retaining, correcting, or rejecting the data in question in accordance with published regulatory guidelines and established scientific principles.

Any additional corrections or revisions made to the data report file during the data validation review are documented, dated and signed by the validation reviewer. The corrections are then entered into the electronic data file and re-processed. A separate file containing the corrections is checked for accuracy against the documented corrections. When all corrections are complete and checked, a final "Level 3 - Validated" data file is produced.

All copies of the annotated and dated data files generated during the data review and validation process are archived for a period of five (5) years.

5.5.2.4 Stray light interference management

Stray light could potentially affect the operation of UVDOAS instruments by lowering the quantified absorbance of the compounds being monitored. The UVDOAS systems that Goodrich will deploy for the monitoring of the Covered Air Toxics have a proprietary software that manages stray light interference to ensure valid data quality. CEREX UVDOAS analyzers compensate for stray light by incorporating the stray light in both the measurement and background data, which effectively nullifies the contribution of stray light.

For fast frequency stray light changes that are not managed by the above-described method, the UVDOAS systems use a previously recorded sample of stray light and subtract it from the absorbance spectrum. The amount of stray light is measured, and the compensation amount is scaled to match. The stray light is continuously measured, and its effects are continuously monitored. If data quality issues are encountered due to increased stray light effects, then additional corrective action may be required, which could include turning the UV light off periodically to record a "dark" spectrum and use of the resultant stray light spectrum as the new subtraction source.

The TDLs that will monitor for hydrogen sulfide and hydrogen cyanide will use a proprietary method that is built into the system’s analysis software that compensates for stray light by quantifying it during background measurements, even though the wavelength of light used in these lasers is not expected to be significantly affected by stray light. Since hydrogen sulfide is not used or stored at the facility, the facility does not have the potential to emit this compound. Therefore, in the event a Table 1-2 Alert Threshold for hydrogen sulfide is monitored under this plan, the monitored concentrations will not be attributable to the facility, but to one or more of the near-by facilities described in Section 2.1 and Table 2-1, titled, “Other Industrial Facilities near Goodrich”, of this plan.

5.5.3 Data Reporting

Reports summarizing fenceline monitoring operations, compound concentration data, and meteorological data will be posted to the public website quarterly, within 60 days after the end of the quarter. The reports will summarize open-path data for covered air toxics (benzene, hydrogen sulfide and hydrogen cyanide), diagnostic compounds, as well as meteorological data and fenceline monitoring operations. Any significant changes to the monitoring system, downtime, and quality assurance activities and results for the quarter will also be summarized. An example report template is provided in Appendix C.

A downloadable data file containing 5-minute and hourly averaged concentration data for the three covered air toxics, as well as meteorological data will also be posted on the website along with the report. This data file will also be posted within 60 days following the end of the quarter for which the data were collected. An example data file template is provided in Appendix D.

Data will be verified and validated according to the steps outlined in Section 5.5.2.3 before final data reports are published on the website to ensure that the data are accurate, valid and representative of conditions at the fenceline.

Additional internal reports to be generated in support of the fenceline monitoring program include Non-Conformance/Corrective Action (NC/CA) Reports. All deficiencies and concerns identified during audits, site visits, and/or during data review will be recorded and reported to the Project Manager within a maximum of two business days following discovery of the problem. Documentation of a suspected or actual non-conformance event (i.e., problem) is typically initiated immediately by the project team member who first identifies the event or condition. Non-conformance events may be identified by a data technician during the course of routine daily data QC review, or by the local field operator during the course of a routine site check.

Documentation of a suspected or actual non-conformance event may be added to over time as investigative and corrective actions are taken. The documentation for such events includes all relevant information necessary to fully identify, characterize and assess the impact of the event or condition on monitoring operations and data validity. The monitoring site where the event occurred, event "Begin" and "End" times, model(s) and serial number(s) of affected equipment, and impacted monitoring parameter(s) are all identified, as are the names of each project team member who may contribute to the documentation record and/or is involved in investigating and resolving the problem. Documentation of non-conformance/corrective action events is archived as a permanent part of the monitoring program record, and is referenced during the data validation process.

In addition to the above mentioned reports, a site Logbook will be maintained. Entries made in the site logbook will comprise a chronological record of all activities that take place at the monitoring site, including routine operations and maintenance, documentation of any problems that occur and subsequent actions taken to resolve the problem, unusual events that might affect the monitoring data, as well as summarized results of calibrations, QC checks and audits. All field documentation, data processing and validation information, and associated reports will be archived by Montrose for at least five (5) years after their generation, at which time they will be handed over to the custody of Goodrich for disposition.

5.6 Backup Measures

House Bill 1189 requires "Temporary Back-up Measures" to implement during equipment failures. In the event that extended downtime is predicted, or unpredicted, preventing the attainment of 75% data completeness, Goodrich will verbally notify APCD within 72 hours of the time Goodrich knows, or has reason to know that extended downtime will occur. Within seven (7) calendar days of the time that Goodrich knows or has reason to know of the occurrence/prediction of such an event, Goodrich shall submit to APCD a written description of the event causing the downtime, the reason for and expected duration of the downtime, and a plan proposing alternate monitoring options for the affected monitors during the extended downtime event. The APCD shall provide a written response to the proposed alternate monitoring plan either accepting or rejecting the proposal. Montrose will also store backup measure equipment at its local Denver, Colorado office and deploy a field technician within 72 hours of an equipment failure.

Table 5-12. Temporary backup measures for open path equipment downtime.

Pollutant	Backup Measure
Benzene	Passive tube sampling by Method 325B
Hydrogen Sulfide[26]	H_2S sensor (Envea)
Hydrogen Cyanide	Passive tube sampling

For the passive tube sampling the technician will follow the requirements of EPA Method 325A while deploying and retrieving the passive samplers and exposed sample tubes at each location. The passive tube samples will be shipped to Enthalpy Analytical LLC in Durham, NC for analysis. Enthalpy is Montrose's NELAP Accredited laboratory nationally known for providing EPA Method 325B services and EPA Method TO-11A services. Sampling will be collected over no more than a seven day period.

For hydrogen sulfide, which is neither stored at nor emitted by the Goodrich Pueblo facility, Montrose will deploy an Envea Cairsen electrochemical sensor. The sensor is a stand-alone unit which will undergo a multipoint calibration in the laboratory prior to deployment. A gas "hood" is installed over the top of the sensor and gas is flowed at approximately 0.5 L/min across the sensing portion of the sensor's face. An Aeroqual gas diluter is used to generate standards of known concentrations and the required accuracy.

[26] Compound is not stored, produced or emitted by Goodrich.

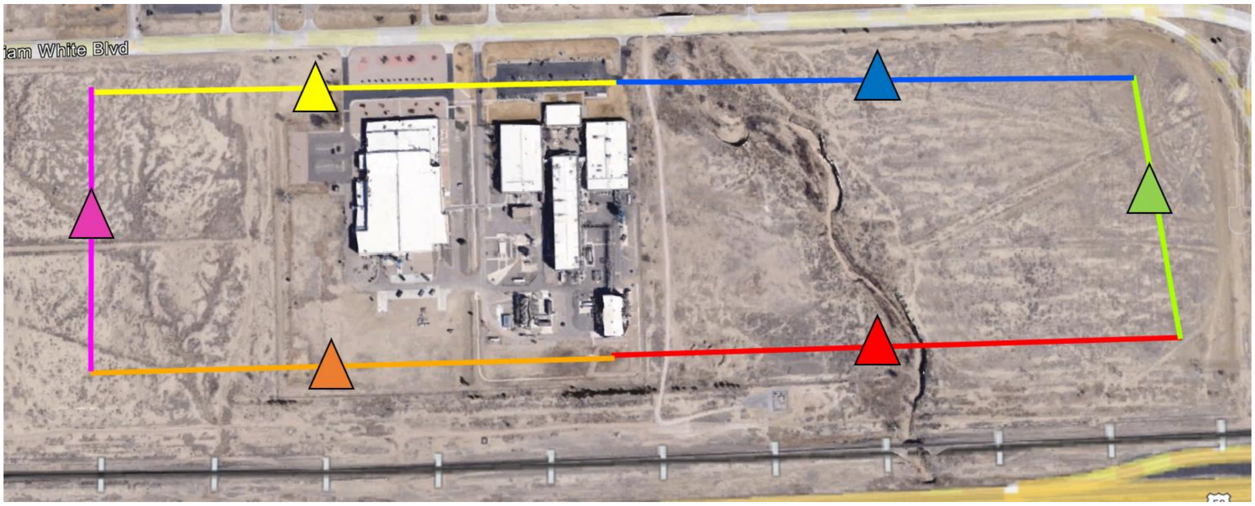


Figure 5-1. Location of Point Samplers/Monitors Should Any Fenceline Equipment Become Non-Operational

For example, as shown in the figure above, should Path 1 monitoring equipment be down for an extended period of time for benzene or hydrogen cyanide, a passive tube sampler would be deployed at the marker indicted. If the Path 1 monitoring equipment went down for an extended period of time for hydrogen sulfide, the sensor would be deployed at the marker indicated.

Appendix A
Equipment Specifications

Met One Instruments, Inc.

010C Wind Speed Sensor
020D Wind Direction Sensor

Both wind speed and wind direction sensors are used in environments ranging from Antarctic cold to arid desert heat. The 010C 010C-1 and 020D instruments meet U.S. EPA and NRC performance specifications for critical regulatory, research or scientific measurement applications.

The 010C Wind Speed Sensor provides accurate and detailed information on horizontal wind speed. The lightweight three-cup anemometer is used in virtually all applications where fast response and low starting threshold(s) are of paramount importance.

The 020D Wind Direction Sensor provides azimuth data for use in micro-meteorological measurements related to operational studies and research. The lightweight airfoil vane is directly coupled to a single precision potentiometer. These sensors are especially useful when a low starting threshold, a high damping ratio, or a short delay distance is required.

020D Wind Direction Sensor

010C Wind Speed Sensor

Reliability

The 010C and 020D are made of stainless steel and anodized aluminum components and are functionally more reliable than any other sensors of their kind:

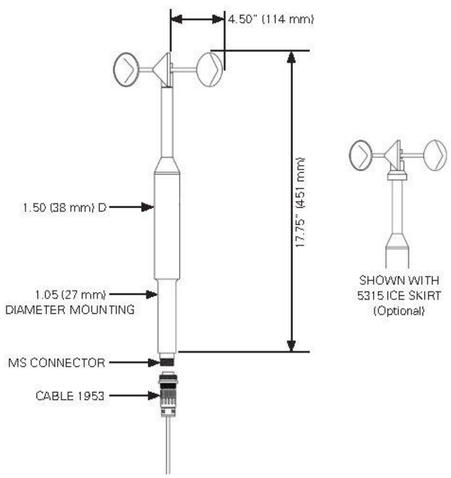
- Built-in electrical field surge protection greatly reduces problems associated with static fields, near-miss lightning hits and poor grounding systems
- Inclusion of Met One Instruments internal heater (AC use only) provides positive clean aspiration through the bearings, thereby greatly increasing sensor bearing life
- Optional, external de-icing heater sleeve for applications where freezing rain, ice and low wind speeds may be encountered

Features

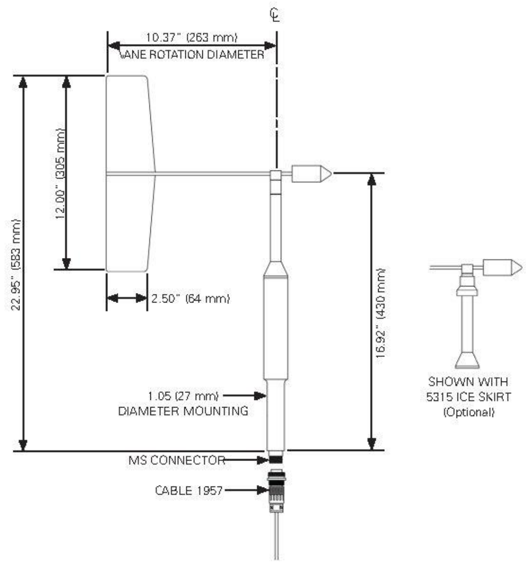
- Low starting threshold
- Internal heater for long bearing life
- High damping ratio
- Low profile to minimize "sensor turbulence"
- Short delay distance
- Quick-disconnect connector
- Ingress Protection Level 65 (IP65)
- Field-replaceable electronic components

010C Wind Speed Sensor
020D Wind Direction Sensor

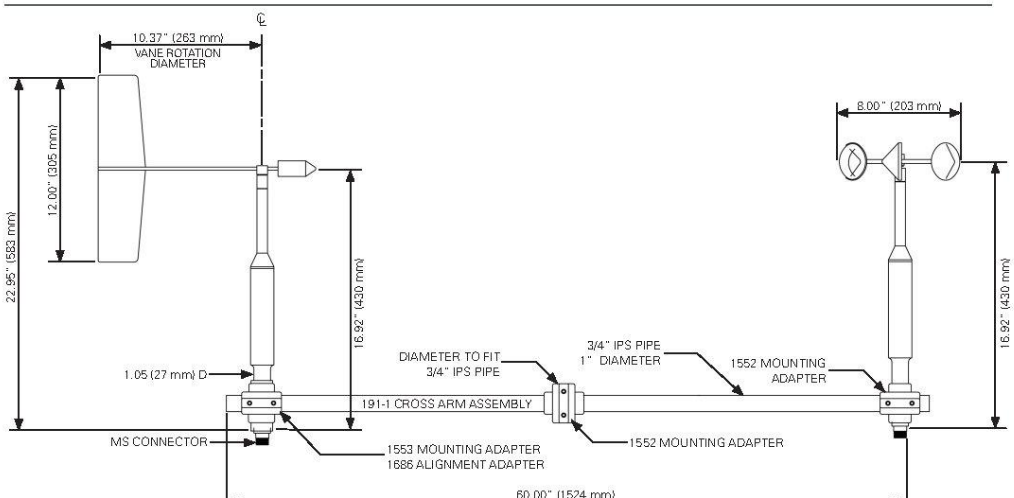
Technical Drawings



010C Wind Speed Sensor



020D Wind Direction Sensor



191-1 Mounting Arm & 010C-020D

Met One Instruments, Inc.

1600 Washington lvd. rants Pass, Oregon 97526 **Phone:** 541.471.7111
Sales: sales metone.com **Service:** service metone.com **Website:** www.metone.com

August 2019

Specifications

010C Wind Speed Sensor
020D Wind Direction Sensor

010CWindSpeedSensor

Performance Characteristics

Maximum Operating Range:	0-135mph (0-60m/s)
Starting Speed:	0.5 mph (0.22 m/s)
Calibrated Range:	0 -112 mph (0 -50 m/s)
Accuracy:	±1% or 0.15 mph (0.07 m/s) Resolution <0.1 mph or m/s
Temperature Range:	-50°C to +65°C (-58°F to +149°F)
Distance Constant:	less than 5 ft (1.5m) of flow (meets EPA specifications)

Electrical Characteristics

Power Requirements:	12 VDC at 10 mA, 12 VDC at 350 mA for internal heater
Output Signal:	11 volt (pulse frequency equivalent to speed)
Output Impedance:	100 Ω maximum

Physical Characteristics

Weight:	1.5 lbs (.68 kg)
Finish:	Clear anodized aluminum; Lexan cup assembly

Cable & Mounting

PN 1953	Cable Assembly; specify length in feet or meters
Mounting:	PN 191 Crossarm Assembly

020DWindDirectonSensor

Performance Characteristics

Azimuth:	Electrical 0° -357° Mechanical 0° -360°
Threshold:	0.5 mph (0.22 m/s)
Linearity:	±1/2% of full scale
Accuracy:	±3° Resolution <0.1 °
Damping Ratio:	Standard 0.6 (magnesium tail) (meets EPA specifications)
Delay Distance:	Less than 3 ft (91 cm)
Temperature Range:	-50°C to +65°C (-58°F to +149°F

Electrical Characteristics

Power Requirements:	12 VDC at 10 mA, 12 VDC at 350 mA for internal heater
Output Signal:	0-5, 0-2.5 (optional 0-1) VDC for 0° -360°
Output Impedance:	Ω maximum

Physical Characteristics

Weight:	1.5 lbs (.68 kg)
Finish:	Clear anodized aluminum

Cable & Mounting

PN 1957	Cable Assembly; specify length in feet or meters PN 191-1
Mounting:	Crossarm Assembly

Wind Sensors W/ Aluminum Cups & Vane

010C Distance Constant:	15 ft. (4.6 m) aluminum cup assembly (meets EPA specifications)
020D Damping Ratio:	0.25 (aluminum tail)

Specifications are subject to change at any time.

TERRA APPLIED SYSTEMS

NEW & EMERGING TECHNOLOGIES

UNISEARCH

A TAS technology partner

LasIR Instruments

LasIR RP - Mini Portable Series
An analyzer and optic assembly designed for applications that require ambient air measurements - potrooms, remote paths, and mobile applications.

LasIR RS - Mini Stack Series
An analyzer with built in optics designed for durability, for in situ, real time stack and duct measurements. Enclosure may vary in size.

LasIR RD and RR(B or M) - Standard Series
Standard series analyzers are designed to send and receive signals from a central control room to various measurement points. The analyzers come in two sizes; table top (RD) available for 1-2 locations and 3U rack mounted versions (RR) capable of measuring up to 16 locations using a single analyzer. Two configurations are available for the rack mounted (RR) analyzers to select the measurement location; the RR (B)-Series which employ beam splitters (2-8 locations) and the RR (M)-Se-ries which employs optical multieplexers (2-16 locations). Use of beam splitters or optical multiplexers is determined by the dust loading in the measurement path.

Improve energy efficiency, reduce costs, and safeguard work environments with in-situ, real time gas analyzers for CEMS, combustion, environmental, fugitive emissions, health, safety and process monitoring.

Sales and Service

TERRA APPLIED SYSTEMS
951 FM646 Rd East. Ste A6
League City TX 77573
tel: 888.256.1366 e: info@TASysLLC.com

UNISEARCH ASSOCIATES INC

LasIR
Industrial Gas Monitors

For CEMS, combustion, environmental, fire detection, fugitive emissions, health, safety and process monitoring applications.

Providing accurate, reliable and continuous measurements at a real-time process level with an exceptional life cycle value.

Multiplexing systems monitor up to 16 locations using sensors at each measurement location connected by cables to a central analyzer.

www.unisearch-associates.com

In-Situ Optical Sensors

Sensors mounted on the stack or duct continuously measure the process flow of gases and emissions.

STACKS AND DUCTS
The LasIR is able to monitor Stacks and Ducts with standard flange connections. Requires line of sight across stack/duct.

Single, dual and multi-pass options offer flexibility for path lengths. Configurations depend on in situ conditions and sensitivity requirements.

OPEN PATHS
The LasIR monitors remote locations with stationary mounts and reflector arrays. Requires line of sight across remote location.

Stack / Duct Optics:

Path Length:
Up to 25 meters

Mounting
9"OD ANSI flanges

Air Purge Requirements - *depending on conditions*
50 psi @ 15 L/min

Environmental Conditions
Gas: -100 to +1800 °C, 5 - 95% RH, 25 - 2000 mbar
Optics: -40 to 65°C, 5-95% RH, 25 - 2000 mbar

Optic Dimensions
Transmitting / Receiving set: 5 kg
NEMA Enclosure: 13"(H) 11"(W) 10"(D) | 10kg

Remote Optics

Path Length:
Up to 1000 meters

Transmitting Telescope Dimensions
15"(H) x 6"(W) x 17"(D) *15 x 15 x 35 cm* | *(4 kg)*

X-Y-Z Mount Dimensions: 6"(H) x 9"(W) x 14.5"(D) | *(5.2 kg)*
Optional Tripod: (4.2 kg)

Single Element Retro Reflectors
4" x 4" x 8" (10 x 10 x 20 cm) | *(0.5 kg)*

7 & 19 Element Reflector Array (*same mounts*)
12" x 10" x 6" (30.5 x 25.4 x 15.2 cm) | *(5 kg)*

Sensitivities

Gas	Detection Limits (ppm -m)	
CO	30	38 mg/m³
CO_2	30	59 mg/m³
CH_4	0.5	0.36 mg/m³
HCl	0.2	0.32 mg/m³
HF	0.03	0.03 mg/m³
H_2O	0.1	0.08 mg/m³
H_2S	5	8 mg/m³
NH_3	0.3	0.23 mg/m³
NO	15	20 mg/m³
O_2	100	140 mg/m³

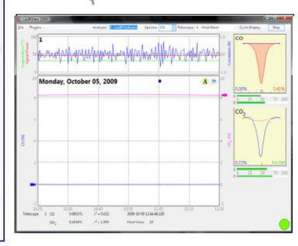
** Detection limits will vary depending on measurement conditions.*

LasIR instruments are designed and built to comply with CSA, UL and CE requirements:

RoHS Compliant
Laser Safety: IEC / EN 60825
General Safety: IEC 61010
Electro-Motive Compliance: IEC / EN 61000

LasIR Multiplexing Systems

Available in 1, 2, 4, 8, 12 and 16 channel configurations.



Real Time Monitoring & Analysis

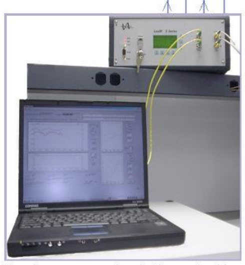
Measurements are taken and analyzed at rates as fast as 1 second.

Located in a controlled environment up to 5000 meters away from measurement locations, the analyzer sends and receives signals to and from the optical sensors via cables.

Multiplexing. Through either splitting or optically switching the light source, one analyzer can monitor up to 16 different locations.

Multiple Species. Depending on the gas and the laser wavelength, simultaneous measurements of up to 4 different gas species with a single analyzer are possible.

Data Logging. LasIRView is a software program that can be used to display Real-Time measurements modify basic parameters such as sampling time and path length and download archived data (via ethernet) for trend analysis on an external computer. An optional Key allows access to diagnostic software for the analyzer.



Signals sent out to optics via fiber optic cables and return to analyzer via coaxial cables. Data is displayed on a networked laptop.

Analyzer Specifications:

Dynamic Range: 5 orders of magnitude

Response Time: 0.1 seconds and higher

Calibration: Factory set

Laser: NIR Diode lasers

Outputs and Networking
RS232, Ethernet (ModBus), 4-20mA, Status relays

Analog Inputs
4-20mA for Temperature and Pressure

Environmental Conditions
5 to +40°C, 5 - 95% RH, 800 - 1200 mbar

Data Logging and Display Software
LasIRView, *(optional Key to access diagnostic software)*

Data Storage
Internal storage & External storage via Ethernet or RS232 to external computer

Power Supply
Input 100 - 240 VAC @50-60Hz, +12 VDC
Output: 12V, 60w *Operating Voltage*: 12 VDC

Dimensions: Rackmount (R-3U) or Desktop (D)
R: 5.25"H x 17"W x 11"D (13 x 43 x 28 cm) |*(5 kg)*
D: 6"H x 11"W x 11"D (15 x 28 x 28 cm) |*(4 kg)*

Cerex UV Sentry - HC Harsh Climate Model

UV DOAS Multi-Gas Analyzer

Designed to withstand extreme environmental conditions during the open path detection of **key hazardous emissions** (such as Benzene and Chlorine)

Features

- Benzene and other gases down to parts-per-trillion minimum detection limits (gas specific) within seconds
- Eliminates many point monitors with a single optical path length up to 1000 meters
- Low cost of ownership, no-maintenance design; only consumables are dust filters and UV lamp
- Data output rates typically 15 sec. to 2 min.
- User-configurable open-source library
- Remote control over network or internet - cellular-ready
- Continuous, automated background update - no cylinder gases or zero air required to update backgrounds
- Raw spectrographic information in .csv format for instant analysis, compared to “black box” solutions
- Simple calibration verification using built-in flow cell

PRODUCT QUALITY ASSURANCE

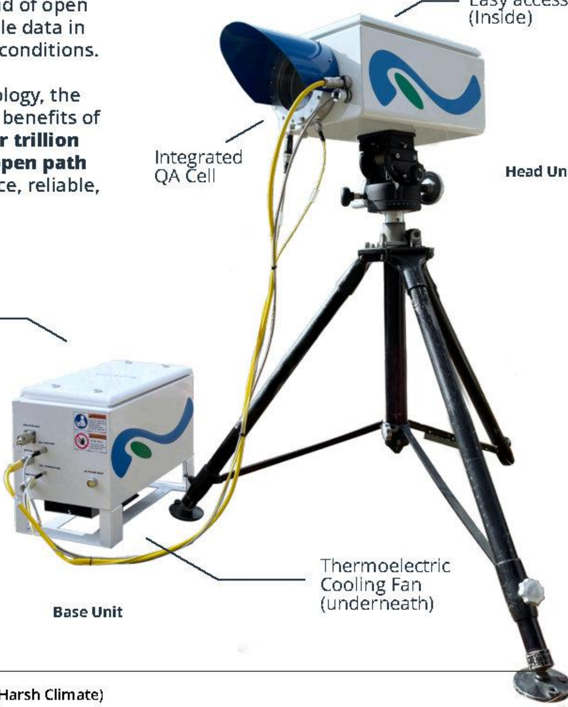
Cerex Monitoring Solutions places customer service and support as its highest priority and commits to long standing relationships that do not end after the sale of an analyzer.

Cerex has sold more than 200 open path systems that are currently fielded and operational

CEREX Monitoring Solutions, LLC
1816 Briarwood Industrial Ct NE
30329 Atlanta, GA, USA
678-570-6662
INFO@CEREXMS.COM

Based on years of the success with UV SENTRY, the Harsh Climate model was developed by Cerex's engineers to meet the demand of open path analyzers that can output reliable data in the midst of extreme environmental conditions.

Utilizing the same proprietary technology, the Harsh Climate model features all the benefits of the UV Sentry **(gas-specific parts per trillion detection limits, 1000+ meters of open path monitoring)** inside a low-maintenance, reliable, and robust package.



General Specifications

Analyzer Model	UV Sentry - HC (Harsh Climate)
Analyzer Type	Open path multi-gas UV DOAS
Applications	Fence-line Monitoring System (FLMS), Benzene, Toluene, and Xylenes (BTEX), Brownfield Remediation, Chlorine Monitoring, Chemical Depot Monitoring, Manufactured Gas Plant Remediation (MGP), Perimeter Ambient Monitoring System (PAMS), Superfund Site Remediation, Tank Farm Monitoring
Minimum Detection Limit	Gas-specific, typical parts per trillion
Method Compliance	✓EPA Method 325 ✓40 CFR 63.658 (MACT) ✓SCAQMD Rule 1180 ✓BAAQMD Rule 12-15
Instrument Cooling	Thermo electric air conditioner - no freon
Operating Conditions	**Temperature** -40C to +60C Meets Mil-STD-810G CN1- method 505.6 **Humidity** 0 to 100% Condensing Meets Mil-STD-810G CN1- method 507.6 **Rain** Direct Exposure Rated Meets IEC 60529 – IP5X **Corrosion** Salt Fog Meets Mil-STD -810G – method 509.6 **Dust/Sand** Direct Exposure Rated* Meets IEC 60529 – IP5X *Shelter recommended to relieve wind loading
Installation	Stainless steel mount for fixed permanent installation, or tripod
Interface	Integrated touchscreen PC with MS Windows™ 10/11 OS USB, ethernet ports

Scan here for more details

CEREX
1816 Briarwood Industrial Ct NE
30329 Atlanta, GA, USA
678-570-6662
INFO@CEREXMS.COM

Appendix B
Units and Abbreviations

Acronym	Definition
%	percent
°	degrees
°C	degrees centigrade
AEGL APCD	Acute Exposure Guideline Levels
	Air Pollution Control Division
ATSDR	Agency for Toxic Substances and Disease Registry
CDPHE	Colorado Department of Public Health & Environment
CLS	classic least squares
cm	centimeter
nm	nanometers (wavelength)
CNS	central nervous system
CV	coefficient of variation
DC	direct current
DOD	Department of Defense
DOE	Department of Energy
DQA	data quality assessment
DQI	data quality indicator
DQO	data quality objective
EDMS	electronic data management system
EPA	U.S. Environmental Protection Agency
FAQ	frequently-asked-questions
FEMA	U.S. Federal Emergency Management Agency
TDL	Tunable Diode Laser
GB	gigabytes
GHz	Gigahertz
HB 21-1189	Colorado House Bill 21-1189
hPa	hectopascals
Hz	Hertz
IPAWS	Integrated Public Alert & Warning System
K	Kelvins
km	kilometer
LAN	local area network
LED	light-emitting diode
mbar	millibar
m/s	meters per second
mm/hr	millimeters per hour
MQO	measurement quality objective
NAS	National Academy of Sciences
NAMS	national air monitoring stations

Acronyms and Abbreviations

Acronym	Definition
ng/m^3	nanograms per cubic meter
NIOSH	National Institute for Occupational Safety and Health
NIST	U.S. National Institute of Standards and Technology
nm	nanometer
O&M	operation and maintenance
PAC	Protection action criteria
PC	personal computer
ppb	parts per billion
ppm	parts per million
QA	quality assurance
QC	quality control
SLAMS	state and local air monitoring stations
SOP	standard operating procedure
TBD	to be determined
TDL	tunable diode laser
UVDOAS	ultraviolet differential optical absorption spectroscopy
VDC	volts direct current
W	watts

Appendix C
Quarterly Report Template

Quarterly Report Template

[Each quarter, a report will be released summarizing recent data and any exceedance events. For consistency, each report will follow the template below. If no changes have been made to the monitoring system, operations, or procedures then the Methods section will match those of previous reports. However, the Results section and Appendices A - E will be updated each quarter to report on the latest data collected by the Fenceline Monitoring System.]

I. Title Page

II. Executive Summary

III. Contact Information

IV. Methods

A. Site Description

B. Instrument Description

1. Open-Path Monitors

- ***Open Path (OP) Ultra Violet Differential Optical Absorption Spectroscopy (UVDOAS)***

- ***Open Path (OP) Tunable Diode Laser Absorption Spectroscopy (TDLAS)***

2. Meteorological Monitors

3. Alternative Monitors (if applicable)

[Describe alternative monitoring methods, including the conditions under which they or the data are used, or state "not applicable" if appropriate]

C. System Design

D. Data Validation and QA/QC Procedures

V. Results

EXAMPLE

A. Monthly Data Summary

Table 6: Monthly Data Summary

Month	Compound	Number of Exceedances[1]	0th[2]	25th[2]	50th[2]	75th[2]	100th[2]	Avg	Pct Detect[3]	Pct Valid[4]	Median 1hr DL[5]

[1] number of 1-hour measurements above the notification threshold value
[2] data quartiles = the value at which a defined percentage of data existing below this value
[3] the percentage of hourly averages above the detection limit (DL) as compared to the total possible hourly averages (excluding data collected during QA/QC activities, calibration, or maintenance)
[4] the proportion of the "Pct Detect" measurements that pass all data verification measures
[5] the median 1-hr detection limit observed across validated measurements per compound for the month specified

B. Summary of Recent Quarters Emergency Notifications

Table 7: Exceedance Events

Datetime	Latitude[1]	Longitude[1]	Path	Analyzer	Compound	Validated 1hr Concentration[2]	WD (in degrees, origin)	WS (mph)

[1] latitude and longitude of the analyzer
[2] all 1-hr concentrations above the notification threshold value

C. Discussion of Events that Activated the Emergency Notification Plan and Responses

D. Summary of Invalidated Data

Table 8: Invalidated Data

Start Time	Stop Time	Latitude[1]	Longitude[1]	Path	Analyzer	Compound	Flags	Notes

[1] latitude and longitude of the analyzer

E. Discussion of Invalidated Data

[Add discussion of invalidated data as needed]

EXAMPLE

F. Discussion of Results

[Discuss the results presented in the following section - "Summary Plots"]

G. Summary Plots

[Include a timeseries for each of the three covered compounds depicting the past quarters data, include a box and whisker plot for each of the covered compounds depicting the quartiles and average values for the quarter, include timeseries for meteorological data (i.e., temperature, humidity, and barometric pressure) for the quarter, and a summary wind rose plot for the quarter.]

H. Discussion of Changes to Monitoring System, Operations and/or Procedures

[Describe any changes to the monitoring system, and/or operations or procedures described in the FMP or QAPP as well as the rationale for these changes.]

VI. Appendices

A. Appendix A: Calibration and QA/QC Data

Table 9: Verification Activities

Date	Type of Verification	Path	Path Length[1]	Analyzer	Compound	Expected Concentration	Measured Concentration	Accuracy (%)	Precision (%)

[1]path length in meters

Table 10: Percent Recovery for Compounds

Path	Benzene (percent data recovery)	H2S (percent data recovery)	HCN (percent data recovery)

Table 11: Percent Recovery for Meteorological Parameters

EXAMPLE

Parameter	Percent Data Recovery
Wind Speed	
Wind Direction	
Temperature	
Humidity	
Pressure	

Table 12: Average O_2 and O_3 Concentrations

Path	Average O_2 Concentration (%)	Accuracy (%)	Average O_3 Concentration (ppb)	Accuracy (%)

B. Appendix B: Calibration Gas Certification Sheets

C. Appendix C: Non-Conformance/Corrective Action Data Sheets

D. Appendix D: Field Data Sheets

E. Appendix E: Results and Discussion for Alternative Monitoring Methods (if applicable)

F. Appendix F: Qualifier Codes

Table 13: List of Data Invalidation Codes

Qualifier Code	AQS Definition *(additional information added in parentheses)*	Type or Related Action
AB	Technician Unavailable. *(use if this affects scheduled QA/QC or necessary maintenance)*	Null Data Qualifier
AD	Shelter Storm Damage.	Null Data Qualifier
AG	Sample Time out of Limits. *(e.g., use if integration time is out of manufacturer recommended range and signal intensity and MDL cannot meet the critical criteria mentioned in the FLMP)*	Null Data Qualifier
AI	Insufficient Data. (cannot calculate)	Null Data Qualifier
AL	Voided by Operator. *(e.g., Datum rejected by data validators)*	Null Data Qualifier

EXAMPLE

AM	Miscellaneous Void.	Null Data Qualifier
AN	Machine Malfunction *(can be used for issues such as an instrument being out of alignment, or an analyzer being offline due to connection problems or instrument failure)*	Null Data Qualifier
AO	Bad Weather. *(Use if weather impacts open-path instrument operation/function)*	Null Data Qualifier
AP	Vandalism. *(Use if vandalism impacts open-path instrument operation/function)*	Null Data Qualifier
AQ	Collection Error. *(use specifically for low analyzer signal events, or when a low analyzer signal prevents the reported data from meeting the critical criteria, while the calculated MDL is lower than the desired value)*	Null Data Qualifier
AT	Calibration.	Null Data Qualifier
AU	Monitoring Waived.	Null Data Qualifier
AV	Power Failure.	Null Data Qualifier
AW	Wildlife Damage. *(Use if damage impacts open-path instrument operation/function)*	Null Data Qualifier
AX	Precision Check.	Null Data Qualifier
AY	QC Control Points (zero/span).	Null Data Qualifier
AZ	QC Audit.	Null Data Qualifier
BA	Maintenance/Routine Repairs.	Null Data Qualifier
BH	Interference/co-elution/misidentification.	Null Data Qualifier
BJ	Operator Error.	Null Data Qualifier
BK	Site computer/data logger down.	Null Data Qualifier
BL	QA Audit.	Null Data Qualifier
BM	Accuracy check.	Null Data Qualifier
DA	Aberrant Data (Corrupt Files, Spikes, Shifts).	Null Data Qualifier
DL	Detection Limit Analyses.	Null Data Qualifier
EC	Exceeds Critical Criteria. *(use when data exceeds critical criteria, such as for MDL)*	Null Data Qualifier
IA	African Dust. *(use for any dust event)*	Informational
IT	Wildfire-U.S. *(use for any wildfire event)*	Informational
J	Construction/Repairs in Area.	Informational
LJ	Identification of Analyte Is Acceptable; Reported Value Is An Estimate.	Quality Assurance Qualifier
MD	Value less than MDL.	Quality Assurance Qualifier
NS	Influenced by nearby sources. *(e.g., in the event of emissions influenced by nearby sources)*	Quality Assurance Qualifier
QP	Pressure Sensor Questionable. *(e.g., use if cell pressure is out of range, indicating malfunction)*	Quality Assurance Qualifier
QT	Temperature Sensor Questionable. *(e.g., use if cell temperature is out of range, indicating malfunction)*	Quality Assurance Qualifier

EXAMPLE

QV	Quality Control Multi-point Verification.	Null Data Qualifier
QX	Does not meet QC criteria. **(e.g., data exceeds automatic criteria for rejection)*	Quality Assurance Qualifier
SC	Sampler Contamination.	Null Data Qualifier
ST	Calibration Verification Standard.	Null Data Qualifier
TC	Component Check & Retention Time Standard. **(use this code for additional instrument checks, e.g., a robustness tests)*	Null Data Qualifier

EXAMPLE

Appendix D
Data Packet Template

Fenceline Air Monitoring System Quarterly Data Packet Template

Tab 1: Monthly Data Summary

Facility	Month	Compound	Number of Exceedances	0th	25th	50th	75th	100th	Ave	Pct Detect	Pct Valid	Median 1hr DL

Tab 2: Exceedance Events

Facility	Datetime	Latitude	Longitude	Path	Analyzer	Compound	Validated 1hr Concentration	WD (in degrees, origin)	WS (mph)

Tab 3: Invalidated Data

Facility	Start Time	Stop Time	Latitude	Longitude	Path	Analyzer	Compound	Flag	Notes

Tab 4: Verification Activities

Date	Type of Verification	Path	Path Length	Analyzer	Compound	Expected Concentration	Measured Concentration	Accuracy (%)	Precision (%)

Tab 5: Data

Facility	Datetime	Latitude	Longitude	Path	Analyzer	Benzene	Benzene DL	Flags Benzene	Hydrogen cyanide	Hydrogen cyanide DL	Flags Hydrogen cyanide

Tab 5: Data (Continued)

Hydrogen sulfide	Hydrogen sulfide DL	Flags Hydrogen sulfide	Temperature	Flags Temperature	Humidity	Flags Humidity	WS	Flags WS	WD	Flags WD	During Exceedance (y/n)

Tab 6: Guidance

<table>
<tr><td colspan="3">Please adhere to the following guidance for data entry</td></tr>
<tr><td rowspan="3">Compound</td><td>Benzene</td><td rowspan="9">For the Data tab: please follow guidance shown here and in the report template for Datetime, Longitude, Latitude, and Path; report hourly concentrations and detection limits (DL) in ppm for all compounds; for Flags, refer to the qualifiers list in Table 8 in the Report template. Note, if multiple flags are needed, separate them using a single space (e.g., "AB AO AL").</td></tr>
<tr><td>Hydrogen cyanide</td></tr>
<tr><td>Hydrogen sulfide</td></tr>
<tr><td>Datetime
Start & Stop Time</td><td>YYYY-mm-dd HH:MM:SS</td></tr>
<tr><td>Month</td><td>YYYY-mm</td></tr>
<tr><td>Date</td><td>YYYY-mm-dd</td></tr>
<tr><td rowspan="4">Type of Verification</td><td>calibration</td></tr>
<tr><td>quality control</td></tr>
<tr><td>audit</td></tr>
<tr><td></td><td>other</td></tr>
</table>

Appendix E
Quality Assurance Project Plan (QAPP) Checklist

HB21-1189 Fenceline Air Monitoring Plan QAPP Checklist

To facilitate consistent Quality Assurance Project Plans (QAPPs) for the Fenceline Air Monitoring Plans (FLMPs), the following QAPP Checklist is provided. This checklist is designed to assist the QAPP writers/reviewers in identifying the major areas that remain to be addressed in the QAPP, and to help explain the type of information required for the various QAPP elements.

Throughout the FLMP and QAPP review process, APCD staff provided each facility with written and verbal comments. This checklist was created to help facilities identify the elements in their QAPP documents that still need additional work, to assure equitable/comparable information for all QAPPs, and to help expedite the FLMP approval process. This checklist consists of a series of lists aimed to identify if all required elements were included in the QAPP.

Each section/element in this checklist includes two check boxes:

> **I (Included) -** The information is included in the QAPP. If the corresponding section and listed elements are included in the QAPP, check "I" box. If information is provided in a different section, include a reference to the appropriate section in "Comments" section of the checklist. If SOPs contain the information required in particular QAPP sections, the QAPP writer can refer to the specific sections within the referenced SOPs where the information can be found.
>
> **NI/NA (Not Included/Not Applicable) –** Information is not included and/or required or necessary for the QAPP. Must provide an explanation in the Comments section of the checklist.

The CDPHE APCD expectation is for this checklist to be completed and included with FLMP for each facility.

Element	I	NI/NA	Comment
Name of organization implementing the project	☐	☐	
Title and version/revision number	☐	☐	
Signature placeholders for approval (e.g., facility personnel, contractor, CDPHE staff, etc)	☐	☐	
Statement that the QAPP is a living document and will be updated/modified as the Rule HB 21-1189 program develops or as a result of independent audit recommendations	☐	☐	
Table of Contents	☐	☐	
List of required QAPP chapters and sections including Appendices	☐	☐	
List(s) of tables and figures	☐	☐	
Header illustrating document control format	☐	☐	
Distribution / Notification List	☐	☐	

Names/titles of key personnel (including contractors and relevant CDPHE) who will receive original and updated copies of the QAPP	☐	☐	
Contact information for key facility personnel	☐	☐	
Project/Task Organization			
Identification of the location(s) where the official version of the QAPP is housed (e.g., agency website, LAN, etc.)	☐	☐	
The organizational structure of project personnel. Should include independent quality assurance (QA) management function to accomplish QA objective of the project	☐	☐	
Identify who is primarily responsible for making changes to monitors within the fenceline air monitoring system (i.e., install, discontinue, replace, etc.)	☐	☐	
Identify who is primarily responsible for developing the QAPP (including document updates and future			

revisions, as this is a living document)			
Identify who is primarily responsible for developing the Quarterly Data Summary Reports	☐	☐	
Identify who is primarily responsible for the overall quality of the project's data	☐	☐	
Responsibilities of contractors / subcontractors	☐	☐	
Identify who is the designated Data System Administrator	☐	☐	
Specify who verifies and validates the data (e.g., QA staff; field technician)	☐	☐	
Specify who manages the QAPP and related documents and records (e.g., QA Manager, records custodian)	☐	☐	
Identify who is responsible for writing/revising/maintaining the QAPP/SOPs?	☐	☐	
Identify who operates, calibrates, and performs required QC checks on analyzers/samplers	☐	☐	

Identify who collects physical samples, if necessary (e.g. for back-up monitoring)	☐	☐	
Identify who performs preventive maintenance and/or instrument repairs	☐	☐	
Identify who tracks and orders equipment for the project, and who tracks inventory and orders supplies and consumables	☐	☐	
Identify who conducts instrument performance audits	☐	☐	
Identify who conducts systems audits	☐	☐	
Identify who performs data quality assessments	☐	☐	
Identify who verifies data quality	☐	☐	
Identify who tracks the completion of corrective actions and who assesses the success of corrective actions	☐	☐	
Identify who oversees training	☐	☐	
Identify any other relevant tasks			

performed by contractors and subcontractors	☐	☐	
Project Definition/Background			
The background/history/description of the Rule HB 21-1189 and Fenceline Air Monitoring	☐	☐	
List of pollutant(s) measured by the fenceline system and point monitors	☐	☐	
Review cycle for the QAPP and associated SOPs	☐	☐	
Project/Task Description			
Summary of the monitoring objective(s)	☐	☐	
Describe the work required to collect, document, and report the ambient monitoring data. Include a summary of the typical fenceline monitoring activities to be performed and measurements to be taken.	☐	☐	
Describe significant project milestones and timelines	☐	☐	

Summary of the QA oversight and responsibilities, and of the required assessments, schedule, and personnel responsible for completing them	☐	☐	
Critical documents and records to be maintained	☐	☐	
Quality Objectives and Criteria for Measurement Data			
Statement of the intended use of the data	☐	☐	
Description of the process used to develop the DQOs	☐	☐	
Include a table with MQOs for all the specific pollutants covered by the QAPP. Explain why the chosen MQOs are adequate for the purpose of fenceline monitoring	☐	☐	
Define all quantitative Data Quality Indicators (DQI) (precision, bias, accuracy, completeness, and sensitivity)	☐	☐	

For each DQI, explain how the facility measures these specific metrics	☐	☐	
Explain how data representativeness and comparability are achieved/addressed	☐	☐	
Include all relevant statistical reporting units	☐	☐	
Training			
Describe relevant training and courses taken by facility personnel (e.g., data review, verification and validation activities, and other QA training/courses)	☐	☐	
Required training material for staff and personnel working on this project (e.g., the QAPP, SOPs, etc.)	☐	☐	
Training frequency	☐	☐	
Documentation and Records			
Describe the organization’s document control system	☐	☐	

List of critical documents that are controlled by the organization (e.g., QAPP, SOPs, OAGs, blank data entry forms, etc.)	☐	☐	
Specify protocols for QAPP/SOP revisions and distribution to staff	☐	☐	
List of critical records generated and maintained as part of this project. Examples to look for may include: • Field QA / QC records • Data collection records • Logbooks • Chain of custody records • Field maintenance records	☐	☐	
• Audit reports (internal and external) • Corrective action records • Other QA / QC records • Commercial or in-house databases or spreadsheets • Training records • Monitoring site files (photographs, measurements, addresses, lease agreements, etc.)			

• Emails that include important monitoring information			
Specific location(s) where documents are files and archived, especially QAPPs / SOPs	☐	☐	
Description of records retention policy	☐	☐	
Back-up procedures for records (both hardcopy and electronic)	☐	☐	
Procedures for correcting data (handwritten and electronic)	☐	☐	
Fenceline System Description			
Description of fenceline system objectives	☐	☐	
Description of fenceline monitoring locations (including maps)	☐	☐	
Description of pollutants monitored at each location	☐	☐	
Monitoring schedule and frequency	☐	☐	
Description of the measurement method for **each** pollutant monitored	☐	☐	

SOP(s) for **each** measurement method (reference in the QAPP and provide individual SOP documents)	☐	☐	
Description of shelter, reflector type, and reflector climate-control requirements	☐	☐	
Information on potential monitor interferences and how they will be addressed (e.g., dust build-up)	☐	☐	
Protocols for making method changes (i.e., swapping out instruments) and/or corrections	☐	☐	
Quality Control Requirements			
Point monitors			
Describe calibration scale or range for calibration standards for each pollutant monitored	☐	☐	
Calibration acceptance criteria	☐	☐	
Calibration frequency	☐	☐	
Calibration standards preparation	☐	☐	
Calibration blanks (if applicable)	☐	☐	
Calibration standard verification procedure and standard requirements (i.e., certification/traceability)	☐	☐	

Detailed description of the types of QC checks performed on all gaseous analyzers (includes manuals and automated procedure when appropriate). Terminology may vary per organization; and, organizations typically perform more than one type of QC check on the gaseous analyzers. The description should include discussions of activities such as: • 1-point QC checks • Precision checks • Biweekly checks • Zero, Precision, Span checks • Multi-point verifications (MPVs)	☐	☐	
Types of QC checks performed on point monitors (e.g., flow rate checks)	☐	☐	
QC check concentration(s), range, and frequency	☐	☐	
QC check acceptance criteria	☐	☐	
Include calculations (formulae) for the various QC checks (when applicable)	☐	☐	
Provide examples of invalid QC checks	☐	☐	
Open-path analyzers			

Describe concentrations or concentrations range for "bump test"/verification for each pollutant monitored	☐	☐	
"Bump test/verification acceptance criteria	☐	☐	
"Bump test"/verification frequency	☐	☐	
"Bump test"/verification standard preparation	☐	☐	
Standard verification procedure	☐	☐	
Detailed description of the types of QC checks performed on all open-path (**includes manuals and automated procedure when appropriate).** *Terminology may vary per organization; and, it is recommended to perform more than one type of QC check on the open-path analyzers. The description should include* ***discussions*** *of activities such as:* • *1-point or multi-point verification QC checks* • *Precision checks* • *Biweekly checks* • *Spectral validation/"goodness*	☐	☐	

of the fit" checks			
Open-path QC checks acceptance criteria	☐	☐	
Provide examples of invalid QC checks	☐	☐	
All instruments			
Description of the various types of instrument performance evaluations conducted by facility personnel and/or contractor	☐	☐	
Instrument performance evaluation frequency	☐	☐	

Audit levels for all instruments and rationale for selecting those concentrations	☐	☐	
Procedures to follow if QC checks exceed acceptance criteria or specifications	☐	☐	
Documentation and reporting requirements	☐	☐	
Instrument/Equipment Testing, Inspection, and Maintenance Requirements			
Describe performance acceptance testing procedures for new equipment (after receipt from vendor)	☐	☐	
Instrument performance acceptance testing SOPs (referenced in the QAPP and attached)	☐	☐	
Procedures to follow when new equipment does not meet purchase requirements or performance specifications	☐	☐	
MDL testing / verification procedure	☐	☐	
General preventive maintenance	☐	☐	

activities for each instrument			
Maintenance schedule and frequency	☐	☐	
Frequency and activities of periodic inspection procedures (for sites, support equipment, etc.)	☐	☐	
Description of critical spare parts maintained	☐	☐	
Description of spare analyzers maintained	☐	☐	
Procedures for resolving potential deficiencies that have been identified during regular audits	☐	☐	
Instrument Calibration and Frequency			
Calibration methods / procedures for point and open-path analyzers, and meteorological/visibility sensors. If already described in earlier sections, reference the appropriate Section of the QAPP	☐	☐	
Types of standards and equipment used needing calibration / certification. Examples: • Open-path Analyzers – "bump" test / verification / consistency			

checks	☐	☐	
• Meteorological and visibility equipment – wind, visibility, RH and temperature standards			
Procedures for certifying equipment performance, including performance testing upon receipt (SOPs; referenced in the QAPP and attached)	☐	☐	
Data Management			
Describe complete data flow path for all pollutants	☐	☐	
Describe data flow from generation through reporting	☐	☐	
Description of how data is collected / Recorded	☐	☐	
Description of how and where data is stored, including raw, processed, validated, and auxiliary data	☐	☐	
Describe type(s) of data acquisition system in use	☐	☐	
Describe types of data handling support equipment (computers,	☐	☐	

modems, wireless routers, etc.)			
How and at what frequency data is transferred from the monitoring station to the central office / cloud	☐	☐	
How data is aggregated	☐	☐	
Procedures to process, compile, and analyze data (referenced in QAPP and attached in a specific SOP)	☐	☐	
Procedures to verify and validate data (referenced in QAPP and attached in a specific SOP)	☐	☐	
The frequency and process for verifying the accuracy of data reporting	☐	☐	
Procedures to test or audit the acceptability of the hardware and software configurations	☐	☐	
Personnel responsible for each data management task	☐	☐	
Data back-up procedures, including those for records stored on local hard drives	☐	☐	
Final data repository	☐	☐	
Data retention time frames	☐	☐	

Security measures (e.g., prevention of data modification or deletion)	☐	☐	
Assessment and Response Actions			
Describe types of periodic assessments performed (internal and external) Examples may include: • Technical Systems Audits • Instrument Performance Evaluations and Audits • Data Quality Assessments • Audits of Data Quality	☐	☐	
• Data Certification			
Assessment frequency and schedule	☐	☐	
Assessment personnel	☐	☐	
Assessment reporting / documentation	☐	☐	
Procedures for reporting the need for and for implementing corrective actions	☐	☐	
Identification of individual(s) responsible for determining the adequacy / success of corrective actions	☐	☐	
Timeframes for reporting and resolving identified deficiencies	☐	☐	

Describe procedure used to guarantee independent and unbiased performance audits	☐	☐	
Reports to Management CDPHE			
Describe types of reports that will be developed. (For internal and external distribution) Examples: • Quarterly data summary reports	☐	☐	
• Corrective Action Reports			
Frequency, content and distribution of reports	☐	☐	
Personnel responsible for developing these reports	☐	☐	
Intended recipient(s) of each report	☐	☐	
Data Validation and Usability			
Describe the procedures used to determine whether data is usable for their intended purpose. Should include some discussion of the following and other similar technical aspects of the monitoring program: • Sample design (including			

methods used) • Data Collection Procedures • Monitoring Procedures • Quality Control • Calibrations • Data Reduction and Processing	☐	☐	
Specific criteria for which, when exceeded, the data is immediately invalidated	☐	☐	
Follow up procedures and timeframe to distinguish between data that may indicate an instrument issue and data	☐	☐	
that may reveal a real exceedance of established threshold limits			
Protocols for specific situations that result in unusable data	☐	☐	
Validation and Verification Methods			
Assure a data review process that provides adequate independence in validation procedures	☐	☐	
Procedures for verifying and validating data, including individual(s) responsible for this task	☐	☐	
Develop and include a data validation			

SOP (referenced in the QAPP and attached)	☐	☐	
Frequency of data verification and validation activities	☐	☐	
Tools utilized in the verification / validation process	☐	☐	
Listing of applicable QA qualifier flags and their definitions (including examples of when to apply them)	☐	☐	
Documentation requirements for each step of the data review process	☐	☐	
Reconciliation with Data Quality Objectives			
The process used to determine if the DQOs have been attained, frequency of this assessment, and individuals responsible	☐	☐	
Discussion of how results will be communicated to decision makers and the community	☐	☐	
Discussion of how results will be documented	☐	☐	
Discussion of potential corrective	☐	☐	

actions resulting from this process			
Discussion of how data anomalies are resolved	☐	☐	

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