Quarterly Report for Goodrich Corporation Fenceline Monitoring Plan-Q3 2024

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II.   Executive Summary

This report summarizes the findings related to the Goodrich Corporation fenceline monitoring plan during the period of July 1st of 2024 to September 30th of 2024 (Q3 of 2024). The data collected during this period were validated following all procedures described in the Goodrich Corporation fenceline monitoring plan. This report includes tables with the validated and invalidated data, statistical analysis results and timeseries of the compounds of interest and meteorological parameters.

III.   Contact Information

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IV.   Methods

A. Site Description

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.
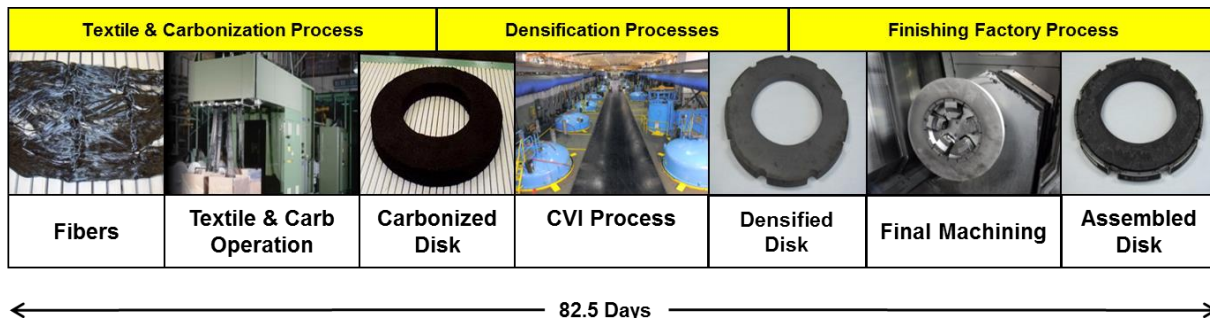
Figure 1. The Goodrich Carbon Brake Manufacturing Process

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

B. Instrument Description

1. Open-Path Monitors

The Goodrich Corporation fenceline air monitoring system includes both open-path tunable diode laser spectrometers (TDLAS), and open-path ultraviolet Doppler optical absorption spectrometers (UVDOAS). Open-path monitors operate by projecting a beam of 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 gases 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 gas' concentration in the air.

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 Corporation system will consist of three TDL analyzers and six UVDOAS analyzers at the locations shown in Figure 2 and as outlined in Table 2. The light is transmitted to a retroreflector and back to a detector co-located with the transmitter. The analyzer software will provide five-minute and hourly-average concentration measurements for each path.

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

For the monitoring of benzene, the Goodrich Corporation facility uses Open Path (OP) Ultraviolet 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 wavelengths 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 or receiver, 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.

A combination of monostatic and bistatic open path instruments have been selected to reduce the need for substantial power at the retroreflector sites and improve detection limits by increasing effective path lengths.

The Goodrich Corporation facility uses the UV Sentry Open Path Multi-Gas Analyzer (UV Sentry) manufactured by Cerex Monitoring Solutions, LLC for the monitoring of benzene. The UV Sentry uses no moving parts to wear out, it should 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 (MDLs) for benzene in real time as data quality indicators. Real time MDL output supports both American Society for Testing and Materials (ASTM) and USEPA methods. The UV Sentry also has a flow through calibration cell to allow for regular QA audits and bump tests.

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

For the monitoring of Hydrogen Sulfide and Hydrogen Cyanide[1], an Open Path (OP) Tunable Diode Laser Absorption Spectroscopy (TDLAS) is used. 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 the 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-TDLAS system consists 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 been selected to reduce the need for substantial power at the retroreflector sites, and improve detection limits by increasing effective path lengths.

The Goodrich Corporation facility uses the LasIR™ Fence Line Monitoring Gas Analyzer manufactured by Unisearch Associates Inc. for the monitoring of Hydrogen Sulfide and Hydrogen Cyanide.[1] 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.

2. Meteorological Monitors

The meteorological monitoring tower is located at the northwest end of the Goodrich Corporation property. This tower is outfitted with high quality meteorological instruments, as outlined in Table 1, and are capable of making accurate 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 meet EPA specifications for accuracy, range and resolution (Table 1) 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.

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[1]   Hydrogen sulfide is neither used nor stored at, nor are they emitted from the Goodrich Corporation. Therefore, the facility does not have the potential to emit this compound, which comprise "Covered Air Toxics" under HB21-1189.

Table 1: 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 to 55
Horizontal wind direction	Met One 020D	Degrees (°)	± 3	0 to 360
Temperature	Met One 065	Degrees of Celsius (^{o}C)	± 0.15	-30 to +50
Relative humidity	Met One 083F/0/35	Percentage (%)	± 2	0 to 100
Barometric pressure	Met One 0192	Atmospheres (atm)	± 0.001	0.3 to 1.09

C. System Design

The fenceline monitoring system will utilize three primary shelters to house the open path analyzers. Shelters 1 and 6 (Figure 2) 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 3 will house one (1) monostatic open-path TDL analyzer, 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 2, Table 2). 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 2) so that power can be shared.
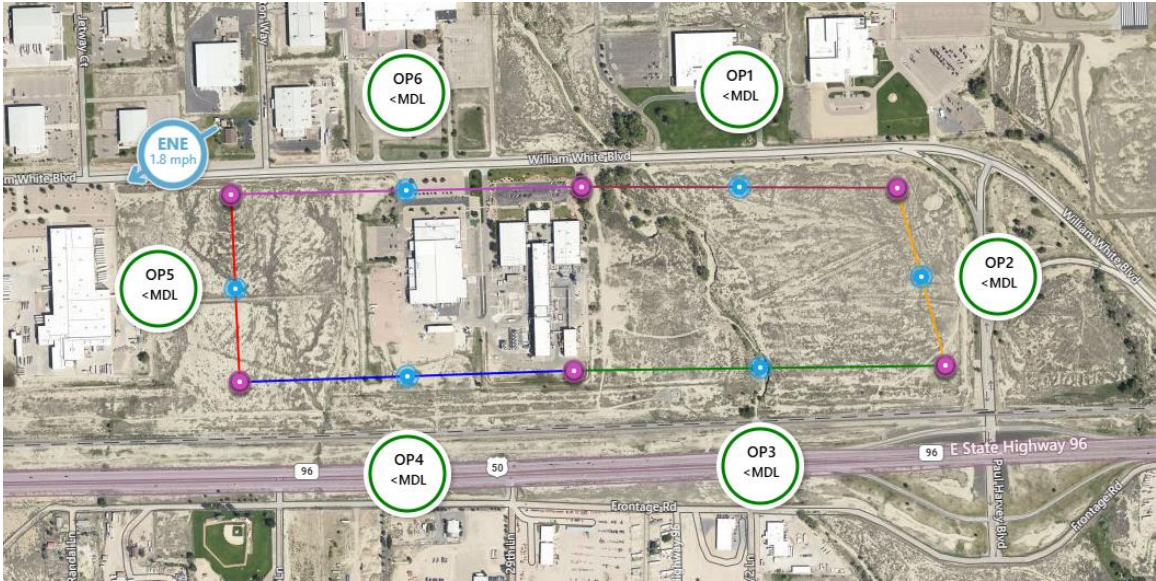
Figure 2. Approximate Layout of the Goodrich Corporation FLMP

Table 2: Descriptions of Each Individual Path

Path	Path Length (one way)	Compounds
1	558 meters	Hydrogen sulfide Hydrogen cyanide Benzene
2	283 meters	Hydrogen sulfide Hydrogen cyanide Benzene
3	613 meters	Hydrogen sulfide Hydrogen cyanide Benzene
4	566 meters	Hydrogen sulfide Hydrogen cyanide Benzene
5	297 meters	Hydrogen sulfide Hydrogen cyanide Benzene
6	569 meters	Hydrogen sulfide Hydrogen cyanide Benzene

D. Data Validation and QA/QC Procedures

-Automated Quality Control Procedures

Many Quality Control procedures for the fenceline monitoring network are integrated directly into the 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 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		^{o}C	35
TDL	MDL	Minimum detection limit	PPB	< 25% of alert threshold

Absolute Signal	Detector Signal	mA	> 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

-*Instrument Quality Control Checks*

Both the UV-DOAS and TDL systems are designed to require only modest service and maintenance. Section 5.4 of the FLMP summarizes the UV-DOAS and TDL maintenance activities as recommended by the manufacturer. These activities will help ensure data integrity and maximize up-time. For the UV-DOAS system, a calibration verification bump test is performed on a quarterly basis using a flow through cell. For the UV-DOAS system, precision is calculated by evaluating the variance of pollutant concentrations during a period of low atmospheric variability. Five-minute data are 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). 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 4.

Table 4: 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

For the TDL system, a calibration verification bump test is 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. 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, 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. 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 the table as follows.

Table 5: 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 intensity (Absolute Power)	Continuous	>0.1 mA
Robustness	Continuous	Compound MDL < 25% of notification threshold

Wind speed, wind direction, temperature, relative humidity and barometric pressure measurement systems will be aligned, tested and calibrated at the time of installation and at six-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 performs 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 are visually inspected to confirm operational integrity. The current data logger readings are assessed for agreement with prevailing conditions.

-*Data Quality Assurance*

All continuous data from the monitoring equipment are transferred to the cloud-based servers every five minutes. Each business day, a data technician checks the data files to ensure that all data were successfully transmitted and stored in the database. If data are missing, they are 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. Level 1 data are manually reviewed for reasonableness and completeness. Initial (daily) review of the data occurs 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. 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 annotates the separate data processing file (i.e., an electronic copy of the original raw data file) and produces a summary report of any suspect data or out-of-tolerance operating conditions. Any situation requiring investigative and/or corrective action is 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 is generated and updated with further information as it becomes available until the problem is fully resolved.

All data reporting forms and activity logs completed during the previous month are stored in Montrose's local Denver office and are 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 QC 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 is 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 detail on null data codes and corresponding descriptions see Table 11 of Appendix F). 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 enters and annotates 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.

"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 the fenceline 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). 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.

V. Results

A. Monthly Data Summary

Table 6: Monthly Data Summary

Month	Path	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]
Jul-24	1	Benzene	0	0.07	0.18	0.27	0.54	74.6	0.5	0.13%	95.00%	0.38
Aug-24	1	Benzene	0	0.19	0.43	0.69	1.06	366.5	1.85	0%	88.50%	0.97
Sep-24	1	Benzene	0	0.19	0.46	0.79	1.16	3.02	0.84	0%	92.10%	1.11
Jul-24	1	H2S	0	1.72	11.1	21	33.9	61	23.3	1.13%	77.20%	29.5
Aug-24	1	H2S	0	1.38	13	22.4	34.4	60.8	24.4	1.1%	87.60%	31.5
Sep-24	1	H2S	0	1.27	12.8	22.9	35.7	59.4	24.9	0.66%	80%	32.3
Jul-24	1	HCN	0	0.01	0.07	0.14	0.33	1.41	0.23	0.02%	99.30%	0.2
Aug-24	1	HCN	0	0.02	0.08	0.13	0.32	2	0.24	0.00%	98%	0.18
Sep-24	1	HCN	0	0.009	0.08	0.16	0.28	1.31	0.2	0.32%	91.70%	0.23
Jul-24	2	Benzene	0	0.14	0.34	0.49	0.83	37.1	1.72	0.00%	98.30%	0.68
Aug-24	2	Benzene	0	0.12	0.36	0.53	0.91	3.5	0.67	0%	98.10%	0.74
Sep-24	2	Benzene	0	0.24	0.53	0.86	1.1	7.9	0.9	0%	95.20%	1.2
Jul-24	2	H2S	0	3.8	16.2	23.4	33.6	74.7	25.5	0.24%	53.00%	33.8
Aug-24	2	H2S	0	2.7	16.4	24.3	33.9	97	25.8	0.15%	59.00%	34.8
Sep-24	2	H2S	0	1.6	17.6	26.4	37.6	90.1	28.5	0.61%	40.60%	38.9
Jul-24	2	HCN	0	0.03	0.27	0.43	0.76	3.5	0.57	0.00%	82.90%	0.61
Aug-24	2	HCN	0	0.01	0.32	0.52	0.83	2.98	0.63	0.00%	90%	0.73
Sep-24	2	HCN	0	0.01	0.1	0.16	0.31	4.6	0.29	0.30%	89.10%	0.23
Jul-24	3	Benzene	0	0.17	0.45	0.64	0.89	25.5	0.81	0.00%	99.00%	0.89
Aug-24	3	Benzene	0	0.12	0.32	0.42	0.56	8.57	0.5	0%	98.5%	0.58
Sep-24	3	Benzene	0	0.23	0.52	0.68	0.99	220.9	1.3	0%	95.00%	0.94
Jul-24	3	H2S	0	0.88	4.6	7.8	14.3	54.1	10.8	0.20%	86.50%	11
Aug-24	3	H2S	0	0.2	3.3	6.25	11.8	53.2	11.3	0.08%	89.80%	11.6

Sep-24	3	H2S	0	0.2	2.7	4.9	8.7	46.5	6.8	0.16%	94.80%	6.9
Jul-24	3	HCN	0	0.003	0.03	0.07	0.19	1.74	0.15	0.60%	87.00%	0.1
Aug-24	3	HCN	0	0.003	0.02	0.06	0.15	12.5	0.18	0.07%	75%	0.08
Sep-24	3	HCN	0	0.003	0.05	0.13	0.58	17.5	0.53	0.60%	95.10%	0.19
Jul-24	4	Benzene	0	0.1	0.26	0.4	0.64	5	0.49	0%	99.04%	0.56
Aug-24	4	Benzene	0	0.14	0.45	0.7	0.97	4.52	0.77	0.28%	98.80%	0.99
Sep-24	4	Benzene	0	0.19	0.99	1.5	2.46	1132	3.5	0%	91.80%	2.13
Jul-24	4	H2S	0	0.58	3.9	7.23	15.9	54	11	0.00%	94%	10.2
Aug-24	4	H2S	0	0.24	4.2	9.2	17.9	54.3	12.5	0.10%	90.90%	12.9
Sep-24	4	H2S	0	0.23	2.02	5.4	13.6	55.5	9.6	0.12%	90.50%	7.6
Jul-24	4	HCN	0	0.03	0.13	0.2	0.39	2.9	0.3	0.00%	98.90%	0.28
Aug-24	4	HCN	0	0.01	0.07	0.13	0.25	2.1	0.21	0.09%	95.30%	0.18
Sep-24	4	HCN	0	0.006	0.08	0.16	0.38	5.4	0.38	0.19%	94.20%	0.23
Jul-24	5	Benzene	0	0.12	0.4	0.66	1.01	5.14	0.83	0.00%	84.70%	0.92
Aug-24	5	Benzene	0	0.1	0.4	0.7	1	13.8	0.82	0.00%	84.00%	1
Sep-24	5	Benzene	0	0.12	0.4	0.68	0.88	2.85	0.7	0.00%	98.90%	1
Jul-24	5	H2S	0	0.3	8.6	15	24.2	68.1	17.6	0.22%	73.00%	21.6
Aug-24	5	H2S	0	0.22	0.22	7.2	13.7	24.6	92.8	0.63%	59.70%	17.1
Sep-24	5	H2S	0	0.35	10.2	17.3	27.6	74.6	19.9	0.32%	63.10%	25.2
Jul-24	5	HCN	0	0.02	0.12	0.24	0.42	3.7	0.35	0.08%	97.90%	0.33
Aug-24	5	HCN	0	0.01	0.14	0.29	0.52	4.4	0.4	0.71%	88.00%	0.4
Sep-24	5	HCN	0	0.02	0.14	0.23	0.36	2.14	0.29	0.35%	97.50%	0.32
Jul-24	6	Benzene	0	0.1	0.38	0.54	0.87	9.1	0.77	0.00%	72.20%	0.76
Aug-24	6	Benzene	0	0.25	0.52	0.75	1.1	597.7	2.9	0.21%	94.30%	1.1
Sep-24	6	Benzene	0	0.26	0.68	1	1.3	2.9	1.03	0.00%	99.50%	1.4
Jul-24	6	H2S	0	0.29	7.2	12.4	20	59.4	14.7	0.29%	85.00%	17.3
Aug-24	6	H2S	0	0.13	4.8	9.7	16.7	56	11.8	0.60%	83.90%	13.6
Sep-24	6	H2S	0	0.23	2.21	4.85	9.4	46.6	7.05	0.13%	92.40%	6.8
Jul-24	6	HCN	0	0.004	0.02	0.05	0.15	1.95	0.15	2.64%	82.20%	0.07
Aug-24	6	HCN	0	0.004	0.15	0.029	0.11	2.17	0.14	2.46%	86.2%	0.04
Sep-24	6	HCN	0	0.005	0.05	0.09	0.14	1.11	0.12	0.52%	94.60%	0.13

[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 (valid data only)

[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 1h measurements that pass all data verification measures compared to the possible hourly averages.

[5] the median 1-hr detection limit observed across validated measurements per compound for the month specified.

B. Summary of Invalidated Data

The invalidated data can be found in file "Goodrich Corporation FLMP Data Packet_Q3 2024". All 5min data have been validated based on the procedures described in the Goodrich Corporation fenceline monitoring plan.

C. Discussion of Invalidated Data

The data was validated based on the procedures mentioned in the fenceline monitoring plan. During this first quarter of the fenceline monitoring program operation, there was a relatively low invalidation rate for benzene and HCN with an average valid data percentage of approximately 90%. For H2S, the average valid data percentage was 87% while some lower percentage rates were observed in Paths 2 and 5. The reason was related to these paths being shorter compared to the rest and therefore having higher detection limits causing the analyzers not to be able to meet the criteria for the detection limits (minimum detection limit was more than 25% of threshold). The higher-than-expected detection limits that were related to the increased signal noise for these paths are being decreasing with instrument optimization. Montrose worked on optimizing the instrument operational parameters to decrease the signal noise and thus the detection limits.

D. Discussion of Results

As shown in the summary plots, the concentration of the three compounds of interest was below detection limit in most cases. There were no threshold exceedances during the first quarter of the fenceline monitoring for any of the compounds. For benzene the average MDL value was around 0.5 ppb, for H2S the average MDL value was approximately 50 ppb, and for HCN the corresponding average MDL was around 0.5 ppb. As discussed in Section C, the higher H2S MDL values for Paths 2 and 5 are related to the interferences of this compounds with water and CO2 which can cause increased signal noise levels. Goodrich Corporation does not store nor emit H2S.

E. Summary Plots
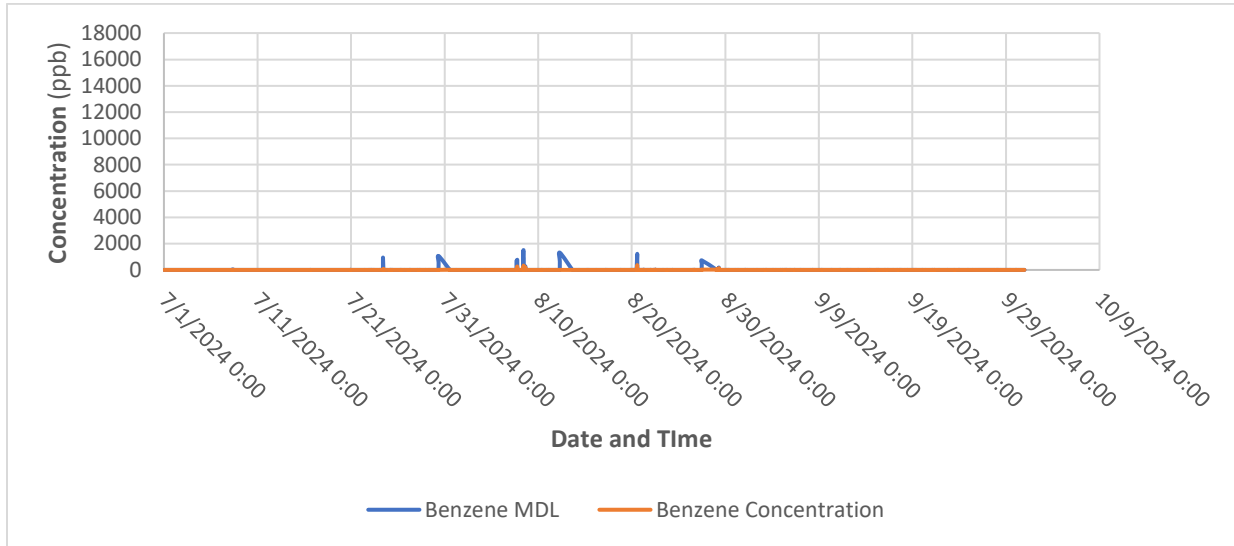
Figure 3. Timeseries of Benzene Path 1
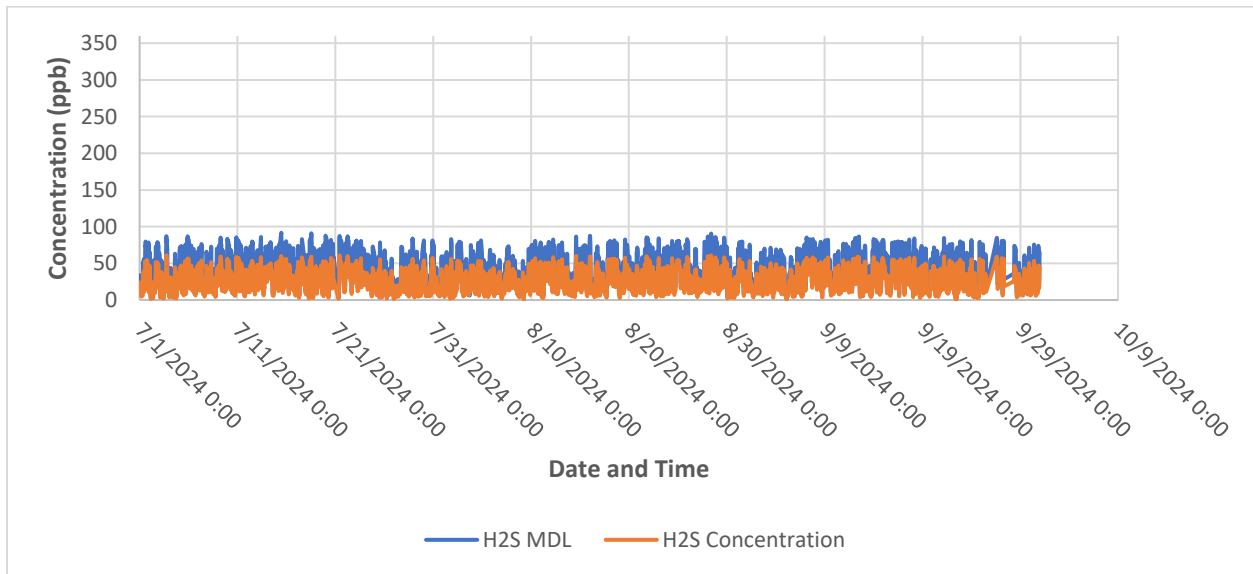
Figure 4. Timeseries of H$_2$S Path 1
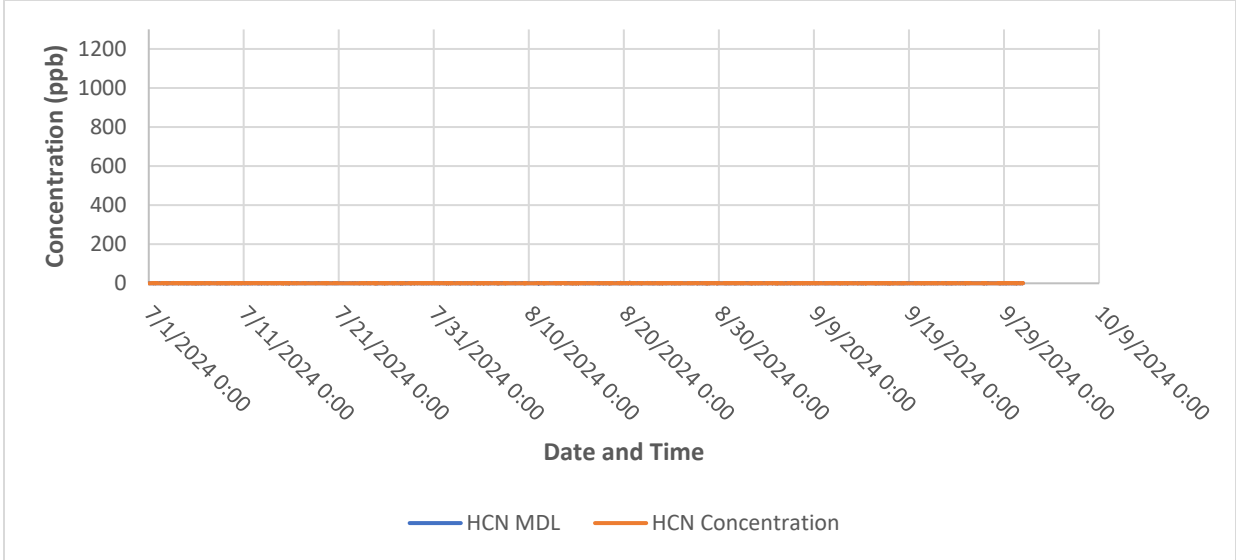
Figure 5. Timeseries of HCN Path 1
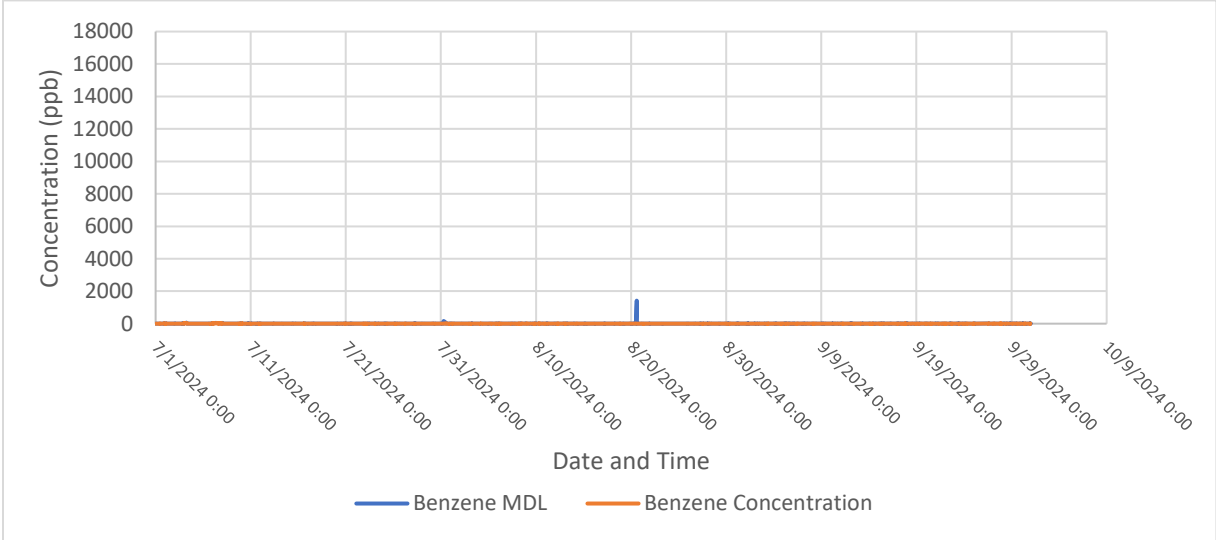
Figure 6. Timeseries of Benzene Path 2
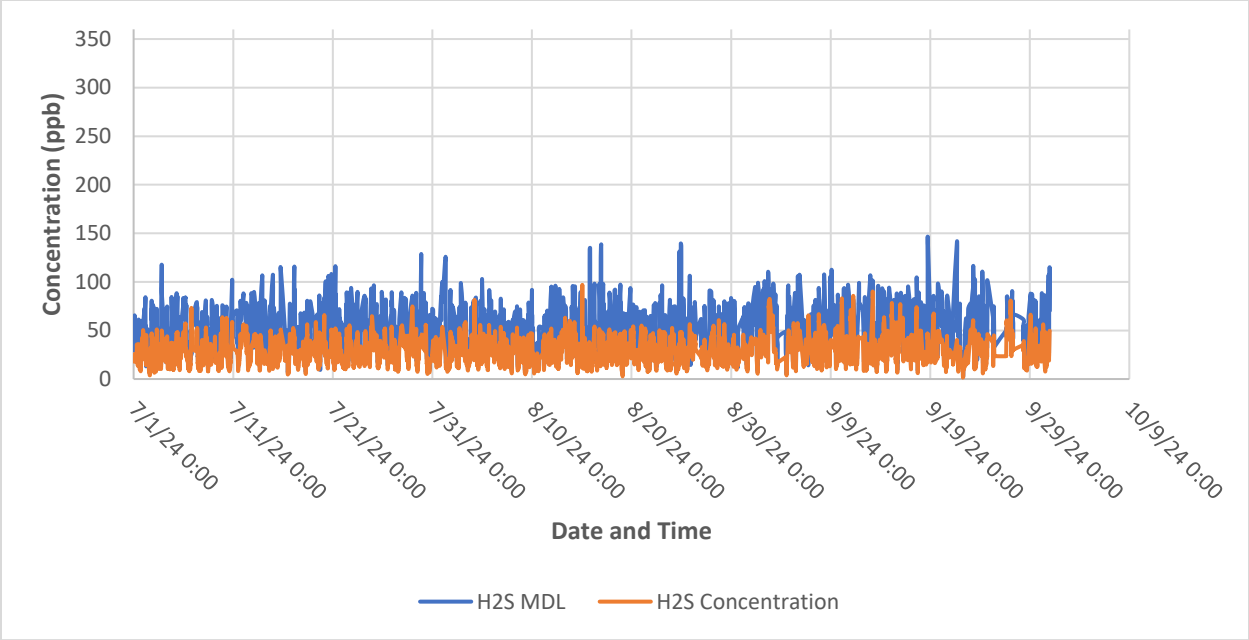
Figure 7. Timeseries of H₂S Path 2
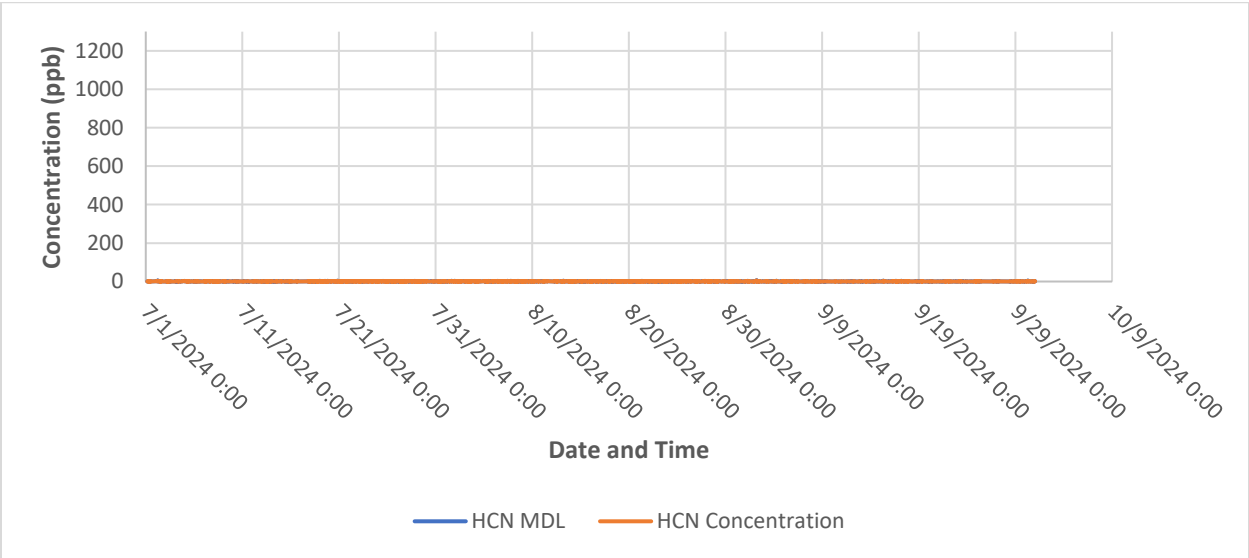
Figure 8. Timeseries of HCN Path 2
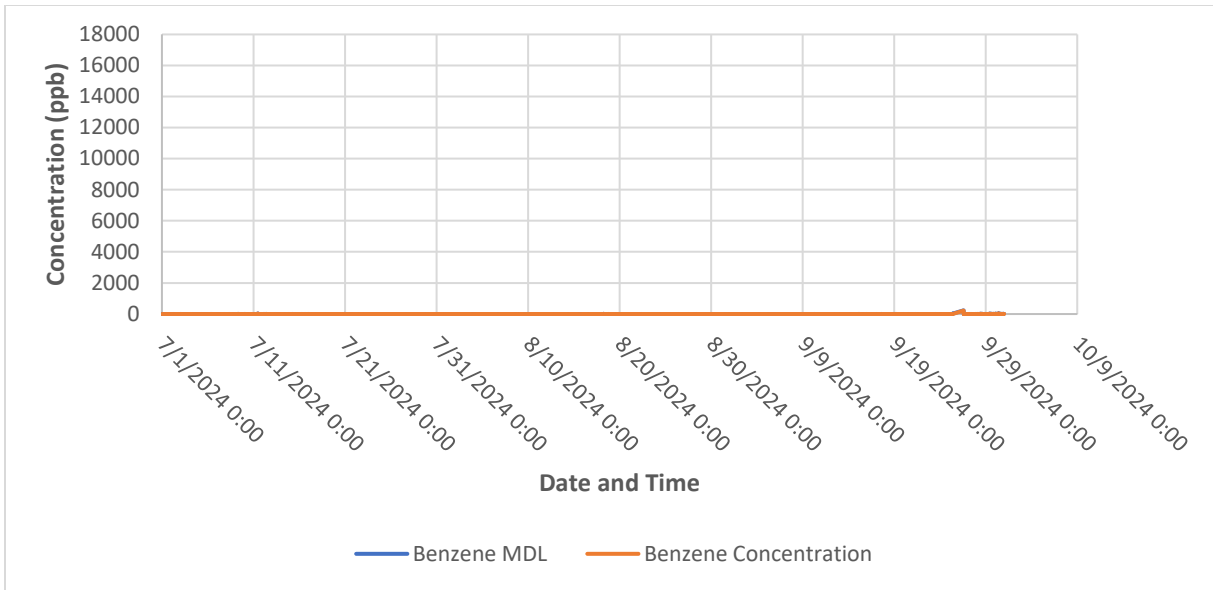
Figure 9. Timeseries of Benzene Path 3
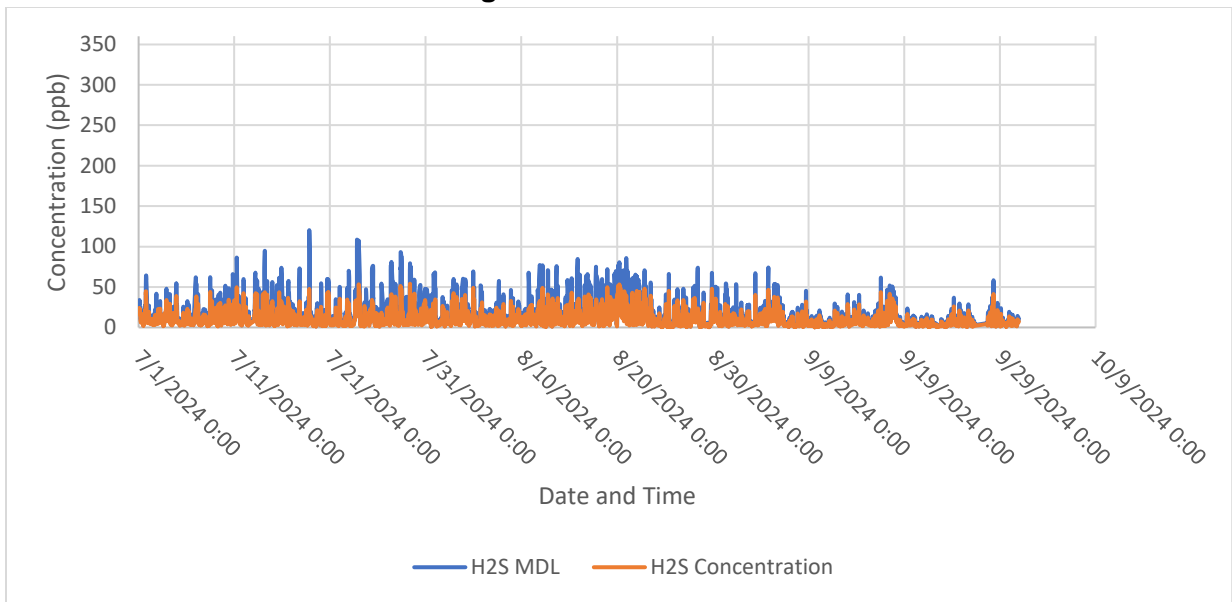
Figure 10. Timeseries of H₂S Path 3
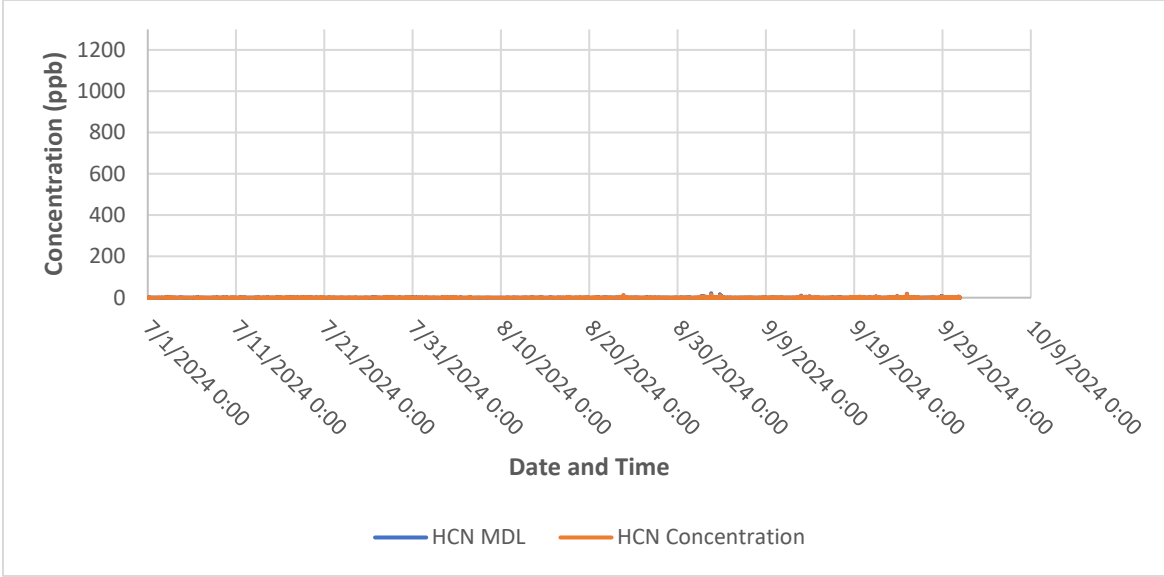
Figure 11. Timeseries of HCN Path 3
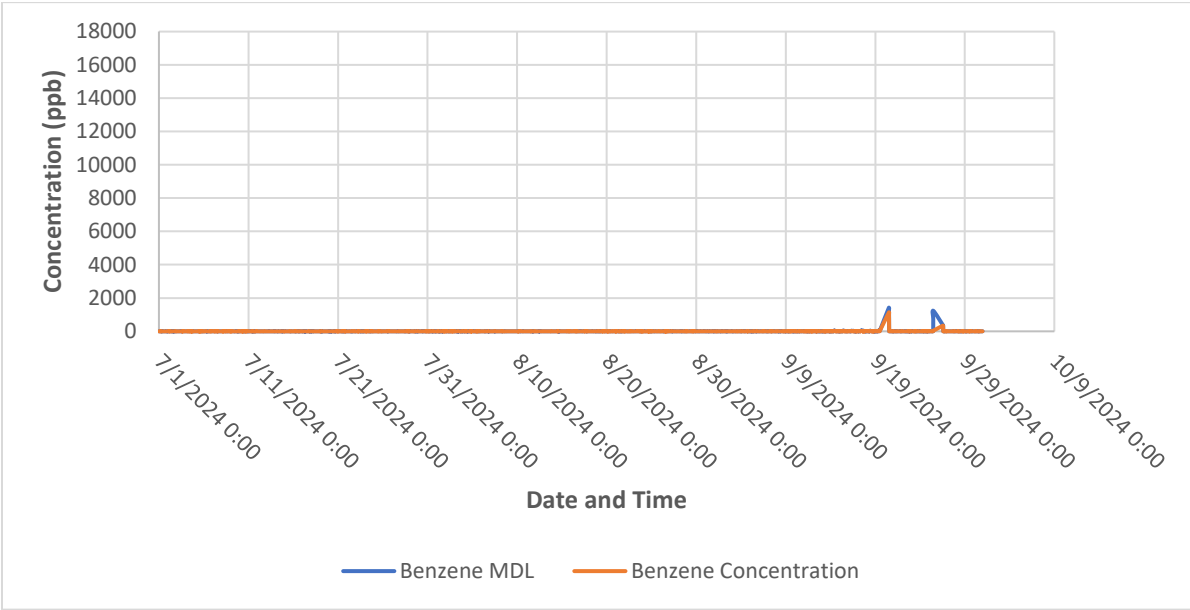
Figure 12. Timeseries of Benzene Path 4
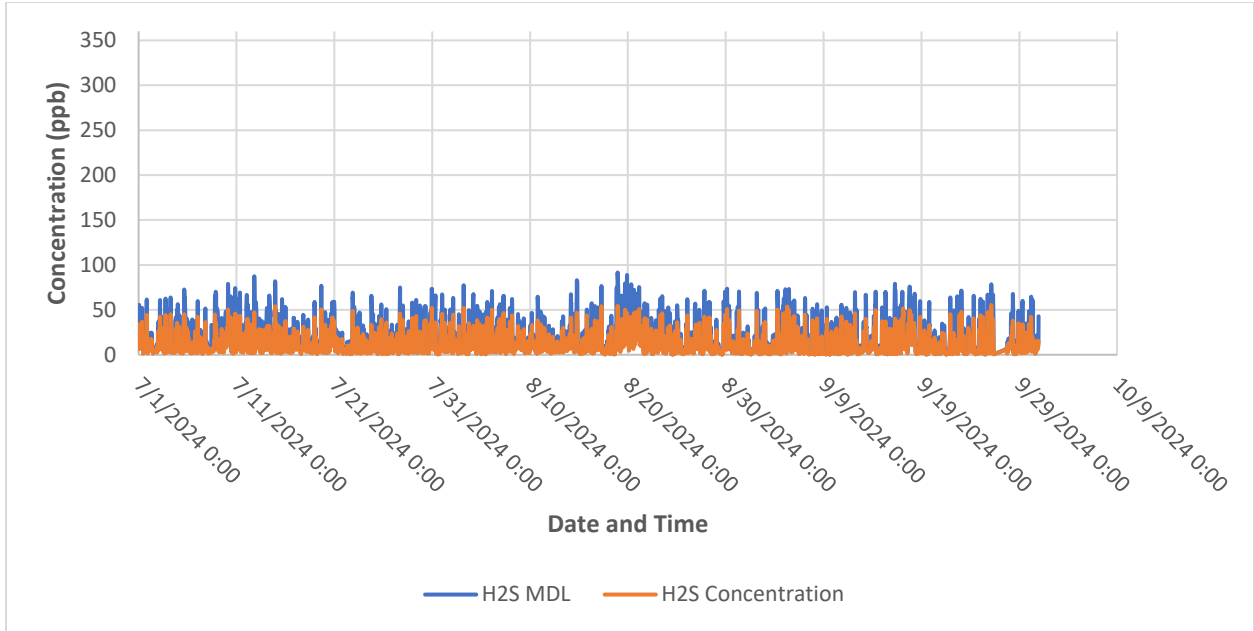
Figure 13. Timeseries of H₂S Path 4
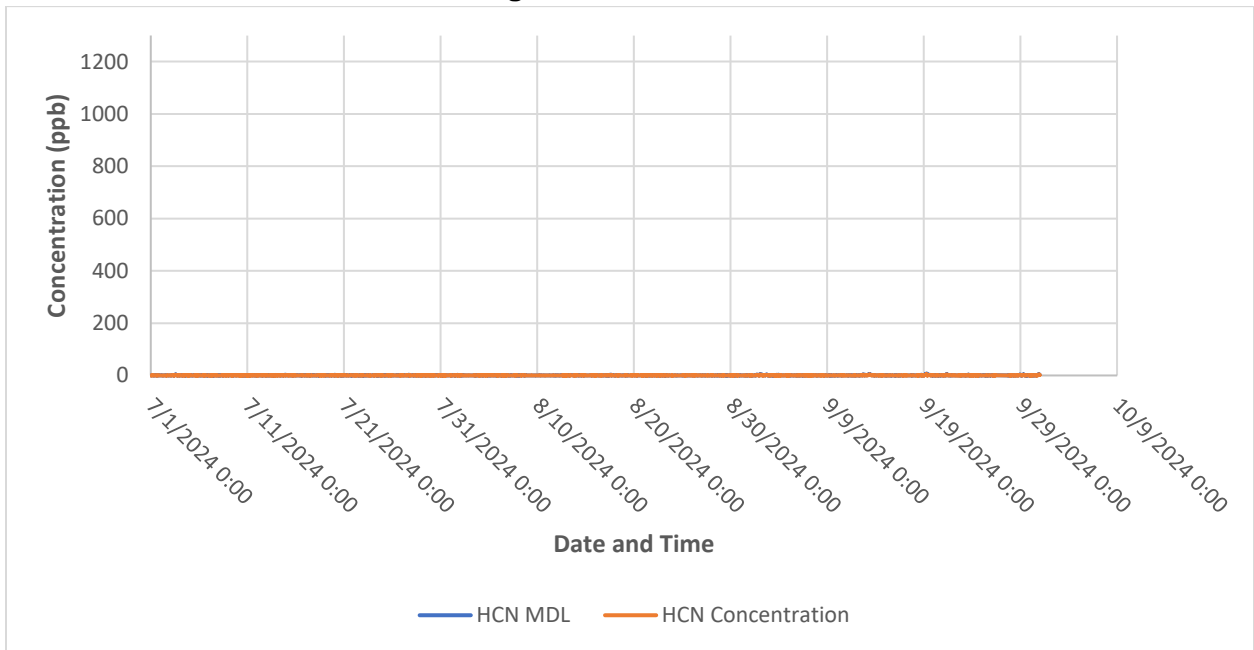
Figure 14. Timeseries of HCN Path 4
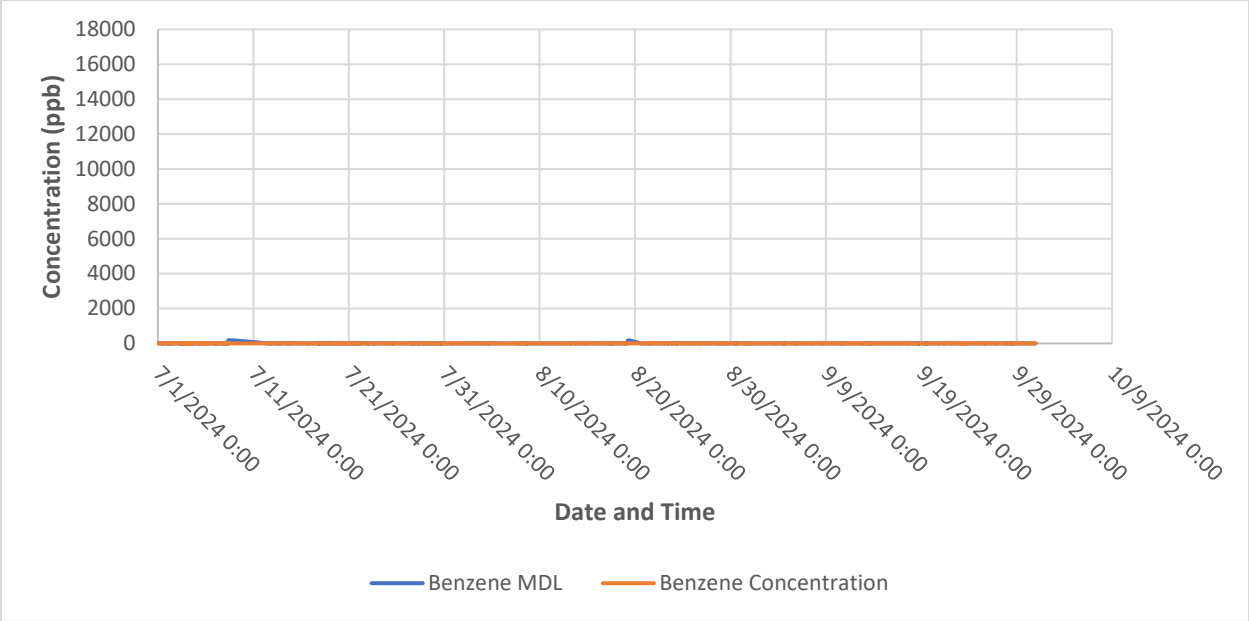
Figure 15. Timeseries of Benzene Path 5
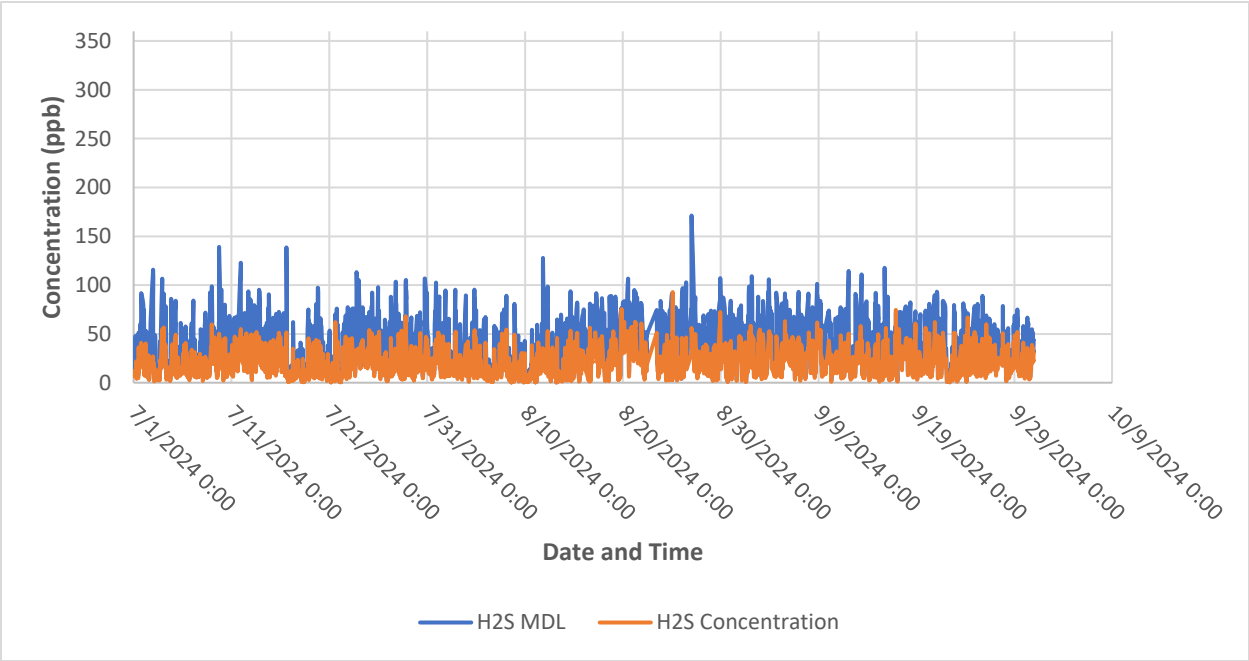
Figure 16. Timeseries of H$_2$S Path 5
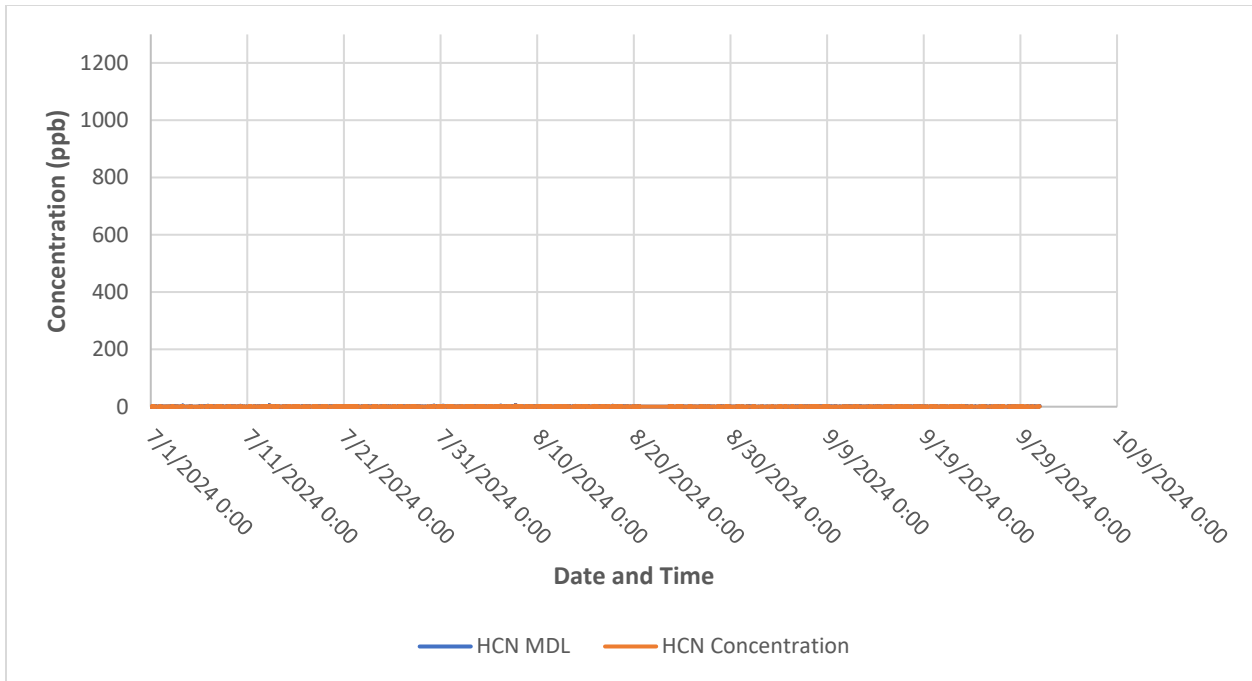
Figure 17. Timeseries of HCN Path 5
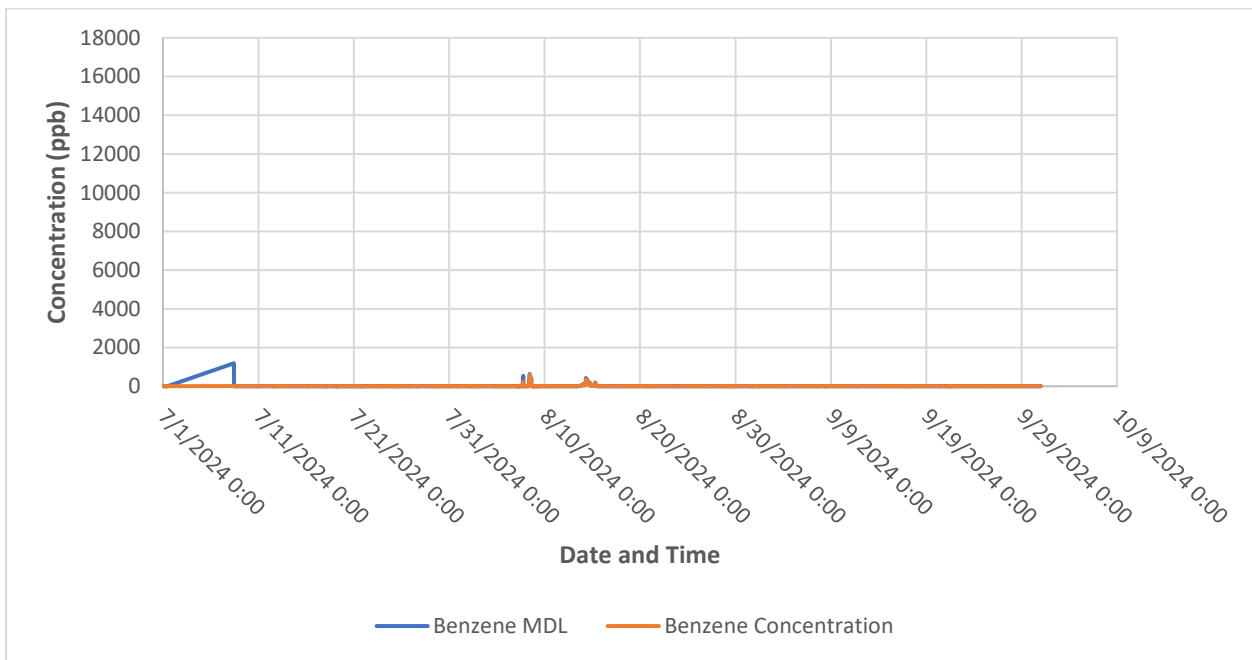
Figure 18. Timeseries of Benzene Path 6
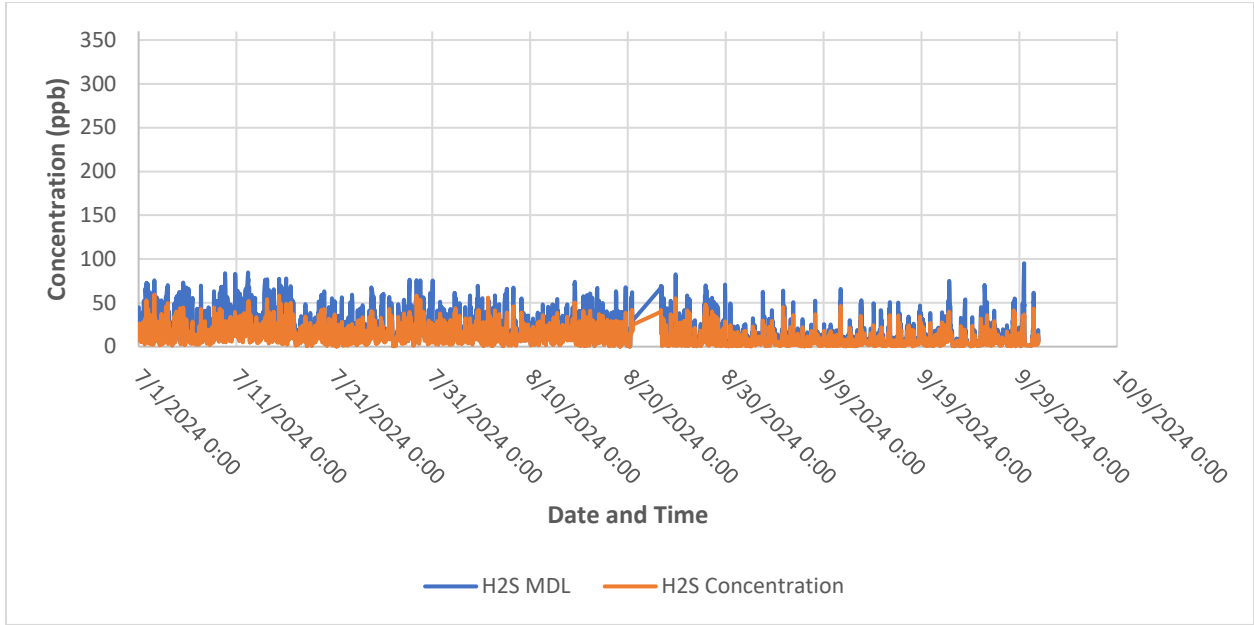
Figure 19. Timeseries of H₂S Path 6
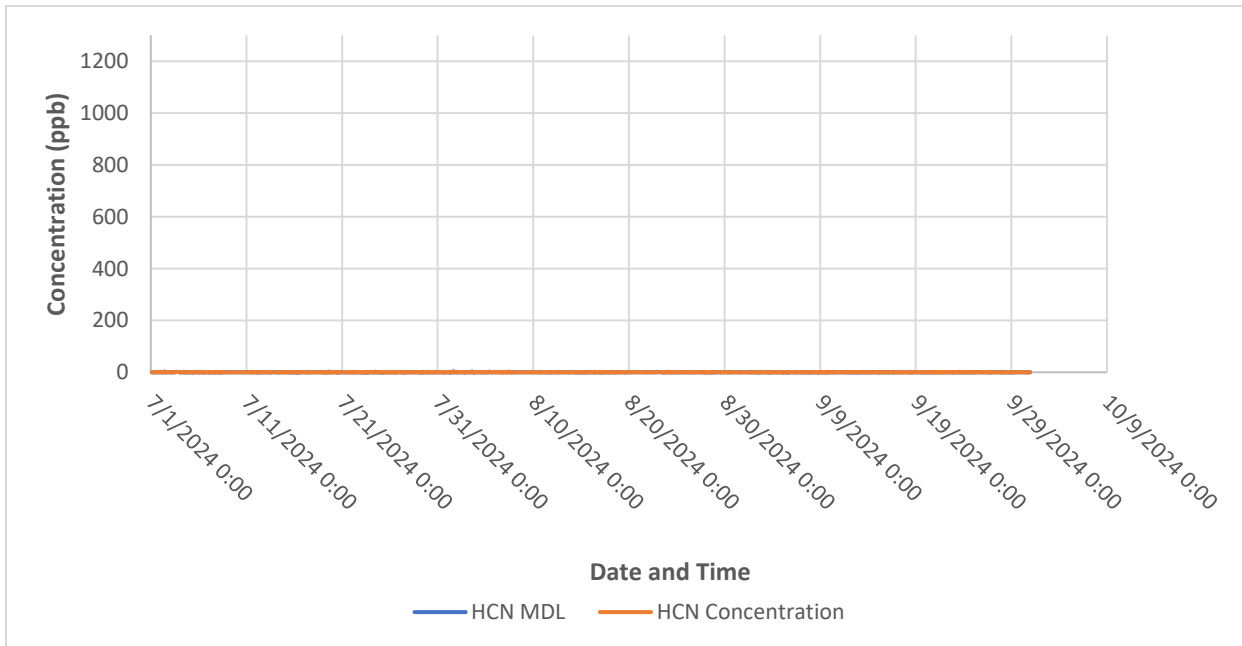
Figure 20. Timeseries of HCN Path 6
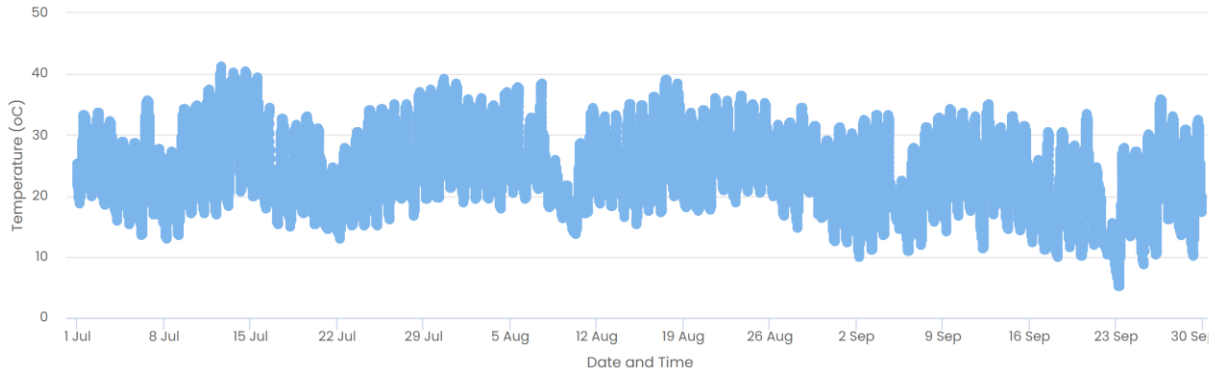
Figure 21. Temperature Timeseries
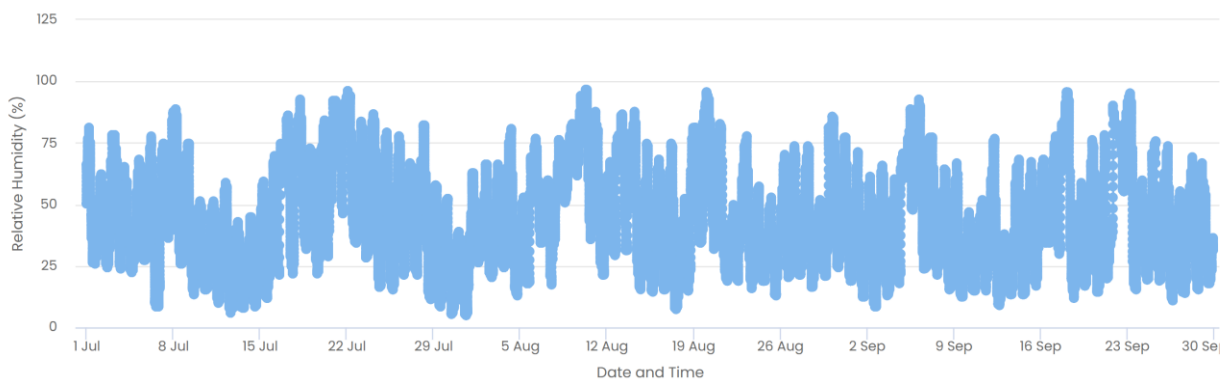
Figure 22. Relative Humidity Timeseries
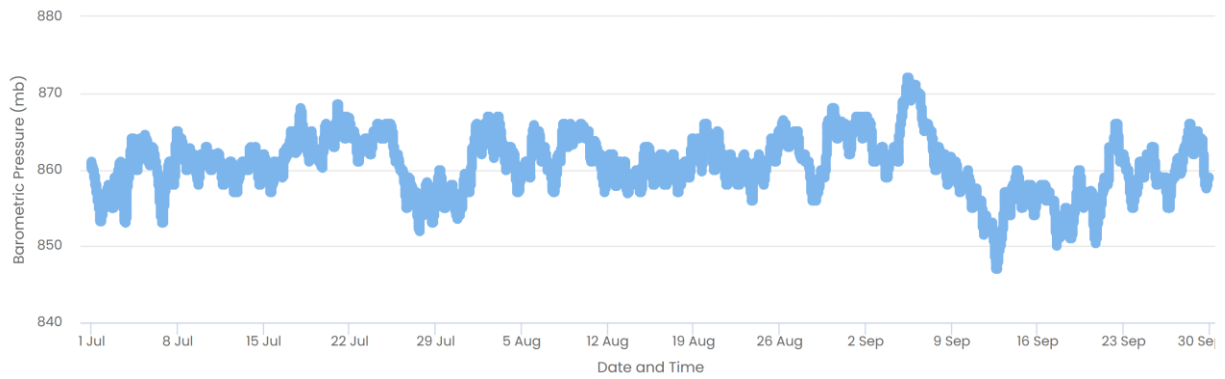
Figure 23. Barometric Pressure Timeseries
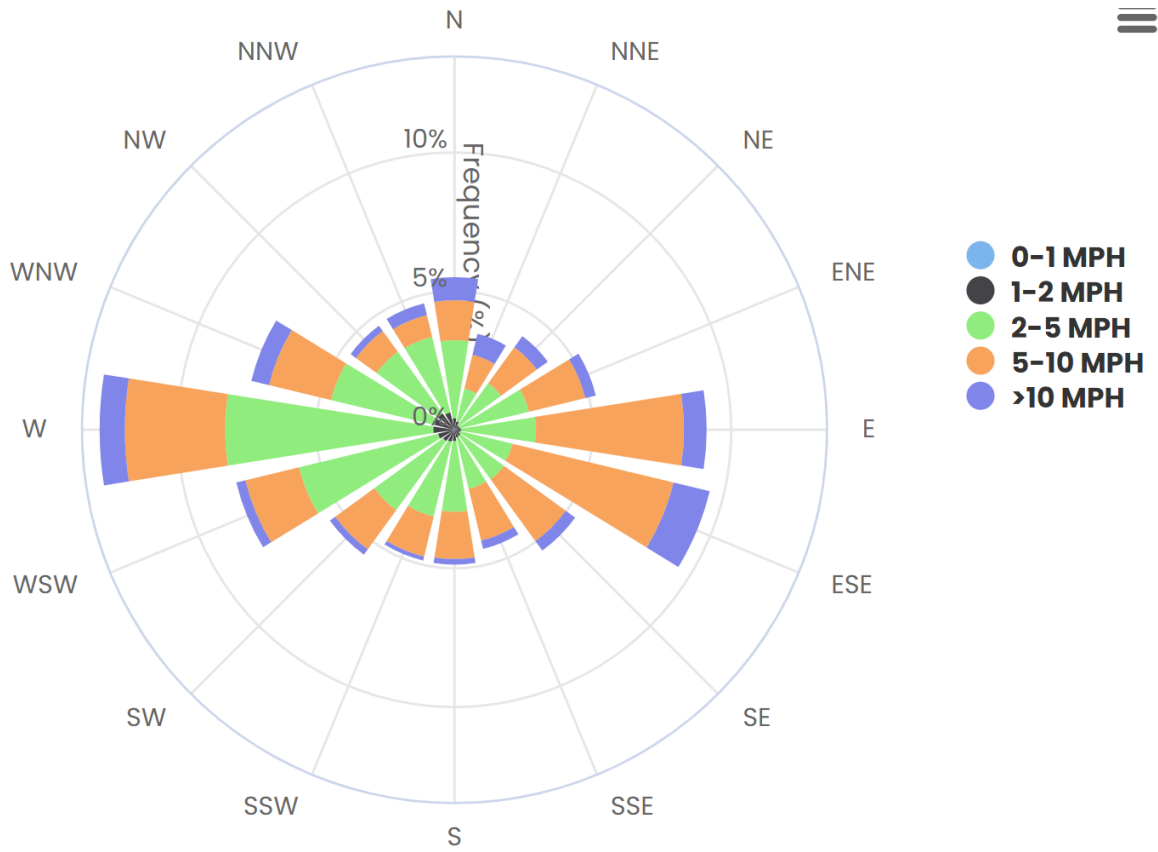
Figure 24. Wind Rose Plot
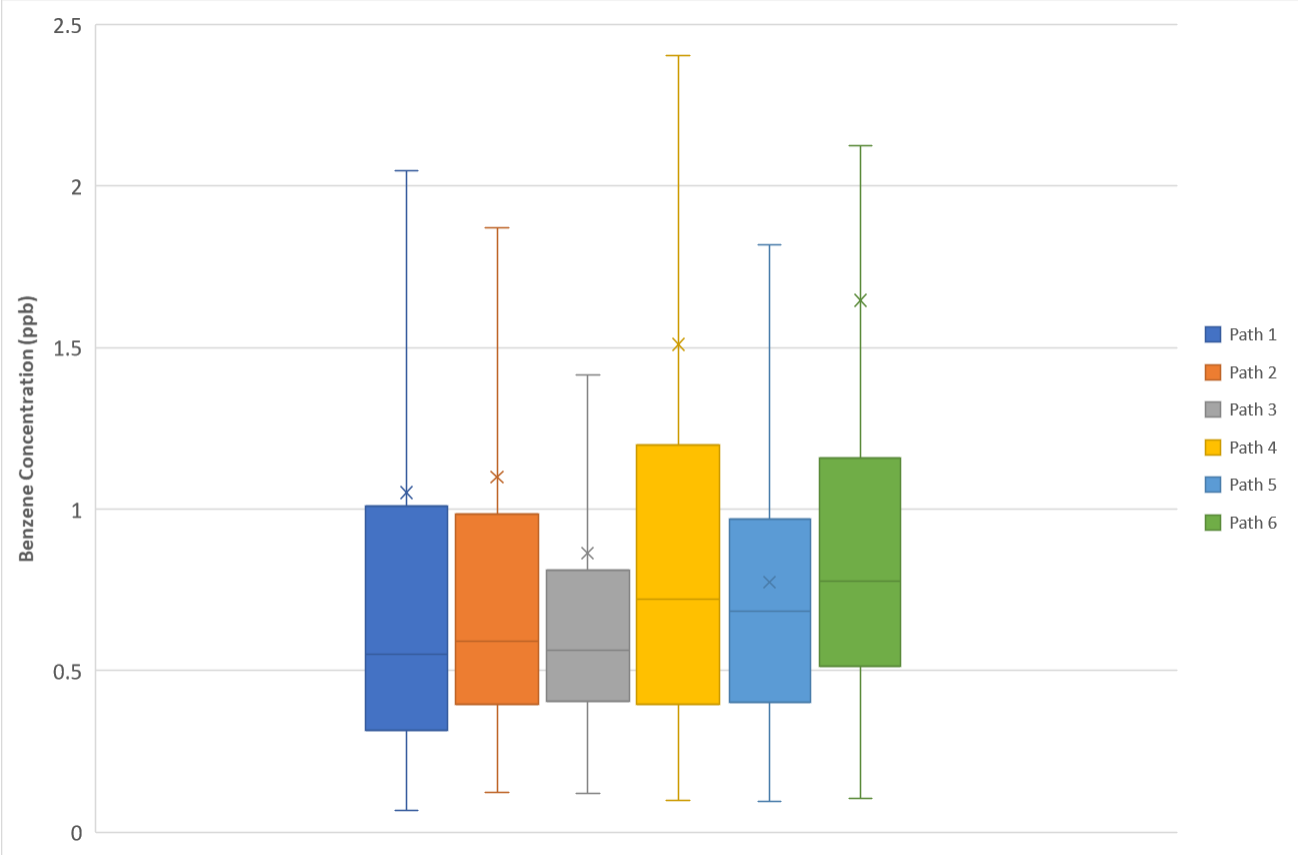
Figure 25. Benzene box plots for Paths 1 to 6.
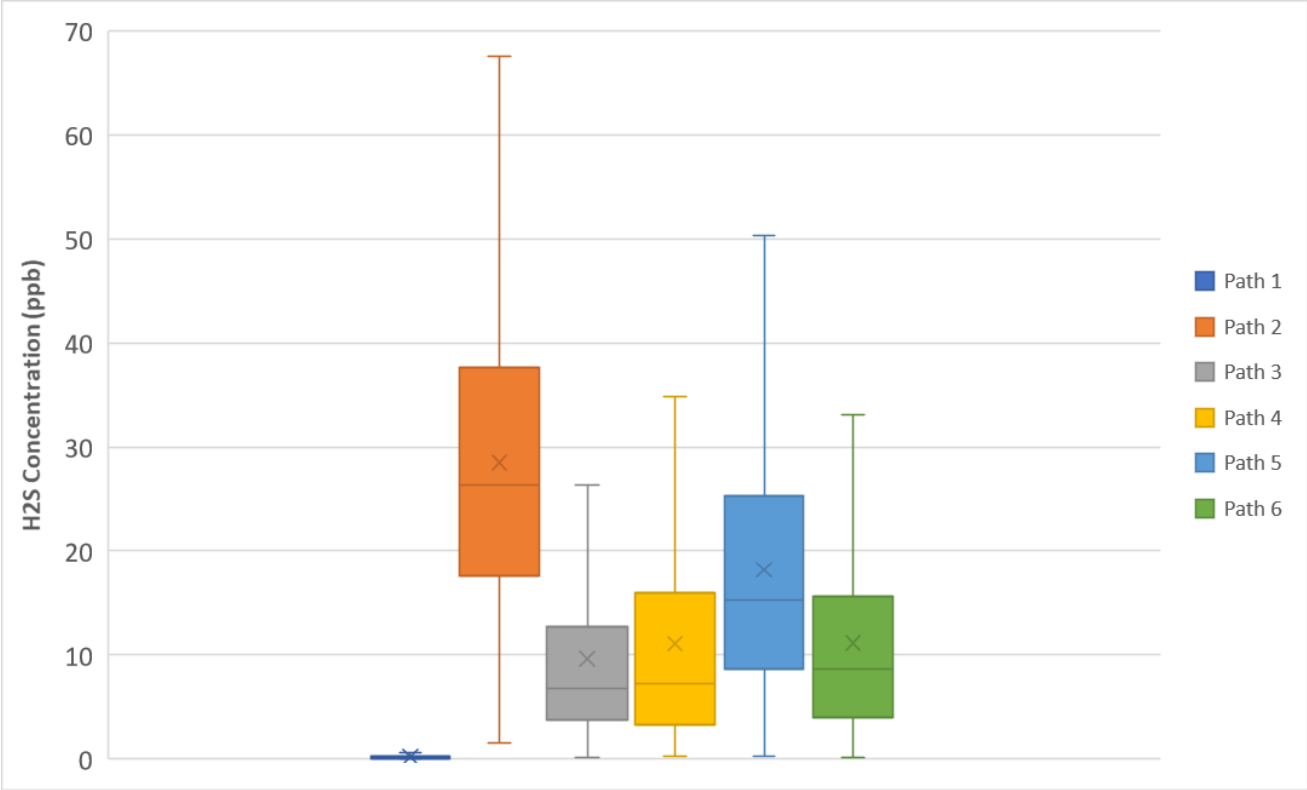
Figure 26. H₂S box plots for Paths 1 to 6.
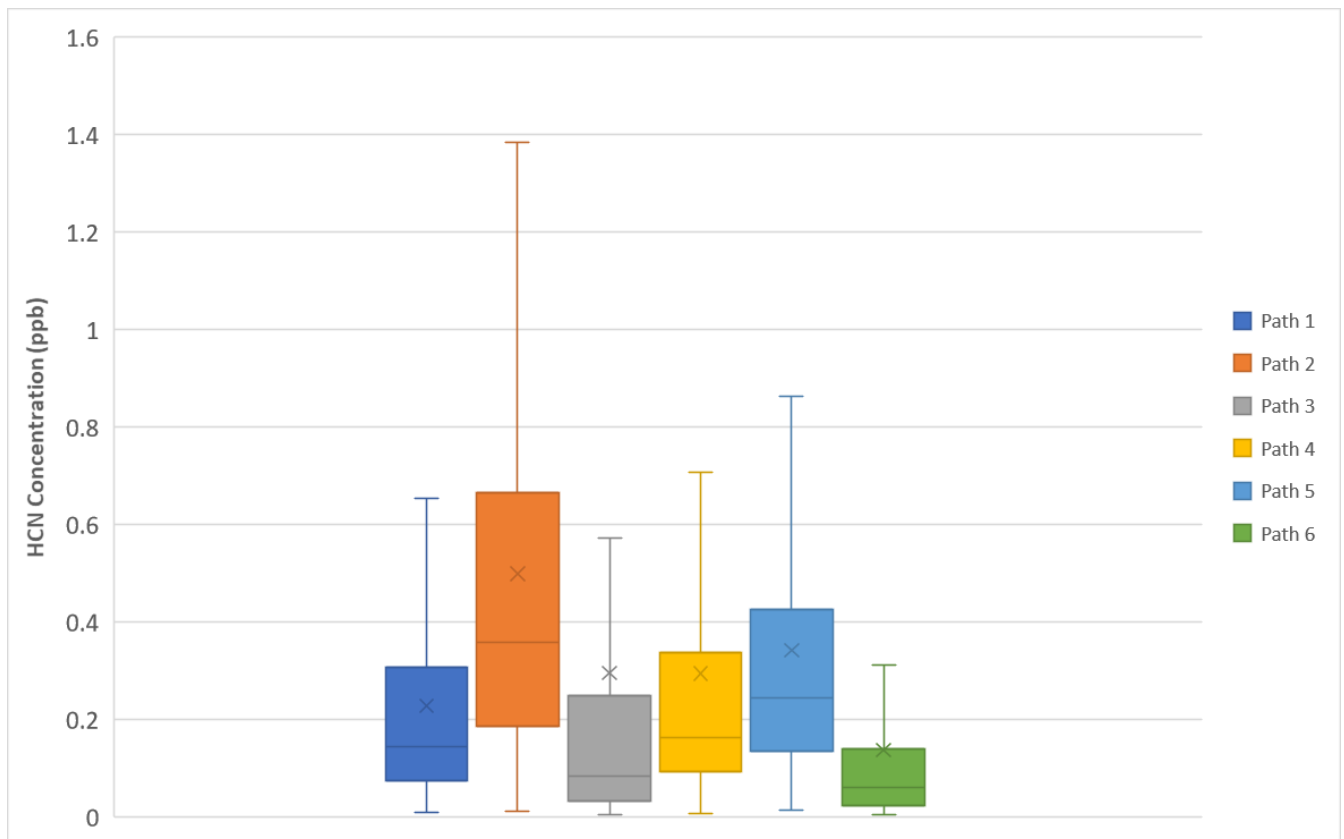
Figure 27. HCN box plots for Paths 1 to 6.

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

Two main changes were performed to the fenceline monitoring plan procedures which are related with the automated QA/QC checks.

1. UV spectrometer temperature: the UV spectrometers were calibrated by the manufacturer at 35°C instead of the 39°C that the older models were used to be calibrated at. Thus, for the automated QA/QC checks, we changed the acceptance criteria to accommodate the updated spectrometer calibration conditions.

2. TDL signal intensity: the manufacturer recommended to monitor the absolute detector power instead of the signal intensity. The reason was related to the fact that the laser signal intensity is affected by multiple instrument parameters (I/O Gain, Signal Gain, signal collimation etc.). Due to these interferences, the signal intensity values that are reported by the analyzer could potentially not be representative of the actual signal power that is measured by the detector. To avoid these issues, we replaced the "signa intensity" parameter on the automated QA/QC checks with the parameter "absolute detector power". The criteria for the data to be considered valid is the absolute detector power to be >0.1 mA.

VI. Appendices

A. Appendix A: Calibration and QA/QC Data

Table 7: Verification Activities

Date	Type of Verification	Path	Path Length[1]	Analyzer	Compound	Expected Concentration	Measured Concentration	Accuracy (%)	Precision (%)
9/27/2024	Bump test	1	558	UVDOAS	Benzene	100	100	18	21.5
9/27/2024	Bump test	1	558	UVDOAS	Benzene	200	200	3	3.5
9/27/2024	Bump test	2	566	UVDOAS	Benzene	100	99	2.9	4.3
9/27/2024	Bump test	2	566	UVDOAS	Benzene	200	190	9.5	2.4
9/27/2024	Bump test	3	613	UVDOAS	Benzene	100	89	11	6.4
9/27/2024	Bump test	3	613	UVDOAS	Benzene	200	182	13.1	15.3
9/27/2024	Bump test	4	566	UVDOAS	Benzene	100	88	12.2	1.8
9/27/2024	Bump test	4	566	UVDOAS	Benzene	200	184	8.2	1.9
9/27/2024	Bump test	5	594	UVDOAS	Benzene	100	105	6.8	7
9/27/2024	Bump test	5	594	UVDOAS	Benzene	200	185	7.5	2.8
9/27/2024	Bump test	6	569	UVDOAS	Benzene	100	122	22	13.9
9/27/2024	Bump test	6	569	UVDOAS	Benzene	200	207	7.7	8.5
10/1/2024	Audit Module	1	1116	TDL	H2S	500 ppmm	542 ppmm	8.4	2.2
9/27/2024	Audit Module	1	1116	TDL	H2S	625 ppmm	772 ppmm	23.5	5.7
10/1/2024	Audit Module	2	566	TDL	H2S	500 ppmm	485 ppmm	3	1.6
9/27/2024	Audit Module	2	566	TDL	H2S	625 ppmm	800 ppmm	28.1	4.6
9/27/2024	Audit Module	3	1226	TDL	H2S	500 ppmm	470 ppmm	6.2	6.4
10/3/2024	Audit Module	3	1226	TDL	H2S	625 ppmm	608 ppmm	2.7	2.4
9/27/2024	Audit Module	4	1132	TDL	H2S	500 ppmm	408 ppmm	18.4	2.4
9/27/2024	Audit Module	4	1132	TDL	H2S	625 ppmm	632 ppmm	1.1	1.6
9/27/2024	Audit Module	5	594	TDL	H2S	500 ppmm	553 ppmm	10.6	3.4
9/27/2024	Audit Module	5	594	TDL	H2S	625 ppmm	776 ppmm	24.2	10.7
9/27/2024	Audit Module	6	1138	TDL	H2S	500 ppmm	460 ppmm	7.9	4.5
9/27/2024	Audit Module	6	1138	TDL	H2S	625 ppmm	746 ppmm	19.4	9.3
9/27/2024	Audit Module	1	1116	TDL	HCN	1010 ppmm	973 ppmm	3.6	0.1
9/27/2024	Audit Module	1	1116	TDL	HCN	420 ppmm	450 ppmm	7.2	0.4
9/27/2024	Audit Module	2	566	TDL	HCN	1010 ppmm	977 ppmm	3.2	0.1
9/27/2024	Audit Module	2	566	TDL	HCN	420 ppmm	454 ppmm	8	0.2
9/27/2024	Audit Module	3	1226	TDL	HCN	1010 ppmm	988 ppmm	2.2	0.1
9/27/2024	Audit Module	3	1226	TDL	HCN	420 ppmm	478 ppmm	13.7	0.2
9/27/2024	Audit Module	4	1132	TDL	HCN	1010 ppmm	964 ppmm	4.6	0.4
9/27/2024	Audit Module	4	1132	TDL	HCN	420 ppmm	460 ppmm	9.6	0.6
9/27/2024	Audit Module	5	594	TDL	HCN	1010 ppmm	968 ppmm	4.2	0.1
9/27/2024	Audit Module	5	594	TDL	HCN	420 ppmm	454 ppmm	8	0.2
9/27/2024	Audit Module	6	1138	TDL	HCN	1010 ppmm	960 ppmm	5	0
9/27/2024	Audit Module	6	1138	TDL	HCN	420 ppmm	444 ppmm	5.8	0.4

[1]path length in meters

Table 8: Percent Recovery for Meteorological Parameters

Parameter	Percent Data Recovery
Wind Speed	100%
Wind Direction	100%
Temperature	100%
Humidity	100%
Pressure	100%

B. Appendix B: Qualifier Codes

Table 9: 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
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 25% of notification threshold)*	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

Qualifier Code	AQS Definition *(additional information added in parentheses)*	Type or Related Action
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

C. Appendix C: Field Data Sheets

7/2/2024 22:17 Montrose KL remote
checks

2:02 PM 7/12/2024 Montrose KL,SD Onsite
Aligned H2S TDL Paths 1 and 2
Aligned Paths 1 and 2 UVDOAS
Opened UV Cabinet door because the spectrometer temps were too high.

8:55 PM 7/15/2024 Montrose KL Remote
Checked systems
Decreased integration time at UVDOAS Path 1

4:54 PM 7/17/2024 Montrose KL Onsite
reprogrammed TEC on communication cabinet
troubleshooted TEC on UV cabinet
aligned Path 1 TDL HCN

7:08 PM 7/22/2024 Montrose KL Remote
checked UV Optimization

10:04 7/24/24 Montrose SD onsite
Aligned TDL path 1 H2s .61 90% power. Other TDL paths look good.

12:48 PM 8/2/24 Montrose FF onsite

aligned HCN path 2 .638 58.5% power

10:50 AM 8/9/2024 Montrose SD onsite
Aligned TDL path 1 HCN .4 47% power, path 1 H2S .6 90% power, path 2 HCN .75 60% power

12:41 PM 8/13/2024 Montrose SD and FF onsite
aligned path 2 HCN .5 33%, path 1 HCN .3 37% , path 1 H2S 43% .5

12:42 PM 8/15/24 Montrose FF onsite
Aligned HCN path 1 and 2

11:45 AM 8/27/24 MOntrose FF onsite
Aligned HCN path 1

11:44 11/5/2024 SD and EO Montrose onsite
Aligned path 2 HCN-.5

2:05 PM 10/18/2024 SD Montrose onsite
Aligned H2s and HCN path 2 both to .5. Installed new verizon router

9:07 AM 10/23/2024 SD and CF Montrose onsite
Aligned path 1 HCN -.33

1:45 PM 9/19/24 Montrose FF Onsite
Aligned both HCN and H2S path 1
Aligned HCN path 2

12:32 PM 9/27/2024 Montrose Onsite KL, CN, JG

calibrated HCN Paths 1 and 2
calibrated H2S paths 1 abd 2
aligned H2S Paths 1 and 2
Calibrated UVs Paths 1 and 2
replaced CISCO AT&T module with Verizon

11:43 AM 10/1/2024 SD Montrose onsite
bump tested H2S Paths 1 and 2 500ppm
Aligned path 2 HCN

11:45 AM 10/3/2024 SD Montrose onsite
Aligned path 2 HCN and H2S. Both around 0.4 on OPM

1:30 PM 10/9/24 FF Montrose ontsite
Aligned path1 H2s and Path 2 HCN both around .485
aligned UV path 2 power around 56 - 70%

11:45 AM 10/16/24 FF Montrose Onsite
aligned path 1 HCN (.307) and H2S (.443)
Aligned Path 2 HCN (.513) and H2S (.411)

11:45 AM 11/2/24 FF Montrose onstie
Aligned HCN path 2 (.685)

1:15 PM 11/7/2024 KL Montrose Onsite
snow since 11/5 is affecting signal

6:30 PM 11/11/2024 FF Montrose onsite
aligned TDL H2S and HCN paths 1 and 2

6:05 PM 11/14/2024 CF Montrose onsite
aligned TDL paths 1 and 2

07/02/2024 22:19 Montrose KL Remote
checks

10:46 AM 7/12/2024 Montrose KL,SD Onsite
Aligned UVDOAS Paths 3 and 4
Aligned H2S TDL Paths 3 and 4
HCN was ok

2:58 PM 7/17/2024 Montrose KL Onsite
Troubleshooted COMS cabinet TEC
Troubleshooted UV Cabinet TEC
Aligned TDL H2S Path 3

5:09 PM 7/22/2024 Montrsoe KL Remote
checked UV Optimization

14:45 7/24/24 Montrose SD Onsite
Aligned H2s path 4 TDL .8 68% power
Aligned HCN path 4 .5 45% power
Aligned H2S path 3 .45 38%
HCN looks good .8 64%

11:06 AM 8/2/24 Montrose FF Onsite
Aligned H2S path 3 TDL .651 46% power
Aligned HCN path 4 TDL .441 36% pwer

6:31 PM 8/7/2024 Mpntrose KL Remote
power outage from 4pm to 6

11:14 AM 8/9/2024 Montrose SD Onsite
Aligned TDL path 4 H2S- .7 power 54%, HCN- .5 44%

1:03 PM 8/15/24 Montrose FF onsite
aligned HCN path 4

11:33 AM 8/20/24 Montrose FF ONsite
Aligned HCN path 3

11:55 AM 8/27/24 Montrose FF onsite
Aligned both HCN & H2S path 4

11:24 AM 9/20/2024 Montrose KL Onsite
replaced fiber cable of UV Path 4
aligned UV Path 4

1:54 PM 10/9/24 Montrose FF onsite
Aligned both HCN and H2s for path 3 (.532)
Aligned H2s for path 4 (.411)
aligned UV path 3

11:45 AM 10/10/2024 Montrose SD Onsite
Aligned Path 3 H2S-.5 and HCN-.5

11:20 AM 10/16/24 FF Montrose Onsite
Aligned Path3 H2S (.52) and HCN (.49)
Aligned path4 H@S (.533) and HCN (.506)

2:10 PM 9/27/2024 Montrose Onsite KL, JG, CN
Calibrated TDL H2S Paths 3 and 4
Calibrated TDL HCN Paths 3 and 4
Calibrated UVs Paths 3 and 4
Aligned TDL H2S Path 3- 0.6
Aligned TDL HCN Path 3- 0.75

11:17 AM 11/7/2024 Montrose KL Remote
snow since 11/7 is affecting the signal

4:35 PM 11/11/2024 FF Montrose Onsite
aligned TDL H2S and HCN Paths 3 and 4

07/02/2024 22:22 Montrose KL Remote
checked systems

1:48 PM 7/12/2024 Montrose KL,SD Onsite
Aligned UVDOAS Paths 5 and 6
Aligned TDL H2S Paths 5 and 6
Aligned TDL HCN Paths 5 and 6

5:00 PM 7/17/2024 Montrose KL Onsite
troubleshooted TEC Comms cabinet
troubleshooted TEC UV cabinet
Aligned UVDOAS path 5
Aligned TDL HCN Path 6
troubleshooted TEC in UV Cabinet Shelter 1

7:13 PM 7/22/2024 Montrose KL Remote
checked UV optimization

11:53 AM 8/2/24 Monrose FF onsite
aligned HCN path 5 .606 power= 45.6%
aligned HCN path 6 .717 power= 59.9%

2:59 PM 8/7/2024 Montrose CN Onsite
Aligned H2S path 6
Aligned UVDOAS Path 5

12:30 PM 8/15/24 Montrose FF Onsite
Aligned UV path 6

12:45 PM 8/20/24 Montrose FF Onsite
Aligned UV path 5

12:50 PM 8/23/2024 Montrose JG Onsite, KL Remote, Unisearch KM Remote
It was found it was HCNpath 5 had a damaged and broken fiber cable. This was replaced and realigned. path 5 HCN the
main fiber port does not work and the internal fiber runs through the spare fiber port. Path 6 is now working it should be
noted that there was an issue earlier in the week I believe that was software related.

12:36 PM 8/27/24 Montrose FF onsite
Aligned H2s Path 5
Aligned UV path 5

2:12 PM 9/19/24 Montrose FF onsite
Aligned both HCN and H2S path 5

2:10 PM 9/27/2024 Montrose Onsite KL, JG, CN
Calibrated TDL H2S Paths 5 and 6
Calibrated TDL HCN Paths 5 and 6
Calibrated UVs Paths 5 and 6
Aligned TDL H2S Path 6- 0.5
Aligned TDL HCN Path 6- 0.5
12:30 PM 10/1/2024 Montrose SD onsite
Aligned paths 6 H2S and HCN H2S-35% and HCN-40%
Aligned path 5 H2S .35

11:00 am 10/3/2024 Montrose SD onsite
aligned path 6 HCN-.5 H2S-.6 on OPM

1:17 PM 11/7/2024 Montrose KL remote
snow since 11/7 is affecting the signal

6:34 PM 11/11/2024 FF Montrose onsite
aligned TDL H2S and HCN Paths 5 and 6
Cannot get any signal at Path 5.

6:02 PM 11/12/2024 Montrose CF, KL Onsite
aligned TDL path 5, couldn't get good signal
troubleshooted system and identified issue: heater at TDL retro 5 was not working

6:03 PM 11/14/2024 Montrose CF Onsite
cleaned TDL retro 5 with isopropyl alcohol
aligned TDL H2S and HCN path 5

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

Non-Conformance Report

Project: PROJ-043815	**Month: July 2024**

LOCATION/SITE: Goodrich Corporation, Pueblo,CO	Parameter(s) Affected: Public Website
Begin Date and Time (LST): July 18, 24 at 6PM	**End Date and Time (LST): July 18, 24 at 8:40pm**
Equipment: Public Website	**S/N#: N/A**

Description of Malfunction or Problem: Make specific reference to Assignable Cause(s). All tests results should be documented on appropriate form(s).

Data stopped being reporting on public website.

Investigative Actions: Describe Assignable Cause(s). Make specific reference to all dates, times and performance test results. All tests results should be documented on appropriate form(s).

Microsoft was experiencing a nationwide outage which was affecting Microsoft's Azure Services (public websites). This issue was substantial and impacted other web services. The Montrose team was diligently monitoring the situation and was fully committed to restoring full platform functionality as quickly as possible once the Azure issue is resolved.

Corrective Action Taken: Make specific reference to all dates, times and performance test results.

The Azure outage was resolved, and the public website went back online. The data were backfilled. No data were lost.

Is Problem Fully Resolved? **Yes __x__ No _____** If "NO", Describe Further Action Required: (File updated NC/CA Report when problem is fully resolved)

Additional Attachments or Information? **Yes _____ No__x__** Client Notified? **Yes __x__ No_____**If so, **date_12/18/24_____**

Field Operator's Assessment of Data Status: (Check One)	☒ **Valid**	☐ **Suspect**	☒ **Invalid**

Additional notes on Data Validity Status: No data were lost.

Originator's Signature: _____**K. Liangou**_____

QA Review: _____*Aricia Boyd*_____

Non-Conformance Report

Project: PROJ-043815	Month: August 2024

LOCATION/SITE: Goodrich Corporation	**Parameter(s) Affected: cell pressure, cell temperature, spectrometer temp, enclosure temp**
Begin Date and Time (LST): 8/13/24 at 9am	**End Date and Time (LST): 8/20/24 at 10am**
Equipment: UVDOAS Path 4	**S/N#: N/A**

<u>Description of Malfunction or Problem:</u> Make specific reference to Assignable Cause(s). All tests results should be documented on appropriate form(s).

While replacing the fiber cables with longer ones, the Arduino board broke.

<u>Investigative Actions:</u> Describe Assignable Cause(s). Make specific reference to all dates, times and performance test results. All tests results should be documented on appropriate form(s).

The instrument stopped reading cell pressure and temperature, spectrometer temperature and enclosure temperature.

<u>Corrective Action Taken:</u> Make specific reference to all dates, times and performance test results.

A new Arduino board was ordered and was replaced with the defective one.

Is Problem Fully Resolved? **Yes __x__ No _____** If "NO", Describe Further Action Required: (File updated NC/CA Report when problem is fully resolved)

Additional Attachments or Information? **Yes _____ No__x__** Client Notified? **Yes __x__ No_____**If so, **date_8/15/24_____**

Field Operator's Assessment of Data Status: (Check One)	☒ **Valid**	☐ **Suspect**	☐ **Invalid**

Additional notes on Data Validity Status: **This UVDOAS is in the same cabinet with UVDOAS Path 3, so these readings can be used for diagnostic purposes.**

Originator's Signature: _____K.Liangou_____

QA Review: *Aricia Boyd*

Form Title: Non-Conformance Report
Document Number: 331AA-QMS-FM-5
Revision Number: R0

Implementation Date: February 07, 2024
Form Owner (Department): MAQS
Form Approval: AHeitmann

Non-Conformance Report

Project: PROJ-043815	Month: August 2024

LOCATION/SITE: Goodrich Corporation	Parameter(s) Affected: all instruments
Begin Date and Time (LST): 8/8/24 at 10am	**End Date and Time (LST): 8/8/24 at 3pm**
Equipment: Paths 1-6, all equipment	**S/N#: N/A**

Description of Malfunction or Problem: Make specific reference to Assignable Cause(s). All tests results should be documented on appropriate form(s).

The BlackHills transformers broke and there was a power outage in the whole Goodrich facility.

Investigative Actions: Describe Assignable Cause(s). Make specific reference to all dates, times and performance test results. All tests results should be documented on appropriate form(s).

The instruments remained online for a couple of hours using power from the UPS and then they shut down.

Corrective Action Taken: Make specific reference to all dates, times and performance test results.

Goodrich coordinated with BlackHills and they restored power to the facility and the shelters. There was data loss during the period of the power outage.

Is Problem Fully Resolved? **Yes __x__ No _____** If "NO", Describe Further Action Required: (File updated NC/CA Report when problem is fully resolved)

Additional Attachments or Information? **Yes _____ No_x___** Client Notified? **Yes __x__ No_____**If so, **date_8/8/24_____**

Field Operator's Assessment of Data Status: (Check One)	☐ **Valid**	☐ **Suspect**	☒ **Invalid**

Additional notes on Data Validity Status: **Data was lost during the power outage.**

Originator's Signature: _____K.Liangou_____

QA Review: *Aricia Boyd*

Non-Conformance Report

Project: PROJ-043815	Month: August 2024

LOCATION/SITE: Goodrich Corporation	Parameter(s) Affected: all instruments
Begin Date and Time (LST): 8/26/24	End Date and Time (LST): 8/26/24
Equipment: Paths 1,2,5 and 6, all equipment	S/N#: N/A

Description of Malfunction or Problem: Make specific reference to Assignable Cause(s). All tests results should be documented on appropriate form(s).

The BlackHills cut power without informing Goodrich Corporation in Shelter 2 and Shelter 6. The instruments in Paths 1,2, 5 and 6 were affected.

Investigative Actions: Describe Assignable Cause(s). Make specific reference to all dates, times and performance test results. All tests results should be documented on appropriate form(s).

The instruments remained online for a couple of hours using power from the UPS and then they shut down.

Corrective Action Taken: Make specific reference to all dates, times and performance test results.

Goodrich coordinated with BlackHills and they restored power to the shelters. There was data loss during the period of the power outage.

Is Problem Fully Resolved? **Yes ___x___ No _____** If "NO", Describe Further Action Required: (File updated NC/CA Report when problem is fully resolved)

Additional Attachments or Information? **Yes _____ No__x___** Client Notified? **Yes ___x___ No_____**If so, **date_8/8/24_____**

Field Operator's Assessment of Data Status: (Check One)	☐ **Valid**	☐ **Suspect**	☒ **Invalid**

Additional notes on Data Validity Status: **Data was lost during the power outage.**

Originator's Signature: _____**K.Liangou**_____

QA Review: _*Aricia Boyd*_____

Form Title: Non-Conformance Report
Document Number: 331AA-QMS-FM-5
Revision Number: R0

Implementation Date: February 07, 2024
Form Owner (Department): MAQS
Form Approval: AHeitmann

Non-Conformance Report

Project: PROJ-043815	Month: August 2024

LOCATION/SITE: Goodrich Corporation	Parameter(s) Affected: all instruments
Begin Date and Time (LST): 8/7/24 at 3pm	**End Date and Time (LST): 8/7/24 at 6pm**
Equipment: Paths 1-6, all equipment	**S/N#: N/A**

Description of Malfunction or Problem: Make specific reference to Assignable Cause(s). All tests results should be documented on appropriate form(s).

An issue occurred with the BlackHills transformers and there was a power outage in the whole Goodrich facility.

Investigative Actions: Describe Assignable Cause(s). Make specific reference to all dates, times and performance test results. All tests results should be documented on appropriate form(s).

The instruments remained online for a couple of hours using power from the UPS and then they shut down.

Corrective Action Taken: Make specific reference to all dates, times and performance test results.

Goodrich coordinated with BlackHills and they restored power to the facility and the shelters. There was data loss during the period of the power outage.

Is Problem Fully Resolved? **Yes ___x___ No _____** If "NO", Describe Further Action Required: (File updated NC/CA Report when problem is fully resolved)

Additional Attachments or Information? **Yes _____ No__x___** Client Notified? **Yes ___x___ No_____**If so, **date_8/8/24_____**

Field Operator's Assessment of Data Status: (Check One)	☐ **Valid**	☐ **Suspect**	☒ **Invalid**

Additional notes on Data Validity Status: **Data was lost during the power outage.**

Originator's Signature: _____K.Liangou_____

QA Review: *Aricia Boyd*

Non-Conformance Report

Project: PROJ-043815	**Month: September 2024**

LOCATION/SITE: Goodrich Corporation in Pueblo	Parameter(s) Affected:H2S, HCN, Benzene Paths 1 and 2

Begin Date and Time (LST): 9/25/24 11:20AM	**End Date and Time (LST): 9/26/24 1:40PM**

Equipment: H2S, HCN, Benzene Paths 1 and 2	**S/N#: N/A**

Description of Malfunction or Problem: Make specific reference to Assignable Cause(s). All tests results should be documented on appropriate form(s).

Instruments in Shelter 2 (H2S, HCN and Benzene Paths 1 and 2) went offline.

Investigative Actions: Describe Assignable Cause(s). Make specific reference to all dates, times and performance test results. All tests results should be documented on appropriate form(s).

Power outage in Shelter 2.

Corrective Action Taken: Make specific reference to all dates, times and performance test results.

Coordinate with site operators and called BlackHills to resolve issue with transformers.

Is Problem Fully Resolved? **Yes __x__ No ____** If "NO", Describe Further Action Required: (File updated NC/CA Report when problem is fully resolved)

Additional Attachments or Information? **Yes ____ No__x__** Client Notified? **Yes _x___ No_____** If so, **date_9/25/24_____**

Field Operator's Assessment of Data Status: (Check One)	☐ **Valid**	☐ **Suspect**	☒ **Invalid**

Additional notes on Data Validity Status: All data for H2S HCN and Benzene Paths 1 and 2 was lost because the instruments were off.

Originator's Signature: _____ Katia Liangou _____

QA Review: _____ *Aricia Boyd* _____

Form Title: Non-Conformance Report
Document Number: 331AA-QMS-FM-5
Revision Number: R0

Implementation Date: February 07, 2024
Form Owner (Department): MAQS
Form Approval: AHeitmann

Non-Conformance Report

Project: PROJ-043815	**Month: August 2024**

LOCATION/SITE: Goodrich Corporation in Pueblo	Parameter(s) Affected:H2S, HCN Paths 5 and 6

Begin Date and Time (LST): 8/22/24 11:20AM	**End Date and Time (LST): 8/23/24 10:40AM**

Equipment: H2S, HCN Paths 5 and 6	**S/N#: N/A**

Description of Malfunction or Problem: Make specific reference to Assignable Cause(s). All tests results should be documented on appropriate form(s).

TDL analyzers in Shelter 6 (H2S, HCN Paths 5 and 6) stopped reporting

Investigative Actions: Describe Assignable Cause(s). Make specific reference to all dates, times and performance test results. All tests results should be documented on appropriate form(s).

The optical fiber cables were malfunctioning.

Corrective Action Taken: Make specific reference to all dates, times and performance test results.

The fiber cables were replaced. The issue was fixed.

Is Problem Fully Resolved? **Yes ___x__ No _____** If "NO", Describe Further Action Required: (File updated NC/CA Report when problem is fully resolved)

Additional Attachments or Information? **Yes _____ No__x__** Client Notified? **Yes ____ No__x___** If so, **date_____**

Field Operator's Assessment of Data Status: (Check One)	☐ **Valid**	☐ **Suspect**	☒ **Invalid**

Additional notes on Data Validity Status: All data for H2S HCN Paths 5 and 6 was lost because the instruments not working properly

Originator's Signature: _____Katia Liangou_____

QA Review: *Aricia Boyd*

Non-Conformance Report

Project: PROJ-043815	**Month: September 2024**

LOCATION/SITE: Goodrich Corporation in Pueblo	**Parameter(s) Affected: Benzene Path 4**
Begin Date and Time (LST): 9/19/24 4:15PM	**End Date and Time (LST): 9/20/24 12:30PM**
Equipment: Benzene Path 4	**S/N#: N/A**

Description of Malfunction or Problem: Make specific reference to Assignable Cause(s). All tests results should be documented on appropriate form(s).

Benzene Path 4, integration time went to 300ms and signal went to zero.

Investigative Actions: Describe Assignable Cause(s). Make specific reference to all dates, times and performance test results. All tests results should be documented on appropriate form(s).

The optical fiber cable was malfunctioning.

Corrective Action Taken: Make specific reference to all dates, times and performance test results.

The fiber cable was replaced. The issue was fixed.

Is Problem Fully Resolved? **Yes ___x__ No _____** If "NO", Describe Further Action Required: (File updated NC/CA Report when problem is fully resolved)

Additional Attachments or Information? **Yes _____ No__x__** Client Notified? **Yes _x___ No_____** If so, **date__9/20/24_____**

Field Operator's Assessment of Data Status: (Check One)	☐ **Valid**	☐ **Suspect**	☒ **Invalid**

Additional notes on Data Validity Status: Benzene Path 4 data during this period is invalid.

Originator's Signature: _____Katia Liangou_____

QA Review: *Aricia Boyd*

E. Appendix E: Calibration verification forms

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

Operator Name(s):____Katia Liangou_____ Test Date (YYYY/MM/DD):__9/27/2024_____

Instrument Model: __UV Bi Path 1_____ Instrument Serial Number:_____

Instrument Parameters	
Optical Path Length (meters)	558 m/ 0.00235m
Maximum Intensity (%)	100
Integration Time (ms)	122

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	100	120	20
2	100	86	14
3	100	70	30
4	100	115	15
5	100	111	11
Averages	100	100	18

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

	Calculated Values	Expected Values
Overall Percent Precision	78.5	**≥ 75%**
Overall Percent Error	18	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature *Katia Liangou*

Witness's Signature *James Garrett*

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

Operator Name(s):___Katia Liangou___ Test Date (YYYY/MM/DD):__9/27/2024___

Instrument Model: __UV Bi Path 1___ Instrument Serial Number:_____

Instrument Parameters	
Optical Path Length (meters)	558 m/ 0.0235m
Maximum Intensity (%)	97
Integration Time (ms)	122

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	200	192	4
2	200	207	3.5
3	200	203	1.5
4	200	204	2
5	200	192	4
Averages	200	200	3

Form Title: UVDOAS Calibration Form		**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13		**Form Owner (Department):** MAQS
Revision Number: Rev. 0		**Form Approval:** Katia Liangou

	Calculated Values	**Expected Values**
Overall Percent Precision	96.5	**≥ 75%**
Overall Percent Error	3	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature .... *Katia Liangou* ....

Witness's Signature .... *James Garrett* ......

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

Operator Name(s): Katia Liangou   Test Date (YYYY/MM/DD): 9/27/2024

Instrument Model: UV Mono Path 2   Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	566 m/ 0.047m
Maximum Intensity (%)	95
Integration Time (ms)	54

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	100	101	1
2	100	99	1.4
3	100	103	3
4	100	92	8
5	100	101	1
Averages	100	99	2.9

Form Title: UVDOAS Calibration Form		**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13		**Form Owner (Department):** MAQS
Revision Number: Rev. 0		**Form Approval:** Katia Liangou

	Calculated Values	Expected Values
Overall Percent Precision	95.7	≥ 75%
Overall Percent Error	2.9	≤ 30%

Notes:
Calibration verification passed.

Operator's Signature ....*Katia Liangou*...........

Witness's Signature *James Garrett*...................

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_   Test Date (YYYY/MM/DD): _9/27/2024_

Instrument Model: _UV Mono Path 2_   Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	566 m/ 0.047m
Maximum Intensity (%)	95
Integration Time (ms)	54

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	200	193	9.7
2	200	190	9.5
3	200	182	9.1
4	200	192	9.6
5	200	194	9.7
Averages	200	190	9.5

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

	Calculated Values	Expected Values
Overall Percent Precision	97.6	≥ 75%
Overall Percent Error	9.5	≤ 30%

Notes:
Calibration verification passed.

Operator's Signature ......*Katia Liangou*..........

Witness's Signature ......*James Garrett*.........

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

Operator Name(s): Katia Liangou   Test Date (YYYY/MM/DD): 9/27/2024

Instrument Model: UV Bi Path 3   Instrument Serial Number:_____

Instrument Parameters	
Optical Path Length (meters)	613 m/ 0.0235m
Maximum Intensity (%)	95
Integration Time (ms)	51

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	100	94	6
2	100	97	3
3	100	88	12
4	100	84	16
5	100	82	18
Averages	100	89	11

Form Title: UVDOAS Calibration Form		**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13		**Form Owner (Department):** MAQS
Revision Number: Rev. 0		**Form Approval:** Katia Liangou

	Calculated Values	Expected Values
Overall Percent Precision	93.6	**≥ 75%**
Overall Percent Error	11	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature *Katia Liangou*

Witness's Signature *James Garrett*

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_ Test Date (YYYY/MM/DD): _9/27/2024_

Instrument Model: _UV Bi Path 3_ Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	613 m/ 0.0235m
Maximum Intensity (%)	95
Integration Time (ms)	51

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	200	213	6.5
2	200	190	5
3	200	150	25
4	200	150	25
5	200	208	4
Averages	200	182	13.1

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024	
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS	
Revision Number: Rev. 0	**Form Approval:** Katia Liangou	

	Calculated Values	Expected Values
Overall Percent Precision	84.7	≥ 75%
Overall Percent Error	13.1	≤ 30%

Notes:
Calibration verification passed.

Operator's Signature ....*Katia Liangou*..............

Witness's Signature ....*James Garrett*..............

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

Operator Name(s):___Katia Liangou___ Test Date (YYYY/MM/DD):_9/27/2024_____

Instrument Model: _UV Bi Path 4_____ Instrument Serial Number:_____

Instrument Parameters	
Optical Path Length (meters)	566 m/ 0.0235m
Maximum Intensity (%)	88
Integration Time (ms)	50

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	100	85	15
2	100	88	12
3	100	90	10
4	100	88	12
5	100	88	12
Averages	100	88	12.2

Form Title: UVDOAS Calibration Form
Document Number: 331AA-OPS-FM-13
Revision Number: Rev. 0

Implementation Date: July 10, 2024
Form Owner (Department): MAQS
Form Approval: Katia Liangou

	Calculated Values	Expected Values
Overall Percent Precision	98.2	≥ 75%
Overall Percent Error	12.2	≤ 30%

Notes:
Calibration verification passed.

Operator's Signature ...... *Katia Liangou* ......

Witness's Signature ...... *James Garrett* ......

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_ Test Date (YYYY/MM/DD): _9/27/2024_

Instrument Model: _UV Bi Path 4_ Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	566 m/ 0.0235m
Maximum Intensity (%)	88
Integration Time (ms)	50

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	200	188	6
2	200	179	10.5
3	200	183	8.5
4	200	187	6.5
5	200	181	9.5
Averages	200	184	8.2

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

	Calculated Values	Expected Values
Overall Percent Precision	98.1	≥ 75%
Overall Percent Error	8.2	≤ 30%

Notes:
Calibration verification passed.

Operator's Signature .... *Katia Liangou* ....

Witness's Signature .... *James Garrett* ....

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

Operator Name(s):___Katia Liangou___ Test Date (YYYY/MM/DD):__9/27/2024_____

Instrument Model:___UV Mono Path 5____ Instrument Serial Number:_____

Instrument Parameters	
Optical Path Length (meters)	594 m/ 0.047m
Maximum Intensity (%)	86
Integration Time (ms)	27

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	100	98	2
2	100	98	2
3	100	111	11
4	100	106	6
5	100	113	13
Averages	100	105	6.8

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

	Calculated Values	**Expected Values**
Overall Percent Precision	93.0	**≥ 75%**
Overall Percent Error	6.8	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature .... *Katia Liangou*

Witness's Signature .... *James Garrett*

Form Title: UVDOAS Calibration Form	Implementation Date: July 10, 2024
Document Number: 331AA-OPS-FM-13	Form Owner (Department): MAQS
Revision Number: Rev. 0	Form Approval: Katia Liangou

Operator Name(s): __Katia Liangou__ Test Date (YYYY/MM/DD): __9/27/2024__

Instrument Model: __UV Mono Path 5__ Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	594 m/ 0.047m
Maximum Intensity (%)	86
Integration Time (ms)	27

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	200	186	7
2	200	180	10
3	200	184	8
4	200	194	3
5	200	181	9.5
Averages	200	185	7.5

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

	Calculated Values	**Expected Values**
Overall Percent Precision	97.2	**≥ 75%**
Overall Percent Error	7.5	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature ....*Katia Liangou*..............

Witness's Signature ....*James Garrett*..........

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

Operator Name(s):___Katia Liangou___ Test Date (YYYY/MM/DD):_9/27/2024___

Instrument Model: _UV Bi Path 6___ Instrument Serial Number:_____

Instrument Parameters	
Optical Path Length (meters)	569 m/ 0.0235m
Maximum Intensity (%)	86
Integration Time (ms)	30

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	100	115	15
2	100	124	24
3	100	128	28
4	100	140	40
5	100	103	30
Averages	100	122	22

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

	Calculated Values	**Expected Values**
Overall Percent Precision	86.1	**≥ 75%**
Overall Percent Error	22	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature .... *Katia Liangou*

Witness's Signature .... *James Garrett*

Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13	**Form Owner (Department):** MAQS
Revision Number: Rev. 0	**Form Approval:** Katia Liangou

Operator Name(s): __Katia Liangou__ Test Date (YYYY/MM/DD): __9/27/2024__

Instrument Model: __UV Bi Path 6__ Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	569 m/ 0.0235m
Maximum Intensity (%)	86
Integration Time (ms)	30

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	Benzene Concentration (PPM)	Measured Concentration (PPM)	Error (%)
1	200	179	10.5
2	200	219	9.5
3	200	207	3.5
4	200	208	4
5	200	222	11
Averages	200	207	7.7

Form Title: UVDOAS Calibration Form		**Implementation Date:** July 10, 2024
Document Number: 331AA-OPS-FM-13		**Form Owner (Department):** MAQS
Revision Number: Rev. 0		**Form Approval:** Katia Liangou

	Calculated Values	Expected Values
Overall Percent Precision	91.5	**≥ 75%**
Overall Percent Error	7.7	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature ....*Katia Liangou*..............

Witness's Signature ....*James Garrett*..............

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _10/1/24_____

Instrument Model: _H2S Path 1_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	558 m
Compound (H2S/HCN)	H2S

Standard Information	
Compound External Audit Cell Concentration (PPMM)	500 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	500	536	7.2
2	500	544	8.8
3	500	538	7.6
4	500	560	12
5	500	532	6.4
Averages	500	542	8.4

	Calculated Values	Expected Values
Overall Percent Precision	97.8%	≥ 80%
Overall Percent Error	8.4 %	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): *James Garrett* _____

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TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_ Test Date (YYYY/MM/DD): _9/27/24_

Instrument Model: _H2S Path 1_ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	558 m
Compound (H2S/HCN)	H2S

Standard Information	
Compound External Audit Cell Concentration (PPMM)	625 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	625	818	30.9
2	625	778	24.5
3	625	758	21.3
4	625	722	15.5
5	625	784	25.4
Averages	625	772	23.5

	Calculated Values	Expected Values
Overall Percent Precision	94.3%	≥ 80%
Overall Percent Error	23.5 %	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____   Witness Signature(s): *James Garrett*

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TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _10/1/24_____

Instrument Model: _H2S Path 2_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	283 m
Compound (H2S/HCN)	H2S

Standard Information	
Compound External Audit Cell Concentration (PPMM)	500 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	500	480	4
2	500	480	4
3	500	498	0.4
4	500	480	4
5	500	486	2.8
Averages	500	485	3

	Calculated Values	Expected Values
Overall Percent Precision	98.4%	≥ 80%
Overall Percent Error	3%	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): *James Garrett*

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TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_   Test Date (YYYY/MM/DD): _9/27/24_

Instrument Model: _H2S Path 2_   Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	283 m
Compound (H2S/HCN)	H2S

Standard Information	
Compound External Audit Cell Concentration (PPMM)	625 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	625	850	36
2	625	782	25.1
3	625	786	25.8
4	625	802	28.3
5	625	782	25.1
Averages	625	800	28.1

	Calculated Values	Expected Values
Overall Percent Precision	95.4	≥ 80%
Overall Percent Error	28.1	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _James Garrett_

MONTROSE
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TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): ___Katia Liangou_____ Test Date (YYYY/MM/DD): _9/27/24_____

Instrument Model: ___H2S Path 3_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	613 m
Compound (H2S/HCN)	H_2S

Standard Information	
Compound External Audit Cell Concentration (PPMM)	500 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	500	492	1.6
2	500	472	5.6
3	500	464	7.2
4	500	420	16
5	500	502	0.4
Averages	500	470	6.2

	Calculated Values	Expected Values
Overall Percent Precision	93.6%	≥ 80%
Overall Percent Error	6.2%	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _James Garrett_____

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): __Katia Liangou_____ Test Date (YYYY/MM/DD):__9/27/24_____

Instrument Model: __H2S Path 4_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	566 m
Compound (H2S/HCN)	H2S

Standard Information	
Compound External Audit Cell Concentration (PPMM)	500 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	500	422	15.6
2	500	410	18
3	500	416	16.8
4	500	392	21.6
5	500	400	20
Averages	500	408	18.4

	Calculated Values	Expected Values
Overall Percent Precision	97.6%	≥ 80%
Overall Percent Error	18.4%	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _____James Garrett_____

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _9/27/24_____

Instrument Model: _H2S Path 4_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	566 m
Compound (H2S/HCN)	H2S

Standard Information	
Compound External Audit Cell Concentration (PPMM)	625 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	625	616	1.4
2	625	644	3
3	625	632	1.1
4	625	632	1.1
5	625	634	1.4
Averages	625	632	1.1

	Calculated Values	Expected Values
Overall Percent Precision	98.4%	≥ 80%
Overall Percent Error	1.1 %	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _James Garrett_

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _9/27/24_____

Instrument Model: _H2S Path 5_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	297 m
Compound (H2S/HCN)	H2S

Standard Information	
Compound External Audit Cell Concentration (PPMM)	625 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	625	748	19.7
2	625	768	22.9
3	625	714	14.2
4	625	890	42.4
5	625	762	21.9
Averages	625	776	24.2

	Calculated Values	Expected Values
Overall Percent Precision	89.3%	≥ 80%
Overall Percent Error	24.2%	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _*James Garrett*_____

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _9/27/24_____

Instrument Model: _H2S Path 6_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	569 m
Compound (H2S/HCN)	H2S

Standard Information	
Compound External Audit Cell Concentration (PPMM)	500 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	500	426	14.8
2	500	468	6.4
3	500	470	6
4	500	452	9.6
5	500	486	2.8
Averages	500	460	7.9

	Calculated Values	Expected Values
Overall Percent Precision	95.5%	≥ 80%
Overall Percent Error	7.9%	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): ___*James Garrett*___

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): __Katia Liangou__   Test Date (YYYY/MM/DD): __9/27/24__

Instrument Model: __H2S Path 6__   Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	569 m
Compound (H2S/HCN)	H2S

Standard Information	
Compound External Audit Cell Concentration (PPMM)	625 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	625	844	35
2	625	694	11
3	625	744	19
4	625	732	17.1
5	625	716	14.6
Averages	625	746	19,4

	Calculated Values	Expected Values
Overall Percent Precision	90.7%	≥ 80%
Overall Percent Error	19.4%	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _*James Garrett*_____

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _9/27/24_____

Instrument Model: _HCN Path 1_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	558 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	420 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	420	448	6.7
2	420	450	7.1
3	420	452	7.6
4	420	450	7.1
5	420	452	7.6
Averages	420	450	7.2

	Calculated Values	Expected Values
Overall Percent Precision	99.6%	≥ 80%
Overall Percent Error	7.2 %	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): ___*James Garrett*___

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): __Katia Liangou__   Test Date (YYYY/MM/DD): __9/27/24__

Instrument Model: __HCN Path 1__   Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	558 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	1010 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	1010	972	3.8
2	1010	972	3.8
3	1010	974	3.6
4	1010	974	3.6
5	1010	974	3.6
Averages	1010	973	3.6

	Calculated Values	Expected Values
Overall Percent Precision	99.9%	≥ 80%
Overall Percent Error	3.6 %	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _James Garrett_

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _9/27/24_____

Instrument Model: _HCN Path 2_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	283 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	420 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	420	452	7.6
2	420	454	8.1
3	420	454	8.1
4	420	454	8.1
5	420	454	8.1
Averages	420	454	8

	Calculated Values	Expected Values
Overall Percent Precision	99.8%	≥ 80%
Overall Percent Error	8%	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _James Garrett_

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Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _9/27/24_____

Instrument Model: _HCN Path 2_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	283 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	1010 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	1010	978	3.2
2	1010	978	3.2
3	1010	978	3.2
4	1010	976	3.4
5	1010	976	3.4
Averages	1010	977	3.2

	Calculated Values	Expected Values
Overall Percent Precision	99.9%	≥ 80%
Overall Percent Error	3.2%	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____   Witness Signature(s): *James Garrett*

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _9/27/24_____

Instrument Model: _HCN Path 3_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	613 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	420 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	420	478	13.8
2	420	476	13.3
3	420	478	13.8
4	420	478	13.8
5	420	478	13.8
Averages	420	478	13.7

	Calculated Values	Expected Values
Overall Percent Precision	99.8%	$\geq 80\%$
Overall Percent Error	13.7%	$\leq 30\%$

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): *James Garrett*

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_ Test Date (YYYY/MM/DD): _9/27/24_

Instrument Model: _HCN Path 3_ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	613 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	1010 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	1010	988	2.2
2	1010	988	2.2
3	1010	988	2.2
4	1010	986	2.4
5	1010	988	2.2
Averages	1010	988	2.2

	Calculated Values	Expected Values
Overall Percent Precision	99.9%	≥ 80%
Overall Percent Error	2.2%	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _James Garrett_

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_ Test Date (YYYY/MM/DD): _9/27/24_

Instrument Model: _HCN Path 4_ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	566 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	420 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	420	458	9
2	420	460	9.5
3	420	458	9
4	420	464	10.5
5	420	462	10
Averages	420	460	9.6

	Calculated Values	Expected Values
Overall Percent Precision	99.4%	≥ 80%
Overall Percent Error	9.6%	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _James Garrett_

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Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_   Test Date (YYYY/MM/DD): _9/27/24_

Instrument Model: _HCN Path 4_   Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	566 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	1010 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	1010	966	4.4
2	1010	968	4.2
3	1010	960	5
4	1010	960	5
5	1010	966	4.4
Averages	1010	964	4.6

	Calculated Values	Expected Values
Overall Percent Precision	99.6%	≥ 80%
Overall Percent Error	4.6%	≤ 30%

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _James Garrett_____

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_   Test Date (YYYY/MM/DD): _9/27/24_

Instrument Model: _HCN Path 5_   Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	297 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	420 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	420	454	8.1
2	420	452	7.6
3	420	454	8.1
4	420	454	8.1
5	420	454	8.1
Averages	420	454	8

	Calculated Values	Expected Values
Overall Percent Precision	99.8%	≥ 80%
Overall Percent Error	8%	≤ 30%

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____ Witness Signature(s): _James Garrett_____

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _9/27/24_____

Instrument Model: _HCN Path 5_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	297 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	1010 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	1010	966	4.4
2	1010	968	4.2
3	1010	968	4.2
4	1010	968	4.2
5	1010	968	4.2
Averages	1010	968	4.2

	Calculated Values	Expected Values
Overall Percent Precision	99.9%	≥ 80%
Overall Percent Error	4.2%	≤ 30%

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Notes:
Calibration verification passed.

Operator Signature(s): _____Witness Signature(s): _James Garrett_

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Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _9/27/24_____

Instrument Model: _HCN Path 6_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	569 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	420 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	420	446	6.2
2	420	446	6.2
3	420	444	5.7
4	420	442	5.2
5	420	444	5.7
Averages	420	444	5.8

	Calculated Values	Expected Values
Overall Percent Precision	99.6%	≥ 80%
Overall Percent Error	5.8%	≤ 30%

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Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
Calibration verification passed.

Operator Signature(s): _____Witness Signature(s): _James Garrett_

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TDL Calibration Form

Operator Name(s): _Katia Liangou_____ Test Date (YYYY/MM/DD): _9/27/24_____

Instrument Model: _HCN Path 6_____ Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	569 m
Compound (H2S/HCN)	HCN

Standard Information	
Compound External Audit Cell Concentration (PPMM)	1010 PPMM

File #	Compound Concentration (PPMM)	Measured Concentration (PPMM)	Error (% Reading)
1	1010	960	5
2	1010	960	5
3	1010	960	5
4	1010	960	5
5	1010	960	5
Averages	1010	960	5

	Calculated Values	Expected Values
Overall Percent Precision	100%	≥ 80%
Overall Percent Error	5%	≤ 30%

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Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Notes:
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Operator Signature(s): _____ Witness Signature(s): _James Garrett_____