Quarterly Report for Phillips 66 Denver Terminal Fenceline Monitoring Plan-Q1 2025

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II. Executive Summary

This report summarizes the findings related to the Phillips 66 fenceline monitoring plan during the period of January 1st of 2025 to March 31st of 2025 (Q1 of 2025). The data collected during this period were validated following all procedures described in the Phillips 66 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

Phillips 66 operates a bulk fuel storage and distribution terminal at 3960 East 56th Avenue, Commerce City (Adams County), Colorado. Gasoline, Ethanol, Jet and Diesel fuel products are received from a pipeline, stored and distributed to market by tank trucks. The principal components of the facility are as follows:

- Gasoline aboveground storage tanks
- Butane aboveground storage tanks
- Jet aboveground storage tanks
- Diesel aboveground storage tanks
- Additive aboveground storage tanks
- Ethanol aboveground storage tank
- Vapor combustor unit (VCU)

The facility lies in an industrial area near the Suncor refinery to the north and east, another bulk terminal, two asphalt plants and a wastewater treatment facility and other nearby industrial sources of Covered Air Toxics.

B. Instrument Description

1. Open-Path Monitors

The Phillips 66 Denver Terminal 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 Phillips 66 open-path system will consist of four analyzers at the locations shown in Figure 1 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 Phillips 66 Denver Terminal 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, 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.

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. Thus, only the light-source/detector end of the monitoring path requires substantial power, communications equipment, and a large shelter.

The Phillips 66 Denver Terminal 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

[1] These two compounds are neither used nor stored at, nor are they emitted from the Phillips 66 Denver Terminal. Therefore, the facility does not have the potential to emit either of these compounds, which comprise "Covered Air Toxics" under HB21-1189. Therefore, in the event an Alert Threshold (Table 1-2 of the Fenceline Monitoring Plan) for either of these compounds is monitored, the monitored concentrations will be assigned a NS qualifier code and attributed to one or more of the near-by facilities described in Section 2.1 and Table 2-1 of the Fenceline Monitoring Plan, titled, "Other Industrial Facilities near the Phillips 66 Facility" .

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 once again been selected to reduce the need for substantial power at the retroreflector sites, and improve detection limits by increasing effective path lengths.

The Phillips 66 Denver Terminal 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 instrumentation are installed on a 10m, heavy-duty aluminum tower. The 3-sided, open latticework tower is fabricated using a high-strength aluminum alloy in three, 10-foot sections and is engineered for the specified wind load per EIA RS-222G. The tower is designed not to twist, rotate or sway, providing a rigid platform for mounting the sensors. It features hinged base leg brackets that permit the tower to be pivoted down into a horizontal position for easy servicing of the sensors. The tower incorporates a lightning rod with a full height ground cable and ground rod.

The meteorological monitoring tower is located at the west end of the Phillips 66 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.

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 (°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 utilizes four primary shelters to house the open path analyzers, identified as the orange and blue pins in Figure 1. Each orange pin shelter houses one (1) monostatic open-path tunable diode laser 4-channel H_2S (TDL) analyzer, one (1) monostatic open-path tunable diode laser 4-channel HCN (TDL) analyzer, and two (2) monostatic open-path ultraviolet differential optical absorption (UV-DOAS) analyzers. Each blue pin shelter houses one (1) fiber optic line from the monostatic open-path tunable diode laser 4-channel H_2S (TDL) analyzer in the orange pin shelter, one (1) fiber optic line from the monostatic open-path tunable diode laser 4-channel HCN (TDL) analyzer in the orange pin shelter, and one (1) monostatic open-path ultraviolet differential optical absorption (UV-DOAS) analyzer.

Each open-path analyzer location has multiple paths identified numerically 1 through 6. At the end of each path there is a retroreflector opposite the analyzer. For example, the line from the analyzer shelter to the retroreflector forms the path. The specific locations for all open path equipment were selected to provide coverage of all facility emission sources within the constraints of the facility footprint.

For the hydrogen cyanide[2] and hydrogen sulfide[2] northwest path (Path 6) and northeast path (Path 1), laser light is transmitted from the most local orange pinned shelters under or above ground via fiber optic cable to the blue pinned shelters then transmitted above ground to monitor the northwest path (Path 6) and northeast path (Path 1). The laser light reflects back to a telescope mounted on the northwest path (Path 6) and northeast path (Path 1) instrument shelters then transmitted back underground to the detector in the most local orange pinned shelter that the laser light originated from.

This monitoring program also includes meteorological monitoring as required in HB21-1189. Meteorological monitoring allows for the characterization of wind patterns for understanding the movement of the three covered air toxics and potential sources of emissions, and whether they are from the Phillips

[2] These two compounds are neither used nor stored at, nor are they emitted from the Phillips 66 Denver Terminal· Therefore, the facility does not have the potential to emit either of these compounds, which comprise “Covered Air Toxics” under HB21-1189.

66 bulk terminal or a neighboring facility. Since the Phillips 66 Denver Terminal does not store, emit or have the potential to emit hydrogen cyanide or hydrogen sulfide, in the event concentrations of those covered air toxics are detected by the Phillips 66 fenceline monitoring system, the source of the detected emissions will necessarily indicate hydrogen cyanide or hydrogen sulfide emissions from a neighboring facility or source. A 10-meter meteorological tower will be installed near the Path 6 instrument shelter (Figure 1), so that power can be shared.

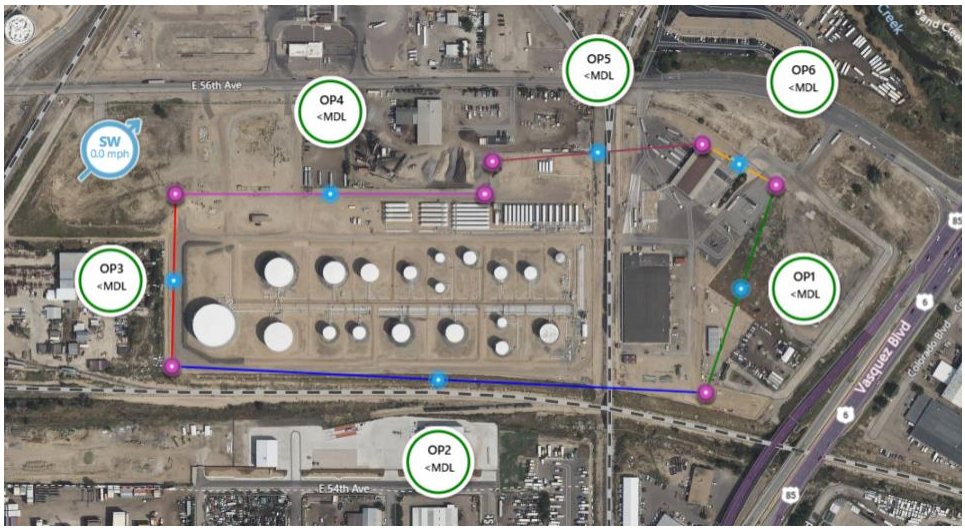

Figure 1: Approximate Layout of the Open-Path Analyzers, Retroreflector Locations, and Meteorological Station

Table 2: Descriptions of Each Individual Path

Path	Path Length	Compounds
1	226 meters	Hydrogen sulfide Hydrogen cyanide Benzene
2	550 meters	Hydrogen sulfide Hydrogen cyanide Benzene
3	165 meters	Hydrogen sulfide Hydrogen cyanide Benzene
4	315 meters	Hydrogen sulfide Hydrogen cyanide Benzene

5	222 meters	Hydrogen sulfide Hydrogen cyanide Benzene
6	138 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 flag
- 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
    - 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		^oC	35
TDL	MDL	Minimum detection limit	PPB	< 25% of alert threshold For all paths except H2S Paths 3,4 and 6 where it is <50% 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 < 25% of alert threshold For all paths except H2S Paths 3,4 and 6 where it is <50% of alert 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 alert threshold for all paths except H2S Paths 3,4 and 6 where it is <50% of alert threshold. 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 alert threshold

Robustness	Continuous	For all paths except H2S Paths 3,4 and 6 where it is <50% of alert 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
- 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. Quarterly Data Summary

Table 6: Quarterly Data Summary

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]
1	Benzene	0	0.0	0.4	0.5	0.9	474.2	2.1	1.20%	95.3%	0.8
1	H2S	0	0.0	2.6	8.1	16.6	55.8	11.3	0.09%	79.8%	14.6
1	HCN	0	0.0	0.3	1.4	3.1	29.5	2.5	1.10%	78.9%	1.6
2	Benzene	0	0.0	0.7	0.9	1.0	23.8	1.1	0.10%	91.3%	0.5
2	H2S	0	0.0	0.0	10.4	20.3	56.8	12.4	0.10%	63.0%	21.5

2	HCN	0	0.0	0.1	0.4	0.8	10.7	0.6	1.80%	70.9%	0.5
3	Benzene	0	0.0	1.3	1.9	3.1	589.6	6.3	0.00%	96.4%	0.5
3	H2S	0	0.0	0.2	3.2	13.0	111.7	9.9	0.00%	63.7%	13.6
3	HCN	0	0.0	1.6	3.6	5.5	15.7	3.7	1.10%	74.8%	5.9
4	Benzene	0	0.0	0.8	1.0	1.5	29.4	1.4	0%	96.2%	1.2
4	H2S	0	0.0	0.0	25.6	43.3	119.0	27.2	0.10%	66.5%	52.7
4	HCN	0	0.0	0.4	1.3	2.7	13.9	1.8	0.00%	68.0%	2.5
5	Benzene	0	0.1	0.3	0.3	0.5	124.8	0.6	0.44%	83.5%	0.4

5	H2S	0	1.0	11.5	19.0	28.0	60.6	20.4	0.00%	68.2%	26.5
5	HCN	0	0.0	0.5	1.7	4.5	21.1	3.0	2.60%	71.6%	2.0
6	Benzene	0	0.2	0.5	0.7	1.0	146.9	1.2	2.50%	97.4%	0.8
6	H2S	0	1.5	23.5	41.3	60.3	157.9	43.5	0.06%	71.4%	67.8
6	HCN	0	0.0	0.8	1.6	3.2	19.5	2.4	0.40%	83.8%	2.1

[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 “P66 FLMP Data Packet_Q1 2025”. All 5min data have been validated based on the procedures described in the P66 fenceline monitoring plan.

C. Discussion of Invalidated Data

The data was validated based on the procedures mentioned in the fenceline monitoring plan. During this second quarter of the fenceline monitoring program operation, there was a high data invalidation rate for the shorter paths (3,4 and 6). The reason was related to the short path length which causes higher detection limits. The higher-than-expected detection limits were related to the increased signal noise that was observed in most of the paths due to the short path (less than 500 m). The instruments have been optimized in order to decrease the calculated MDLs. There is an improvement in most of cases between the previous quarters.

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 second quarter of the fenceline monitoring for any of the compounds. For benzene, the average median MDL value was around 9.1 ppb, for H2S the average MDL value was approximately 13.3 ppb, and for HCN the corresponding average MDL was around 12.5 ppb. As discussed in Section C, the higher H2S MDL values are related to the path lengths being shorter than 500 meters. Phillips 66 does not store nor emit H2S and HCN.

E. Summary Plots

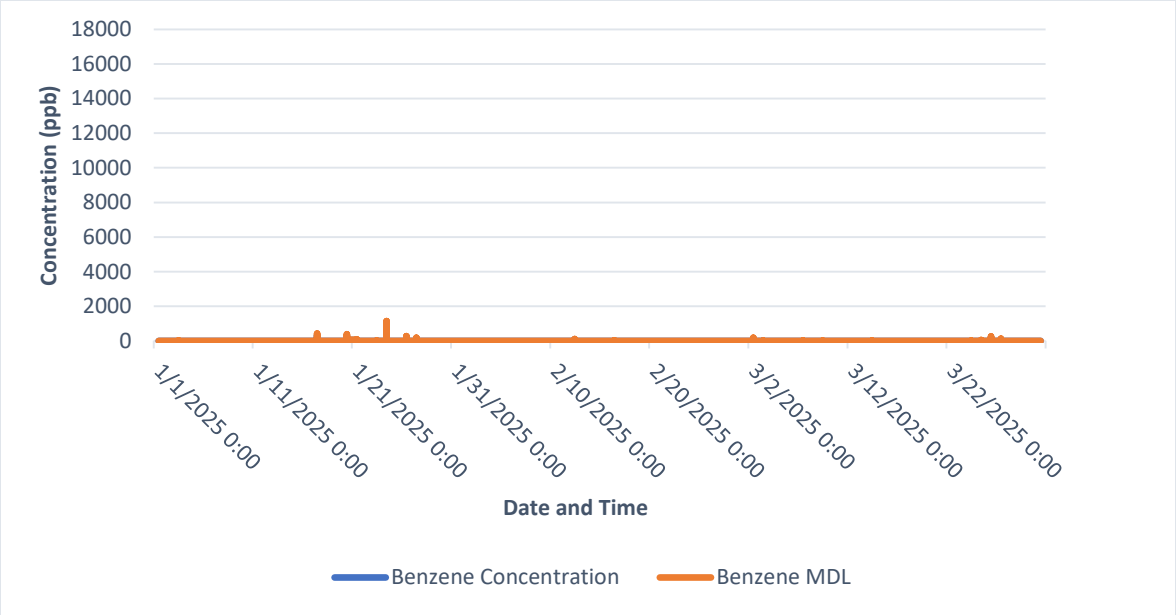

Figure 2. Timeseries of Benzene Path 1

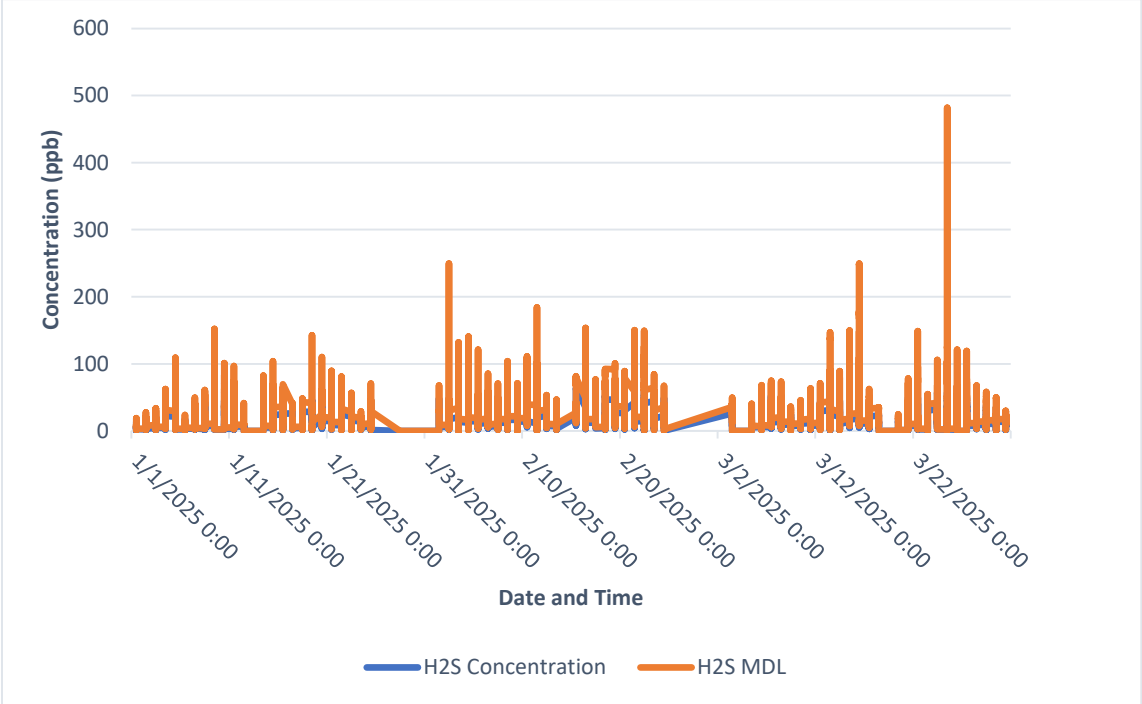

Figure 3. Timeseries of H_2S Path 1

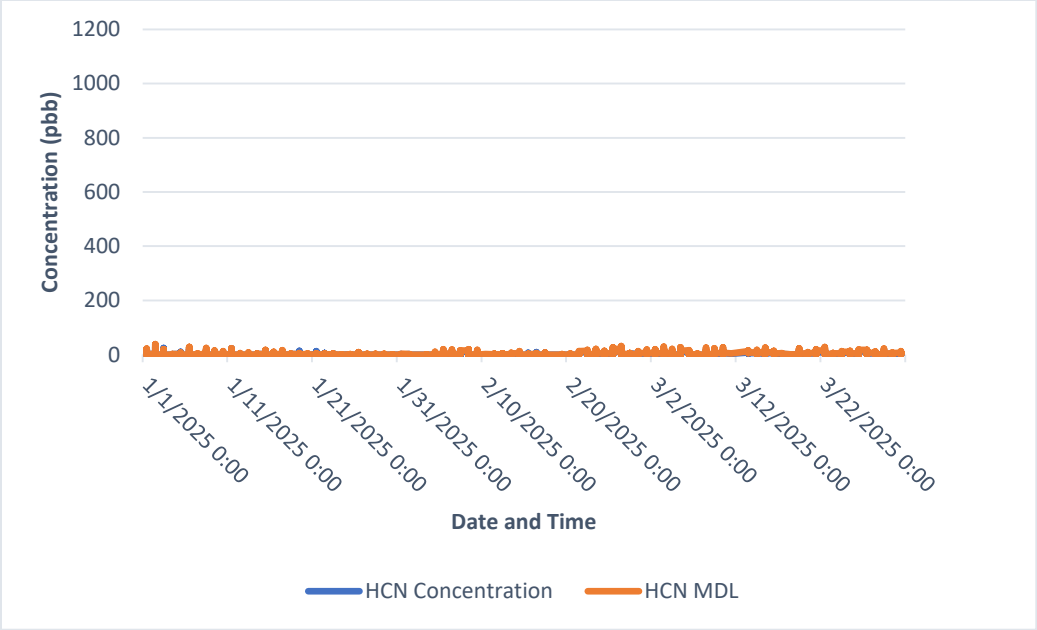

Figure 4. Timeseries of HCN Path 1

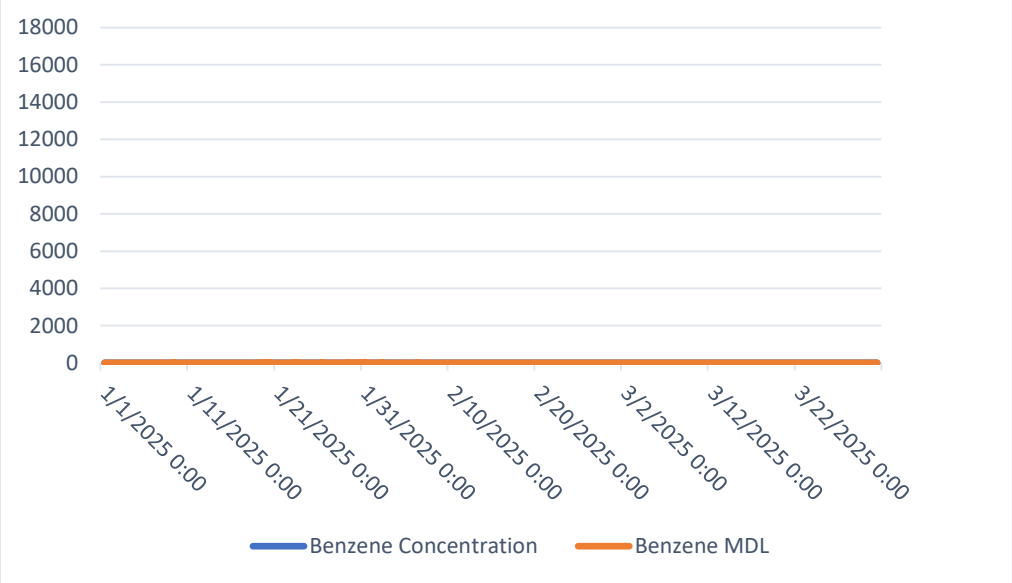

Figure 5. Timeseries of Benzene Path 2

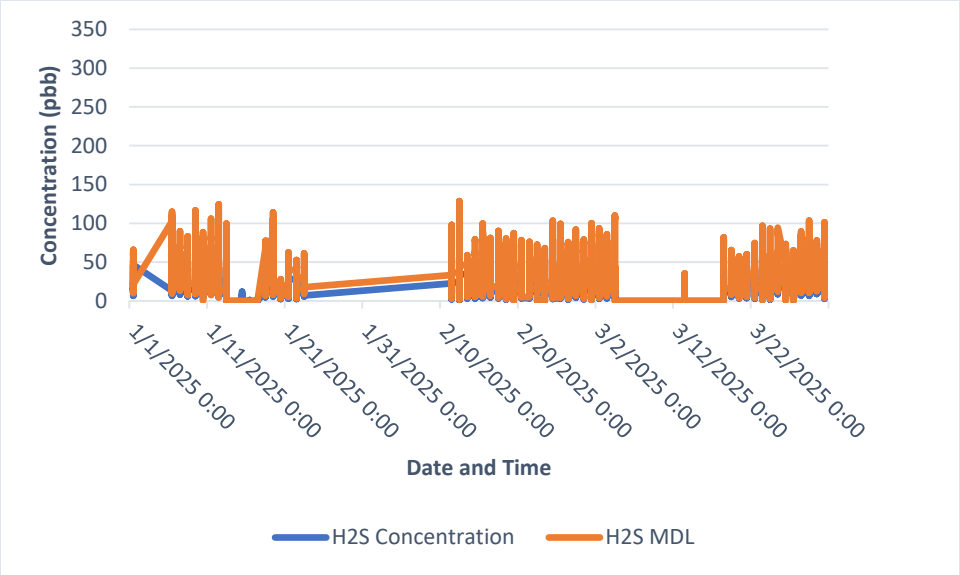

Figure 6. Timeseries of H_2S Path 2

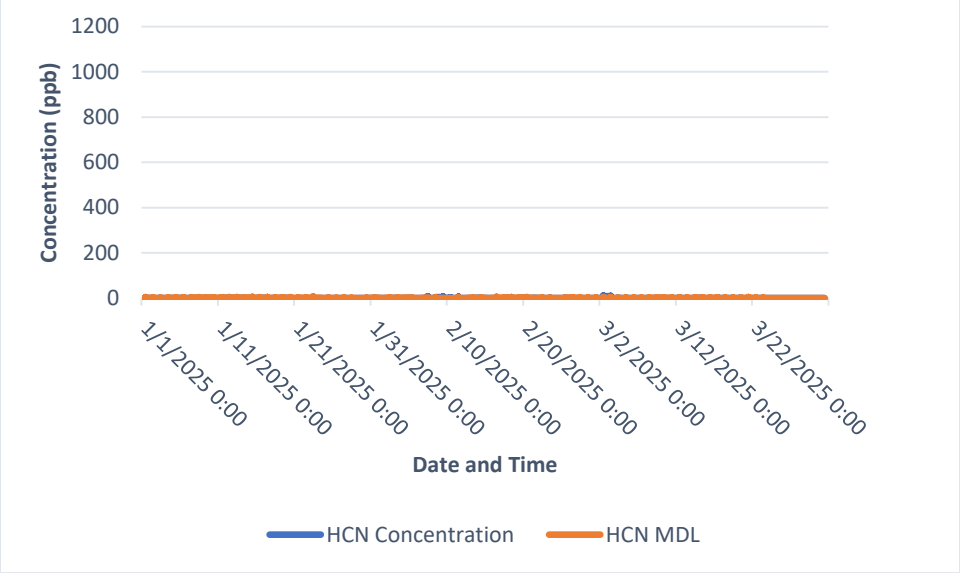

Figure 7. Timeseries of HCN Path 2

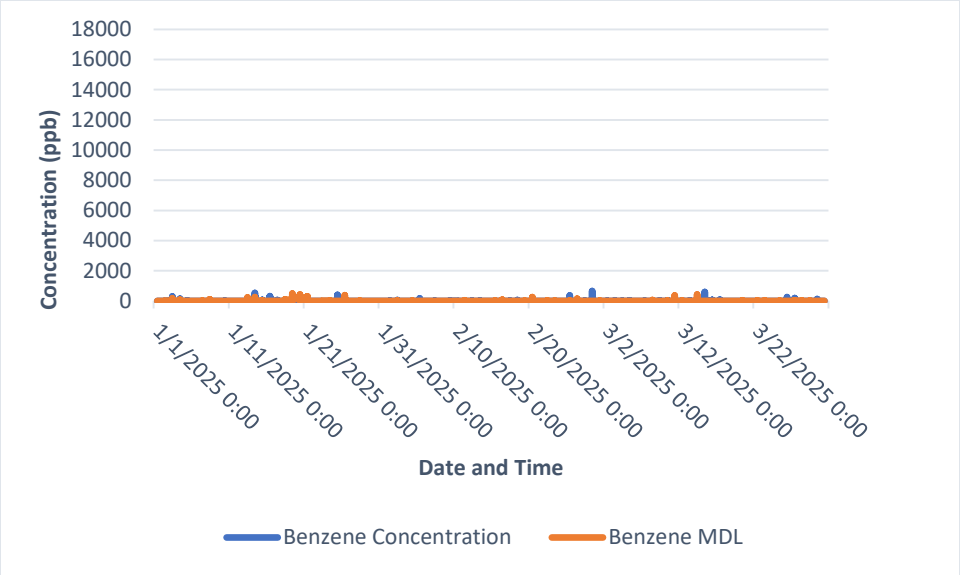

Figure 8. Timeseries of Benzene Path 3

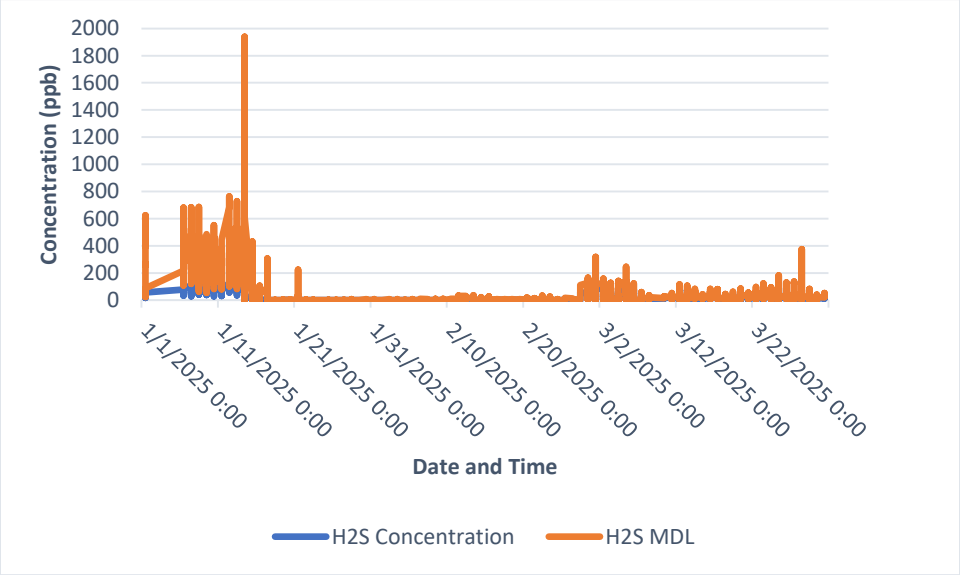

Figure 9. Timeseries of H_2S Path 3

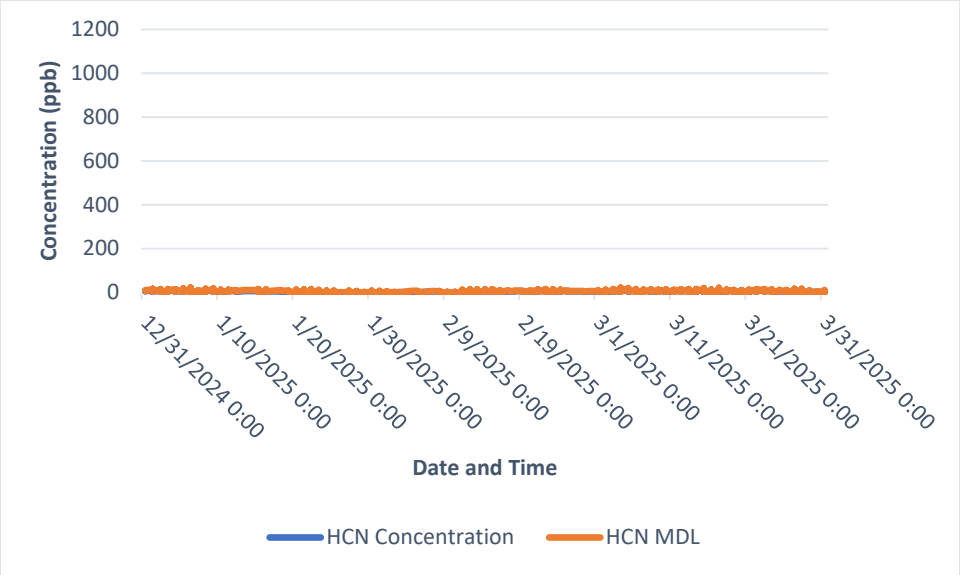

Figure 10. Timeseries of HCN Path 3

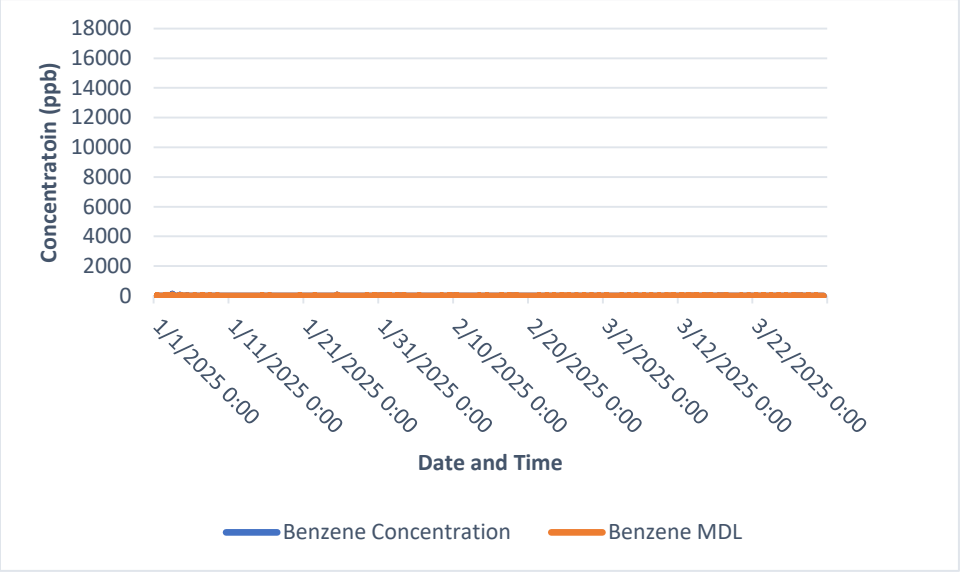

Figure 11. Timeseries of Benzene Path 4

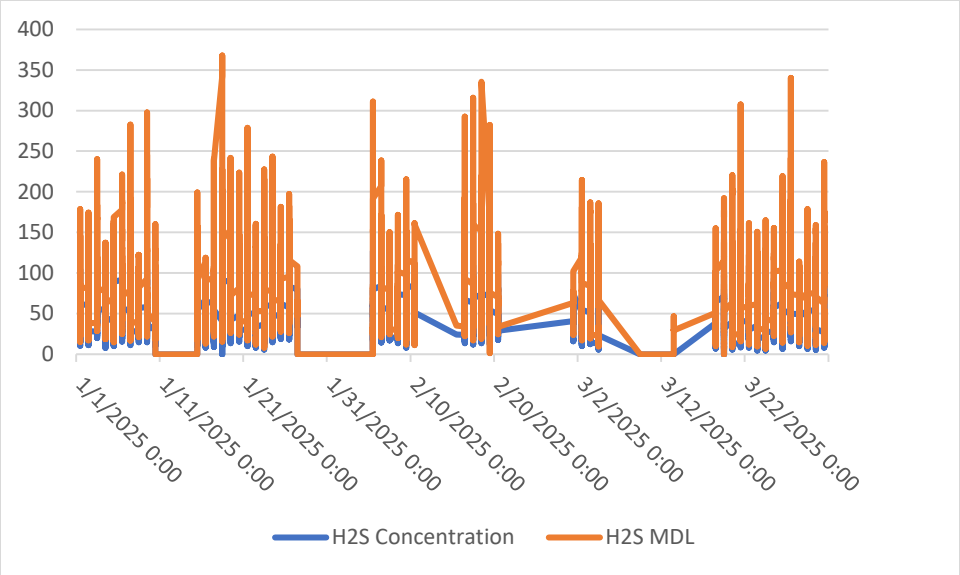

Figure 12. Timeseries of H_2S Path 4

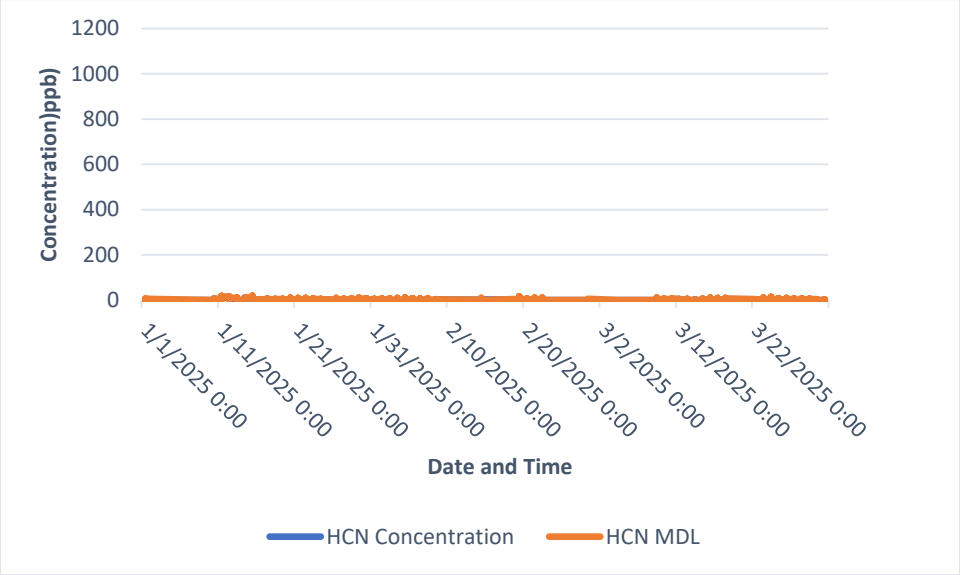

Figure 13. Timeseries of HCN Path 4

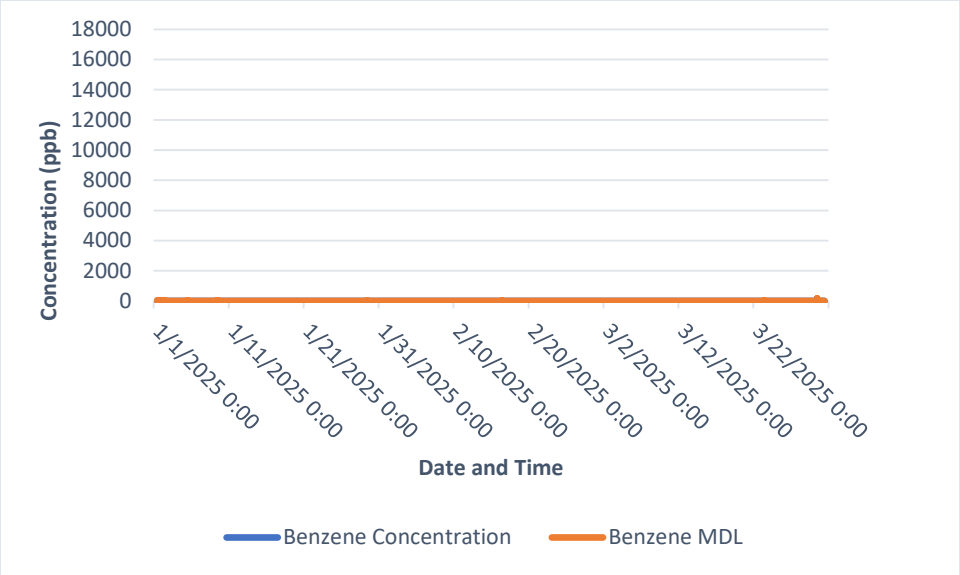

Figure 14. Timeseries of Benzene Path 5

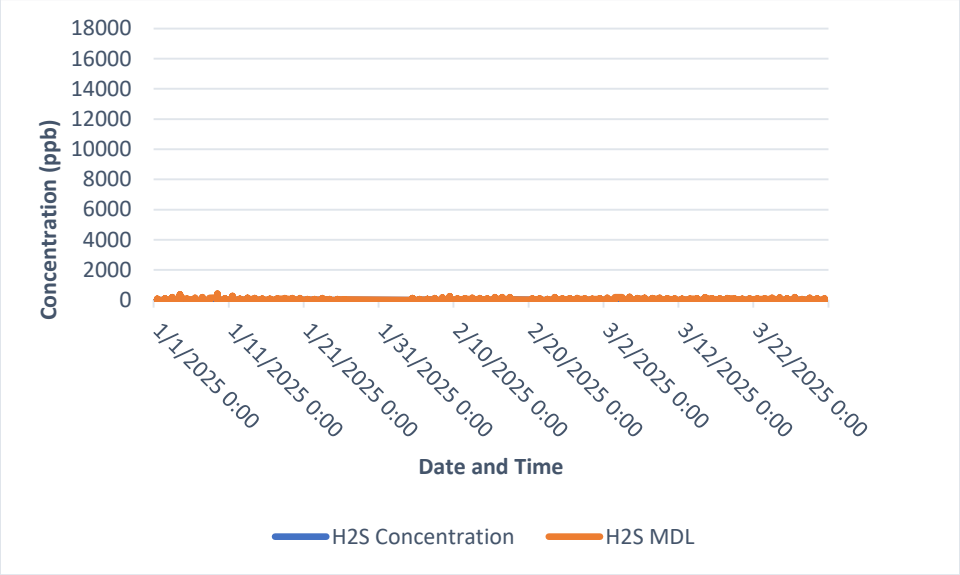

Figure 15. Timeseries of H_2S Path 5

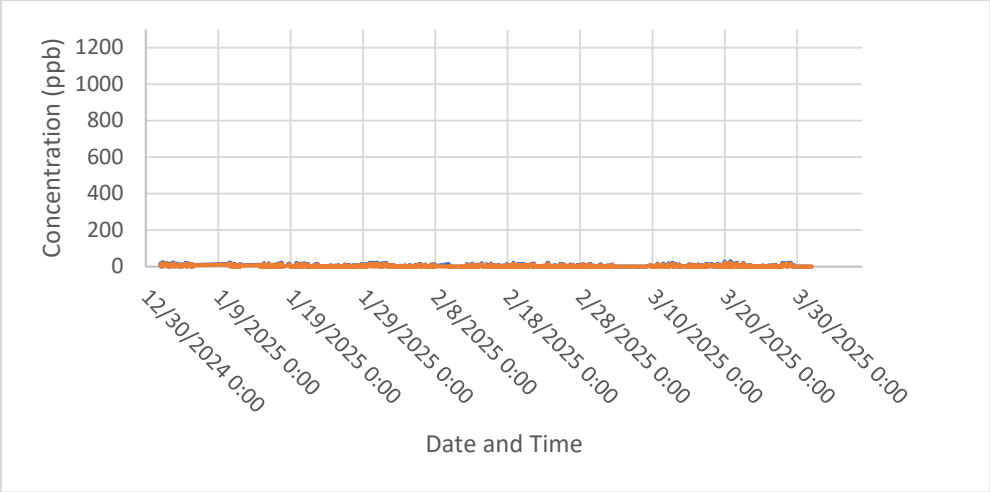

Figure 16. Timeseries of HCN Path 5

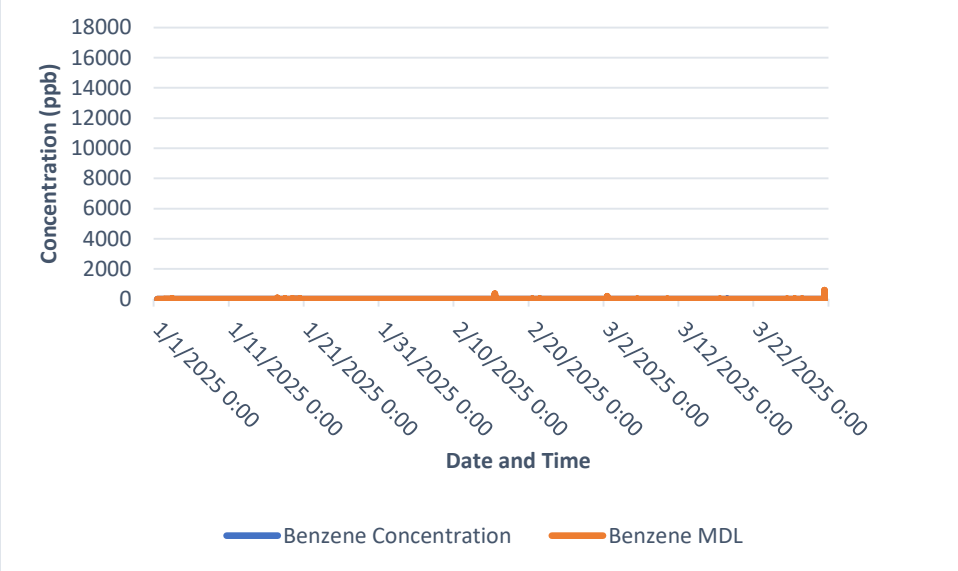

Figure 17. Timeseries of Benzene Path 6

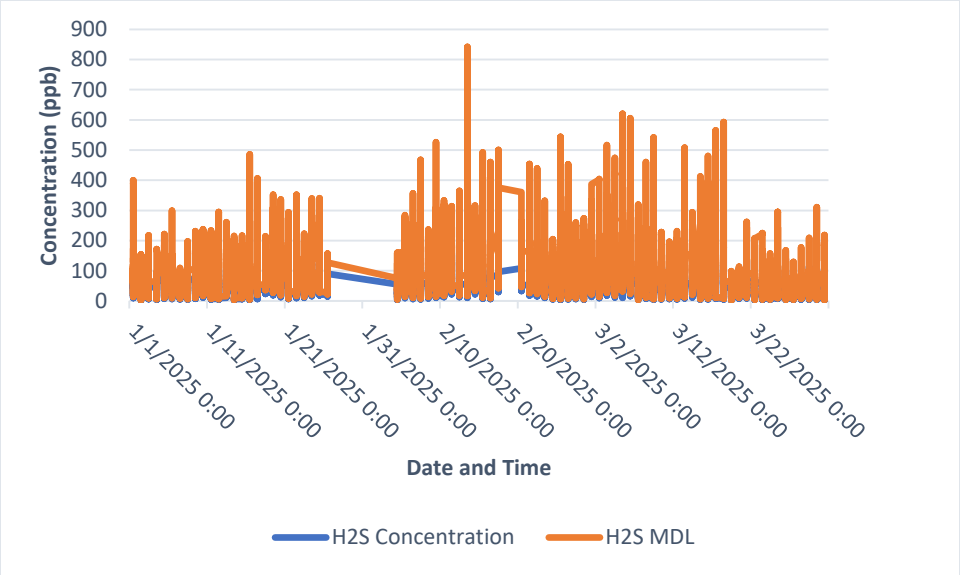

Figure 18. Timeseries of H_2S Path 6

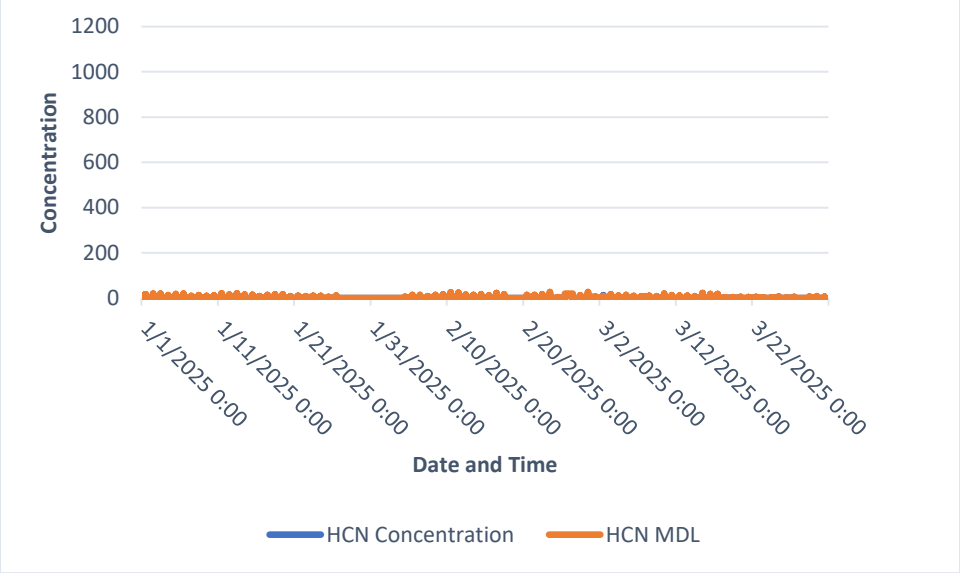

Figure 19. Timeseries of HCN Path 6

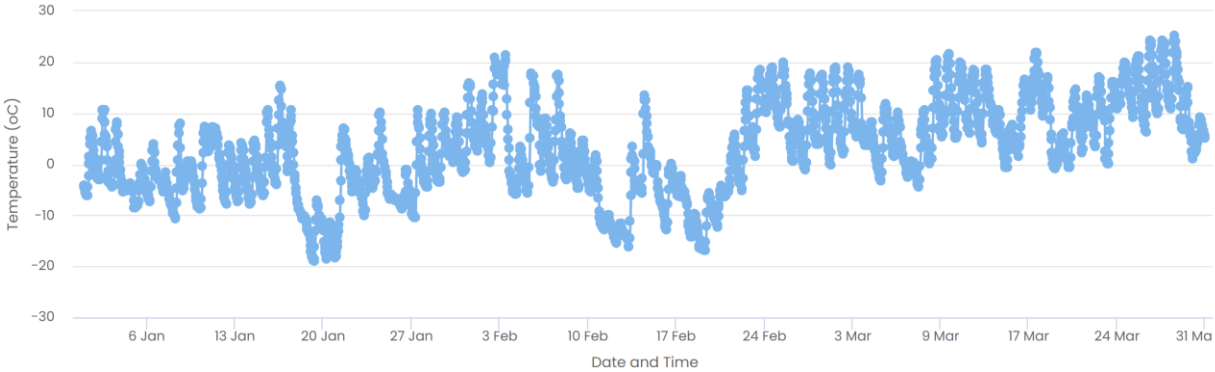

Figure 20. Temperature Timeseries (2025)

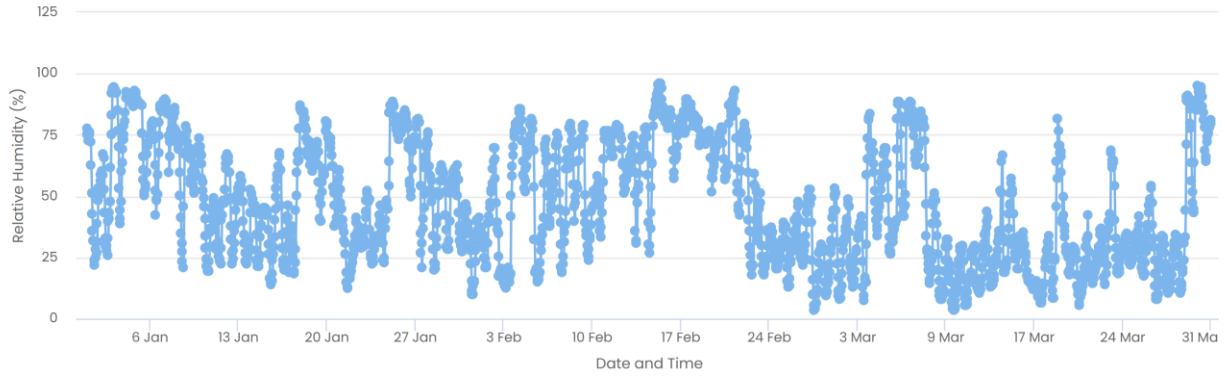

Figure 21. Relative Humidity Timeseries (2025)

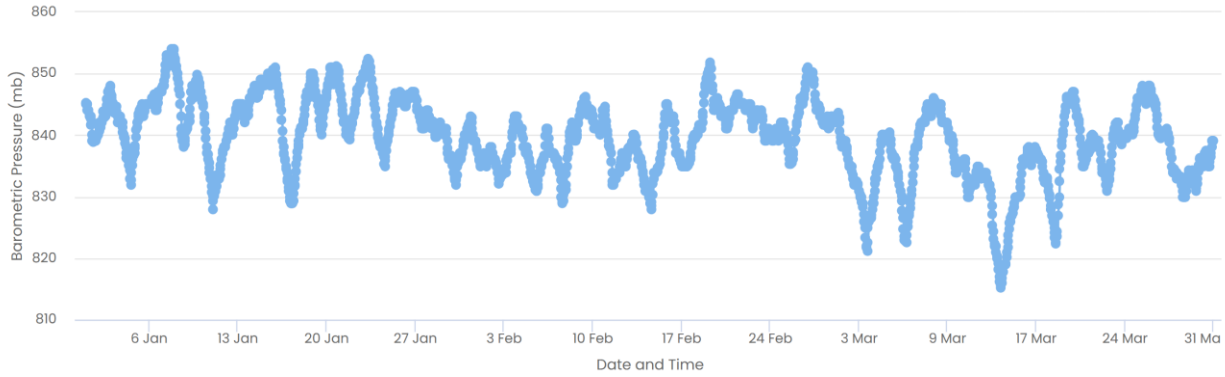

Figure 22. Barometric Pressure Timeseries (2025

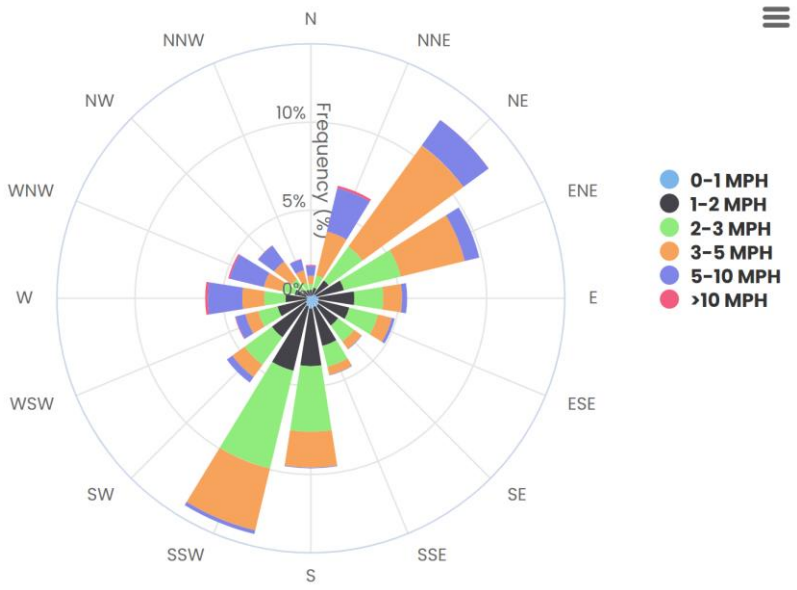

Figure 23. Wind Rose Plot

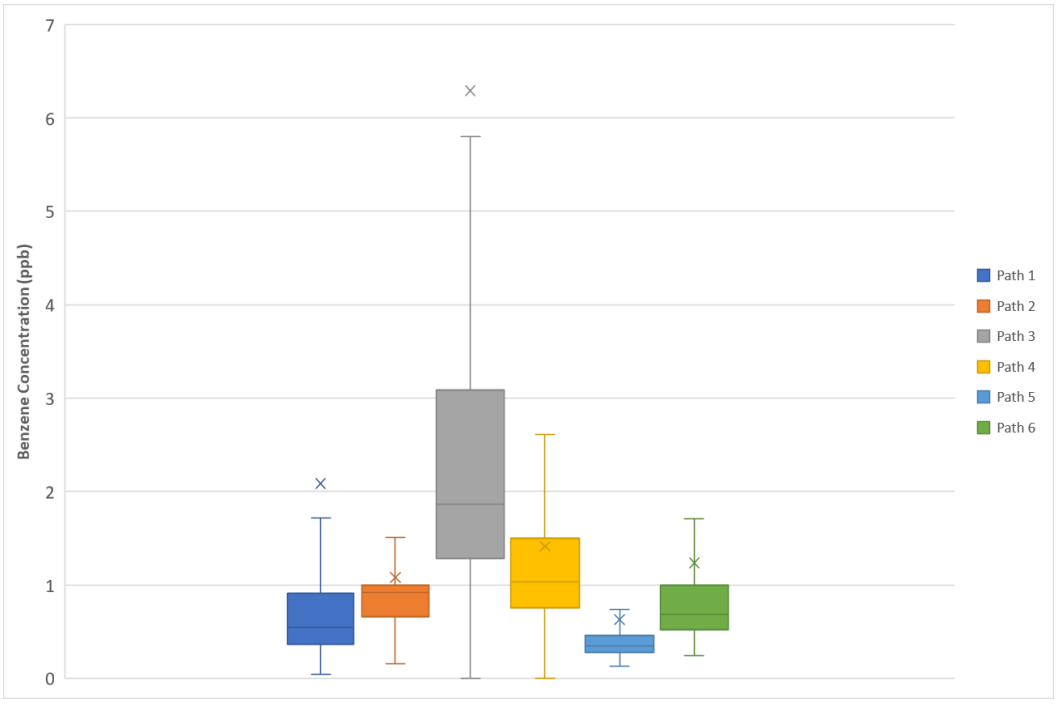

Figure 24. Benzene Box Plots for Paths 1 to 6.

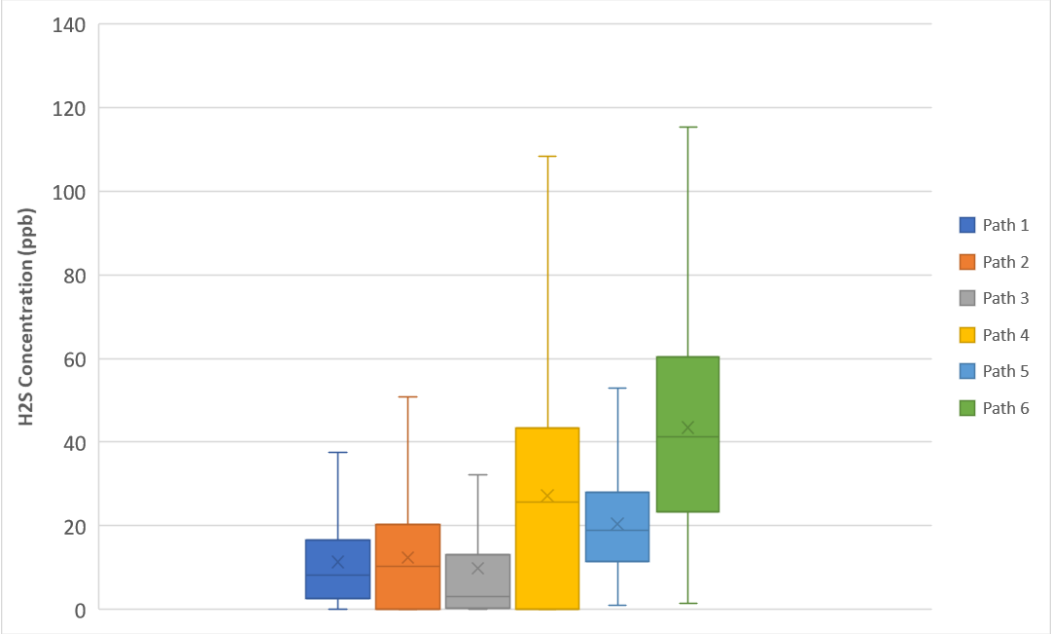

Figure 25. H_2S Box Plots for Paths 1 to 6.

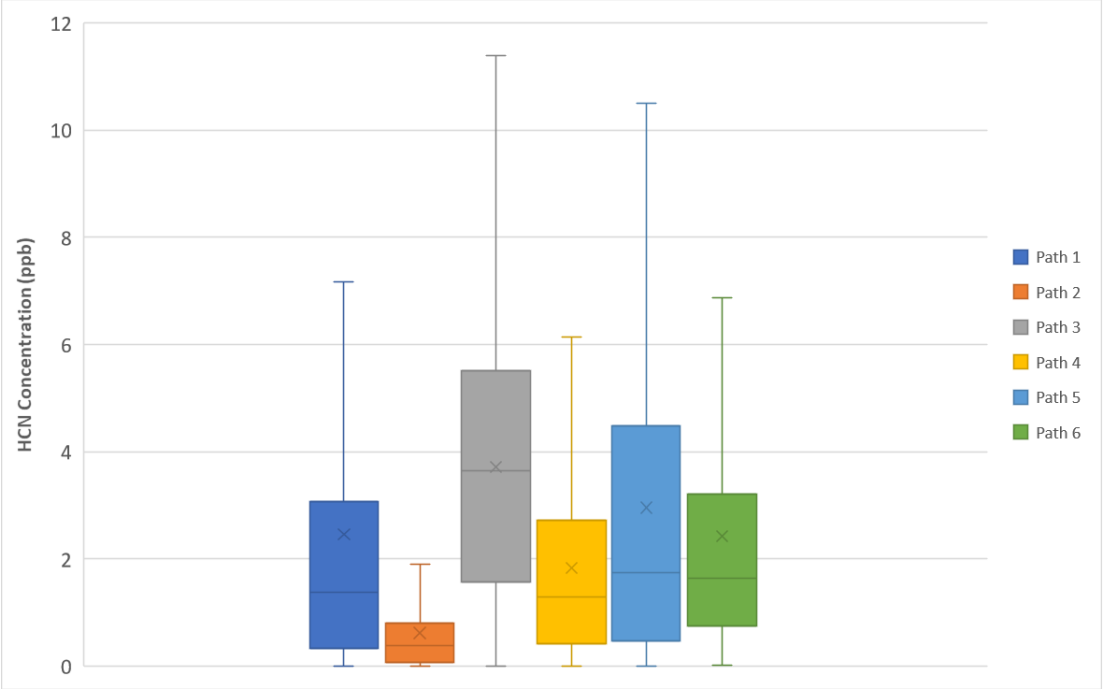

Figure 26. HCN Box Plots for Paths 1 to 6.

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^{o}C instead of the 39^{o}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.
3. H2S MDL: the H2S MDL threshold was increased to 50% of the alert threshold for paths 3,4 and 6. The reason for this change is related to these paths being shorter causing the MDL to be increased compared to the longer paths. The fenceline monitoring plan has been updated and sent to the Division for review.

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 (%)
3/6/2025	Bump test	1	452	UVDOAS	Benzene	100	119	18.6	6.4
3/6/2025	Bump test	1	452	UVDOAS	Benzene	200	210	5.5	5
3/12/2025	Bump test	2	1100	UVDOAS	Benzene	100	123	22.6	17.5
3/6/2025	Bump test	2	1100	UVDOAS	Benzene	200	197	2.3	1.8
3/6/2025	Bump test	3	330	UVDOAS	Benzene	100	113	12.8	6.1
3/6/2025	Bump test	3	330	UVDOAS	Benzene	200	254	13.5	6.7
3/12/2025	Bump test	4	630	UVDOAS	Benzene	100	76	24.2	9.7
3/6/2025	Bump test	4	630	UVDOAS	Benzene	200	240	20.8	17.5
3/6/2025	Bump test	5	444	UVDOAS	Benzene	100	105	7.4	6.5
3/6/2025	Bump test	5	444	UVDOAS	Benzene	200	227	13.7	6.9
3/6/2025	Bump test	6	276	UVDOAS	Benzene	100	121	21	9.5
3/6/2025	Bump test	6	276	UVDOAS	Benzene	200	228	13.9	9
3/7/2025	Audit Module	1	452	TDL	H2S	500 ppmm	391	21.8	2.1
3/7/2025	Audit Module	1	452	TDL	H2S	625 ppmm	582	6.9	0.5
3/7/2025	Audit Module	2	1100	TDL	H2S	500 ppmm	567	13.4	1.9
3/7/2025	Audit Module	2	1100	TDL	H2S	625 ppmm	658	5.2	1.8
3/7/2025	Audit Module	3	330	TDL	H2S	500 ppmm	414	17.2	1.8
3/7/2025	Audit Module	3	330	TDL	H2S	625 ppmm	751	20.2	4.1
3/7/2025	Audit Module	4	630	TDL	H2S	500 ppmm	496	2	2.4
3/7/2025	Audit Module	4	630	TDL	H2S	625 ppmm	634	1.6	1.1
3/7/2025	Audit Module	5	444	TDL	H2S	500 ppmm	411	17.8	3.1
3/7/2025	Audit Module	5	444	TDL	H2S	625 ppmm	552	11.7	2
3/7/2025	Audit Module	6	276	TDL	H2S	500 ppmm	440	12	3.6
3/7/2025	Audit Module	6	276	TDL	H2S	625 ppmm	596	4.7	4.1
3/7/2025	Audit Module	1	452	TDL	HCN	1010 ppmm	1092	8.1	0
3/7/2025	Audit Module	1	452	TDL	HCN	420 ppmm	506	20.5	0.3
3/7/2025	Audit Module	2	1100	TDL	HCN	1010 ppmm	1080	6.9	0.1
3/7/2025	Audit Module	2	1100	TDL	HCN	420 ppmm	494	17.6	0.3
3/7/2025	Audit Module	3	330	TDL	HCN	1010 ppmm	1096	8.5	0.1
3/7/2025	Audit Module	3	330	TDL	HCN	420 ppmm	518	23.2	0.7
3/7/2025	Audit Module	4	630	TDL	HCN	1010 ppmm	1072	6.1	1.1
3/7/2025	Audit Module	4	630	TDL	HCN	420 ppmm	507	20.7	0.7
3/7/2025	Audit Module	5	444	TDL	HCN	1010 ppmm	1096	8.5	0.1
3/7/2025	Audit Module	5	444	TDL	HCN	420 ppmm	501	19.2	0.3
3/7/2025	Audit Module	6	276	TDL	HCN	1010 ppmm	1059	4.8	0.2
3/7/2025	Audit Module	6	276	TDL	HCN	420 ppmm	504	20	0

[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
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

3:30 PM 1/2/25 MONTROSE ONSITE CF

ALIGNED UV PATH 1 & 2

H2S PATH 5 & 6 NOTE: A LOT OF DUST/ACTIVTY AT ASPHAULT PLANT

ACROSS PATH 5

11:11 AM 1/7/2025 Montrose Remote KL

Bad weather conditions 1/6 night to 1/7

3:00 PM 1/8/2025 Montrose ONSITE EO

Aligned UV PATHS 1-4 & H2S 5 & 6

2:25 PM 1/9/2025 Montrose Remore KL

BAD WEATHER-SNOW

2:13 PM 1/10/2025 Montrose Onsite EO

Aligned H2S Path 5

8:30 AM 1/14/2025 Montrose Onsite EO

Training with KL, ML, TC

Cleaned Equipment, Aligned H2S PATH 5 & UV PATH 3

10:55 AM 1/15/25 Montrose onsite CF

Aligned path 5 H2S & HCN, dusted path 5 tdl retro

10:57 AM 2/4/2025 Montrose Onsite ML

Aligned path 5 H2S & HCN

11:09 AM 2/4/2025 Montrose Onsite ML

Aligned UV Path 1

12:57 PM 2/4/2025 Montrose onsite ML

Realigned H2S Path 5

2:14 PM 2/13/2025 Montrose Onsite CF/TC

Changed lamp and ozone filter UV Path 1 and ozong filters UV Path 5,6.

Changed filter on reflectors PATH 1,5,6. Aligned UV Path 1,5,6.

Aligned path 5 HCN, H2s

Aligned path 6 HCN

4:13 PM 2/16/2025 Montrose Remote KL

bad weather 2/14-2/16

11:45 AM 2/20/2025 Montrose onsite ML

UV Path 1 Alignment

11:57 AM 2/20/2025 Montrose onsite ML

TDL H2S Path 5 Alignment

1:02 PM 2/20/2025 Montrose onsite ML

TDL H2S Path 5 Realignment

5:09 PM 3/6/2025 Montrose ONsite CN,ML

aligned UVs

calibrated UVs

5:10 PM 3/7/2025 Montrose Onsite JG

Calibrated TDLs

2:59 PM 3/12/2025 Montrose Onsite CN

aligned H2S Paths 5 and 6

aligned uv path 6

12:00 PM 3/18/2025 Montrose Onsite ML

Cleaned UV and TDL reflectors at OPTs 5 & 6

12:19 PM 3/18/2025 Montrose Onsite ML

Aligned H2S and HCN path 5

Swapped out new Arduino connection for UV Path 5 & checked alignment

1:27 PM 3/18/2025 Montrose Onsite ML

Aligned UV path 6

Aligned TDL H2S Path 6

11:10 AM 3/26/2025 Montrose Onsite ML

Aligned TDL H2S Path 5

12:02 PM 4/17/2025 Montrose Onsite ML

Aligned H2S path 5

12:29 PM 4/17/2025 Montrose Onsite ML

Aligned H2S Path 1 after cleaning retro

12:36 PM 4/17/2025 Montrose Onsite ML

Aligned H2S and HCN path 6 after cleaning retro

2:13 PM 4/28/2025 Montrose Onsite ML

ALigned H2S Path 1 and HCN Path 6

2:35 PM 4/28/2025 Montrose Onsite ML

Aligned H2S Path 5 TDL

11:47 AM 5/13/2025 Montrose Onsite ML

Aligned H2S path 1

Cleaned TDL path 5 retro

Aligned H2S and HCN path 5

12:43 PM 5/16/2025 Montrose Onsite ML

Aligned TDL H2S path 5

4:15 PM 5/19/2025 Montrose Onsite ML

Aligned HCN path 5

Cleaned reflector

12:17 PM 5/29/2025 Montrose Onsite ML

Aligned TDL H2S and HCN path 5

Aligned UV path 5

11:11 AM 1/7/2025 Montrose Remote KL

Bad weather conditions 1/6 night to 1/7

3:00 PM 1/8/2025 Montrose ONSITE EO

ALIGNED UV PATHS 1-4 & H2S 5&6

2:24 PM 1/9/2025 Montrose Remote KL

Bad weather

11:22 AM 1/14/2025 Montrose Onsite TC

Aligned Path 3 UV. Aligned Path 2 UV.

2:00 PM 1/20/2025 Montrose Remote KL

bad weather 1/17-1/20

12:08 PM 1/23/2025 Montrose Onsite TC/ML

Shelter 4 TDL path 4 H2S aligned

12:09 PM 1/25/2025 Montrose Remote KL

Bad weather 1/25-1/26

aligned h2s path2 .323 44%

aligned h2s path 3 .451 45%

aligneed UV path2

aligned all of the paths for 4 (UV &TDL) HCN = .509 H2s= .623

2:18 PM 2/13/25 MONTROSE ONSITE TC, CF

CHANGED OZONE & RETRO FILTERS PATH 2,3,4 UVS

CHANGED BULB PATH 2 UV

ALIGNED ALL THREE UV PATHS

4:15 PM 2/16/2025 Montrose Remote KL

BAD WEATHER 2/14-2/16

12:23 PM 2/20/2025 Montrose onsite ML

UV Path 2 Alignment & UV Path 3 data backup

12:48 PM 2/20/2025 Montrose onsite ML

UV Path 5 Alignment & TDL H2S path 4 alignment

12:30 PM 2/24/25 Montrose Onsite EO

Aligned UV Path 2 & H2S 3

Data Backup on UV path 4

2:18 PM 2/26/2025 Montrose Onsite EO

Aligned UV Path 4

5:06 PM 3/6/2025 Montrose Onsie CN, ML

calibrated UVs

5:06 PM 3/7/2025 Montrose Onsite JG

calibrated tdls

aligned tdls

troubleshooted h2s path 3- detector needed to be adjusted

2:55 PM 3/12/2025 Montrose Onsite CN

Calibrated UVs paths 2 and 4

aligned UV Path 2, 4 and HCN Path 4

1:05 PM 3/18/2025 Montrose Onsite ML

Aligned UV path 2 and UV path 3

Swapped out Arduino connection in UV path 3

11:28 AM 3/26/2025 Montrose Onsite ML

Aligned TDL H2S Path 3

Aligned UV Path 3

11:36 AM 3/26/2025 Montrose Onsite ML

Aligned UV path 4

11:37 AM 4/1/2025 Montrose Onsite ML

Swapped arduino port on UV path 2

11:45 AM 4/17/2025 Montrose Onsite ML

Aligned HCN path 4

11:52 AM 4/17/2025 Montrose Onsite ML

Aligned HCN Path 3 and cleaned retro reflectors

2:32 PM 4/28/2025 Montrose Onsite ML

Aligned HCN path 4 TDL

11:37 AM 5/13/2025 Montrose Onsite ML

Aligned HCN path 4 and cleaned retro

Aligned UV path 2

12:52 PM 5/16/2025 Montrose Onsite ML

Aligned HCN path 4

4:07 PM 5/19/2025 Montrose Onsite ML

ligned HCN path 4

Cleaned Reflector

11:51 AM 5/29/2025 Montrose Onsite ML

Aligned HCN PAth 4 and H2S path 4

Aligned UV path 4

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

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-043819	**Month: December 2024**

LOCATION/SITE: Phillips 66 Denver	**Parameter(s) Affected: HCN Paths 2, 3 and 4**
Begin Date and Time (LST): 12/19/2024 11:15AM	**End Date and Time (LST): 12/21/24 1:30PM**
Equipment: HCN TDL Shelter 3 (Paths 2,3,4)	**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).

TDL Shelter 3 computer went through updates and the HCN scripts for the average calculations stopped running.

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).

Montrose received alerts that HCN Paths 2,3 and 4 are not reporting.

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

Remoted into the TDL Shelter 3 computer once the updates were completed and restarted the scripts.

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: HCN Paths 2,3 and 4 data was not collected during this time.

Originator's Signature: **Katia Liangou**

QA Review: Aricia Boyd

Form Title: Non-Conformance Report **Implementation Date:** February 07, 2024
Document Number: 331AA-QMS-FM-5 **Form Owner (Department):** MAQS **Revision Number:** R0 **Form Approval:** AHeitmann

Non-Conformance Report

Project: PROJ-043819	**Month: February 2025**

LOCATION/SITE: Phillips 66 Denver	**Parameter(s) Affected: H2S Path 3**
Begin Date and Time (LST): 2/24/2025 12:20 pm	**End Date and Time (LST): 2/25/2025 12:35 pm**
Equipment: TDL Shelter 3 H2S Path 3	**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 H2S Path 3 stopped being reported on the public website and on the AirSense online platform.

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).

Montrose identified that the issue was related with the scripts that calculate the five minute averages.

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

The scripts were restarted and troubleshooted and 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: No data for H2S Path 3 were reported during this period.			

Originator's Signature: **Katia Liangou**

QA Review: Aricia Boyd

E. Appendix E: Calibration verification forms

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): 3/7/25

Instrument Model: H2S Path 1 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	226 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	406	18.8
2	500	380	24
3	500	396	20.8
4	500	384	23.2
5	500	390	22
Averages	500	391	21.8

	Calculated Values	**Expected Values**
Overall Percent Precision	97.9%	**≥ 80%**
Overall Percent Error	21.8 %	**≤ 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): 

Montrose Air Quality Services
5120 Northshore Dr. North Little Rock, AR 72218
T: (501-)900-6400
www.montrose-env.com

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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): 3/7/25

Instrument Model: H2S Path 1 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	226 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	582	6.9
2	625	584	6.6
3	625	576	7.8
4	625	582	6.9
5	625	584	6.6
Averages	625	582	6.9

	Calculated Values	**Expected Values**
Overall Percent Precision	99.5 %	**≥ 80%**
Overall Percent Error	6.9 %	**≤ 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

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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): 3/7/25

Instrument Model: H2S Path 2 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	550 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	552	10.4
2	500	564	12.8
3	500	574	14.8
4	500	574	14.8
5	500	572	14.4
Averages	500	567	13.4

	Calculated Values	**Expected Values**
Overall Percent Precision	98.1 %	**≥ 80%**
Overall Percent Error	13.4 %	**≤ 30%**

TDL Calibration Form

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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): 

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

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: H2S Path 2 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	550 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	676	8.2
2	625	656	5
3	625	658	5.3
4	625	652	4.3
5	625	646	3.4
Averages	625	658	5.2

	Calculated Values	**Expected Values**
Overall Percent Precision	98.2 %	**≥ 80%**
Overall Percent Error	5.2 %	**≤ 30%**

TDL Calibration Form

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Document Number: 331AA-OPS-FM-15	**Form Owner (Department):** MAQS
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Notes:
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Operator Signature(s):  Witness Signature(s): 

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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): 3/7/25

Instrument Model: H2S Path 3 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	165 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	400	20
2	500	420	16
3	500	420	16
4	500	420	16
5	500	410	18
Averages	500	414	17.2

	Calculated Values	**Expected Values**
Overall Percent Precision	98.2 %	**≥ 80%**
Overall Percent Error	17.2 %	**≤ 30%**

TDL Calibration Form

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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

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

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: H2S Path 3 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	165 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	796	27.4
2	625	746	19.4
3	625	746	19.4
4	625	732	17.1
5	625	736	17.8
Averages	625	751	20.2

	Calculated Values	**Expected Values**
Overall Percent Precision	95.9%	**≥ 80%**
Overall Percent Error	20.2 %	**≤ 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

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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): 3/7/25

Instrument Model: H2S Path 4 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	315 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	502	0.4
2	500	490	2
3	500	514	2.8
4	500	492	1.6
5	500	484	3.2
Averages	500	496	2

	Calculated Values	**Expected Values**
Overall Percent Precision	97.6 %	**≥ 80%**
Overall Percent Error	2 %	**≤ 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

TDL Calibration Form

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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): 3/7/25

Instrument Model: H2S Path 4 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	315 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	622	0.5
2	625	634	1.4
3	625	640	2.4
4	625	638	2.1
5	625	634	1.4
Averages	625	634	1.6

	Calculated Values	**Expected Values**
Overall Percent Precision	98.9 %	**≥ 80%**
Overall Percent Error	1.6 %	**≤ 30%**

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

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: H2S Path 5 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	222 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	424	15.2
2	500	412	17.6
3	500	424	15.2
4	500	386	22.8
5	500	408	18.4
Averages	500	411	17.8

	Calculated Values	**Expected Values**
Overall Percent Precision	96.9 %	**≥ 80%**
Overall Percent Error	17.8 %	**≤ 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

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

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: H2S Path 5 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	222 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	532	14.9
2	625	558	10.7
3	625	562	10.1
4	625	560	10.4
5	625	546	12.6
Averages	625	552	11.7

	Calculated Values	**Expected Values**
Overall Percent Precision	98 %	**≥ 80%**
Overall Percent Error	11.7 %	**≤ 30%**

TDL Calibration Form

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Operator Signature(s):  Witness Signature(s): 

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

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: H2S Path 6 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	138 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	454	9.2
2	500	414	17.2
3	500	430	14
4	500	446	10.8
5	500	456	8.8
Averages	500	440	12

	Calculated Values	**Expected Values**
Overall Percent Precision	96.4%	**≥ 80%**
Overall Percent Error	12 %	**≤ 30%**

TDL Calibration Form

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

Notes:
Calibration verification passed.

Operator Signature(s): 

Witness Signature(s): James Garrett

TDL Calibration Form

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

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: H2S Path 6 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	138 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	564	9.8
2	625	574	8.2
3	625	600	4
4	625	622	0.5
5	625	618	1.1
Averages	625	596	4.7

	Calculated Values	**Expected Values**
Overall Percent Precision	95.9 %	**≥ 80%**
Overall Percent Error	4.7 %	**≤ 30%**

TDL Calibration Form

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

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

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: HCN Path 1 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	226 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	506	20.5
2	420	506	20.5
3	420	506	20.5
4	420	508	21
5	420	504	20
Averages	420	506	20.5

	Calculated Values	**Expected Values**
Overall Percent Precision	99.7 %	**≥ 80%**
Overall Percent Error	20.5 %	**≤ 30%**

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Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: HCN Path 1 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	226 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	1092	8.1
2	1010	1092	8.1
3	1010	1092	8.1
4	1010	1092	8.1
5	1010	1092	8.1
Averages	1010	1092	8.1

	Calculated Values	**Expected Values**
Overall Percent Precision	100 %	**≥ 80%**
Overall Percent Error	8.1 %	**≤ 30%**

TDL Calibration Form

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Notes:
Calibration verification passed.

Operator Signature(s): 

Witness Signature(s): 

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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): 3/7/25

Instrument Model: HCN Path 2 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	550 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	494	17.6
2	420	94	17.6
3	420	492	17.1
4	420	496	18.1
5	420	494	17.6
Averages	420	494	17.6

	Calculated Values	**Expected Values**
Overall Percent Precision	99.7 %	**≥ 80%**
Overall Percent Error	17.6 %	**≤ 30%**

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Notes:
Calibration verification passed.

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

TDL Calibration Form

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Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: HCN Path 2 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	550 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	1080	6.9
2	1010	1078	6.7
3	1010	1080	6.9
4	1010	1080	6.9
5	1010	1082	7.1
Averages	1010	1080	6.9

	Calculated Values	**Expected Values**
Overall Percent Precision	99.9%	**≥ 80%**
Overall Percent Error	6.9 %	**≤ 30%**

TDL Calibration Form

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Notes:
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Operator Signature(s):  Witness Signature(s): James Garrett

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

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: HCN Path 3 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	165 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	516	22.9
2	420	514	22.4
3	420	518	23.3
4	420	518	23.3
5	420	522	24.3
Averages	420	518	23.2

	Calculated Values	**Expected Values**
Overall Percent Precision	99.3%	**≥ 80%**
Overall Percent Error	23.2%	**≤ 30%**

TDL Calibration Form

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

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: HCN Path 3 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	165 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	1098	8.7
2	1010	1096	8.5
3	1010	1096	8.5
4	1010	1096	8.5
5	1010	1094	8.3
Averages	1010	1096	8.5

	Calculated Values	**Expected Values**
Overall Percent Precision	99.9%	**≥ 80%**
Overall Percent Error	8.5 %	**≤ 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): 

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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): 3/7/25

Instrument Model: HCN Path 4 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	315 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	502	19.5
2	420	506	20.5
3	420	508	21
4	420	508	21
5	420	510	21.4
Averages	420	507	20.7

	Calculated Values	**Expected Values**
Overall Percent Precision	99.3 %	**≥ 80%**
Overall Percent Error	20.7 %	**≤ 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): 3/7/25

Instrument Model: HCN Path 4 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	315 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	1080	6.9
2	1010	1060	5
3	1010	1060	5
4	1010	1082	7.1
5	1010	1078	6.7
Averages	1010	1072	6.1

	Calculated Values	**Expected Values**
Overall Percent Precision	98.9 %	**≥ 80%**
Overall Percent Error	6.1 %	**≤ 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): 

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TDL Calibration Form

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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): 3/7/25

Instrument Model: HCN Path 5 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	222 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	500	19
2	420	500	19
3	420	502	19.5
4	420	502	19.5
5	420	500	19
Averages	420	501	19.2

	Calculated Values	**Expected Values**
Overall Percent Precision	99.7 %	**≥ 80%**
Overall Percent Error	19.2 %	**≤ 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

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TDL Calibration Form

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

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: HCN Path 5 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	222 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	1096	8.5
2	1010	1096	8.5
3	1010	1094	8.3
4	1010	1096	8.5
5	1010	1096	8.5
Averages	1010	1096	8.5

	Calculated Values	**Expected Values**
Overall Percent Precision	99.9 %	**≥ 80%**
Overall Percent Error	8.5 %	**≤ 30%**

TDL Calibration Form

Form Title: TDL Calibration Form	**Implementation Date:** August 8, 2024
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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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Revision Number: Rev. 1	**Form Approval:** Katia Liangou

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: HCN Path 6 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	138 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	504	20
2	420	504	20
3	420	504	20
4	420	504	20
5	420	504	20
Averages	420	504	20

	Calculated Values	**Expected Values**
Overall Percent Precision	100%	**≥ 80%**
Overall Percent Error	20 %	**≤ 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

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TDL Calibration Form

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

Operator Name(s): Katia Liangou Test Date (YYYY/MM/DD): 3/7/25

Instrument Model: HCN Path 6 Instrument Serial Number: _____

Instrument Parameters	
Optical Path separation(meters-one-way)	138 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	1056	4.6
2	1010	1058	4.8
3	1010	1060	5
4	1010	1060	5
5	1010	1060	5
Averages	1010	1059	4.8

	Calculated Values	**Expected Values**
Overall Percent Precision	99.8%	**≥ 80%**
Overall Percent Error	4.8 %	**≤ 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): 

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UVDOAS Calibration Form

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): 3/6/25

Instrument Model: UV Mono Path 1 Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	452 m/ 0.047m
Maximum Intensity (%)	71
Integration Time (ms)	55

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	100	115	15
2	100	127	27
3	100	117	17
4	100	111	11
5	100	123	23
Averages	100	119	18.6

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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	18.6	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett

UVDOAS Calibration Form

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): 3/6/25

Instrument Model: UV Mono Path 1 Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	452 m/ 0.047m
Maximum Intensity (%)	78
Integration Time (ms)	55

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	200	198	1
2	200	215	7.5
3	200	217	8.5
4	200	201	0.5
5	200	220	10
Averages	200	210	5.5

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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 %	**≥ 75%**
Overall Percent Error	5.5 %	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett

UVDOAS Calibration Form

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): 3/12/25

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

Instrument Parameters	
Optical Path Length (meters)	1100 m/ 0.047m
Maximum Intensity (%)	94
Integration Time (ms)	95

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	100	111	11
2	100	112	12
3	100	126	26
4	100	129	29
5	100	135	35
Averages	100	123	22.6

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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	82.5	**≥ 75%**
Overall Percent Error	22.6	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett

UVDOAS Calibration Form

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): 3/6/25

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

Instrument Parameters	
Optical Path Length (meters)	1100 m/ 0.047m
Maximum Intensity (%)	96
Integration Time (ms)	90

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	200	195	2.5
2	200	202	1
3	200	196	2
4	200	192	4
5	200	196	2
Averages	200	197	2.3

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	98.2	**≥ 75%**
Overall Percent Error	2.3	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett

UVDOAS Calibration Form

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): 3/6/25

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

Instrument Parameters	
Optical Path Length (meters)	330 m/ 0.047m
Maximum Intensity (%)	83
Integration Time (ms)	99

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	100	104	4
2	100	116	16
3	100	116	16
4	100	119	19
5	100	109	9
Averages	100	113	12.8

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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	93.9	**≥ 75%**
Overall Percent Error	12.8	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett

UVDOAS Calibration Form

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): 3/6/2025

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

Instrument Parameters	
Optical Path Length (meters)	330 m/ 0.047m
Maximum Intensity (%)	83
Integration Time (ms)	99

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	200	254	27
2	200	232	16
3	200	254	27
4	200	266	33
5	200	264	32
Averages	200	254	27

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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	93.3	**≥ 75%**
Overall Percent Error	13.5	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett

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UVDOAS Calibration Form

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): 3/12/25

Instrument Model: UV Mono Path 4 Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	630 m/ 0.047m
Maximum Intensity (%)	99
Integration Time (ms)	95

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	100	83	17
2	100	71	29
3	100	83	17
4	100	81	19
5	100	61	39
Averages	100	76	24.2

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	90.3	**≥ 75%**
Overall Percent Error	24.2	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett

UVDOAS Calibration Form

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): 3/6/25

Instrument Model: UV Mono Path 4 Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	630 m/ 0.047m
Maximum Intensity (%)	95
Integration Time (ms)	99

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	200	246	23
2	200	196	2
3	200	293	46.5
4	200	234	17
5	200	231	15.5
Averages	200	240	20.8

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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	82.5	**≥ 75%**
Overall Percent Error	20.8	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett

UVDOAS Calibration Form

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): 3/6/25

Instrument Model: UV Mono Path 5 Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	444 m/ 0.047m
Maximum Intensity (%)	87
Integration Time (ms)	67

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	100	105	5
2	100	108	8
3	100	107	7
4	100	94	6
5	100	111	11
Averages	100	105	7.4

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Revision Number: Rev. 0	**Form Approval:** Katia Liangou

	Calculated Values	**Expected Values**
Overall Percent Precision	93.5	**≥ 75%**
Overall Percent Error	7.4	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett

UVDOAS Calibration Form

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): 3/6/25

Instrument Model: UV Mono Path 5 Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	444 m/ 0.047m
Maximum Intensity (%)	89
Integration Time (ms)	67

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	200	208	4
2	200	220	10
3	200	237	18.5
4	200	243	21.5
5	200	229	14.5
Averages	200	227	13.7

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	93.1	**≥ 75%**
Overall Percent Error	13.7	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett

UVDOAS Calibration Form

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): 3/6/25

Instrument Model: UV Mono Path 6 Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	276 m/ 0.047m
Maximum Intensity (%)	76
Integration Time (ms)	93

Standard Information	
Benzene Standard Concentration (PPM)	100

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	100	110	10
2	100	118	18
3	100	116	16
4	100	134	34
5	100	127	27
Averages	100	121	21

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Form Title: UVDOAS Calibration Form	**Implementation Date:** July 10, 2024
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Revision Number: Rev. 0	**Form Approval:** Katia Liangou

	Calculated Values	**Expected Values**
Overall Percent Precision	90.5	**≥ 75%**
Overall Percent Error	21	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett

UVDOAS Calibration Form

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): 3/6/25

Instrument Model: UV Mono Path 6 Instrument Serial Number: _____

Instrument Parameters	
Optical Path Length (meters)	276 m/ 0.047m
Maximum Intensity (%)	76
Integration Time (ms)	93

Standard Information	
Benzene Standard Concentration (PPM)	200

File #	**Benzene Concentration (PPM)**	**Measured Concentration (PPM)**	**Error (%)**
1	200	206	3
2	200	225	12.5
3	200	256	28
4	200	223	11.5
5	200	229	14.5
Averages	200	228	13.9

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Revision Number: Rev. 0	**Form Approval:** Katia Liangou

	Calculated Values	**Expected Values**
Overall Percent Precision	91	**≥ 75%**
Overall Percent Error	13.9	**≤ 30%**

Notes:
Calibration verification passed.

Operator's Signature Katia Liangou

Witness's Signature James Garrett