

Ambient air monitoring data summary report

KPK - Grant #1

Air Toxics and Ozone Precursor Program
[ATOPs]

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COLORADO
Air Pollution Control Division
Department of Public Health & Environment

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1. Executive Summary

1.1. Report Purpose

The purpose of this report is to summarize the air data observed by the Colorado Department of Public Health and Environment (CDPHE) in response to general community concern surrounding a pump jack facility, operated by KPK. The facility operates southwest of Legacy Elementary School, located in Longmont, Colorado.

1.2. Background Information

- Community concern was communicated regarding the KPK pump jack facility, located southwest of Legacy Elementary School.
- Mobile monitoring was performed by the MOOSE (Mobile Oil & gas Optical Sensor of Emissions) on 3/20/25, 3/21/25, and 6/5/25 through dwell and transect measurements.
- A Pyxis micro GC, deployed as a stationary air quality monitor, was stationed about 50 feet to the north of the KPK pump jack facility, accompanied by an Airmar meteorological station from 4/10/25 through 7/23/25.

1.3. Air Monitoring Objective:

- The Air Toxics and Ozone Precursors Program (ATOPs) within the Air Pollution Control Division (APCD) of the CDPHE deployed two air monitoring assets (Table 1) in response to the request of the OGHIR (Oil & Gas Health Information and Response) Program.
- Mobile and stationary monitoring were performed in order to evaluate the air concentration of compounds that may be harmful to nearby communities.

Table 1. Summary table showing air monitoring deployments conducted by CDPHE at the KPK Grant pump jack facility.

Monitoring Asset	Monitoring Type	Compounds Measured	Deployment Dates	Sampling Duration	Deployment Location
MOOSE ^a	Mobile	Benzene, Methane	March 20, 21, and June 5, 2025	1-10 Seconds	KPK - Grant
RATTLER ^b	Stationary	Benzene	April 10 – July 23, 2025	10 minutes	KPK - Grant
Airmar	Stationary	Meteorology	April 10 - July 23, 2025	1 second	KPK - Grant

(a) [Mobile Oil & Gas Optical Sensor of Emissions](#)

(b) Remote Air Tracking Trailer for Localized Emissions Recording

1.4. Key Findings

- The MOOSE observed average benzene concentrations of 0.28 and 0.22 ppb during transect measurements on March 20 and 21 and an average benzene concentration of 0.38 ppb during a dwell measurement (approximately 25 minutes) on June 5.
- The RATTLER measurements, between April 10 and July 23, showed an overall average benzene concentration of 0.20 ppb, similar to the typical background benzene concentration for this region. The maximum 10-minute value observed was approximately 1.88 ppb and was not from the direction of the pump jack.
- The highest 10-minute benzene concentration recorded by the RATTLER during the measurement period from the direction of the pump jack was 1.63 ppbV.

2. Introduction



Figure 1. Aerial image of KPK Grant #1 site (red rectangle), wind mast deployment location (yellow circle), and RATTLER deployment location (yellow rectangle).

A concerned community member submitted a monitoring request to OGHIR regarding the KPK pump jack facility, located approximately 255 feet southwest of the Legacy Elementary School grounds in Longmont, CO. In response, CDPHE-APCD-ATOPS deployed the MOOSE on March 20 and 21, 2025. MOOSE measurements were performed using two methods, transects and dwelling. Transects were performed by driving 2-5 mph to intersect the emission plume, which also allows for background measurements before and after the plume to fully evaluate any elevations. Dwelling measurements occur when the MOOSE is stationary while downwind of a suspected emissions source allowing for a longer sampling period. Measurements on both days showed little to no increased values of methane and benzene; however, FLIR imaging on March 20, 2025, indicated that the wellhead of the pump jack was leaking. As a result of the leak detection, CDPHE-APCD-ATOPS then deployed the RATTLER (Remote Air Tracking Trailer of Localized Emissions Recording) on April 10, 2025, approximately 50 feet north of the pump jack, to perform continuous, stationary monitoring of the source.

The RATTLER was equipped with a Pyxis micro gas chromatograph (Pyxis mGC) to measure benzene emissions and an Airmar anemometer to measure wind speed and wind direction. The RATTLER was deployed from April 10, 2025, to July 23, 2025. During this time, the operator of the facility made several attempts to fix the leaks, but

none were successful. The leaks were eventually fixed on June 13, 2025, and verified by FLIR imaging from the operator. Stationary air monitoring continued after the leaks were reported to be repaired to confirm the repairs.

3. Methods

3.1. Stationary Measurements

The Pyxis mGC was deployed on April 10 through July 23, 2025, for continuous monitoring, and was located approximately 50 feet to the north of the KPK Grant pump jack facility.

3.1.1. Micro Gas Chromatography

The Pyxis mGC has the ability to separate benzene from other compounds within an air sample on a near real-time resolution of approximately 10 minutes. It operates similarly to a gas chromatograph, but on a much smaller scale. The system uses a preconcentrator to adsorb VOC compounds and then separates these compounds with a column. As each compound emerges from the column, it passes over a photoionization detector (PID) to identify VOCs through high-energy photons of light produced by a 10.6 electron volt (eV) lamp to determine the concentration of the individual compound.

This Pyxis mGC offers continuous measurements and versatility in monitoring location. This instrument is powered by a mobile, solar powered trailer, the RATTLER, which contains an onboard battery bank and two 365 watt (W) solar panels, allowing for enough power for the Pyxis mGC and its temperature regulated case to operate without interruption. This means the Pyxis mGC is not limited by where it can be deployed.

The Pyxis mGC monitoring objectives for this deployment were:

1. Continuously measure benzene concentrations surrounding the KPK Grant pump jack facility.
2. Determine if any period of measurement increases above values typically observed in this region (background levels).

These measurements consist of downwind emissions from the pump jack facility when the winds pass over the pump jack location and towards the direction of the monitor. All Pyxis mGC measurements were conducted before and after the leaks were fixed.

3.1.2. AIRMAR Weather Station 110WX

The AIRMAR Weather Station is a sensor that measures meteorological parameters on a continuous 1-second time resolution. The measured meteorological parameters

include wind speed, wind direction, barometric pressure, humidity, and temperature. The weather station operates by continuously emitting a series of electronic outputs. Multiple pairs of receiving sensors are arranged around a central mast and measure the wind speed and wind direction based upon the time of flight difference between when those ultrasonic pulses are received. Additional sensors within the anemometer record temperature, humidity, and barometric pressure. The weather station is powered through the use of a 50W solar panel to offer continuous measurement without interruption and expand the capability of the weather station to operate in remote locations.

3.2. Mobile Measurements

The MOOSE is a van customized with cutting-edge scientific optical instrumentation to measure near real-time ambient air pollution concentrations while driving. Inside the MOOSE mobile laboratory are two optical instruments that measure compounds using ultraviolet (UV) and infrared (IR) light. These respective instruments are the Mobile extractive Differential Optical Absorption Spectroscopy (MeDOAS) instrument and the Mobile extractive Fourier Transform Infra-Red (MeFTIR) instrument. Different air pollutants absorb light better from different wavelengths of the light spectrum (e.g., IR or UV). Therefore, having different instrumentation that uses IR or UV allows us to accurately measure more compounds potentially present in the air at lower concentrations. The MOOSE is a powerful monitoring tool and can be used to accomplish different monitoring objectives.

For this deployment, the monitoring objectives were:

1. Locate and measure the emission plume influenced by the well incident for benzene and methane to evaluate concentrations of compounds that may be harmful to nearby communities.
2. Measure outside of the well emission plume to determine what background concentrations (emissions transported to this area from other sources) are within this area.
3. Measure before and after any leaks were fixed in order to determine when the emissions resulting from the incident have returned to background levels.

To accomplish these measurement objectives, three sampling methods were performed:

1. upwind transects - used to determine background levels
2. downwind transects - used to determine levels within an emission plume
3. downwind dwelling - used to estimate longer exposures of the measured compounds

Transect measurements are performed by driving at reduced speeds while crossing through the emission plume. This also allows for background (typical air concentration) measurements to be taken before and after the plume. The plume is identified by the presence of volatile organic compounds (VOCs) or by prevailing wind direction and proximity to the site. Each transect measurement occurs for about 10-60 seconds, the amount of time it takes to pass through the plume. Dwelling measurements occur when the MOOSE is stationary and downwind of a suspected source, allowing for a longer sampling period. However, due to wind shifts and the distance from the source, dwell periods may have periodic measurements that are at the edge of or outside the plume.

In order to identify when a targeted source influences an intersected plume, accurate measurements of wind direction and speed are necessary. During MOOSE deployments both a weather station mounted on the roof of the van as well as a deployable wind mast are used to help with this identification.

Links to additional technical details and data about the MOOSE can be found on the CDPHE air toxics [website](#).

3.3. Data Processing

Data processing was performed for the measurements collected during this monitoring period in order to organize the data into a useful format from the respective transect, dwell, and stationary periods. Two species of interest are provided in this report, benzene and methane. Two MOOSE deployments were performed before the leak was fixed and before continuous monitoring by the Pyxis mGC. The Pyxis mGC measurements occurred before and after the repair to the pump jack. The measurements are split into these categories (before and after the leak fix) to limit the contribution of air toxics from additional sources and to understand the air concentrations before and after repairs were carried out on the pump jack.

3.4. Data Evaluation

All data from measurements performed by the three monitoring devices are managed with the same method for statistical analyses. Any negative values are replaced with zero to indicate that the compound was not detected at that time. Values that are greater than zero but less than the detection limit, the lowest value the instrument can reliably detect, are replaced with half of the detection limit value. These values are filtered in this way to account for variability within an instrument response and to limit bias from being overly high or low. The detection limits for each compound measured by a given instrument are listed in Table A1. To assess emissions from the KPK Grant pump jack facility, only measurements collected when the wind direction was coming

from the direction of the KPK Grant facility relative to the location of the instrument are included in the following analyses.

3.5. Quality Control & Assurance

To ensure reliability and validity of field measurements, proper quality control (QC) and quality assurance (QA) must be carried out before, during, and after data collection. QC processes ensure instruments are operating under the same parameters throughout a measurement period to maintain consistency. QA processes implement checks and validation of the collected data to ensure completeness and accuracy. By carrying out proper QC and QA, confidence in the data is established. QC/QA procedures for individual monitoring assets are briefly described in the sections below.

3.5.1. Pyxis mGC

Manual bump checks occur bi-weekly in which a known concentration of benzene gas is flowed to the Pyxis mGC. After the instrument response is received, a percent error is calculated to ensure that benzene is within +/-30% of the expected value for all bump checks and calibrations. If the error is greater than 30%, a full multi-point calibration is performed and any previous data is flagged accordingly. In addition, routine evaluations are performed bi-weekly to ensure proper flow rates and adequate temperatures are achieved. Data is downloaded from the Pyxis mGC on a weekly basis and assessed for validity.

3.5.2. SPOD

Manual bump checks are performed monthly in which a known concentration of isobutylene gas is flowed directly to the PID. A comparison of the instrument response is performed to ensure that the concentration is within 20% of the expected value. If the error is greater than 20%, a full multi-point calibration is performed and any impacted data is flagged accordingly. Data is downloaded from the SPOD on a weekly basis and assessed for validity.

3.5.3. AIRMAR Weather Station 110WX

Prior to sampling, the anemometer is manually oriented due north by referencing a compass. This ensures accurate wind direction data throughout the sampling period.

3.5.4. MeDOAS

The MeDOAS uses ultraviolet (UV) light to detect various UV absorbing compounds within the instrument sampling chamber. The intensity of the UV light through the chamber is verified to meet the manufacturer recommendations through the use of a calibration lamp with a known intensity. Daily wavelength calibrations are performed to

identify the UV absorption spectrum for compounds typically found in background air. The internal temperature is maintained around 30°C to avoid condensation on the mirrors which direct the light source through the sampling chamber. The pressure within the sampling chamber is maintained around 845 Torr to ensure proper flow of the sample through the instrument. To ensure the detector does not overheat during measurements, the detector temperature is maintained around -50°C using liquid nitrogen. Data is processed after sampling and analyzed to confirm validity.

3.5.5. MeFTIR

The MeFTIR uses infrared (IR) light to detect various IR absorbing compounds that are collected in the instrument sampling chamber. The intensity of the IR light through the chamber is verified to meet the manufacturer's recommendations before monitoring and throughout the deployment. Quarterly checks are performed by the manufacturer to ensure correct identification of a reference compound. The internal temperature is actively maintained at approximately 30°C to avoid condensation on the mirrors that direct the light source through the sampling chamber. The pressure within the sampling chamber is maintained at around 845 Torr to ensure proper flow of the sample through the instrument. The detector is cooled throughout monitoring to ensure no overheating occurs of the detector components. Data is processed after sampling and analyzed to confirm validity.

4. Results

4.1. Pyxis mGC

Measurements from the Pyxis mGC were conducted just north of the KPK Grant pump jack facility. Benzene data was removed from April 10 - April 22, 2025, due to the instrument not passing its scheduled bi-weekly calibration, indicating an instrument malfunction. A full calibration was executed on April 22 which indicated proper functionality. All remaining benzene data is valid.

The maximum 1-hour rolling benzene average observed between April 10 and July 23, 2025 was 0.85 ppbV with a deployment average benzene value of 0.20 ppbV. The averages for this deployment are similar to values typically observed for benzene concentrations for this region. The highest 10-minute concentrations of benzene recorded during the measurement period were 1.88 ppbV and 1.74 ppbV (Fig. 2); however, both of these were measured when the wind was not coming from the direction of the pump jack, indicating that the KPK facility was likely not the source during these two plume events.

Benzene concentrations were observed above the baseline from the direction of the KPK Grant pump jack facility throughout the measurement period, but these concentrations were not consistently observed. This indicates that intermittent emissions may have been coming from the pump jack during the measurement period and before the leak was fixed on June 13, 2025 with one instance occurring above 1 ppbV. Between these two periods, the highest 10-minute concentration of benzene recorded when the wind was coming from the pump jack was 1.63 ppb, observed on 5/31/25 before the leak was fixed. Higher concentrations of benzene coming from the direction of the pump jack were observed during periods of relatively low wind speed, indicating good confidence that these increased concentrations were likely from the pump jack (Fig. 3).

During the continuous monitoring, it was observed that the average benzene background concentration increased after 6/10/25 with increased variability in the measurement. It is suspected that the instrument required maintenance. However, consistent quality assurance checks, which include bump checks and calibrations, certified the benzene data was valid throughout the sampling period and with the removal of the background, showed similar values to the measurements collected prior to this period.

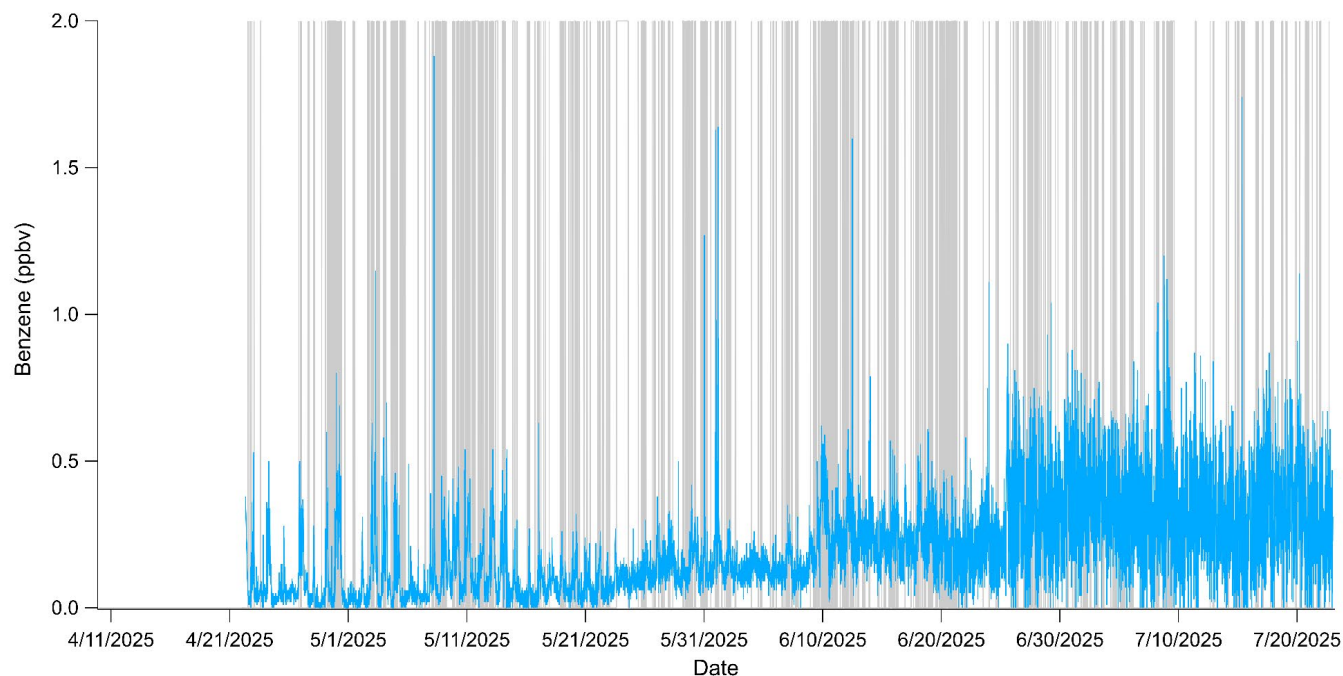


Figure 2: Time series showing 10-minute Pyxis mGC benzene concentrations in ppbV observed throughout the post cap measurement period (April 10 - July 23, 2025). Grey vertical lines indicate the periods of time when the wind direction was coming from the KPK Grant pump jack facility direction relative to the instrument.

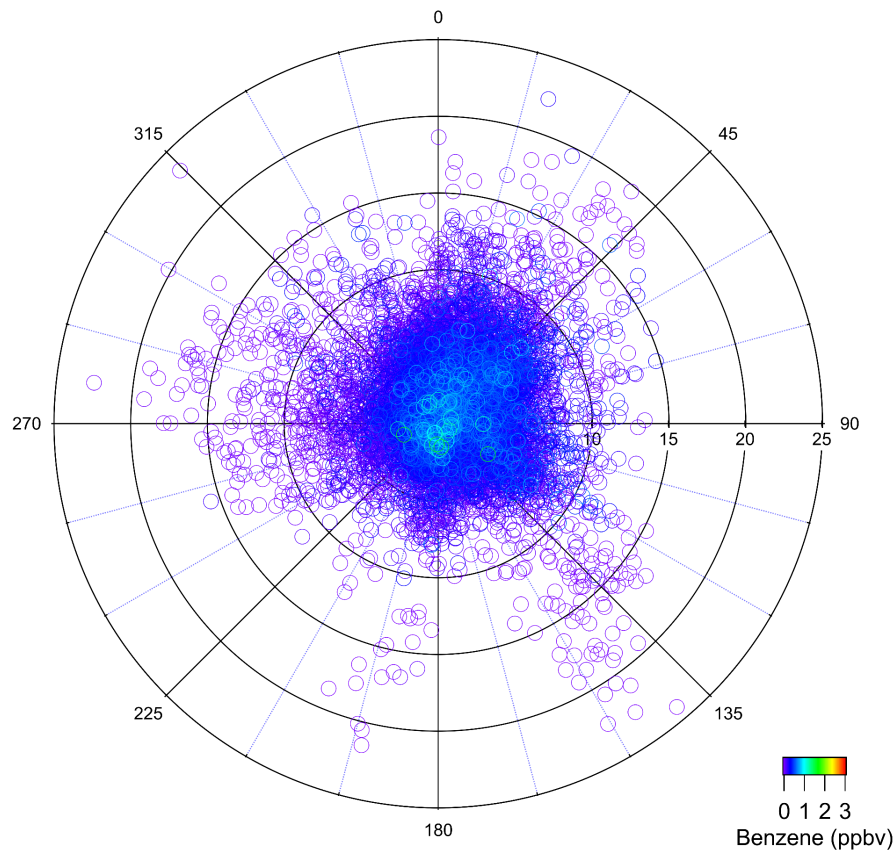


Figure 3: Polar plot showing 10-minute averaged wind speed and wind direction data collected from the AIRMAR weather station. The wind direction is identified by the angle (degrees, where 0 degrees indicates North) and the wind speed is indicated by the radial value (mph). Each marker is colored by the benzene concentration observed from the Pyxis mGC at the time of a given wind speed and direction measurement to demonstrate the potential source winds of the pollution.

4.2. Mobile Measurements

The MOOSE was requested to perform measurements at the KPK Grant #1 site on 3/20/25. A wind mast was set up to the east of the site, and a weather station, mounted on the roof of the van, was used to collect wind data to pair with the data for source identification. During these measurements, the average benzene value was 0.28¹ ppb (Table A1), and the average methane concentration was 72.56 ppb. During measurements, intermittent emission spikes were recorded, and an audible hiss/pressure was heard coming from the wellhead, which indicated there was likely a leak from the source. Forward-looking Infrared (FLIR) imaging identified stray gas being emitted from the wellhead.

¹Values below the detection limit cannot be validated.

The next day (3/21/25), the MOOSE returned to the site to determine the persistence and possible variability of the leak based on emission concentrations. A series of transect and dwell measurements were made which indicated average benzene and methane concentrations of 0.22¹ ppb (Table A2) and 27.03 ppb, respectively. FLIR imaging on 3/21 did not indicate a leak at the wellhead, indicating a possible intermittent issue.

Follow-up measurements were performed at the KPK Grant #1 pumpjack on 6/05/25. A 30-minute downwind dwell measurement was performed while FLIR imaging was recorded. An average benzene concentration of 0.4¹ ppb with a maximum value of 2.48 ppb and an average methane concentration of 55.1 ppb with a maximum value of 408.1 ppb was observed. The FLIR imaging indicated that the leak was from the top of the wellhead.

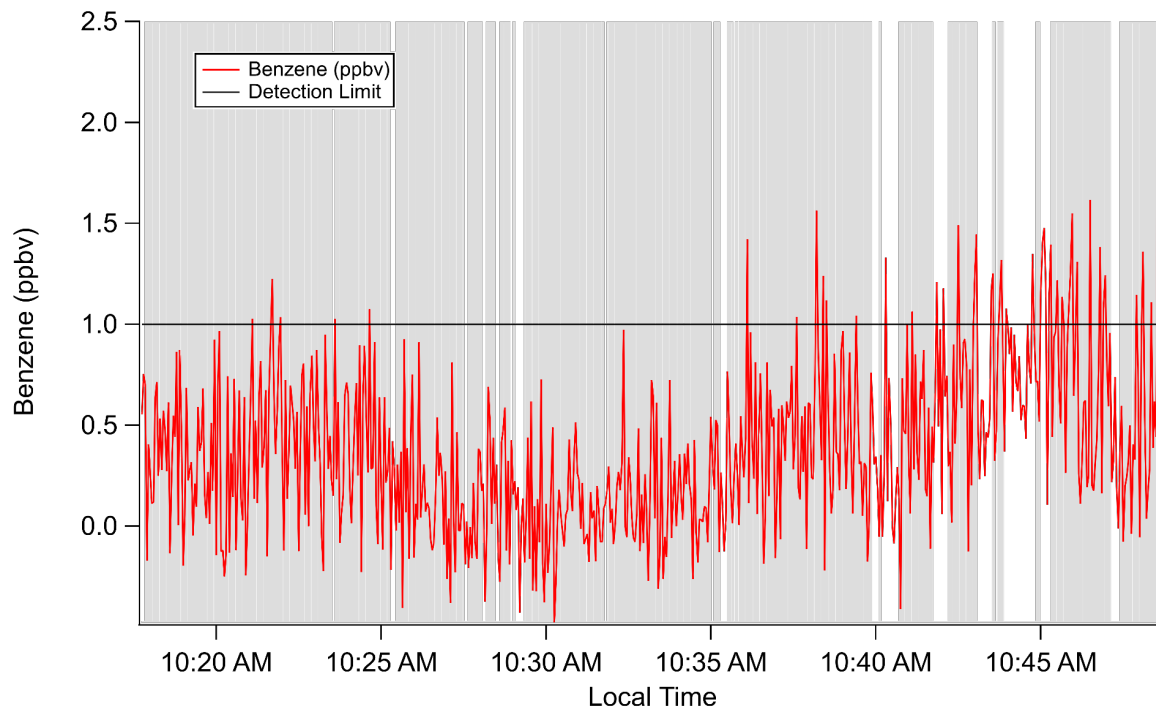


Figure 4: Benzene mixing ratio (red) and detection limit (black) during the 6/5/25 dwell period. Shaded regions indicate when winds were coming from the site.

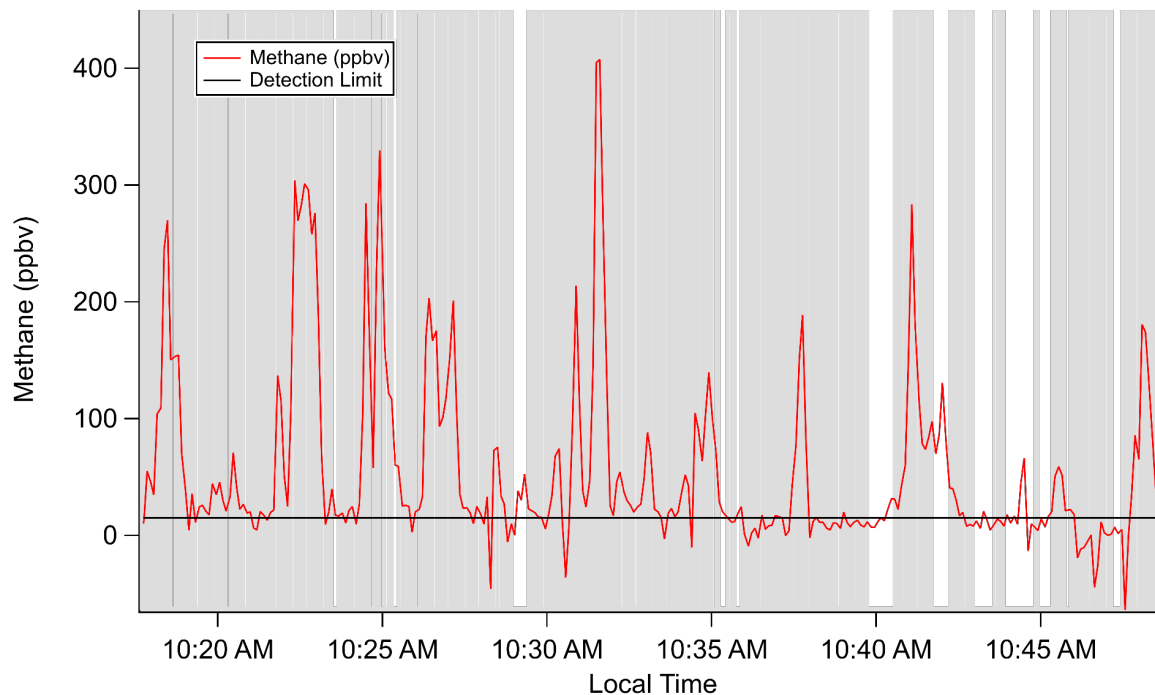


Figure 5: Methane mixing ratio (red) and detection limit (black) during the 6/5/25 dwell period. Shaded regions indicate when winds were coming from the site.

5. Summary

CDPHE-APCD-ATOPs began monitoring in the proximity of the KPK Grant #1 pump jack near Legacy Elementary School, located in Longmont, CO on March 20 and 21, 2025 due to community concern surrounding the pump jack. The sampling was conducted by a mobile asset (MOOSE) which discovered the pump jack to have a leaking wellhead. A stationary asset (Pyxis mGC) was then deployed in order to evaluate the air concentration of compounds that may be harmful to nearby communities before and after the pump jack leak was fixed on June 13, 2025.

Measurements from the stationary Pyxis mGC instrument conducted from the KPK Grant #1 pump jack found benzene concentrations to remain near typical concentrations observed within this region. The maximum 1-hr rolling average concentration of benzene from April 10 to July 23 was 0.85 ppbV. Increased benzene concentrations above typical values were observed throughout the sampling period, but were not consistent, indicating intermittent releases. These values did not exceed 1 ppbV. The highest 10-minute benzene concentration from the direction of the pump jack was observed to be 1.63 ppbV before the leak was fixed. Higher values of benzene were observed during the sampling period; however, these measurements did not have a wind direction that correlated with the location of the pump jack, indicating an alternative source.

Appendix A

Table A1: Instrument detection limits by compound.

Instrument	Species (Formula)	Detection Limit	Units
Pyxis MGC	Benzene (C ₆ H ₆)	0.05	ppbV
MeDOAS	Benzene (C ₆ H ₆)	1	ppbV
MeFTIR	Methane (CH ₄)	15	ppbV

Table A2: Benzene (ppbV) and methane (ppbV) statistics collected by the MOOSE from the KPK Grant pump jack on March 20.

	Benzene (ppbV)	Methane (ppbV)
Maximum	1.27	434.46
Minimum	0.00 ^a	7.50 ^a
Average	0.28 ^b	72.56
Median	0.00 ^a	33.63
Standard Deviation	0.38 ^b	100.53
Number of Observations	19	16

(a) Non-detect

(b) Values below the detection limit cannot be validated.

Table A3: Benzene (ppbV) and methane statistics collected by the MOOSE from the KPK Grant pump jack on March 21.

	Benzene (ppbV)	Methane (ppbV)
Maximum	0.50 ^b	38.33
Minimum	0.00 ^a	7.50 ^a
Average	0.22 ^b	27.03
Median	0.00 ^a	31.00
Standard Deviation	0.25 ^b	9.42
Number of Observations	9	11

(a) Non-detect

(b) Values below the detection limit cannot be validated.

Table A4: Benzene (ppbV) statistics collected by the Pyxis mGC from all measurements collected at the KPK Grant #1 site from 4/10/25-7/23/25.

	Benzene (ppbV)
Maximum	1.88
Minimum	0.00 ^a
Average	0.16
Median	0.20
Standard Deviation	0.16
Number of Observations	13219

(a) Non-detect

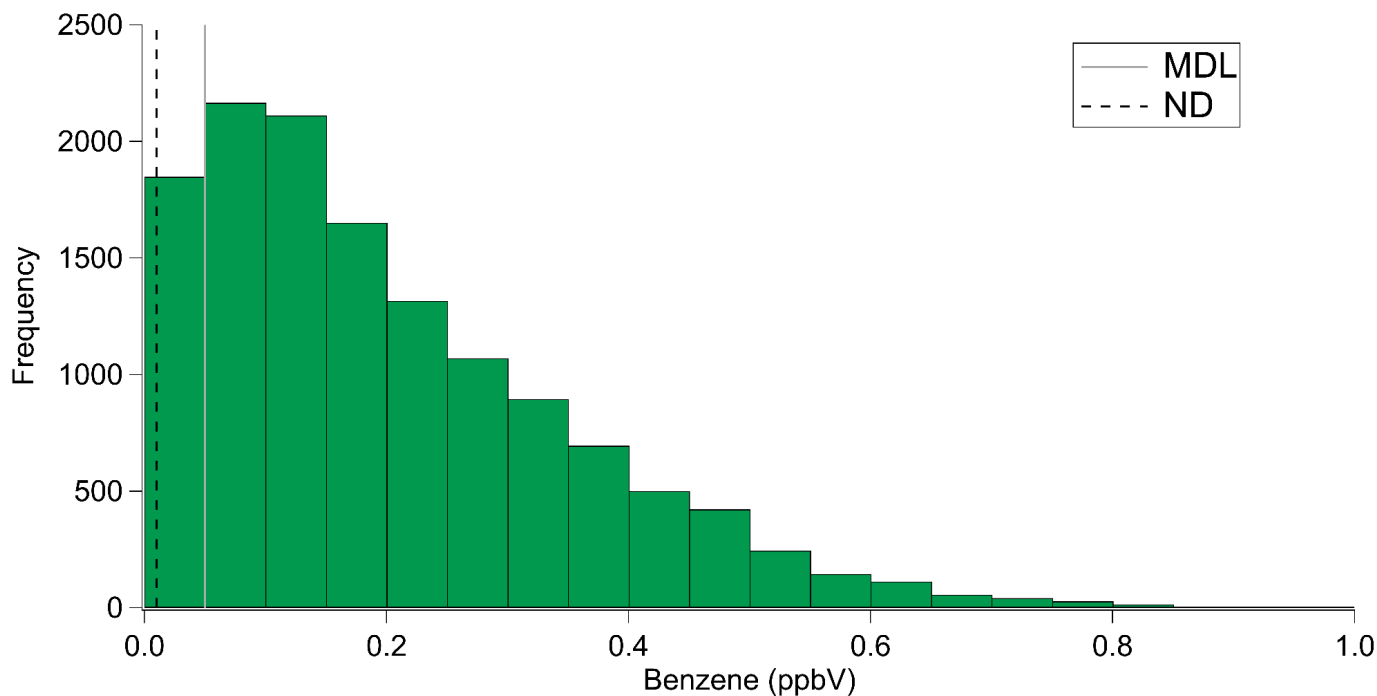


Figure A1: Histogram of benzene (ppbV) observations from the Pyxis mGC from April 10 to July 23, 2025. Data shows that 2.0% of the total observations are non-detects (ND, black dashed line) and 11.5% are below the detection limit (MDL, grey line).