



Technical Memorandum

November 26, 2023

To	CSX Transportation	Tel	
Prepared By	GHD	Email	
Reviewed By	GHD, CSX Transportation	Ref. No.	12628999
Approved By	GHD	Distributed By	CSX Transportation
Subject	Memo 6 – Summary of Real-Time Air Monitoring Results November 25, 2023, 05:00 to 23:59 Eastern Time Livingston, Kentucky – Train Derailment		

The purpose of this memorandum is to provide CSX Transportation (CSXT) with a summary of the real-time air monitoring activities, results, and observations from real-time air monitoring being performed at the location of a train derailment, and subsequent fire near the town of Livingston, Kentucky at approximate Mile Post (MP) 138.2 on the Cincinnati Corbin (CC) subdivision (Site). The derailment occurred on November 22, 2023, and involved approximately sixteen (16) mixed freight rail cars containing various commodities including multiple tank cars containing molten sulfur.

This memorandum summarizes the real-time air monitoring data collected between 05:00 and 23:59 Eastern Time (ET) on November 25, 2023 (monitoring period). GHD collected remotely monitored real-time air monitoring data from stationary locations around the perimeter of the Site and within the surrounding community. GHD mobile industrial hygiene (IH) professionals also manually recorded real-time air monitoring data using hand-held instruments throughout the work areas, Site perimeter, and within the surrounding community.

Real-time air monitoring was used primarily as a screening tool to quickly indicate the presence of elevated airborne concentrations of Site-specific constituents of interest (COI) associated with molten sulfur: flammability as a percentage of the lower explosive limit (%LEL), hydrogen sulfide, sulfur dioxide; and Site specific COIs associated with methanol: %LEL, and methanol; in addition to COIs related to the subsequent fire: respirable particulate matter with a diameter of 2.5 microns or less (PM_{2.5}) and total particulate matter with a diameter of 10 microns or less (PM₁₀). Oxygen was monitored in conjunction with flammability. Oxygen rich or deficient environments may shift the LEL or upper explosive limit (UEL) and cause erroneous readings for flammable gases.

Real-time air monitoring activities and strategies were performed in accordance with the Site-specific Air Monitoring Plan (AMP), developed by GHD, reviewed by a certified industrial hygienist (CIH), and provided to CSXT on November 22, 2023. An amendment to the AMP (AMP – Version 2) was provided to CSX on November 23, 2023. AMP – Version 2 provides air analytical sampling procedures for hydrogen sulfide, and sulfur dioxide and includes Acute Exposure Guideline Levels (AEGL), protective action criteria (PAC), and National Ambient Air Quality Standards (NAAQS) standards and guidelines for community air monitoring for sulfur dioxide. A second amendment including standards, guidelines, and monitoring tactics for methanol based on a revised list of Site-specific COI was provided to CSXT on November 25, 2023 (AMP – Version 3).

Evaluation of readings relative to established action levels were based on an approximate 1-minute average of concentrations measured by the air monitoring instruments. When readings of a COI were sustained at a concentration at, or above, the action level for the appropriate time period (generally one minute), they were considered an exceedance. Conversely, instantaneous readings that dispersed quickly and were not sustained

for over one minute represent transient concentrations and are not representative of ambient conditions over a sustained duration.

GHD identified the following Site activities with potential exposures to the Site-specific COI during the monitoring period:

- Tank car inspection, assessment, and relocation activities
- Ground disturbance activities

The remotely monitored and manually collected real-time air monitoring data and tactics are summarized below.

Remotely Monitored Real-Time Air Monitoring System

GHD has established a real-time remotely monitored air monitoring system to measure ambient air at locations with potential airborne exposures to the Site-specific COI. GHD deployed instruments **Honeywell AreaRAE monitors (AreaRAE)** equipped with a catalytic bead sensor specific for measuring %LEL, and electrochemical sensors specific for hydrogen sulfide, sulfur dioxide, and oxygen.

Each remotely monitored real-time air monitoring instrument was deployed approximately 4.5 feet above the ground to represent the air quality within the typical breathing zone of personnel in the area. AreaRAE units continuously monitor airborne concentrations of COI and using radio telemetry transmit instantaneous readings (approximately every 20-60 seconds) to a host computer for simultaneous monitoring from a central location.

During the monitoring period, GHD maintained four (4) previously established stationary instruments located at the Site perimeter and the surrounding community. During this monitoring period a fifth stationary instrument was deployed. The locations of the stationary meters are described below:

1. AreaRAE 02225 – Church
2. AreaRAE 02056 – Rail Car Staging
3. AreaRAE 01871 – Rolloff Staging Area
4. AreaRAE 02103 – Residential Property
5. AreaRAE 01234 – Rail Car Staging 2
 - This location was deployed at 07:13 ET on November 25, 2023.

Remotely monitored real-time air monitoring locations are shown on Figure 1. During this monitoring period, the remotely monitored air monitoring system recorded 75,308 real-time air monitoring readings for sulfur dioxide, %LEL, hydrogen sulfide, and oxygen. The details of each location, monitoring period, and a summary of the remotely logged monitoring data are summarized in Table 1.

Table 1 Remotely Monitored Real-Time Air Monitoring Data Summary

Location / Meter ID	Total Number of Readings ¹	COI Number of Readings Above Action Level (Action Levels) ²			
		SO ₂ (≥0.2 ppm)	% LEL (≥1%)	H ₂ S (≥0.5 ppm)	%Oxygen (≤19.5 or ≥ 23.5%)
AreaRAE 02225 – Church	13,050	0	0	0	0
AreaRAE 02056 – Rail Car Staging	17,144	0	0	0	0
AreaRAE 01871 – Rolloff Staging Area	17,004	0	0	0	0
AreaRAE 02103 – Residential Property	15,612	0	0	0	0
AreaRAE 01234 – Rail Car Staging 2 <i>Deployed 07:13 ET</i>	12,498	0	0	0	0
Definitions: COI – Constituent of interest SO ₂ – Sulfur dioxide					

LEL – Lower explosive limit
H₂S – Hydrogen sulfide
ppm – Parts per million
% – percent
≥ – greater than or equal
≤ – less than or equal
ET – Eastern time

Notes:

1. AreaRAE units continuously monitor airborne concentrations of COI and transmit instantaneous readings (approximately every 20-60 seconds) to a computer for simultaneous monitoring using radio telemetry.
2. The evaluation of airborne concentrations relative to the established action levels for the associated COI were based on the approximate one-minute average. As such, the number of readings displayed may have represented transient concentrations but may not represent a one-minute action level exceedance.

Manually Collected Real-Time Air Monitoring Data

A GHD mobile team manually collected real-time air monitoring data at the perimeter of the work areas, inside the work zones, and surrounding community. The manually collected real-time air monitoring data was collected at breathing zone height (approximately 4.5 feet) using handheld instruments. The data collected from these handheld devices was logged into an electronic handheld data collection device. The purpose of the manually logged data was to characterize exposures in real-time during the various operations throughout the Site, as well as identify any potential fugitive emissions related to mitigation activities.

GHD used the following handheld instruments to measure airborne concentrations:

- **Honeywell MultiRAE instruments** equipped with a catalytic bead sensor specific for %LEL, and electrochemical sensors specific for sulfur dioxide, hydrogen sulfide, and oxygen.
- **Honeywell MiniRAE 3000 instruments** equipped with a photoionization detector (PID) 11.7 eV lamp for monitoring of methanol (as total VOCs).
- **Gastec methanol** colorimetric detection tubes.
- **TSI DustTrak DRX (DustTrak)** aerosol monitors equipped with a light-scattering laser photometer to detect particulate matter.

GHD mobile teams logged over 468 real-time air monitoring readings during the monitoring period. The manually collected real-time air monitoring data locations are shown on Figure 1. A summary of the manually logged data for the monitoring period is provided below in Table 2.

Table 2 Manually Logged Real-Time Air Monitoring Data

COI	Action Level ¹	Reading Type	Result
Hydrogen Sulfide	≥0.5 ppm	Number of Readings	451
		Number of Readings Above Action Level	0
		Maximum Reading	<0.1 ppm
Sulfur Dioxide	≥0.2 ppm	Number of Readings	457
		Number of Readings Above Action Level	0
		Maximum Reading	0.1 ppm
Respirable Particulate Matter (as PM _{2.5})	≥2.5 mg/m ³	Number of Readings	131
		Number of Readings Above Action Level	0
		Maximum Reading	0.191
Respirable Particulate Matter (as PM ₁₀)	≥5 mg/m ³	Number of Readings	131
		Number of Readings Above Action Level	0
		Maximum Reading	0.194
%LEL	≥1% LEL	Number of Readings	468
		Number of Readings Above Action Level	0
		Maximum Reading	<1 %
Oxygen	≤19.5% or ≥23.5%	Number of Readings	462

		Number of Readings Above Action Level	0
Methanol	≥100 ppm	Number of Readings	25
		Number of Readings Above Action Level	0
		Maximum Reading	<0.1 ppm
		Definitions:	
COI – Constituent of interest LEL – Lower explosive limit ppm – Parts per million % – percent mg/m ³ – milligrams per cubic meter ≥ – greater than or equal ≤ – less than or equal PM 2.5 – Particulate matter 2.5 microns in diameter or less PM 10 – Particulate matter 10 microns in diameter or less			
Notes:			
1. The evaluation of airborne concentrations relative to the established action levels for the associated COI were based on the approximate one-minute average.			

Real-Time Air Monitoring Data Evaluation and Summary of Results

The **remotely monitored** real-time air monitoring data for the monitoring period indicated the following:

- **Hydrogen Sulfide (Action Level 0.5 ppm)**
 - No hydrogen sulfide readings were documented above the action level.
- **Sulfur Dioxide (Action Level of 0.2 ppm)**
 - No sulfur dioxide readings were documented above the action level.
- **%LEL (Action Level of 1% LEL)**
 - No %LEL readings were documented above the action level.
- **Oxygen (Normal Range 19.5-23.5%)**
 - No oxygen readings were documented outside the normal range.

The **manually collected** real-time air monitoring data for the monitoring period indicated the following:

- **Hydrogen Sulfide (Action Level 0.5 ppm)**
 - No hydrogen sulfide readings were documented above the action level.
- **Sulfur Dioxide (Action Level of 0.2 ppm)**
 - No oxygen readings were documented above the action level.
- **Respirable Particulate Matter - as PM_{2.5} (Action Level 2.5 mg/m³)**
 - No PM 2.5 readings were documented above the action level.
- **Respirable Particulate Matter - as PM₁₀ (Action Level 5 mg/m³)**
 - No PM 10 readings were documented above the action level.
- **%LEL (Action Level of 1% LEL)**
 - No %LEL readings were documented above the action level.
- **Oxygen (Normal Range 19.5-23.5%)**
 - No oxygen readings were documented outside the normal range.
- **Methanol (Action Level 100 ppm)**
 - No readings collected for the purpose of worker exposure monitoring were documented above the methanol action level. Investigative readings above 100 ppm for methanol were documented and are described below. As these were investigative readings, and not representative of the typical breathing zone of a worker, they are not considered action level exceedances as described in the AMP –

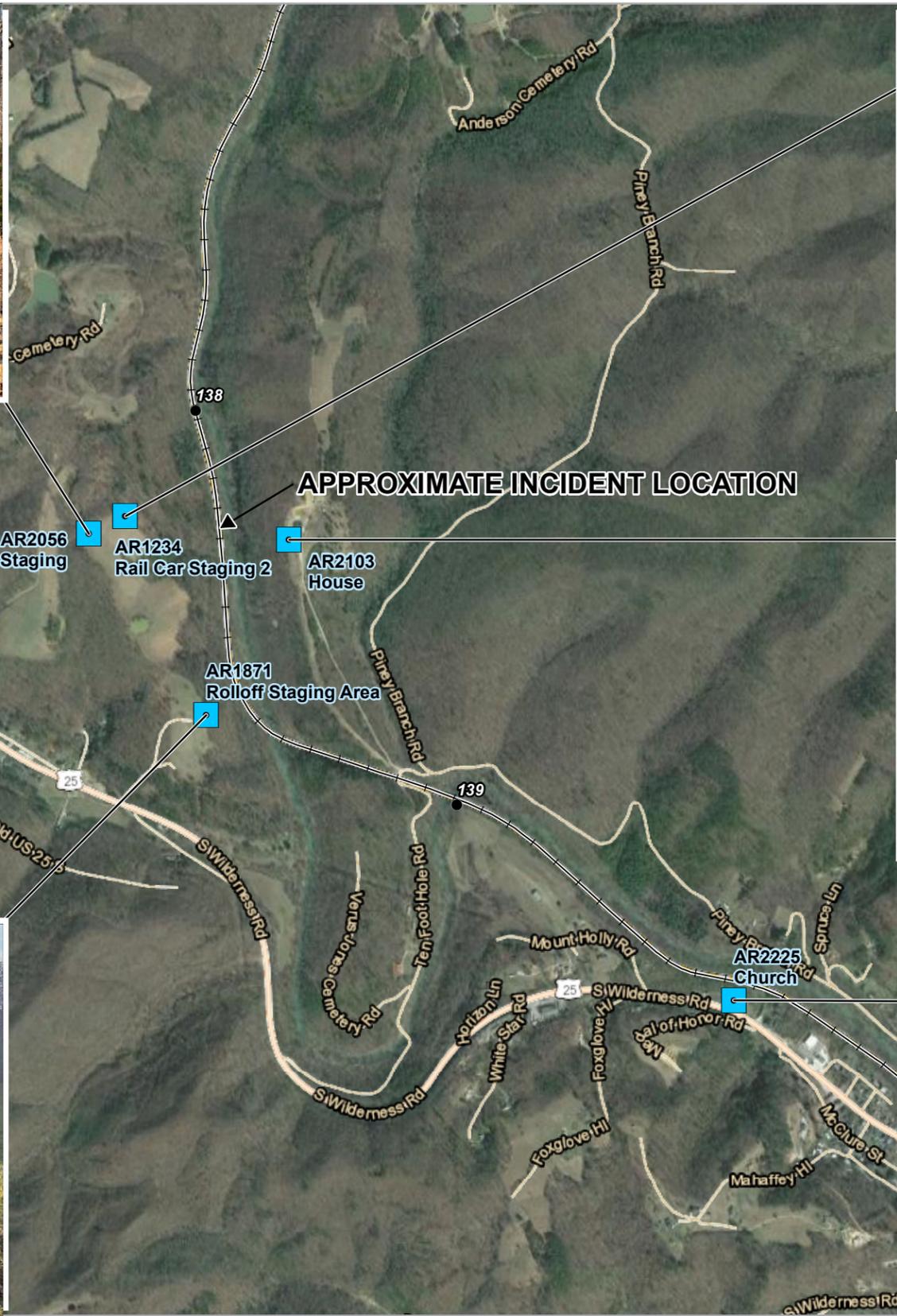
Version 3. Investigative readings are collected periodically in order to facilitate operational decisions on Site.

– **Investigative Methanol Readings**

- Readings were collected near the bottom outlet valve (BOV) (approximately six inches from the valve), and within the damaged jacket of tank car NATX 303953. Tank car NATX 303953 last contained methanol.
 - Prior to tank car relocation activities, airborne concentrations of methanol near the BOV and within the jacket were below instrument detection limits.
 - Following tank car relocation activities, airborne concentrations of methanol were documented at approximately 400 ppm near the BOV and within the damaged jacket.
 - Subsequent readings from approximately five feet were documented below the instrument detection limits.
 - The surrounding area around the BOV was cordoned off with caution tape, and personnel in the area were notified to stay clear.
 - At approximately 17:55 ET airborne concentrations of methanol near the BOV and within the damaged jacket of NATX 303953 were below detection limits of the instruments.
- No air monitoring readings were taken around the protective housing on top of the tank car due to access issues prior to the tank car being stabilized following relocation activities.

Quality Assurance and Quality Control

The information contained in this memorandum will be considered preliminary, as a final Quality Assurance / Quality Control (QA/QC) of the data has not been completed. At the completion of the project, a report will be prepared in which the data collected through real-time air monitoring will be compiled, summarized, and reported to CSXT. Data contained in the final report will have been through the final QA/QC process, will be reviewed by a GHD Certified Industrial Hygienist (CIH), and will be considered final.

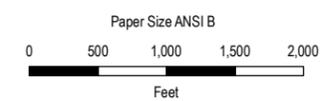


Legend

- Stationary Monitoring Location (5)
- Mile Post
- Track Centerline

NOTES:

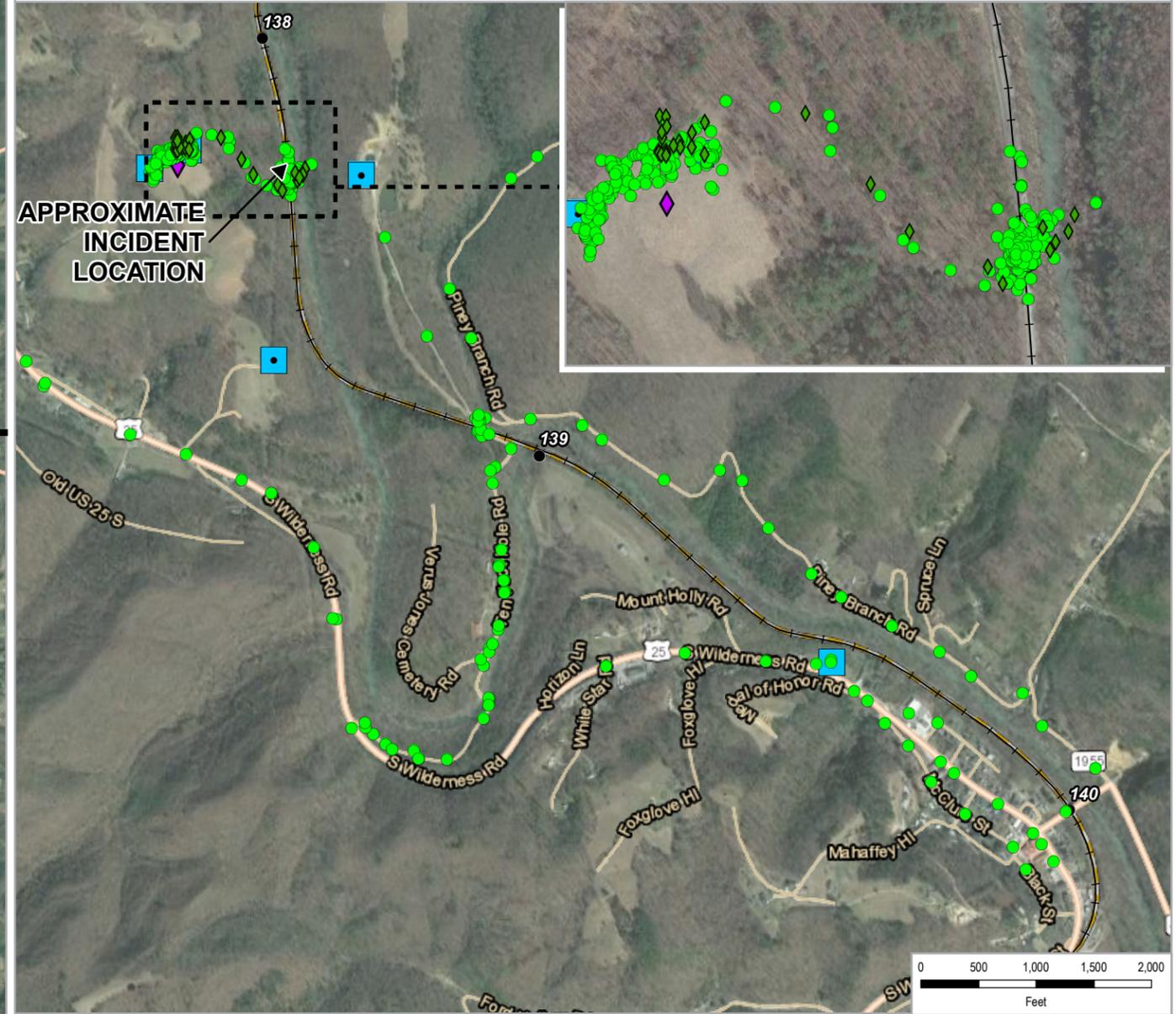
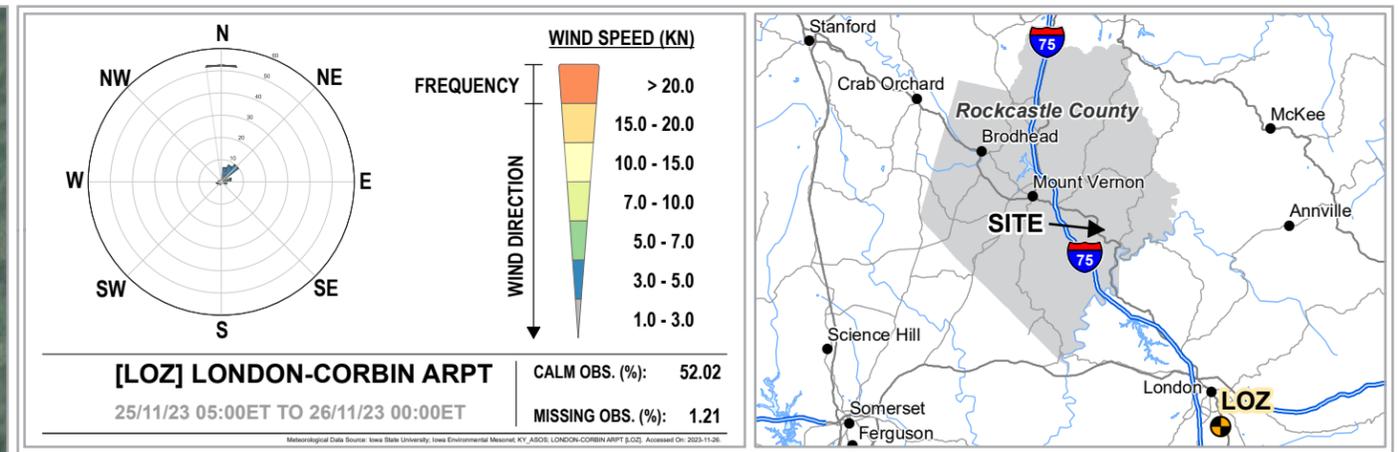
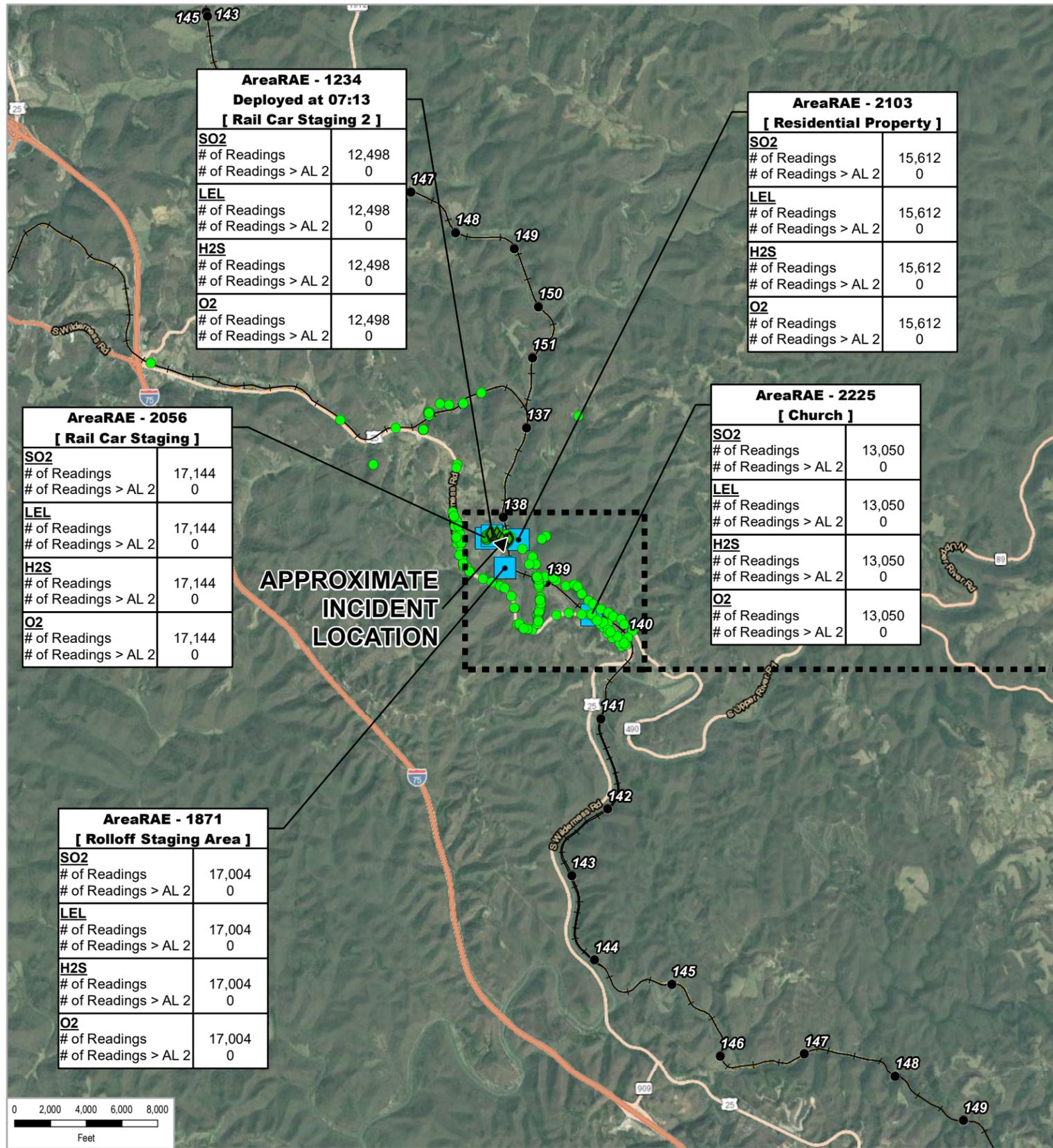
1. > AL = Above Action Level 2
2. Action Level for Hydrogen Sulfide is ≥ 0.5 ppm
3. Action Level for Sulfur Dioxide is ≥ 0.2 ppm
4. Action Level for Nitrogen Dioxide is ≥ 0.2 ppm
5. Action Level for LEL is ≥ 1.0 %
6. Action Level for PM2.5 is ≥ 2.5 mg/m3
7. Action Level for PM10 is ≥ 5.0 mg/m3
8. Action Level for Oxygen is $\leq 19.5\%$ or $\geq 23.5\%$
9. AreaRAE readings are reported as 1-minute averages



CSXT FIRE
CINCINNATI CORBIN SUB - MP 138.2
LIVINGSTON, KENTUCKY

2023/11/25 - 08:00 (ET)
AREARAE DEPLOYMENT LOCATIONS

Project No. 12628999
 Date Nov 25, 2023



- Legend**
- Real Time Air Monitoring Location (Above Action Level) (0)
 - Real Time Air Monitoring Location (Below Action Level) (468)
 - Stationary Monitoring Location (5)
 - Real Time Methanol Monitoring Location (Above Action Level) (0)
 - Real Time Methanol Monitoring Location (Below Action Level) (25)
 - GHD Host Location (1)
 - Weather Station (LOZ)
 - Mile Post
 - Track Centerline
- NOTES:**
- > AL = Above Action Level 2
 - Action Level for Hydrogen Sulfide is ≥ 0.5 ppm
 - Action Level for Sulfur Dioxide is ≥ 0.2 ppm
 - Action Level for Methanol is ≥ 100.0 ppm
 - Action Level for LEL is ≥ 1.0 %
 - Action Level for PM2.5 is ≥ 2.5 mg/m3
 - Action Level for PM10 is ≥ 5.0 mg/m3
 - Action Level for Oxygen is ≤ 19.5 % or ≥ 23.5 %

Paper Size ANSI B

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Kentucky South FIPS 1602 Feet

GHD

**CSXT FIRE
CINCINNATI CORBIN SUB - MP 138.2
LIVINGSTON, KENTUCKY
2023/11/25 - 05:00 TO
2023/11/25 - 23:59 (ET)
AIR MONITORING RESULTS SUMMARY**

Project No. 12628999
Date Nov 26, 2023