

## **New Continuous Air Monitors at Bristol Landfill**

Since May 2023, the City of Bristol, VA (“the City”) has operated air monitors at four locations (“Monitoring Stations”) around the quarry landfill. Station 1 is northeast and generally upwind of the quarry; Stations 2 and 3 are downwind to the southwest and southeast located between the quarry landfill and the Tennessee border; and Station 4 is situated on the western rim of the quarry landfill. The units were placed in these locations to monitor what is happening downwind, upwind, along the perimeter of the landfill property (between the landfill and the Virginia/Tennessee border), and right on the rim of the landfill. At each of these locations, the City had installed a MultiRAE® unit, leased from Field Data Solutions (FDS). Each of the MultiRAE® units provided continuous measurements in ambient air of total volatile organic compounds (TVOCs) at parts per billion (ppb) and hydrogen sulfide (H<sub>2</sub>S) at parts per million (ppm) levels. Additionally, the unit at Station 4 measured ammonia at ppm levels. One thousand parts per billion (ppb) is equal to one part per million (ppm).

During the second week of May 2024, the City replaced each of the FDS MultiRAE® units with new monitors custom configured for the quarry landfill. The City purchased new CTair units from Scentroid – a specialty odor and air monitoring company (<https://scentroid.com/about-scentroid/>) head-quartered near Toronto, ON. These units are set up to check for compounds that prior air monitoring and air sampling suggest might be coming from the landfill. Additionally, there is a new weather station located at Station 3 collecting meteorological data such as wind direction, wind speed, temperature, relative humidity, and barometric pressure. Both the previous MultiRAE® units and the new CTair units satisfy the Federal Court’s Consent Final Order requirement to maintain a continuous ambient air monitoring network for TVOC and H<sub>2</sub>S around the Landfill. Similarities and differences are summarized below.

- **Sensor Technology:** The MultiRAE® and CTair units use comparable types of sensor technologies. TVOC concentrations are measured using a photo ionization detector (PID). Both the MultiRAE® and CTair units measure TVOC concentrations at the ppb level. H<sub>2</sub>S concentrations are measured using an electrochemical sensor. The primary difference is the level of sensor sensitivity. The new CTair units use H<sub>2</sub>S sensors that are more sensitive and measure at the parts per billion levels while the MultiRAE® units measured H<sub>2</sub>S at the ppm level.
  - The H<sub>2</sub>S sensor used in the CTair units is manufactured by Membrapor (a company headquartered in Switzerland) and as discussed with the manufacturer’s representative, there is high likelihood that the H<sub>2</sub>S sensor has cross sensitivity with other reduced sulfur compounds. Other reduced sulfur compounds include, but are not limited to, carbonyl sulfide, dimethyl sulfide, dimethyl disulfide, and methyl mercaptan. Therefore, the H<sub>2</sub>S sensor

measures not only H<sub>2</sub>S but also measures these other reduced sulfur compounds.

- **Benzene Monitoring:** The CTair units are equipped with two separate PID sensors – one to measure TVOCs and one specifically to measure for benzene. TVOC is a “non-specific” measure of the level of organic (carbon-containing) chemicals in the air but does not identify or measure individual chemicals. TVOC measured by the CTair units around the landfill may reflect contributions from anthropogenic sources (e.g., motor vehicles, construction equipment, lawnmowers) other than the landfill and volatile compounds released from vegetation. Previous studies of the composition of the landfill gas identified individual VOC compounds such as acetone, alcohols, ketones, and benzene and related compounds. Of the individual VOC compounds found in the landfill gas, benzene was selected for special sensor monitoring. Benzene is a common VOC that may be a public health concern in some situations. It is a constituent of the landfill gas, but also has many other sources in ambient and indoor air such as gasoline engines, petroleum retail and storage facilities, some consumer products, and tobacco smoke (ATSDR Public Health Statement for Benzene, 2015. Accessed online at [ATSDR Public Health Statement for Benzene.](#))
- **Trigger Level for the Benzene Sensor:** Because low levels of benzene are frequently present in ambient air, it is important for the sensors to be able to identify levels of benzene that could be associated with the landfill – as opposed to other common sources in the community. To help make this distinction, the benzene sensor is programmed to start taking measurements when the companion CTair PID sensor measures TVOCs at a level of 160 ppb or higher.
  - In selecting the TVOC trigger level of 160 ppb, Stantec reviewed results from studies of the gases pulled directly from the landfill’s sidewall odor mitigation system and from 24-hour synoptic ambient air samples collected at locations around the landfill. The samples were tested by the analytical laboratory for an extensive list of individual compounds, referred to as Target Analytes, using EPA Method TO-15. Based on the approximate proportions of benzene to the total concentration of Target Analyte compounds measured in the landfill reaction gas and synoptic ambient air samples, Stantec determined that concentrations of benzene at or above the health-based benchmark of 9 ppb were most likely to occur when the TVOC PID sensor is measuring levels of greater than 160 ppb. The TVOC trigger level for activating the benzene sensor is low enough to capture levels of benzene

that are potentially associated with the landfill gas as opposed to local non-landfill sources.

- In other words, when TVOC levels at the monitoring station exceed 160 ppb, both the TVOC and benzene sensors are programmed to take measurements at the same time. When TVOC levels are at or below 160 ppb, the benzene sensor will stop measuring.
- When the City initiated the air monitoring program in May 2023, 9 ppb of benzene was selected as the health-based benchmark for comparing the results from 24-hour ambient air samples collected at locations around the landfill. For the continuous monitoring, it was desirable to establish a TVOC trigger level that would capture benzene concentrations at or above the health-based benchmark level of 9 ppb.
  - The health-based benchmark concentration, sometimes referred to as a screening level is the concentration of a chemical, benzene in this case, that a person could be exposed to continuously for a specified length of time (1 to 14 days) without appreciable risk of experiencing adverse health effects when exposed. The benchmark level of 9 ppb for benzene was selected based on the EPA Reference Concentration (RfC) and ATSDR Minimal Risk Levels (MRL) for non-cancer health effects from breathing benzene in ambient air. Both the RfC and MRLs are set well below exposure levels where health effects have been reported.
  - Concentrations of benzene in ambient air higher than the benchmark do not necessarily mean that adverse health effects are occurring or will occur but do suggest additional evaluation may be appropriate.
  - The CTAir monitoring stations first full month of deployment at the landfill was June 2024. Benzene is one of the compounds of interest measured at each station at levels as low as 0 parts per billion (ppb).
    - Station 4, which is located at the rim of the quarry landfill, had observed benzene readings during the June 2024 reporting period.
    - The other three CTAir locations (Stations #1-#3), located along the perimeter of the landfill property near the adjacent community, did not have measurable benzene concentrations for the same time period.

- Summary Reports: Weekly summaries of average and peak TVOC, benzene, and H<sub>2</sub>S levels are being compiled from the CTair monitoring results. Reports will be posted on the Landfill website. The CTair report format is similar to the MultiRAE® report format published since May 2023, including graphs and meteorological conditions.
  
- Interpreting Reports and Results: As mentioned above, both the CTair and MultiRAE® units use PID and electrochemical sensors to measure TVOCs and H<sub>2</sub>S. However, there are differences in the design and technology of the sensors. It is important to keep this in mind when comparing reports from the new CTair units to past reports from the MultiRAE® units, especially for TVOCs at individual Monitoring Stations.
  - TVOC is a generalized term that refers to a variety of compounds in the air. The City has supplemented TVOC continuous air monitoring in the past with laboratory tests to determine the specific compounds that can be in the landfill and the ambient air. There are potentially hundreds of low molecular weight compounds present in ambient air at any given time. The TVOC sensors stationed around the landfill report the levels as a single number for each increment of time during the day. The TVOC levels recorded by the PID sensors are an approximate measure and do not distinguish individual compounds in the mixture. This is why the CTair units are equipped with benzene-specific PID sensors.
  
  - There are numerous man-made and natural sources of TVOCs such as emissions from motor vehicles and machinery (including diesel engines), consumer products and industrial sources, decomposing vegetation and other organic matter -- even emissions from plants such as pine trees.
  
  - Levels of TVOCs are expected to vary a lot over time (for example, over the course of 24-hours and from one day to the next) and between Monitoring Stations. Weather conditions, especially changes in relative humidity, can also influence levels of TVOCs.
  
  - Analysis of the data collected during the first month using the new benzene sensors (June 2024) at each of the four CTair stations demonstrates that while benzene is detected on the rim of the landfill, benzene from the landfill is most likely not migrating off landfill property.
  
- Monitoring for ammonia was discontinued based on the results of air samples collected from locations on the floor of the quarry and on the rim at Station 4 in

August 2023 and sent to the laboratory for analysis by NIOSH Method 6015. Of the seven samples collected, ammonia was present at 33 ppb (just above the laboratory Reporting Limits of 28 to 33 ppb) in one sample and not detected in the other six samples. The results from the analytical laboratory indicated that the landfill is not a source of ammonia that could move offsite into the community. To put the laboratory analytical results in context, the current EPA's RfC for ammonia is 700 ppb (500 µg/m<sup>3</sup>), accessed on-line at [https://iris.epa.gov/ChemicalLanding/&substance\\_nmbr=422](https://iris.epa.gov/ChemicalLanding/&substance_nmbr=422). The EPA RfC is 20 times higher than the analytical result from that single sample.