

# Studying Variation in Lead Contamination and Air Pollution across NYC Parks using Low-Cost Monitoring Tools

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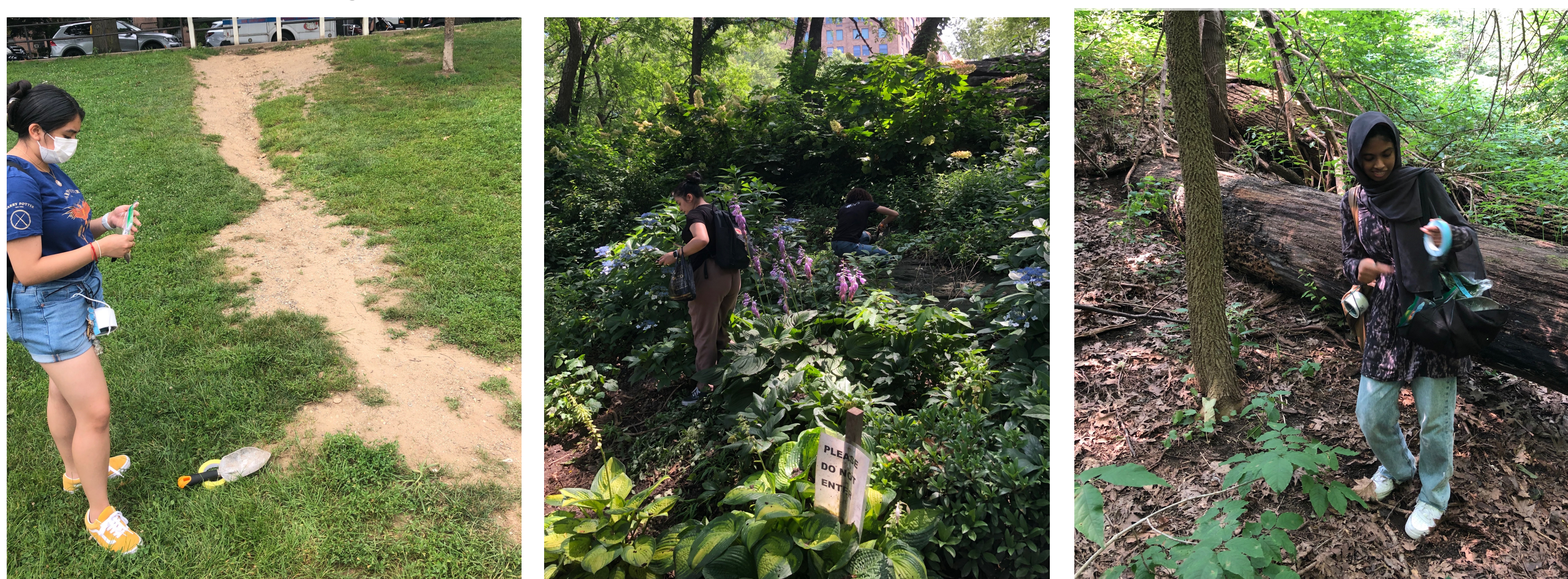
## INTRO

- Long-term exposure to environmental contaminants such as lead in soil and fine particulate matter (PM<sub>2.5</sub>) in air are linked to a variety of adverse health effects.
- Since air pollution historically contained lead in combustion sources, studying contaminated soil is necessary to understand the risks of previous air pollution.
- Both air and soil pollution vary significantly in space and time, and not everyone is at the same risk of exposure.
- Parks offer a variety of ecosystem services, one of which is assumed to be protection from pollution in the rest of the city. However, this shielding effect has not been quantitatively explored.
- *In which areas are lead contamination and/or air pollution highest?*
- *Do parks have a shielding effect against contamination? Within a park, how does contamination vary?*

## METHODS

- Six local high school students collected 343 soil samples and continuous air pollution measurements in six large NYC Parks over the course of nine field days from 7/13 to 8/4/21.
- An array of PurpleAir sensors, low-cost monitors that measure a variety of PM sizes, were used contemporaneously. Measurements were recorded in real time and checked relative to each other when co-located (within 1 ug/m<sup>3</sup>). GPS location and time were recorded concurrently during transits and combined.
- Soil sample lead concentrations were analyzed using a portable XRF.
- Data analysis was conducted in Google Earth Pro and R.

**Figure 1: High School Student Researchers Collecting Soil Samples.** In this community-based research approach, students discussed scientific literature, provided input on which parks to sample and how to analyze data, and summarized their findings for an outdoor science fair in August.

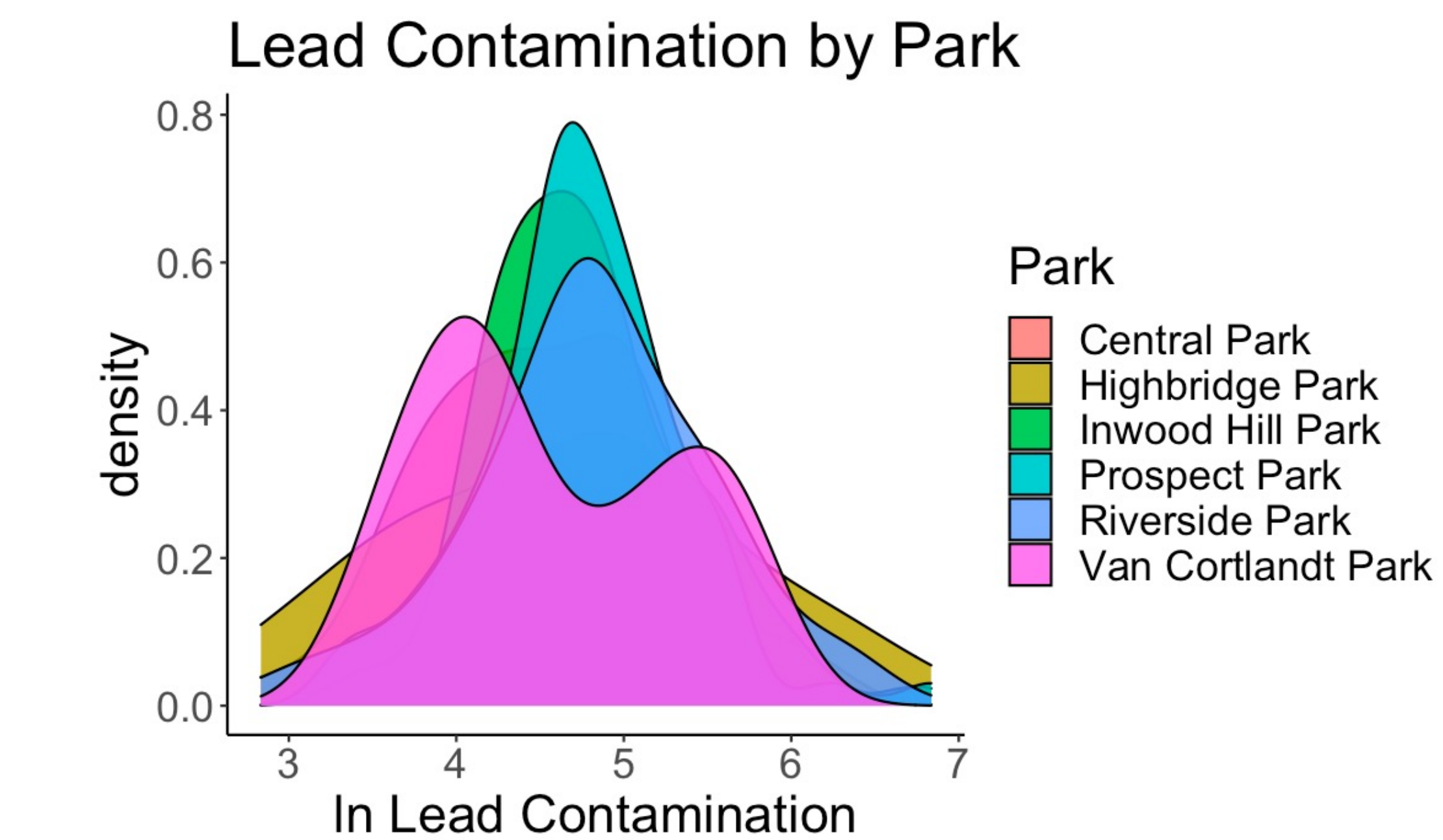


**Figure 2: Google Earth Images of 343 Soil Samples in six New York City Parks**



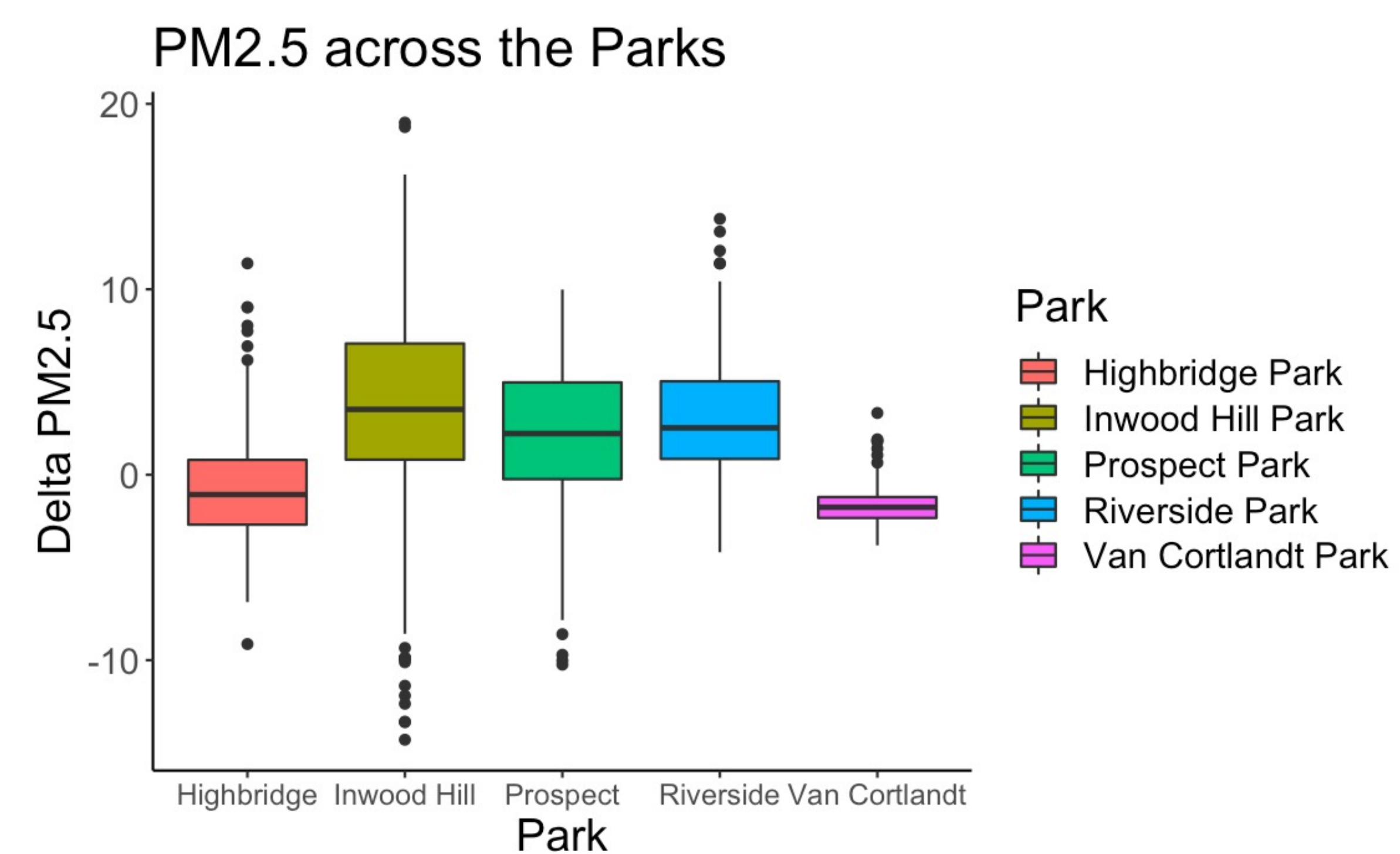
## RESULTS

### Lead Contamination



**Figure 3: Density plot showing the distribution of lead concentration (natural log transformed) in soil samples, colored by park.** Of the 343 samples analyzed, 11 (3.2% of samples) were above the EPA's safe limit for children's exposure of 400 ppm. The mean lead concentration was 166 ppm, with a maximum value of 930 ppm.

### Air Pollution



**Figure 4: Boxplots showing the difference between PM<sub>2.5</sub> in each park and a reference PurpleAir sensor.** Positive values denote more air pollution inside the park compared to the reference sensor at City College. The majority of PM<sub>2.5</sub> measurements in Inwood Hill, Prospect, and Riverside Parks were greater than those of the reference sensor.

- Of the 1175 PurpleAir measurements made, the median amount of PM<sub>2.5</sub> (μg/m<sup>3</sup>) was 26.3, with 57% of measurements above 25 (the EPA 24-hour safe exposure limit). The maximum PM<sub>2.5</sub> level was 146.1 μg/m<sup>3</sup>.
- Wildfire smoke from the West Coast entered the city on 7/20, causing a four-fold increase (22 to 90 μg/m<sup>3</sup>) in average PM<sub>2.5</sub> in a reference sensor.

## DISCUSSION

- Lead contamination was highly heterogeneous within each park.
- Air pollution, despite variation between parks, stayed within 20 μg/m<sup>3</sup> of the reference sensor.
- While greenspaces are often thought of as refuges from environmental contamination, air pollution was higher in three parks compared to a reference sensor. This may be due to the proximity of major roadways on a park's perimeter.
- Next steps include collecting air pollution data, including chemical composition, in smaller parks.

## ACKNOWLEDGEMENTS

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Scan to view the interactive lead concentration map:

