SOILED IT!

Examining Contaminants in Cemetery Soil

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Introduction

Cemeteries with pre-20th century burial sites may be at risk for soil contamination. Arsenic was not banned in embalming fluids until 1905 in the United States[1], allowing arsenic to leach into the soil around burial sites from before 1905. Wooden caskets also posed problems, as some wooden caskets were treated with arsenic-containing preservatives. The popularization of metal caskets by 1950 prevented new arsenic contamination, but allowed casket materials, as well as paint, to leach lead into cemetery soil.[2]

Green-Wood Cemetery has been an active burial site since the mid-18th century, putting it at risk for these contaminants. Studies on cemetery soil contaminants are important because soil pollutants can leach into the ground and ponds. Since cemeteries are often used as ecological background sites, a heightened presence of contaminants such as arsenic and lead could prove cemeteries unfit for such use[1]. Moreover, arsenic contamination in ponds and groundwater can poison wildlife and humans.

Research Question and Hypotheses

Question:

Do cemeteries contribute to the contamination of surrounding soil?

Hypotheses:

- Soil around burial sites will have elevated levels of arsenic and lead
- Older sites and sites at lower elevations will have higher arsenic
- Green-Wood will have higher concentrations of organic matter

Methods

Sample Collection:

- Extracted all soil samples using soil core 33" long, ⅞" wide
- Collected 10 control samples in Prospect Park at random locations spread across the park to establish background contamination level
- Collected 30 samples at Green-Wood
  - 5 sets of 3 samples each from different elevations with burial years within 10 years of each other
  - 5 sets of 3 samples each with different burial years and same elevation
- Recorded sample coordinates, burial year, and elevation

Sample Testing:

- Tested each sample twice for arsenic and lead
- Tested each sample once for nitrogen, potassium, and phosphorus

Results

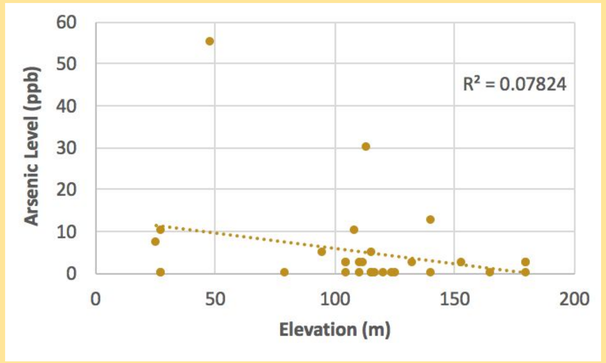


Figure 1: Arsenic levels vs elevation in Green-Wood Cemetery

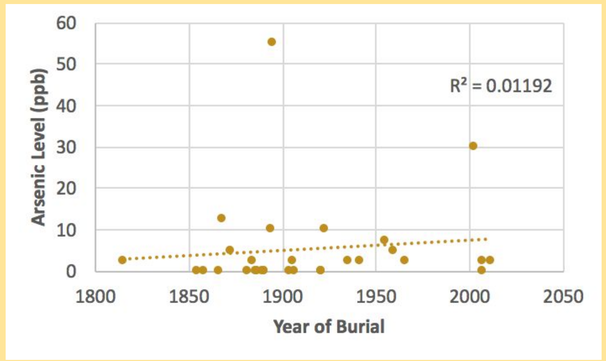
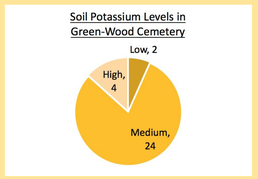
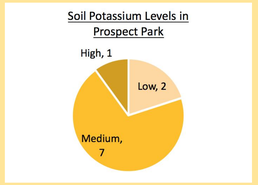
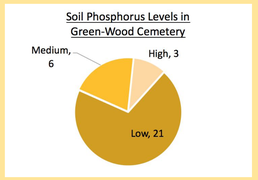
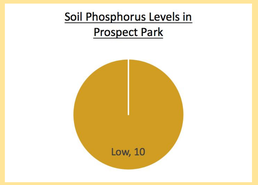


Figure 2: Arsenic levels vs burial year is Green-Wood Cemetery









Figures 3-6: a comparison of phosphorus and potassium levels in Green-Wood and Prospect Park

Field Images

Figure 7: The students with a complete soil core from Green-Wood

Figure 8: After taking the core students label and store samples for testing

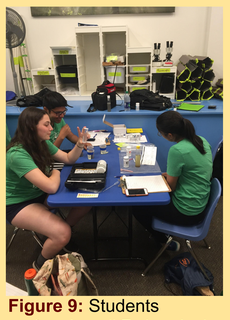


Figure 9: Students performing all 7 chemical tests on each sample

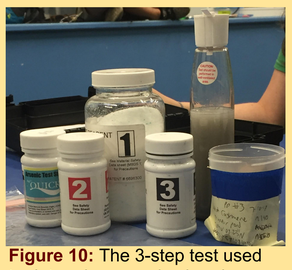


Figure 10: The 3-step test used to determine arsenic abundance

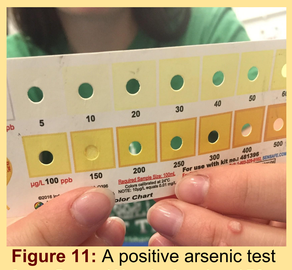


Figure 11: A positive arsenic test from Green-Wood showing 150 parts per billion

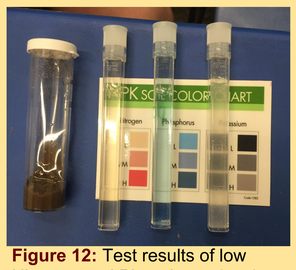


Figure 12: Test results of low Nitrogen and Phosphorus levels, and a medium Potassium level

Discussion

Data Analysis:

In our testing of the soil samples from both sites, all 80 lead tests were negative. The team decided to exclude this portion of the study from the results since it is unknown whether the negative tests were a result of an absence of lead in the soil or a systematic error in the testing method.

Data displaying the nitrogen levels in the soil at both sites was also excluded from the results section since each of the 40 tests indicated low levels of nitrogen, proving that nitrogen levels in the soil did not differ between the two sites.

The arsenic test results show that there is no correlation between burial year and arsenic abundance in the soil. The data also shows no clear correlation between burial site elevation and arsenic abundance in the soil. The average arsenic abundance from the 10 samples taken from the background site, Prospect Park, was approximately 3 parts per billion. The average arsenic abundance for the 30 samples taken in Green-Wood Cemetery was approximately 5 parts per billion. While our tests did show slightly higher arsenic levels at Green-Wood Cemetery, this difference is not significant enough to definitively conclude that burial sites are a source of soil contamination.

The results for the organic matter (potassium, phosphorus) in the soil also showed no significant difference between Green-Wood and Prospect Park. It can be concluded that cemeteries do not affect organic matter levels in soil.

Future Directions:

For continuations of the study, a larger sample size could be taken at both sites. The study could also be expanded by testing for these contaminants in the ponds at Green-Wood. Further analysis could also be done by testing for a wider range of heavy metals such as nickel, zinc, copper, mercury, and iron.

Acknowledgements

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References

[1] Spongberg, A. L., & Becks, P. M. (2000, January). Inorganic Soil Contamination from Cemetery Leachate.
[2] "A Brief History of Caskets." Northwoods Casket Company, 4 Mar. 2011.