The Research Plan:

A. **RATIONALE:** In recent years, the role of urban trees in improving air quality has received increasing attention, as trees have relatively higher capacity of metal accumulation compared with other types of vegetation. In this project, I investigated which tree species could potentially help absorb lead contaminants from the soil and reduce the lead levels. The trees presented two benefits in this project: Not only do certain species help to reduce lead in soils by up taking lead, they also provide environmental, social and economic benefits. Planting a new tree in the contaminated soil on a residential property is significantly less expensive than either cementing or trying to cover up the contaminated soil.

B. **Research Question:** Are Street Trees Helping Keep Streets Clean?

C. Procedures:

Scouting and Mapping out Sampling Locations:

To determine which houses to take soil and tree samples from I will use the soil lead data that was collected at Hofstra University last summer and put it into a spreadsheet. The data will be separated into three different categories: high lead levels (400ppm-400+ppm), medium lead levels (200ppm-400ppm), and low lead levels (30ppm- 200ppm). To determine the most ideal locations for sampling I will use Google Earth Satellite for virtual scouting. Based on the scouting, I will record whether the property has street trees or yard trees in the spreadsheet. Street trees will be chosen over residential trees for logistical reasons (little to no coordination

will be required with the homeowners) and for consistency among locations. There will be 15 houses selected (5 from each category) from which to sample.

The residential properties that were selected to revisit will be based on the lead levels found in the soils from last year at Hofstra University, the distance from Hofstra University, and the accesibility, meaning that permission won't be required from homeowners. Google Earth imaging will be used to determine if there was a tree on the property and then I will record in the data sheet if it is a street tree, property tree, a sapling or an old tree.

Once I determined which residential properties to visit, a route for the most efficient use of time will be mapped out. The starting location is at the furthest property and I will continually work back toward Hofstra University. The data sheet is used to easily record the information. On the spread sheet the address, GPS coordinates, tree type (as in street tree or property tree), tree DBH (diameter breast at height), tree species, XRF ID number, lead found in the tree and lead found in the soil will be recorded.

To further expand the study, an additional 15 samples will be collected on Hofstra Universities campus. The same method was used, but instead of recording the street address, the trees were labeled as tree #1, #2 etc.

To determine the GPS coordinates, the compass app on the iPhone will be used. Then It will be determined if the tree was a street tree or a property tree. Then the DBH of the tree will be measured. To measure the DBH, a measuring tape is wrapped around the tree, and then the DBH is recorded in cm. Measuring the DBH of the tree will aid in the identification of the tree species. To assist with identification, photographs will be taken of the leaves, the bark, and the full tree,

then a tree identification book will be used to determine the tree species. Each of the trees from which we collect will be identified with the help of my mentor.

XRF Process:

To find the lead levels in the trees and soil a tool called the XRF is going to be used. The XRF is a portable device used to measure the elemental composition of a sample. It does this by measuring the fluorescent (or secondary) X-ray emitted from a sample when it is excited by a primary X-ray source. Since the XRF emits X-rays, I cannot use the portable device due to safety reasons.

My mentor will direct the XRF beam at the soil or the tree, and then the concentration of lead in ppm (parts per million) in the sample will be recorded. The XRF is usually used in soil or leaves. There are very limited studies using the XRF on trees. Due to the limited research, it was concluded that the X-ray beams only went approximately through the bark and no further, meaning they did not reach the core of the tree. In the future, the power of the XRF should be further researched. For this project, it was assumed that the beams reached no further than the outer bark of the trees.

Data Analysis:

To analyze the data, I will use a one sample t-test and excel. Since the sample size is going to be so small and limited. With the one sample t-test I set a test value of zero, I choose zero as the test value because the number of trees that contained lead are assumed to be very limited. I will do two separate tests; one will test the significance of the tree species that contained lead and the second one will test the significance of the lead levels found in the trees. I will use excel to visualize the results shown in the one sample t-tests.

Detail all procedures and experimental design including methods for data collection. Describe only your project. Do not include work done by mentor or others. • Risk and Safety: Identify any potential risks and safety precautions needed. • Data Analysis: Describe the procedures you will use to analyze the data/results.

D. BIBLIOGRAPHY:

Block, Colleen N, et al. “Use of Handheld X-Ray Fluorescence Spectrometry Units for Identification of Arsenic in Treated Wood.” Environmental Pollution (Barking, Essex : 1987), U.S. National Library of Medicine, July 2007, www.ncbi.nlm.nih.gov/pmc/articles/PMC2556294/.

Gulson. “Environmental Health and Medicine Education.” Centers for Disease Control and Prevention, Centers for Disease Control and Prevention, 2000, www.atsdr.cdc.gov/csem/csem.asp?csem=34&po=10.

Lindeberg, and Johan. “X-Ray Based Tree Ring Analyses.” X-Ray Based Tree Ring Analyses, 1 Feb. 2004, pub.epsilon.slu.se/462/.

Liu, Yan-Ju, et al. “Lead and Cadmium in Leaves of Deciduous Trees in Beijing, China: Development of a Metal Accumulation Index (MAI).” Environmental Pollution, Elsevier, 21 June 2006, www.sciencedirect.com/science/article/pii/S0269749106003332?via%3Dihub.

Martin, Ronald R, et al. “Arsenic Uptake in Orchard Trees: Implications for Dendroanalysis.”

Chemosphere, Pergamon, 20 Apr. 2000,
www.sciencedirect.com/science/article/pii/S0045653599005019?via%3Dihub.

McGladdery, Candice, et al. “Elemental Assessment of Vegetation via Portable X-Ray Fluorescence (PXRF) Spectrometry.” Journal of Environmental Management, Academic Press, 1 Feb. 2018,
www.sciencedirect.com/science/article/pii/S0301479718300033?via%3Dihub.

Sapkota, Yadav, et al. “Portable X-Ray Fluorescence Spectroscopy for Rapid and Cost-Effective Determination of Elemental Composition of Ground Forage.” Frontiers in Plant Science, Frontiers Media S.A., 19 Mar. 2019, www.ncbi.nlm.nih.gov/pmc/articles/PMC6433940/.

Turner, Andrew, et al. “Application of Field-Portable-XRF for the Determination of Trace Elements in Deciduous Leaves from a Mine-Impacted Region.” Chemosphere, Pergamon, 21 June 2018,
www.sciencedirect.com/science/article/pii/S0045653518311858?via%3Dihub.

Watmough, Shaun A, and Thomas C Hutchinson. “Historical Changes in Lead Concentrations in Tree-Rings of Sycamore, Oak and Scots Pine in North-West England.” Science of The Total Environment, Elsevier, 13 Jan. 2002,
www.sciencedirect.com/science/article/pii/S0048969701011494?via%3Dihub.

Post Research Summary:

No changes were made.