ABSTRACT

“RUNAWAY FUEL”

A study conducted using GLOBE soil testing procedures to analyze soil and runoff water samples at gas stations.

Cameron R. Dickard - 6th grade
Alpena Middle School, Alpena, AR, USA

The purpose of this project was to use GLOBE protocols to analyze the soil and runoff rain water at gas stations for pH levels, Phosphorus, Nitrogen, and Potash. It was predicted that the runoff from gas and oil would have varying affects on the levels of pH, Phosphorus (P), Nitrogen (N), and Potash levels in the soil and rain water around the gas stations compared to the control samples.

Three soil samples and three rain water samples were collected from three different gas stations for analysis. A control sample was collected from an area where gas station runoff wasn’t present. Following GLOBE soil testing procedures, chemical tests for P, N, and K were tested along with pH and oil. 110g of each soil was mixed together with 110ml of distilled water and let set overnight, then chemical analysis was conducted. The rain water runoff was also analyzed.

All soil samples showed traces of oil along with rainwater from gas station-B. Nitrogen tests were all negative. Phosphorus tests were negative for soil. Phosphorus for rainwater: station A=2ppm, station B=1.33ppm, & station C=2.67ppm. Potash for soil: station A=0.33ppm, station B=1ppm & station C=0ppm. Potash for runoff rainwater: station A=3ppm, station B=2ppm & station C=2ppm. pH results for soil: station A=7ppm, station B=7.17ppm, and station C=7.17ppm. Runoff rainwater results for pH: station A=3ppm, station B=6.83ppm, and station C=6.5ppm.

The soil and water samples from the gas stations had low levels of Phosphorus (P), Nitrogen (N), and Potash (K). The researcher thought the runoff rainwater would show stronger results for oil. It’s hypothesized that runoff rainwater possibly depleted the nutrients in the soil.

RUNAWAY FUEL

Cameron Dickard - 5th grade
Alpena Elementary/Middle School
Alpena, AR
Teacher: Roger G. Rose
May 3, 2019

TABLE of CONTENTS

RESARCH QUESTION AND HYPOTHESIS:

Background Information:

In rural Ozark communities, it is not uncommon for people to use gas, oil, and windshield washer fluid from a gas station. Have you ever seen the stains on the pavement around gas pumps? When it is raining spilled gas, oil, and windshield washer fluid mixes with the rainwater and could runoff in to the soil. The researcher read many articles on the internet about the effects gas stations have on soil and water in and around the three gas stations chosen by the researcher. The researcher is reading many articles about gas station runoffs to see what the gas, oil, and windshield washer fluid will do to the soil. The researcher also accessed the GLOBE website in order to check the GLOBE protocols for testing soil and water.

Research Question:

The purpose of this project was to use GLOBE protocols to analyze the soil and water, searching for contamination around multiple gas stations according to the pH levels, Phosphorus (P), Nitrogen (N), and Potash (K) levels. The research question being addressed in this project is, **“When it rains can oil, windshield washer fluid, and gas runoff contaminate the soil according to pH, Phosphorus (P), Nitrogen (N) and Potash levels?”**

Hypothesis and Engineering Goal:

It was predicted that the runoff from gas and oil would have varying affects on the levels of pH, Phosphorus (P), Nitrogen (N), and Potash levels in the soil and rain water around the gas stations compared to the control samples.

DETAILED METHODS & PROCEDURES:

First, the researcher located three different gas stations where it appears that runoff rain water has been getting into the surrounding soil. The researcher got permission from each gas station representative to analyze the soil around the gas station as well as rain water runoff. Three samples of rain water and soil were collected from each of the three gas stations. The middle school science teacher trained the researcher's parent in the proper use of the home-use soil test kit. The samples were taken to the researcher's home and they were analyzed for pH, Phosphorus, Nitrogen, and Potash levels. An approved home-use chemical soil test kit was used to measure this. In order to test the soil with the chemical test kit, 110 grams of each soil was measured on a digital balance scale and placed in plastic containers. 110 ml of distilled water was added to each container of soil. The soil was thoroughly mixed with the water and it was left to set overnight. The next day, a plastic pipette was used to collect water from each soil sample. Then, according to the instructions on the chemical soil test kit, each was tested for Phosphorus, Nitrogen and Potash levels. Each soil sample was also tested for the presence of oil using oil test strips in the water from the soil/water mixture. The rain water samples were tested using the same chemical test kit since the researcher was trying to analyze contaminated that could enter the soil through the rain water runoff. The researcher used the pipette to collect rain water from each sample to the test containers. The same instructions were followed to test for Phosphorus, Nitrogen, and Potash of the rain water samples. Each sample was also tested for the presence of oil using oil test strips in the rain water. The researcher was instructed in the proper procedures for using the chemical tests for soil and water. All of the testing was conducted at the researcher's home under the supervision of a designated supervisor who had been trained on how to use the test kits and the appropriate safety procedures to be used.

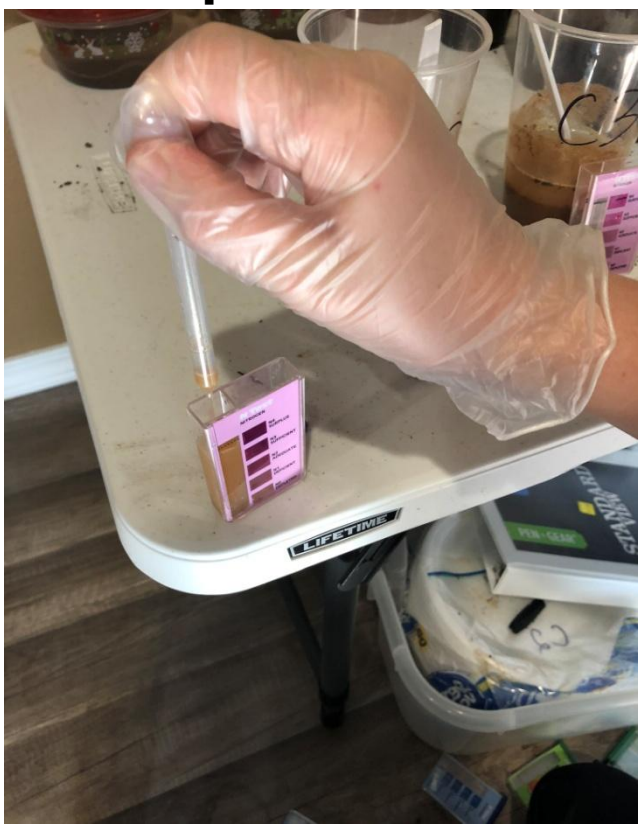
Risk and Safety Factors addressed: All directions and safety precautions as listed in the Home-use soil test kit instruction manuals were followed. Protective lab gear, such as, lab coat, safety glasses, and gloves was used according to the test kit manual recommendations. The testing was done in a well ventilated area at home or in the school science lab. All testing was directly supervisor by the designated supervisor who had been trained in lab safety procedures for testing soil and water samples by the middle school science teacher. The student was also trained in lab procedures for testing soil and water samples. After chemical testing was completed, unused reagents were stored according to the manufacturer's recommendations as described in the testing manual in the middle school science lab. Used chemical reagent solutions were disposed of according to the schools hazardous chemical disposal plan by the designated supervisor. The researcher reviewed the following documents before conducting the testing: Instruction manual and the MSDS from the Home-use soil lab test kit, the Arkansas Department of Education - Lab Safety Guide for Arkansas School K-12, and the GLOBE Soil Testing Protocols.

Collecting Water & Soil Samples

Collecting Samples and Testing

Testing Soil & Water Samples

Testing Soil & Water Samples



MATERIALS:

Chemical Soil Test Kit	Distilled Water
Plastic Cups	Plastic Pipettes
Plastic Bags	Garden Spade
Oil Test Strips	Rubber Gloves

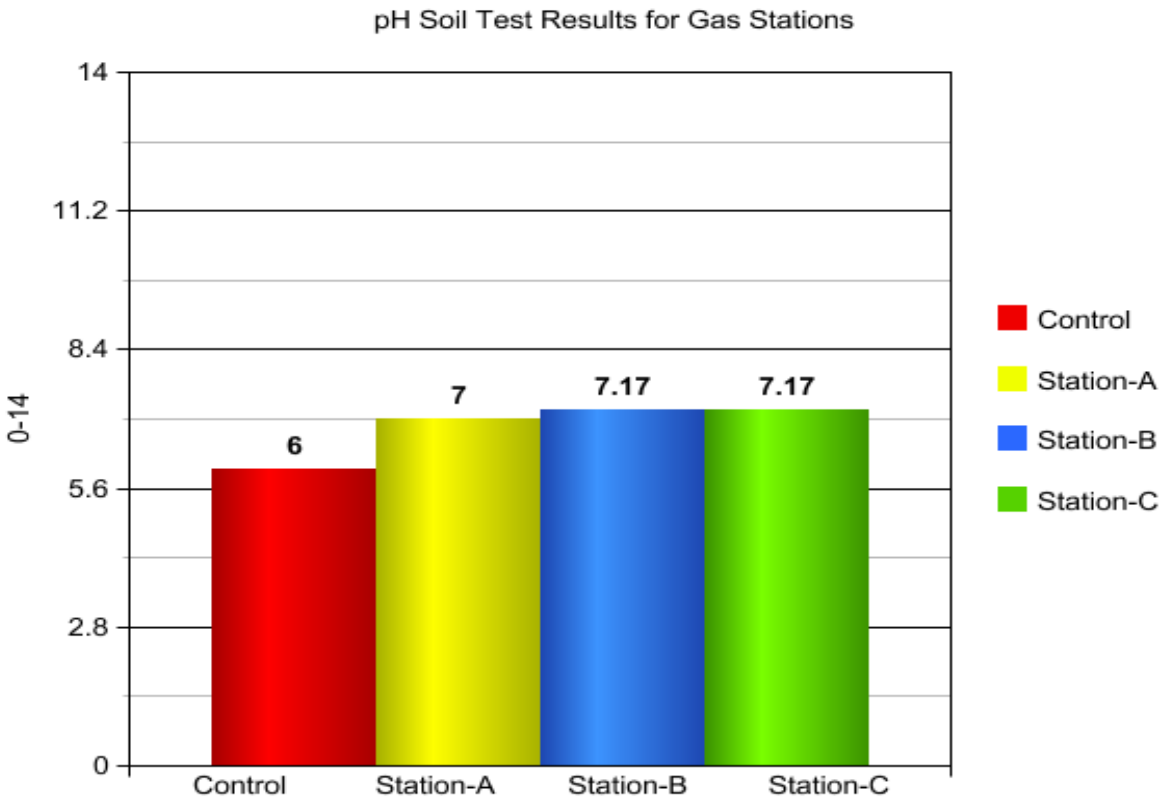
DATA SUMMARY:

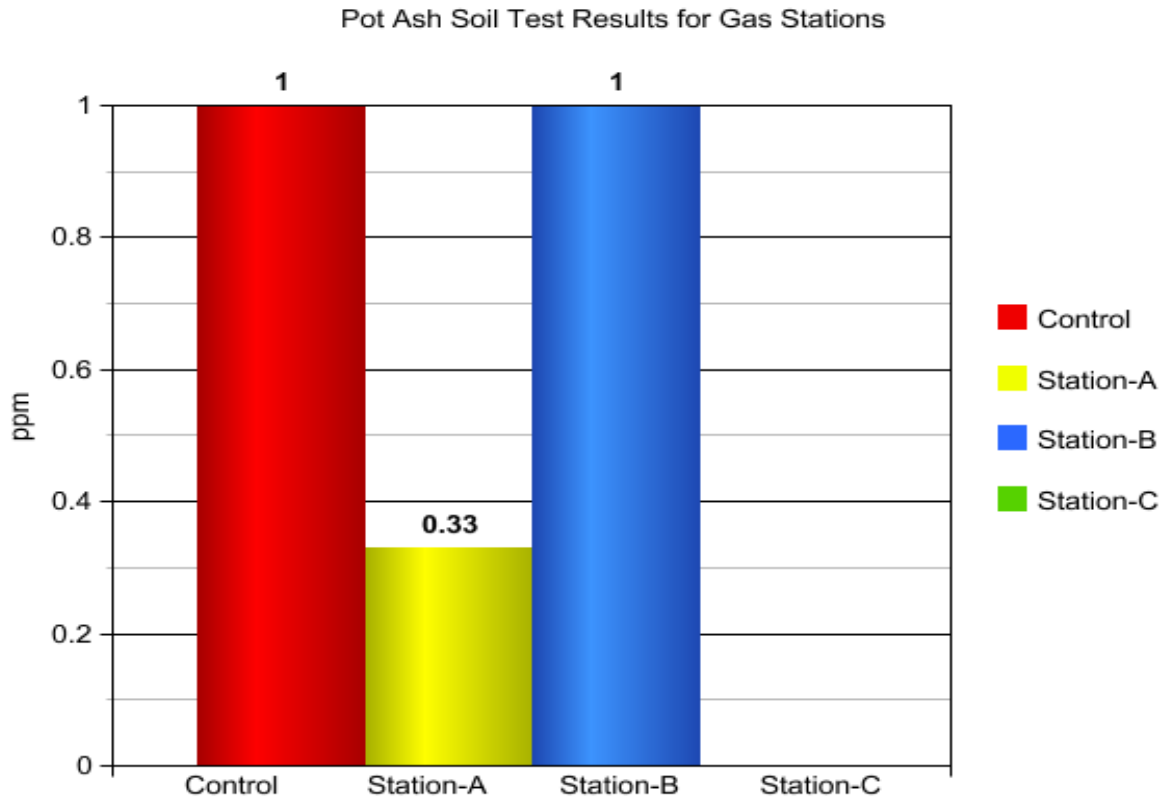
Chemical Soil Test Results: All samples of soil showed small traces of oil. Rain water from gas station B was the only rain sample that showed small traces of oil. All samples for Nitrogen tested negative. The results for Phosphorus were negative for soil. Phosphorus for rain water samples were gas station A= 2 ppm, gas station B= 1.33 ppm, and gas station C= 2.67 ppm. The results for Potash for soil for gas station A= 0.33 ppm, gas station B= 1ppm and gas station C= 0ppm. The results for Potash for rain water for gas station A= 3ppm, gas station B= 2ppm and gas station C= 2ppm. Results for pH for the soil at gas station A= 7ppm, gas station B= 7.17 ppm, and gas station C= 7.17 ppm. Rain water results for pH for gas station A= 3 ppm, gas station B= 6.83 ppm, and gas station C= 6.5 ppm.

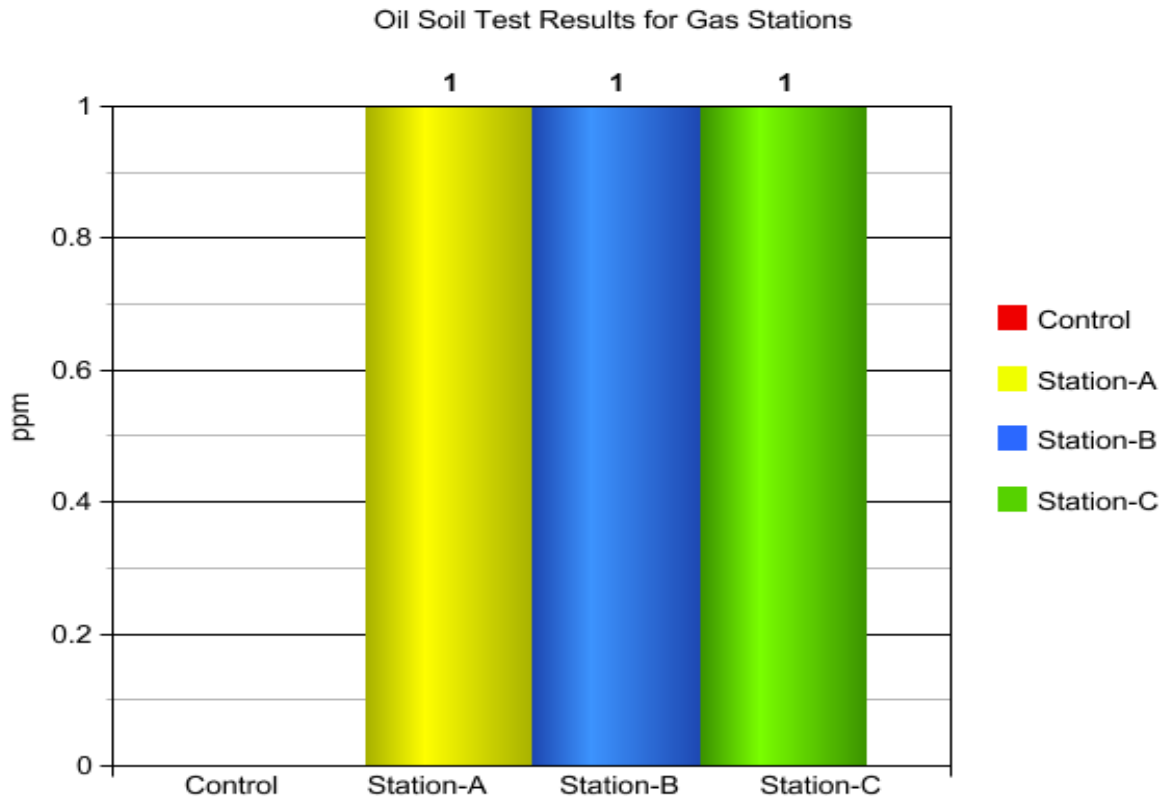
RESULTS:

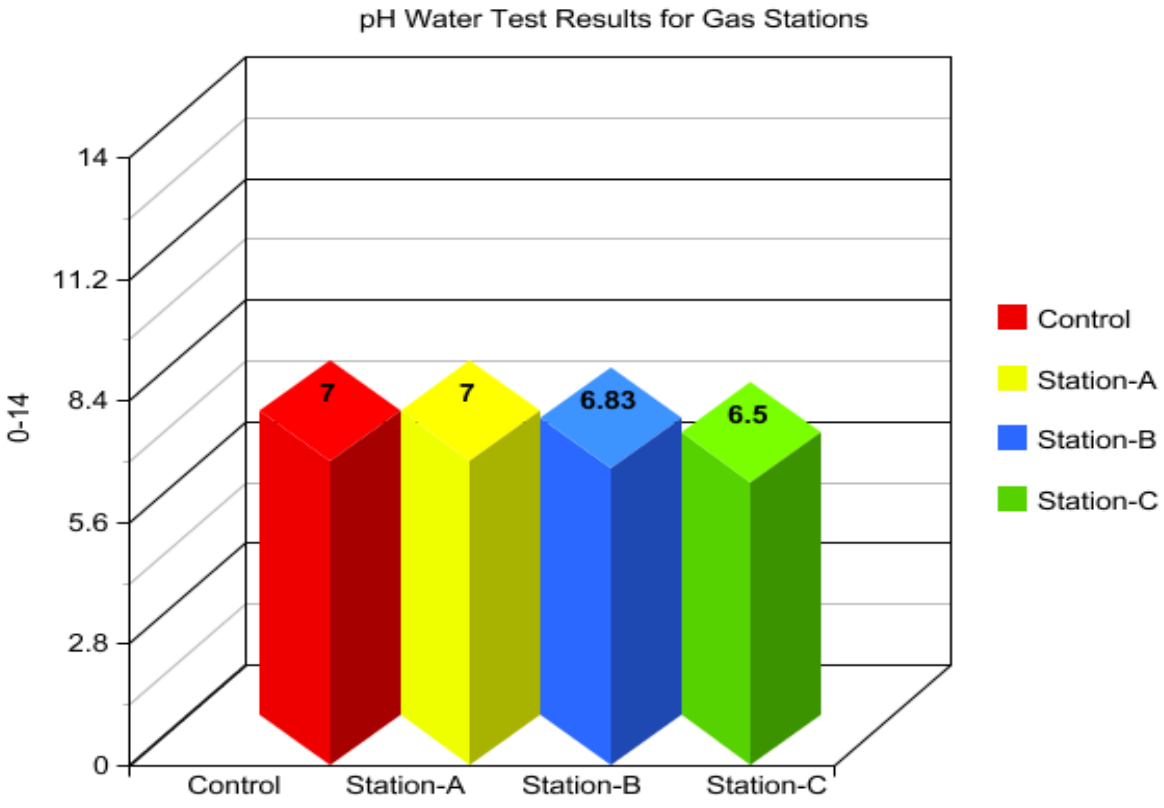
Soil Test Results for Water Runoff at Gas Stations																			
	pH				Nitrogen				Phosphorus				Pot Ash				Oil			
	Gas Station				Gas Station				Gas Station				Gas Station				Gas Station			
Sample	CON	A	B	C	CON	A	B	C	CON	A	B	C	CON	A	B	C	CON	A	B	C
1	6.0	7.5	7.5	7.0	0	0	0	0	2	0	0	0	1	0	1	0	0	1	1	1
2	NA	6.5	7.0	7.0	NA	0	0	0	NA	0	0	0	NA	1	1	0	NA	1	1	1
3	NA	7.0	7.0	7.5	NA	0	0	0	NA	0	0	0	NA	0	1	0	NA	1	1	1
TOTAL	6.0	21.0	21.5	21.5	0	0	0	0	2	0	0	0	1	1	3	0	0	3	3	3
MEAN	6.0	7.0	7.17	7.17	0	0	0	0	2	0	0	0	1	0.33	1	0	0	1	1	1

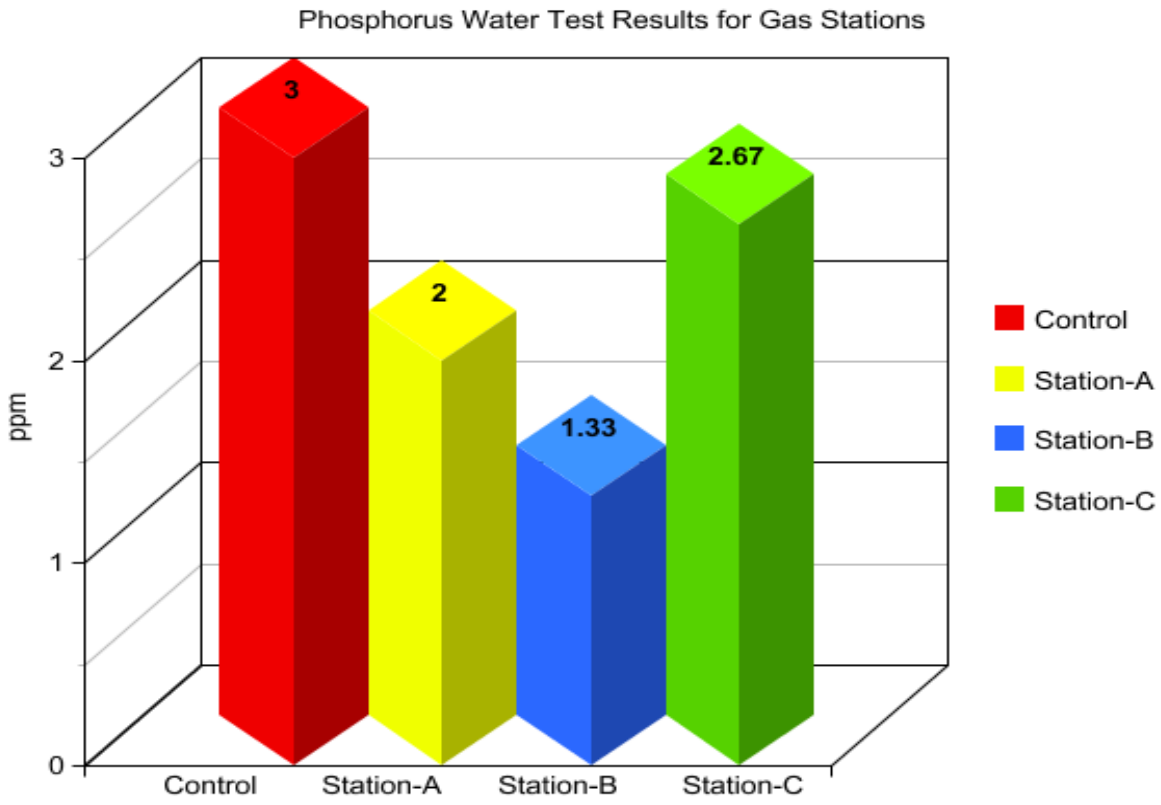
Water Test Results for Water Runoff at Gas Stations																				
	pH				Nitrogen				Phosphorus				Pot Ash				Oil			
	Gas Station				Gas Station				Gas Station				Gas Station				Gas Station			
Sample	CON	A	B	C	CON	A	B	C	CON	A	B	C	CON	A	B	C	CON	A	B	C
1	7.0	7.0	7.0	6.5	0	0	0	0	3	2	1	3	2	3	2	2	0	0	1	0
2	NA	7.0	7.0	6.5	NA	0	0	0	NA	3	1	3	NA	3	2	2	NA	0	1	0
3	NA	7.0	6.5	6.5	NA	0	0	0	NA	1	2	2	NA	3	2	2	NA	0	1	0
TOTAL	7.0	21.0	20.5	20.5	0	0	0	0	3	6	4	8	2	9	6	6	0	0	3	0
MEAN	7.0	7.0	6.83	6.5	0	0	0	0	3	2	1.33	2.67	2	3	2	2	0	0	1	0

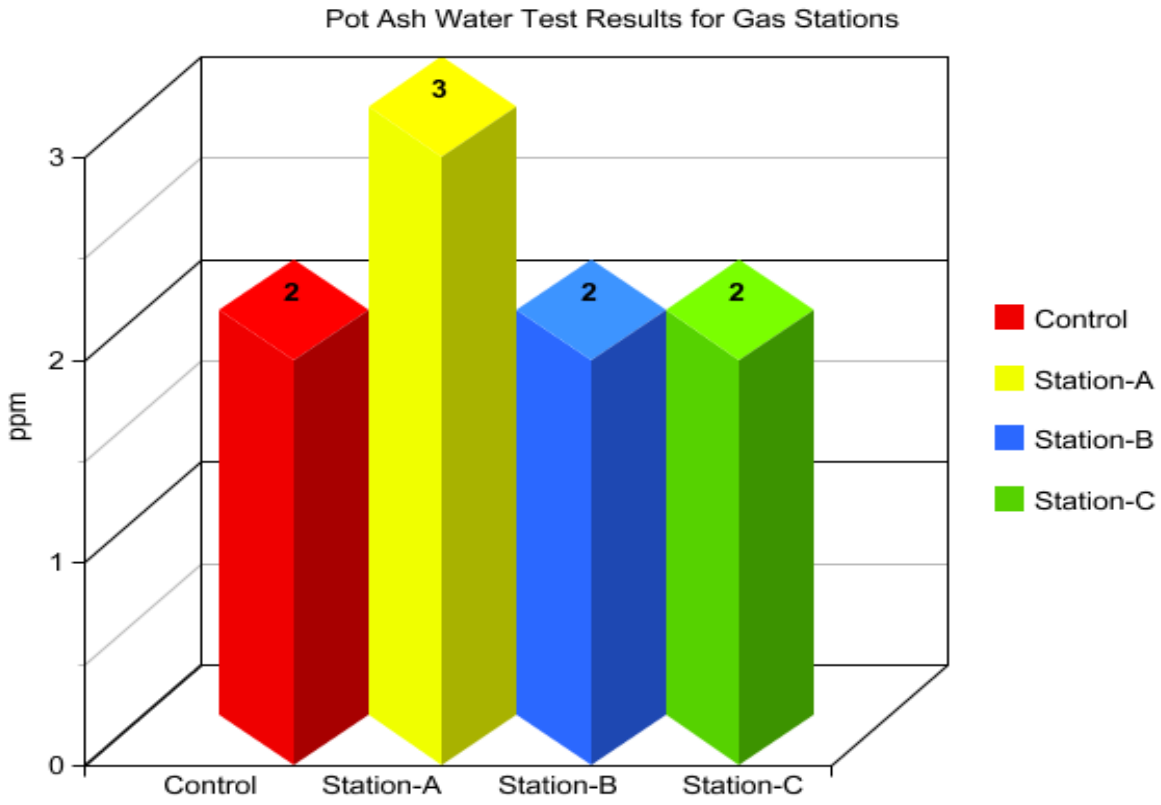

pH Soil Test Results for Gas Stations
14
11.2
8.4
5.6
2.8
0
0-14
6
7
7.17
7.17
Control
Station-A
Station-B
Station-C
Control
Station-A
Station-B
Station-C


Pot Ash Soil Test Results for Gas Stations
1
0.8
0.6
0.4
0.2
0
ppm
1
0.33
1
Control
Station-A
Station-B
Station-C
Control
Station-A
Station-B
Station-C


Oil Soil Test Results for Gas Stations
1
1
1
1
0.8
0.6
0.4
0.2
0
ppm
Control
Station-A
Station-B
Station-C
Control
Station-A
Station-B
Station-C


pH Water Test Results for Gas Stations
14
11.2
8.4
5.6
2.8
0
0-14
7
7
6.83
6.5
Control
Station-A
Station-B
Station-C
Control
Station-A
Station-B
Station-C


Phosphorus Water Test Results for Gas Stations
ppm
3
2
1
0
3
2
1.33
2.67
Control
Station-A
Station-B
Station-C
Control
Station-A
Station-B
Station-C


Pot Ash Water Test Results for Gas Stations
ppm
3
2
1
0
2
3
2
2
Control
Station-A
Station-B
Station-C
Control
Station-A
Station-B
Station-C

CONCLUSION:

The data supported the hypothesis. The soil and water samples from the gas stations had low levels of Phosphorus (P), Nitrogen (N), and Potash (K). This supports that the runoff depleted the nutrients in the soil. The rain water runoff didn't show the data that the researcher thought it would have probably because the chemicals that are in the rain water were not the chemicals that were tested for.

DISCUSSION:

It appeared that the gas and oil depleted the nutrients of the soil, which would make the soil contaminated. In the future the researcher would like to test for different chemicals to see what contaminates would appear during testing. Then build a water filtration system that may help the gas stations with contamination.

ACKNOWLEDGEMENT:

The researcher was assisted in his project by his parent who took him around to collect the water and soil samples and monitored him as he conducted the chemical testing of the samples. The researcher's teacher, Mr. Rose, instructed the student in the proper use of the soil and water test kits that were used for testing the samples. Mr. Rose also taught the researcher how to use the computer program to create the graphs for the project.

REFERENCES/BIBLIOGRAPHY:

Amadi, Amadi, Samuel D. Abbey, and Anthony Nma. "Chronic effects of oil spill on soil properties and microflora of a rainforest ecosystem in Nigeria." *Water, Air, and Soil Pollution* 86.1-4 (1996): 1-11.

Gaylard, Adrian P., Kerry Kirwan, and Duncan A. Lockerby. "Surface contamination of cars: a review." *Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering* 231.9 (2017): 1160-1176.

Benson, Alvin K., Kelly L. Payne, and Melissa A. Stubben. "Mapping groundwater contamination using dc resistivity and VLF geophysical methods–A case study." *Geophysics* 62.1 (1997): 80-86.

Leuvering, Jan HW, et al. "Sol particle immunoassay (SPIA)." *Journal of immunoassay* 1.1 (1980): 77-91.

Moseley, Clifford L., and Michael R. Meyer. "Petroleum contamination of an elementary school: a case history involving air, soil-gas, and groundwater monitoring." *Environmental science & technology* 26.1 (1992): 185-192.

Penman, H. L. "Gas and vapour movements in the soil: I. The diffusion of vapours through porous solids." *The Journal of Agricultural Science* 30.3 (1940): 437-462.

Tarte, Andre. "Method and apparatus for testing soil contamination." U.S. Patent No. 5,786,527. 28 Jul. 1998.