# *The Rise of Phosphorus Levels in Flatlands with Decreasing Water Flow*


***Research Report By:***

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# ***Abstract:***

Phosphorous is an important element to plant life which aids in its forming of cell membrane. With increasing phosphorous levels, plant life should increase as well, however that did not happen. The moisture levels in the soil have steadily decreased which should cause the phosphorous to decrease too, but instead the phosphorus levels increased. Thus, we decided to investigate the problem. We began our research by plotting a 10m by 10m area in a flat grassy area adjacent to the stream. We took nine samples from Site 4 (E.S.S.R.E) in four consecutive days. We tested the moisture levels by weighing the soil and then we dried it and weighed it again. In doing so, we tested the soil's phosphorous level. We checked the levels in correspondence to the moisture in the soil. Our hypothesis was incorrect but we concluded that dryer soil would indeed not trap phosphorus.

# *Introduction:*

Phosphorus is a critical nutrient used by all organisms to grow and maintain themselves. In its organic form, phosphate contributes to the transformation of solar energy into chemical energy; enables plants to mature properly and provides animals through the food chain with the energy they need to survive. Hence, without phosphorus, there can be no life (Huelsman, 2010).

Unlike the other biogeochemical cycles involving other critical nutrients such as nitrogen and carbon, phosphorus does not appear as a gas in the atmosphere. Instead, in the form of orthophosphate, it is weathered from rocks by rain and surface runoff until it is deposited as sedimentation in the soil. It is also released into soil through the decomposition of plants and animals where it can be reabsorbed by crops and other plants. It can also be released into the environment through animal feces (Huelsman, 2010).

Because of its critical role in plant life, one would expect that where large amounts of phosphorus are present, the plant life would be abundant. However, longitudinal data from E.S.S.R.E Site 4 (N 39.35733; W 076.63840) has shown that the quantity and diversity of plant life in Site 4 has been steadily declining rather than remaining stable or increasing (E.S.S.R.E 2001-2011); while the phosphorus levels in the soil at this location have in fact been steadily increasing. Furthermore, when performing the E.S.S.R.E 2011 Soil Biota Survey, this year's interns observed that both of these trends continued (E.S.S.R.E 2001-2011). Even more mysterious, Site 4 has historically contained large amounts of water flowing through it which should make conditions good for over all plant health.

Yet unpublished research done in E.S.S.R.E 2009 demonstrated that the water content in the soil in Site 4 has steadily been decreasing. We suspect that change in the structure of the dam in Site 4 (See Figure 1) along with increased phosphorus runoff from E.S.S.R.E Site 3 (N 39.35797; W 076.63836) is causing the following: instead of the water flowing at a steady rate that carries the phosphorus runoff through Site 4, it is no longer doing so, and the decrease in water content in the soil is causing the phosphorus to conjugate in Site 4.

**Figure 1**

# Methods:

A 10m by 10m square area was measured near the dam in E.S.S.R.E Site 4(N 39.35733:W076.63840). The western edge of the area square was maintained 5.6 meters from the dam while the stream in Site 4 served as the northern border. The $100m^2$ area was then subdivided into 3.33m by 3.33m squares plots. On July 21, 22, 25 and 26, 2011, 9 soil samples 15 cm deep by 2.5 cm in diameter were taken each day using a metal auger, one from each of the nine plots. Each of the samples was tested for phosphorus (ppm) using model STH-14 of the Lamotte chemical testing kits. The remainder of each soil sample was massed in grams and then baked for 24 hours in a 107.22 $^oC$ oven. All samples were then remassed to determine their final mass. The original percentage of water in each original sample that was then determined. Over the course of the experiment a total of 36 soil samples were taken and tested.

# Results:

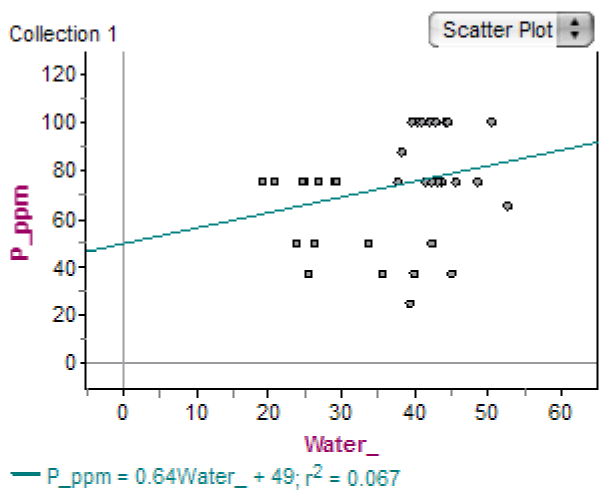


Figure 1

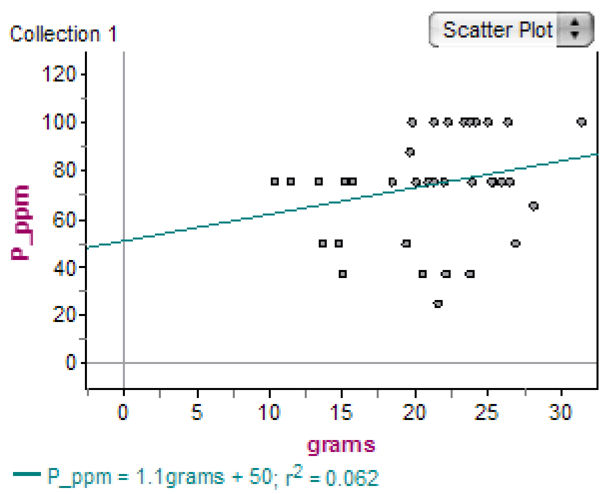


Figure 2

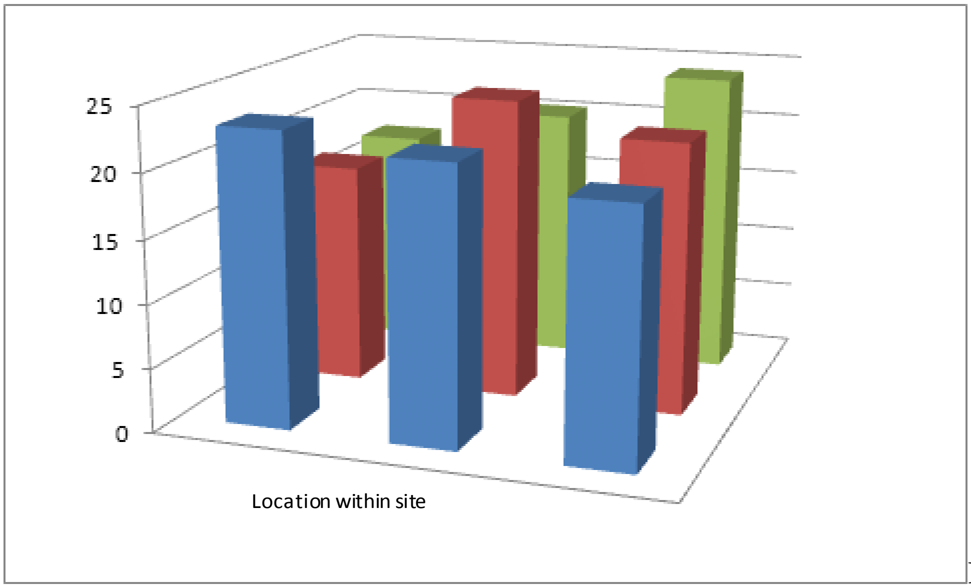

Figure 3

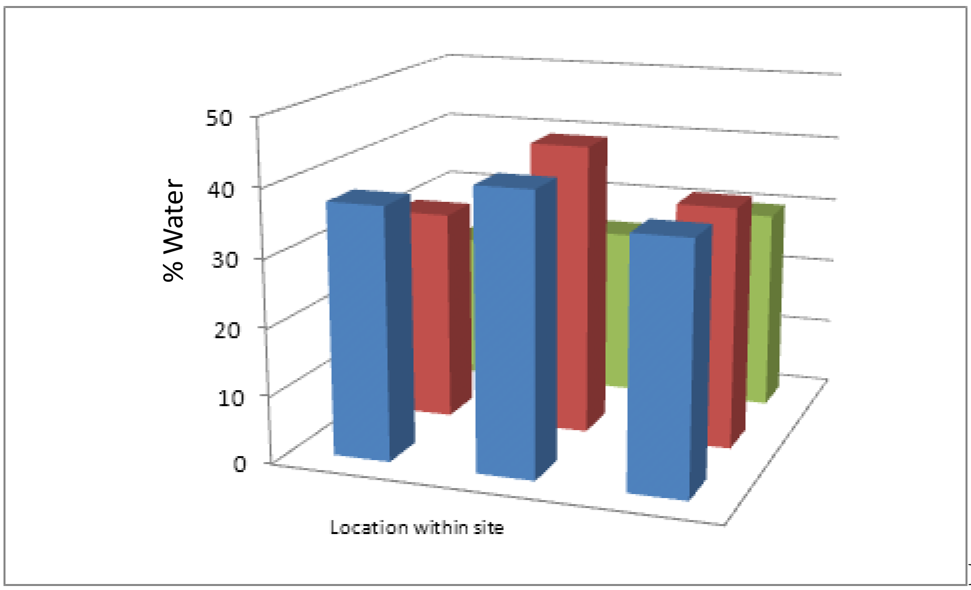

Figure 4

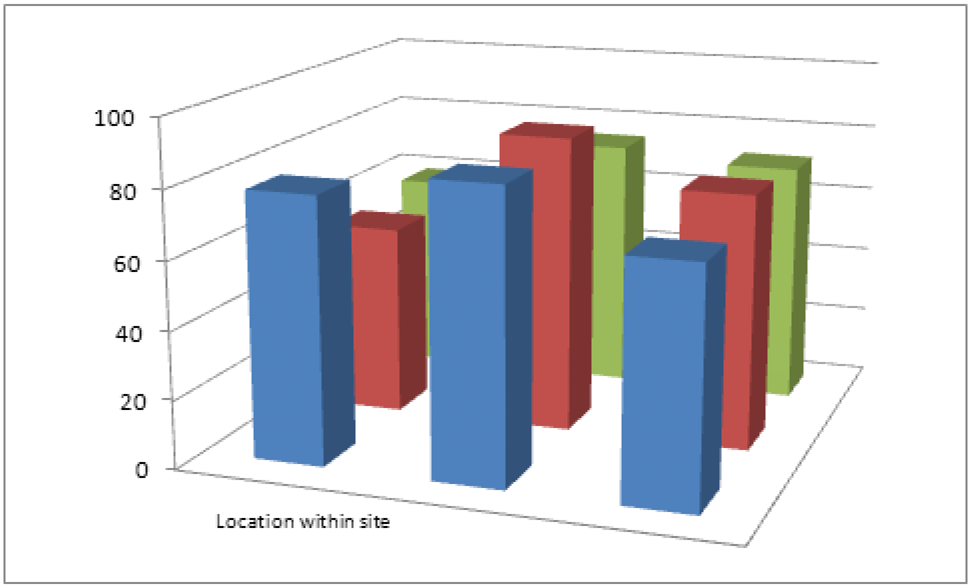

Figure 5

# *Discussion:*

As Figures 1 and 2 show, the hypothesized correlation between lower densities of water in the soil in site 4 as the source of the increasing phosphorus levels there is incorrect. As water levels increased, phosphorus levels also increased. However, when examining the distribution of the sampling, we noticed another possible explanation for the data we collected. As shown in Figure 3, the soil nearest the stream had the largest mass of water. This shows that water flow through the site is highest near the stream. Meanwhile, Figure 4 shows that the portion of soil near the stream that retains water is decreasing, confirming that the condition on which we based our hypothesis, hence together Figures 3 and 4 show that while Site 4 may be drying up, the rate of water flow through it is actually increasing. Furthermore, figure 5 shows that along the stream, phosphorus levels in the soil are dropping. Therefore, we suspect leeching is causing this drop. As the stream moves through the soil, it takes the phosphorus with it. We can then hypothesize that it is a change in water flow, not a change in water density, which is altering phosphorus levels in Site 4.

However, while this may explain the differences in phosphorus levels in the different areas of the site we tested, it does not explain what has been causing the phosphorus levels to increase steadily for the past decade (the original anomaly on which we based our research). One possibility that our research showed that might explain this anomaly can be seen in Figure 5. The middle plots of our research area, which have the lowest densities of plant life, have the highest levels of phosphorus. Therefore, perhaps it is changes in plant life in Site 4 that lie at the root of the phosphorus anomaly. In further research, we would begin to investigate this hypothesis by comparing phosphorus levels and plant diversity in Site 4. Based on this year's data, we would predict that areas with less plant diversity would have higher levels of soil phosphate.

# *Bibliography:*


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# *Acknowledgements:*


Thank you to Human Capital Development, Inc. , Larry and Kathy Jennings, and DR. Holliday Cross Heine for funding our research and projects. Thanks to Mr. Brock and the TAs for answering our questions and helping us in our studies.