Stocking Lake Watershed – Soil Phosphorus Study

Preliminary Findings

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INTRODUCTION

This project sampled soils along topographic gradients to determine potential movement of phosphorus from source areas to off-site locations (e.g. lakes, rivers and streams). Phosphorus movement occurs as either sediment-derived P that is attached to soil particles and moves via soil erosion or soluble forms of P that can move as water moves through the soils and landscapes. Our sampling techniques should be able to capture both forms of P movement in landscapes of Stocking Lake Watershed.

METHODS

We prioritized the four highest source-areas of P based on P modeling results (Lewandowski, 2010). Those areas are potato fields, row-crop agriculture with manure applications, shoreland areas with septic systems and commercial timber lands.

Within these areas, we sampled along the pathways of P movement. The first sampling was by depth until we encountered soil layer(s) that is seasonally saturated and thus a pathway for P movement off-site. Additionally, we sampled different landscape positions from the tops of the hills to local lows. This allows us to trace P movement from erosion and sedimentation within the different land-use types. Soil morphological properties were described at each location and for each depth in order to further characterize the results.

Samples from each landscape position and horizon were analyzed for Bray P (low pH conditions) and soil pH. Basic statistics were determined to investigate influences of land-use, landscape position, depth in the soil and soil texture on P levels.

RESULTS & DISCUSSION – *Preliminary*

Values of Bray P varied widely within most of the landscapes sampled. The septic system landscape had the highest range of values followed by the row crop agriculture with manure application landscape and then the potato field landscape (Figure 1). All of the average values are in well into the very high soil test phosphorus range for the existing land-use based on University of Minnesota recommendations. This indicates that all land-uses have the potential to be acting as P sources within the watershed if soil erosion occurs or soluble phosphorus is moving in soil-water to a water table that discharges into a lake, river or stream.

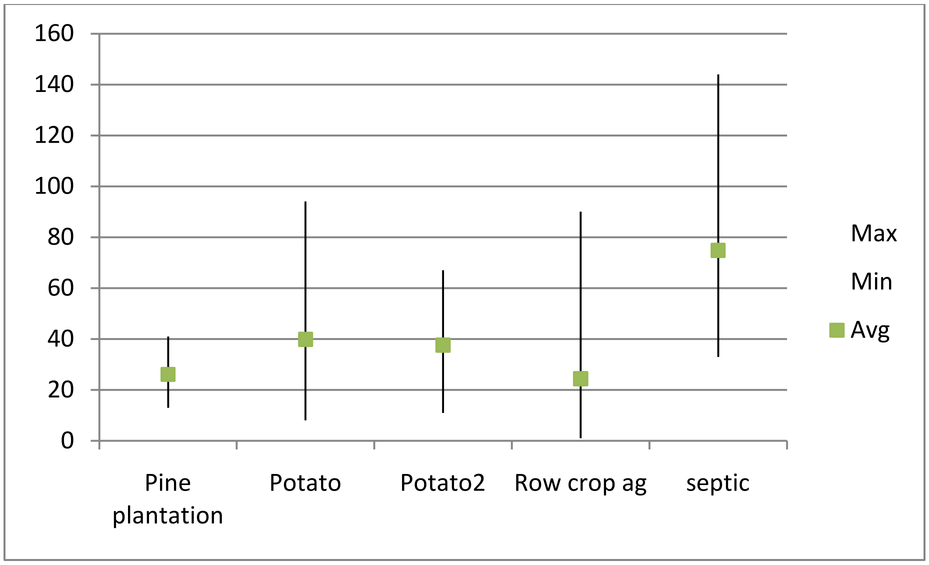

Figure 1. Comparison of maximum, minimum and average Bray P (ppm) values for the five landscapes sampled.

The highest average value for Bray P among all the landscapes tested was the septic system landscape (Figure 1). Maximum and minimum values of soil test P in this landscape are also the highest. In fact the only three soil P values over 100 ppm (144, 142 and 122) were sampled on this site. These values are unusually high no matter what the intended use of the land.

So is the septic system the cause of these very high values? Not likely. The in-ground trench system at this location is installed at least 18-24" below the surface and the effluent from this system to the water table is downward due to the sandy soils below. Very high soil-test P values are found in the two surface layers of soil and one layer immediately below the top layer both down gradient from the septic system (Figure 2). Based on land use, our sampling and soil descriptions, we presume that P-rich fertilizer is being utilized by the homeowner to encourage healthy turf grass growth.

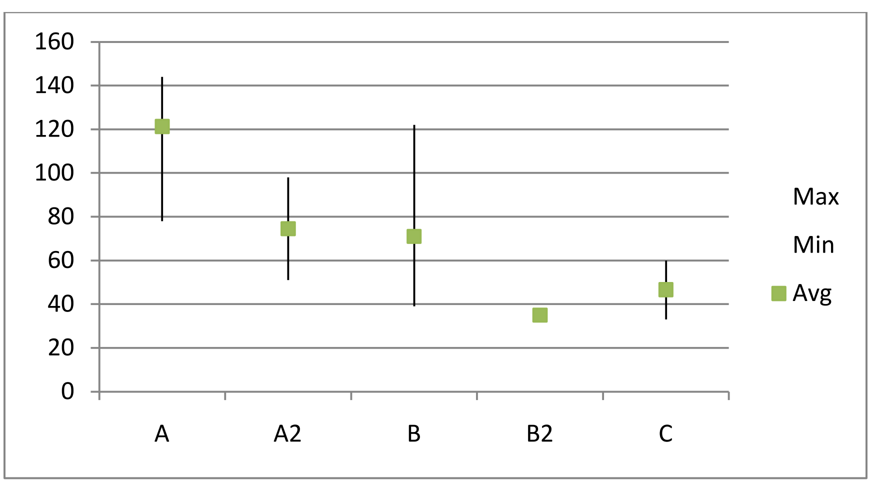

Figure 2. Maximum, minimum and average Bray P (ppm) by soil layer (horizon) for septic landscape.

Landscape position does not appear to be a large factor in explaining variation in Bray P values (Figure 3). There is a slight increase in average soil test P moving to the lower part of the landscape (footslope and toeslope). These differences are likely not statistically valid but do demonstrate a trend. Because P values are high in the lowest landscape positions, these areas could be acting as P source areas either due to erosion (if water flows across area) or soluble P due to water tables close to the soil surface.

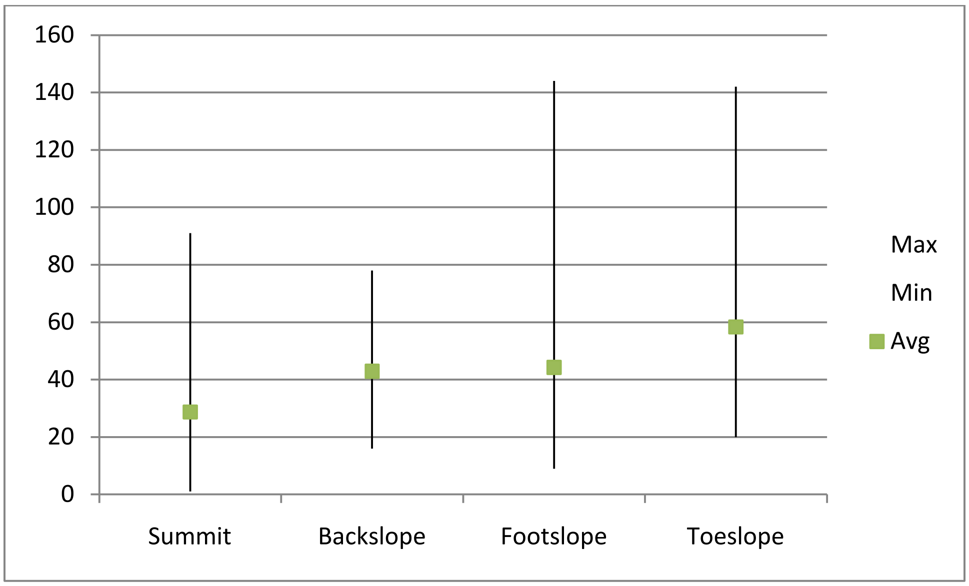

Figure 3. Effect of landscape position across all sites (upslope areas to low-lying areas) on Bray soil test P values (ppm).

Trends of how P is moving in the soil may be evaluated by investigating soil test P values with different soil horizons (depth). For most of the sites investigated, it was presumed that the source of the P is at the surface (fertilizers, manure, organic matter mineralization) and P content would decrease with depth. This is generally the case found in our data (Figure 4). The C horizon values are one notable exception to this trend. They were only described at one location, the septic landscape. Since the P concentrations at this site were high everywhere, this skews the otherwise fairly clear trend of decreasing P with depth. It is important to note that average values for soil test P even at the deeper depths (B2-B4) are in the medium to very high categories based on UM turf grass recommendations (2010) and corn fertilizer recommendations (2006). This indicates the potential that P is moving into the soils in the soluble form and when it reaches the water table, can quickly move into surface waters and become a pollutant source.

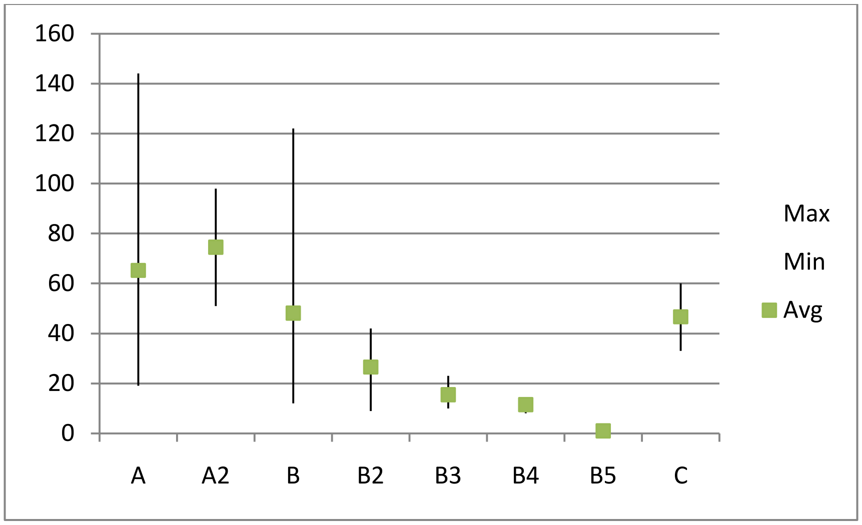

Figure 4. Descriptive statistics for soil test P (ppm) with depth from soil surface.

The last parameter investigated is the effect of soil texture on soil test P. It is expected that finer textured soils (those with more silts and clays) will hold more P when compared to coarse textured sandy soils. Because this area is largely comprised of sandy soils, soil test P values would be expected to be low or very low where P sources do not influence the soil. The trends observed (Table 5) indicate there is no relationship between soil textures and P concentrations. A wide range of values was observed in each texture group, except sandy clay loam (scl), which likely indicates a spectrum of impacts from land-use differences and distance from P source(s).

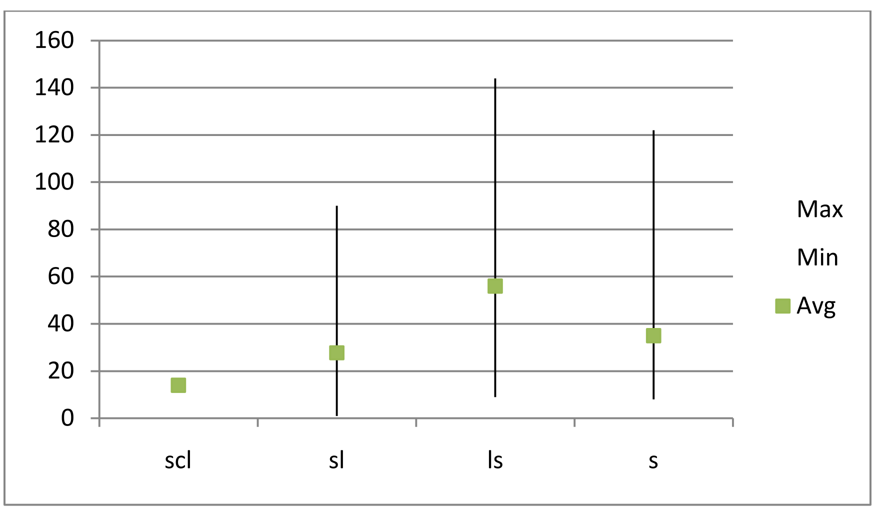

Figure 5. Descriptive statistics for soil test P (ppm) trends with soil textures (from finer textures to coarser) sandy clay loam, sandy loam, loamy sand and sand.