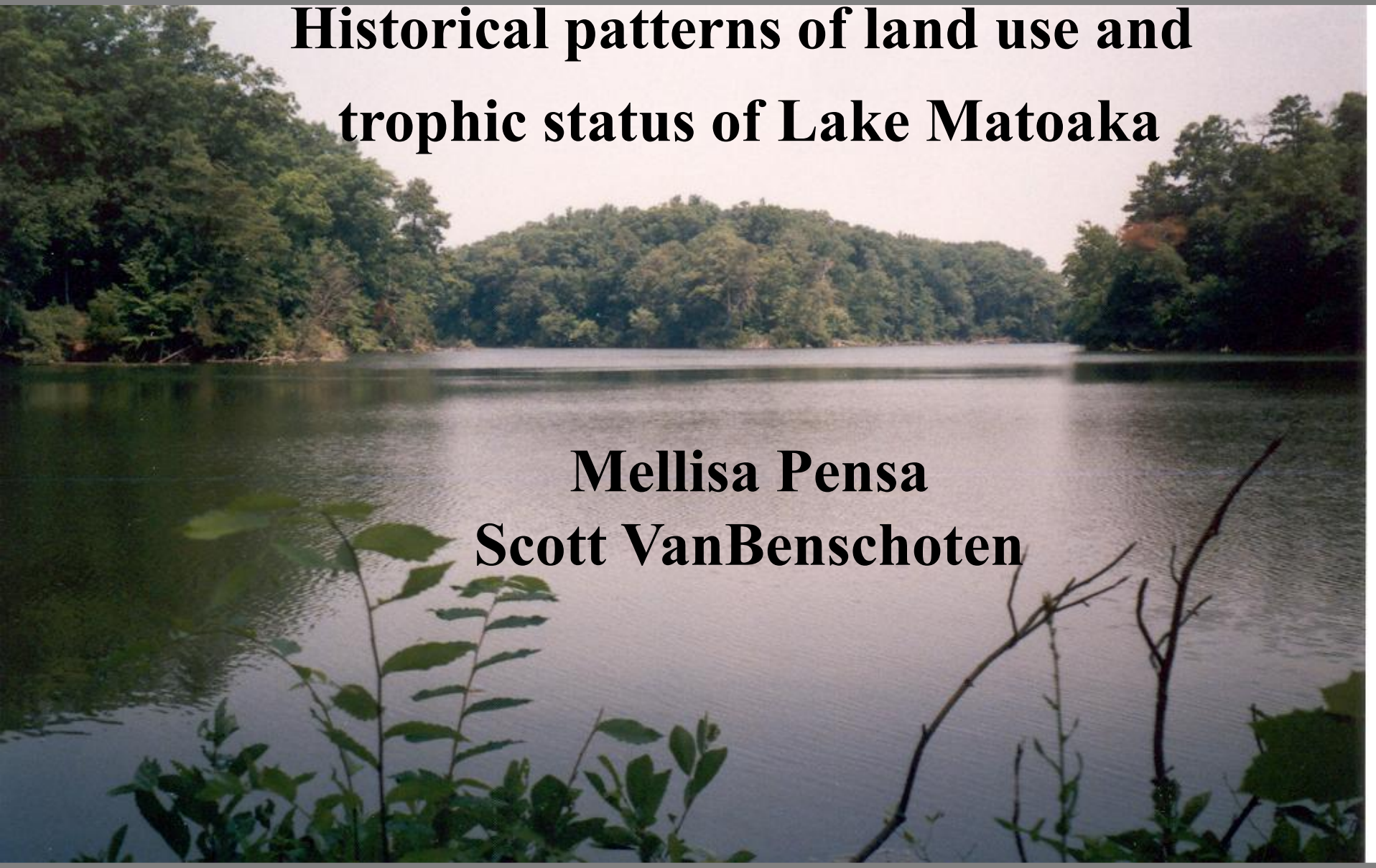
Historical patterns of land use and trophic status of Lake Matoaka



Mellisa Pensa
Scott VanBenschoten

Lake Matoaka is a productive impoundment located on the Virginia coastal plain.

Home a diverse assemblage of fishes, the lake currently exists in a hypereutrophic state.

How did Lake Matoaka get to be so full of algae and submerged aquatic vegetation?

First, some lake history...

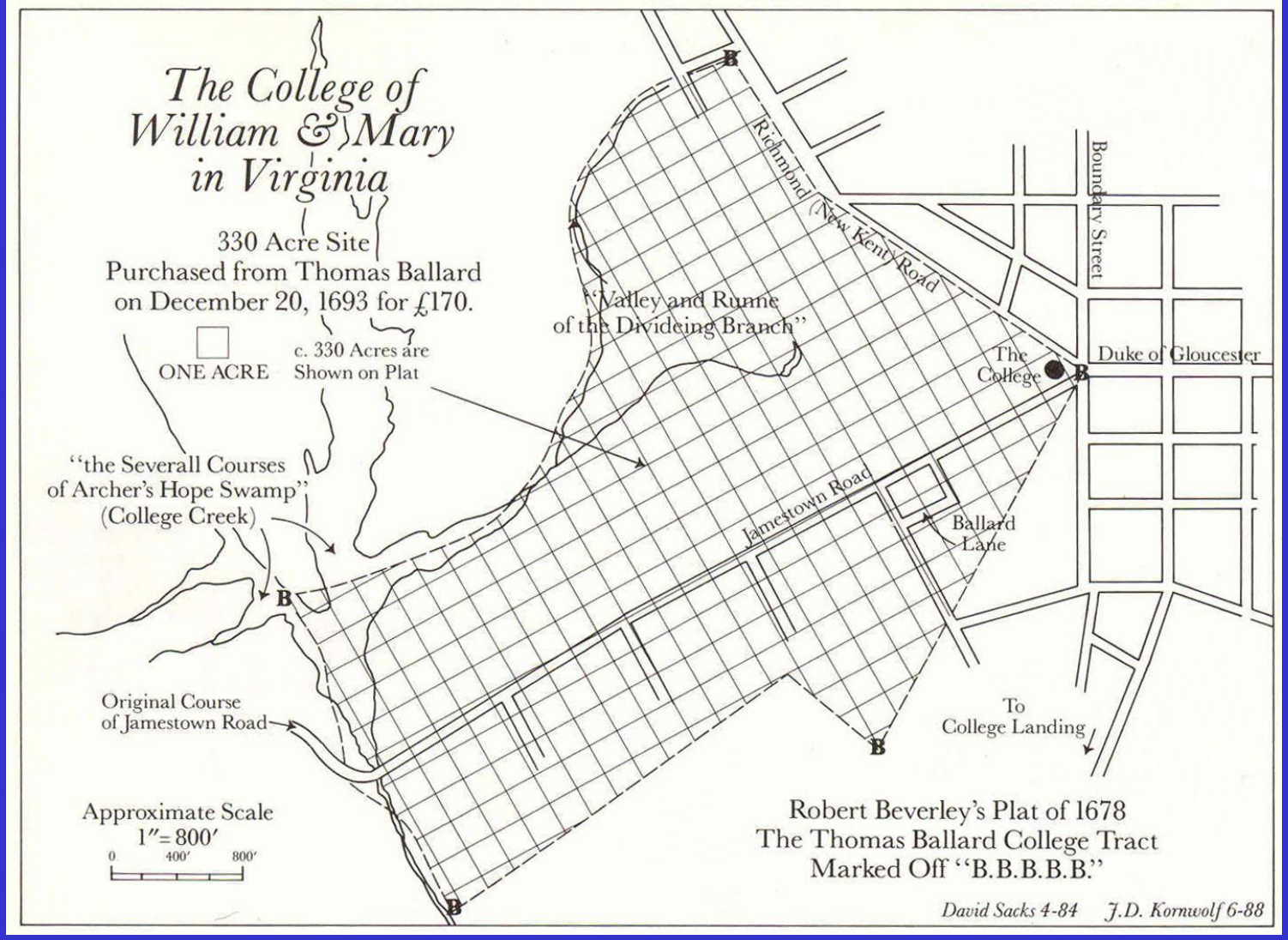


Fig. 14. *Plan of the Original Lands of The College of William and Mary, Williamsburg, 1693*, by the author, after David Sacks's honors thesis (College of William and Mary, 1984).

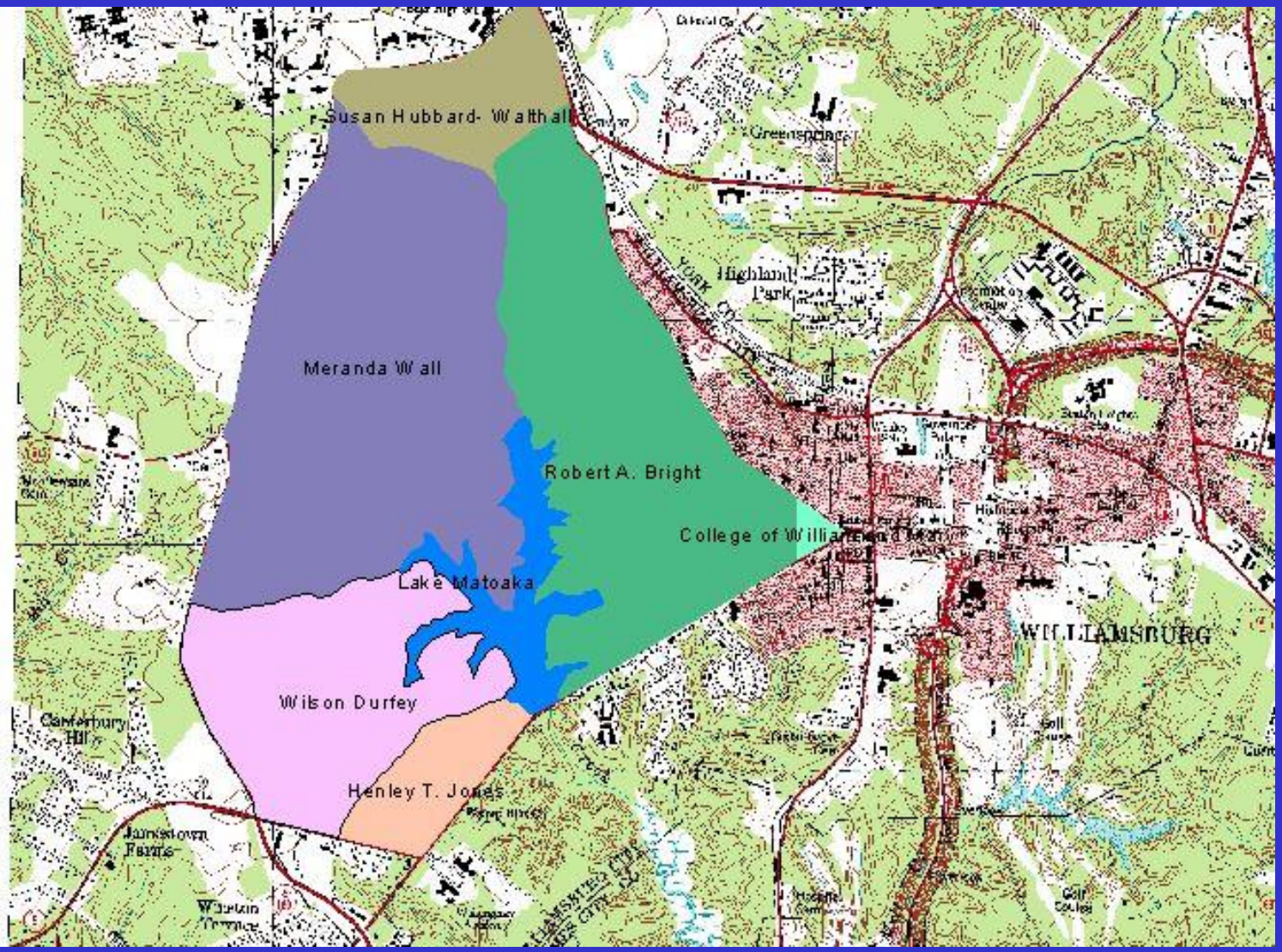
“The severall courses of Archer’s Hope Swamp” (now called College Creek) became a mill pond (now Lake Matoaka) with a dam built between 1700 and 1750.”

--David Sacks Honors’ Thesis, pg. 7

Oldest man-made lake in Virginia?

Saint Simon Map 1781

1866 Property Owners within the Lake Matoaka Watershed



1934 aerial photo of Lake Matoaka:

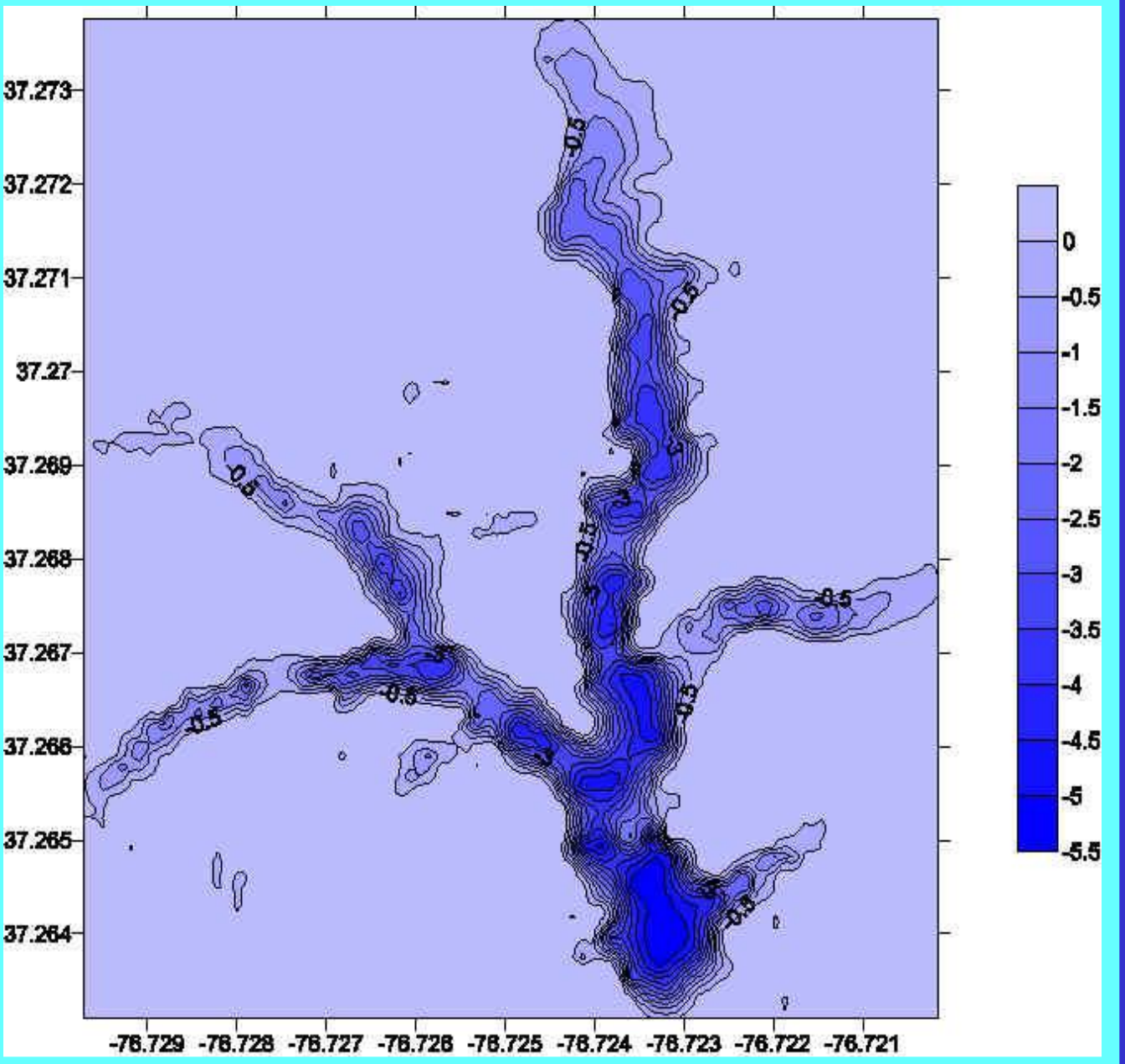
Signs of forestry, agriculture, housing, changing land use.

2000 aerial photo of Lake Matoaka:

Developed on east side; still forests on west.

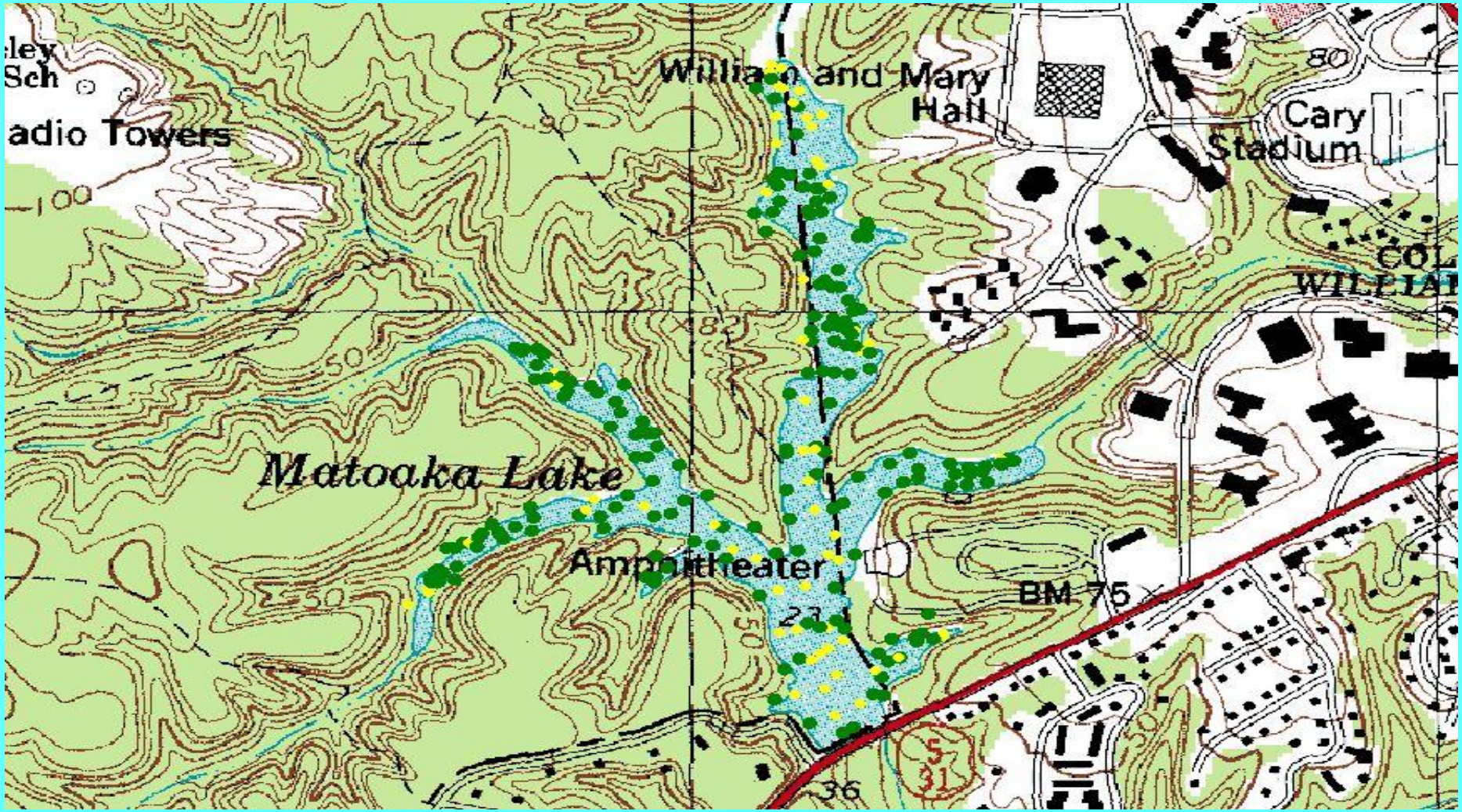
What are the impacts of development?

Up until the last 20 years or so, the entire town in the Lake Matoaka watershed used the lake as a detention basin for water, sediment, and contaminants.



Lake Matoaka Bathymetry

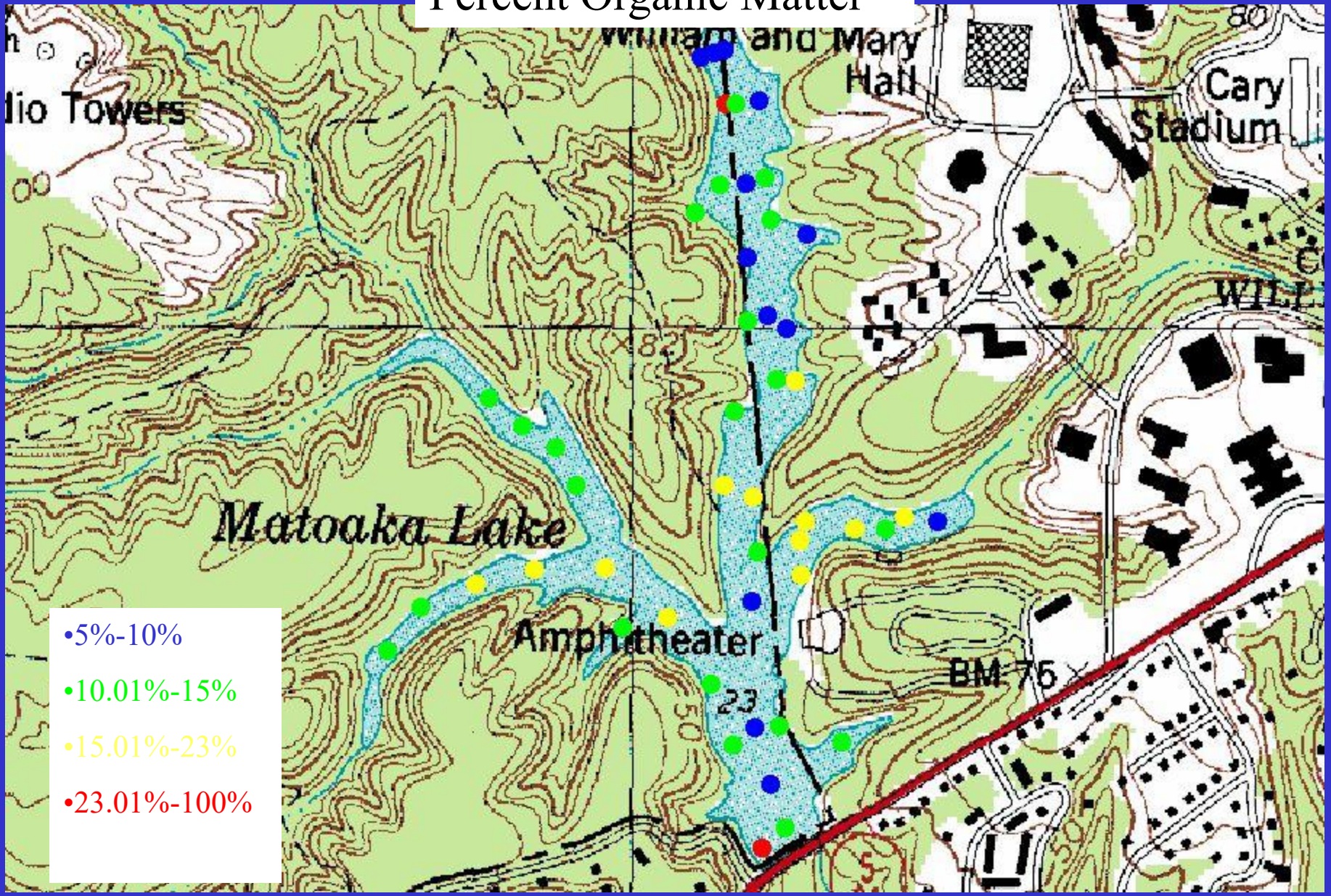
Evidence of infilling and possible changes in dam height



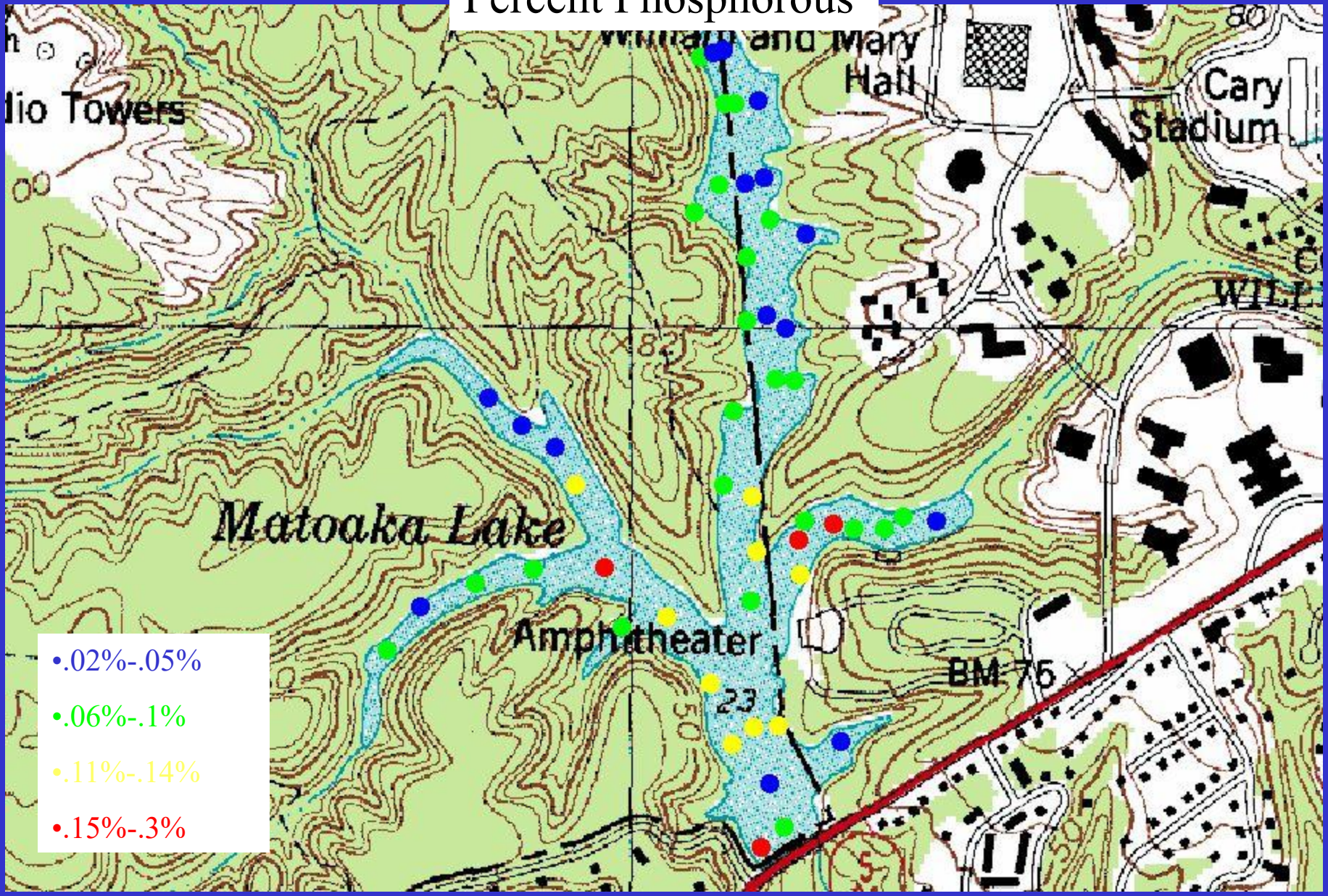
Yellow—Pondweed absent

Green—Pondweed present

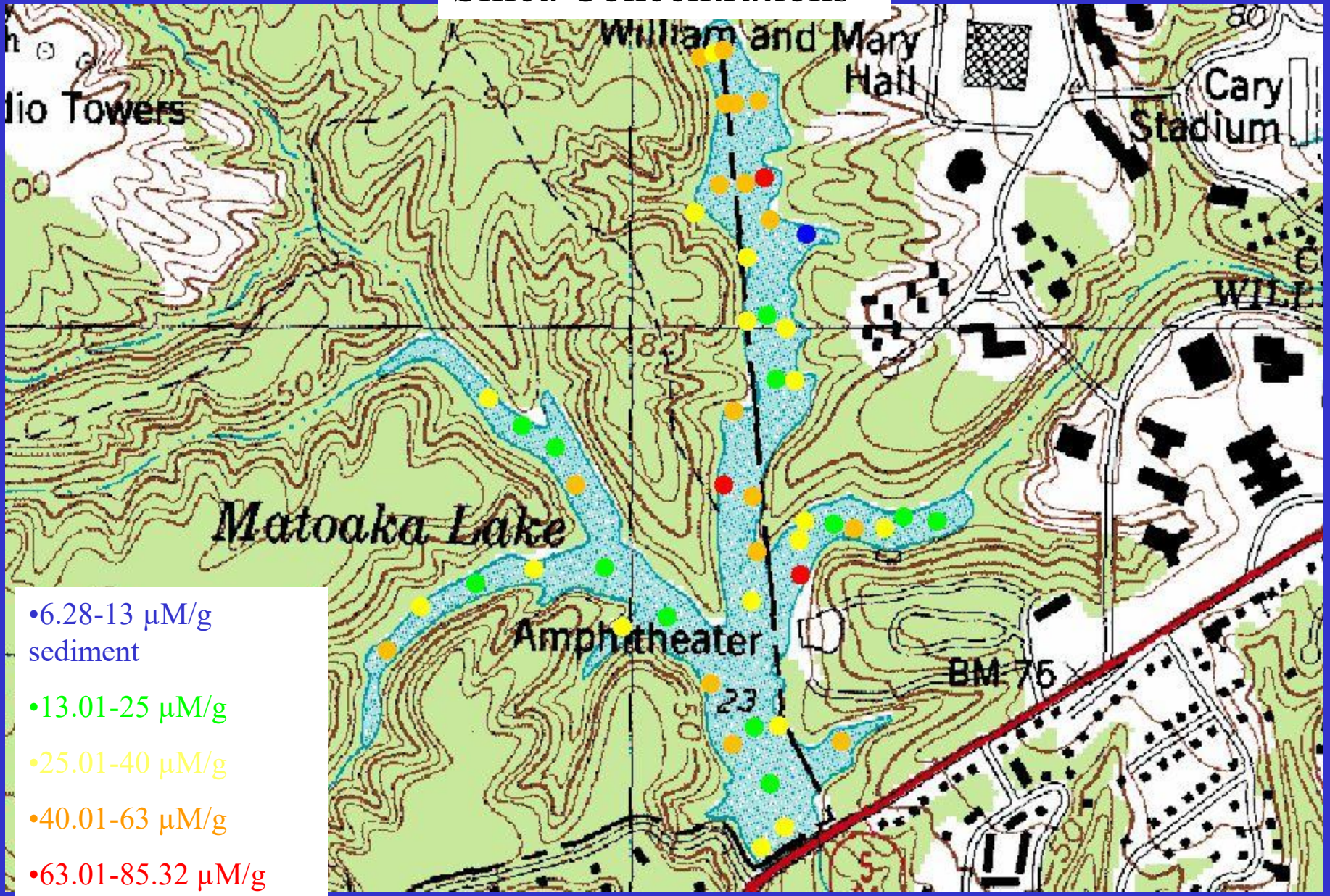
Percent Organic Matter



Percent Phosphorous



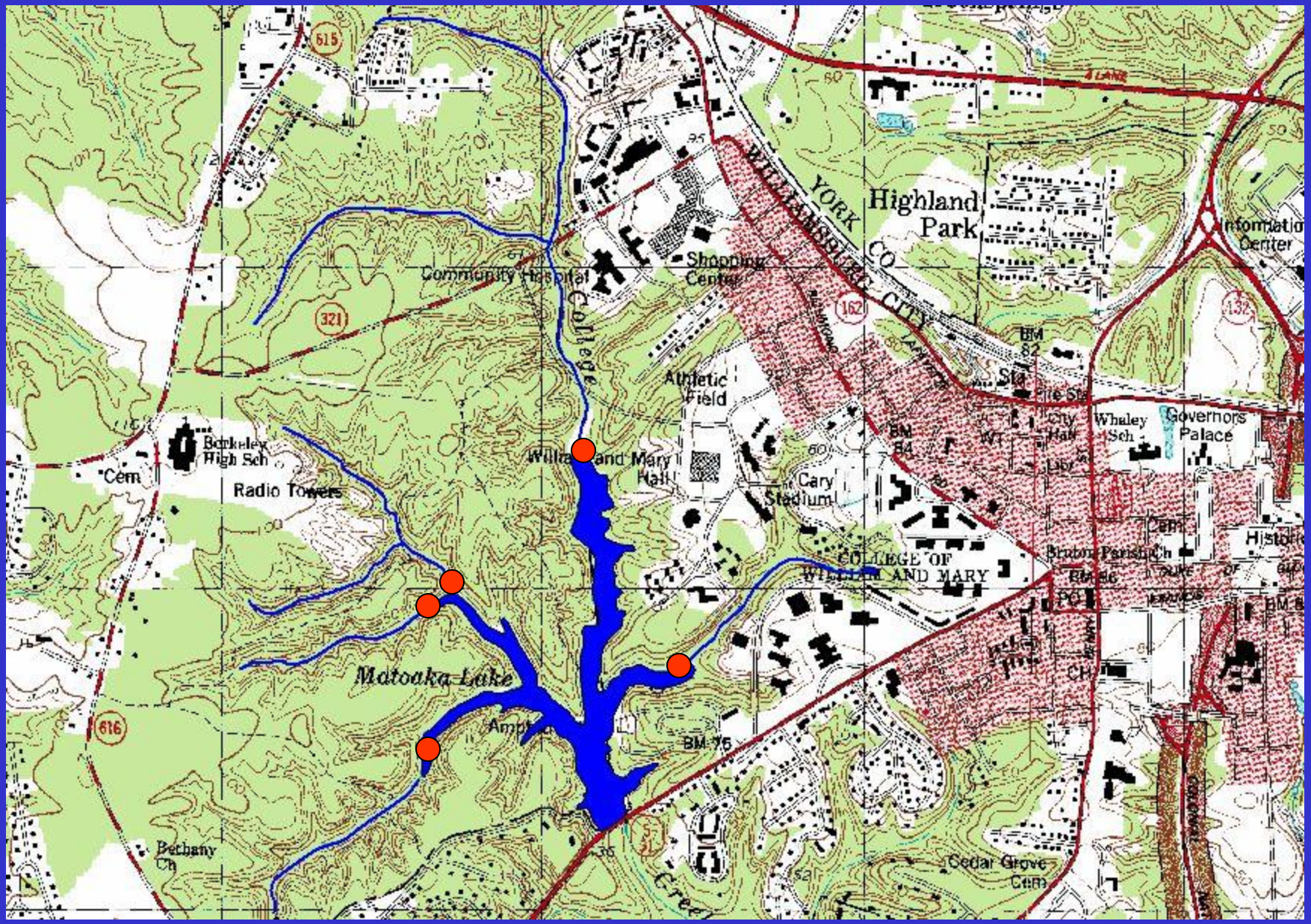
Silica Concentrations

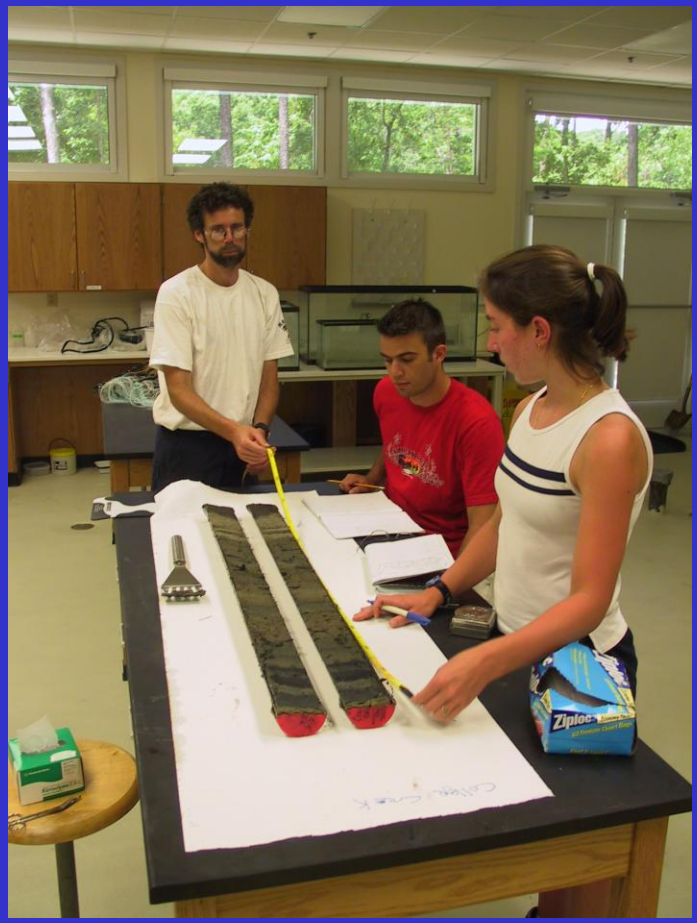


Surface sediments: Some spatial differences in concentrations of organic matter, phosphorus, and silica, but generally high concentrations everywhere.

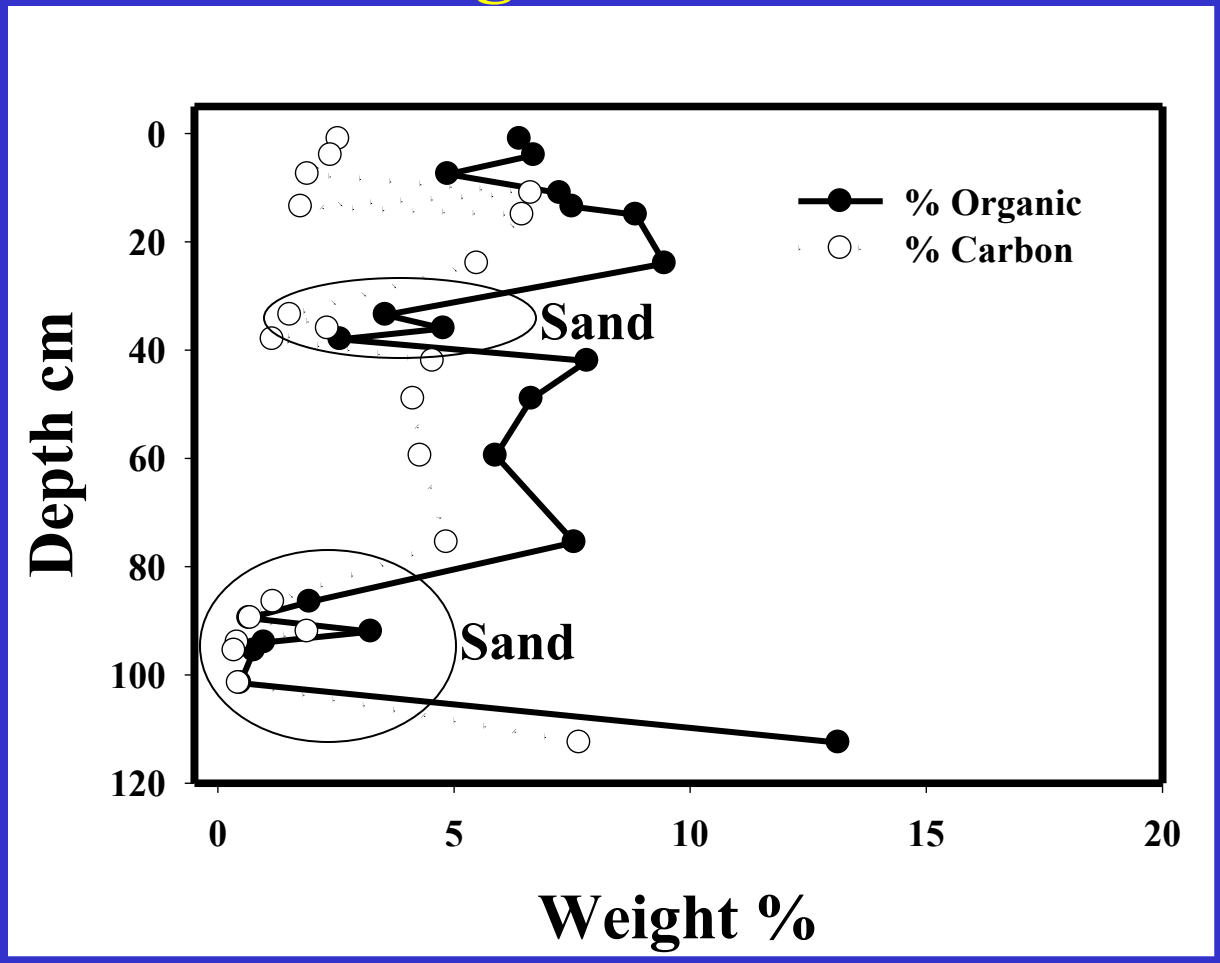
Organic matter and nutrients are fairly well distributed throughout the entire lake bottom away from stream deltas.

5 Core Collection Sites



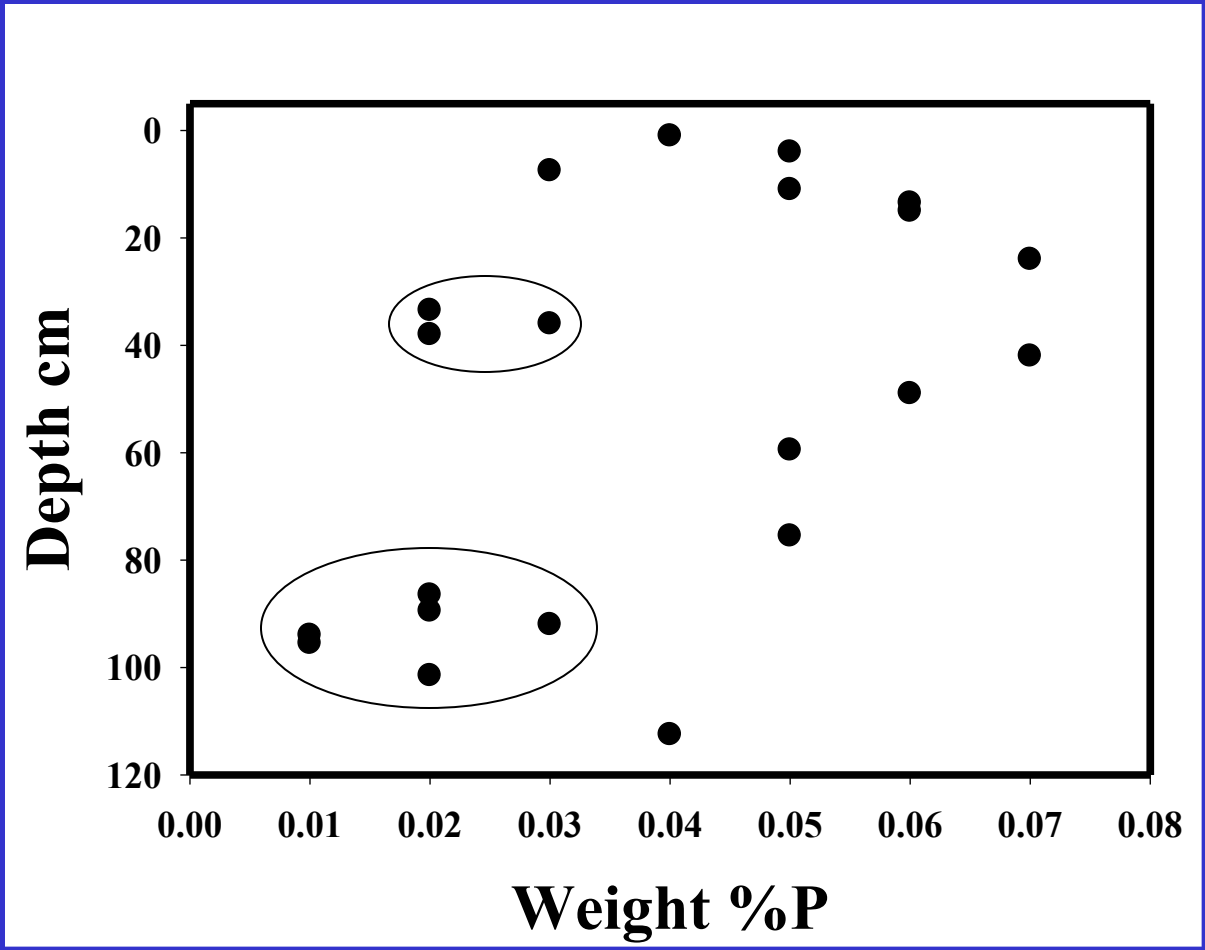

Ziploc

College Creek Core



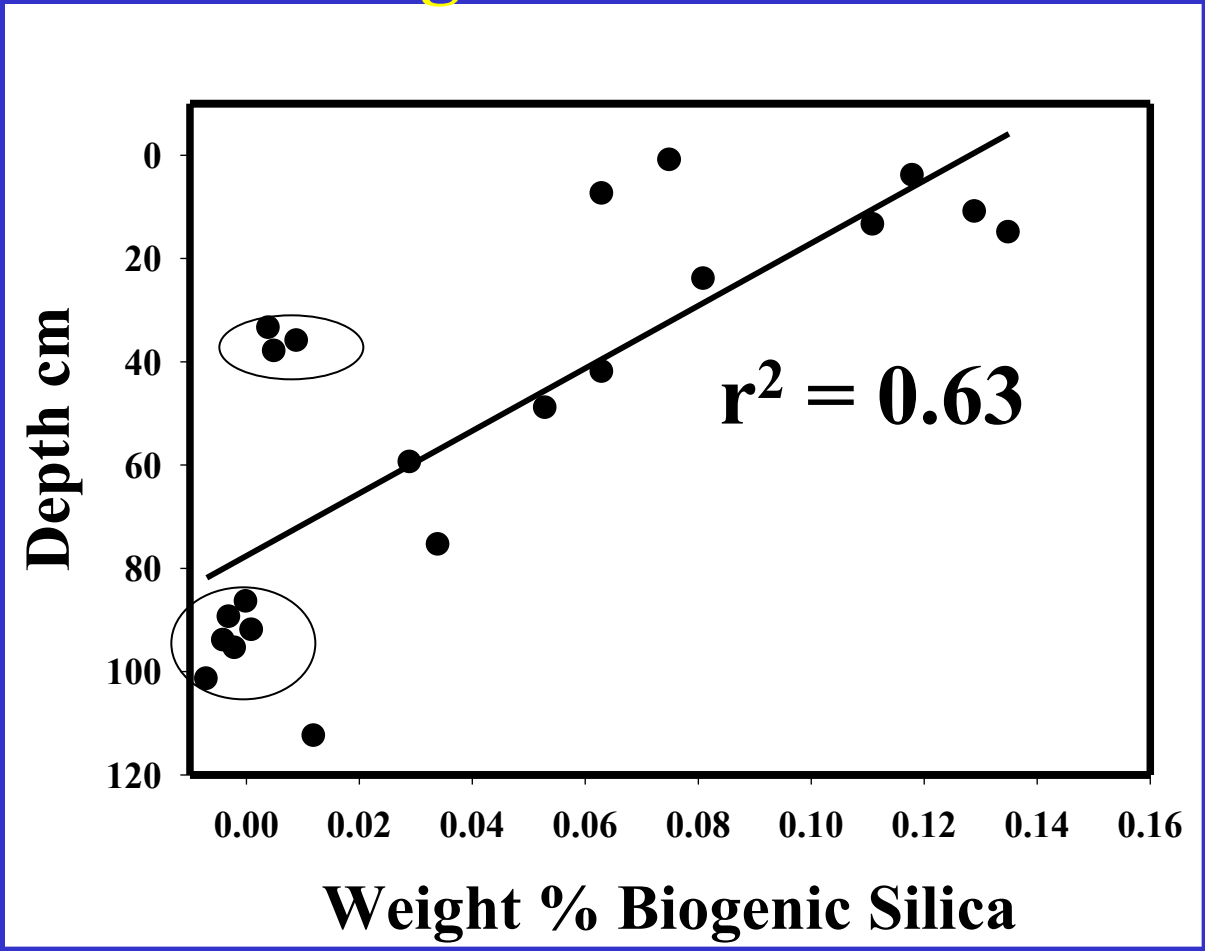
History of organic deposition does not demonstrate clear pattern of decomp.

College Creek Core



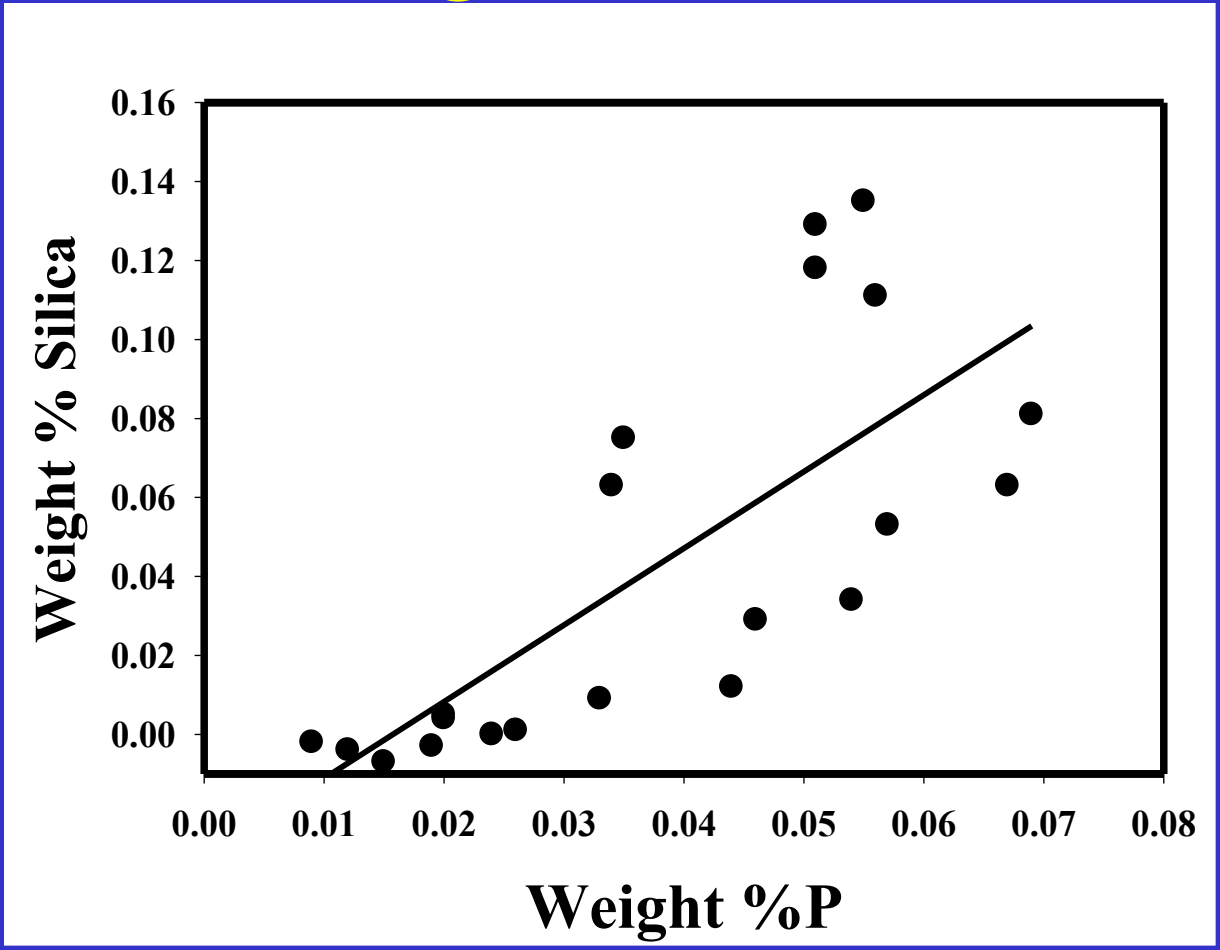
Recent decreases in sediment P could reflect better sewage controls.

College Creek Core

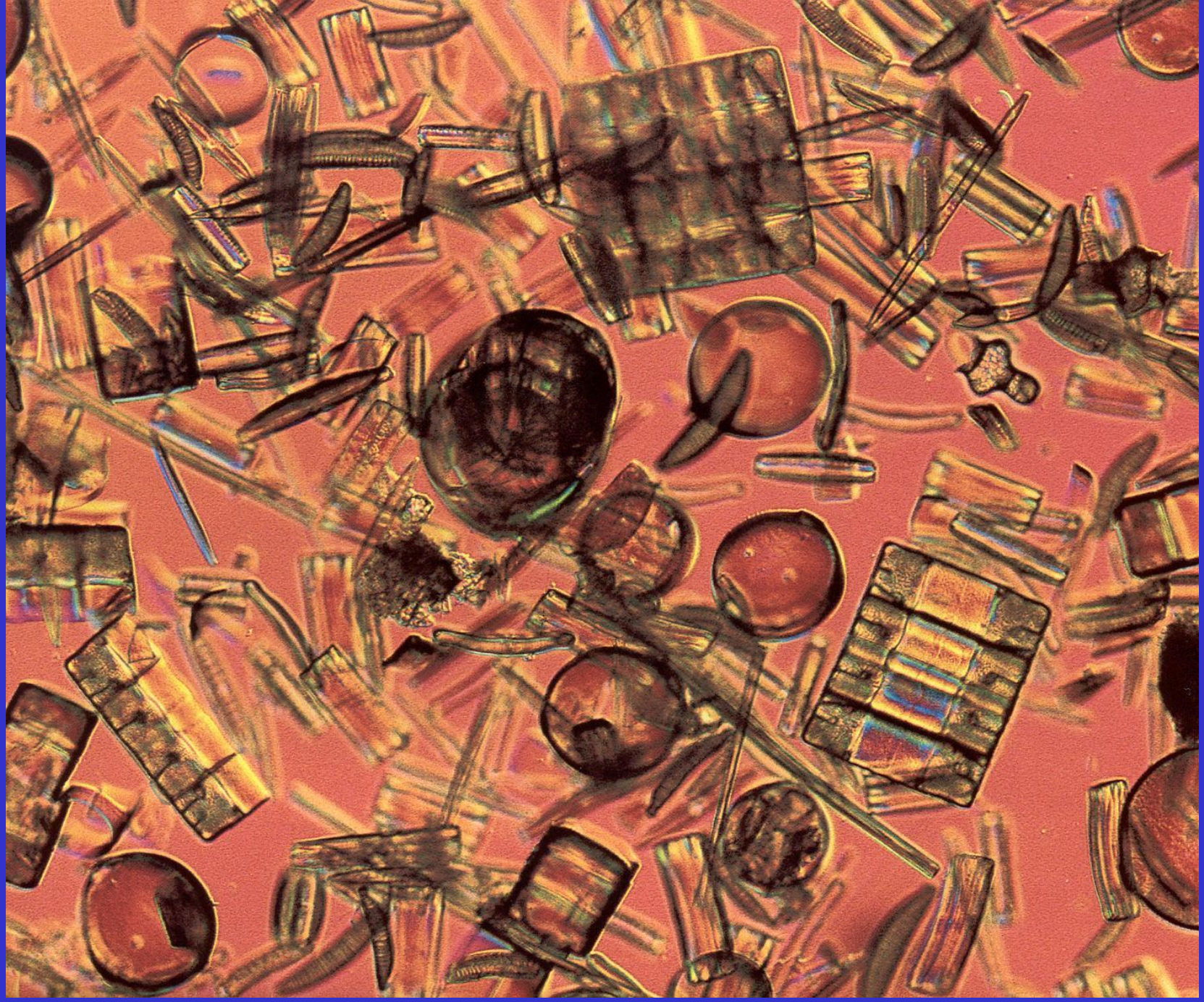


Biogenic silica has increased in deposition throughout recent history of lake. Proxy for diatom algal blooms.

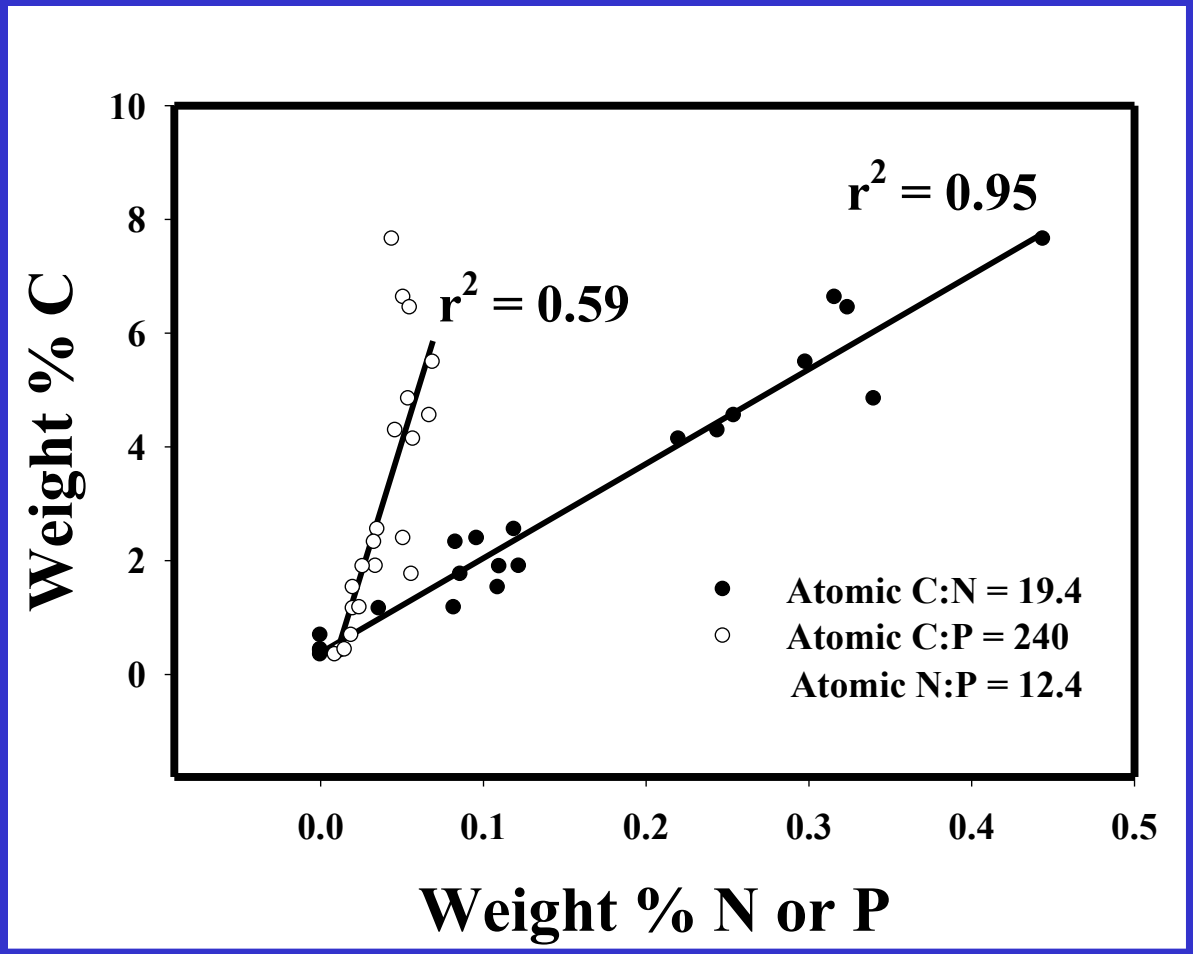
College Creek Core



Phosphorus and silica are positively correlated. Connection between nutrients and algal blooms @ north end of lake.

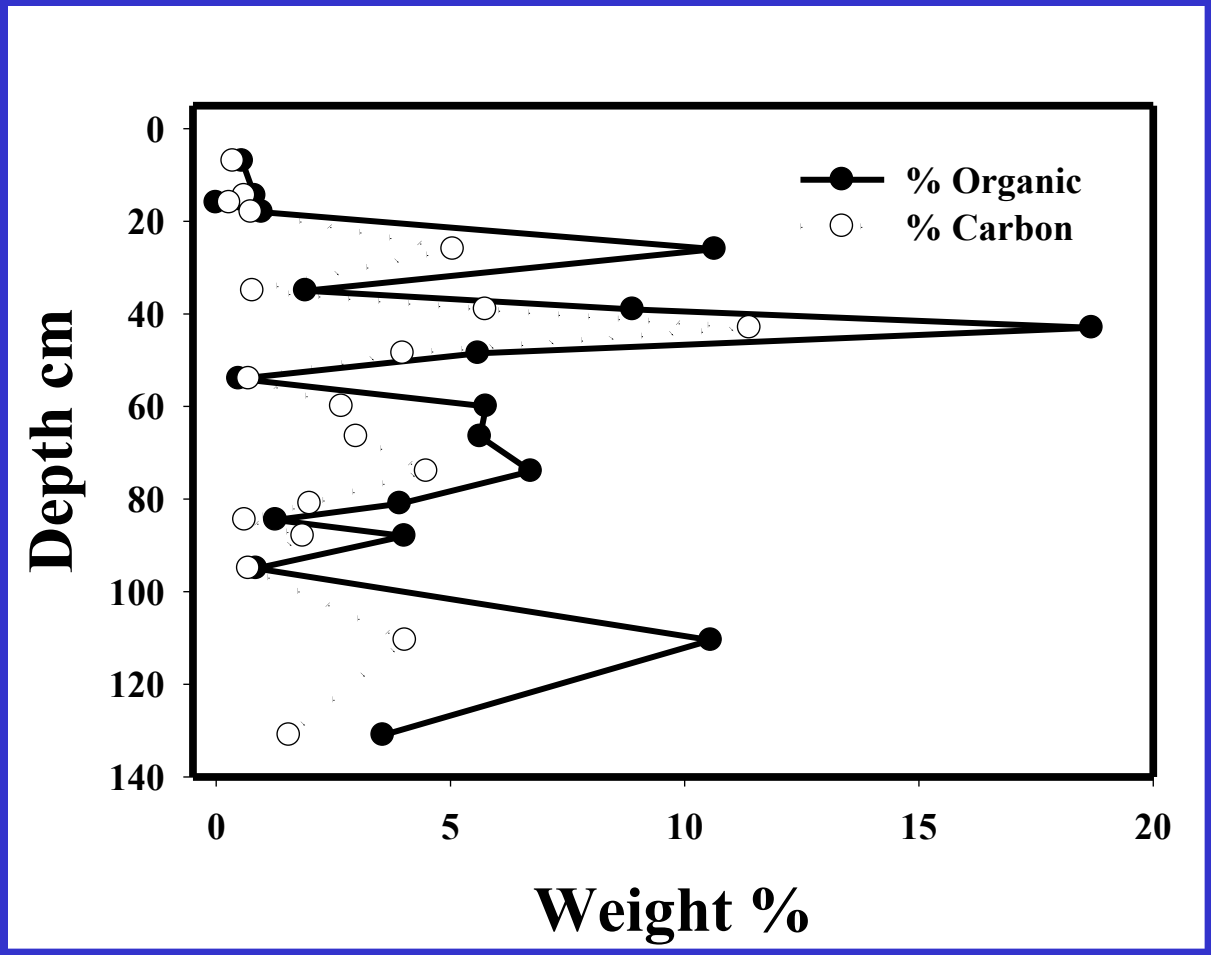


College Creek Core



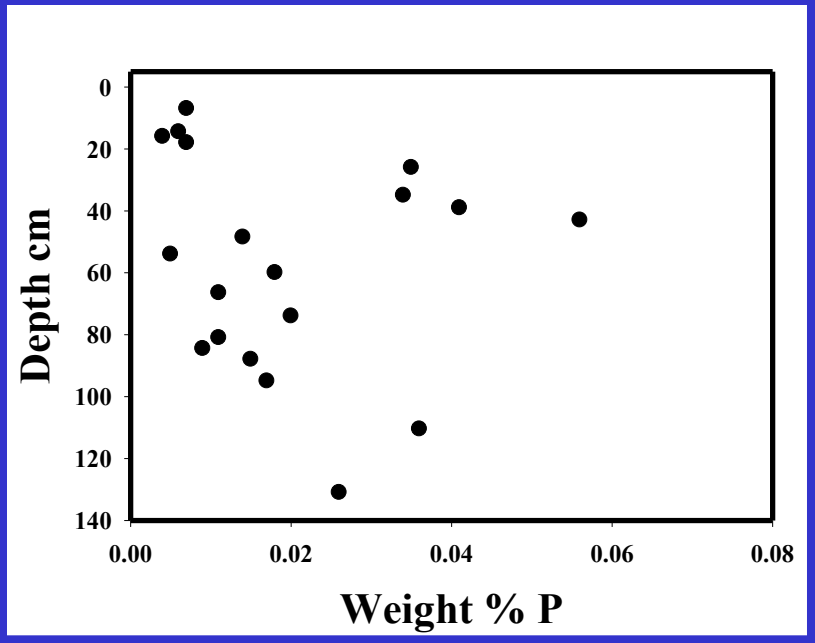
Sediment organic matter in delta exhibits a terrestrial carbon signal

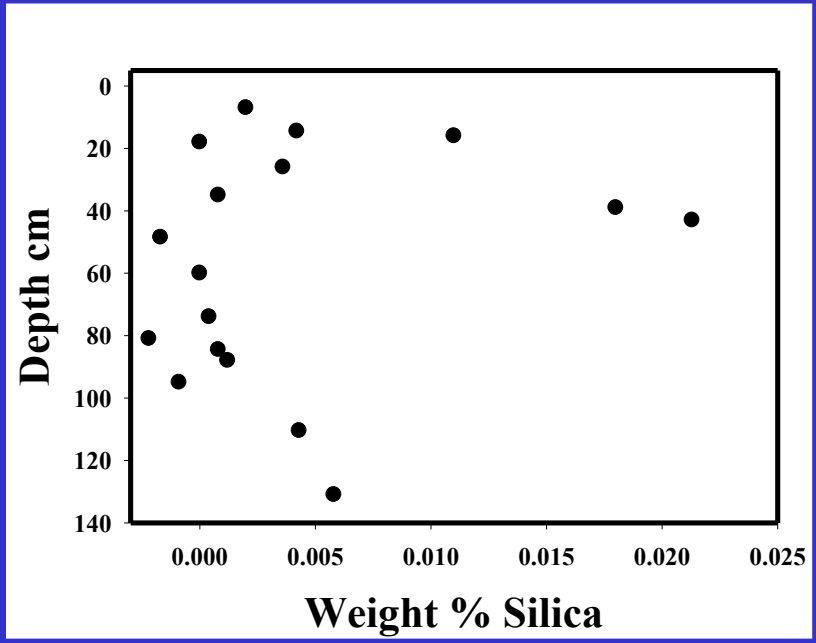
Strawberry Creek Core



Dates???

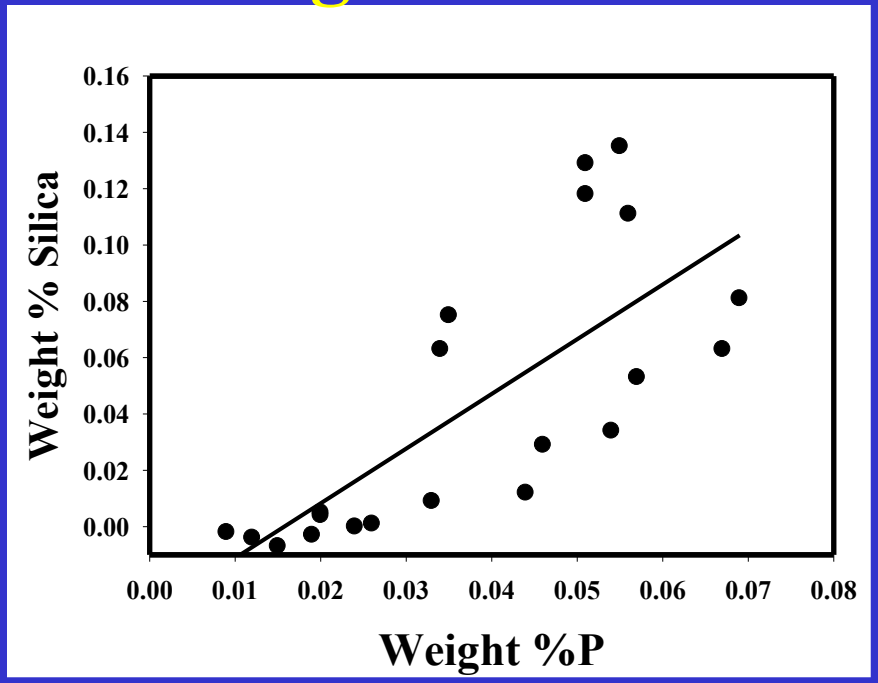
Strawberry Creek Core



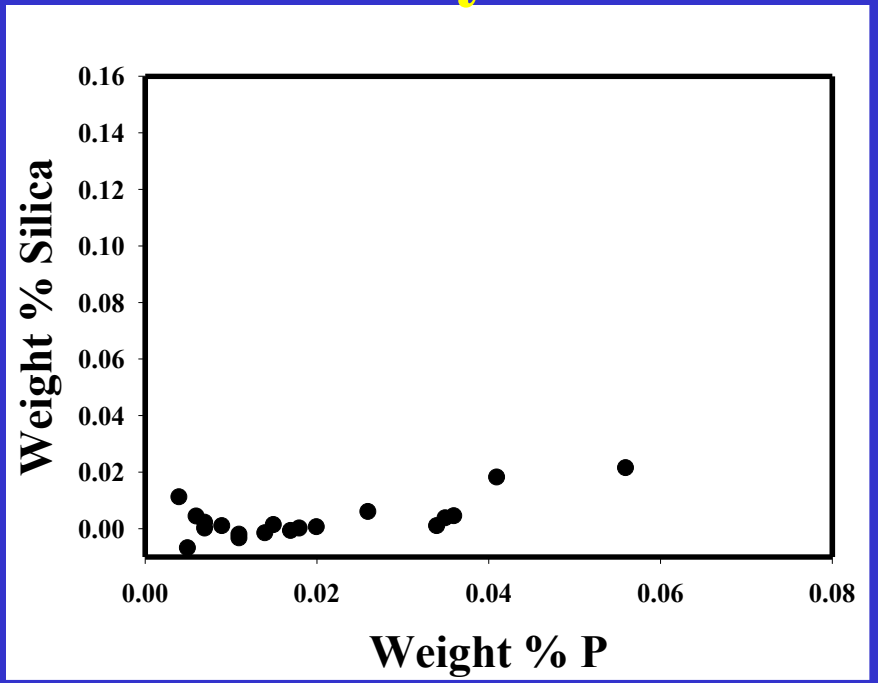


Unlike College Creek, no obvious patterns of phosphorus or biogenic silica deposition. No algal blooms on this side of the lake?

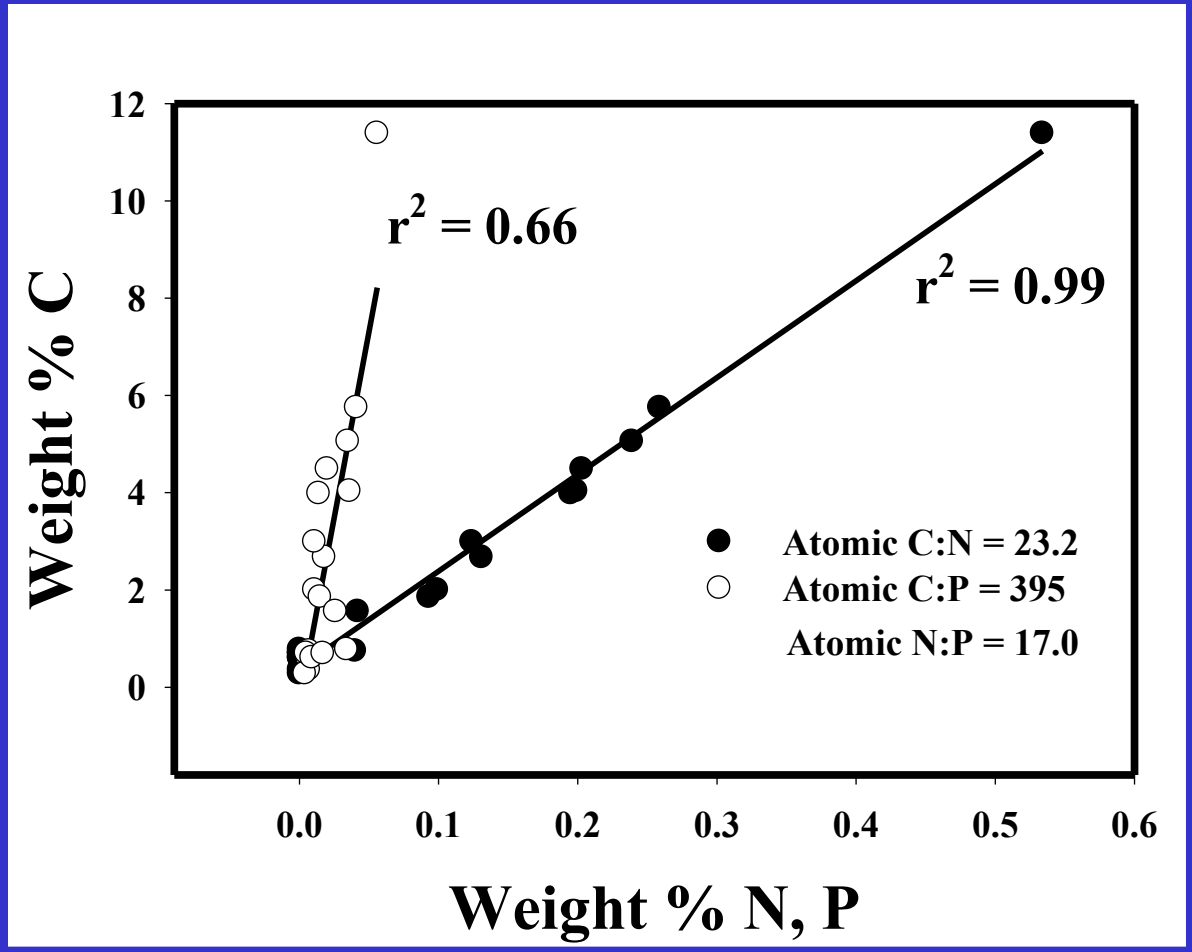
College Creek



Strawberry Creek



Phosphorus and biogenic silica enrichment in the College Creek delta. Indicators of excess nutrient loading?

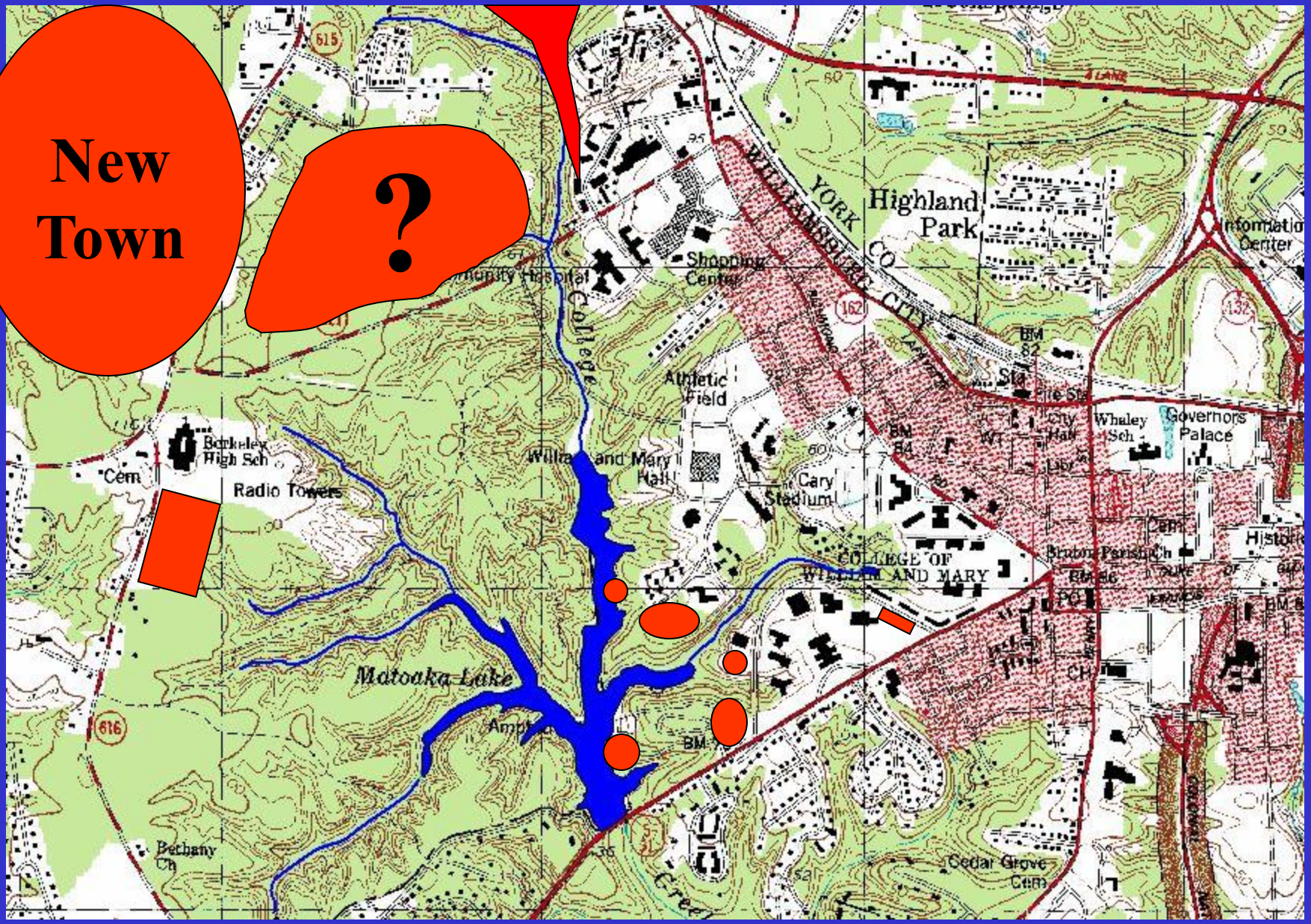


Strawberry Creek delta exhibits terrestrial carbon signature more pronounced than College Creek.

Source Sediments	C:N:P
College Creek delta	240:12:1
Berkeley delta	245:13:1
Strawberry delta	395:17:1
Lake-wide surface seds	114:??:1
“Redfield” algae	106:16:1

Organic matter in delta sediments includes terrestrial component, whereas the rest of the lake bottom is covered with algae and submerged aquatic vegetation.

The spectre of ongoing development



The future of Lake Matoaka

Continued infilling by organic matter and sediment = EUTROPHICATION

Internal loading of nutrients from lake bottom will continue to fuel plant and algal production for decades to come.

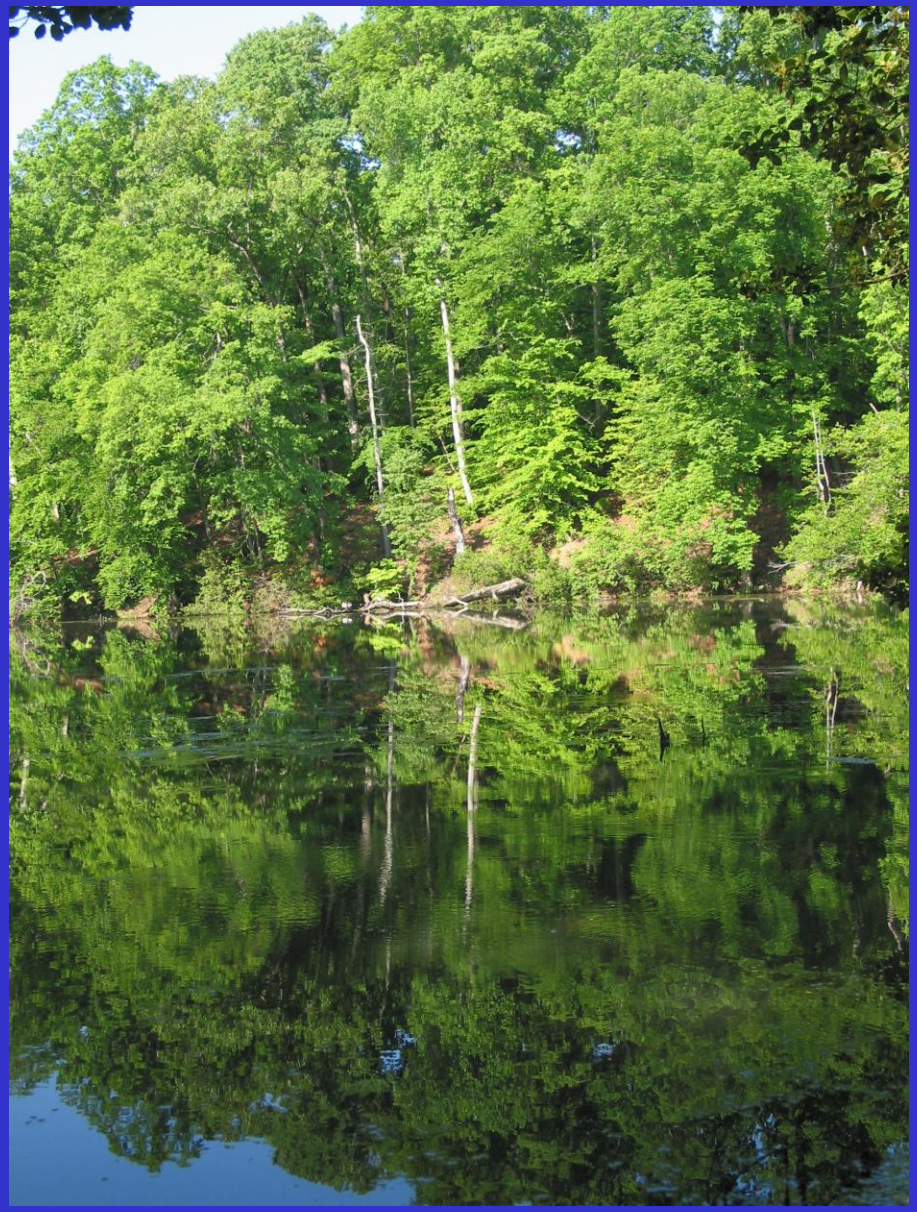
Work ongoing:

Analysis of cores from other deltas

Collection and analysis of deeper sediment samples earlier in lake history

Comparison with geology theses

Modelling land use change and inputs of water, sediment and nutrients from the watershed to the lake.



Funding:
Jeffress Trust

Technical assistance:
Tim Russell