Experimental Manipulation of Entire Watersheds through BMPs:Nutrient Fluxes, Fate and Transport and Biotic Responses

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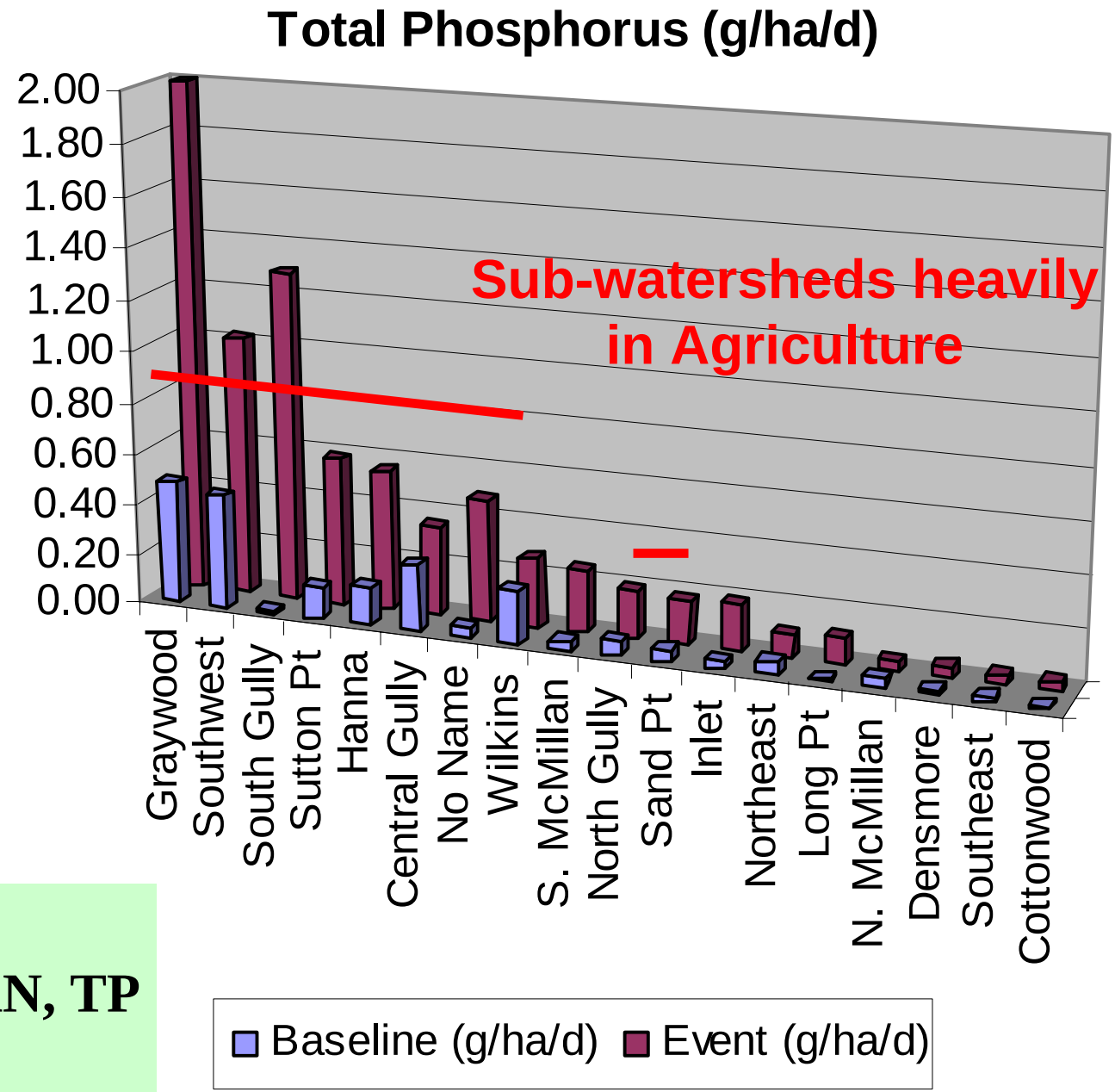
Experimental Manipulation of Entire Watersheds through BMPs:Nutrient Fluxes, Fate and Transport and Biotic Responses

Goals

1. **To demonstrate, through the experimental watershed approach, that implementation of BMPs in agricultural dominated watersheds will preserve soil and reduce nutrient loss from a series of sub-watersheds.**

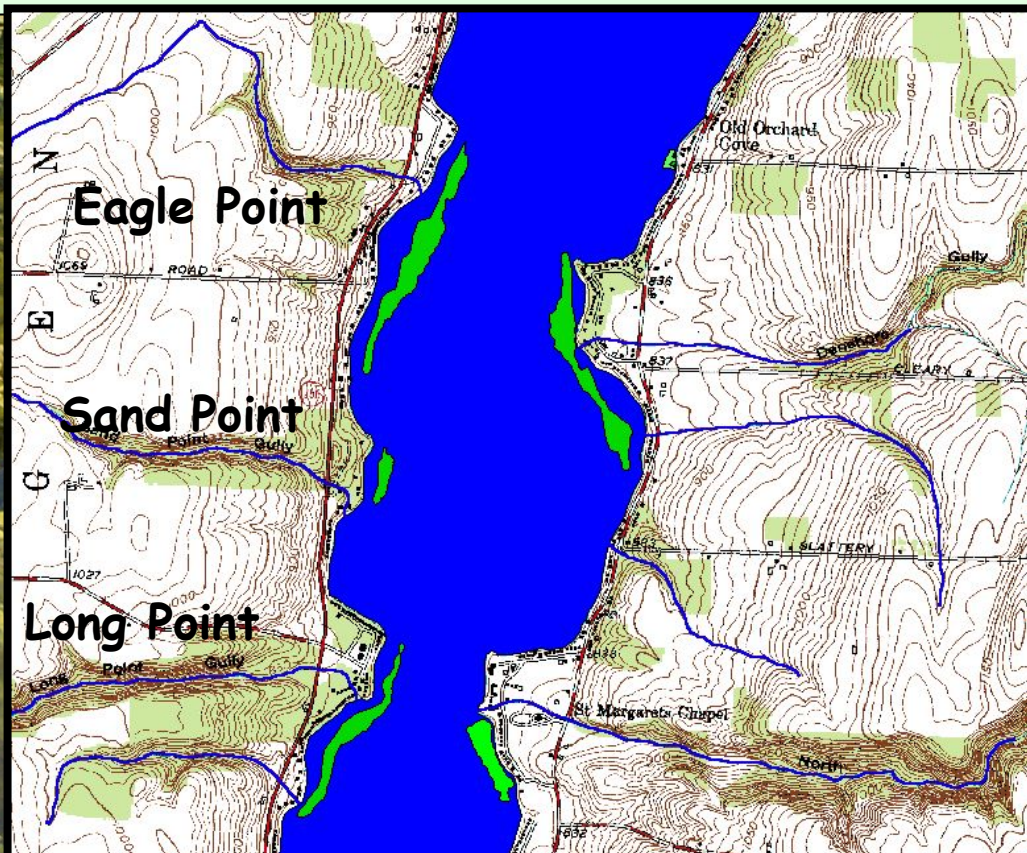
2. **To evaluate the impact of instituted BMPs by considering the impacts on the down stream lake community on the watershed scale.**

3. **To evaluate the fate and transport of nutrients over space and time.**



High Losses
NO_3, SRP, TKN, TP
Soil, Na

Excessive growth of filamentous algae on or around milfoil beds is related to loss of nutrients from watersheds heavily used in agriculture. The surface area measurements we obtain by GPS are multiplied by biomass quadrat measures to estimate the standing crops of milfoil at each site.



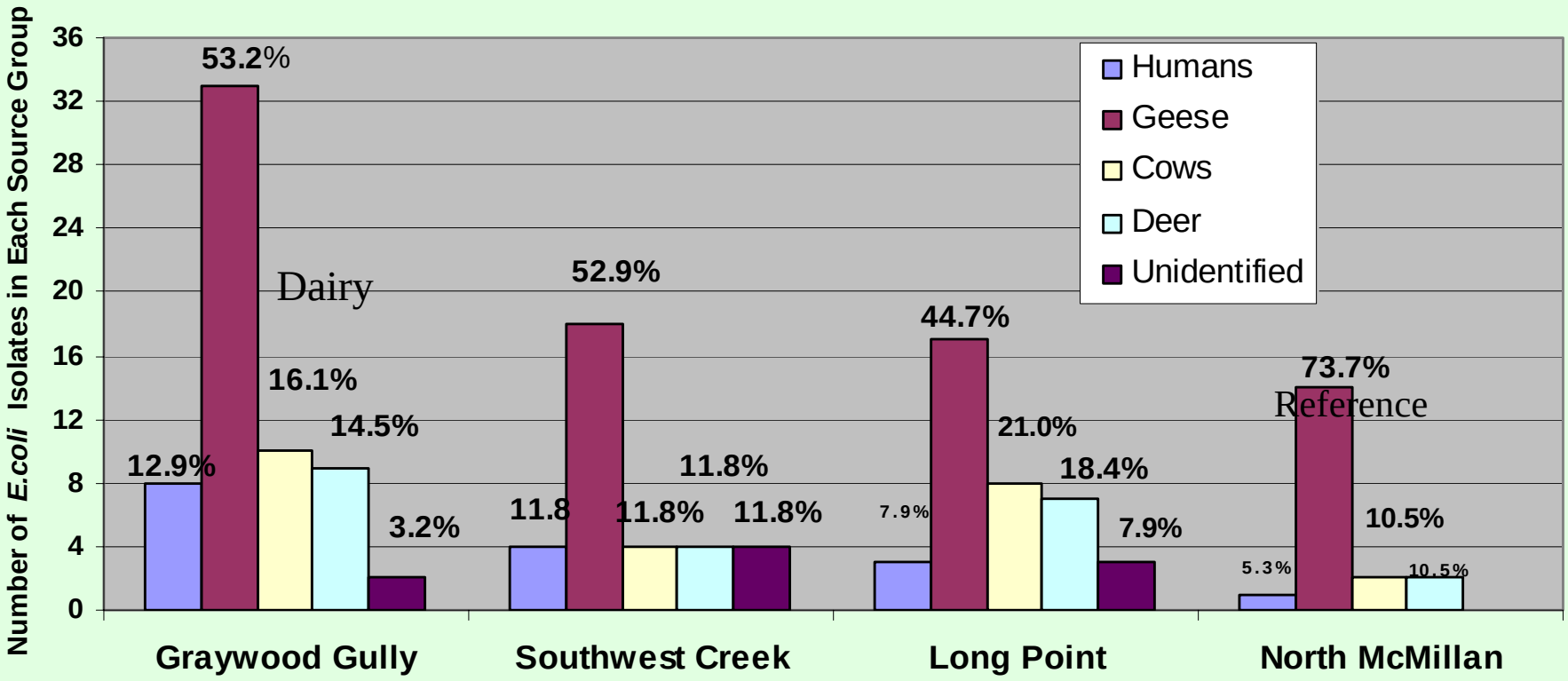
E. coli contamination is a well documented problem around Conesus Lake with several reports of elevated *E. coli* levels in the watershed.

WHAT IS THE SOURCE?

- Generally was believed to be due to agricultural practices in the watershed – especially dairy cattle.
- **Quantification** by traditional methods provides little understanding of the particular sources (Cows? Humans?).
- **Bacterial Source Tracking** using PCR (Polymerase Chain Reaction) provides a tool to identify sources of *E. coli* contamination based on genetic fingerprinting.
- **Created a Library:** A total of 150 *E. coli* isolates were PCR amplified and an average of 30 isolates per source group were used for comparison with unknown samples.
- **Analyzed Unknowns:** A total of 153 *E. coli* isolates were identified from stream water during winter and spring of 2003 and 2004.

E. coli Source Distribution in Conesus Lake Sub-watersheds

Winter and Spring, **non-events**



During precipitation events, coliform losses attributed to cattle increase dramatically

Pre- BMPs Results

***Greater loss of nutrients and soils from agricultural watersheds – especially during hydrometeorlogic events**

***Elevated levels of NO_3, SRP, TP, TKN and soil in streams**

***Macrophyte beds in lake associated with watersheds in agriculture at stream mouths**

***Macrophyte biomass highly correlated with phosphorus loading**

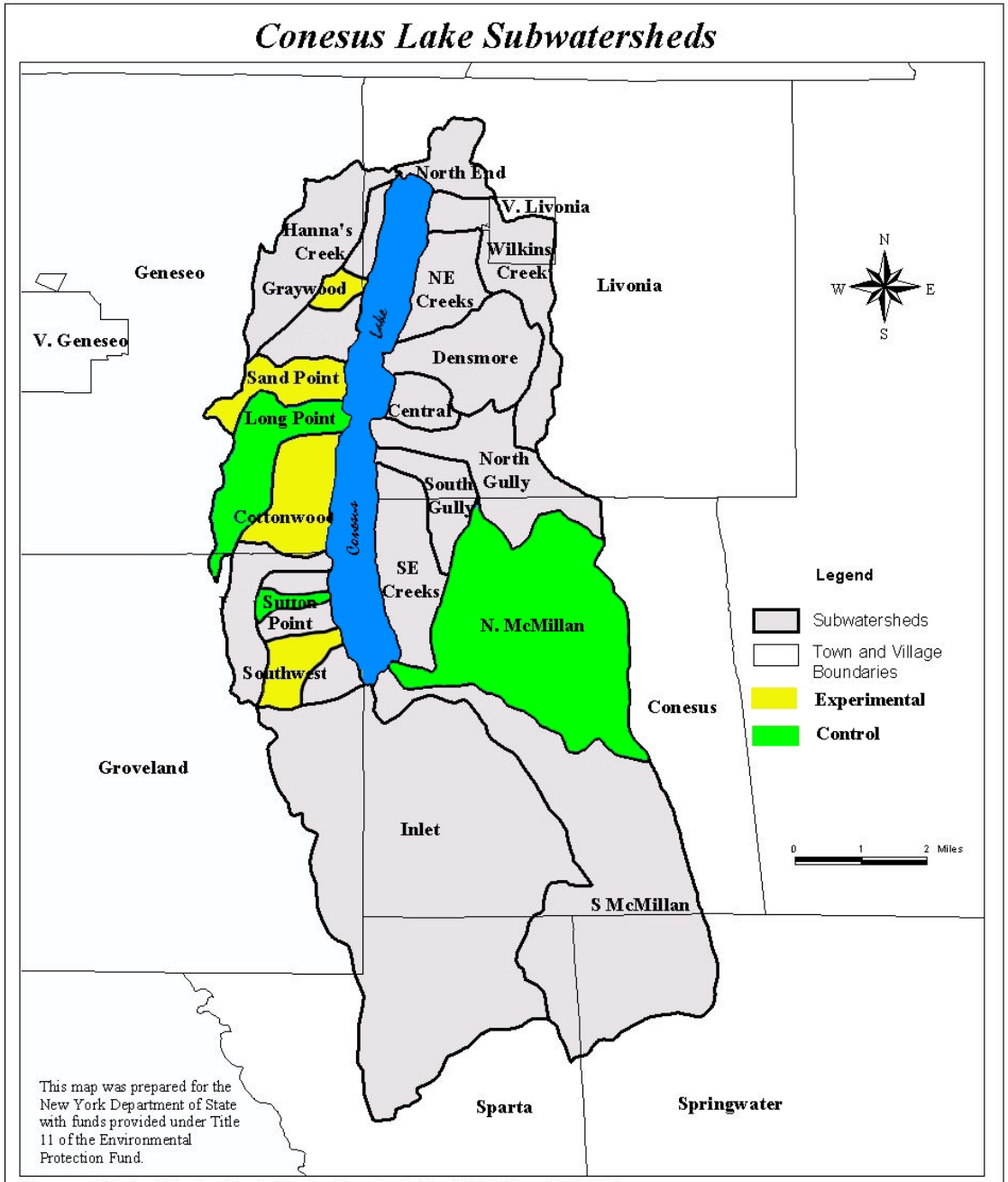
***Algae biomass at stream mouths stimulated by water (e.g. phosphorus) from watershed**

***Non-agricultural sources of *E. coli* are prevalent during non-events. Geese, rather than dairy cattle, were predominant**

***During events *E. coli* from cattle are prevalent.**

Collaborative approach of local agencies, farming community and academics

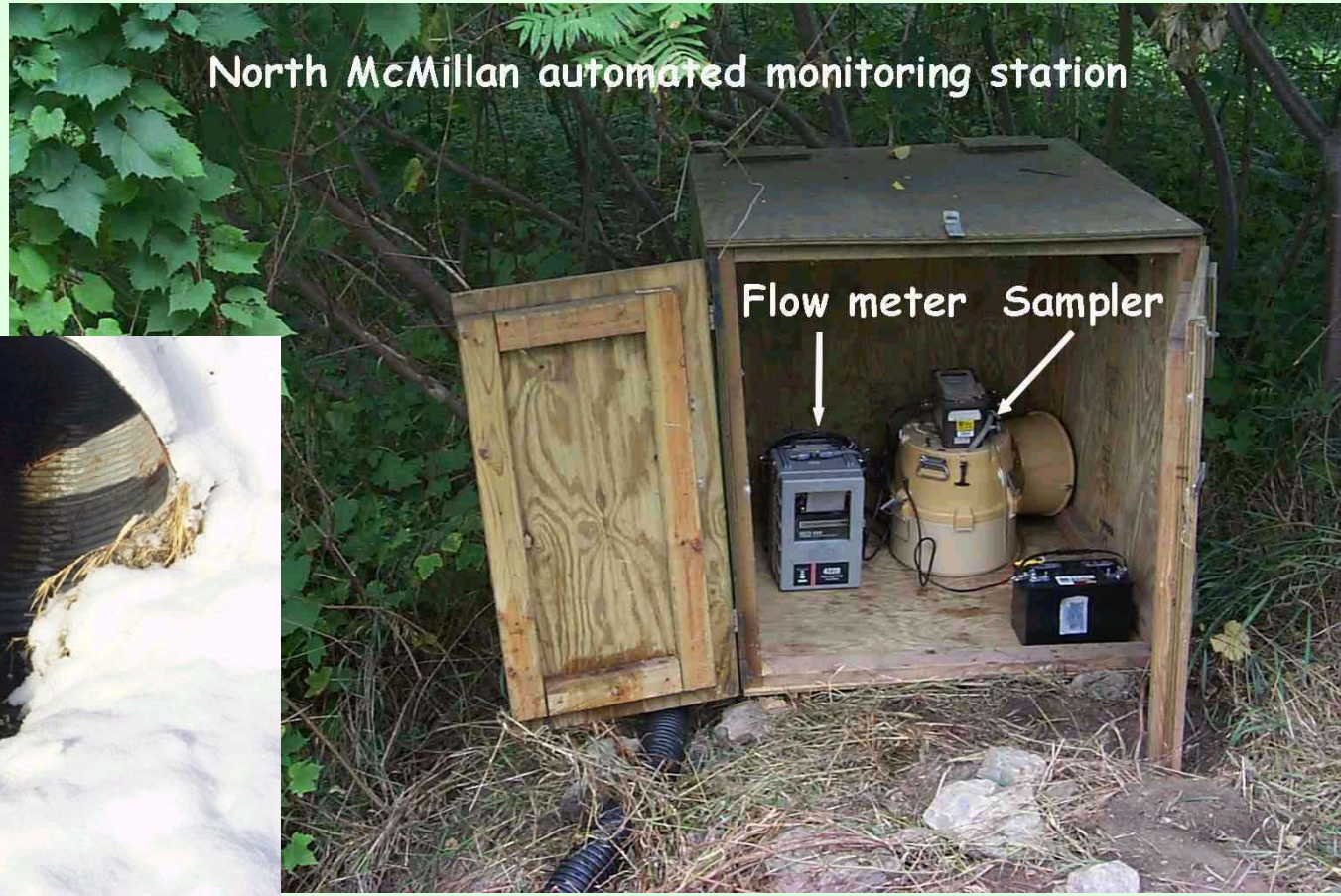
Experimental and Reference Watersheds



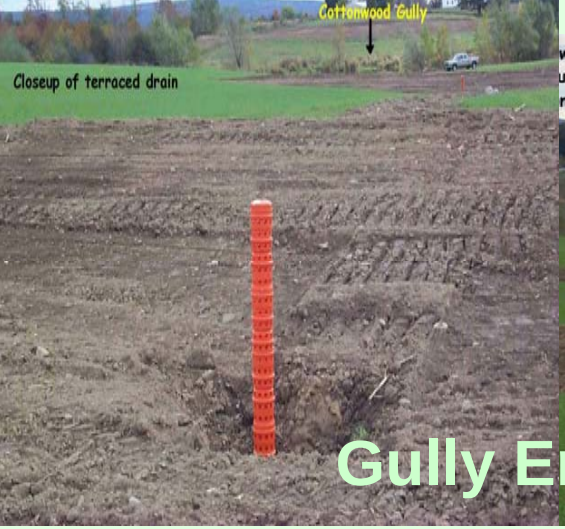
Map prepared by the Livingston County Planning Department, May 26, 2000. (rev. 12/3/2000)
M:\Arcview\Conesus Lake Watershed\subwatershed.apr

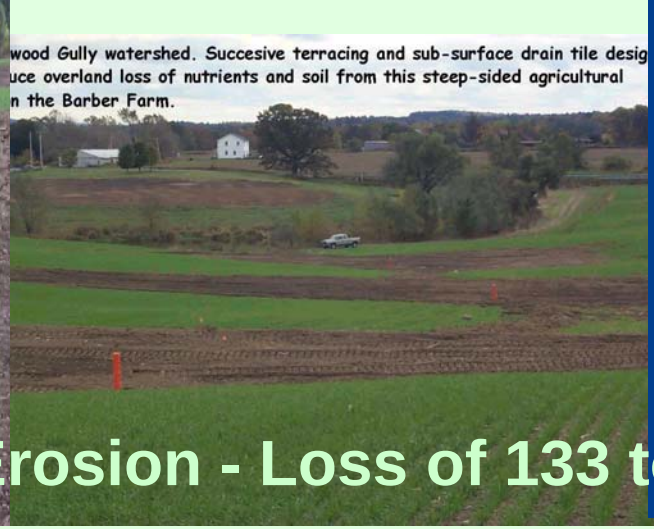
Sources: Watershed boundary derived from the Conesus Creek watershed boundary, New York State Department of Environmental Conservation, 2000, and the Livonia quadrangle, US Geological Service, 1951.

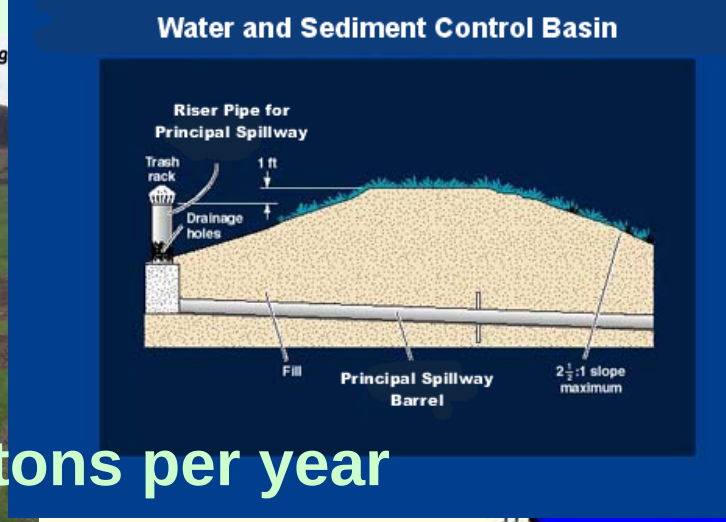
What effect do the implemented management plans have on retaining soil and nutrients within the watershed?



Pre- and Post- BMP monitoring of stream sites (continuous flow and chemistry)



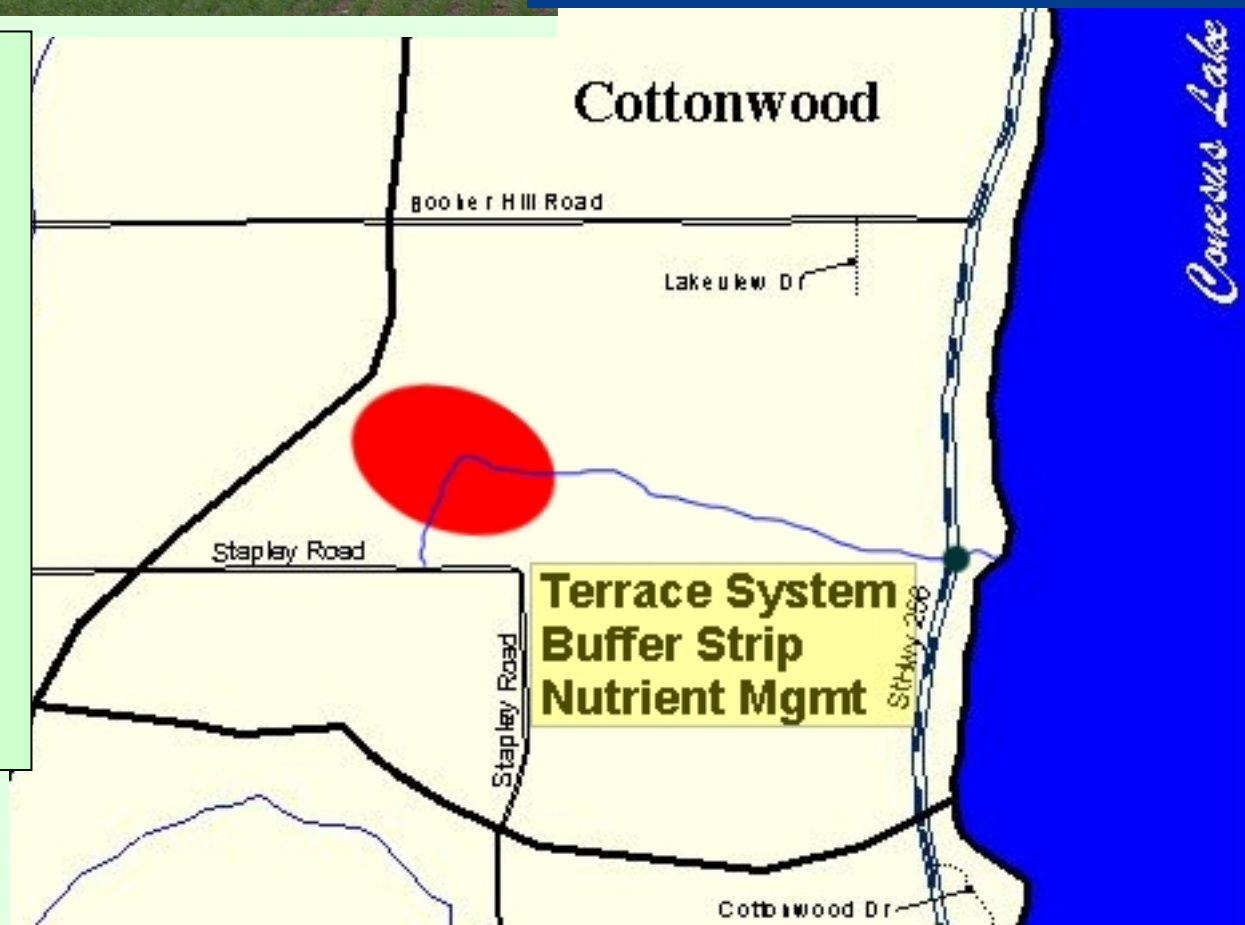




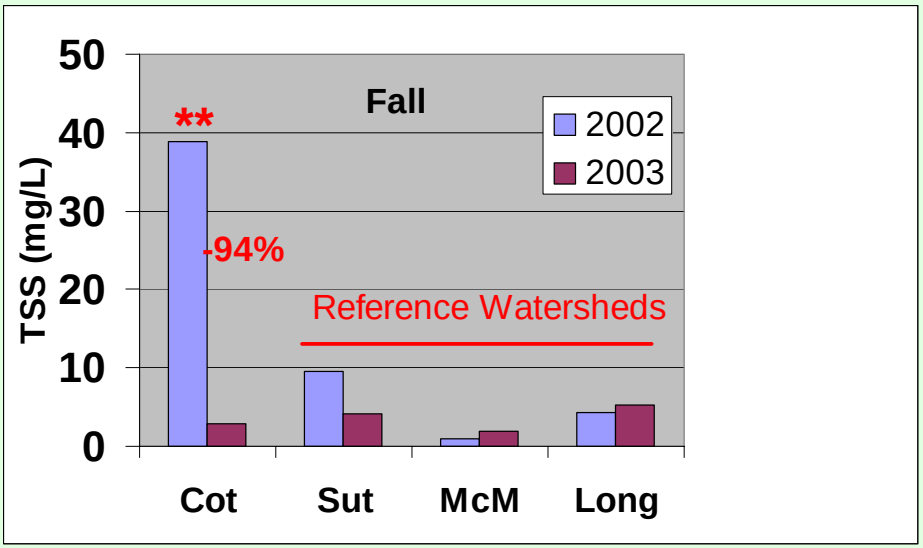
Gully Erosion - Loss of 133 tons per year

AEM Planning

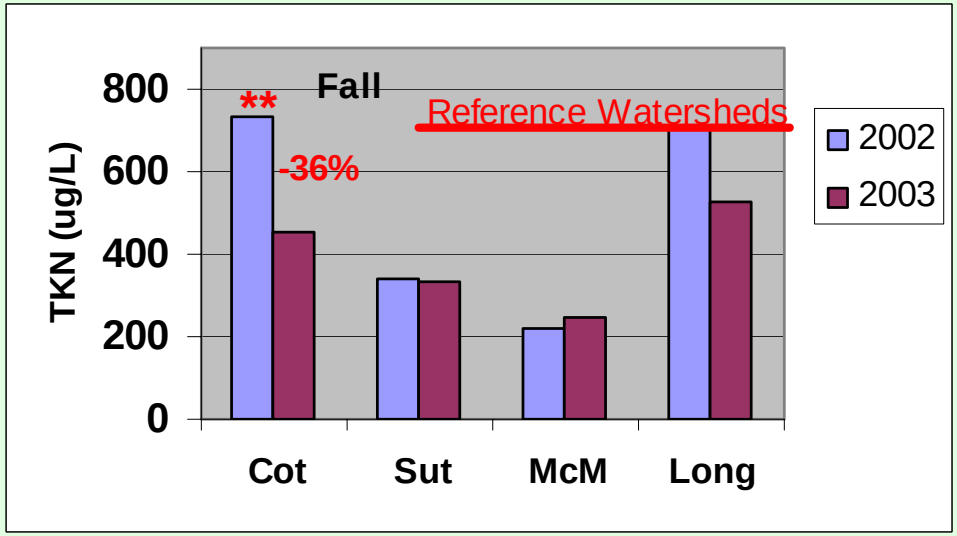
- *Total farm planning
  - *Nutrient Reduction
  - *Runoff reduction
  - *Strip cropping
  - *Buffer strips (alfalfa)
- *Teracing
- **Gully Plugs



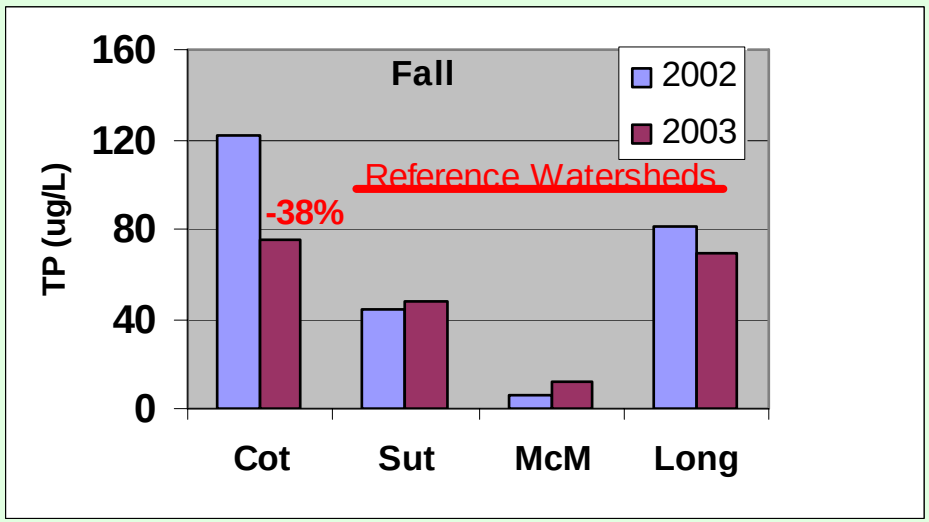
SOIL LOSS



ORGANIC NITROGEN LOSS



Phosphorus Loss



Major decrease in particulates with “gully plugs”, not in reference watersheds

No change or an increase in dissolved fractions


Conesus Lake
Graywood Watershed, February 2003

AEM Planning (All Exp. watersheds)

*Total farm planning

*Nutrient Reduction

*Runoff reduction

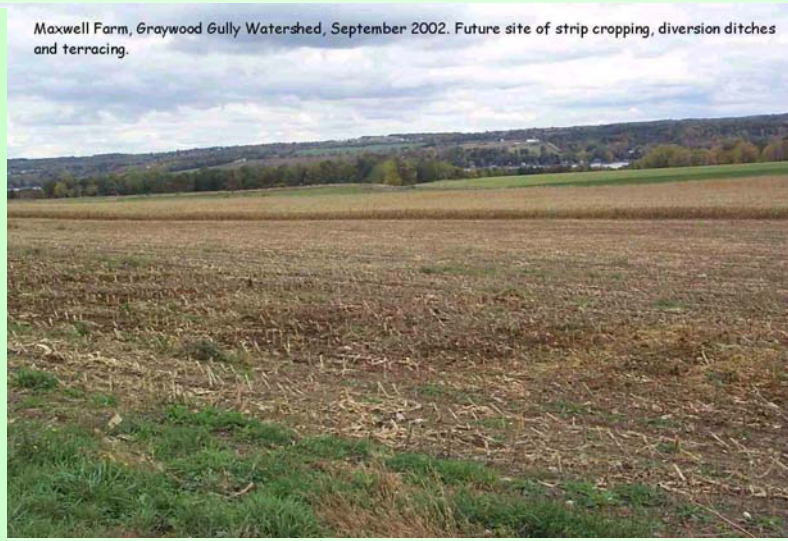
*Strip cropping

**Eliminated winter manure spreading

in hydrologically sensitive areas (HSAs) and and highly erodable land (HEL)

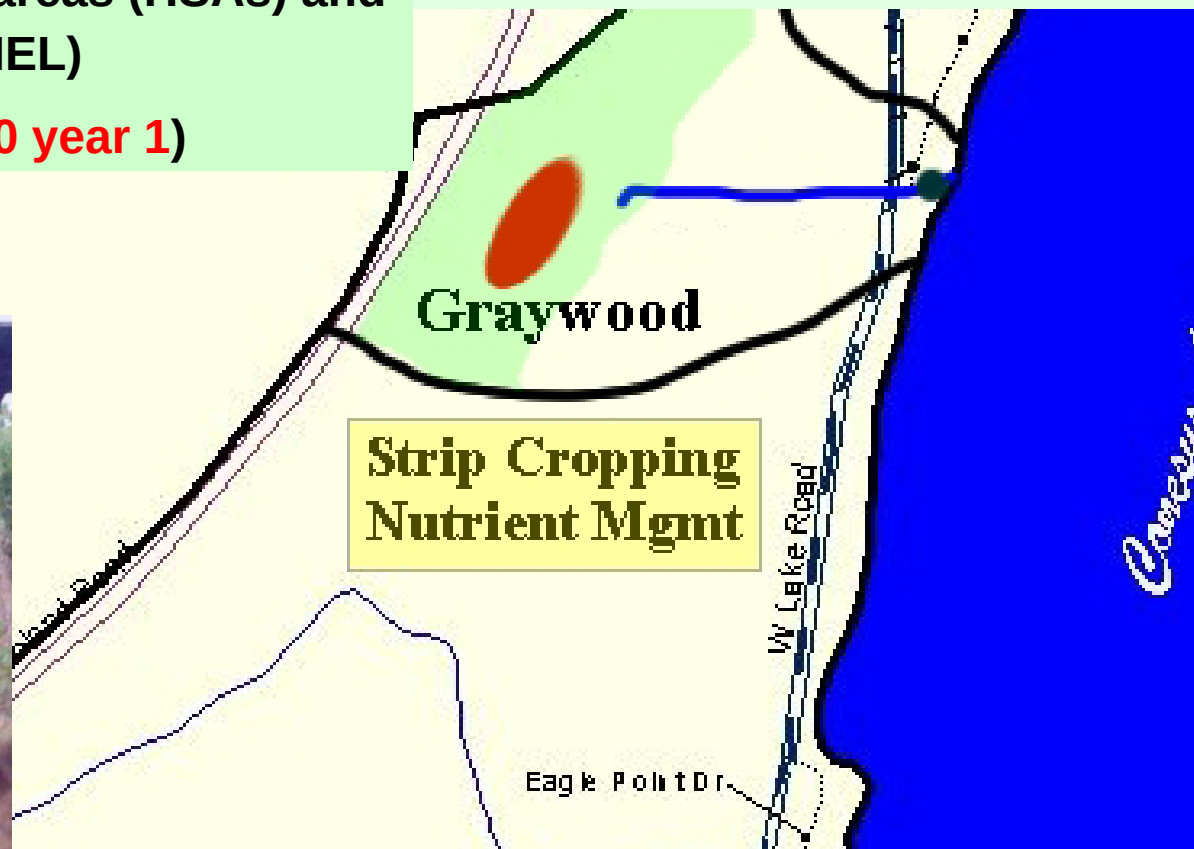
* Reduced fertilizer use ($5,000 year 1)

while maintaining yields

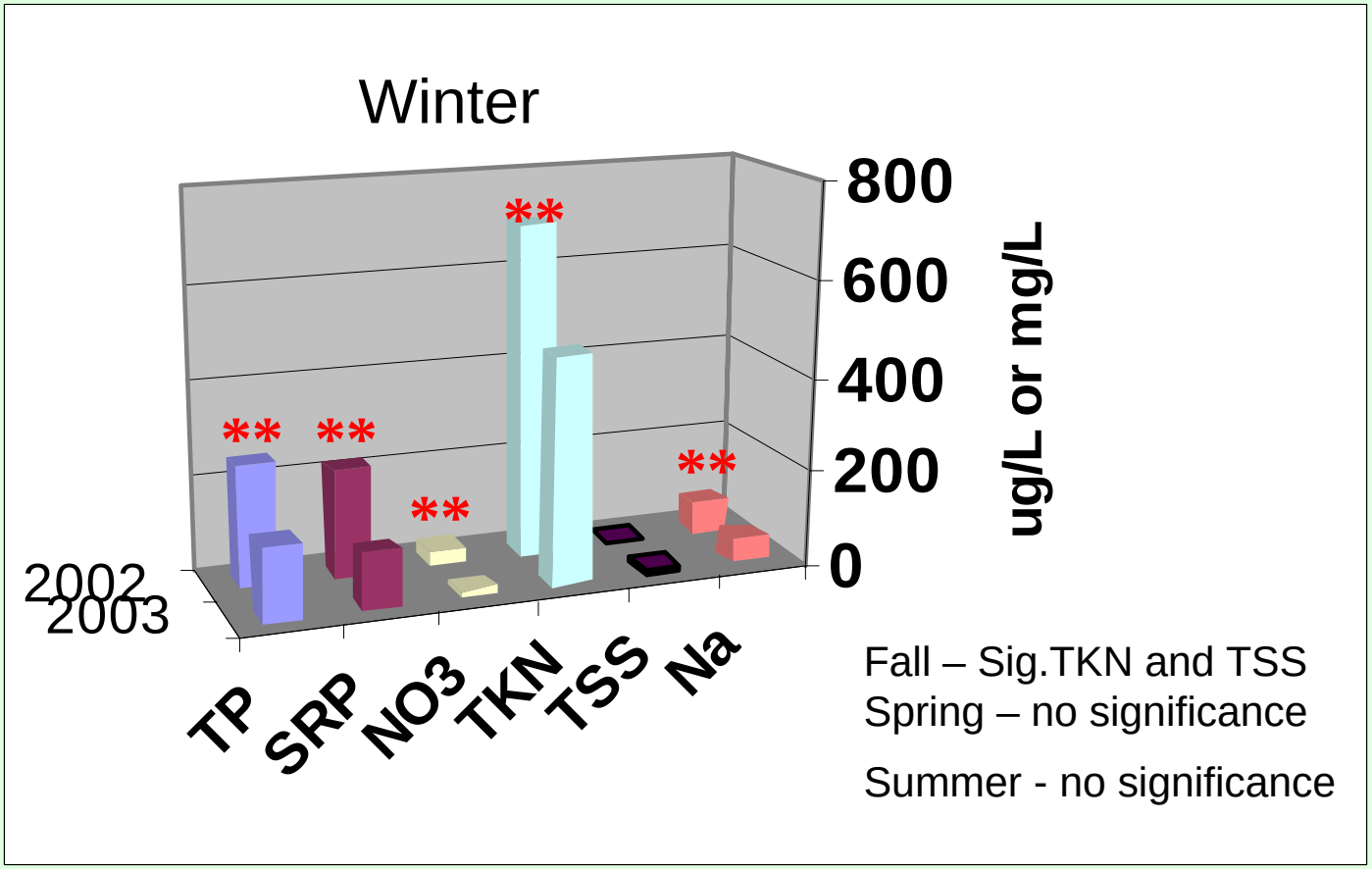


SRP = 210 mg SRP/L

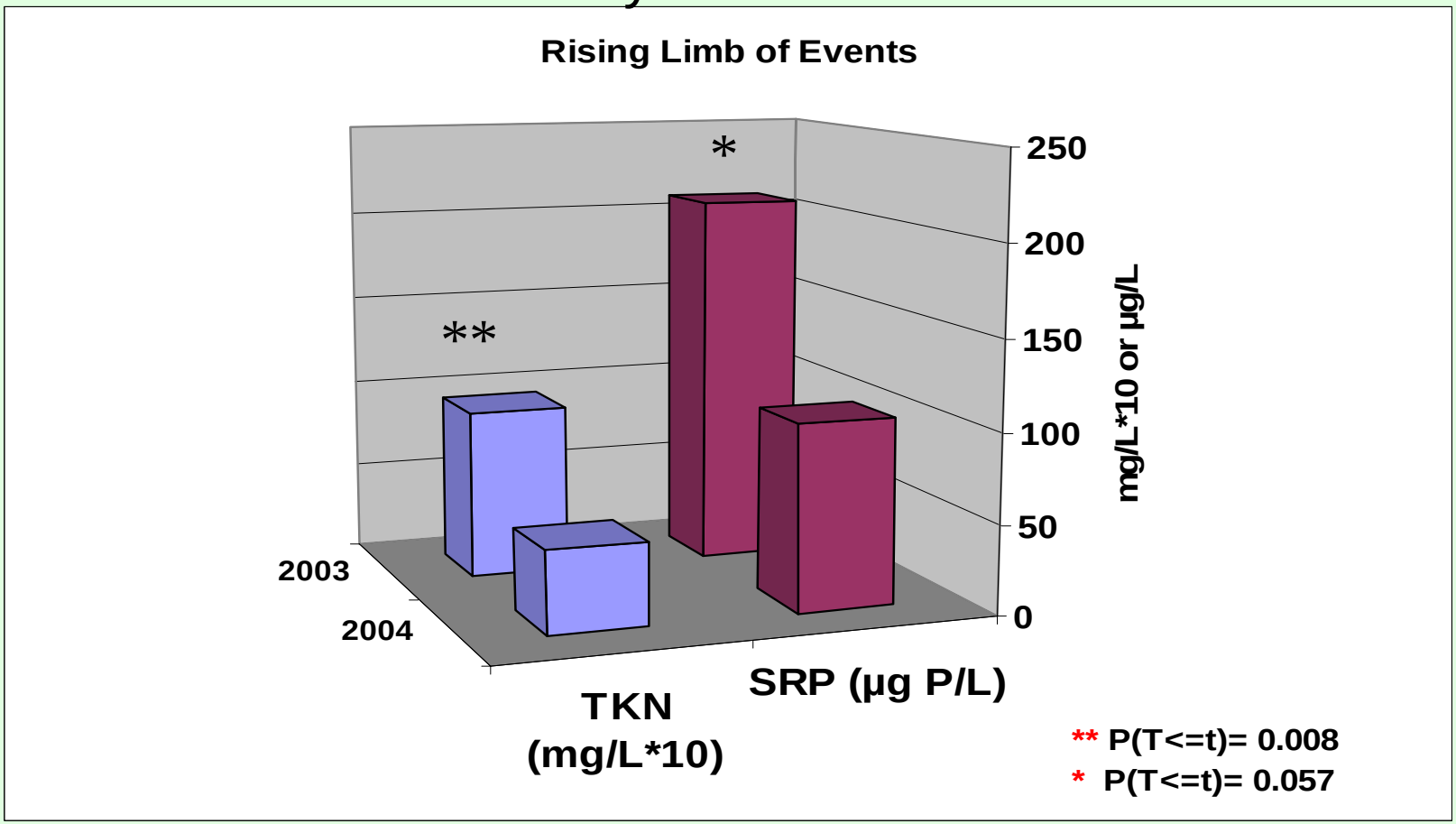
TKN = 1000mg N/L



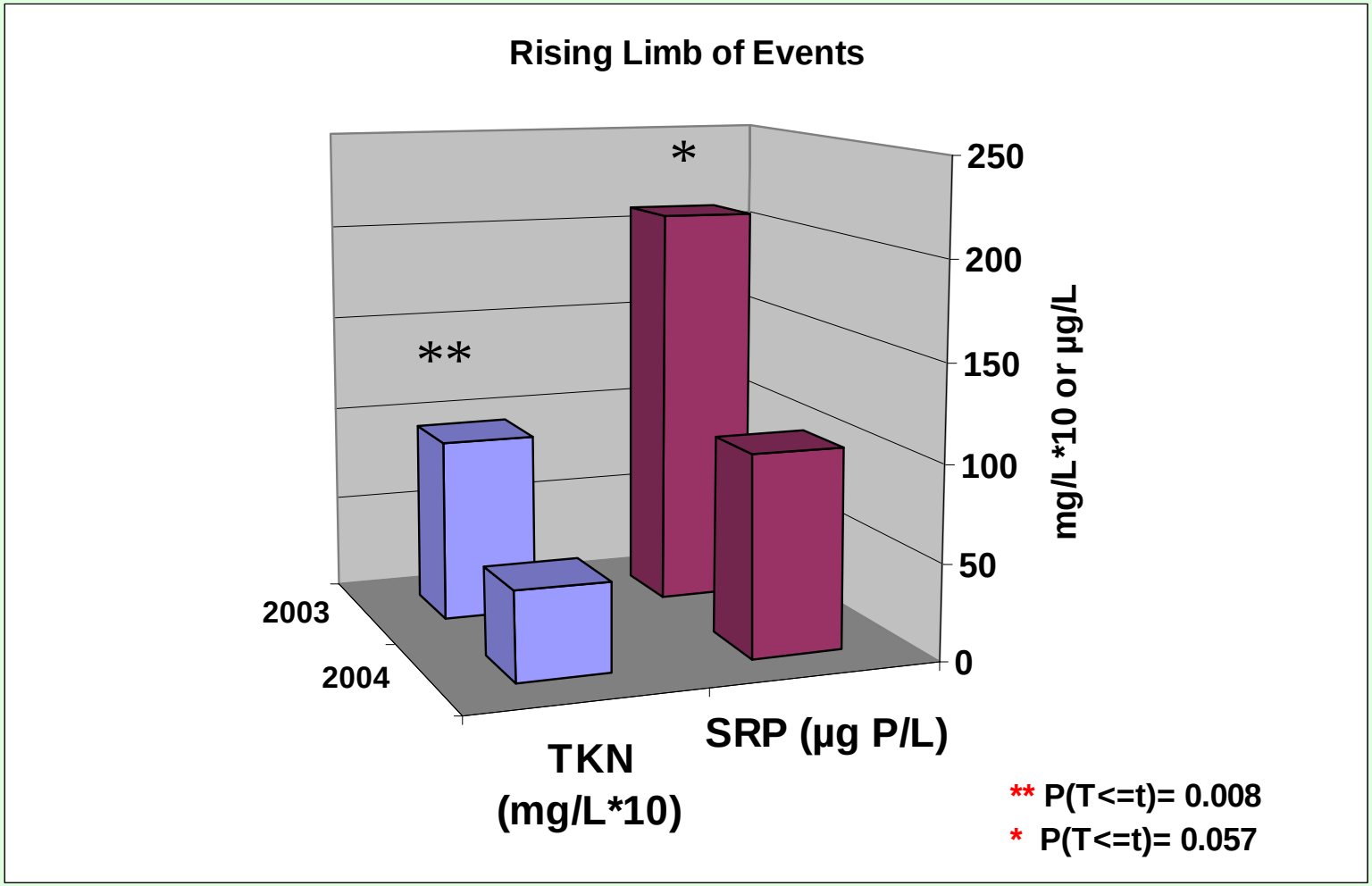
Effect of Management Practices on the Graywood Watershed (non-events)



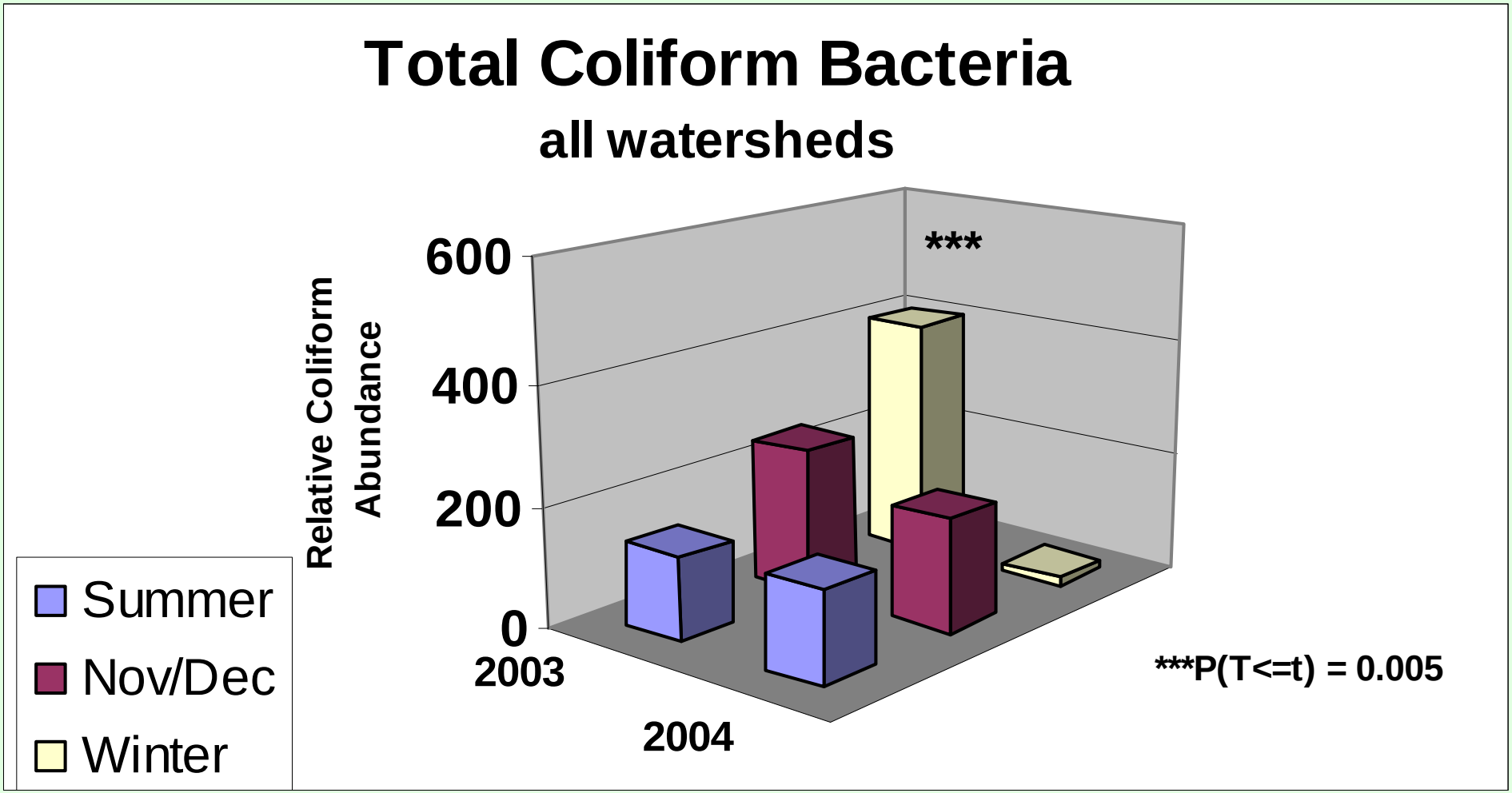
Graywood Events

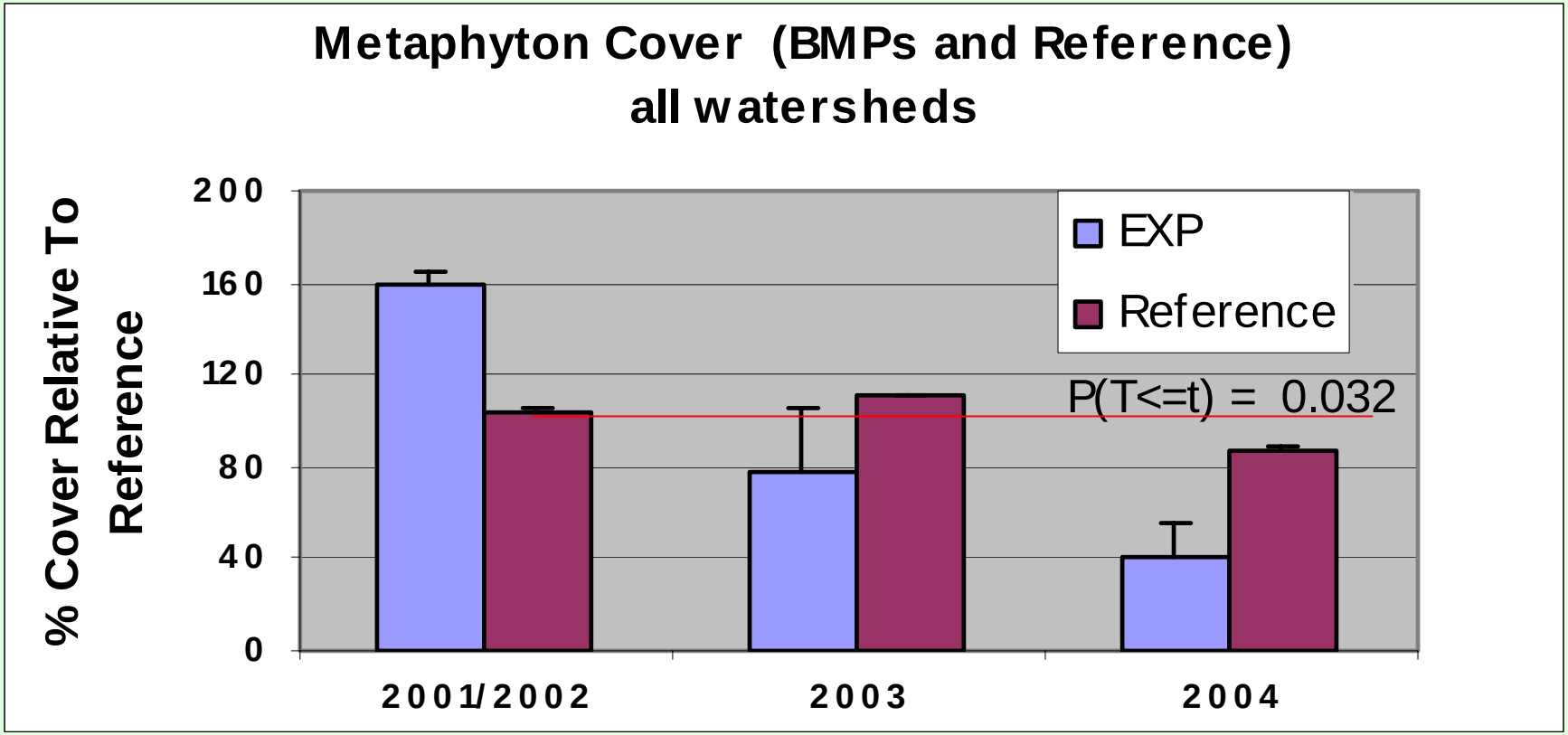


Graywood Events

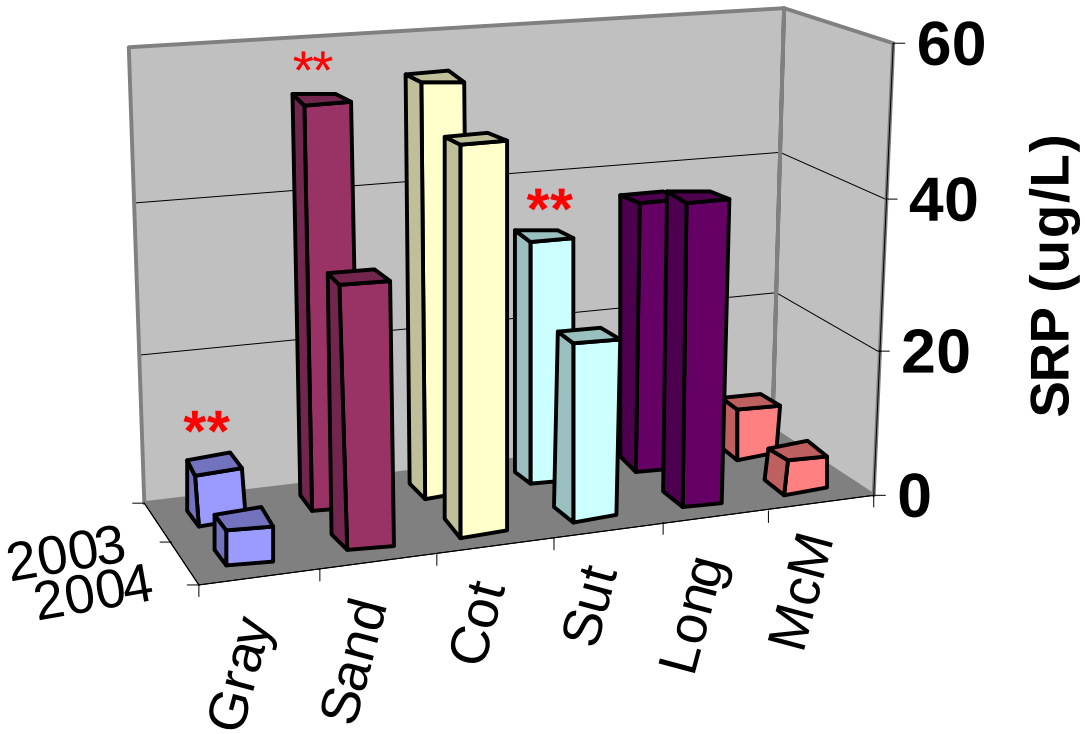


What effect did these management plans have on downstream biotic streams?




Metaphyton Cover (BMPs and Reference)
all watersheds
% Cover Relative To Reference
200
160
120
80
40
0
EXP
Reference
P(T<=t) = 0.032
2001/2002
2003
2004

Phosphorus Dynamics During Metaphyton Bloom



(July and August)

Summary (preliminary results)

***Demonstrated that some management practice very quickly retained nutrients and soils within the watershed.**

***Demonstrated that some MPs reduce nutrient (TP, SRP, NO_3, TKN) and soil loss to downstream systems.**

***Metaphyton and coliform bacteria were reduced in streams and in the lake in managed watersheds.**

***Macrophytes – some suggestions of a reduction but no response yet.**

Demonstrate to the Finger Lakes farming community, the utility and effectiveness of the implemented BMPs allowing regional policy makers and managers to develop optimal strategies for improving land usage in watersheds while significantly improving water quality and decreasing abundance of nuisance plant species in downstream ecosystems

The collaborative approach provides a mechanism for the farming community to be proactive in watershed issues through education, implementation of BMPs, and by its traditional stewardship of the land it farms and is a logical step in the implementation of the Conesus Lake Watershed Management Plan.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WATERSHED
HELP PROTECT
OUR WATER SUPPLY


The Cooperative State
Research, Education, and
Extension Service
USDA
EDUCATION

Agricultural Contribution of *E. coli* During Event and Non-Event Periods