Long-Term Water Quality Data Sets in the Cayuga Lake Watershed:

Identifying Nutrient "Hot Spots" for Equitable Management

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Who collects long-term water quality data sets?

Who?

Most datasets are collected by government agencies in order to construct mathematical models to guide watershed management. Data are used to calibrate models that aim to simulate natural processes.

Why?

The goal is to predict, set goals and manage the flux of non-point source (NPS) pollutants such as nutrients from a large watershed to an impaired water body such as a lake or a bay

Then What?

After model is calibrated, water quality data continues to be collected on a smaller scale for the purpose of assessing whether model-based watershed management goals are being met.

Large-scale watershed modeling/management programs are few and far between due to cost, which typically runs in the millions to tens of millions of dollars. Such programs are found almost exclusively in high-profile, i.e., economically and politically sensitive, watersheds.

Examples of Model-Based Programs to Manage Watershed-Wide NPS Pollution

Programs that include initial (calibration) and ongoing water quality data sets

Program includes initial (calibration) water quality data set

Chesapeake Bay Program
Science. Restoration. Partnership.

1983-
Federal agencies, state & local gov'ts, NGOs, private interests

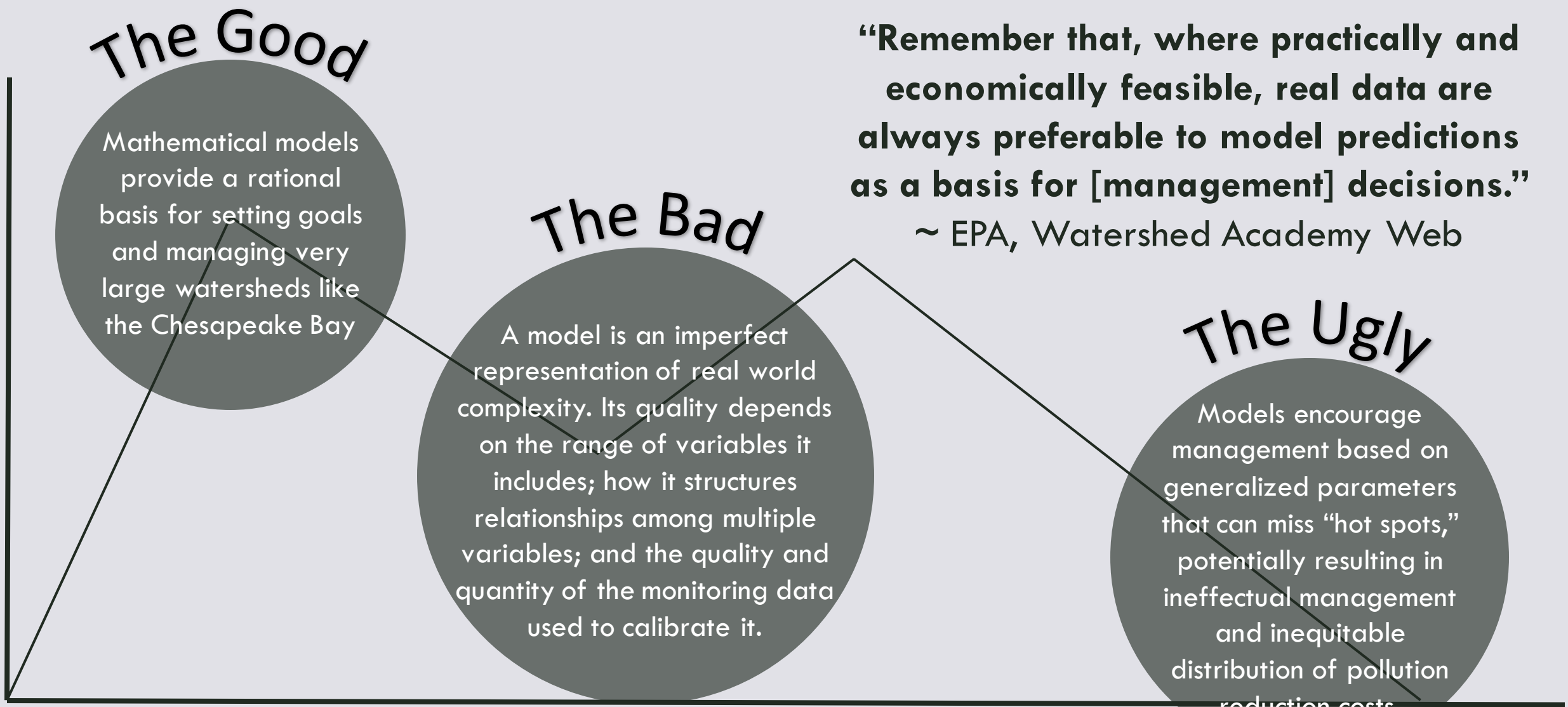
Lake Champlain Basin Program

1990-
Agencies of NY, VT and Quebec, NGOs, communities, private

Cayuga Lake TMDL, April-November, 2013 (tributary data)

2013-
NYSDEC, Cornell University, NGO (Upstate Freshwater Institute)

Model-Based Watershed Management: The Good, the Bad and the Ugly



"Remember that, where practically and economically feasible, real data are always preferable to model predictions as a basis for [management] decisions."

~ EPA, Watershed Academy Web

Community-Based Monitoring Aims to Document Instead of Simulate

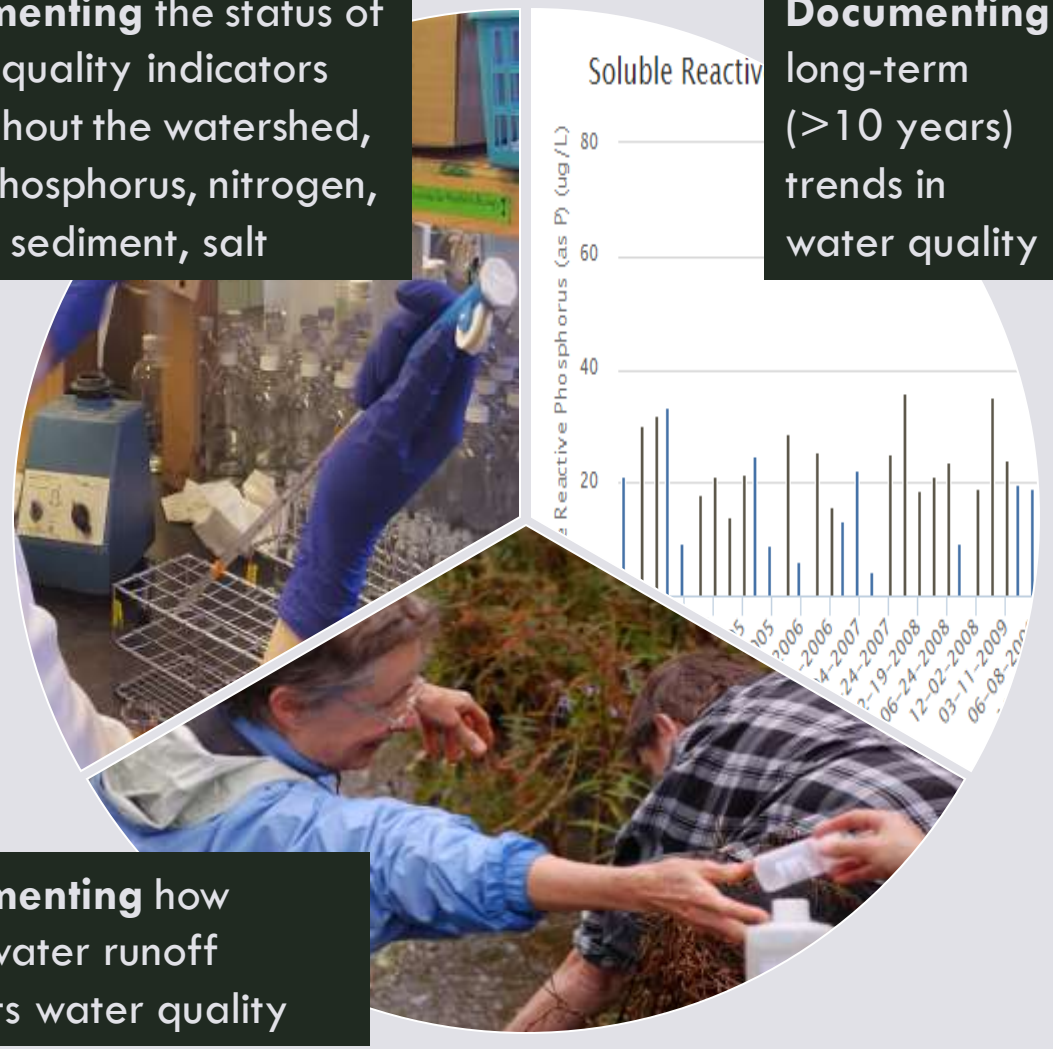
Instead of trying to simulate natural processes, community-based monitoring aims to guide watershed management decisions by:

Directly **determining** pollutant loading from tributaries

Identifying "hot spot" sub-watersheds and catchment areas for focused management

Documenting the status of water quality indicators throughout the watershed, e.g., phosphorus, nitrogen, E. coli, sediment, salt

Documenting long-term (>10 years) trends in water quality



Documenting how stormwater runoff impacts water quality

Community-Based Monitoring Programs Require Scientific Support

University Support

Alabama Water Watch

NGO Support

ADOPT A STREAM FOUNDATION

WATERKEEPER® ALLIANCE

CSi

State Support

Michigan Clean Water Corps

DEQ Department of Environmental Quality

CSLAP

Department of Environmental Conservation

Combinations of university, NGO and/or state government support:

CMC Chesapeake Monitoring Cooperative

Community-Based Monitoring : The Good, the Bad and the Ugly

CSI Addresses Issues of Data Quality, Data Management and Funding Associated with Volunteer Monitoring Programs

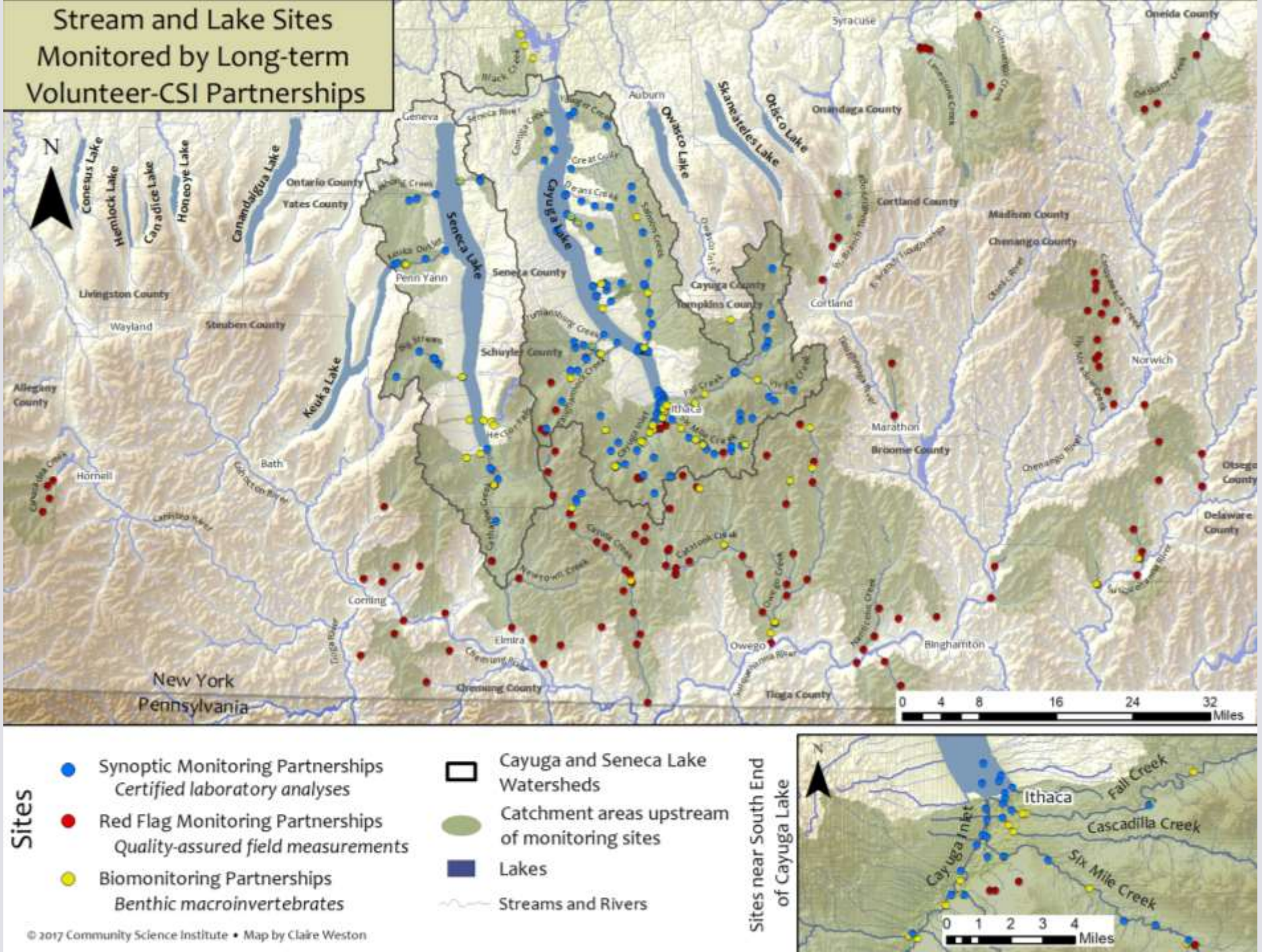
Monitoring data are regulatory-quality because the data are produced by a state and nationally certified environmental testing lab

Data are made publicly available free of charge in an online interactive database complete with interpretive maps and graphs

Core funding is provided by local governments in Tompkins County

CSI Addresses Issues of Data Quality, Data Management and Funding Associated with Volunteer Monitoring Programs

As a result of these program elements, CSI has been able to partner with nine volunteer groups, some for more than a decade, to collect and publicize some 50,000 water quality data items from over 100 monitoring locations on streams draining 70% of the Cayuga Lake watershed.


Stream and Lake Sites Monitored by Long-term Volunteer-CSI Partnerships
N
Conesus Lake
Hemlock Lake
Canadice Lake
Honeoye Lake
Canandaigua Lake
Ontario County
Yates County
Geneva
Seneca River
Auburn
Owasco Lake
Skaneateles Lake
Otisco Lake
Onondaga County
Syracuse
Oneida County
Cortland County
Madison County
Chenango County
Seneca Lake
Cayuga Lake
Seneca County
Cayuga County
Tompkins County
Penn Yann
Livingston County
Wayland
Steuben County
Schuyler County
Keuka Lake
Ithaca
Cortland
Norwich
Marathon
Broome County
Allegany County
Hornell
Bath
Corning
Elmira
Chemung County
Owego
Binghamton
Tioga County
Otsego County
Delaware County
New York
Pennsylvania
0 4 8 16 24 32 Miles
Sites
Synoptic Monitoring Partnerships
Certified laboratory analyses
Red Flag Monitoring Partnerships
Quality-assured field measurements
Biomonitoring Partnerships
Benthic macroinvertebrates
Cayuga and Seneca Lake Watersheds
Catchment areas upstream of monitoring sites
Lakes
Streams and Rivers
© 2017 Community Science Institute • Map by Claire Weston
Sites near South End of Cayuga Lake
N
Ithaca
Fall Creek
Cascadilla Creek
Six Mile Creek
Cayuga Inlet
0 1 2 3 4 Miles

What, if anything, can monitoring data tell us about nutrient "hot spots" in the Cayuga Lake Watershed?

- Measurements of dissolved phosphorus and total nitrogen provide reasonably good indicators of nutrient bioavailability.
- Agriculture has the potential to act as a non-point source of nutrient loading to streams and lakes.
    - Other sources include golf courses, lawns and POTWs

Questions:

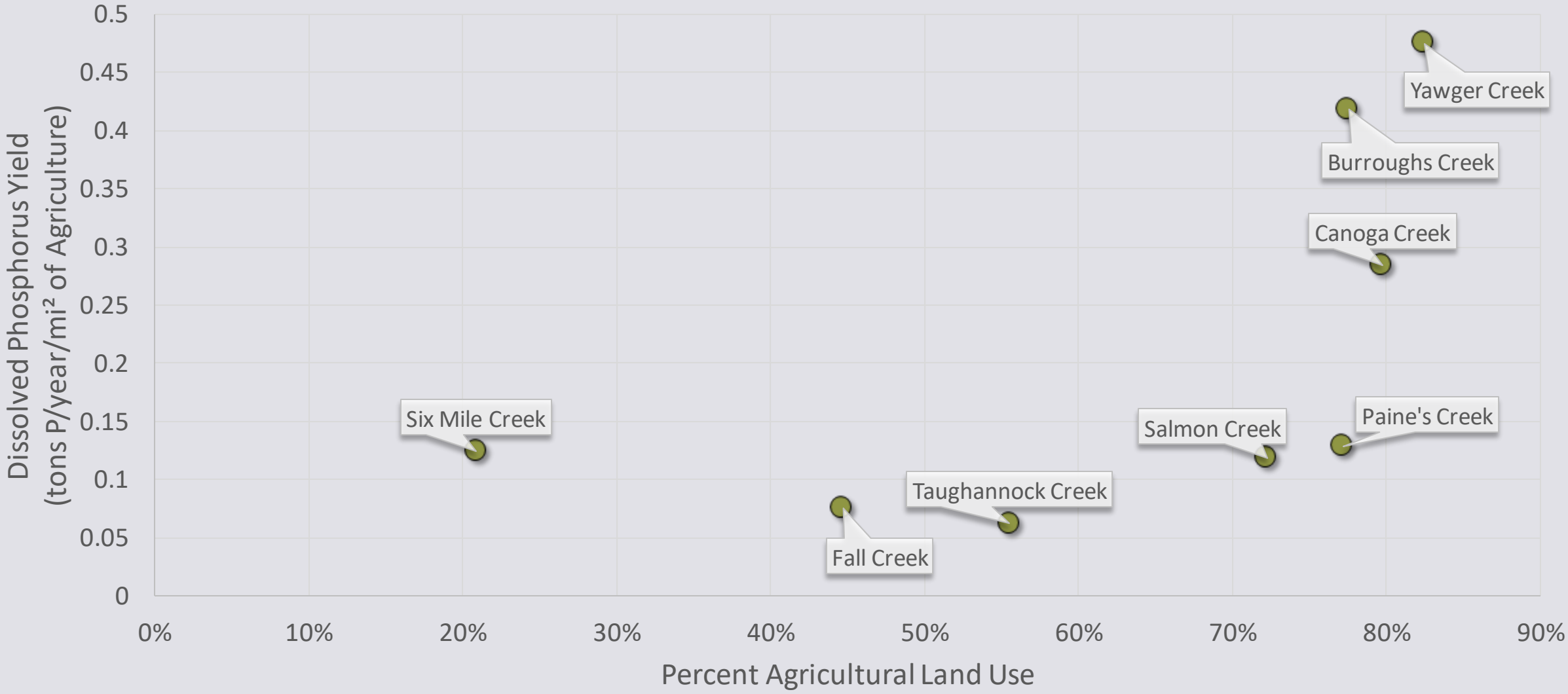
- *How much phosphorus and nitrogen are streams loading to Cayuga Lake?*
- *Is there a relationship between nutrient loading and agricultural land use?*

Note: Loads in ungauged streams are estimated +/- approx. 30%

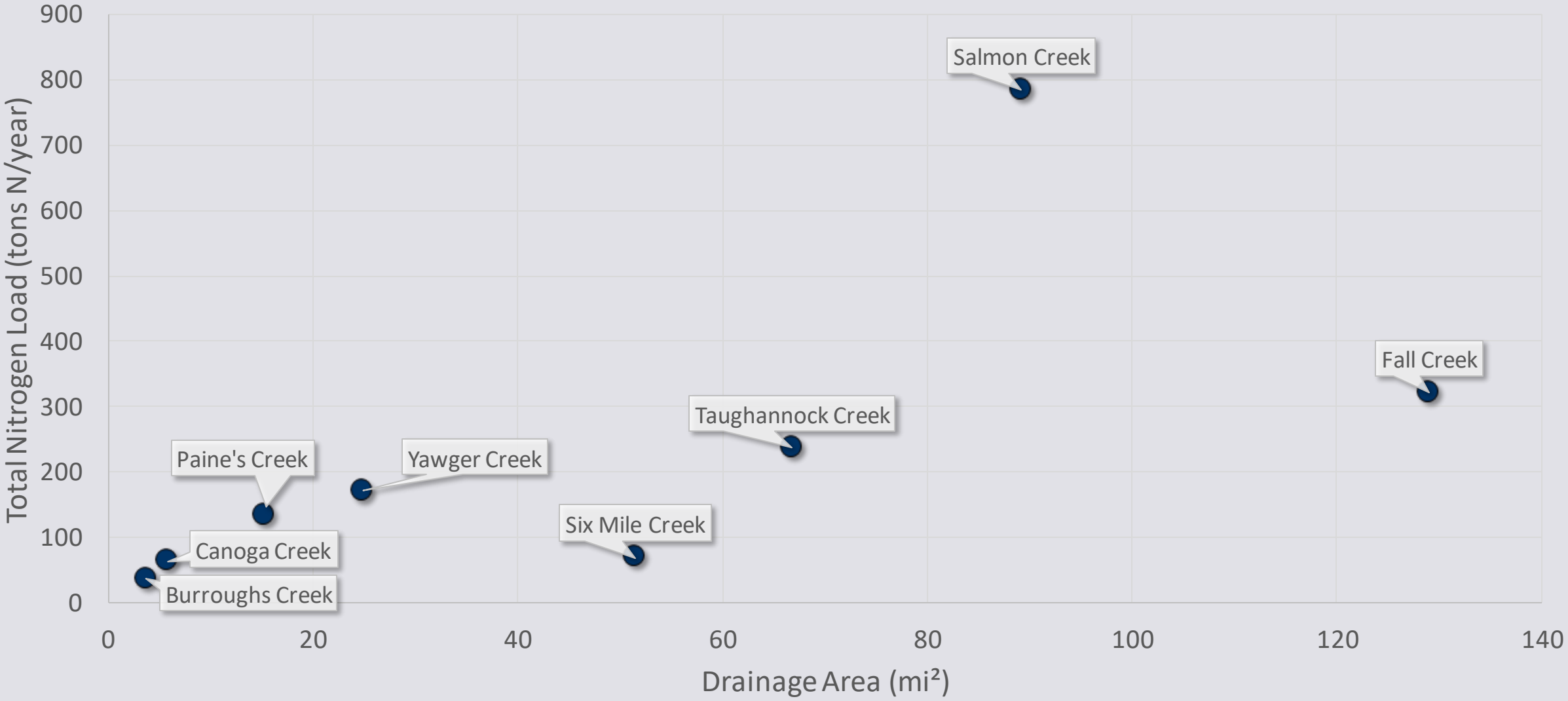
Loading of Dissolved Phosphorus from Selected Sub-Watersheds to Cayuga Lake (tons P/year)

Yields of Dissolved Phosphorus from Selected Sub-Watersheds of Cayuga Lake (tons P/year/mi2 agricultural land use)

Dissolved Phosphorus Yields in Relation to Percent Agricultural Land Use in Sub-Watersheds

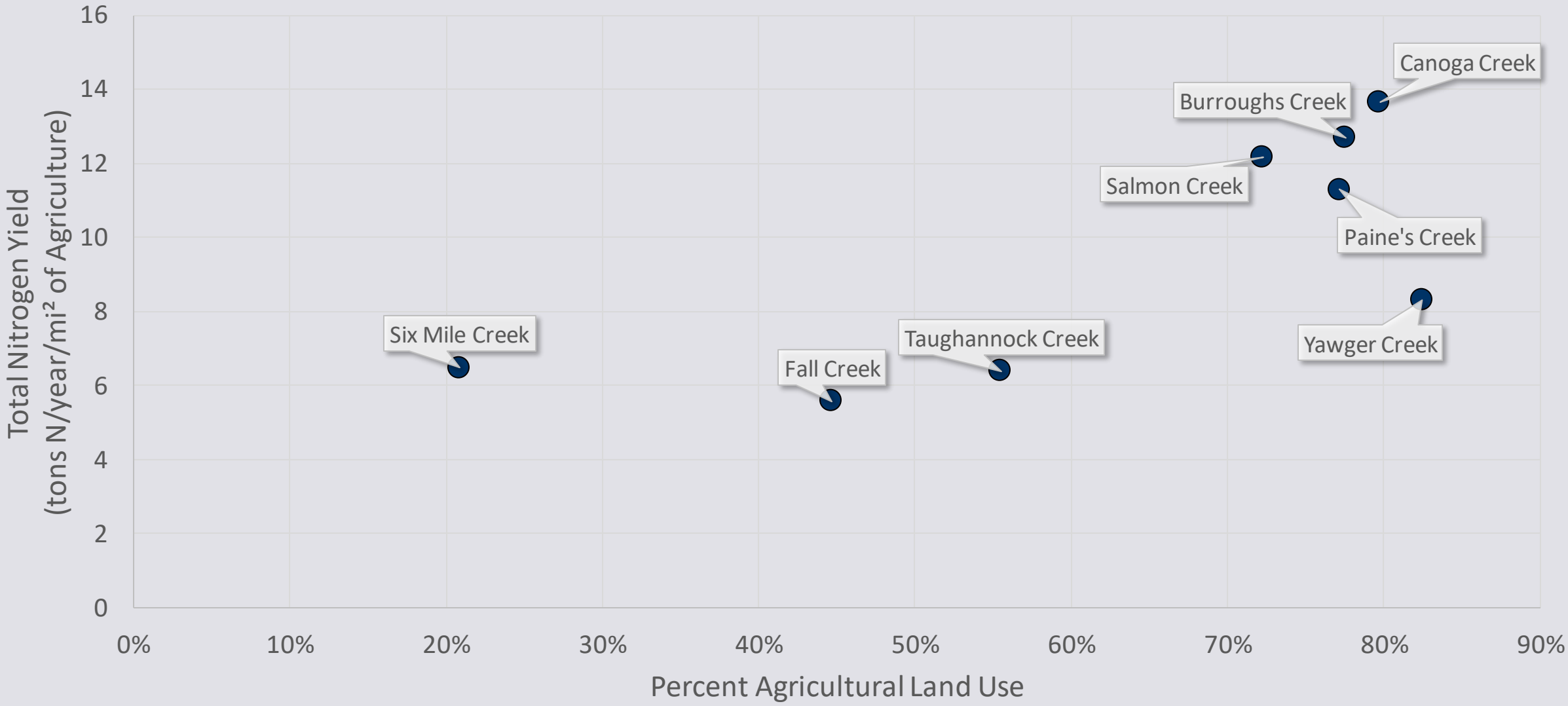


Loading of Total Nitrogen from Selected Sub-Watersheds to Cayuga Lake (tons N/year)



Yields of Total Nitrogen from Selected Sub-Watersheds of Cayuga Lake (tons N/year/mi2 agricultural land use)

Total Nitrogen Yields in Relation to Percent Agricultural Land Use in Sub-Watersheds



Nutrient Yield Appears to be Related to Agricultural Land Use

- Yield is the amount of phosphorus or nitrogen that a sub-watershed exports to Cayuga Lake from each acre of its land.
- If each acre of agricultural land produced the same amount of nutrient runoff, then yields should be the same – and the graphs of yields should be flat – regardless of the sub-watershed or of how much land was in agricultural use.
- Instead, we observe that nutrient yields vary widely across sub-watersheds, by a factor of 9 for dissolved phosphorus and a factor of 2 for total nitrogen.
- This indicates that significant reductions in nutrient loading could be achieved by improving nutrient management in "hot spot" sub-watersheds with high nutrient yields.

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