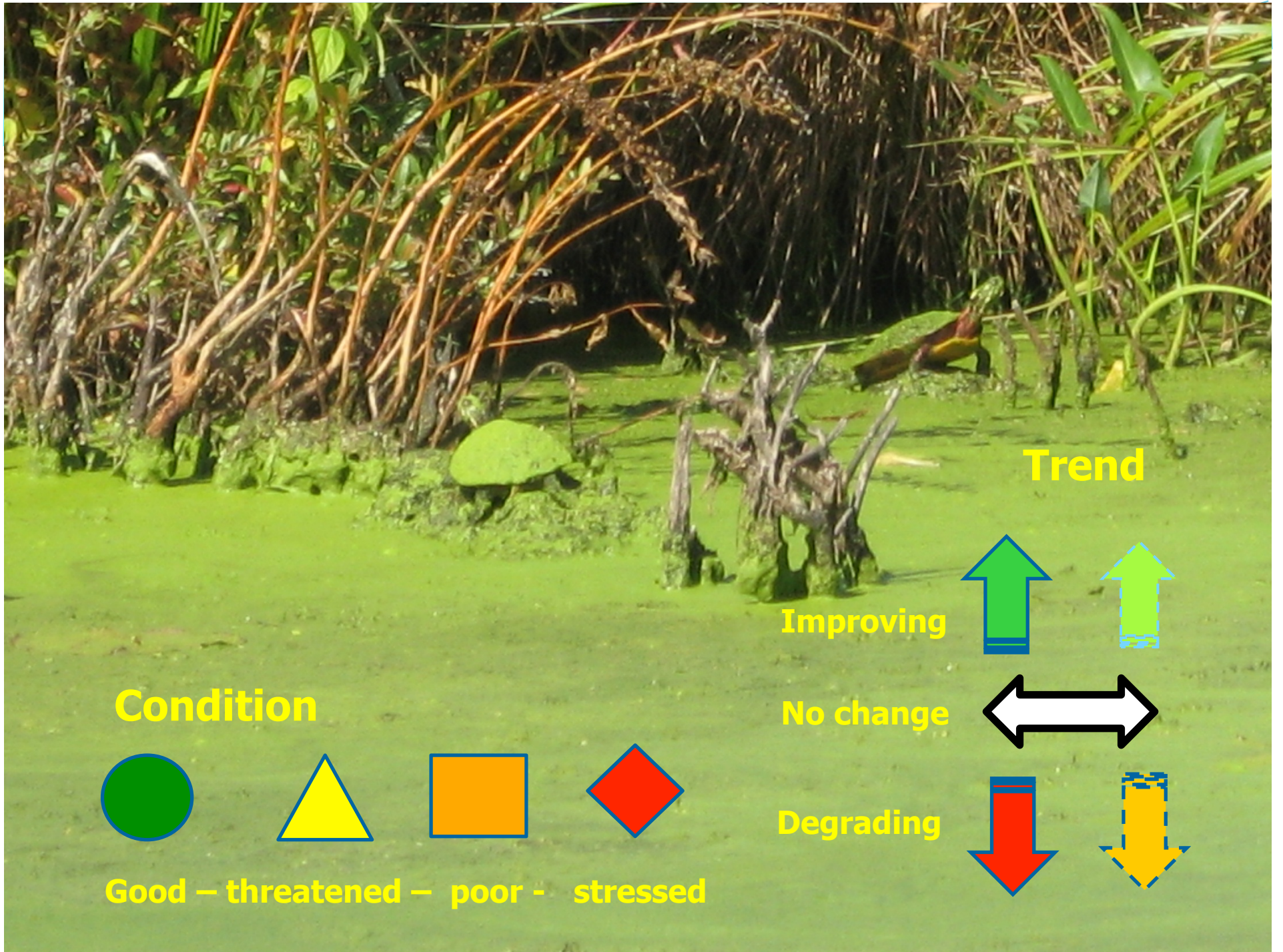


# Copake Lake Annual Meeting

July 12, 2014

George Knoecklein  
Northeast Aquatic Research  
74 Higgins Highway  
Mansfield Center, CT



**Condition**



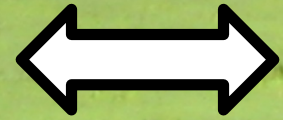
**Good – threatened – poor - stressed**

**Trend**

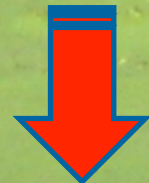
**Improving**



**No change**


















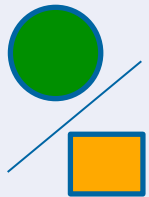














**Degrading**



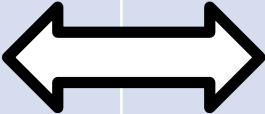








# Copake Lake Condition

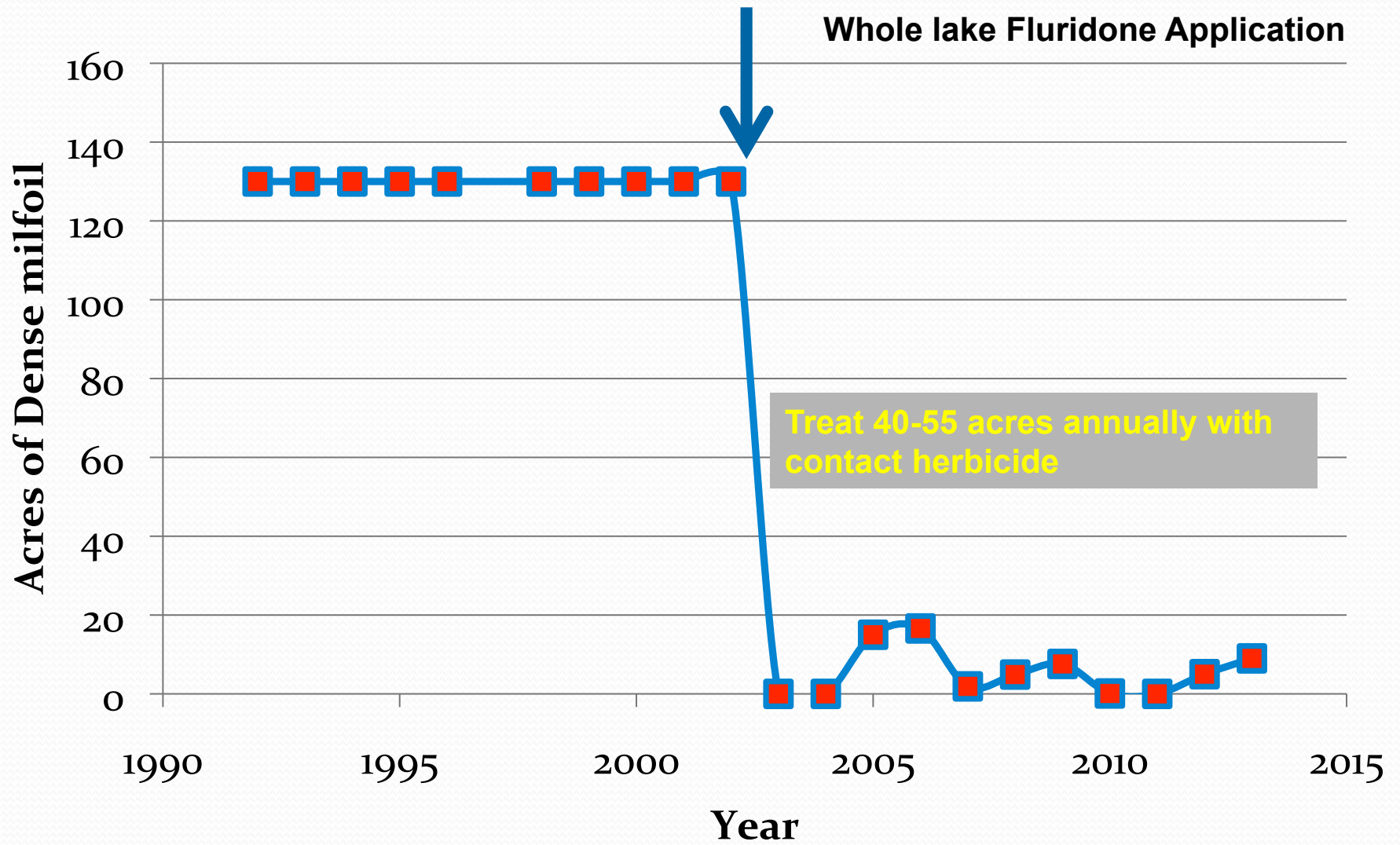
↓ Whole lake Fluridone application

	2000	2005	2006	2007	2008	2009	2010	2011	2012	
Milfoil & Curly										
Water clarity										
Native plant diversity										

# Copake Lake Condition

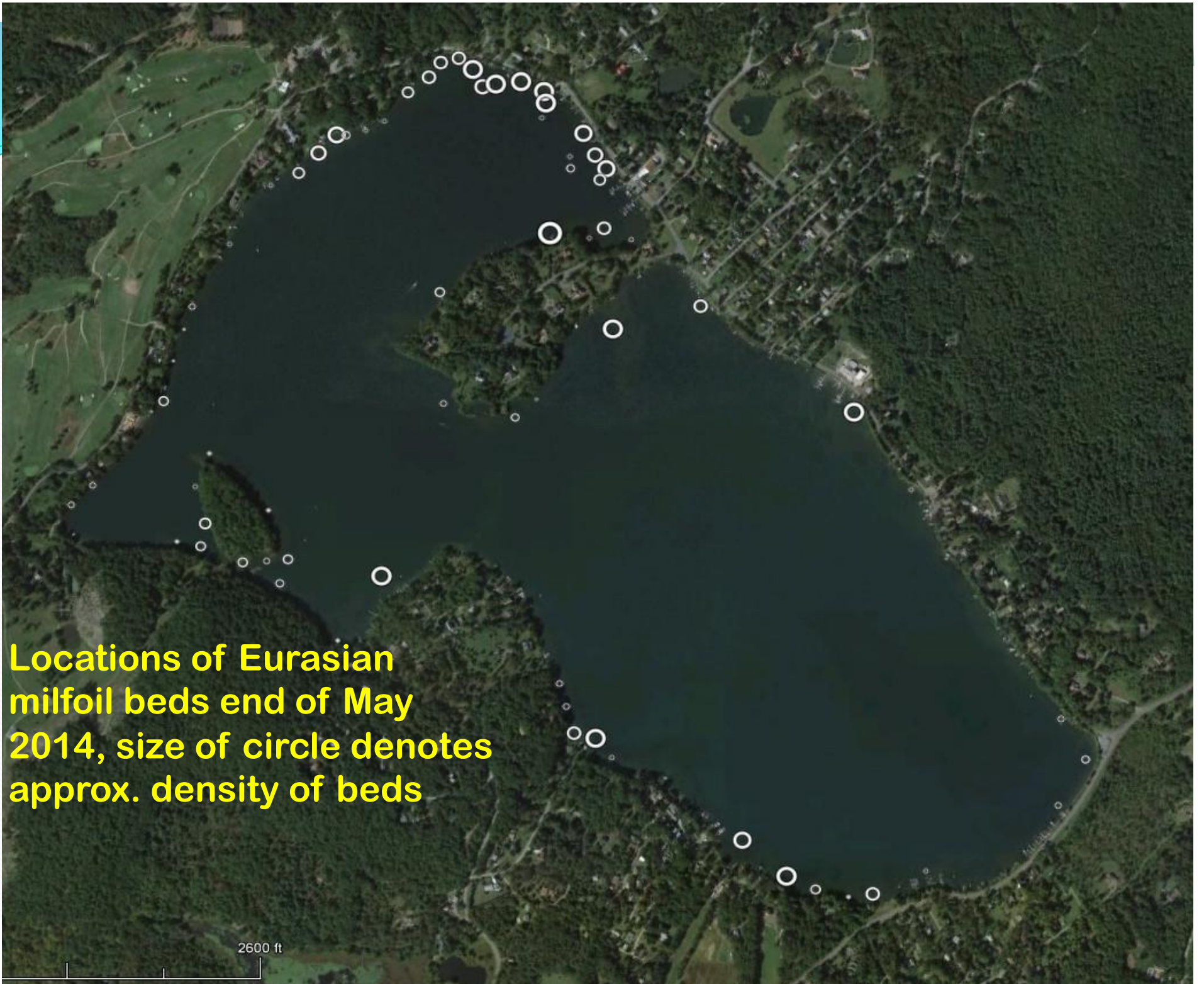
	2013	2014									
Milfoil & Curly											
Water clarity											
Native plant diversity				There are now 11 species of native aquatic plants in Copake Lake							

# Acres of Milfoil

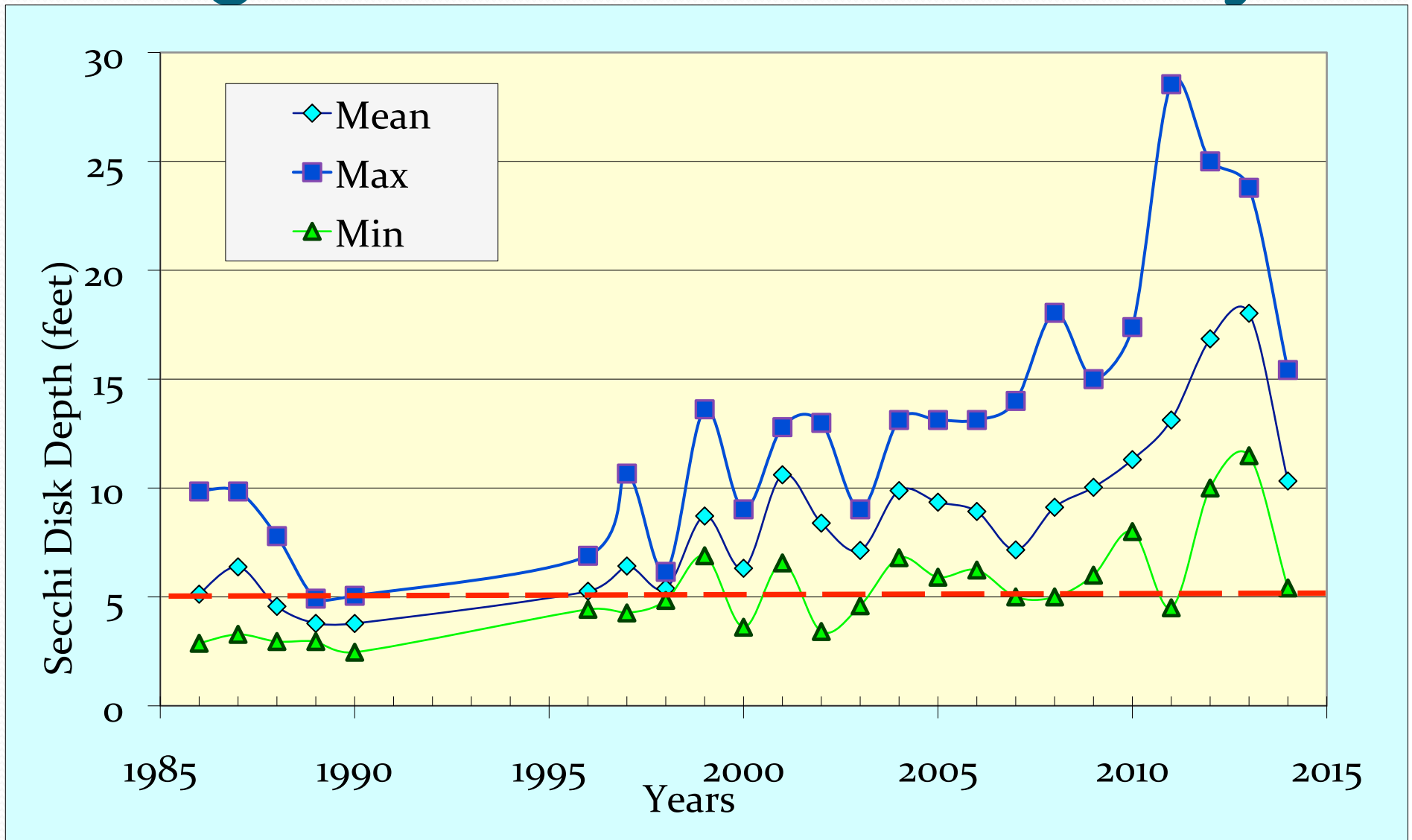


**Locations of Eurasian  
milfoil beds end of May  
2014, size of circle denotes  
approx. density of beds**

2600 ft

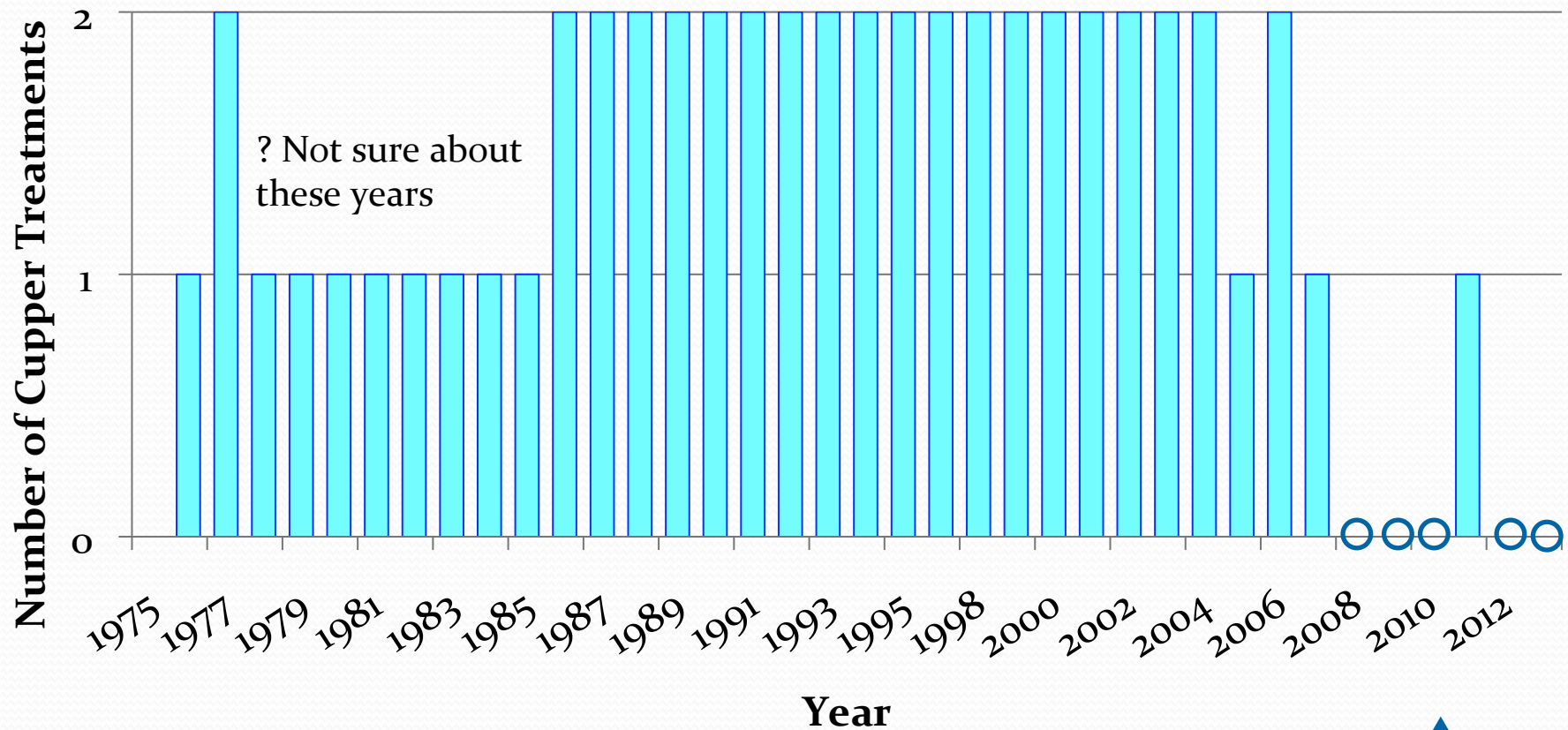


# Long-term trend in water clarity



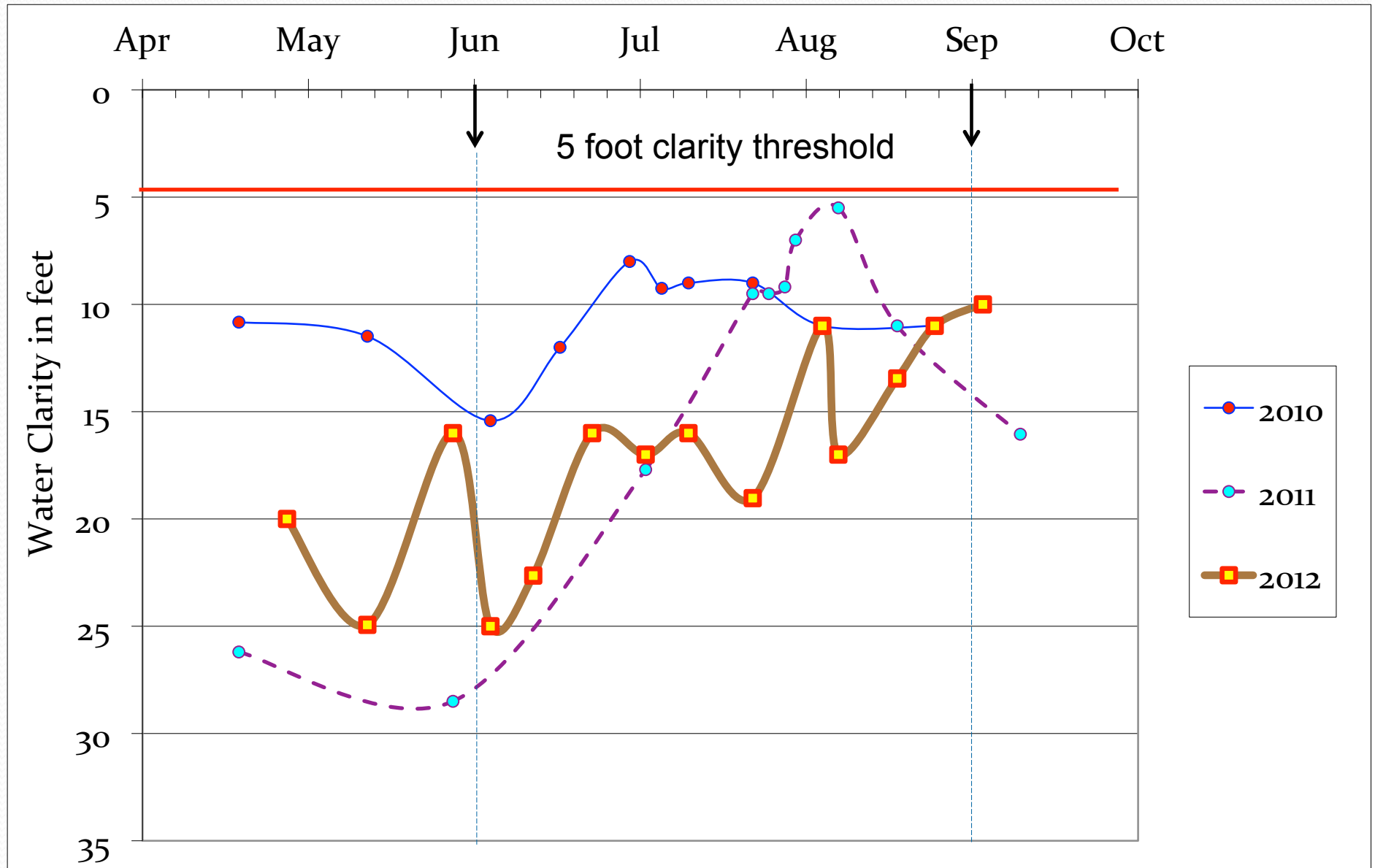
# Trend in copper sulfate applications

Beginning in 2005 need for whole lake copper treatments has declined

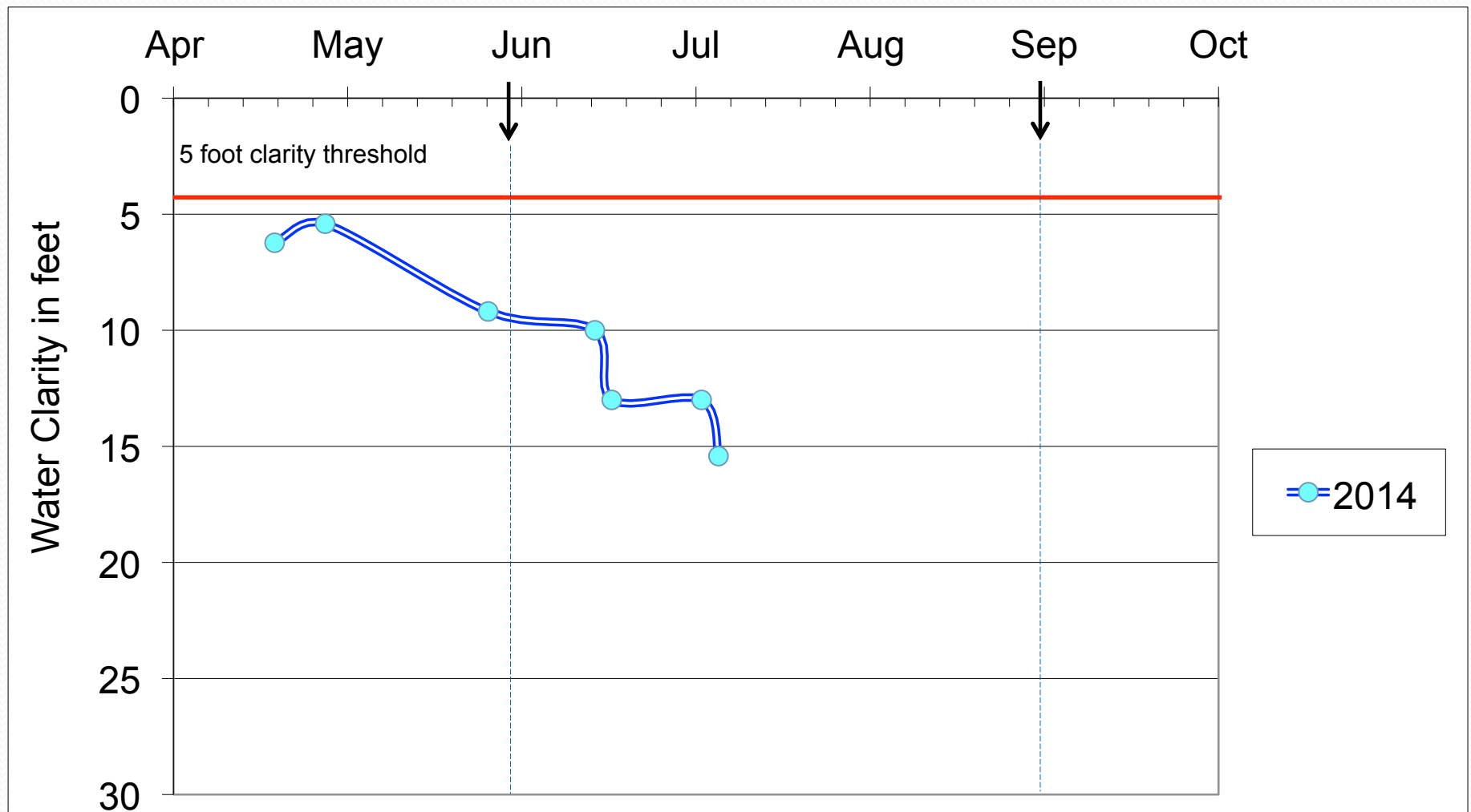


No applications 

# Trends in Seasonal Water Clarity

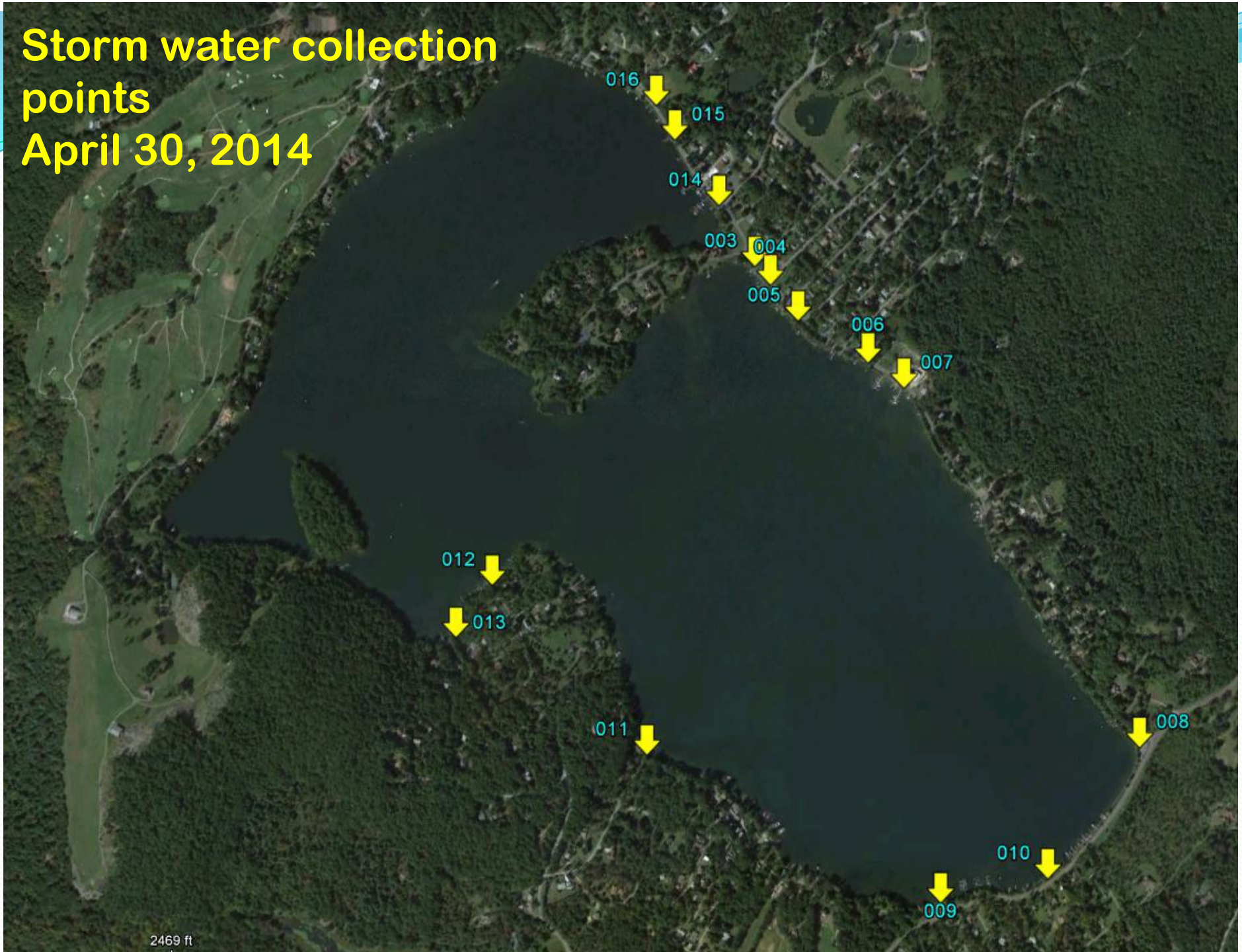


# 2014 water clarity

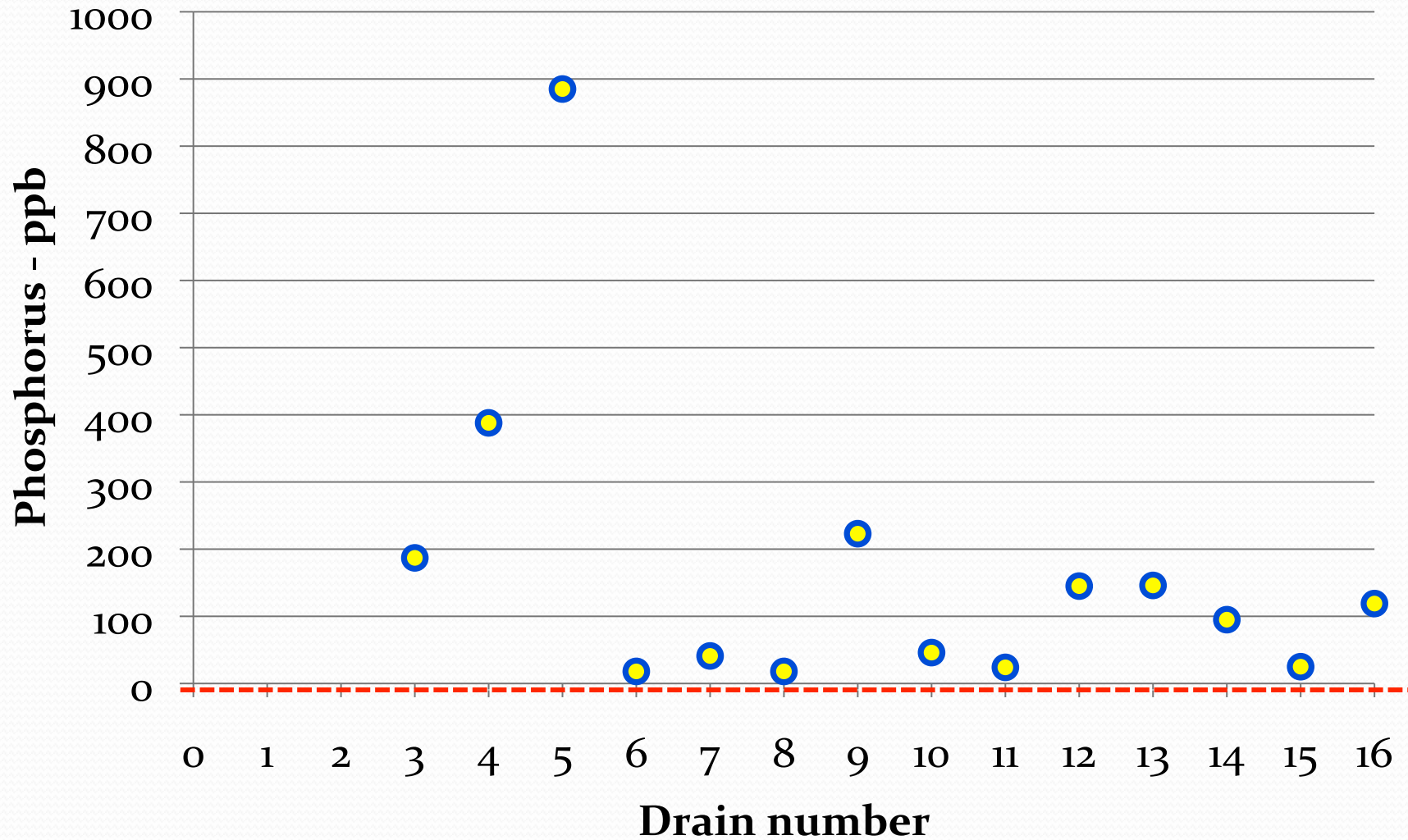


# Storm water collection points

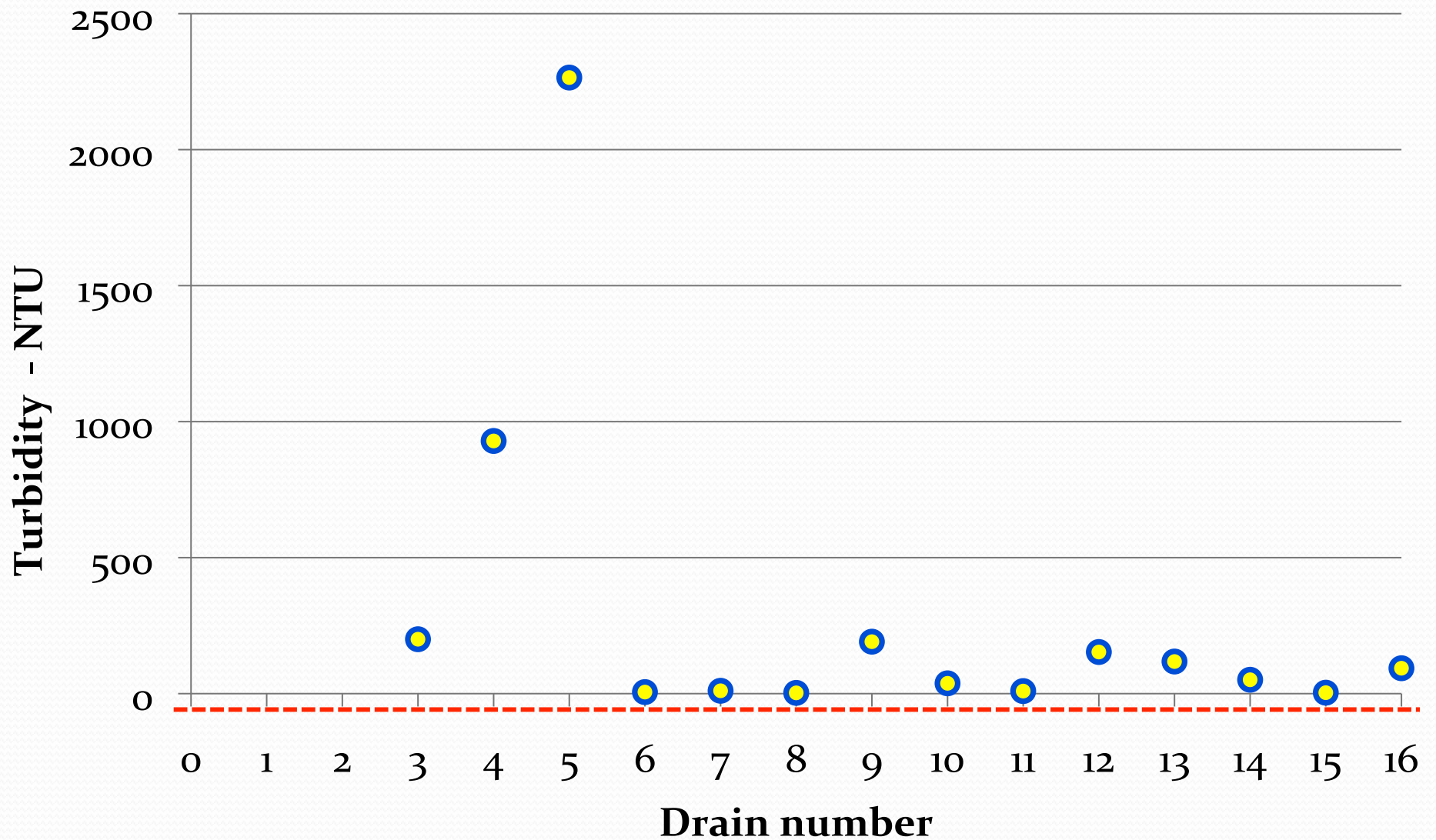
April 30, 2014



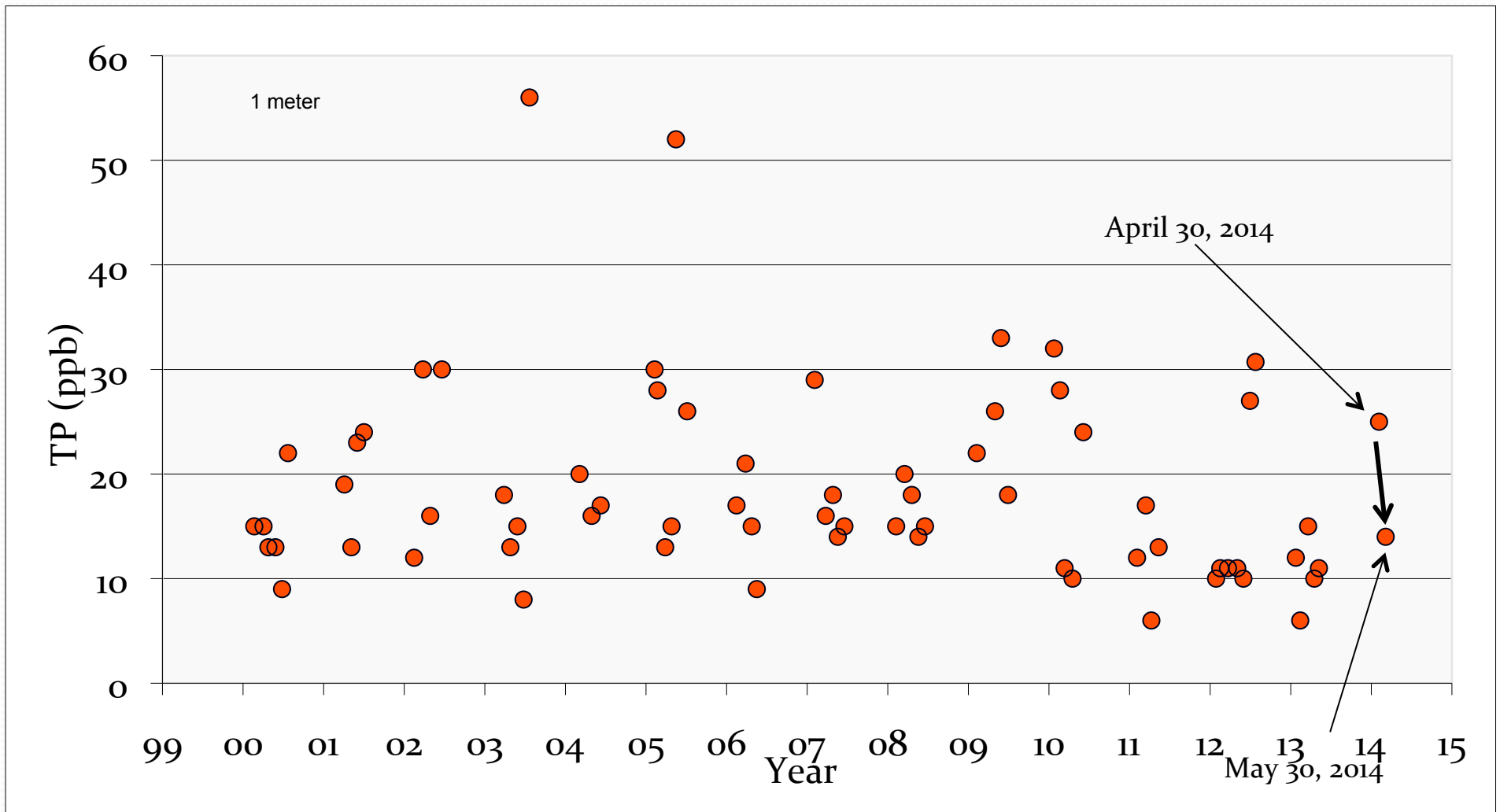
# Storm water quality April 30, 2014



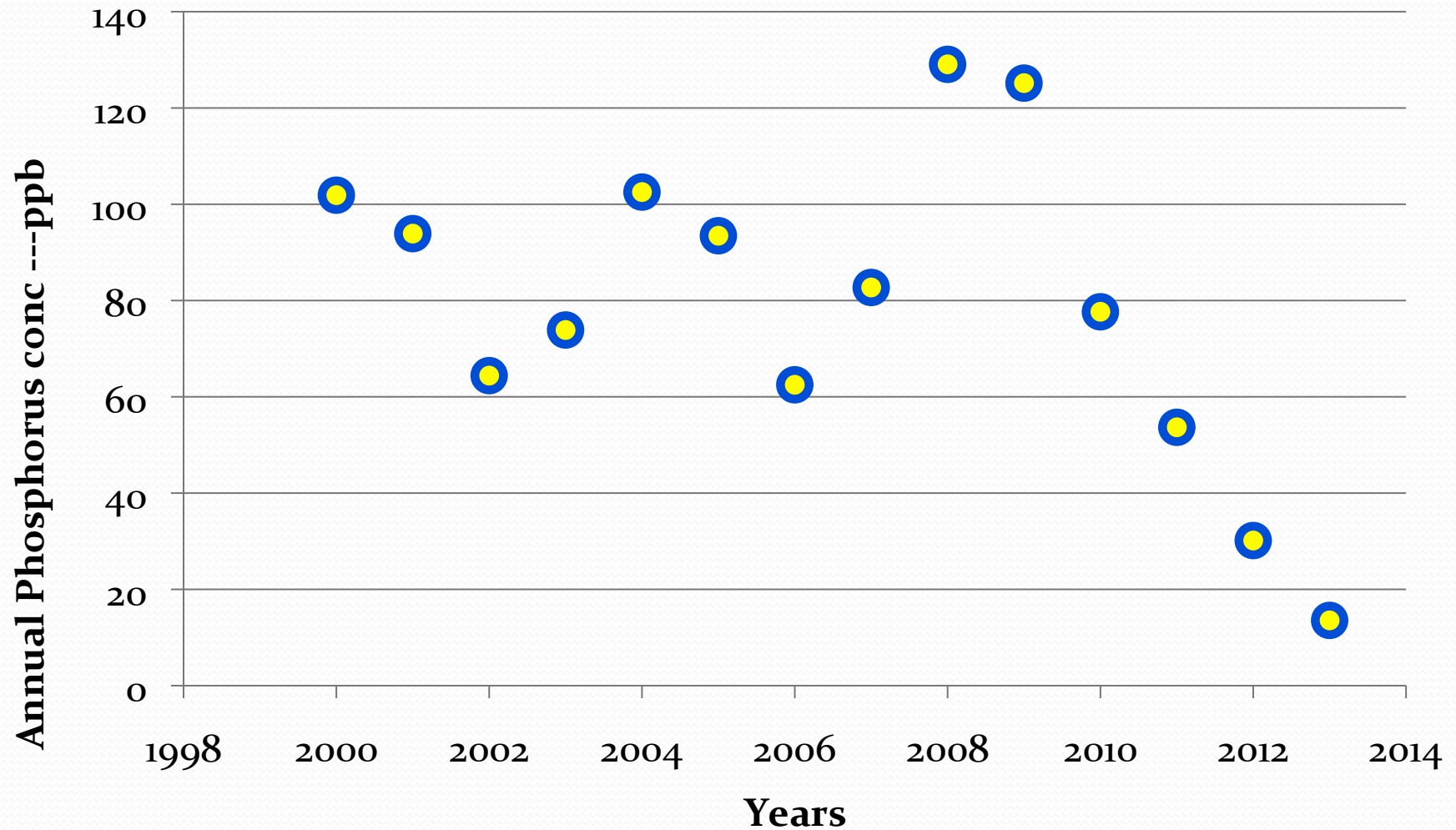
# Storm water quality April 30, 2014



# Long-term phosphorus record



# Long-term trend in whole-lake annual average phosphorus content





Lake 226 – Northwest Ontario



N & C only

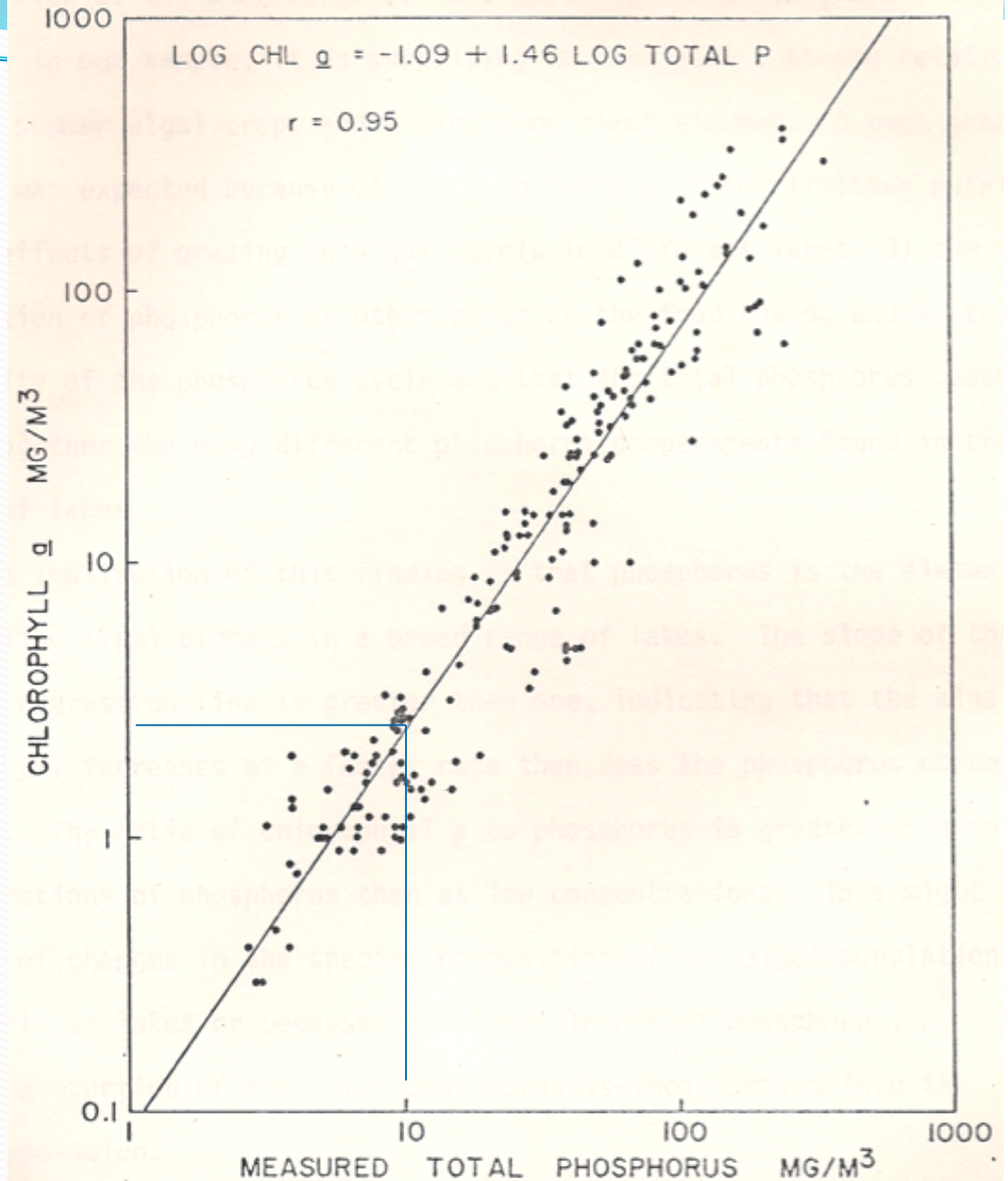
N, C, and P

Phosphorus enriched = poor water

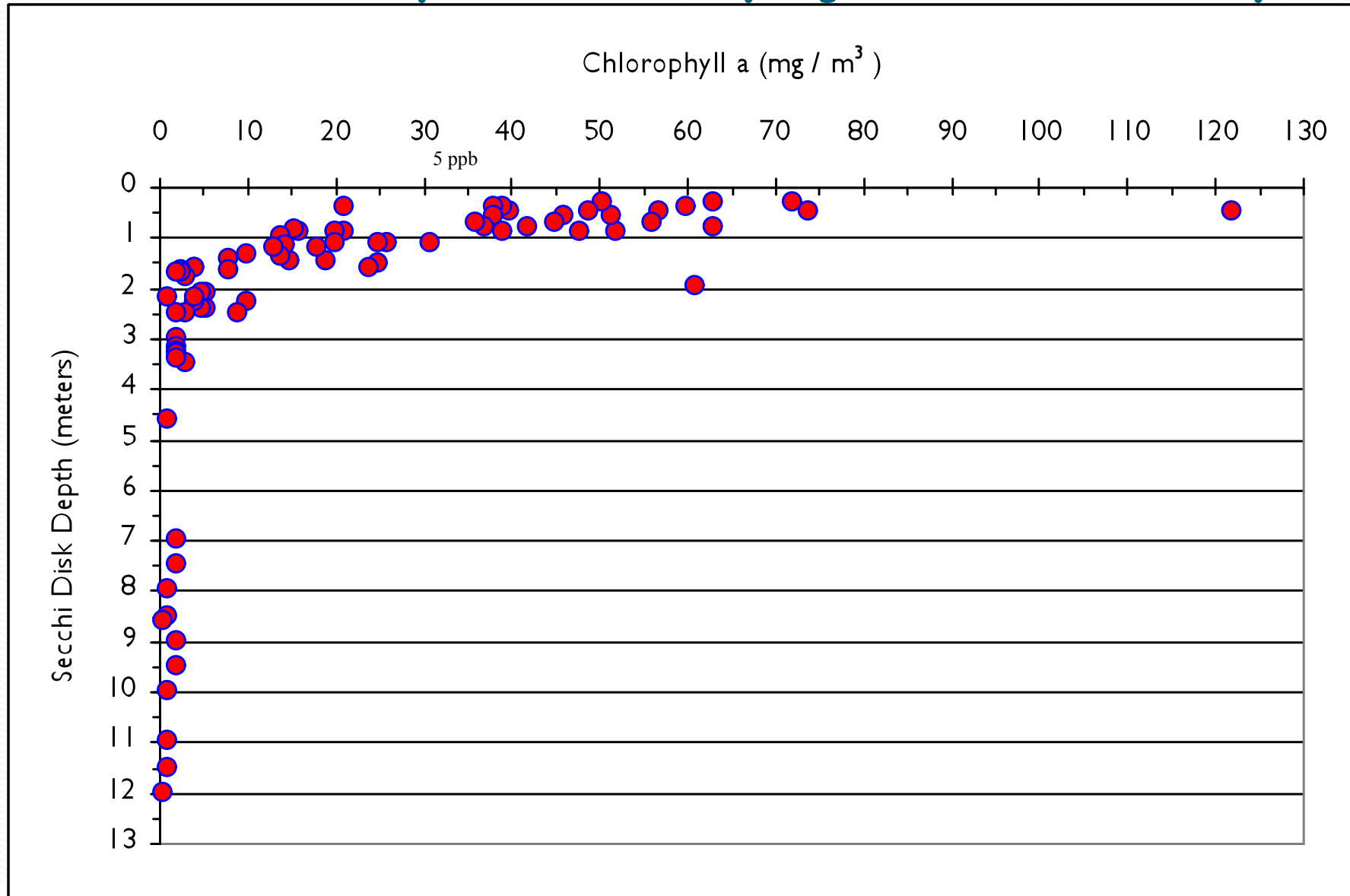
# Phosphorus and Chlorophyll *a*

Linearity of the relationship between phosphorus and chlorophyll indicates cause and effect.

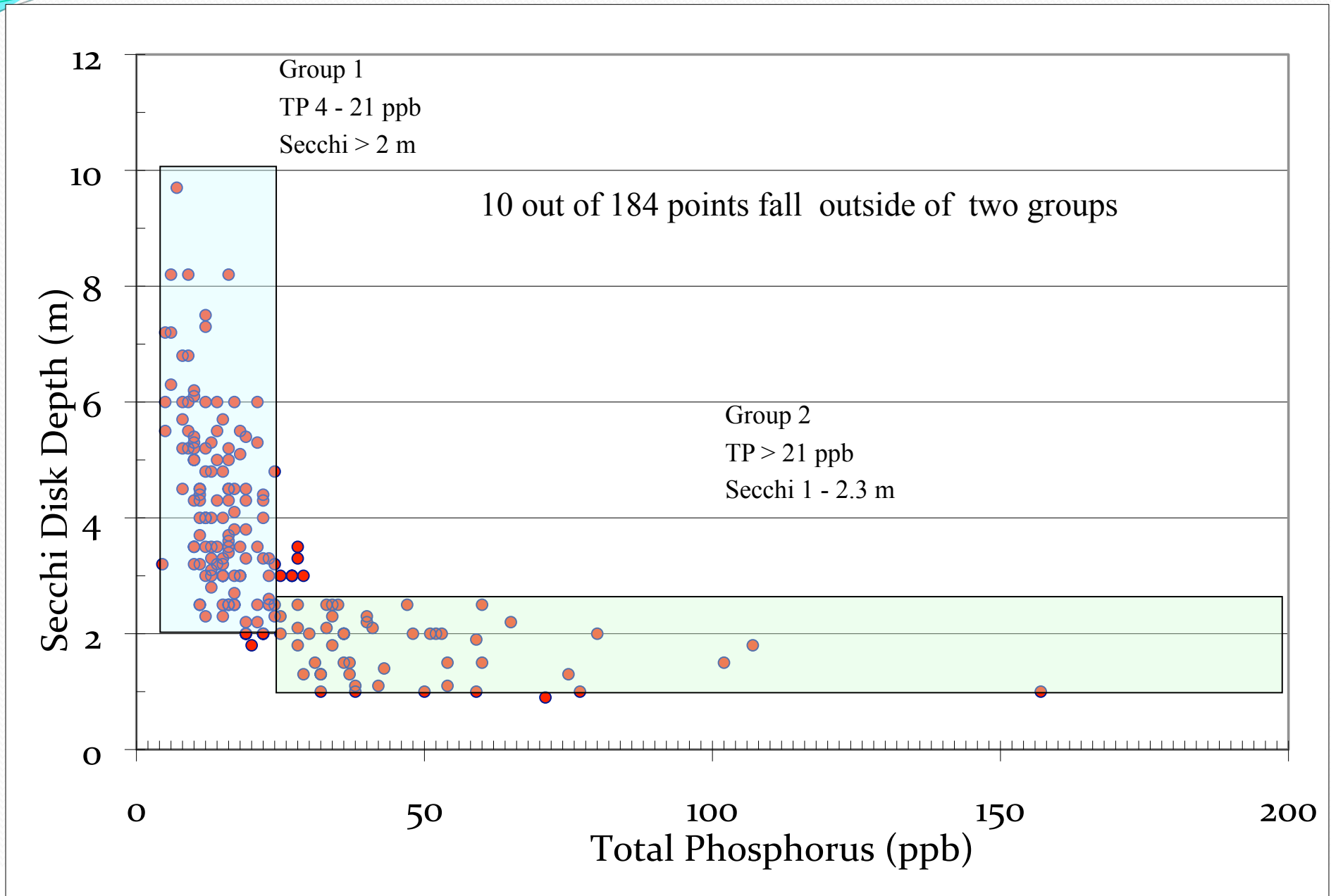
Bachmann and Jones  
1976



# Secchi Depth/Chlorophyll Relationship



# Distribution of lakes along phosphorus and Secchi gradients



# Harmful Bluegreen Algae HABs

- Beside: –More Phosphorus = More Algae = Eventual bluegreen algae dominance = Toxin Formation;
- There is no short answer-although Scott K. is working on this more than anybody else I know!
- *Known HAB toxins:*
  - *microcystin saxatoxin, anatoxin, cylindrospermopsin, nodularin, homoanatoxin, hepatotoxin, cytotoxin, hemolysins, aplysiatoxin, scytophycin, debromoaplysiatoxin, lyngbyapeptins*
    - *And this doesn't include lipopolysaccharides*

# WHO guidelines

Relative Probability of Acute Health Effects	Cyanobacteria (cells/mL)	Microcystin-LR ( $\mu\text{g/L}$ )	Chlorophyll-a ( $\mu\text{g/L}$ )
Low	< 20,000	<10	<10
Moderate	20,000-100,000	10-20	10-50
High	100,000-10,000,000	20-2,000	50-5,000
Very High	> 10,000,000	>2,000	>5,000

# HABs in Copake October 6, 2012

- 7 samples collected from shoreline scum

<u>Location</u>	<u>Microcystin ppb</u>
• West side of lake	1.1
• CLBS dock	1.6
• North Shore	2.5
• Lighthouse Marina	4.3
• Bluebird Road	4.6
• Dam	37.5
• Cove Colony	49.0

# What are HABs

Phytoplankton in lakes consists of 12 large groups of different algae

Cyanobacteria (fresh water HABs)

Diatoms

Green algae

Euglenoids

Chrysophytes

Dinoflagellates – (Marine HABs - red tide)

Cryptomonads

Haptophytes

Synurophytes

Red algae

Brown algae

Raphidoidiopytes

# What are HABs

- Cyanobacteria (or bluegreen algae) come in two major groups
  - Colonial bluegreens
    - ~55 genera
  - Filamentous bluegreens
    - ~ 65 genera

HABs are a subset of about 38 genera and about 90 species that for some reason produce toxins, of which just a few genera cause most of the HAB problems



# Summary

1. Phosphorus has been decreasing overall but spring flooding caused high runoff into the lake
2. This indicates that nutrients are still present in the watershed and groundwater feeding the lake
3. Sunlight shining on sediments rich in nutrients will grow filamentous algae, especially in areas where groundwater nutrient loading is high
4. HABs are a potential threat to the lake, although with lower phosphorus this likelihood is minimized.

