Lake Pocotopaug

Action Plan

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Why am I here

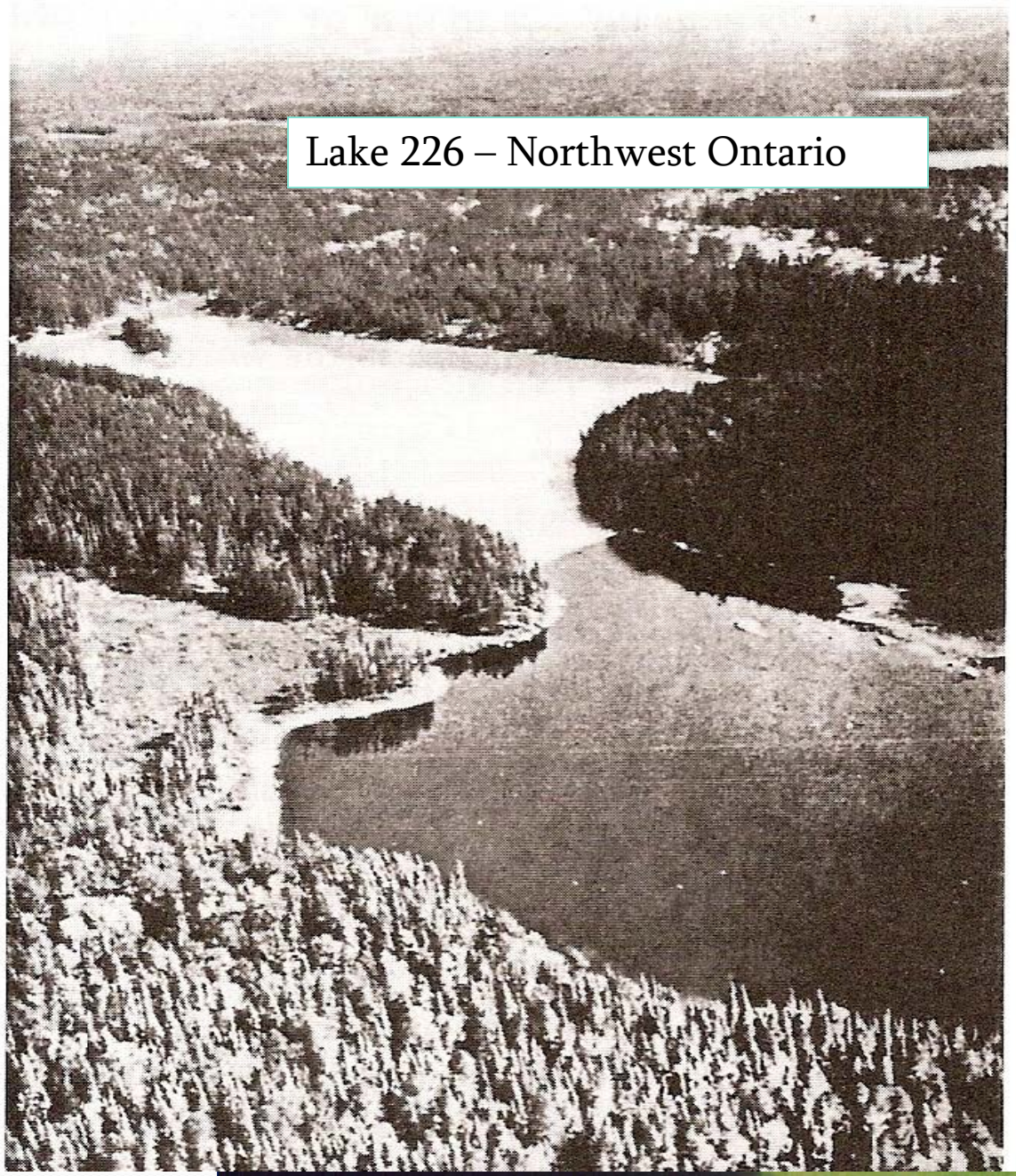
Review the water quality data collected from the lake and the watershed over the years

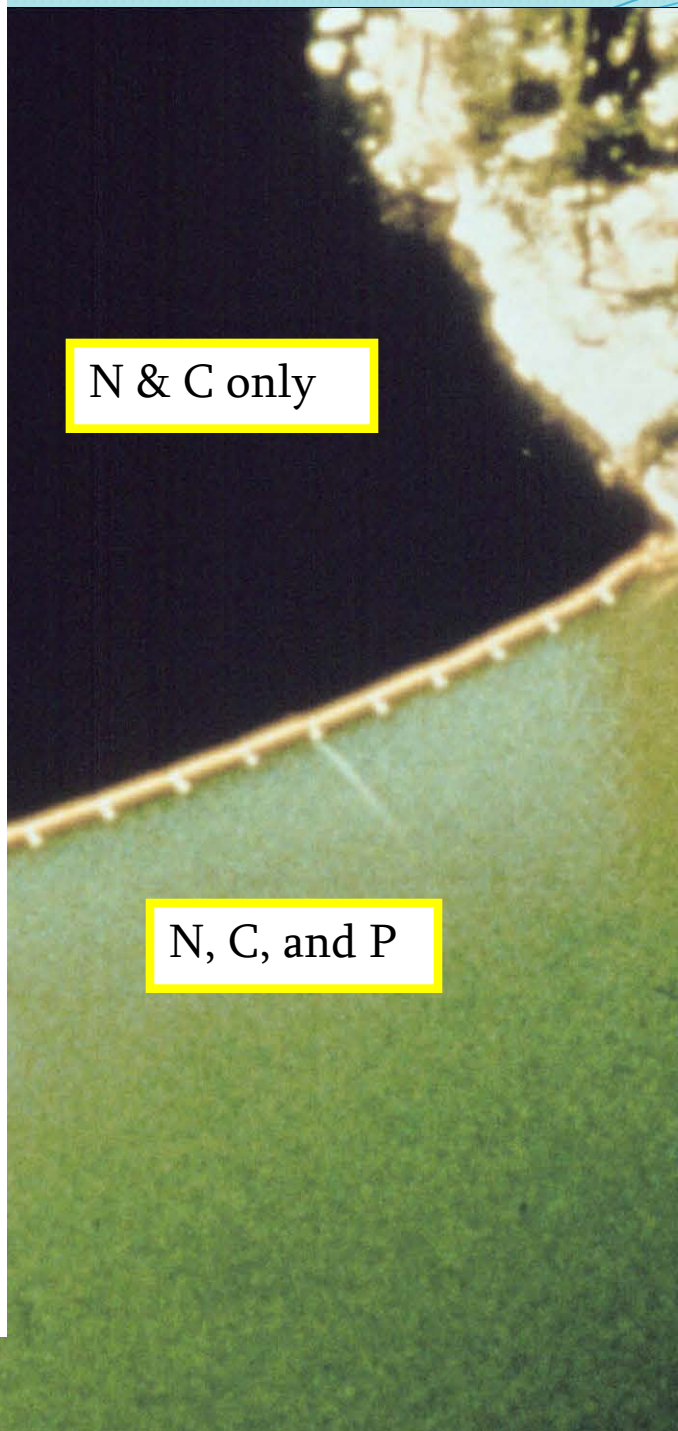
Re-interpret the results into an understandable and meaningful set of actions designed to improve the water quality of the lake for the long-term

Flow of this presentation

1. First a little background on how lakes behave
   a. Include some definition of concepts
   b. Scattered within here will be illumination of my approach
2. Next a brief tour though the history of data and reports produced about Lake Pocotopaug
   a. Try to keep this data-lite without compromising past efforts
   b. What have we learned about the condition of the lake and watershed
3. Finally I will bring together what we know and present an action plan

Lakes are magical / mystical entities…
…that deserve our full appreciation and respect…





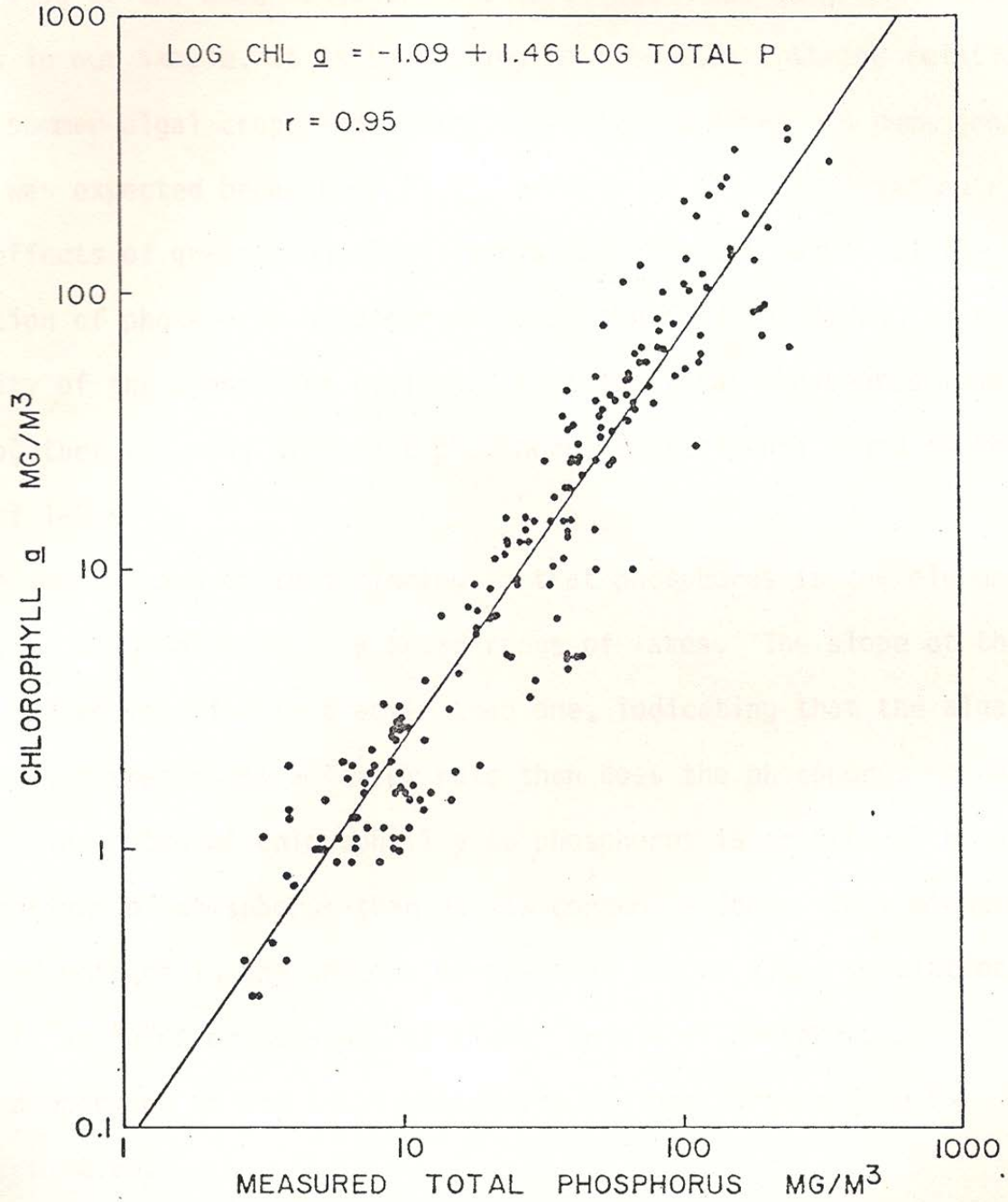
Source: Schindler et al 1975

Phosphorus and Chlorophyll *a*

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

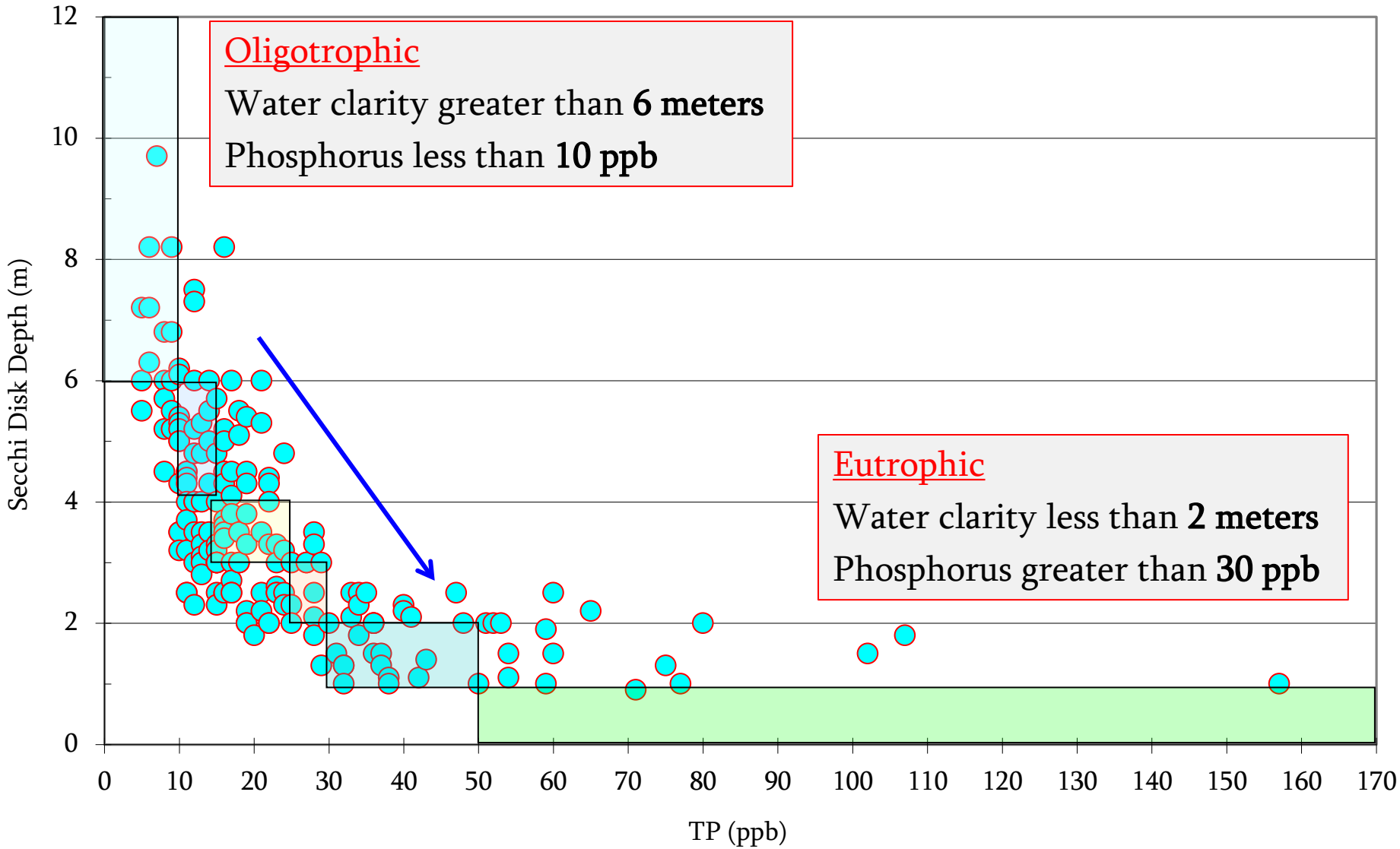
Phosphorus causes chlorophyll

Phosphorus labeled as the limiting nutrient



Source: Bachmann and Jones 1976

Phosphorus and water clarity



Source Frink and Norvell 1984

Water Quality Changes

Oligotrophic

Very low nutrients
Very clear
Light to bottom

No dissolved oxygen loss

Low nutrients
Slightly less clear
Light not to bottom

Very little water with no dissolved oxygen

Moderate nutrients
Only moderately clear
Light half way to bottom

More water with no dissolved oxygen

High nutrients

Not clear
Lots of darkness

Lots of water with no dissolved oxygen

Eutrophic

<u>Increasing Phosphorus</u>

- Increase amount of algae in the water column
- Decrease water clarity
- Increase bottom anoxia

The demise of lakes due to internal loading

Watershed loading

Add nutrients

Increase algae growth

Decrease water clarity

Accelerate anoxia

Increase nutrient recycling

If you feed them – they will grow !

What does it mean to study a lake?

Critical Information Needed to Manage A Lake:

- Water clarity
- Phosphorus / Nitrogen
- Algae composition
- Temperature / Dissolved oxygen
- Watershed contributions

CT DEEP Lake trophic categories and ranges of indicator parameters

Category	Phosphorus (ppb)	Nitrogen (ppb)	Secchi Depth (m)	Chlorophyll-*a* (ppb)
Oligotrophic	0 – 10	0 – 200	6+	0 – 2
Oligo-mesotrophic	10 – 15	200- 300	4 – 6	2 – 5
Mesotrophic	15 – 25	300 – 500	3 – 4	5 – 10
Meso-eutrophic	25 – 30	500 – 600	2 – 3	10 – 15
Eutrophic	**30 – 50**	**600 – 1000**	**1 – 2**	**15 – 30**
Highly Eutrophic	50 +	1000 +	0 – 1	30 +

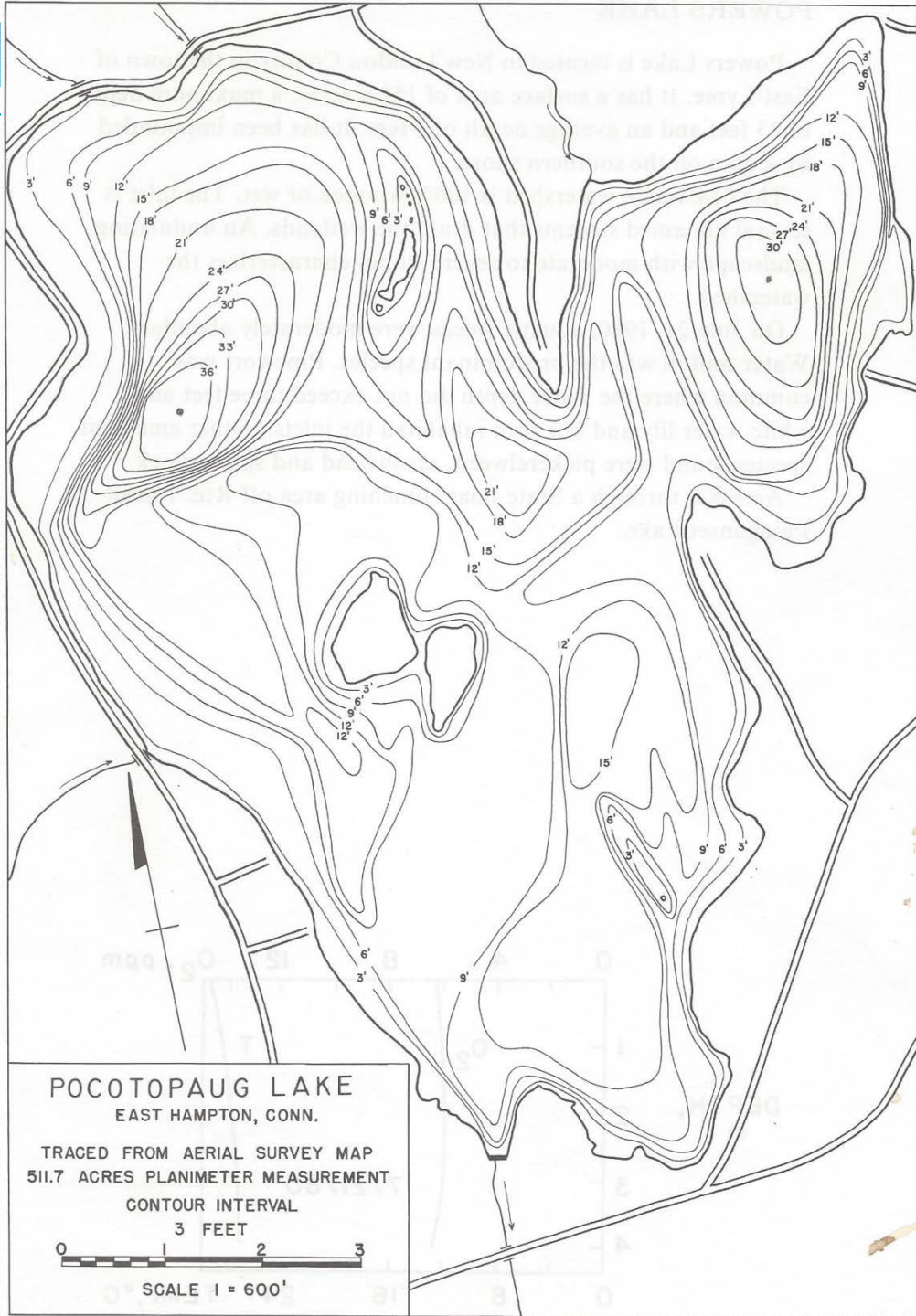
Source: CT DEP 1991

History

- 1930's Ed Deevey (statewide survey)
- 1970's CT Agricultural Exp. Station (statewide survey)
- 1987-89 Baker Hill pollution runoff into lake
- July 1988 CT DEP issues orders to Arzi
- 1988 and 1990 Algae Bloom
- 1991 Scott Sutkowski
- 1992 Lake Pocotopaug Study Group
- 1992-1993 Frugo McClelland
- 1994, 95, 96, 97, 98, 99, 2000 Lake Study Group
- December 1999 unexplained fish kill
- June 2000 1st Alum treatment and fish kill
- June 2001 2nd Alum treatment no fish kill
- 2000, 01, 02, 03, 04 ENSR International
- 2004 Friends of Lake Pocotopaug formed
- 2005, 06, 07, 08 AECOM
- 2009 Lake Loading Response Model AECOM

Basic Lake Pocotopaug Facts

- Surface area of 511 acres
- Maximum depth of 38 feet
- Lake volume of 5,780 acre-feet
  - (or 1.8 billion gallons)✡



Lake Pocotopaug Watershed

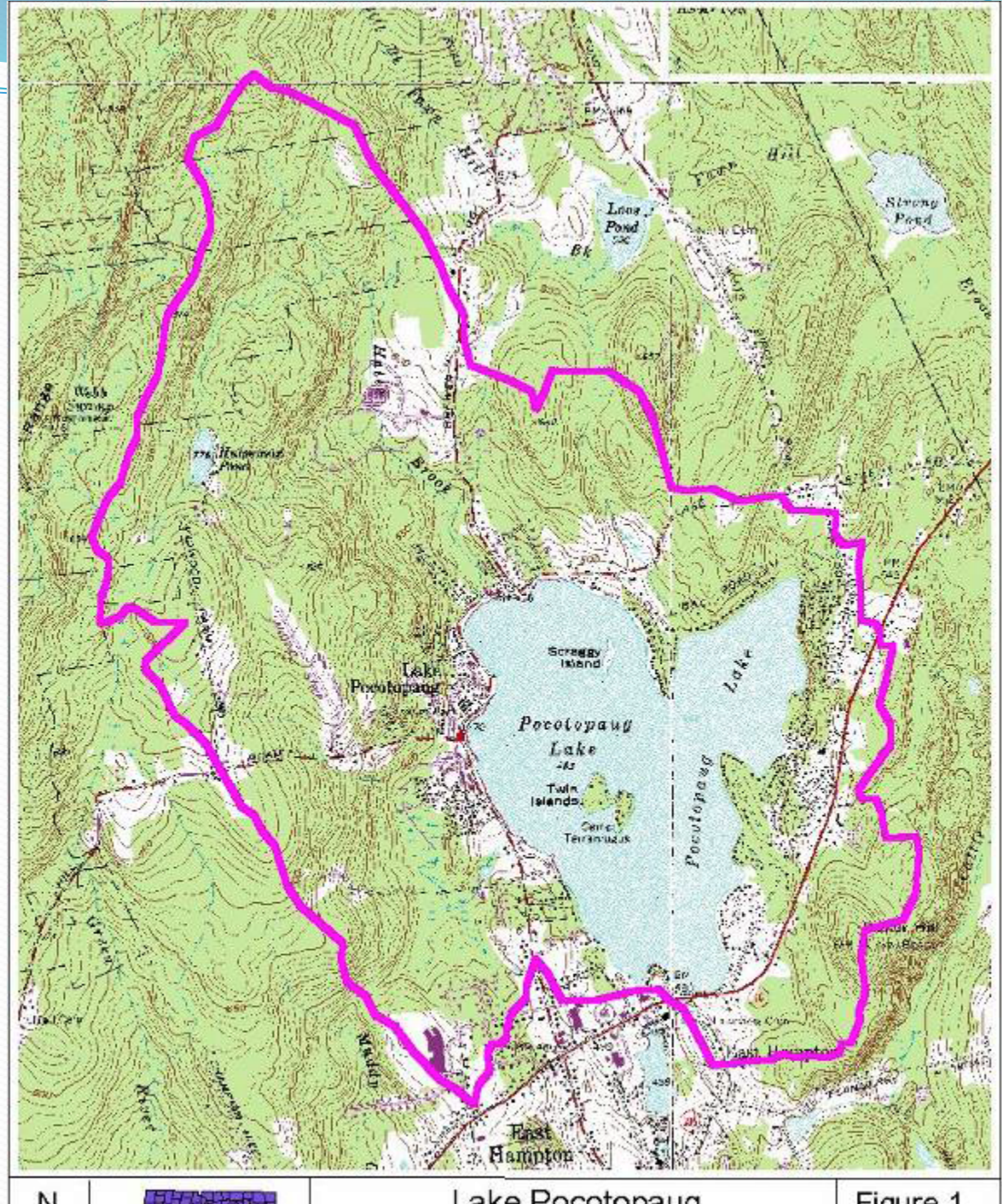
Watershed Area 2,893 acres

Drainage Area 2,382 acres

Two truisms

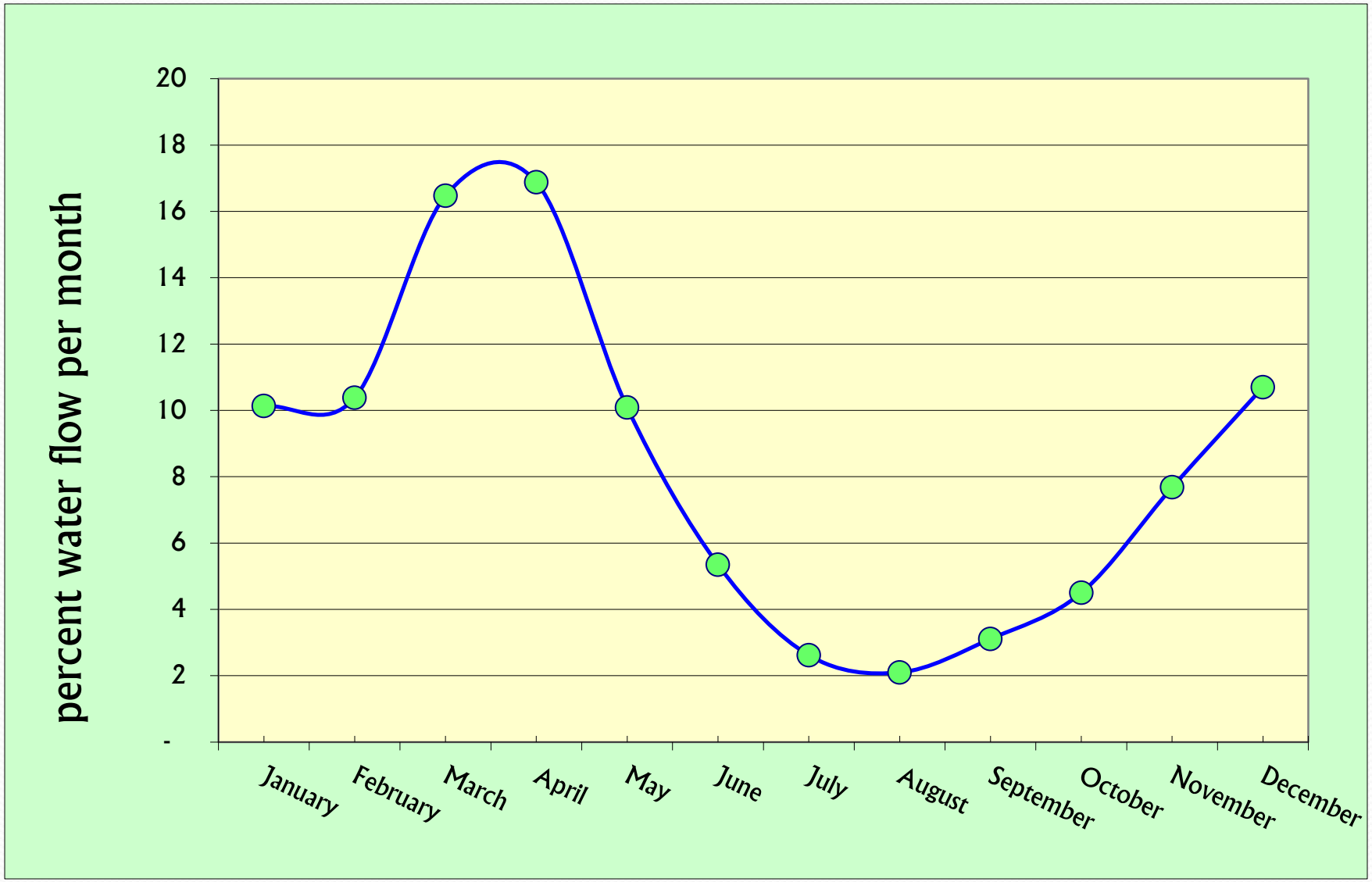
<u>Everything</u> that happens within this boundary affects the lake. ... But to what degree?

The lake reflects the human impact on the landscape because the changes made there are manifest in the water

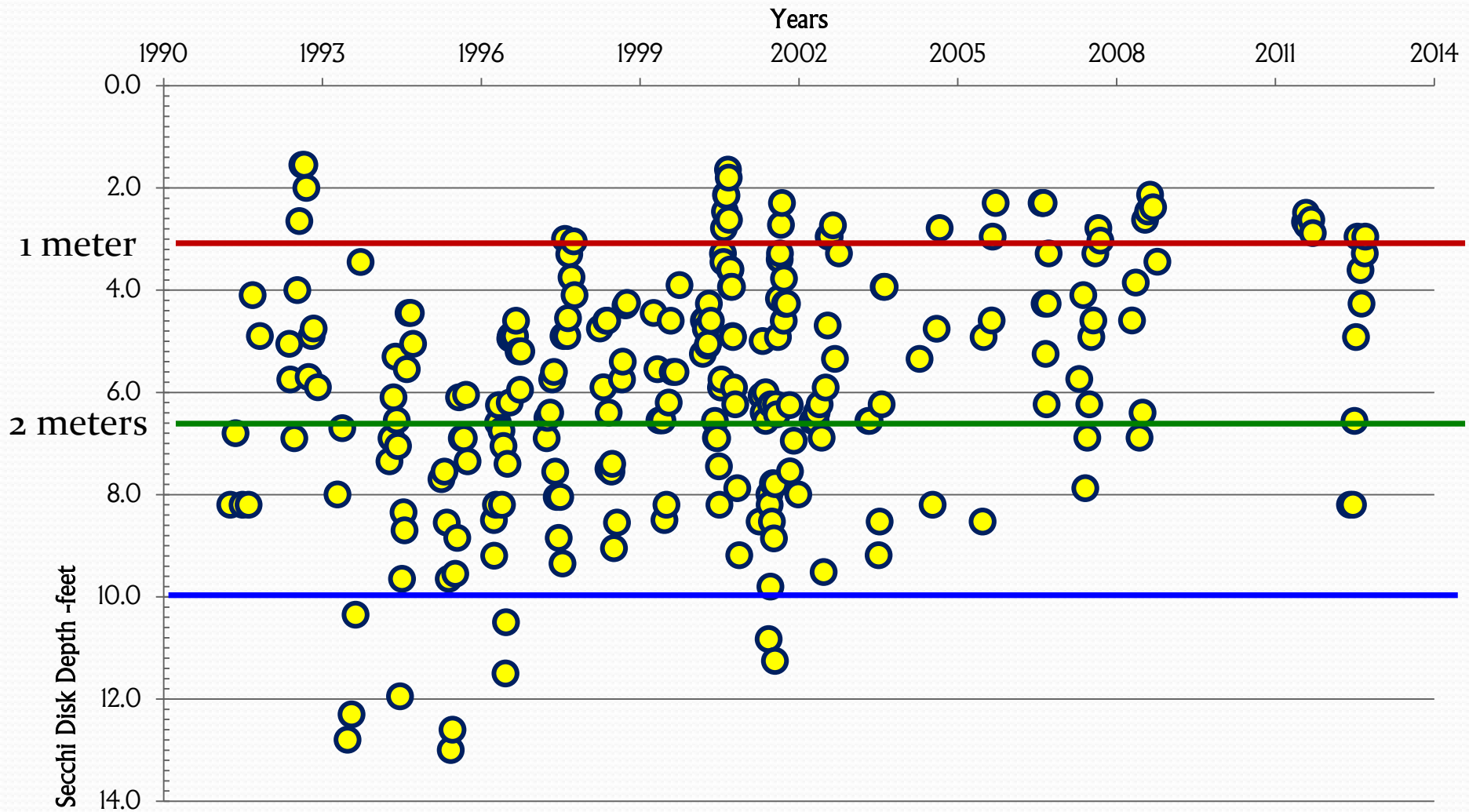


Pocotopaug flushing rate (times/year) ~ 1.3, 1.25, 1.1, 0.98

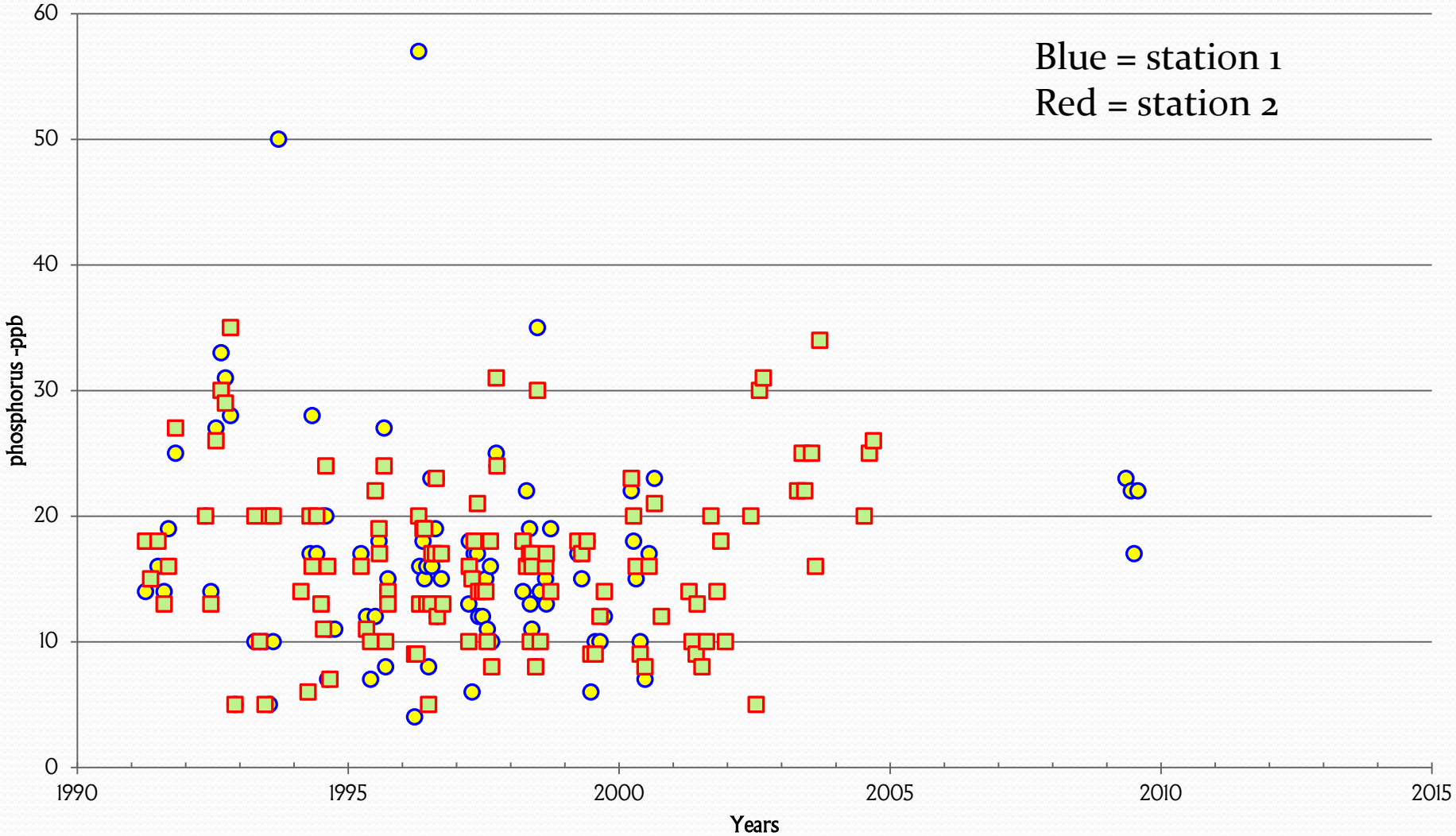
Hydrologic Cycle



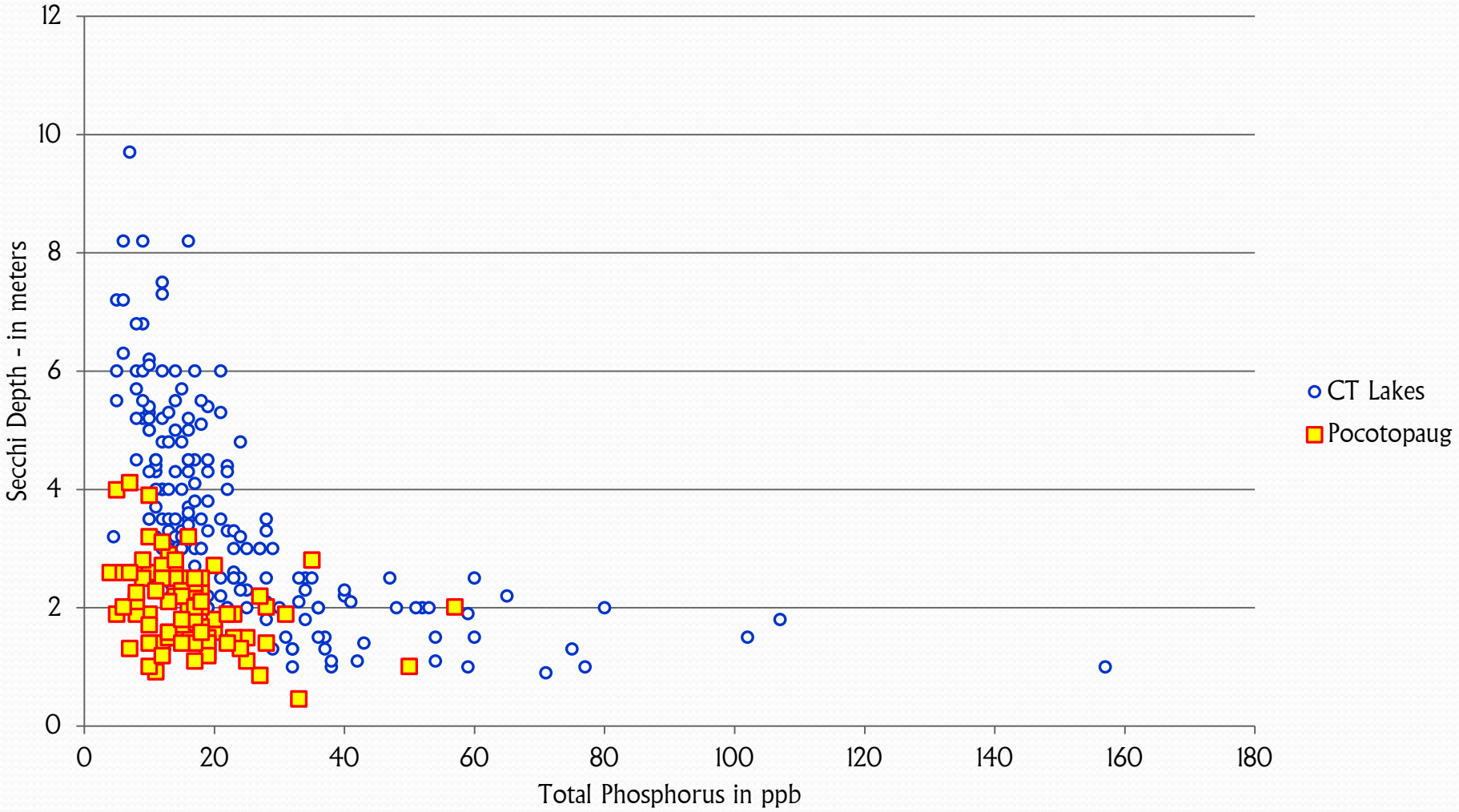
Water Clarity Record



Phosphorus Record - surface



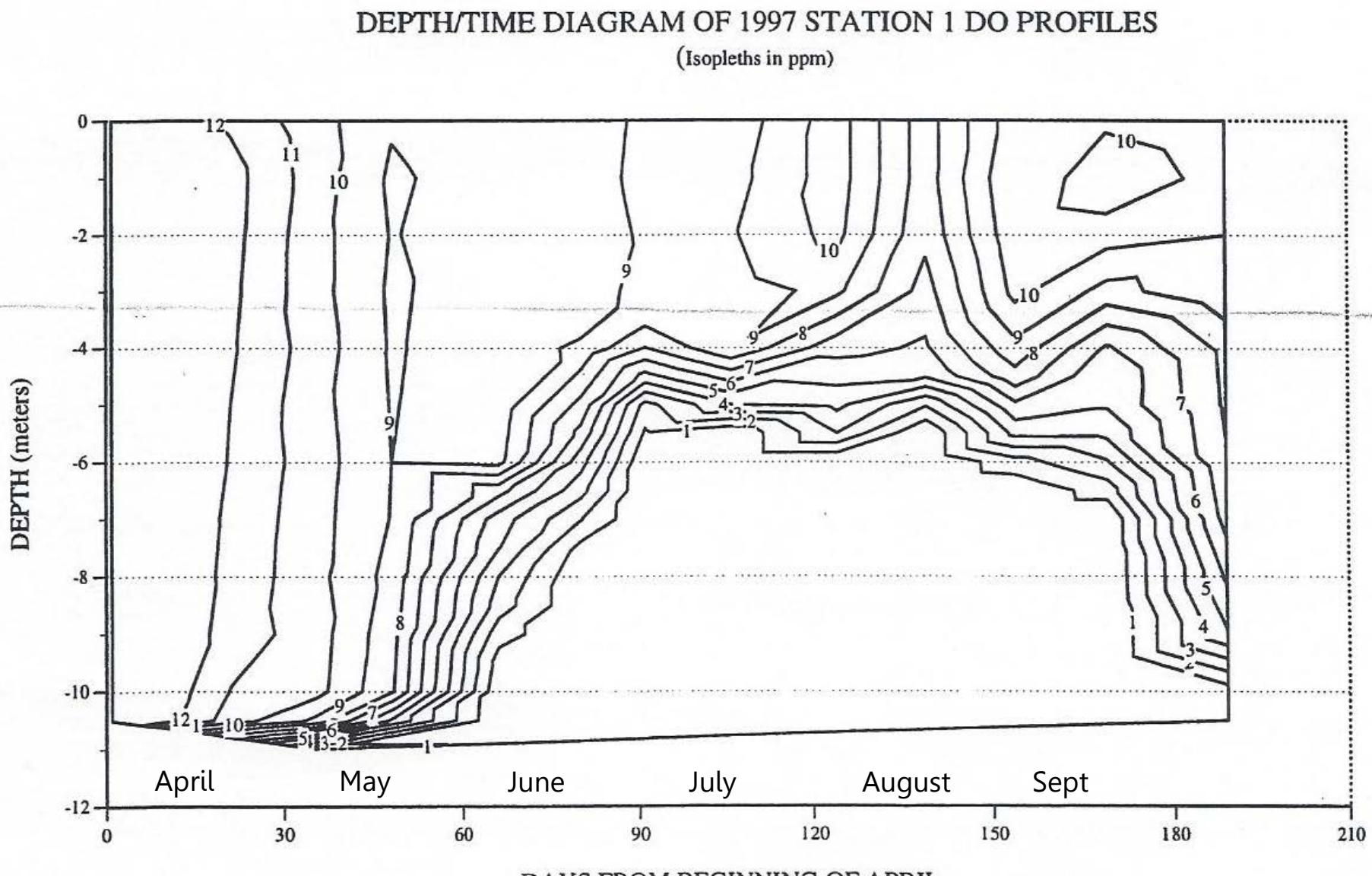
Relationship Between Water Clarity and Total Phosphorus in Lake Pocotopaug

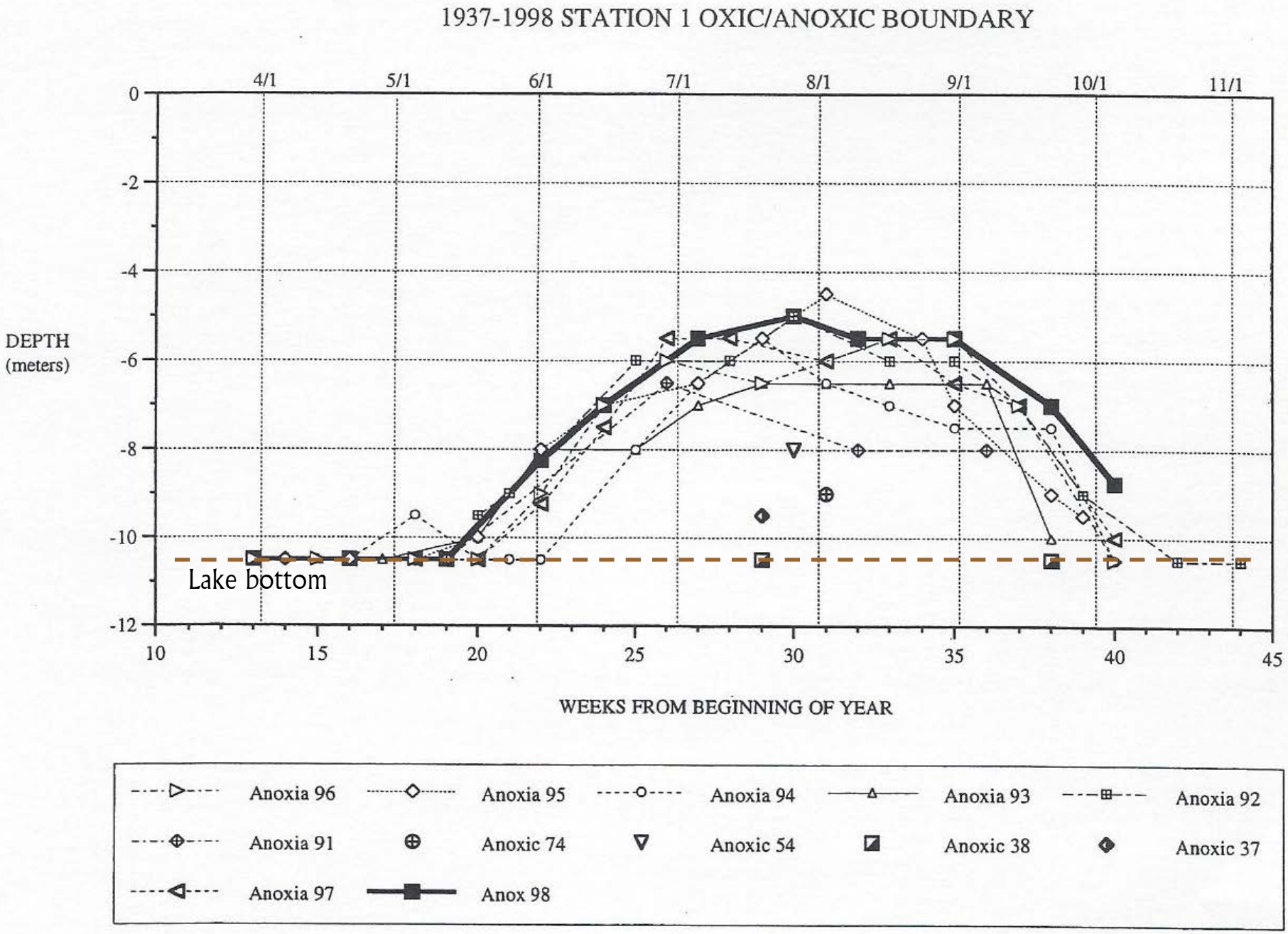


Summary 1

- Lake Pocotopaug typically has poor clarity but not correspondingly high phosphorus

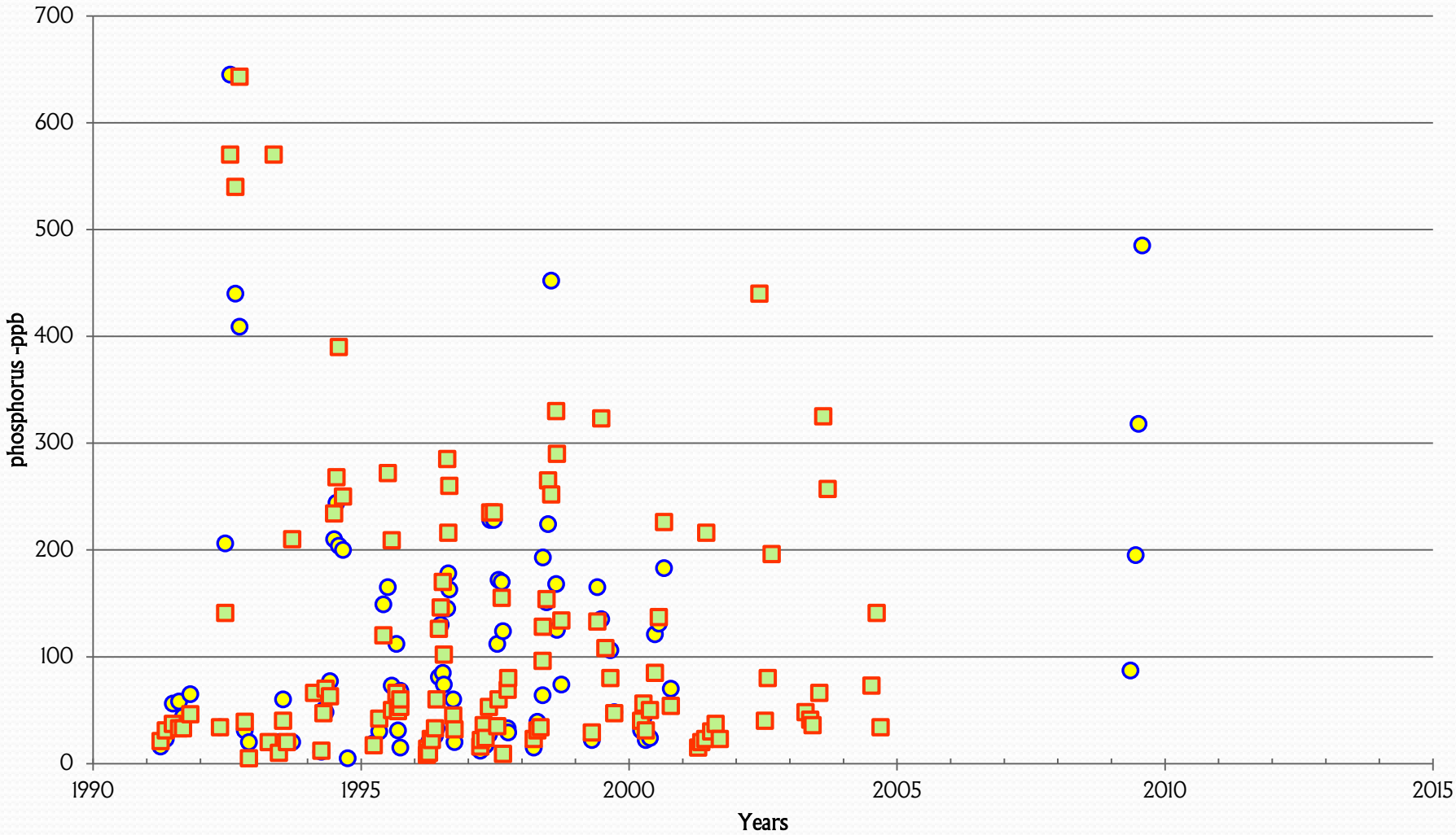
Typical distribution of Dissolved Oxygen





Source: Lake Pocotopaug Study Group

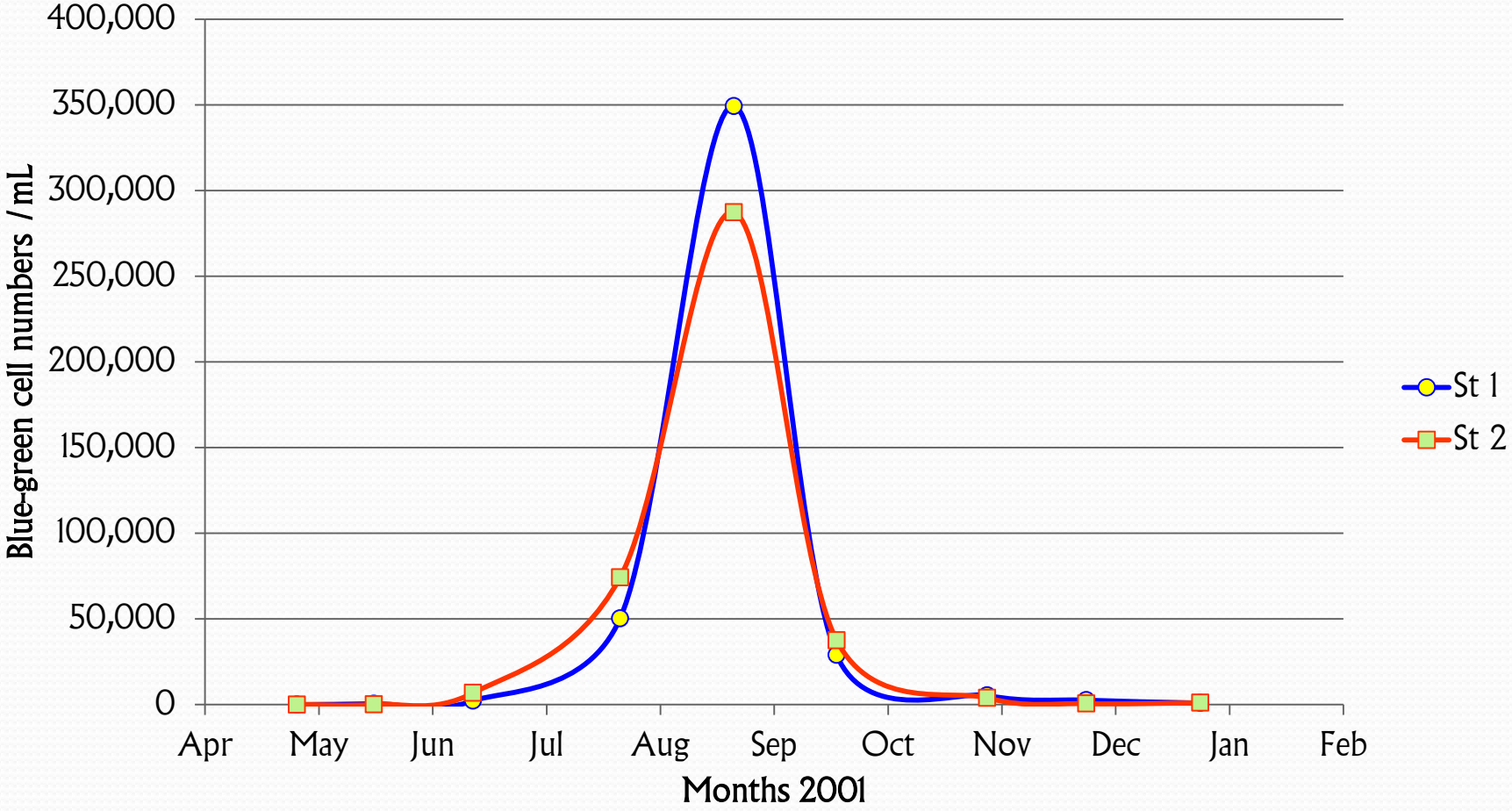
Phosphorus record -bottom



Summary 2

- Dissolved oxygen loss in bottom water is serious each year apparently causing large internal release of phosphorus

Blue-green algae abundance



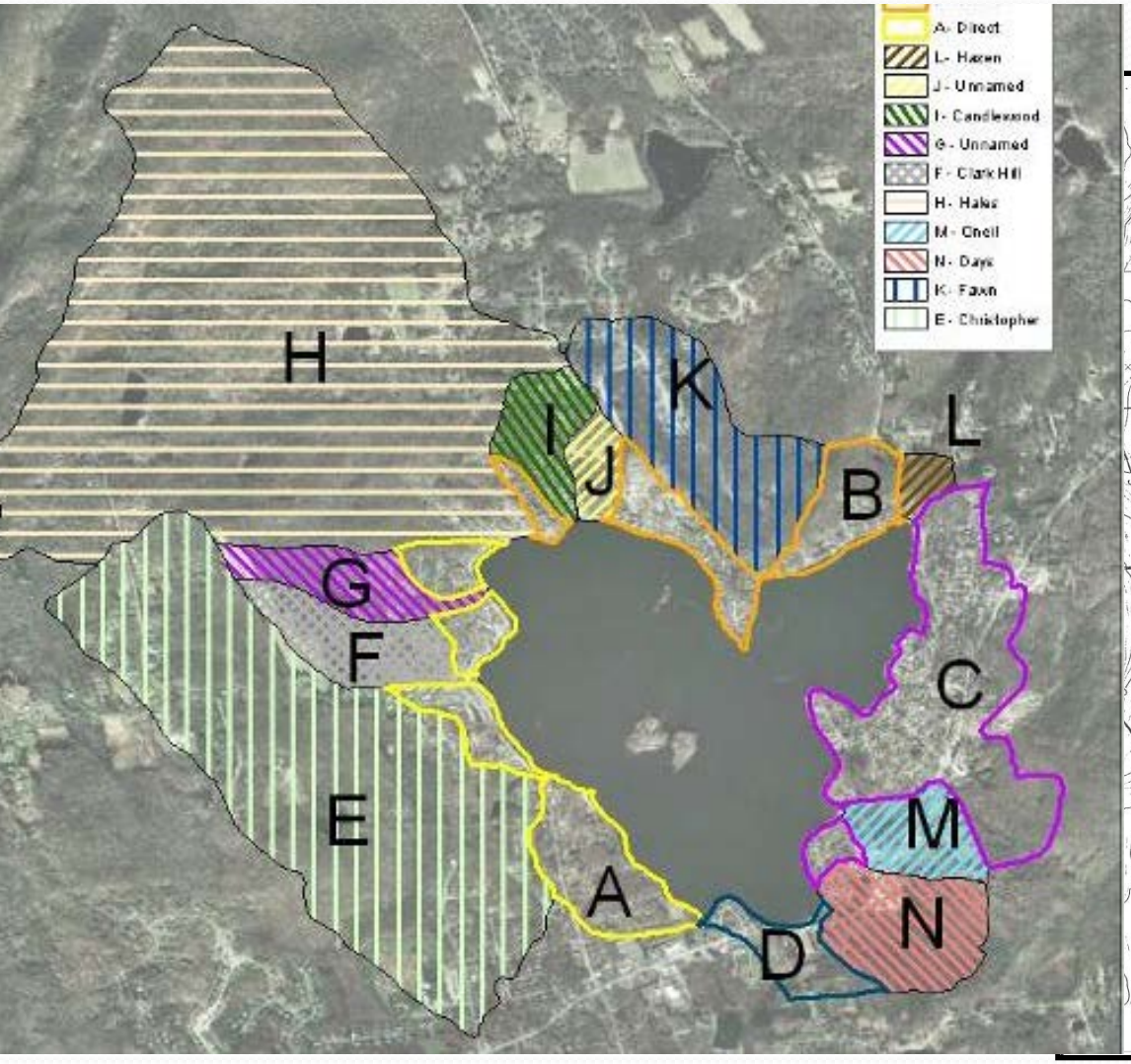
Summary 3

- The lake has the potential to grow excessive numbers of bluegreen algae with high numbers of toxin producers during the summer months

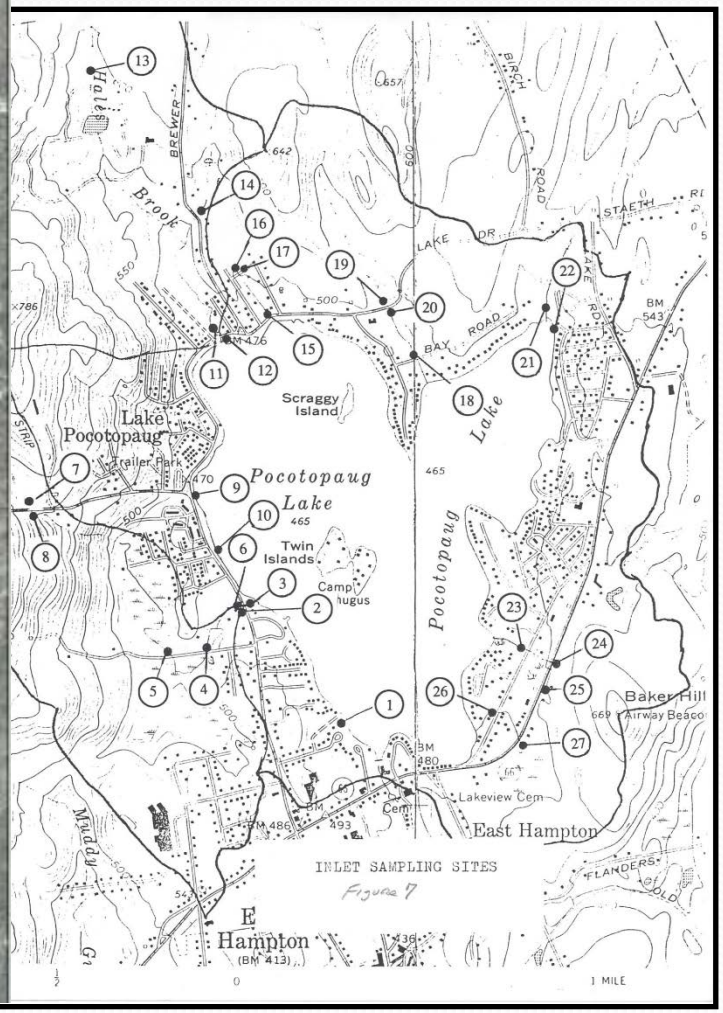
Observations	*Notifications*	*Further monitoring*	*Public Posting*
Visual Rank Category 1	Not needed	No change	Not needed
Visual Rank Category 2, or blue-green algae cells >20k/ml and < 100k	Notify CT DPH, CT DEEP	Increase regular visual surveillance until conditions change.	Not needed
Visual Rank Category 3, or blue-green algae cells > 100k/ml	Update/inform CT DPH & CT DEEP and expand risk communication efforts. (See Risk Communication section.)	Collect samples for analysis and/or increase frequency of visual assessment.	POSTED BEACH CLOSURE: If public has beach access, alert water users that a blue-green algae bloom is present. POSTED ADVISORY: At other impacted access points.

Watershed Contributions

14 Sub-basins



Initially 27 drainage basin stations
Increased to 39



Sub-basin sizes and # of sample sites

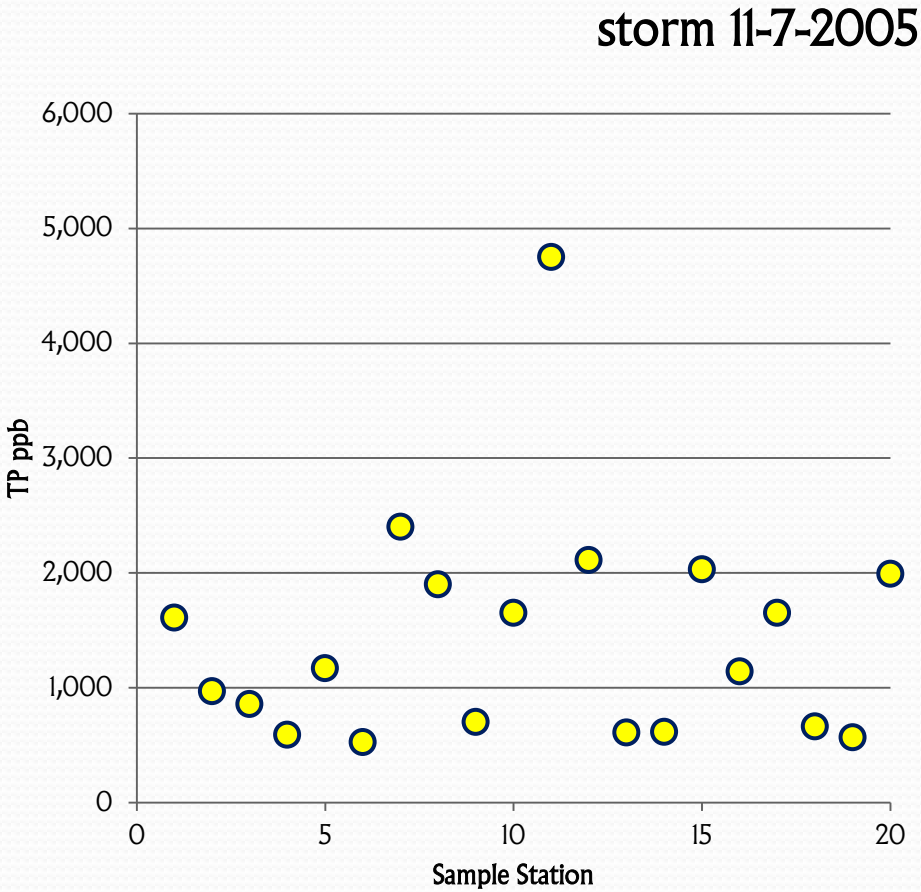
Code	Name	Acres	# of Stations
A	Direct	122	2
B	Direct	94	0
C	Direct	208	3
D	Direct	34	0
E	Christopher	496	8
F	Clark Hill	61	1
G	Un-named	50	2
H	Hales	890	6
I	Candlewood	44	3
J	Un-named	22	1
K	Fawn	144	3
L	Hazen	13	1
M	O'Neill	46	3
N	Days	81	2

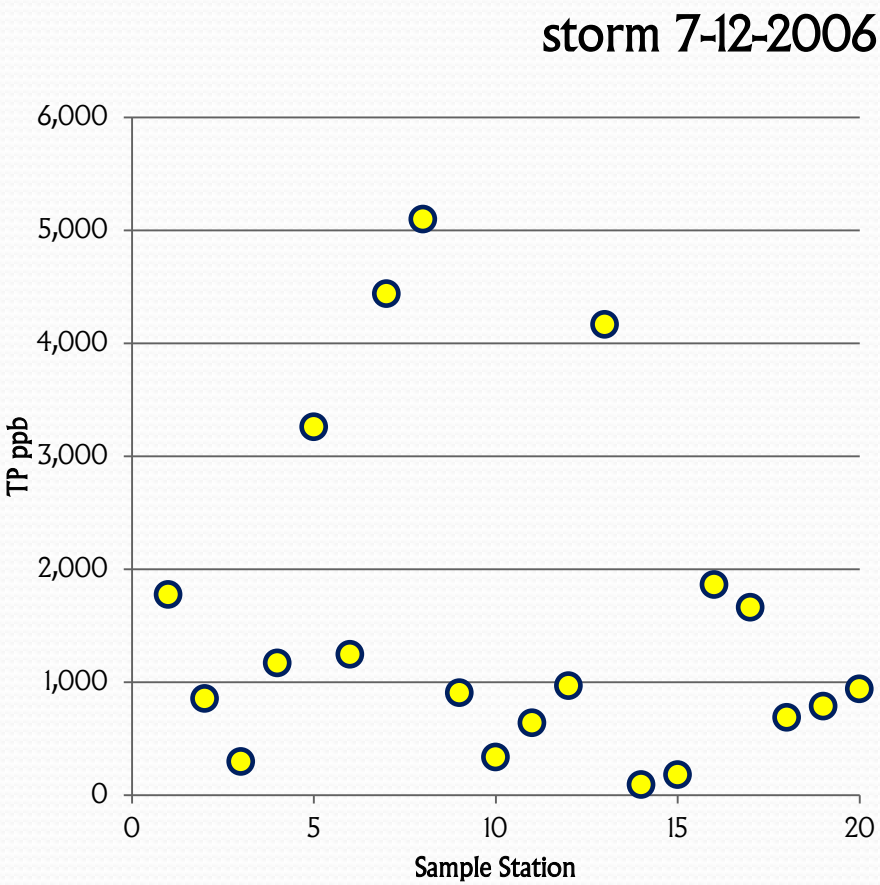
4 sites unaccounted for

Tributary water condition

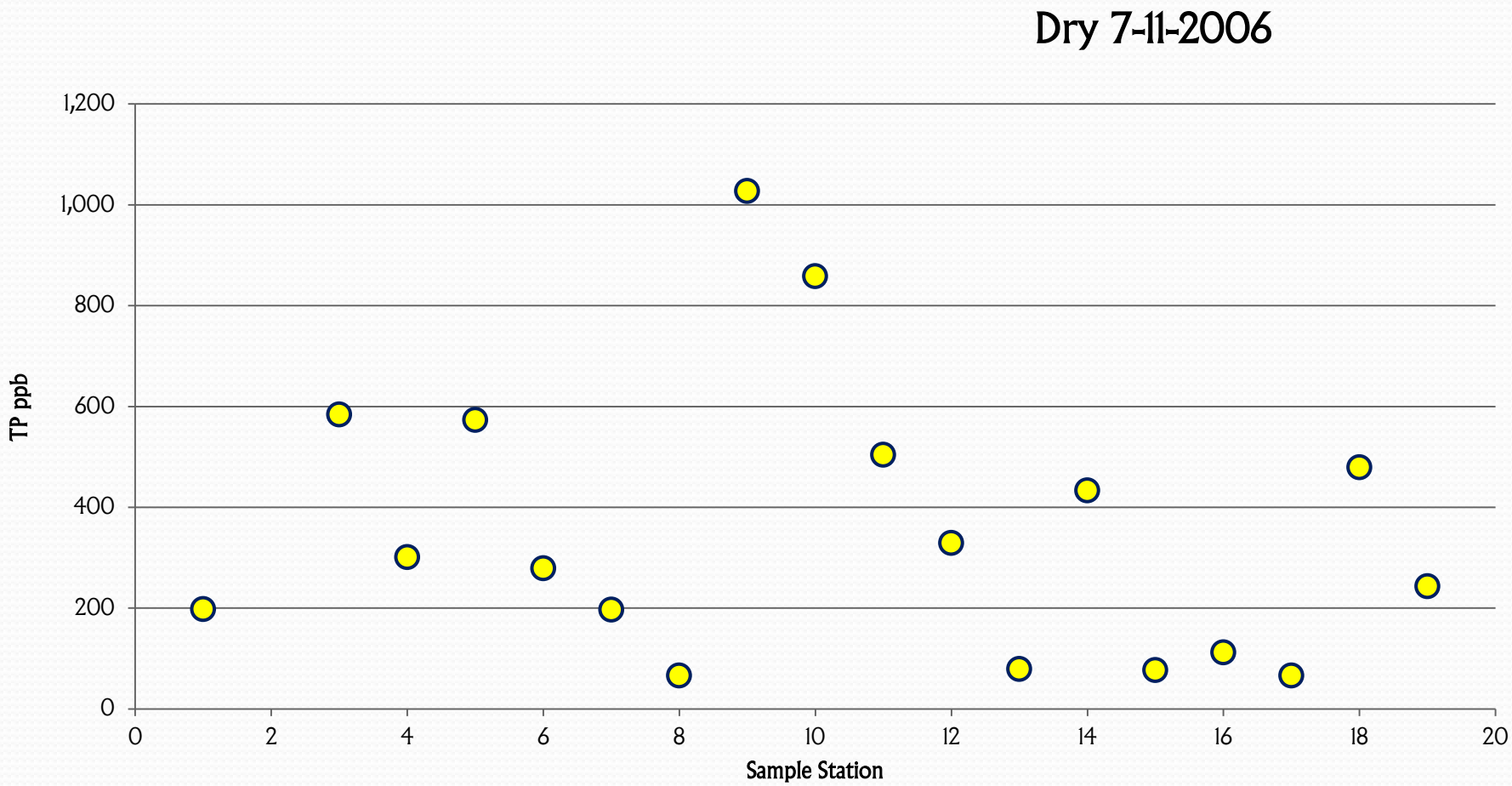
Code	Name	Acres	Ave P	Max P	Max Turbidity
			ppb	ppb	
H	Hales	890	235	3,090	290
E	Christopher	496	347	4,438	300
C	Direct	208	408	1,990	~
K	Fawn	144	119	335	1.9
A	Direct	122	520	1,775	~
N	Days	81	233	940	78
F	Clark Hill	61	560	3,760	180
G	Un-named	50	747	5,096	~
I	Candlewood	44	308	1,863	~
M	O'Neill	46	719	3,260	250
J	Un-named	22	147	320	~
L	Hazen	13	244	1,660	~

Tributary phosphorus concentrations during 2 storms





Tributary phosphorus during dry period



Summary 4

- The watershed contributes huge amounts of phosphorus during storm flows and high amounts of phosphorus during dry periods
- Water is generally extremely turbid during storm flows
- If these storm occur during the summer low flow times the nutrient load may become trapped in the lake

Prior Recommendations Fugro McClelland 1993

- Identified internal loading as prime problem
- Algicide to control algae
- Watershed Management

  Reduce the volume of storm water

  Improve the quality of storm water

  Improve management of personal property

  - control erosion
  - hook up grey waters to sewer system
  - reduce fertilizer use
  - avoid washing cars
  - discourage feeding waterfowl
  - prevent dumping of wastes or litter into stream channels
  - replant shorelines

Prior Recommendations WMC Consulting Engineers 1995

- Developed extensive storm water renovation management plan that included:
  - Identified P&Z regulation modifications
  - Identified IW&W regulation modifications
    - Including erosion and sedimentation control plan
  - Identified modifications to town Road Standards
  - Inventoried hydraulic structures and drainage systems
  - Made specific recommendations for improvement projects
  - Made a detailed field reconnaissance
  - Developed a comprehensive watershed management plan

Prior Recommendations ENSR 2002

- Control non-algal turbidity
- Reduce phosphorus and turbidity from watershed
  - Agricultural best management practices

    Bank and slope stabilization

    Source controls on residential land

    Zoning and land-use planning

    Waste water management

    Buffer strips

    Catch Basin sumps and hoods

    Oil/Grit chambers

    Street Sweeping/catch basin cleaning

    Detention and infiltration systems

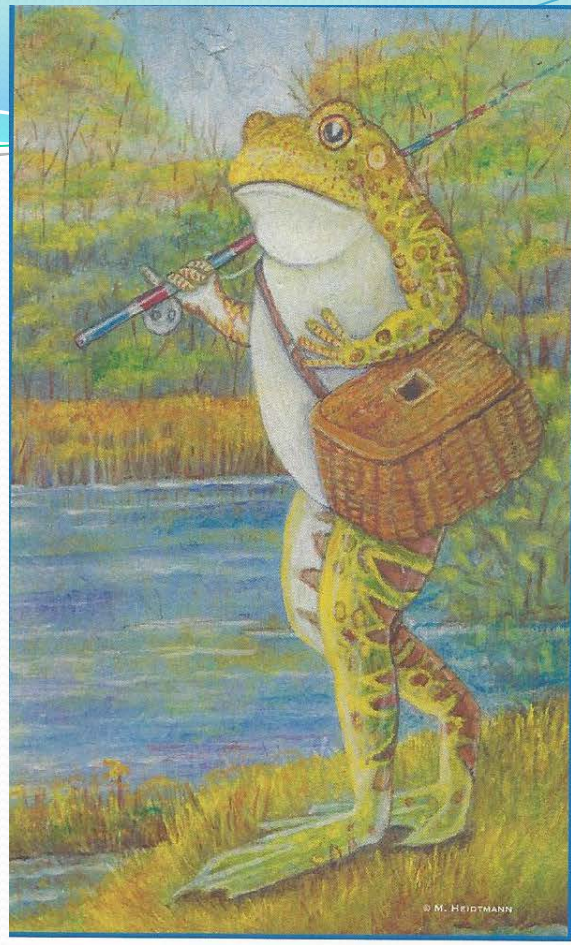
    Created wetlands

Prior Recommendations AECOM 2009

- Estimated potential phosphorus load reduction needed to achieve target water quality conditions in the lake
- Ranked sub-basins into action priority groups
  - 1 = C (direct on east side), E (Christopher), K (Fawn)
  - 2 = A (direct), B (direct), M (O'Neill), N (Days)
  - 3 = F (Clark), I (Candlewood), J (Un-named),
  - 4 = D (direct), G (un-named), H (Hales), L (Hazen)
- Leaching Chambers
- Dredging pond in Christopher Brook
- Entire range of LID options
- New town ordinances
- Another Alum treatment / aeration

Action Plan

- 1) Revitalize Volunteer Lake Study Group
- 2) initiate regular planning meetings to organize future efforts:
  - include representatives from Town staff, Planning & Zoning, Inland Wetlands, ZBA, Building Official/Code enforcement, Public Works, Friends of the Lake, Lake Commission, CT DEEP
- 3) Initiate educational programs
- 4) Review the WMC Lake Management Plan (1995) to determine if regulation recommendations have been incorporated
- 5) Update the WMC 1995 study with EPA Track Down Survey that uses Urban Stream Assessment protocols making EH eligible for Federal restoration funds
  - Include inventory of hydraulic structures and drainage systems in GIS
- 6) Develop Lake Management Overlay Zone with LID
- 7) Continue to organize existing database and upload to community accessible website
- 8) Coordinate with Regional Conservation Districts
- 9) Investigate methods to reduce internal loading
  - Either Alum or Aeration
- 10) Review maintenance plans for all recent developments



The Lake Pocotopaug Watershed: An Owner's Manual

Town of East Hampton Connecticut
Conservation/Lake Commission
Inland Wetlands and Watercourse Agency

Creeping Normalcy

"Perhaps the commonest circumstance under which societies fail to perceive a problem is when it takes the form of a slow trend concealed by wide up-and-down fluctuations"

- Jared Diamond

Collapse

Questions