# Modeling Lakes?

Center for Watershed Science & Education

UW- Stevens Point

Lake Leaders 2010

# What's a model

***One definition:  A mathematical description to help visualize something***

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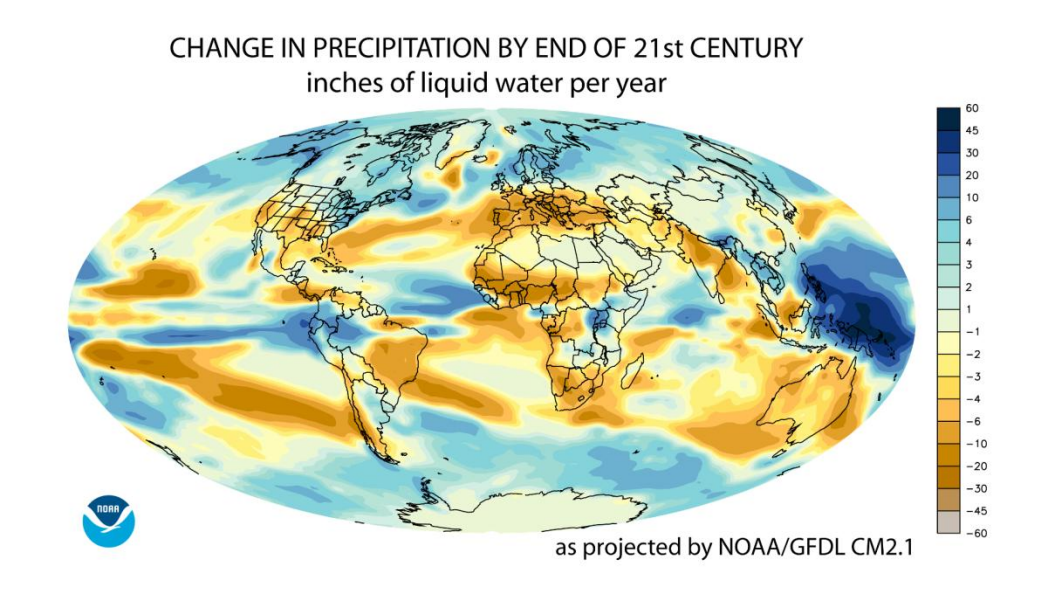
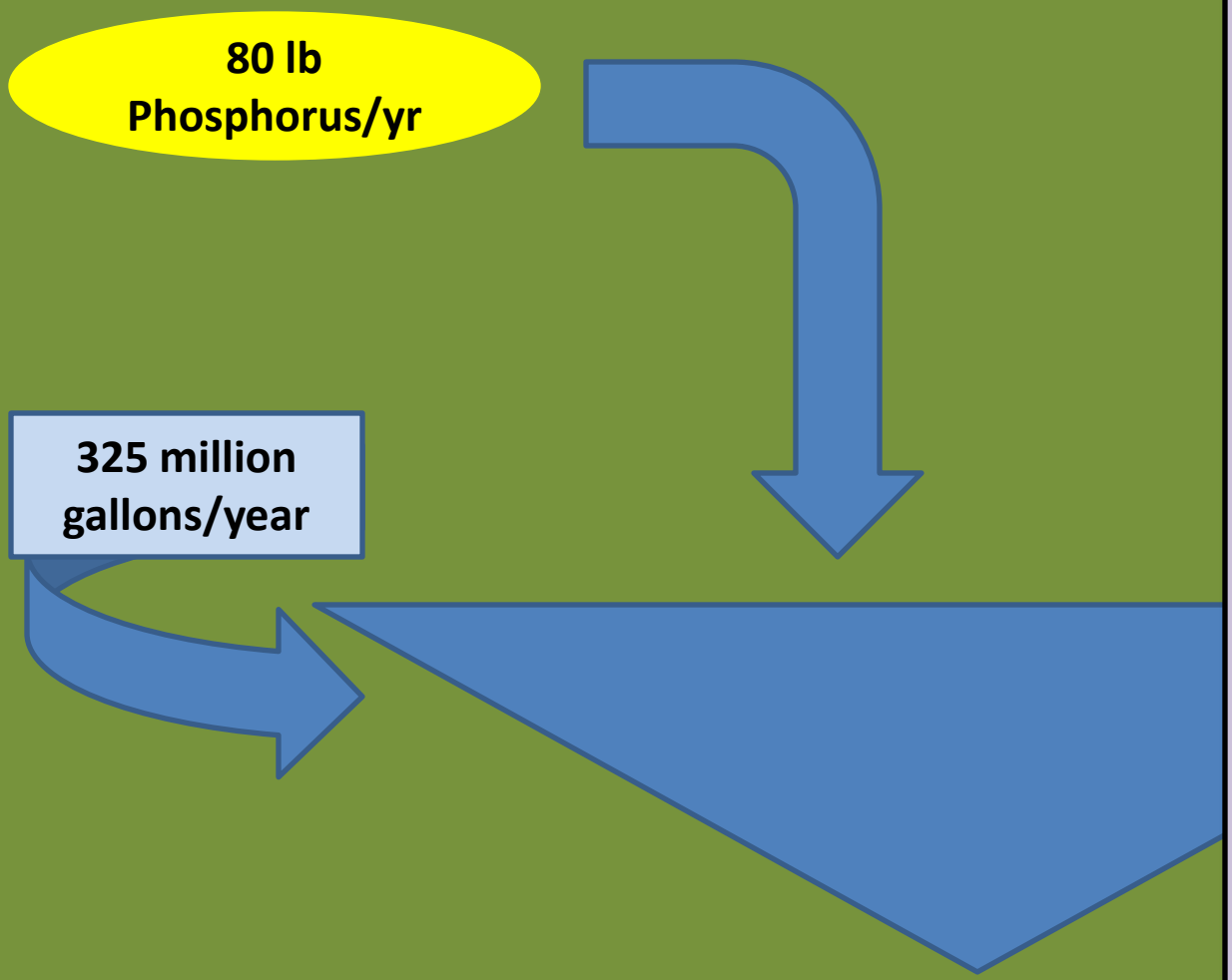
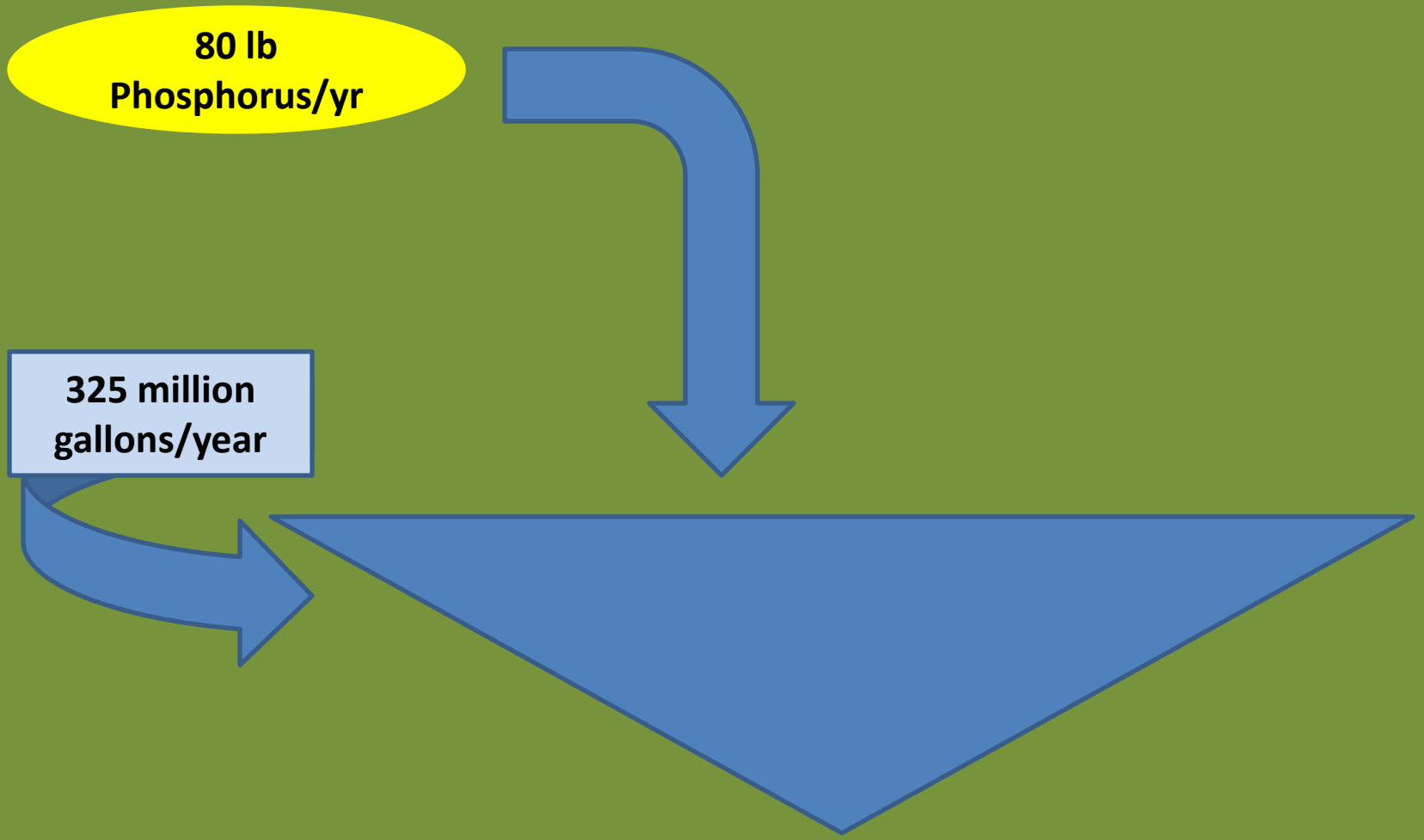


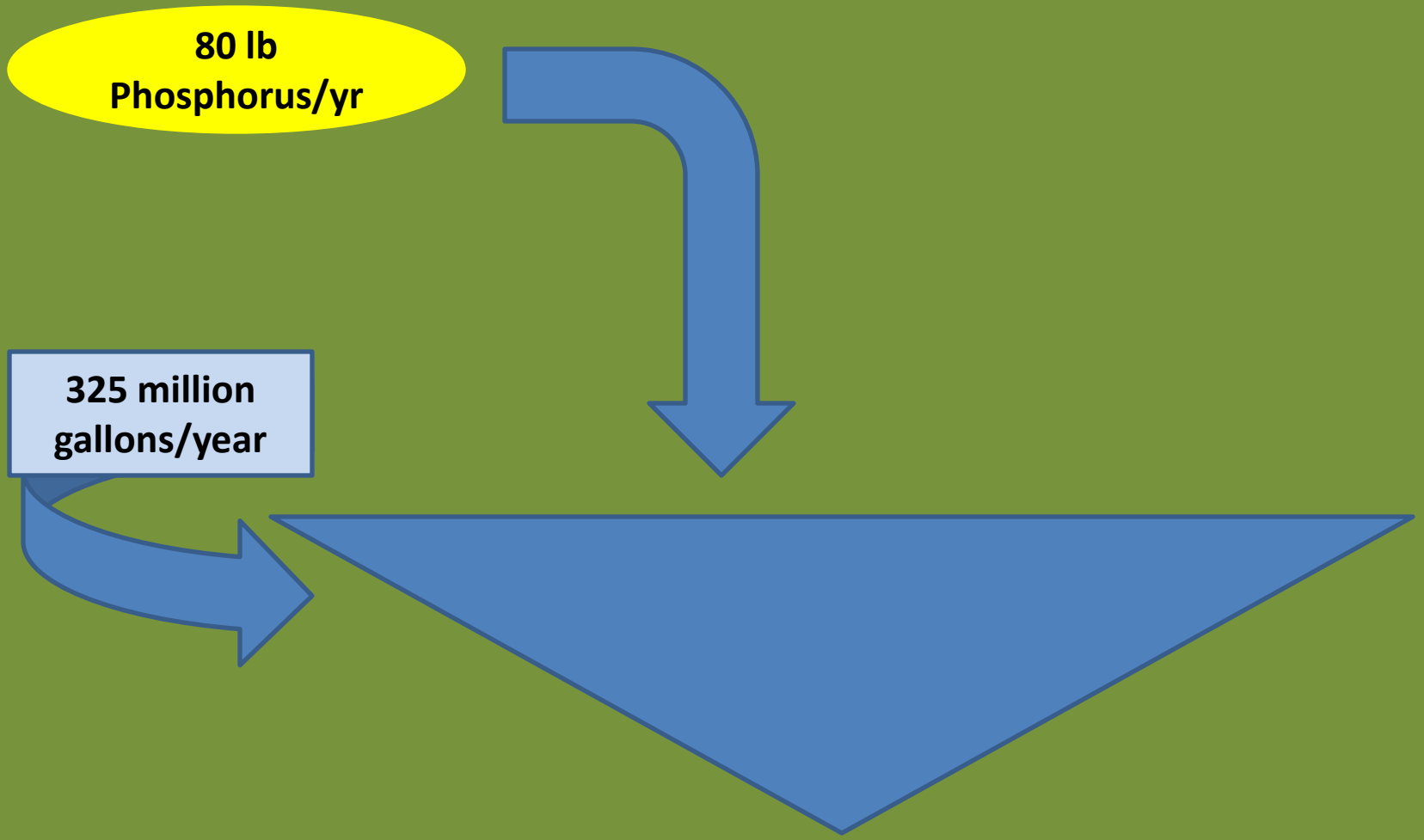



# A model for the phosphorus concentration in a lake

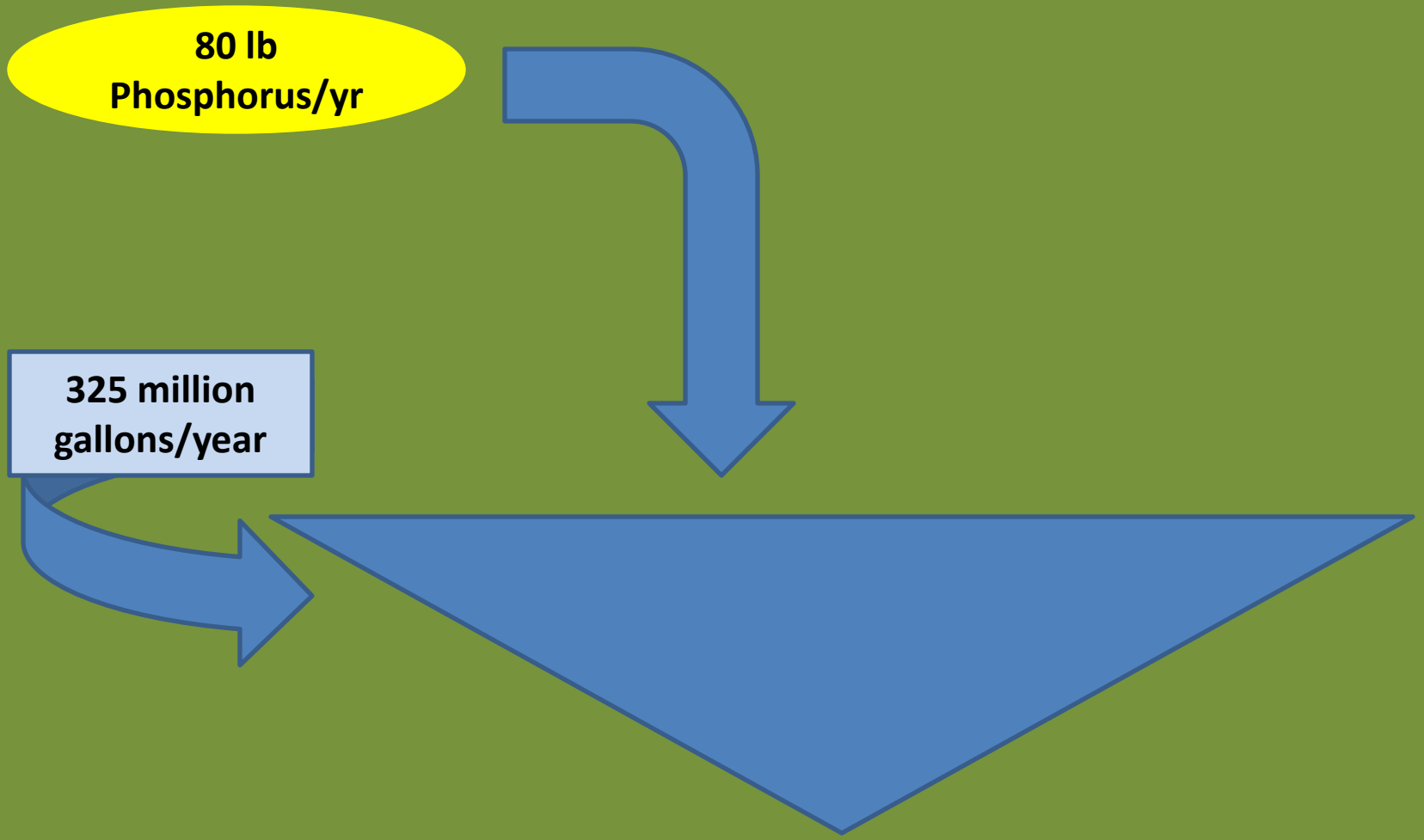
$$\text{Amount of Phosphorus} = \frac{\text{Amount of Phosphorus}}{\text{Amount of Water}}$$




# = 80 lb/ 325 million gallons =




# = 80 lb/ 3 billion lbs water=




**= 80 lb/ 3 billion lbs water= 27 ppb**

# Why Model?

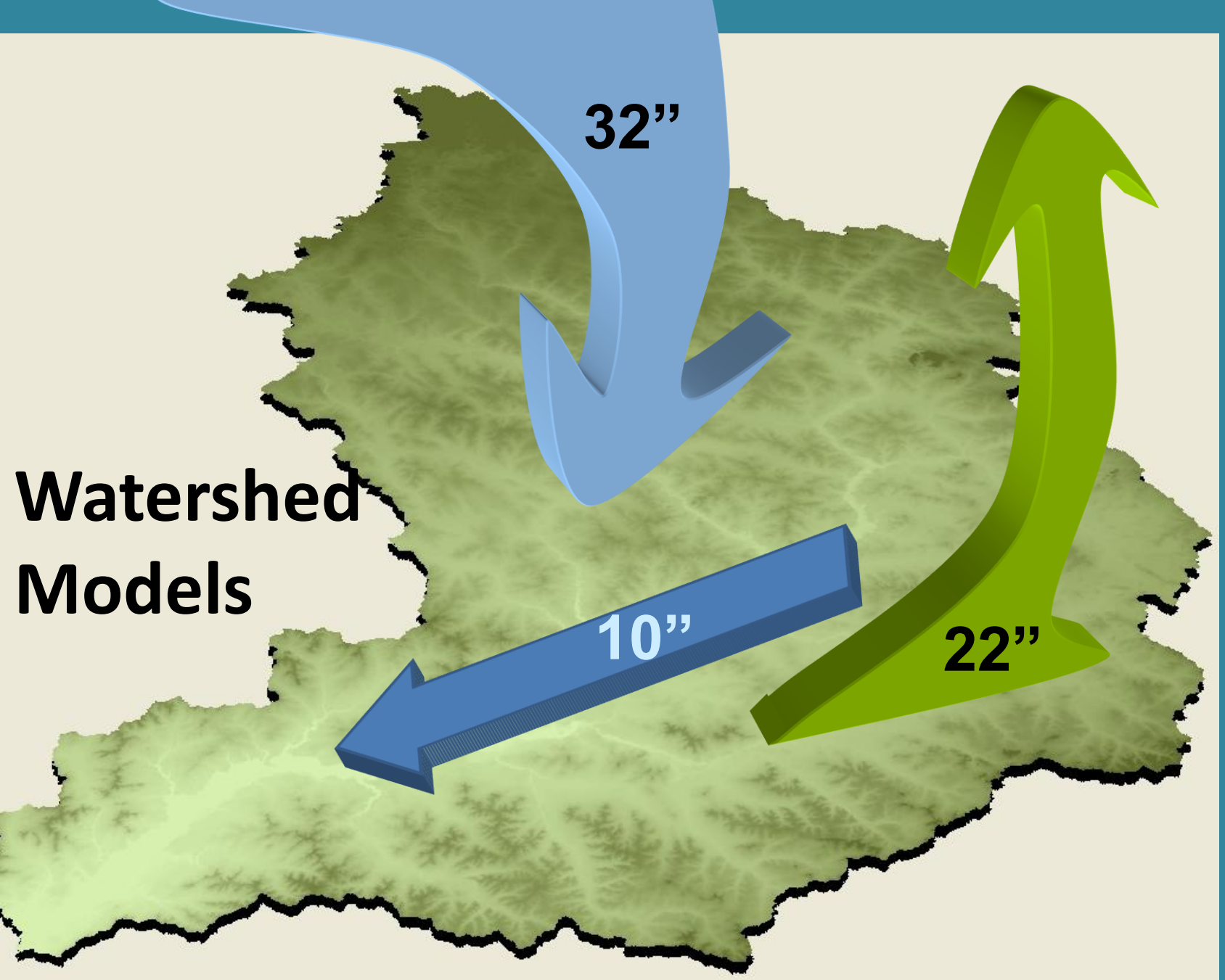
- Groundwater flow– where water is coming from?
- Lake concentration —what if we change the amount added?
- Watershed modeling– can watershed changes help and by how much?
- In-Lake Restoration – “experiment” with treatment, diversions etc.

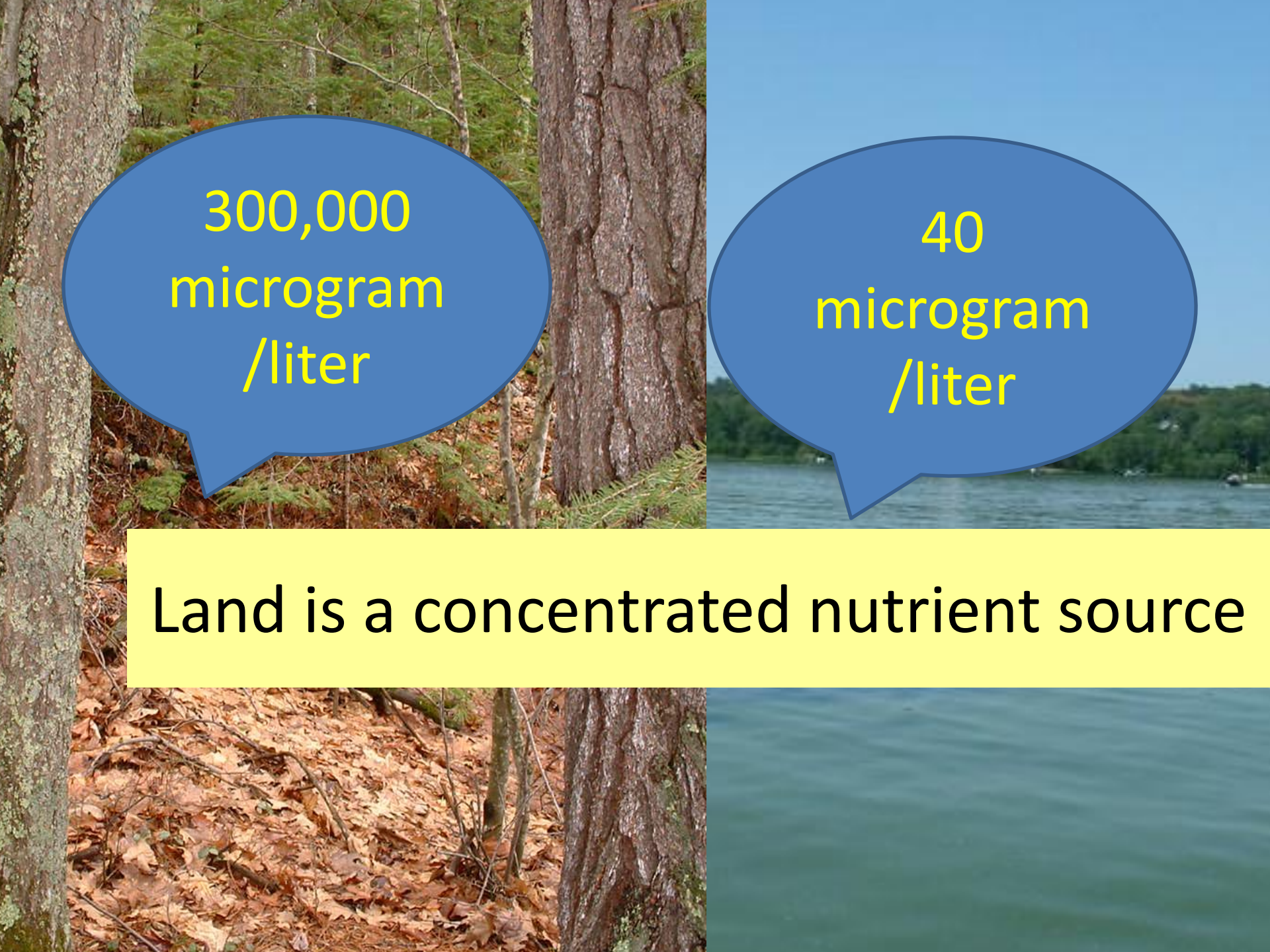
# Rule #1

**“All models are wrong but some are useful”**

George Box

# Watershed Models






Land is a concentrated nutrient source

**Simple Model: Assign annual transfer rate to different land uses**

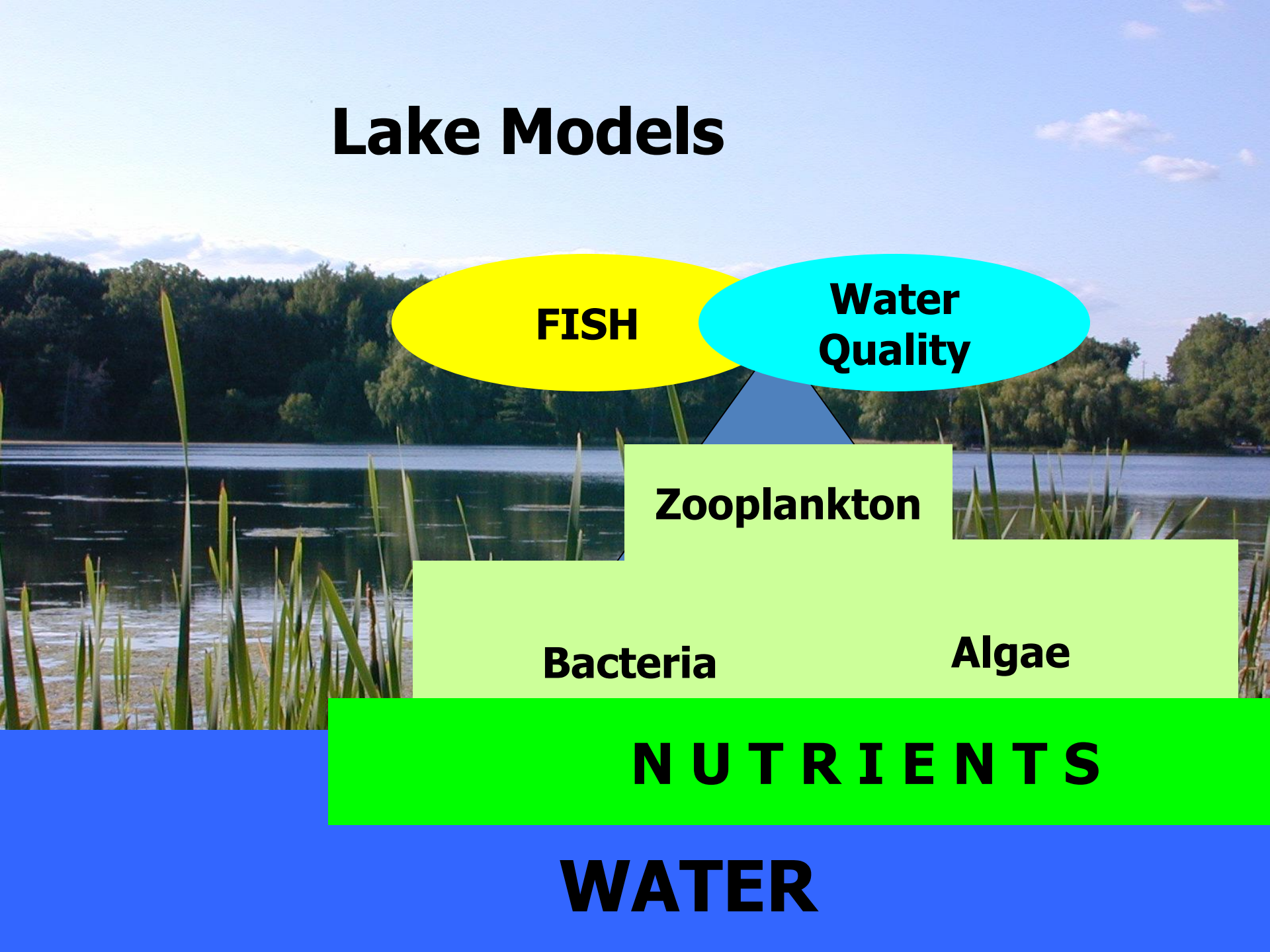
**Complex Model: Simulate every storm, interaction with ground, conveyance to channel, transport to lake**

# Rule #2

**“Make everything as simple as possible, but not simpler”**

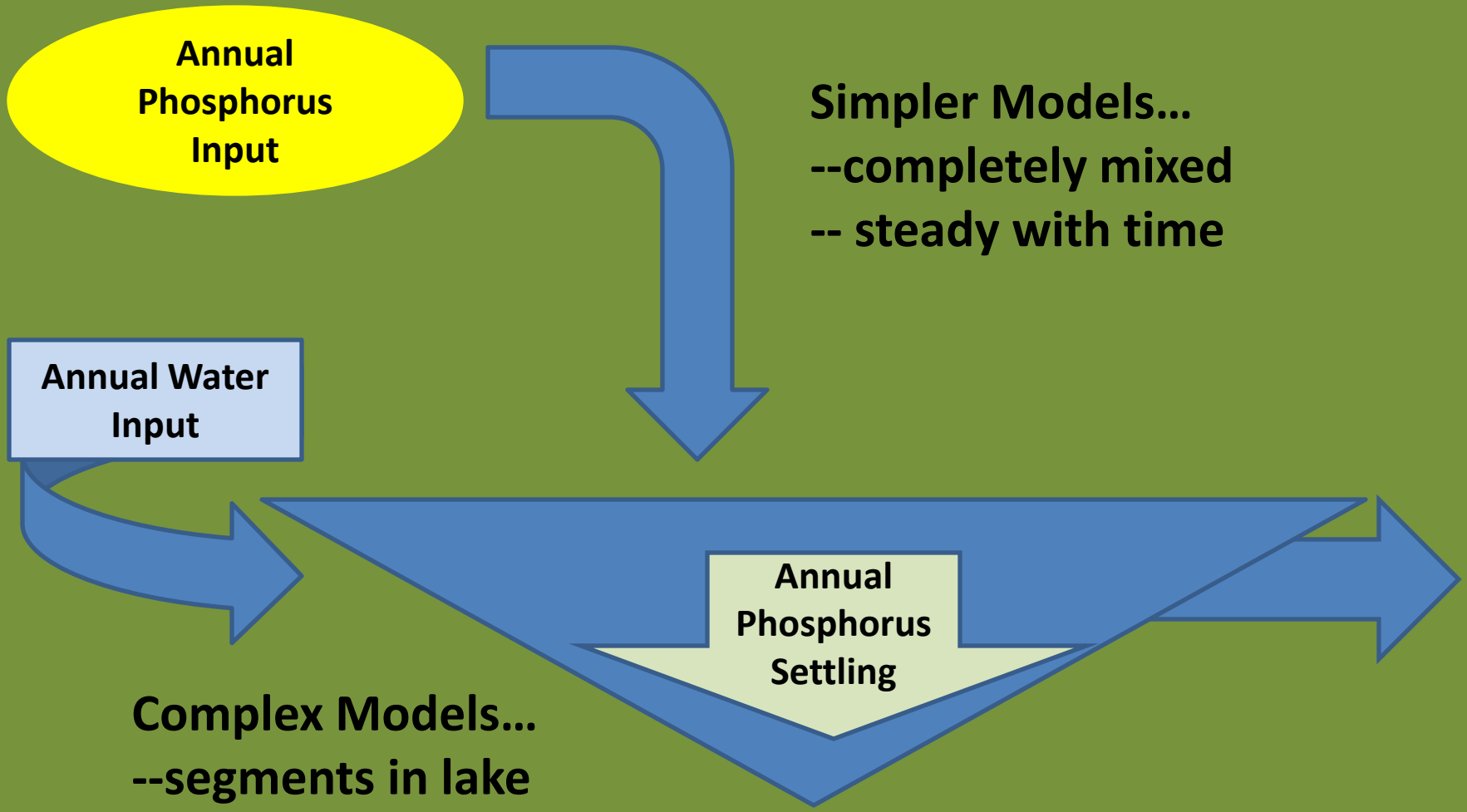
**A. Einstein**

# Lake Models


FISH
Water Quality
Zooplankton
Bacteria
Algae
N U T R I E N T S
WATER

# Lake Models

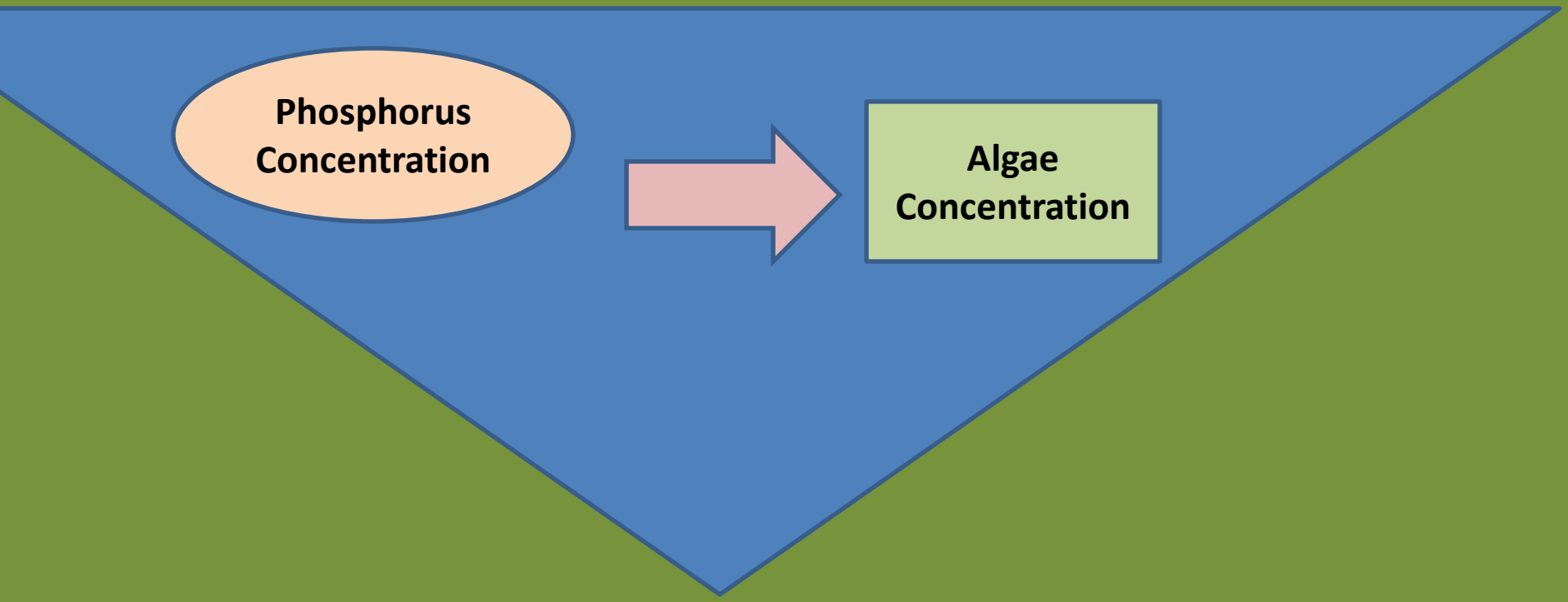
| Phosphorus Concentration (μg/l) | Productivity |
|---|---|
| 10 | Low (Oligotrophic) |
| 10-20 | Medium (Mesotrophic) |
| Greater than 20 | High (Eutrophic) |




**Simpler Models…**
**--completely mixed**
**-- steady with time**

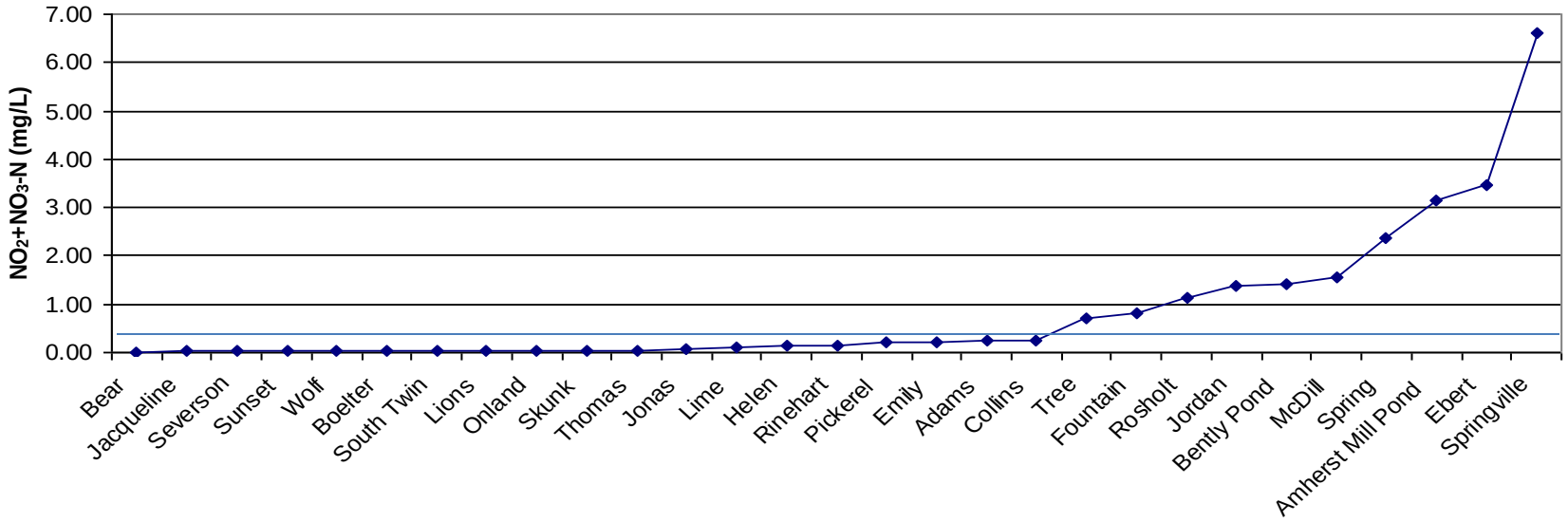
**Complex Models…**
**--segments in lake**
**--vary with time**
**--biology!**

# Lake Response Model?

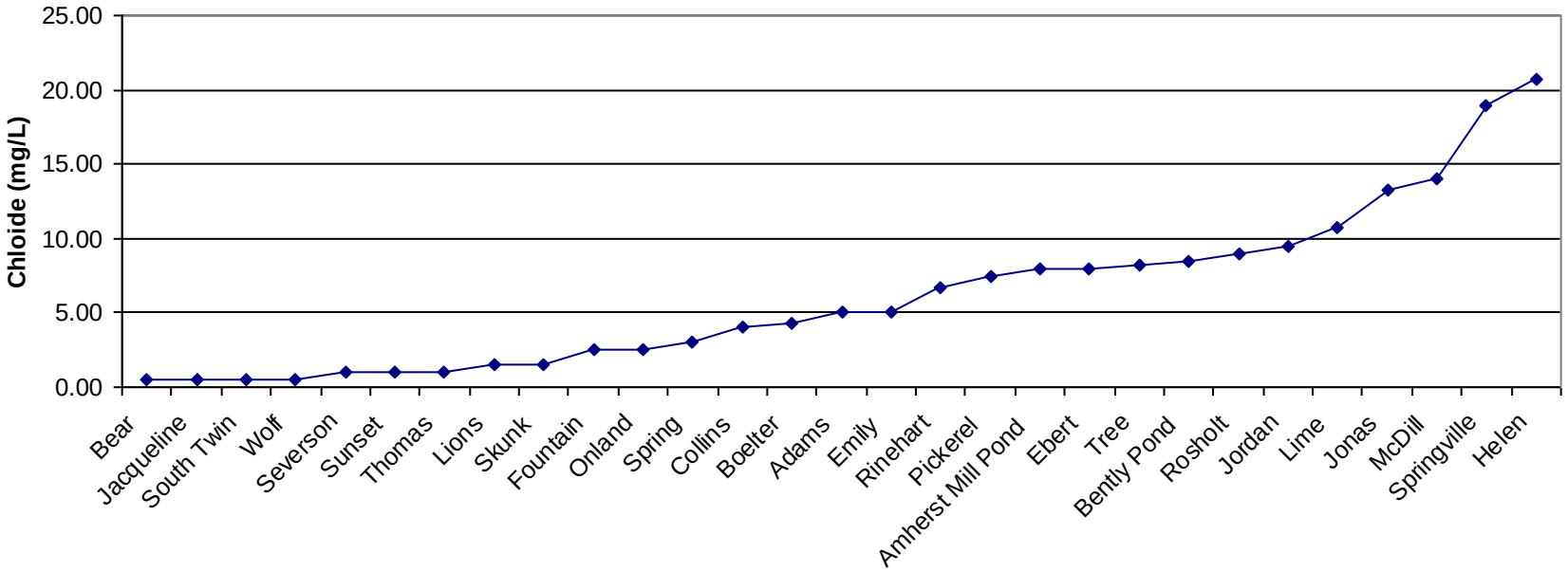


# Application to Portage County

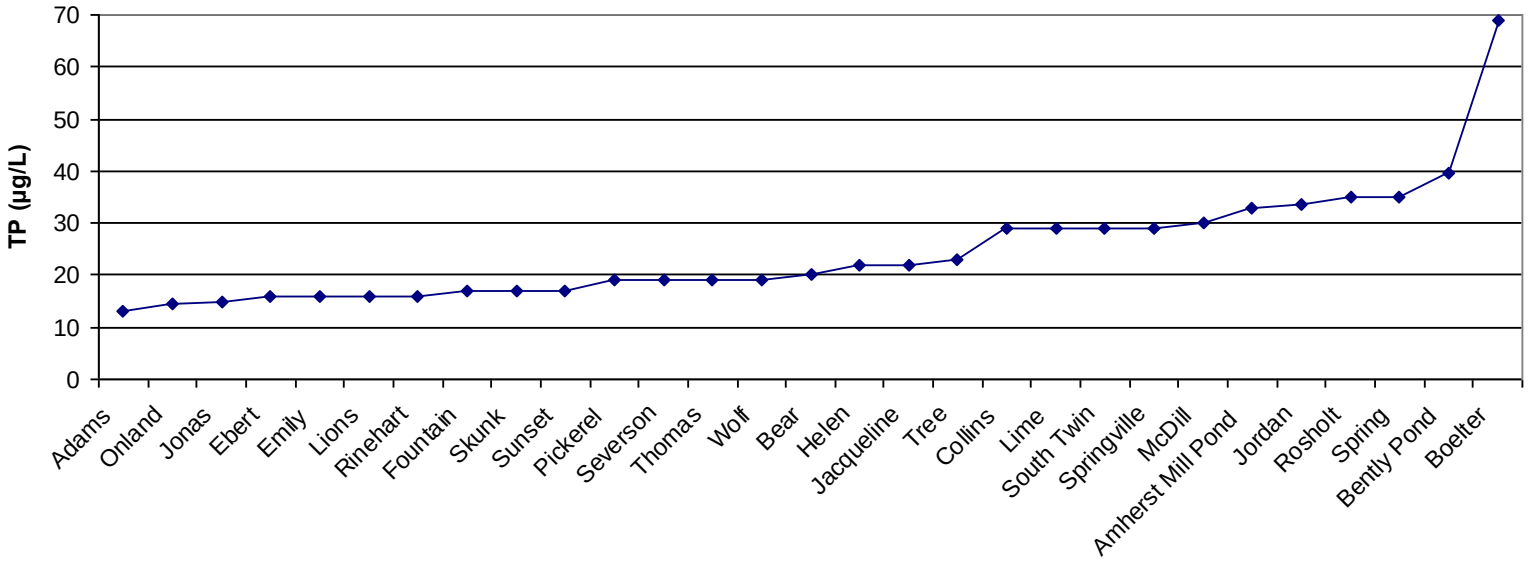
## Median Nitrate



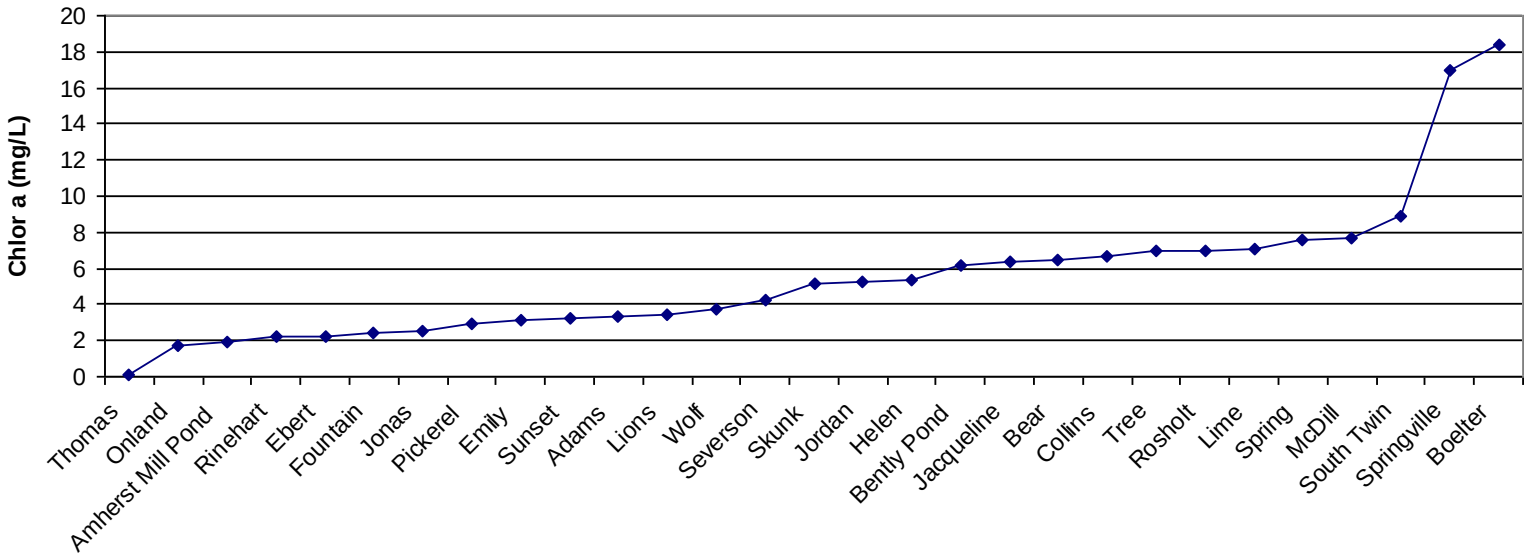

## Median Chloride

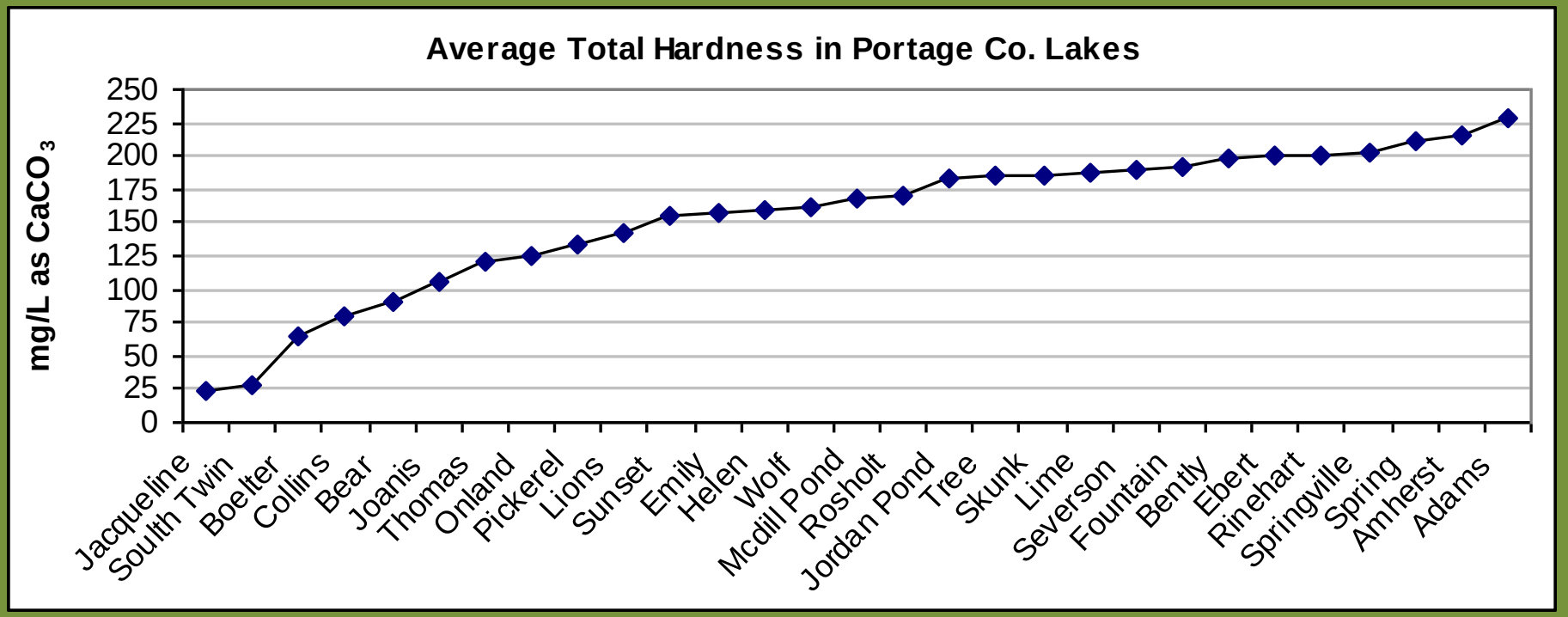


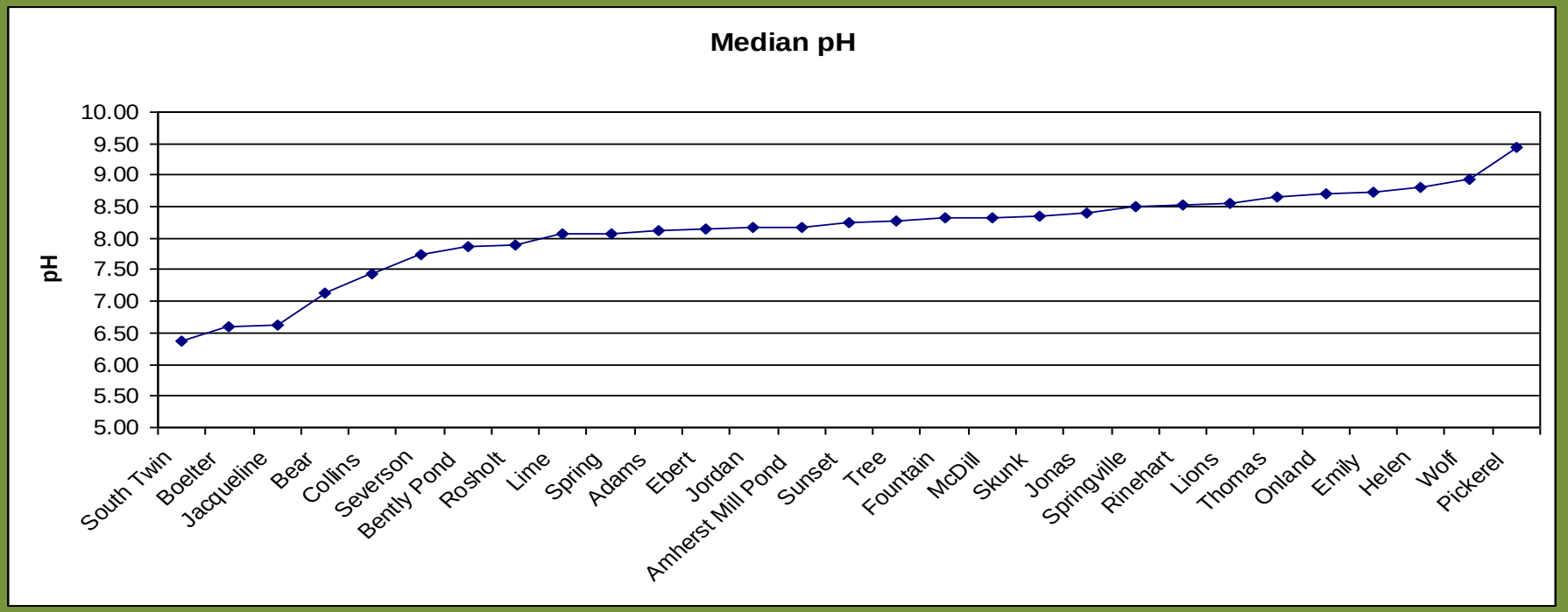
## Median Total Phosphorus

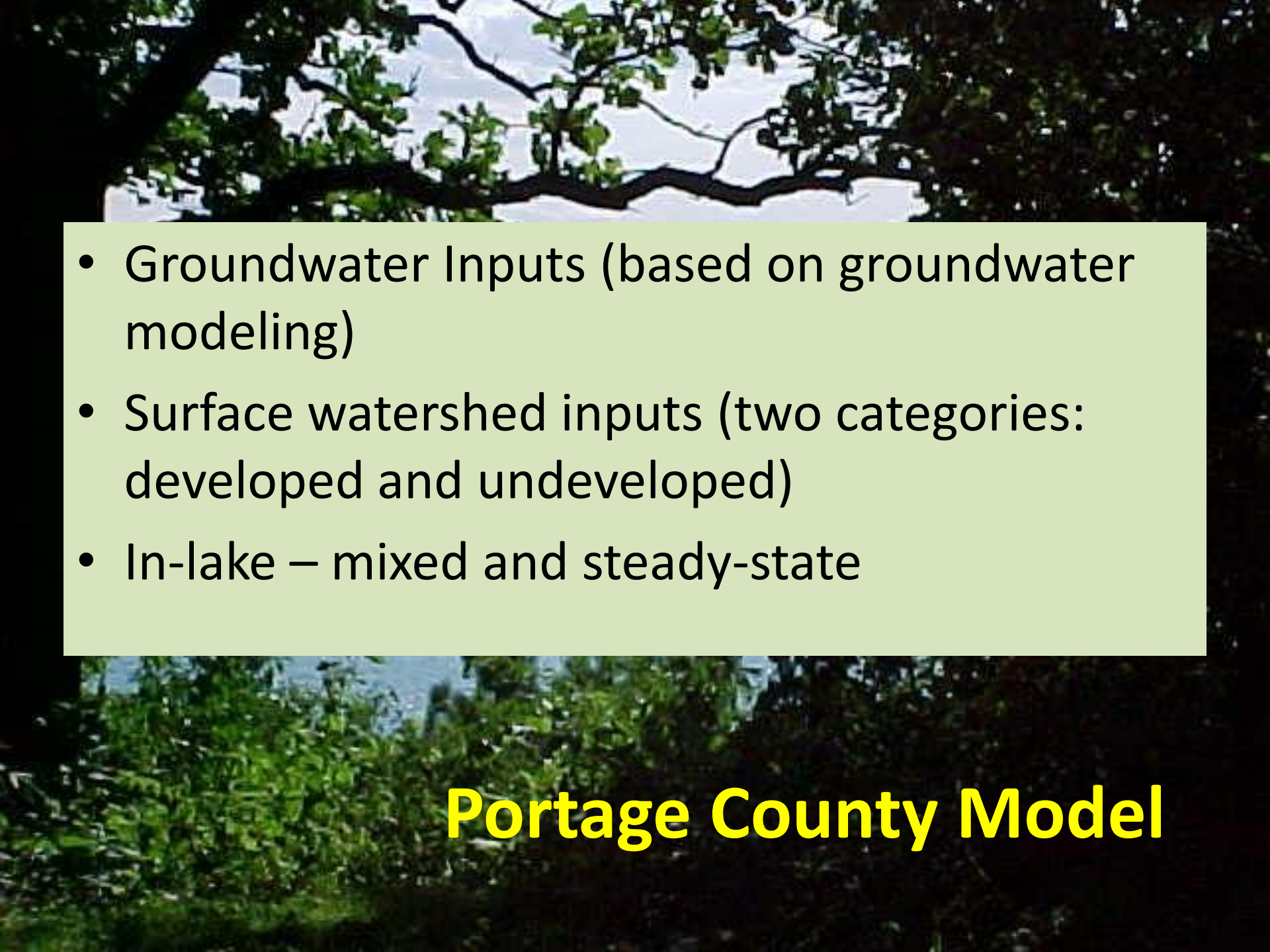



## Median Chlorophyll A



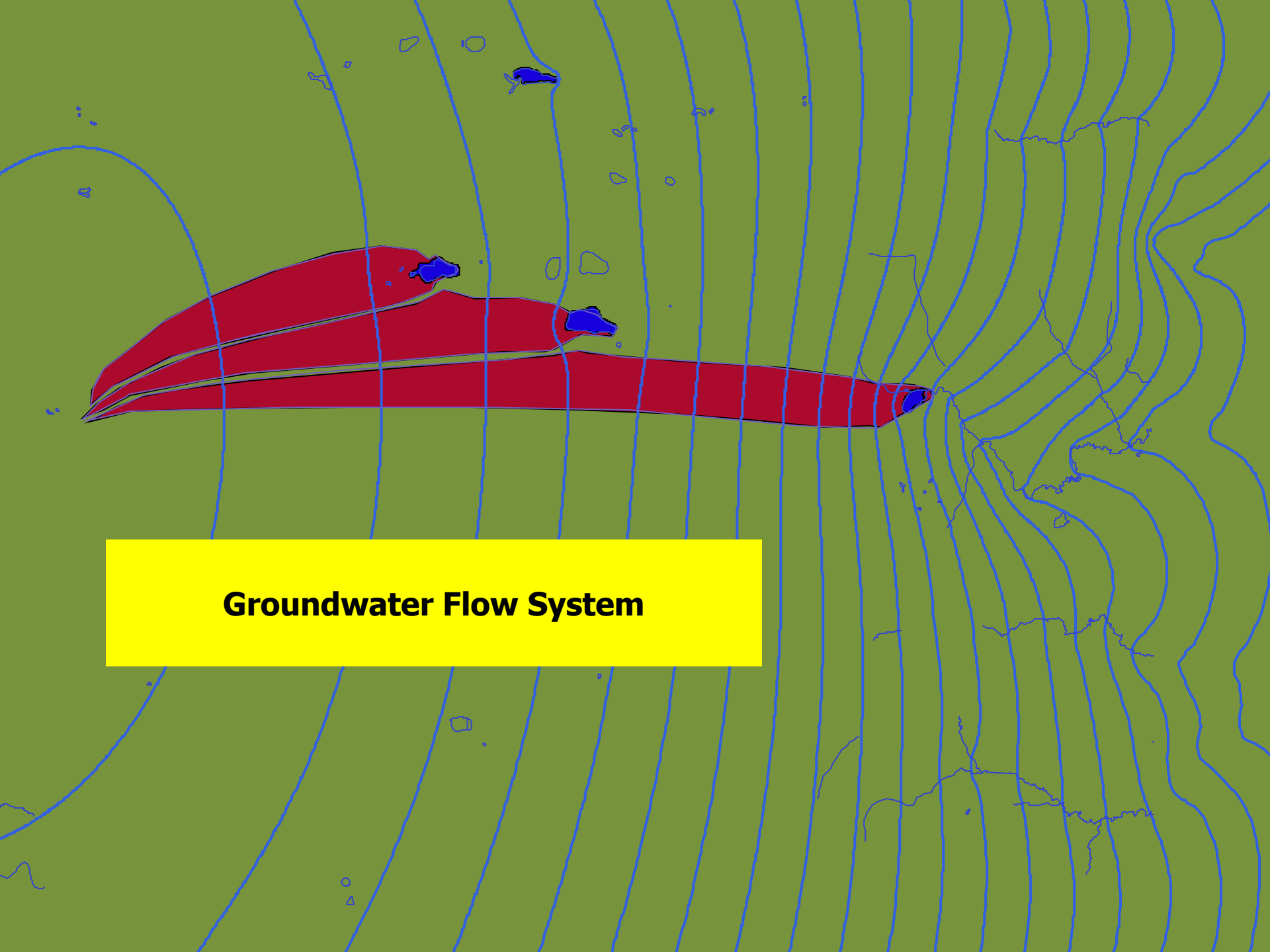

Average Total Hardness in Portage Co. Lakes
mg/L as CaCO3
250
225
200
175
150
125
100
75
50
25
0
Jacqueline
South Twin
Boelter
Collins
Bear
Joanis
Thomas
Onland
Pickerel
Lions
Sunset
Emily
Helen
Wolf
Mcdill Pond
Rosholt
Jordan Pond
Tree
Skunk
Lime
Severson
Fountain
Bently
Ebert
Rinehart
Springville
Spring
Amherst
Adams

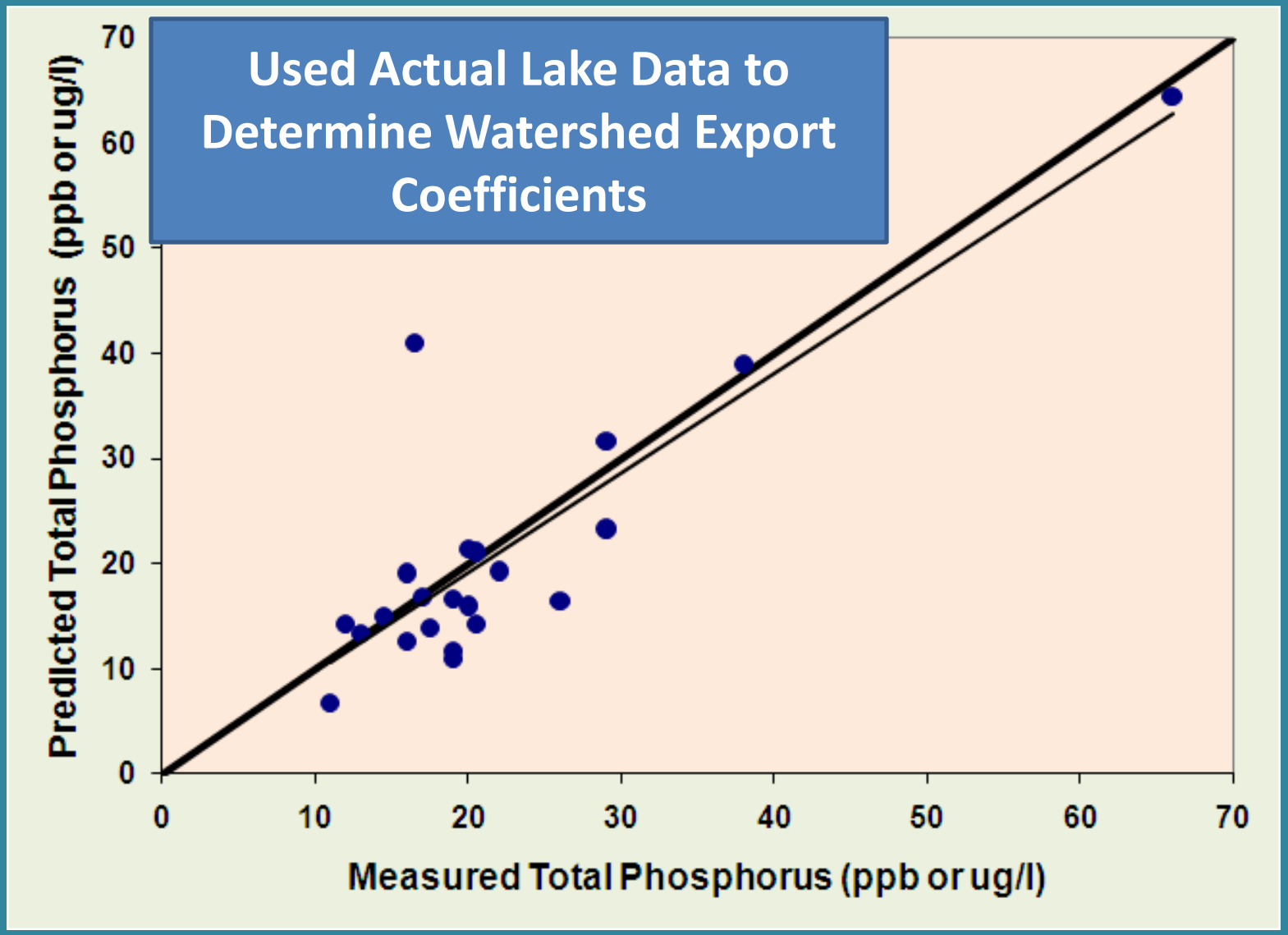

Median pH
pH
10.00
9.50
9.00
8.50
8.00
7.50
7.00
6.50
6.00
5.50
5.00
South Twin
Boelter
Jacqueline
Bear
Collins
Severson
Bently Pond
Rosholt
Lime
Spring
Adams
Ebert
Jordan
Amherst Mill Pond
Sunset
Tree
Fountain
McDill
Skunk
Jonas
Springville
Rinehart
Lions
Thomas
Onland
Emily
Helen
Wolf
Pickerel

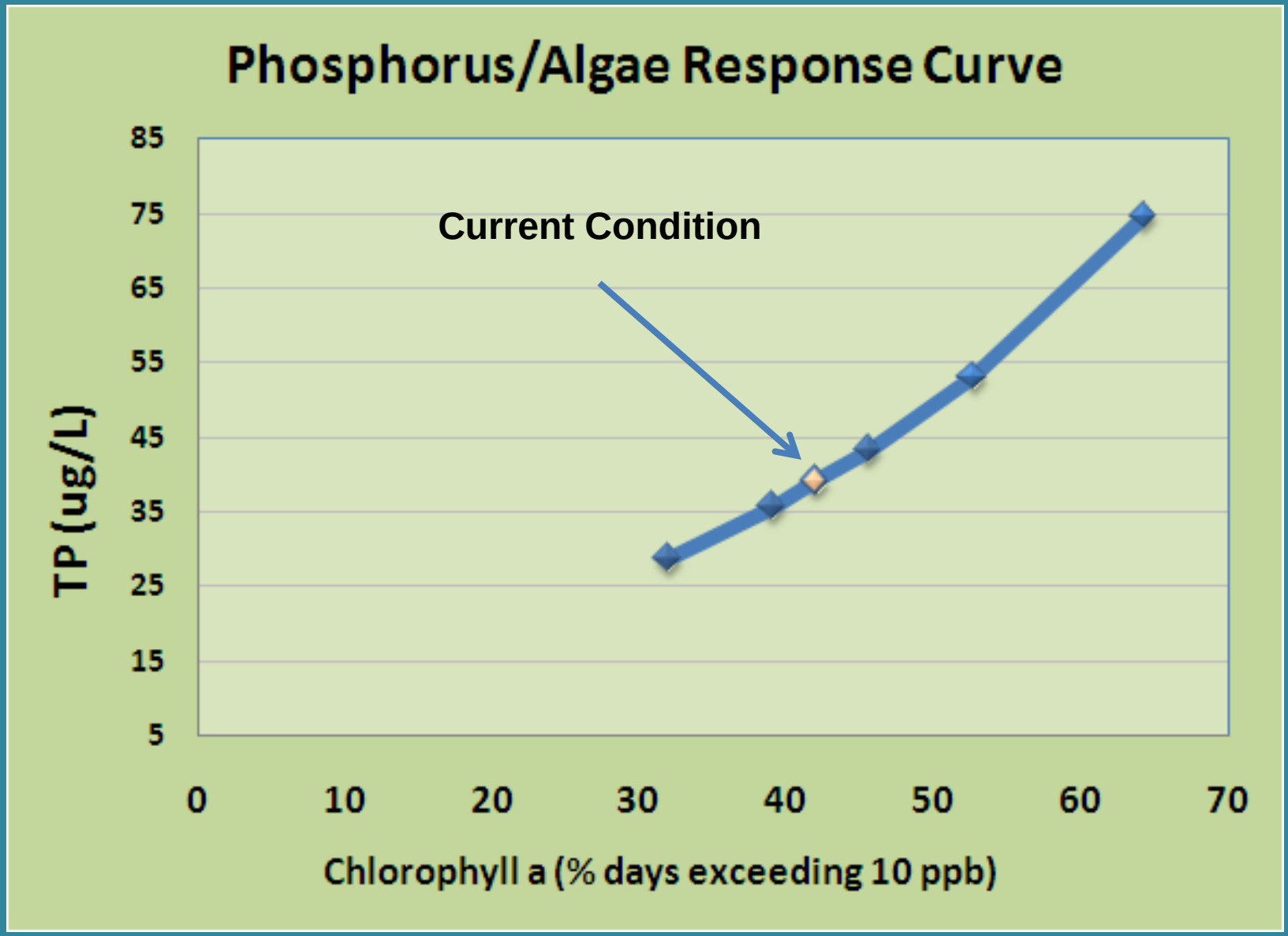


- Groundwater Inputs (based on groundwater modeling)
- Surface watershed inputs (two categories: developed and undeveloped)
- In-lake – mixed and steady-state

# Portage County Model


Groundwater Flow System


Used Actual Lake Data to Determine Watershed Export Coefficients
Predicted Total Phosphorus (ppb or ug/l)
Measured Total Phosphorus (ppb or ug/l)
0
10
20
30
40
50
60
70


Phosphorus/Algae Response Curve
Current Condition
TP (ug/L)
85
75
65
55
45
35
25
15
5
0
10
20
30
40
50
60
70
Chlorophyll a (% days exceeding 10 ppb)

Questions