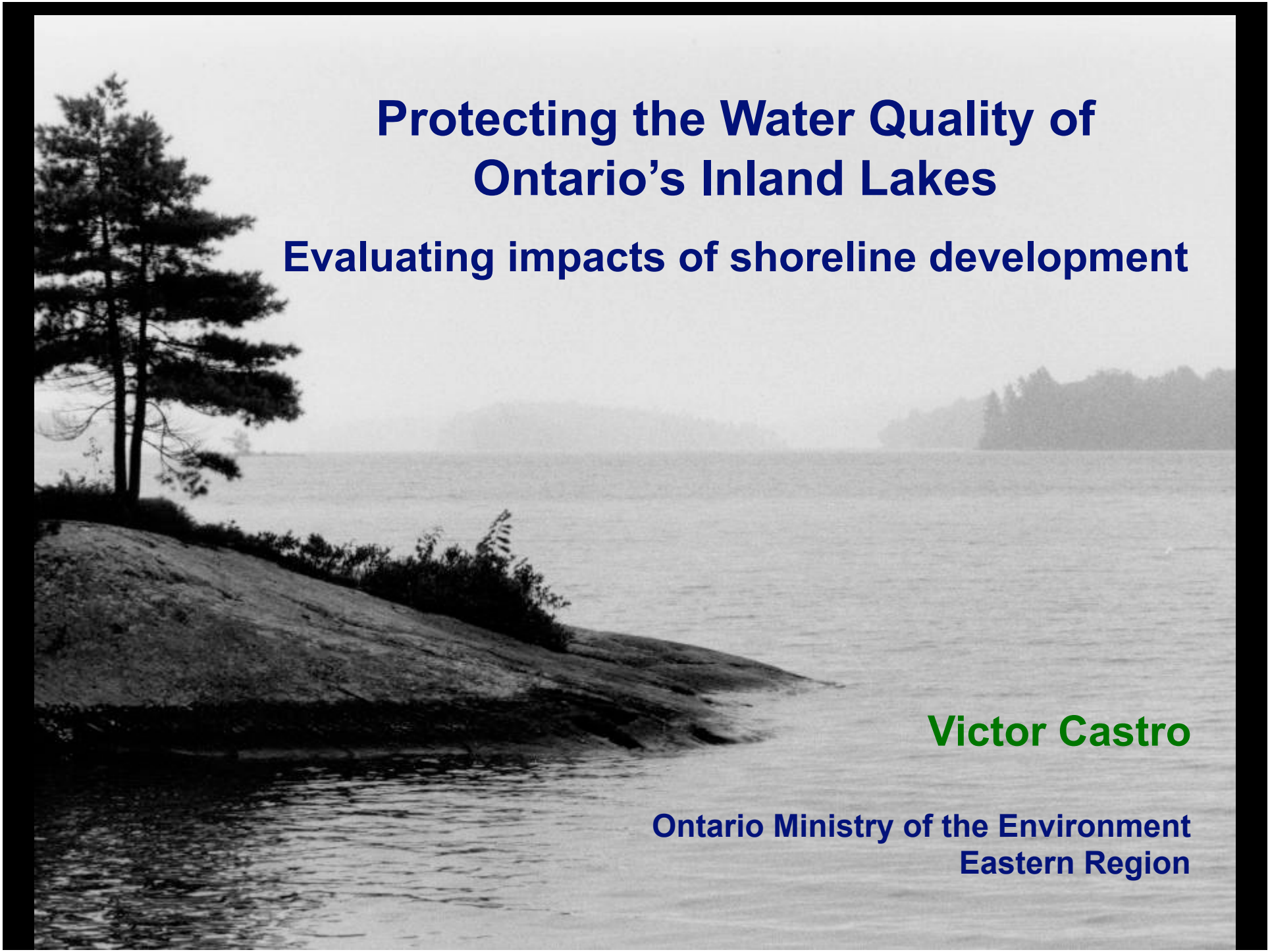


Protecting the Water Quality of Ontario's Inland Lakes

Evaluating impacts of shoreline development

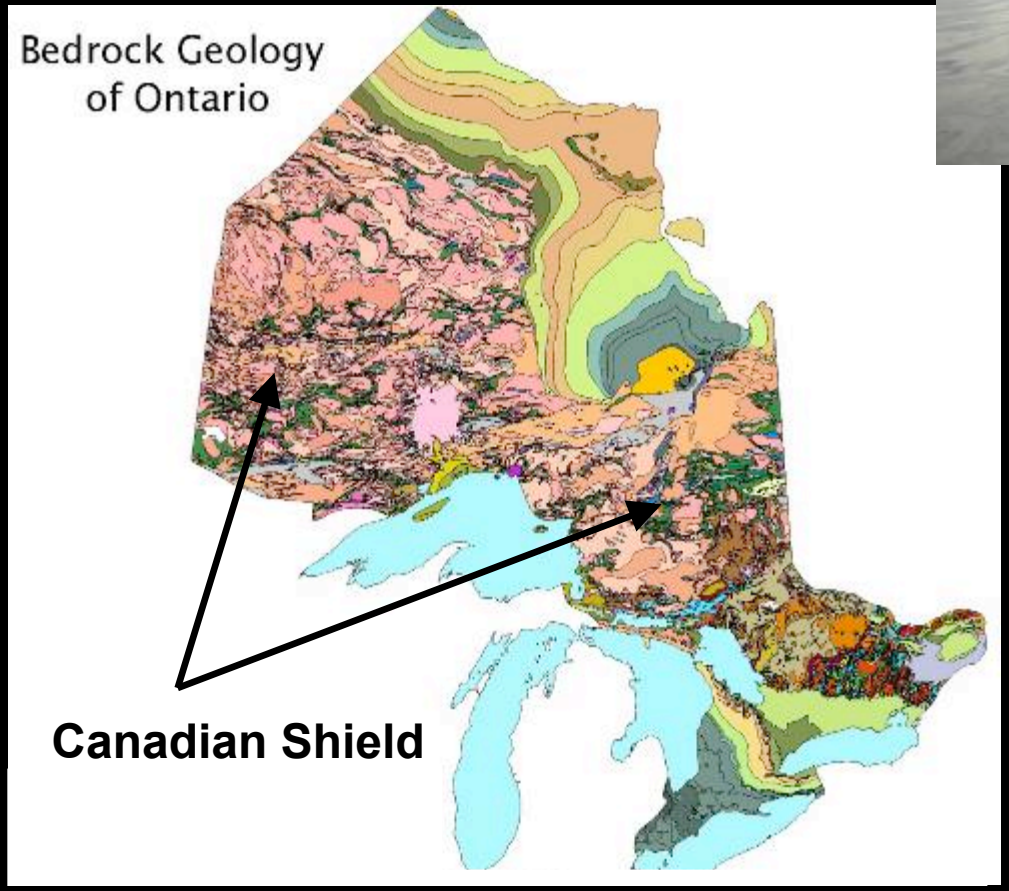
Victor Castro

Ontario Ministry of the Environment
Eastern Region

Summary of Presentation

- Overview of water quality impacts related to shoreline development
- Role of phosphorus
- Brief description of the Lakeshore Capacity Model
- Application to Tay River Watershed

Ontario's Inland Lakes



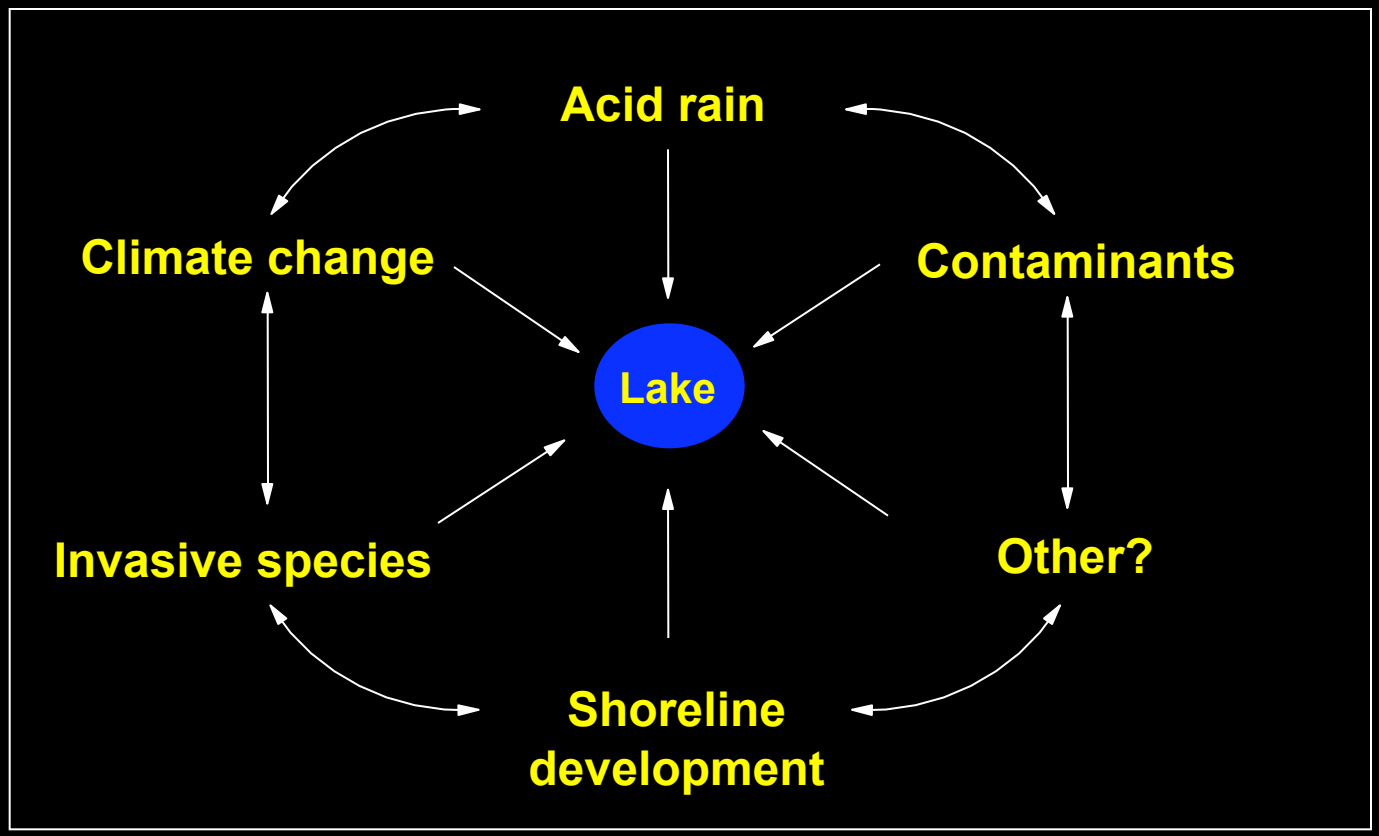
- ~250,000 lakes greater than 1 ha in size
- majority on Canadian Shield
- water quality is generally good

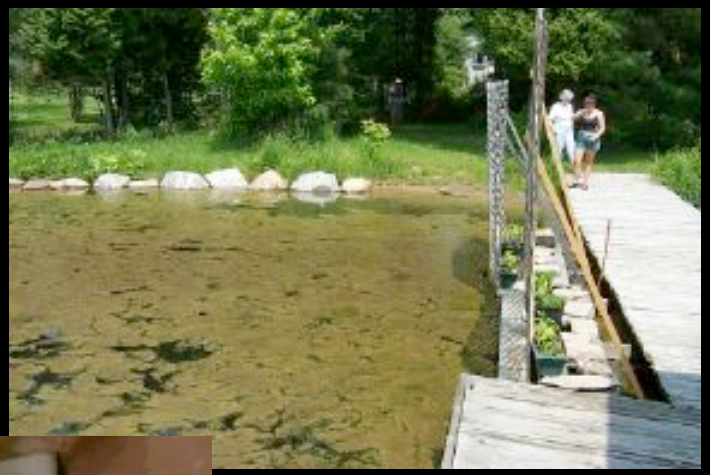
The economic value of clean water in Ontario

- ~2 million adult anglers per year
- $1.2 billion in fishing gear, boats, etc.
- $1.3 billion in activities related to fishing
- $1 billion annually on recreational boating
- commercial fisheries (~$42.5 million)
- water-related tourism (~$5.5 billion)

(Source: Economic Services Branch, MOE, 1997)

Threats to water quality of inland lakes





Algal blooms:

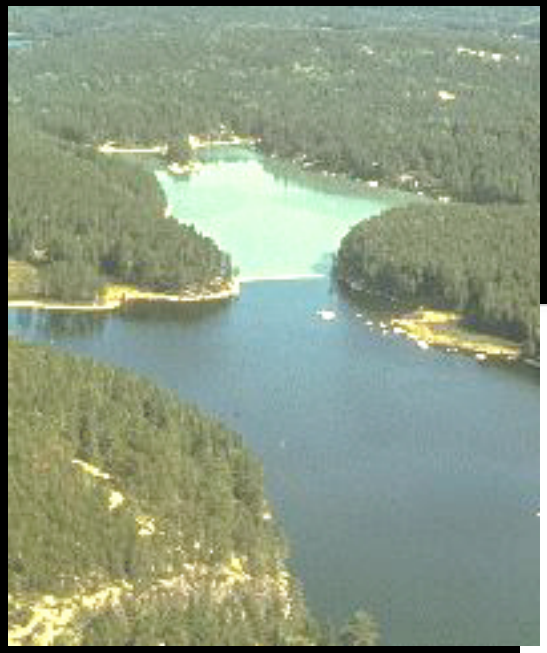
1) Reduced water clarity
2) Loss of deep-water oxygen
3) Taste and odour
4) Toxins

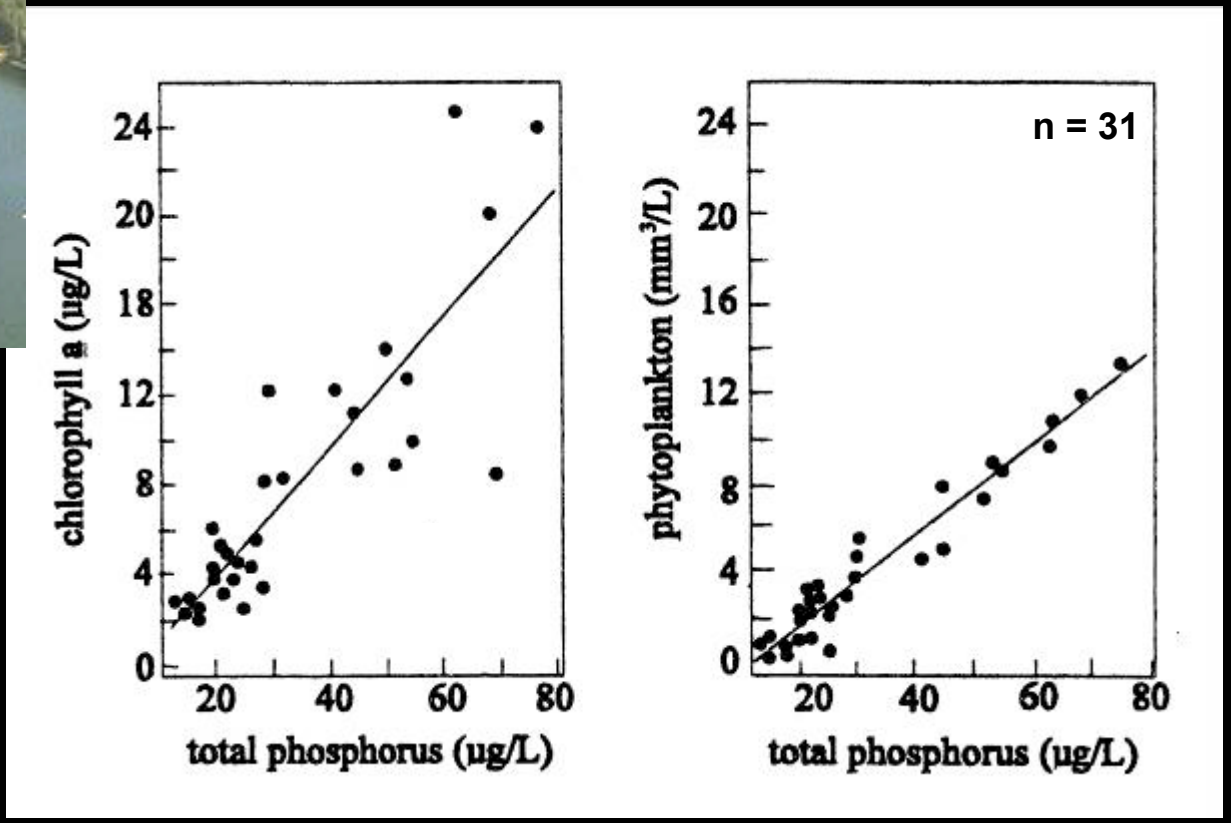
What factors control the growth of algae?

1) Light/water clarity
2) Temperature
3) Biological factors
4) Nutrients…

(Courtesy: Fisheries and Ocean Canada)

The importance of phosphorus –> algae





“A simple method for predicting the capacity of a lake for development based on lake trophic status”

J. Fish. Res. Bd. Can.

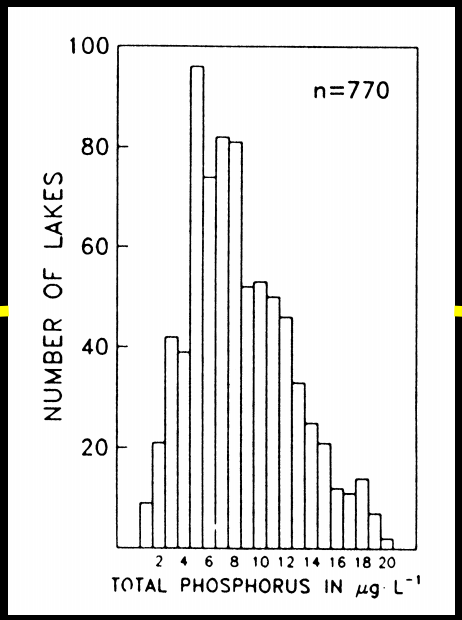
(Dillon and Rigler, 1975)

How does the Lakeshore Capacity Model work?

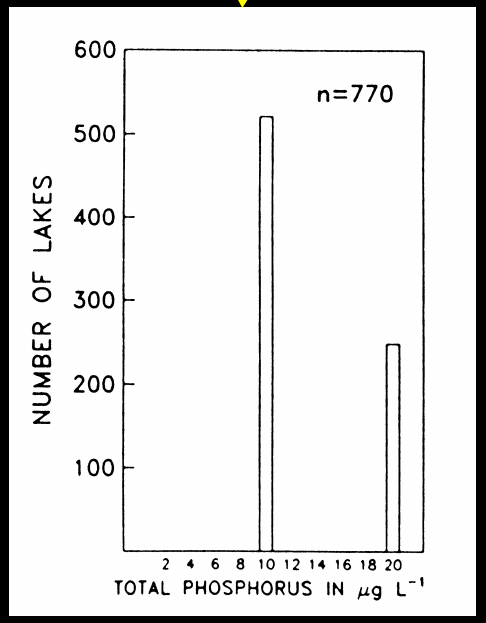
1. **What would be the impact on water quality (phosphorus) of adding X number of new lots?**
   - **risk assessment**

2. **How much development (ie. number of new lots) can be added before water quality (phosphorus) is degraded beyond a given end-point?**
   - **currently 10 micrograms/L**
   - **proposed guideline: natural + 50%**

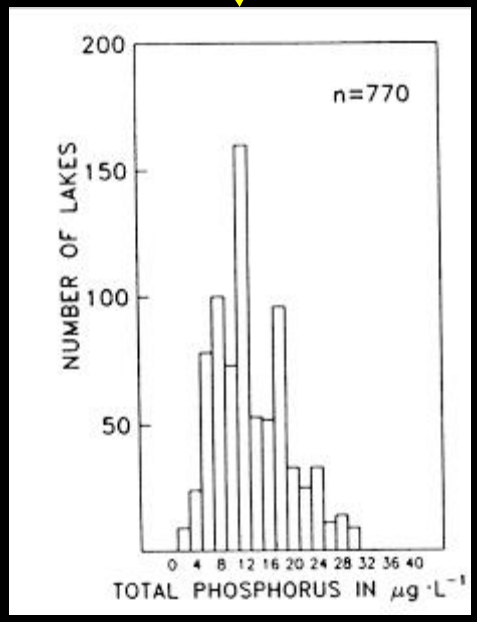
Present distribution



Distribution under existing guideline



Distribution under proposed guideline



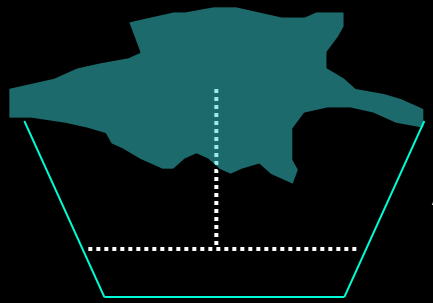
(Hutchinson et al., 1991)

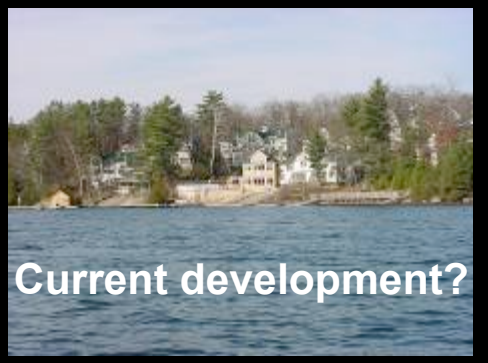
Step 1 - Collect information about the lake

1. Location (lat, long)

2. 

3. 

4. 
Ave. depth

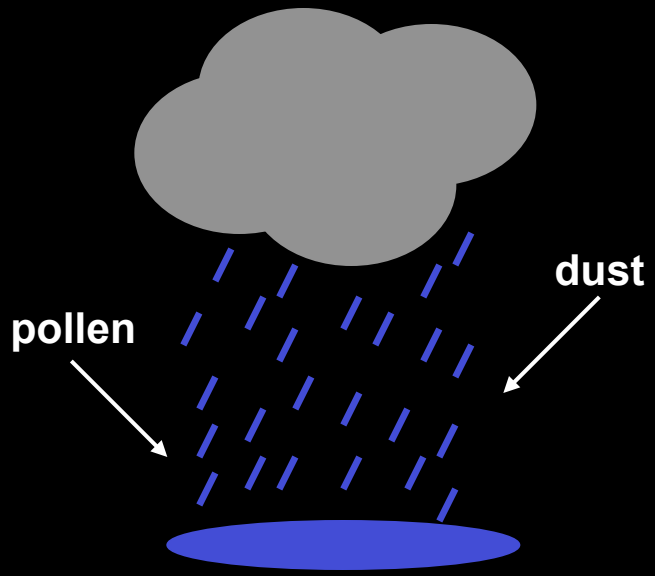
5. 

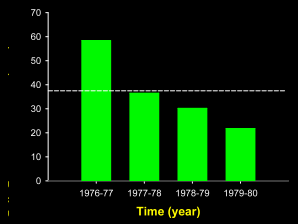
6. Land-use
   - % forested
   - % agriculture
   - % urban
   - % wetland

7. Oxygen in deep-waters?

Step 2 – Calculate ‘natural’ phosphorus load

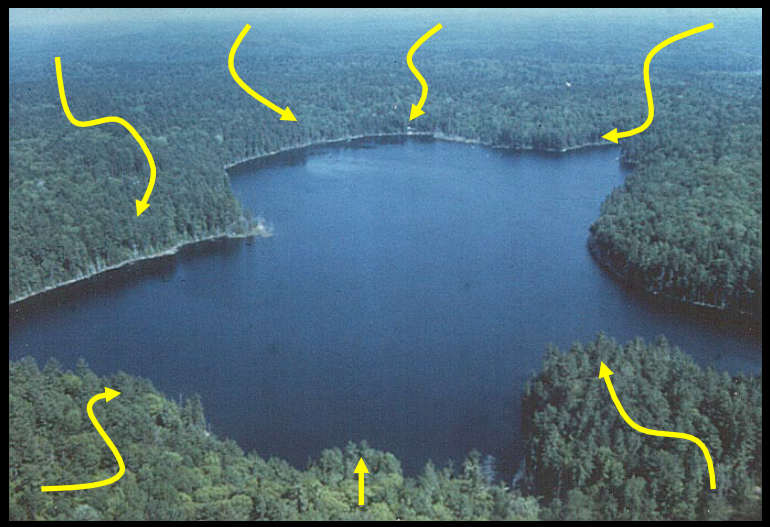
(1) From the atmosphere





Step 2 – Calculate ‘natural’ phosphorus load

(2) From the watershed

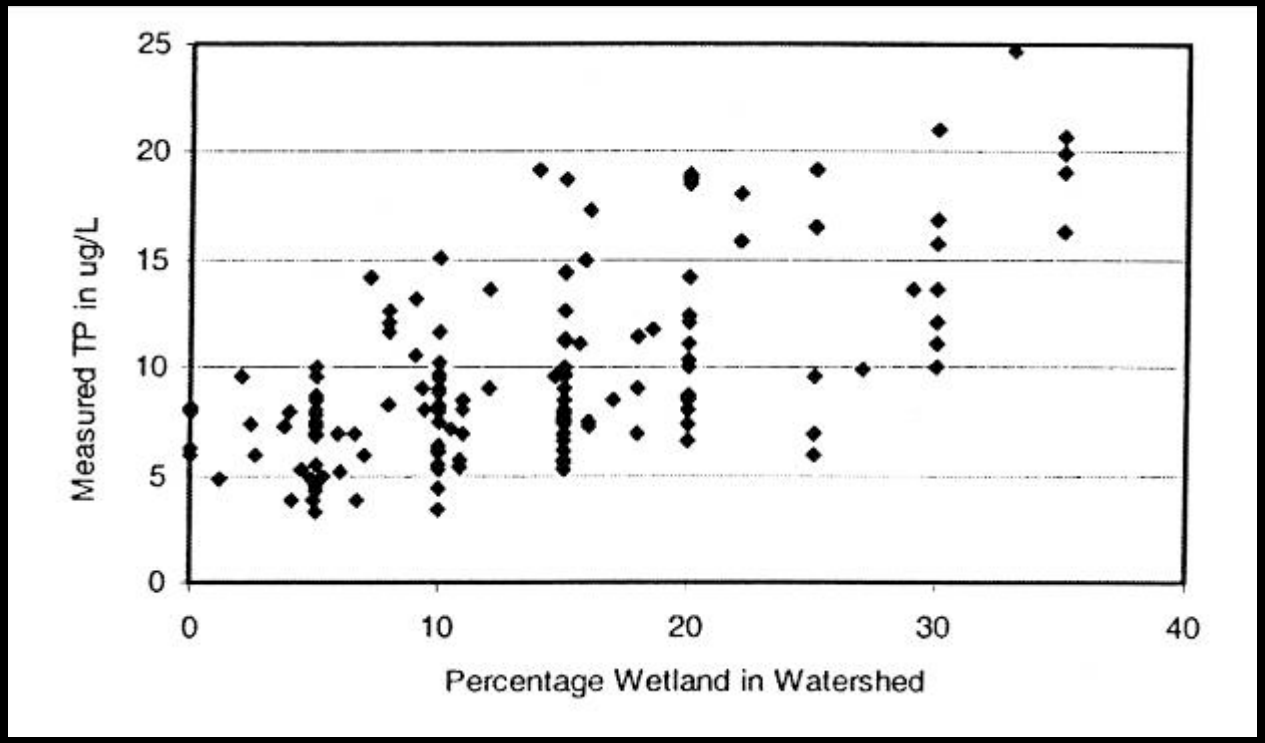


Must consider…

- geology
- land-use
- wetland area

Step 2 – Calculate ‘natural’ phosphorus load

(3) The importance of wetlands



(Hutchinson, 2002)

Step 3 – Calculate 'development' phosphorus load

Need to consider…

(1) Phosphorus contributed by each person, based on:

- septic tank measurements
- data from STP's
- estimates of TP in food
- 0.6 – 0.8 kg TP/person/year

(2) # of people in each house, cottage, resort, etc.

- varies depending on use
- seasonal cottage = 0.69 per capita years/year
- resort = 1.27 per capita years/year

(3) # of development units

Q **What would be the impact on water quality of adding X number of new developments?**

- risk assessment

Q What would be the impact on water quality of adding X number of new developments to the watershed?

- risk assessment

A

‘Natural’ phosphorus	4.9 micrograms/L
Existing phosphorus	5.4 micrograms/L
75 cottages	9.2 micrograms/L
75 cottages + resort	13.3 micrograms/L

Q How much development (ie. number of new lots) can be added before water quality is degraded beyond a given end-point?

- currently 10 micrograms/L
- proposed guideline: natural + 50%
  (= 7.35 micrograms/L)

A **Existing guideline (10 micrograms/L)**

- 92 cottages or 53 resort units

Proposed guideline (natural + 50%)

- 39 cottages or 22 resort units

Example: Summary of results

- Current development is acceptable under current and proposed water quality guidelines

- Proposed development projects would exceed both existing and proposed water quality guidelines

- To meet current guidelines, 92 cottages, 53 resort units, or some combination would be acceptable

- To meet proposed guidelines, 39 cottages, 22 resort units, or some combination would be acceptable

Major assumptions

1) 100% of phosphorus from septic/sewage systems (within 300 metres) reaches lake

   - precautionary approach
   - lag effects

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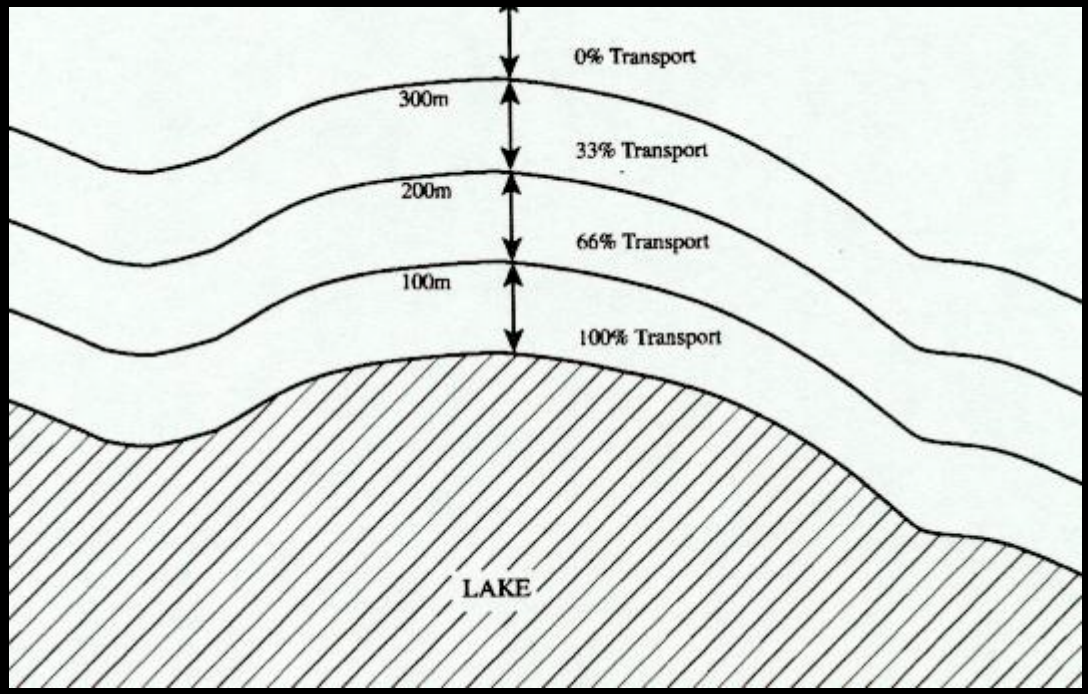


Major assumptions

2) Septic systems are primary source of ‘development’ phosphorus

   - true in recreational lakes in Ontario
   - model is flexible

Other considerations

1) Phosphorus is only one aspect of water quality and water quality is only one aspect of lake management
2) Model is only as good as the input data used

    - model should be calibrated to each region
    - scientific review

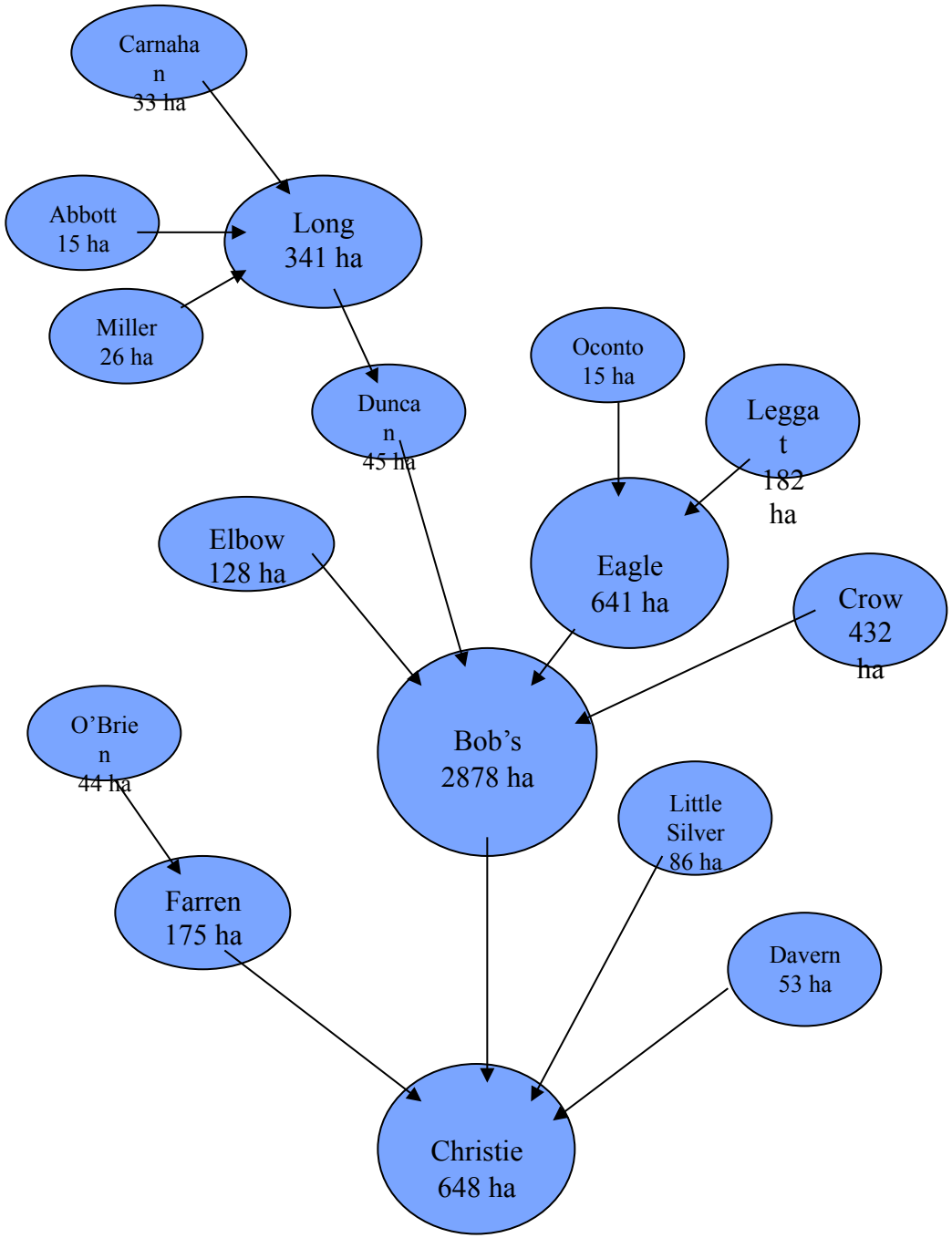
3) Dissolved oxygen

4) Important to recognize model limitations

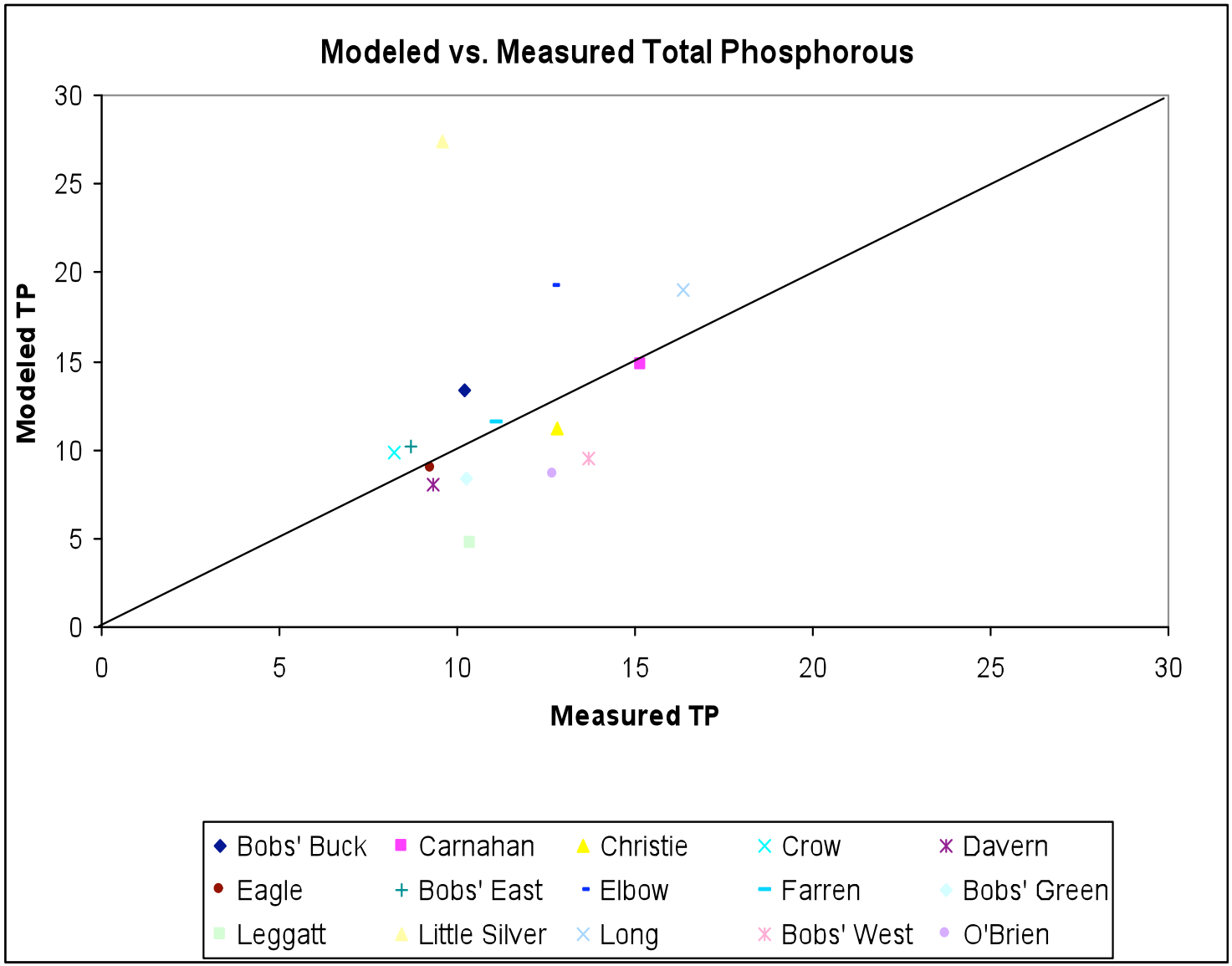
    - not accurate enough to predict lot by lot impacts
    - model equations were designed using a very specific set of lakes

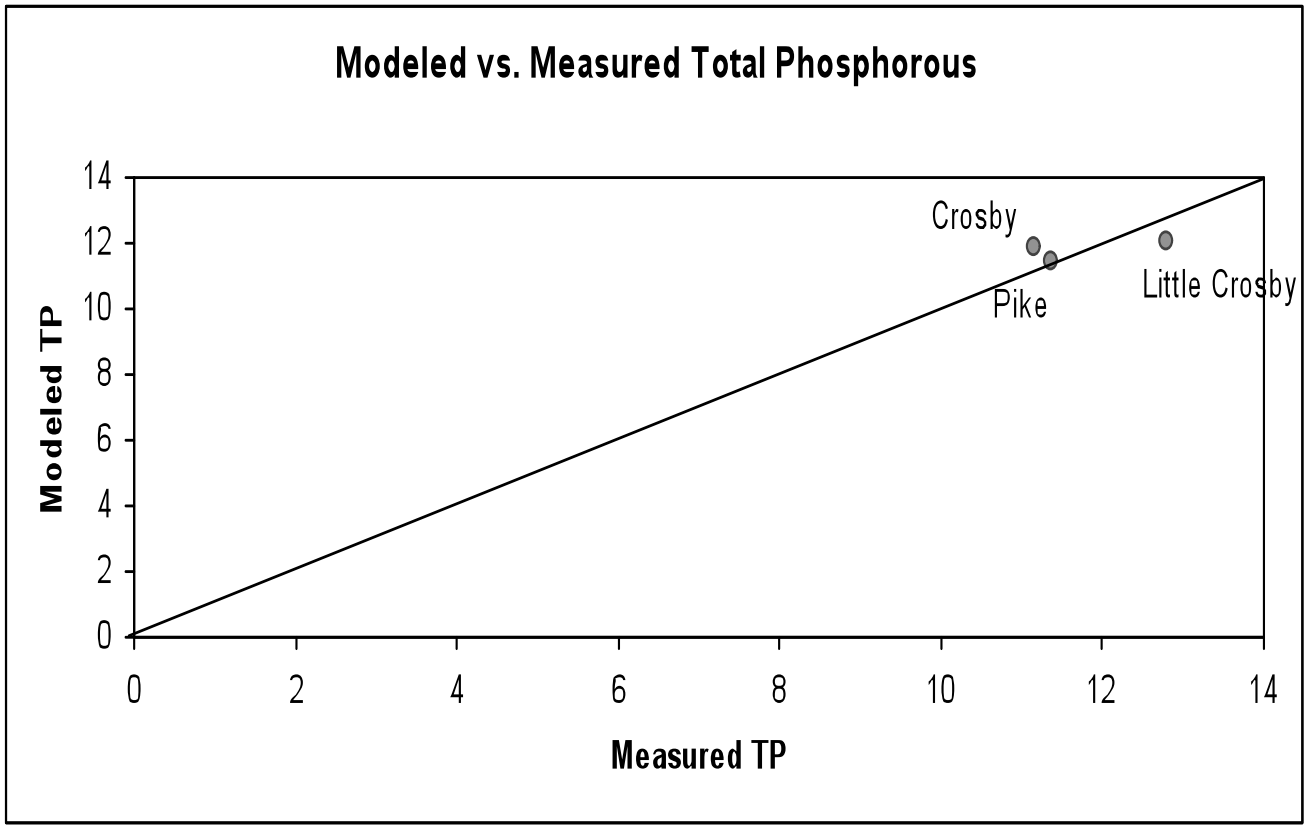
Tay River Watershed

- students hired to model Tay River watershed
- RVCA and MOE sampled most lakes in watershed this past summer
- Updated watershed data using GIS
- Still require updated development counts for many lakes


Carnahan
33 ha
Abbott
15 ha
Long
341 ha
Miller
26 ha
Duncan
45 ha
Oconto
15 ha
Legget
182 ha
Elbow
128 ha
Eagle
641 ha
Crow
432 ha
O'Brien
44 ha
Bob's
2878 ha
Little Silver
86 ha
Farren
175 ha
Davern
53 ha
Christie
648 ha

Lake Name	Measured	Modeled Current	Modeled Background	Background + 50%
Abbott	14	7.9	7.9	11.9
Bob's (Buck)	10.22	13.3	10.9	16.3
Bob's (East)	8.72	10.2	8.8	13.3
Bob's (Green)	10.24	8.4	7.2	10.8
Bob's (West)	13.68	9.5	8.9	13.3
Carnahan	15.16	14.9	14.9	22.3
Christie	12.8	11.2	9.4	14.0
Crow	8.21	9.8	9.0	13.5
Davern	9.3	8.0	5.7	8.5
Duncan	14	18.8	18.3	27.4
Eagle	9.26	8.9	7.2	10.8
Elbow	12.71	19.3	17.9	26.9
Farren	11.08	11.5	6.4	9.5
Leggatt	10.34	4.8	4.3	6.4
Little Silver	9.6	27.4	22.2	33.3
Long	16.37	19.0	18.3	27.4
Miller	13	10.8	14.4	21.6
O'Brien	12.71	8.6	5.1	7.7
Oconto	26	15.7	14.1	21.2
Pike	11.38	11.4	n/a	n/a
Crosby	11.18	11.8	n/a	n/a
Little Crosby	12.8	12.0	n/a	n/a


Modeled vs. Measured Total Phosphorous
Modeled TP
Measured TP
0
5
10
15
20
25
30
Bobs' Buck
Carnahan
Christie
Crow
Davern
Eagle
Bobs' East
Elbow
Farren
Bobs' Green
Leggatt
Little Silver
Long
Bobs' West
O'Brien


Modeled vs. Measured Total Phosphorous
Modeled TP
Measured TP
0
2
4
6
8
10
12
14
Crosby
Pike
Little Crosby

Tay River Watershed
Application of the Lakeshore Capacity Model and an Assessment of Mean Volume Weighted Hypolimnetic Dissolved Oxygen Levels (DRAFT)

Report Prepared by:
Water Resources Unit
Ministry of the Environment
Eastern Region
October 2008

Pike Lake Subwatershed
Application of the Lakeshore Capacity Model (DRAFT)

Report Prepared by:
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Water Resources Unit, Eastern Region

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