Planning For Lake Health

Supporting The Decision Making Process For Smart Economic Development

Presenters:
Sean Miller, M.Sc., Senior Ecologist and Associate
Douglas Kerr, P.Eng., Civil Engineer and Associate

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Introduction

Sean Miller, Ecologist

- Project Manager and team leader for Environmental and Assessment
- Studied at UWO and York University in biology
- 12 years experience working with aquatic systems in Ontario; MOE, Seven Sound RAP, Gartner Lee Ltd
- Surface water quality as primary technical focus, study design, monitoring, impact assessment, mitigation, assimilation, lower trophic dynamics
- Also worked with fish sampling, habitat assessment, site assessment, groundwater sampling, soil classification, vegetation surveys

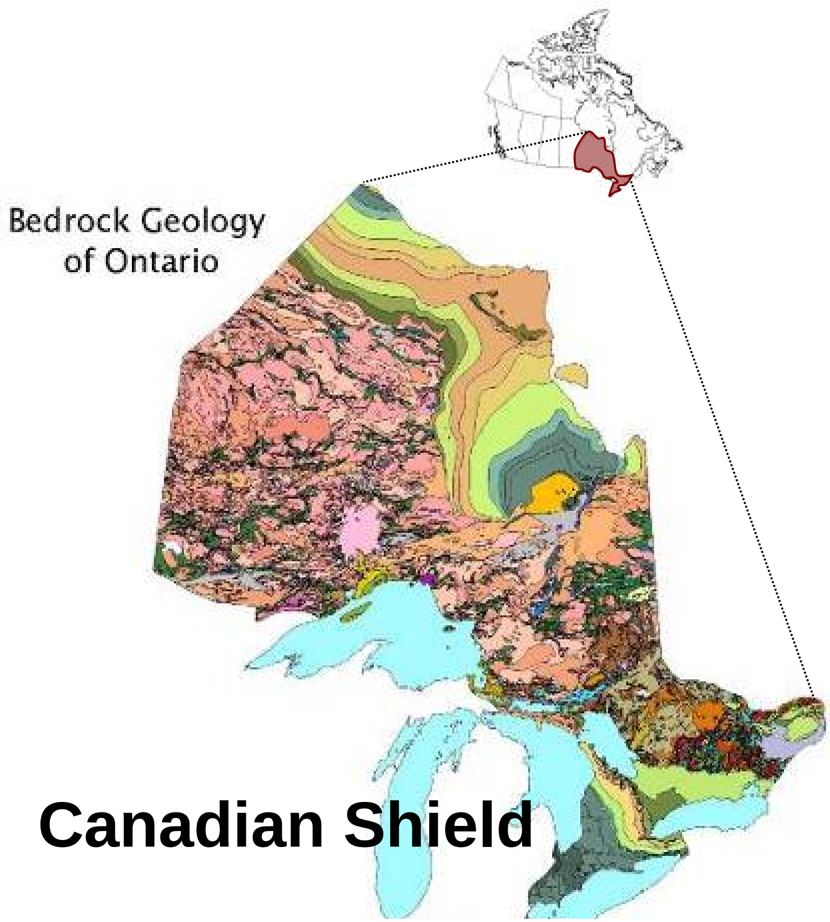
Introduction

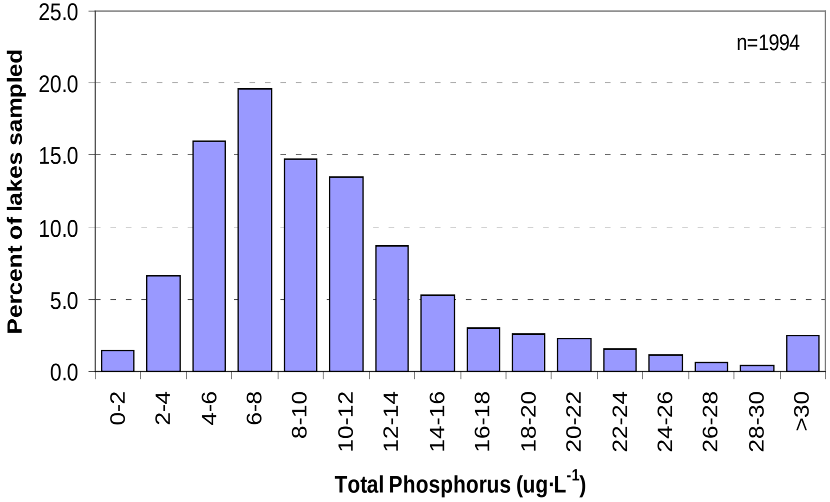
Douglas Kerr, P.Eng., Senior Civil Engineer and Associate

- B.E.Sc. Bachelor of Engineering Science, Civil Engineering, University of Western Ontario, London, Ontario, 1999
- Registered Professional Engineer, Ontario, 2004
- Provides detailed designs of site services, grading and drainage and stormwater management for commercial, institutional, industrial and residential developments.
- Provides detailed design for small to medium sized water and wastewater treatment plants.

Water Quality in Ontario

- 200,000+ lakes
- Majority on Precambrian (Canadian) Shield
- Soft-water, acidic, nutrient-poor





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The Economic Value of Clean Water in Ontario

- ~2 million adult anglers per year, $1.2 billion in fishing gear, boats, etc., $1.7 billion in activities related to fishing.
- $1 billion annually on recreational boating
- Commercial fisheries (~$42.5 million)
- Water-related tourism (~$5.5 billion)

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Threats to Water Quality of Inland Lakes

Aerial Deposition

Climate Change

Spills

Invasive Species

Shoreline Development

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Water Quality Indicators of Shoreline Developments

Algal abundance (phytoplankton, Chl-a)

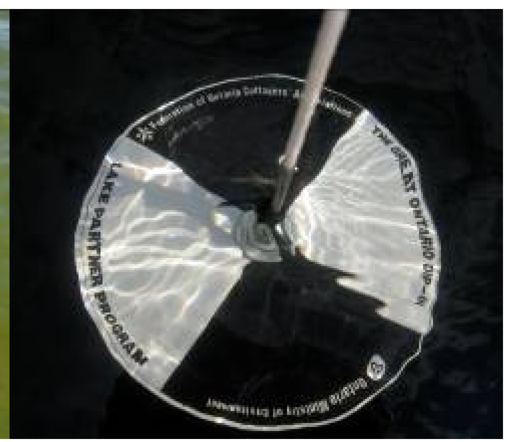
Transparency (Secchi disc depth)

Hypolimnetic dissolved O_2

These water quality parameters cannot be managed directly

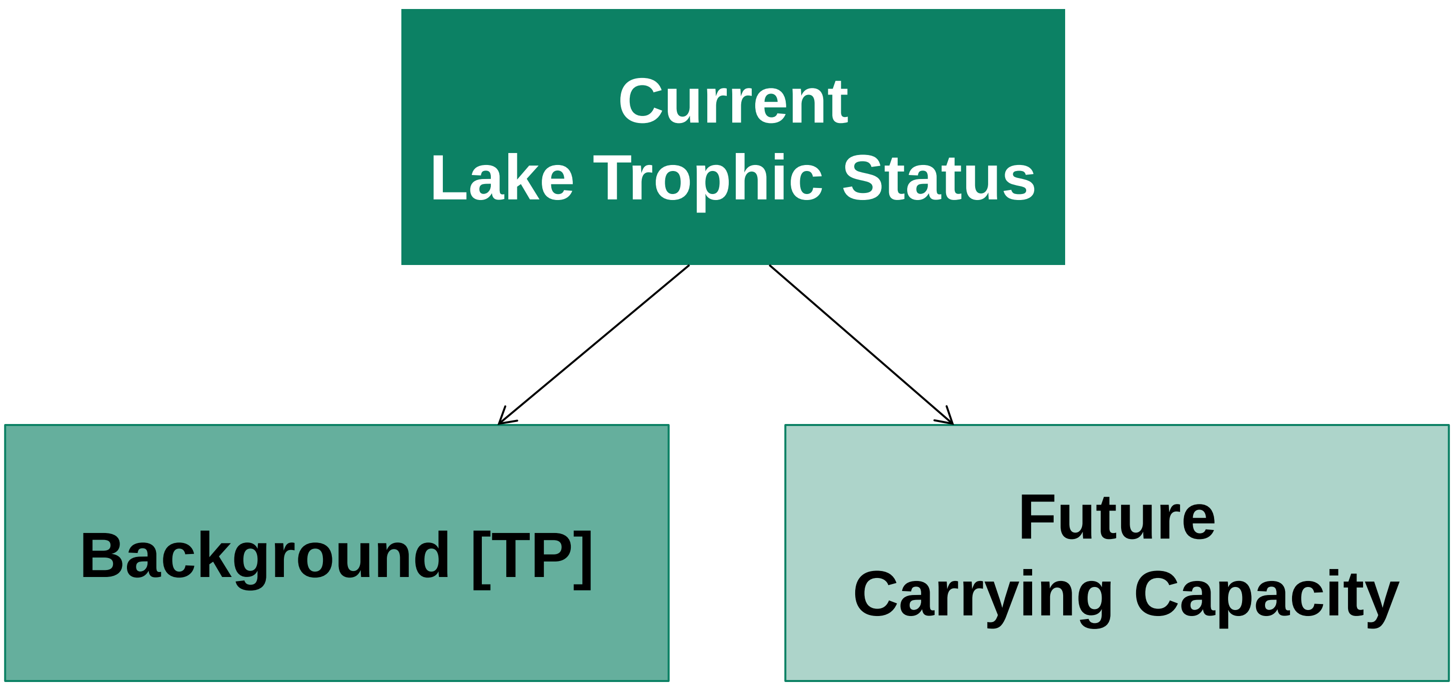
Total phosphorus [TP] the most reliable indicator of trophic status

Photo: Kathryn Hargan



What is the Lakeshore Capacity Assessment?

"a planning tool and model used to predict how much development can be sustained along the shoreline of a lake without impairing water quality"



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Lakeshore Capacity Assessment Handbook

Lakeshore Capacity Assessment Handbook

Protecting Water Quality in Inland Lakes on Ontario's Precambrian Shield

May 2010

Ontario

Guidance document for municipalities and other stakeholders managing development of inland lakes within Ontario's Precambrian Shield

- Tri-Ministry (MOE, MMAH and MNR), with input from stakeholders
- Planning tool that helps municipalities meet their obligations under the Planning Act
- Includes a revised PWQO for phosphorus (for inland lakes in the Precambrian Shield)

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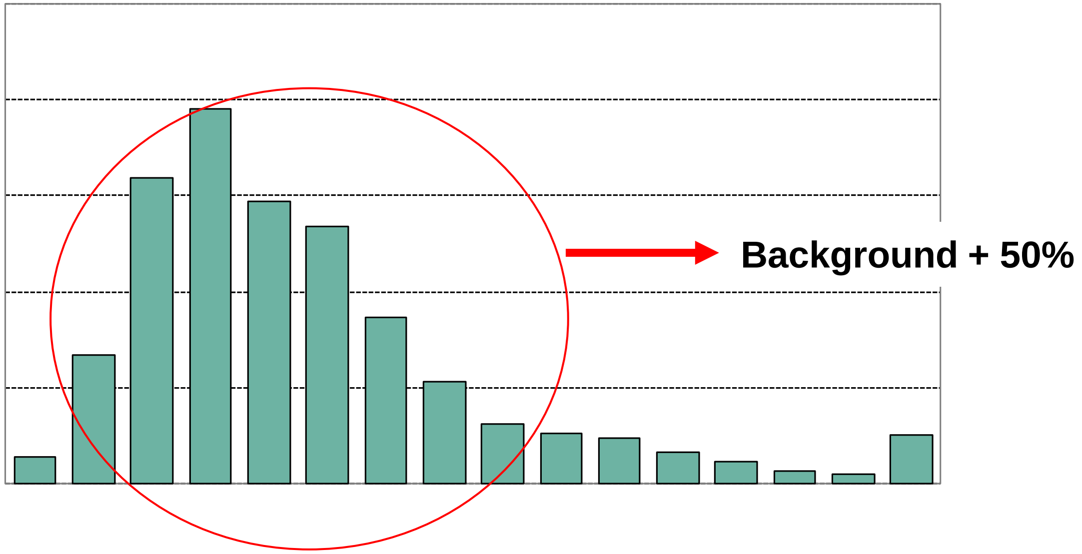
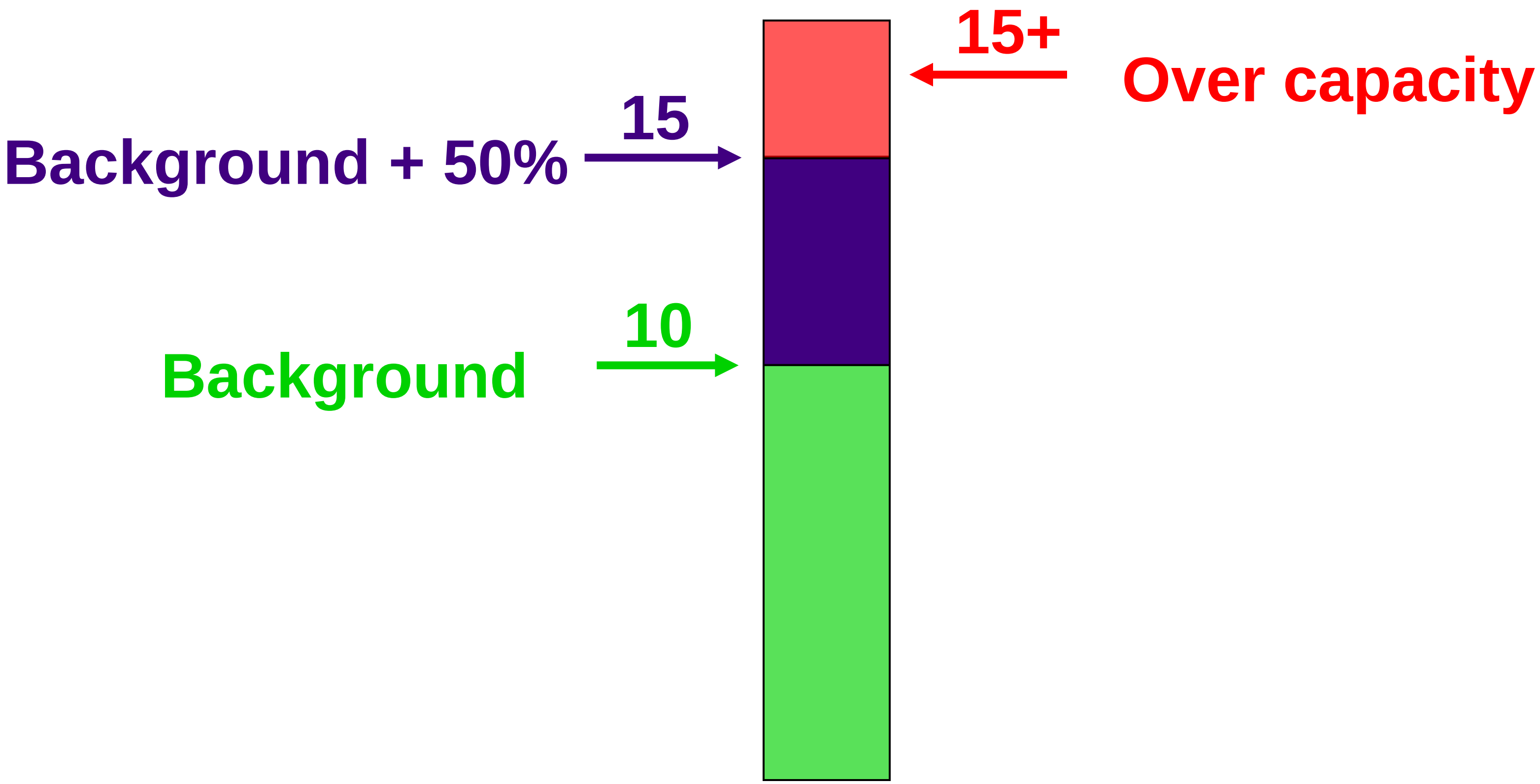
Guideline for Phosphorus

- Allow a change in P to some level above a baseline concentration
  - Lake-specific, recognizing differences in responsiveness to development
  - Development capacity would be proportional to baseline trophic status

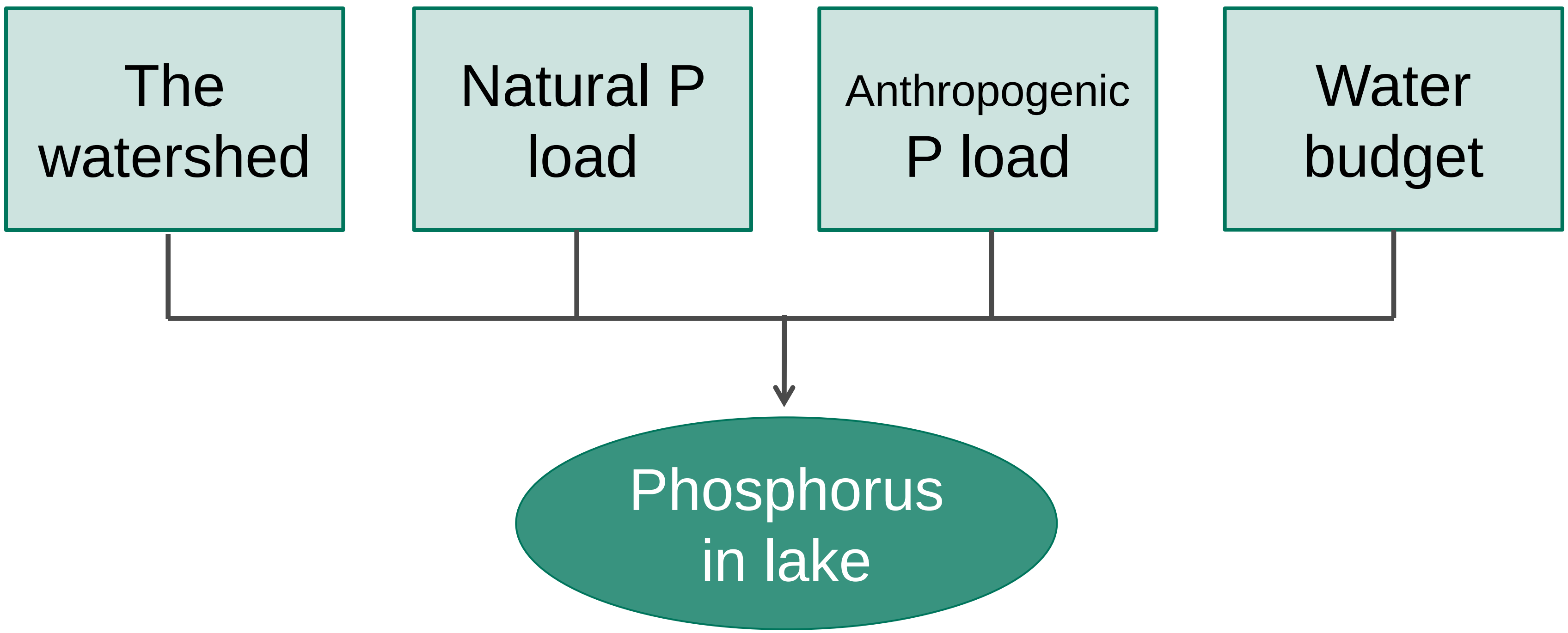


New PWQO = background + 50% of pre-development TP

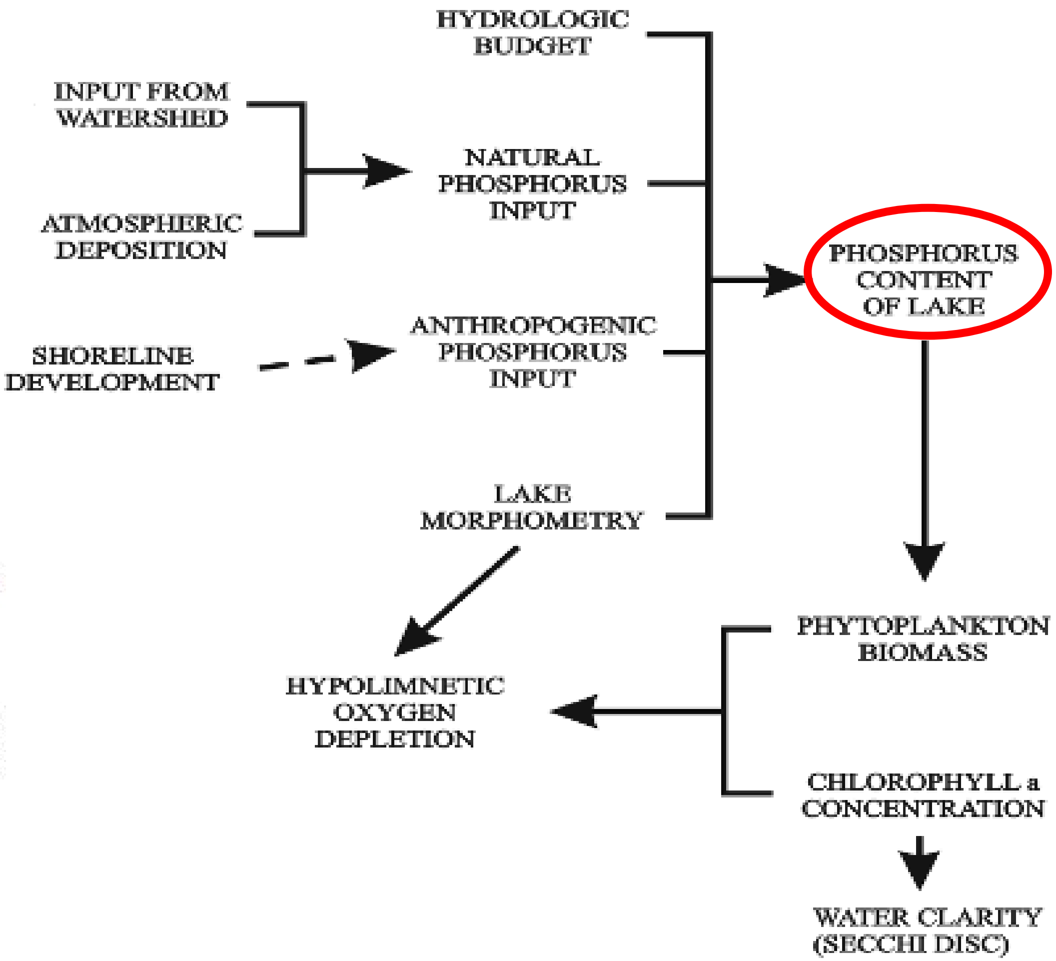
Guideline for Phosphorus



The Lakeshore Capacity Model – The Basics



Applying the Lakeshore Capacity Assessment



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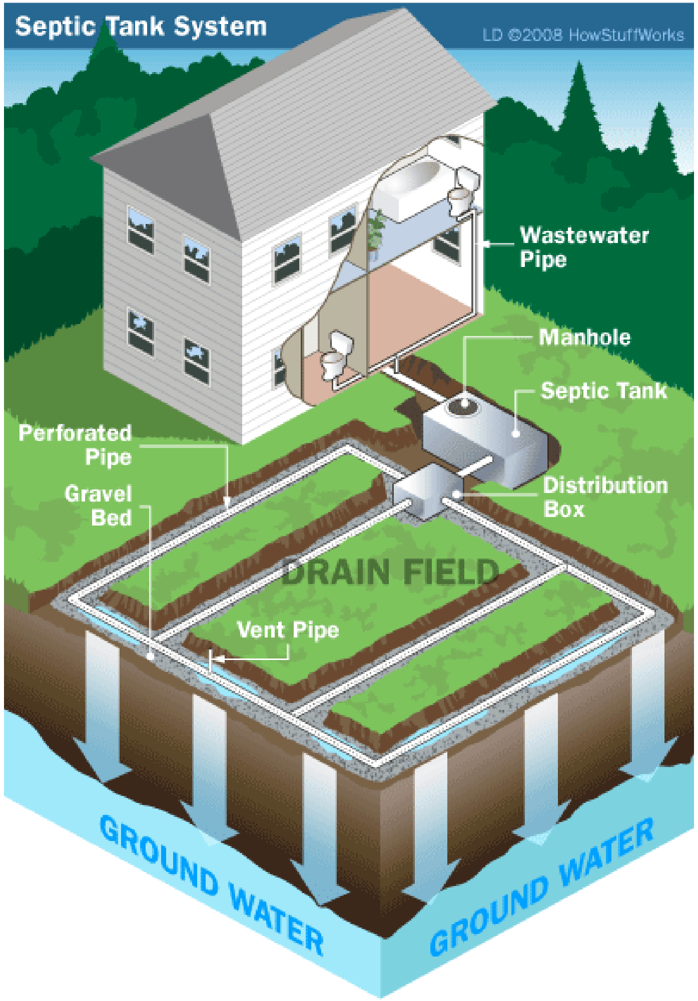
Anthropogenic factors: Septic Systems



Two processes contribute to P retention:

1. Adsorption to charged surfaces of sediments (slows down movement)

2. Precipitation/mineralization of Fe/Al complexes as insoluble minerals (P may remobilize if soil becomes saturated)

Source: http://science.howstuffworks.com

Factors Influencing P Retention in Soils

P export from septic systems

age and usage of residences
water load (seasonal vs. permanent usage)

% $CaCO_3$ in bedrock
Non-calcareous (<1% $CaCO_3$) > calcareous

soil depth and type
Fine grained > coarse grained

properly functioning septic system

acidic conditions

O_2
saturation of tile field causes reducing conditions

Phosphorus migration to the lake

= 97 %

= 2 %

= 1 %

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What does this all mean?

Land-Use Planning Applications and BMPs

- Recommendations and restrictions for development on lakes at capacity
- Best Management Practices for shorelines, septic system design and operation

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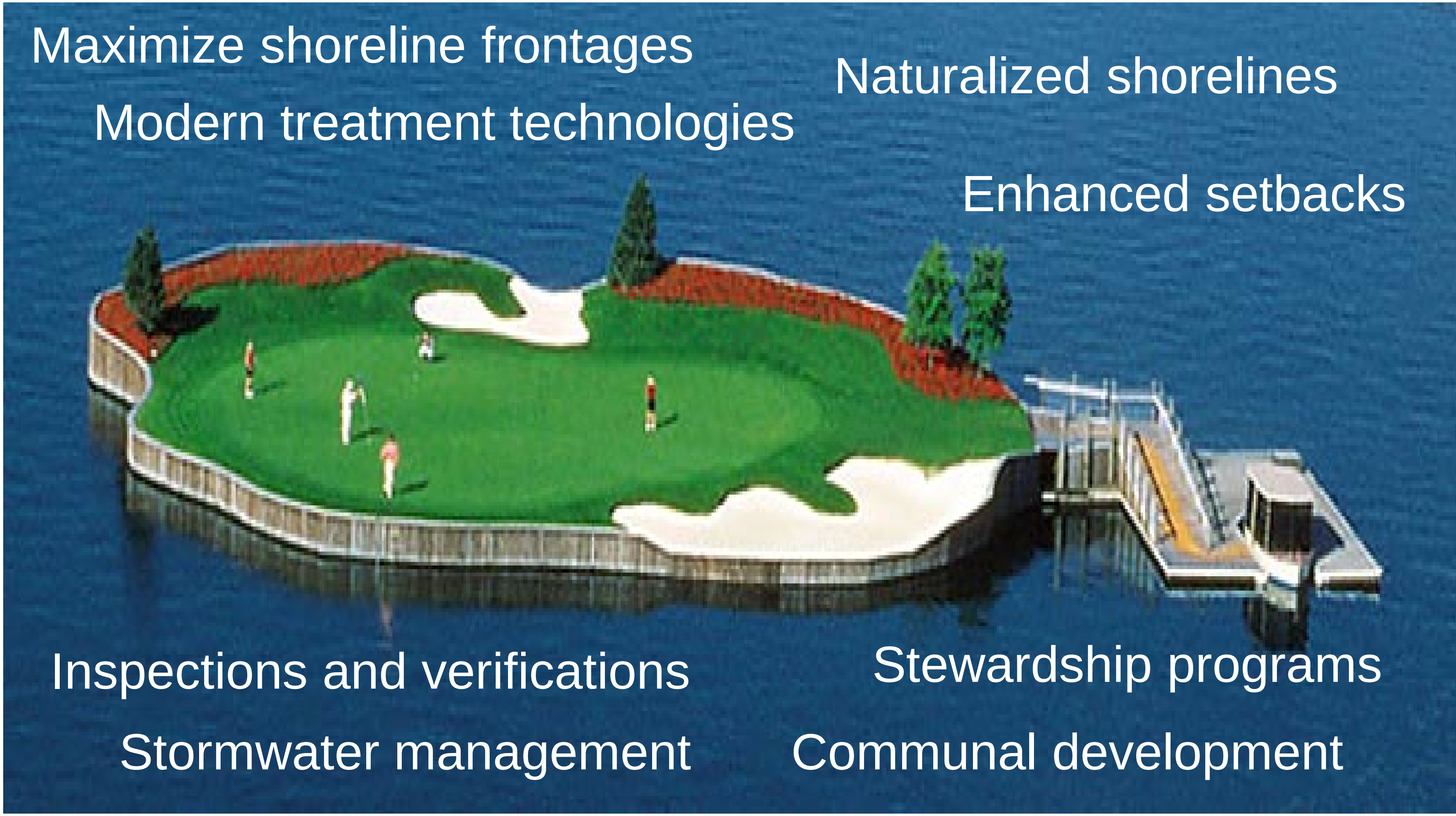
Minimizing the Impacts of Development on Water Quality



Pushing the Science for a Solution

What is happening in the Province

- Companies are manufacturing an add-on septic technology for phosphorus removal (low-level)
- The technology uses degeneration of a Fe/Al rod to stimulate electro-coagulation of phosphorus
- The MOE is approving up to 15 of these systems to use as test cases
- Local example: recent settlement on Red Horse Lake

Waterloo Biofilter® Systems Inc.

PREMIER TECH AQUA

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Wastewater Treatment Options

Individual Systems/Septic Systems

- A number of new and developing technologies to improve phosphorus removal

Communal or Cluster Systems

- MOE approves systems with daily flows > 10,000L such as developments of multiple units or large lodge types

Wastewater Treatment Options

Communal System Benefits

- Significant improvements in instrumentation, control and remote monitoring have made communal a viable option
- Equalization storage helps to balance wastewater quality and quantity so the treatment process sees a reliable flow
- Packages come largely skid assembled or pre-packaged for easy installation by local trades
- Can often use pre-cast concrete tanks
- Larger developments allow sewage disposal systems to be located back from the waterfront
- Particularly suitable for seasonal occupancy

Wastewater Treatment Options

Communal Systems

- Membrane Bioreactor Solutions
- SBR (Sequencing Batch Reactor)
- Add on filtration processes specifically for P
- Sludge recirculation resulting in less sludge and improved sludge management

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Case Study #1: East Lake

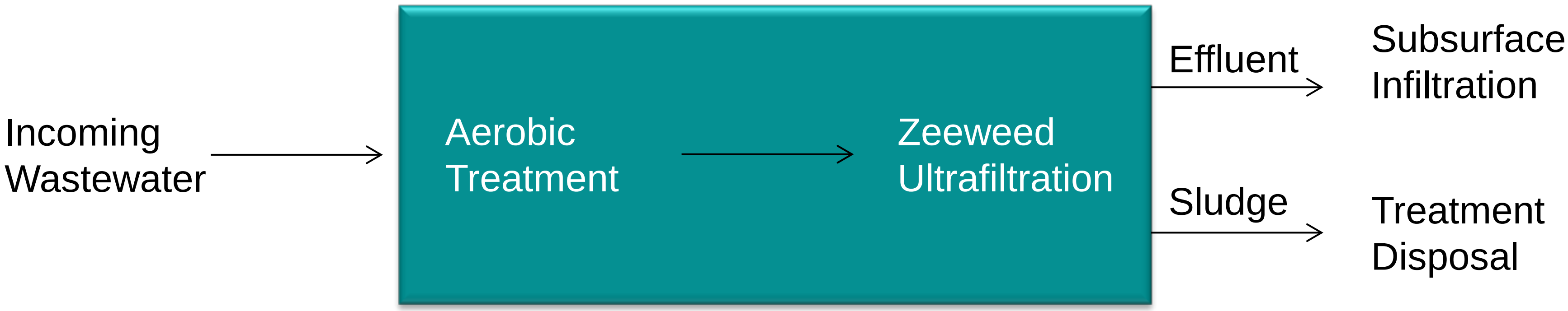
- Located on East Lake
- 237 cottages at Sandbanks Summer Village
- Condominium type ownership
- Environmental Impact Study determined that lake water quality was one of the prime concerns
- Lake capacity assessment determined that existing 2 year-round homes and one seasonal home contributed 5 kg of P per year

Case Study #1: East Lake

- Provided the design for the state-of-the-art water and wastewater treatment plants
- Wastewater from the cottages and communal facilities is treated with a membrane bioreactor
- Plant consists of 5 concrete tanks (2 for primary sedimentation, EQ, aeration, sludge storage) and treatment building
- Subsurface discharge
- ECA limit of 5 kg/year for P (0.17 mg/L)
- ECA objective of 0.10 mg/L for P

Case Study #1: East Lake

ZENON/GE
Z-Mod Package



Case Study #1: East Lake

Case Study #1: East Lake

Results

- Similar plant in near Orillia
- Currently 200 mobile homes with future expansion of another 200
- ECA limit of 0.20 mg/L for P
- ECA objective of 0.08 mg/L for P
- Routinely Ammonia, BOD, TSS and P are all below detectable reporting limit (< 0.02 mg/L for P)

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Case Study #1: East Lake

Case Study #1: East Lake

Discussion

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