



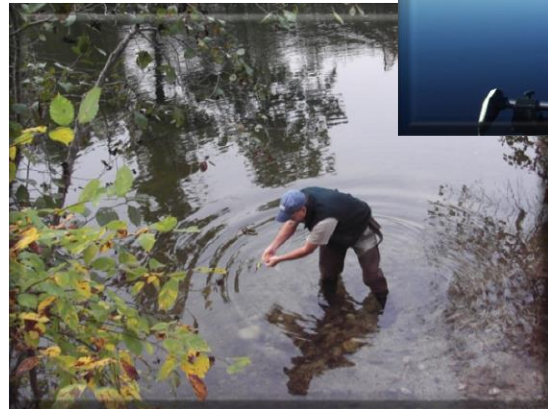
# Province Lake Watershed Management Plan

*Province Lake Golf Club  
July 20, 2013*



# FB Environmental Associates

- ❑ Offices in Portsmouth NH and Portland ME
- ❑ Small business founded in 2001 to conduct impaired lake assessments
- ❑ 95% Public sector projects  
“Where science meets civics”
- ❑ Work throughout New England – particularly in this NH/ME border region



# AGENDA

- 1) Watershed Plan Overview & Features  
*Forrest Bell, FB Environmental*
- 2) Draft Water Quality Summary  
*Jennifer Jespersen, FB Environmental*
- 3) Watershed and Septic Survey  
*Sam Wilson, AWWA*
- 4) Questions/Discussion

# Why Develop a Watershed Plan?

## **Problem:**

- Province Lake is an Impaired Waterbody
- Historical and Current Cyanobacteria Blooms

## **Solution:**

- Investigate Issues and Develop a Systematic Approach for Addressing these Issues.





# Phosphorus

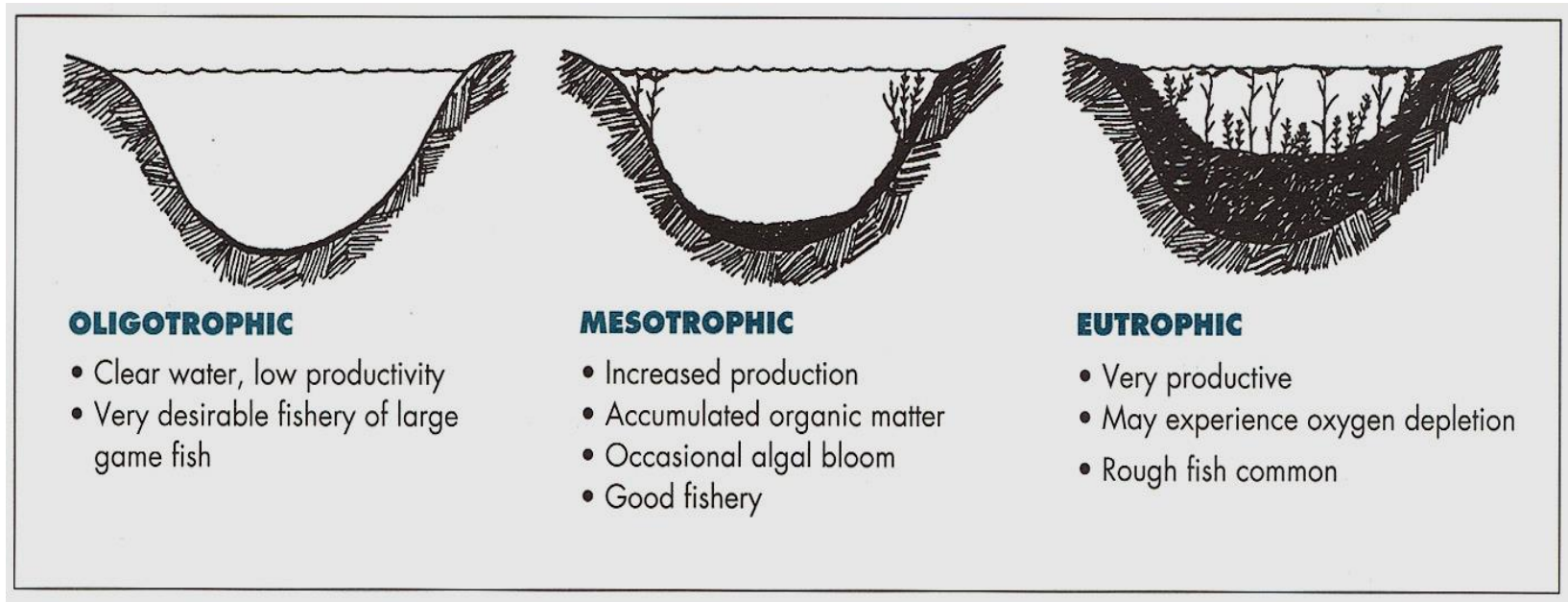


- **Phosphorus** is one of the major nutrients needed for plant growth.
- Naturally present in small amounts.
- Generally, as phosphorus increases, the amount of algae also increases.



**Too Much P= Algae Blooms, Low DO, Fish Kills!**

# Speeding aging of lakes

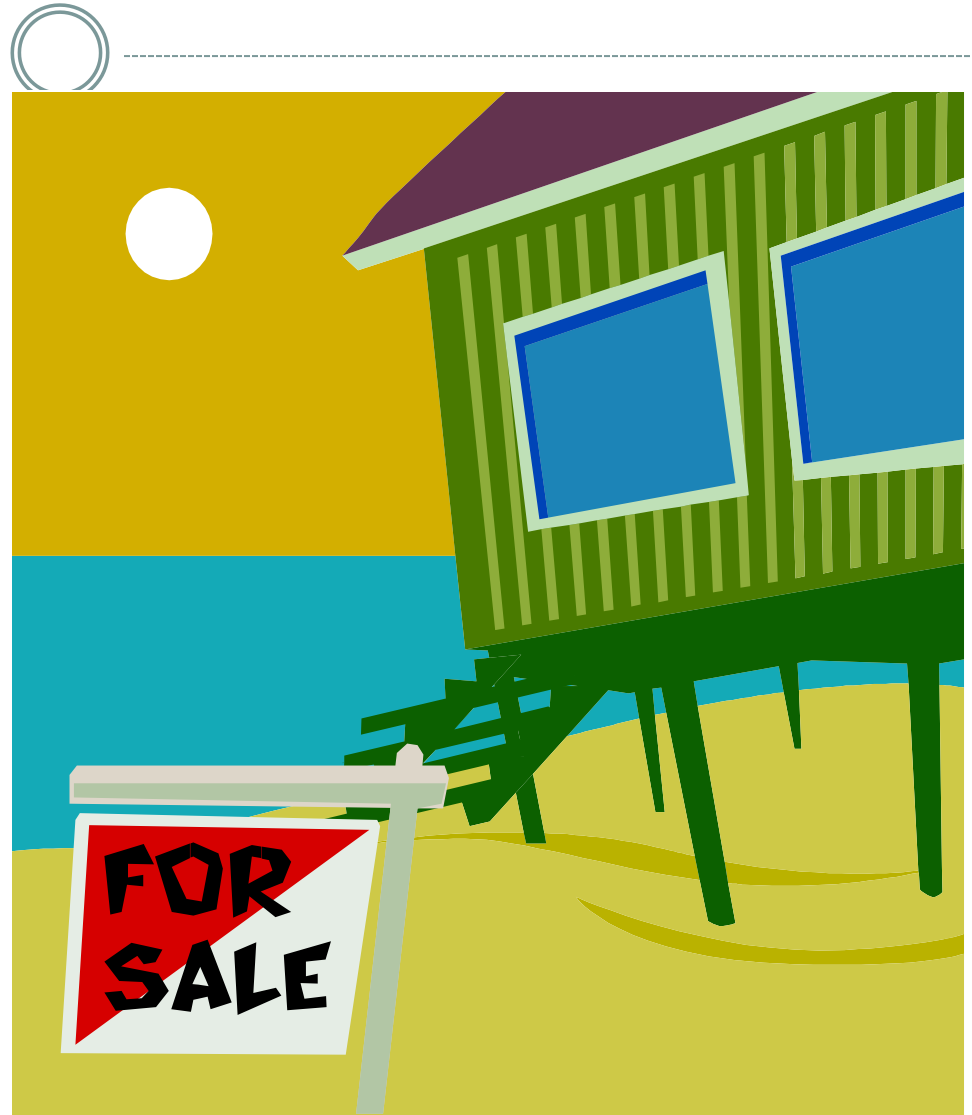


**10,000's YEARS IN NATURAL CONDITIONS**

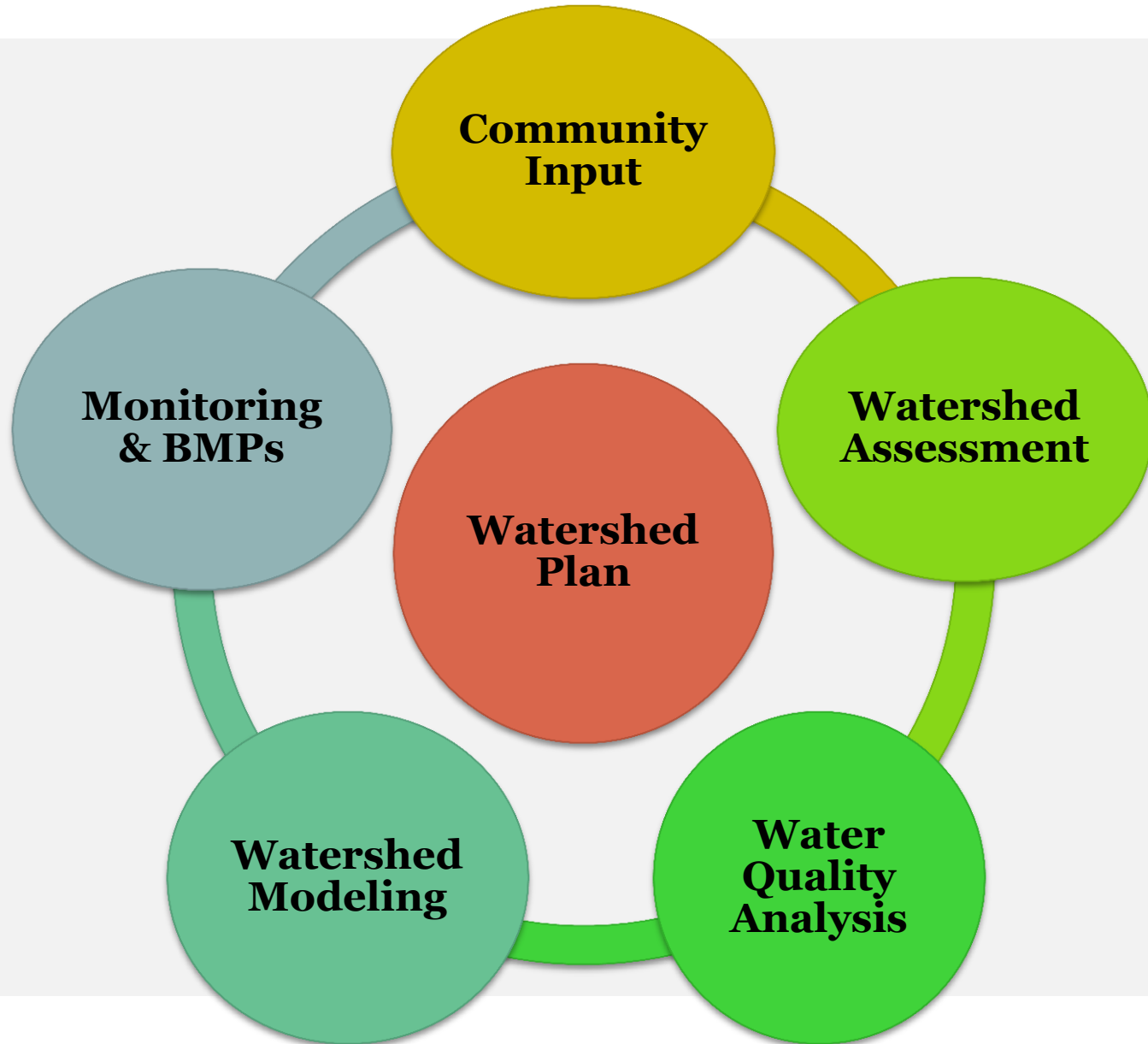
**10's to 100's YEARS UNDER HUMAN INFLUENCE**

# Water Quality & Property Values

- For every 3 ft. decline in water clarity, shorefront property values can decline as much as 20%.
- Declining property values affect individual landowners and economics of entire communities.
- With property rights comes property responsibility



# Toolbox for Watershed Management Plan





# Developing the Watershed Plan

- A. Analyze Water Quality Data
- B. Collect Background Information & History
- C. Complete Modeling Work
- D. Set Water Quality Goal
- E. Write a Really Useful Report & Action Plan



**Multi-step  
Process  
involving  
Stakeholder  
Input**

# Project Timeline



- **Sense of Urgency**
- **Complete in Summer 2014**

Water  
Quality  
Analysis

Identify  
Pollutant  
Sources

Set Water  
Quality Goal

3 Public  
Meetings

Finalize  
Management  
Plan

# Public Participation

## *Key to a Successful Watershed Plan*

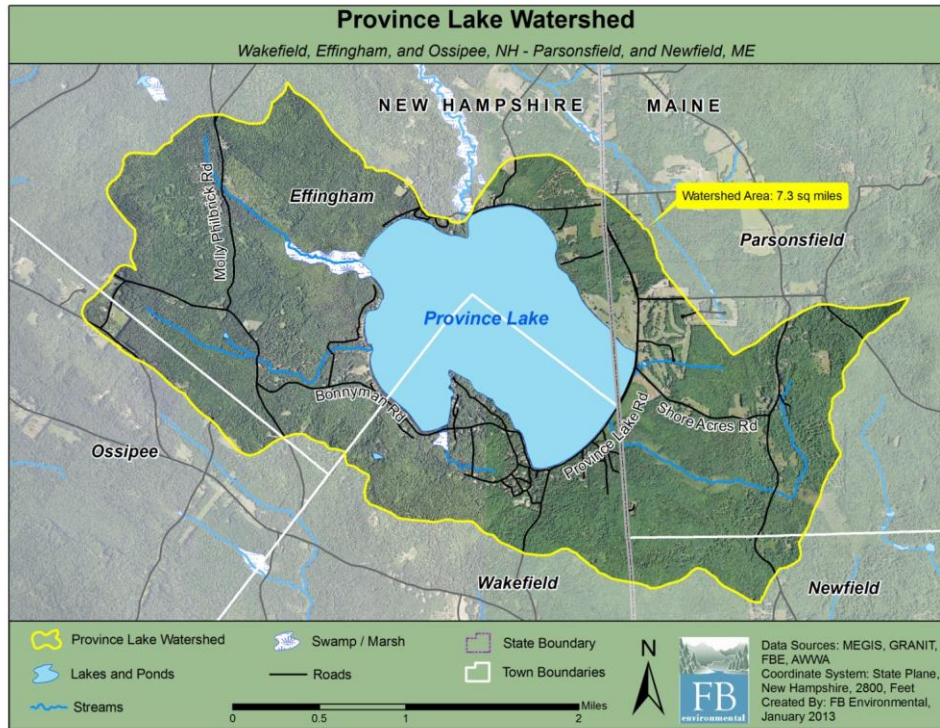
- **Steering Committee Meetings**
- **Three Public Meetings**
  - *Initial Input- July '13*
  - *Community Forum- Jan. '14*
  - *Present the Plan- July '14*



**Develop the  
Action Plan**

# Province Lake

## *Physical Attributes*

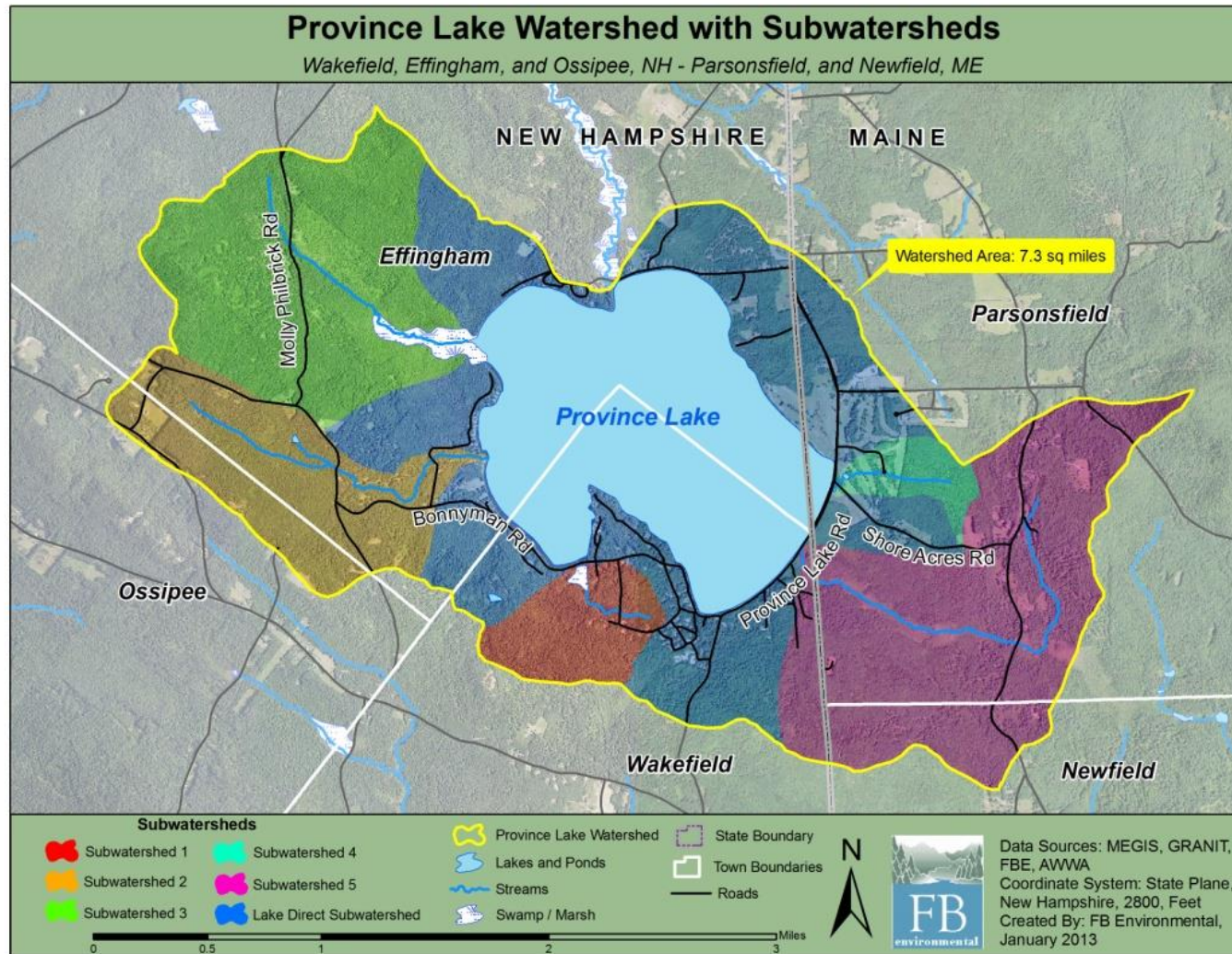


- **2 States, 3 Towns**
- **Lake Area ~ 1,014 acres**
- **Avg. depth – 9 feet**
- **Max. depth – 16 feet**
- **Low Flushing Rate- 1/year**
- **Watershed – 7.3 sq. miles**
- **Shallow, non-stratified – wind driven system**
- **Small Watershed relative to lake surface area**



# Province Lake Watershed

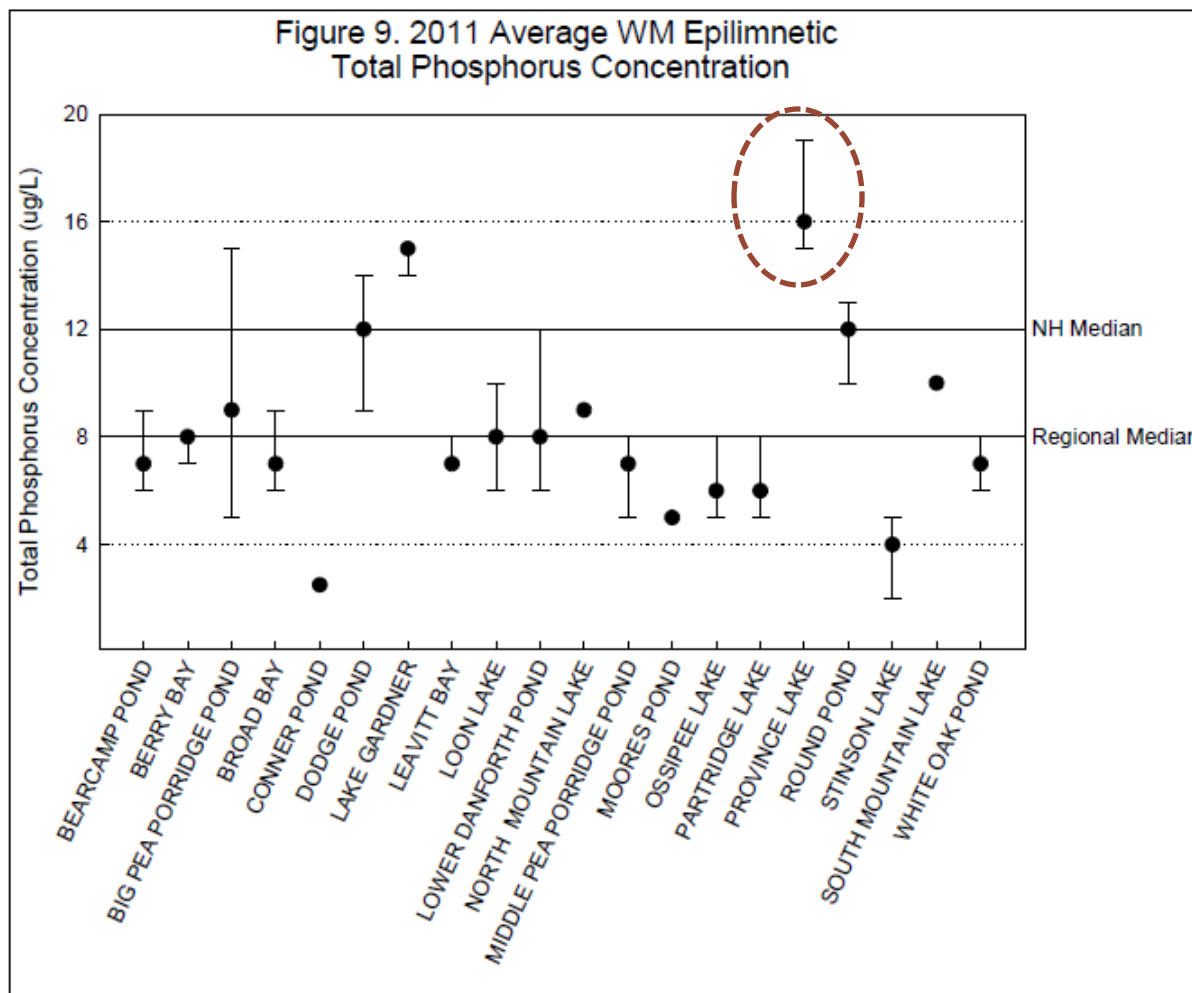
## *Subwatersheds*





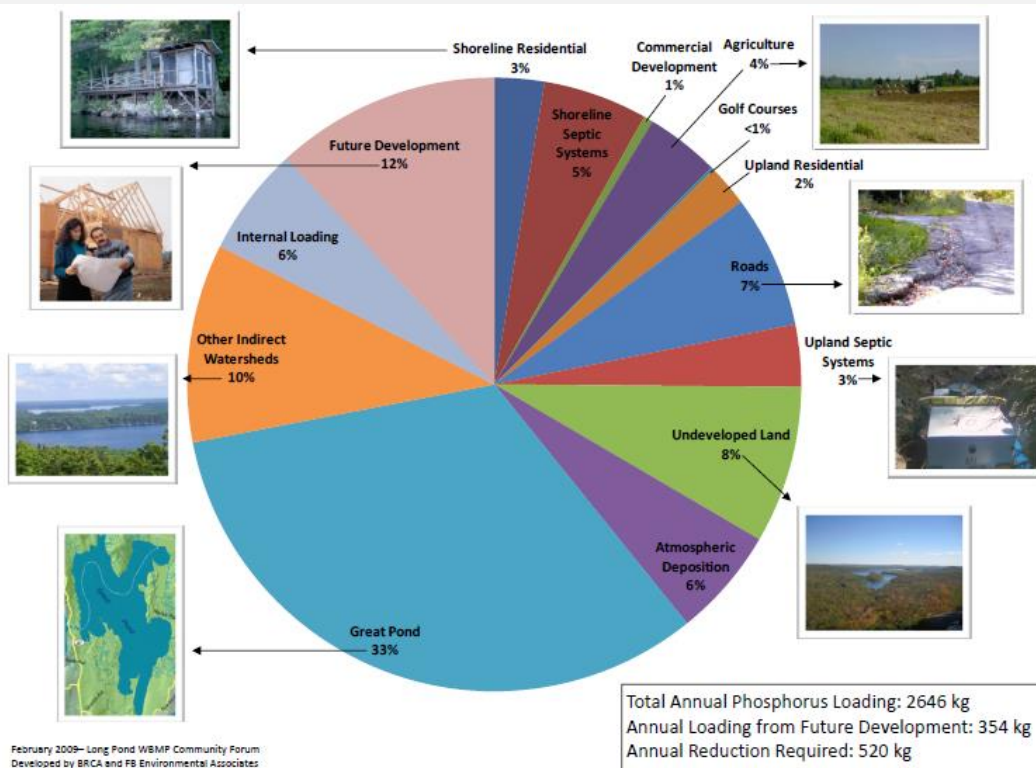
# Province Lake

## *NH DES Regional Lake Assessment*



# Land Use Modeling

## *Determine Relative Contribution of Pollutants From the Watershed*



- ✓ Atmosphere
- ✓ Septic Systems
- ✓ Waterfowl
- ✓ Land Use
  - Agriculture & Urban
  - Forest and Wetlands
- ✓ Internal Loading

# Buildout Analysis



How  
Much?

- How Much Land is Currently Available for Development?

Where  
&  
When?

- Where & When Will Development Occur?

Effects?

- What are the Impacts from Future Development?

# Build Out Analysis

## *Estimating Future Development*

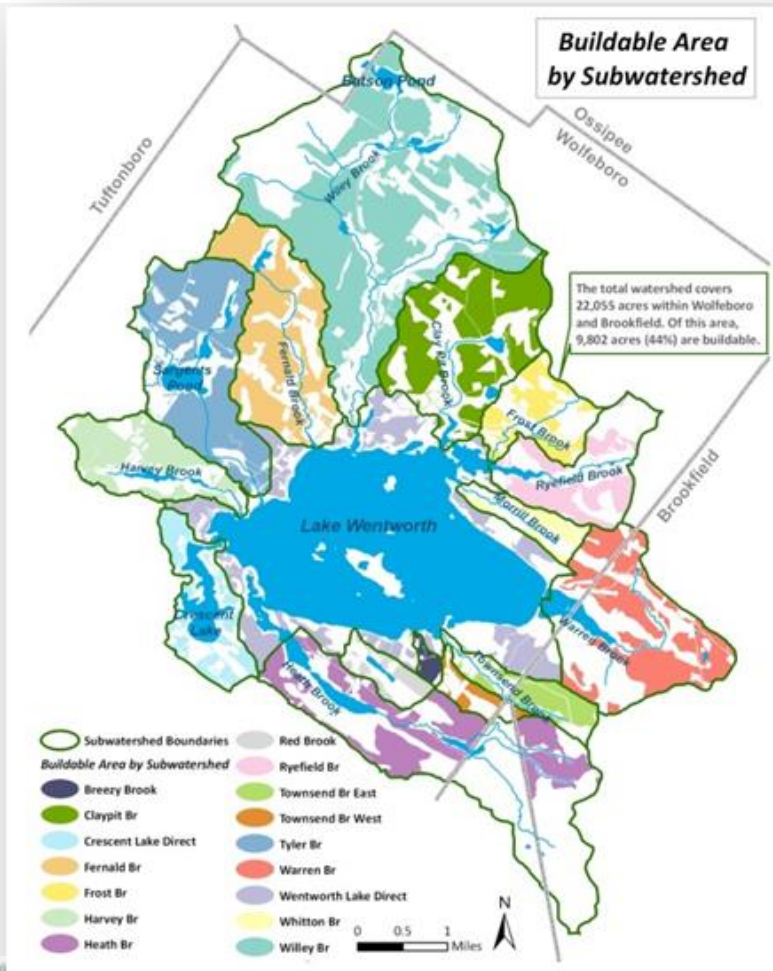
### Population Growth Rates

**Increase since 1990:**

Wakefield – 60%

Effingham – 64%

Parsonsfield – 28%



*Example: Nearby Lake Wentworth Buildout*

# Watershed Features

## *Unique Features*



*Photo: NH golf*

### **Province Lake Golf Club**

- Began using phosphorus free fertilizers in .....
- Working with project team to improve environmental conditions at the course.
- Already doing a lot!



# Watershed Features

## *Unique Features*



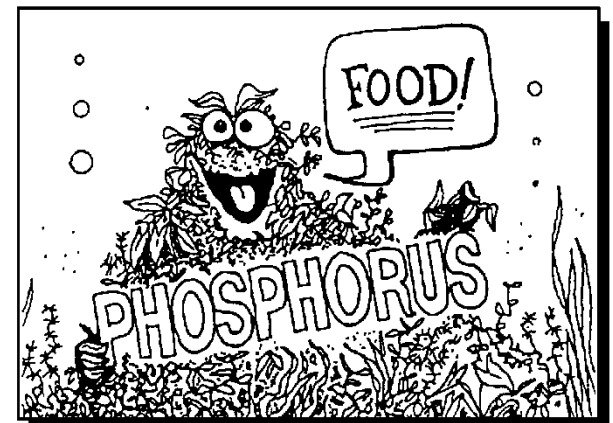
### **Route 153**

- Project team initiated a meeting on-site with NH DOT and Maine DOT.
- Developing a consistent, cost-effective plan to address road runoff in both states.

# Feature: Failing Septic Systems

## *Can Result In:*

- ❖ Delivery of disease-causing bacteria to drinking water or recreational waterbodies;
- ❖ Contribute excessive phosphorous to local lakes and streams via groundwater;
- ❖ Delivery of chemicals and hormones.

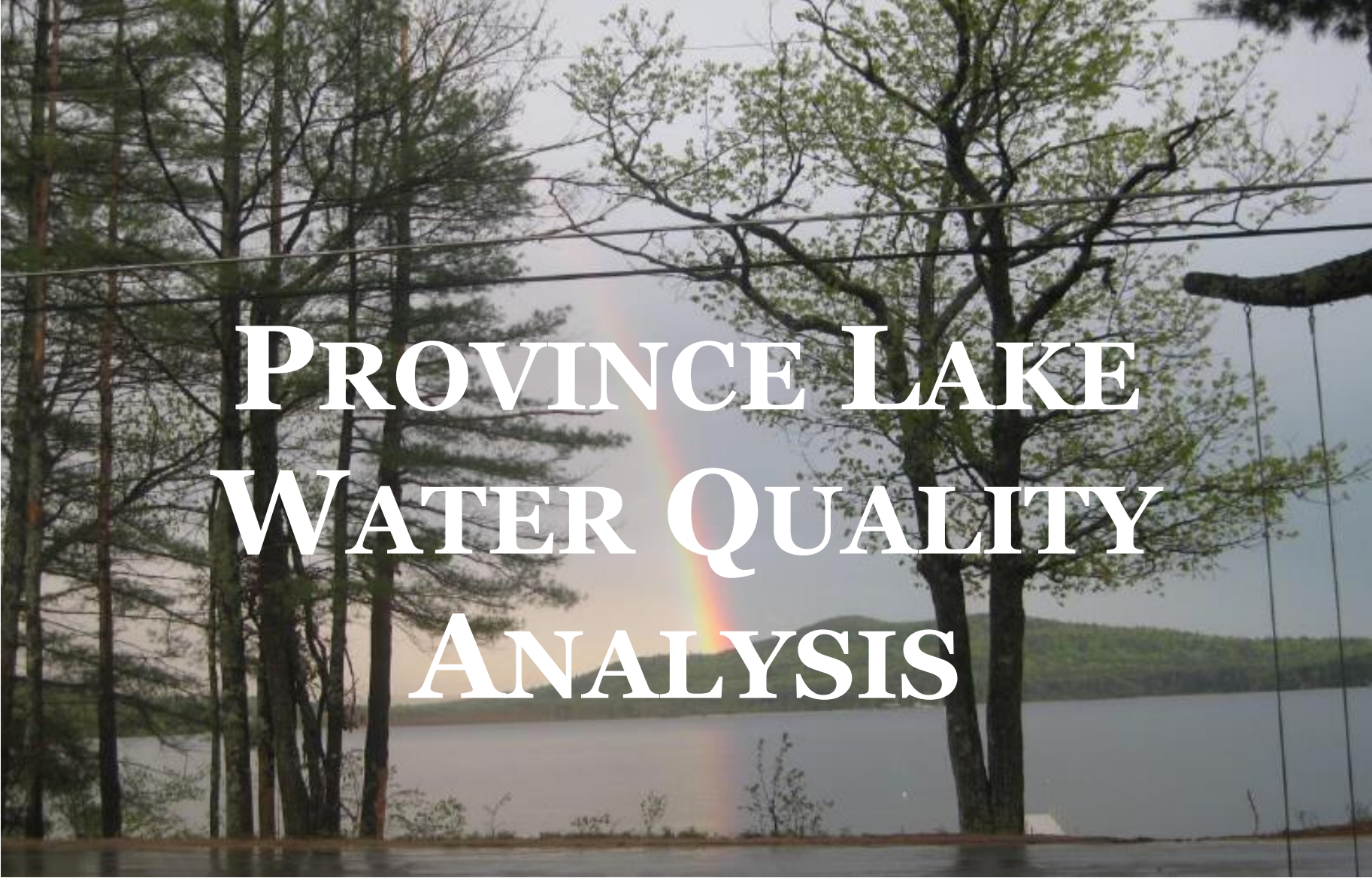


# Septic System Survey

- ❖ Estimate the % of Total Phosphorus Load
- ❖ Information about Age, Pumping Frequency, Distance to Shore, Fertilizer Use, etc.



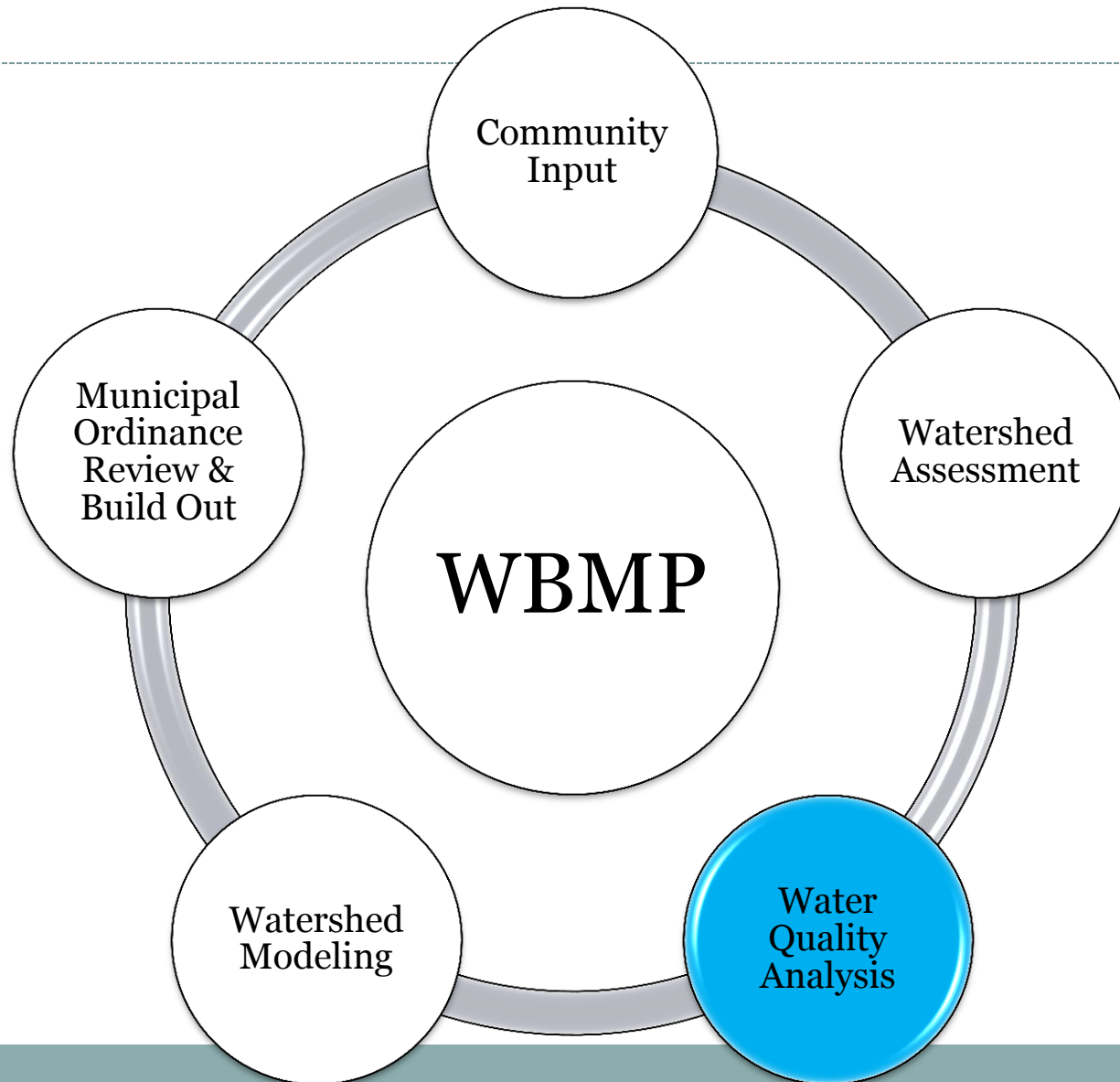




# PROVINCE LAKE WATER QUALITY ANALYSIS

## SUMMARY & RECOMMENDATIONS

# Water Quality Analysis

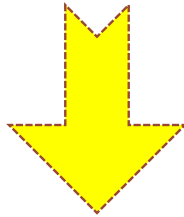




# GOAL



- Summarize WQ Data
- Compare to WQ Standards
- Present Trends
- Provide Recommendations



**Set a Reasonable  
&  
Achievable Target**

## *Province Lake Water Quality Analysis*

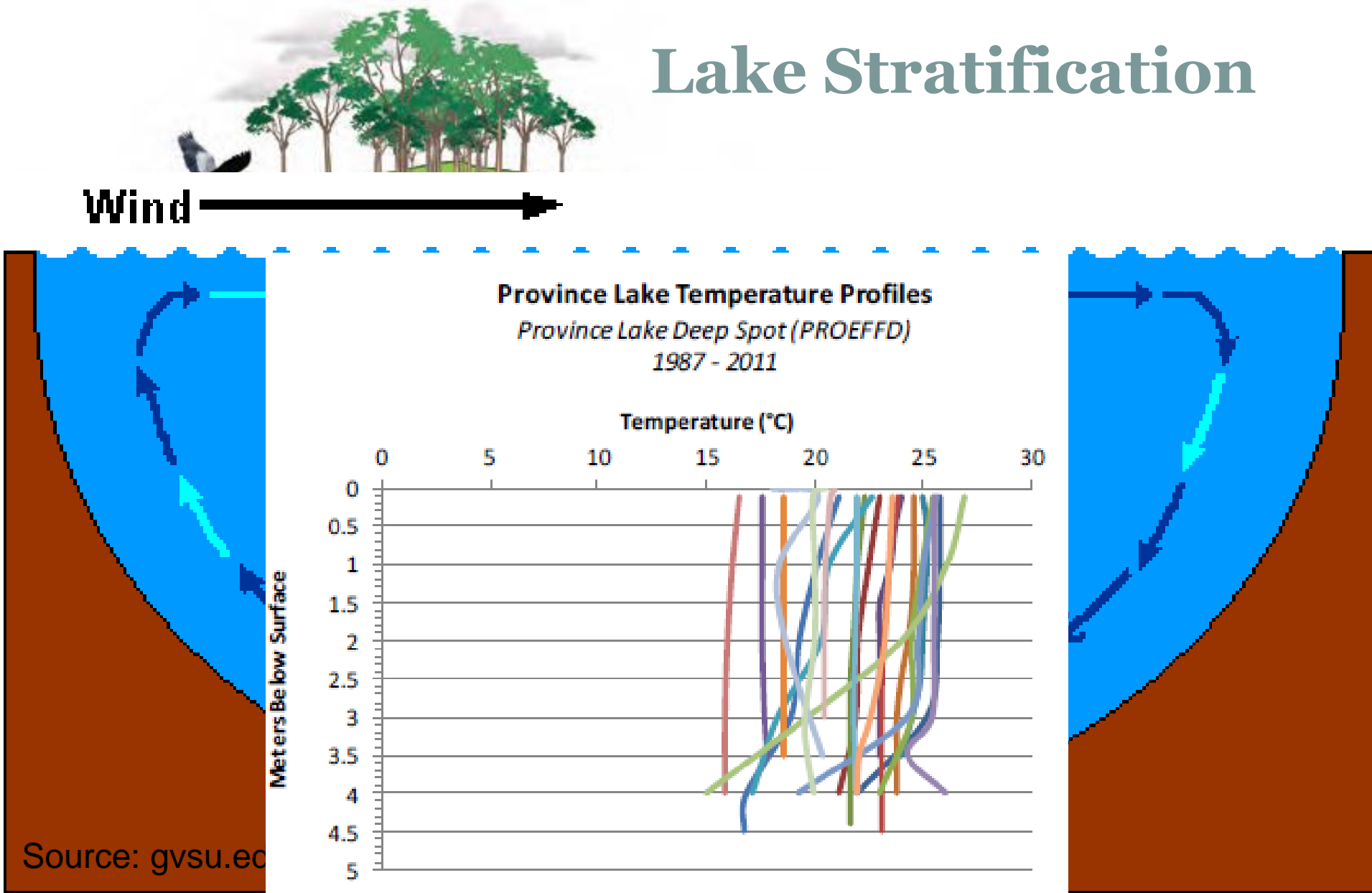


DRAFT- July 2013



FB Environmental Associates  
97A Exchange St., Portland, ME  
(207) 221-6699  
[www.fbenvironmental.com](http://www.fbenvironmental.com)  
[info@fbenvironmental.com](mailto:info@fbenvironmental.com)

# Lake Stratification



**Figure 1** Complete mixing of water can occur when all water within the lake is generally the same temperature. Wind helps to drive this process.

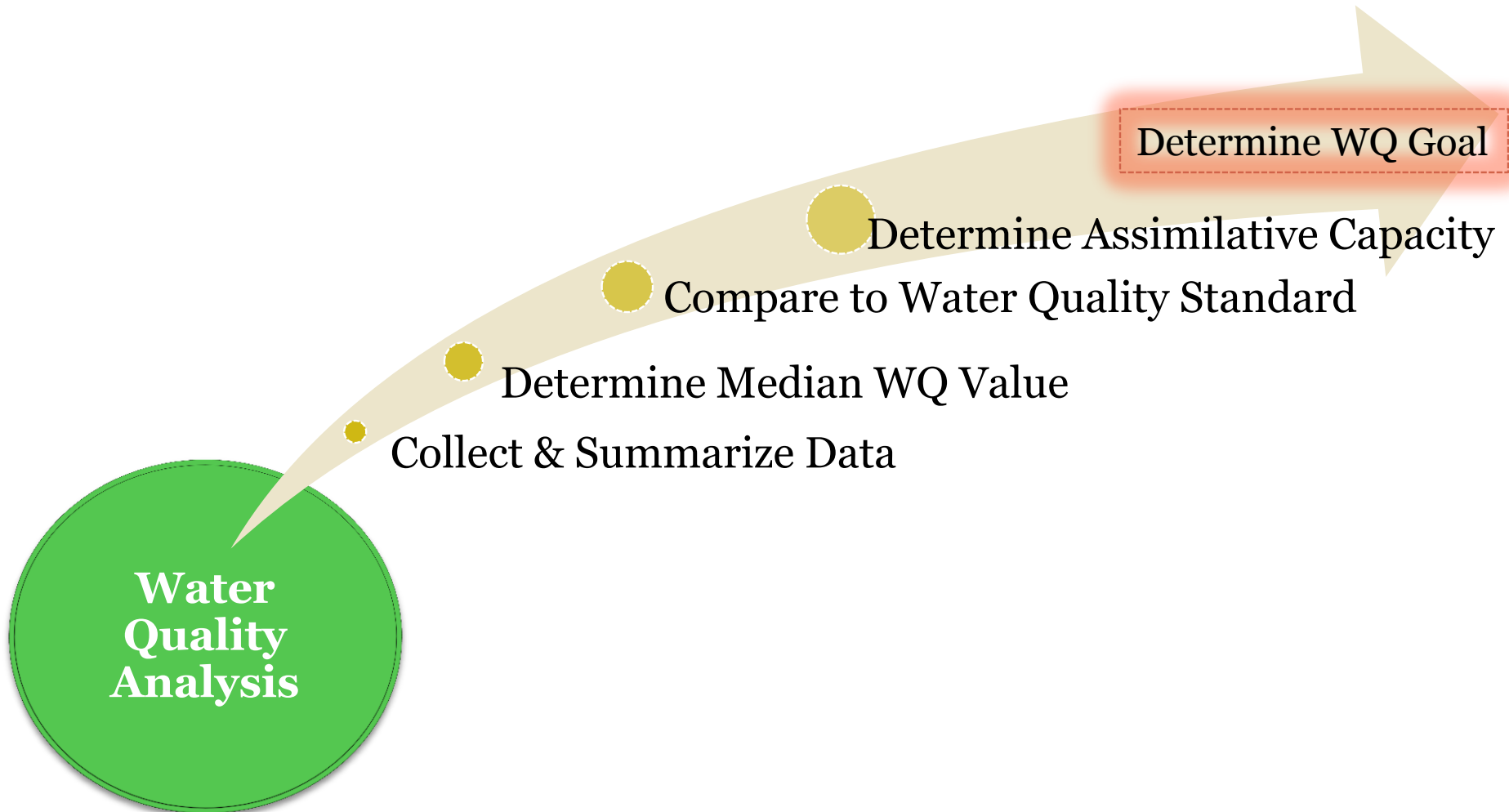
# THE PROBLEM



- Impaired for Aquatic Life Use (High TP & Chl-a)
- Impaired for Primary Contact Recreation (Cyanobacteria)



# WQ Analysis & Setting WQ Goals





# WQ Data Sources

1. NH DES Trophic Reports (5 years)
2. NH VLAP (22 years)
3. NH DES Fish Study Data

❖ *24 Years of Data*

❖ *1991-2012 (VLAP)*

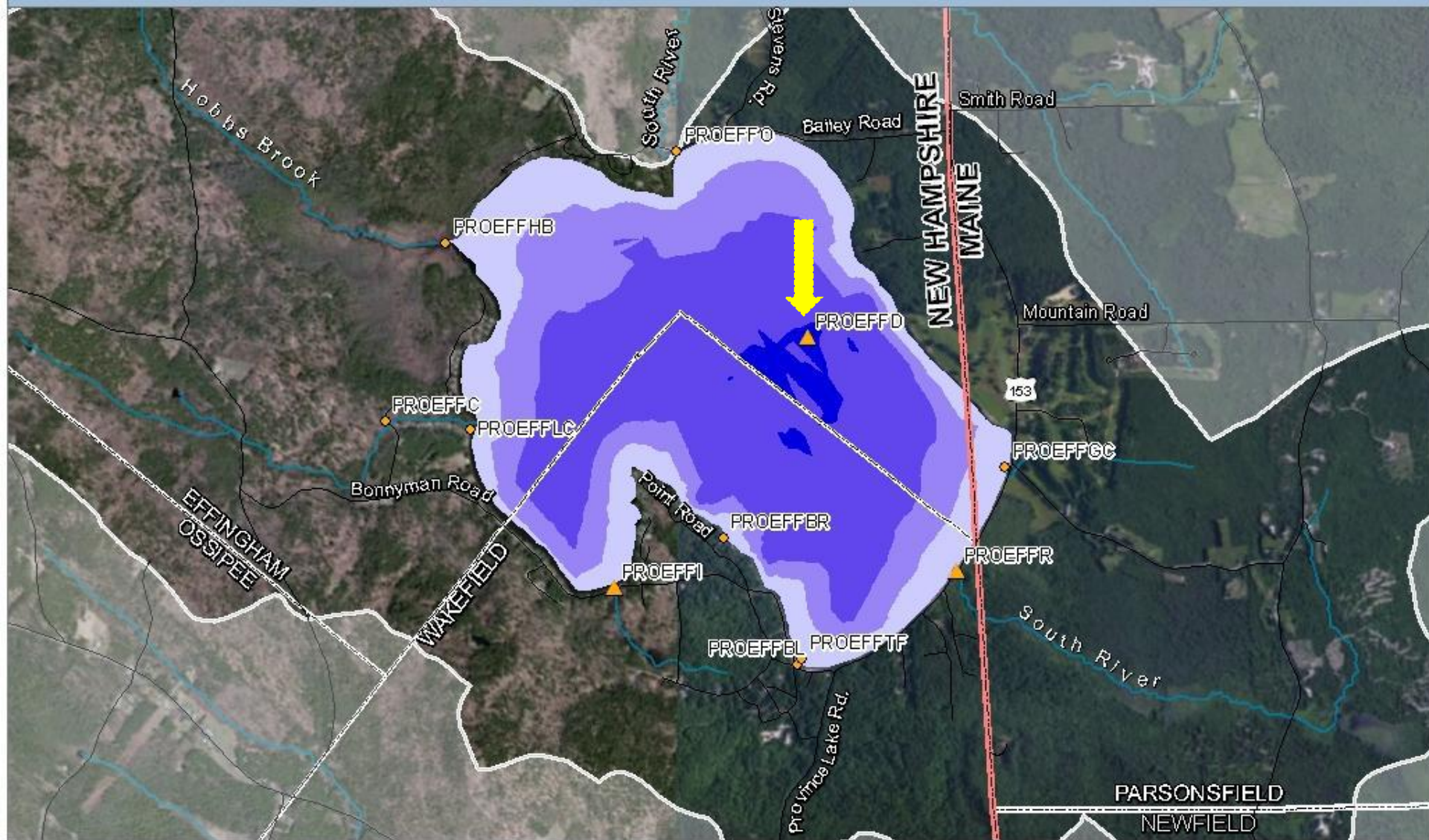


## Water Quality Data Available for Province Lake

<i>Data Source</i>	<i>Agency/Organization</i>	<i>Years Sampled</i>	<i># of Years Sampled</i>
<i>NH VLAP</i>	NHDES	<i>1991-2012</i>	<i>22</i>
<i>NH Trophic Survey</i>	NHDES	<i>1979, 1987, 1988, 2006, 2007</i>	<i>5</i>

# Water Quality Monitoring Sites

## Province Lake Watershed



NH / ME State Boarder

Towns

Province Lake Watershed

Streams

Past Water Quality Monitoring Sites

Current Water Quality Monitoring Sites

Roads

**Average Lake Depth**

<2.5 feet

2.5 - 7.5 feet

7.5 - 12.5 feet

12.5 - 17.5 feet



Data Source: MEGIS, NHDES  
NH GRANIT  
Coordinate System:  
NAD 1983 UTM Zone 19N  
Created by W. Baker,  
FB Environmental - May, 2013

# WQ Parameters

- Water Clarity (Secchi Disk Transparency or SDT)
- Total Phosphorus (TP)
- Chlorophyll-a (Chl-a)
- Dissolved Oxygen & Temperature
- ❖ *Color, pH & Turbidity were also assessed*



Turbid lake having large algal population results in shallow SDT reading, low clarity

# WQ Standards

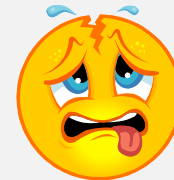


*“Measurements for ALU ensures that waters provide suitable habitat for survival and reproduction of desirable fish, shellfish, and other aquatic organisms.”*

**Meets or Exceeds WQ Criteria = Supporting**



**Does Not Meet Criteria = Impaired**



**“Nutrient Indicator” = Phosphorus**

**“Response Indicator” = Chlorophyll-a**



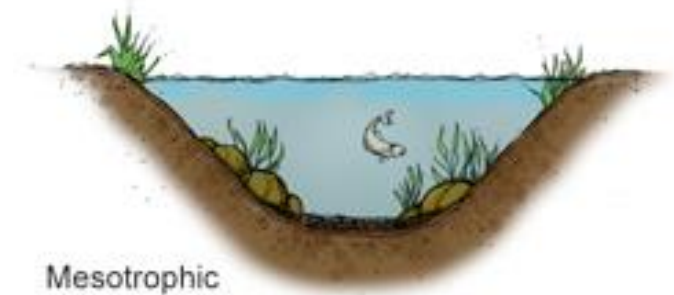
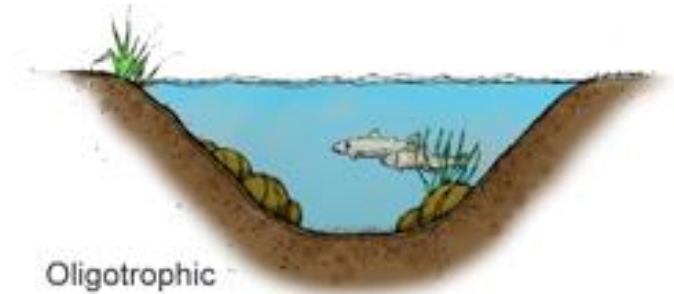
# Trophic State

## □ Degree of Eutrophication

Year	Trophic State
1979	Oligotrophic
1987	Oligotrophic
2006	Mesotrophic

### NHDES Trophic System:

- Summer Bottom DO (mg/L)
- Mean SDT (m)
- Aquatic Vascular Plant Abundance
- Mean Chl-a (ppb)



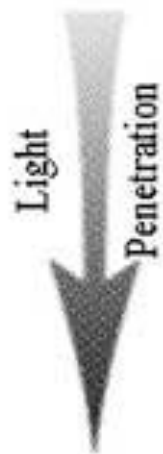
# Water Clarity



- Measured with a Secchi disk
- Characterize existing water quality
- Track long-term trends



Clear lake having a small algal population results in a deep SDT reading, high clarity



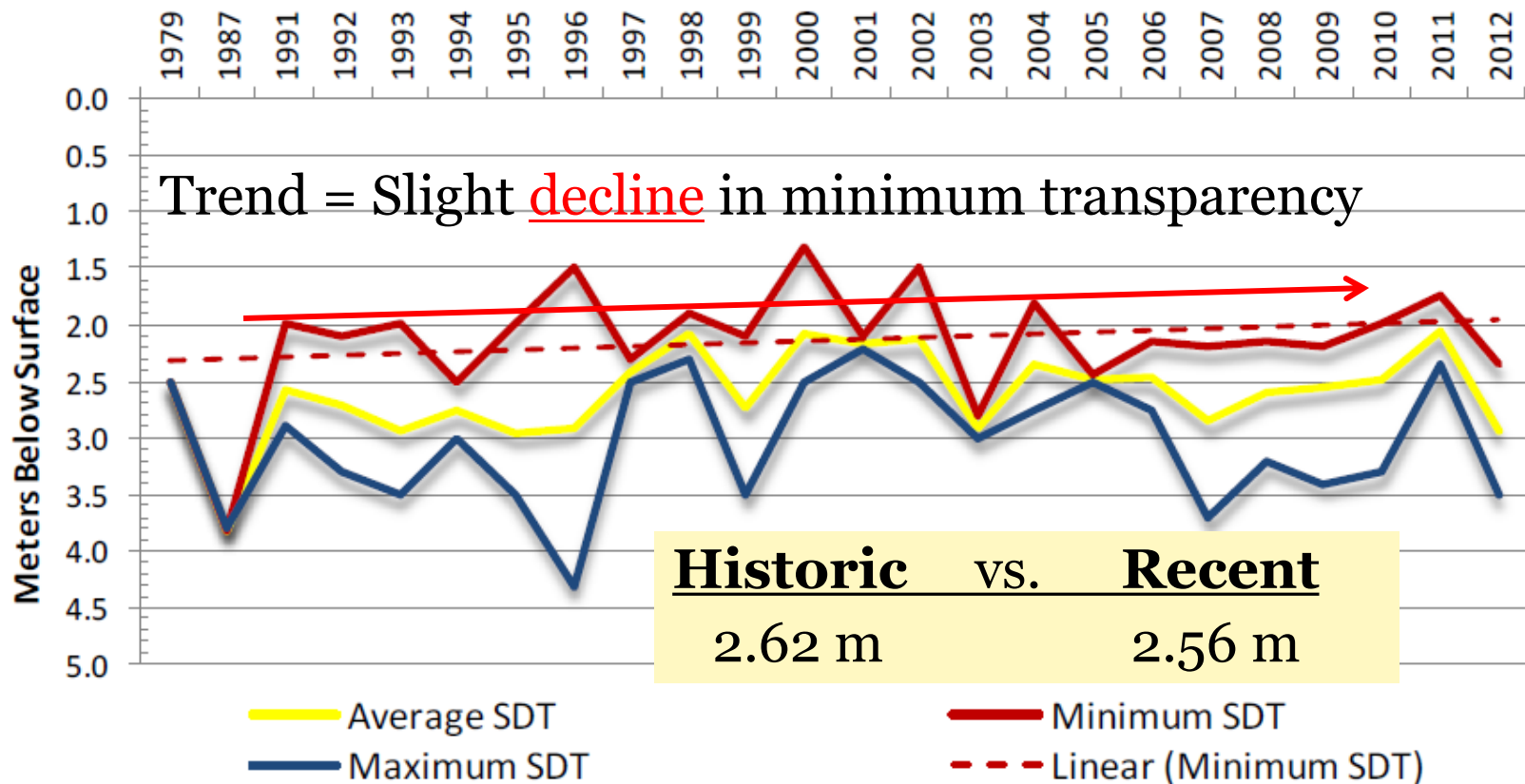
Turbid lake having large algal population results in shallow SDT reading, low clarity



# Water Clarity



Province Lake Seasonal Transparency  
Annual Average (1979-2012)  
*Deep Spot (Station PROEFFD)*



Range = 1.3 m to 4.3 m

Mean = 2.6 m (8.5 ft)

# Total Phosphorus

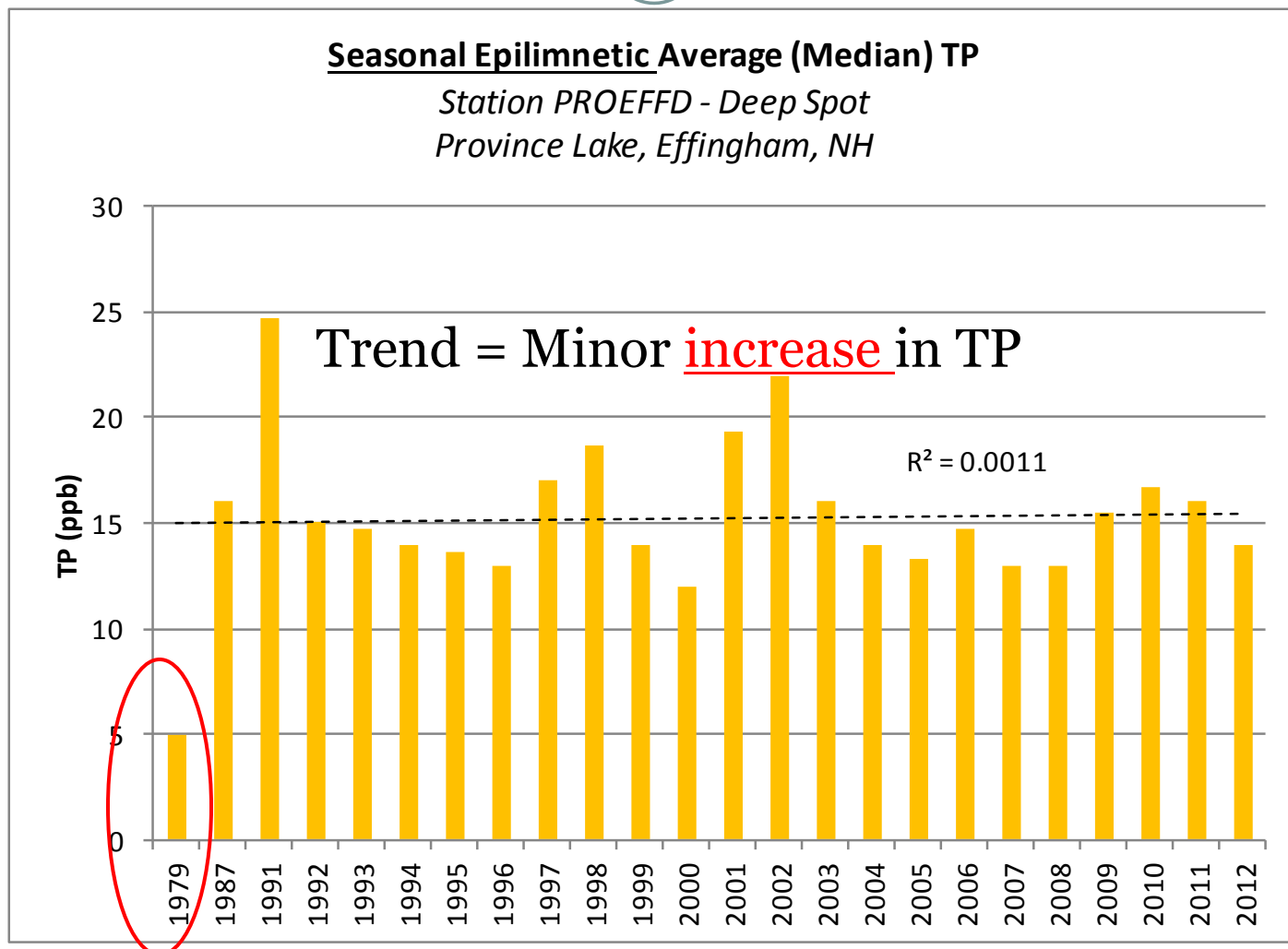


- ❑ Major nutrient needed for plant growth.
- ❑ Present in small amount in lakes.
- ❑ Excess phosphorus can lead to algae/cyanobacteria blooms.





# Total Phosphorus



Range = 5 ppb to 46 ppb

Recent Median = 14.3 ppb

# CHLOROPHYLL-A



- Measurement of the green pigment used for photosynthesis
- Used as an estimate of algal abundance/lake productivity
- Higher Chl-a = more algae in the lake
- Correlated with TP (more TP= more Chl-a)

**Chl- a > 5 ppb is  
considered high**



# CHLOROPHYLL-A

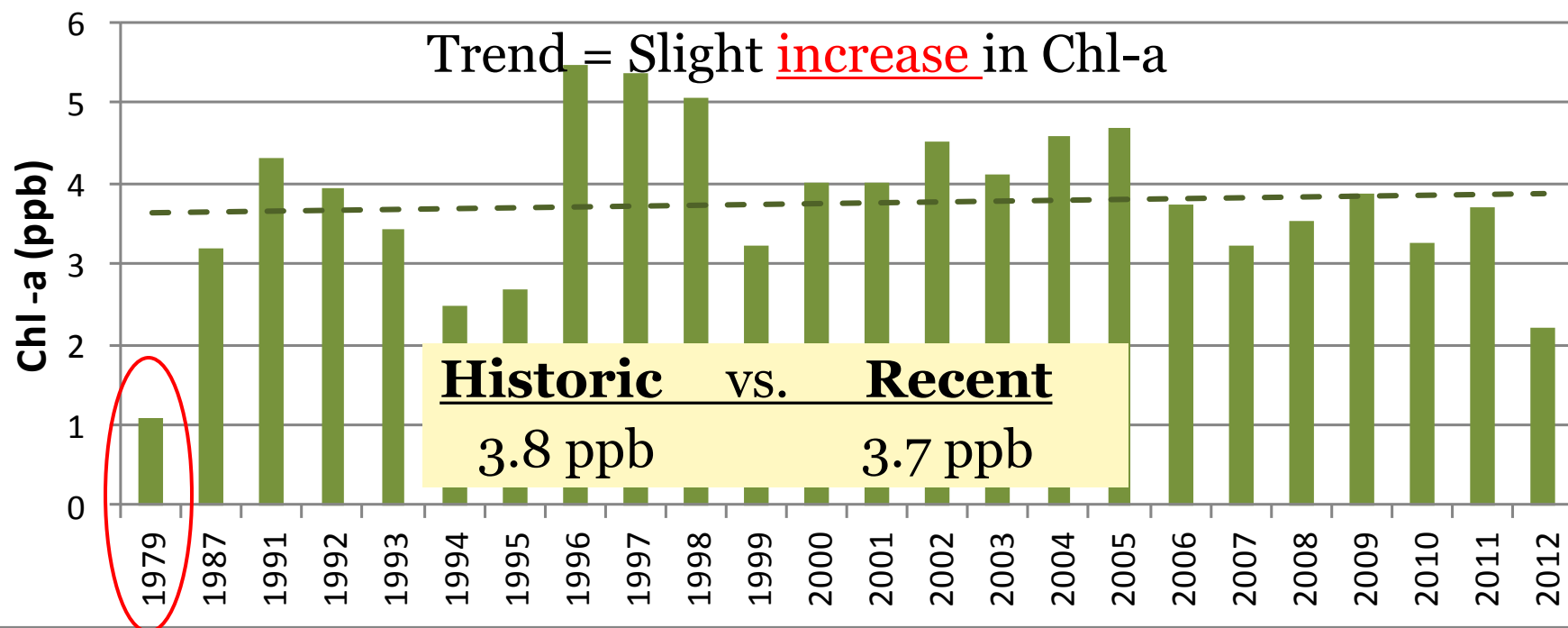


## Average (Mean) Annual (Seasonal) Chlorophyll-a

May 15 - October 15

*Province Lake ~ Effingham, NH*

1979-2012



Range = 1.1 ppb to 10.6 ppb

Mean = 3.7 ppb

# COLOR



- Influenced by suspended and dissolved particles in the water (*Geology, Vegetation, Land-use Activity, Wetlands*)
- Colored lakes warm up faster in the spring.
- Can affect type and timing of plankton growth.



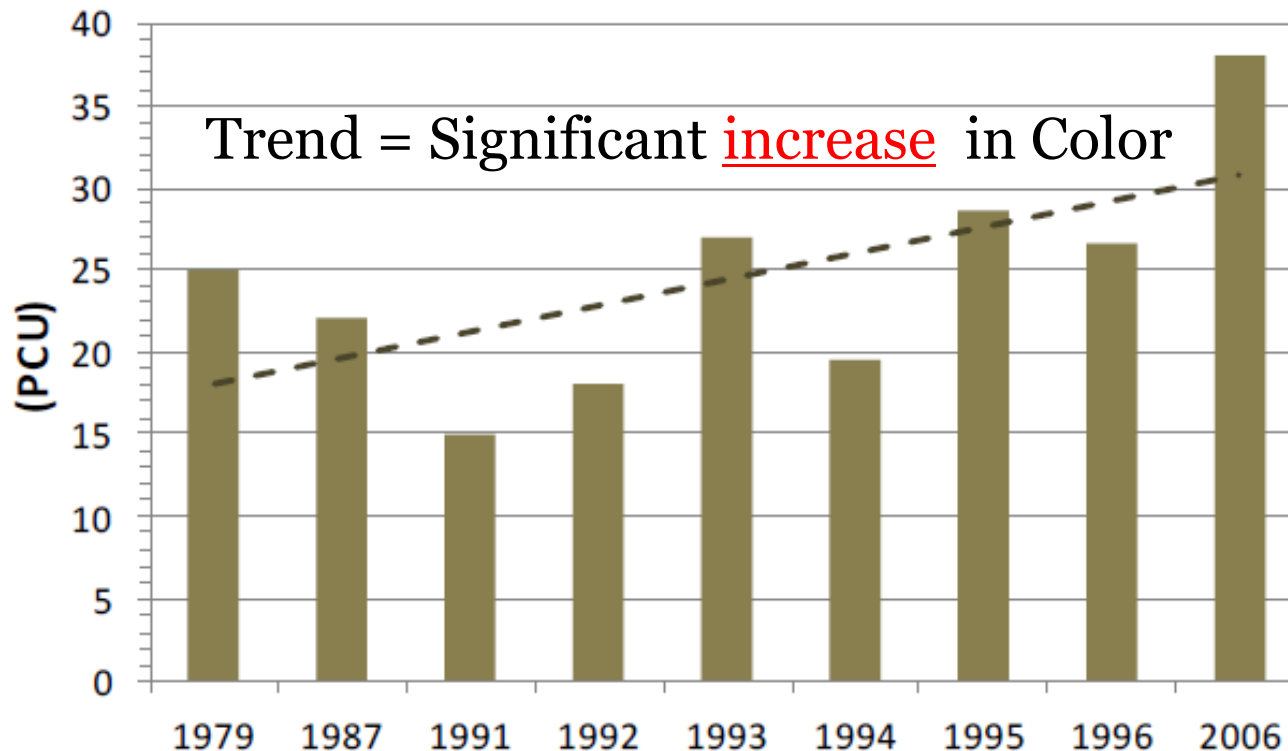


# COLOR



## Historical Apparent Color

*Deep Spot- Mean, Annual, Seasonal, Epilimnetic  
Province Lake, Effingham, NH*



Range = 12 ppb to 48 ppb

Annual Mean = 24 PCU

# PHYTOPLANKTON & BACTERIA



- ❑ Indicator of general lake water quality
- ❑ Abundance of Cyanobacteria- indicates excessive TP
- ❑ Increased water temperature and sunlight
- ❑ Cyanotoxins are a public health concern

**Exceeded 70,000 cells/mL:**

September 2, 2010

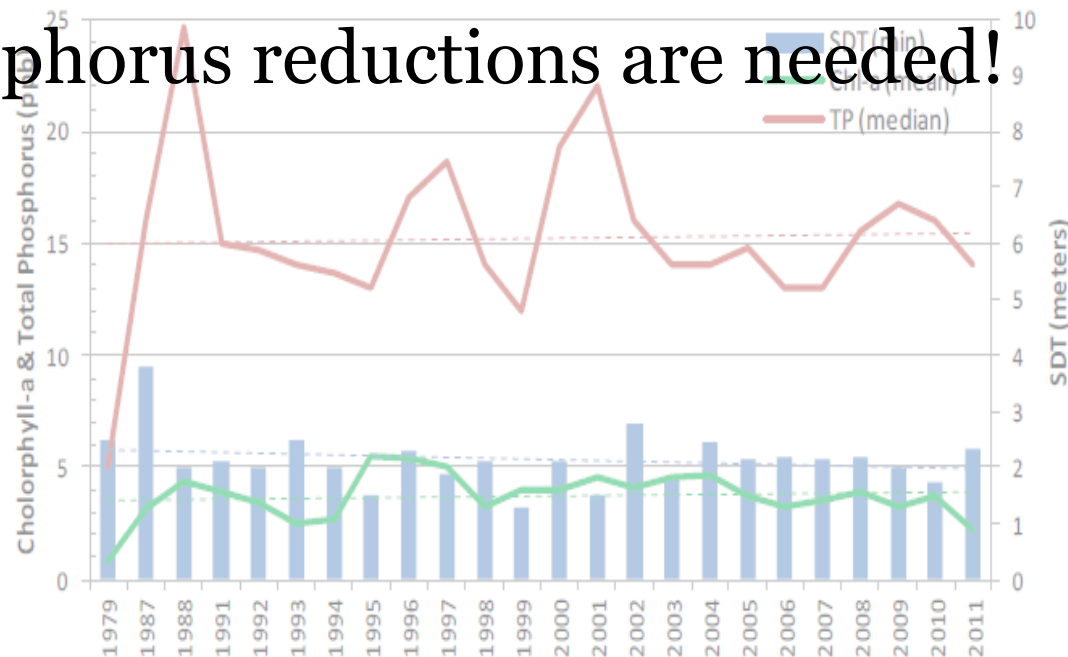
September 6, 2012

(\*No counts in Sept. 2011, below June 2013)



# SUMMARY OF WATER QUALITY

- Declining trend for all parameters over time;
- No significant difference between historic and recent data;
- Limited data prior to 1991 limits understanding of historical conditions;
- Phosphorus reductions are needed!





# Future Monitoring Recommendations

- ❑ Include **apparent color** in future monitoring;
- ❑ Conduct **sediment coring**
- ❑ **Collect consistent data** about cell counts, toxicity and species type **for future cyanobacteria blooms**;
- ❑ **Conduct intensive tributary monitoring** to better understand nutrient & sediment loading;
- ❑ **Extend VLAP monitoring into mid-October** to capture fall conditions



# Setting Water Quality Goals



**Assess Historical WQ**



**Determine Reductions  
Needed to Meet  
Standards**



**Set Water Quality Goal**

# Compare to Thresholds



## PROVINCE LAKE:

- Phosphorus = 14.3 ppb
- Chlorophyll-a = 3.7 ppb

## NH Criteria for Mesotrophic Lakes:

- Phosphorus < 12 ppb
- Chlorophyll-a < 5.0 ppb



**25% reduction**

# Compare to Threshold



## PROVINCE LAKE:

- Phosphorus = 14.3 ppb
- Chlorophyll-a = 3.7 ppb

## NH Criteria for Oligotrophic Lakes:

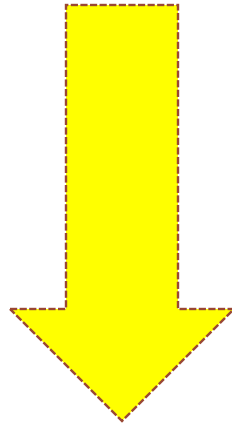
- Phosphorus < 8 ppb
- Chlorophyll-a < 3.3 ppb



**50% reduction**

# INTERIM WATER QUALITY GOAL

- ✓ Prevent Cyanobacteria Blooms
- ✓ Reduce In-lake Total Phosphorus



**14.3 ppb to 10.8 ppb**

**25% reduction**



# Research Questions

- 1) *How have past practices affected current conditions?*
- 2) *What do the trends look like when we add data from 1956, 1965-67 and 1975-78?*
- 3) *How has the color of the lake changed, and is it affecting available  $P$  in the water?*
- 4) *What is the internal  $P$  load, and how is it affecting cyano blooms?*
- 5) *Is the current interim goal enough to prevent future blooms?*



A woman with short brown hair and glasses, wearing a blue long-sleeved shirt and blue jeans, is crouching on a sandy beach. She is holding a white sign with the number '202' in blue. The sign is partially obscured by the text 'PROVINCE LAKE WATERSHED SURVEY'. The background shows a wooden structure made of horizontal planks, possibly a pier or a breakwater, with a sandy area in front of it. The ground is covered in sand and some brown seaweed or debris.

# PROVINCE LAKE WATERSHED SURVEY

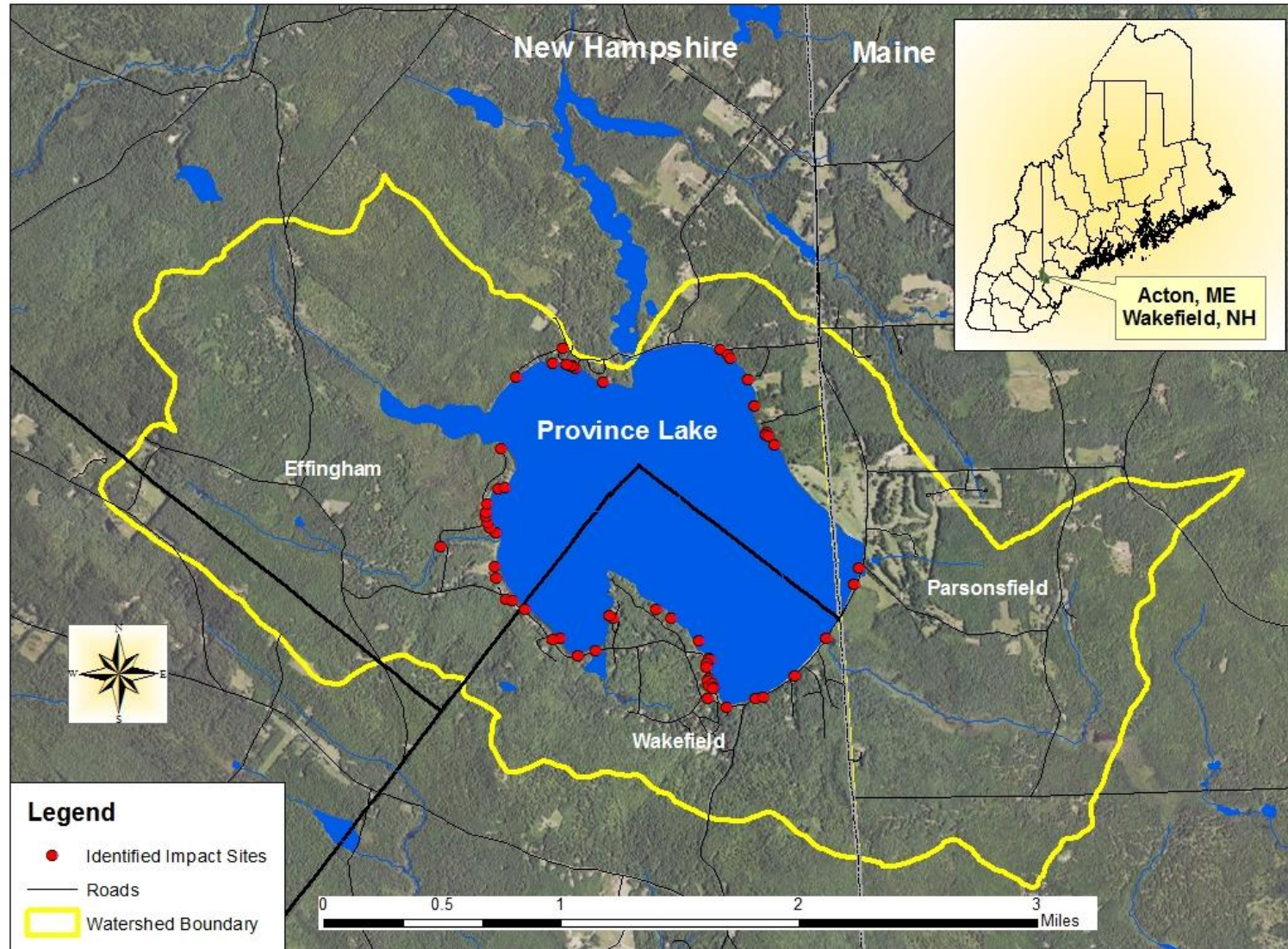
# Goals of the Watershed Survey

- ❖ Collect baseline information about sources of pollution (erosion) and the state of septic systems in the shorezone (250 ft.)
- ❖ Estimate P loading from septic systems
- ❖ Educate watershed citizens about NPS





# Province Lake Watershed Survey



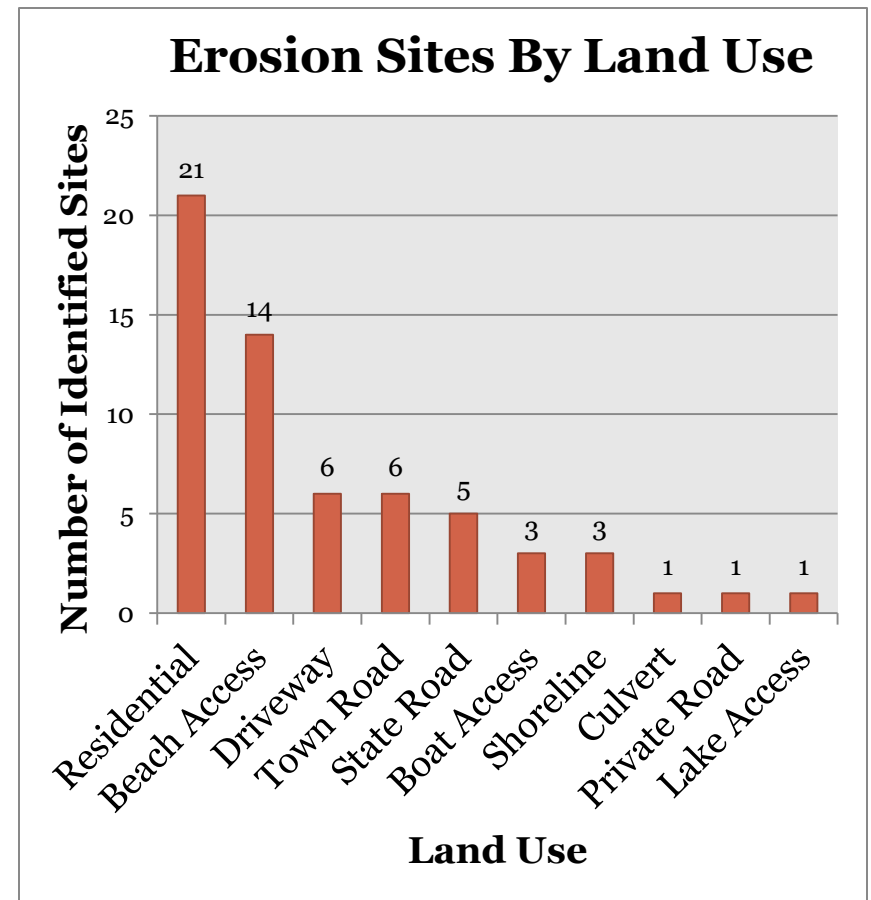
# Survey Method

- Volunteers trained on how to identify erosion sites.
- Identified erosion sites and recorded information on standardized sheets.
- Results compiled and analyzed.



# Survey Results

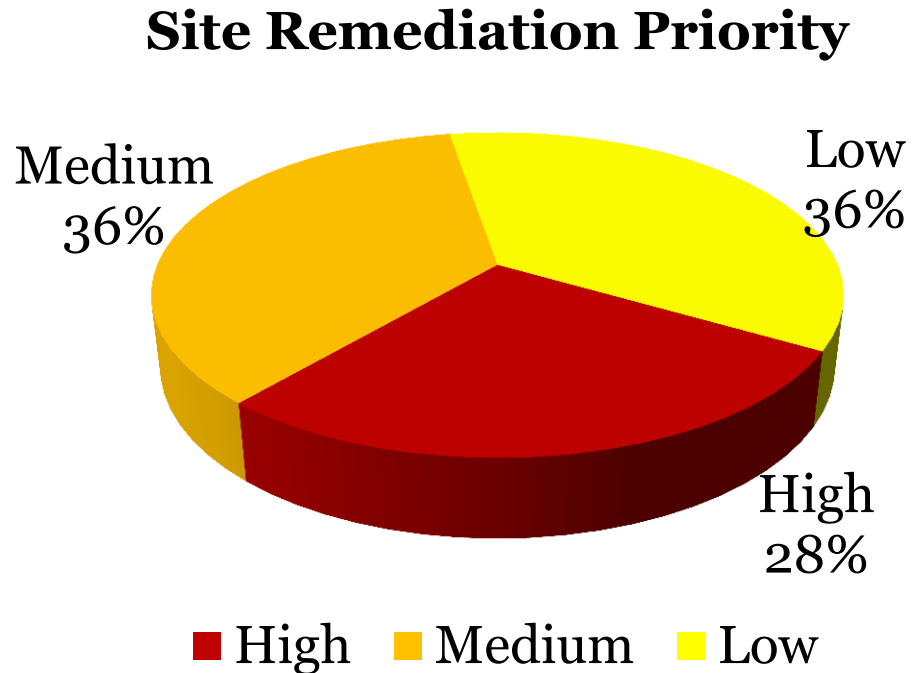
- Volunteers and technical leaders found a total of **61 sites** which are impacting or have potential to impact the lake.
- **Residential properties** accounted for 21 of the sites (**34%**).
- **Roads** accounted for 12 of the sites (**21%**).
- **Beach access** accounted for 14 of the sites (**23%**).





# What's Next?

- **28%** of the sites were identified as **high priority**; these sites should be the first to receive remediation.
- Call AWWA at **(603) 473-2500** for free advice on how to fix erosion problems.



# Upcoming Septic Survey

- Septic survey -**August 24<sup>th</sup>**.
- Please complete via mail or email if possible.
- Chance to **win a \$100 gift certificate** to Mulligan's WoodFire Tavern!!!







**Questions?**

