

The Water Quality of the Lakes Region (and the State) – Trends and Issues of Concern



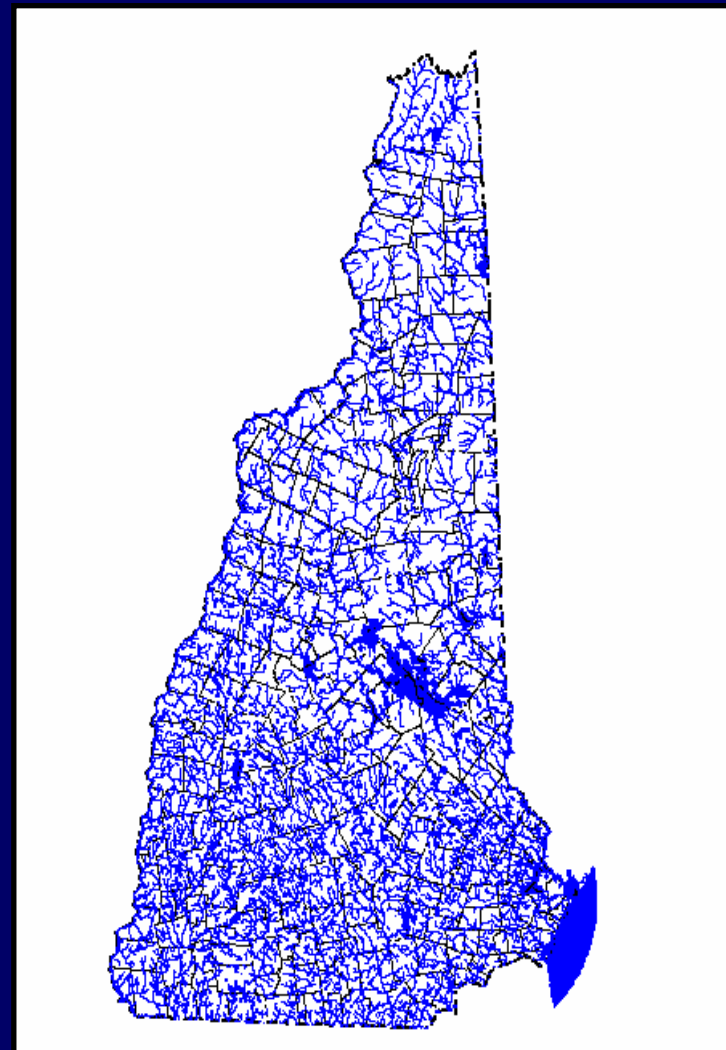
Jody Connor, NHDES Limnology Center Director

Overview

- Overview of water resources in New Hampshire
- Key factors impacting water quality
 - Phosphorus
 - Land-use changes
 - Invasive species

NH Surface Waters by Waterbody Type

Waterbody Type	Total Size
Rivers & Streams	9,612 Miles
Impoundments	21,752 Acres
Lakes & Ponds	164,609 Acres
Estuaries	17.7 Square Miles
Ocean	70.2 Square Miles
Wetlands	? (not Assessed but in progress)



Top 10 Big Lakes in NH

Waterbody Name / Town	Area (acres)
Winnepesaukee / Wolfeboro	44,585.24
Umbagog / Errol	7,849.82
Squam Lake / Holderness	6,764.36
Winnisquam / Belmont	4,264.20
Newfound Lake / Bristol	4,105.91
Sunapee Lake / Sunapee	4,090.04
Moore Reservoir / Littleton	3,489.91
Ossipee Lake / Ossipee	3,091.83
Lake Wentworth / Wolfeboro	3,071.53
Massabesic Lake / Auburn	2,899.94

Deepest Lakes in NH

Waterbody Name/Town	Depth (m)
Newfound Lake / Bristol	55.5
Winnipesaukee / Broads	54.9
Winnisquam / Belmont	53
Silver Lake / Madison	50
Connecticut River / Pittsburg	49.7
Moore Reservoir / Littleton	44.8
Merrymeeting Lake / New Durham	41.2
Dan Hole Pond / Tuftonboro	40
Diamond Pond / Stewartstown	33
Sunapee Lake / Sunapee	31.9

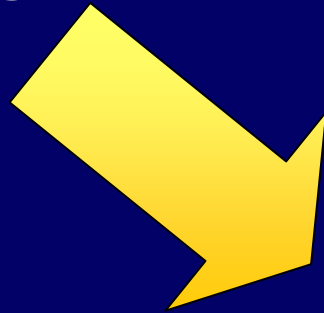
Clearest Lakes in NH

Waterbody Name / Town	Clarity (m)
Nubanusit / Nelson	11.6
Russell Pond / Woodstock	11.4
Winnipesaukee / Alton	11
Gilmore Pond / Jaffrey	10.7
Merrymeeting Lake / New Durham	10.3
Spofford Lake / Chesterfield	10.2
Connor Pond / Ossipee	10.2
Blue Pond / Madison	10.2
Sunapee Lake / Sunapee	9.8
Willard Pond / Antrim	9.8

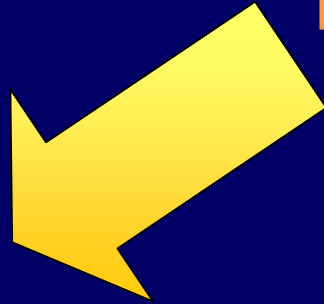
Size, Depth, and Trophic Status of Waterbodies in the Meredith Area

Lake Name	Total Area (acres)	Max Depth (ft)	Clarity (ft)	Trophic Status
Lake Winnepesaukee	44,585	180	30	Oligotrophic
Lake Waukewan	912	70	22	Oligotrophic
Lake Wicwas	327	36	13	Mesotrophic
Lake Pemigewasset	241	29	11	Mesotrophic
Lake Winnisquam	4264	173	20	Oligotrophic

Increased Phosphorus



Increased Algae



Decreased Clarity



Decreased Lake Quality and ...

An aerial photograph of a lake. A yellow floating barrier, likely a boom, stretches across the middle of the lake, separating the water into two distinct zones. The water to the left of the barrier is a deep, dark blue, indicating low nutrient levels. The water to the right is a bright, opaque green, indicating high nutrient levels. The surrounding land is covered in dense green trees and vegetation. The text 'Low nutrient loading' is overlaid on the dark blue water, and 'High nutrient loading' is overlaid on the green water.

***Low nutrient
loading***

***High nutrient
loading***

Lake Symptoms Due to Excess P

- Cyanobacteria
- Algae blooms
- Low clarity
- Excessive plant growth
- Increased sedimentation (muck)
- Odors
- Anoxia



LAKE WINNIPESAUKEE WATERSHED MANAGEMENT PLAN

Phase 1 Subwatersheds:

Meredith, Paugus & Saunders Bays and Lake Waukewan



WAUKEWAN

11% Developed
72% Forested
15% Water
2% Agriculture

MEREDITH BAY

10% Developed
48% Forested
30% Water
2% Agriculture

SAUNDERS BAY

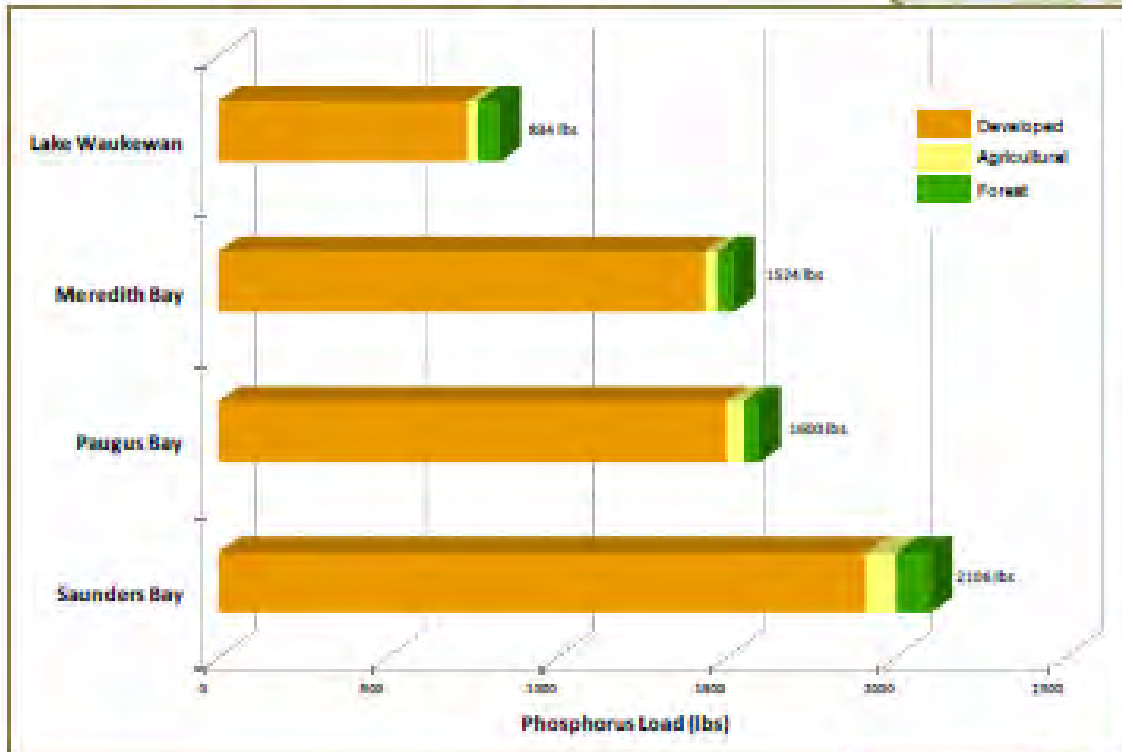
15% Developed
53% Forested
29% Water
3% Agriculture

PAUGUS BAY

25% Developed
54% Forested
17% Water
4% Agriculture

PHOSPHORUS LOAD

2009 Estimated Phosphorus (lbs) by Land Use



WAUKEWAN

11% Developed
72% Forested
15% Water
2% Agriculture

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48% Forested
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SAUNDERS BAY

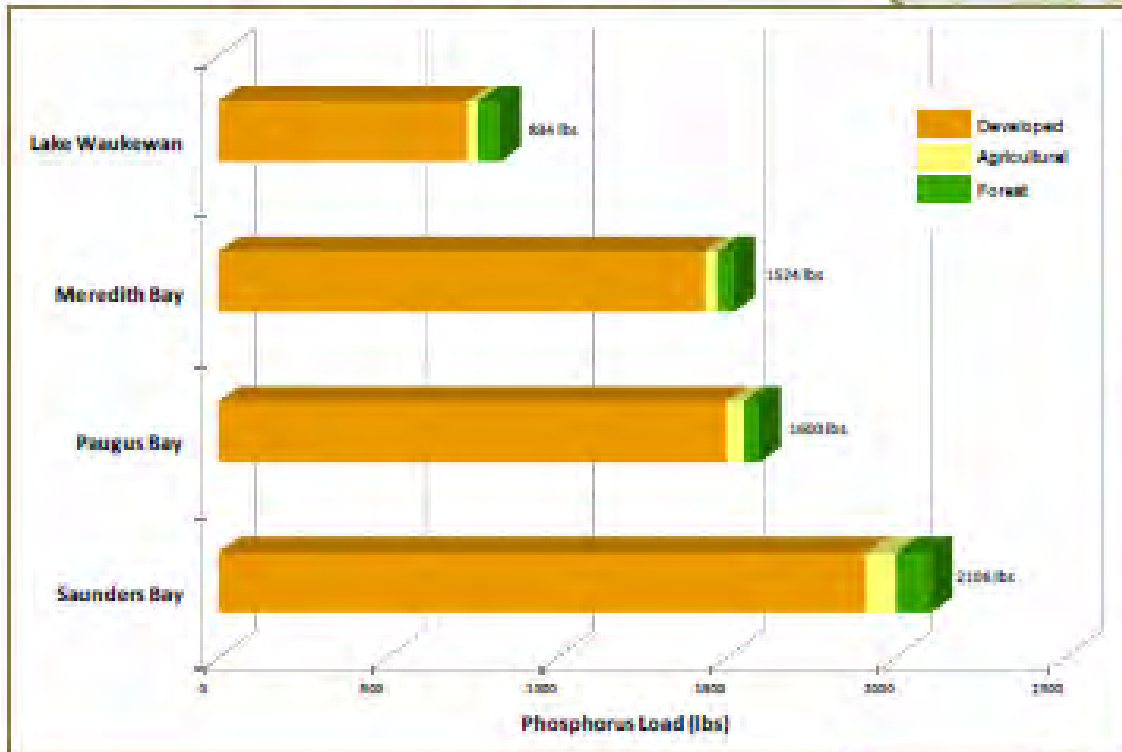
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PHOSPHORUS LOAD

2009 Estimated Phosphorus (lbs) by Land Use



Phosphorus: The Limiting Nutrient for NH's Lakes

Many of the sources of P are regulated in NH:

Source	Law/Control
Household cleaning products	RSA 485-A:55
Dishwasher Detergents	RSA 485-A:55
Fertilizers	RSA 483-B
Manure and Animal Yard Wastes	BMPs/Dept of Ag WQ Standards RSA 485-A:8
Failed Septic Systems	RSA 485-A:29
Erosion	Terrain alteration/RSA 483-B

Phosphorus: The Limiting Nutrient for NH's Lakes, Cont.

Sources of Phosphorus and relevant laws:

Source	Law/Control
Gasoline/Oils	EPA/Underground storage tanks
Impervious Areas/Shoreline Development	Shoreland Protection Act, RSA 483-B
Wetfall	Precip Monitoring and EPA/DES air standards
Litter/Trash	RSA 485-A:15
Boat Discharges	RSA 487:2
Discharges	RSA 485-A:13

Many State Programs Have Been Established to Monitor our Lakes and Ponds:

Program	Responsibility
Volunteer Lake/River Assessment	Physical / Chemical collection of lake, pond and river quality data
Lakes Assessment	Physical / Chemical / Biological collection of lake and pond data to assess trophic state delineation
Biomonitoring	Physical / Chemical / Biological collection of water quality data from wadable streams and rivers
Beach	Collection of relevant beach quality information from Designated Beach areas
Complaints/Other	Complaint investigations related to water quality impacts

Other DES Lake Programs

Clean Lakes

Exotic Species

Acid Monitoring

Toxic Cyanobacteria

Mercury Sampling

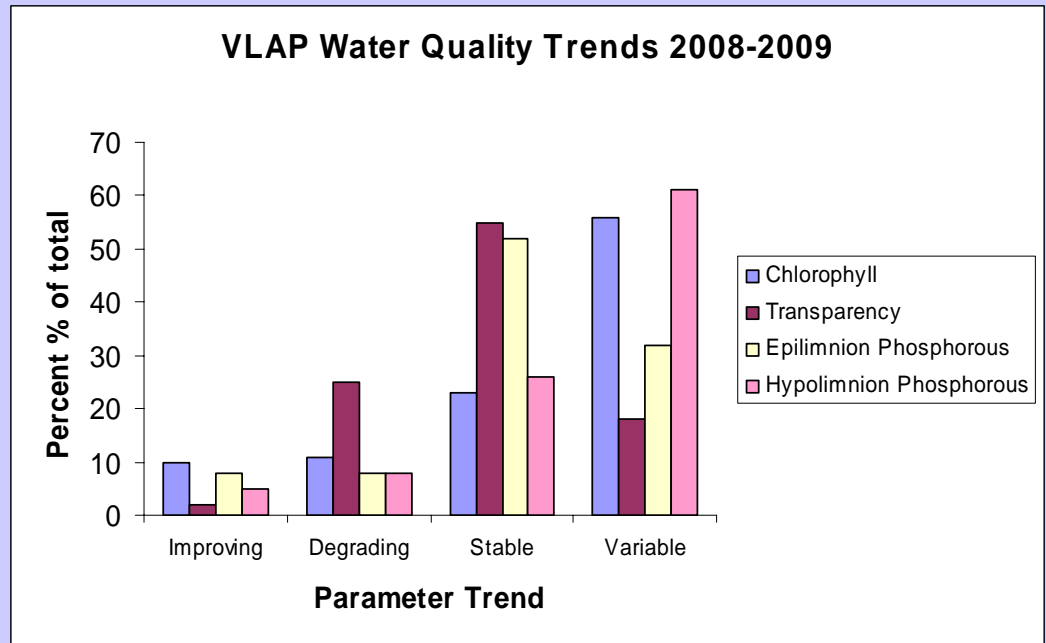
Boat Inspection

Lakes Management & Protection

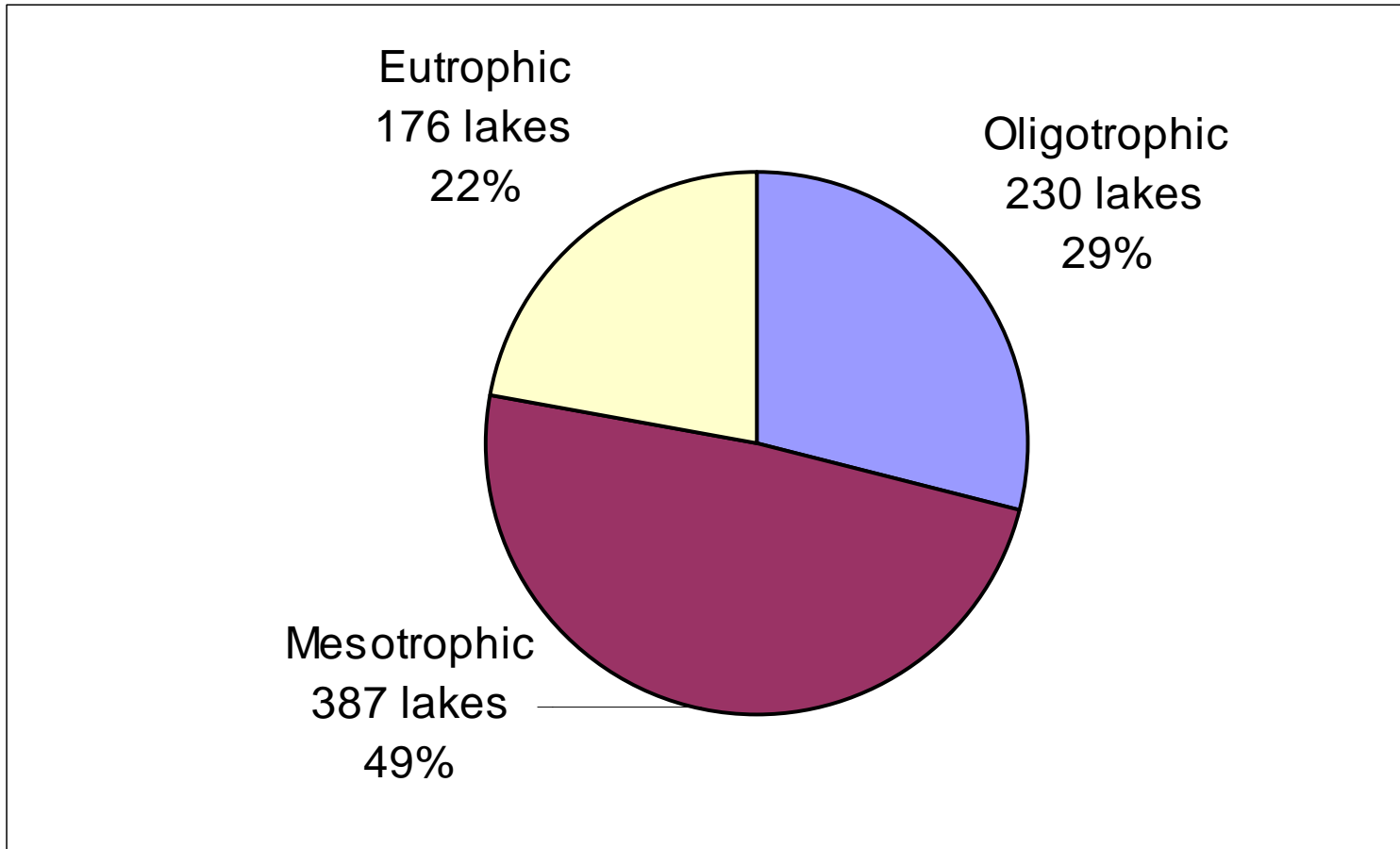
NH Trends in Water Quality

(based on VLAP data)

- A large number of lakes have stable trends
 - Transparency and epilimnetic phosphorus show stable trends at greater than 50% of lakes, and chlorophyll concentrations are stable and/or improving at 33% of lakes.
- 25% of lakes show a degrading (decreasing) transparency trend, 14% of which cannot be explained by a degrading (increasing) chlorophyll trend.



Trophic Status of NH Lakes



What Do We Know?

- Overall, NH Lake Water Quality is Very Good
 - According to the 305(b) Report: the acres of lakes and ponds that have been assessed meet EPA's standards but all lakes and rivers are impaired for mercury in fish while others for pH
 - Not high % of acres assessed!
 - According to the National Secchi Dip-In: NH has repeatedly been ranked one of the “Top Five” states in the country for water clarity
 - Most lakes (78%) are categorized as having ‘excellent’ or ‘good’ water quality based on their trophic status

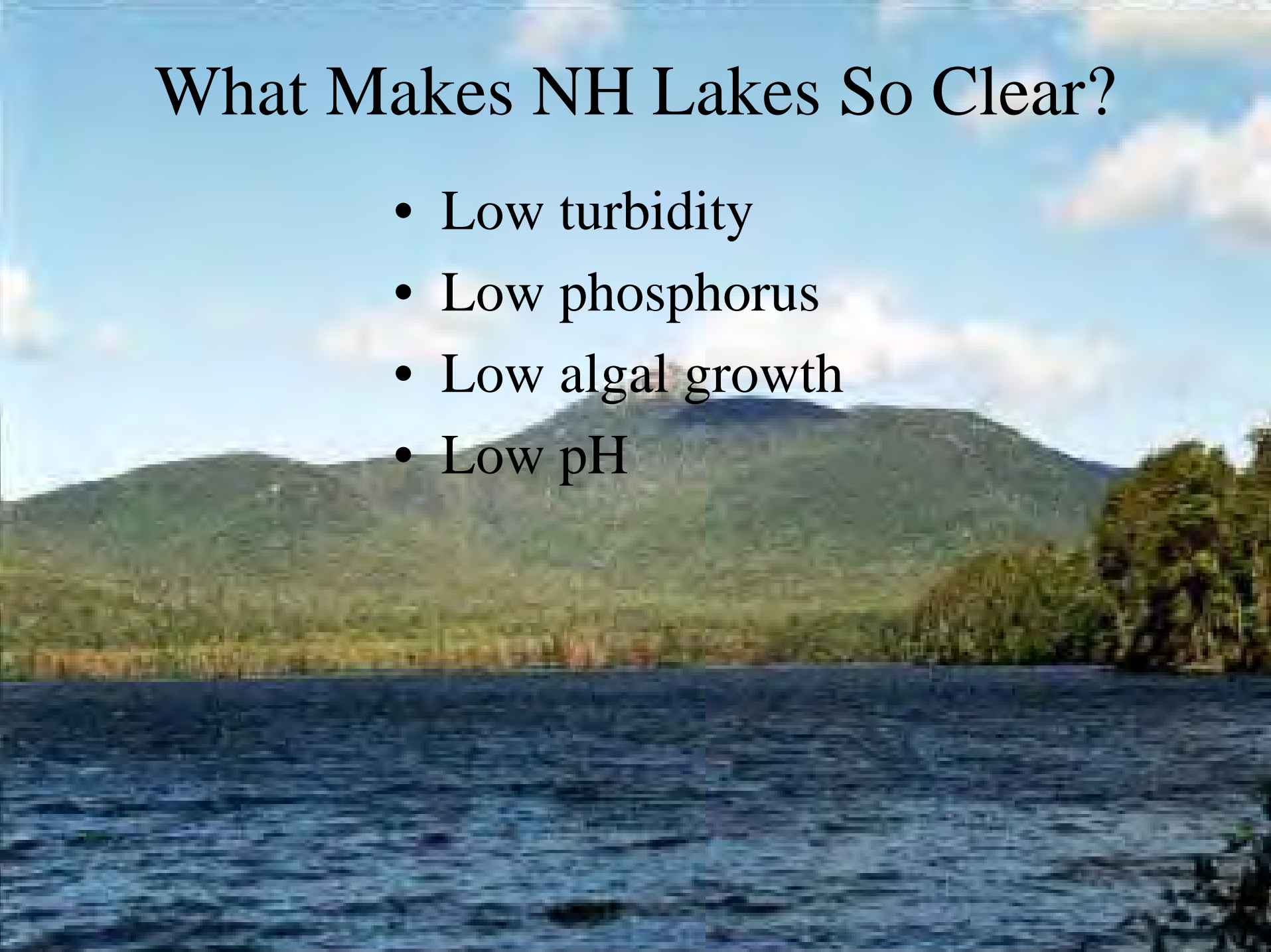
Where Do We Stand Nationally in Terms of Clarity?

1. Oregon
2. Montana
3. New Hampshire

NH's lakes are ranked 3rd in
clarity in the U.S.

What Makes NH Lakes So Clear?

- Low turbidity
- Low phosphorus
- Low algal growth
- Low pH



Today's Top Concerns About NH Waterbodies

- **Overall Water Quality**
- **Threats and Impairments from Invasive Species**
- **Air-Borne Pollution (acid deposition, mercury)**
- **Population Growth & Shoreland Development**
- **Increasing Demand on Finite Resource**
- **Stormwater Runoff and Increases in Impervious Surfaces**
- **Inadequate Buffers**
- **Increased Sedimentation and Impacts on Aquatic Life**
- **Increased Water Temperatures**
- **Increased Chlorides and other Contaminants**

General Threats to our Lakes, Ponds, Rivers and Streams:

Then

(Pre Clean Water Act of 1972)

Point Source Pollution Discharges



Now

Nonpoint Source (NPS) Pollution/
Stormwater Runoff



Watershed Activities and Factors That Affect Water Quality

- Construction
- Road Runoff
- Shoreline Erosion
- Forestry Activities
- Fertilizing
- Wash Runoff
- Unauthorized Herbicide Application
- Sediment
- Septic System Seepage
- Disruption
- Agriculture
- Gasoline/Oil Spills
- Urban/Commercial Development
- Illegal Discharges
- Beach or Shoreline Erosion

Lake Quality and Economic Response to Watershed Activities

- Increased sedimentation
- Increased bottom 'muck'
- Increased plants and algae
- Increased cyanobacteria
- Decreased clarity
- Decreased oxygen
- Decreased aesthetic value
- Decreased recreational value
- Decreased property values



**We
Don't want to see this**



Lake Impacts



Protecting NH Lakes and Ponds for the Future

- Although many lakes and ponds still show stable or improving trends...this is not the time to become complacent!
- Watershed management is imperative to prevent extensive negative land-use changes.
- Surface water quality trends reflect land-use changes that can be measured through increasing phosphorus and conductivity (land clearing, pavement salting, septic systems, stormwater runoff)

Plan Ahead to Prevent Future Water Quality Problems

- **Low Impact Development**
- **Use Watershed Best Management Practices**
- **Encourage responsible Lake Management**
- **Help support watershed ordinances**

Yes, YOU can make a difference!

Special State Programs

- **Identify pollutant source(s) before addressing lake symptoms**
 - **WHY** are the water quality trends deteriorating? “What’s in Your Lake”
 - **Pollutant source detection?**
 - **Identify land-use changes?**
 - **Manage the watershed?**
 - **Protect the lake?**

Other Big Problems ...

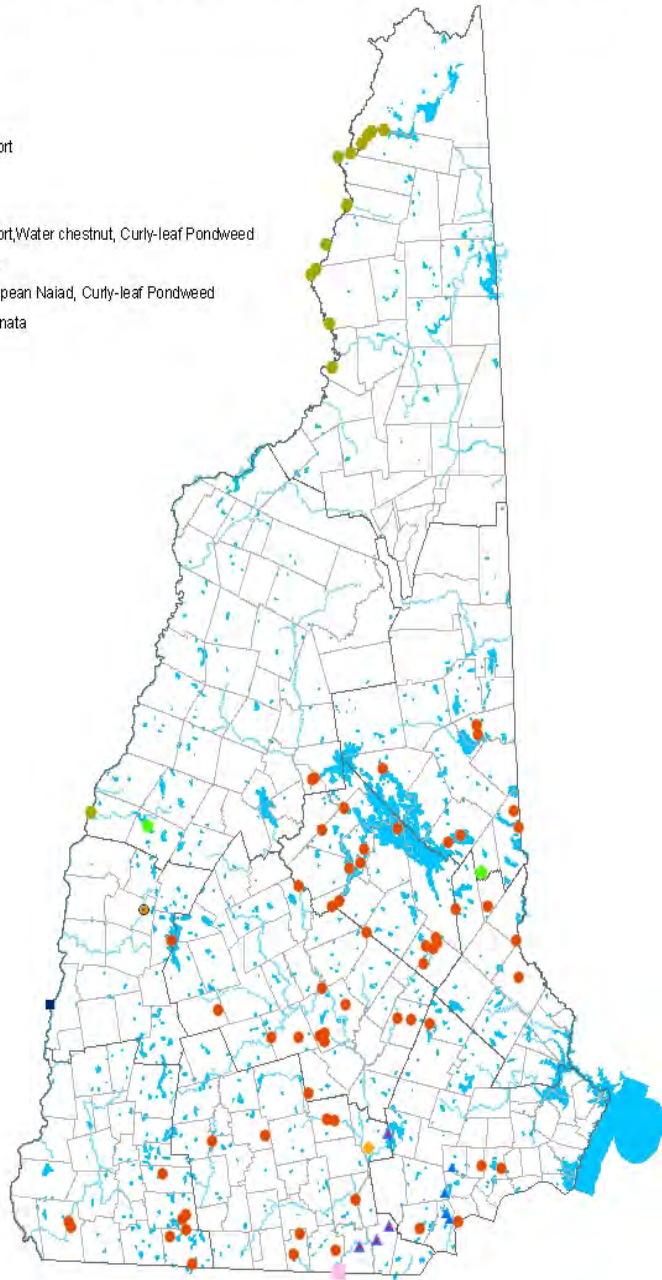
- Invasive Species
 - Impairs designated uses of waterbodies
 - Creates declines in shorefront property values
- Cyanobacteria Blooms
 - Toxic to humans and animals!



Exotic Aquatic Plant Infestations in New Hampshire

Infestation Type SPECIES

- Variable milfoil
- ▲ Farwort
- ▲ Variable milfoil, Farwort
- Eurasian milfoil
- ◆ Brazilian elodea
- Variable milfoil, Farwort, Water chestnut, Curly-leaf Pondweed
- Curly-leaf Pondweed
- Eurasian milfoil, European Naiad, Curly-leaf Pondweed
- *Didymosphenia geminata*



Updated April 2009

Exotic Aquatic Species in NH

- 76 infested waterbodies
- 83 infestations

Fanwort



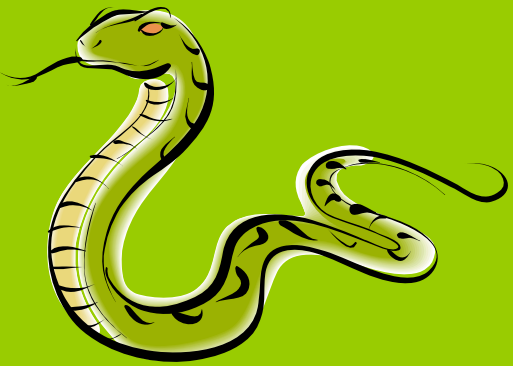
Eurasian milfoil



Variable milfoil



Water chestnut



Toxins

- Lethal dose (LD-50) of microcystin = 25 - 150 $\mu\text{g}/\text{kg}$ of body weight (**0.025 - 0.150 mg/kg**)
- Compared with some of the most venomous snakes in the world

Common Name	LD-50 (mg/kg)
Coastal Taipan	0.009
Field's Horned Viper	0.02
Many Banded Krait	0.08
Indian Krait	0.089
Beaked Sea Snake	0.107

Note: this comparison based on route of exposure (intraperitoneal). LD-50 can differ among different exposure routes

Future Challenges

- **Smart growth with increasing development**
- **Stormwater runoff**
- **Funding to protect and/or rehabilitate lakes**
- **Acid Deposition/Mercury in Fish**
- **Water Access/Competing water uses**
- **Invasive Species/Cyanobacteria**
- **Public education**
- **Cooperative partnerships**

