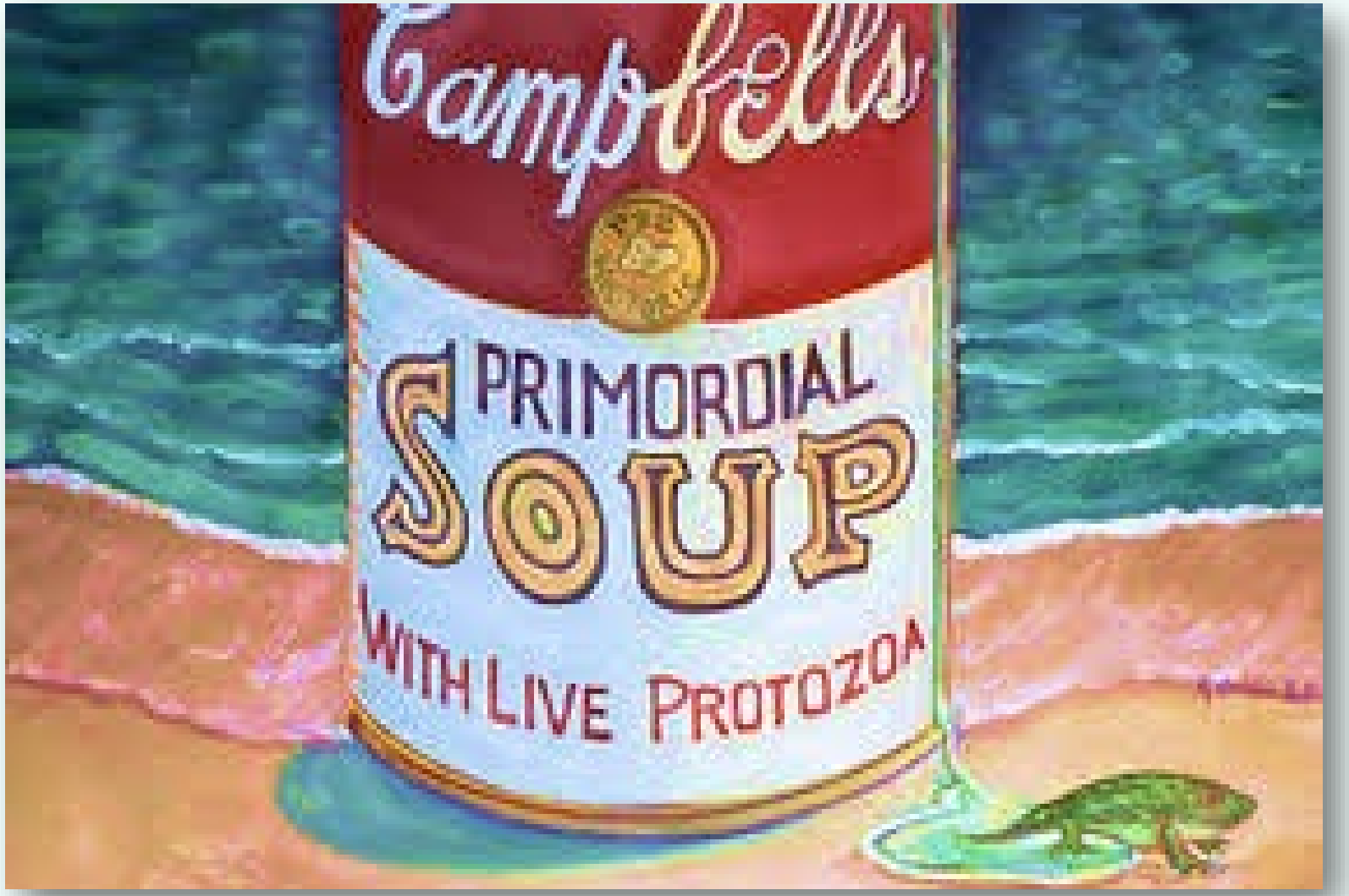
Navigating the Waters:
Ensuring Resilient Futures for New Hampshire's Lakes

Essentials questions of navigation

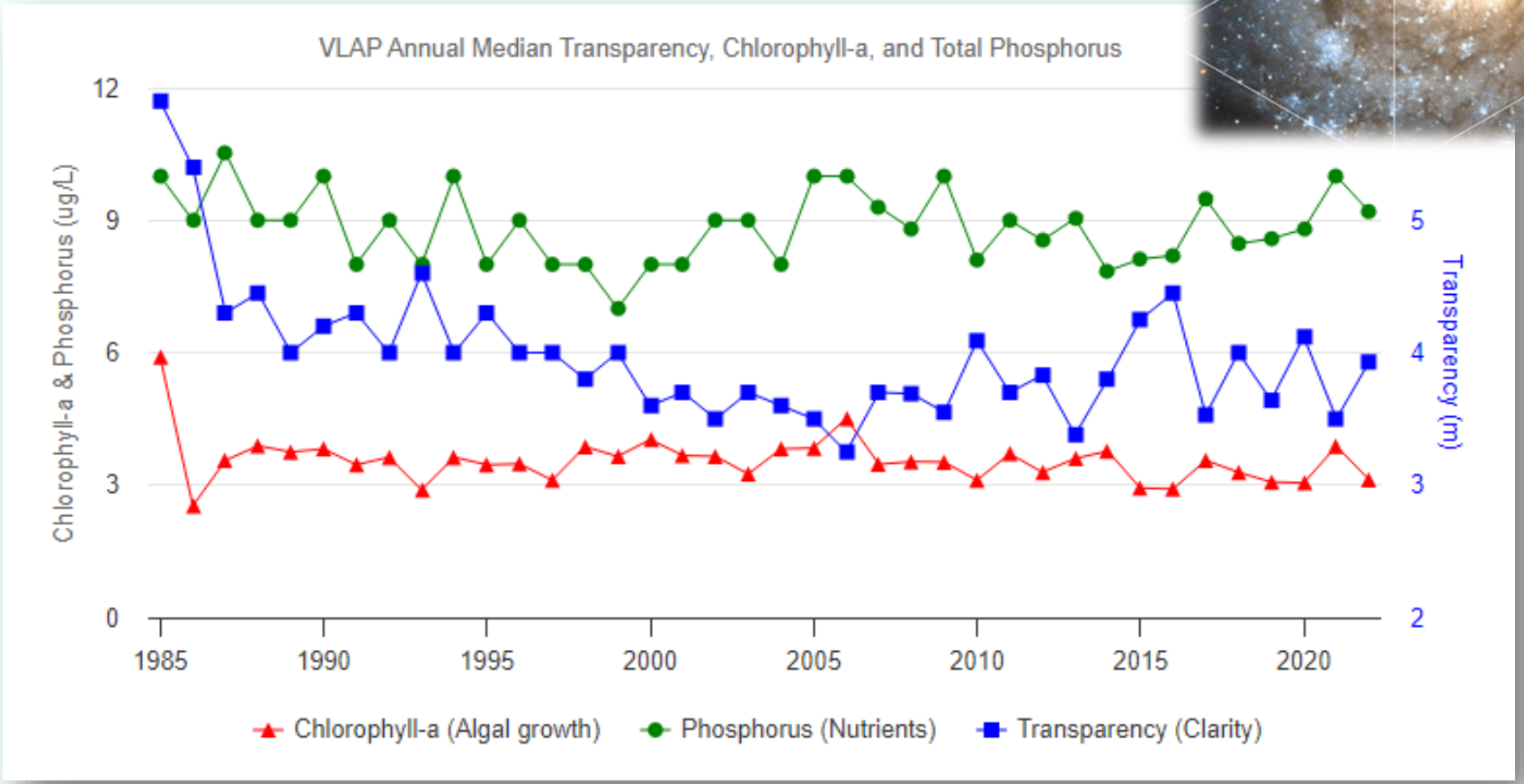
- Point of origin?
- Where are we now?
- Destination?
- Hazards ahead?
- Tools to get there?
- Where is that destination again?

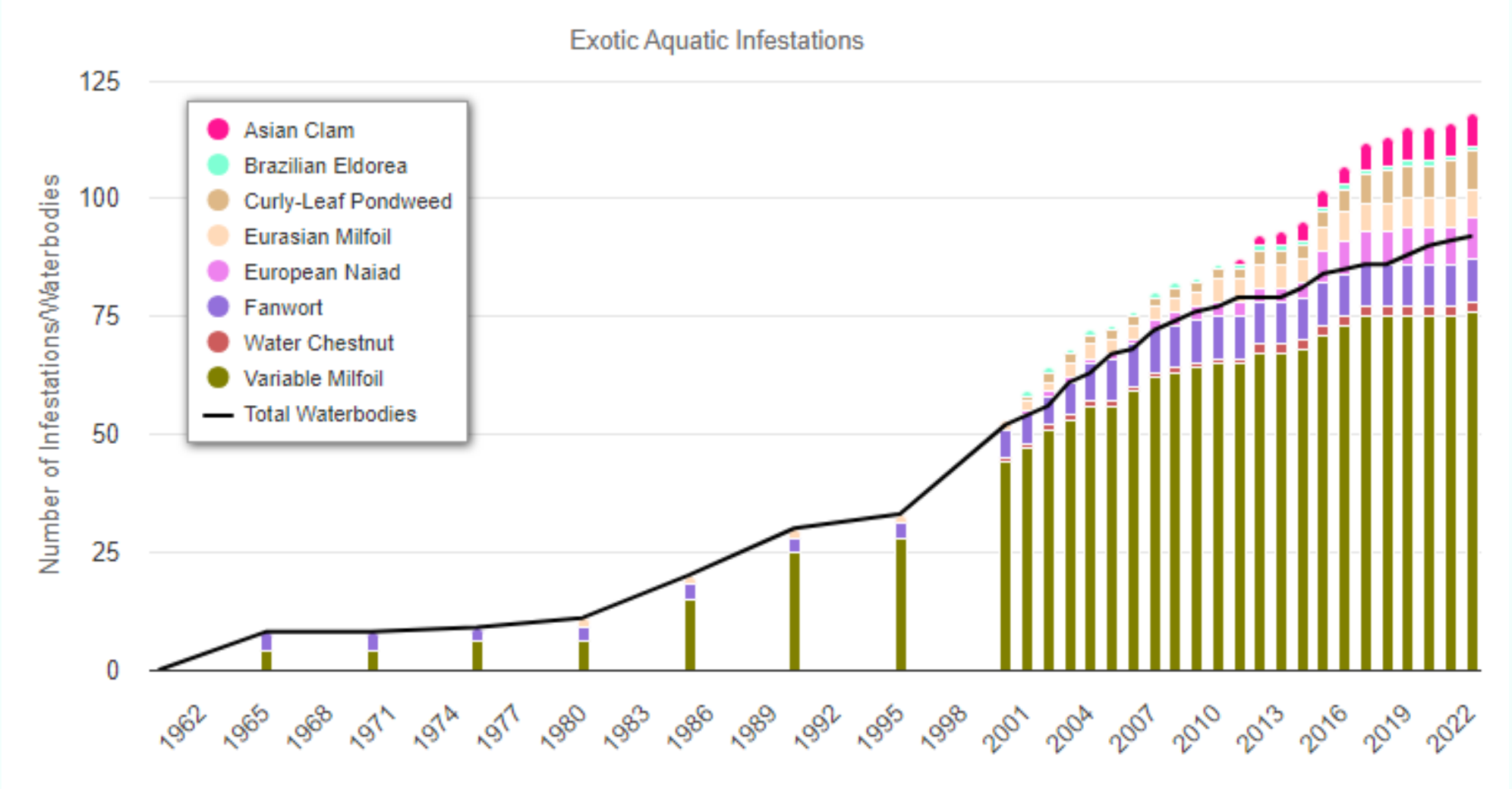
Point of origin

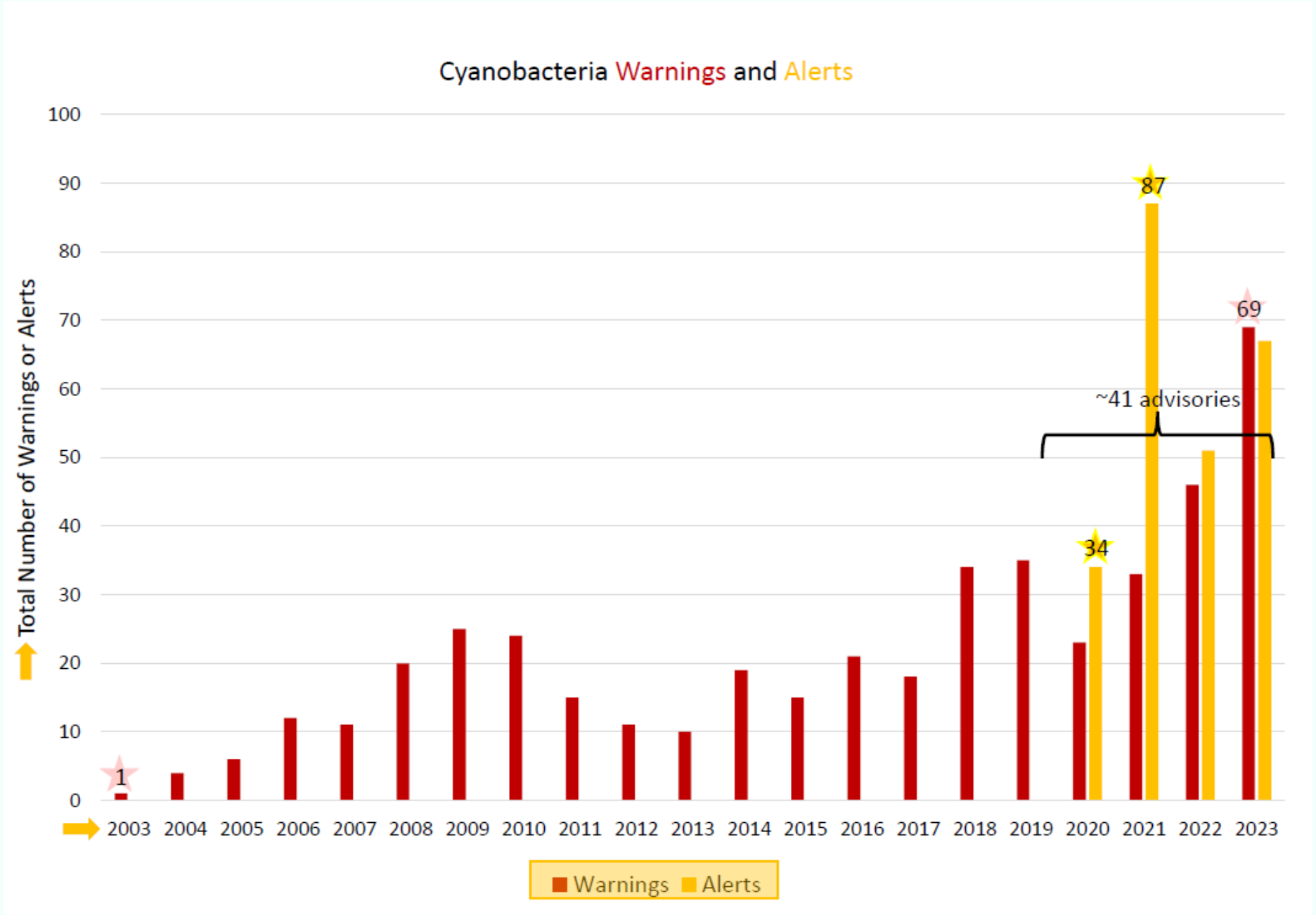
- What did our lakes look like before dams?
- Puddles?
- Ponds?
- Disconnected?
- Era of deforestation?
- Era of sewage assimilation?



Where are we now?




Exotic Aquatic Infestations
Number of Infestations/Waterbodies
125
100
75
50
25
0
Asian Clam
Brazilian Eldorea
Curly-Leaf Pondweed
Eurasian Milfoil
European Naiad
Fanwort
Water Chestnut
Variable Milfoil
Total Waterbodies
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
2013
2016
2019
2022


Cyanobacteria Warnings and Alerts
Total Number of Warnings or Alerts
100
90
80
70
60
50
40
30
20
10
0
1
87
69
34
~41 advisories
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Warnings
Alerts

Summary of **Stormwater** Influenced Parameters	
Area of lake impairments	Number of Impairments
53,555.6 Acres (38.7%)	193 (40.7%)
96 beaches (94.1 %)	96 Beaches (94.1%)

Summary of **Nutrient** Influenced Parameters	
Area of lake impairments	Number of Impairments
47,479 Acres (34.3%)	157 (33.1%)
29 beaches (28.4 %)	29 beaches (28.4 %)

How did we get here?

Stressors

- Nutrients
- Stormwater
  - Chlorides
  - Sediment
  - Chemicals
- Human waste
- Intensity of use
- Loss of natural buffers
- Development in watershed
- Legacy impacts – deforestation, contaminants
- Changing hydrology
- Changing temperatures

The Path Ahead

Lots of ways to think about lake conditions

- Wicked problems
- Lake Trophic levels
- Altered Steady States
- Hysteresis
- Resiliency

What we got here is a Wicked Problem

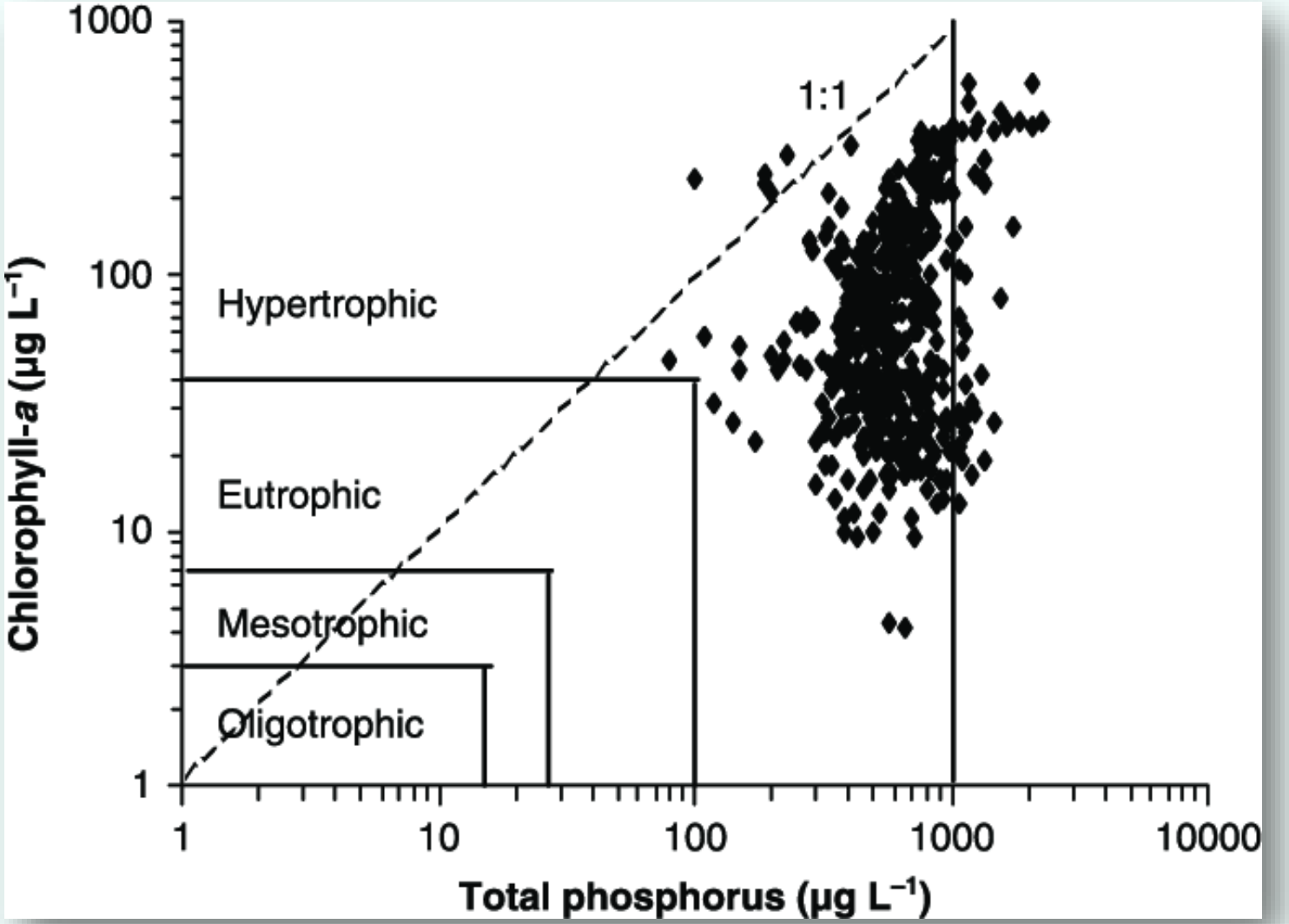
a **wicked problem** is a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize.

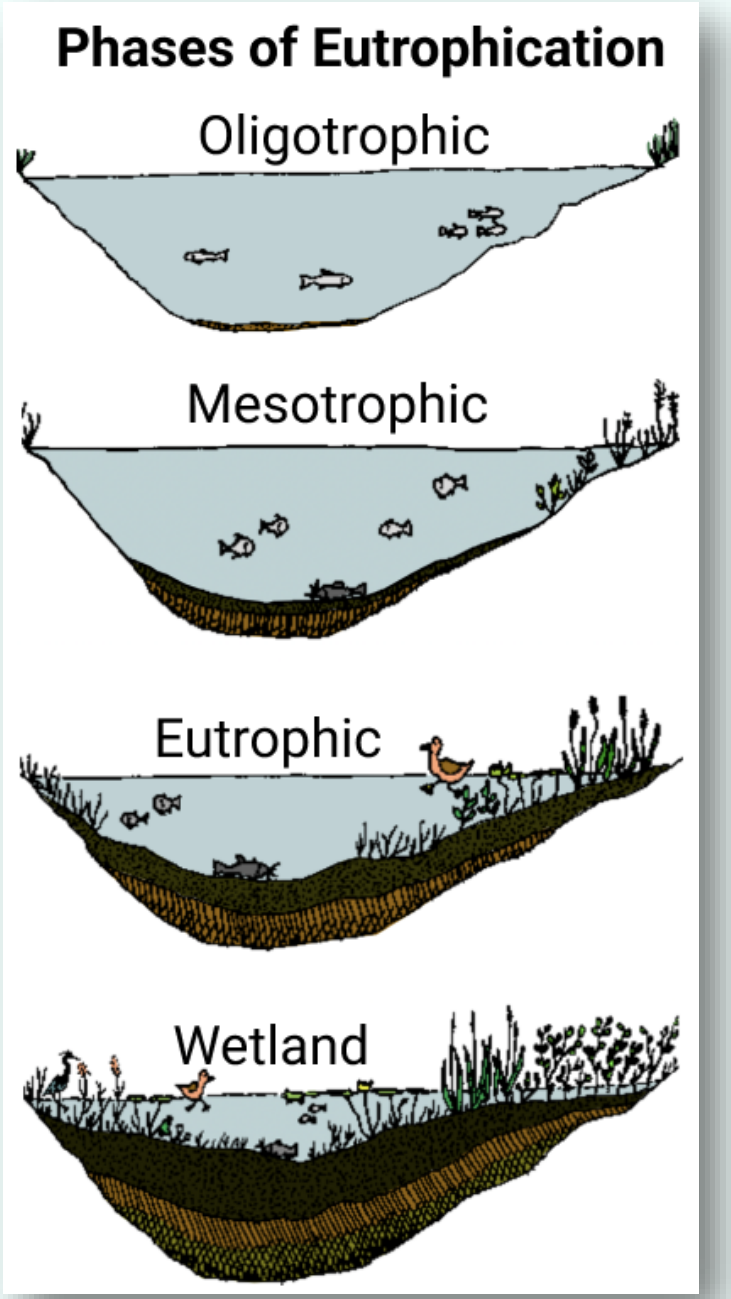
Aspects of wicked problems

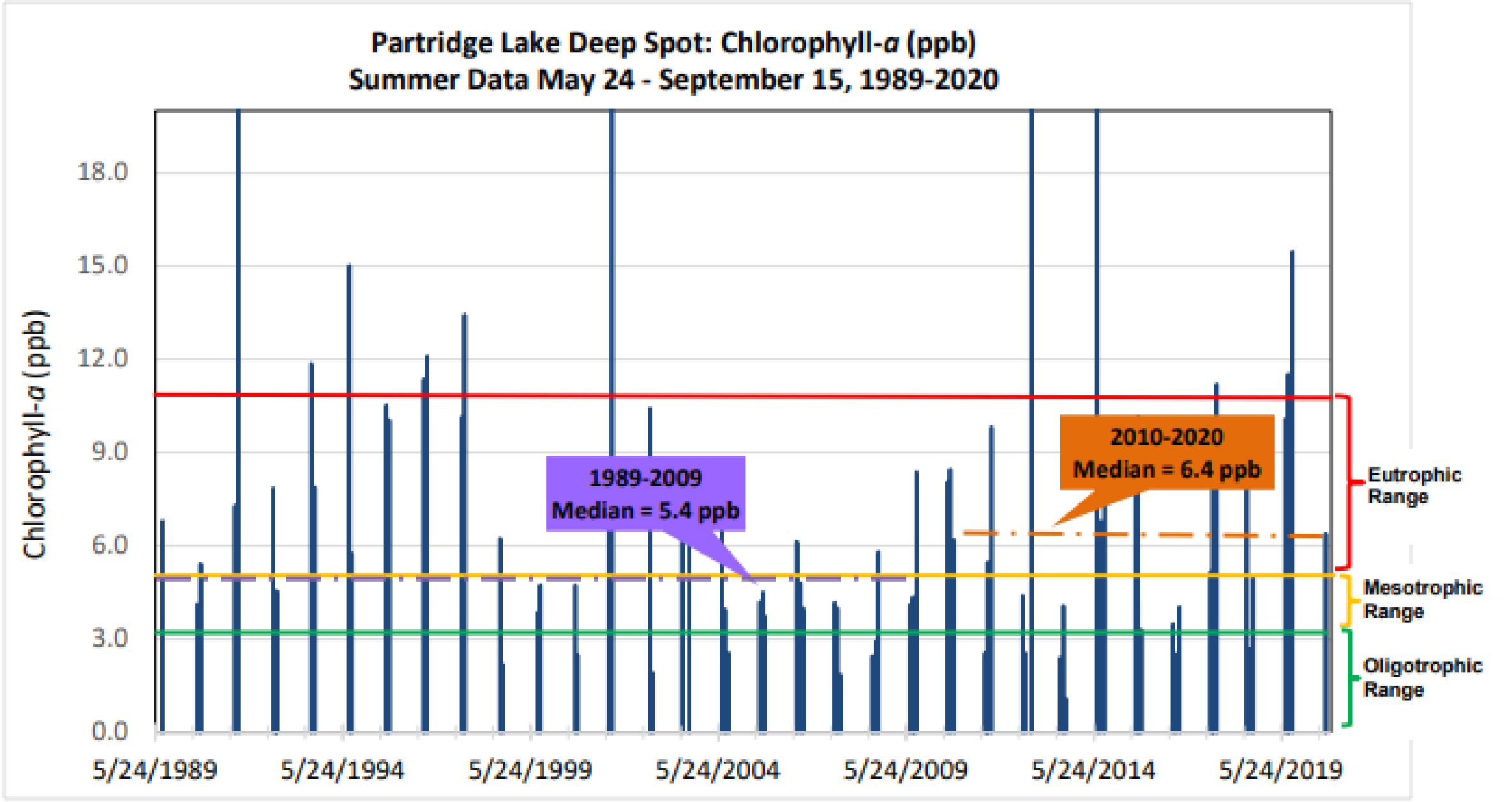
1. The problem is not understood until after the formulation of a solution.
2. **Wicked problems have no stopping rule.**
3. **Solutions to wicked problems are not right or wrong.**
4. Every wicked problem is essentially novel and unique.
5. Every solution to a wicked problem is a "one shot operation".
6. Wicked problems have no given alternative solutions.

Conklin, Jeffrey (2006). Dialogue mapping: building shared understanding of wicked problems. Chichester, England: Wiley. ISBN 978-0-470-01768-5.

Lakes just wanna be meadows!

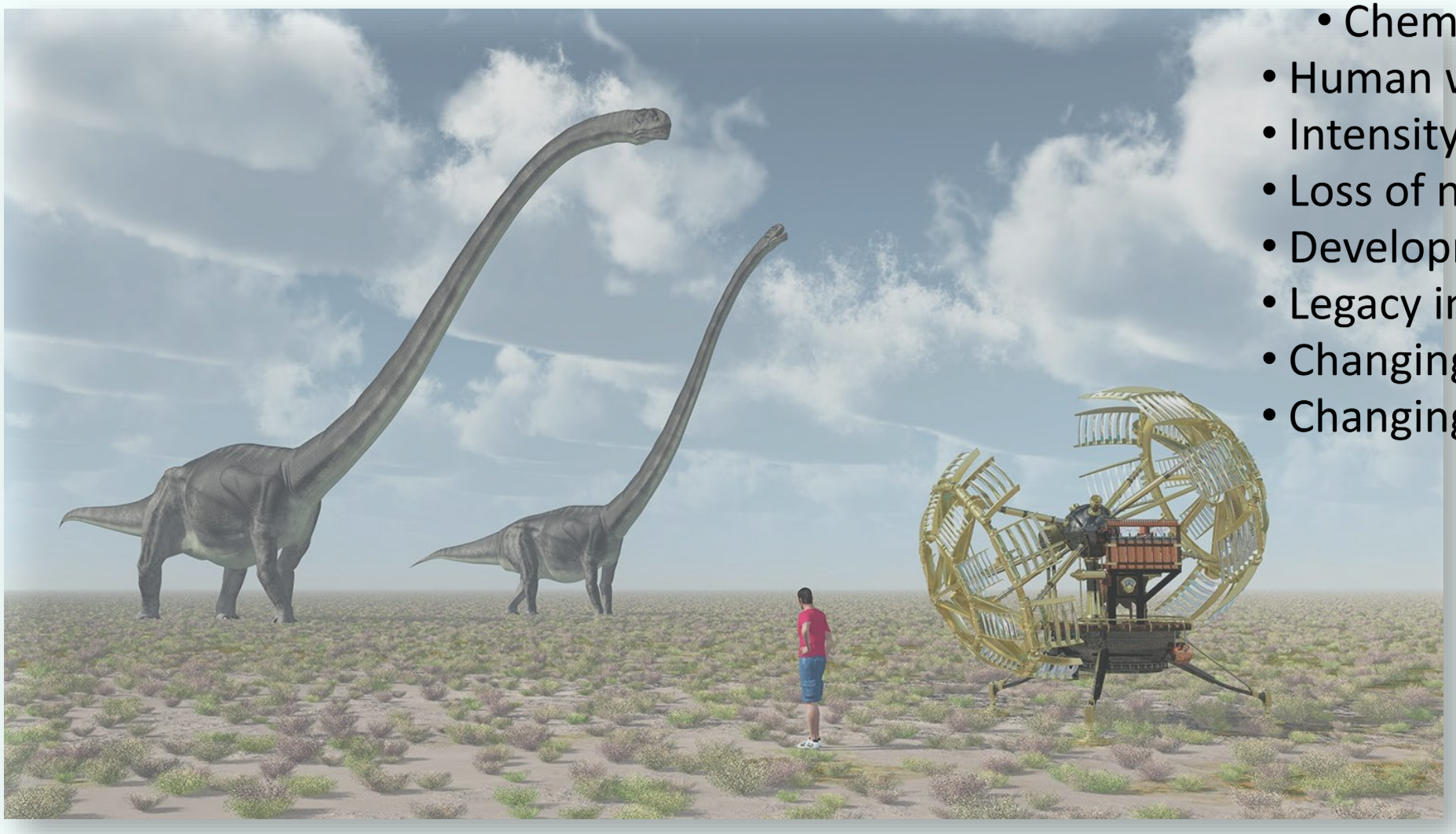






[Partridge Lake Watershed Restoration Plan (nh.gov)]

Stressors push forward time



- Nutrients
- Stormwater
  - Chlorides
  - Sediment
  - Chemicals
- Human waste
- Intensity of use
- Loss of natural buffers
- Development in watershed
- Legacy impacts – deforestation,
- Changing hydrology
- Changing temperatures

Alternative stable states

Differing arrangements of an ecosystem's characteristics maintained through different stabilizing feedbacks with abrupt shifts between.

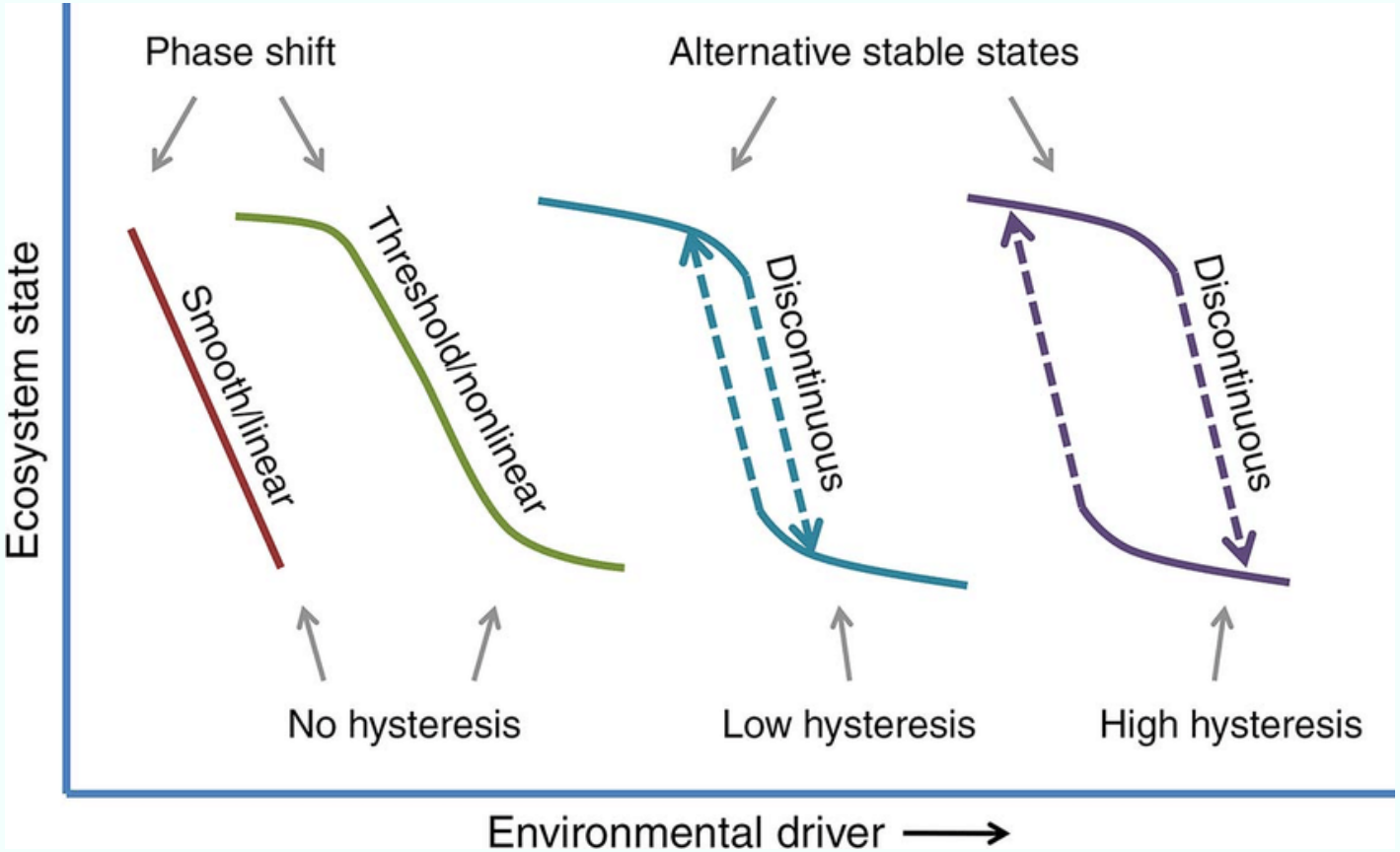
Plant and Soil elibrary [Alternative Stable State Theory and Regime Shifts - passel (unl.edu)]


STOP THE RIDE
I WANT OFF

What is the path forward?

Hysteresis -- (from Greek “deficiency”)

- “the way to reverse a change is different than just reversing what caused the change in the first place”
- you can’t step in the same river twice.



According to the Dictionary of Ted --

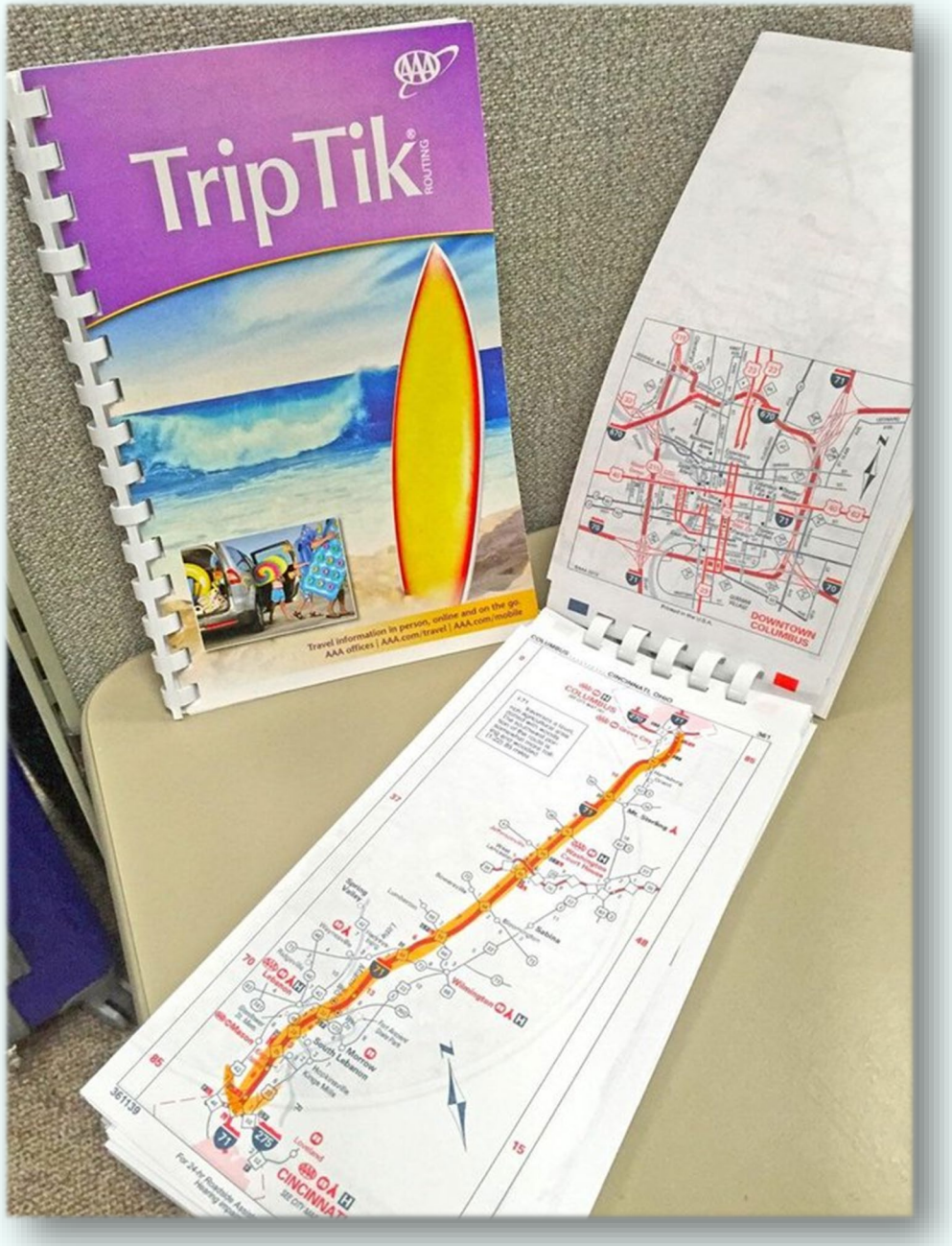
- Resiliency is maximizing the length of time to get to the next steady state.
- Restoration is attempting to mimic natural processes to improve lake conditions.

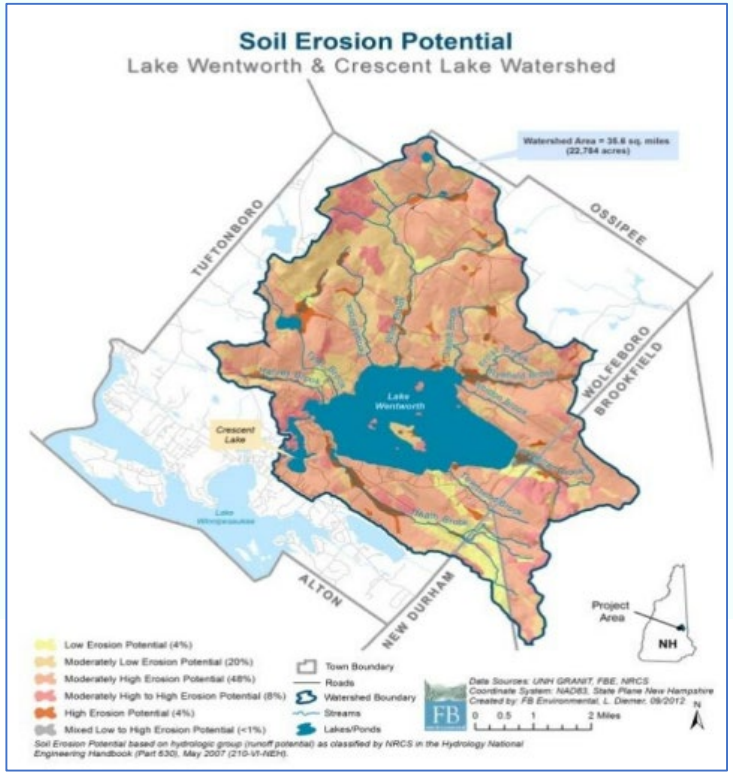
Choose your adventure!

Hazards ahead

Tools to get there

- Consider the Wicked Problem
- Make a plan
- Control what is controllable
- Adapt
- Find your people
- Teach others
- Implement the plan
- Adapt
- Policy – local, state





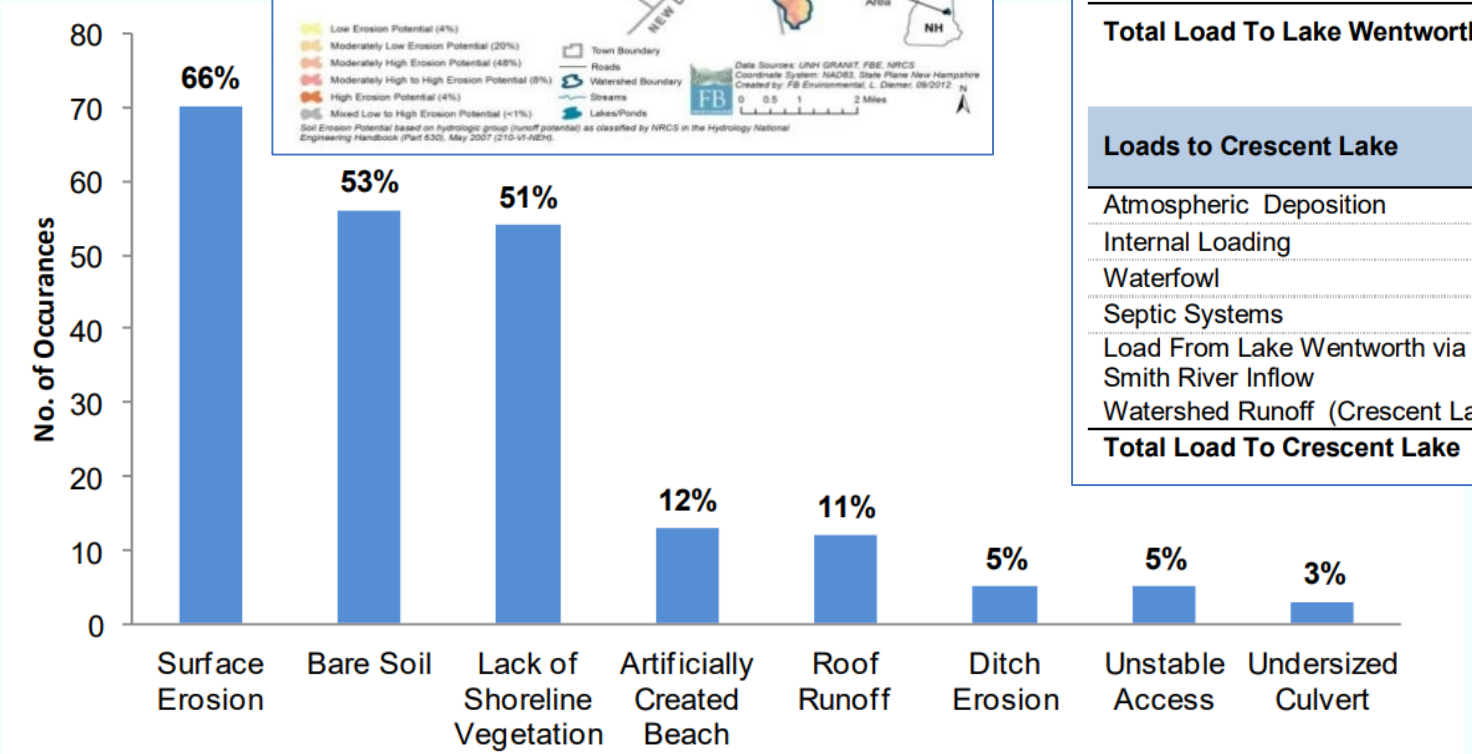


Table 3.8. *Total phosphorus and water loading summary for Lake Wentworth and Crescent Lake.*

Loads to Lake Wentworth	TP (kg/year)	TP (%)	Water (m^3/year)	Water (%)
Atmospheric Deposition	244	25%	7,664,541	14%
Internal Loading	0	0%	NA	NA
Waterfowl	20	2%	NA	NA
Septic Systems	79	8%	67,009	>0.2%
Watershed Runoff	643	65%	46,728,516	86%
Total Load To Lake Wentworth	**986**	**100%**	**54,460,066**	**100%**

Loads to Crescent Lake	TP (kg/year)	TP (%)	Water (m^3/year)	Water (%)
Atmospheric Deposition	12	2%	373,066	1%
Internal Loading	0	0%	0	0%
Waterfowl	4	1%	0	0%
Septic Systems	13	3%	11,185	0%
Load From Lake Wentworth via Smith River Inflow	365	71%	54,461,988	96%
Watershed Runoff (Crescent Lake)	124	24%	1,903,818	3%
Total Load To Crescent Lake	**517**	**100%**	**56,750,056**	**100%**

Source: Lake Wentworth and Crescent Lake Watershed Management Plan, 12/12.

Site 9: South Shore Road

Site Description

- The majority of South Shore Road directly abuts Partridge Lake at a near vertical slope.
- Various trees along the slope aid in the structural integrity of the slope itself.
- Many exposed tree roots were observed due to loss in slope material due to erosion.
- The edge of South Shore Road is approximately 3 feet to 5 feet above the water line.

Proposed Improvements

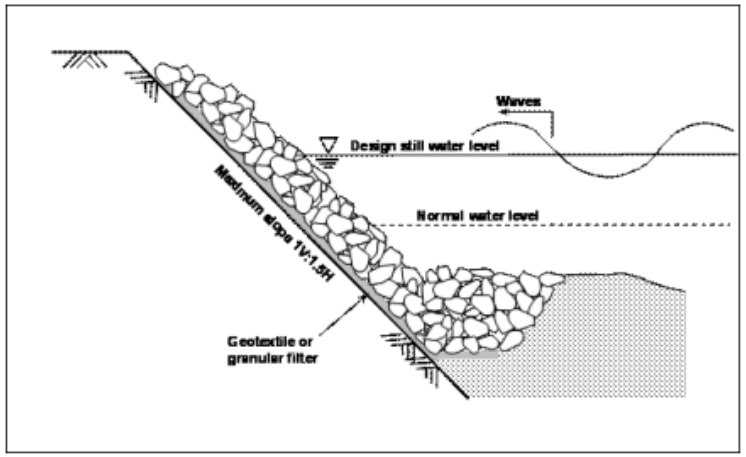
- Add fill to build back slope and stabilize tree roots.
- Install shoreline restoration and protection measures along South Shore Road to lower the chance of a washout.
- A stone retaining wall is recommended in areas where slope is greater than 1V : 1.5H.
- Riprap slopes are recommended in areas where slopes are less than 1V : 1.5H. Where possible, erosion control fabric and biostabilization techniques (e.g., live stakes and live fascines) should be used to further stabilize the slope.
- Install plantings along areas with limited vegetation.

Estimated Cost: **$137,000**

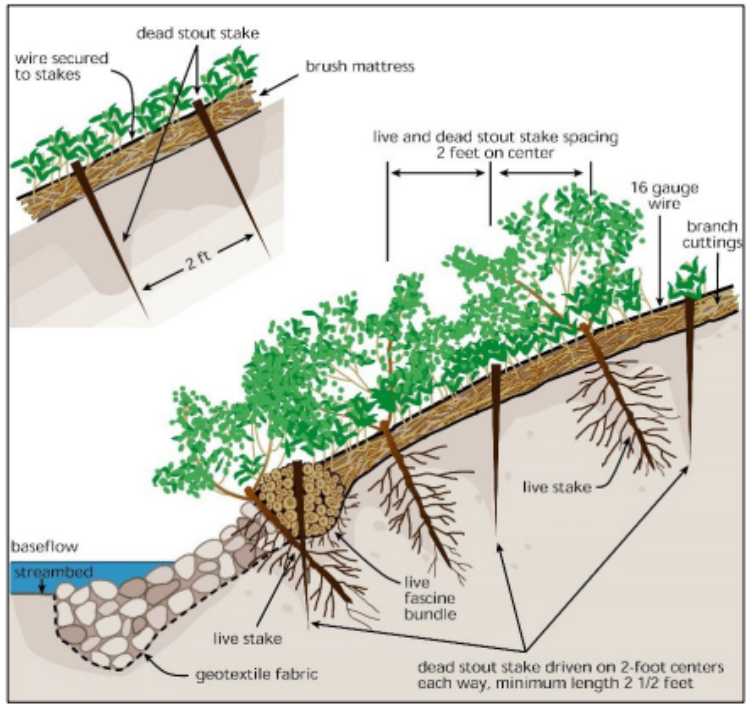
**See Appendix 3 for detailed breakdown*

Estimated Pollutant Reductions

- Total Phosphorus: **2.2 lb/yr**
- Total Nitrogen: **4.3 lb/yr**
- Total Suspended Solids: **5200 lb/yr**



Source: Federal Highway Administration



Slope Stabilization with Toe Protection

Source: Stream Corridor Restoration: Principles, Processes and Practices, 1998, Federal Interagency Stream Restoration Working Group.

GENERAL NOTES

No. | Revision/Issue | Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
21 Depot Street, Merrimack, NH 03054

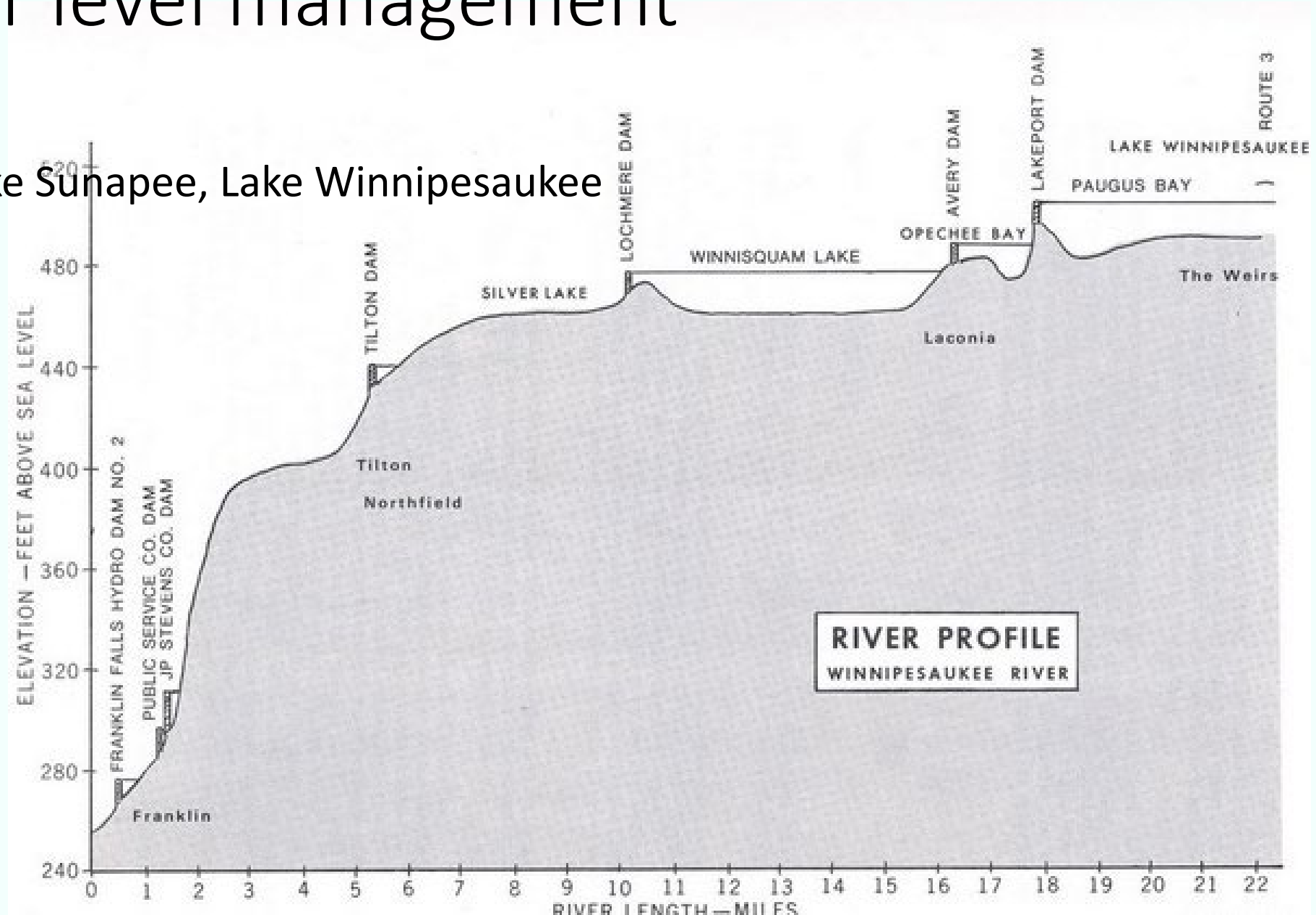
Site 9

Project No.: 366-01
Date: July 2021
Drawn By: NP
Checked By: NC
Scale: As Shown
Sheet: C-18

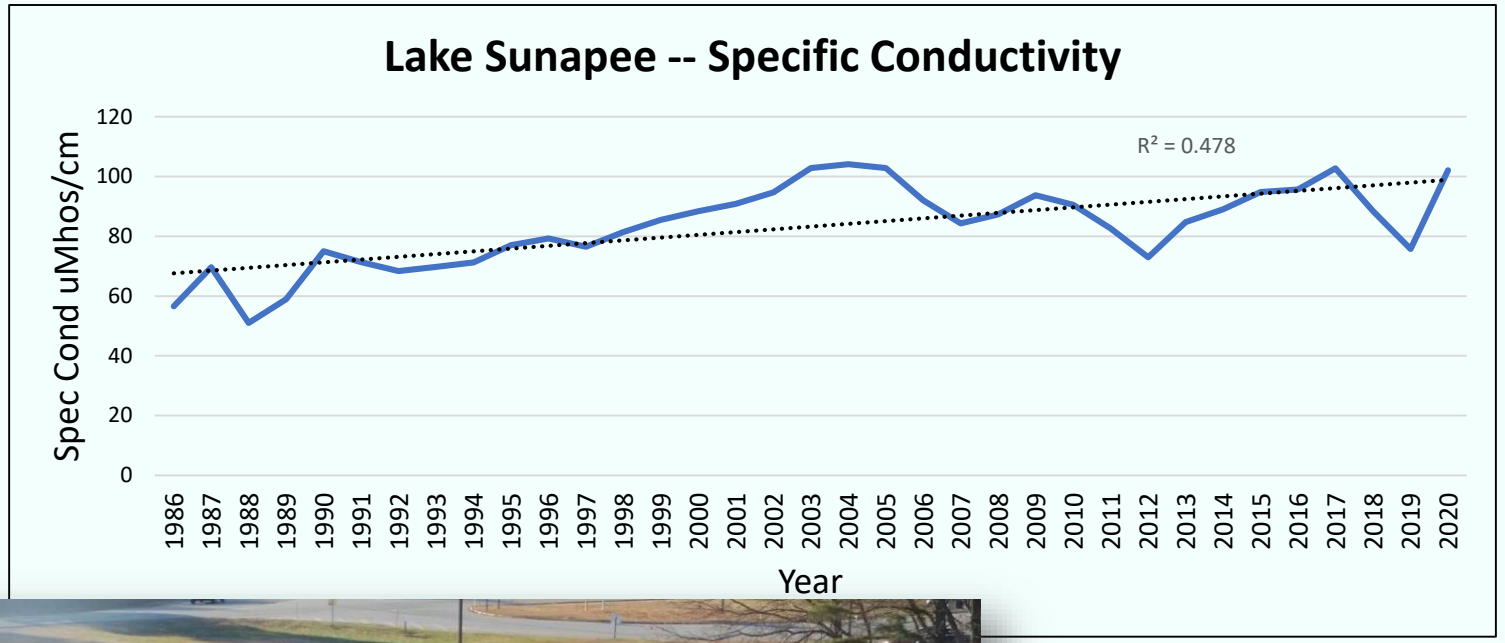
Role of water level management

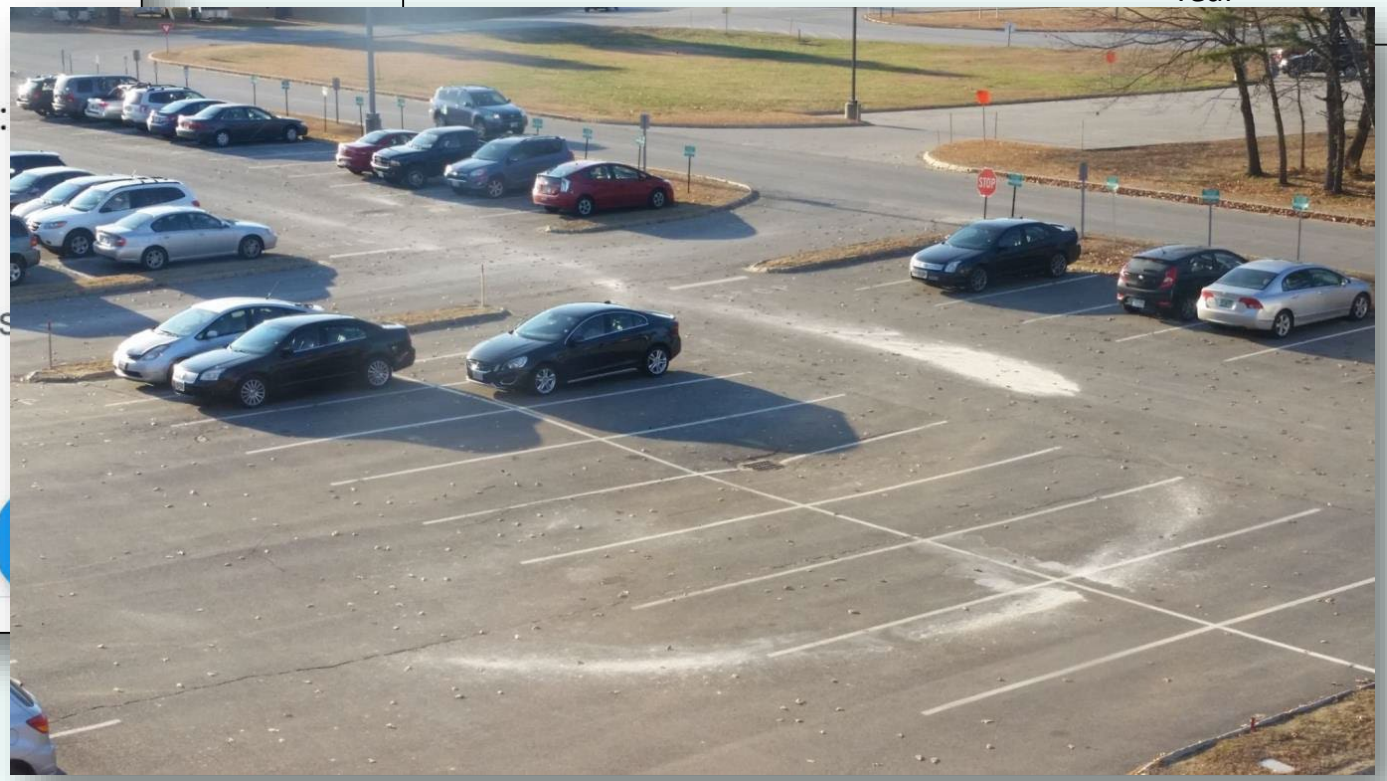
The Balancing Act

- Lake Ossipee, Lake Sunapee, Lake Winnipesaukee




92% 9:19 AM
Follow
salt shaming
@SaltShaming
Salt = bad for lakes. Let's stop overusing road salt. Opinions are my own. cover:
johnchammond.com
Joined November 2019
40 Following 104 Followers
Not followed by anyone you're following
Tweets
Tweets & replies

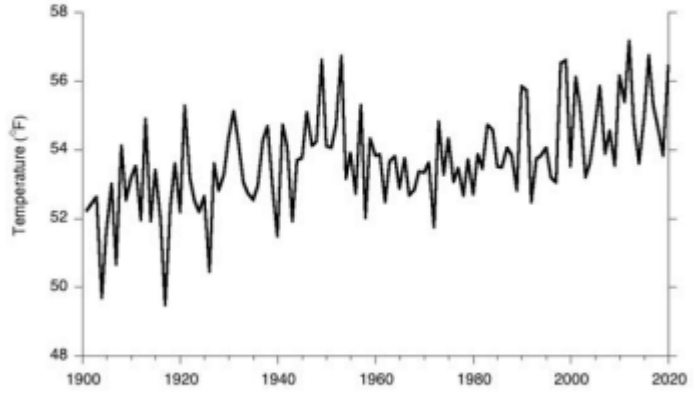

Lake Sunapee -- Specific Conductivity
Spec Cond uMhos/cm
120
100
80
60
40
20
0
R² = 0.478
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
Year



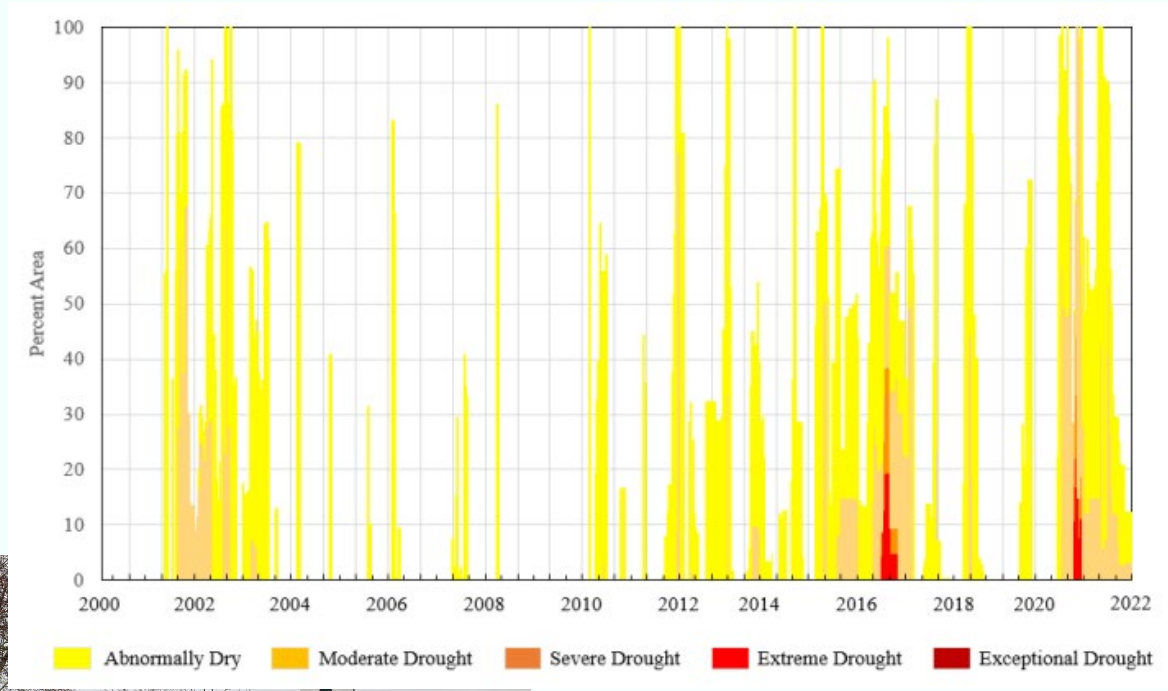
Climate assessment

Figure 2. New Hampshire Annual Maximum Temperature, 1901-2020

Trends are estimated using Sen's slope; statistically significant trends ($p \leq 0.05$) are highlighted in **bold and are underlined**.



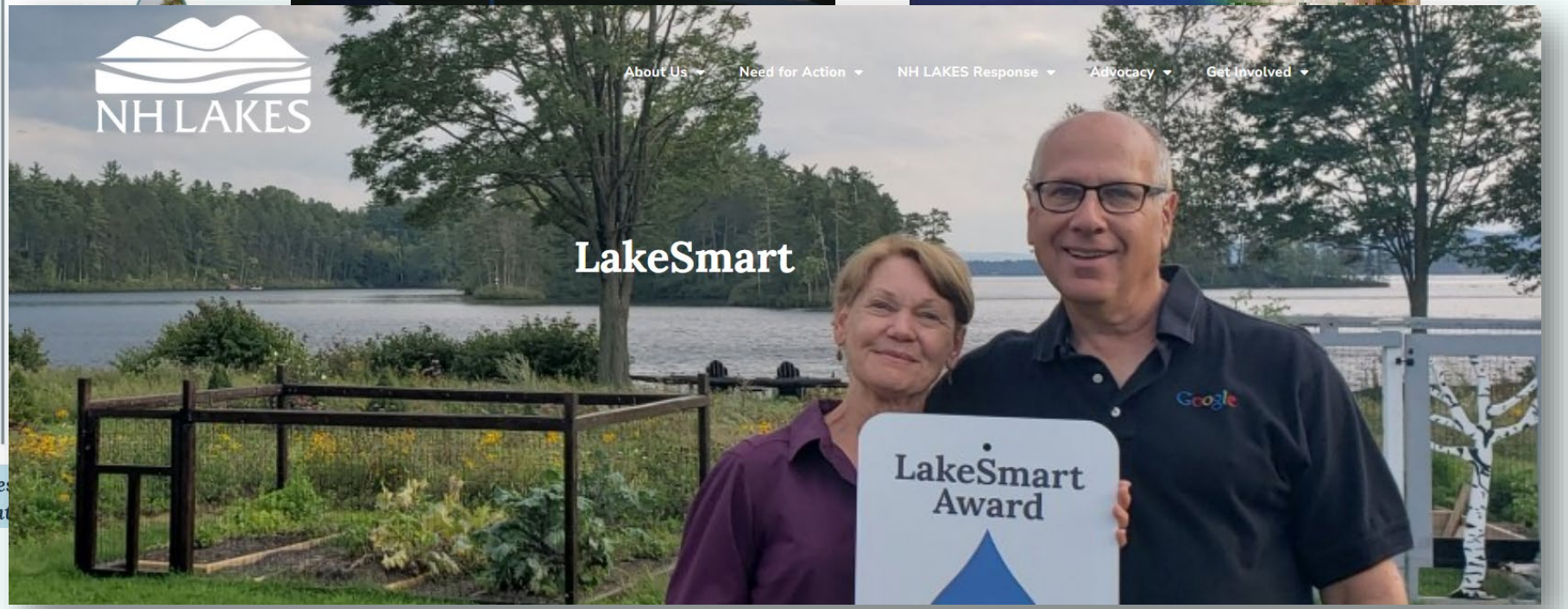
1901–2020: **0.19**°F per decade
1971–2020: **0.39**°F per decade



Lemcke-Stampone, Mary D.; Wake, Cameron P.; and Burakowski, Elizabeth, "New Hampshire Climate Assessment 2021" (2022). The Sustainability Institute. 71. https://scholars.unh.edu/sustainability/71

Upstream has climate, too.

Don’t reinvent the wheel!



In-lake management

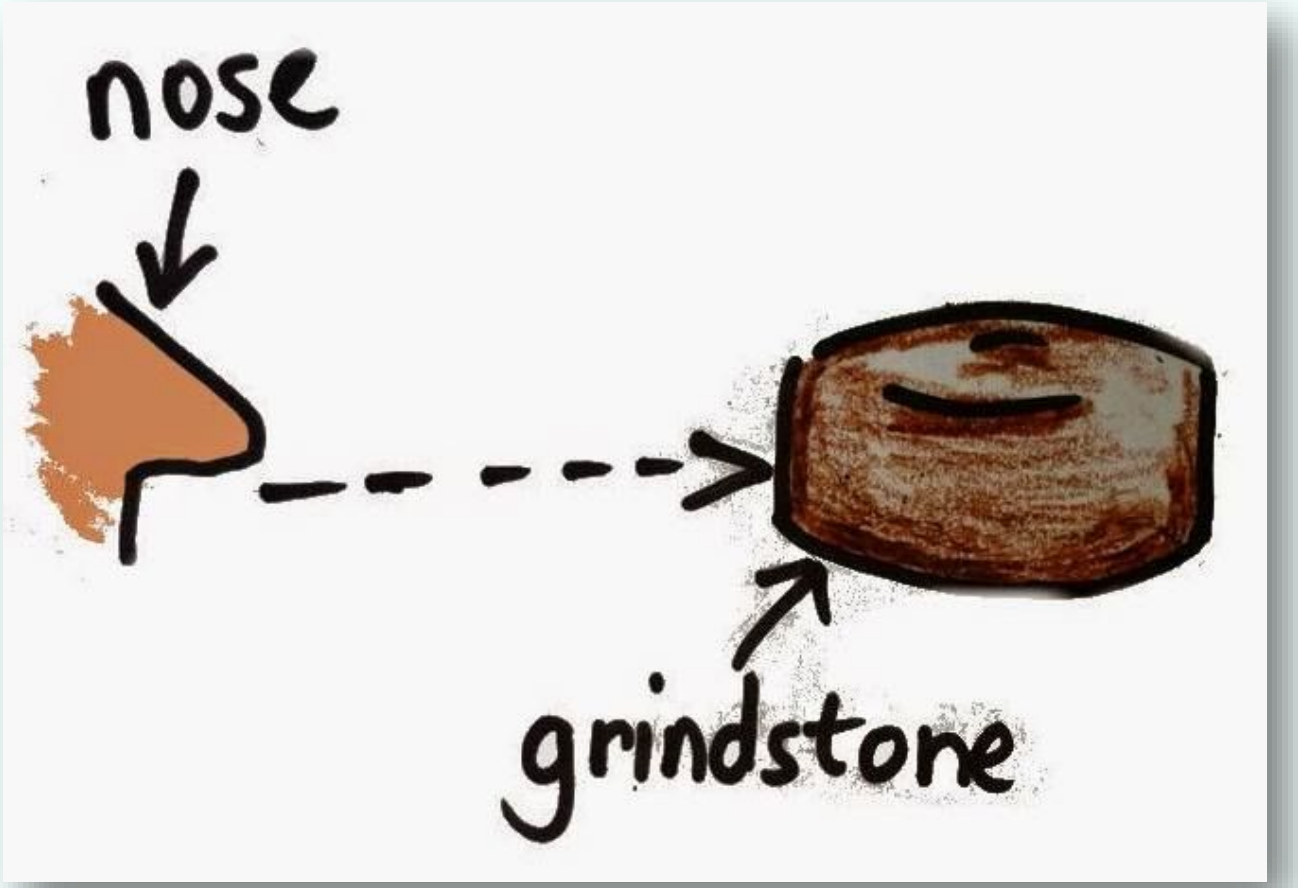
- Last resort
- Rare circumstances
- Expensive
- Control external loads

Beware fairy dust!

Source: Winnipesaukee Forum, ITD

Adaptive management = no quick fix

- Monitoring
- Planning
- Measuring
- Evaluating
- Informing
- Coalition building
- Lather, rinse, repeat



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Culture \ ˈkəl-chər \ -- the integrated pattern of human knowledge, belief, and behavior that depends upon the capacity for learning and transmitting knowledge to succeeding generations

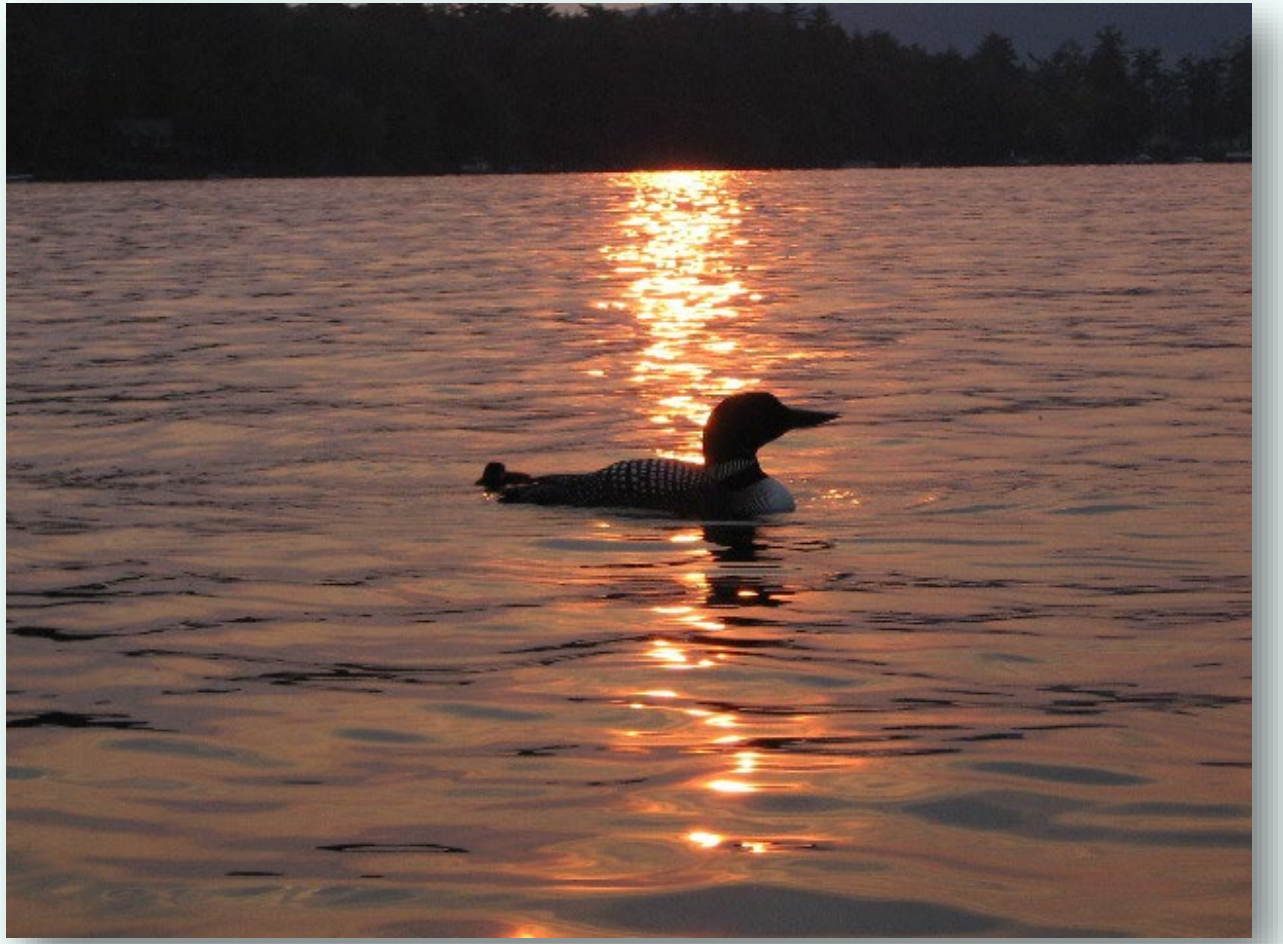
“Where grows? – where grows it not? If vain our toil,
We ought to blame the culture, not the soil.”

-- Alexander Pope

I dream of a world in which …

Best Management Practices are just practices!

We have a choice.



We can have resilient lakes, or ….

We can have human resilience in an altered steady state environment

Enjoy the Congress!!

Contact me anytime

- Ted Diers
- 603-271-2951
- Ted.diers@des.nh.gov