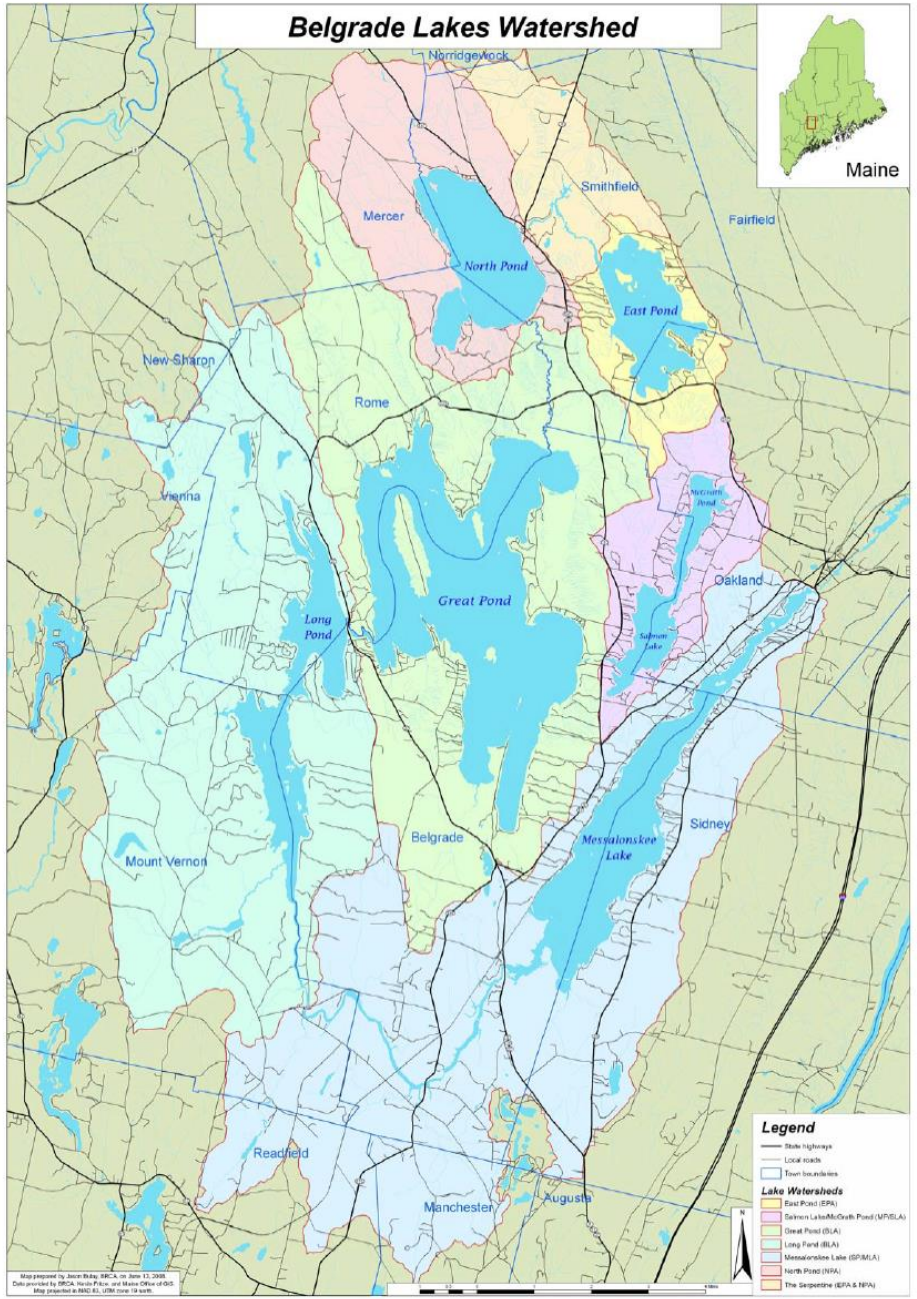
Presentation to Rome WQ Committee

- Peter L. Kallin, Ph.D.
- April 11, 2022



Watershed ~180 sq miles
Portions of 13 municipalities
Portions of 3 counties

7 LAKES ALLIANCE
Ensuring Our Future

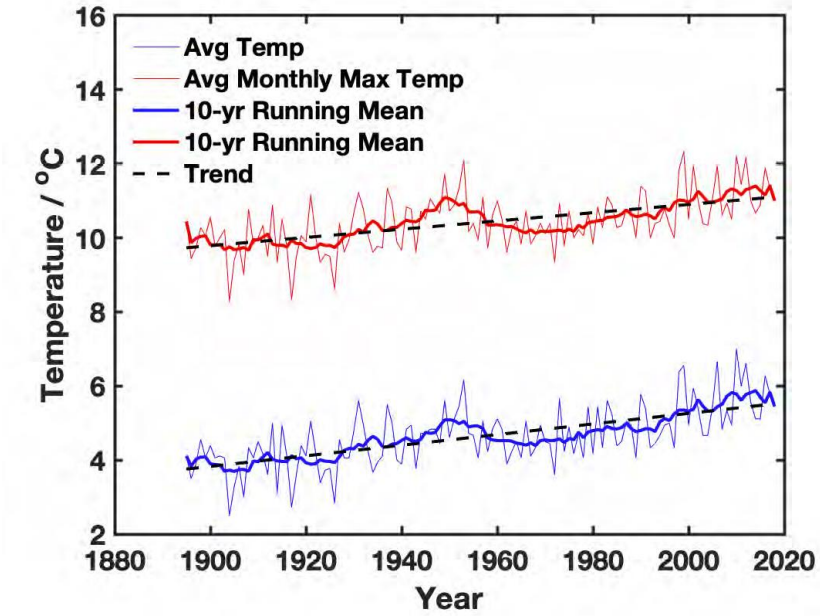
What did 7 Lakes do with Rome $ Last Year?

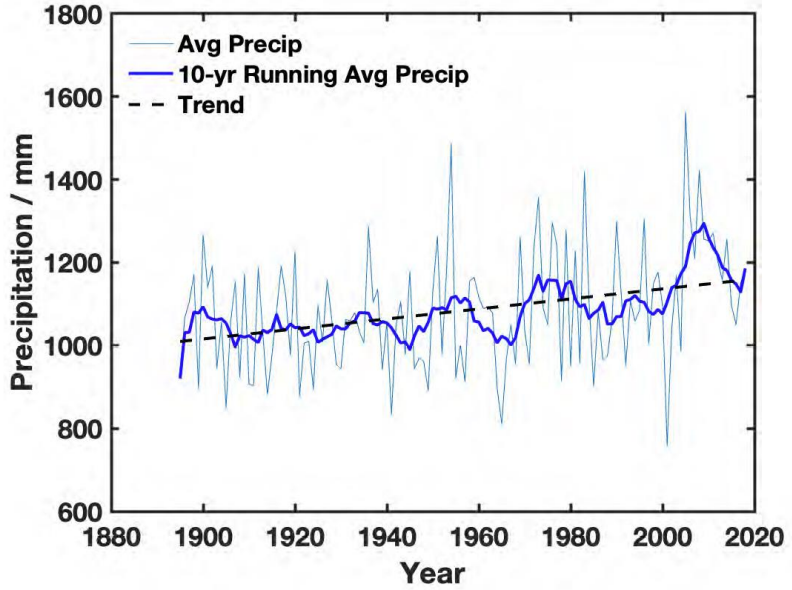
- 7 Lakes received $8000 for our Youth Conservation Corps
  - YCC is largest in Maine-Employed about 21 youth and installed 132 BMPs across the watershed, protecting our lakes and learning job skills
- Specifically in Rome:
  - YCC completed 17 projects, installing 26 BMPs
    - 8 projects on Great Pond
    - 9 projects on Long Pond (incl. Watson Pond)
    - Total Project Value **$60,432.33**

Overview

- Water Quality Basics
  - Physical properties of water
  - Watershed land use drives water quality
- Climate Impacts
  - Increased major precipitation events
    - More erosion
    - More nutrient loading
  - Increased water temperatures
    - Earlier ice out, later ice in
    - Stronger stratification, hypolimnetic anoxia (< 2 mg/l)
    - Increased risk of harmful algal blooms (HABs)
  - Some lakes more susceptible to impacts than others
- Overview of recent and ongoing Watershed Management Plans

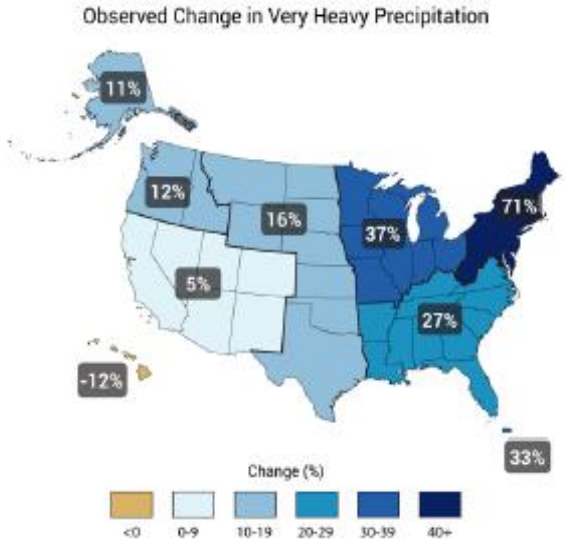
Climate Change in Maine (Data below from NOAA)





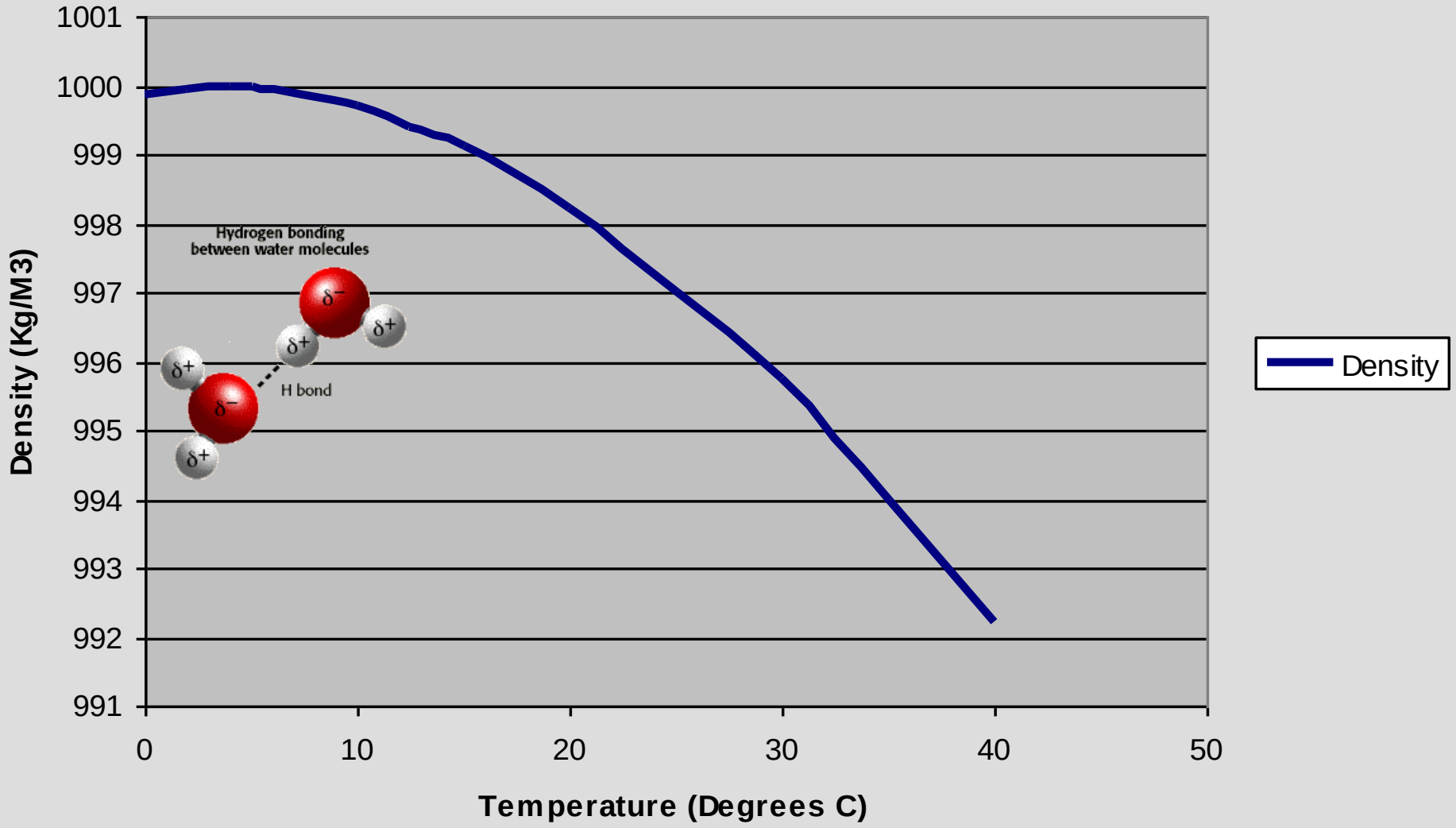
Increasing temperatures: Stronger and longer stratification in lakes

Increasing precipitation:
More runoff of nutrients from the watershed

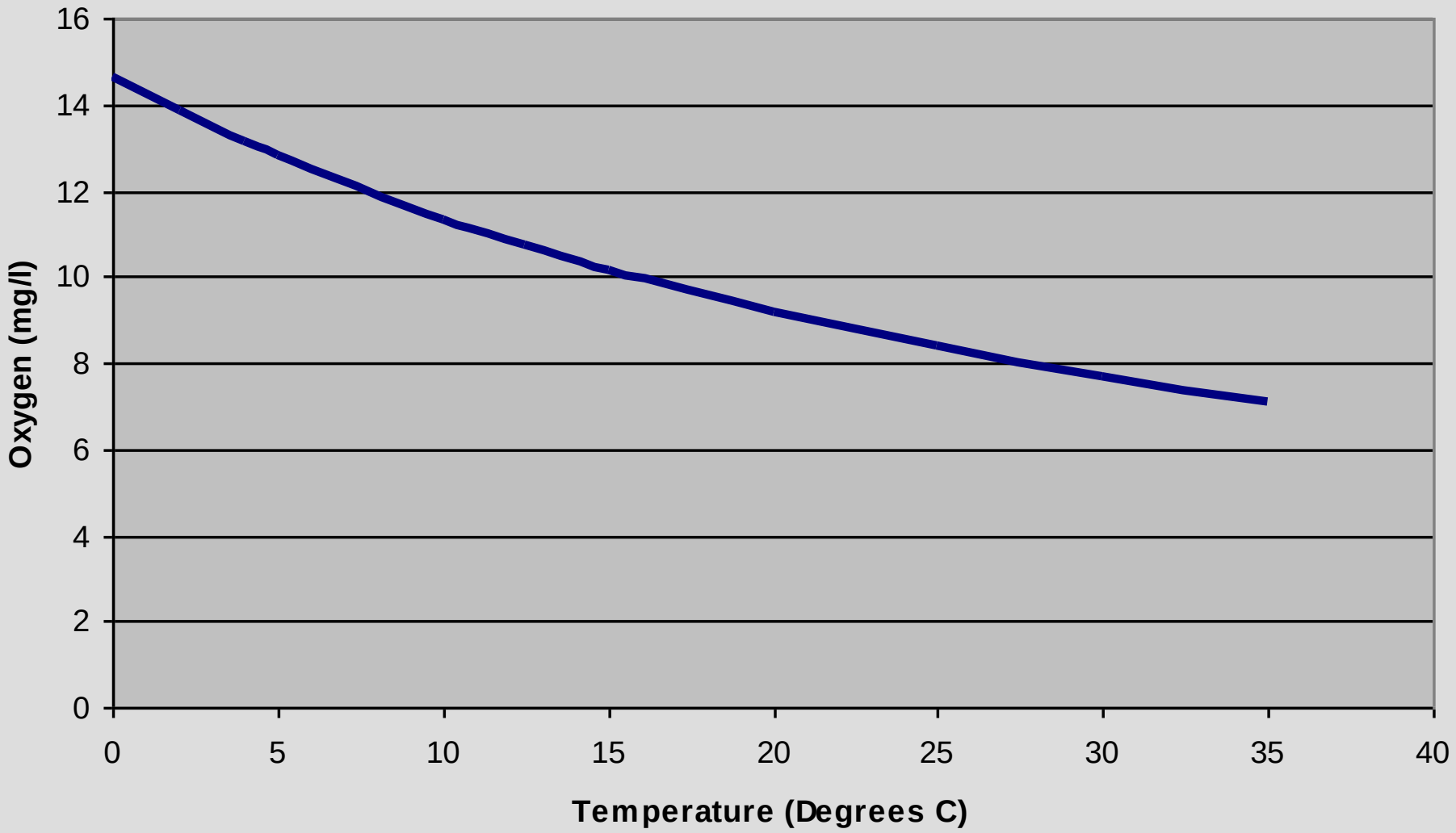


National Climate Assessment, 2014 showing percent increases in heavy precipitation events between 1958 and 2012 by region. (Figure updated from Karl et al, 2009)

Density of Fresh Water



Saturated Dissolved Oxygen



The Seasonal Cycle of Lake Stratification

Early Spring (just after ice melt): Lake saturated with oxygen

“Spring Turnover”

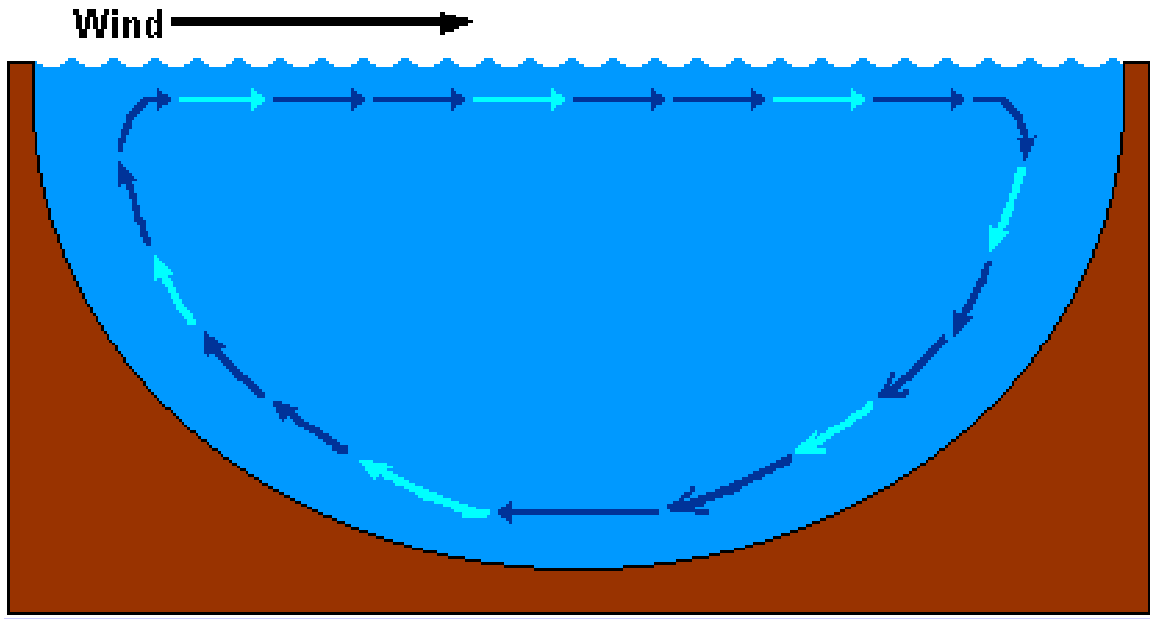
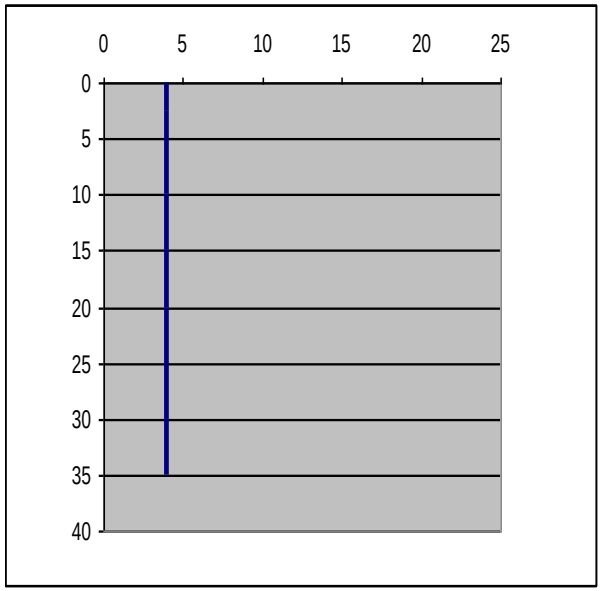
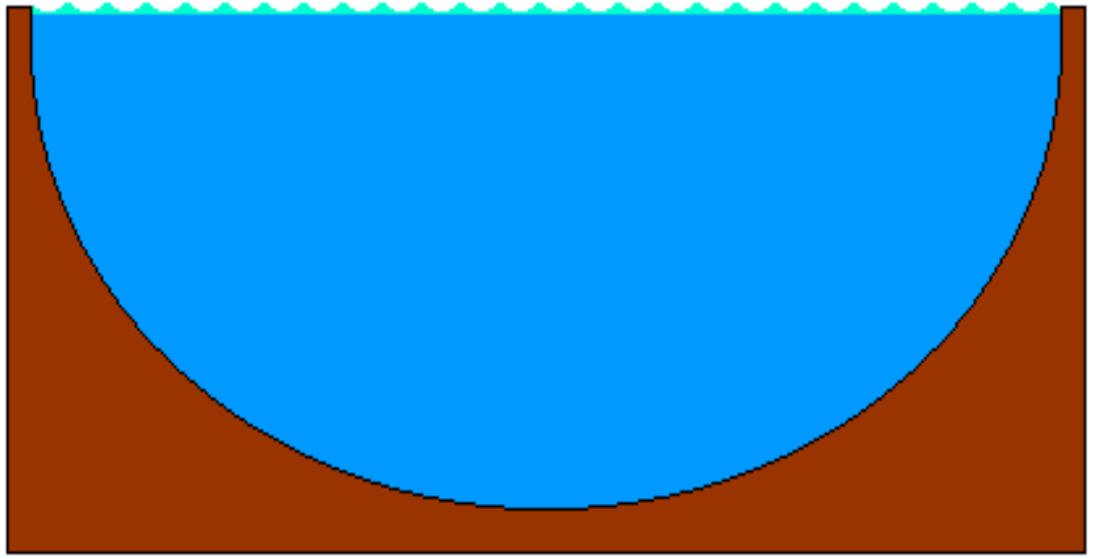


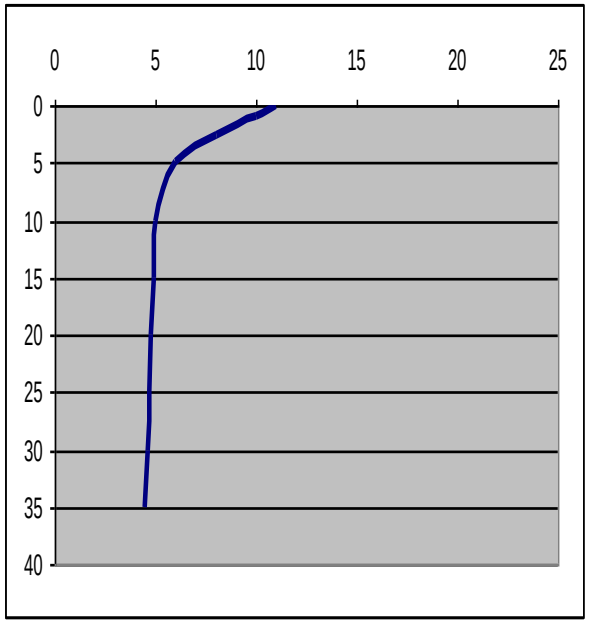
Figure 1 Complete mixing of water can occur when all water within the lake is generally the same temperature. Wind helps to drive this process.



Temperature (C) vs Depth (M)

Approaching summer





Temperature (C) vs Depth (M)

Figure 2 As summer approaches, the surface of the lake begins to get warmer. This creates a relatively warm surface layer over a relatively cool bottom layer. They are separated by a zone that changes temperature very rapidly with depth.

Summer stratification: No replenishment of oxygen to hypolimnion

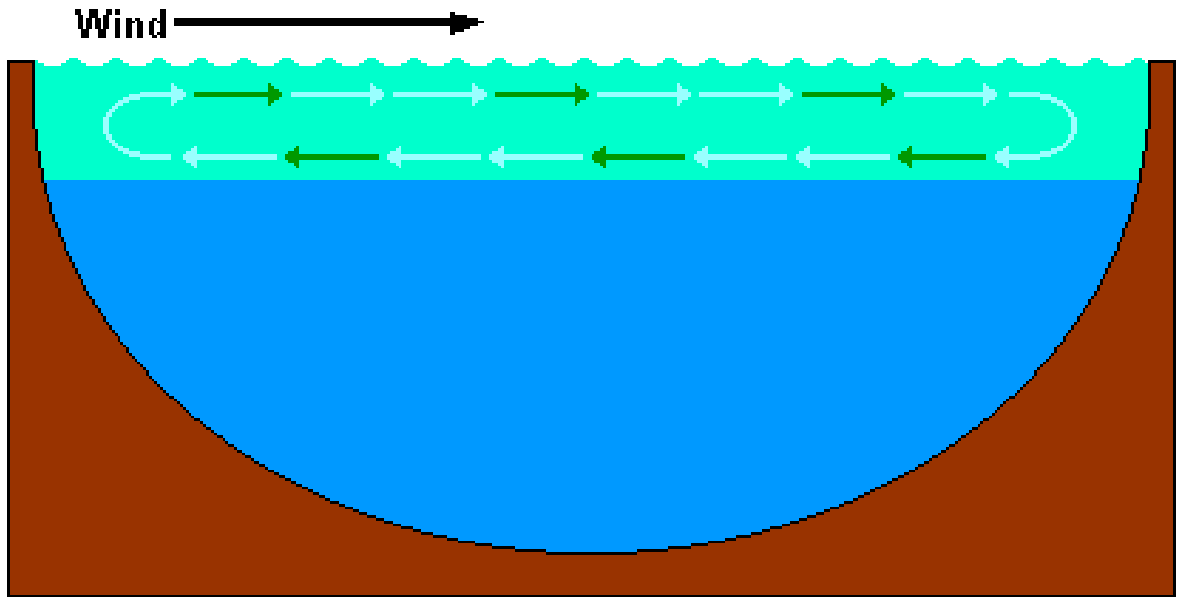
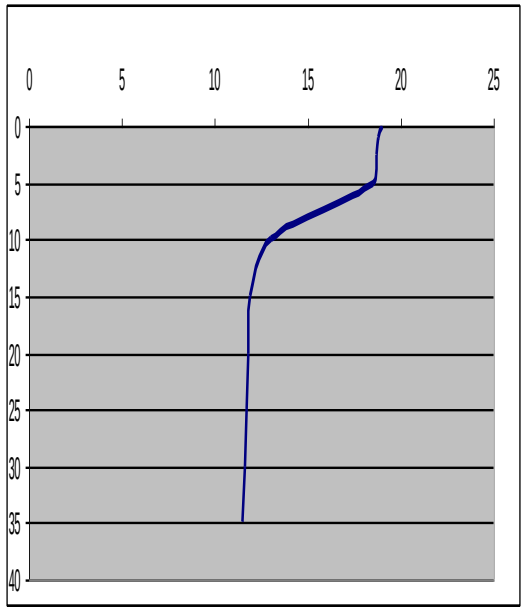
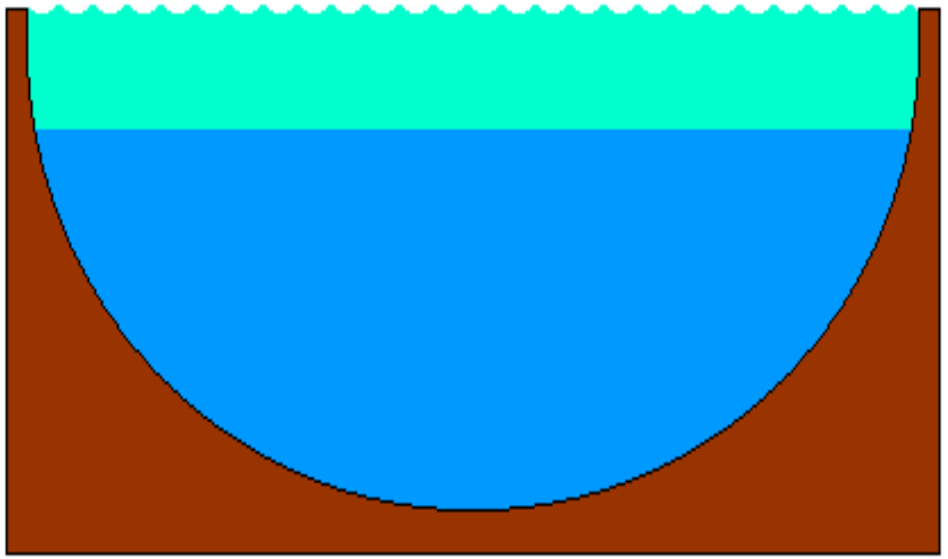


Figure 3 During summer density differences act as a barrier to complete mixing of the lake. This deprives the lake bottom of oxygen.

Temperature (C) vs Depth (M)



Dead organic matter sinks from the epilimnion to the hypolimnion.
The decay of this organic matter leads to O2 depletion of the hypolimnion.



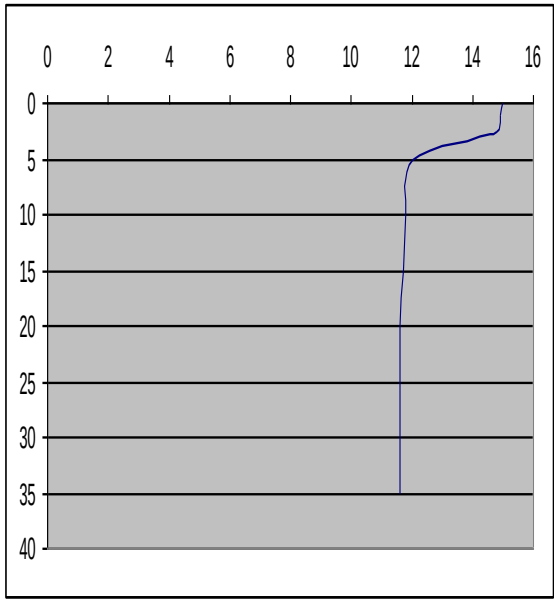


Figure 4 As seasonal temperatures decrease, so does the depth of the warm water layer known as the epilimnion. Conversely, the cold layer known as the hypolimnion increases in thickness.

“Fall Turnover”: Lake mixes and cools, replenishes oxygen

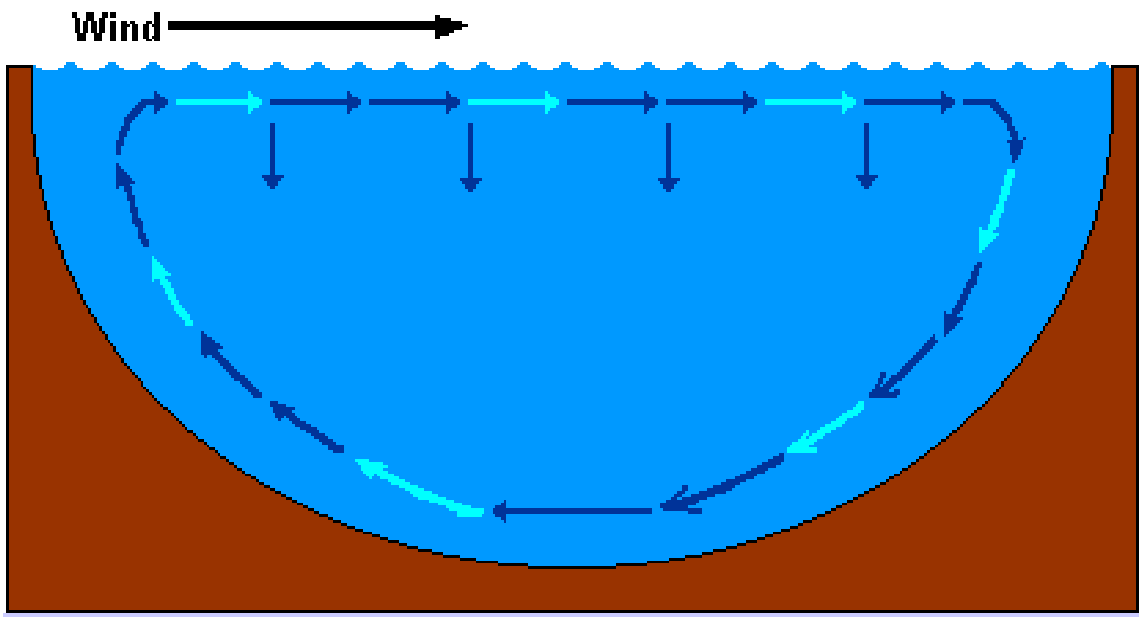
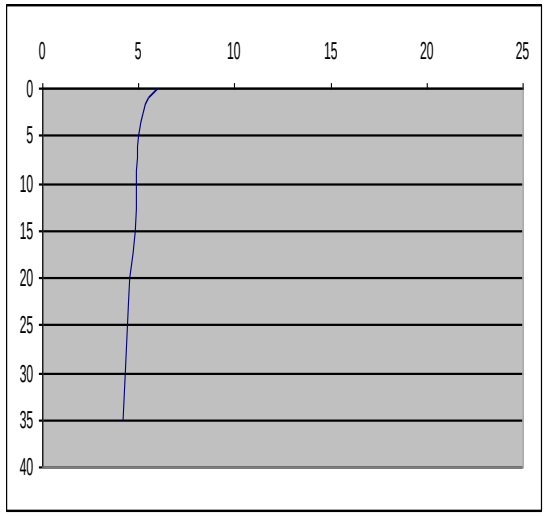


Figure 5 Complete mixing of water can occur when all water within the lake is generally the same temperature. In addition, the atmosphere cools the water at the lake's surface. This dense water sinks to the bottom and further contributes to lake mixing.

Temperature (C) vs Depth (M)



Ice cover: no replenishment of oxygen

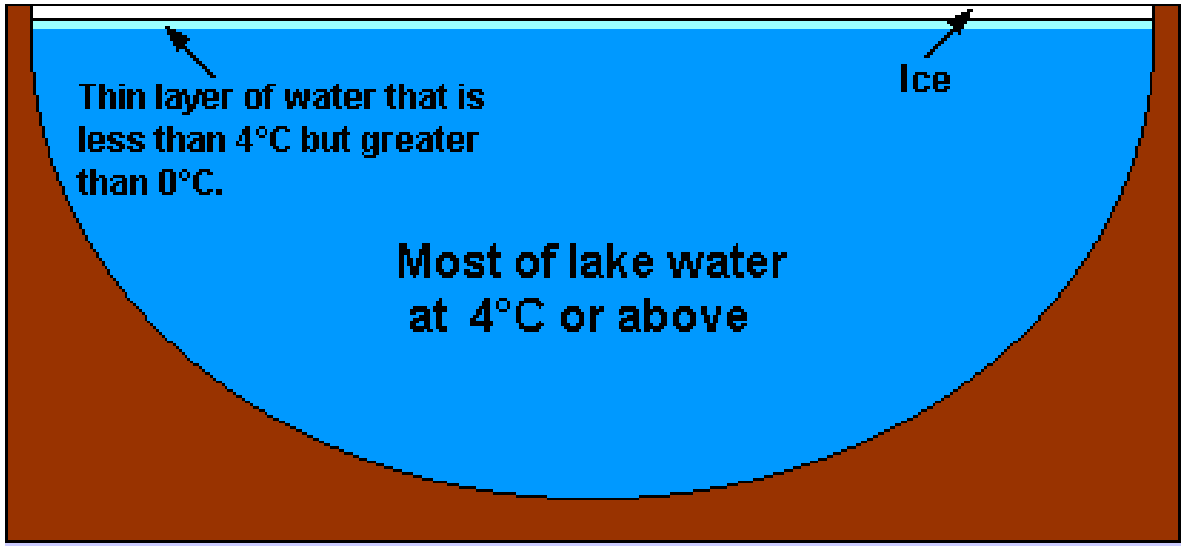
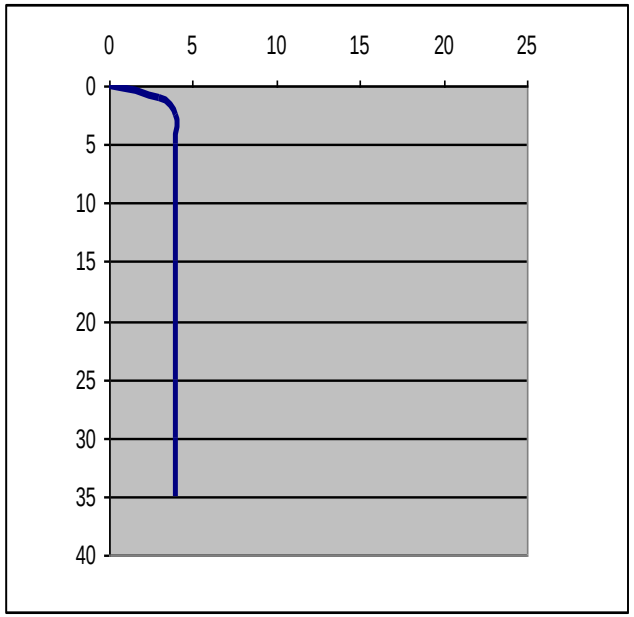
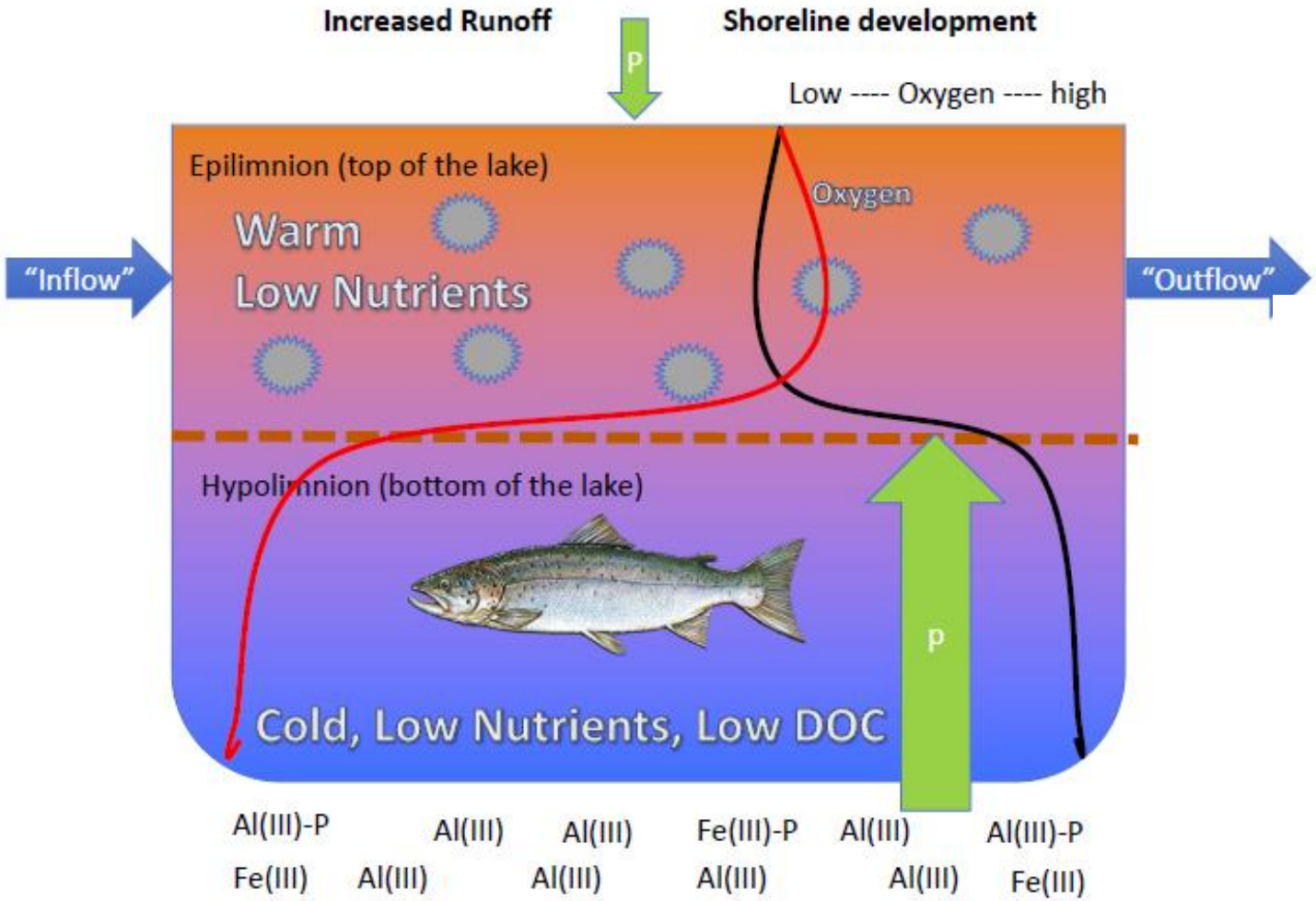


Figure 6 During the winter, ice prevents lake water mixing. Stratification can occur during this time of winter stagnation.

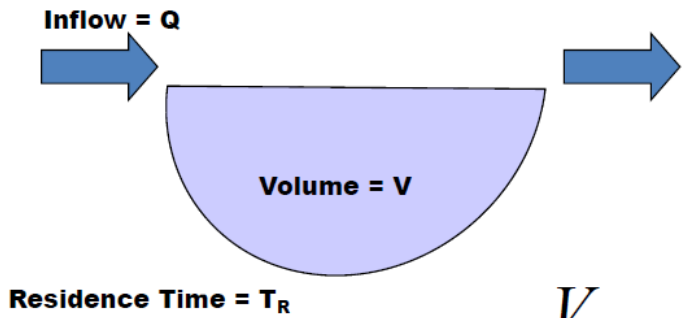
Temperature (C) vs Depth (M)



Lake Feedbacks

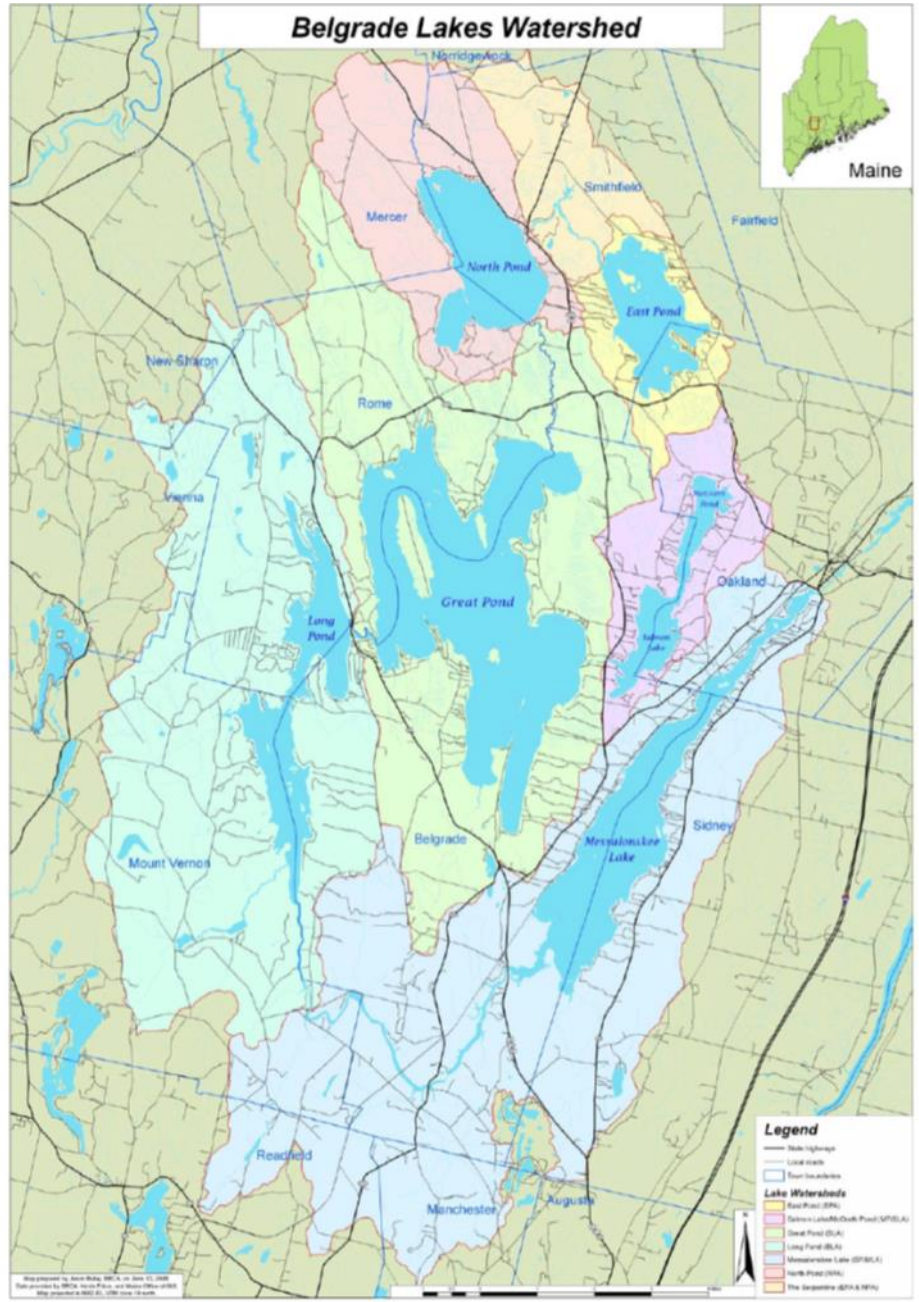


Concept of Residence Time



$$T_R = \frac{V}{Q}$$

Lake	Residence Time (yrs)
East Pond	4.00
North Pond	0.74
Great Pond	1.89
Long Pond South Basin	0.28
Long Pond North Basin	0.36
Salmon-McGrath	1.69
Messalonskee	0.63

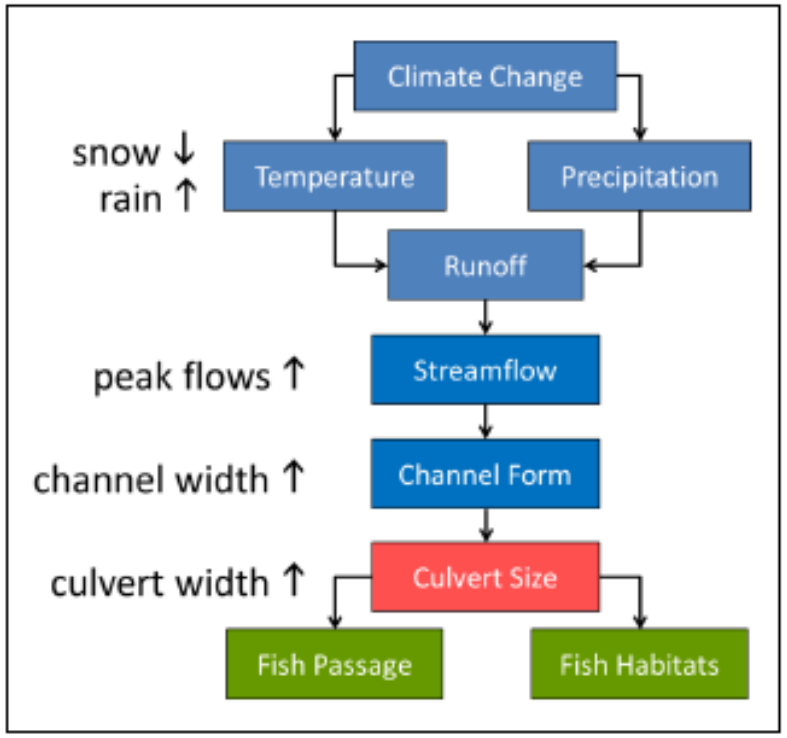

Belgrade Lakes Watershed
Maine
Norridgewock
Smithfield
Mercer
Fairfield
North Pond
East Pond
New Sharon
Rome
Vienna
Great Pond
Long Pond
Oakland
Belgrade
Mount Vernon
Messalonskee Lake
Sidney
Readfield
Manchester
Augusta
Legend
Lake Watersheds

Climate Issues

- Changes in precipitation
  - Decreasing pH , more frequent intense storms, increased dissolved organic carbon (DOC), flood events, higher stormwater flows and sediment loading
- Ice in-Ice out, warming temperatures
  - Longer growing season, longer stronger stratification, hypolimnetic anoxia, decreased coldwater refugia for salmonids, enhanced likelihood of internal loading, cyanobacteria, invasive species

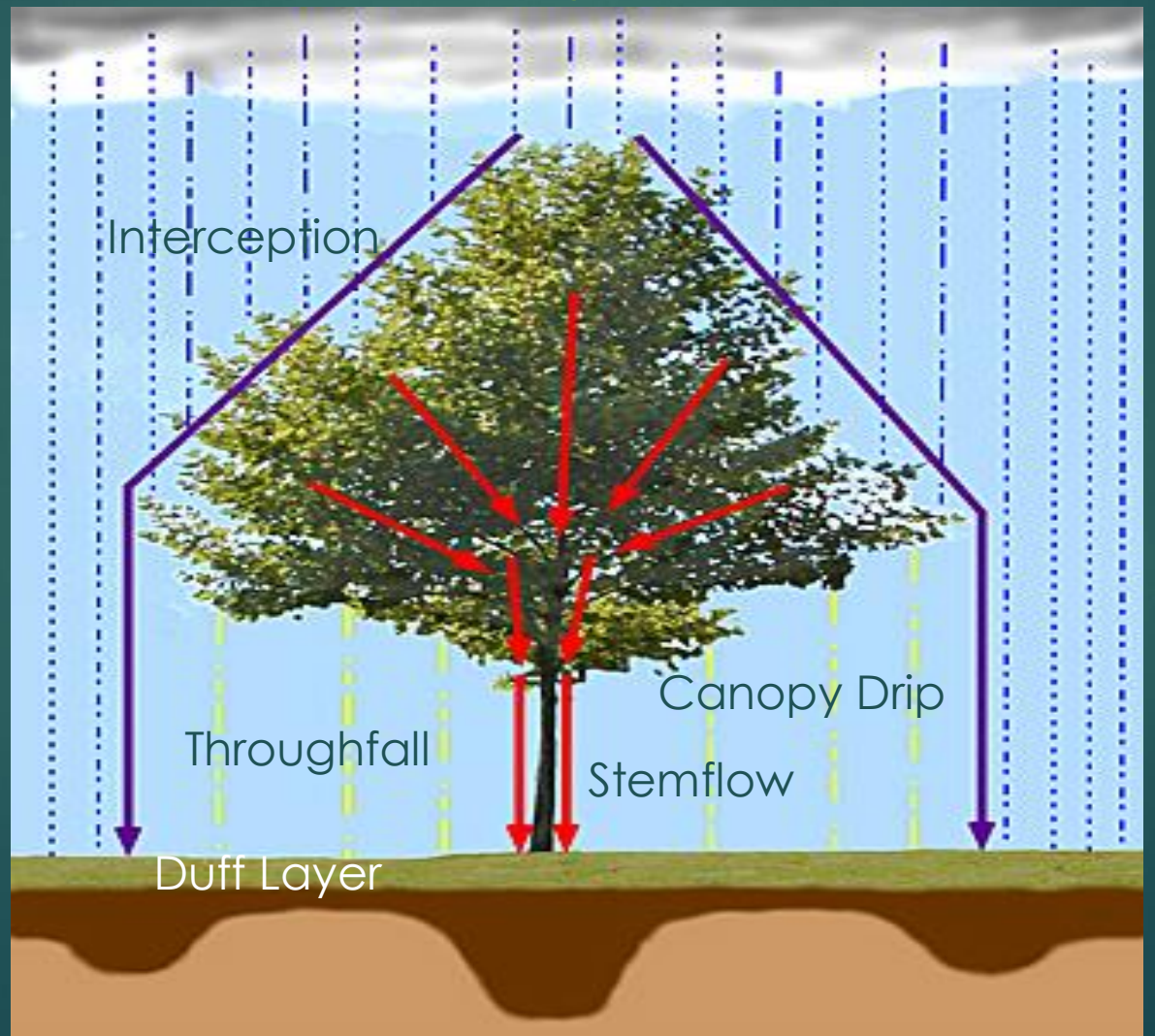
Coping with Increased Stormwater Runoff

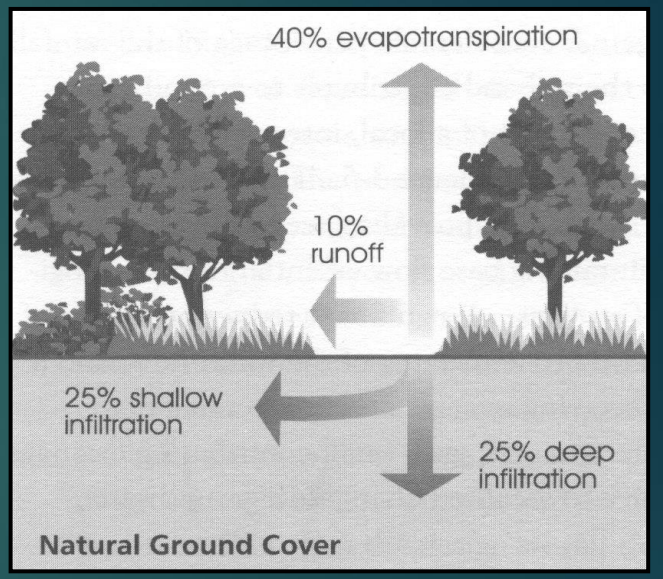
- Need bigger, wider culverts
- Fish passage!
- Need wider, more biodiverse riparian buffers
- More emphasis on slowing, spreading overland flows, avoiding concentration
- Minimize impervious surfaces
- Infiltration BMPs
- More vegetation
- Conserving forest lands in lake watersheds
- Green Infrastructure

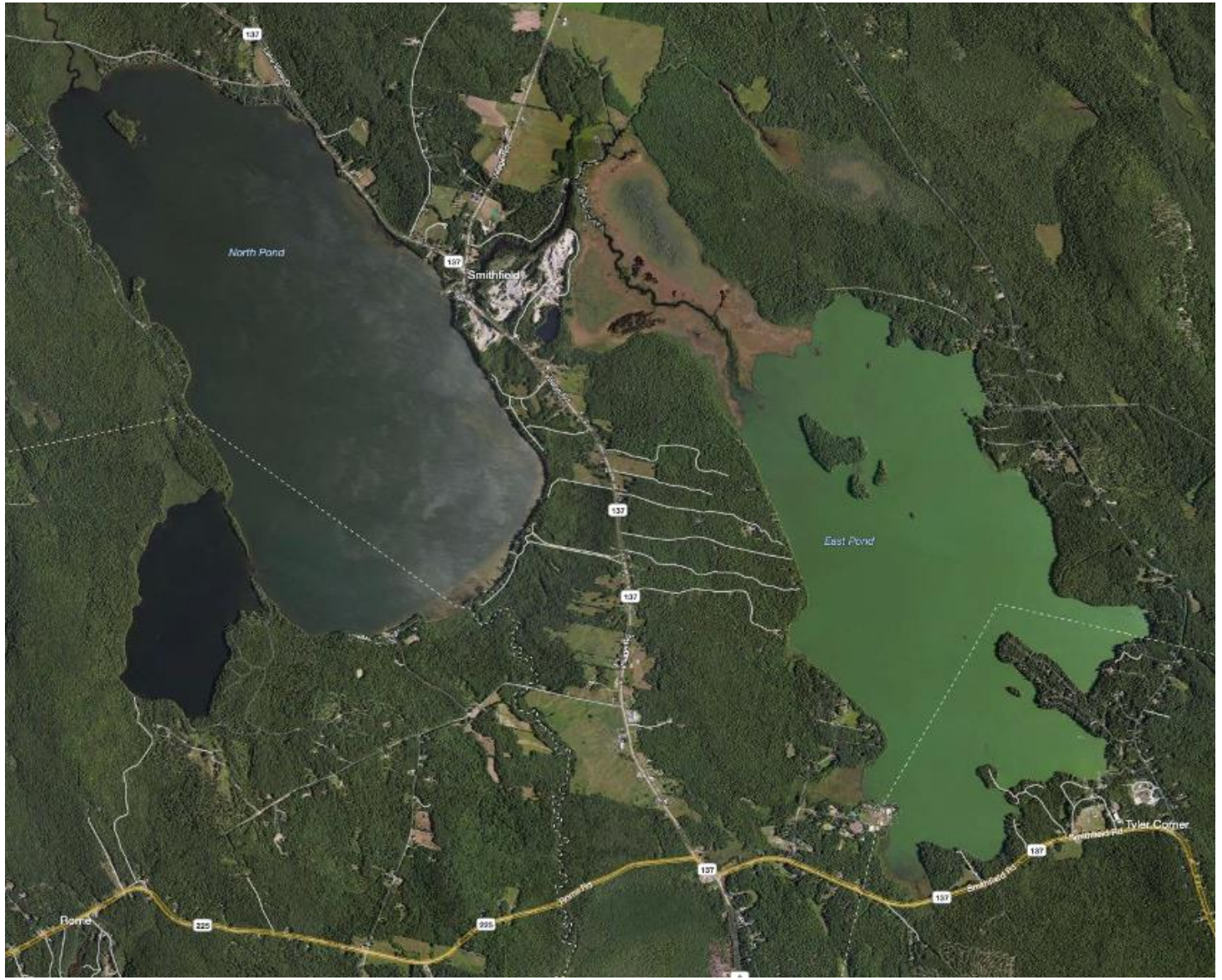


Transpiring Recyclable Energy Efficient Stormwater System

TREES



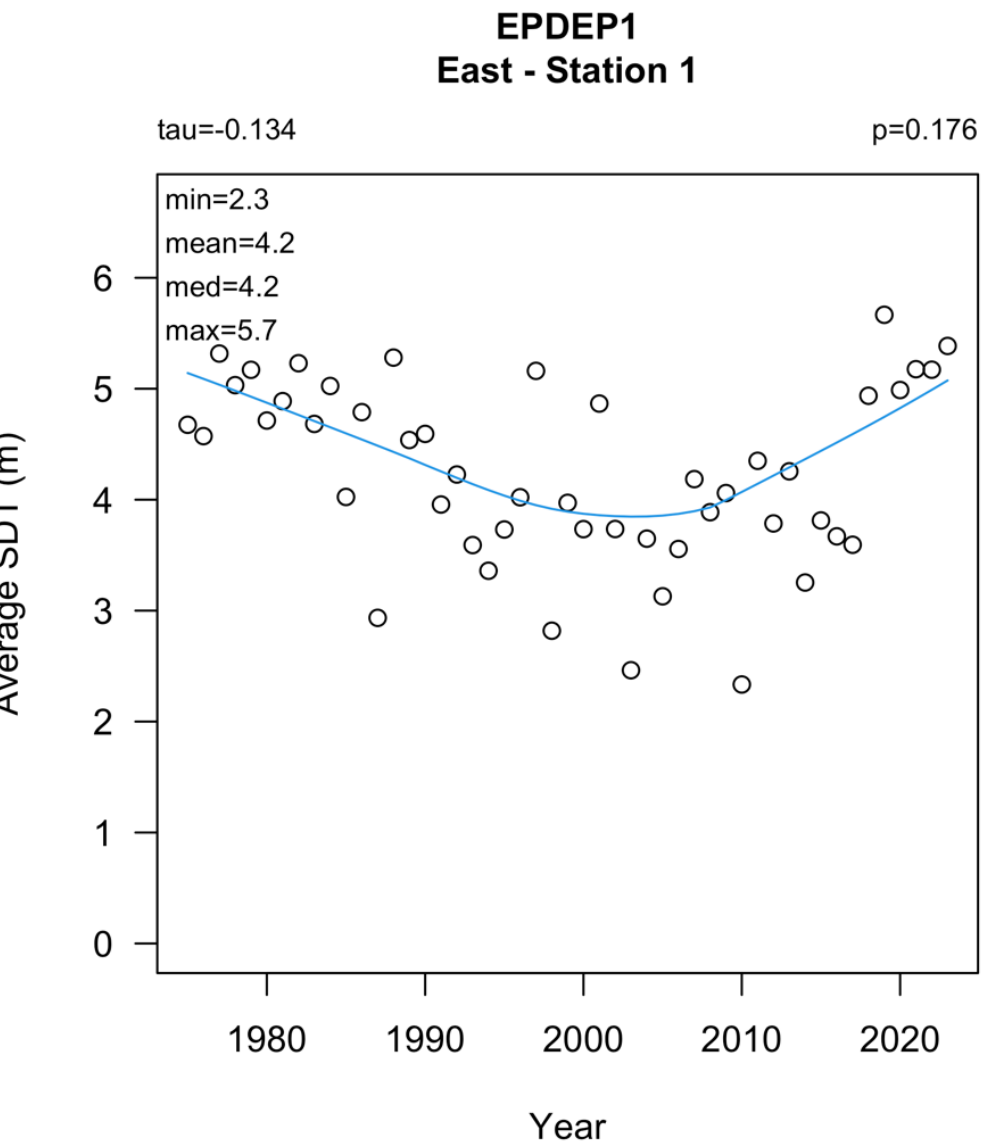


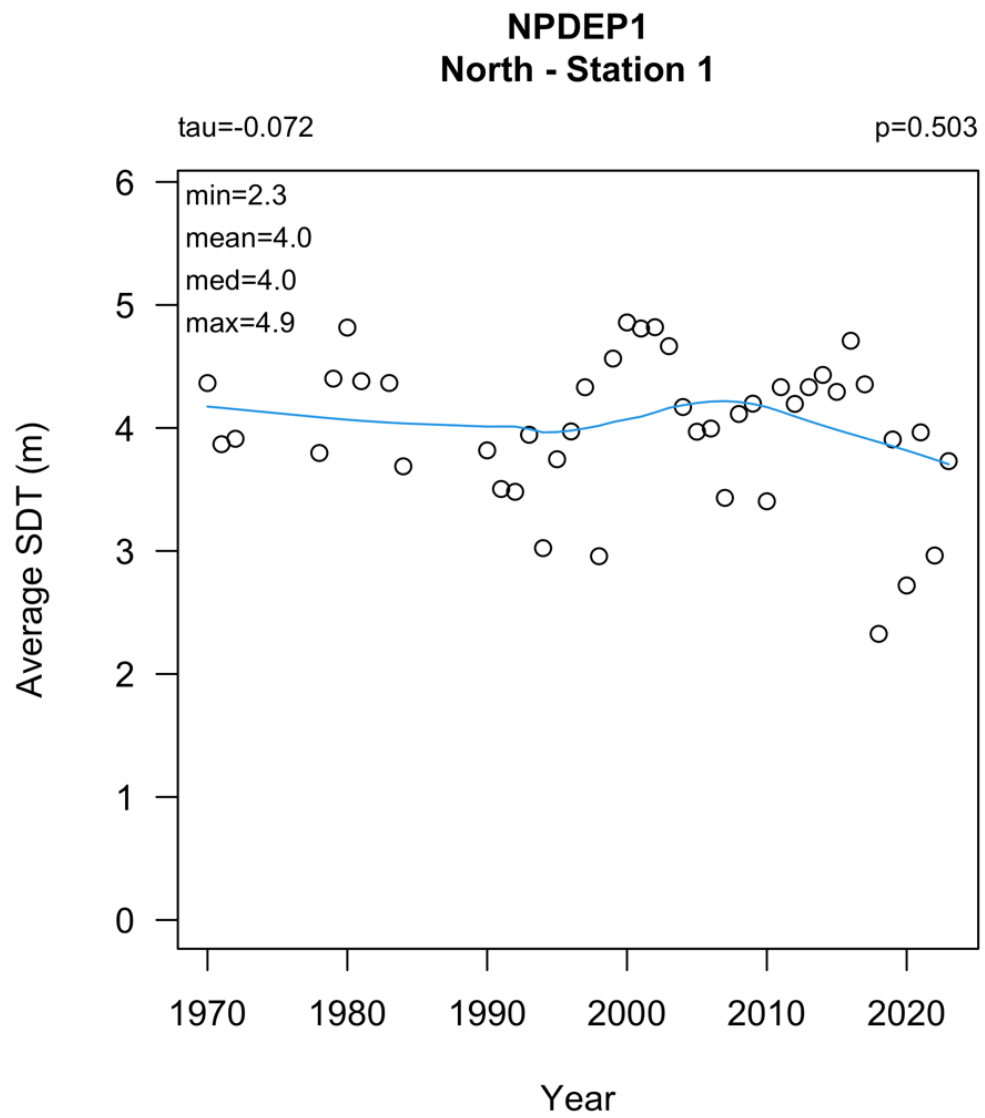


North Pond vs. East Pond Aug 2012

East Pond is 5 feet deeper
More Fe than Al in sediments
Develops anoxia at bottom
Reduction of iron releases P
“Internal Load”
High winds mix
Results in bloom

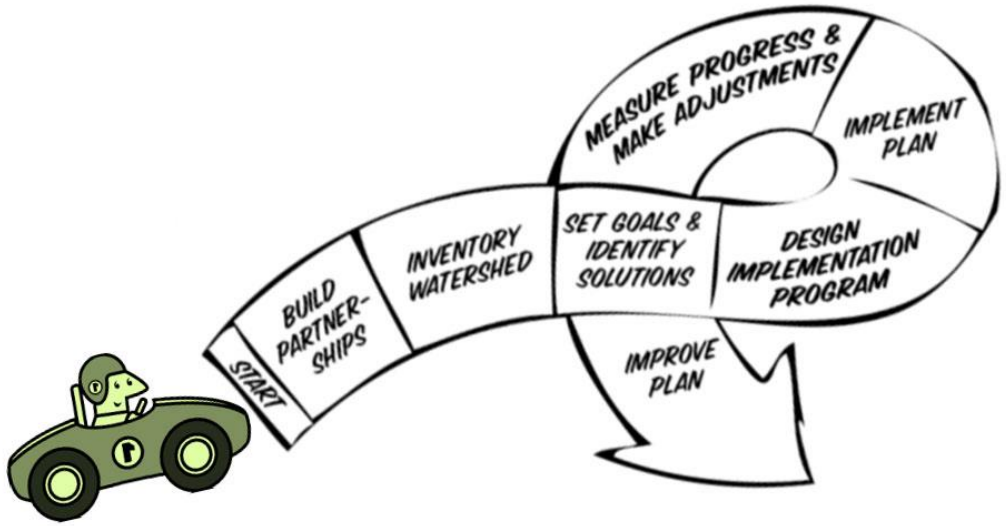
Spring and Fall 2018: Alum treatment of deepest part of lake
($1M+ 45 g Al/$m^2$ sediment surface 350 tons of floc)


EPDEP1
East - Station 1
tau=-0.134
p=0.176
min=2.3
mean=4.2
med=4.2
max=5.7
Average SDT (m)
Year
0
1
2
3
4
5
6
1980
1990
2000
2010
2020


NPDEP1
North - Station 1
tau=-0.072
p=0.503
min=2.3
mean=4.0
med=4.0
max=4.9
Average SDT (m)
Year
0
1
2
3
4
5
6
1970
1980
1990
2000
2010
2020

9- Element EPA Watershed Management Plans

- **Summary of the nine minimum elements to be included in section 319-funded watershed plans for threatened or impaired waters**
- a. Identify causes and sources of pollution
- b. Estimate pollutant loading into the watershed and the expected load reductions
- c. Describe management measures that will achieve load reductions and targeted critical areas
- d. Estimate amounts of technical and financial assistance and the relevant authorities needed to implement the plan
- e. Develop an information/education component
- f. Develop a project schedule
- g. Describe the interim, measurable milestones
- h. Identify indicators to measure progress
- i. Develop a monitoring component



Watershed Management/Protection Plans

North Pond Protection Plan, 2024 – 2033:

- DEP's NPS Priority Watersheds List: Threatened - Watch List
- Chapter 502: Most at Risk from New Development
- Current In-Lake phosphorus: **22.2ppb** (5yr average, 19ppb 10yr average)
- Goal In-Lake phosphorus: **10ppb**
- 50% of annual phosphorus load is internal loading, 31% watershed runoff, 7% from septic systems
- 91 nonpoint source (NPS) pollution sites (aka erosion sites) in watershed
- Goal: Reduce External Load by 90kg/yr – watershed restoration & septic
- Goal: Reduce Internal Load by 872kg/yr – Alum Treatment

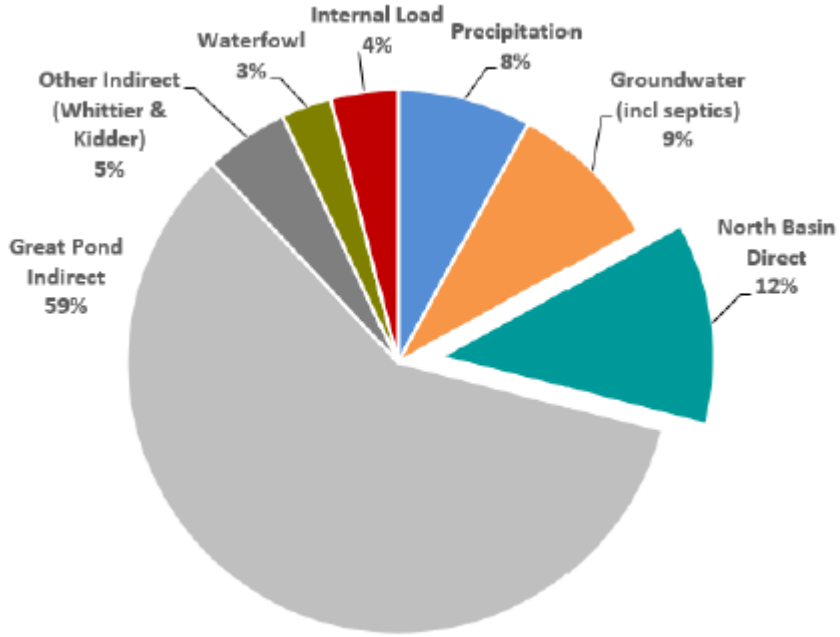
Watershed Management/Protection Plans

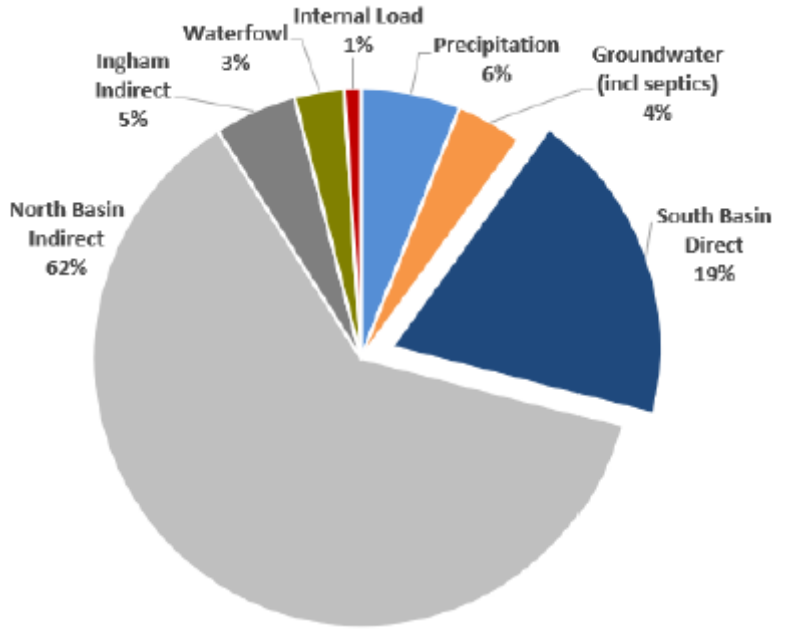
Great Pond Management Plan, 2021 – 2031:

- DEP's NPS Priority Watersheds List: Impaired (2010) – declining water clarity and increasing phosphorus
- Current In-Lake phosphorus: **9ppb** (Station 1 avg) **10ppb** (Station 2 avg)
- Goal In-Lake phosphorus: **8.5ppb**
- 48% of annual phosphorus load is direct watershed runoff, 24% indirect watershed, 10% internal loading, 3% from septic systems
- 237 NPS sites identified in 2018 survey (215 current estimate)
- Goal: Reduce Direct Load by 101 kg/yr – watershed restoration & septic
- Goal: Reduce Indirect (upstream) Load by 29 kg/yr

Long Pond Watershed Management Plan 2022-2032

- DEP's NPS Priority Watersheds List: Impaired (2006) due to declining water clarity
- Current In-Lake phosphorus: **8.3ppb** (both basins)
- Goal In-Lake phosphorus: North Basin - **8.1ppb**; South Basin - **7.9ppb**
- 148 NPS sites identified in the 2020 survey (130 current estimate)
- Goal: Reduce North Basin Load by 86 kg/yr
- Goal: Reduce South Basin Load by 38 kg/yr





Erosion Control

North, Great, and Long Pond Status

Erosion Control Programs

- Road & Driveway Restoration (319 Grants)
- Youth Conservation Corps (YCC)
- LakeSmart Awards

Erosion Control - 319

North, Great, and Long Pond

Over $1.06M in federal grants
since 2009
Plus $1.36M local match
(road associations, towns, landowners)

Current Status

- Great Pond II (2024-2025):
  - 52% construction budget unallocated, looking for projects
- North Pond IV (2024-2025):
  - 46% construction budget unallocated, looking for projects
- Long Pond V (2023-2024):
  - Construction budget allocated, finishing projects

319 Road & Driveway Projects

2023:

Great Pond

- 6 Projects Completed, $47K

North Pond

- 2 Projects, $7.8K (End of old grant)

Long Pond

- 8 Projects Completed, $83K

2024 Plan:

Great Pond

- 9 Projects identified ~$85K

North Pond

- 8 Projects identified ~$90K

Long Pond

- 5 Projects identified, ~$78K

Youth Conservation Corps

2023 had largest crew to date:
19 high school and college students – 3 crews

2023 Numbers:

Great Pond
- 18 Projects Completed, 35 BMPs, $52K value

North Pond
- 7 Projects Competed, 19 BMPs, $28K value

Long Pond
- 18 Projects Completed, 36 BMPs, $63K value

In Rome only: 17 Projects, 26 BMPs, $60K.

2024 Projects:

Great Pond
- 38 Projects on the list

North Pond
- 18 Projects on the list

Long Pond
- 24 Projects on the list

Erosion Control - LakeSmart

2023 Numbers:

North Pond:

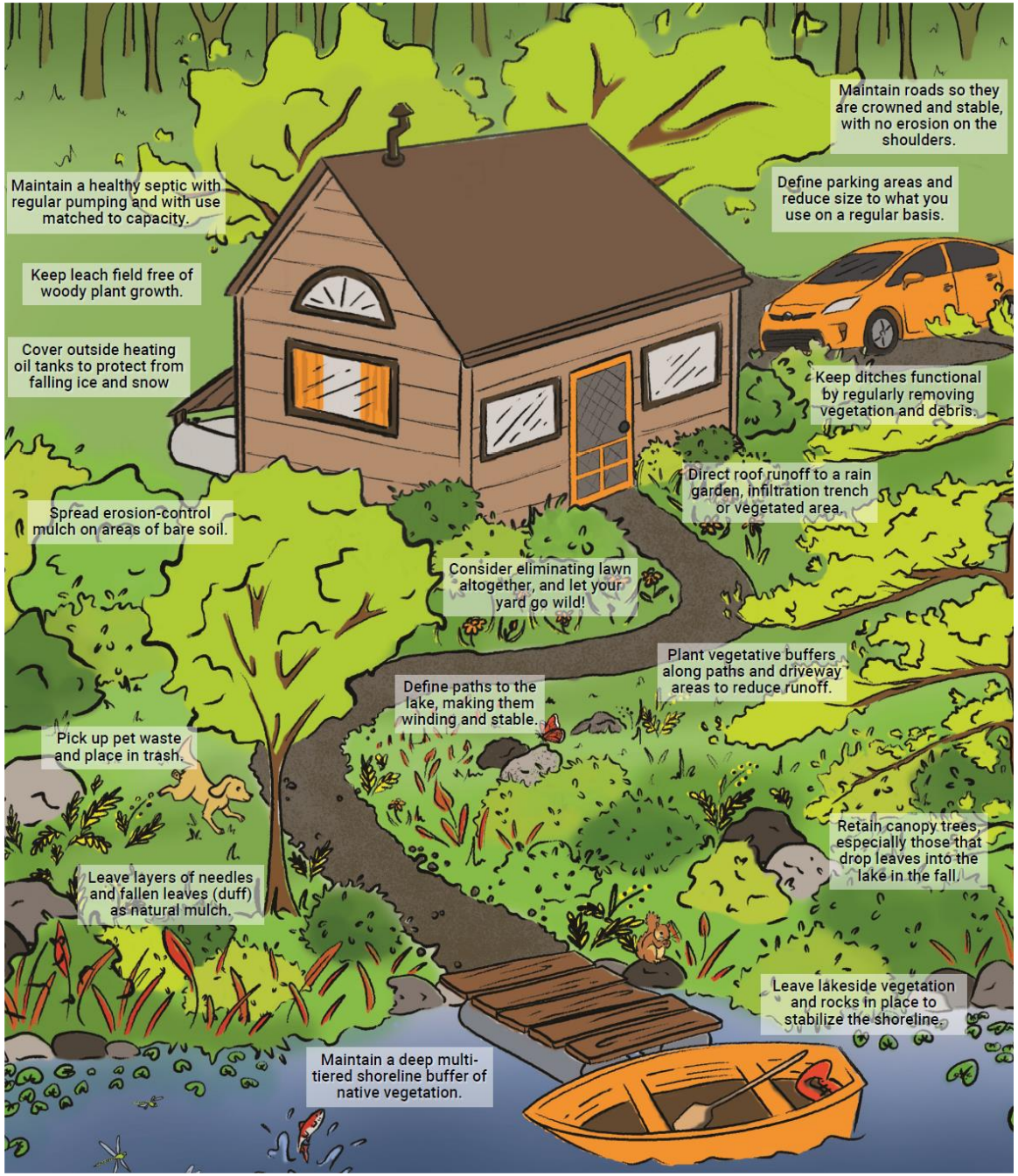
22 Evaluations, 7 Awards

Great Pond:

9 Evaluations, 3 Awards

Long Pond:

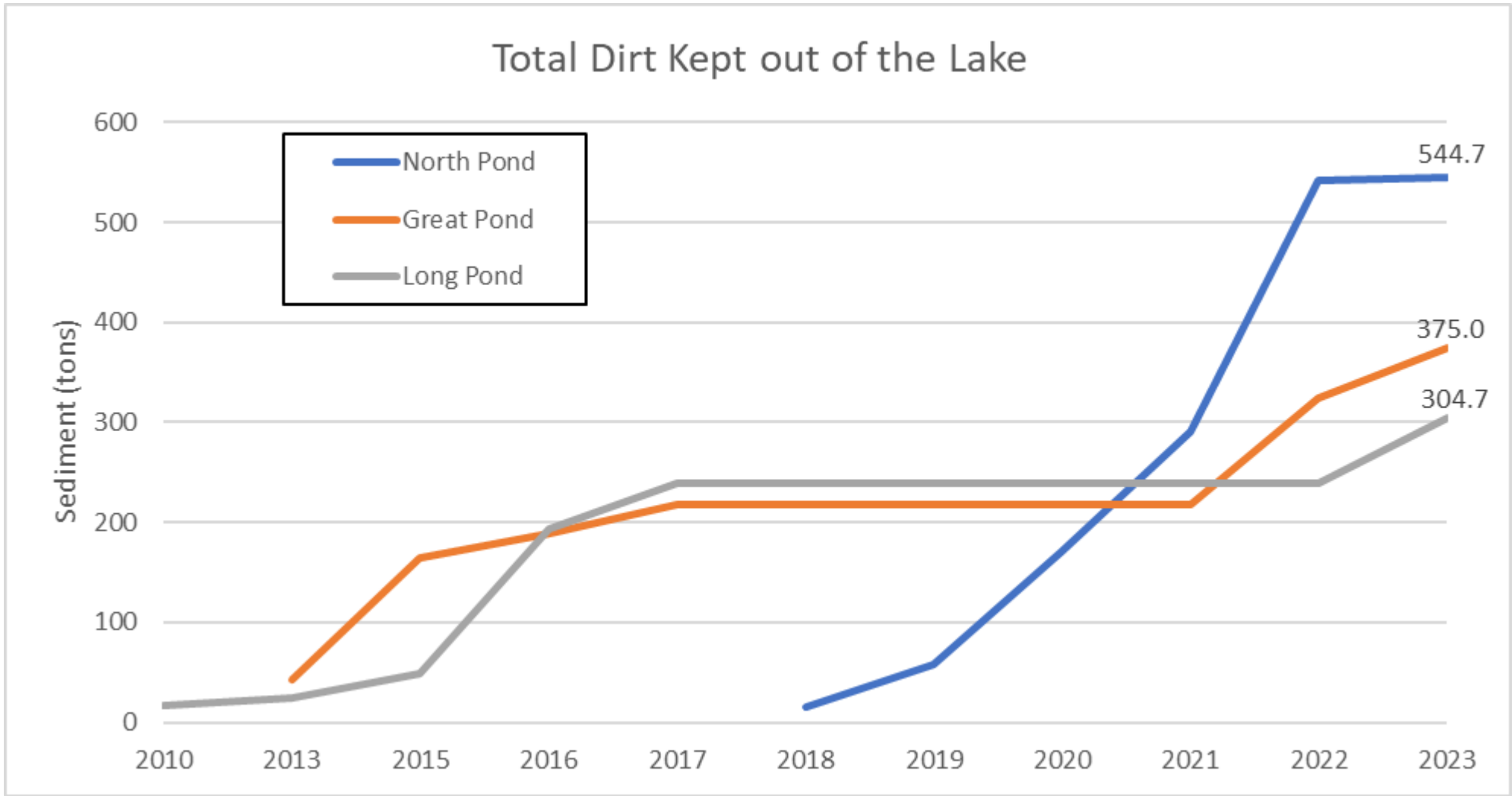
5 Evaluations, 3 Awards

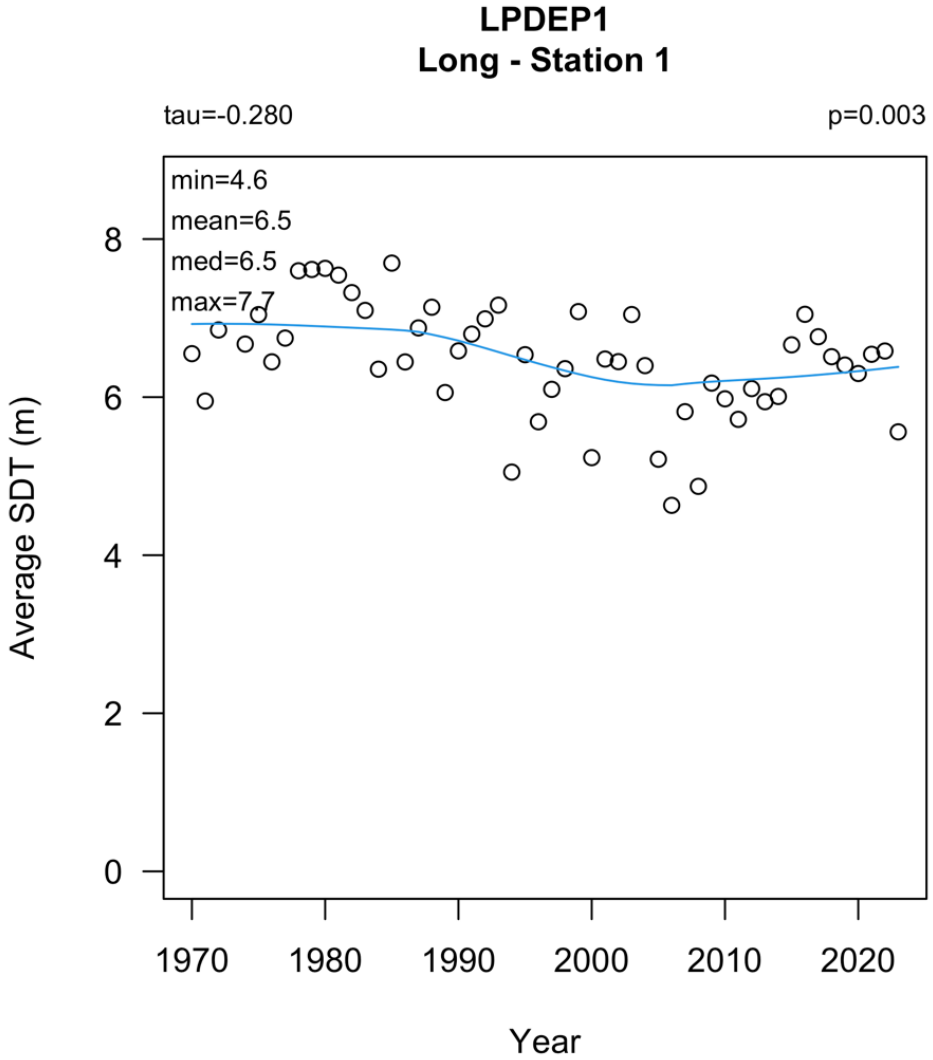


WWW.LAKESMART.ORG

LakeSmart AWARD

PROTECTING OUR LAKES & PONDS


Total Dirt Kept out of the Lake
Sediment (tons)
600
500
400
300
200
100
0
North Pond
Great Pond
Long Pond
544.7
375.0
304.7
2010
2013
2015
2016
2017
2018
2019
2020
2021
2022
2023


LPDEP1
Long - Station 1
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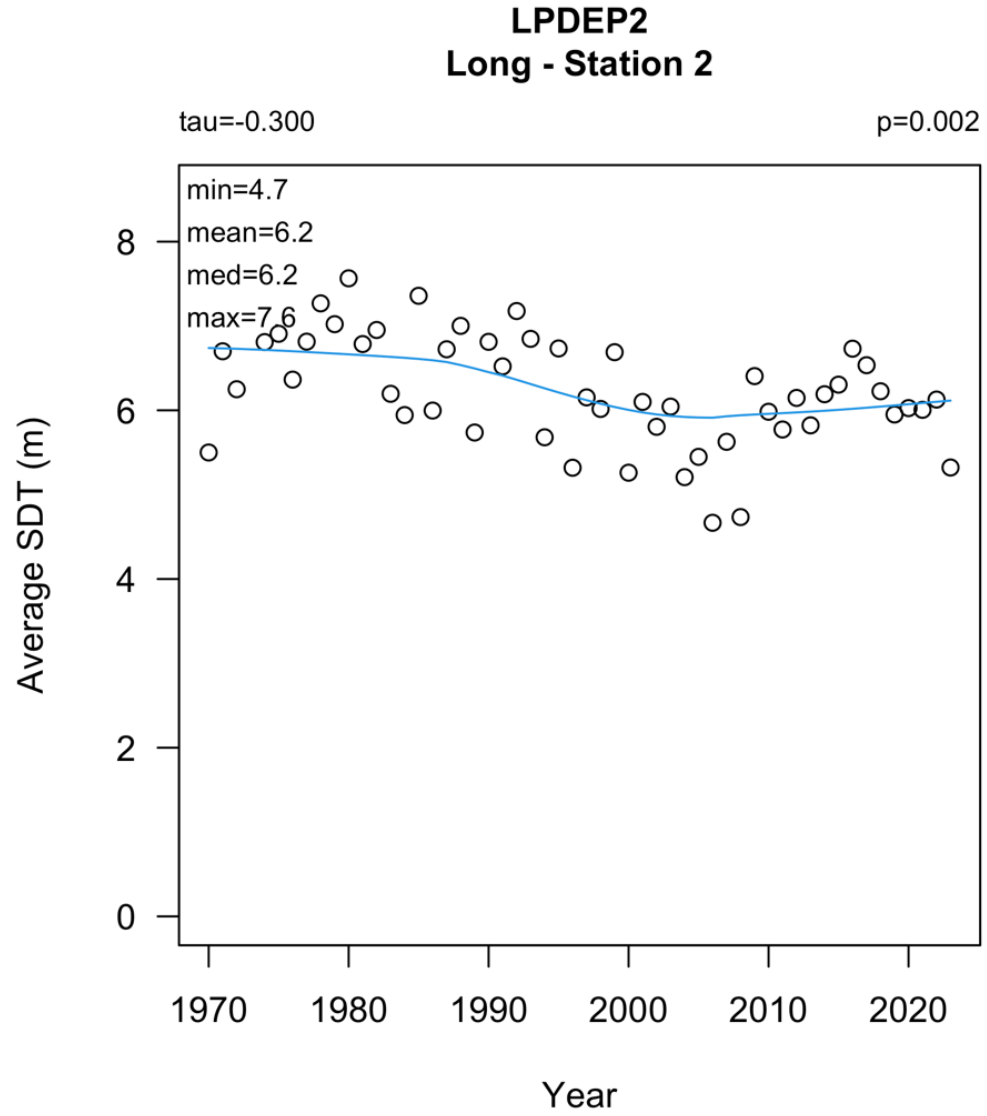
p=0.003
min=4.6
mean=6.5
med=6.5
max=7.7
Average SDT (m)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year


LPDEP2
Long - Station 2
tau=-0.300
p=0.002
min=4.7
mean=6.2
med=6.2
max=7.6
Average SDT (m)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year

Buffers and Shoreland Zoning

The roots of the willows do not suffer the banks of the canals to be destroyed; and the branches of the willows, nourished during their passage through the thickness of the bank and then cut low, thicken every year and make shoots continually, and so you have a bank that has life and is of one substance.

-Leonardo Da Vinci (1452-1519)

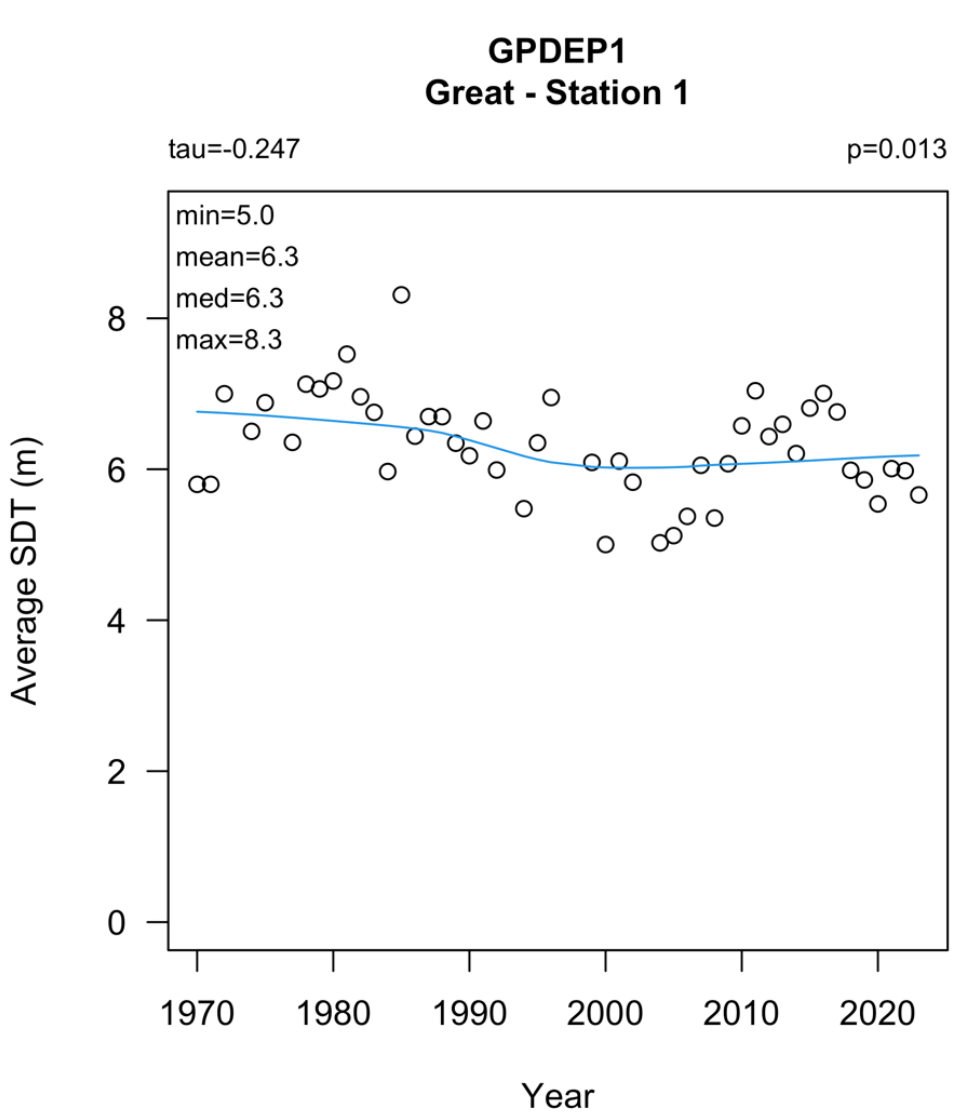
Questions?

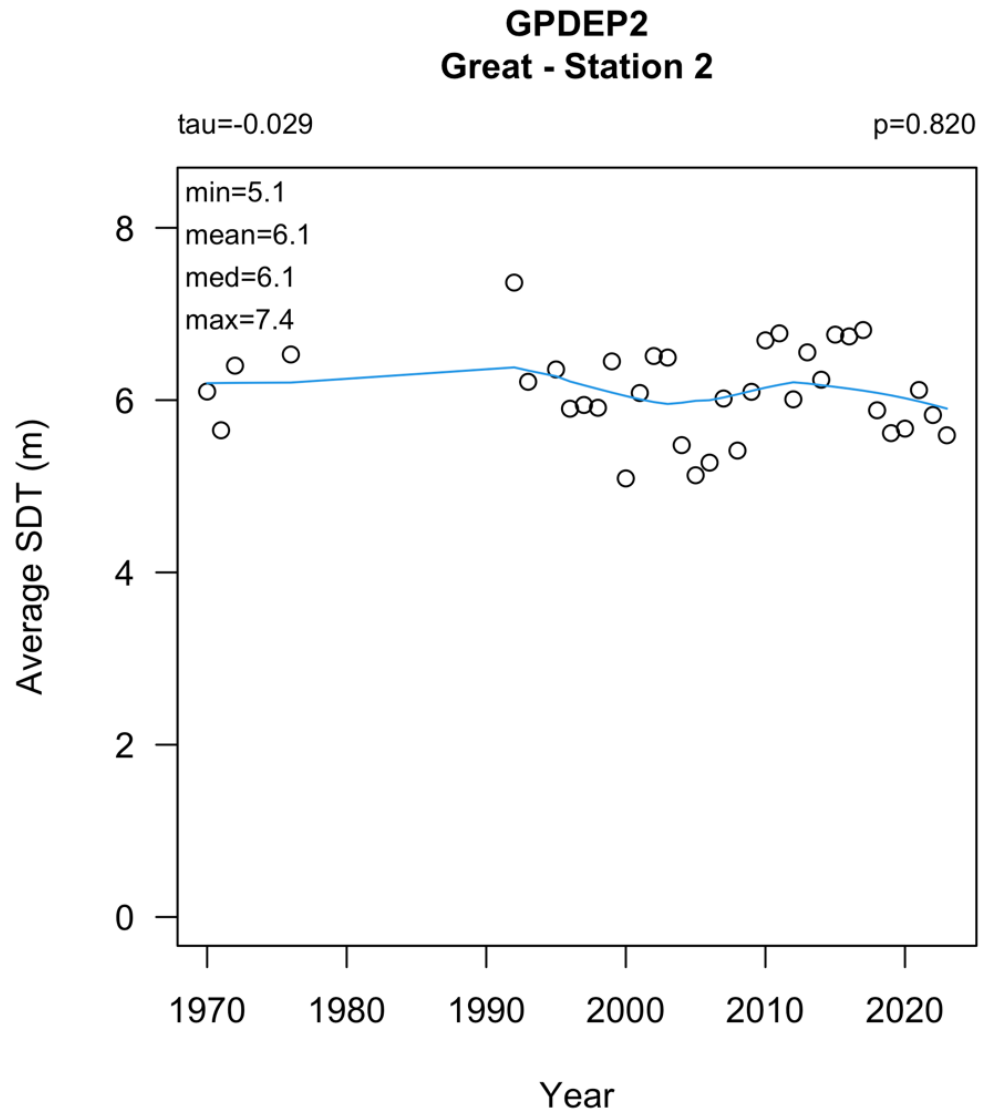
“Water is the most critical resource issue of our lifetime and our children’s lifetime. The health of our waters is the principal measure of how we live on the land.”

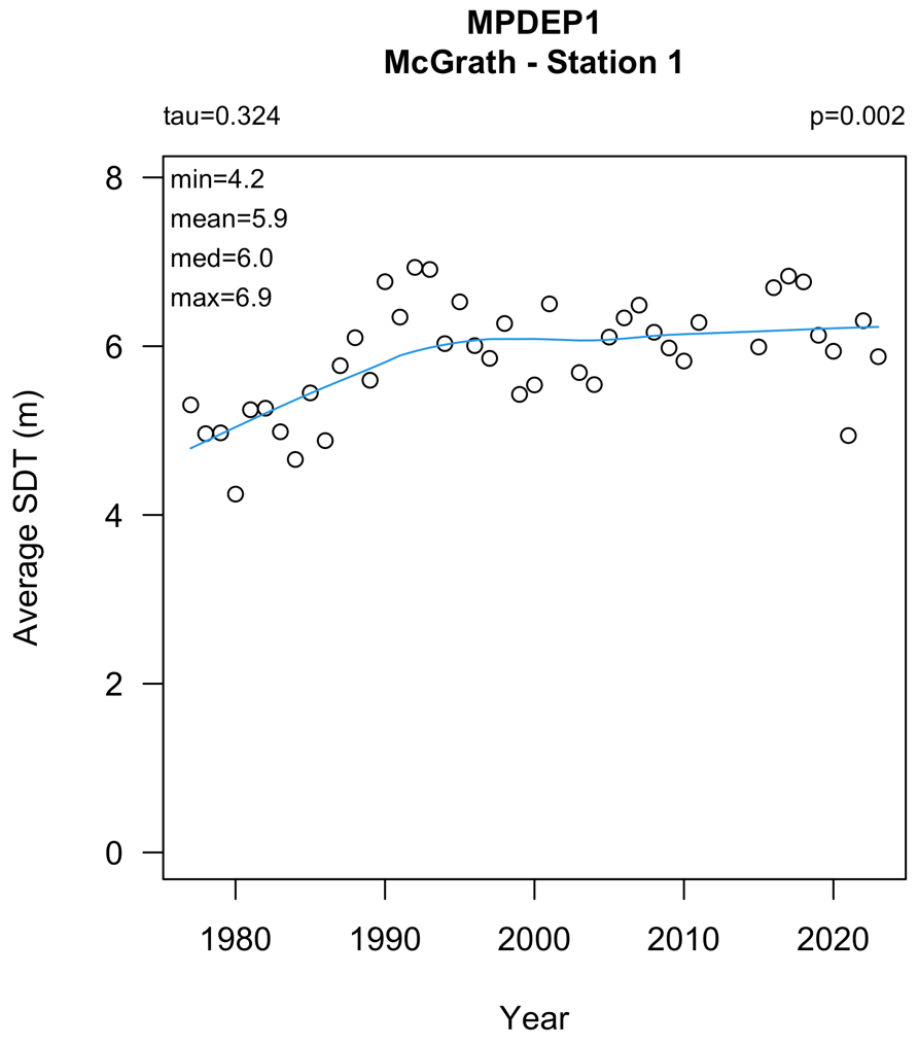
-- Luna Leopold

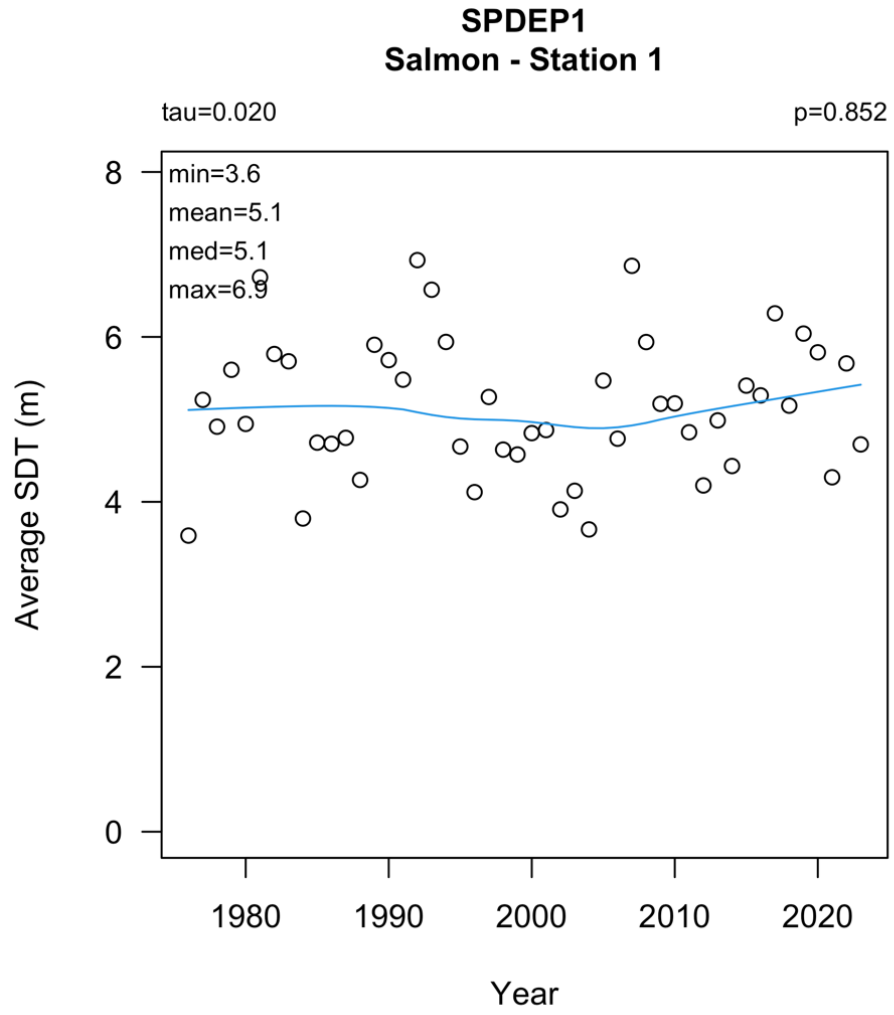
Unless someone like you cares a whole awful lot, nothing is going to get better. It's not.

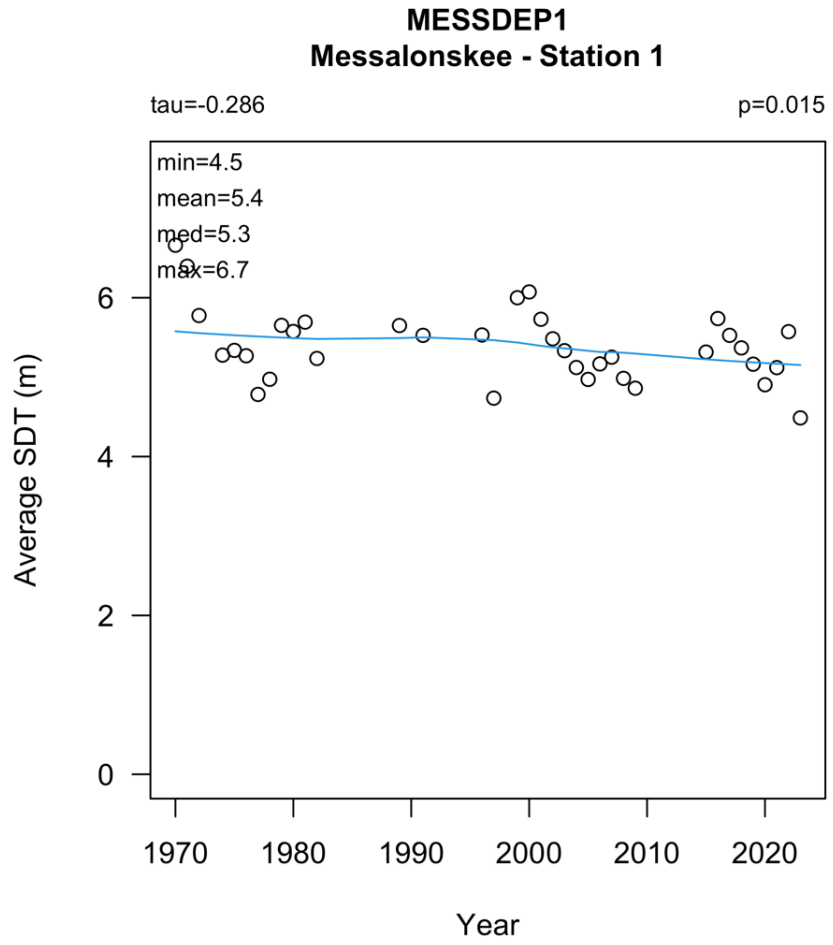
Dr. Seuss,The Lorax

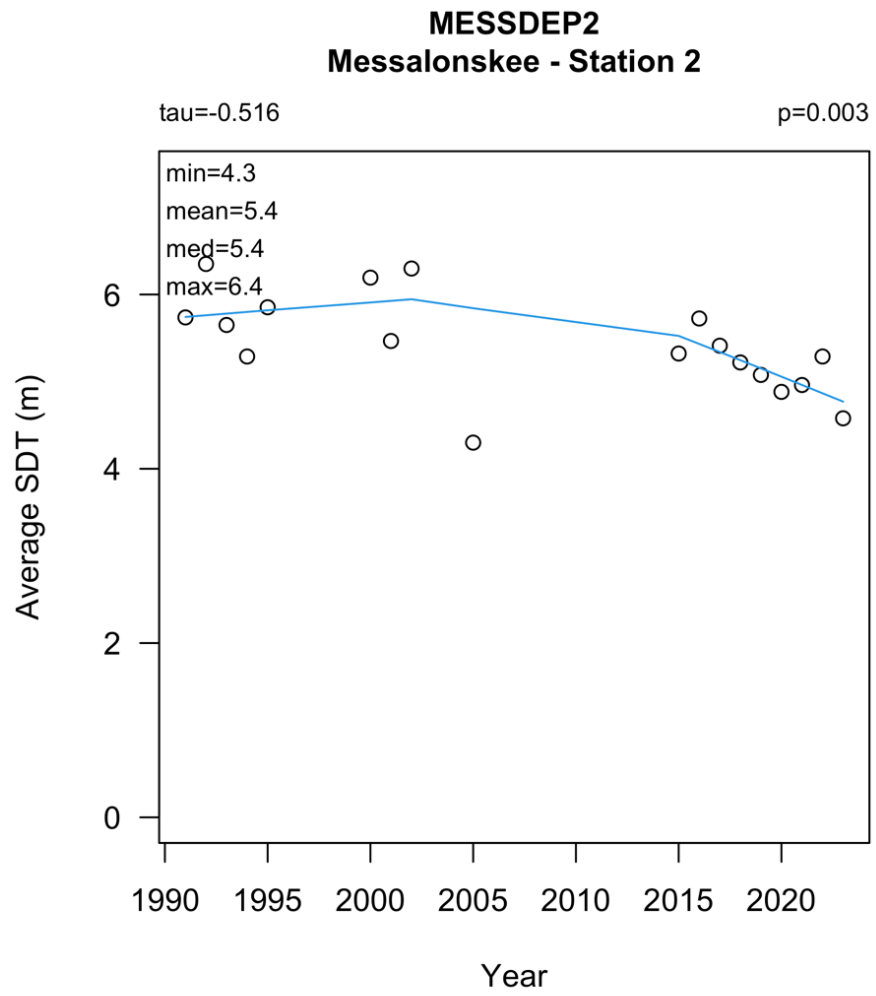

GPDEP1
Great - Station 1
tau=-0.247
p=0.013
min=5.0
mean=6.3
med=6.3
max=8.3
Average SDT (m)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year


GPDEP2
Great - Station 2
tau=-0.029
p=0.820
min=5.1
mean=6.1
med=6.1
max=7.4
Average SDT (m)
0
2
4
6
8
1970
1980
1990
2000
2010
2020
Year


MPDEP1
McGrath - Station 1
tau=0.324
p=0.002
min=4.2
mean=5.9
med=6.0
max=6.9
Average SDT (m)
Year
0
2
4
6
8
1980
1990
2000
2010
2020


SPDEP1
Salmon - Station 1
tau=0.020
p=0.852
min=3.6
mean=5.1
med=5.1
max=6.9
Average SDT (m)
Year
0
2
4
6
8
1980
1990
2000
2010
2020


MESSDEP1
Messalonskee - Station 1
tau=-0.286
p=0.015
min=4.5
mean=5.4
med=5.3
max=6.7
Average SDT (m)
0
2
4
6
1970
1980
1990
2000
2010
2020
Year

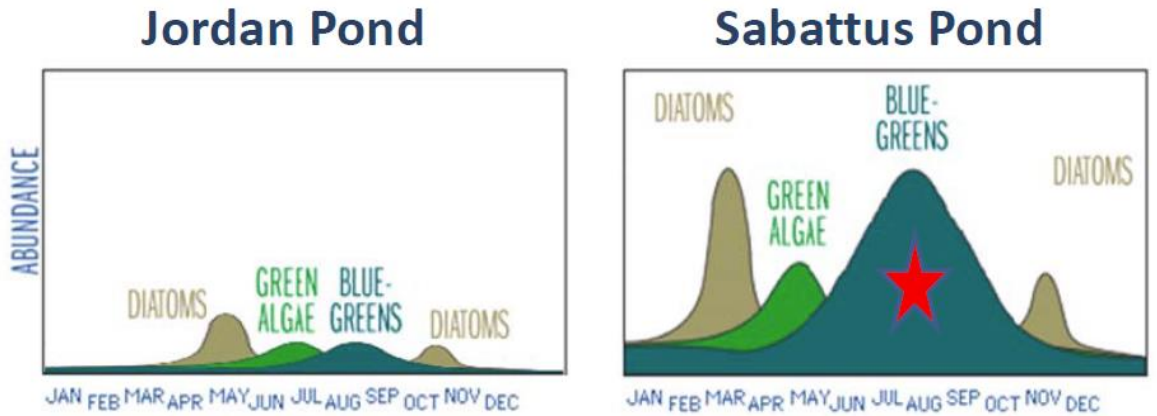

MESSDEP2
Messalonskee - Station 2
tau=-0.516
p=0.003
min=4.3
mean=5.4
med=5.4
max=6.4
Average SDT (m)
0
2
4
6
1990
1995
2000
2005
2010
2015
2020
Year

Paying for infrastructure

- MA- Proposed 1% increase in Real Estate Transfer Tax
- ME- Clean Water State Revolving Fund (CWSRF)
  - Funded by Maine Municipal Bond Bank and USEPA ($50M approved last year)
  - ME is #46 in capital spending as a % of state budget (7%)
- NJ- NJ Environmental Infrastructure Financing Program
  - Clean Water State Revolving Fund (CWSRF) Administered by NJDEP
    - Corporate business tax- NJ Infrastructure Bank
    - Help municipalities, MUAs, Counties, Water groups
    - Coordinate with USEPA CWA funding

Harmful Algal Blooms

- Cyanobacteria
  - Potential neurotoxins, hepatotoxins
  - BMAA possible ALS association

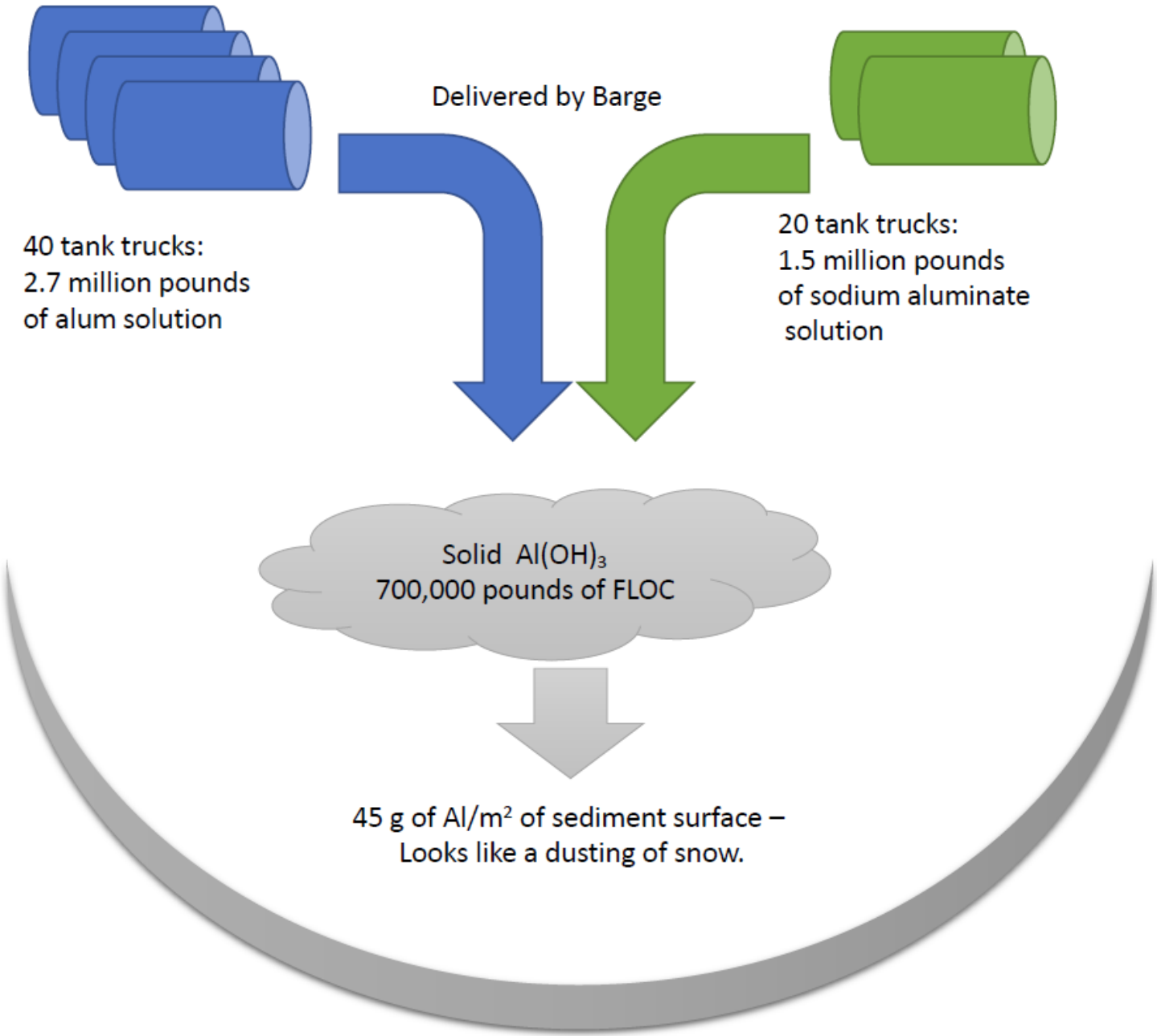


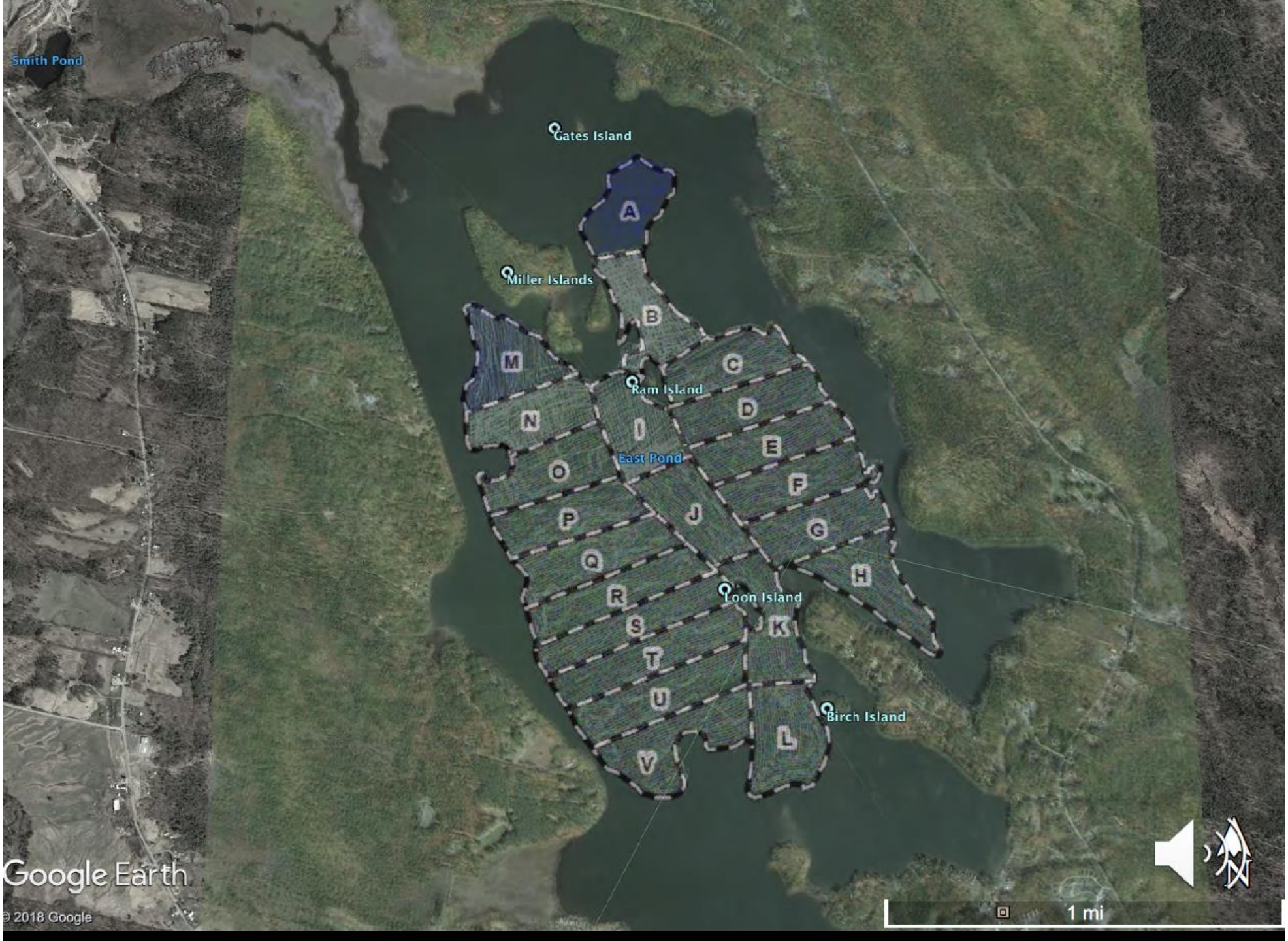
Source: Linda Bacon MEDEP

- Prevention: reduce nutrient loading, especially P and N
- Detection: Need enhanced and more monitoring (Drinking water/recreational standards)
  - USEPA Region 1 Tiered monitoring program (Hilary Snook)
    - **Bloomwatch APP** (Smartphone app to submit photos of blooms)
    - **Cyanoscope** (Fluorometer kit to collect samples and upload photos for ID)
    - **Cyanomonitoring** by network of citizen scientists to identify factors and vulnerabilities
- Advisory warnings: Need refined reporting and warning system

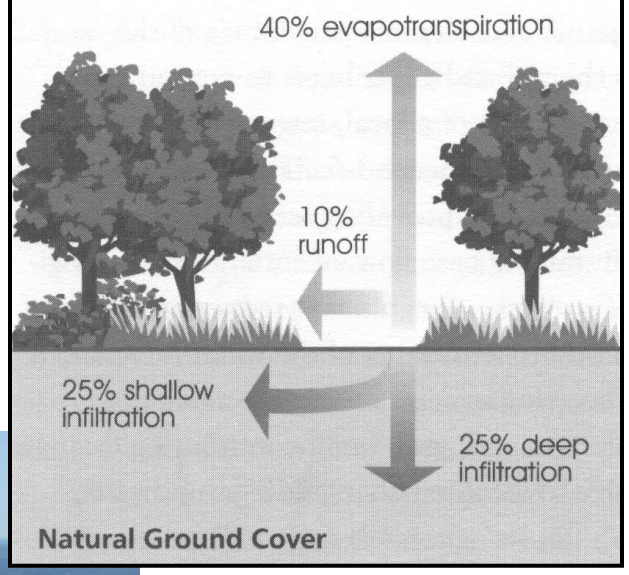
Get involved with Lake Stewards of Maine VLMP
Contact congressional representatives to restore proposed EPA budget cuts!

Alum by the Numbers

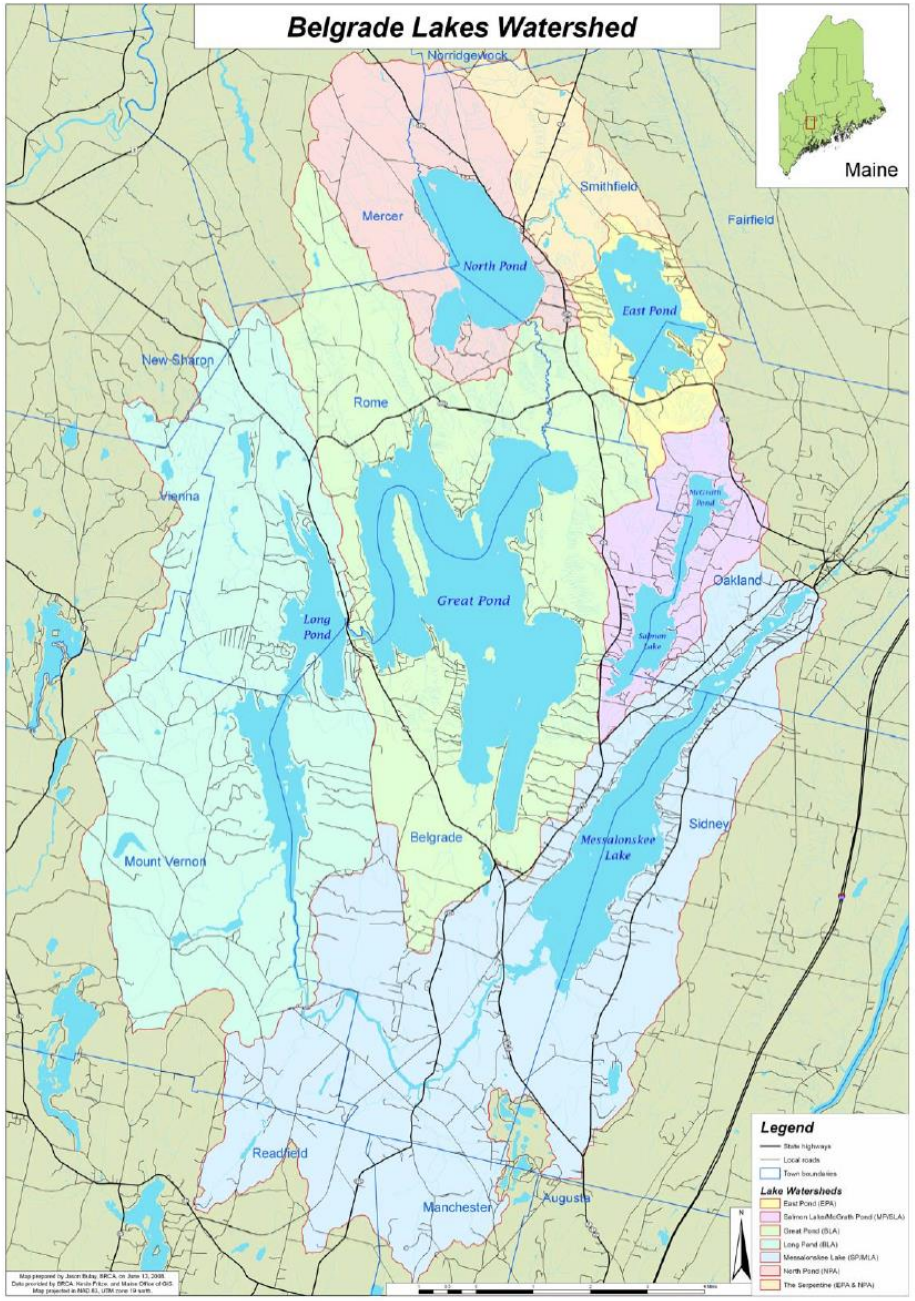


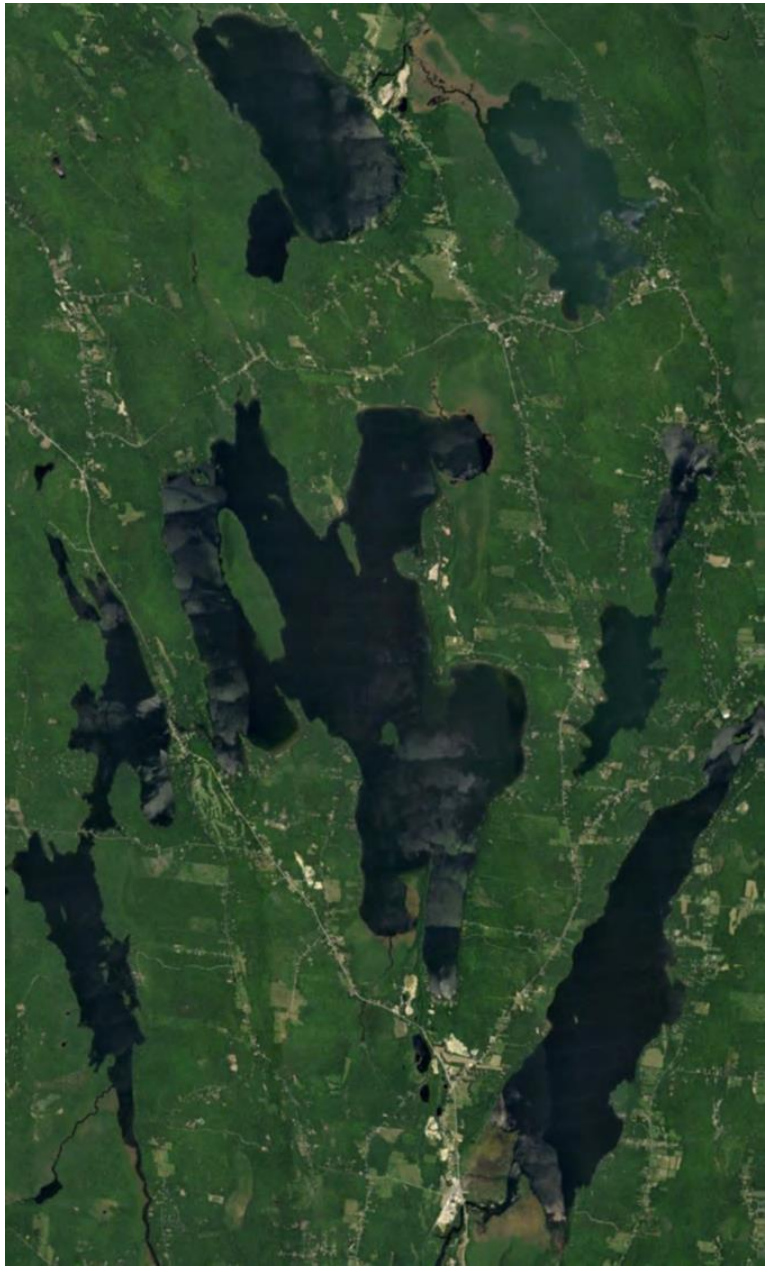

Smith Pond
Gates Island
A
Miller Islands
B
M
C
Ram Island
N
I
D
East Pond
E
O
F
P
J
G
Q
H
R
Loon Island
S
K
T
U
Birch Island
L
V
Google Earth
© 2018 Google
1 mi

Natural Watershed



Nutrients added slowly
Large woody debris
Biodiversity increases but slowly
Everyone somebody's lunch
Stable shorelines





Watershed ~180 sq miles
Portions of 13 municipalities
Portions of 3 counties