Little Averill Lake Water Quality Trends

Kellie Merrell and Leslie Matthews, PhD

19 August 2020

Virtual Presentation to Little Averill Camp Owners

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
LAKES & PONDS PROGRAM

— VTDEC Environmental Scientists; Leslie Matthews, Ph.D and Kellie Merrell surveying Shadow Lake -photo C. Cano

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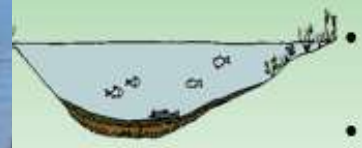
Three Major Lake Classes as Defined by Limnologists

Oligotrophic Lakes

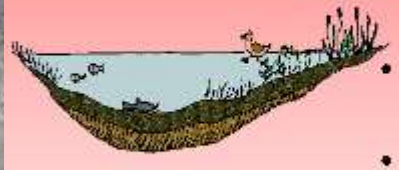
- Low nutrient enrichment = very little plant and algae growth
- Clear water
- Supports coldwater fish species

Mesotrophic Lakes

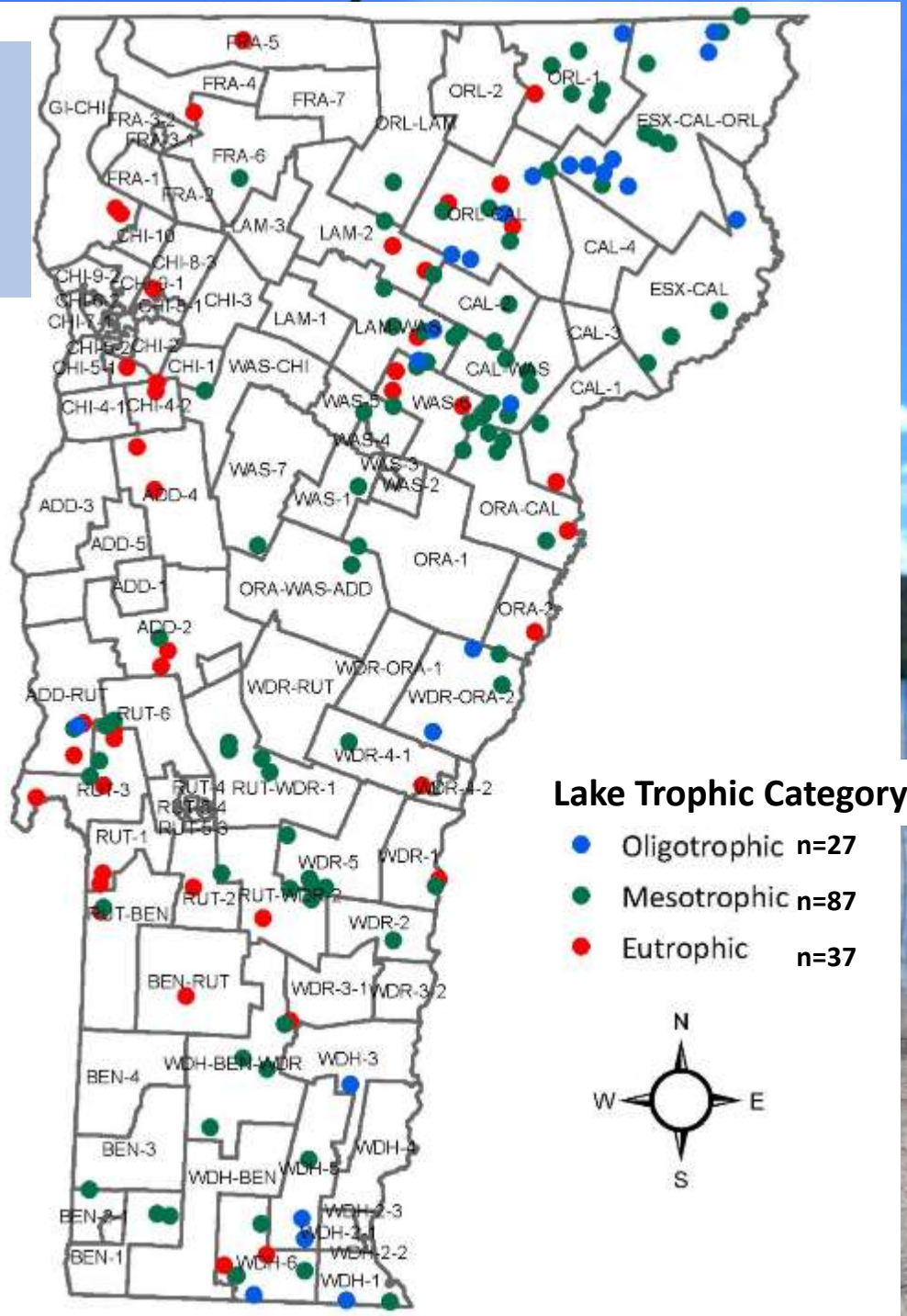


- Moderate nutrient enrichment = some plant and algae growth
- Moderate water clarity
- Supports mostly warmwater fish species

Eutrophic Lakes



- High nutrient enrichment = abundant plant and algae growth
- Reduced water clarity
- Only supports warmwater fish species



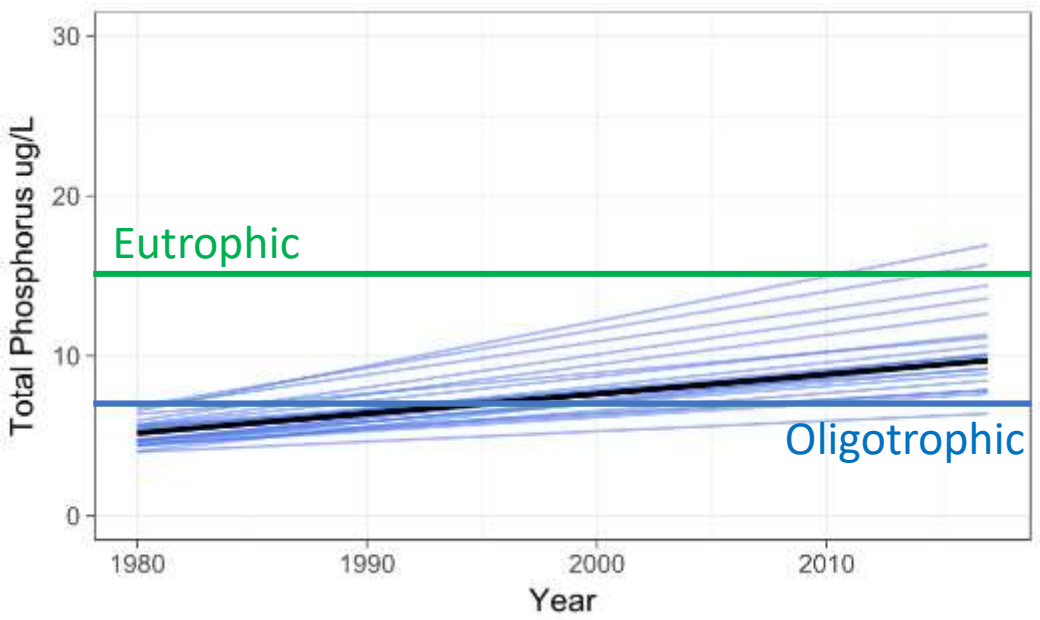
Lake Trophic Category as of 1980

- Oligotrophic n=27
- Mesotrophic n=87
- Eutrophic n=37

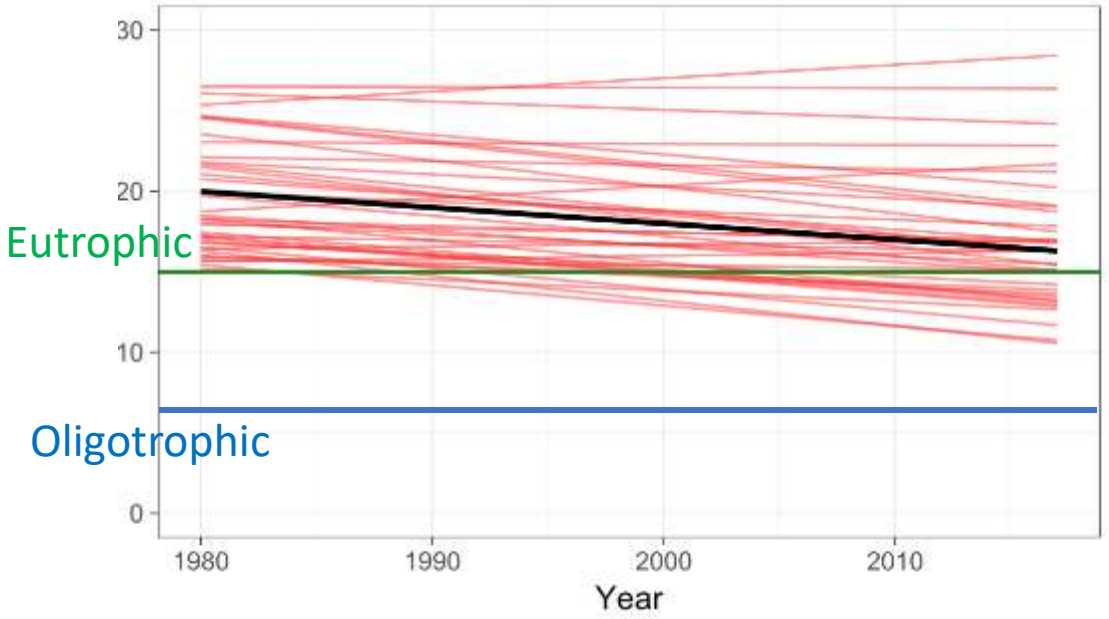
N
W E
S

96 % of the Oligotrophic Lakes have increasing phosphorus trends, compared to 0% of Eutrophic Lakes

OLIGOTROPHIC



EUTROPHIC



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WVPS Burlington 107.9 is operating at reduced power today for tower maintenance.

Vermont's 'Jewels' Under Threat: Clearest, Cleanest Lakes Face Phosphorus Pollution

By JOHN DILLON · AUG 5, 2019

PROGRAM VPR News | Share | Tweet | Email

Sara Gluckman is the volunteer lake monitor for Shadow Lake in Glover. Water samples there and in other cold water lakes in Vermont show increasing levels of phosphorus.

JOHN DILLON /VPR

https://www.vpr.org/post/vermonts-jewels-under-threat-clearest-cleanest-lakes-face-phosphorus-pollution#stream/0

Is Vermont Losing Its Oligotrophic Lakes?

Leslie Matthews, Kellie Merrell, and Perry Thomas

In the early 1970s, a series of experiments conducted in several small lakes in northwestern Ontario established the critical role phosphorus plays in lake ecology. In one of these experiments, now a classic in the history of limnological science, an hourglass-shaped lake was divided into two separate but similar bays using a vinyl curtain installed in the narrow middle section. One bay of the lake was fertilized with nitrogen and carbon, while the other was fertilized with both those nutrients, but in addition, phosphorus. Only the bay fertilized with phosphorus developed algal blooms, turning the bay into pea soup, while the other bay remained clear.

One year after D.W. Schindler published this classic paper on the results of the Ontario experiments (Schindler 1976), the nascent Vermont Lakes and Ponds Management and Protection Program (LPMPP) began monitoring phosphorus. Each year, the LPMPP samples 40-100 lakes and ponds greater than 20 acres (more recently including lakes greater than 10 acres) during spring turnover, following the progression of ice-out from south to north, and from low to high elevation, throughout the state. The goal is to collect water samples for phosphorus testing when the lakes are well mixed, after ice out but before the lakes become stratified by sunshine and warming temperatures. The phosphorus concentrations in these samples give an indication of the availability of phosphorus for the coming growing season and allow us to examine trends in phosphorus concentrations over time. The aim of the program is to visit each lake on an approximately five-year rotation – many lakes have been sampled with even greater frequency.

Lake scientists classify lakes into trophic levels based on the amount of available nutrients in the water that support lake productivity. Nutrients such as phosphorus are necessary to support the growth of algae and aquatic plants. These algae and plants, in turn, support the rest of the lake's inhabitants, including fish, that depend directly or indirectly on these primary producers. Eutrophic lakes have the highest nutrient levels. These lakes support abundant algae and plant growth. Mesotrophic lakes have moderate nutrient enrichment, supporting moderate algae and plant growth. Both eutrophic and mesotrophic lakes support warm water fisheries (e.g., bass, perch, and pickerel). Oligotrophic lakes, in contrast, have low nutrient enrichment. These lakes are clear and deep. They remain well oxygenated to the bottom throughout the summer and they support coldwater fish species (e.g., lake trout, rainbows, and browns)

Although nutrients provide necessary nourishment for the lake ecosystem, nutrients can also become too much of a good thing. Phosphorus becomes a significant pollutant when human activity in a watershed leads to levels that exceed a lake's natural condition. The Clean Water Act facilitated substantial reductions in phosphorus pollution by requiring treatment of waste water and other point sources. However, non-point sources of phosphorus pollution, such as urban and agricultural run-off, remain a concern.

In 2016, Stoddard et al. reported disturbing evidence from the 2007 and 2012 National Lakes Assessments that the total phosphorus (TP) in lakes and ponds has increased on a continental scale. The increases were particularly acute for oligotrophic lakes – those with initial phosphorus levels less than 10 µg/L. Similarly, in updating the Vermont Lake Score Card (http://dec.vermont.gov/watershed/lakes-ponds/data-maps/scorecard) we observed that many oligotrophic lakes in Vermont appeared to be exhibiting increases in TP levels, when examined individually. Prompted by these results, we undertook a more thorough analysis of phosphorus trends in Vermont lakes and ponds over the last four decades.

We examined phosphorus trends in 148 lakes and ponds greater than 20 acres in size that were sampled at least once during the 1980s, at least once since 2000, and have been sampled at least three times with a median of 11 sampling events per lake over 37 years. We defined trophic condition based on the average spring TP for the lake during the 1980s using Vermont's thresholds. The dataset includes 24 oligotrophic (< 7 µg/L TP), 87 mesotrophic (7-15 µg/L TP) and 37 eutrophic lakes (> 15 µg/L TP). The 148 lakes in the study data set aren't a random sample. However, they do not significantly differ from the overall population of Vermont lakes greater than 20 acres with respect to elevation, alkalinity, watershed human disturbance or watershed/lake area ratio (data not shown). Therefore, the study lakes are reasonably representative of all 298 Vermont lakes greater than 20 acres in size.

Figure 1 compares the median and average spring TP concentrations for the study lakes during the decade of the 1980s versus the current decade. The average spring TP for the eutrophic lakes has declined significantly, mesotrophic lakes have increased slightly, while the oligotrophic lakes have increased dramatically relative to their starting point in the 1980s.

https://www.vpr.org/sites/vpr/files/lakelinematthews_et_al_2018__1_.pdf

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The official blog of the Vermont Department of Environmental Conservation's Watershed Management Division

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https://vtwatershedblog.com/2018/02/01/vermont-lakes-are-some-of-the-best-lakes-in-the-nation/

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Vermont Lakes are Some of the Best Lakes in the Nation

Posted on February 1, 2018 by ANRWSMDBLOG

Great Averill Pond in Averill, Vermont is one of Vermont's high quality, clear water (oligotrophic) lakes.

This past year, there were multiple stories in the media covering massive algal blooms in Lake Carmi, tons of phosphorus pouring into state surface waters, and the seemingly never-ending efforts to clean up Lake Champlain. These stories would leave many Vermonters to believe that Vermont's lakes are in deep trouble. While these issues are very important, and restoration will be addressed through long-term management activities across multiple sectors, these headlines are not representative of the majority of the lakes and ponds of Vermont.

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2020 We Still Don't Know Why So Many of Vermont's Low Nutrient Lakes are Increasing in Phosphorus

- Land Use in the watershed and along tributaries and lakeshore
- Climate Change
  - Longer duration of stratification/lower dissolved oxygen levels
    - More net internal loading
  - More intense precipitation/runoff events
  - Lake Browning
- Recovery from Acid Rain and Lake Browning
- Atmospheric Dust

LITTLE AVERILL - data through 2019

Learn How Lakes Are Scored

Lake Area:
470.2 acres

Basin Lake Area Ratio:
6

Max Depth:
35.1 meters

Mean Spring TP:
6.8 ug/L

Mean Summer TP:

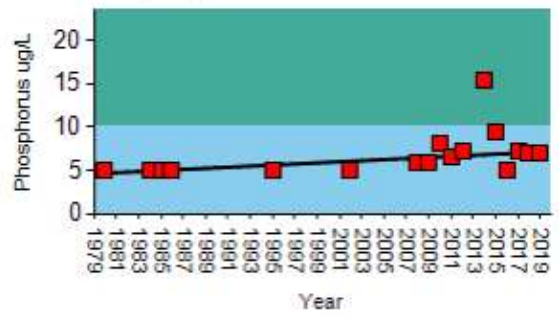
Mean Summer Chla:

Mean Summer Secchi:

Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic

Spring TP Trend: p = 0.0047 | CV = 38
Highly significantly increasing

Spring TP Annual Means



Summer TP Trend: p = n/a | CV = Insufficient Data

Summer TP Annual Means

Summer Secchi Trend: p = n/a | CV = Insufficient Data

Summer Secchi Annual Means

Summer Chla Trend: p = n/a | CV = Insufficient Data

Summer Chla Annual Means

Stresses / Impairments

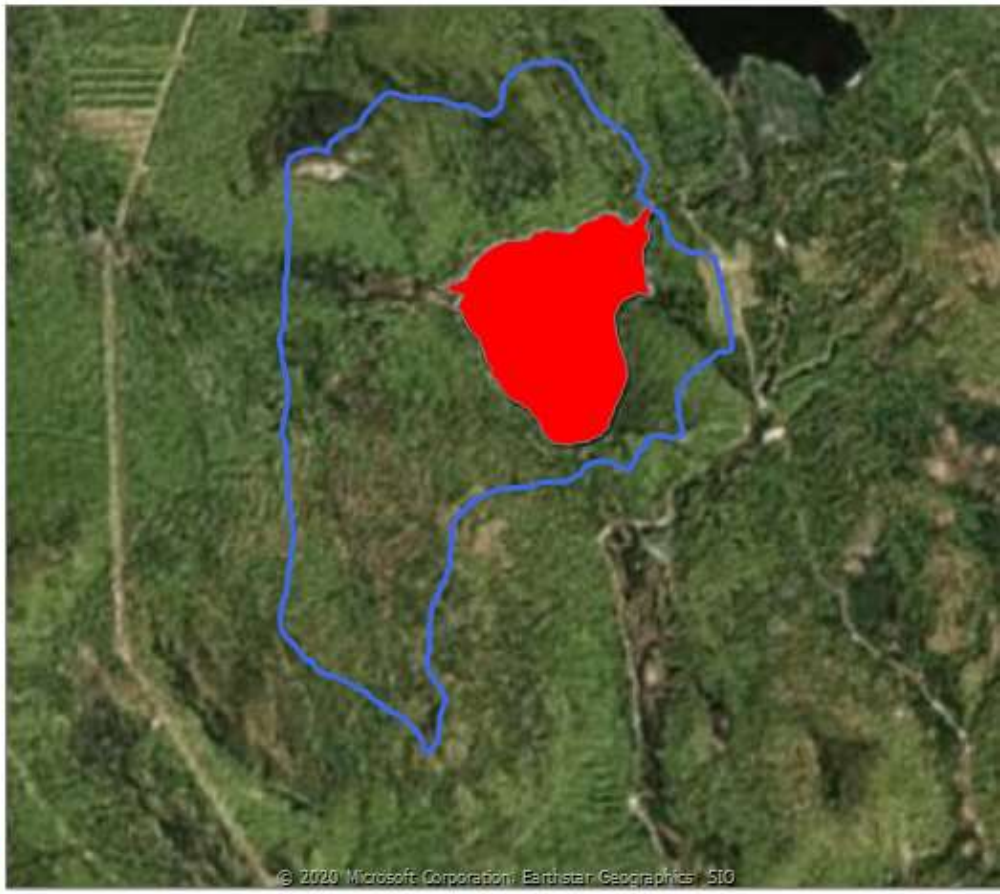
Altered -- Flow alteration

Stressed -- pH

Trend Score: Poor

WQ Standards Status: Altered

Watershed Score: Minimally Disturbed

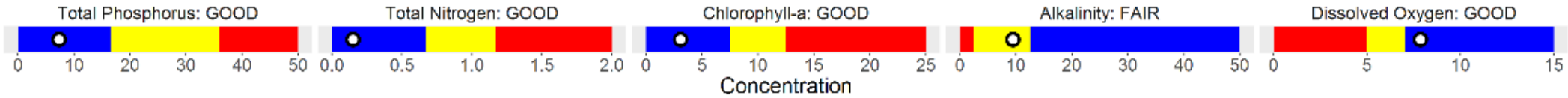


Map

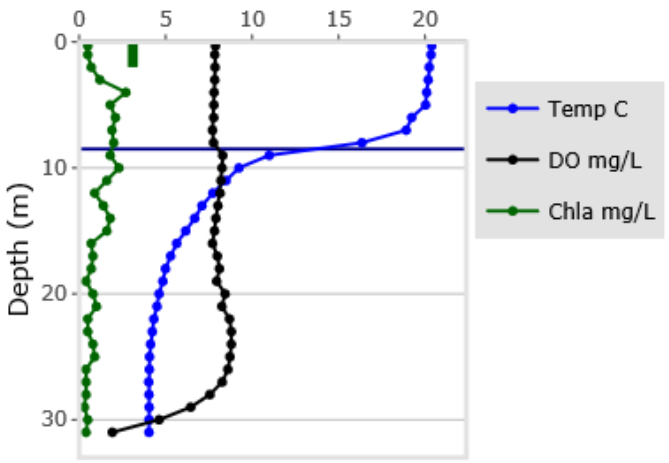
LITTLE AVERILL Report Card

Total Phosphorus	GOOD
Total Nitrogen	GOOD
Chlorophyll-a	GOOD
Alkalinity	FAIR
Dissolved Oxygen	GOOD
Lakeshore Disturbance	GOOD
Lakeshore Habitat	GOOD
Shallow Water Habitat	GOOD
Physical Complexity of Habitat	GOOD

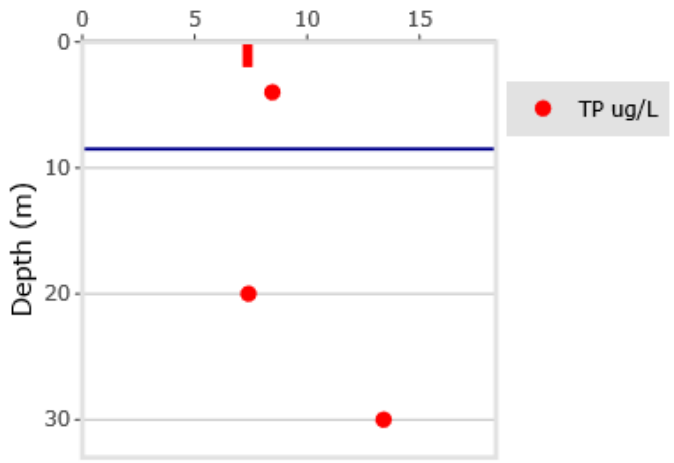
For more information about how lakes are scored, see:
Gauging the health of Vermont Lakes: Results of the 2007 National Lake Assessment



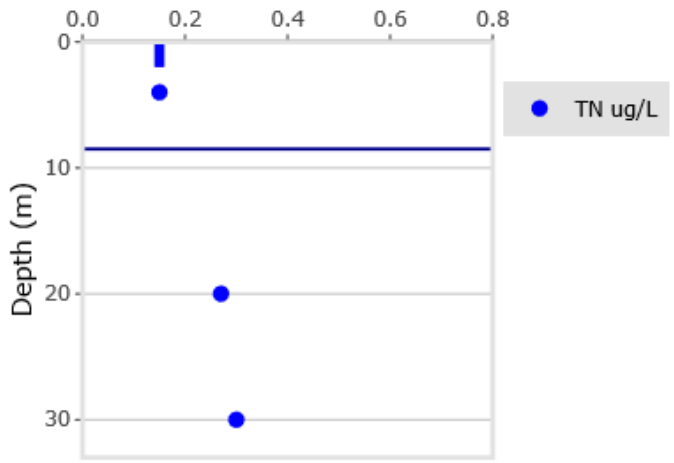
Temperature, Dissolved Oxygen, Chlorophyll-a



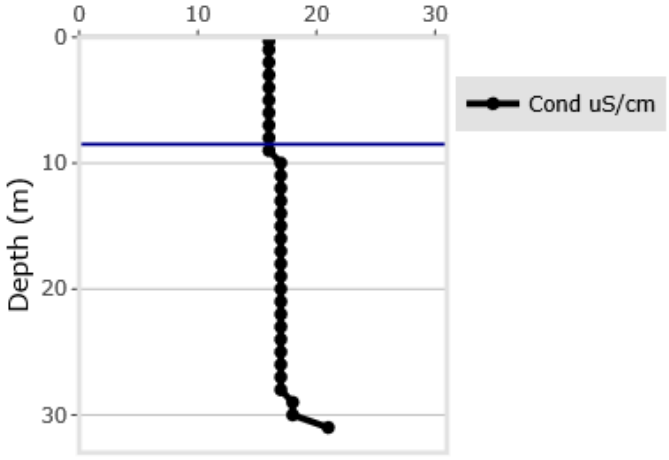
Total Phosphorus



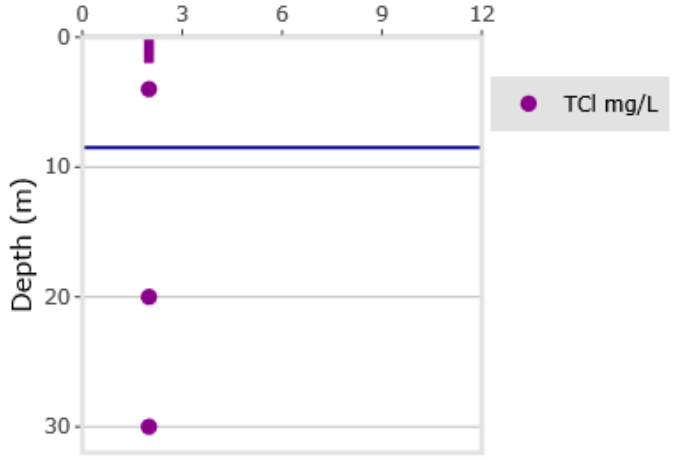
Total Nitrogen



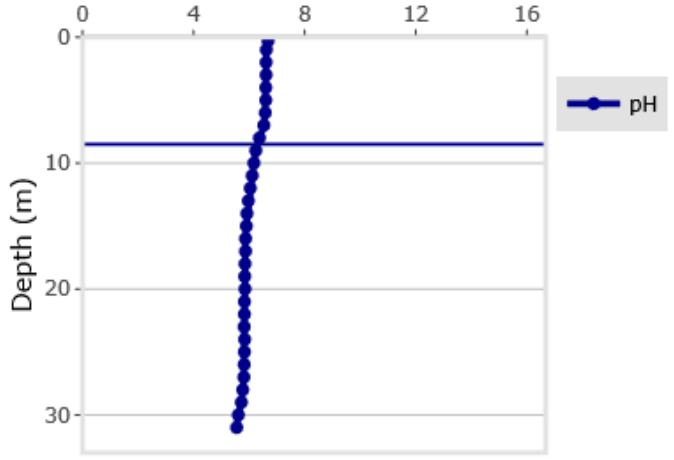
Conductivity



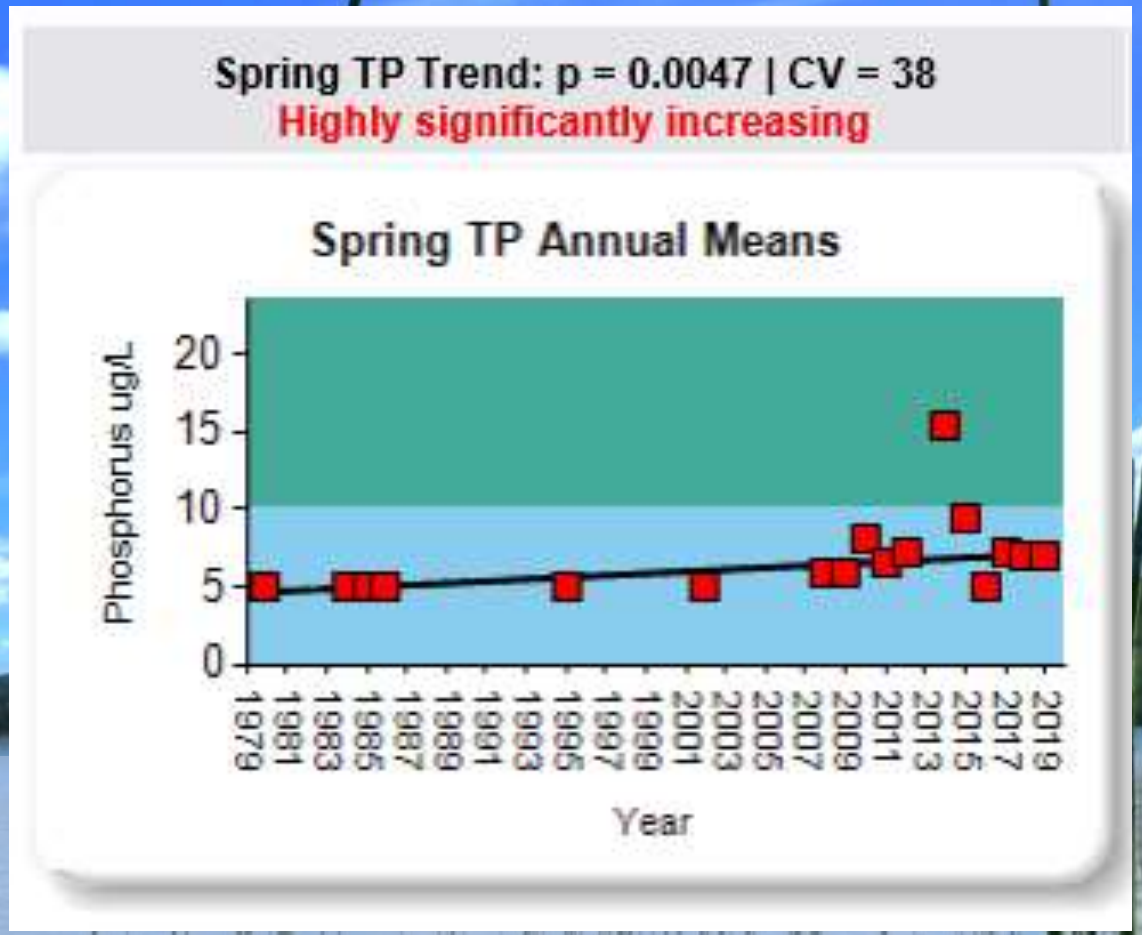
Chloride



pH



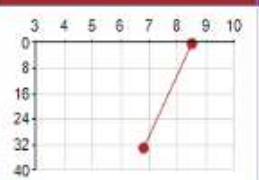
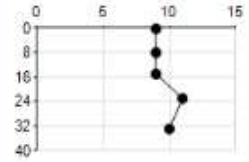
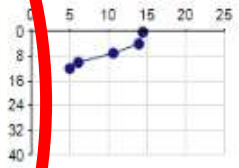
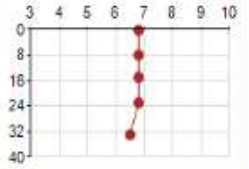
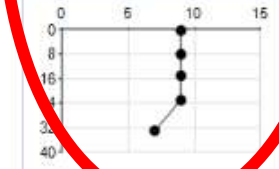
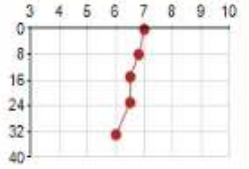
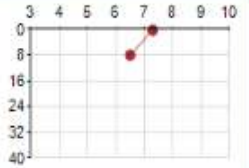
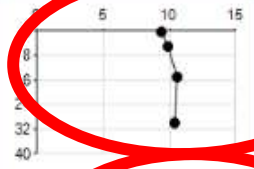
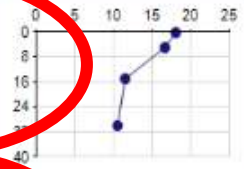
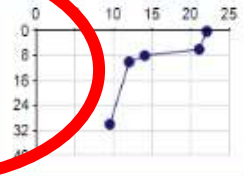
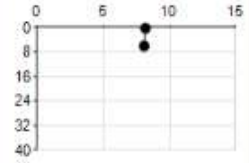
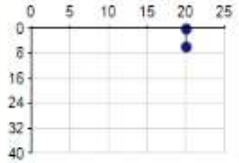
Climate Change:



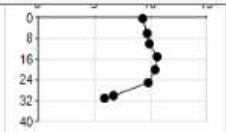
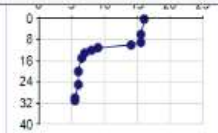
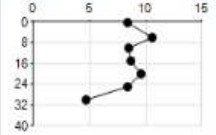
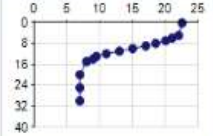
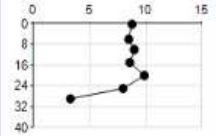
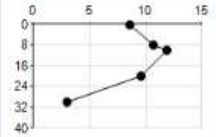
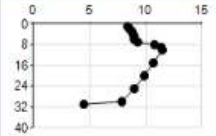
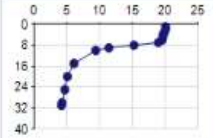
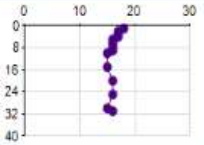
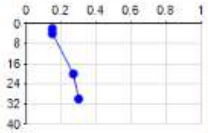
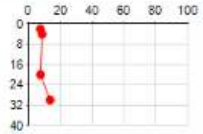
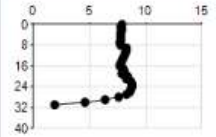
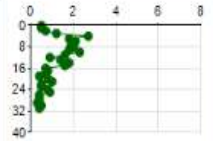
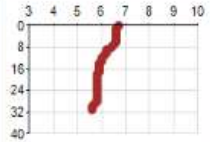
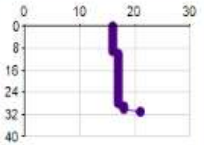
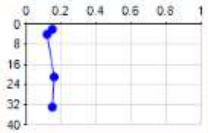
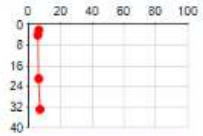
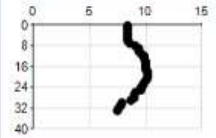
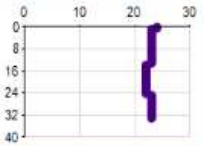
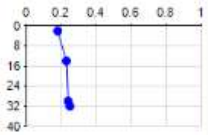
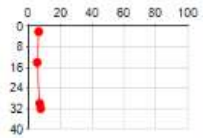
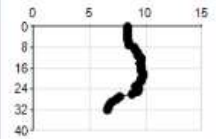
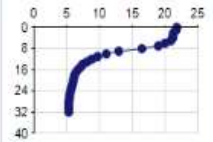
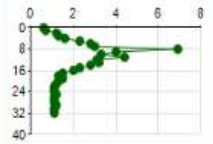
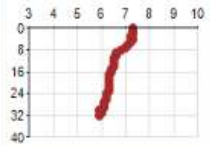
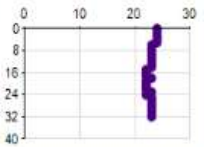
Longer duration of stratification/lower dissolved oxygen levels

More net internal loading

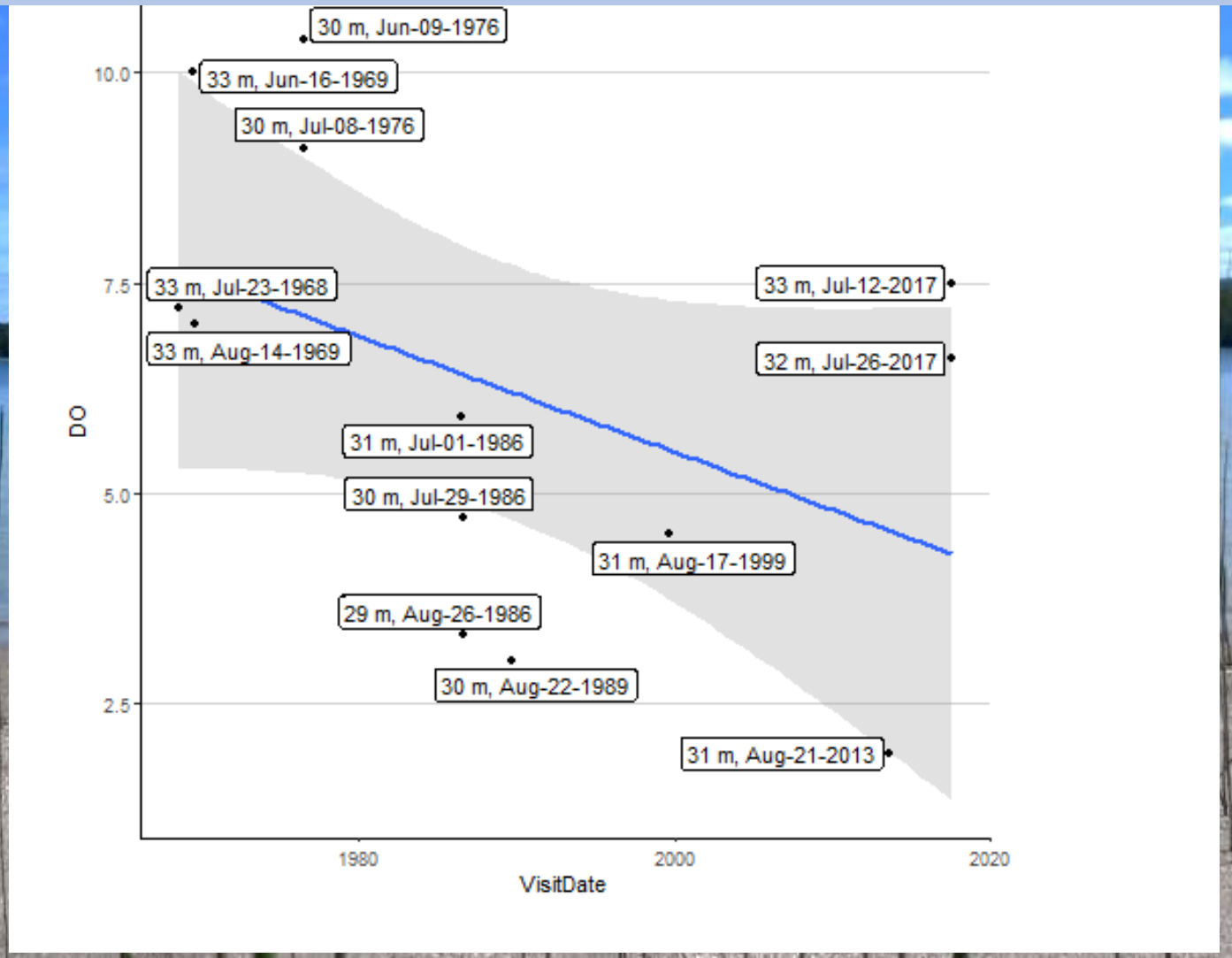
Summer Profiles (all years for one lake)

Visit Date	Station	Project ID	Total Nitrogen	Total Phosphorus	Dissolved Oxygen	Temperature	Chla	pH	Cond
7/23/1968	2	None							
6/16/1969	2	None							
8/14/1969	2	None							
8/9/1972	2	None							
6/9/1976	2	None							
7/8/1976	2	None							
8/3/1976	2	None							

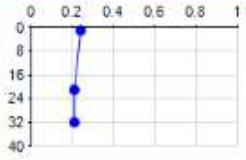
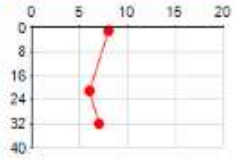
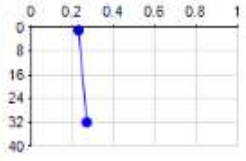
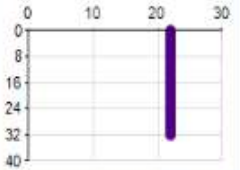
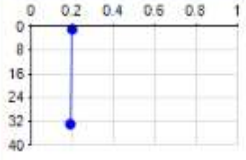
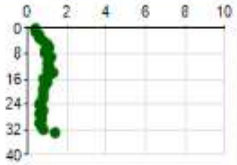
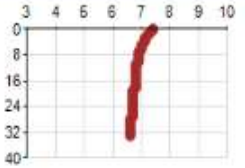
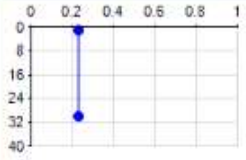
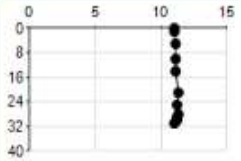
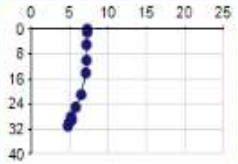
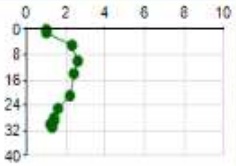
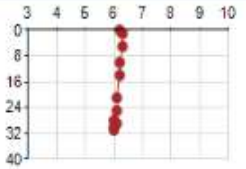
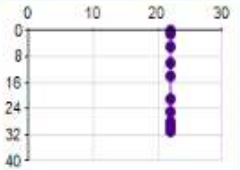
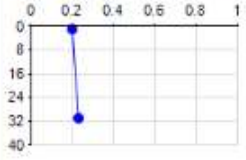
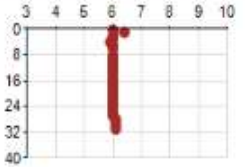
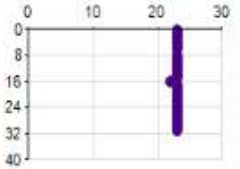
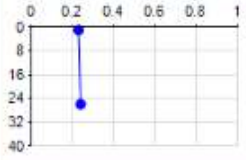
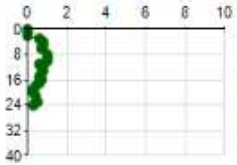
Summer Profiles (all years for one lake)

Visit Date	Station	Project ID	Total Nitrogen	Total Phosphorus	Dissolved Oxygen	Temperature	Chla	pH	Cond
7/1/1986	1	None							
7/29/1986	1	None							
8/26/1986	1	None							
8/22/1989	1	None							
8/17/1999	1	RemapHg							
8/21/2013	1	LakeAsmt							
7/12/2017	1	LakeAsmt							
7/26/2017	1	LakeAsmt							

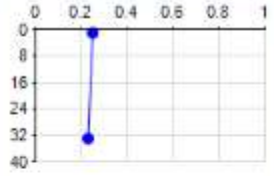
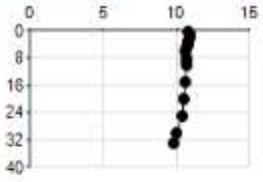
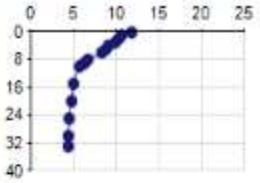
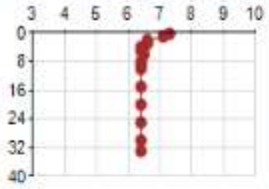
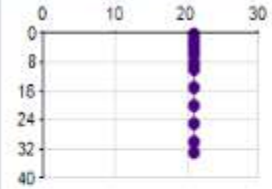
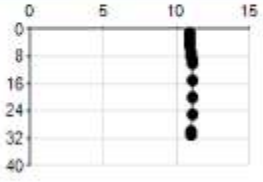
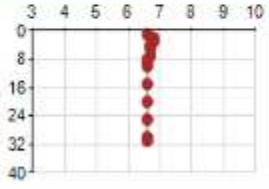
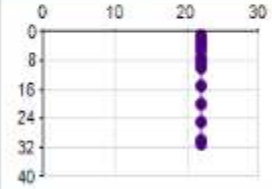
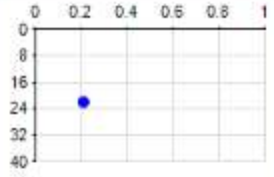
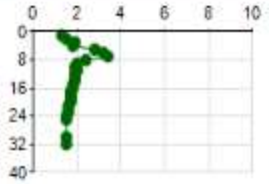
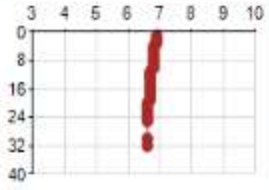
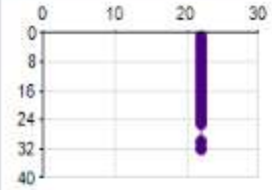
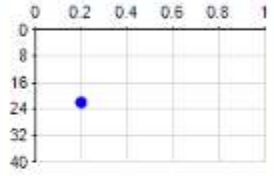
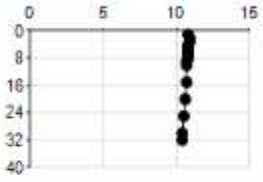
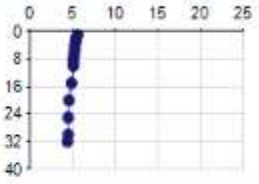
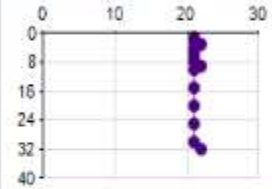
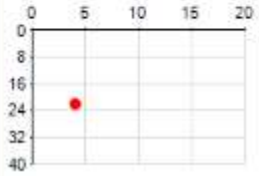
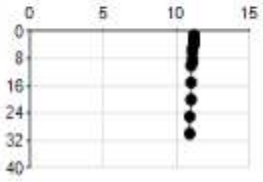
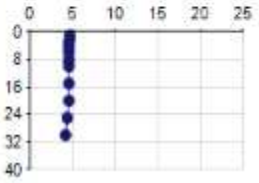
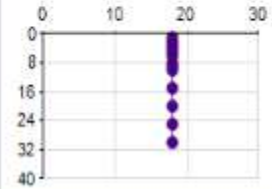
Summer Dissolved Oxygen Readings at 30-33m depth since 1968



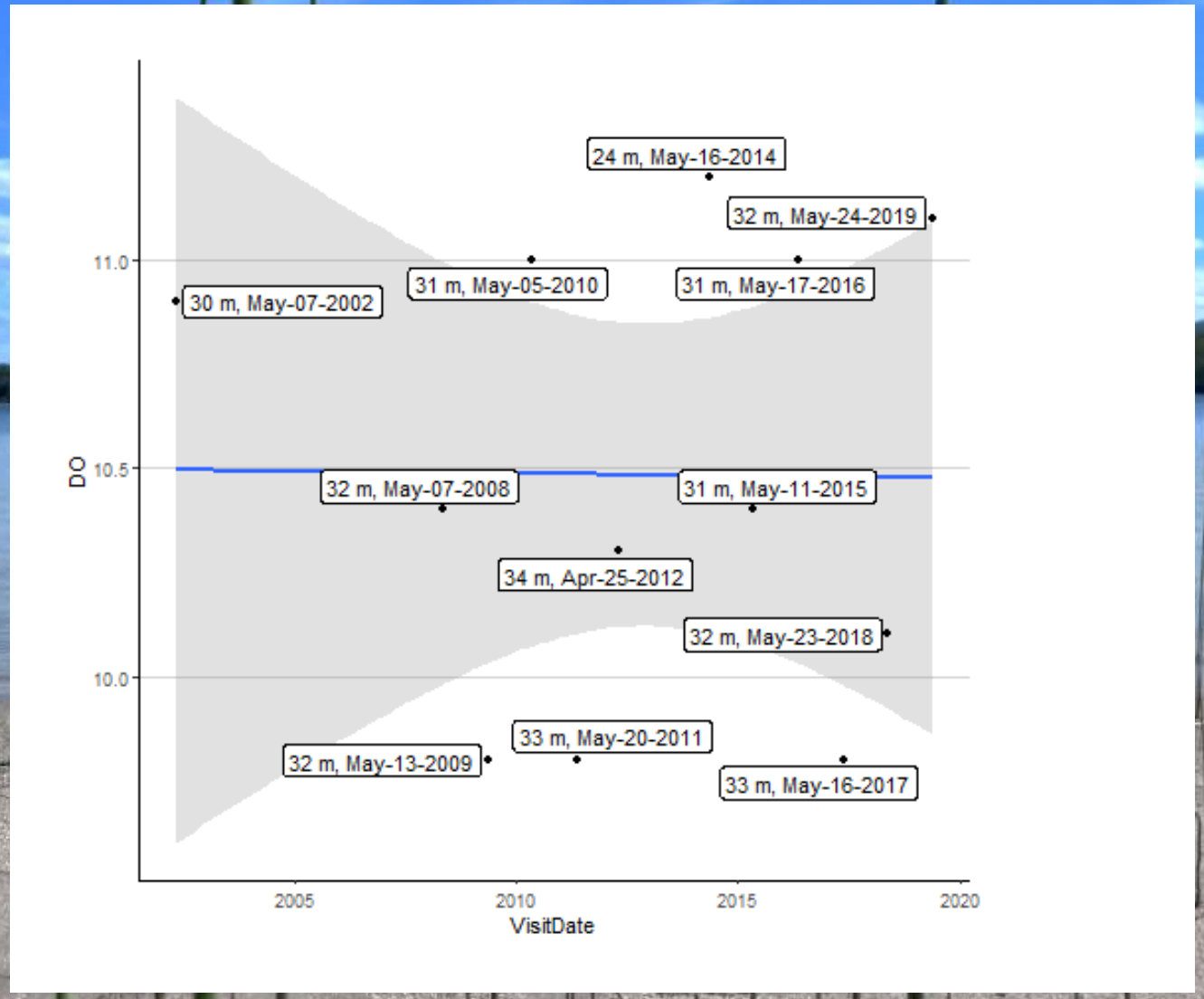
Spring P Profiles (all years for one lake)

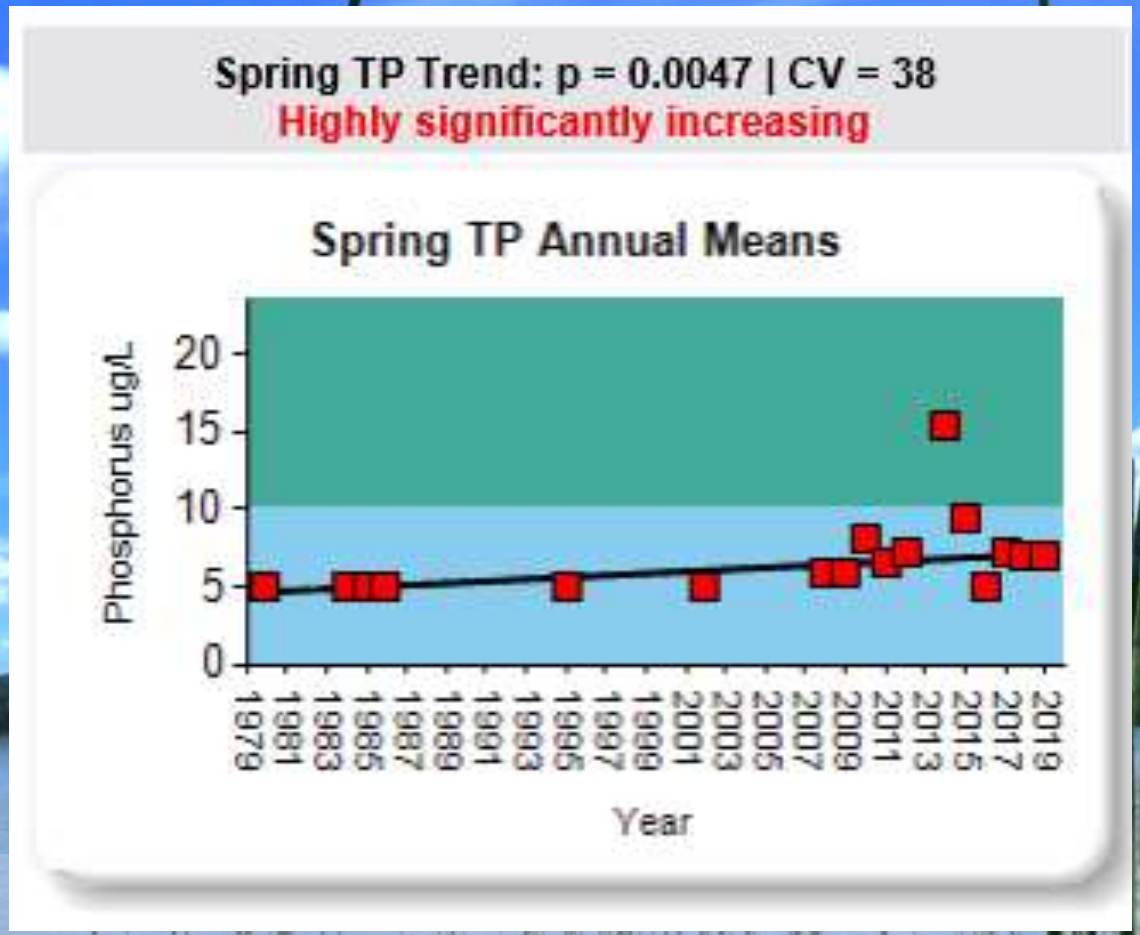
Year	Date	Total Nitrogen	Total Phosphorus	Dissolved Oxygen	Temperature	Chla	pH	Cond
2019	May 24							
2018	May 23							
2017	May 16							
2016	May 17							
2015	May 11							
2014	May 18							
2012	April 25							

Spring P Profiles (all years for one lake)

Year	Date	Total Nitrogen	Total Phosphorus	Dissolved Oxygen	Temperature	Chla	pH	Cond
2011	May 20							
2010	May 5							
2009	May 13							
2008	May 7							
2002	May 7							

Spring Dissolved Oxygen Readings at 30-33m depth since 2002

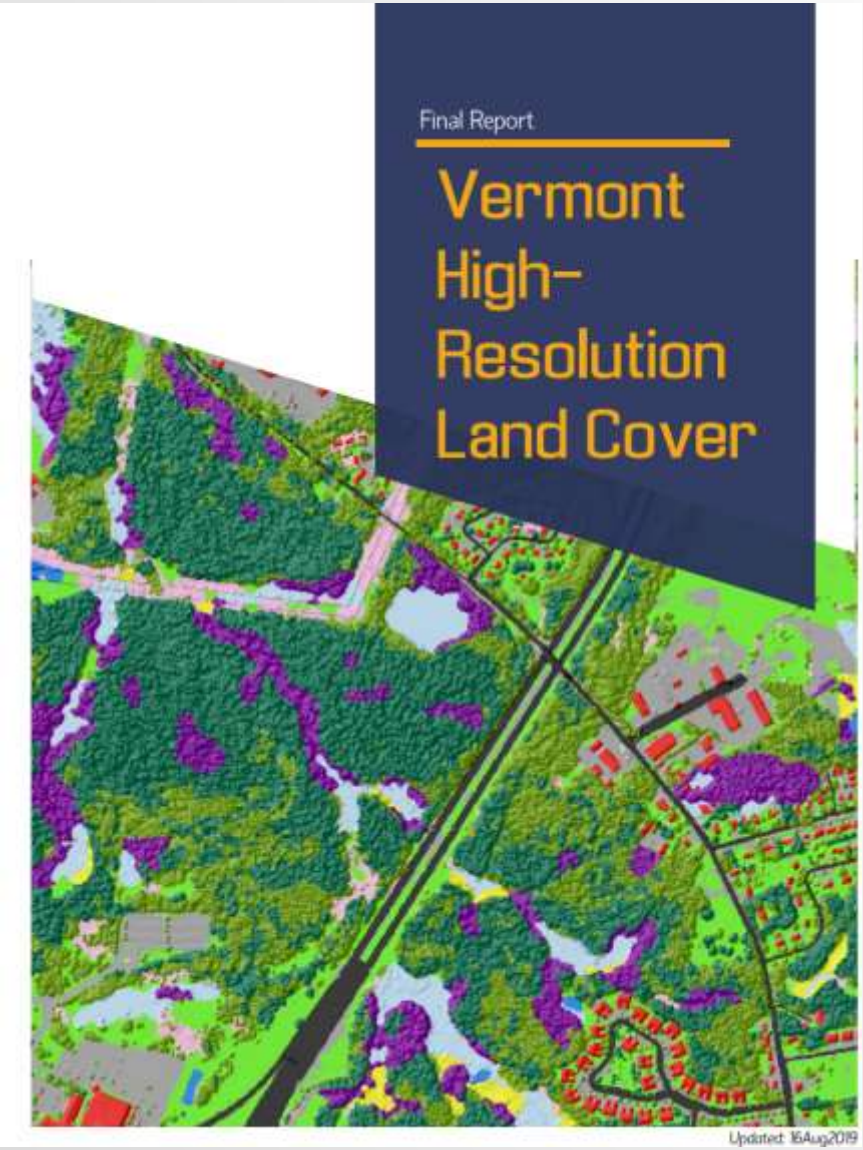




Land Use: Lakeshore

Potential lakeshore, tributary and watershed sources

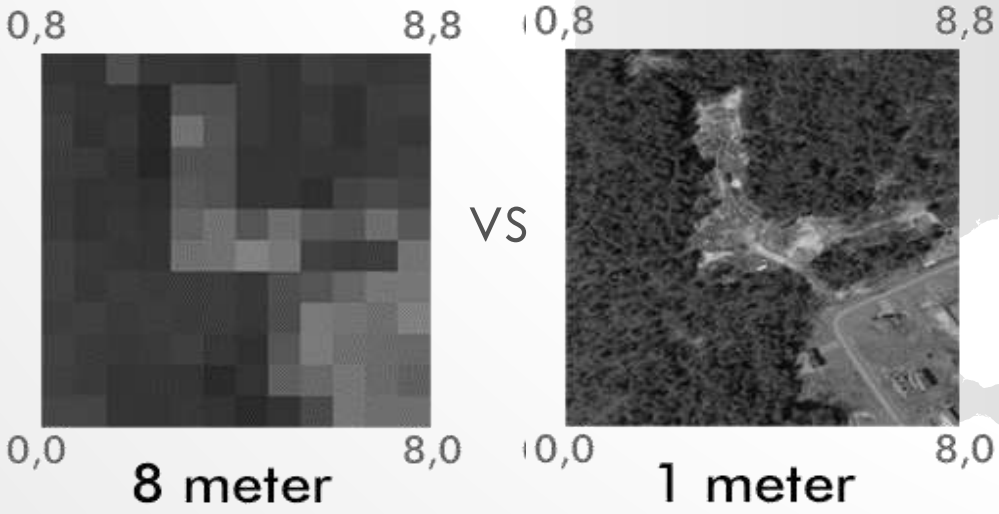
HIGH RESOLUTION LANDCOVER

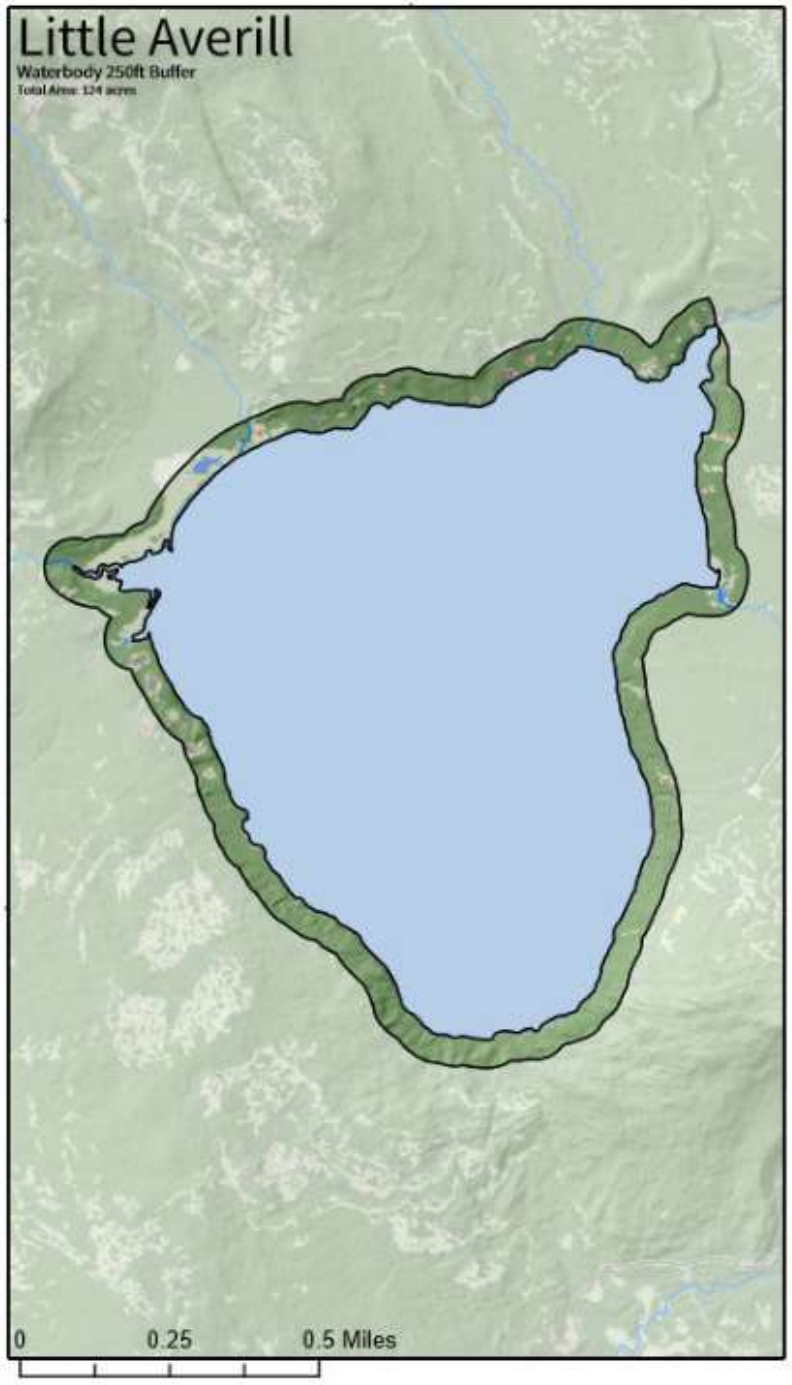


Half-meter resolution landcover classification for all of Vermont.

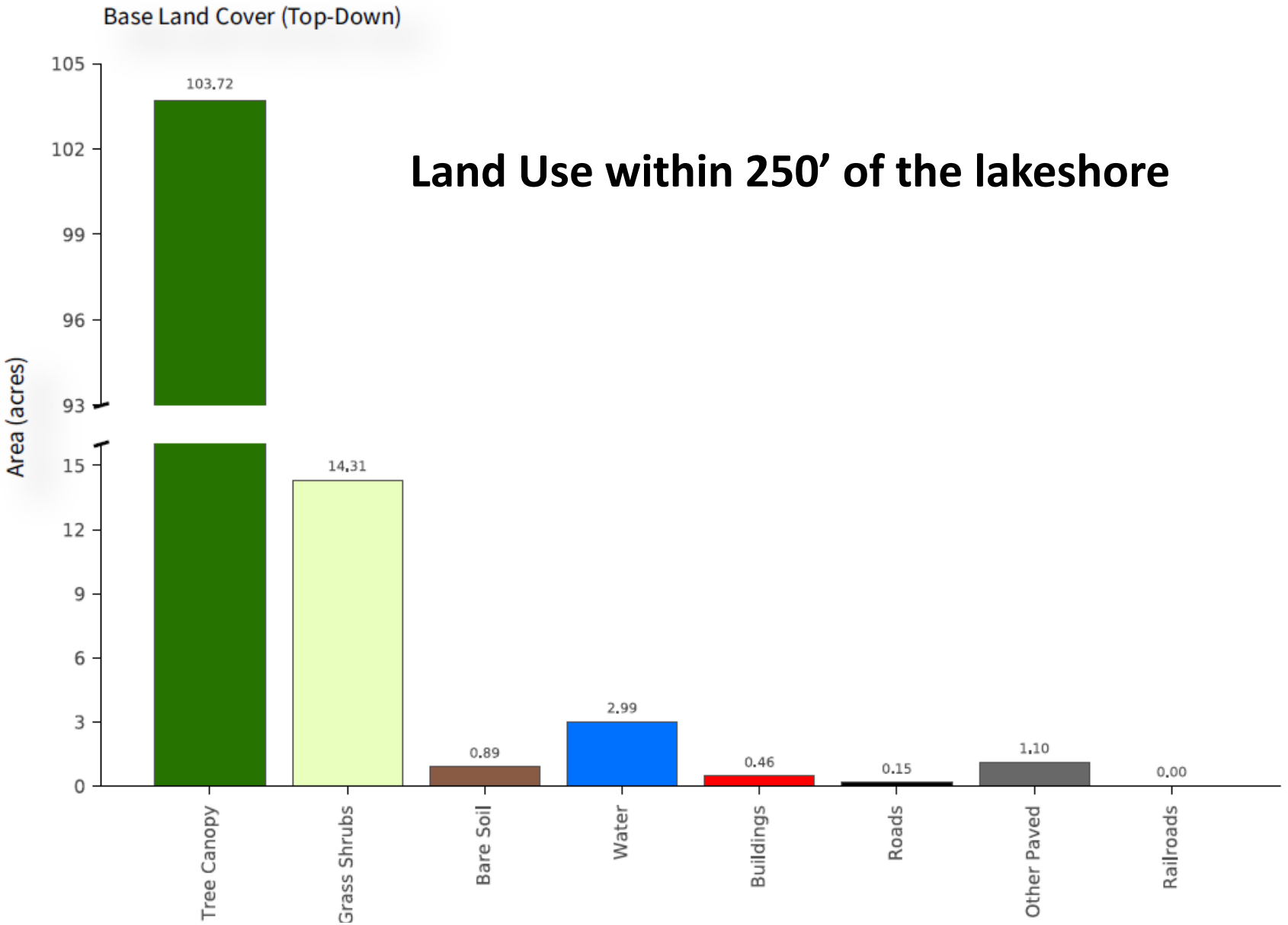
A project in partnership with:

- UVM Spatial Analysis Lab (SAL)
- Vermont Center for Geographic Information (VCGI)
- Lake Champlain Basin Program (LCBP)

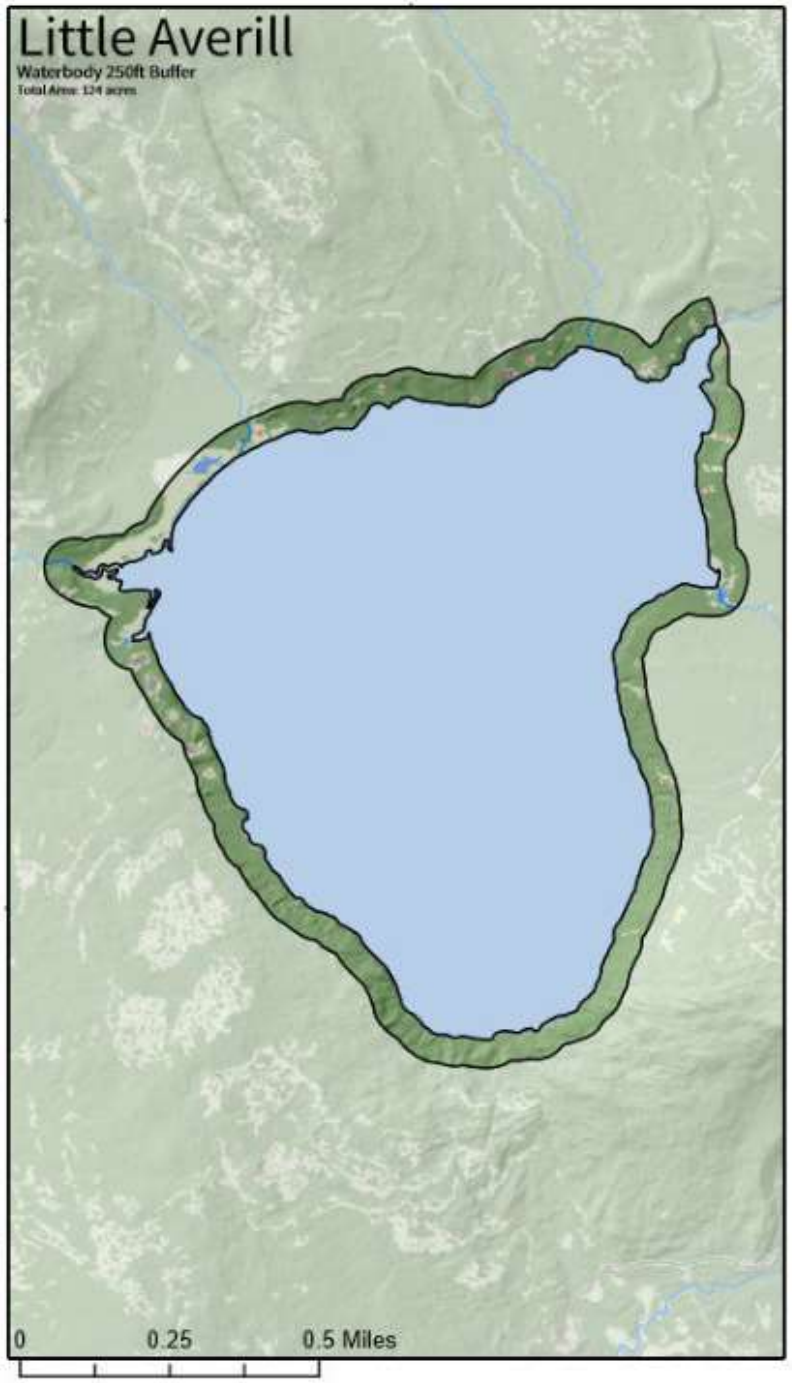




Land Use within 250’ of the lakeshore



Preliminary land use analyses conducted by VT ANR’s Colin Dowey using new 0.5m resolution land cover data created by the UVM Spatial Analysis Laboratory



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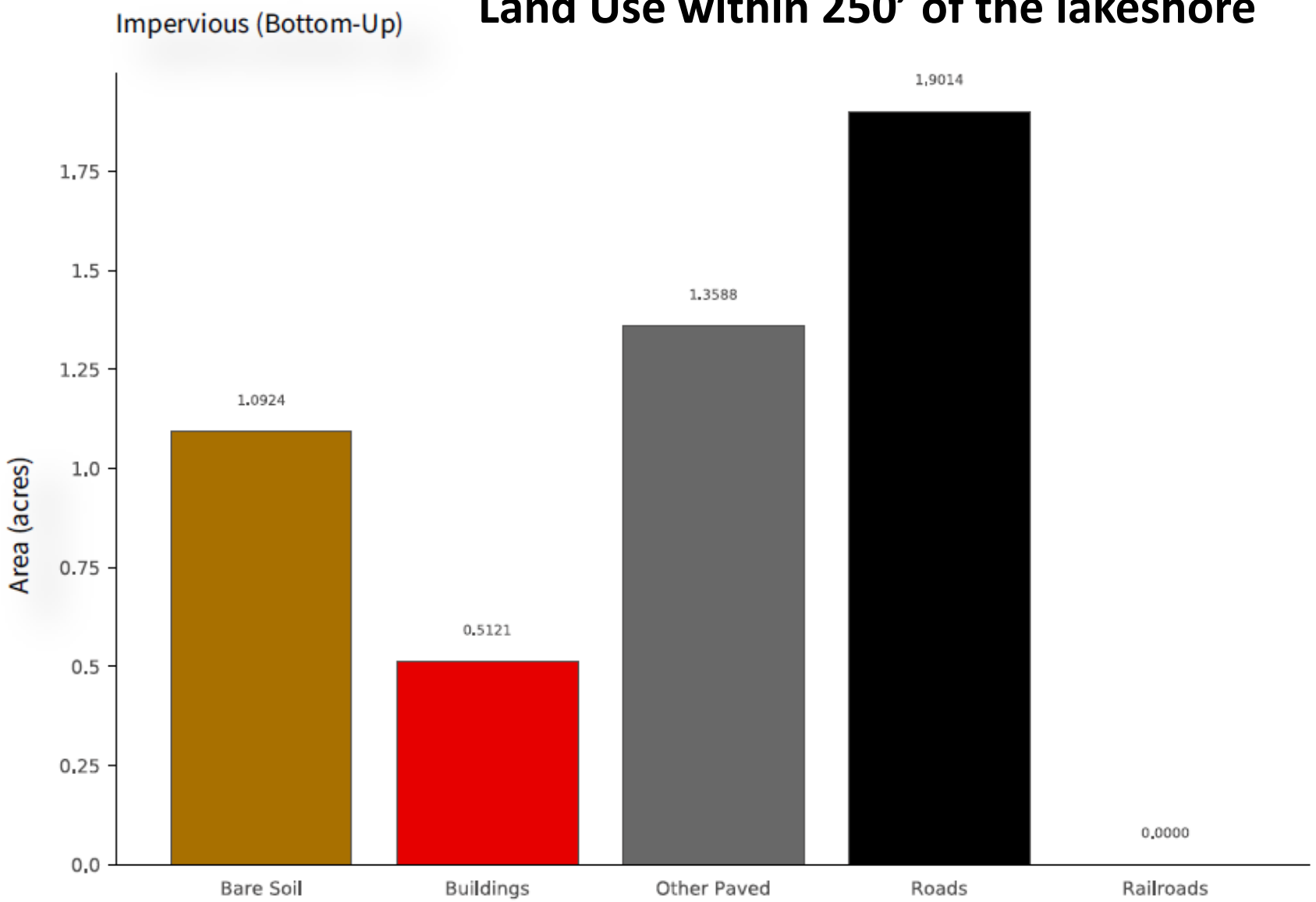

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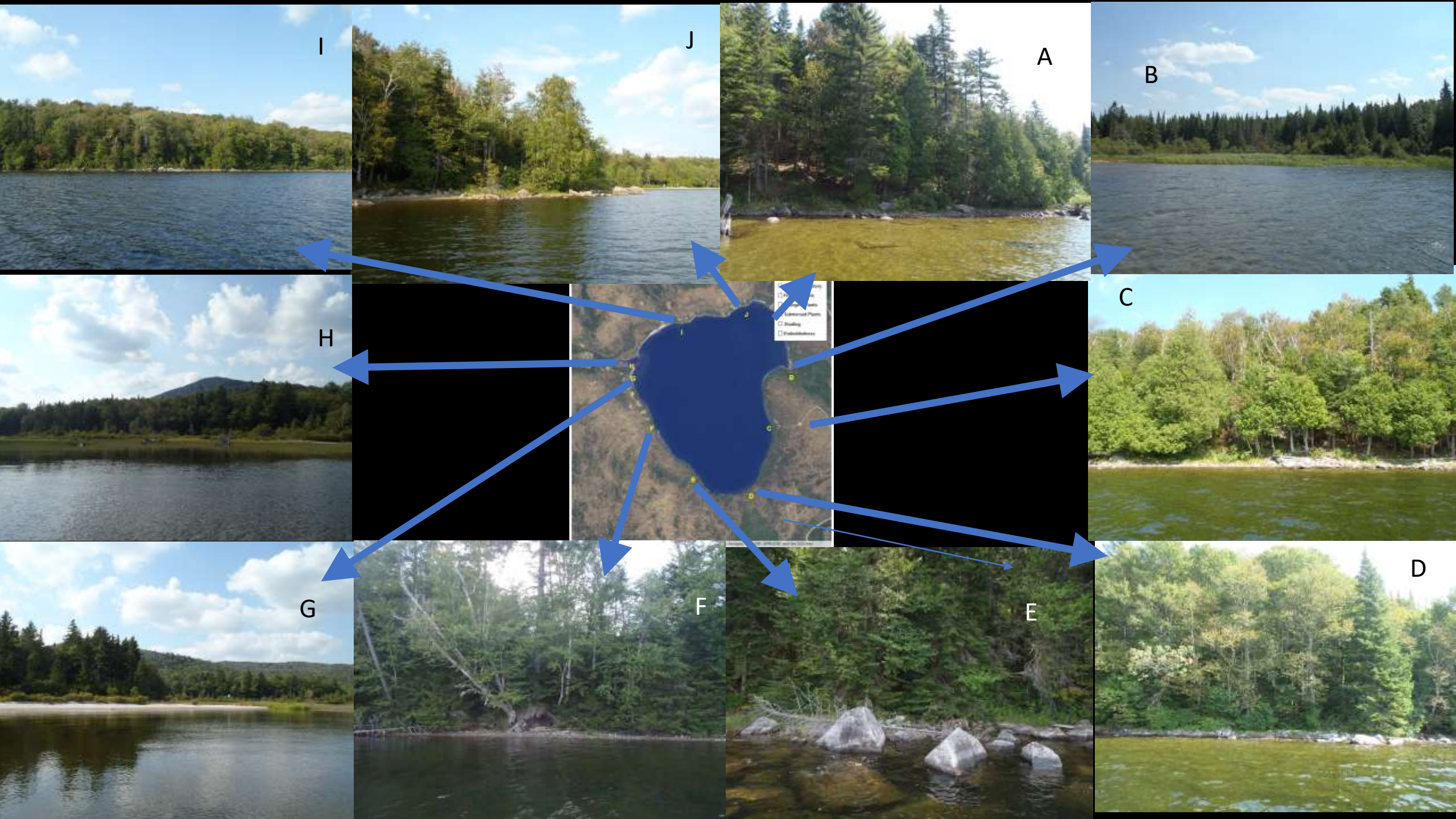
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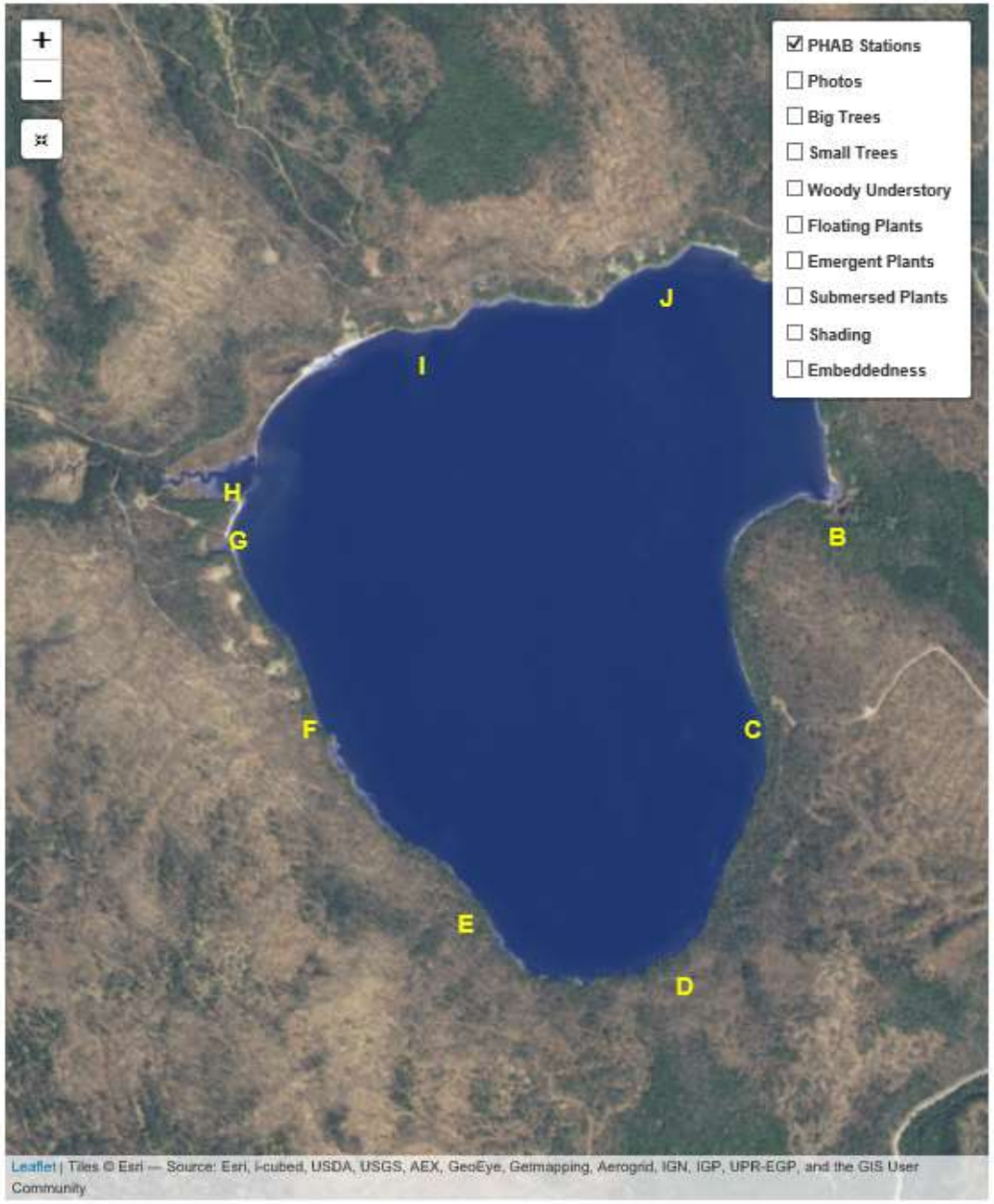
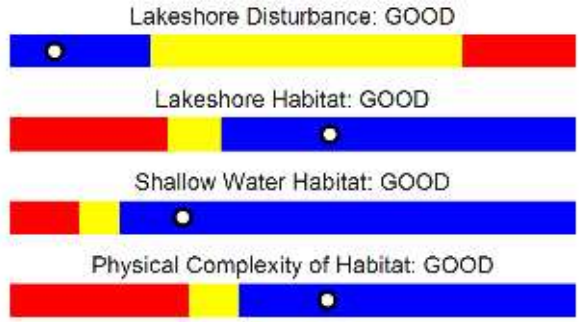
Interactive Map



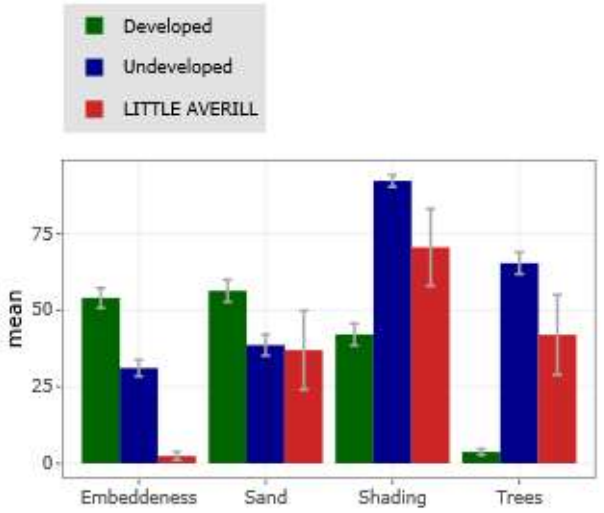
Assessments

Assessments based on habitat indexes developed by EPA's National Lake Assessment program.



Habitat Comparisons

Comparison of the average habitat characteristics of sites around LITTLE AVERILL with the average habitat characteritics at undeveloped and developed sites at other lakes in the state.



SHORELAND BEST MANAGEMENT PRACTICES

https://dec.vermont.gov/watershed/lakes-ponds/lakeshores-lake-wise/bmp

Lake Wise
Vermont Lakeshore Management

Lake Wise practices apply to the land surrounding a lake that is within 250 feet of the lake's mean water level.

Managing Vermont lakeshores according to consistent practices will maintain property values, good water quality, good aquatic habitat, good fishing, swimming, boating, bird-watching and more favorite activities around and benefits of Vermont lakes. Using Best Management Practices ensures lakeshore conditions are met.

Click here for a single page listing of all Vermont Shoreland BMPs

Best Management Practices

Conserving Lakeshores - Ensuring Natural Conditions
Shoreland Vegetation Management Standards - Ensuring Natural Conditions
Resloping, Rock Toe & Rip Rap - Bank Stabilization
Live Staking - Bank Stabilization
Establishing No Mow Zones - Bank Stabilization
Planting and Maintaining Vegetated Areas
Planning Pathways - Minimizing Access Points
Infiltration Steps - Ensuring Clean Runoff
Rain Gardens - Ensuring Clean Runoff
Waterbars - Ensuring Clean Runoff
Vegetative Swales - Ensuring Clean Runoff
Vegetated Berms (not yet available) - Ensuring Clean Runoff
Lake-Friendly Yard Maintenance - Pet Waste, Yard, etc.
Crowned Driveways, Good Gravel & Rock or Grass
Lined Drainage Ditches (not yet available) - Proper Construction
Open Top Culverts & Rock Aprons - Controlling Runoff
Infiltration Trenches - Controlling Runoff
Turn-outs - Controlling Runoff
Pervious Pavement - Water Infiltration
Dripline Trenches- Controlling Runoff
Roof Top Downspout Disconnection and Drywells
Managing Invasive Plants
Establishing Natural Communities

List of Shoreland BMPs

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
LAKES & PONDS PROGRAM

Lake Wise Conditions, BMPs and Fact Sheets

While living along a shore, it's critical to understand the conditions that help protect the functions and values of lakes, such as water quality; aquatic habitat; fishing; swimming; boating; bird-watching; property values; and others. Using Best Management Practices (BMPs) will help achieve the healthy shoreland conditions needed to protect the lake.

Driveway

Condition	BMP and Fact Sheets
• Defined and minimized driveway • Minimized soil compaction • No erosion • Runoff channeled away from the lake	• Crowned driveways, good gravel, & rock- or grass-lined drainage ditches • Open-top culverts & rock aprons • Infiltration trenches • Turnouts • Pervious pavement • Non-structural BMPs

Recreation Area

Yards, Footpaths, Gardens, Patios

Condition	BMP and Fact Sheets
• Minimum of 15 ft of vegetation from shoreline • Minimal lawn area • Soil erosion is not occurring on site • No pet waste accumulation • No solid waste scattered • No pesticide, fertilizer, or runoff to lake	• Infiltration steps • Rain gardens • Waterbars • Lake-friendly yard maintenance • Planting & re-naturalizing areas • Planning pathways • Establishing no-mow zones • Vegetated swales • Vegetated Berms • Vegetation Protection Standards

Structures/Septic

Condition	BMP and Fact Sheets
• Less than 20% of property contains impervious surfaces • Properly functioning leach field • No uncovered oil tanks • No erosion caused from impervious surface runoff	• Septic system primer • Ensuring septic system quality • Dripline trenches • Drywells • Infiltration trenches • Rain gardens • Vegetated swales

Shorefront

Condition	BMP and Fact Sheets
• Natural conditions • Stable bank • Minimum of 15 ft width of vegetation area for developed sites • Minimum of 100 ft width for undeveloped sites • No unfiltered runoff to the lake • Shallow water areas natural and not "cleaned up"	• Conserving lakeshores • Resloping, rock toes & riprap • Live staking vegetation • Planting & re-naturalizing areas • Planning pathways • Waterbars • Establishing no-mow zones • Vegetation Protection Standards

Crowned Driveways, Good Gravel, & Rock or Grass Lined Drainage Ditches

Proper construction

Lake friendly living means using lakeshore Best Management Practices

BMP

Crowned Roads, Good Gravel, and Rock-lined Drainage Ditches

STANDARDs

Driveway

- Defined and minimized driveway
- Minimized soil compaction
- No erosion
- Runoff channeled away from the lake

LAKE BENEFITS

Every road or driveway can become a conduit for rainwater or snowmelt, eroding the road material and introducing it to nearby streams or lakes. The runoff brings damaging sediment and nutrients into water. It is critical to properly maintain driveways in the shoreland area due to their proximity to the lake. Minimizing the potential for erosion will keep lake water and shorelines clean and free from algal and plant growth caused by sedimentation.

Crowned Driveways

Description: Driveway crowning is the primary means by which surface water is drained off the driveway surface. To crown a driveway means to create a high point that runs lengthwise along the center of the road. Either side of this high point is sloped gently away from the center toward the outer edge of the road. Crowning is one of the quickest ways to get water off the driveway, preventing significant erosion of the road surface.

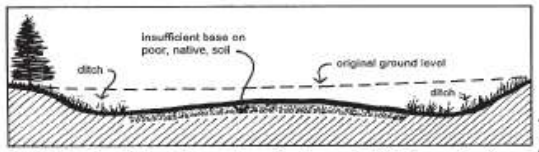
Source: Gravel Road Maintenance Manual

Crowned driveway with a rock-lined drainage ditch.

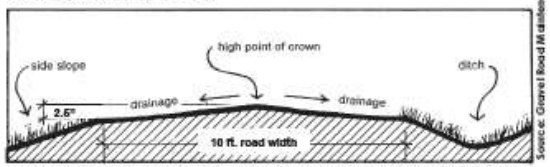
Purpose: A properly crowned driveway allows water to flow immediately off the road into surrounding vegetation or a stabilized ditch instead of into the lake (see figures below for a comparison between poor and proper driveway construction).

How to:

1. Measure the width of the gravel driveway with a long measuring tape.
2. Divide the width in half to find the high point of the crown. For example, if the driveway is 10 feet wide, the high point will be at the 5-foot mark.
3. Calculate the height of the crown by counting 1/2-inch for every foot of driveway from the center to the edge. For example, a 10-foot driveway will have a 2 1/2-inch-high crown in the center.
4. Pour your top layer of gravel in the center of the driveway. Use 3/4-inch sized stones for the top layer.
5. Spread the gravel out using a metal rake from side to side, shaping the crown at the desired height.
6. Smooth the gravel to each side so it gently slopes down to both driveway edges.



Poorly constructed road: poor base, inadequate ditching and built below original ground level.



Source: Gravel Road Maintenance Manual

Crown profile: ½" of crown per foot of road width from the center. (e.g. 10 ft/2 = 5 ft high point of crown, 5 ft x 1/2" = 2 1/2" crown height).

Septic System Primer

The basics and Vermont on-site regulations

Lake friendly living means using lakeshore Best Management Practices

BMP

Septic System Primer

STANDARDs

Structures/Septic

- Properly functioning Leachfield

LAKE BENEFITS

Knowing the layout of your septic system and how it works ensures that you will get the most efficient use out of it, while preventing any contamination to the lake. Properly functioning septic systems keep the lake safe for human and wildlife use. Read the companion BMP "Ensuring Septic System Quality" to learn more about assessing and caring for your wastewater treatment system.

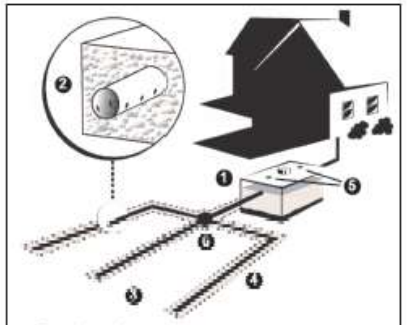
PERMITTING

More information on Regional Office Permits, permit conditions, and the importance of complying with permit conditions can be found at the Dept. of Environmental Conservation's Drinking Water and Ground Water Protection at: http://dec.vermont.gov/water/programs/ww-systems/permit-compliance.

Septic System Primer

Description and Purpose:

Septic systems are wastewater treatment systems that collect, treat, and disperse wastewater generated by a home or business. The wastewater is treated and discharged to the soils rather than collected and transported to a wastewater treatment plant. The typical septic system consists of a septic tank and a leachfield to disperse the wastewater into the ground.

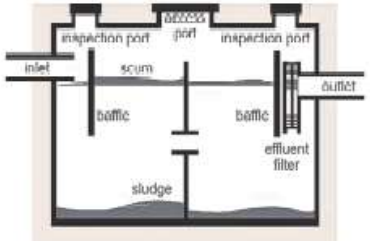


Typical Septic System

The first point of treatment of a septic system is the **SEPTIC TANK** that is a buried, watertight container usually made of concrete, fiberglass or polyethylene. Its job is to hold the wastewater long enough for solids to settle to the bottom (forming sludge) and for the oil and grease to float to the top (as scum).

The tank should have an **EFFLUENT FILTER** at the outlet to keep solids from leaving the tank and clogging the leachfield.

Many systems include a **DISTRIBUTION BOX** that splits the flows from the septic tank into multiple leach lines in the dispersal system.



Cross section of a two-compartment septic tank

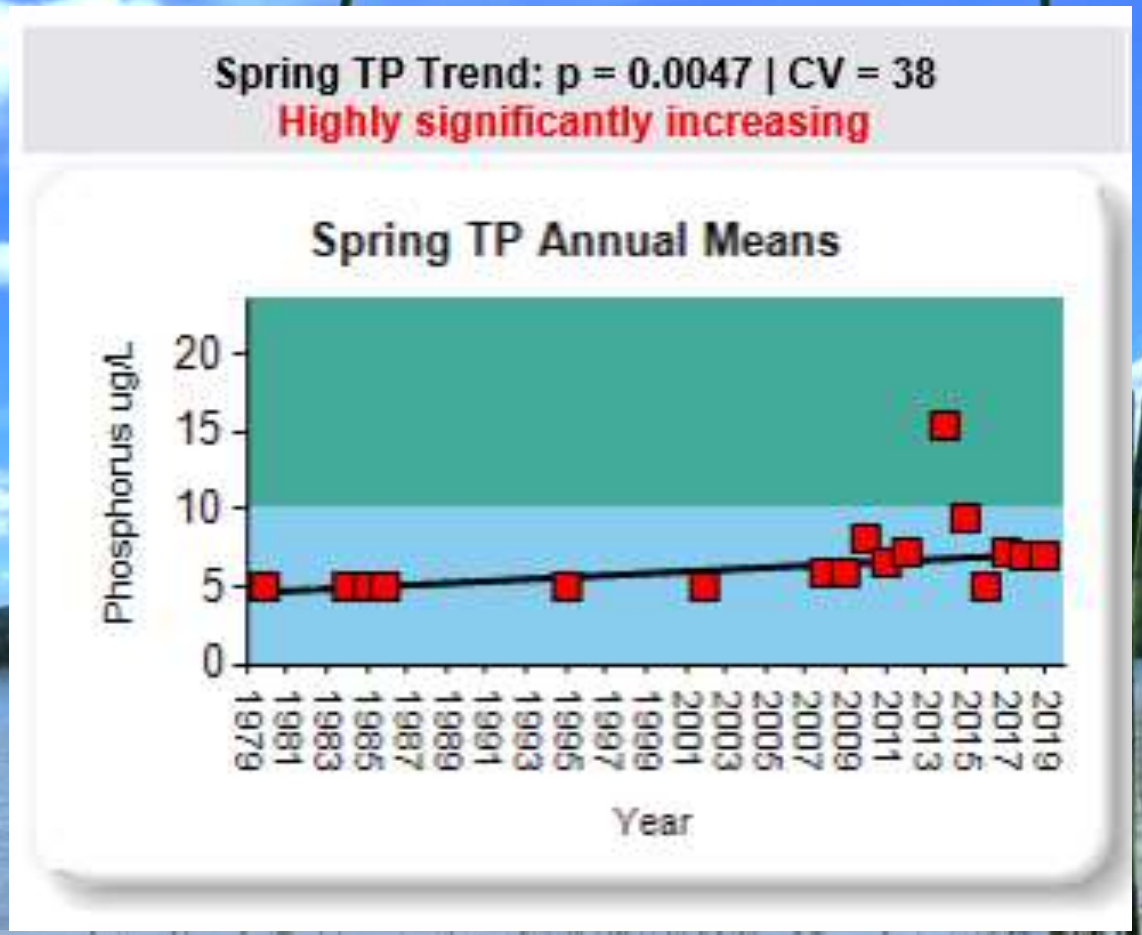
The dispersal system or **LEACHFIELD** can be completely below the natural grade (ground level) and consist of an absorption bed or trenches, be placed at-grade, or be a mound, above ground. Further treatment of the wastewater occurs as it flows into and through the soils. If the leachfield is uphill of the septic tank, or if an at-grade or mound system is constructed, there typically will be a **PUMP TANK** to dose or pressurize the dispersal system.

Learn More About Septic Systems:

- 5-minute video on septic systems – "It's All Connected": www.ewashtenaw.org/government/departments/environmental_health/recycling_home_toxics/green_media/septic_video.

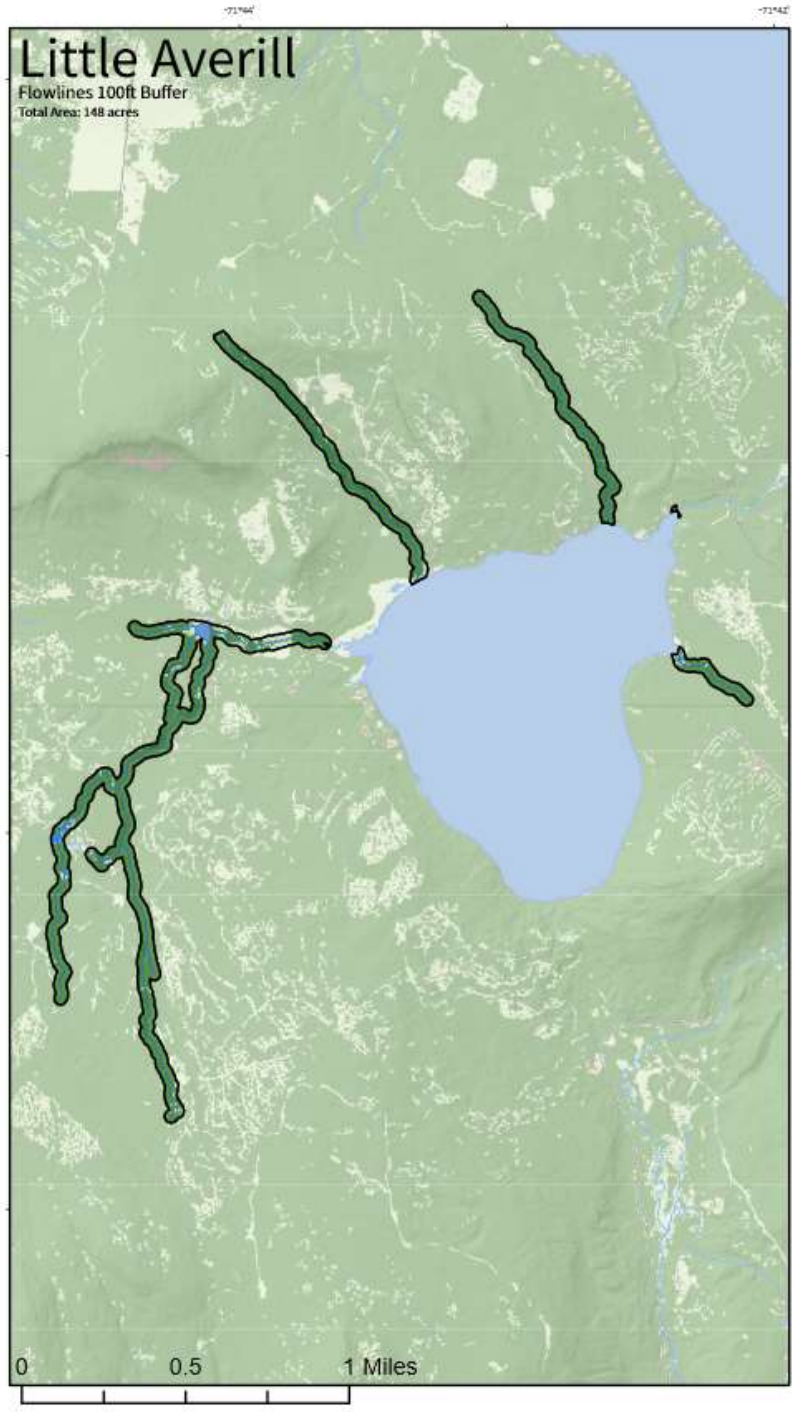
Animated interactive model of how a

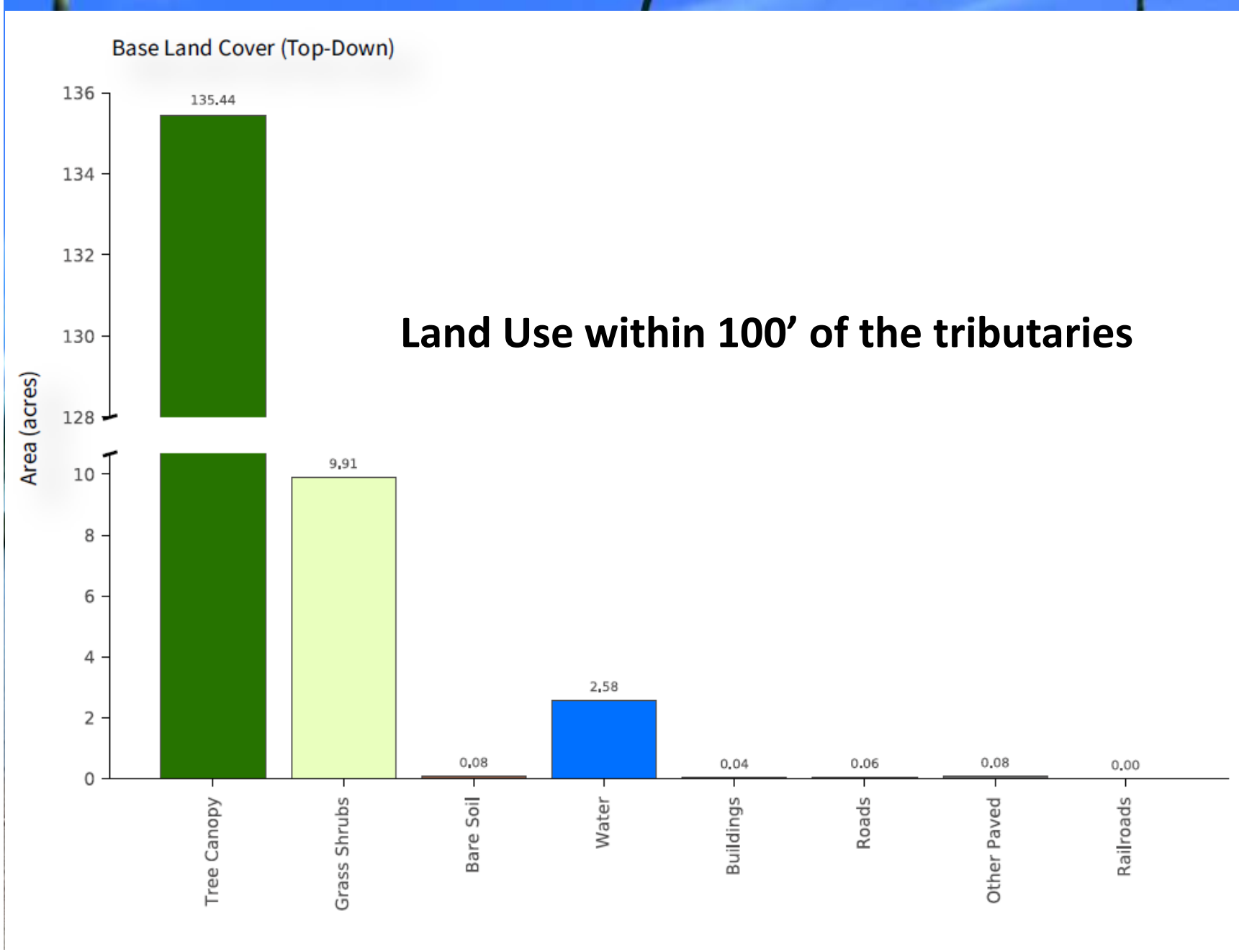
- septic system works www.gbra.org/septic.swf



Land Use: Tributaries

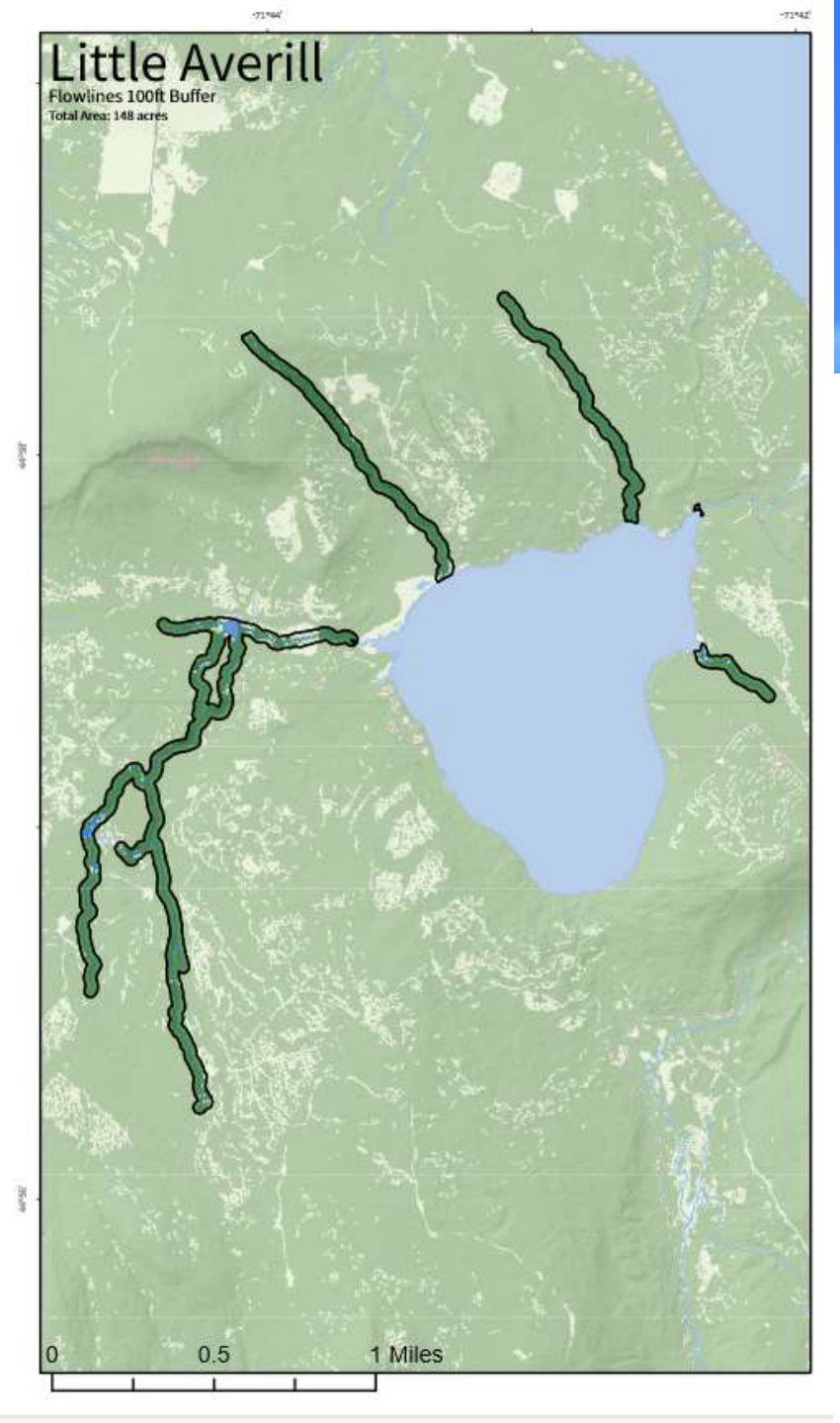
Potential lakeshore, tributary and watershed sources

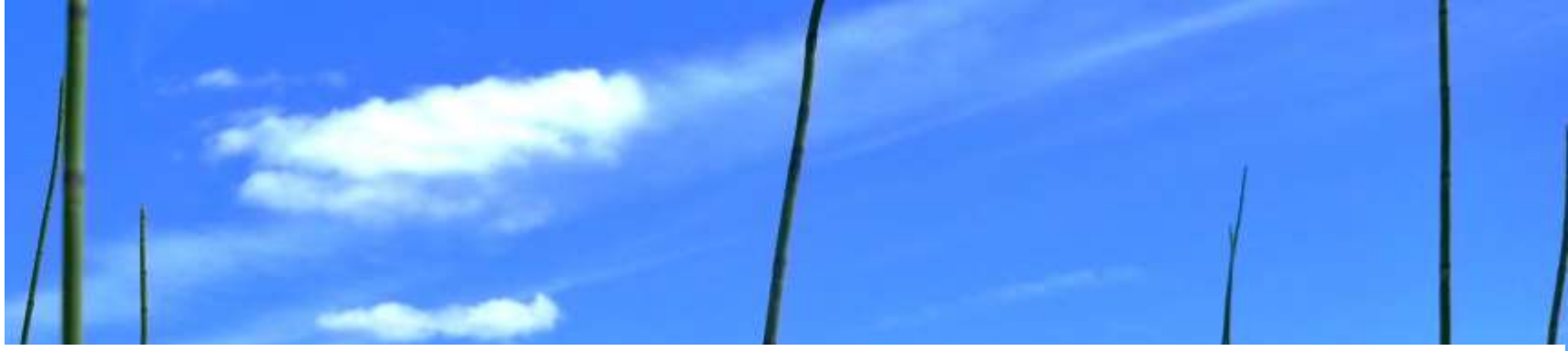




Land Use within 100’ of the tributaries

Preliminary land use analyses conducted by VT ANR’s Colin Dowey using new 0.5m resolution land cover data created by the UVM Spatial Analysis Laboratory





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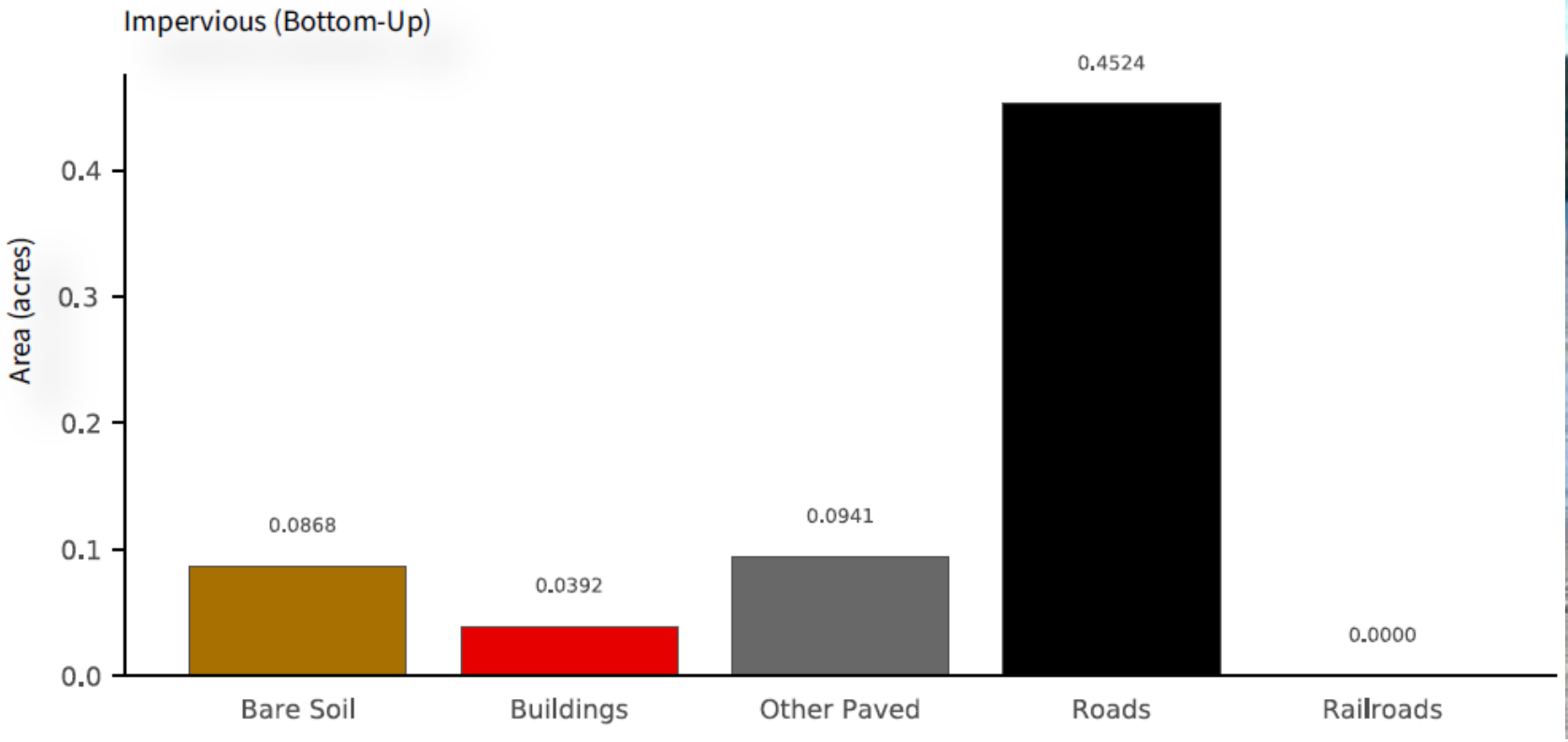

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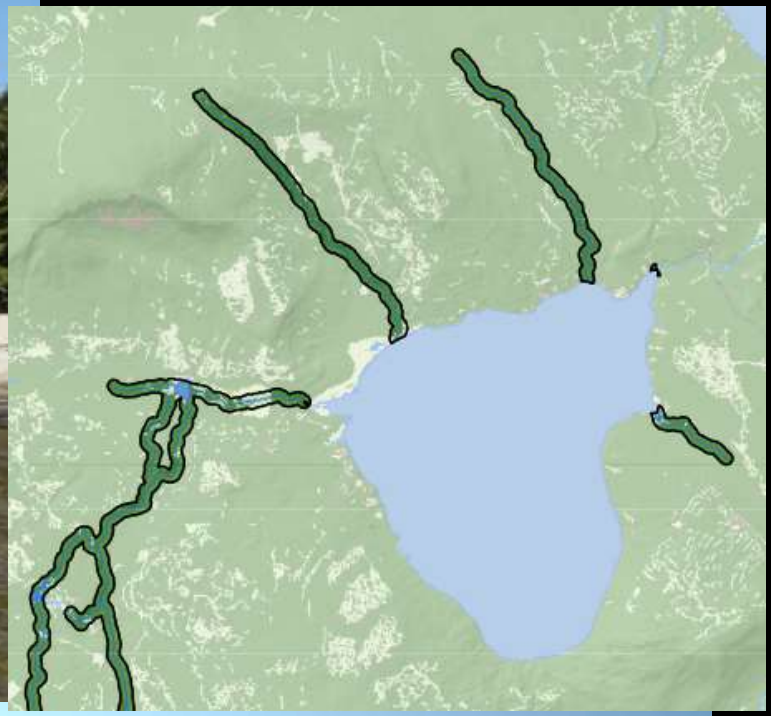
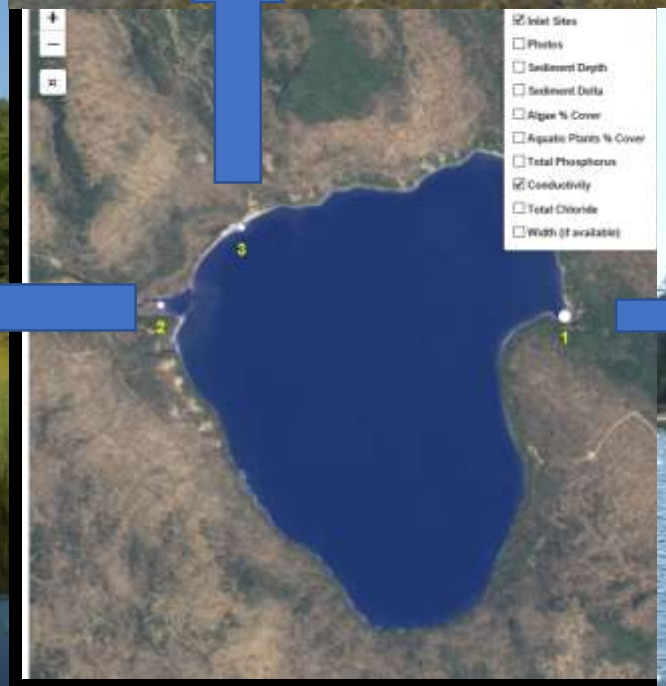
Land Use:
3 Tributaries





Water Quality Data | Physical Characteristics and Macrophytes

Sediment and Algae

InletNo	Sediment Depth (cm)	Sediment Delta (sq meters)	Algae %Cover
2	0	0	0
4	0	0	0
1	30	0	0
3	25	0	0

Aquatic Plants

InletNo	Plants % Cover	Dominant Plant 1	Dominant Plant 2	Dominant Plant 3
2	30	Equisetum sp.	Glyceria borealis	Dulichium arundinaceum
4	0	NA	NA	NA
1	80	Typha sp.	Equisetum sp.	Dulichium arundinaceum
3	0	NA	NA	NA

Water Quality Data | Physical Characteristics and Macrophytes

Analytical Data

InletNo	TP (ug/L)	TN (mg/L)	TCI (mg/L)
1	44.8	1.05	2
2	20.9	0.34	2
3	14.9	0.22	2

Hydrolab Data

InletNo	Conductivity uS/cm	Turbidity NTU	Temp C	DO mg/L	DO %	pH	Chla (ug/L)
1	68	NA	16.00	3.05	32.2	6.13	3.6
2	40	NA	14.65	8.23	84.4	6.48	1.2
3	39	NA	15.18	4.45	46.1	6.01	0.5

Water Quality Data | Physical Characteristics and Macrophytes

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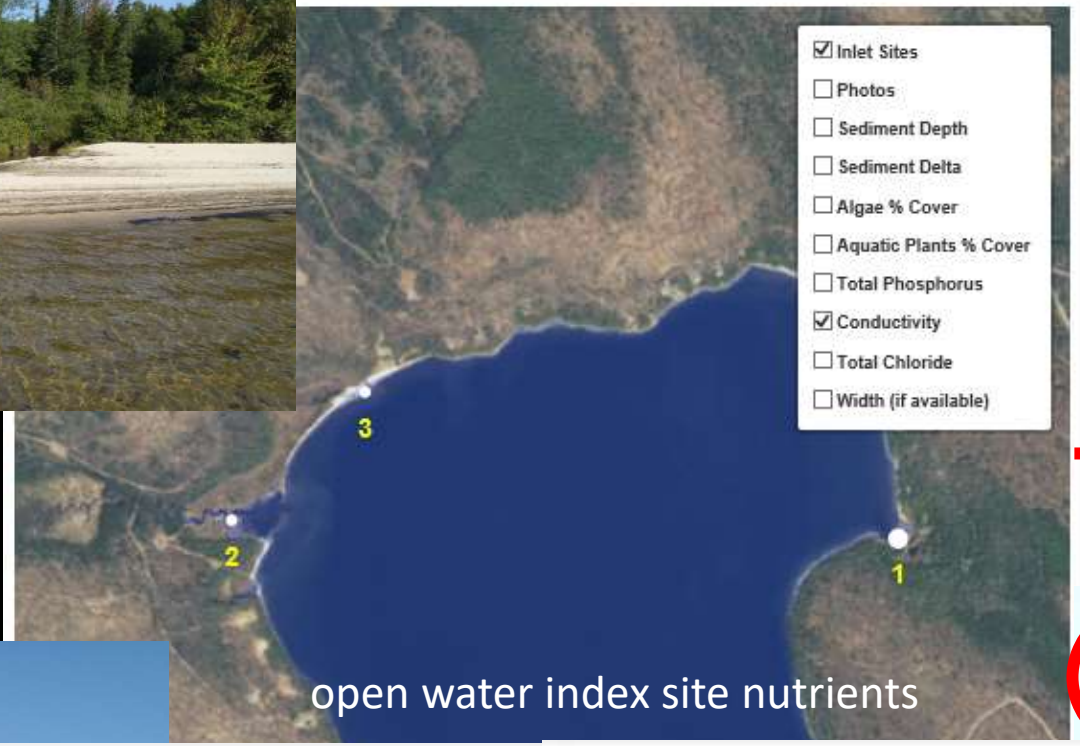
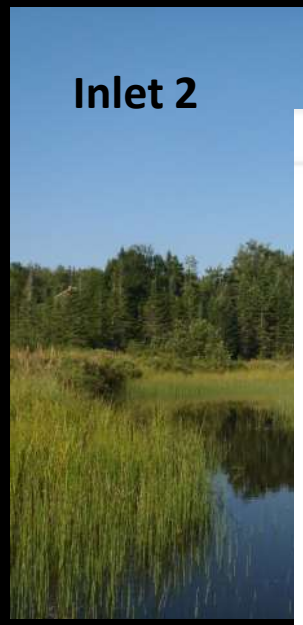
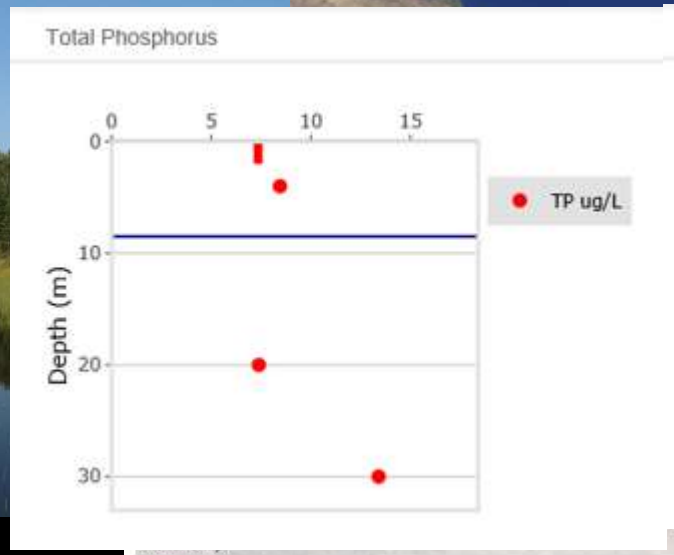
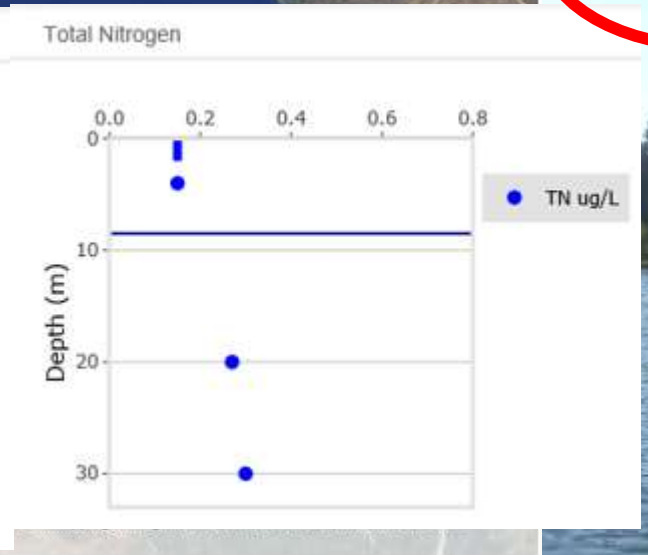


open water index site nutrients

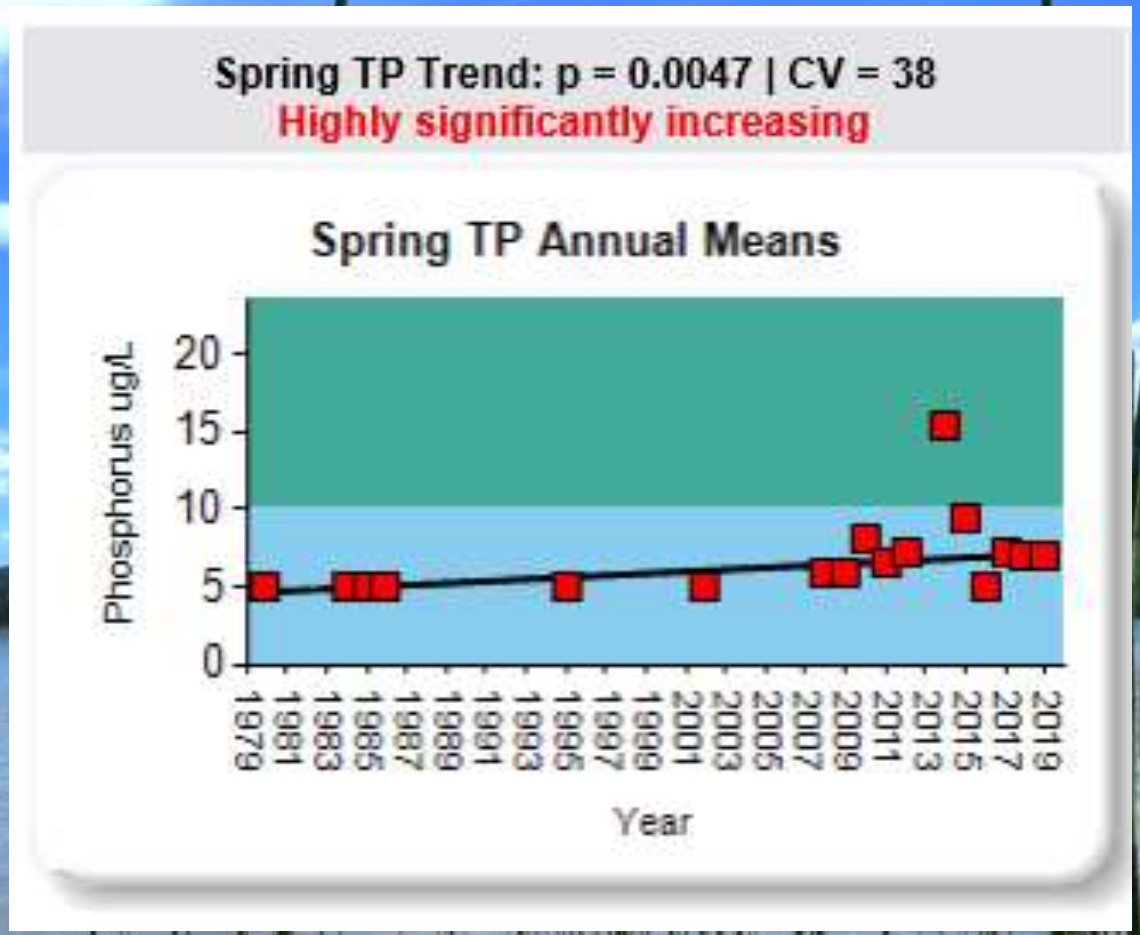
Inlet 2





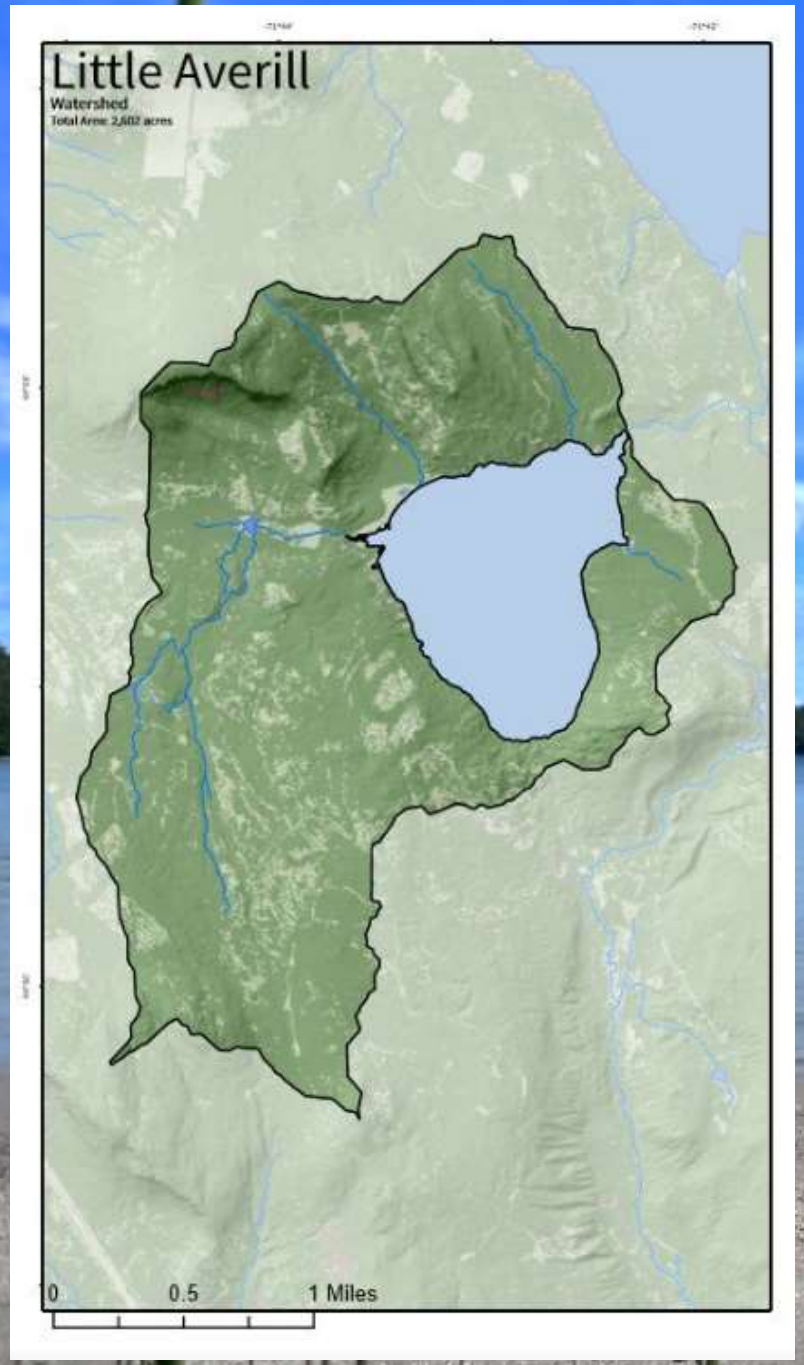


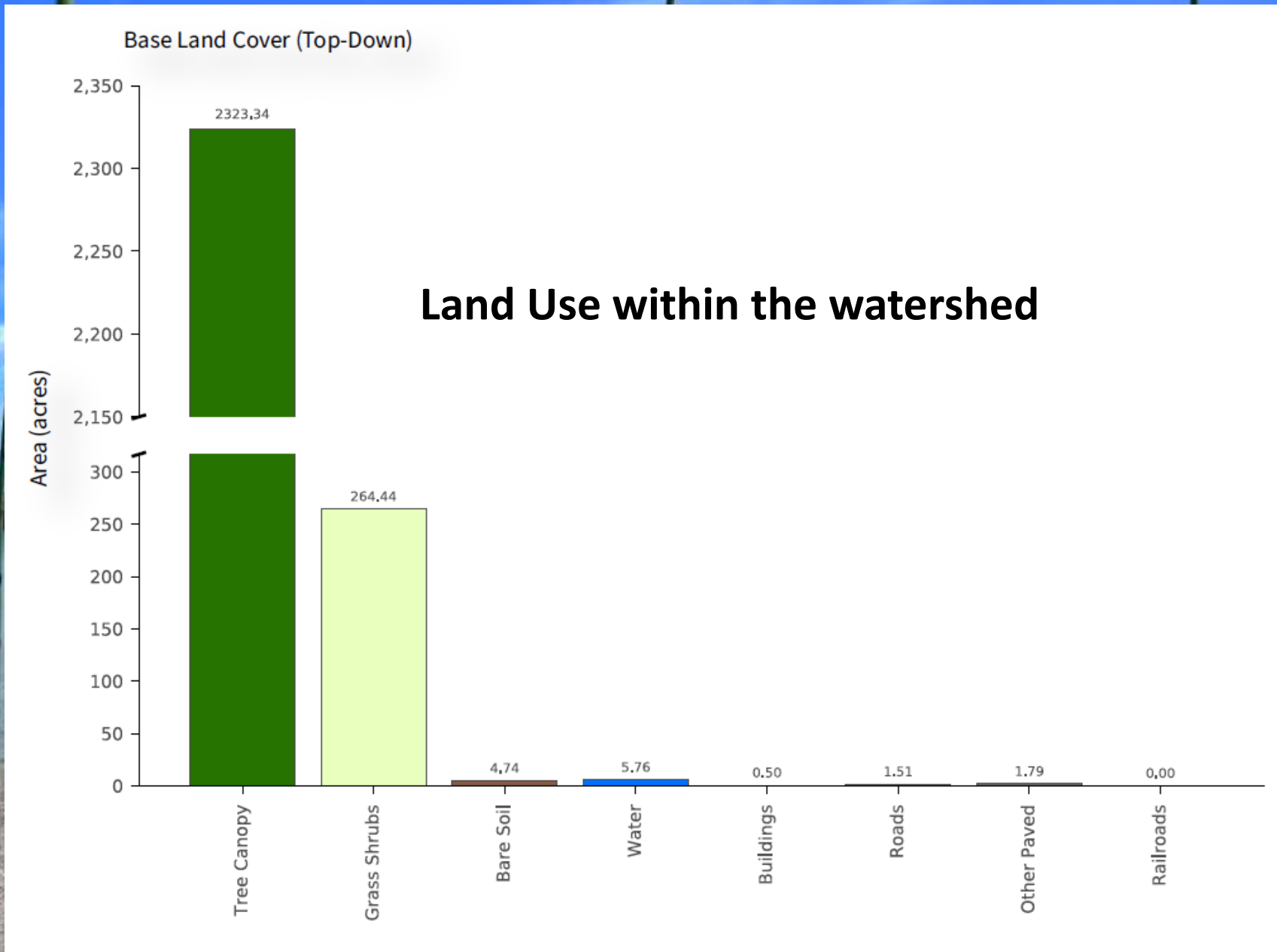
Inlet 1



Land Use: Watershed

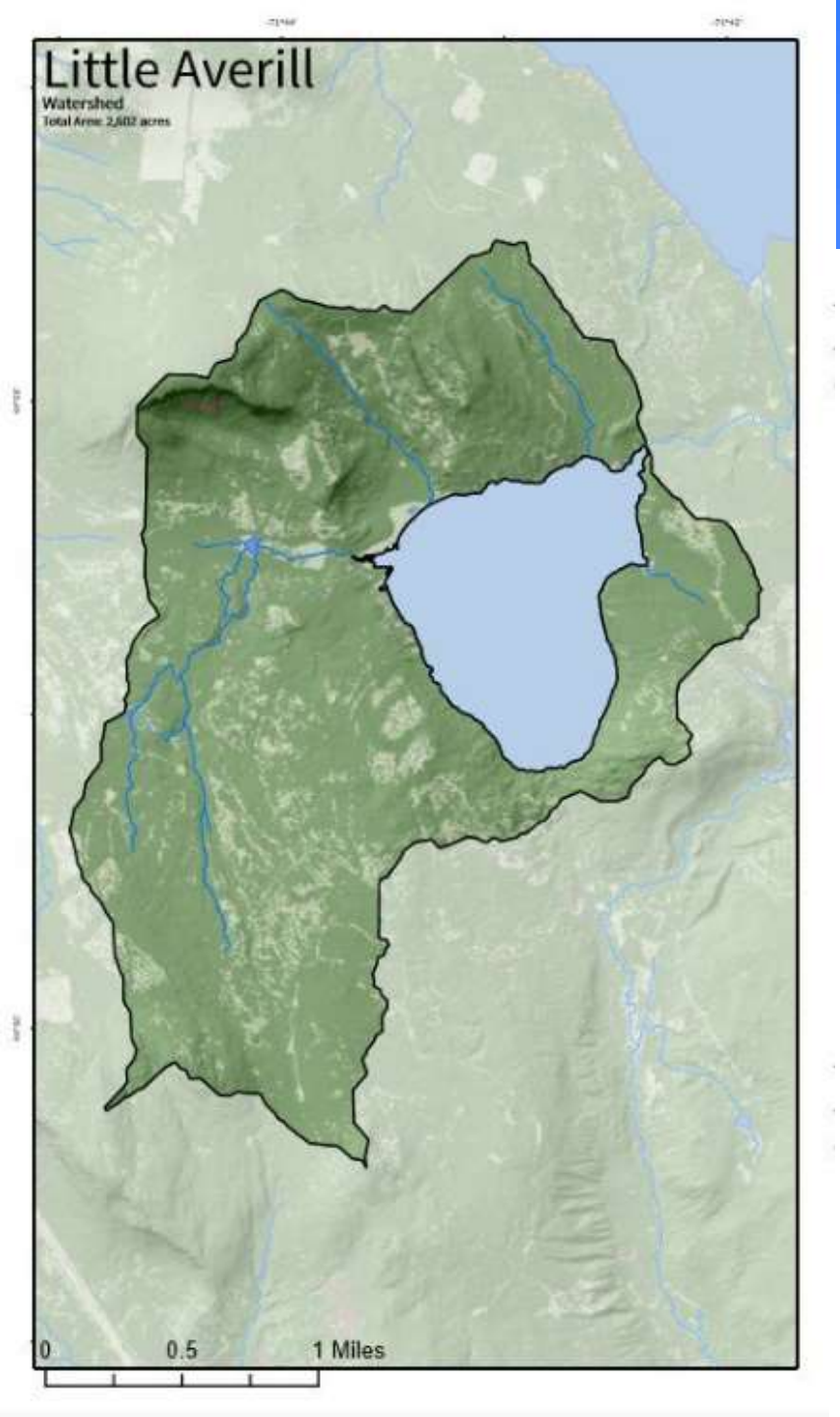
Potential lakeshore, tributary and watershed sources



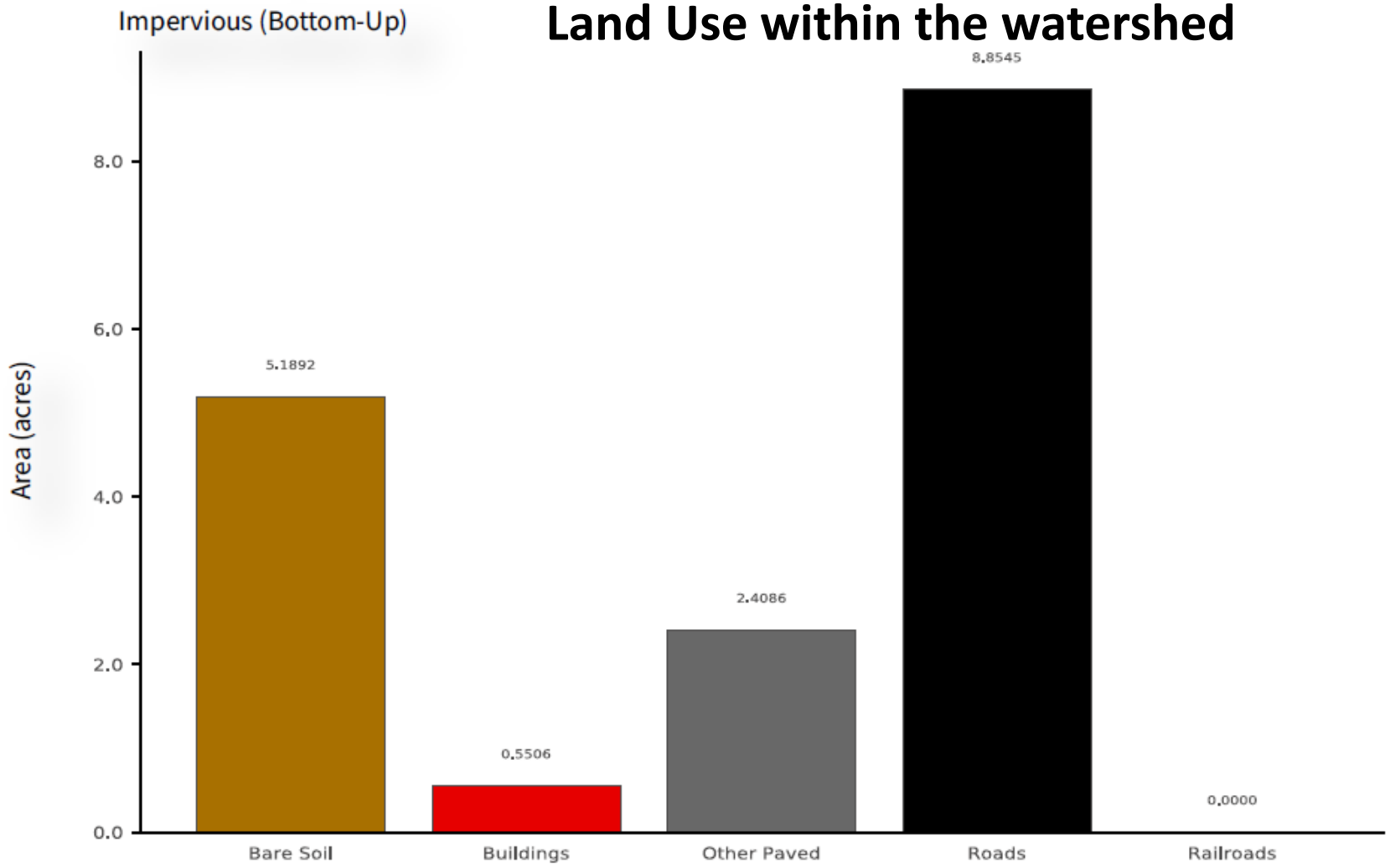


Land Use within the watershed

Preliminary land use analyses conducted by VT ANR's Colin Dowey using new 0.5m resolution land cover data created by the UVM Spatial Analysis Laboratory



Land Use within the watershed



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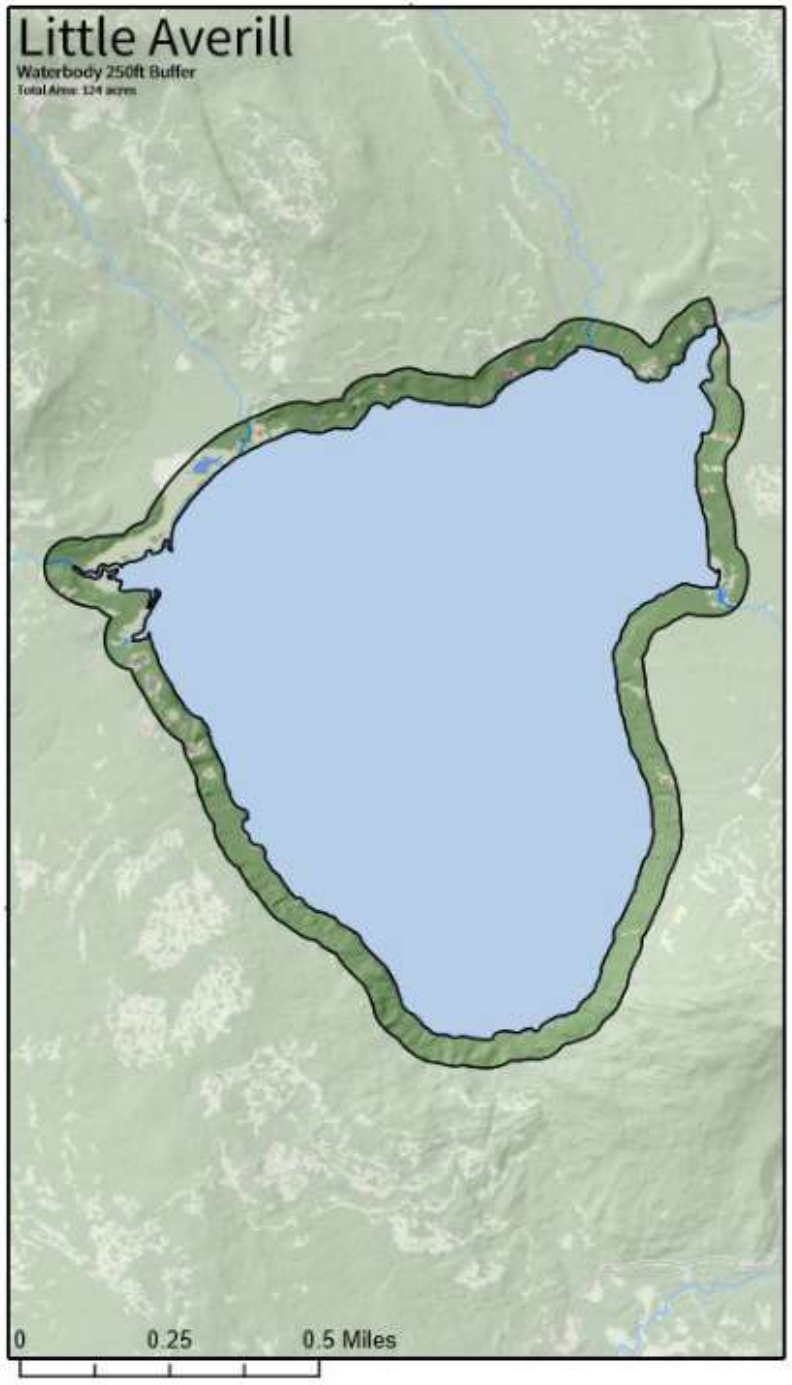
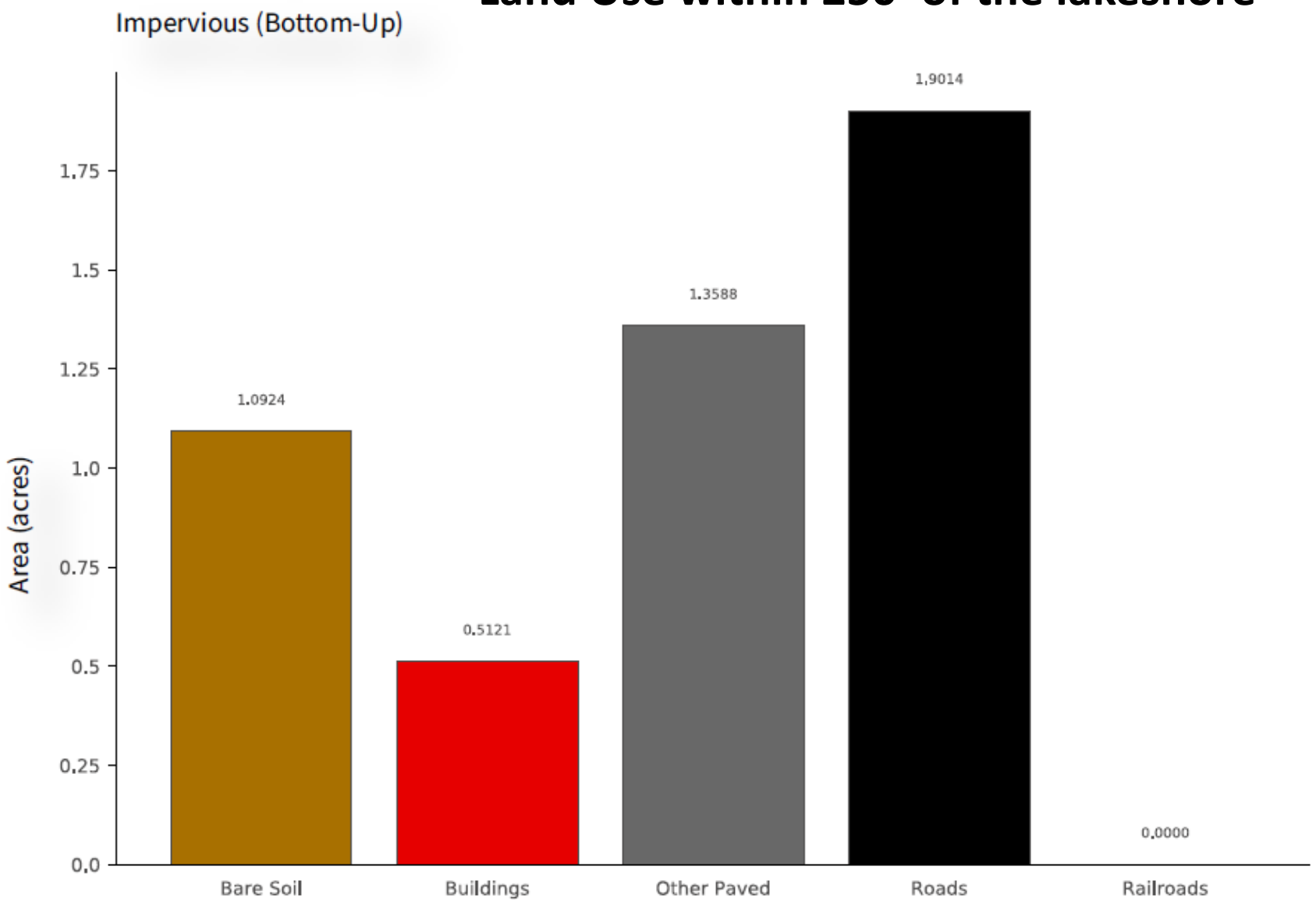


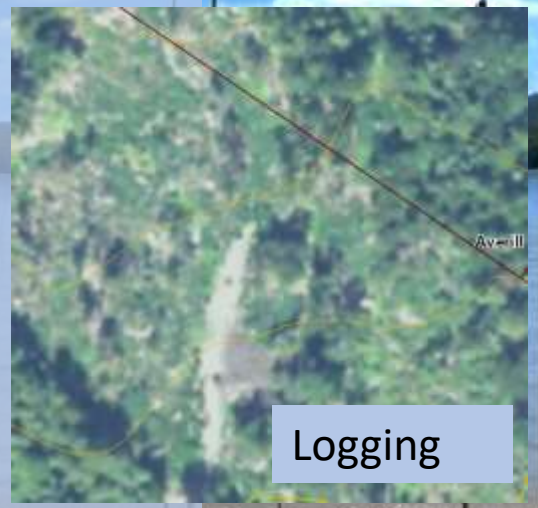
Land Use within 250’ of the lakeshore



Preliminary land use analyses conducted by VT ANR’s Colin Dowey using new 0.5m resolution land cover data created by the UVM Spatial Analysis Laboratory

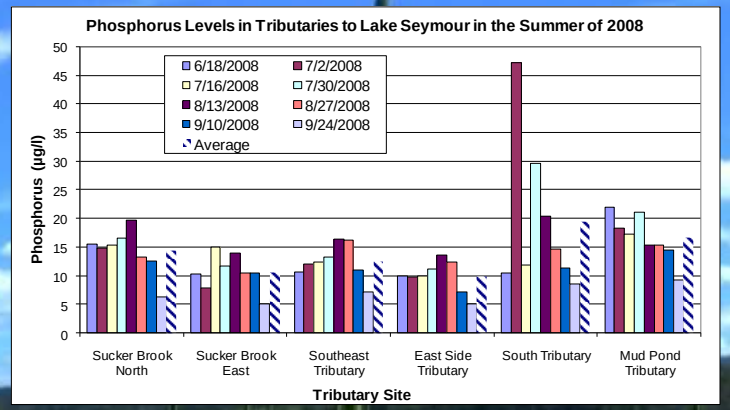
What are the potential drivers of increased phosphorus levels on Little Averill Lake

- Runoff from shoreland development – 5 acres total, most with intact buffers
- Trails and roads – mostly VAST trails and seasonal roads/driveways
- Forestry operations
- Climate Change
  - Changing lake temperatures and stratification
  - Increased intense runoff events and erosion of gullies and tributaries
- No agriculture or upland development

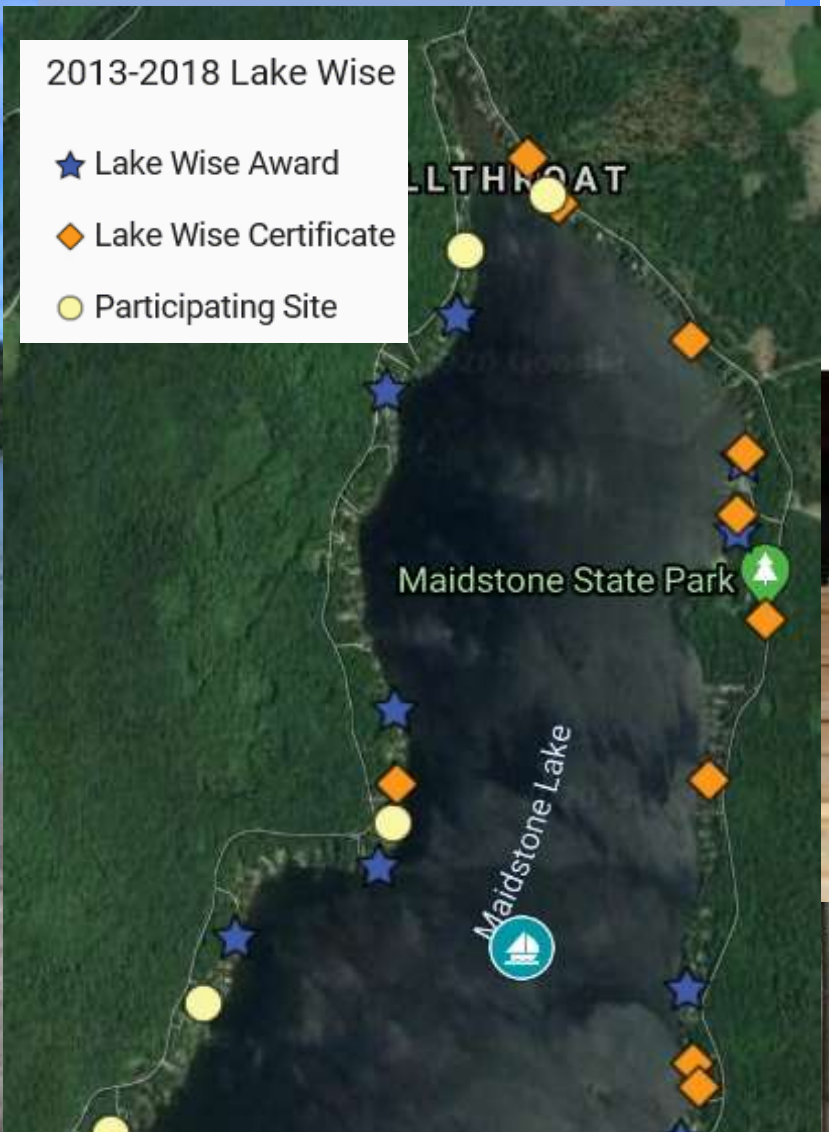


Seymour Lake Community Turned Their Trends Around and So Can Little Averill Lake

- Tributary water quality sampling to ID phosphorus source areas
- Lake wise Assessments and implementation
- Road assessments and projects
- Large scale implementation projects and grants
- Community outreach - shorelands – septic – forestry
- Farm assessments and implementation with OCNRCD
- Drawdown/water level management was discontinued in 2004 after the construction of the new dam



Maidstone Lake Wise Assessment and Implementation



NECTAR
landscape design studio, llc

NorthWoods – Youth Conservation Corps implementing Lake Wise practices on Maidstone Lake

Checklist of Lake Protection Actions

This checklist provides guidance on actions that help protect Vermont lakes and is based on the Lake Score Card.

Check-off all the helpful actions occurring around your lake. For those items not checked, decide which steps to take to maintain or help improve lake conditions. For more information, follow the links below, or contact the Lakes and Ponds Program at 802-490-6198.

Nutrient Trend and Shoreland Conditions Management Programs and Actions	✓
Does your lake have a Lake Association? Many lakes and ponds have associations dedicated to taking care of the lake. Join yours or consider starting one. Locate a lake association here.	
Do you know if your lake is sampled by the Spring Phosphorus monitoring program? Spring phosphorus data can predict the amount of algal growth that will occur during the summer and show if a lake's water quality is changing. To learn more, click here.	
Does your lake participate in the Lay Monitoring Program? Volunteers collect water clarity and nutrient enrichment data during the summer to document the conditions of the lake and show how the lake may be changing over time. Read more.	
Does your lake community work with the local town officials? Town Select Boards, Planning and Conservation Commissions make good partners for lakes.	
Does your lake participate in the Lake Wise Program? Shoreland owners are taught lake friendly practices which leads to earning the Lake Wise Award for excellent shoreland management. To learn more, click here.	
Does your lake community practice Shoreland BMPs? Shoreland Best Management Practices and Fact Sheets are available to explain the best techniques for developing and living along a lake. Click here for BMPs.	
Are private roads and driveways maintained according to the standards of the Better Roads Program? Read more.	
Are most septic tanks around the lake pumped every 3 to 5 years? A poor or overloaded system can introduce disease-causing organisms into the lake, resulting in a human health threat and can introduce nutrients into the lake. Here's more.	
Has your lake held a Septic Social? Septic socials are fun gatherings that showcase septic system care and improvements.	

Permitting Required for Lakes	✓
Are your lake residents informed on the Shoreland Protection Act? Vermont's Shoreland Protection Act regulates land use within 250 feet of the lake's mean water level. Click here to learn more.	
Are your lake residents aware of the Lake Encroachment Permit? A Lake Encroachment permit is required for many activities occurring in the water, including seawalls, riprap, and fill. Click here to learn more.	

Aquatic Invasive Species	✓
Does your lake participate in aquatic invasive species spread prevention? To learn more about why spread prevention actions are important. Click here.	
Is there a VIP (Vermont Invasive Patroller) on your lake? Here's How and Why to Get Trained	
At public access locations, does your lake have Aquatic Invasive Species signs posted? To request signs, click here.	
Is there a Public Access Greeter Program at your lake? Here's more information.	
If your lake has an aquatic invasive species, is there a Management Program underway? Management programs are essential for controlling an invasive infestation and for preventing further spread to other areas.	

Mercury in Fish Management Programs and Actions	✓
Atmospheric pollution and disposal practices for hazardous wastes can release mercury into Vermont's lakes and ponds. This toxin can accumulate in fish and there are fish consumption advisories for some Vermont lakes.	
What legislation helps project Vermont lakes from mercury pollution? The Federal Clean Air Act Amendments in 1990, requiring stronger emissions controls, were largely passed from Vermont lake monitoring findings. Read More.	
Does your Solid Waste District offer hazardous waste pick-up? Although the majority of mercury entering a lake comes from the atmosphere, mercury is also found in many household items and can leach into the environment. Click here for more information on proper disposal of household products.	

Other Useful Information for Lake Residents	✓
Do residents and visitors know how to recognize cyanobacteria (also called blue-green algae)? Learn about cyanobacteria in Vermont here.	
Do you have a wetland on your shore? Wetlands protect lake water quality and shorelines. They are also protected by law. Learn more.	
Have you explored your watershed using the ANR Natural Resources Atlas?	
Have you read your Basin Plan? Vermont is divided into 15 major water planning units. Basin plans identify important resources in each basin and the measures being taken to protect or restore them. Read more.	
Stay up to date with the Lakes and Ponds Program - Follow us on Facebook!	
Do you read the Watershed Management Division's Blog?	

Checklist of Vermont Lake Protection Actions (*updated April 2017*)
Vermont Agency of Natural Resources Department of Environmental Conservation Lakes and Ponds Program
http://www.dec.vermont.gov/watershed/lakes-ponds

https://dec.vermont.gov/sites/dec/files/wsm/lakes/docs/Score%20Card%20Checklist_2017_final%20Apr%202017.pdf

Potential for **Reclassification**

- Reclassification is a process defined under VT's Water Quality Standards to maintain existing use via increased protections
- Spring Phosphorus data suggests Little Averill could be reclassified to A1 using the combined nutrient criteria, but summer monitoring is needed to confirm
- Reclassification to ORW for Unusual, Scenic and Natural Features using the Lake Protection Classification System

Lake Assessment Report — **LITTLE AVERILL 2013**

LITTLE AVERILL Lake Protection Classification

Category	Score	Feature	Score
Wilderness Score	0	Beach	1
Wilderness-Like Score	0	Ledge	0
		Bouldered Shore	1
		Vegetation	1
		Islands	0
		Steep Slopes	1
		Peaks	1
		Scenic Bottom	0
		Cliffs	1
		# Total Features	6

Table 3. Combined Nutrient Criteria for Aesthetics Uses in Lakes, Ponds, and Reservoirs Except for Lake Champlain and Lake Memphremagog[1,2]

	Class A(1)	Classes A(2) and B(1)	Class B(2)
Nutrient Concentrations			
Total Phosphorus[3] (µg/L)	12	17	18
Nutrient Response Conditions			
Secchi Disk Depth (meters)[4]	5.0	3.2	2.6
Chlorophyll-a (µg/L)[3]	2.6	3.8	7.0
pH	Not to exceed 8.5 standard units.		
Turbidity	Consistent with the criteria in § 29A-302(4) of these rules.		
Dissolved Oxygen	Consistent with the criteria in § 29A-302(5) of these rules.		

1. Compliance with nutrient criteria shall be achieved either by compliance with the nutrient concentration values specified above or by compliance with all nutrient response conditions. In situations where the applicable nutrient concentrations are achieved but the nutrient response conditions are not met as a result of nutrient enrichment, the Secretary may establish alternate nutrient concentration values on a site-specific basis, as necessary, to achieve compliance with the nutrient response conditions. All waters shall maintain a level of water quality that provides for the attainment and maintenance of the water quality standards of downstream waters.

2. Applies to lakes and reservoirs greater than 20 acres in surface area with a drainage area to surface area ratio less than 500:1, excluding Lake Champlain and Lake Memphremagog.

3. June through September mean not to be exceeded in the photosynthetic depth (euphotic) zone at a central location in the lake.

4. June through September mean not to be less at a central location in the lake.

In Summary

- Phosphorus levels are increasing in Little Averill Lake and we do not know why
- Concerned citizens can help!
  - Help identify potential sources of phosphorus along the lakeshore, tributaries and watershed
  - Form a lake association to get organized
  - Begin collecting total phosphorus and chlorophyll a next year in addition to water clarity at the deep hole index site that Don sampled this year
  - Consider collecting water samples at the tributaries
  - Enlist the help of the NRCD and VTDEC to begin implementing Lake Wise practices at the camp properties
  - Work to identify hydrologically connected roads in the watershed
  - Reach out to forestry folks to look for possible sources associated with those practices in the watershed
  - Consider petitioning VTDEC to reclassify to A1 for Aesthetics Use
  - Request a follow up webinar/meeting to see how NRDC and VTDEC can help!

Extra Miscellaneous Slides

Other data we have collected on Little Averill

- Aquatic Plant Survey
- Littoral Habitat
- National Lake Assessment
- Sediment Diatoms
- Crayfish trap data