

A scenic landscape featuring three interconnected lakes nestled in a valley. The water is calm, reflecting the surrounding lush green forests and rolling hills. The lighting suggests a bright, possibly morning or afternoon, sun.

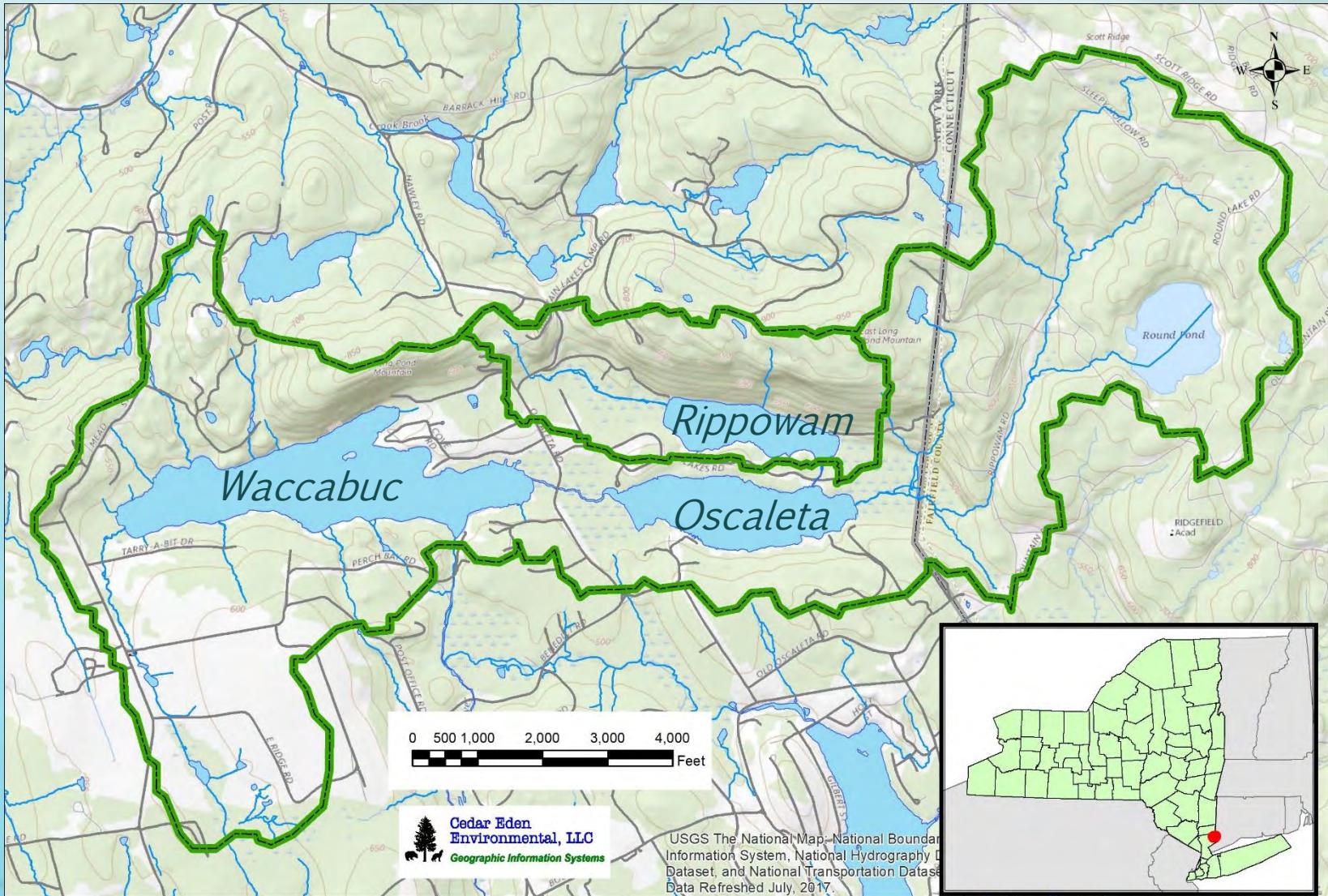
Lake & Watershed Management Plan Development for Three Connected Lakes

Town of Lewisboro, Westchester County, NY

Michael R. Martin, CLM

NYSFOLA Annual Conference – May 4, 2019

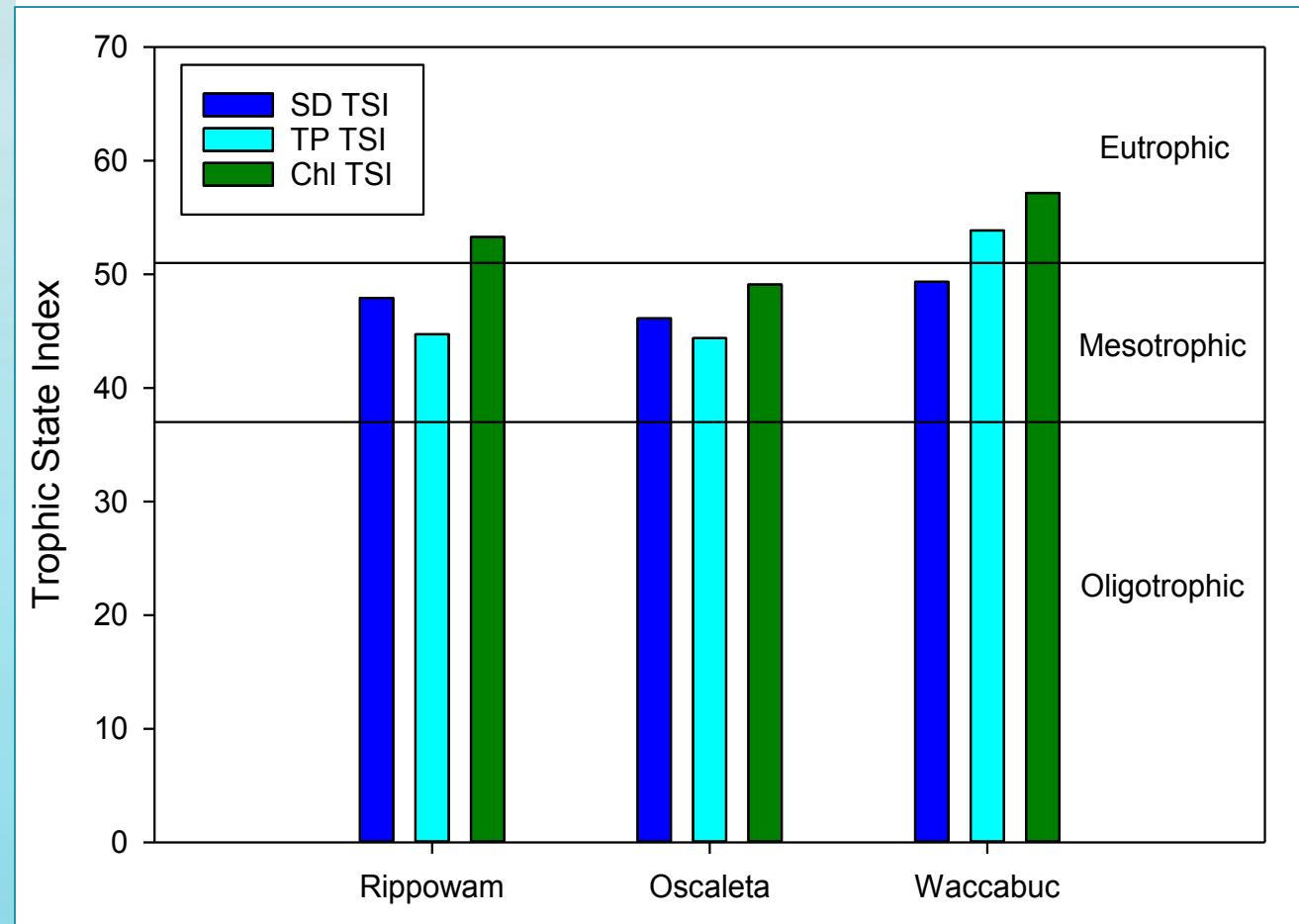
Location of the Three Lakes Watersheds



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Environmental, LLC

Problem Statement

- Excess Nutrients
- Hypolimnetic Anoxia
- Harmful Algal Blooms
- Excessive growth of aquatic macrophytes



Background

- Initial investigations began in 2003
- Lake and Watershed Management Plan in 2004
- CSLAP Monitoring 2004 to Present
- Management Plan Implementation 2004 to Present
- Management Plan Update began in 2018

Selected Morphological Characteristics

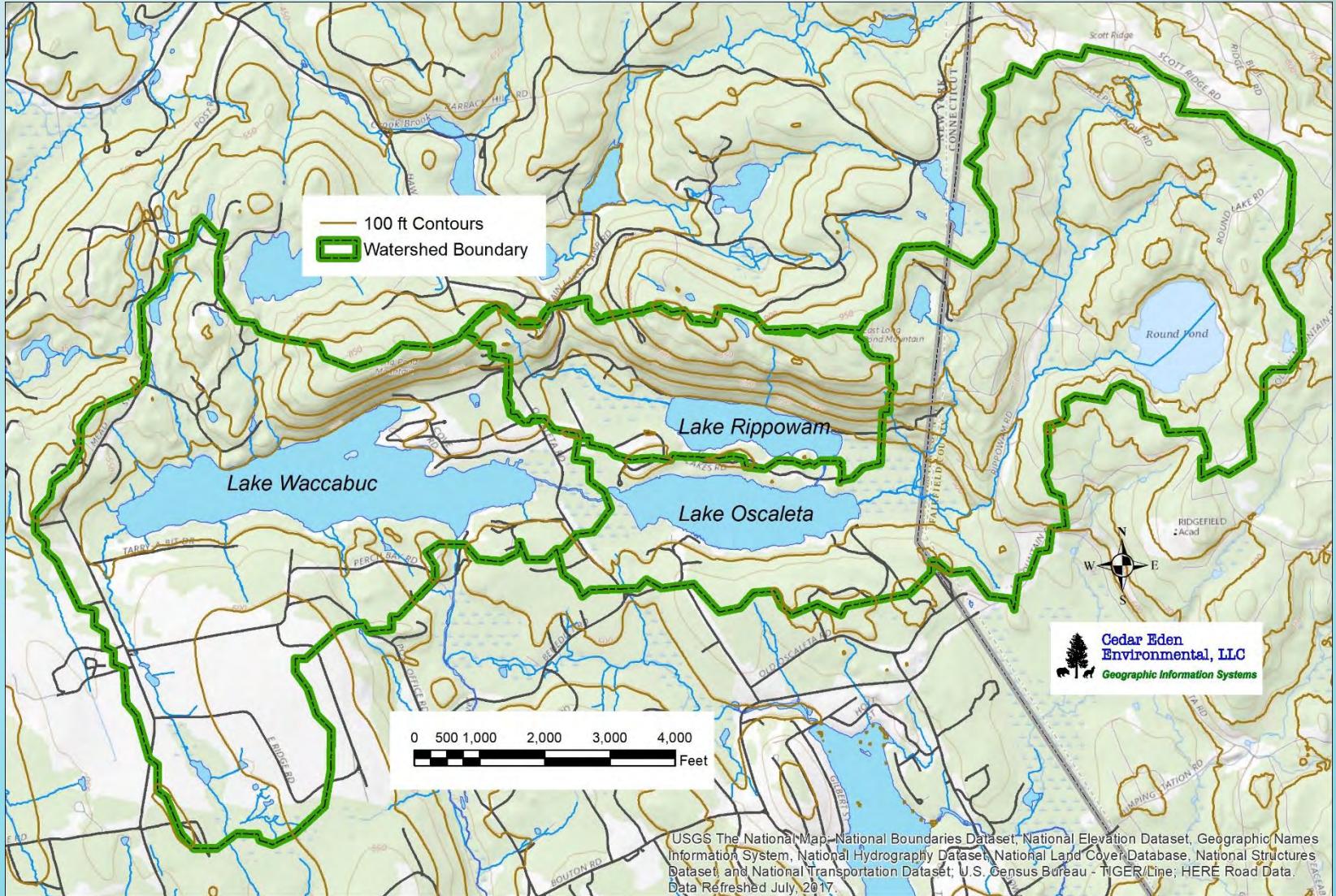
Lake Characteristic	Lake Rippowam	Lake Oscalaeta	Lake Waccabuc
Surface Area	33.9 ac 13.7 ha	65.2 ac 26.4 ha	138.0 ac 55.9 ha
Maximum Depth	20 ft 6.1 m	36 ft 10.8 m	44 ft 13.4 m
Mean Depth	13.5 ft 4.1 m	19.4 ft 5.9 m	23.3 ft 7.1 m
Lake Volume	150 million gallons 566,536.1 m ³	412 million gallons 1,557,959.9 m ³	3696 million gallons 13,990,063.4 m ³
Hypolimnion Volume	0.1 million gallons 456 m ³	61 million gallons 230,898 m ³	369 million gallons 1,398,107 m ³
Flushing Rate	4.7 times/year	3.2 times/year	1.4 times/year
Phosphorus Retention Coefficient	0.48 percent	0.48 percent	0.55 percent

The background of the slide features a soft-focus photograph of a natural landscape. It appears to be a body of water, possibly a lake or river, with a dense forest of evergreen trees lining the left bank. In the distance, large, rugged mountains are visible through a layer of low-hanging fog or mist, giving the scene a serene and somewhat ethereal atmosphere. The overall color palette is dominated by cool blues and greens.

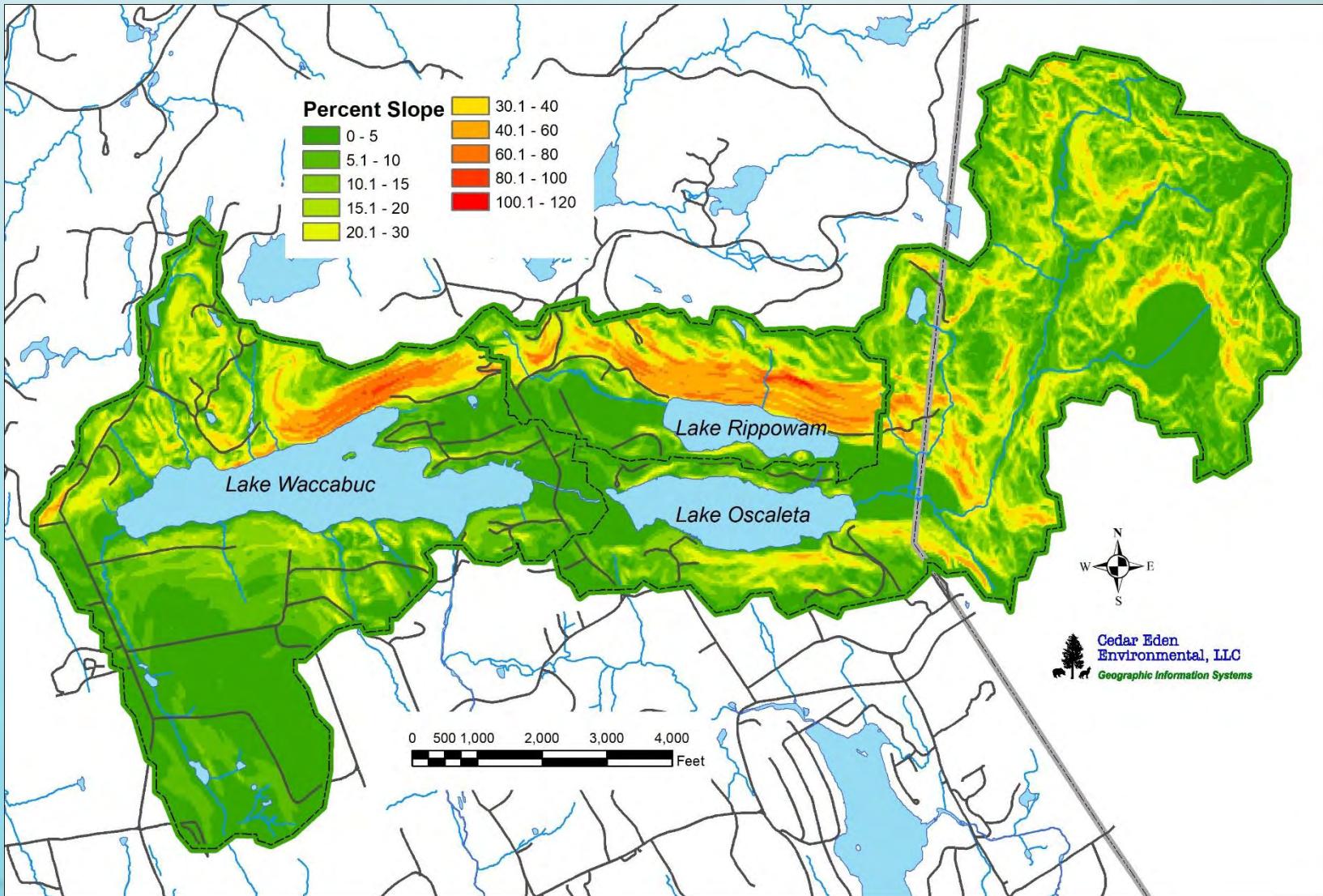
The Watershed

Watershed Characteristics

- Rippowam
279 acres
- Oscaleta
1,282 acres
- Waccabuc
2,196 acres



Topography

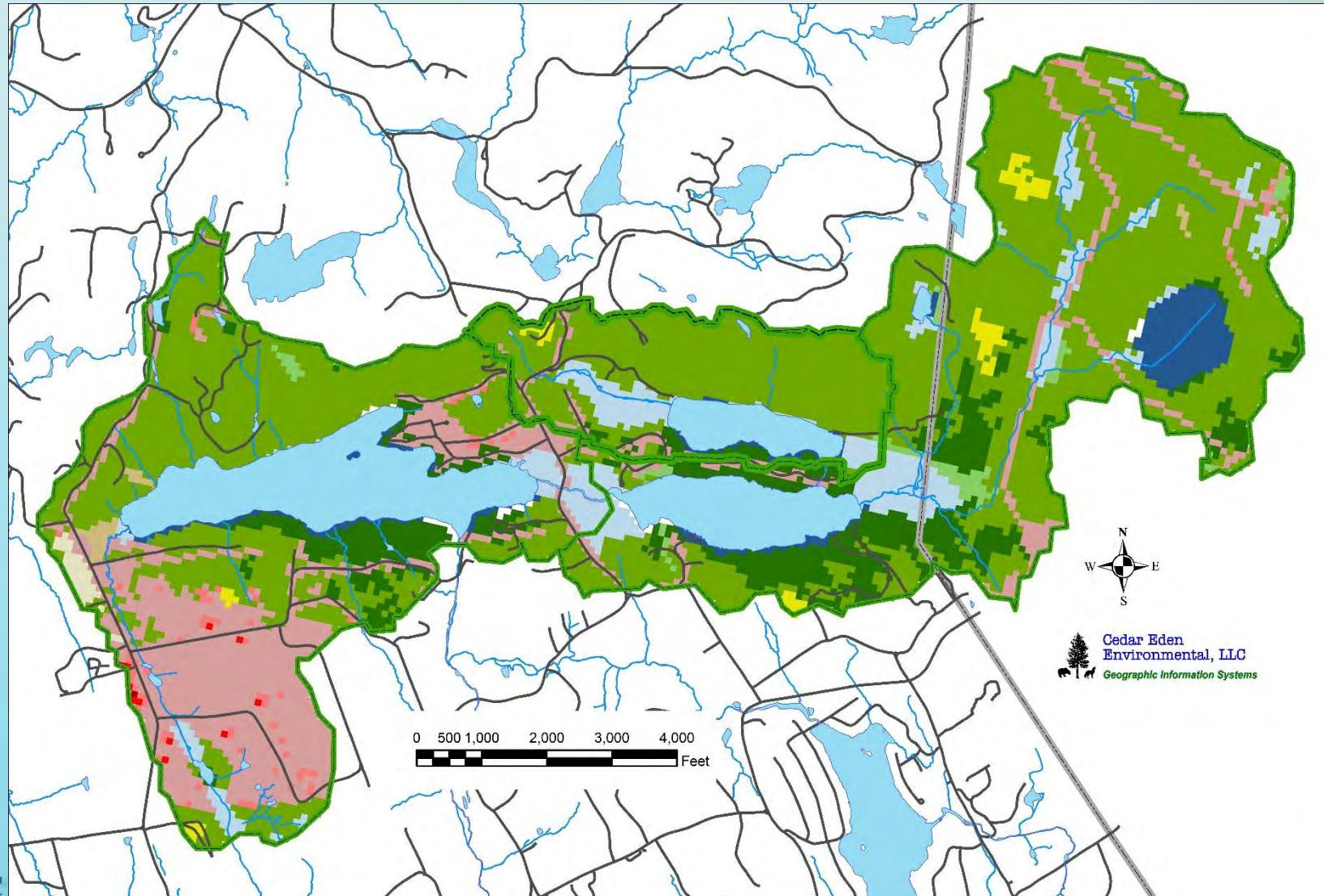


Land Use

2011 NLCD Land Cover

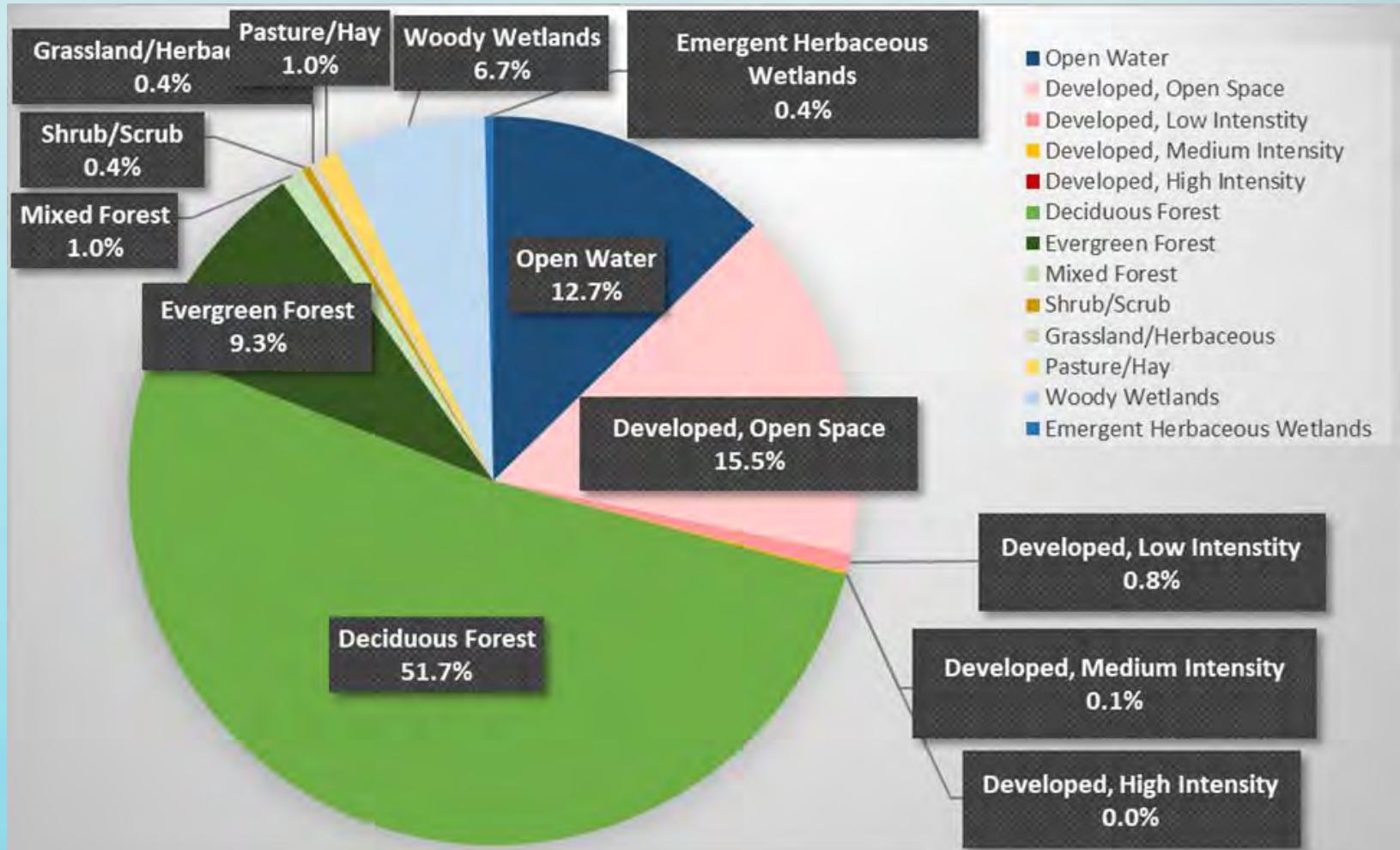
Land Use Class

- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Pasture/Hay
- Woody Wetlands
- Emergent Herbaceous Wetlands

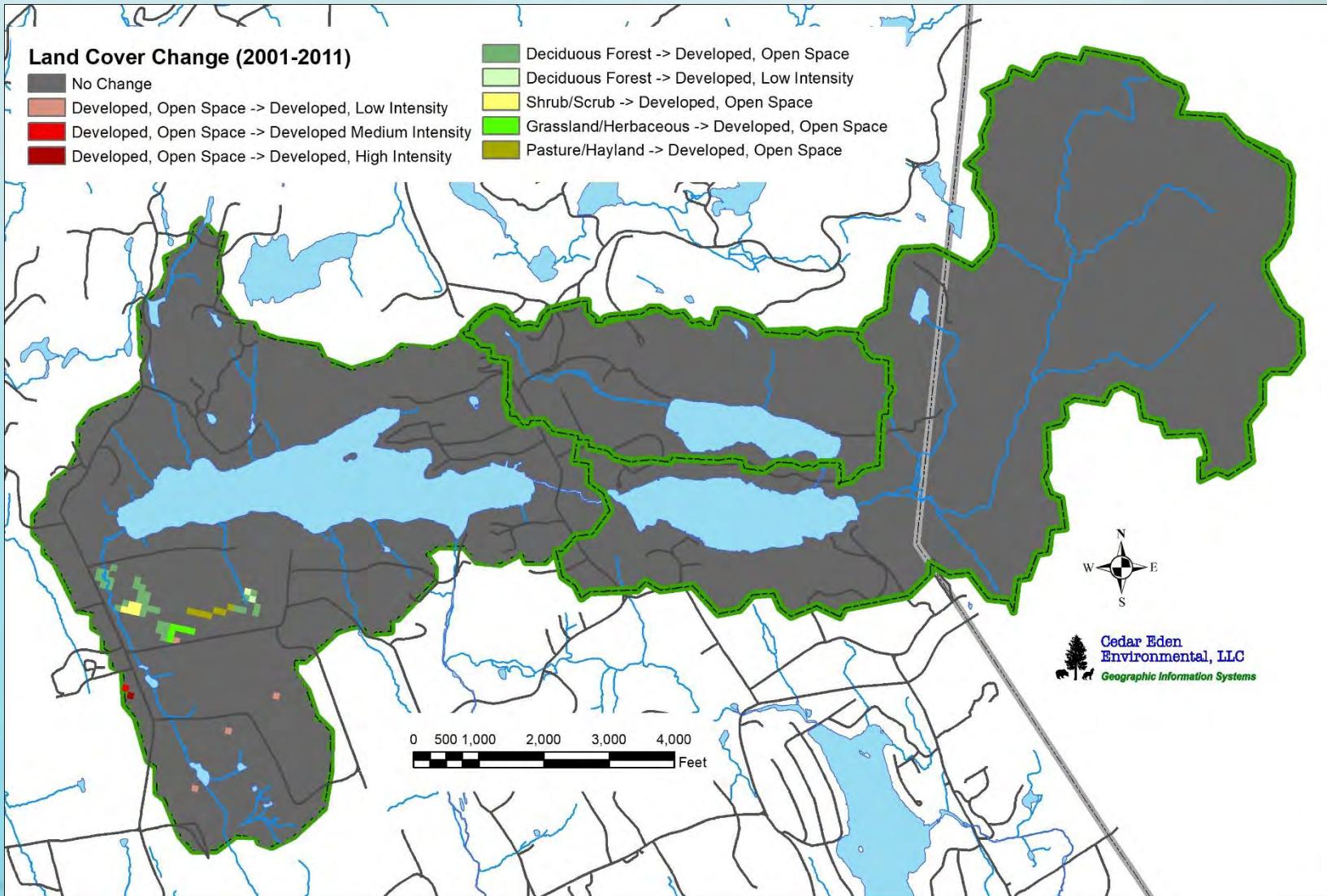


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Topography

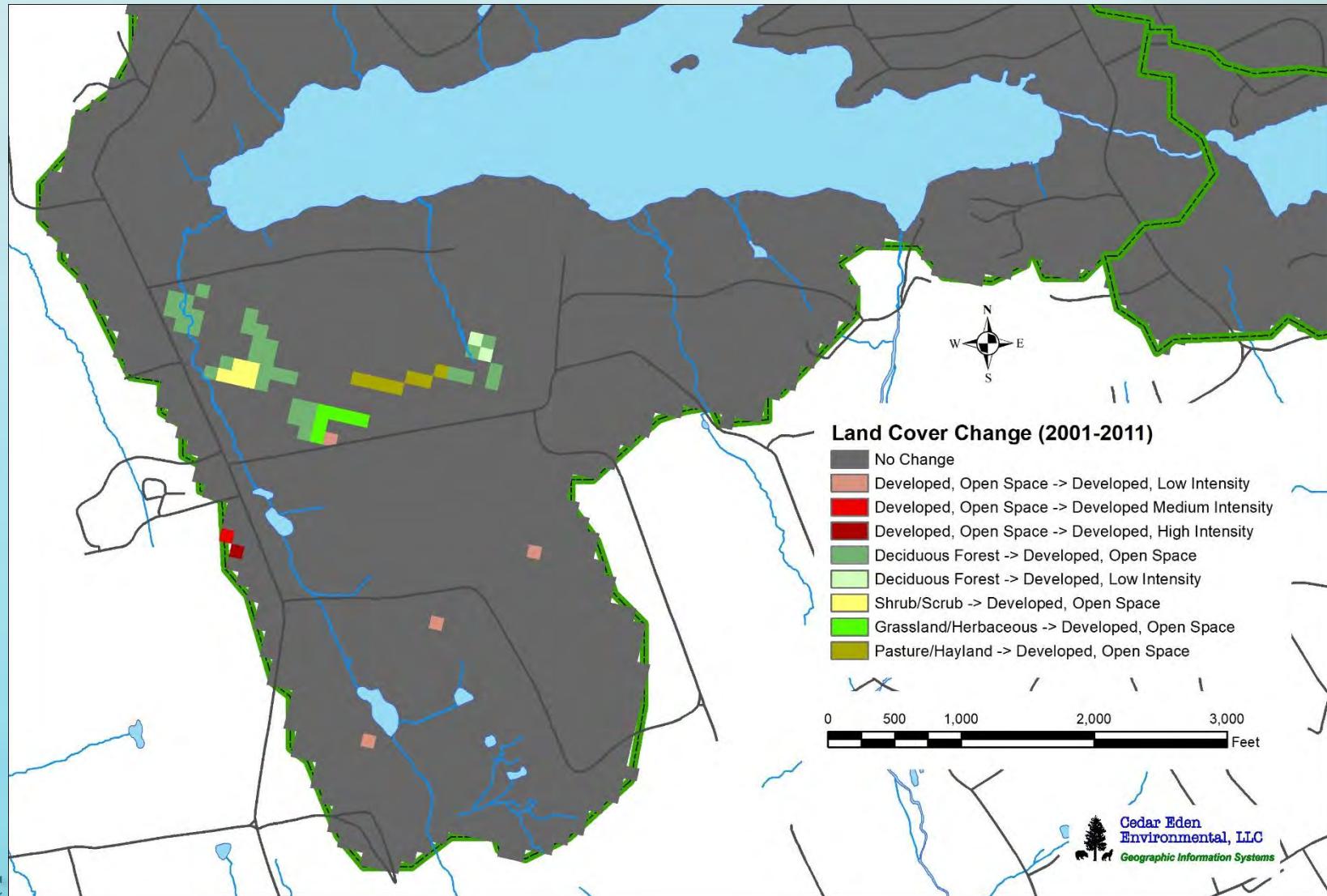


Land Use Change 2001-2011

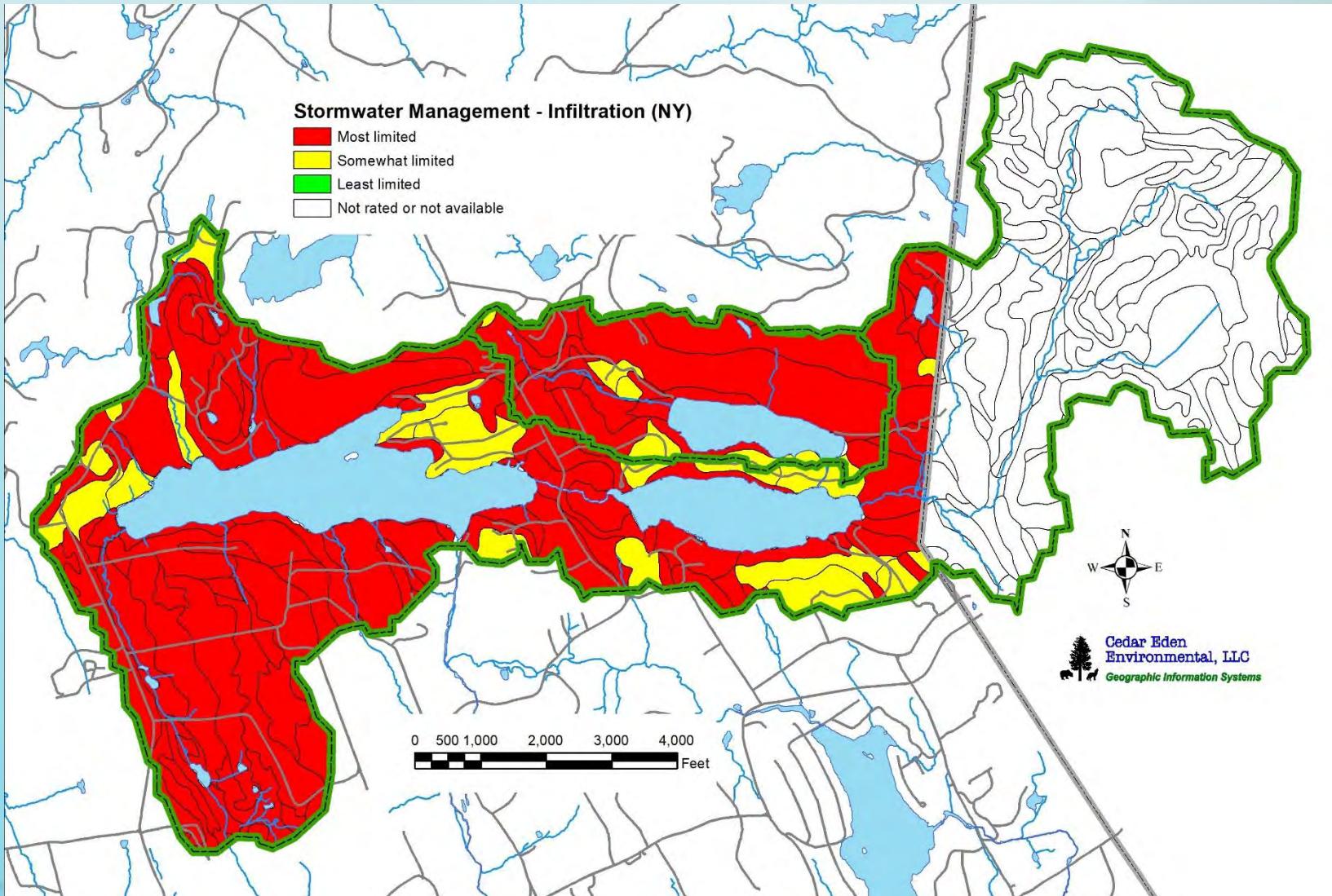


Land Use Change 2001-2011

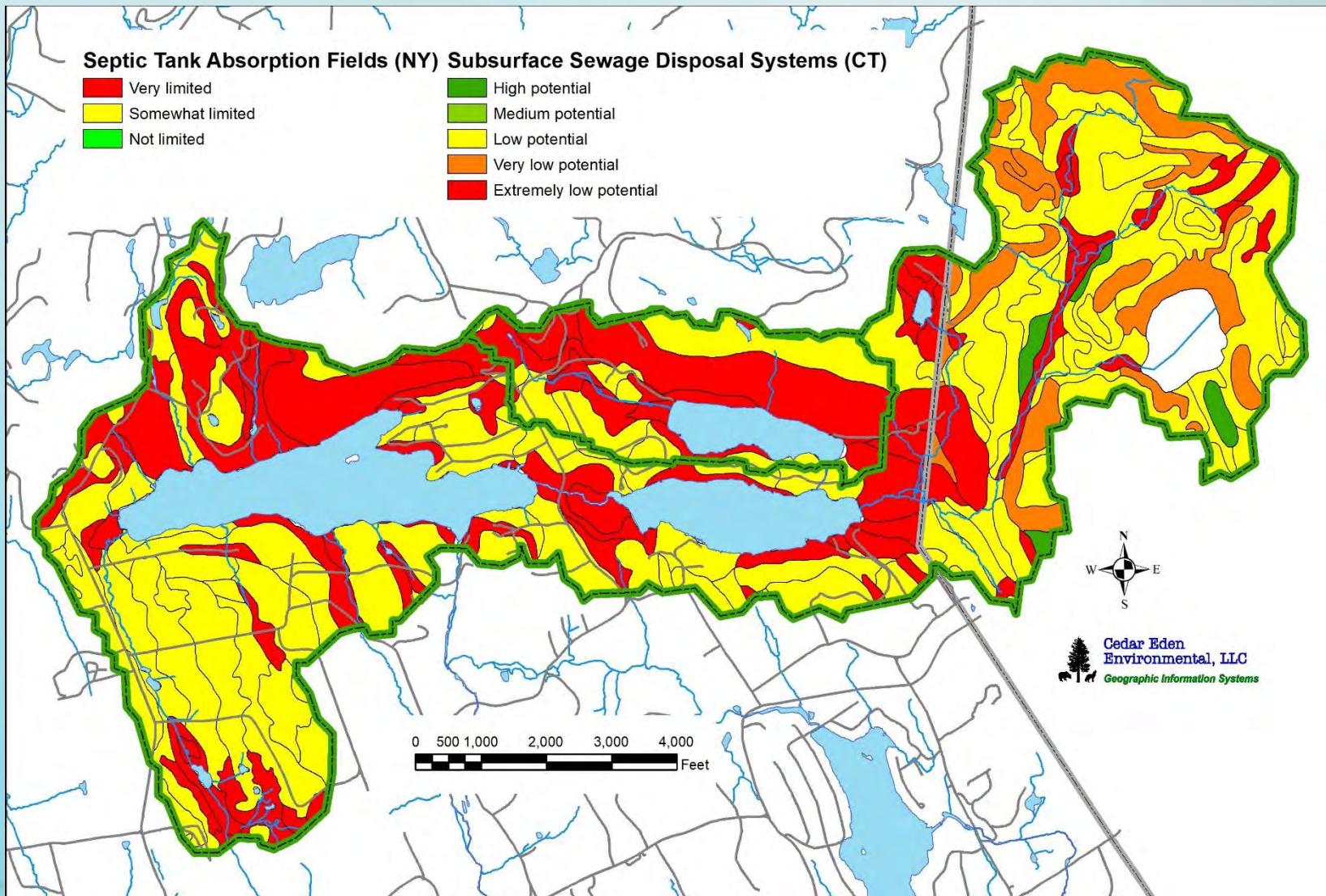
- Approx. 13 acres



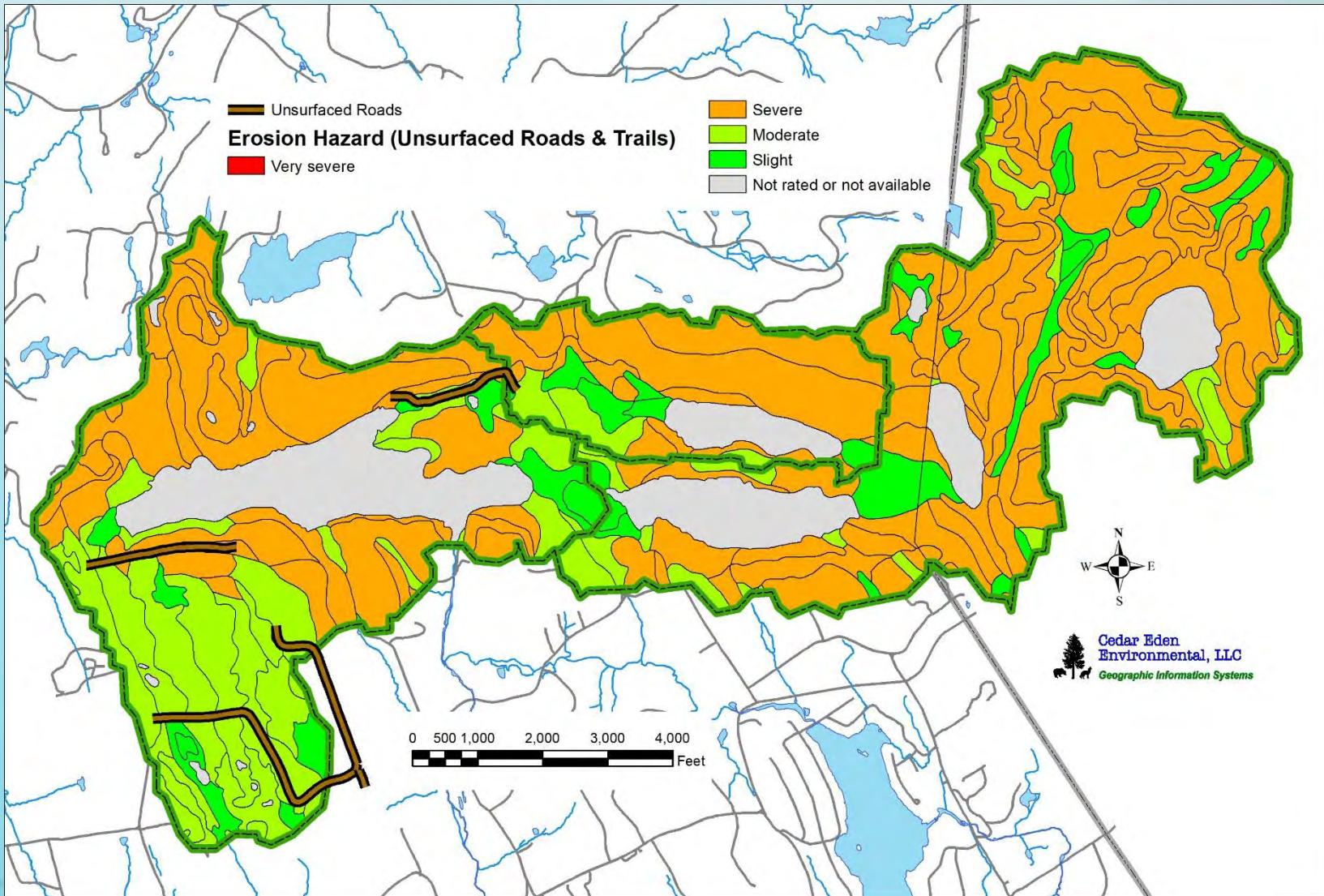
Soil Limitations for Stormwater Management



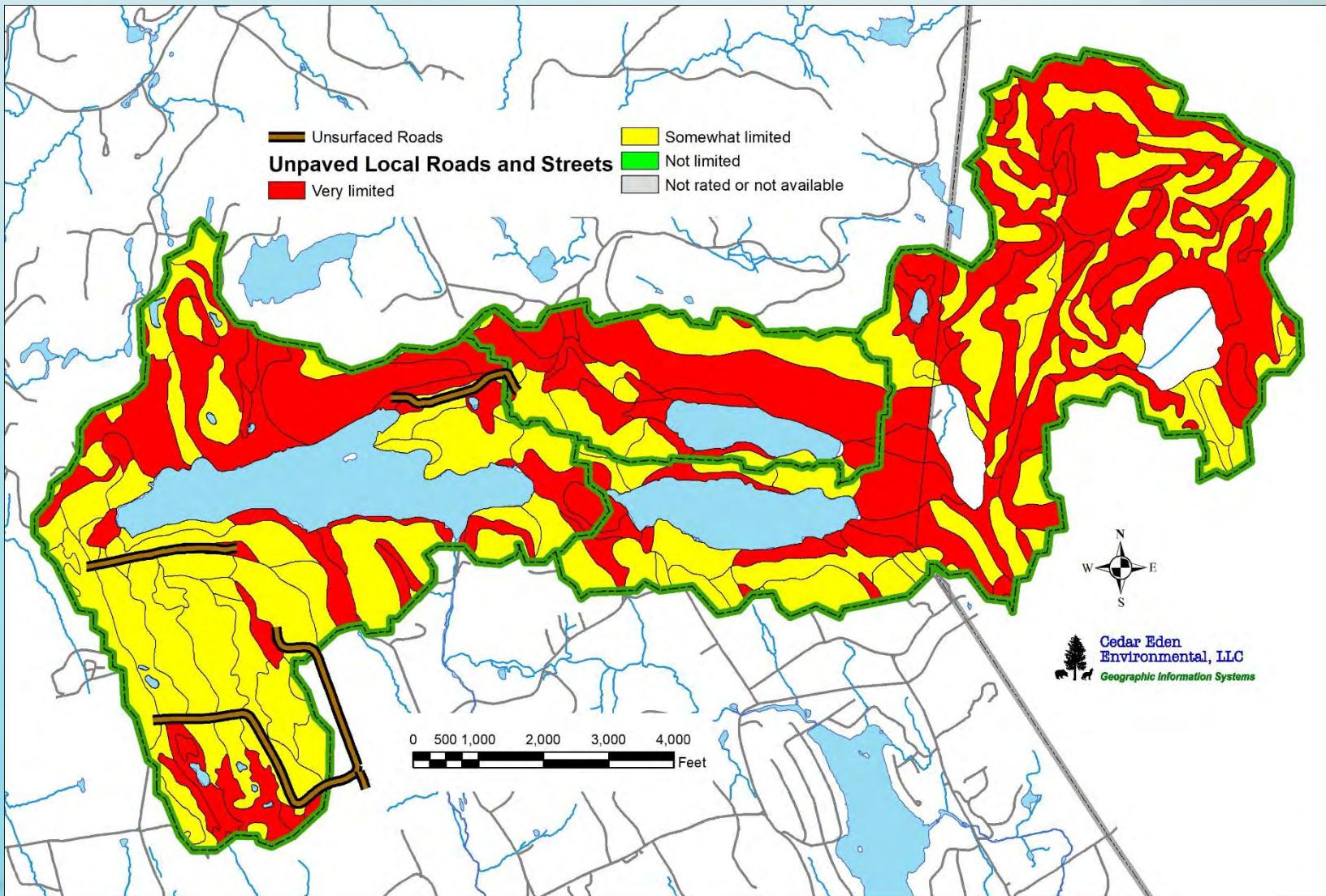
Soil Limitations for Septic Systems



Soil Erosion Hazard for Unsurfaced Roads



Soil Limitation for Unpaved Local Roads

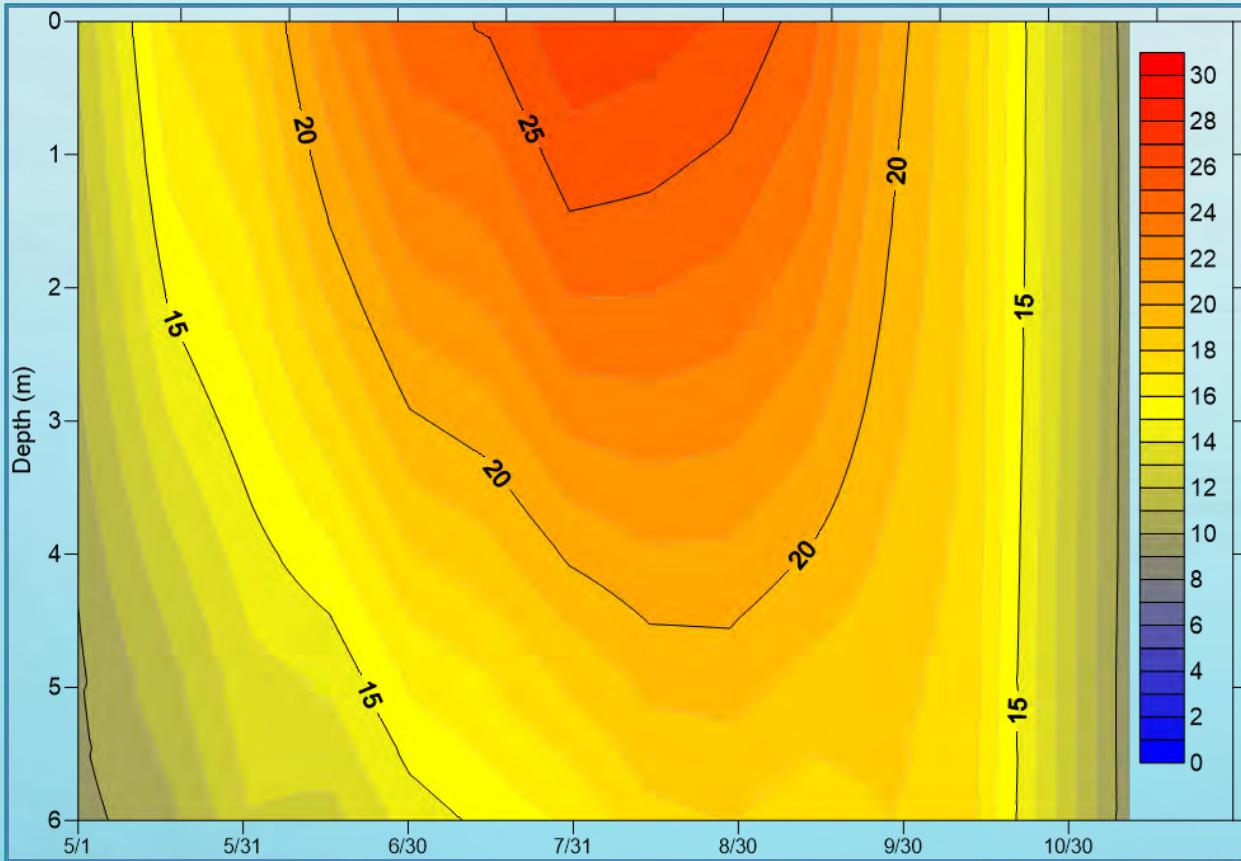


The background of the slide features a wide-angle photograph of a natural landscape. In the foreground, there is a calm body of water, possibly a lake or a wide river. Beyond the water, there are rolling green hills and mountains. The sky is clear and blue, suggesting a sunny day. The overall scene is peaceful and representative of a natural environment.

Water Quality

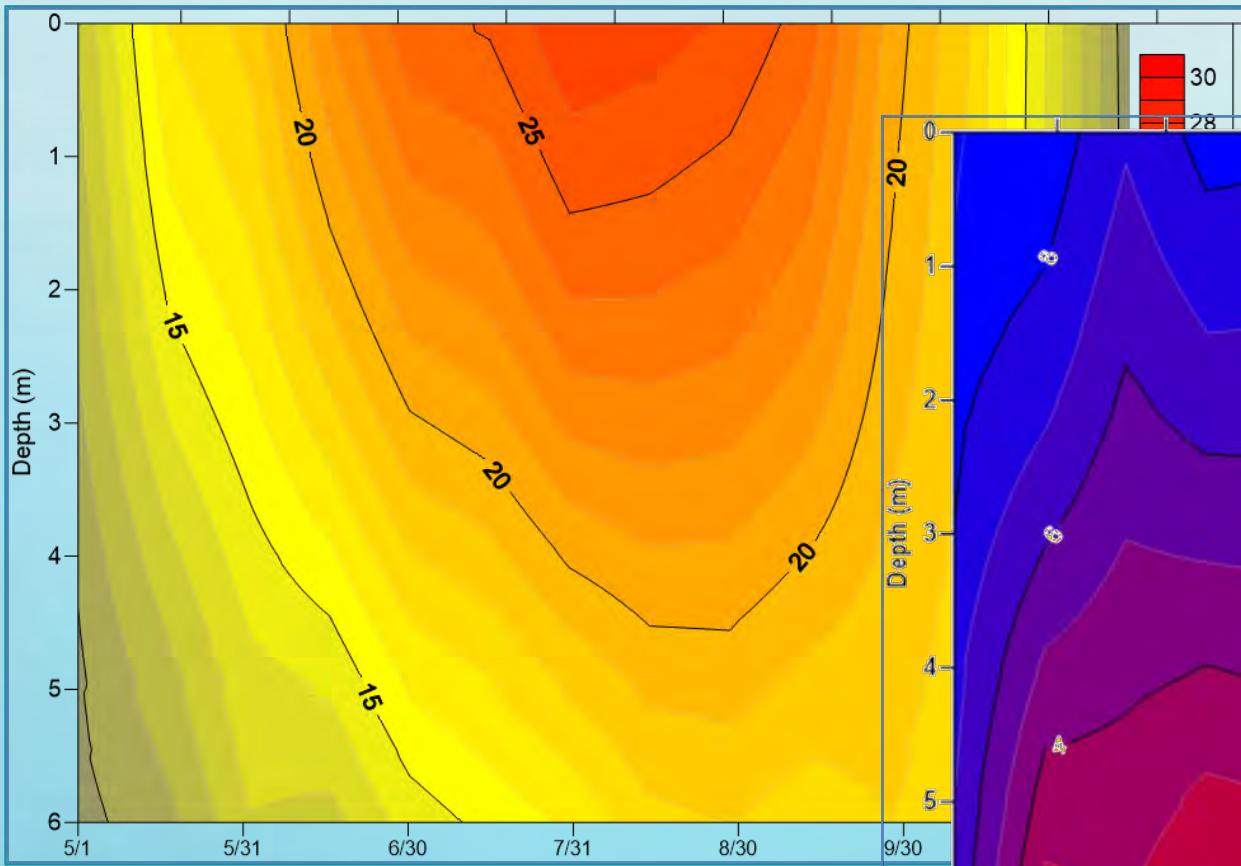
Lake Rippowam Dissolved Oxygen & Temperature

Temperature Isopleths

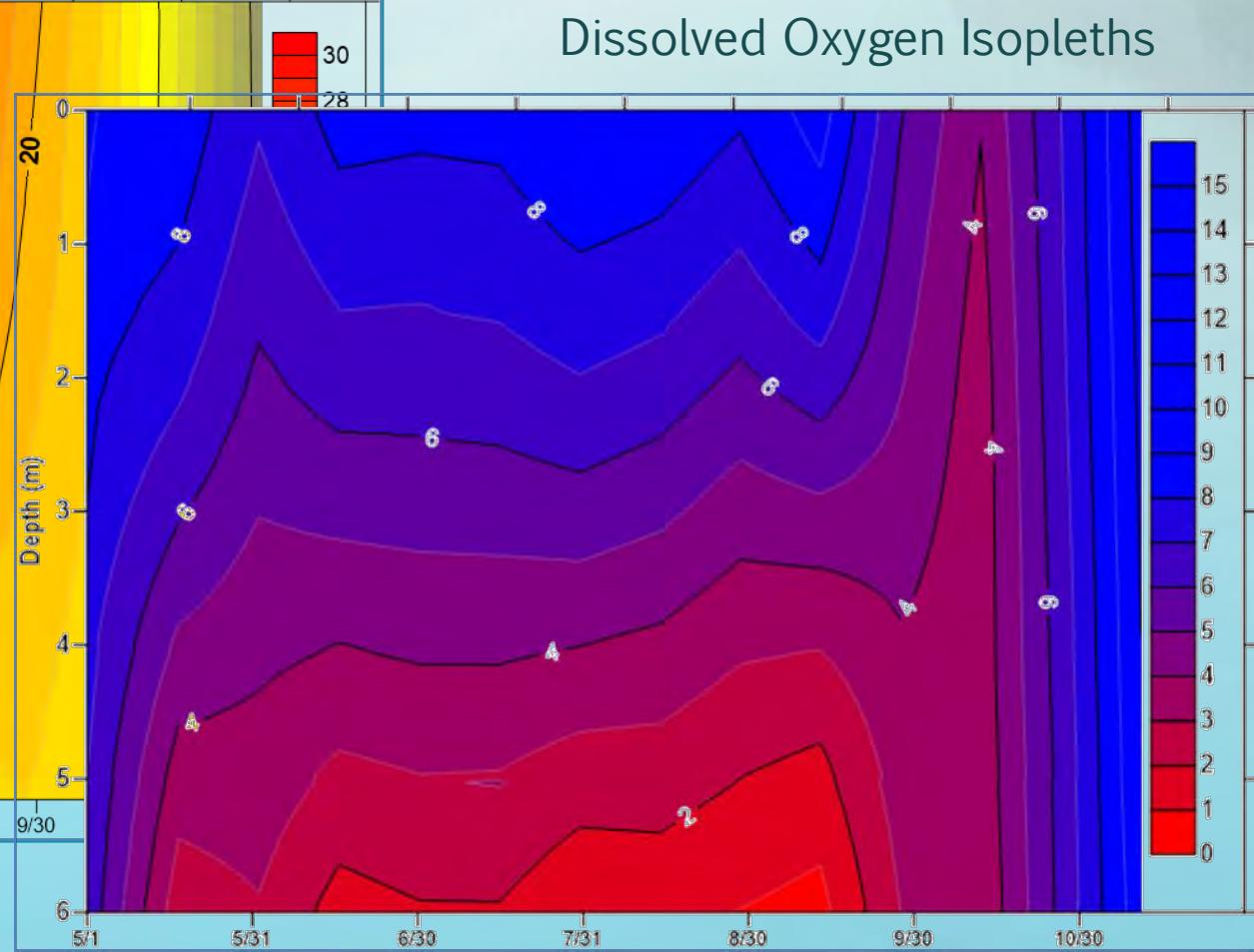


Lake Rippowam Dissolved Oxygen & Temperature

Temperature Isopleths



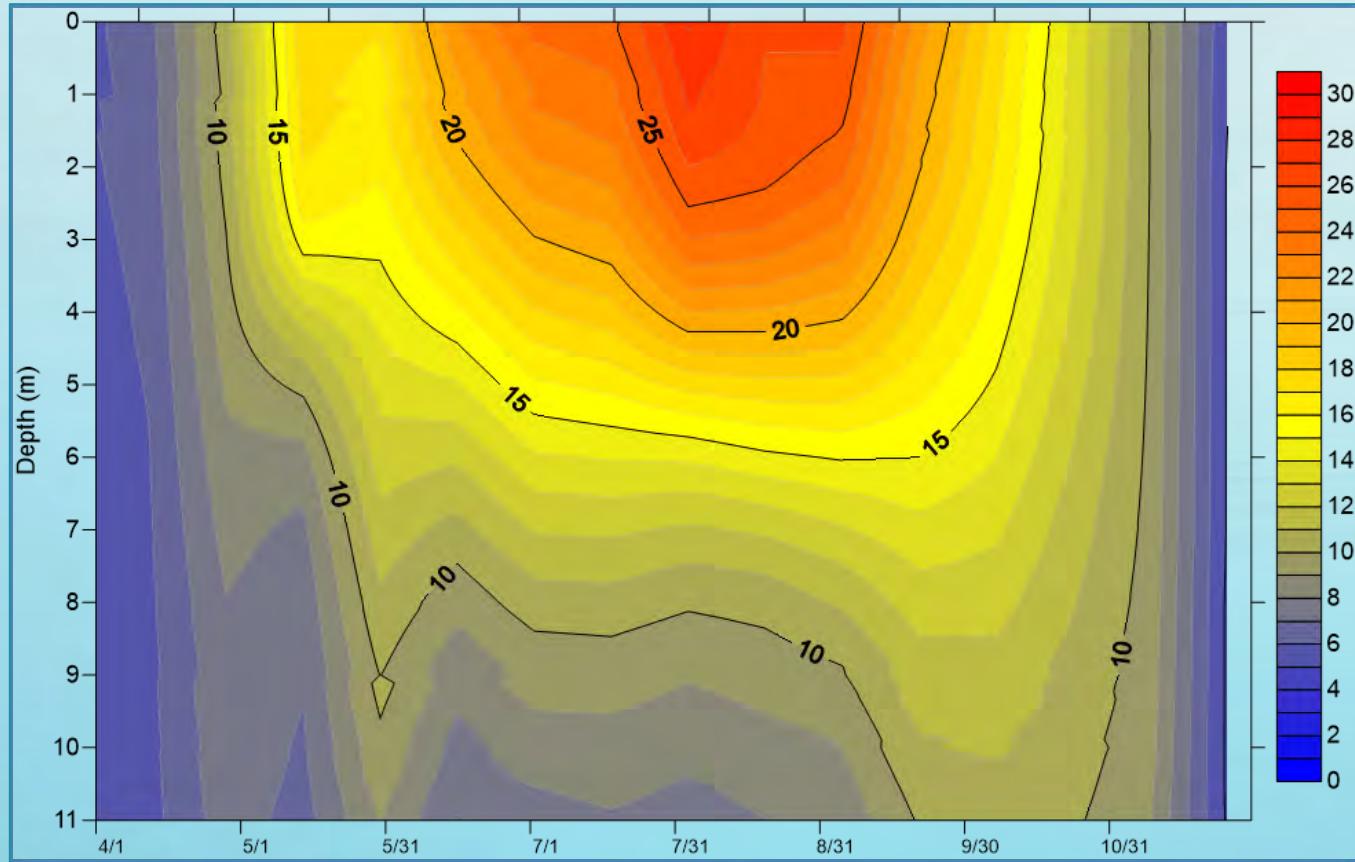
Dissolved Oxygen Isopleths



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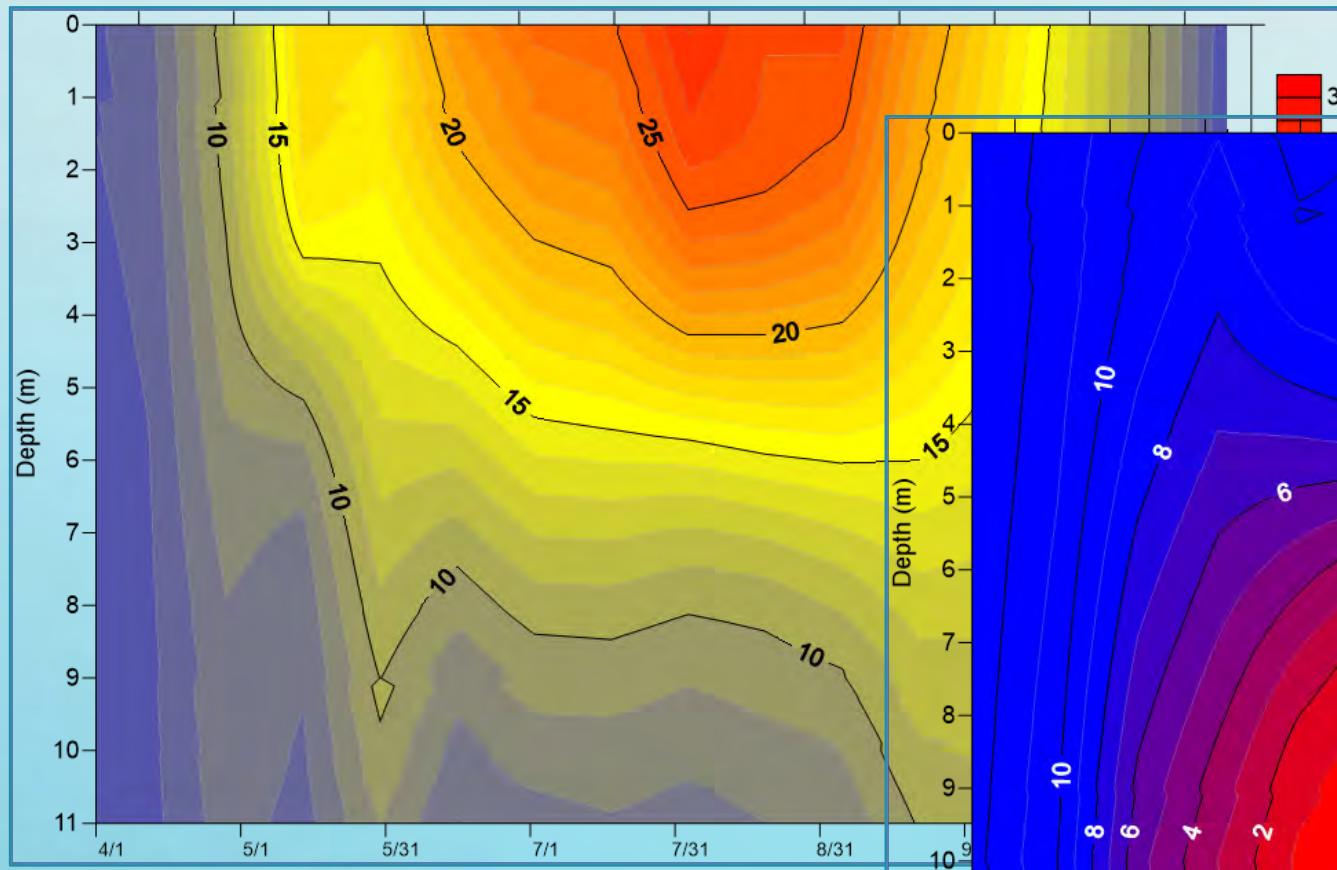
Lake Oscaleta Dissolved Oxygen & Temperature

Temperature Isopleths

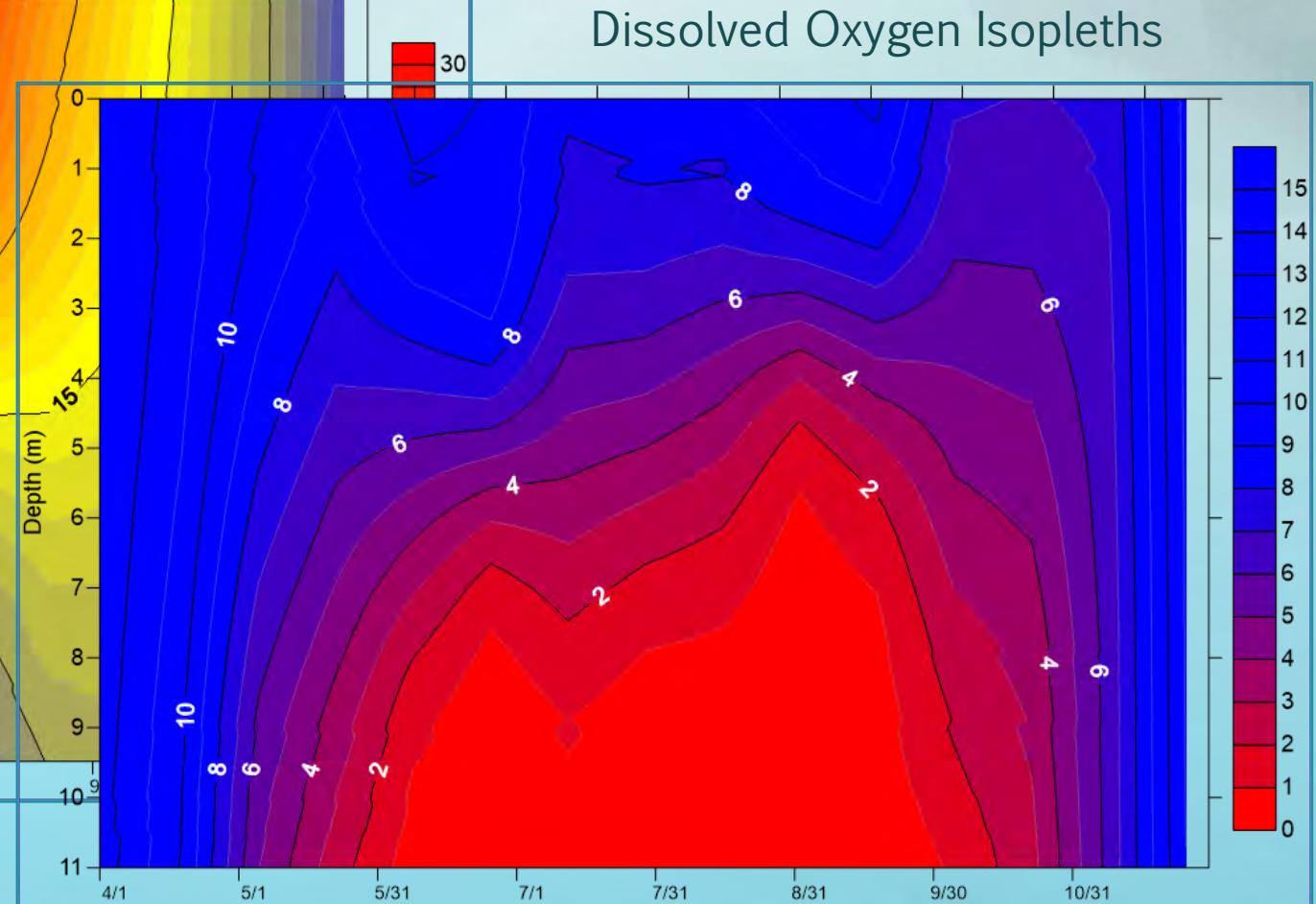


Lake Oscaleta Dissolved Oxygen & Temperature

Temperature Isopleths



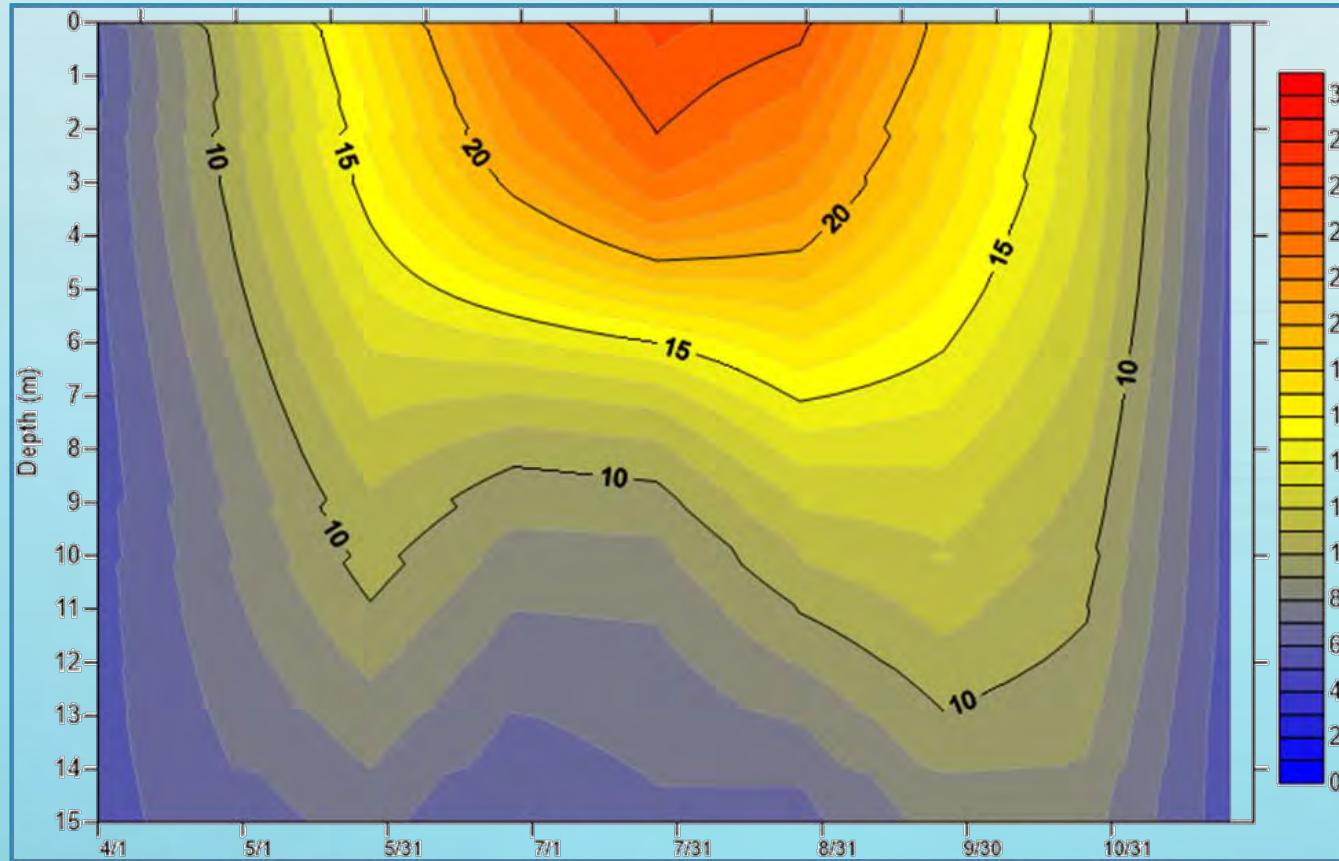
Dissolved Oxygen Isopleths



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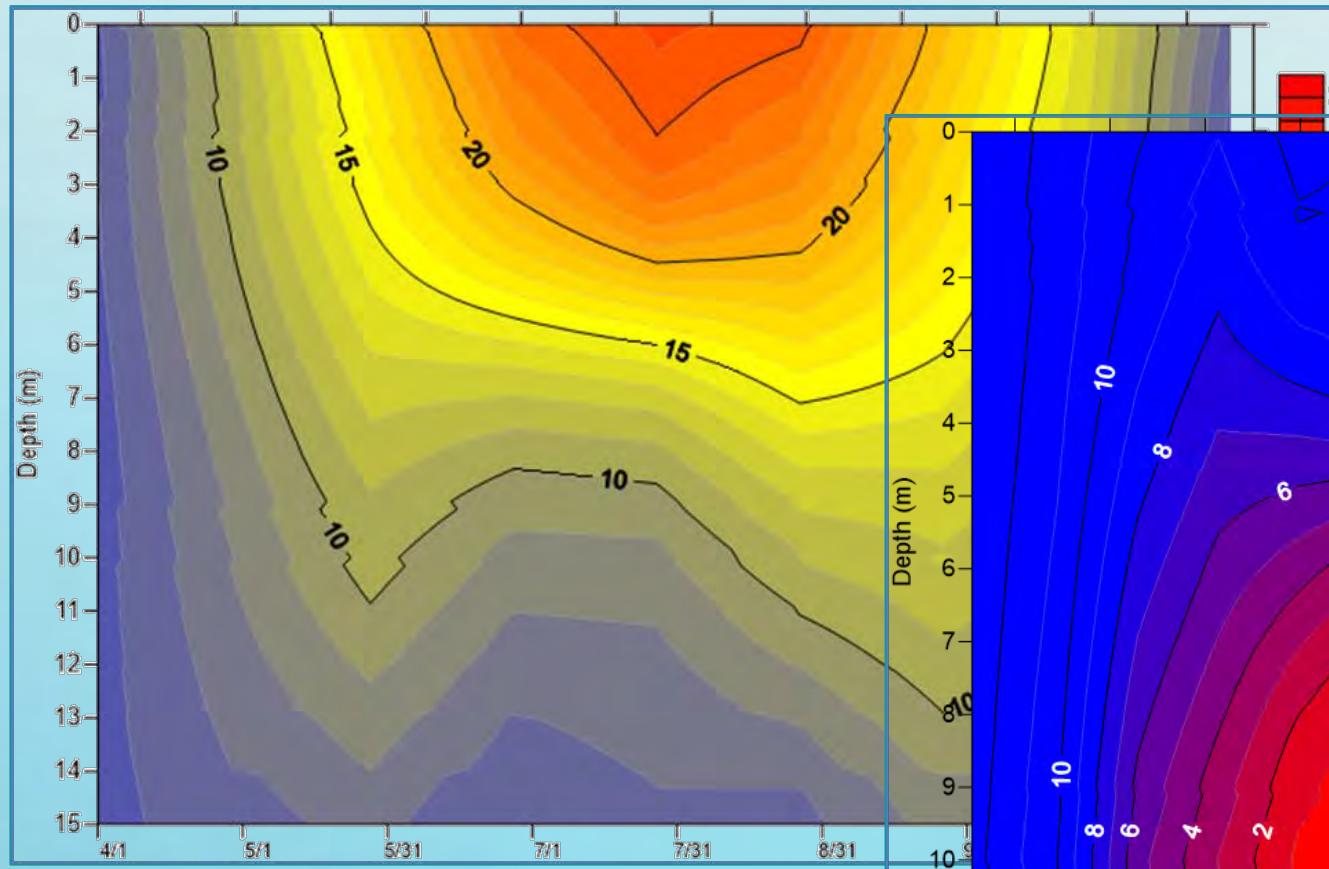
Lake Waccabuc Dissolved Oxygen & Temperature

Temperature Isopleths

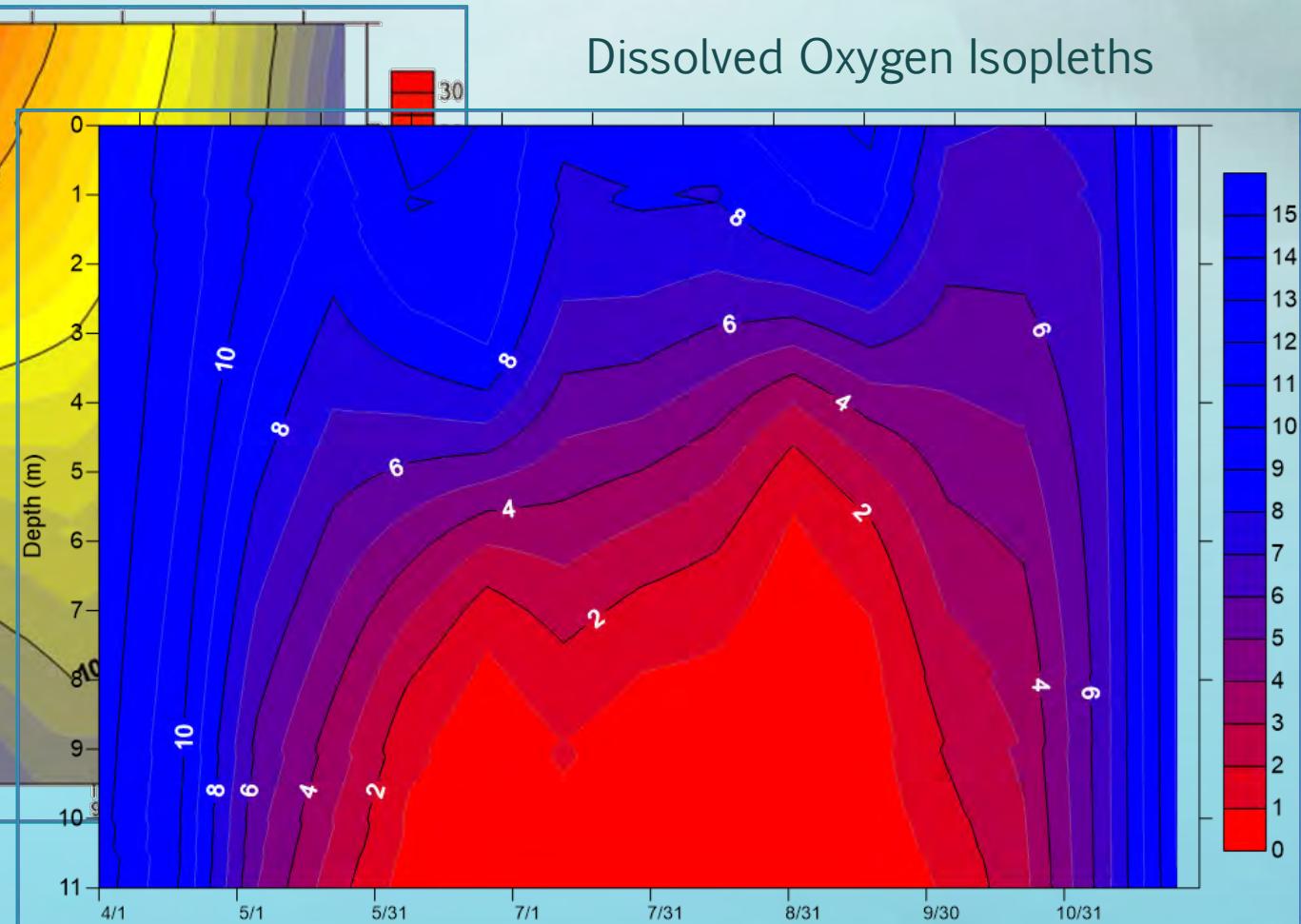


Lake Waccabuc Dissolved Oxygen & Temperature

Temperature Isopleths

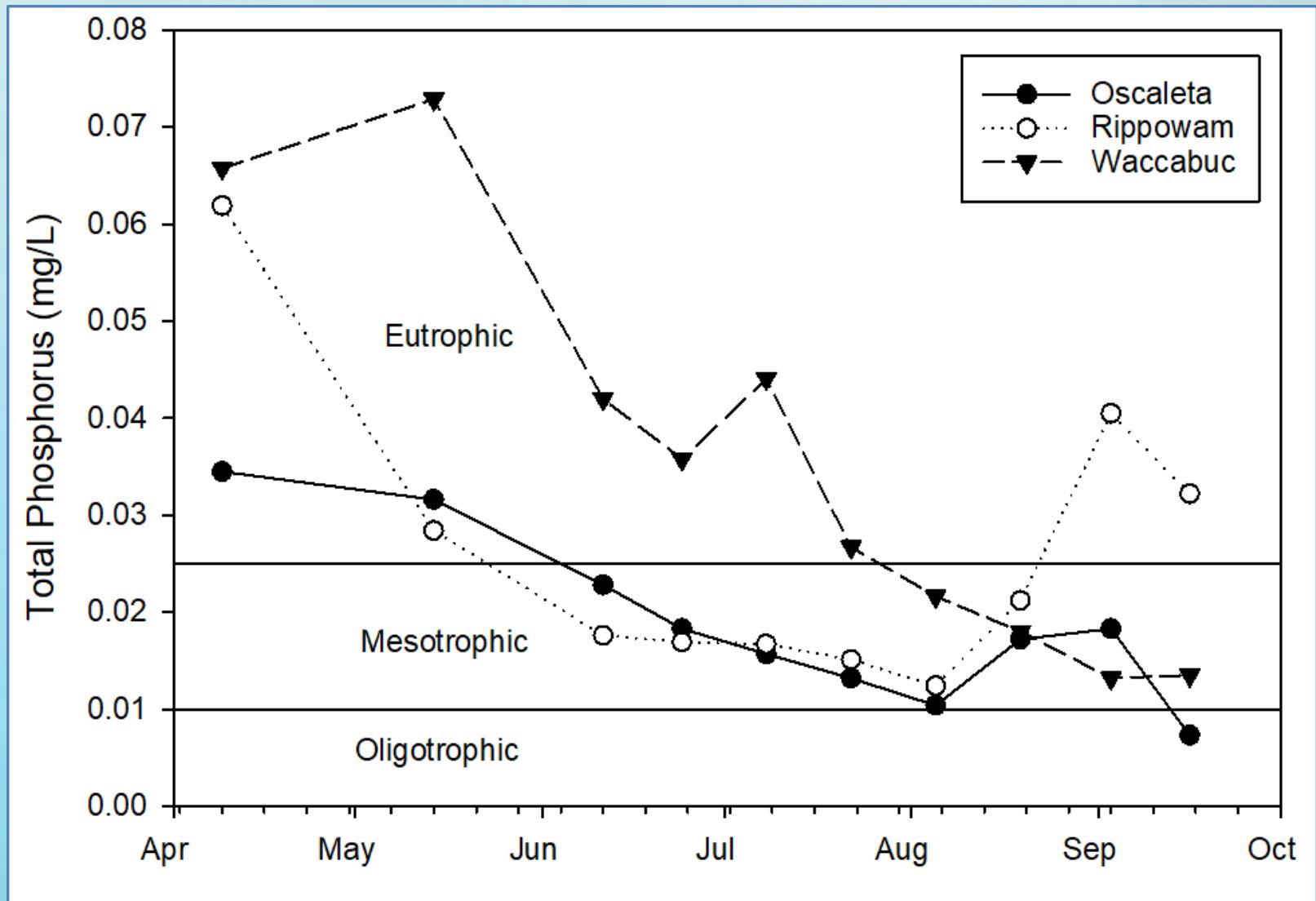


Dissolved Oxygen Isopleths

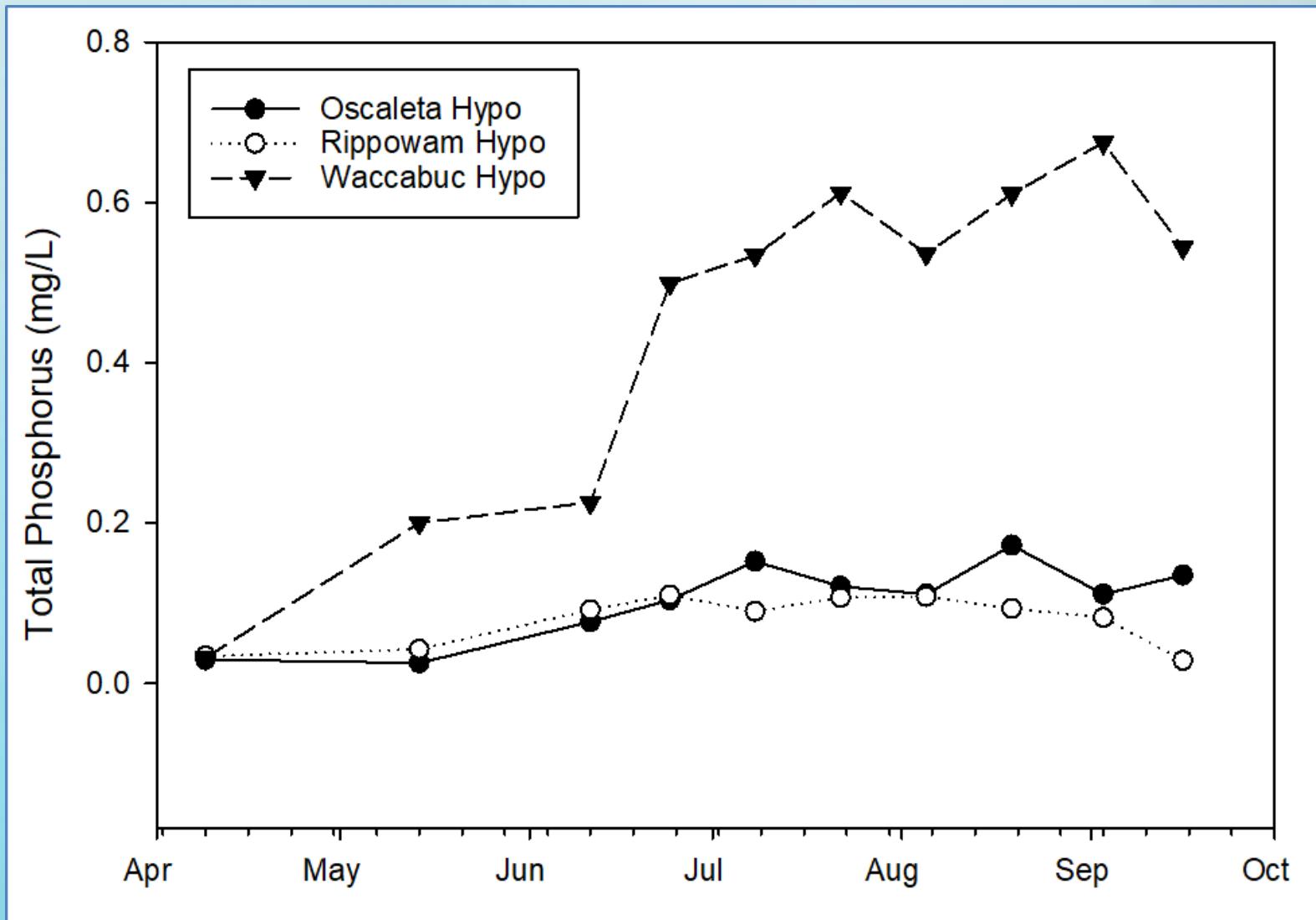


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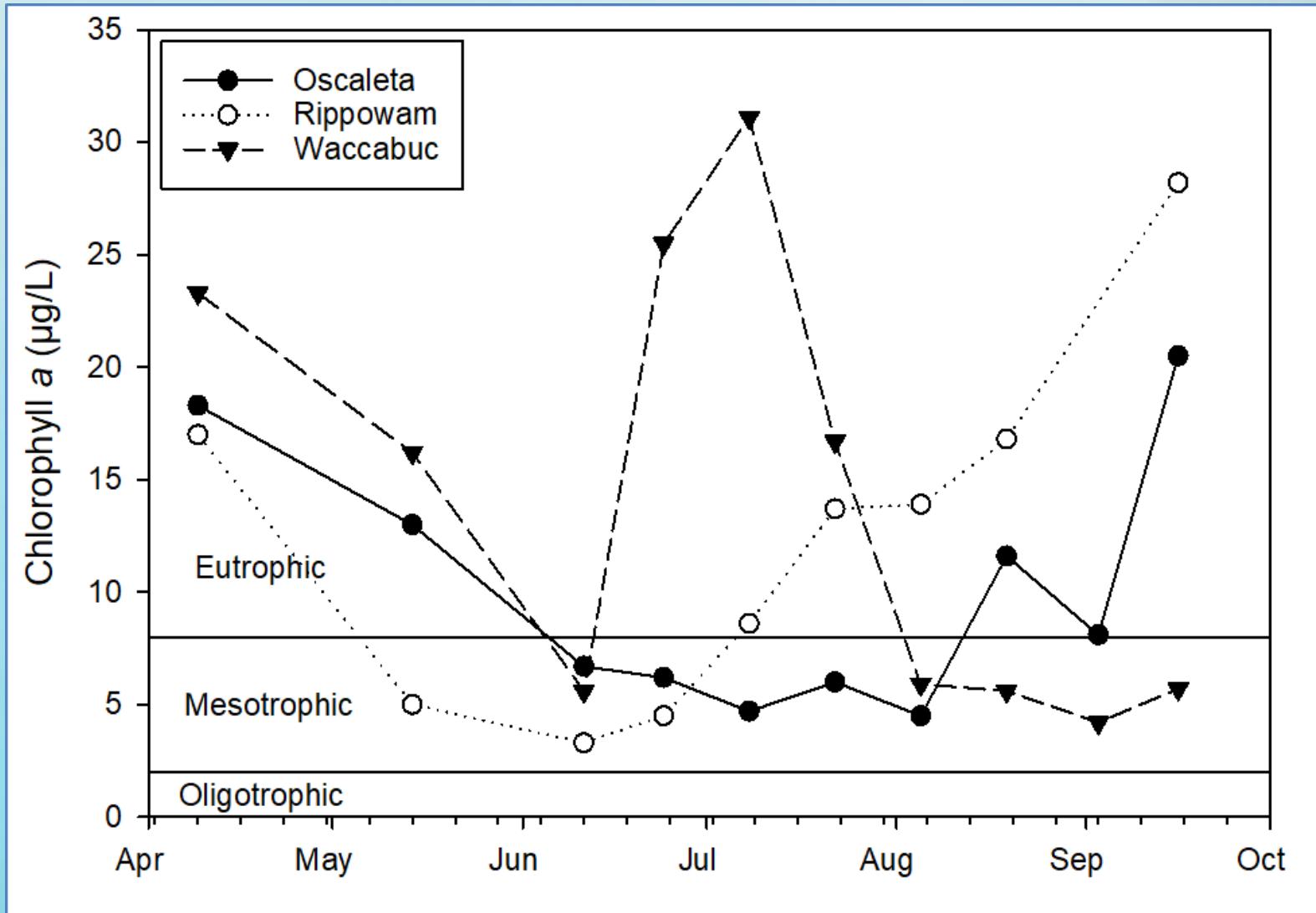
Total Phosphorus (epilimnia)



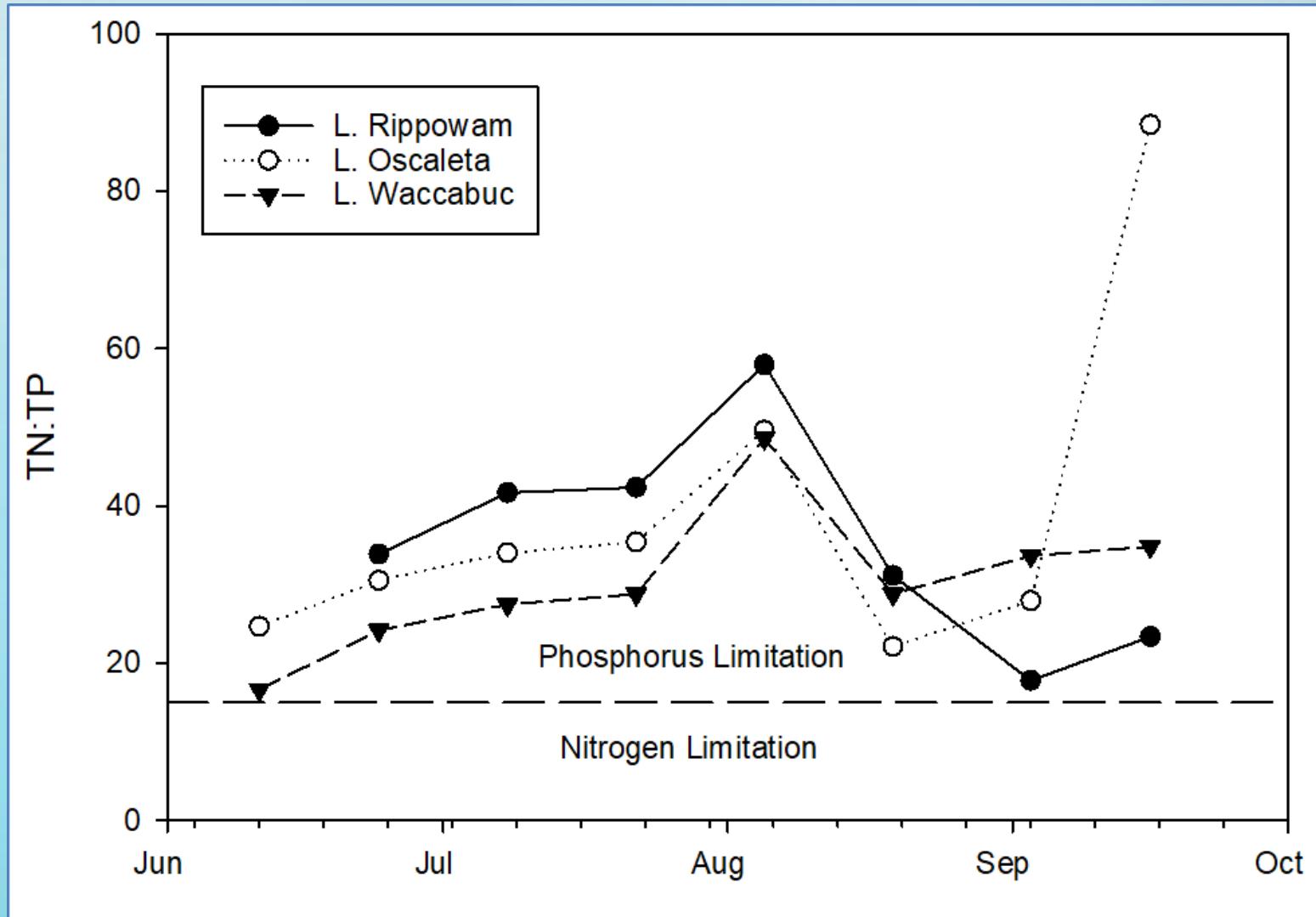
Total Phosphorus (hypolimnia)



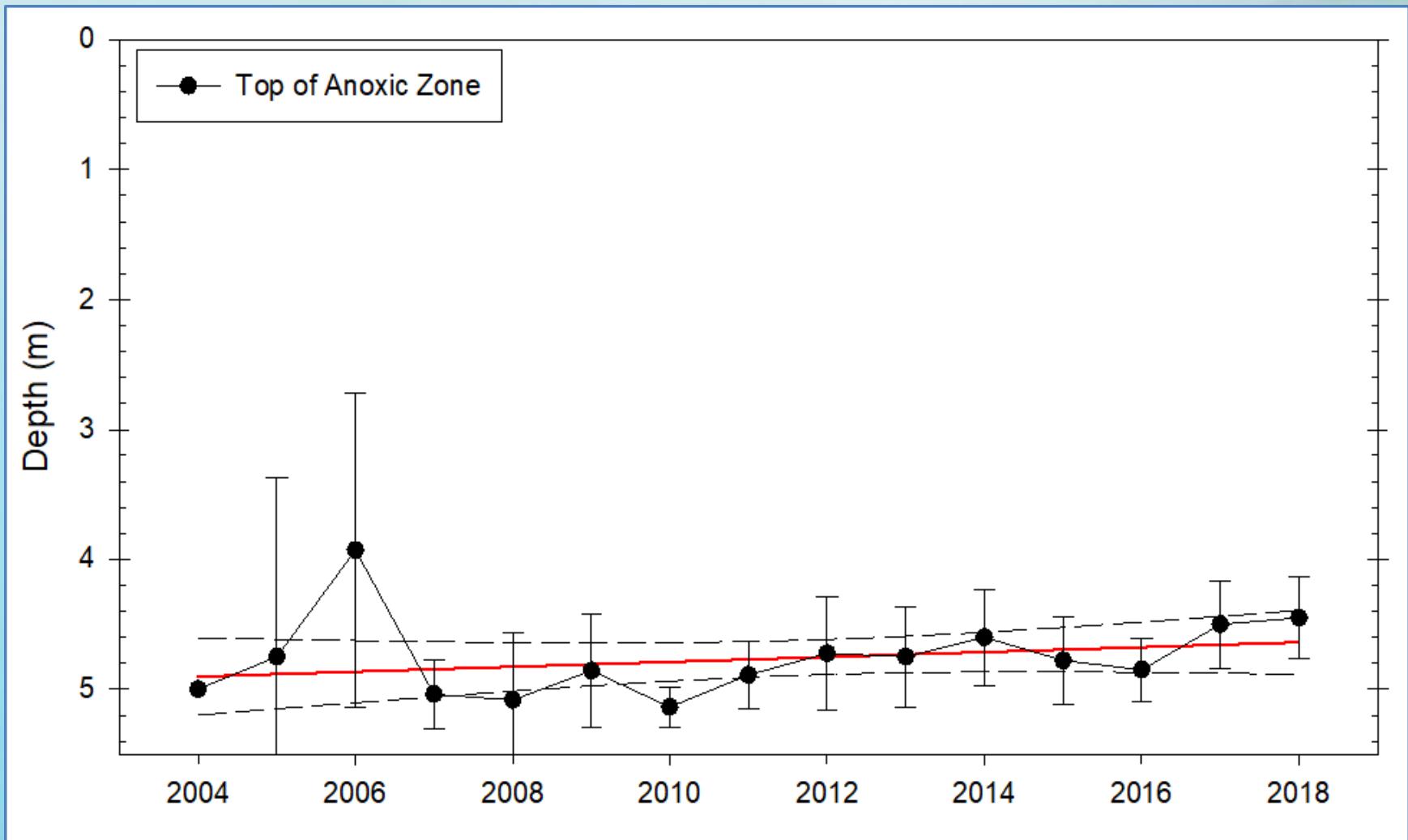
Chlorophyll *a*



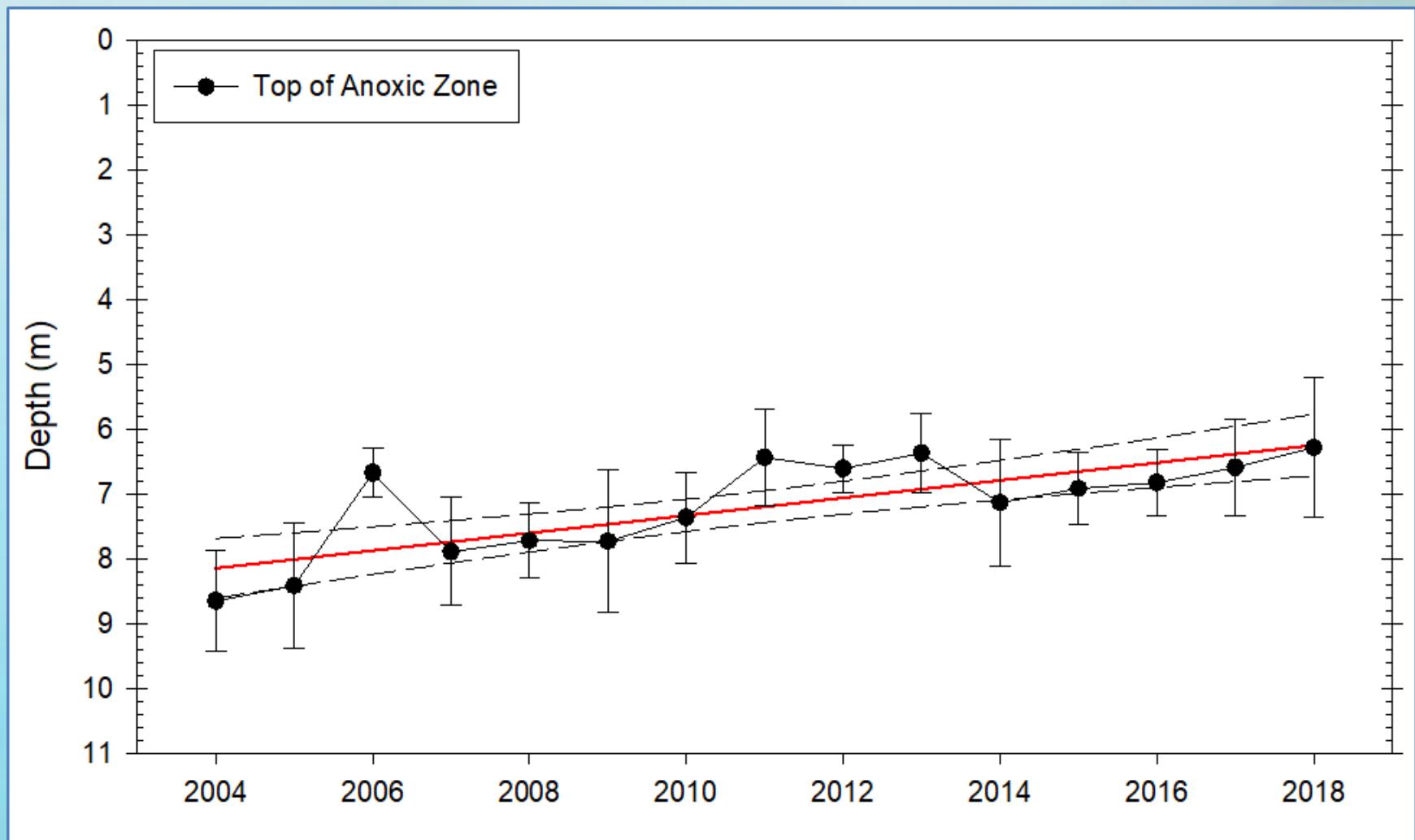
Limiting Nutrient



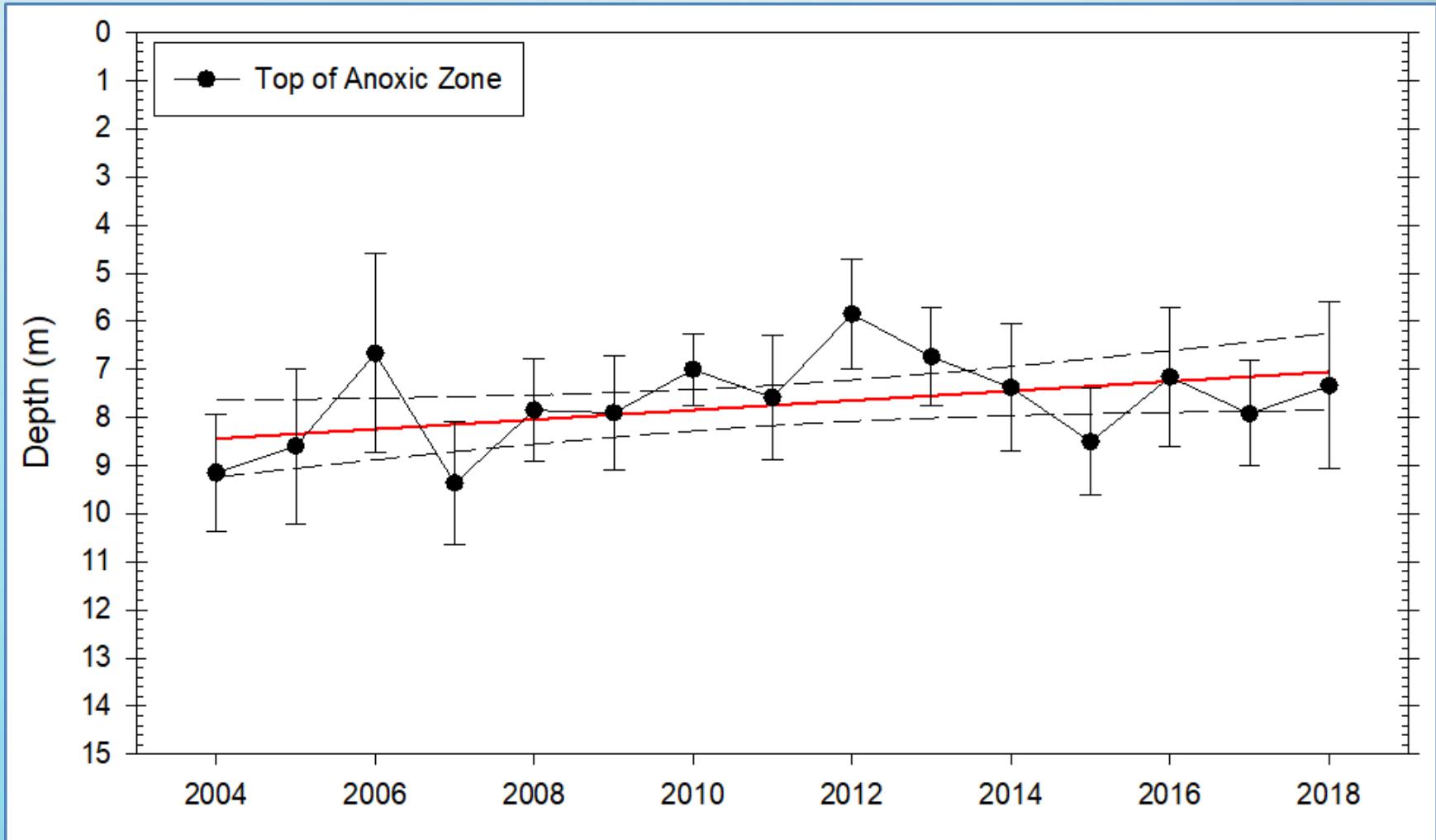
Lake Rippowam Anoxia Trend



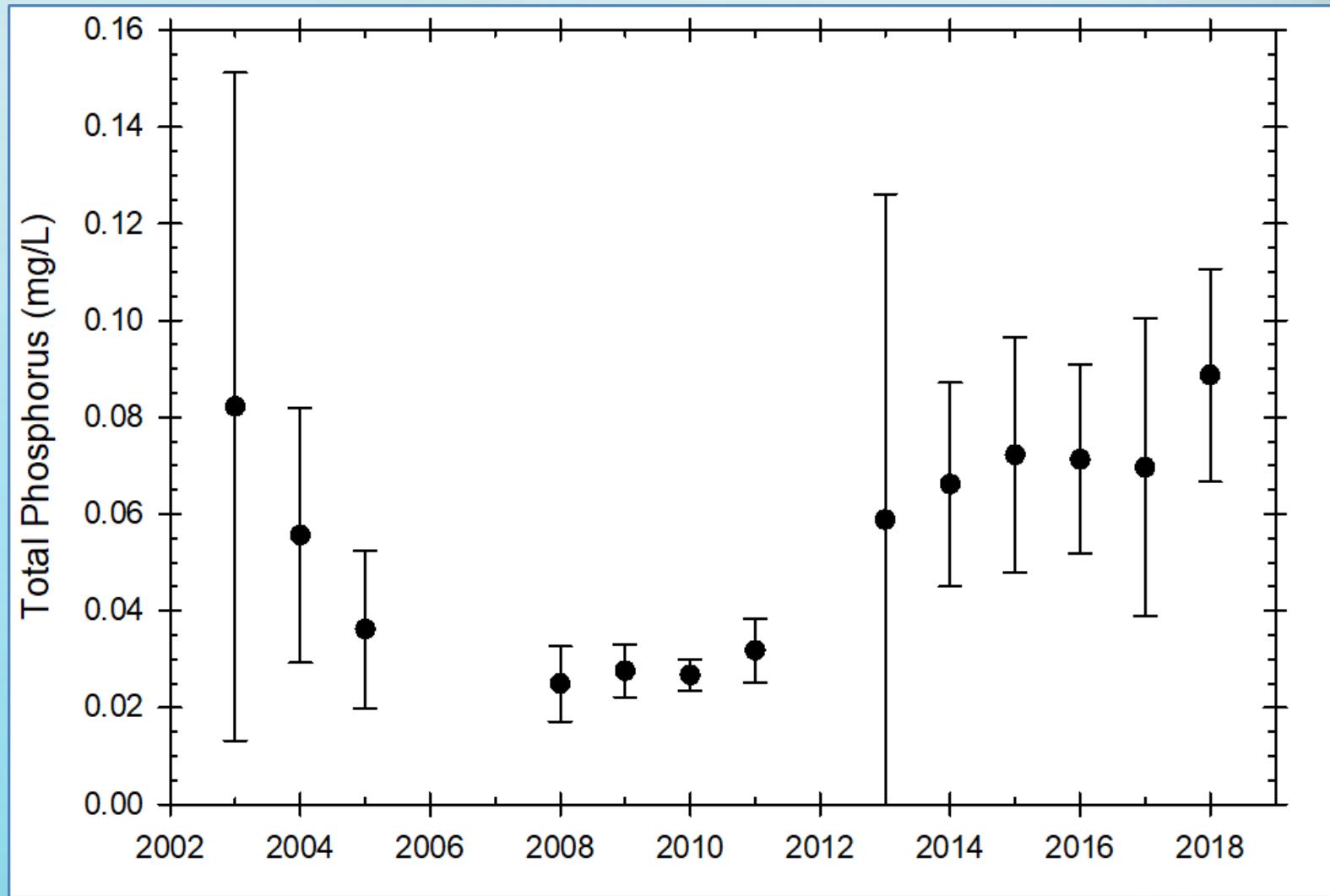
Lake Oscaleta Anoxia Trend



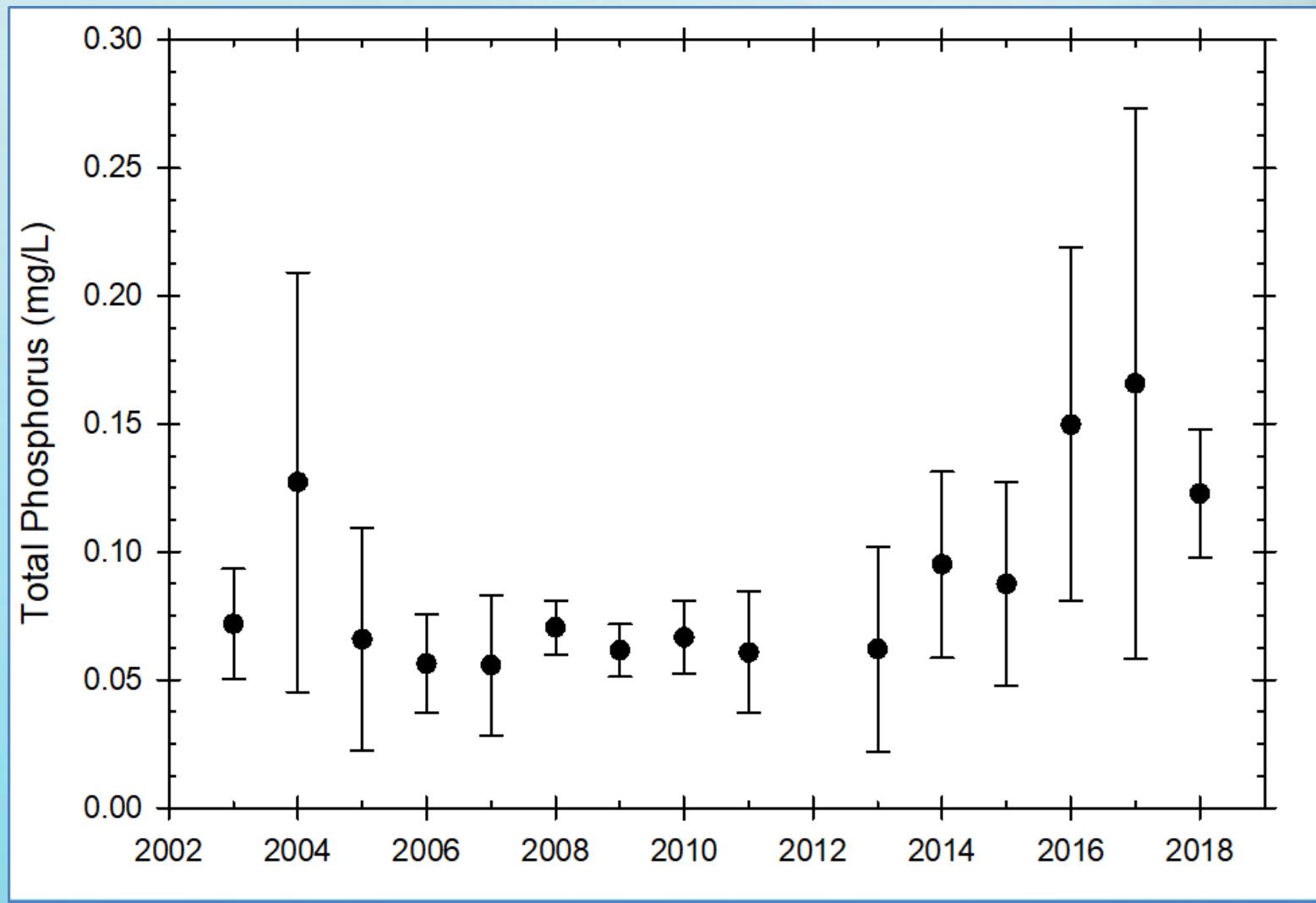
Lake Waccabuc Anoxia Trend



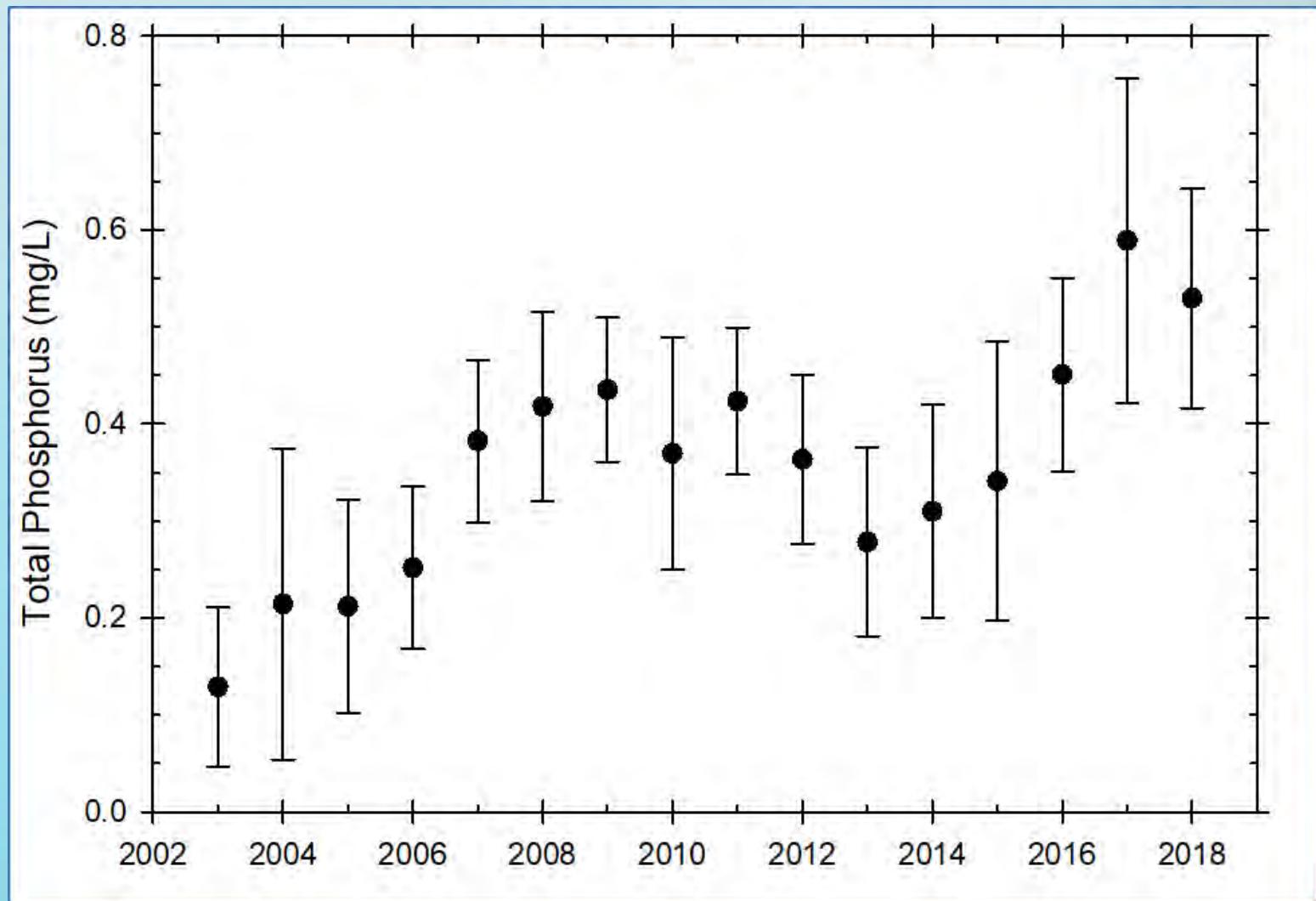
Lake Rippowam Hypolimnetic TP Trend



Lake Oscaleta Hypolimnetic TP Trend



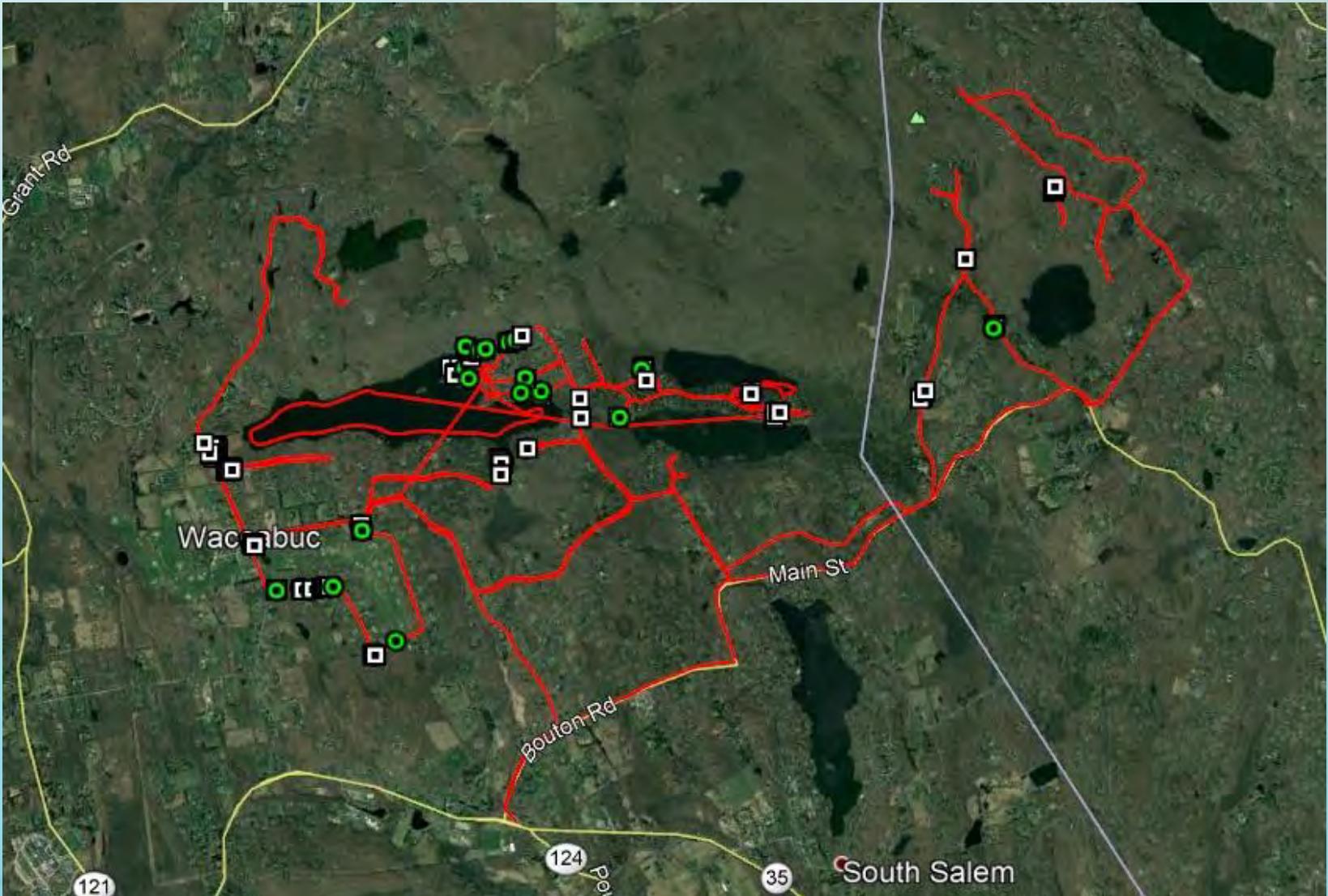
Lake Waccabuc Hypolimnetic TP Trend





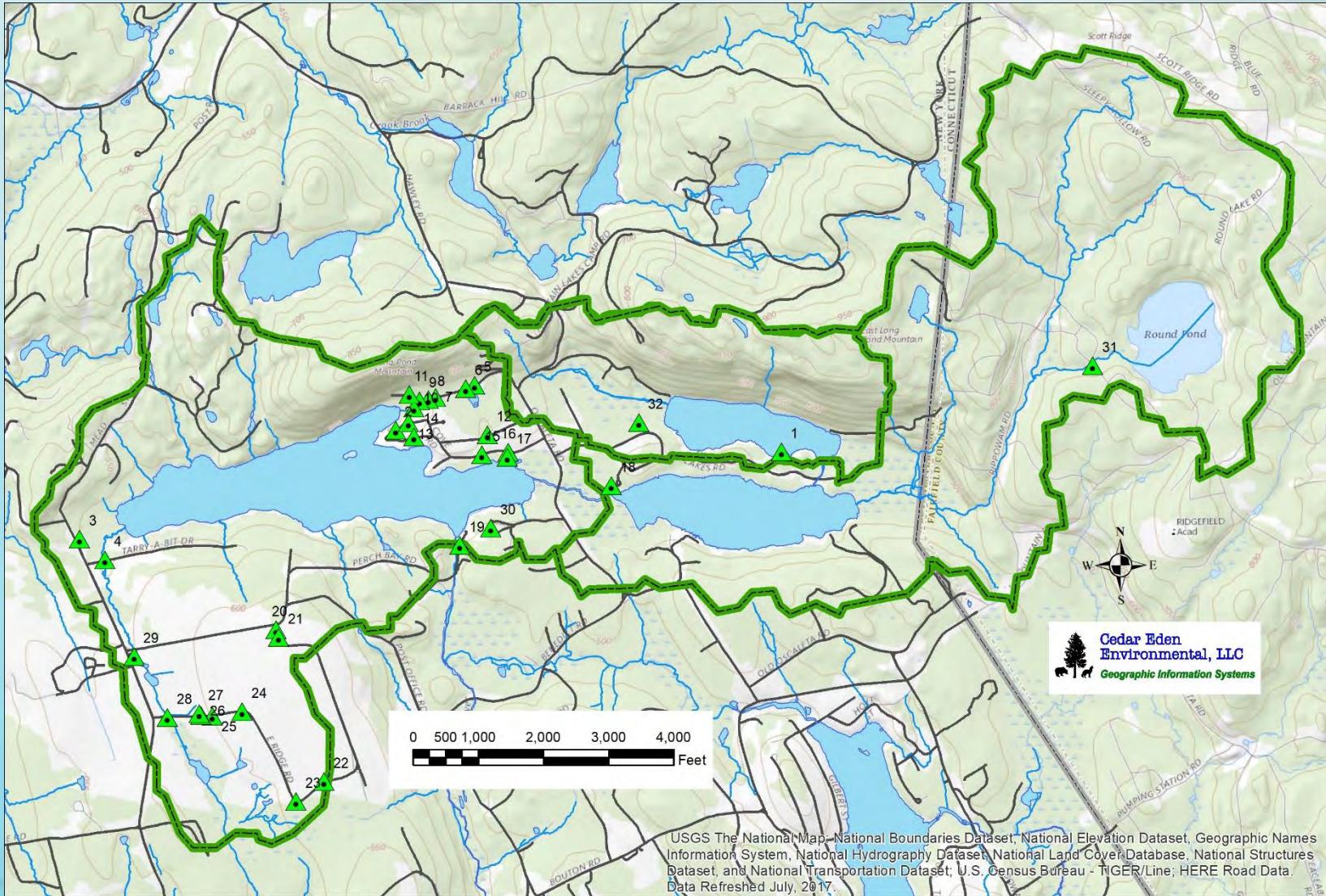
Watershed NPS Investigation

Watershed NPS Areas

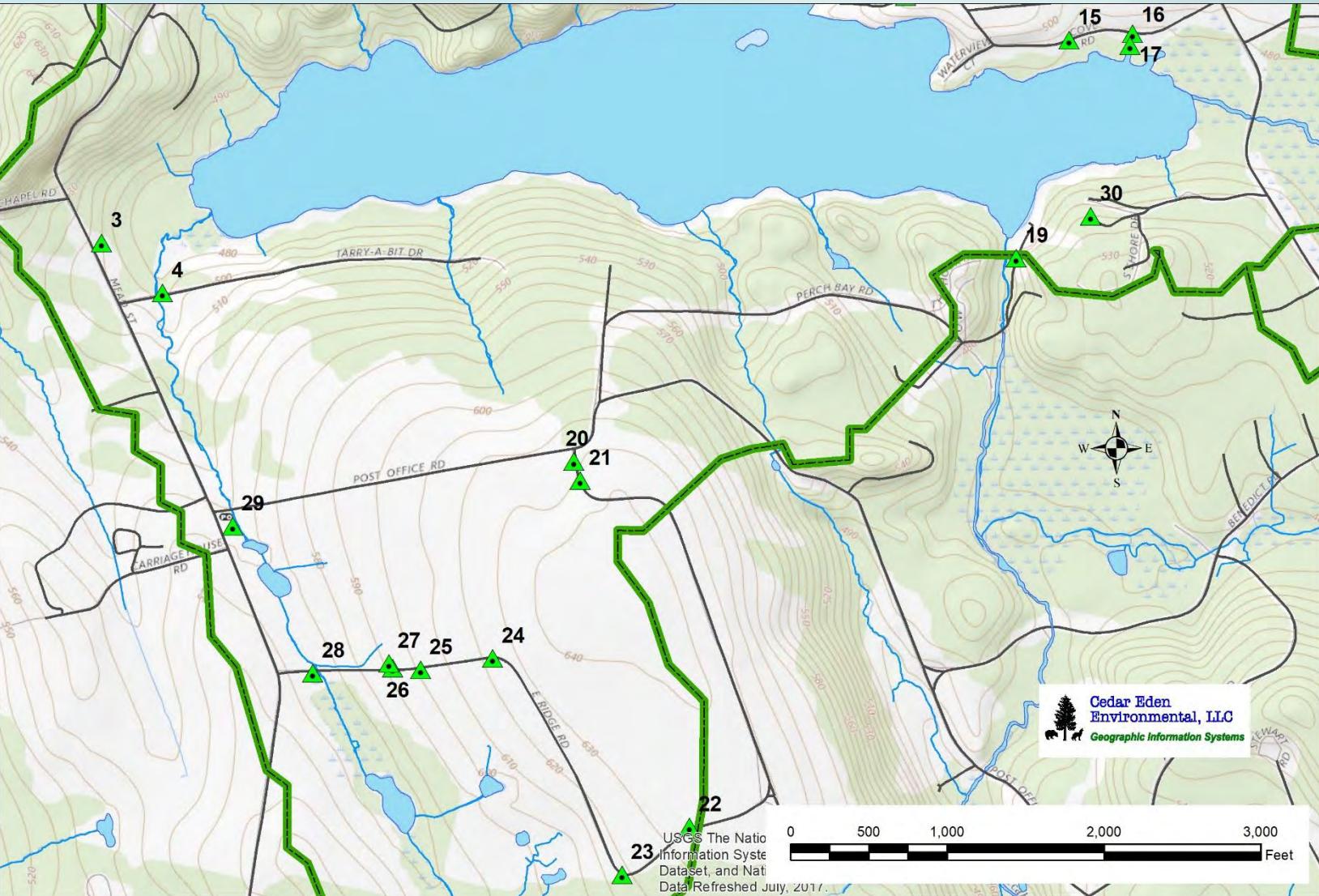


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Watershed NPS Areas

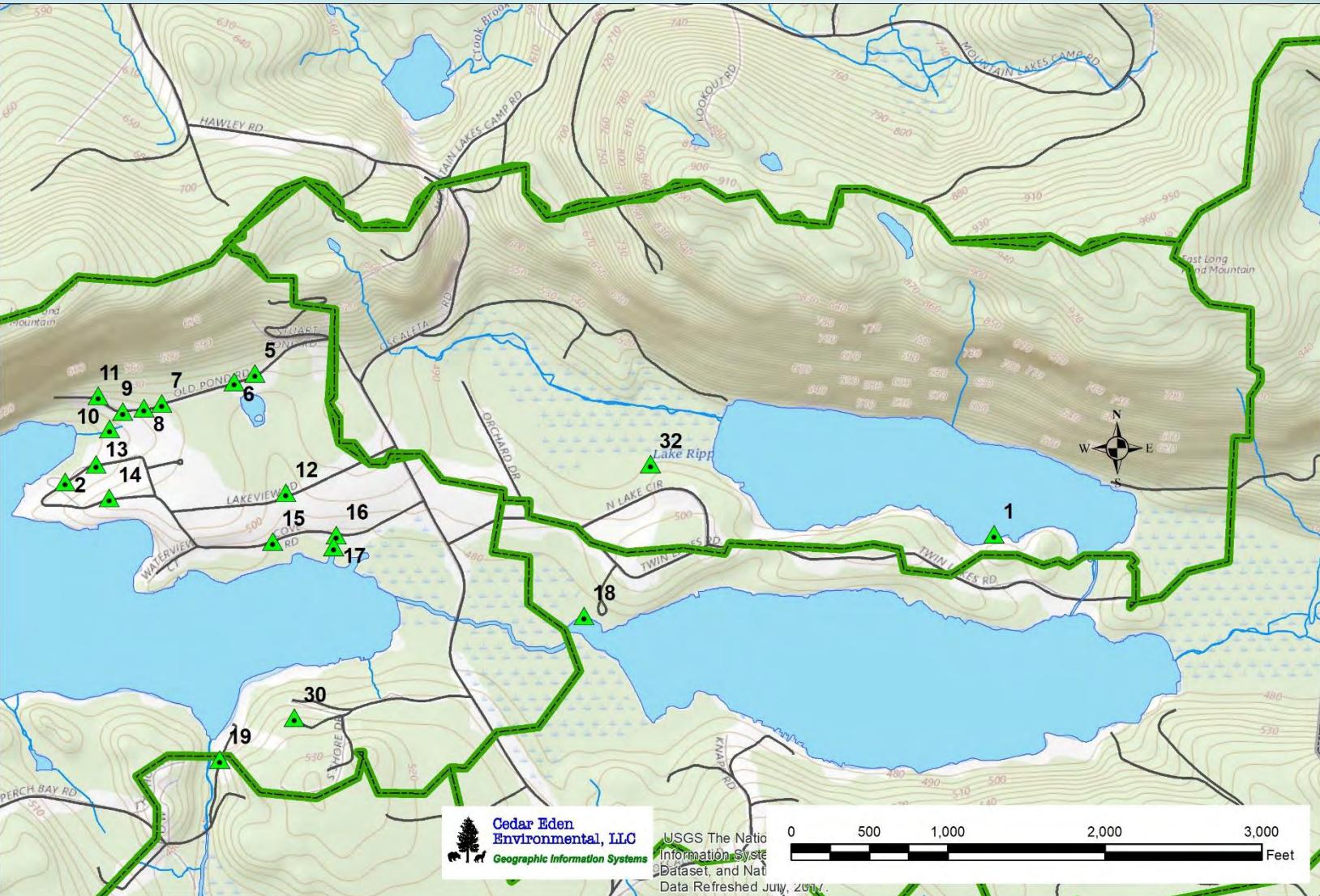


Watershed NPS Areas



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Watershed NPS Areas



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Eroding Gravel Roads



Eroding Gravel Roads



Eroding Gravel Roads



Eroding Gravel Roads



Stormwater Runoff



Stormwater Runoff



Stormwater Runoff

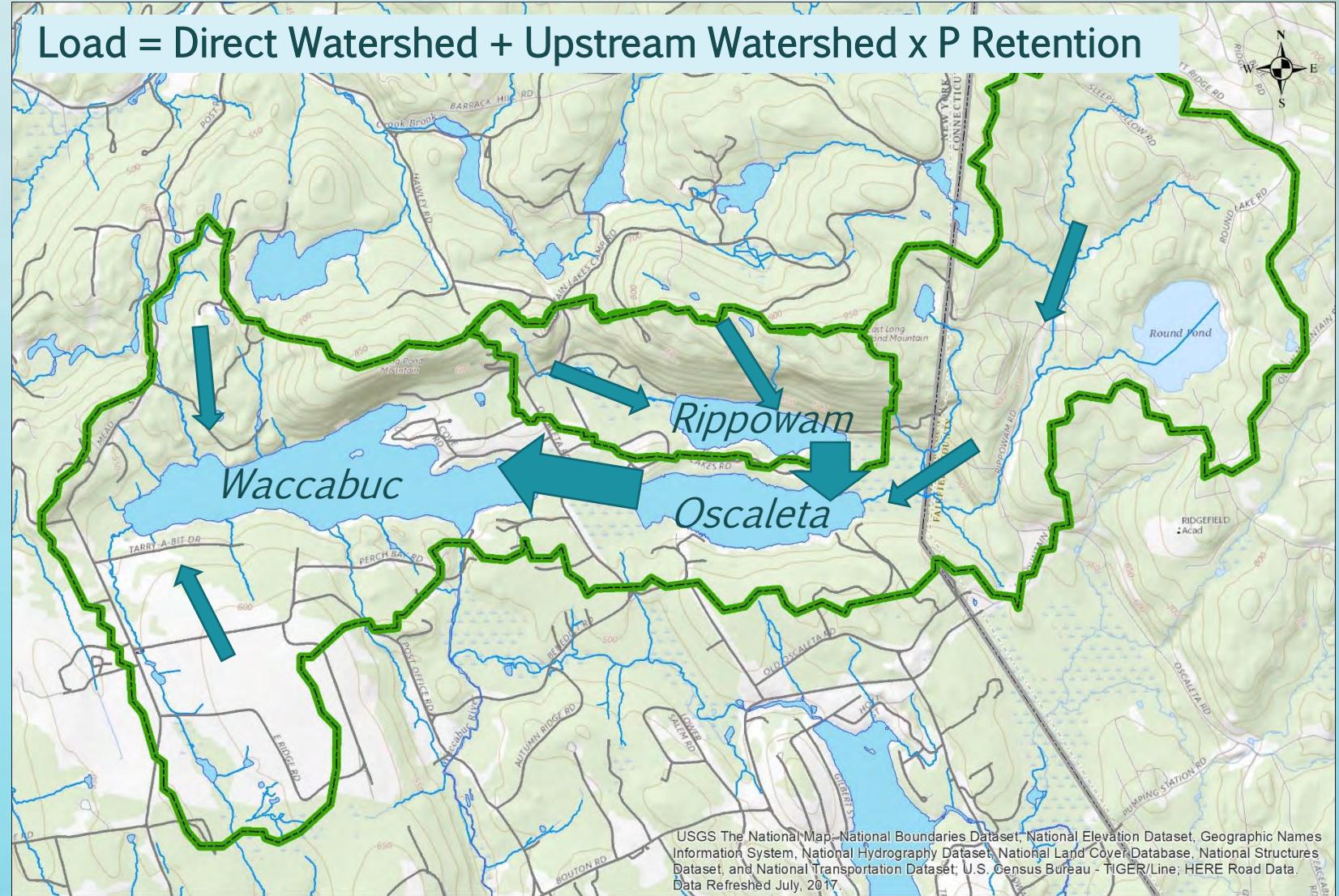


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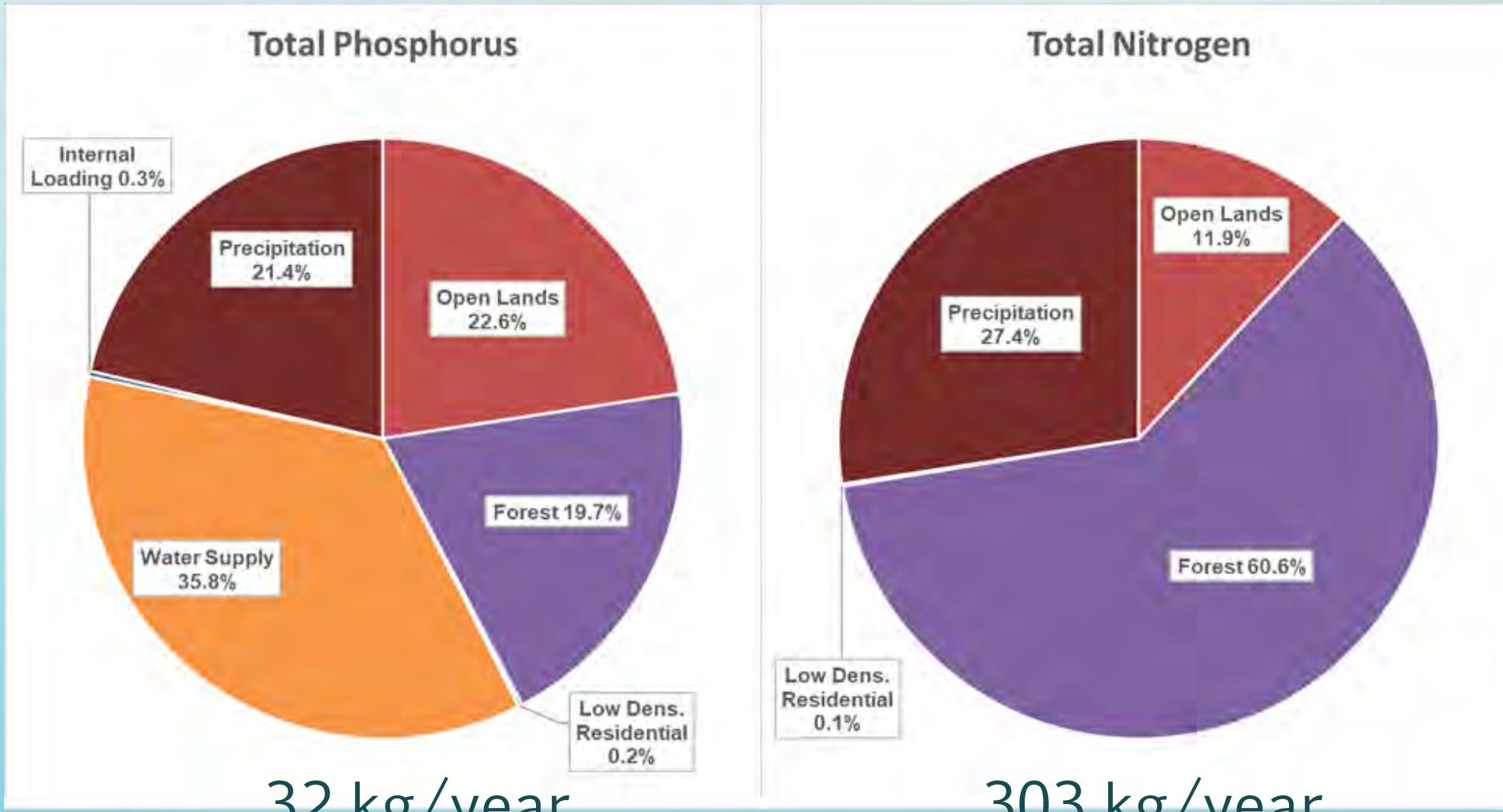
Pollutant Budgets

Pollutant Budgets for Lake Chains

- Rippowam 279 acres
- Oscaleta 1,282 acres
- Waccabuc 2,196 acres

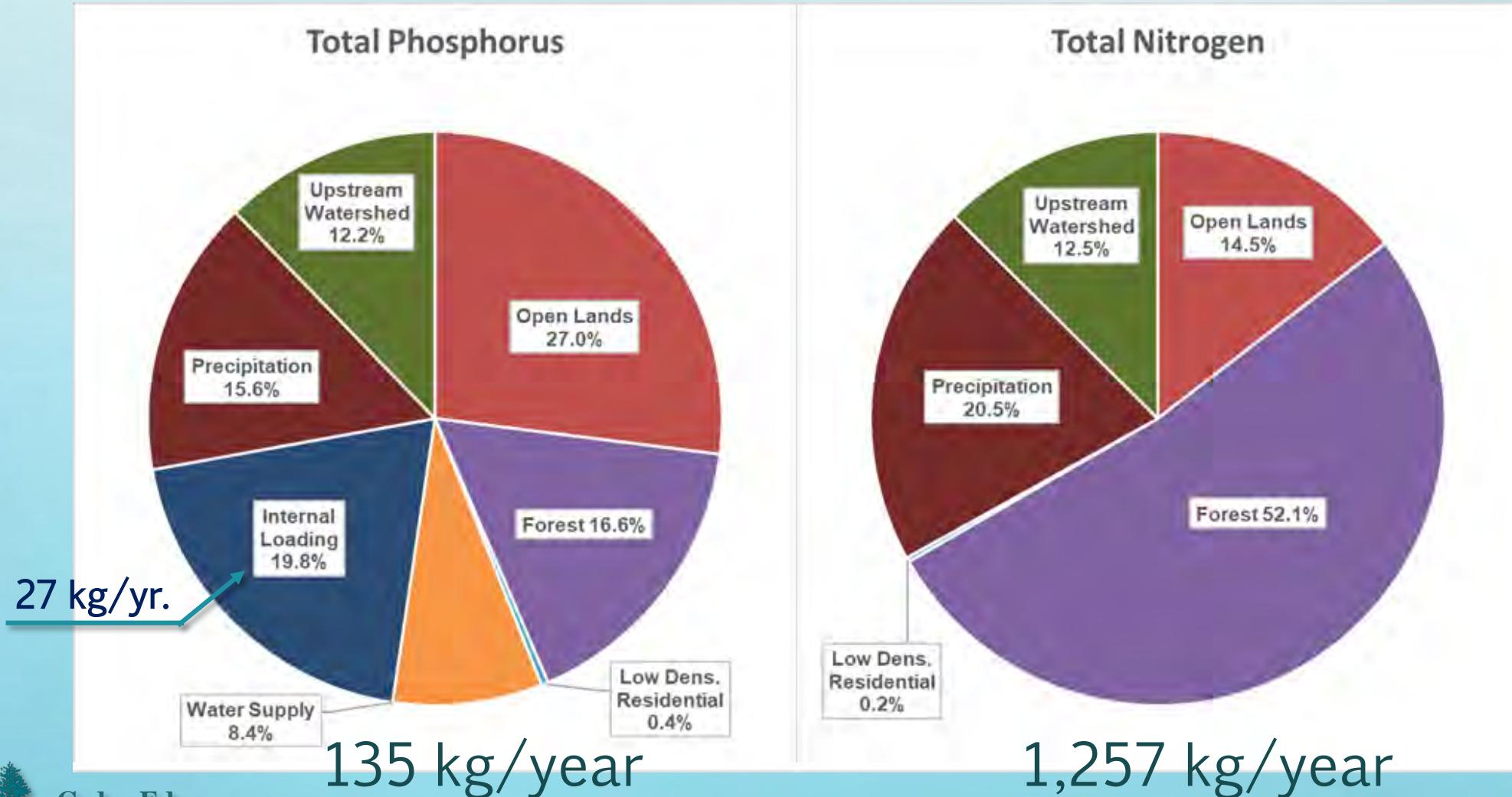


Lake Rippowam Annual Pollutant Budgets

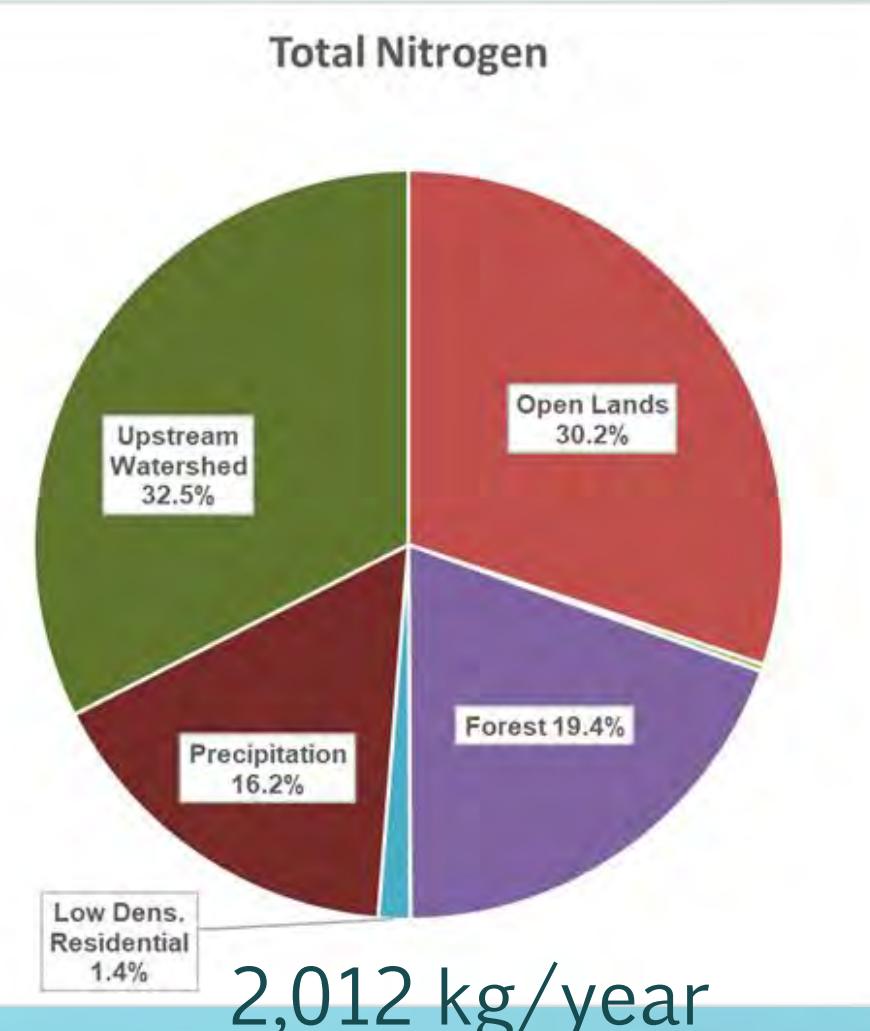
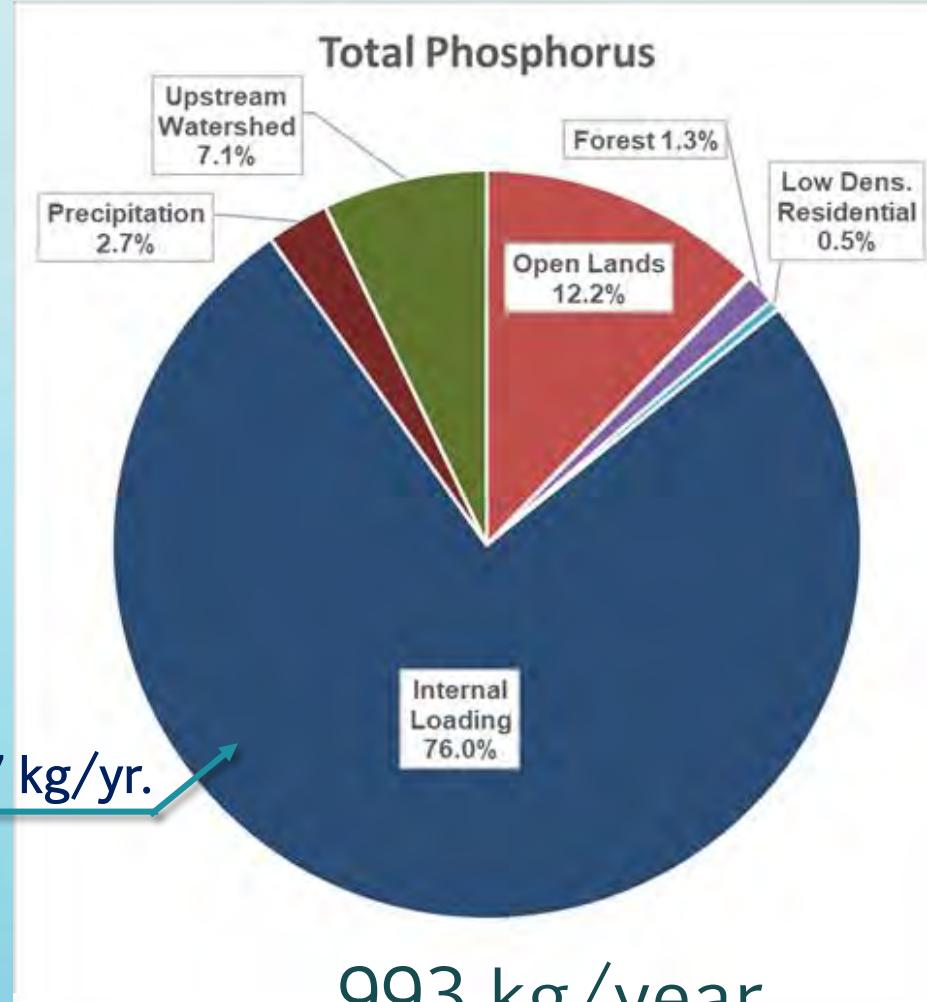


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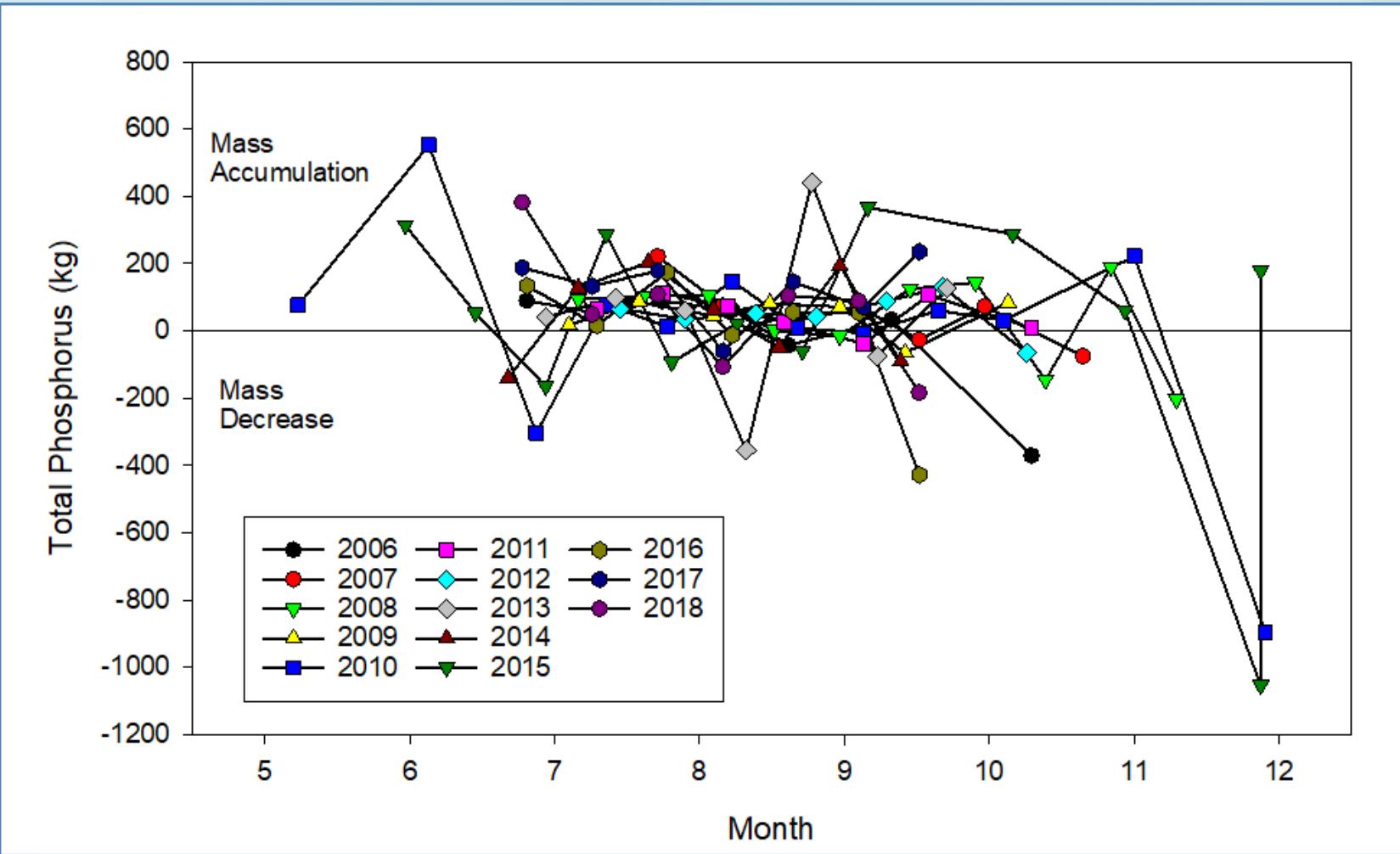
Lake Oscaleta Annual Pollutant Budgets



Lake Waccabuc Annual Pollutant Budgets



Lake Waccabuc Internal Loading



Phosphorus Reduction to Reach 0.020 mg/L and Recommended Management Practices

- Lake Rippowam: 12.6 kg/year (39 percent)
 - Switching to alternate water supply anti-corrosion measure (36%)
 - Modest changes in SW management of impervious surface runoff
- Lake Oscaleta: 34.5 kg/year (26 percent)
 - Switching to alternate water supply anti-corrosion measure (27%)
 - Modest changes in SW management of impervious surface runoff
 - Minimizing internal phosphorus load (Aeration, Alum or PhosLock®) (20%)
- Lake Waccabuc: 874 kg/year (88 percent)
 - Minimizing internal phosphorus load (Aeration, Alum or PhosLock®) (76%)
 - Moderately aggressive stormwater management
 - Dirt & gravel roads, Impervious surfaces, Untreated runoff from paved roads

Thank you . . .

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