

# Seneca Lake

## General Lake Information

<b>Location</b>	Seneca, Yates, Ontario, and Schuyler counties
<b>Basin</b>	Oswego-Seneca-Oneida
<b>Size</b>	17,259 hectares (42,648 acres)
<b>Lake Origins</b>	Natural
<b>Watershed Area</b>	184,441 hectares (455,772 acres)
<b>Retention Time</b>	16.7 years
<b>Mean Depth</b>	89.0 meters
<b>Maximum Depth</b>	188.0 meters
<b>Public Access</b>	Public ramps, car top/hand launches, several beaches
<b>Major Tributaries</b>	Catharine Creek, Keuka Lake Outlet, and multiple named and unnamed tributaries
<b>Lake Tributary To...</b>	Seneca River to Oswego River to Lake Ontario
<b>WQ Classification</b>	AA (TS) (potable water, bathing, swimming, trout spawning), B (T) (bathing, swimming, trout waters)
<b>Lake Sites Latitude</b>	North: 42.7711; South: 42.453
<b>Lake Sites Longitude</b>	North: -76.95; South: -76.887
<b>Sampling Years</b>	CSLAP: 2017
<b>2017 Samplers</b>	North: Addison Mason; South: Dan Corbett, Larry Martin, Laurie Corbett, Sue Martin
<b>Main Contact</b>	North: Addison Mason; South: Dan Corbett

## Background

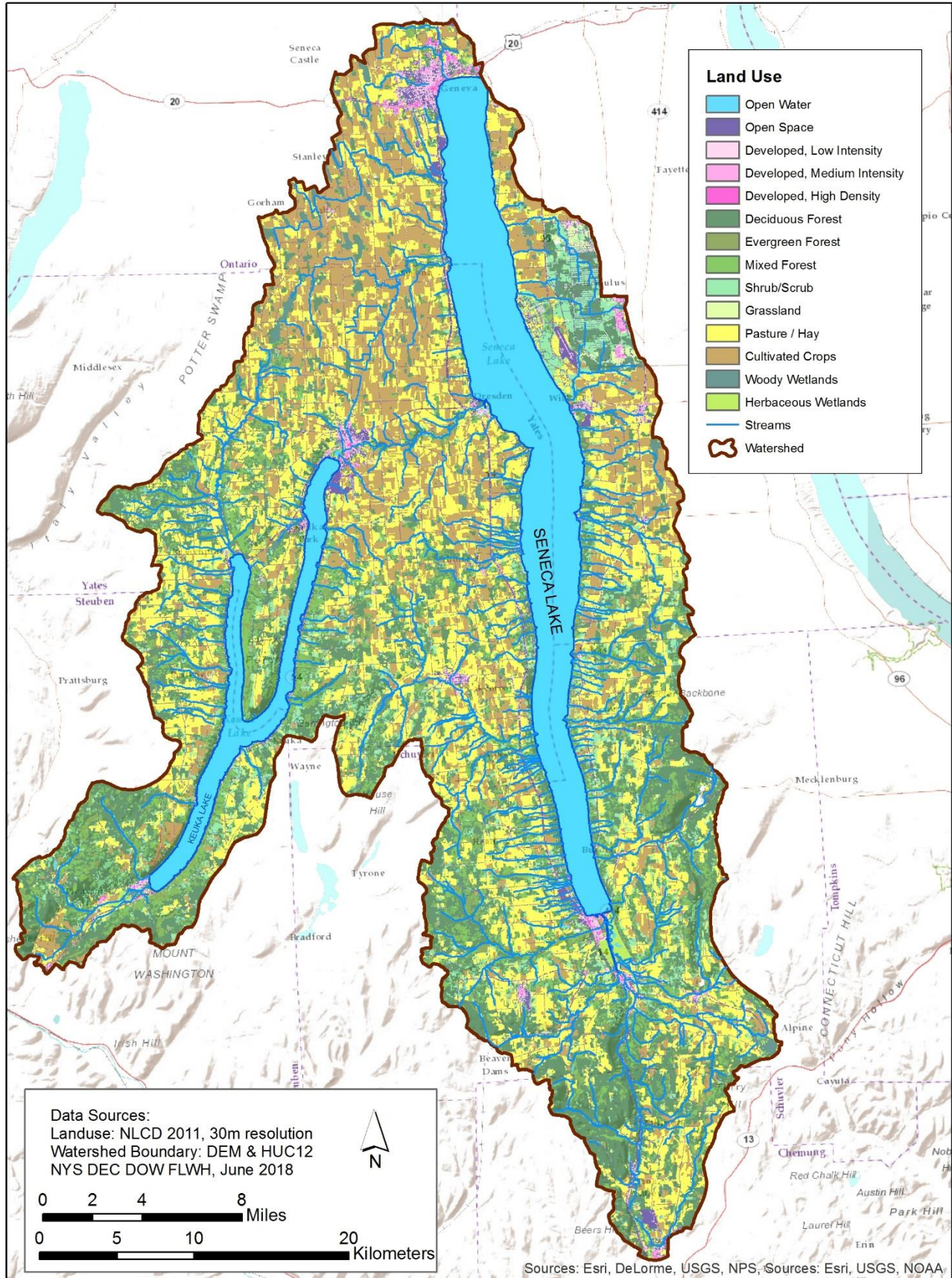
Located within Ontario, Yates, Seneca, and Schuyler counties, Seneca Lake lies in the geographic center of the Finger Lakes. At the northern tip of the lake is the City of Geneva, and at the southern tip is the Village of Watkins Glen. Seneca lake has the largest volume of water of the Finger Lakes.

## Watershed Management

Seneca Lake is considered a highly-valued water resource due to its designation of a Class AA(TS) drinking water supply, such that the water can be used as a potable source with limited treatment. The (TS) subdesignation refers to the lake support of trout spawning. The inclusion of this waterbody on the DEC/DOW Priority Waterbodies List as a Threatened water is a reflection of the particular resource value reflected in this designation and the need to provide additional protection, rather than any specifically identified threats.

Seneca Lake is not included on the current (2016) NYS Section 303(d) List of Impaired/TMDL Waters. There are no impacts/impairments that would justify the listing of this waterbody.

# Lake Map



## Historic Water Quality Data

### CSLAP/DEC Historic Data

CSLAP sampling was conducted on Seneca Lake in 2017. CSLAP reports for each of the past several years can be found on the NYSFOLA website at <http://nysfola.mylaketown.com>. The most recent CSLAP report for Seneca Lake, using the template developed for all CSLAP lakes, can also be found on the NYSDEC web page at <http://www.dec.ny.gov/lands/77821.html>. Other monitoring efforts conducted in Seneca Lake include the Finger Lakes Synoptic Water Quality Investigation (FL/SWQI) from 1996 to 2000, the NYSDEC Disinfection by-products (DBPs) Study (Callinan et al. 2013) in 2004, and the Finger Lakes Water Hub winter sampling in 2018.

### Non-DEC/CSLAP Data

NYSDEC is currently compiling a list of external water quality lake data. This information will be evaluated for inclusion in next year's report.

## Summary of 2017 CSLAP Sampling Results

Table 1: North Site\*























Open Water Indicators	2017 Sampling Results								Seasonal Change	Long Term Avg.
	6/28	7/10	7/30	8/14	8/27	9/11	9/24	10/1		
Chl.a (µg/L)	3.4	3.1	6	2.5	6.9	4.7	10.2	4.5		5.2
BG Chl.a (µg/L)	0	.9	1.9	0	0	0	0	0		0.5
Clarity (m)	4.4	3.3	2.5	3.9	2.1	4	2.4	4.4		3.4
pH	7.1	7.7	7.6	7.5	7.6	8	8.1	7.6		7.6
Cond (µmho/cm)	627.4	456.4	601.1	603.1	638.4	636.1	608.9	647.6		602
Surf Temp (°C)	22	23	21	20	21	19	20	19		21
Bott Temp (°C)	11	16	11	16	14	15	18	17		15
TN (mg/L)	.604	.684	.58	.428	.317	.449	.528	.475		0.508
TP (mg/L)	.006	.012	.023	.015	.016	.013	.019	.014		0.015
Deep TP (mg/L)	.009	.008	.007	.011	.008	.013	.009	.013		0.010
Surface N:P Ratio	101	57	25	29	20	35	28	34		

Table 2: South Site\*

Open Water Indicators	2017 Sampling Results								Seasonal Change	Long Term Avg.
	6/19	7/3	7/17	7/30	8/15	8/25	9/10	9/23		
Chl.a (µg/L)	2.1	2.3	3.9	3.9	3.7	9.3	4.3	3.2		4.1
BG Chl.a (µg/L)	0	.3	1.5	.3	0	0	0	0		0.3
Clarity (m)	3.3	5	1.6	2.5	4	2	6	2.4		3.3
pH	7.3	7.3	7	7.9	7.9	7.9	7.4	8.1		7.6
Cond (µmho/cm)	588	573.4	619.6	615.5	618.9	599.2	532.1	617.8		596
Surf Temp (°C)	15	22	23	22	23	24	20	22		21
Bott Temp (°C)	14	14	15	18	14	18	19	19		16
TN (mg/L)	.565	.544	.634	.518	.359	.407	.444	.44		0.489
TP (mg/L)	.008	.008	.018	.019	.011	.02	.015	.019		0.015
Deep TP (mg/L)	.008	.006	.008	.011	.006	.008	.009	.01		0.008
Surface N:P Ratio	71	68	35	27	33	20	30	23		

\*Highlighted results indicate eutrophic values



## Results Relative to Historic Data

The summer (mid-June through mid-September) average readings are compared to historical averages for all CSLAP sampling seasons in the “Lake Condition Summary” table, and are compared to individual historical CSLAP sampling seasons in the “Long Term Data Plots” Section.

### Potable Water Indicators

The 2017 data from the north site indicated slightly higher productivity- lower water clarity in response to higher nutrient and algae levels- than in the DEC dataset for Seneca Lake in the late 1990s (the DEC site was near the present CSLAP south site on Seneca Lake). It is not known if the shoreline, and sometimes widespread, cyanobacteria (HAB) blooms on the lake in the last few years represent an ephemeral event or a significant ecological change in development.

Potable water conditions, at least as measurable through CSLAP, are summarized in the Lake Scorecard and Lake Condition Summary Table.

### Limnological Indicators

The 2017 data suggests that the north site of Seneca Lake is typical of *mesotrophic* (moderately productive) lakes, based on intermediate water clarity (Secchi disk depth generally between 2 and 5 m), nutrient (TP levels generally between 0.010 and 0.020 mg/l) and algae levels (chl.a generally between 2 and 8 µg/l). Although measured water temperatures decreased during the summer, it is not likely that these are representative of lakeside conditions (and this was not observed in the south lake site). No other strong seasonal changes were measured.

The trophic state indices (TSI) evaluation suggests that each of these trophic indicators is “internally consistent”—each of these indicators is in the expected range given the readings of the other indicators.

Overall limnological and trophic state conditions are summarized in the Lake Scorecard and Lake Condition Summary Table.

### Biological Conditions

Aquatic Invasive Species (AIS) plants reported in the lake include Eurasian watermilfoil and curly leafed pondweed. In addition, quagga mussels, zebra mussels, mud bithynia, scud, bloody-red shrimp, and rudd have also been documented in the lake. The large number of access points and proximity to other infested lakes constitute a high vulnerability to new AIS introductions. The hydrilla findings in several locations in Cayuga Lake threaten Seneca Lake and other Finger Lakes.

Biological conditions in the lake are summarized in the Lake Scorecard and Lake Condition Summary Table.

### Lake Perception

Aquatic plants do not grow to the lake surface in locations near the CSLAP sites, and recreational assessments are highly favorable despite moderate water clarity and are consistent with the lack of nearby surface weed growth.

Overall lake perception is summarized on the Lake Scorecard and Lake Condition Summary Table.

### Harmful Algal Blooms

Water quality conditions suggest a moderate susceptibility to blooms, based on nutrient and algae levels, and blooms have been reported in several locations in recent years. This may be due to more detailed surveillance and evaluation of blooms in recent years. It is not yet known if these water quality conditions, and the unexpected susceptibility to blooms, are representative of normal bloom conditions in the lake, and if these conditions are stable. The cause of these blooms, in Seneca Lake and in other New York state lakes, continues to be actively investigated.

## Evaluation of Lake Use

Seneca Lake is presently among the lakes listed on the Oswego-Seneca-Oneida River drainage basin Priority Waterbody List (PWL) as *threatened*. Use assessments are compared to the criteria established in the NYSDEC Consolidated Assessment and Listing Methodology (CALM), found at [https://www.dec.ny.gov/docs/water\\_pdf/asmtmeth17.pdf](https://www.dec.ny.gov/docs/water_pdf/asmtmeth17.pdf).

Lake Use				
	PWL	Average Year	2017	Primary issue
<b>Potable Water</b>				No impacts
<b>Swimming</b>				Algae blooms
<b>Recreation</b>				Algae blooms
<b>Aquatic Life</b>				Invasive animals
<b>Aesthetics</b>				Algae blooms
<b>Habitat</b>				Invasive plants
<b>Fish Consumption</b>				Not applicable

Supported / Good  
 Threatened / Fair  
 Stressed / Poor  
 Impaired  
 Not Known

### Potable Water

Seneca Lake is considered a highly-valued water resource due to its designation as a Class AA(TS) drinking water supply, so that the water can be used as a potable source with limited treatment. The inclusion of this waterbody on the DEC/DOW Priority Waterbodies List (PWL) as a *threatened* water is a reflection of the particular resource value reflected in this designation and the need to provide additional protection, rather than any specifically identified threats. One section of the lake, within 1 mile of Keuka Outlet mouth, is designated as Class B. The CSLAP 2017 data indicated that there were no known impacts to potable water, although the analyzed parameters are not comprehensive in terms of potable water suitability.

### Swimming

Public bathing is also evaluated as *threatened* by occasional growths of aquatic plants and algal blooms that can discourage swimming and other recreational uses. Although all uses are supported in the lake, these threats should continue to be monitored. Recent concerns have been raised regarding the presence of harmful algal blooms in Seneca Lake in 2017 which led to beach closures.

### Non-Contact Recreation

Trophic indicators (phosphorus, chlorophyll a and water clarity) are well below the state guidance values indicating impacted/stressed recreational uses. However, 2017 CSLAP data indicated recreation was *impaired* due to harmful algal blooms.

### Aquatic Life

Aquatic life is considered to be fully supported based on DFWMR assessments that indicate a healthy fishery. Traditionally, lake trout, smallmouth bass and yellow perch have been the mainstay of Seneca Lake's fishery. The lake's excellent fishery has benefitted greatly in recent years from steady annual stocking of hatchery-reared lake trout, brown trout and landlocked salmon. The lake's rainbow trout fishery is sustained entirely by natural reproduction – mostly in Catherine Creek and its tributaries. An important factor in recent resurgence of the Seneca salmonid fishery is DEC's ongoing control of the parasitic sea lamprey. The control program involves applications of the highly selective chemical lampricide, TFM, to known sea lamprey nursery areas in Catherine Creek and Keuka Lake Outlet at three-year intervals.

### Aesthetics

The PWL did not evaluate aesthetics, however the 2017 CSLAP data indicated this use was *stressed* due to harmful algal blooms.

### Fish Consumption

There are no health advisories limiting the consumption of fish from this waterbody (beyond the general advice for all NYS waters). However due to the uncertainty as to whether the lack of a waterbody-specific health advisory is based on actual sampling, fish consumption use is noted as unassessed.

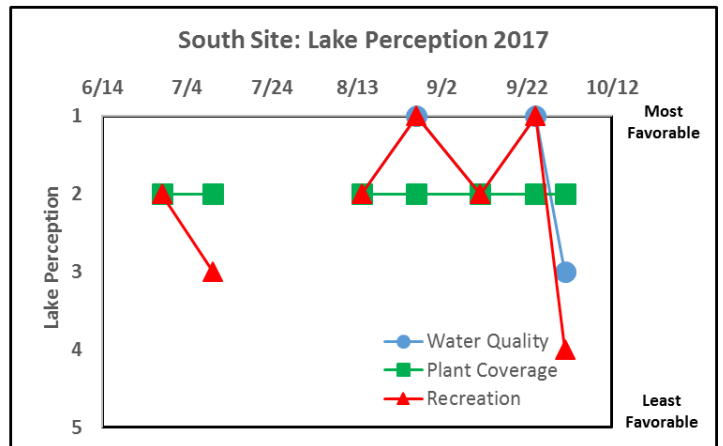
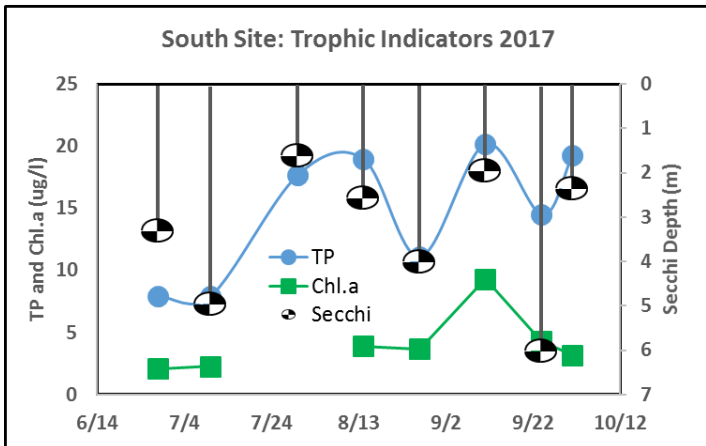
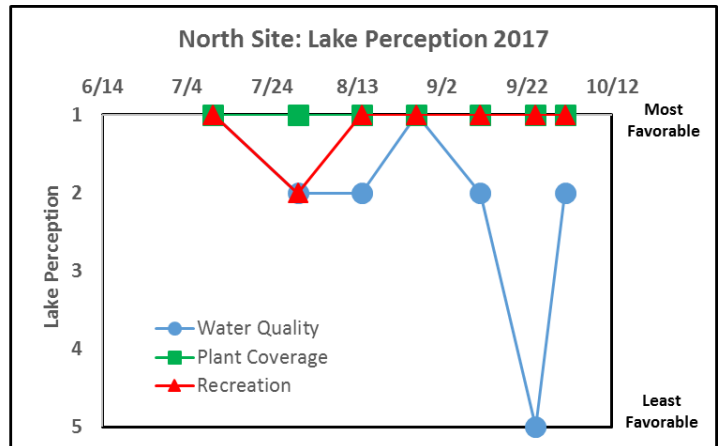
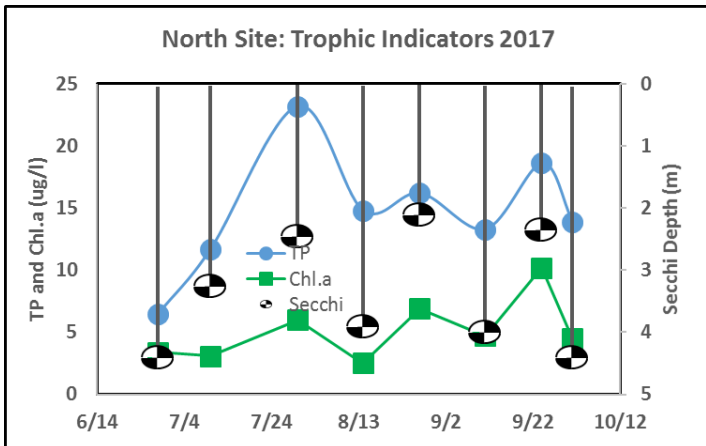
LAKE CONDITIONS SUMMARY – SENECA LAKE NORTHERN SITE*								
CATEGORY	Indicator	Min	86-17 Avg	Max	2017 Avg	Classification	2017 Change?	Long Term Change?
EUTROPHICATION INDICATORS	Water Clarity	2.10	3.36	4.40	3.36	Mesotrophic	Insufficient Data	Insufficient Data
	Chlorophyll <i>a</i>	2.50	5.16	10.20	5.16	Mesotrophic	Insufficient Data	Insufficient Data
	Total Phosphorus	0.007	0.015	0.023	0.015	Mesotrophic	Insufficient Data	Insufficient Data
POTABLE WATER INDICATORS	Hypolimnetic TN	0.32	0.53	0.68	0.53	Close to Surface N Readings	Insufficient Data	Not yet known
	Hypolimnetic DOC							
LIMNOLOGICAL INDICATORS	Hypolimnetic Phosphorus	0.007	0.010	0.013	0.010	Close to Surface TP Readings	Insufficient Data	Insufficient Data
	Nitrate + Nitrite	0.09	0.19	0.40	0.19	Intermediate NOx	Insufficient Data	Insufficient Data
	Ammonia	0.02	0.04	0.10	0.04	Low Ammonia	Insufficient Data	Insufficient Data
	Total Nitrogen	0.32	0.51	0.68	0.51	Intermediate Total Nitrogen	Insufficient Data	Insufficient Data
	Total Dissolved Nitrogen							
	pH	7.12	7.65	8.10	7.65	Alkaline	Insufficient Data	Insufficient Data
	Specific Conductance	456	602	648	602	Hardwater	Insufficient Data	Insufficient Data
	True Color	1	3	4	3	Uncolored	Insufficient Data	Insufficient Data
	Calcium	26	28	31	28	Highly Susceptible to Zebra Mussels	Insufficient Data	Insufficient Data
	Chloride	129	148	167	148	>75th Percentile of NYS Lakes	Insufficient Data	Not yet known
LAKE PERCEPTION	WQ Assessment	1	2.1	5	2.1	Not Quite Crystal Clear	Insufficient Data	Insufficient Data
	Aquatic Plant Coverage	1	1.0	1	1.0	Plants Not Visible	Insufficient Data	Insufficient Data
	Recreational Assessment	1	1.1	2	1.1	Could Not Be Nicer	Insufficient Data	Insufficient Data
BIOLOGICAL CONDITION	Fish					Coldwater fishery	Not known	Not known
	Invasive Species-Plants					Eurasian watermilfoil; Curly leafed pondweed		
	Invasive Species-Animals					quagga mussels; zebra mussels; mud bithynia; scud; bloody-red shrimp; rudd		
LOCAL CLIMATE CHANGE	Surface Water Temperature	19	20.6	23	20.6		Insufficient Data	Insufficient Data
	Bottom Water Temperature	11	14.8	18	14.8		Insufficient Data	Insufficient Data
HARMFUL ALGAL BLOOMS	Open Water FP Chl.a	2.1	5.1	11.6	5.1	Few readings indicate high algae levels	Not known	Not known
	Open Water FP BG Chl.a	0.0	0.3	1.9	0.3	No readings indicate high BGA levels	Not known	Not known
	Open Water Microcystin	<DL	<DL	<DL	<DL	Open water MC consistently not detectable	Not known	Not known
	Open Water Anatoxin a	<DL	<DL	<DL	<DL	Open water Anatoxin-a consistently not detectable	Not known	Not known
	Shoreline FP Chl.a	1.0	4392.9	118356.3	6346.6	Most readings indicate high algae levels	Not known	Not known
	Shoreline FP BG Chl.a	0.0	4302.6	118356.3	6247.1	Most readings indicate high BGA levels	Not known	Not known
	Shoreline Microcystin	<DL	30.4	390.0	44.3	Occasionally very high shoreline bloom MC	Not known	Not known
	Shoreline Anatoxin a	<DL	0.2	4	0.2	Shoreline bloom Anatoxin-a at times detectable	Not known	Not known

\* There is no historic data at this site. Long-term averages are based on 2017 data only.

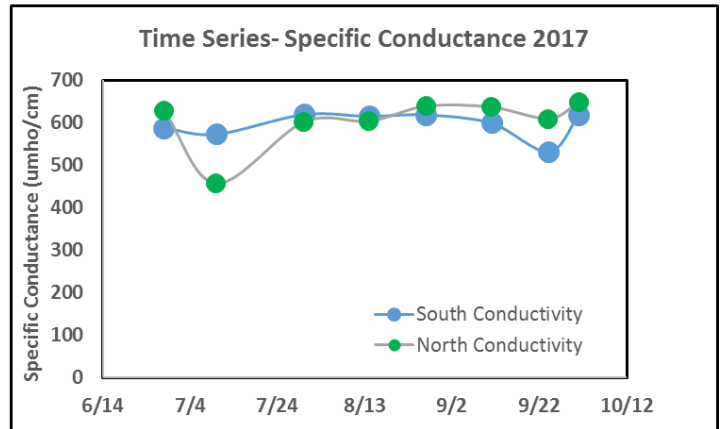
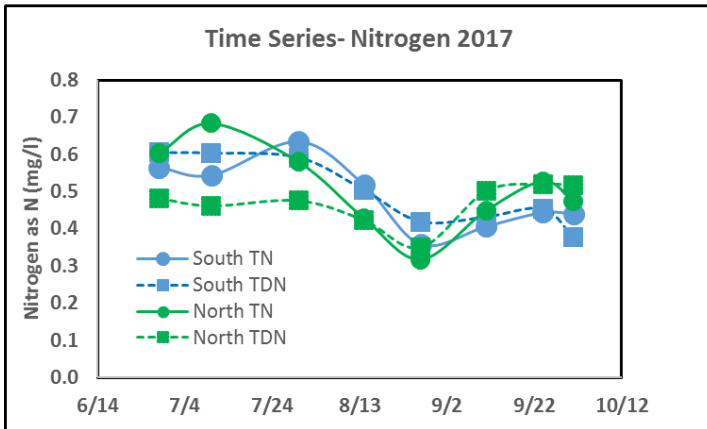
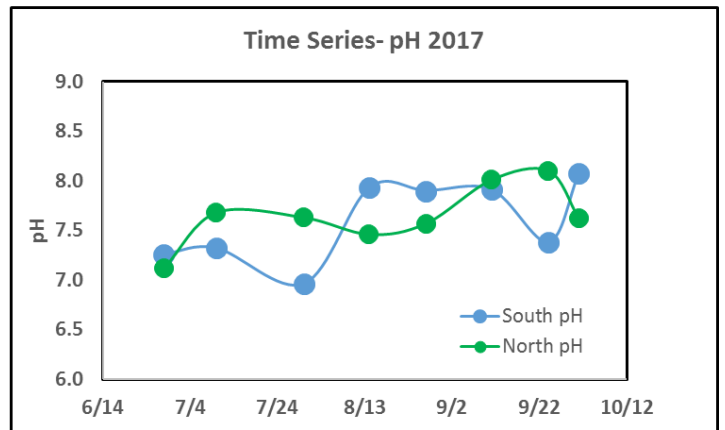
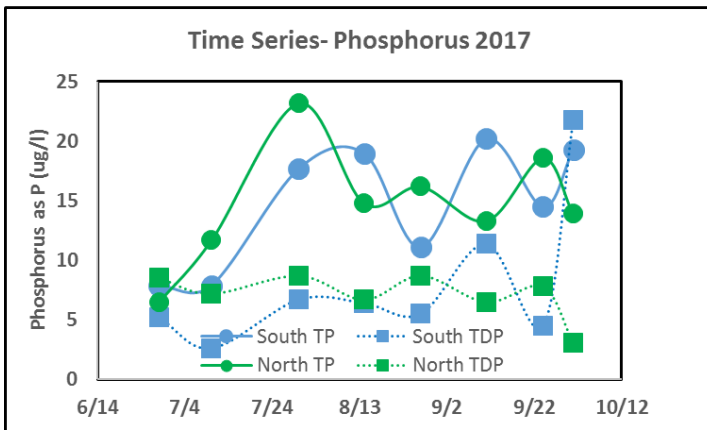
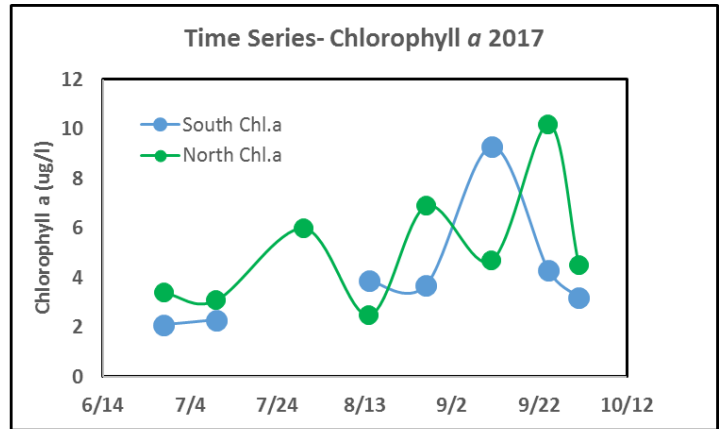
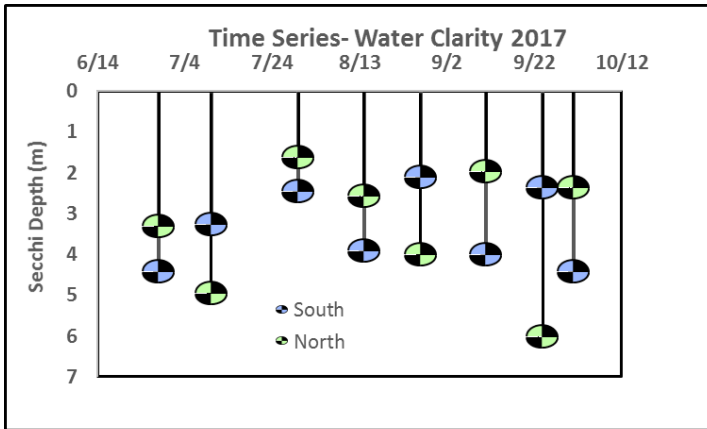
LAKE CONDITION SUMMARY – SENECA SOUTHERN SITE								
CATEGORY	Indicator	Min	86-17 Avg	Max	2017 Avg	Classification	2017 Change?	Long Term Change?
EUTROPHICATION INDICATORS	Water Clarity	1.60	5.68	11.60	3.34	Oligotrophic	Lower Than Normal	No Change
	Chlorophyll <i>a</i>	0.67	2.84	9.30	4.09	Mesotrophic	Within Normal Range	No Change
	Total Phosphorus	0.003	0.012	0.040	0.015	Mesotrophic	Within Normal Range	No Change
	Total Dissolved Phosphorus	0.002	0.007	0.022	0.008	> 1/2 of P potentially available	Within Normal Range	Not yet known
POTABLE WATER INDICATORS	Hypolimnetic TN	0.29	0.70	1.06	0.53	Close to Surface N Readings	Lower Than Normal	Not yet known
	Hypolimnetic DOC						Not known	Not known
	Hypolimnetic UV254						Not known	Not known
LIMNOLOGICAL INDICATORS	Hypolimnetic Phosphorus	0.003	0.009	0.047	0.008	Close to Surface TP Readings	Within Normal Range	No Change
	Hypolimnetic Dissolved P	0.002	0.003	0.005	0	> 1/4 of bottom P potentially available		
	Nitrate + Nitrite	0.01	0.36	0.94	0.16	Intermediate NOx	Lower Than Normal	No Change
	Ammonia	0.00	0.03	0.28	0.04	Low Ammonia	Within Normal Range	Slight Increase
	Total Nitrogen	0.36	0.65	1.33	0.49	Intermediate Total Nitrogen	Within Normal Range	No Change
	Total Dissolved Nitrogen	0.38	0.50	0.61	0.50	> 1/2 of nitrogen dissolved		
	pH	6.96	7.84	8.33	7.59	Alkaline	Within Normal Range	No Change
	Specific Conductance	532	596	620	596	Hardwater	Insufficient Data	Insufficient Data
	True Color	1	3	5	3	Uncolored	Insufficient Data	Insufficient Data
	Calcium	19	40	55	30	Highly Susceptible to Zebra Mussels	Lower Than Normal	No Change
Chloride	18	128	148	77	>75th Percentile of NYS Lakes	Lower Than Normal	Not yet known	
LAKE PERCEPTION	WQ Assessment	1	2.0	3	2.0	Not Quite Crystal Clear	Insufficient Data	Insufficient Data
	Aquatic Plant Coverage	2	2.0	2	2.0	Subsurface Plant Growth	Insufficient Data	Insufficient Data
	Recreational Assessment	1	2.3	4	2.3	Excellent	Insufficient Data	Insufficient Data
BIOLOGICAL CONDITION	Fish					Coldwater fishery	Not known	Not known
	Invasive Species-Plants					Eurasian watermilfoil; Curly leafed pondweed		
	Invasive Species-Animals					quagga mussels; zebra mussels; mud bithynia; scud; bloody-red shrimp; rudd		
LOCAL CLIMATE CHANGE	Air Temperature	18	23.3	27	23.3		Insufficient Data	Insufficient Data
	Water Temperature	15	21.4	24	21.4		Insufficient Data	Insufficient Data
HARMFUL ALGAL BLOOMS	Open Water FP Chl.a	1.5	4.6	8.5	4.6	No readings indicate high algae levels	Not known	Not known
	Open Water FP BG Chl.a	0.0	0.3	1.5	0.3	No readings indicate high BGA levels	Not known	Not known
	Open Water Microcystin	<DL	<DL	<DL	<DL	Open water MC consistently not detectable	Not known	Not known
	Open Water Anatoxin a	<DL	<DL	0.0	<DL	Open water Anatoxin-a at times detectable	Not known	Not known
	Shoreline FP Chl.a	1.0	4392.9	118356.3	6346.6	Most readings indicate high algae levels	Not known	Not known
	Shoreline FP BG Chl.a	0.0	4302.6	118356.3	6247.1	Most readings indicate high BGA levels	Not known	Not known
	Shoreline Microcystin	<DL	30.4	390.0	44.3	Occasionally very high shoreline bloom MC	Not known	Not known
	Shoreline Anatoxin a	<DL	0.2	4	0.2	Shoreline bloom Anatoxin-a at times detectable	Not known	Not known



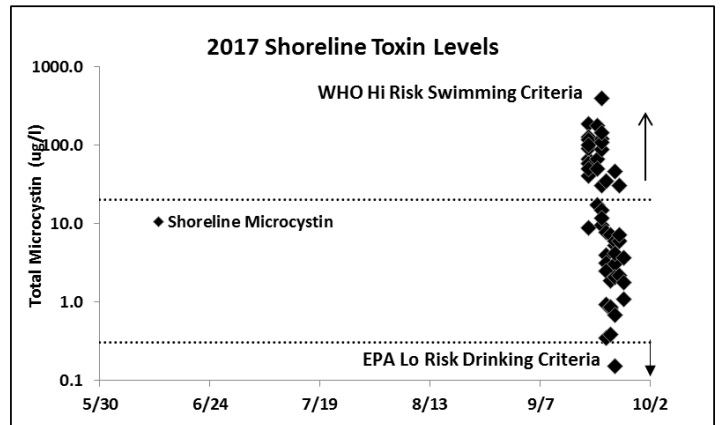
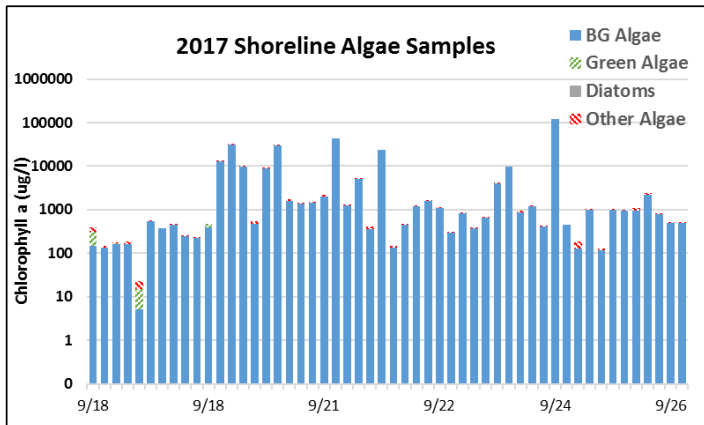
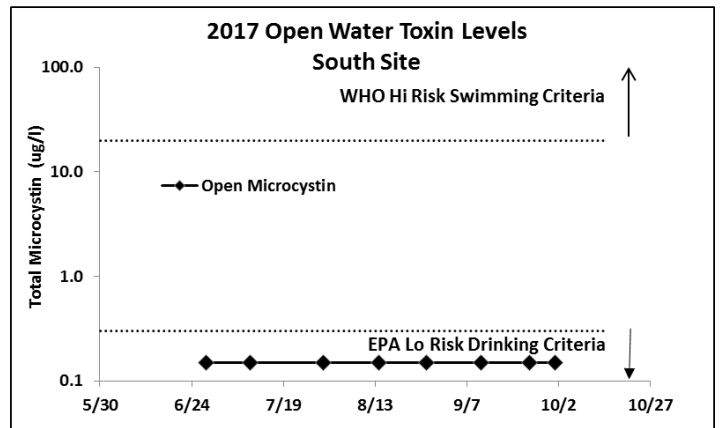
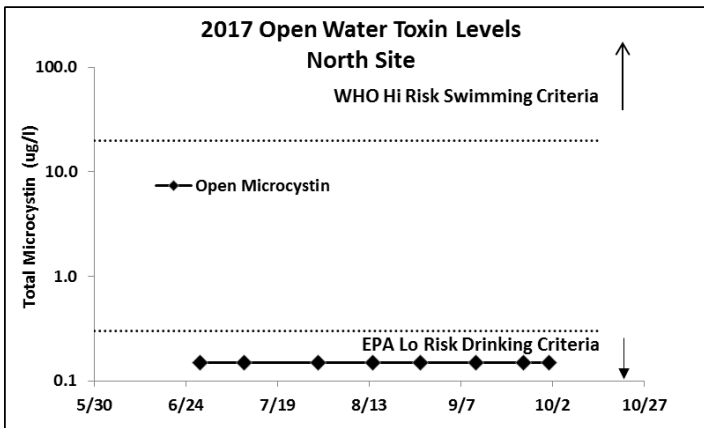
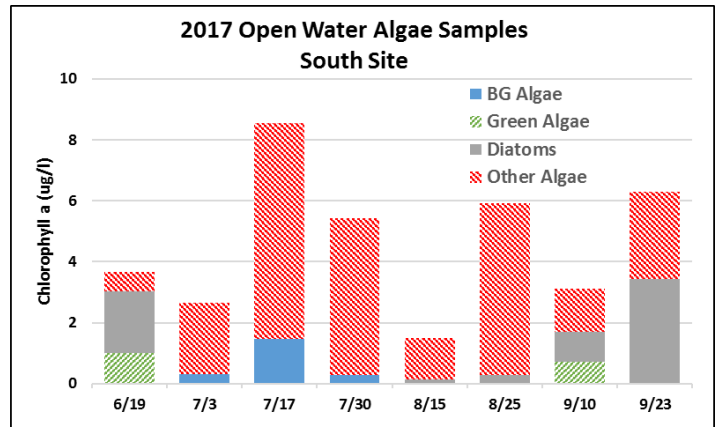
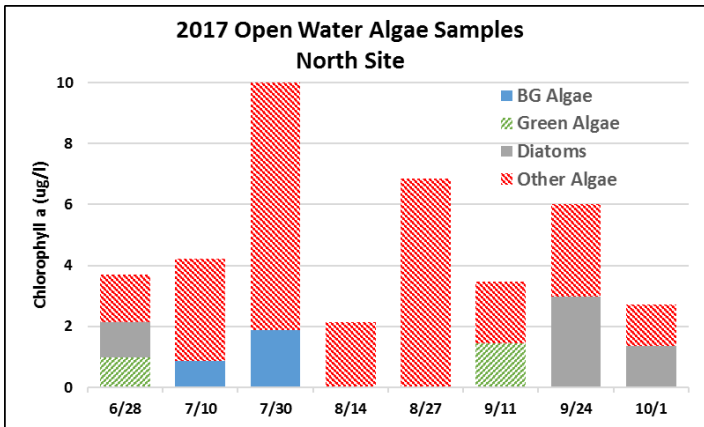
2017 Time Series: Trophic Indicators



# 2017 Time Series: Both Sampling Sites



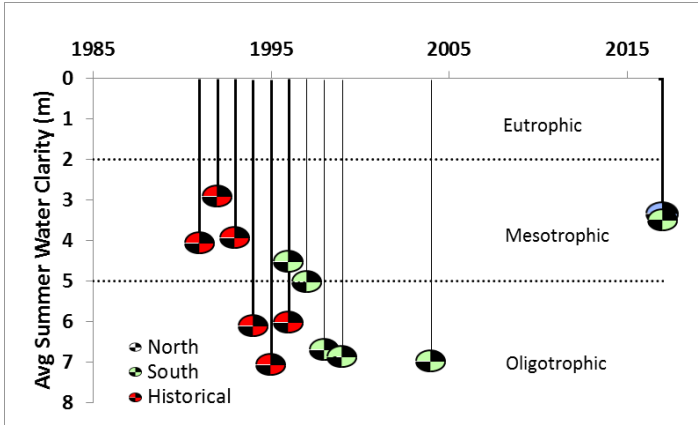
# Time Series: Algae and Cyanobacteria



## Long-Term Data Series

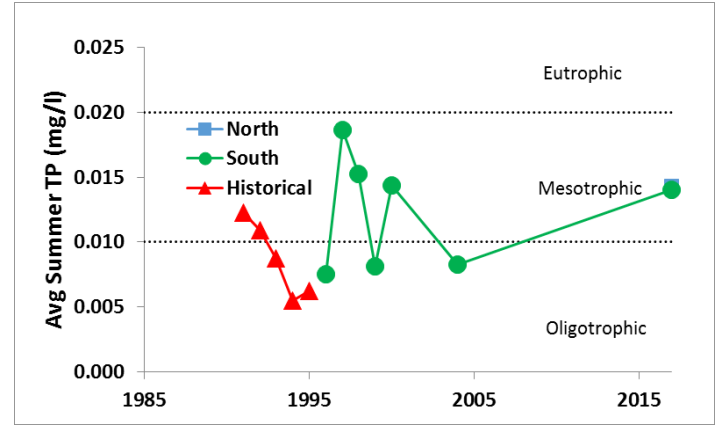
### Water Clarity

- Decline in clarity since late 90s-early 2000s
- Mostly typical of meso-oligotrophic lakes



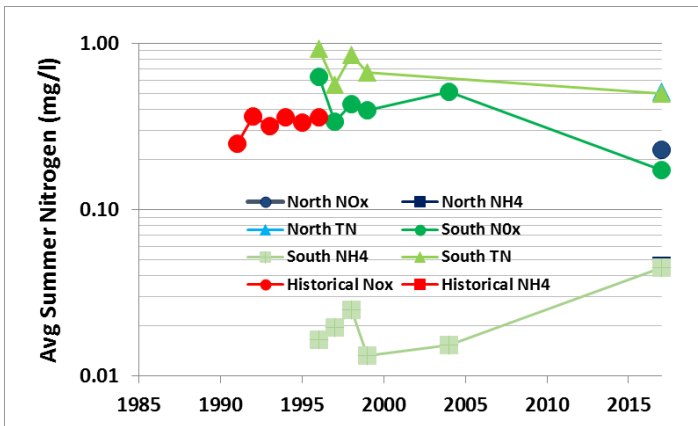
### Summer TP

- Variable but an increase in summer TP since early 2000s
- Readings typical of mesotrophic lakes



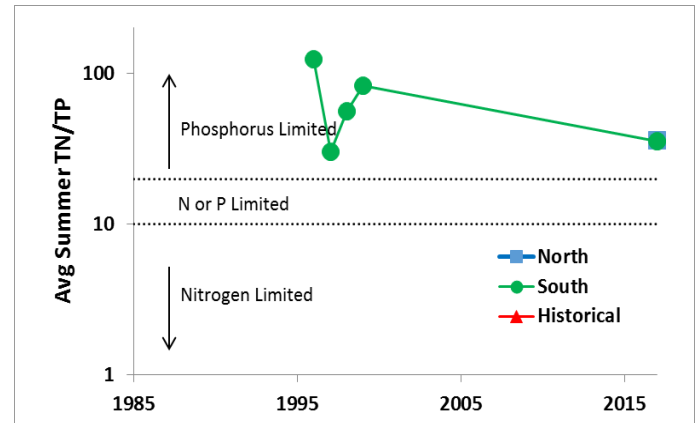
### Summer Nitrogen

- Slight decrease in NO<sub>x</sub>
- Slight increase in NH<sub>4</sub>



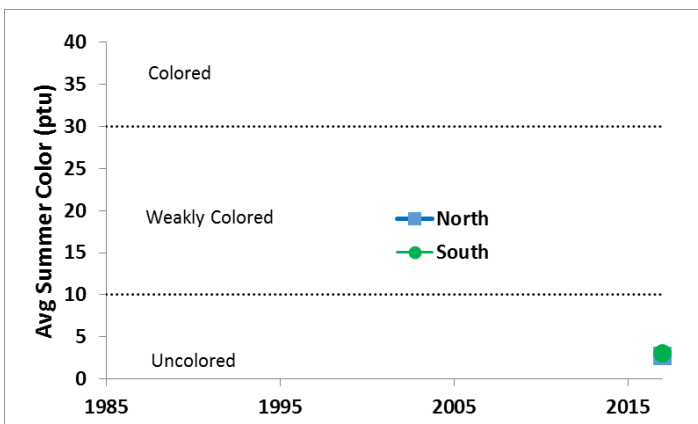
### Summer TN/TP Ratio

- Slight decrease since late 90s
- Readings typical of phosphorus limited lakes



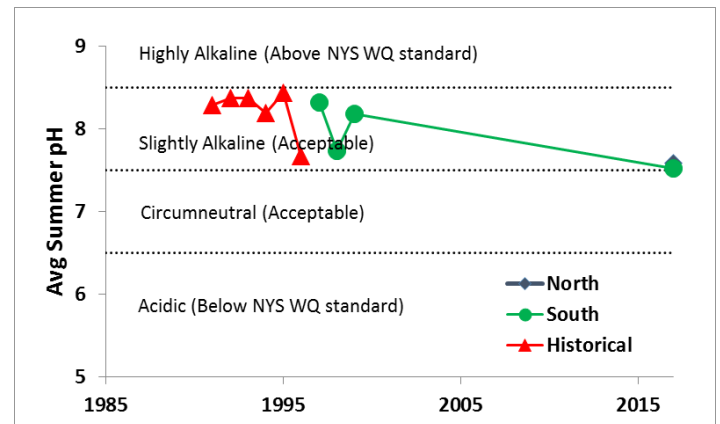
### Summer Color

- No long-term data



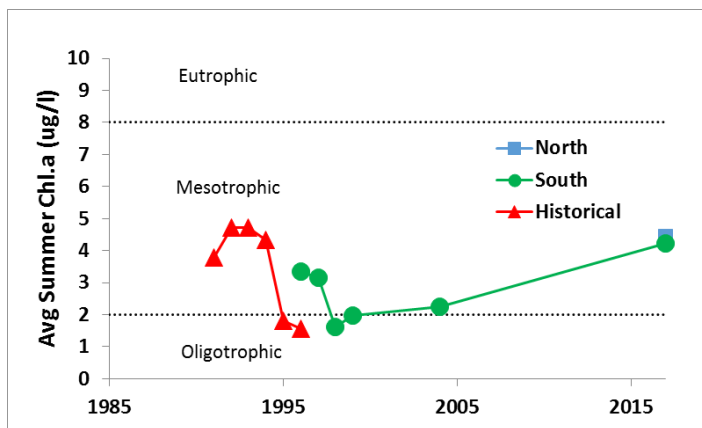
### Summer pH

- Most readings typical of a slightly alkaline lake



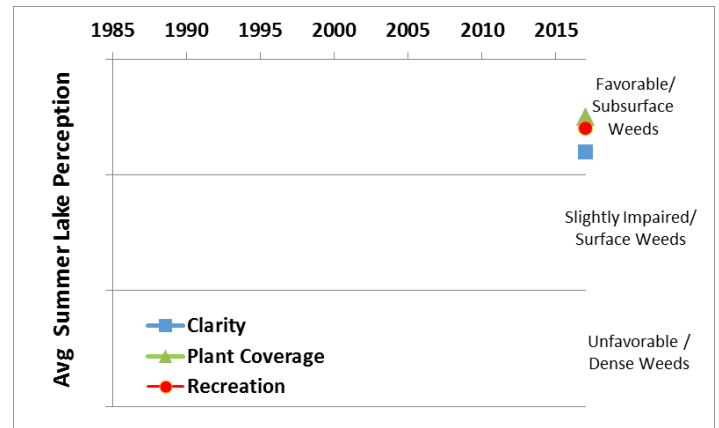
### Summer Chl.a

- Slight increase
- Mostly typical of meso-oligotrophic lakes



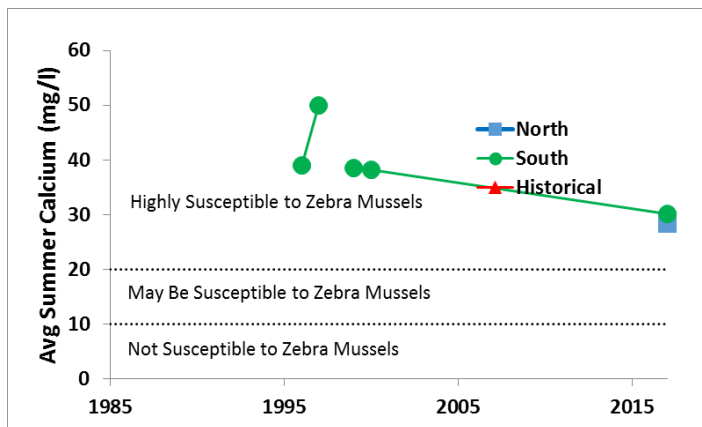
### Summer Lake Perception

- No long-term data



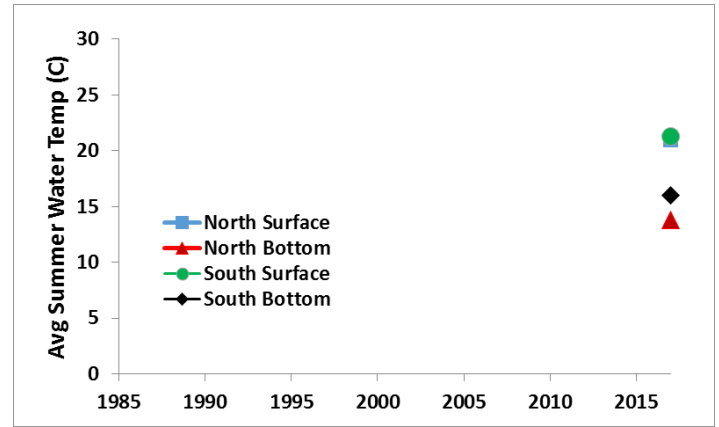
### Summer Calcium

- A decline in 2017
- Readings typical of lakes highly susceptible to mussels



### Summer Water Temperature

- No long-term data



### Summer Conductivity

- No long-term data

