Seneca Lake	Seneca Lake Pure Waters Association	Town of Geneva	Seneca County
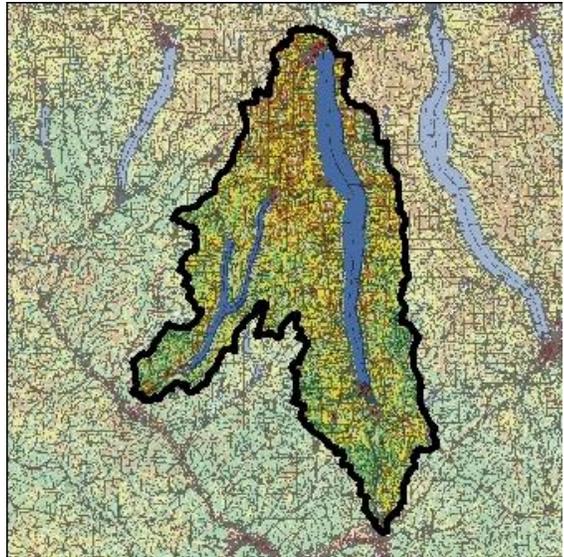
Mid North Site (3)	**Lake Characteristics**	Surface area (ac/ha)	42648 / 17259
		Max depth (ft/m)	191 / 58
		Mean depth (ft/m)	291 / 89
		Retention time (years)	16.70
		Lake Classification	AATS
		Dam Classification	C

Watershed Characteristics	Watershed area (ac /ha)	455772/184441
	Watershed / Lake ratio	11
	Lake & wetlands %	15.4%
	Agricultural %	40.1%
	Forest, shrub, grasses %	38.0%
	Residential	6.3%
	Urban	0.1%

CSLAP Participation	Years	1991-1996, 2017-2018
	Volunteers	Addison and Diane Mason, Jacob and Karen Welch, Larry and Susan Martin, Dan and Laurie Corbett, David Youst, Charles and Peter Hornsberger, Brian and Patricia Cusimano, Edward and Mary Ann Marks, Sayre Fulkerson

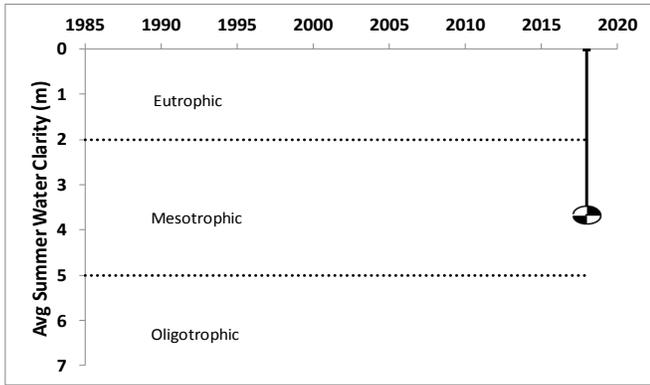| **Trophic state**	**HABs Susceptibility**	**Invasive Vulnerability**	**PWL Assessment**
Mesoligotrophic	Frequent blooms, Low susceptibility	Invasives present, High Vulnerability	Threatened

Water quality values for Seneca Lake for the 2018 sampling season. "Seasonal change" shows current year variability. Light red color indicates eutrophic conditions in top table and bloom conditions in bottom table. Summer averages for each of the CSLAP years and long term trend analyses show trends in key water quality indicators over a consistent index period (mid-June thru mid-September).

Open Water Indicators	2018 Sampling Results								Seasonal change	Long Term Avg	Long Term Trend?	18 Diff from Avg
	6/26	7/7	7/23	8/4	8/19	9/3	9/15	10/3				
Clarity (m)	3.5	5.3	3.2	2.3	2.3	4.7	4.7	4.8	∿	3.8	↑↑	no
Surface TP (mg/l)	0.007	0.007	0.009	0.013	0.015	0.007	0.007	0.010	∿	0.009	↑↑	no
Surface TDP (mg/l)	0.004	0.004	0.004	0.005	0.010	0.004	0.002	0.003	∿	0.004	↑↑	
Deep TP (mg/l)	0.008	0.005	0.008	0.006	0.004	0.033	0.005	0.007	∿	0.009		
Deep/Surface TP	1	1	1	0	0	5	1	1	∿	1		
TN (mg/l)	0.759	0.560	0.587	0.599	0.523	0.454	0.444	0.578	∿	0.563	↑↑	no
TDN (mg/l)	0.716	0.559	0.594	0.579	0.518	0.519	0.353	0.466	∿			
N:P Ratio	103	85	63	47	34	70	62	58	∿	62		
Deep/Surface NH4												
Chl.a (ug/l)	5.5	3.5	3.8	4.8	7.8	2.4	6.2	8.8	∿	5.4	↑↑	no
pH	7.7	8.6	7.7	8.3	7.8	7.7	7.9	7.5	∿	7.9	↑↑	no
Cond (umho/cm)	519	673	735	700	699	716	637	599	∿	660	↑↑	no
Upper Temp (degC)	18	21	22	23	24	26	22	19	∿	22	↑↑	no
Deep Temp (degC)	16	11	17	15	17	25	20	17	∿	17		no
FP BG Chl.a (ug/l)	0	0	0	1	0	0	1	0	∿	0	↑↑	no
HABs reported?	no	no	no	no	shore	no	no	shore				

Shoreline bloom and HABs notifications

Date of first listing	Date of last listing	# weeks on the DEC notification list	# Weeks with updates
8/24/2018	10/5/2018	6	2

Shoreline HAB Sample Dates 2018															
HAB Indicators	HAB criteria	8/19	9/4	9/4	9/4	9/4	9/4	9/4	9/4	9/9	9/9	9/11	9/11	9/11	9/11
BGA	25 - 30 ug/L	430.1	696.4	1499.6	1038.4	455.4	1074.6	826.5	399.6	229.4	1535.6	5424.1	2078.0	2634.4	2223.5
microcystin	20 ug/L	400.0	200.0	100.0	440.0	39.0	670.0	270.0	25.0	7.2	180.0	41.0	150.0	61.0	410.0
anatoxin - a	4 ug/L														
HAB Indicators	HAB criteria	9/11	9/11	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/12	9/13	9/13	9/13	9/13
BGA	25 - 30 ug/L	1449.7	4462.3	3326.0	3001.5	11962.5	7701.8	58875.9	1237.5	2160.0	51410.5	605.3	122.0	399.6	117.3
microcystin	20 ug/L	49.0	57.0	33.0	1200.0	380.0	2100.0	380.0	250.0	17.0	410.0	3.9	84.0	720.0	88.0
anatoxin - a	4 ug/L														
HAB Indicators	HAB criteria	9/13	9/13	9/13	9/13	9/13	9/15	9/16	9/17	9/18	9/18	9/23	9/23	9/27	
BGA	25 - 30 ug/L	693.6	257.5	2204.2	64.6	416.5	19.5	283.1	159.9	406.4	1087.0	1047.4	94.8	155.2	
microcystin	20 ug/L	27.0	32.0	240.0	46.0	160.0	3.4	4.3	110.0	400.0	520.0	1400.0	120.0	110.0	
anatoxin - a	4 ug/L														

HABs Status   Open water Algae

2018 Open Water Algae Samples

2018 Open Water Toxin Levels

Shoreline Algae

2018 Shoreline Algae Samples

2018 Shoreline Toxin Levels

Seneca Lake Mid North (S3) Long Term Trend Analysis
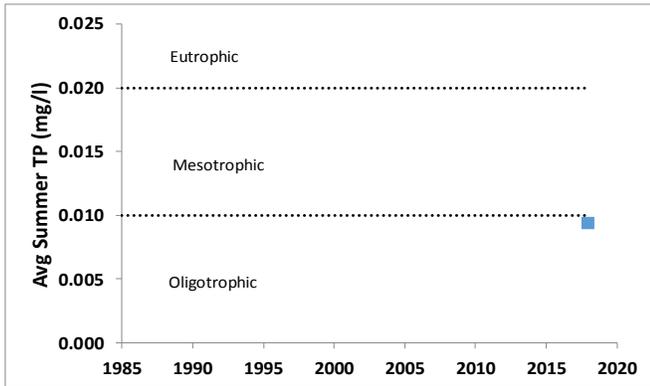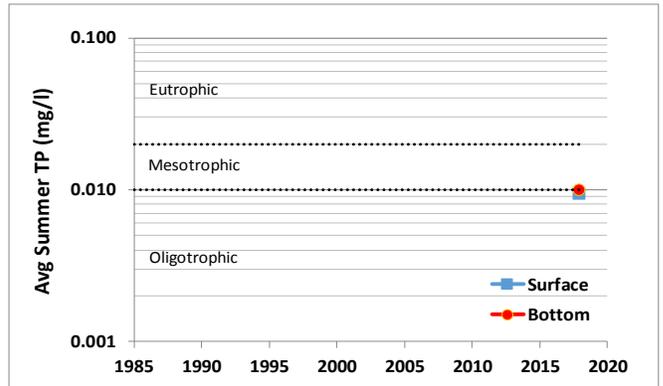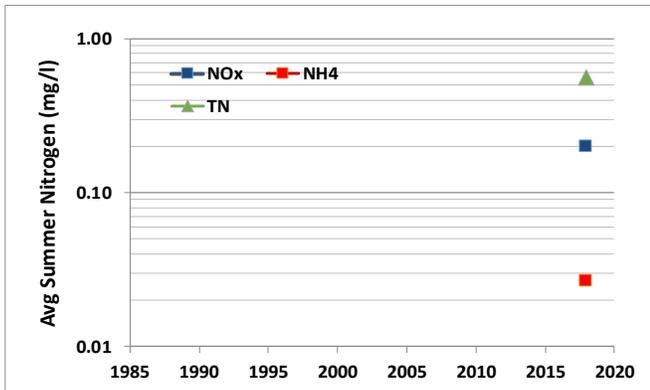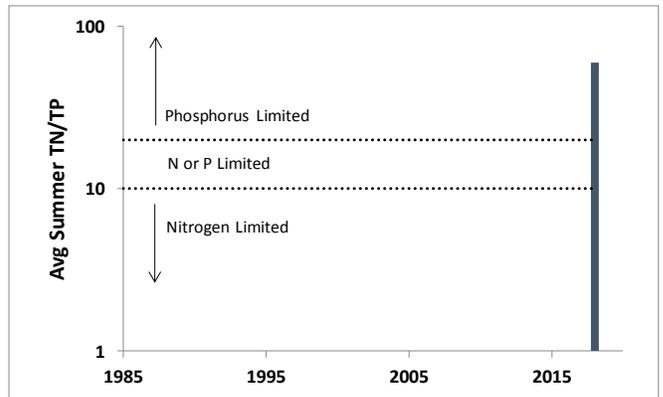
Clarity

Chlorophyll *a*
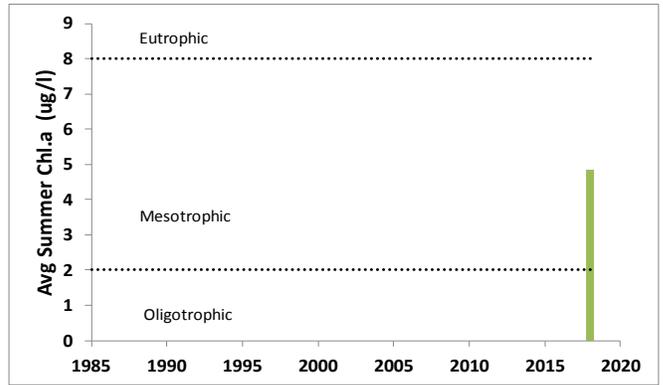
Surface Phosphorus
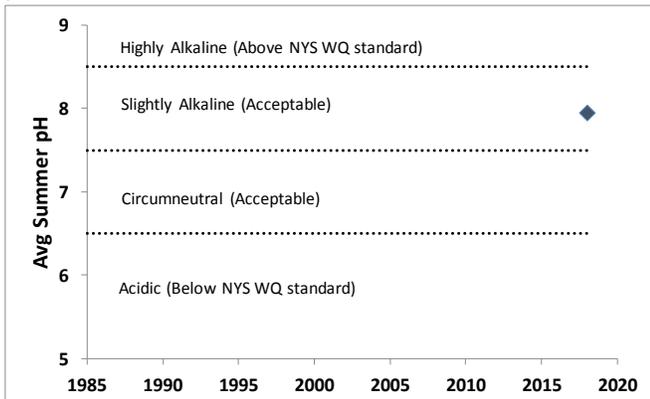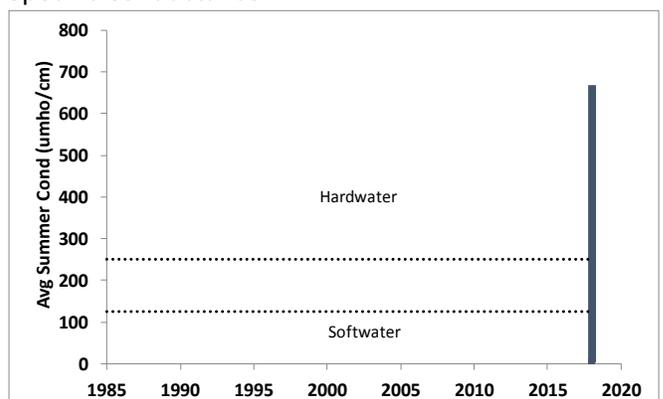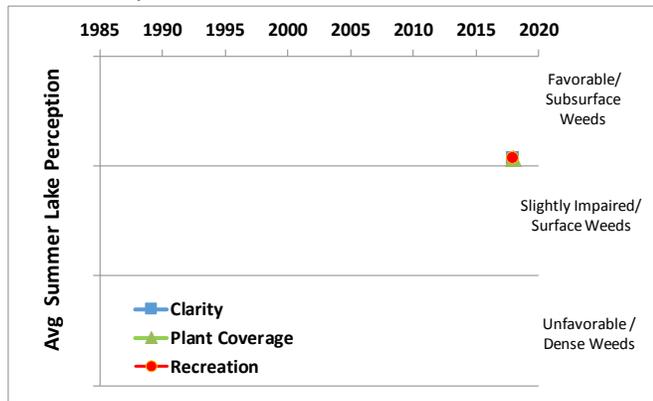

Surface and Deep Phosphorus

Nitrogen

TN : TP

pH

Specific Conductance

Lake Perception

Avg Summer Lake Perception

1985 1990 1995 2000 2005 2010 2015 2020

Favorable/
Subsurface
Weeds

Slightly Impaired/
Surface Weeds

Unfavorable /
Dense Weeds

- Clarity
- Plant Coverage
- Recreation

Surface and Deep Temperature

Avg Summer Water Temp (C)

- Surface
- Bottom
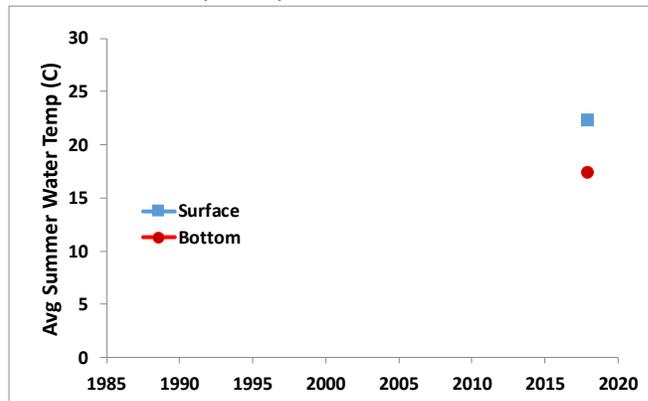
In Season Water Clarity

In Season 2018 and Typical Water Clarity

June   July   Aug   Sept

Secchi disk transparncy m)

— Typical
◑ 2018
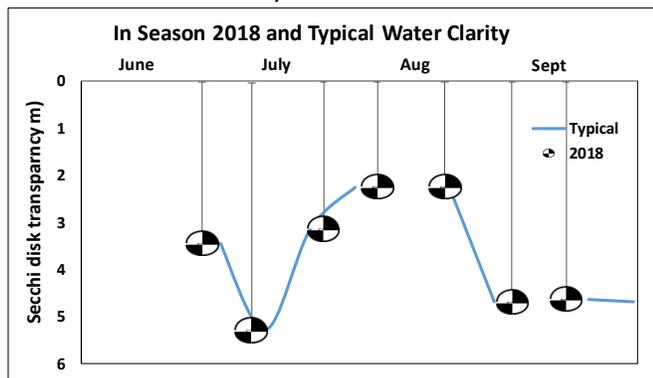
In Season Water Temperature

In Season 2018 and Typical Top and Bottom Temp

Water temperature (C)

June   July   Aug   Sept

— Typical Surface   ■ 2018 Surface
— Typical Bottom   ■ 2018 Bottom
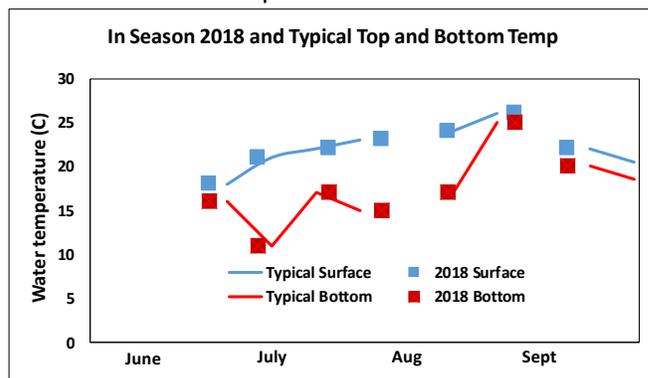
Scorecard

Lake Use

	PWL	Average Year	2018	Primary issue
Potable Water	🔺 (yellow)	🔴 (red diamond)	🔴 (red diamond)	Algae levels
Swimming	🔺 (yellow)	🔴 (red diamond)	🔴 (red diamond)	Algae blooms
Recreation	🟢 (green)	🔴 (red diamond)	🔴 (red diamond)	Algae blooms
Aquatic Life	🟢 (green)	🔺 (yellow)	🟢 (green)	Invasive animals
Aesthetics	🟢 (green)	🔴 (red diamond)	🔴 (red diamond)	Algae blooms
Habitat	🟢 (green)	🔺 (yellow)	🔺 (yellow)	Invasive plants
Fish Consumption	🟢 (green)	☐ (not known)	☐ (not known)	Not applicable

Legend:
- ● Supported / Good
- ▲ Threatened / Fair
- ◆ Stressed / Poor
- ■ Impaired
- ☐ Not Known

CSLAP sampling summary- Seneca Lake Mid North (S3), 2018

Q. What is the condition of the lake?
A. The mid-north site of Seneca Lake is mesoligotrophic, or moderately unproductive, based on moderate water clarity, moderate algae levels (chlorophyll a), and low nutrient (phosphorus) levels. Soluble nutrients were analyzed for the first time in 2018. Most of the phosphorus in the lake is soluble, indicating a high potential for more algae growth. Most of the nitrogen in the lake is soluble. The lake has slightly alkaline, extremely hard water, low water color, and moderately high nitrogen levels.

Q. How did 2018 compare to previous years?
A. This site was sampled for the first time in 2018, so comparisons to previous years are not possible.

Q. How does this lake compare to other nearby lakes?
A. Compared to other nearby lakes, the mid-north site of Seneca Lake usually has higher water clarity, conductivity, calcium, and chloride levels, and lower chlorophyll *a* levels and phosphorus readings. Seneca Lake usually has similar recreational and water quality assessments, and similar aquatic plant coverage.

Water clarity was similar in all four CSLAP sampling sites, with the highest readings found at the mid north (site 3) location that had the lowest phosphorus readings (although pH and conductivity readings were also slightly higher at that site, and chlorophyll *a* levels were similar at all four sites). In general, overall water quality conditions were similar at the north (site 1), mid-south (site 2), mid-north (site 3) and south (site 4) sites.

Q. Are there any (statistically significant) trends?
A. With only one year of data, long-term trends can't be evaluated at this site.

Q. Has the lake experienced harmful algal blooms (HABs)?
A. Water quality conditions indicate a low susceptibility to blooms, but frequent blooms have been reported along the shoreline or in the open water. The open water algal community in the lake is usually comprised of low cyanobacteria levels. This community is comprised primarily of *Dolichospermum* (aka *Anabaena*) and other cyanobacteria taxa. Overall open water algae levels are low to intermediate. Open water toxin levels are consistently below recreational levels of concern. Shoreline blooms have been documented at multiple locations in the lake, comprised primarily of cyanobacteria comprised of *Microcystis* and *Dolichospermum.* The shoreline algal community exhibits periodically high toxin levels.

In 2018, overall algae levels were low to intermediate, with other algae the most common taxa in open water samples, and with low cyanobacteria levels. Open water toxin levels were undetectable. Shoreline blooms in 2018 were documented in several places in the lake, comprised primarily of cyanobacteria with high toxin levels. The most common taxa were similar to those described above.

Q. Have any aquatic invasive species (AIS) been reported?
A. There are invasive plants reported or present at Seneca Lake, and invasives have been reported in nearby waterbodies. Invasive species reported in the lake include Eurasian watermilfoil, curly leafed pondweed and water chestnut. Quagga and zebra mussels, mud bithynia, scud, bloody-red shrimp, and rudd have been reported in Seneca Lake. Seneca Lake has high vulnerability for new invasives, based on calcium levels, the presence of multiple AIS, and many public access points.

Q. Are any lake uses likely to be affected by these conditions?
A. Seneca Lake supports potable water, recreation and public bathing use. Public water supply is stressed by shoreline HABs and threatened by raw water cyanotoxins. Public bathing and recreation are stressed by HABs, and impacted by shoreline HABs and associated cyanotoxins. Aquatic life is threatened by the presence of invasive animals. Aesthetics are poor due to HABs, and impacted by the presence of invasive aquatic plants. Habitat is fair due to the presence of invasive aquatic plants. Fish Consumption use is considered to be unassessed. There are no health advisories limiting the consumption of fish from this waterbody (beyond the general advice for all waters). However, due to the lack of actual fish sampling data, fish consumption use is noted as unassessed, rather than fully supported but unconfirmed.

How to Read the Report

This guide provides a description of the CSLAP report by section and a glossary. The sampling site is indicated in the header for lakes with more than one routine sampling site.

Physical Characteristics influence lake quality:
- Surface area is the lake's surface in acres and hectares.
- Max depth is the water depth measured at the deepest part of the lake in feet and meters.
- Mean depth is either known from lake bathymetry or is 0.46 of the maximum depth.
- Retention time is the time it takes for water to pass through a lake in years. This indicates the influence of the watershed on lake conditions.
- Lake classification describes the "best uses" for this lake. Class AA, AAspec, and A lakes may be used as sources of potable water. Class B lakes are suitable for contact recreational activities, like swimming. Class C lakes are suitable for non-contact recreational activities, including fishing, although they may still support swimming. The addition of a T or TS to any of these classes indicates the ability of a lake to support trout populations and/or trout spawning.
- Dam classification defines the hazard class of a dam. Class A, B, C, and D dams are defined as low, intermediate, high, or negligible/no hazard dams in that order. "0" indicates that no class has been assigned to a particular dam, or that no dam exists.

Watershed characteristics influence lake water quality:
- Watershed area in acres and hectares
- Land use data come from the most recent (2011) US Geological Survey National Land Use Cover dataset

CSLAP Participation lists the sampling years and the current year volunteers.

Key lake status indicators summarize lake conditions:
- Trophic state of a lake refers to its nutrient loading and productivity, measured by phosphorus, algae, and clarity. An oligotrophic lake has low nutrient and algae levels (low productivity) and high clarity while a eutrophic lake has high nutrient and algae levels (high productivity) and low clarity. Mesotrophic lakes fall in the middle.
- Harmful algal bloom susceptibility summarizes the available historical HAB data and indicates the potential for future HAB events.
- Invasive vulnerability indicates whether aquatic invasive species are found in this lake or in nearby lakes, indicating the potential for further introductions.
- Priority waterbody list (PWL) assessment is based on the assessment of use categories and summarized as fully supported, threatened, stressed, impaired, or precluded. Aesthetics and habitat are evaluated as good, fair, or poor. The cited PWL assessment reflects the "worst" assessment for the lake. The full PWL assessment can be found at http://www.dec.ny.gov/chemical/36730.html#WIPWL.

Current year sampling results

- Results for each of the sampling sessions in the year are in tabular form. The seasonal change graphically shows the current year results. Red shading indicates eutrophic readings.
- HAB notification periods on the DEC website, updated weekly http://www.dec.ny.gov/chemical/83310.html
- Shoreline HAB sample dates and results. Samples are collected from the area that appears to have the worst bloom. Red shading indicates a confirmed HAB.
- HAB sample algae analysis. Algae types typically change during the season. These charts show the amount of the different types of algae found in each mid-lake or shoreline sample. Samples with high levels of BGA are HABs. The second set of charts show the level of toxins found in open water and shoreline samples compared to the World Health Organization (WHO) guidelines.
- If there are more than ten shoreline bloom samples collected in a year, bloom sample information is instead summarized by month (May-Oct.) as minimum, average, and maximum values for blue-green algae and microcystin.

Long Term Trend Analysis puts the current year findings in context. Summer averages (mid-June thru mid-September) for each of the CSLAP years show trends in key water quality indicators. The graphs include relevant criteria (trophic categories, water quality standards, etc.) and boundaries separating these criteria.

In-Season Analysis shows water temperature and water clarity during the sampling season. These indicate seasonal changes and show the sample year results compared to the typical historical readings for those dates.

The Lake Use Scorecard presents the results of the existing Priority Waterbody List assessment for this lake in a graphical form and compares it to information from the current year and average values from CSLAP data and other lake information. Primary issues that could impact specific use categories are identified, although more issues could also affect each designated use.

The Lake Summary reviews and encapsulates the data in the lake report, including comparisons to historical data from this lake, and results from nearby lakes.

Glossary of water quality and HAB indicators

Clarity (m): The depth to which a Secchi disk lowered into the water is visible, measured in meters. Water clarity is one of the trophic indicators for each lake.

TP (mg/L): Total phosphorus, measured in milligrams per liter at the lake surface (1.5 meters below the surface). TP includes all dissolved and particulate forms of phosphorus. TSP, or total soluble phosphorus, was collected in 2018 and discussed in the lake narrative section.

Deep TP: Total phosphorus measured in milligrams per liter at depth (1-2 meters above the lake bottom at the deepest part of the lake)

TN: Total nitrogen, measured in milligrams per liter at the lake surface. TN includes all forms of nitrogen, including **NOx** (nitrite and nitrate) and **NH$_4$** (ammonia).

N:P Ratio: The ratio of total nitrogen to total phosphorus, unitless (mass ratio). This ratio helps determine if a lake is phosphorous or nitrogen limited.

Chl.a (µg/L): Chlorophyll a, measured in micrograms per liter. Indicates the amount of algae in the water column. This is an extracted chlorophyll measurement.

pH: A range from 0 to 14, with 0 being the most acidic and 14 being the most basic or alkaline. A healthy lake generally ranges between 6.5 and 8.5.

Cond (µmho/cm): Specific conductance is a measure of the conductivity of water. A higher value indicates the presence of more dissolved ions. High ion concentrations (> 250) usually indicate hardwater, and low readings (< 125) usually show softwater.

Upper Temp (°C): Surface temperature, measured in degrees Celsius

Deep Temp (°C): Bottom temperature, measured in degrees Celsius

BG Chl.a (µg/L): Chlorophyll a from blue-green algae, measured in micrograms per liter. This is an "unextracted" estimate using a fluoroprobe. This result is not as accurate as the extracted chlorophyll measurement described above.

HABs: Harmful Algal Blooms. Algal blooms that have the appearance of cyanobacteria (BGA)

BGA: Blue-green algae, also known as cyanobacteria

Microcystin (µg/L): The most common HAB liver toxin; total microcystin above 20 micrograms per liter indicates a "high toxin" bloom. However, ALL BGA blooms should be avoided, even if toxin levels are low.

Anatoxin-a (µg/L): A toxin that may be produced in a HAB which targets the central nervous system. Neither EPA nor NYS has developed a risk threshold for anatoxin-a, although readings above 4 micrograms per liter are believed to represent an elevated risk.