Water Quality Report

Silver Lake 2025

Report prepared for: ***Silver Lake Association***

Monitoring performed by: *Aquatic Ecosystems Consulting (AEC)*

Monitoring performed: *Water Quality/Vegetation Survey - Summer 2025 (August 23)*

Report prepared by: *Steve S. Di Lonardo, M.S. Biology (AEC)*
Alissa Perrone, M.S. Biology (AEC)
Dr. John Wehr, Ph.D. Biology (Fordham University)

Summary

In the summer of 2025, the Silver Lake Association hired Aquatic Ecosystems Consulting (AEC) to evaluate the lake's water quality and identify specific issues. To achieve this, AEC developed a comprehensive sampling plan that included collecting data on water quality indicators, the phytoplankton community, and vegetation coverage and composition, all intended to guide best management practices.

All water quality data was within optimal ranges except for oxygen, which was low in shallow areas with dense aquatic vegetation. The phytoplankton assemblages (algal communities) observed in Silver Lake in summer 2025 were relatively sparse (low density), as compared with other shallow lakes in the region. The August species composition in Silver Lake was characterized by a diversity of green algae and diatoms. Importantly, cyanobacteria, which include members that can produce nuisance surface blooms, comprised a relatively low percentage of the algal assemblages. The vegetation survey indicated that Silver Lake was greatly impacted by mostly dense aquatic vegetation covering approximately 66% of its surface. The currently employed method to address the excessive vegetation growth, mechanical pulling, promotes the proliferation of the vegetation, which already covers most of the lake area that is shallow enough to support rooted aquatic vegetation. Second, mechanical pulling of the rooted aquatic vegetation without removing the plants and more importantly the root systems, is creating dozens of small islands in the shallow zones of Silver Lake. Over time, these islands accumulate organic matter and appear to be growing. Over time, the continued use of the management method will result in the shallow parts of Silver Lake to no longer be navigable and become wetlands. Because of this, Silver Lake residents should discontinue the mechanical pulling of vegetation and root systems. Several alternate methods have been explored, including sterile triploid carp, and all were not approved for Silver Lake or not yet approved for use in New York State, except for herbicide treatment. Given the cost, the need for annual treatment and the very high vegetation coverage, Silver Lake Association should consider employing targeted treatment with herbicides.

Methods

Water Quality Study

We sampled surface water quality at 7 sampling points within 6 designated sampling areas (Figure 1). One of these areas (Site 6) was considered the “deep water” site. It is at this site that AEC measured temperature, oxygen, oxygen saturation, pH, and conductivity at 1-meter increments (vertical profile). Sampling at multiple sites provides a comprehensive representation of water quality conditions in the different sections and regions of Silver Lake.

Figure 1. Silver Lake map with sampling locations.

Source: Google Maps

Vegetation Survey

A vegetation survey was performed to characterize vegetation (% coverage, density, species) to help guide the targeting and magnitude of management and to identify invasive species. The following table lists the variables we examined and their associated methods (Table 1).

Table 1. List of variables and associated analytical methods

Variable	***Method***
pH	*YSI multi-meter*
Conductivity	*YSI multi-meter*
Water Clarity	*Secchi Disc*
Phytoplankton	*Fixed samples with Lugol's. Identified species with an inverted microscope.*
Temperature and Oxygen	*YSI Multi-Meter*
Phytoplankton Community Identification and Characterization	*Microscopy*
Vegetation Survey	*Visual Survey*

Water quality monitoring data was categorized into physical, and biological parameters. We measured these variables to characterize water quality to identify water quality conditions affecting aesthetics, recreation, or public health.

Physical Parameters

For all sampling locations temperature, oxygen, oxygen saturation, pH and conductivity were monitored in Silver Lake (Table 2).

Table 2. Physical parameters monitored in Silver Lake mid-summer 2025 (measurements outside of optimal range are bold and italicized).

Sample Site	Temp ^{o}C	O2 (mg/L)	O2 saturation (%)	pH	Conductivity (*u*s/cm)
1	21.7	***3.7***	***42.0***	7.5	275
2a	19.5	***3.5***	***39.0***	7.6	305
2b	23.7	6.6	79.0	7.7	216
3	24.0	***4.0***	***48.0***	7.7	248
4	20.9	7.1	81.5	8.0	301
5	23.7	***5.5***	***68.0***	7.7	238
6	24.4	***6.3***	***77.0***	7.7	198

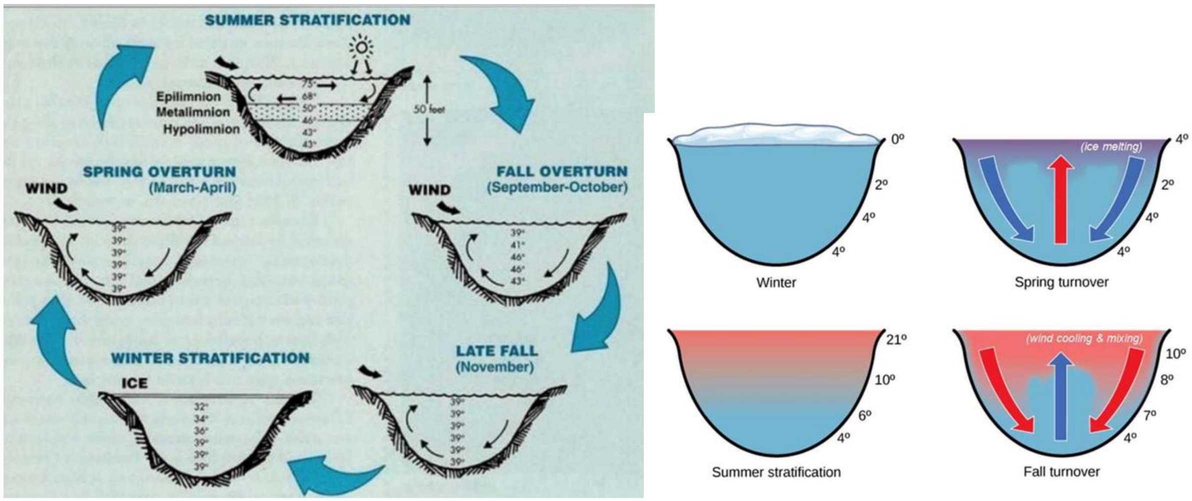
Water Temperature

Water temperature in Silver Lake is about average for the summer and reflects the atmospheric temperature (weather). Regionally, a trend towards higher water temperatures, especially during spring and autumn, has been observed, which extends the growing season and favors the occurrence of algae blooms or increased aquatic vegetation.

Water Temperature-Oxygen Profile

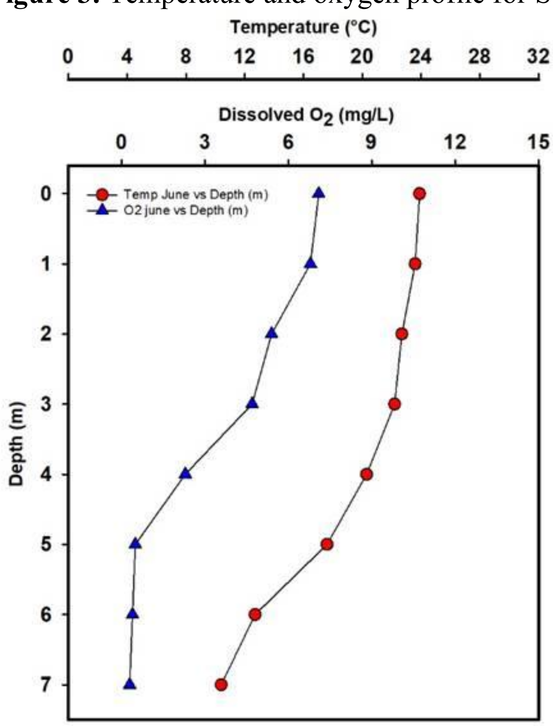
The temperature-oxygen profile was obtained in a deep-water location where the maximum depth is about 7m (~23ft). In Northern regions, as warming occurs during spring, a mixing event called a turnover occurs where temperature is uniform from the surface to the bottom. Thereafter, the water column in the lake is stratified (**separated into 2 distinct layers with very little mixing**) where the top layer is warmer, and the bottom region is cool. This only occurs in regions of a lake that are deep enough (generally 2-11 meters). As temperatures get cooler in the fall, a similar turnover occurs and is followed by cooler surface water and warmer water near the bottom (Figure 2). During the turnover when water mixes, nutrient rich water from the bottom mixes with surface water and promotes primary productivity (plant and algal growth).

Figure 2. Description of lake summer stratification
Courtesy: https://images.app.goo.gl/LVULHNnyWYFqcbYi8



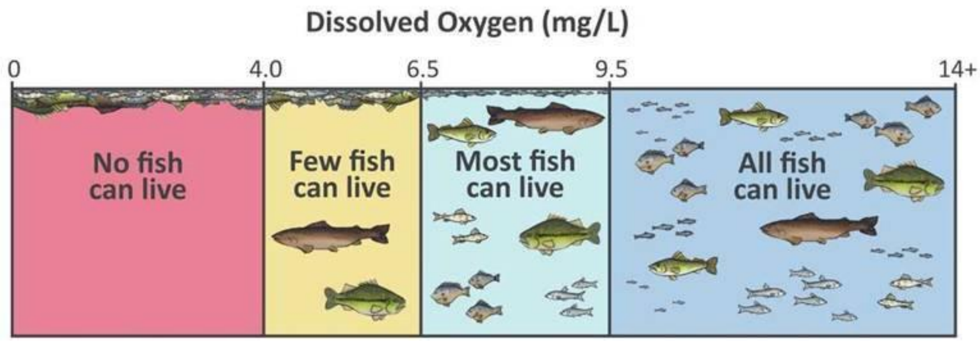
Characterization of this temperature profile is achieved by measuring temperature at every meter from surface to bottom (Figure 3). In addition to providing a snapshot of lake conditions, the measurement of a vertical temperature and oxygen profile is important for examining year to year patterns. Recent studies have mentioned the warming of lake benthic layers and the impact this has on nutrient dynamics in a lake and can also promote the growth of algae. During the warmer summer months, the upper water layer is warmer, well oxygenated, and usually relatively nutrient poor, while the lower layer is cooler, has very low oxygen and is nutrient rich. The summer monitoring (August) indicates pronounced stratification below 4 meters, which, anoxic (no oxygen) conditions exist (Figure 3).

Figure 3. Temperature and oxygen profile for Summer 2025 in Silver Lake.



Oxygen
Dissolved oxygen (DO) is one of the most important indicators of water quality. It is essential for the survival of fish and other aquatic organisms. Dissolved oxygen is gaseous, molecular oxygen in the form of O_2 originating from the atmosphere or as a byproduct of photosynthesis. Once dissolved in water, it is available for use by living organisms and can play a significant role in many chemical processes in the aquatic environment. Measurement of dissolved oxygen in lakes is an indicator of ecosystem health: low dissolved oxygen measurements are an indicator of impaired water quality. In ecosystems with high photosynthetic production or eutrophic systems, dissolved oxygen fluctuates significantly from day to night as photosynthesis stops at night in the absence of sunlight. Healthy oxygen levels in aquatic environments are greater than 6.5 mg/L (Figure 4).

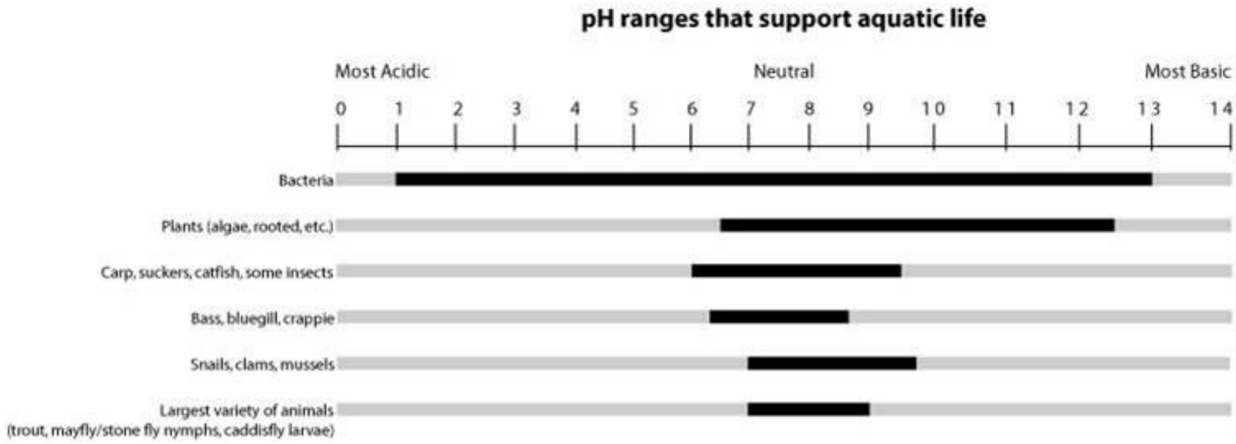
Figure 4. Dissolved oxygen tolerance ranges for fish. Source: Dissolved Oxygen (DO) (datastream.org).



In 2025, several dissolved oxygen measurements in Silver Lake were below the optimal range (Table 2). It is important to investigate measurements outside of the range, especially in repeated measurements as it suggests possible impairment of water quality. For Silver Lake, the oxygen levels below optimal ranges are likely due to the very dense aquatic vegetation coverage, which when decaying at the end of each summer, cause elevated bacterial activity, which depletes dissolved oxygen. This reinforces the need to manage aquatic vegetation in Silver Lake.

pH
The pH of water in rivers, lakes, and wetlands is important to plant and animal life. Most animal species cannot survive if the water is too acidic (generally below 5.0), or too basic (above 9.0). Optimal pH for many species is between 7.0 and 9.0 (Figure 5). In 2025, the pH measurements in Silver Lake were all within the optimal pH range.

Figure 5. pH tolerance ranges for aquatic organisms. Source: pH | Limno Loan Program.



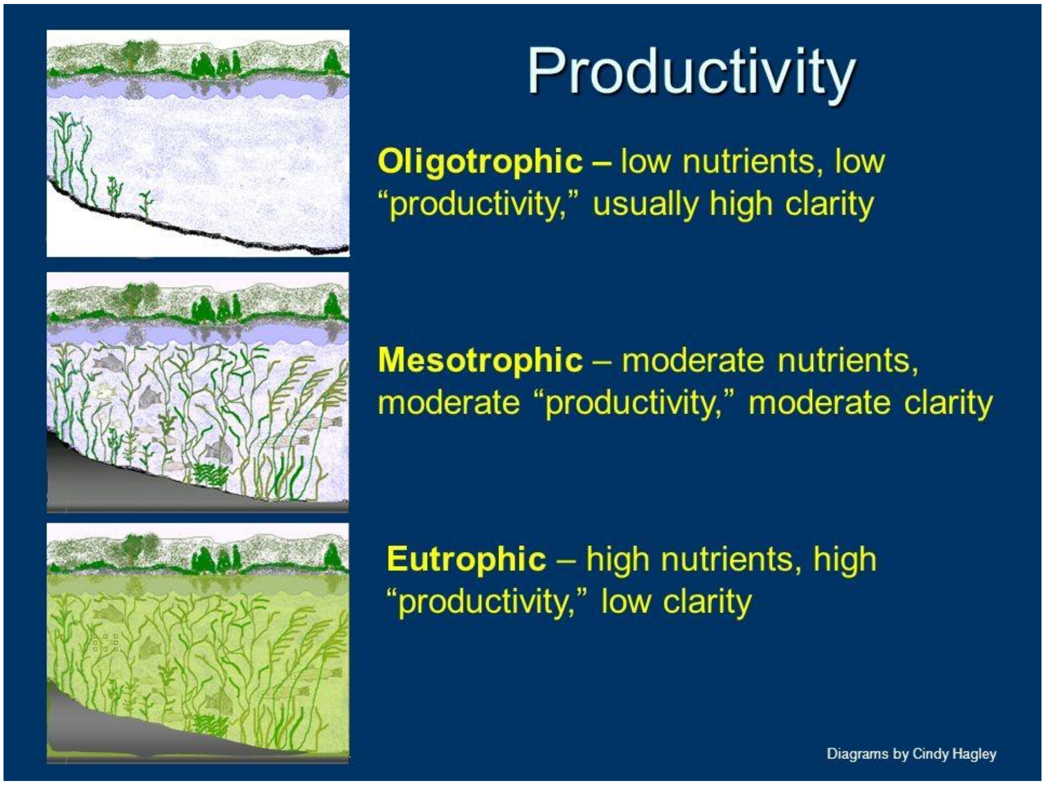
Conductivity

Conductivity measurement in water corresponds to a measure of dissolved salts. Yearly measurements fluctuate based on the amount of precipitation runoff which can concentrate or dilute dissolved salts, and road salt use. The concentration of dissolved salts in waterbodies has been increasing in the Northern Latitudes due to the use of salt and de-icers to maintain safe road conditions in the winter. Unfortunately, the increased dissolved salt is having negative ecological impacts such as delaying spring turnover (the mixing of water and reoxygenation of bottom layers in a lake), and having concentrations above optimal ranges, harming less tolerant freshwater organisms, which in turn favors nuisance species. In Silver Lake, the mean conductivity measurements in 2025 were 254.4 *u*s/cm, which is within the optimal range for supporting aquatic life. The land elevation, watershed size and lack of primary roads surrounding the lake help conductivity remain within its optimal range. Elevated conductivity is a primary water quality concern because it signals external factors that can be directly controlled through improved management practices.

Biological Parameters

Biological parameters are monitored to evaluate indices of primary productivity (photosynthetic growth). Silver Lake has high vegetation coverage (66.7%), with mostly medium to very high densities. According to the North American Lake Management Society's trophic state index, Silver Lake is consistent with meso-eutrophic or moderate to high productivity lake, where vegetation is high, but the vegetation coverage outcompetes algae, which is sparse, and clarity is moderate.

Figure 6. Indices of primary productivity in aquatic environments.



Aquatic vegetation
The measure of vegetation coverage in Silver Lake is recorded to characterize extent, composition and density of aquatic vegetation coverage and guide management.

In the summer of 2025, approximately 66.7% of Silver Lake had moderate to very dense aquatic vegetation coverage (Table 3a,b).

Table 3a. Silver Lake aquatic vegetation coverage at each sampling site and total coverage.

Site	Site Area (km)	Site Area (Acres)	Vegetated Area (acres)	% Vegetated
1	1	25.9	6.5	25
2a	0.52	13.5	13.2	**98**
2b	0.23	6.0	1.8	30
3	0.44	11.4	11.3	**99**
4	0.68	17.6	17.2	**98**
5	0.82	21.2	21.2	**100**
6	0.91	23.5	8.2	35
Total	**4.6**	**119.0**	**79.4**	**66.7**

Table 3b. Silver Lake aquatic vegetation relative density and primary species composition.

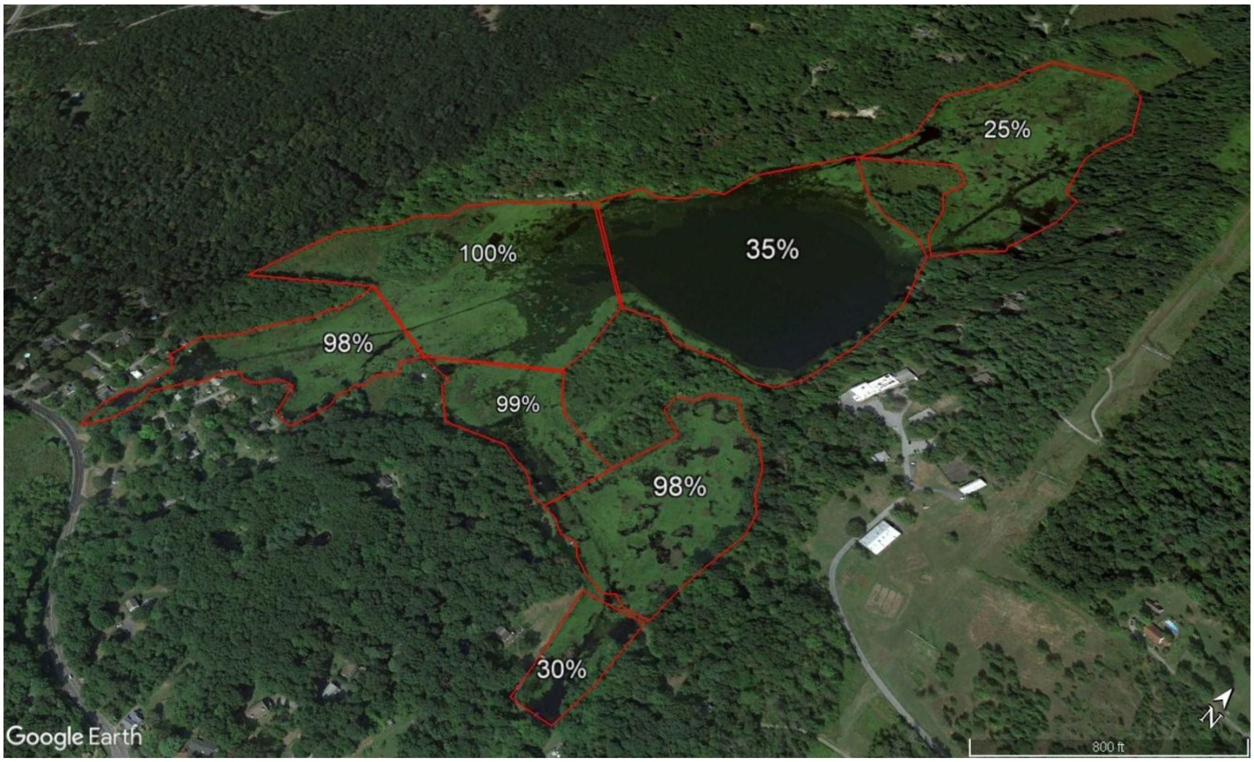
<table>
<tr><th>Site</th><th>Low</th><th>Moderate</th><th>High</th><th>Very High</th><th>Species</th></tr>
<tr><td>1</td><td></td><td colspan="3">100%</td><td>bladderwort, fanwort, curly leaf pond weed</td></tr>
<tr><td>2a</td><td>85%</td><td colspan="3">15%</td><td>bladderwort, fanwort, coontail</td></tr>
<tr><td>2b</td><td>30%</td><td>55%</td><td>13%</td><td>2%</td><td>fanwort, coontail, pickerel weed, broadleaf pondweed</td></tr>
<tr><td>3</td><td colspan="2">85%</td><td colspan="2">15%</td><td>bladderwort, fanwort, coontail, pickerel</td></tr>
<tr><td>4</td><td colspan="2">80%</td><td>7.50%</td><td>12.50%</td><td>fanwort</td></tr>
<tr><td>5</td><td colspan="2">60%</td><td>40%</td><td rowspan="2"></td><td>fanwort, coontail</td></tr>
<tr><td>6</td><td colspan="2">90%</td><td>10%</td><td>fanwort, coontail</td></tr>
</table>

Dozens of floating masses, comprised of dense root systems, remain as remnants from the mechanical vegetation pulling. Some of these masses appear to be accumulating sediment and have the potential to grow in size (Figure 7).

Figure 7. Photographic illustration of dense aquatic vegetation coverage and small islands resulting from mechanical pulling of aquatic plant root systems in Silver Lake.

A very high percentage (mostly >90%) of the shallow sections of Silver Lake were covered with aquatic vegetation (Figure 8).

Figure 8. Silver Lake vegetation coverage map 2025.



Phytoplankton Community Characterization

Background. Monitoring programs routinely use information based on the abundance (biomass) and species composition of phytoplankton (freely-floating **algae**) of lakes, because they integrate - reflect a longer view of - ecological conditions, unlike nutrient samples collected on a single date. A diverse phytoplankton community is generally regarded as an indication of a healthy lake. Algae form the base of lake food webs and generate most of the oxygen (along with aquatic plants), but occasionally can cause nuisance problems. For example, a diversity of species of diatoms, green algae and various flagellates (Figure 9a) with no single species in abundance, indicate lower nutrient levels and a generally healthy lake. In contrast, a dense phytoplankton assemblage dominated by a few species of cyanobacteria (Figure 9b) indicate elevated nutrients (human-caused eutrophication) and deteriorated water quality.

Figure 9 a,b. Examples of plankton assemblages from moderate and high nutrient conditions.

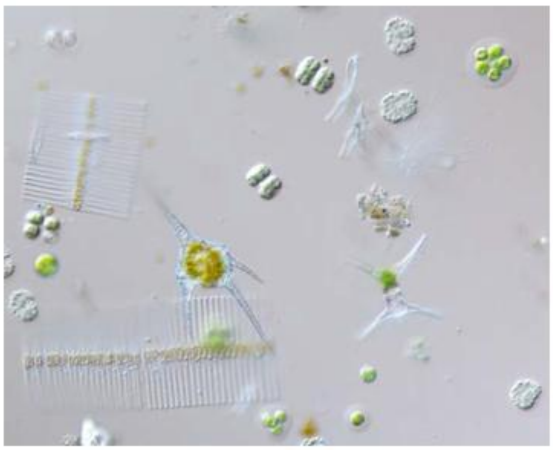


Figure A. Example of a summer phytoplankton assemblage from a moderately nutrient-rich lake, with a diverse collection of diatoms, green algae, dinoflagellates, and cyanobacteria.

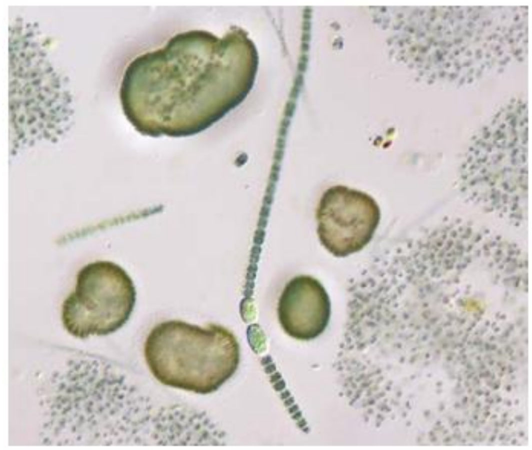
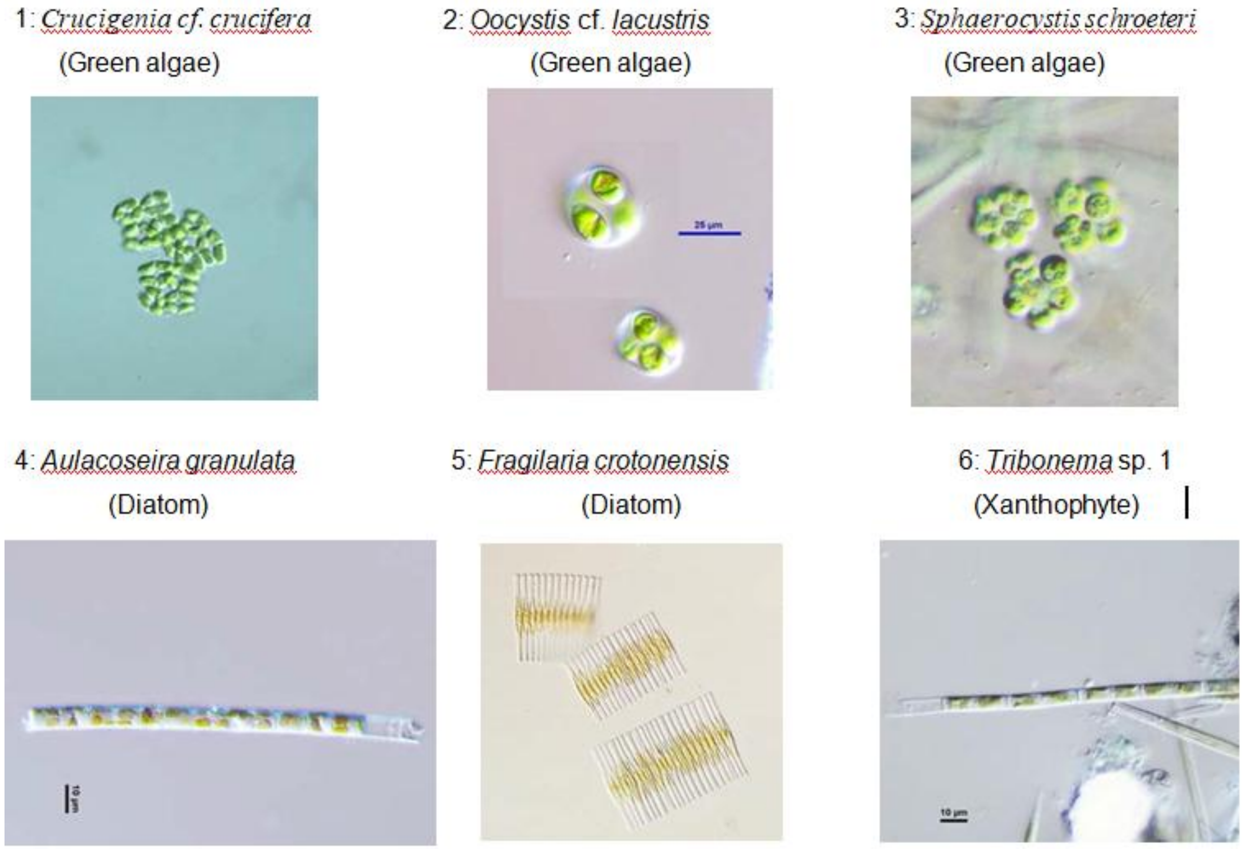


Figure B. Example of a summer phytoplankton bloom from a eutrophic lake, with high levels of nitrogen and phosphorus, and low diversity, composed primarily of cyanobacteria.

Phytoplankton in Silver Lake. This survey was the first year in which we assessed the phytoplankton from Silver Lake (Rhinebeck, NY). Sampling was conducted in August. While just a single date, summer is typically the period in which adverse or excessive algal growth can occur in eutrophied lakes. Example images of a few common algal species we observed in Silver Lake in August 2025 are shown (Figure 10).

Samples and Purpose. Sampling was conducted on August 23, 2025. Three sampling stations were positioned around the lake, designated as Site 6 (Deep), Site 1, and Site 4. Our purpose was (1) to assess the major algal groups in the community, and (2) assess what the species composition tells us about lake water quality.

Figure 10. Examples of common phytoplankton species observed in Silver Lake, August 2025.



Because some species of cyanobacteria (blue-green algae), can on occasion occur in heavy ("bloom") densities and impair water quality, this assessment provides a percentage assessment of the relative importance of cyanobacteria in each period: the **Cyano Index**, with values from 0 to 100% of total biovolume (Table 4). Full details of the species observed from 2025 are listed in Appendix 1.

Comments and Ecological Indications. The phytoplankton assemblages (algal communities) observed in Silver Lake in summer 2025 were relatively sparse in term of the number of cells or colonies present (low density), as compared with other shallow lakes in the region. The August species composition in Silver Lake was characterized by a diversity of green algae and diatoms. **Importantly, cyanobacteria, which include members that can produce nuisance surface blooms, comprised a relatively low percentage of the algal assemblages** (Table 4). The "Cyanobacteria Index" is less than 15% across all sample locations. Green algae were the most important group in the two main lake stations, with diatoms dominating near a culvert.

Table 4. A summary of the relative biomass contained within each taxonomic category of algae in Silver Lake in August 2025. Braun-Blanquet scores were coveted to median values top calculate the values below.

	Deep Site	Site 1	Site 4
% Cyanobacteria (Index)	14.2%	8.8%	5.4%
% Green algae	**53.8%**	**57.8%**	13.8%
% Euglenophytes	13.2%	7.8%	2.3%
% Chrysophytes	7.5%	12.7%	4.6%
% Diatoms	10.4%	11.8%	**68.5%**
% Dinoflagellates	0.9%	1.0%	0.8%
% Cryptomonads	0.0%	0.0%	4.6%

How to Read These Data (See Appendix 1):

List species of algae observed in samples collected from a 1-m depth by location, on August 23, 2025**.** The numbers after species names represent the relative abundances (in ranks) of each species by site, to assess differences in species richness and composition. The ranks are as follows: **0** = absent or not seen; **1**= rare; **2** = occasional; **3** = common; **4** = abundant or dominant; **5** = massive or blooms. Rank numbers in Table 4 represent Braun-Blanquet score ranges; 0 = 0%; 1= $\leq$ 1%; 2= 1 to 5%; 3 = 6 to 25%; 4 = 26-50%; and 5:= > 50%.

Conclusions

In 2025, Silver Lake water quality within optimal ranges for all but dissolved oxygen. The phytoplankton community was sparse and dominated by diatoms. Vegetation coverage was moderate to very dense and covered 66.7% of Silver Lake. With the extent and density of aquatic vegetation, the bacterial decay of vegetation as it dies off at the end of the summer depletes dissolved oxygen and can explain the lower than optimal dissolved oxygen in Silver Lake. The cause of the excess vegetation is the amount of nutrients in Silver Lake, which is connected to a wetland, and its physical characteristics, with 75% of the lake being shallow enough to sustain rooted aquatic vegetation. In an ideal world, to achieve a reduction in the amount of aquatic vegetation, the amount of bio-available aquatic nutrients would have to be reduced so less plant biomass can be sustained. This could be achieved by adding a phosphorus binding agent to deactivate phosphorus, which drives aquatic vegetation growth. Unfortunately, this method is not approved in NYS. Second, the lake would have to be dredged to a depth where rooted aquatic plants cannot grow and reduce sediment nutrient storage. Dredging is prohibitively expensive, far exceeds lake association budgets, and can only be achieved with government grants.

However, there are best practices that can incrementally minimize watershed nutrient entry into Silver Lake including buffer vegetation, minimizing impervious surfaces, avoiding the use of lawn or plant fertilizers (which promote algae and aquatic plant growth), and silt fencing when construction occurs in the watershed (to minimize nutrient input and filling in of Silver Lake which promote aquatic vegetation and algae growth). Residents are strongly encouraged to enhance their individual waterfronts with native buffer plantings, using guidance available from resources such as Westchester Buffer Vegetation and NYSDEC. The Silver Lake Association should establish buffer vegetation along the banks of Silver Lake as a critical measure for capturing nutrients before they enter the lake. Lastly, the Silver Lake Association should send out regular seasonal communications to residents about best practices, including leaf litter disposal, lawn and yard care clippings, road salt, and the use of silt fences for any construction projects.

Other solutions include eliminating aquatic vegetation growth which includes mechanical harvesting, the addition of triploid grass carp and treatment with herbicides. The use of triploid grass carp was not approved by New York State due to Silver Lake's connection to a network of wetlands. Mechanical harvesting is currently in use, but has many issues. Namely, it promotes the propagation of aquatic vegetation across the lake, which includes some invasive nuisance species. More importantly, the extensive root system with the aquatic vegetation is being dislodged from the sediment and is creating numerous small islands in the lake. Since the areas in the lake where this occurs are shallow, the islands persist, are accumulating sediment, and will eventually make some parts of the lake not navigable and filled in. Because of this, **AEC recommends the use of targeted herbicide treatment to maintain navigation channels and dockside sections of Silver Lake.** Though it will be required annually, this is the least impactful management method currently allowed. The cost is likely comparable to or less expensive than mechanical harvesting (depending on how many treatments are required in a season).

Appendix 1. Detailed list of common phytoplankton (algal) species by taxonomic group, collected from Silver Lake on August 23, 2025, listed by sampling location with relative abundances as ranks.

0 = absent or not seen	1 = rare	2 = occasional	3 = common	4 = abundant or dominant	5 = massive or blooms

Sampling station ➔	Deep Site	Site 1	Site 4
Cyanobacteria ("blue-green algae")			
Aphanizomenon flos-aquae	1	1	0
Aphanocapsa cf. holsatica	2	1	0
Aphanothece cf. nidulans	0	0	2
Gomphosphaeria cf. aponica	2	1	0
Planktothrix sp. 1	1	2	0
Pseudanabaena sp.	0	0	1
Woronichinia naegeliana	1	0	0
Chlorophyta (green algae)			
Ankistrodesmus falcatus	0	1	0
Botryococcus braunii	1	0	0
Closteriopsis cf. acicularis	2	2	0
Coelastrum cf. microporum	1	0	0
Cosmarium sp. cf. pachydermum	0	0	1
Cosmarium sp. cf. venustum	0	0	1
Crucigenia cf. crucifera	3	3	0
Eudorina sp. 1	1	0	0
Gomphonema cf. truncatum	0	0	1
Kirchneriella sp. 1	1	1	0
Microspora sp. 1 (quadrate)	0	0	2
Mougeotia sp. 1 narrow	0	0	2
Oedogonium sp. 1 - sterile	0	0	1
Oocystis lacustris	2	2	0
Pediastrum duplex	1	0	0
Pediastrum tetras	1	0	0
Quadrigula lacustris	1	2	1
Scenedesmus cf. ellipticus	1	1	0
Sphaerocystis schroeteri	2	2	1
Staurastrum sp. 1	1	1	0
Tetraedon minimum	0	1	0
Euglenophyta (Euglenophytes)			
Euglena acus	1	0	1
Euglena sp. 1	1	1	0
Trachelomonas cf. hispida	2	1	1
Trachelomonas volvocina	2	2	1

Appendix 1. Detailed list of common phytoplankton in Silver Lake in 2025, continued.

0 = absent or not seen	1 = rare	2 = occasional	3 = common	4 = abundant or dominant	5 = massive or blooms

Sampling station ➔	Deep Site	Site 1	Site 4
Chrysophyta / Xanthophyta (Golden algae)			
Dinobryon bavaricum	1	2	0
Dinobryon divergens / cylindricum	1	1	0
Tribonema sp. 1	2	2	2
Bacillariophyta (Diatoms)			
Amphora cf. ovalis	0	0	1
Aulacoseira granulata	0	0	3
Aulacoseira granulata v. angustissma	1	1	2
Cocconeis placentula	1	1	1
Ctenophora pulchella	0	0	1
Encyonema cf. minutum	0	0	1
Eunotia cf. curvata	0	0	1
Fragilaria cf. capucina	0	1	2
Fragilaria crotonensis	2	2	1
Gomphonema cf. parvulum	0	0	1
Gomphonema sp. 1	0	0	1
Navicula sp. 1 (small; 15 um)	0	1	2
Navicula sp. 2 (unident)	1	0	1
Navicula sp. 3 (large, lanceolate)	0	0	1
Nitzschia cf. acicularis	0	0	2
Nitzschia cf. linearis; > 200 um	0	0	2
Nitzschia sp. 1; linear-lanceolate 20-25 um	0	1	1
Nitzschia sp. 2; 15 um	0	0	2
Pinnularia cf. gibba; >60 um	0	0	1
Pinnularia cf. saprophila	0	0	1
Pinnularia sp. 1; GV, large	0	1	1
Sellaphora sp. 1 (large, linear-elliptic)	0	0	1
Tryblionella sp. 1	0	0	1
Ulnaria delicatissima	1	0	1
Ulnaria ulna	1	0	2
Pyrrophyta (Dinoflagellates)			
Ceratium hirundinella	1	0	0
Peridinium sp. 1	0	1	1
Cryptophyta (Cryptophytes)			
Cryptomonas sp. A (20-24 um)	0	0	2
Total number of taxa (richness)	**32**	**28**	**41**