



EVERBLUE
LAKES

Lake Peekskill

2024 Final Report

March 2025



Lake Peekskill Summary of Services:

As part of the Services agreed upon for 2024, EverBlue Lakes has:

- ▶ Performed aeration system maintenance, including system start-up and full compressor maintenance, 3 diffuser inspections and cleanings, compressor maintenance, and system winterization.
- ▶ Used CiBiobase Sonar Scanning Technology to develop an updated bathymetric survey, lake bottom hardness survey and aquatic vegetation biomass survey of both lakes.
- ▶ Obtaining proper permitting and used Peroxide algaecide treatments for the beach areas
- ▶ Conducted water quality sampling 5 times for the season and analyzed the following parameters:
 - ▶ Total Phosphorus
 - ▶ Ortho Phosphorus
 - ▶ Total Nitrogen
 - ▶ Nitrate and Nitrite
 - ▶ Algal Community Assessment
 - ▶ Sediment organic content and total phosphorus (please note this is only done twice per season)

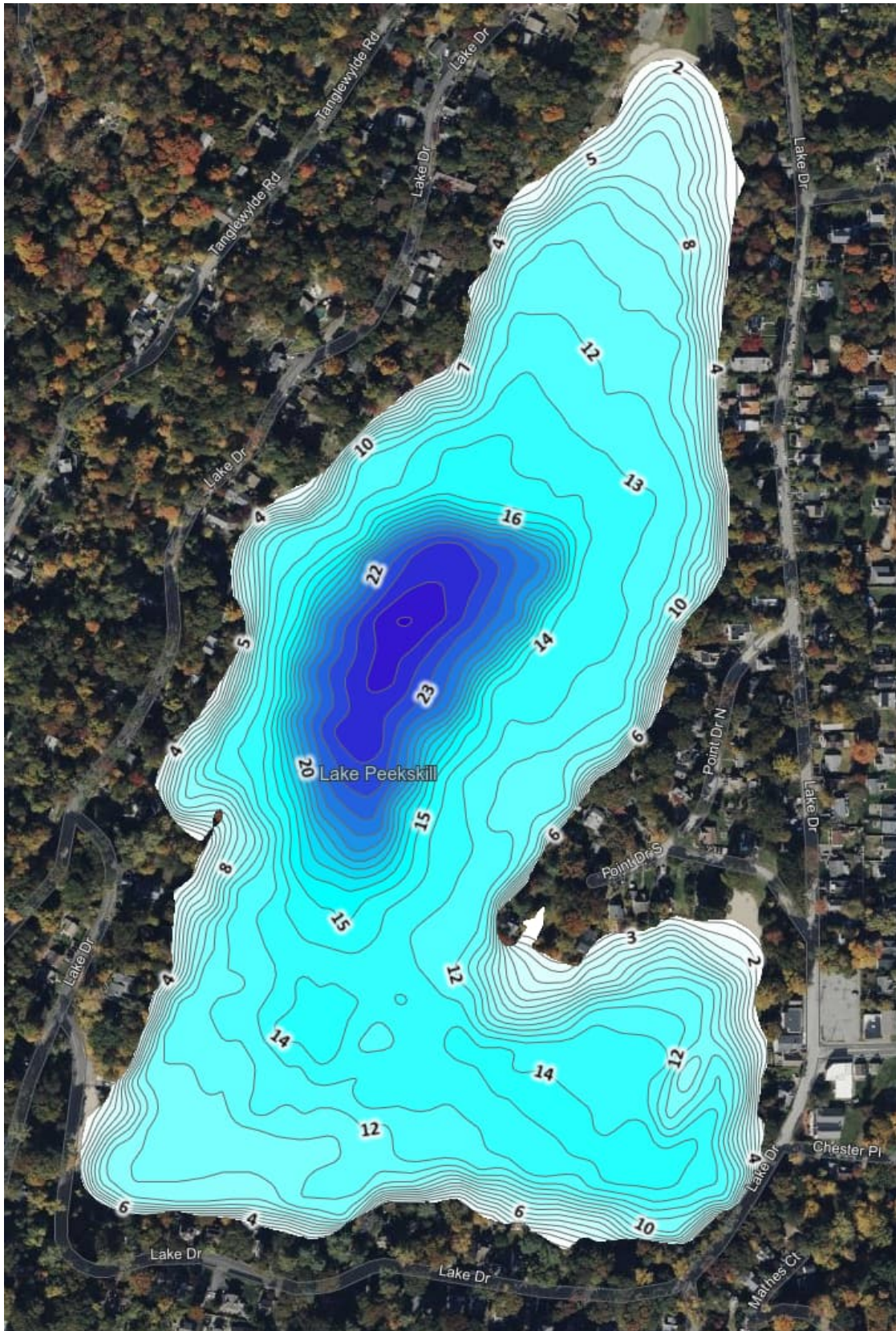


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Lake Peekskill Analysis and Findings

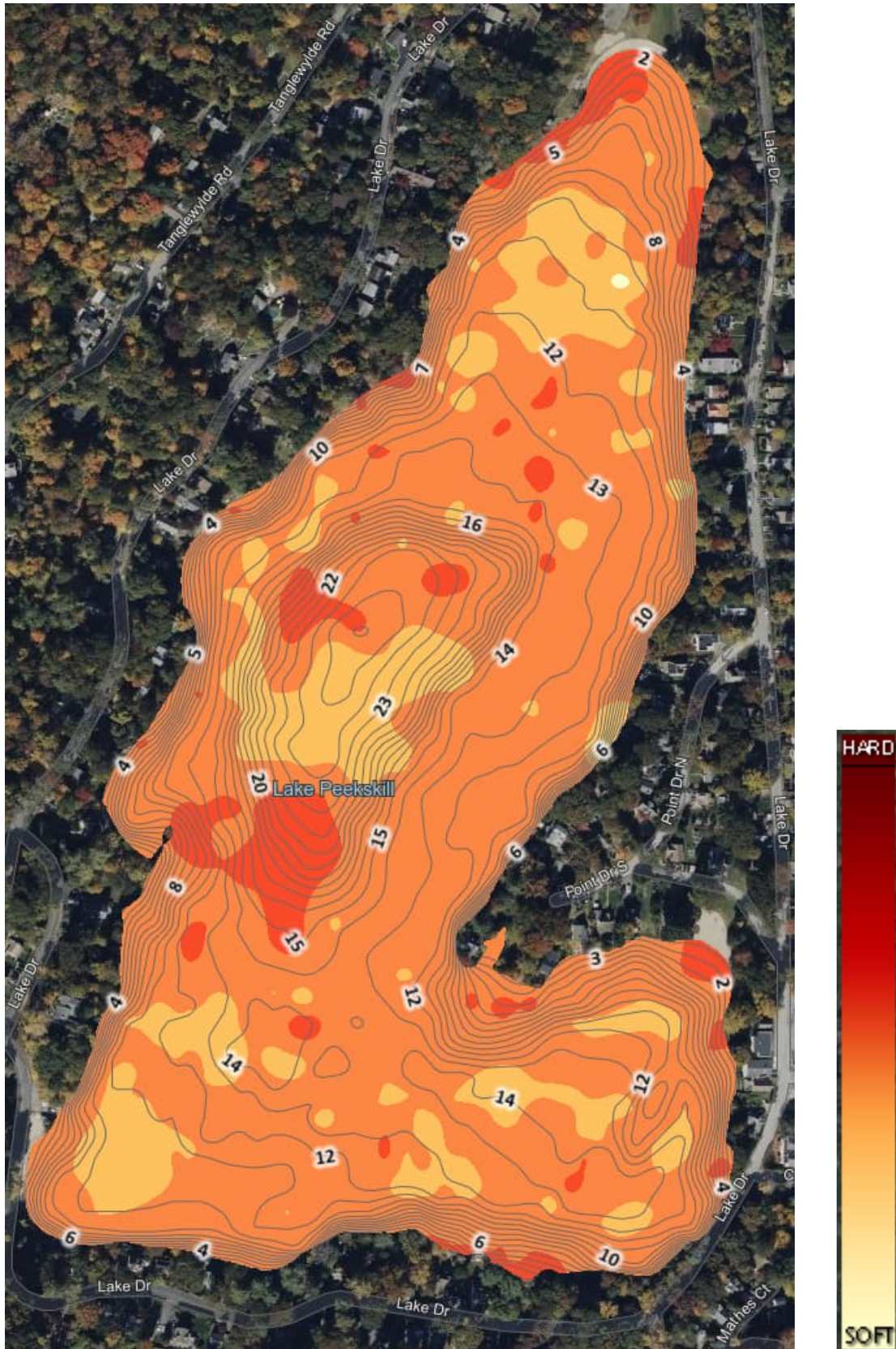


Bathymetric Map Of Lake Peekskill





Lake Bottom Hardness Map Of Lake Peekskill





Lake Peekskill Vegetation Biovolume Analysis and Bottom Hardness %

Lake Peekskill – Biovolume Analysis	
80– 100%	0.0%
60 – 80%	0.0%
40 – 60%	0.6%
20 – 40%	4.0%
0 – 20%	95.4%



The biovolume scale represents the percentage of water volume occupied by vegetation, ranging from 0-20% (low vegetation density) to 80-100% (high vegetation density). Lower percentages indicate sparse plant growth, while higher percentages signify dense vegetation presence in the water column.

Lake Peekskill - Bottom Hardness %	
>0.4	1%
0.3-0.4	57%
0.2-0.3	41%
0.1-0.2	1%
<0.1	0%

hard

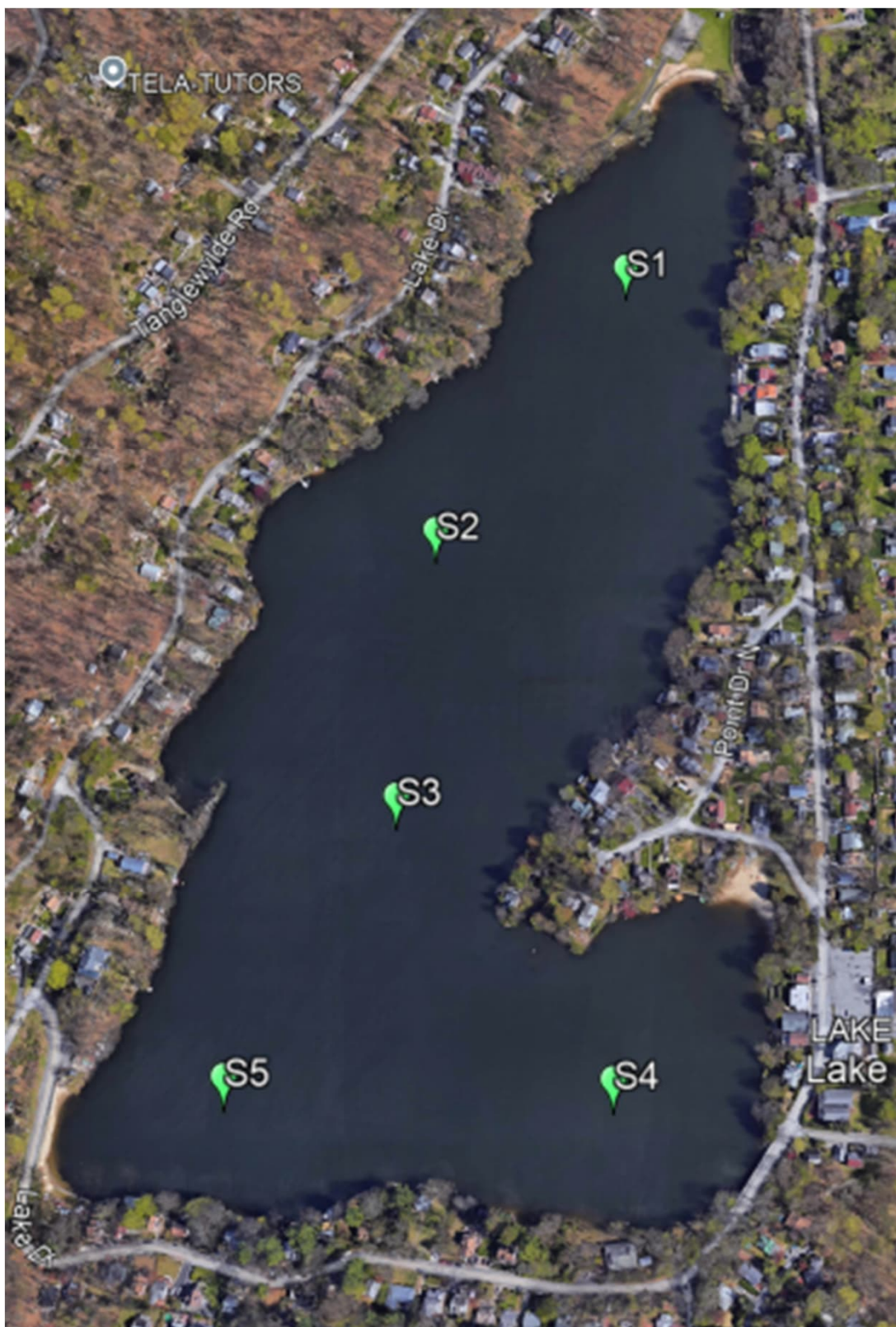


soft

The sediment hardness scale ranges from 0.1 (soft bottom) to greater than 0.4 (hard bottom). Values closer to 0.1 indicate softer, more organic sediment, while values approaching 0.4 represent firmer, more compacted sediment or hard bottom.

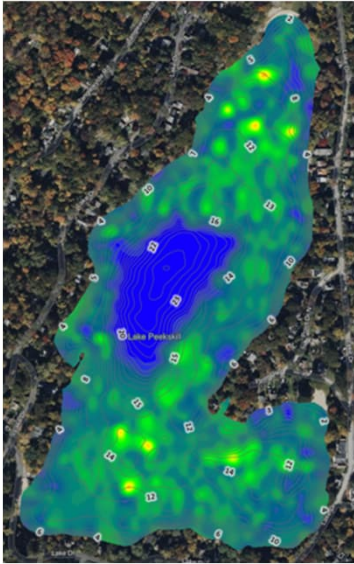


Lake Peekskill Sediment Sampling Sites



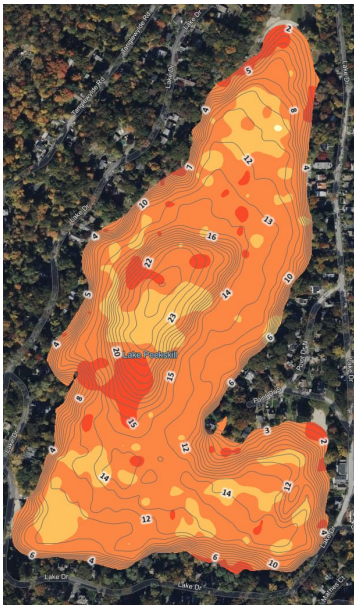


Vegetation Biovolume Analysis and Bottom Hardness Analysis for Lake Peekskill



The Aquatic Vegetation Biovolume is very close to optimal for a lake in a highly developed suburban land-use setting. There is a healthy, but not overabundant/nuisance aquatic plant community.

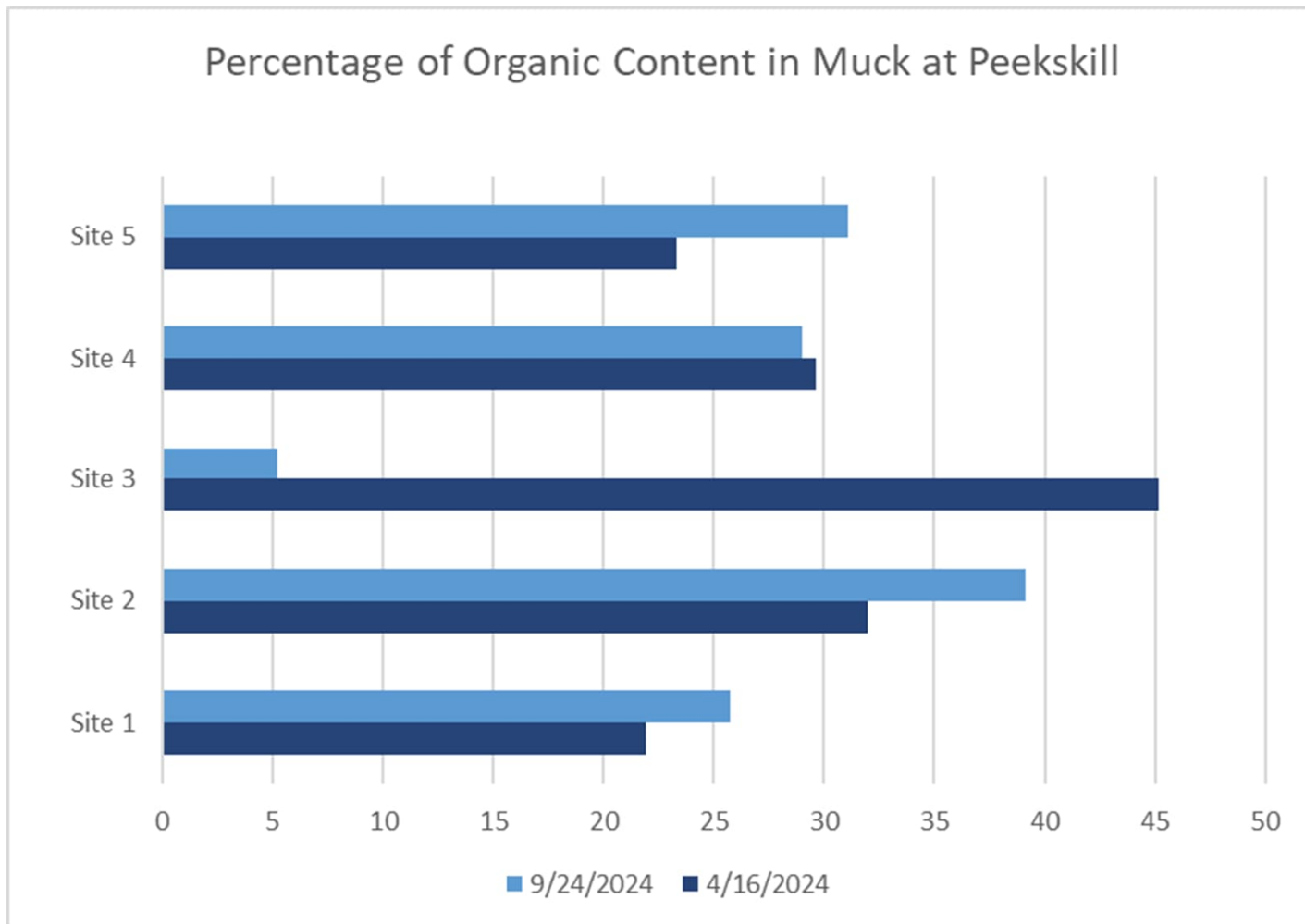
Aquatic plants get most of their nutrients from lake-bottom sediments. A balanced aquatic plant community means that sediment fertility is relatively under control. It is reasonable to conclude that the aeration system and past biological treatment of the lake has likely reduced lake-bottom muck and fertility. However, there additional improvement would be desirable.



Similarly, the relative bottom-hardness analysis is indicative of a relatively hard-bottom lake. For a lake in a highly developed area, the lake bottom is more consolidated than lakes with similar development and land use patterns. This means that there is less organic sediment/muck than is common in area lakes. Again, this is a good indication that the aeration system and past biological treatment has delivered benefit to the lake.



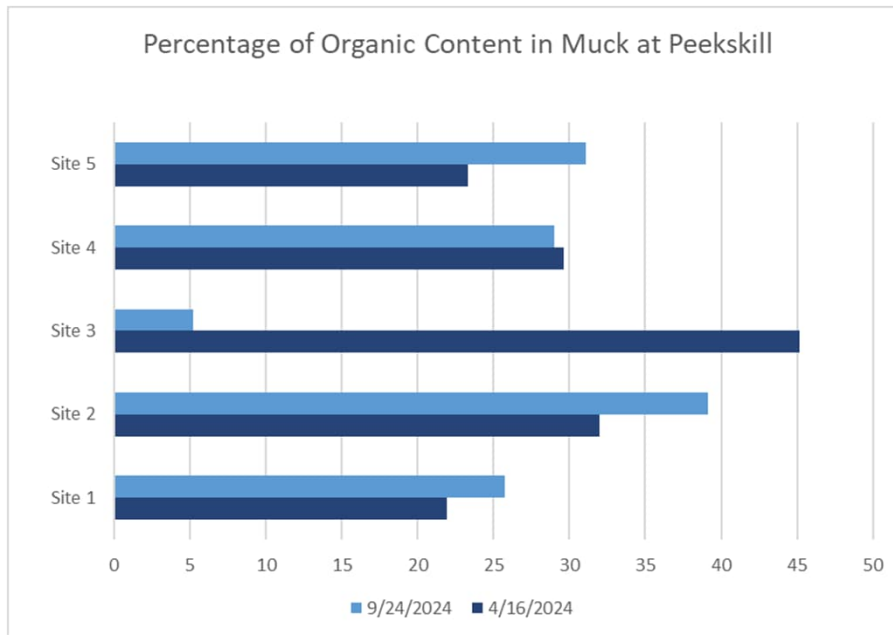
Lake Peekskill – Organic Percentage of Muck



The percentage of organic content within the muck increased in all sites except for Sites 3 and 4. Please note that at the end of the season, peat moss came up from the bottom, so theoretically it was at Site 3 location and towards Site 4.



Sediment Analysis for Lake Peckskill



The Good News

On average the percent organic content (fertility) for Lake Peckskill is on average lower than what is typical for lakes in highly developed areas.

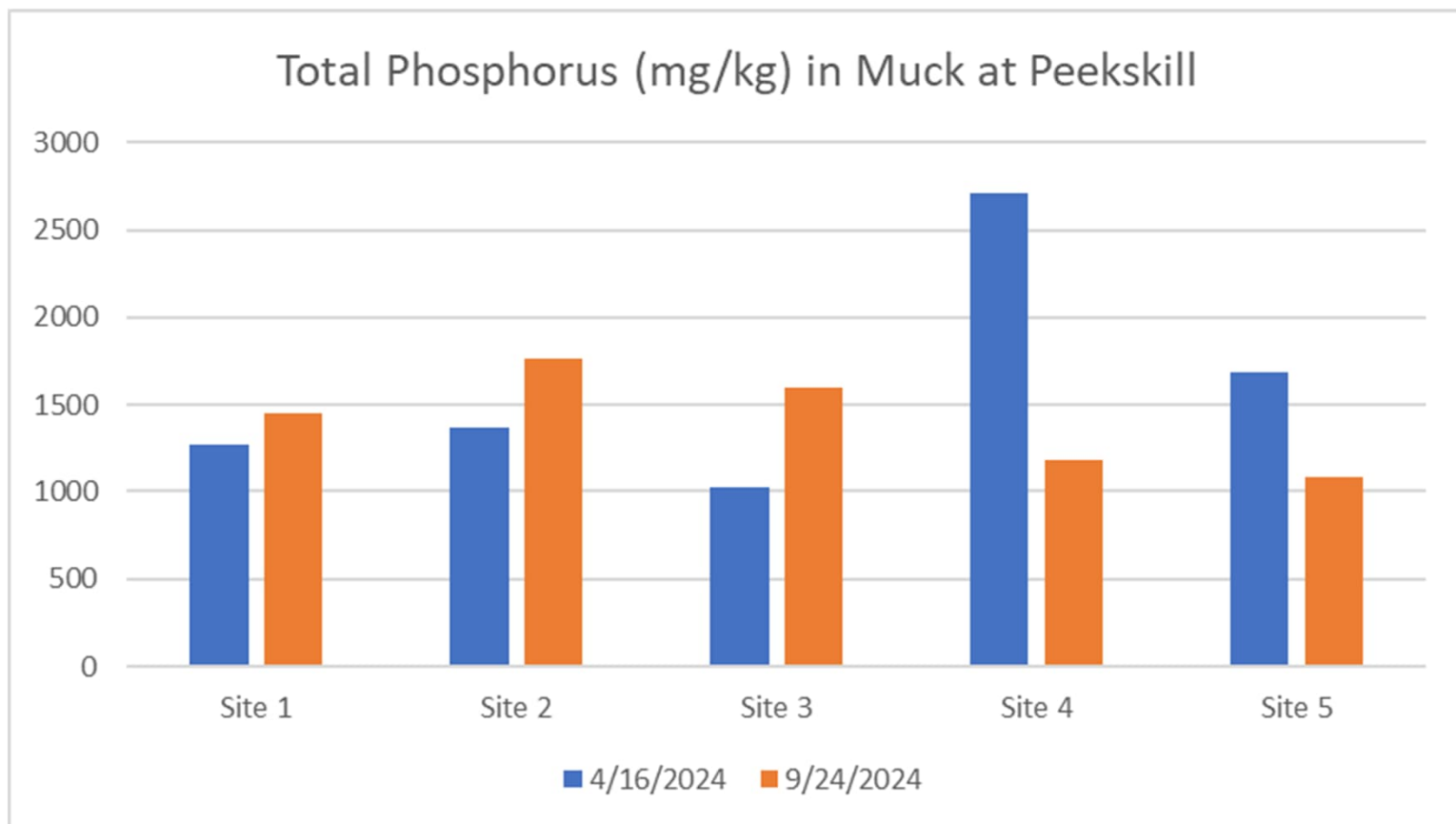
The Bad News

On average percent organic increased through the season. This could be due to on-going inputs from the water shed, by also could be from a redistribution of the organic sediment that surfaced as tussocks or peat islands.

The bottom-line is that further improvement is needed with target to get all sites below 20% organic to reduce a critical food source for the undesirable blue-green algae.



Lake Peekskill – Total Phosphorus Muck

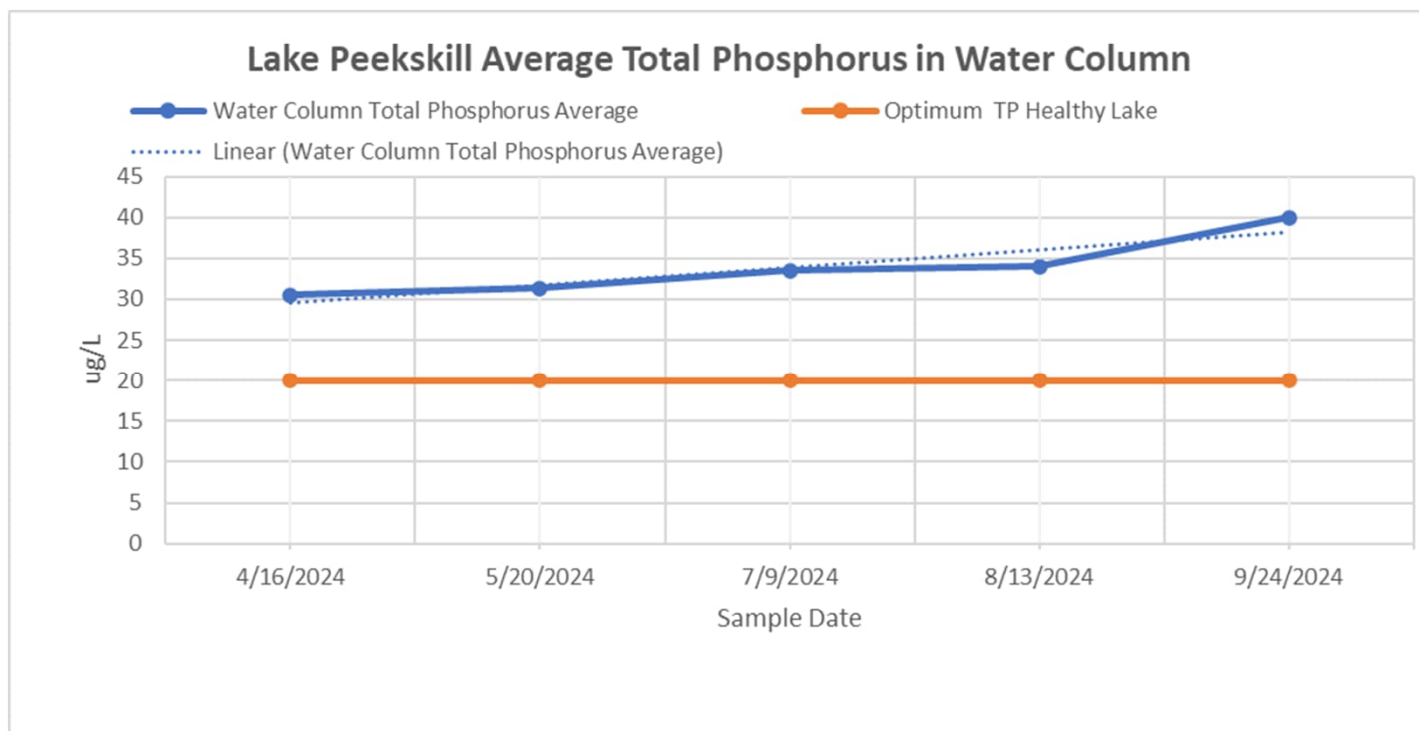


The total phosphorus within the muck increased within 3 of the 5 sites from the initial sample. Site 4 and Site 5 had a reduction in the organic content.

It is likely that there was a redistribution of sediment phosphorus as a result of the surfacing of the tussocks from the lake-bottom. However, except for Site 4, these sediment phosphorus levels are slightly lower than what is typical for highly developed lakes with similar land use as Lake Peekskill.



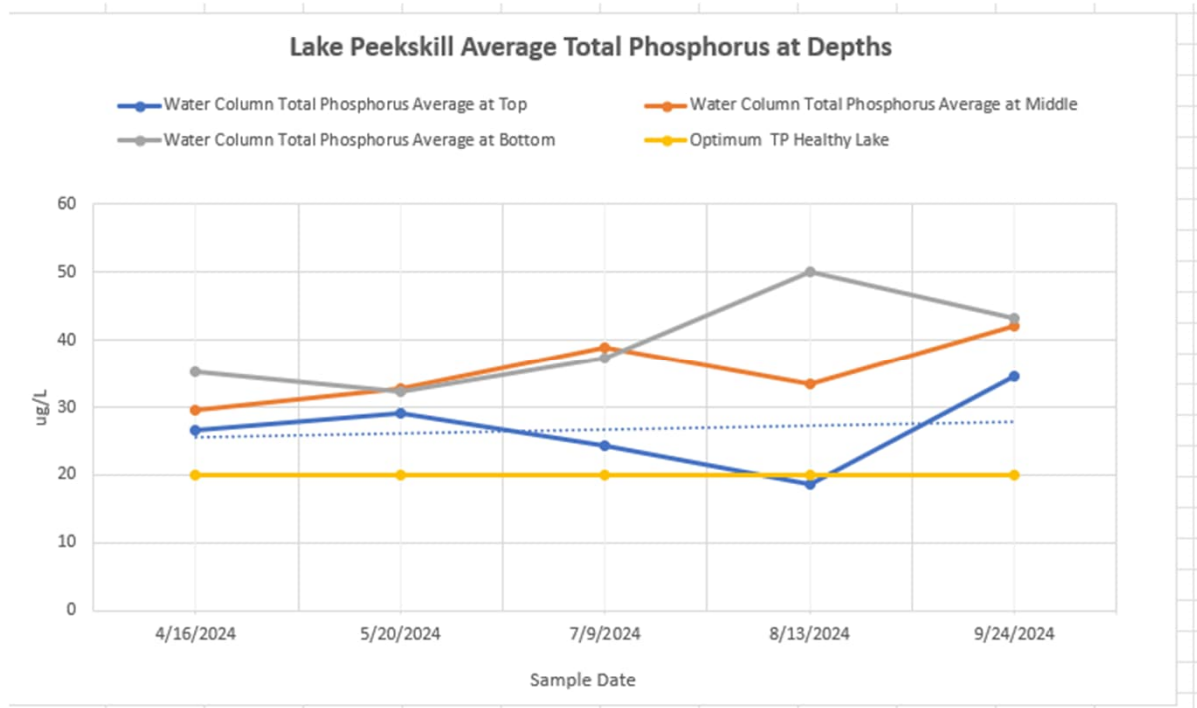
Lake Peekskill - Total Phosphorus



Excess phosphorous in the waterway will cause algae and aquatic plants to grow uncontrollably resulting in decreased dissolved oxygen. Algae blooms can be triggered with levels of total phosphorous greater than 20 micrograms per liter, but generally 30 micrograms per liter or more is the threshold for having a high risk for harmful algal blooms.

At Lake Peekskill in 2024, all visits had higher than optimum total phosphorus levels. Sampling Sites 1 and 2 overall were higher than Site 4, with the highest values being at middle and bottom depths. The highest reading at Site 1 was at the bottom water column in August with a value of 58 ug/L. Likewise, Site 2 had the highest reading at the bottom in August with a value of 59 ug/L. Site 4 was always above optimum levels, but the highest value was in September at the bottom water column at 39 ug/L.

The highest average reading was 40 micrograms per liter in September, which is 2x higher than the optimum level.



Assessing Phosphorus changes with depth provides the most important insights into why Lake Peekskill remains under continual risk for harmful algal blooms.

Phosphorus is significantly higher at the lake bottom than at the surface and higher than the middle of the water column for most of the season. Since the aeration system is keeping the lake well oxygenated all the way to the bottom, it is highly unlikely that the elevated phosphorus at depth is due to chemical release from sediments which only happens when the bottom is out of oxygen.

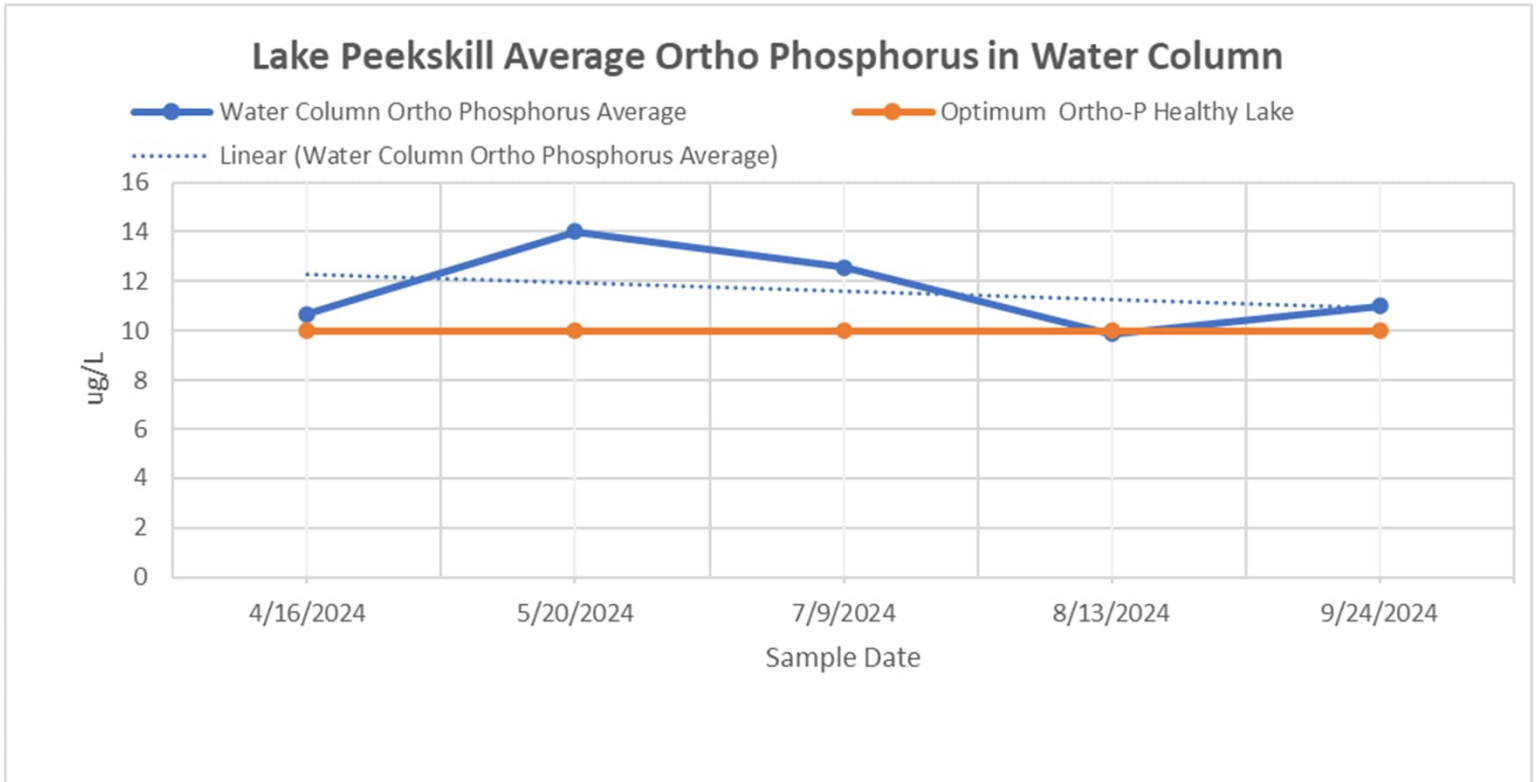
It is much more likely that the elevated phosphorus is from ground water seepage (septic systems) and watershed loading events where colder, phosphorus rich stormwater flows with some velocity into the lake. Because the rainwater is colder than the water in the lake it is heavier and will tend to sink and flow along the bottom of the lake rather than spread out along the surface.

While these are not easy problems to fix, it is important that the plan moving forward takes these problems into account and educates members of the lake community on why Lake Peekskill is still struggling with water quality issues despite the investments that have already been made.

The key message is to avoid “throwing out the baby with the bath water” on aeration and the current watershed efforts looking for the next “magic bullet” fix. The reality is that there is no magic bullet out there and the investments that have been made are taking the lake in the right direction. We need to get there faster and go farther.



Lake Peekskill - Ortho Phosphorus

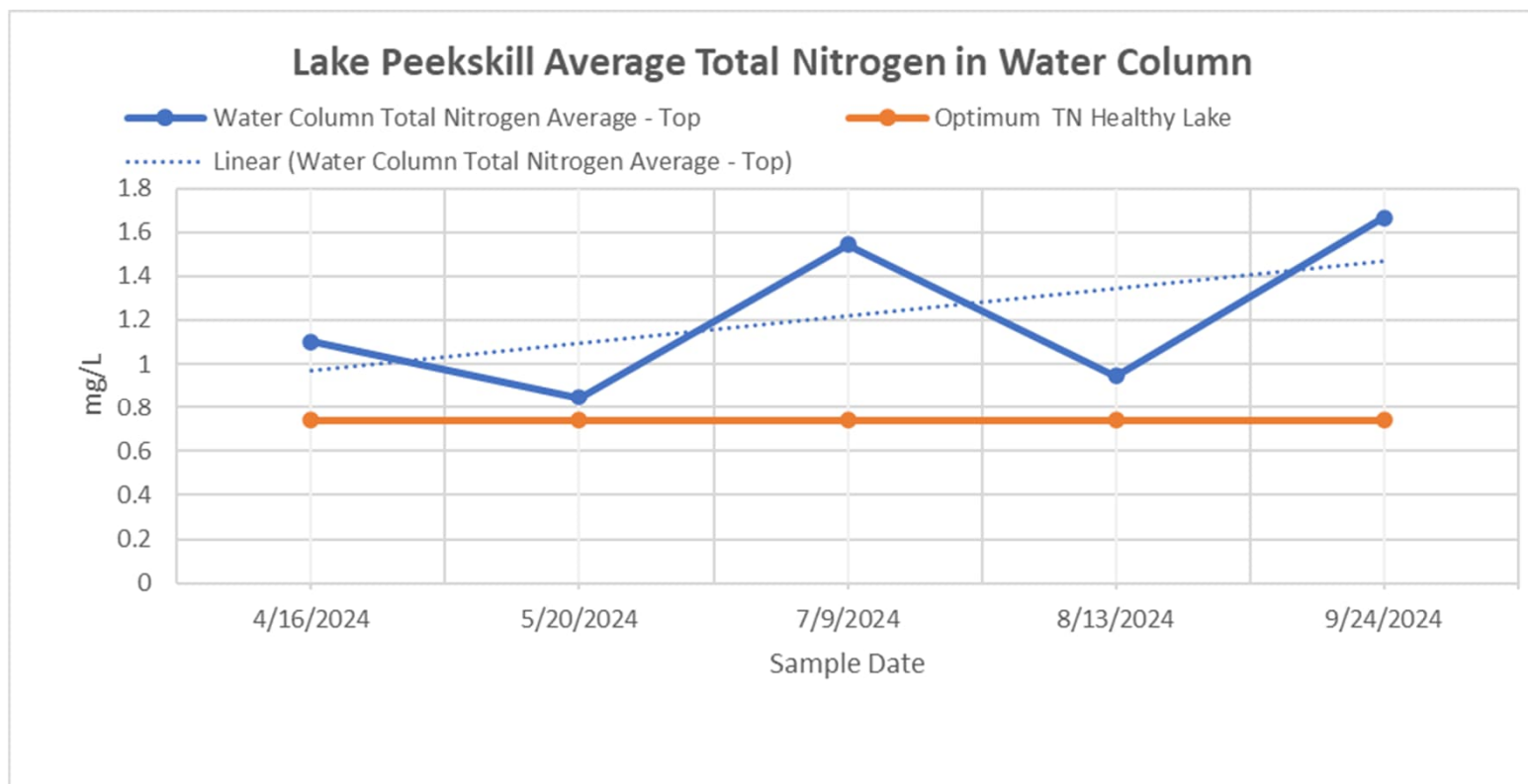


The ortho phosphorus or soluble reactive phosphorus is the form of phosphorus that is immediately biologically available for additional algal growth to utilize. An ortho phosphorus level of 10 micrograms per liter or less is considered optimal for a healthy lake. In 2024, all sampling sites were similar in value.

The ortho phosphorus was at or above the optimal level during all the visits with the highest average being 14 ug/L in May. Generally, the ortho phosphorus was consistent throughout the water column but the highest values were found at the surface and the bottom.



Lake Peekskill – Nitrogen



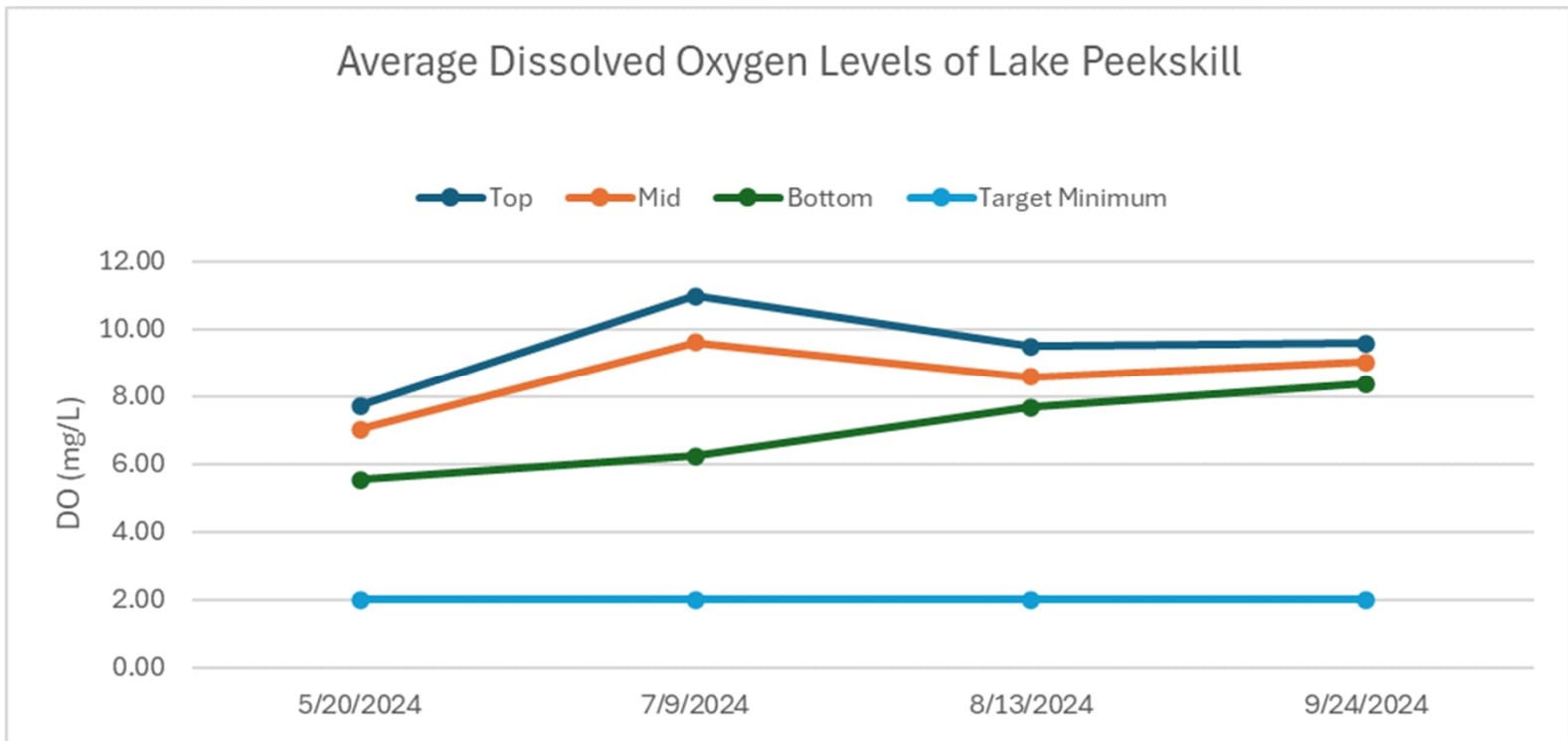
Nitrogen is the second most important nutrient within a lake for plant and algal growth. Nitrogen can increase due to runoff, decomposition and even some blue-green algae is capable of “fixing” atmospheric nitrogen into the water column.. At Lake Peekskill, the total nitrogen (which includes nitrite, nitrate, organic nitrogen and ammonia) had various spikes throughout the season but was always above the optimum level.

Nitrite levels in healthy lakes are less than 1 mg/L. From the analysis, all nitrite levels were unremarkable and not elevated.

The nitrate levels did fluctuate throughout the season like the total nitrogen (which can be part of the reason for the peaks there). Levels of nitrate should be below 0.5 mg/L within a healthy lake, but if decomposition is occurring, there will be typically higher values at the lake bottom. The nitrate was elevated in the bottom water column during the visits. In August, the nitrate was analyzed at 0.7 mg/L at the surface in Site S4. There was also elevations in the nitrate levels in the middle depths in July and August at Site S1.



Lake Peekskill – Dissolved Oxygen



With the aeration system, the average dissolved oxygen levels remained high throughout the sampling period. However, in Sampling Point 2, the dissolved oxygen level did dip slightly below 4 mg/L at the bottom in May but increased and remained between 5.13 mg/L – 7.9 mg/L for the remainder of our in-situ sampling dates.

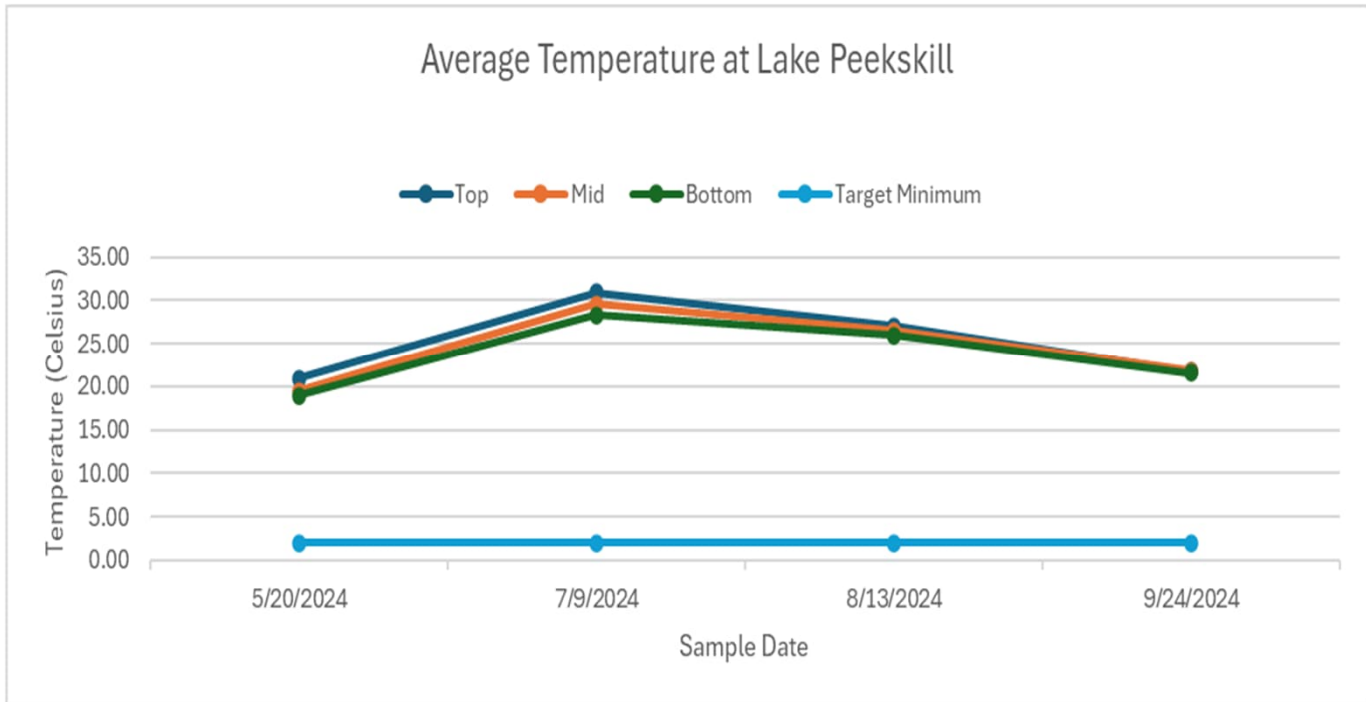
This data confirms that the aeration system is adequately designed, operated effectively in 2024 and is delivering the benefits expected from this management method.

Because the lake experienced serious, detrimental bloom conditions in 2024, it remains clear that additional management methods are needed to reduce/eliminate harmful algal blooms moving forward.

Unfortunately, the peroxide-based algaecide treatments applied to mitigate active blooms did not deliver the desired results in 2024. Other management strategies in conjunction with aeration should be evaluated for 2025.



Lake Peekskill – Temperature



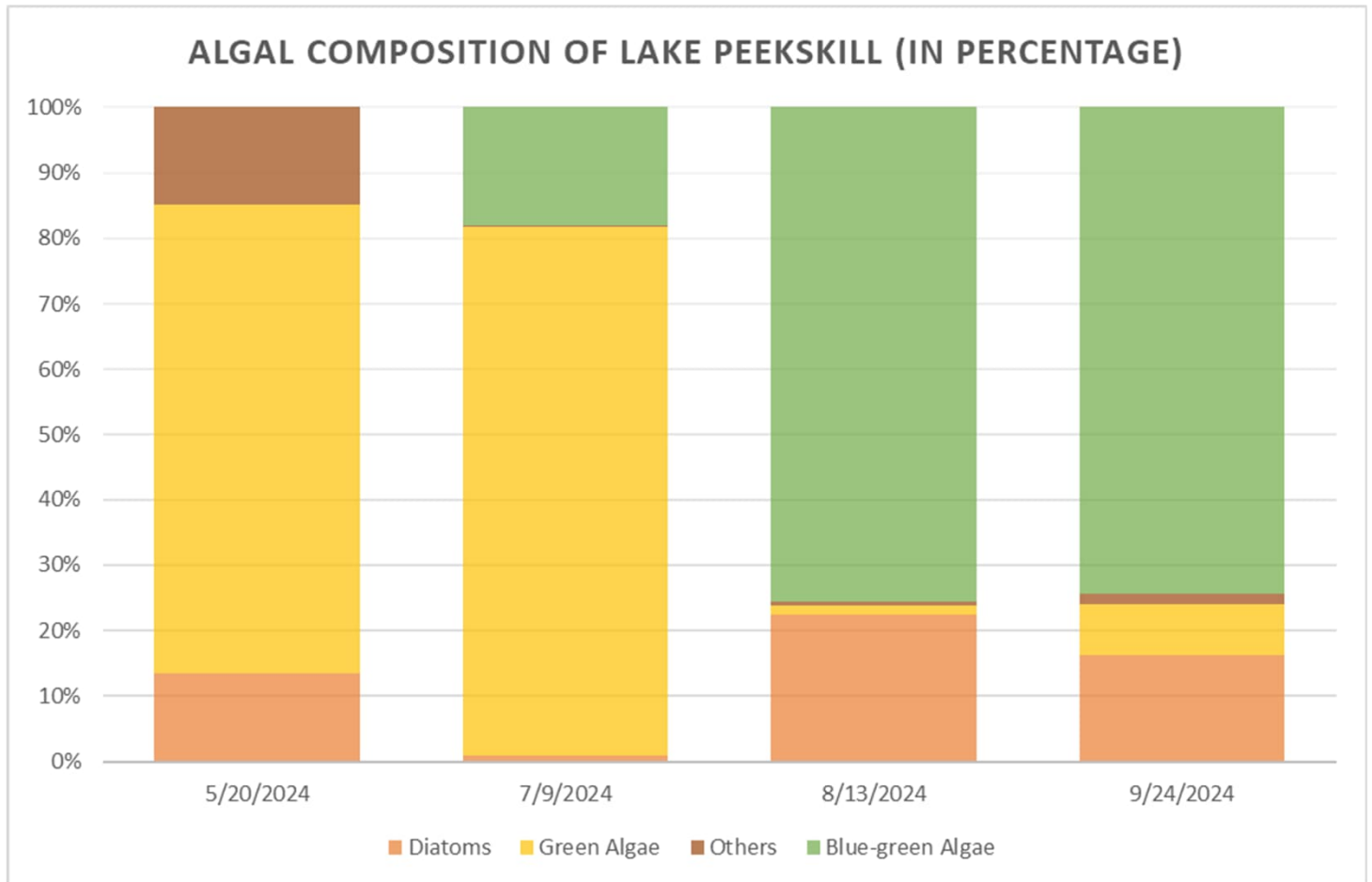
The temperature on average didn't fluctuate too significantly for the top, middle, and bottom depths. This is indicative that thermal stratification is not occurring at Lake Peekskill during the sampling period.

This is expected and confirms that the aeration system is adequately designed and operated effectively in 2024.

Surface water temperatures exceeded 86 degrees on the 7/9 sampling date providing near perfect growing conditions for blue-green algae. This enabled blue-green algae to dominate the ecosystem and despite aggressive aeration and treatment, it was not enough to regain control of the algae in 2024.



Lake Peekskill – Algal Composition



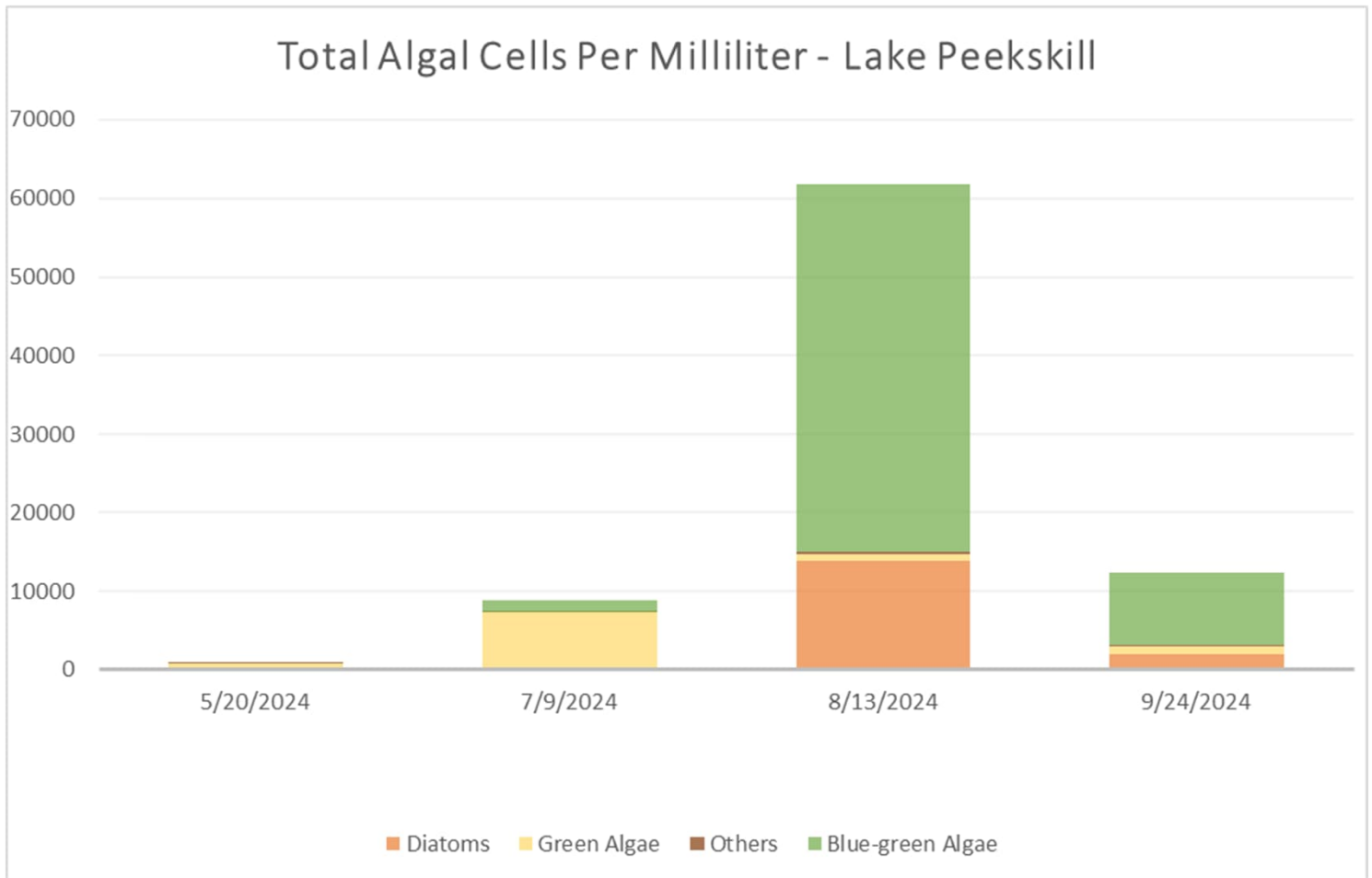
Initially green algae was the dominant species but by August, blue-green algae was fully dominant and remained that way through September to the end of the season.

We suspect that the shift was already well under way during and shortly after the July 9 sampling event and correlated with excessive warm water conditions measured on the July 9 sampling event creating the perfect environment for blue-green algae to take over.

Please note that besides July, diatoms remained around 20% of the phytoplankton composition.



Lake Peekskill – Total Cell Count

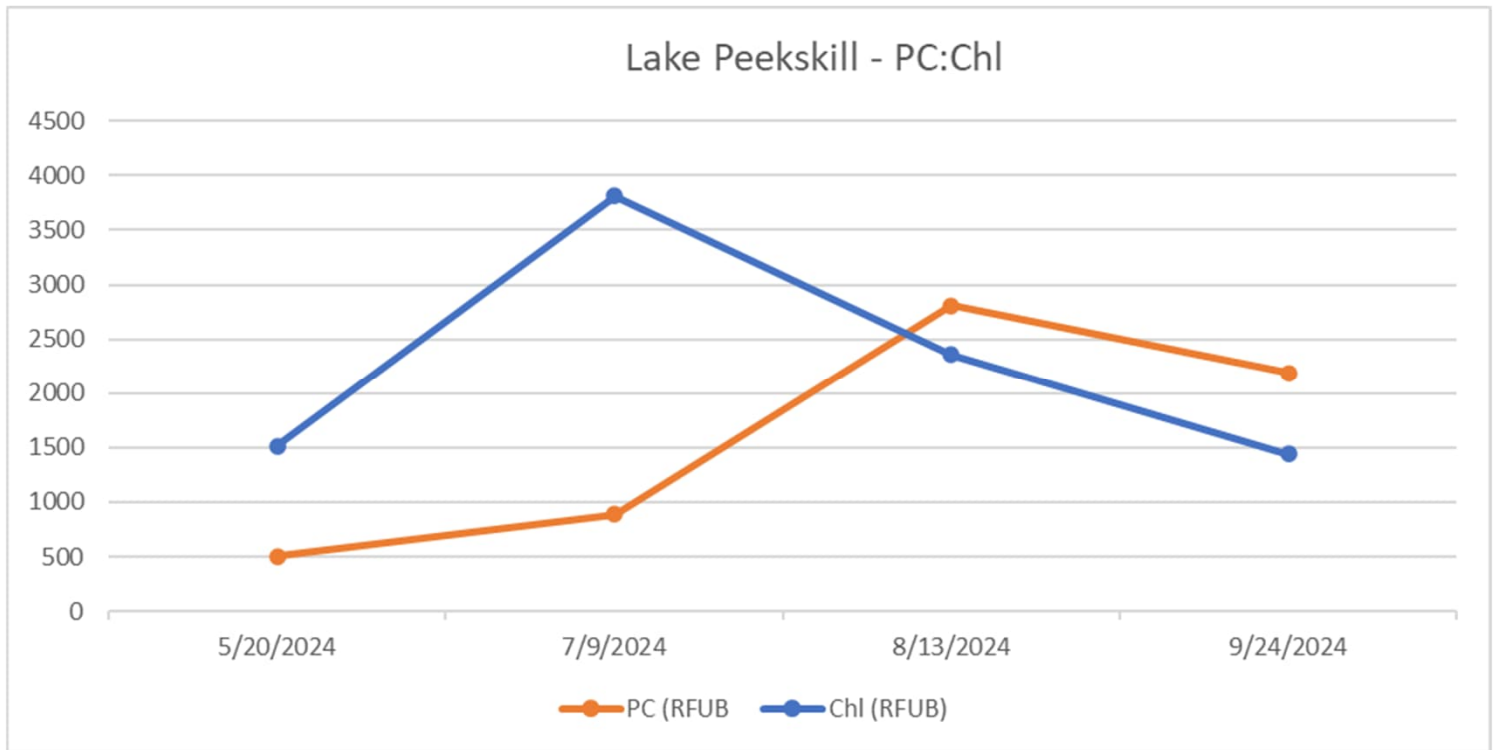


Lake Peekskill's total cell count became the highest recorded in August with a total cell count of 61,828 cells/ml with 46,742 cells/ml being blue-green algae. WHO recommends an advisory be posted when blue-green cell counts are above 20,000 cells/ml. By September, the cell counts were lower with only 9,173 cells/ml being blue-green algae.

A key lesson learned in 2024 is that once the lake shifts to blue-green algae dominance, it is very difficult to get it back.



Lake Peekskill – PC and Chlorophyll



The higher the chlorophyll values within a lake/pond, then the higher the chances of algae and vegetation are present. The PC:Chl ratio helps determine how significant a blue-green algae bloom is happening, with a lower ratio equaling a lower blue-green algae value. So, as shown on the graph, the PC line is above the Chl line in August and September, which is when the most severe blue-green algal blooms were occurring.



Lake Peekskill 2024 Discussion

The results of the CiBiobase Sonar Scanning Technology showed that Lake Peekskill ranges in depth from 2-4 feet around the perimeter and has a deep basin with a depth of 23 plus feet. As is typical in a lake with a deep basin, primarily the aquatic vegetative is seen in the shallower depths where the sunlight can penetrate the bottom, promoting photosynthesis. This is also shown on the CiBiobase Biovolume Sonar map. As noted, the aquatic plant community is healthy and in balance and lake-bottom sediment and phosphorus is lower than expected for a highly developed lake with the land-use pattern around Lake Peekskill.

All the nutrient levels were elevated throughout the season at Lake Peekskill: the total phosphorus, ortho-phosphorus and total nitrogen. Elevated nutrient levels and warm water temperatures provide the ideal environment for harmful algal blooms. As seen and discussed, the highest level of nutrients were found at the bottom of the water column, suggesting internal loading. External loading is evident when the total phosphorus is elevated at the surface after rainfall events.

The dissolved oxygen level remained above the minimum amount and the temperature readings did not show that thermal stratification was occurring. Typically, with higher dissolved oxygen levels at the bottom water column, chemical internal loading is minimized. We are confident that the aeration system is achieving this objective.

However, internal loading from groundwater filtration can elevate bottom phosphorus and nitrogen and provide a source of food for algae growth. Septic leach fields is the most likely source of the elevated phosphorus and nitrogen at the bottom.

Mitigating the impacts of groundwater infiltration and watershed loading remain the top two priorities for improvement for the lake.

Towards the end of the season, peat rose from the bottom of the lake, presumably at/near Site 3, which shows a drastic decrease in the amount of organic content within the lake. This “bottom shift” is important and is a further sign that the aeration system is working on the bottom of the lake. However, these events understandably cause concern among community members. Efforts were made by EverBlue Lakes and the Town to remove the floating organic material. This effort was moderately successful but should be revisited this Spring if visible organics remain at the surface.

Blue-green algal blooms remain the biggest concern at Lake Peekskill, as the cell counts were at advisory level in August. By reducing the nutrient load and by minimizing the amount of external and internal loading, as well as decreasing the amount of muck then there should be reductions in the amount of blue-green algal blooms.



Recommendations for 2025

Monitoring

- Water Quality and sediment monitoring should be continued in 2025. Cost is the same as 2024.
- It would be useful to work with interested community member(s) to collect stormwater samples during or just after a moderate to heavy rain event to assess stormwater for phosphorus and nitrogen levels. EverBlue can supply sample bottles and training/instruction. We can add this service to the monitoring for just the cost of processing the samples at \$90 per sample.

Aeration System Maintenance

- We recommend continuation of the maintenance program for the aeration system. Cost is the same as 2024.

Treatment

We recommend the following treatment program for Lake Peekskill in 2025:

- Peroxide-Based Algaecide Treatment – While this strategy was not as successful as we expected in 2024. It remains the best mitigating approach to stopping blue-green algae blooms in the short term. New research has shown that earlier application of this treatment can reduce the blue-green algae spores that reside at the lake bottom and prevent their activation and development into active blue-green algae blooms. We can develop the plan and cost for this treatment effort for Lake Peekskill. Costs will be similar to 2024. However, unlike in 2024, we will not continue to use this treatment if blooms start to get out of control. We will use this treatment more strategically to prevent the development of bloom conditions.

Recommendations for 2025

Treatment (*Continued*)

- Pilot Testing of Storm Drain Inserts – EverBlue has identified a promising technology for improving stormwater filtration from road drains. The Technology is low cost and easy to install.

The cost per basin is \$600 - \$800 per basin for the complete system depending on basin size and configuration. We recommend targeting 2 – 3 basins to start as a pilot test.

1. Catch Basin Insert



2. Catch Basin Filter Cover with insert in basin



3. Catch Basin Filter Cover with overflow protection with insert in basin





Recommendations for 2025

Treatment (Continued)

- Biological Treatment for Lake Peekskill EverBlue has worked for more than a year with the NY DEC to develop a permit process for the Biological Treatment Process for lakes. This effort has paid off. The NY DEC has completed the effort to develop a permitting process.

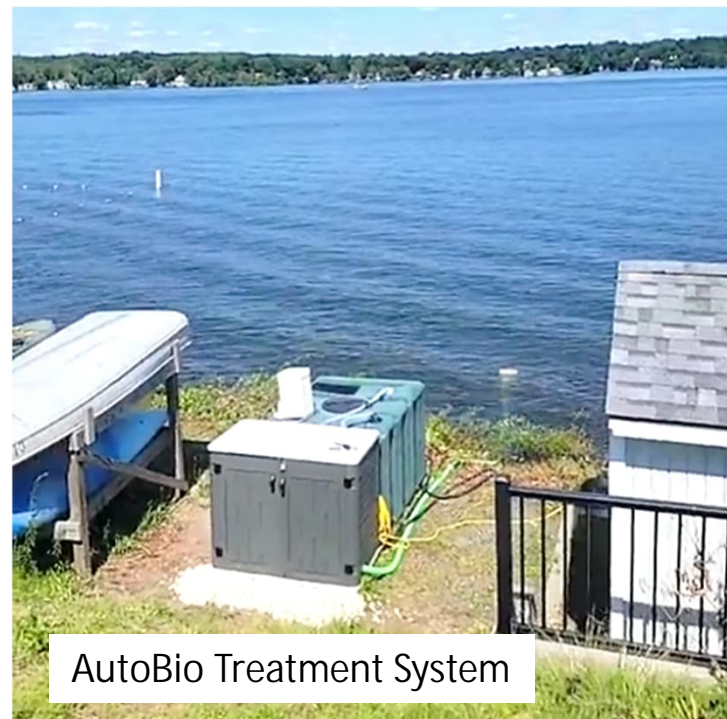
At this time EverBlue Lakes Simple Water Solutions, New York Formulation is the only Biological Treatment Formulation that has been thoroughly reviewed by the NY DEC. While the new permit process does not guarantee that a permit will be issued, EverBlue Lakes is in the best position to obtain permit approval from the State because of our efforts over the last year.

The permit process is NOT easy or fast and will require the completion of a Wetlands Permit, SEQOR Permit and WTC permit.

The good news is that EverBlue Lakes AutoBio Technology has also been reviewed and favorably regarded by the NY DEC.

We recommend starting the permitting process this Spring for the implementation of EverBlue Lakes AutoBio Systems for Lake Peekskill.

EverBlue Lakes can develop a plan and proposal for the Biological Treatment for Lake Peekskill and assist in the permit process.



AutoBio Treatment System