AQUATIC ECOSYSTEM RESEARCH
A Freshwater Conservation Company

MEMO

Date: August 19, 2022

To: Ball Pond Advisory Commission

From: Aquatic Ecosystem Research

Re: Results of Lake and Cyanobacteria Monitoring of August 19, 2022

Dear BPAC Members:

On Wednesday, August 17th, AER visited Ball Pond to conduct monthly water quality monitoring and cyanobacteria monitoring as part of the 2022 lake management program. On-the-water transportation was graciously provided by George Buck. Water column profile data, total depth measurements, Secchi transparency data, and water samples were collected from a deep water site centrally located in the lake (N 41.46289959 W -73.52354861).

Sample collections, preparations, and analyses, as described in our April 25th memo, were followed.

Cyanobacteria and Algae Community

The cyanobacteria cell concentration in the sample collected on August 17th from the top three meters of the water column was only 727 cells/mL, and lowest of the season. The cell concentration was characteristic of Visual Rank Category 1 conditions. Connecticut's Visual Rank Category system characterizes conditions from Category 1 (good conditions) to Category 3 (conditions that present great enough health risk to warrant beach closure signage; CT DPH & CT DEEP 2021). The relative abundance of cyanobacteria

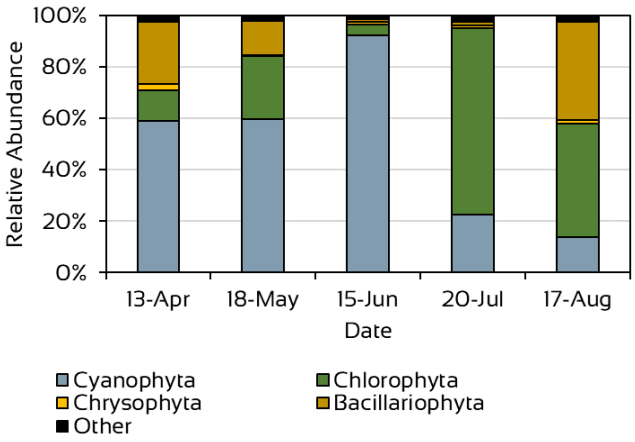

Figure 1. Relative abundance (%) of the important taxa in the Ball Pond samples collected in 2022.

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continued to decrease from approximate 92% of all cells counted on June 15th, to 22% on July 20th, to 14% on August 17th (Fig. 1). The most abundant cyanobacteria genus was *Aphanizomenon spp*. Others from the counts or observed in the plankton net samples included *Aphanocapsa spp*., *Chroococcus spp*., *Dolichospermum spp*., *Lyngbya spp*., and *Microcystis spp*.

During the field data collection, the relative phycocyanin concentrations were measured throughout the water column (Fig. 2). Phycocyanin is the auxiliary photosynthetic pigment unique to the cyanobacteria, and therefore a good surrogate of relative cyanobacteria biomass. Levels in the top three meters of the water column were the lowest of the season, and corroborated the low cyanobacteria cell counts.

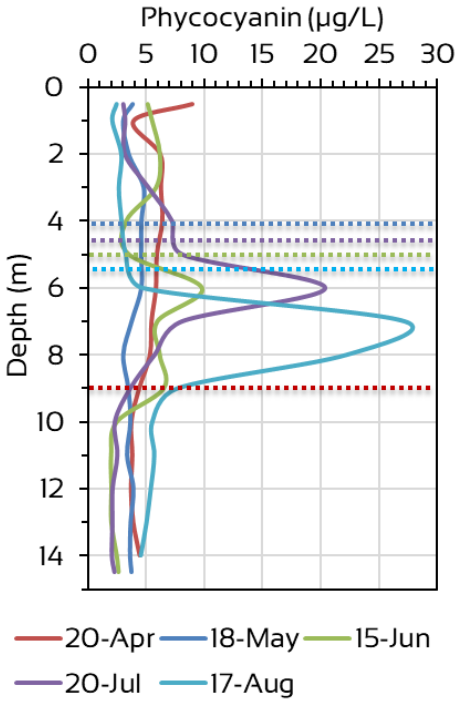

Figure 2. Profiles of relative phycocyanin concentrations throughout the water column of the deep-water site of Ball Pond in 2022. Dotted lines represent the position of the thermocline and correspond to the phycocyanin profiles by color.

The maximum relative phycocyanin concentrations on August 17th were observed at 7 and 8 meters of depth. These depths corresponded with the lower boundary of the metalimnetic layer. A similar maximum was observed on July 20th but was not as prominent as that observed on August 17th (Fig. 2).

In response to the observation, a water sample was collected at 7 meters of depth and analyzed with microscopy. Nearly all of the cyanobacteria observed from that sample was from the genus *Planktothrix* (formerly *Oscillatoria*; Fig. 3). There are some species of *Planktothrix*, e.g., *Planktothrix rubescens*, that are renowned for forming high concentrations at lower depth, near or below the thermocline. Their ability to regulate buoyancy provides the means to maintain a position at depth in the water column. Their photosynthetic pigments provide the means to photosynthesize at these depths – whereas other algae cannot – and at those depths they can take advantage of high phosphorus concentrations building up in the hypolimnion of the lake.

Chlorophyta (aka green algae) and Bacillariophyta (aka diatoms) were the most abundant taxa in the samples collected near the surface. The taxon with greatest richness (number of genera) were the Chlorophyta as is often the case in lakes in the Northeast. A very small centric diatom, *Cyclotella spp*., was the most abundant organism in the algae counts.

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Figure 3. Filaments of *Planktothrix spp*. collected at 7 meters of depth at the deep-water site on Ball Pond on August 17, 2022. Total magnification is 100X in the image on the left, and 400X in the image on the right.

Temperature and Oxygen Conditions

As noted above, the water column was stratified with the thermocline detected between 5 and 6 meters of depth and with strong resistance to mixing. Surface water temperatures of 24 and 25°F (75 to 77°F) were lower than those observed on July 20th. Temperature rapidly decreased with depth and were <10°C (50°F) from 8 meters of depth to the bottom. Oxygen concentrations between 7 and 8 mg/L in the first three meters of the water column began to decreased precipitously by 4 meters of depth; concentrations of <1 mg/L were measured from 6 meters of depth to the bottom.

The water sample collected at 14 meters of depth had a clear sulfide odor to it. This indicated that oxygen had been depleted for a protracted period of time and that compounds other than oxygen (e.g., sulfates) were being utilized for cellular respiration. This is a clear indication of phosphorus release and build up in the waters above the sediment.

Table 1. Site characteristics and cyanobacteria cell concentrations at deep water site at Ball Pond on August 17, 2022.

Site	Cyanobacteria cells (cells/mL)	Total Depth (m)	Secchi Transparency (m)	Temperature Top/Bottom (°C)	Oxygen Top/Bottom (mg/L)
Deep-Water Site	727	14.7	2.91	25.1 / 7.5	7.4 / 0.0

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August 17th Secchi disk transparency (water clarity) was the greatest of the season at 2.91 meters, which was almost 1 meter greater than that measured on July 20th (2.02 meters). This measurement also corroborated the low cell concentrations described above.

August 14th Observations of Cyanobacteria

On August 14th, AER conducted a quantitative aquatic plant survey. Much of the littoral zone (area receiving enough sunlight to support plant growth) did not have plants growing. However, filamentous algae were observed growing throughout much of the littoral zone and even deeper. A sample of the filamentous growth was collected on August 14th and examined with microscopy. The dominant algae identified was the filamentous cyanobacteria *Lyngbya spp.* (Fig. 4). The filamentous green algae, Spirogyra spp., was also observed but was not nearly as abundant. Some species of *Lyngbya* have been characterized as potentially toxigenic (CT DPH & CT DEEP 2021). A full report on findings from the plant survey is forthcoming.

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Literature Cited

Connecticut Department of Public Health and Connecticut Department of Energy and Environmental Protection. 2021. Guidance to Local Health Departments for Blue–Green Algae Blooms in Recreational Freshwaters. See https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/environmental_health/BEACH/2021/Guidance-to-LHD-for-Blue-Green-AlgaeBlooms_June2021_FINAL.pdf

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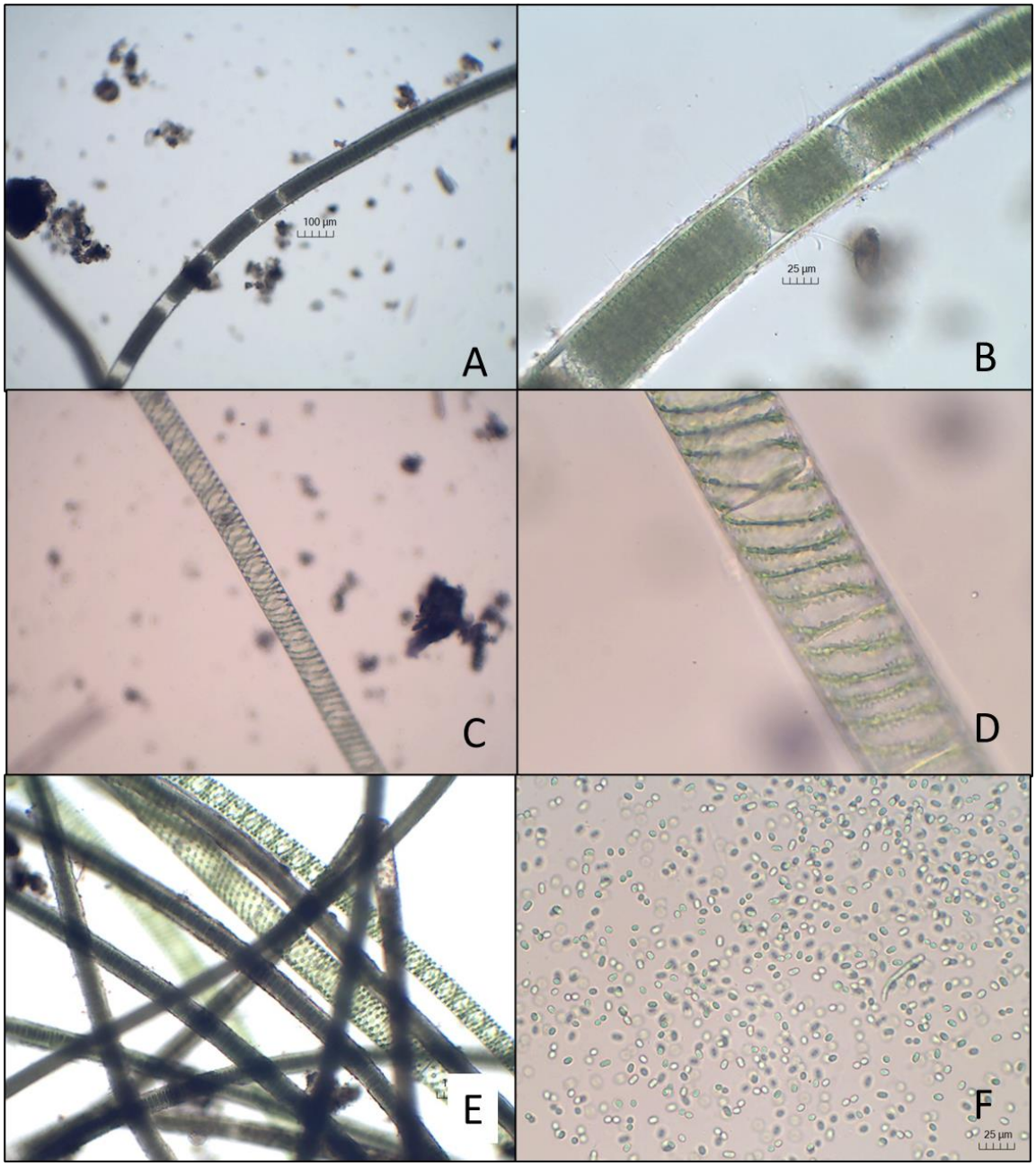

Figure 4. Micrographs of algal specimens collected from Ball Pond on August 14, 2022. A) the Cyanophyte *Lyngbya spp*. (total mag 100X); B) *Lyngbya spp*. (total mag. 400X); C) the Chlorophyte *Spirogyra spp*. (total mag. 100X); D) *Spirogyra spp*. (total mag. 100X); E) mix of *Lyngbya spp*. and *Spirogyra spp*. (total mag. 100X); F) the Cyanophyte *Aphanothece spp*. (total mag. 400X).

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