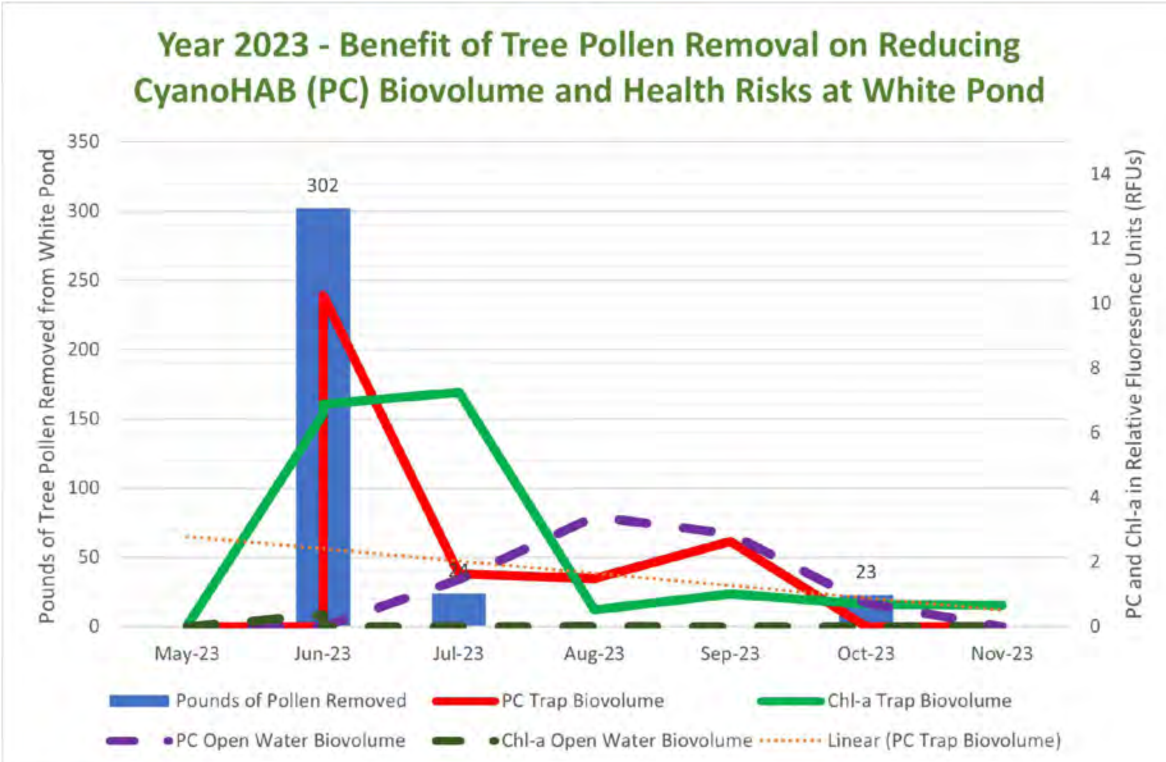
YEAR 2023 SUMMARY REPORT
RESTORATION OF WHITE POND'S WATER QUALITY

RESTORATION METHOD: PASSIVE HARVESTING, SUSTAINABLE REMOVAL AND COMPOSTING OF 'CYANOHABS' AND TREE POLLEN USING THE A-POD TECHNOLOGY (U.S. Patent No. 10,745,879)



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HEA

TABLE OF CONTENTS

ATTACHMENTS

1 .0 INTRODUCTION

This report serves to summarize Higgins Environmental Associates, Inc. (HEA's) activities, data and findings for ecological restoration services completed in 2023 at White Pond in Concord, Massachusetts. This work was completed by HEA under contract to the Town of Concord, in accordance with HEA's Proposal No. 10220C dated April 19, 2023.

Ecological restoration activities since the Fall of 2021 focused on improving water quality and controlling health risks to people, pets and wildlife posed by potentially toxic (PTOX) cyanobacteria, also referred to by some as harmful algae blooms (HABs); collectively "cyanoHABs" for the purpose of this report.

In 2021 to 2022, the dominant (85-90%) cyanoHABs were either *Microcystis* sp. or *Dolichospermum* sp. These are both gas vacuolate cyanoHAB species that can regulate their own buoyancy, move up and down in the water column to obtain nutrients from sediments or deeper waters. They can occupy shallower waters than other cyanobacteria species and often create scums and dense accumulations (*i.e*., blooms) in water bodies. Over 50 percent of the biomass (388.5 dry to moist pounds) of the dominant, toxic forms of cyanoHABs were removed from the pond from October 2021 through October 2022 by passive harvesting and permanent removal from the pond using the A-Pod technology (U.S. Patent No. 10,745,879). These cyanoHABs were then biodegraded on land in a controlled manner.

In 2023, HEA documented that cyanoHABs were no longer the dominant form of cyanobacteria but early in the season (late May to June), HEA documented that *Microcystis* sp. was beginning to actively colonize on tree pollen (as a nutrient substrate) that was falling on the pond surface. This tree pollen to cyanoHAB conversion rate was fast enough to be visually observable. As such, 2023 use of the A-Pod technology focused on passive harvesting and removal of primarily tree pollen and lesser amounts of similar forest particulates as A-Pod trap residue suspended solids (collectively "tree pollen") on and within waters of White Pond. Removal of this early-season, external, terrestrial nutrient source (tree pollen) using the A-Pods in sentinel-mode, likely kept the previously dominant forms of cyanoHABs from recurring (*i.e*., being the dominant specie) in 2023.

Based on vertical water quality profile sampling and laboratory analysis for phytoplankton in September 2023, the PTOX cyanoHABs *Microcystis* and *Dolichospermum* were no longer dominant or present and phytoplankton species were diverse and dominated by green algae (8-30 feet) and cryptophytes (at depth, 50 feet) with lessor biovolume and diverse species of cyanobacteria.

In 2023, water clarity remained improved at a median depth of 24.2 feet (same as year 2022) and approximately 5 feet better (deeper) than the historic, 30-year median (1987-2017) of 19.6 feet. Dissolved oxygen content of water also improved in 2023 compared to all historic dissolved oxygen profile data to date (since 1987) likely due to increases in water clarity, and oxygenic (*i.e*, oxygen producing) phytoplankton (to 50 feet) plus the healthy presence of the "benthic meadows" of benthic oxygenic macroalgae, *Nitella* documented in HEA's 2022 report as well as by USGS (2001) at Walden Pond.

In 2023, a total of 349 dry to moist U.S. pounds of tree pollen were harvested and removed from White Pond using the A-Pods. Nutrient content of the tree pollen was very similar to cyanoHAB solids previously removed (388.5 pounds) from 2021-2022. Based on field vertical sonde measurements and laboratory analysis, water quality of White Pond has notably improved compared to historical data (1949 through 2021) and approximates Walden Pond in terms of sonde data and water clarity (water samples for laboratory analysis were not obtained from Walden, our 2023 reference location for work at White Pond). The zooplankton population (diversity and biomass) was visually greater (more than twice the apparent biomass) at White Pond compared to Walden which in 2023 was experiencing a bloom of the invasive, fresh water jellyfish called "Peach Blossom". HEA has not observed or read reports/records of this jellyfish specie being present at White Pond but it is present in fresh water bodies throughout North America including within New England and New York.

Importantly, HEA's water and biotic quality assessments in 2023 have documented a sustainable improvement of White Pond's biologic integrity (314 CMR 4.000 - Massachusetts Surface Water Quality Standards), compared to historical data (1987-2021), by passively harvesting and removing previously dominant cyanoHABs then tree pollen using the A-Pods.

This 2023 Report serves to supplement prior work and findings in years 2021 and 2022 including monthly sonde vertical profile assessment of nearby Walden Pond in 2023 as a comparative reference location to assessments at White Pond.

Note: At times, this report refers to potentially toxic forms of cyanobacteria as either "PTOX cyanobacteria" or as "cyanoHABS". In this report, HEA will also use the term "cyanobacteria" when referring to non-PTOX forms of cyanobacteria and for discussion of multi-parameter sonde data, the acronym BGA-PC ('blue green algae-phycocyanin) or just PC. In 2023, HEA included a new sonde probe to assess for chlorophyll-a (Chl-a) content which is a measure of the photosynthetic pigment chlorophyll-a contained in most all phytoplankton. Based on HEA's 2023 assessments, Chl-a is present in tree pollen as well.

To assist in HEA's evaluation and for the benefit of Concord, HEA has also included some information from both a National Science Foundation (NSF) grant completed by HEA in 2021 and 2022 and, in 2023, from HEA's ongoing lake science and restoration research (sampling and laboratory analysis for phytoplankton biomass and biovolume samples collected from 8-30 feet and at 50 feet in White Pond). The remainder of this report is broken down by section to aid the reader in understanding work completed and results achieved in 2023 compared to historical results from White Pond and as a current (2023) reference site to Walden Pond. HEA has also included charts and photographs within this report text to help the reader understand the work and findings at White Pond.

1.1 Historic CyanoHAB Impacts on Surface Water Quality of White Pond

Historical water quality information including presence/absence of cyanoHAB scums and water clarity have been regularly recorded since the 1980s by the Friends of White Pond, the White Pond Advisory Committee, the Town of Concord, by academic studies and as early as 1940s by Massachusetts agencies charged with water quality assessments. CyanoHAB scums have been documented as being present in White Pond since the 1980s. As documented in field records, cyanoHAB bloom events have occurred in both wet and dry annual precipitation years but have increased in annual frequency of occurrence since 2014. From 2015 to 2021, Concord's Health Department posted No-Contact Advisories at White Pond due to frequent cyanoHAB events occurring above Massachusetts health guidelines. In 2022, HEA utilized the A-Pod technology to control health risk drivers (primarily cyanoHAB scums) while also removing the larger biovolume, suspended biomass of cyanoHABs below the water surface. In 2022 and 2023, Massachusetts health guidelines for cyanoHABs were not exceeded and no-contact advisories were not posted by Concord's Health Department.

Historically, and as confirmed by more recent investigations by HEA and the Town (Leland, 2022), cyanoHABs were primarily of the genus *Microcystis* sp. with lesser and sometimes competing occurrences of *Dolichospermum* sp.. Both types of cyanoHABs can contain cyanotoxins at times, that can negatively affect the health of people, pets and wildlife. Initially as part of HEA's NSF work and later under contract to Concord, HEA documented elevated cyanoHAB biomass extending over the entire water body column (surface to 64 feet deep) and water body area-volume based on vertical assessment multiparameter sonde transects throughout the pond. Additional information on previously dominant cyanoHABs and related water quality and restoration actions by HEA and the A-Pod passive harvesting technology is provided with HEA's Year 2022 report for Concord and is available for download on HEA's website (www.higginsenv.com).

1.2 Year 2023 Restoration Activities and Assessment at White Pond

In 2023, HEA continued to provide similar services to the Town of Concord as in 2022 but work focused on removing tree pollen as it was evident that cyanoHABs were beginning to colonize this external loading (terrestrial) nutrient source as a substrate for cyanoHAB growth *i.e.*, "new production" (Caraco *et. al.*, 1992; Dugdale and Goering, 1967). By removing tree pollen in 2023, cyanoHAB bloom events and health advisories were mitigated and not required, respectively. In 2023, White Pond's water quality and biological integrity (314 CMR 4.00 - Massachusetts Surface Water Quality Standards) remained improved relative both to previously cyanoHAB dominated conditions documented by HEA in 2021 and 2022 and historically (1940s to 2021 data by others - relative to cold water fisheries habitat - *i.e.*, depth interval of favorable dissolved oxygen > 6 mg/L concentrations corresponding to temperatures less than 20 degrees Celsius).

2.0 SUMMARY OF PASSIVE HARVESTING AND REMOVAL OF CYANOHABs USING THE A-POD TECHNOLOGY

2.1 The A-Pod Technology Process

The A-Pod technology can be used actively or passively to trap, concentrate and permanently remove total solids (suspended and dissolved) including tree pollen and forest particulates, cyanoHABs, their toxins and nutrients from fresh, estuarine and marine waters. The following annotated photographs taken at White Pond in October 2021 during HEA's NSF work depicts and helps to explain the A-Pod process.

The A-Pod was the third ecological restoration apparatus and process patented by Mr. Higgins of HEA. The first two patents (*i.e.*, the P-Pod and S-Pod) are intended to extract or biodegrade contaminants and nutrients from in-place sediment or to remove targeted areas of soft sediment, akinete beds and resting cyanoHABs. In 2022, Mr. Higgins filed a fourth patent (US Provisional Patent No. 18/485,127) for an additional apparatus and process called the C-Pod (early prototype in photo) to help make the collection, *in-situ* biodegradation and permanent removal process for cyanoHABs and the annually-recurring nutrient substrates tree pollen and forest particulates easier. Each of these patented apparatuses and processes are portable, scalable and can operate with minimal carbon footprint or disturbance to non-target areas or sensitive resources. More information is provided at www.higginsenv.com.

2.2 2023 Significant Ecological and Health Milestones Achieved

As documented by field data and laboratory testing results provided with this report, significant ecological restoration milestones were achieved in 2023 for White Pond as follows:

HEALTH:

❏ In 2023, previously dominant potentially toxic forms of cyanoHABs (*Microcystis*/ *Dolichospermum*) were no longer dominant. Note: From October 2021 through October 2022, a total of 388.5 dry to moist pounds of cyanoHABs and suspended solids were harvested and removed; this removal corresponded to a 51% reduction in remaining cyanoHAB biovolume and a cyanoHAB phosphorus content reduction of 44% by October 2022; refer to HEA's 2022 report for details.

❏ In 2023 (and 2022), Board of Health restrictions or advisories for water contact were not required or issued when A-Pods were in-place and functioning to harvest and remove tree pollen and forest particulates (pine sap flakes, pine needles, oat tree catkins, insects and similar terrestrial-forest external sourced particulates). Laboratory analysis documented that tree pollen and forest particulates (removed in 2023) contained elevated concentrations of the same types of nutrients (carbon, iron, nitrogen, phosphorus and sulfur) as contained in cyanoHABs harvested and removed from the pond in 2021 and 2022.

❏ In June 2023, by monitoring and laboratory analysis from a controlled container (a C-Pod) within four days HEA documented that *Microcystis* were rapidly colonizing and increasing their population biomass (PC) and cyanotoxin content by using tree pollen as a nutrient/growth substrate. The C-Pod contained pond water, tree pollen and initial colonizing *Microcystis* under ambient (*in-situ*) controlled, conditions. This documented occurrence of *Microcystis* growth utilizing tree pollen as a substrate, prompted a health-prudent decision to harvest and remove tree pollen and forest particulates from White Pond using the A-Pods.

❏ In 2023, a total of 349 dry to moist pounds of tree pollen and forest particulates (*i.e.*, external loading, new production sources of nutrients) were harvested and removed from White Pond using the A-Pods and biodegraded on land and to a limited extent *in-situ* within a C-Pod.

❏ In 2023, open water and beach monitoring conducted by the Town of Concord documented that *Microcystis* and/or *Dolichospermum* (documented as being dominant cyanoHABs in 2021-2022), were no longer dominant or present at concentrations of health concern.

WATER QUALITY:

- ❏ In 2023, water clarity remained improved at the same 24.2 foot median depth as in 2022 (May to November) versus the historic 30-year (1987-2017, typically June to August) median of 19.6 feet, a sustained improvement of approximately 5 feet. In 2023, water clarity was comparable to the reference pond (Walden) of 25.3 feet. Note: In 2023, Walden had a bloom of invasive freshwater jellyfish which likely improved water clarity somewhat (by predation of pelagic phytoplankton and zooplankton).

- ❏ In September 2023, total phosphorus content of surface water samples (discrete vertical profile samples at 10, 30, 50 and 55 feet) had the lowest concentration of phosphorus in the month of September since (equal to) 1988. 2023 total phosphorus results: 10 ft at 0.006 mg/L; 30 feet at 0.005 mg/L; 50 feet at 0.015 mg/L; and, 55 feet at 0.048 mg/L. EPA's 2000 Nutrient Criteria for total phosphorus criteria of oligotrophic waters is < 0.010 mg/L.

  Note: White Pond, historically and currently, contains biogeochemical conditions (high iron to phosphorus ratio, high iron to sulfur ratio, biotic conditions, and dissolved oxygen content that has historically and currently favored phosphorus sedimentation with minimal recycling (*i.e.*, internal loading from sediments) as documented by laboratory testing results of surface water and sediment (Table 2 and 3, and by others in Reference section of this report) and radiocarbon dating (Stager et al, 2020) of sediment.

- ❏ Based on a comparison of 2023 water quality sonde and laboratory testing results (nutrients) with historical records, the oligotrophic status of White Pond and extent of cold water fisheries habitat (depth interval-volume of favorable dissolved oxygen) were improved over data going back to 1949. However, from comparison of monthly historical temperature profiles in the Fall, water temperature has been increasing (shallow and at depth) over time and is likely related to increasing air temperatures with climate change. Improvement in dissolved oxygen is attributed to A-Pod passive harvesting and removal of previously dominant cyanoHABs in 2021 and 2022 which would otherwise tend to increase temperature (solar radiance on suspended solids) and reduce dissolved oxygen (degradation of cyanoHABs over time combined with decreased photosynthesis (by shading)) of natural and deeper occurring oxygenic cyanobacteria, phytoplankton and benthic macroalgae communities.

BIOLOGIC INTEGRITY: (314 CMR 4.000 - Massachusetts Surface Water Quality Standards)

- ❏ Increased water clarity would enhance: 1) photosynthetic function of the extensive and deep benthic macro-alga (*Nitella*) meadows and diversity (particularly deeper types) of oxygenic phytoplankton and cyanobacteria (photoautotrophs and photoheterotrophs); 2) improved dissolved oxygen content with water depth that supports fisheries and biogeochemical processes; and, 3) cooler water temperature by removal of previously dominant cyanoHABs (*i.e*., somewhat of a heat sink).

❑ The biologic integrity of White Pond's naturally-occurring biotic communities (shell and fin fisheries, zooplankton, phytoplankton, insects and crustaceans) and importantly, the health of benthic macro-alga *Nitella* meadows have been improved by harvesting and removal of previously dominant cyanoHABs in 2021 and 2022, and tree pollen and forest particulates in 2023.

❑ HEA has included monthly sonde vertical profile monitoring of a reference station (Walden Pond - western deepest basin) with same day (within an hour) of monthly monitoring at White Pond (all three deep basins). In 2023, cyanobacteria populations and variance with depth based on monthly sonde surveys were very similar between both ponds. The majority of water quality information (temperature, pH, dissolved oxygen, etc.) were also very similar between both ponds with some data indicating that Walden Pond has a higher degree of impact from dissolved ions (road deicing salts, etc.) than White Pond.

❑ Vertical profile sampling and laboratory analysis (GreenWater Laboratories) of surface water in September 2023 documented a diverse group of phytoplankton (green algae dominant) in the top 50 feet. More-extreme environment adapted (low sunlight radiance, anoxic tolerant) photoheterotrophic phytoplankton and cyanobacteria were present at depths of 50 feet and greater. Diversity of phytoplankton types and extent throughout the water column are a positive metric of a water bodies' biologic integrity.

❑ In 2023, with admittedly limited sampling or analysis, HEA qualitatively documented in vertical plankton net tows from 40 feet deep to surface, that White Pond had (visually) approximately twice or more the zooplankton biomass and species diversity than Walden Pond. As noted before though, Walden Pond had an active fresh water jellyfish bloom in 2023 which would have reduced zooplankton communities (especially smaller forms).

❑ At White Pond, in 2021-2023, HEA documented the presence of "benthic meadows" of beneficial benthic macroalgae (*Nitella*) and moss from depths of approximately 5 to 45 feet throughout the pond. Walden Pond has similar benthic meadows. These would serve as significant sinks for nutrients, another source of dissolved oxygen production with photosynthesis, and as habitat for benthic fauna.

❑ Based solely on visual assessment and knowledge, both Walden and White Ponds have healthy populations of crayfish, lesser amounts of shellfish (mussels), and both warm and cold water fisheries. Both ponds are stocked with trout in the spring and fall of each year.

HEA was able to meet and speak with many people from Concord and other towns that were using White Pond for boating, swimming and fishing. Many would introduce themselves and thank us for our work and provide personnel feedback of their knowledge of the pond and its water quality over time.

3.0 YEAR 2023 SUPPLEMENTAL ASSESSMENTS AND FINDINGS

In 2023, field work took place between May 5th and November 6, 2023. Field sampling locations are depicted on **Figure 1 - General Location of White and Walden Ponds**. A bathymetric map (depth to bottom contours) and field information are depicted on **Figure 2 - MassWildlife Bathymetric Map for White Pond**. A summary of field data collected by HEA and previously by others (1987-2017) is provided on **Table 1 - Monthly Field Data Summaries for White Pond - Emphasis on CyanoHAB data**.

Assessments began on May 5, with vertical sonde surveys and an initial visual assessment of a sediment core sample. In 2023, as a similar water reference location, HEA included monthly sonde vertical profile assessments and a September zooplankton vertical (to 40 feet) tow net survey of Walden Pond (western-most deep basin, approximately 100 feet deep). Walden and White Ponds are both glacial kettle ponds with similar bathymetry, soil types, geologic setting, water clarity, fisheries (cold and warm), and importantly, extensive “benthic meadows” of the macro-alga *Nitella*.

On May 11 and 12, two A-Pods were installed in White Pond’s similar to Year 2022. A-Pods were removed on October 24, 2023.

The first 2023 sediment gravity core and discrete (top 1-2 inches) of soft sediment samples for laboratory analysis were collected on May 16 from profundal sediments in the eastern-most, deepest basin of White Pond. Weekly to monthly A-Pod trap and water quality assessments of Walden and White Pond continued through November 6, 2023. Discrete depth profile surface water samples and additional sediment samples were collected on September 27 from the same location (eastern most basin). Sediment sampling took place after surface water sampling. Additional sediment samples (gravity core and discrete) from the eastern-most basin were collected on November 6, 2023.

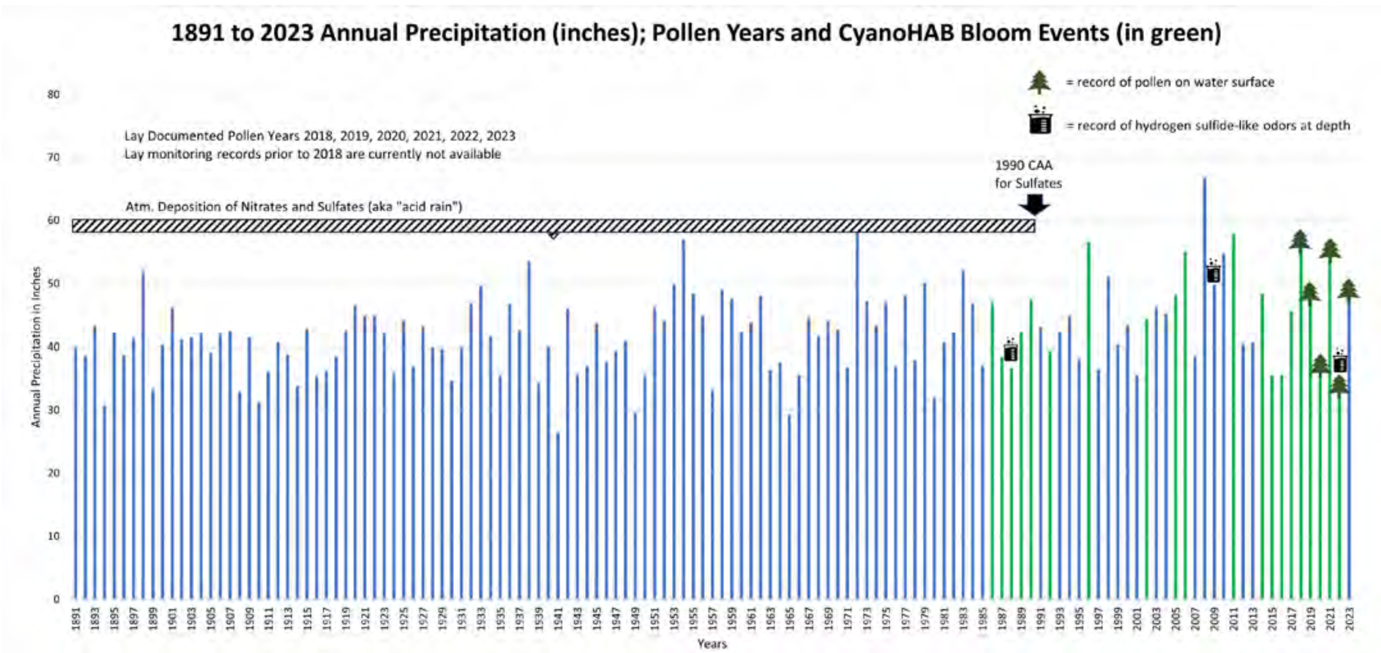
From early May through early July, significant amounts of tree pollen (primarily white pine and lessor amounts of oak) were falling on White Pond. This dry deposition from terrestrial areas around the pond included other forest particulates: pine sap flakes, pine needles, oak catkins, small flowers, insects and later seeds. Tree pollen deposition and removal at the A-Pod traps continued until the first week of July. Similar amounts or types of tree pollen deposition were only minimally observed during monthly assessments at Walden Pond. Accumulation of forest particulates within the A-Pod traps continued to varying degrees throughout the season (July through October) but were less in biovolume and weight than early-season tree pollen.

In 2023, a total of 326 moist pounds of mostly tree pollen and 23 pounds of dry-moist forest particulates (in total 349 pounds) were harvested and removed from White Pond using the A-Pods and biodegraded on land in a controlled manner. Previously, from October 2021 to October 2022, a total of 388.5 moist-dry pounds of primarily cyanoHABs were harvested and removed using the A-Pods.

Laboratory analysis of tree pollen and forest particulate residue samples contained elevated concentrations of the same types of nutrients contained within previously removed cyanoHABs (2021-2022). CyanoHABs (microscopically identified as *Microcystis*) were visually observed and as confirmed by field sonde and laboratory testing, to be colonizing and growing off tree pollen as an apparently well-suited nutrient substrate. Visual observations and field sonde testing results of cyanobacteria colonizing tree pollen in White Pond prompted removal of tree pollen and forest particulates, as an external loaded terrestrial source of nutrients to White Pond. CyanoHABs were only detected at concentrations below thresholds of concern early in the 2023 season by the Town. Testing by HEA of surface water quality in September had no reported cyanoHABs that were previously dominant prior to 2023.

The A-Pod traps were only emptied during the initial (mid-May to first week of July) tree pollen deposition timeframe and then not again until the A-Pods were removed on October 24, 2023. Trap contents of accumulating forest particulates from the second week of July until October 24 were biodegrading and concentrating in place within the traps, under aerobic conditions. HEA also completed microscopic analysis to confirm tree pollen types and submitted samples of tree pollen and later “trap residue” forest particulates for laboratory analysis of nutrient content. They contained elevated concentrations of the same types of nutrients detected previously in cyanoHABs removed from the pond, using the A-Pods in 2021-2022.

Laboratory results for surface water (2022 through 2023) are summarized on **Table 2**. Laboratory results for sediment (2021-2023), cyanoHAB solids (2021-2022) and tree pollen/forest particulates and trap solid residue (2023) samples are summarized on **Table 3**. Over twelve different charts are included within this report text and/or as attachments to document annual precipitation fluctuations since year 1891, Benefit of Tree Pollen Removal in 2023 (**Chart 1**), nutrient and phytoplankton results, and monthly sonde survey data (**Charts 2** through **12**).



The preceding chart depicts mean annual precipitation records since 1891 from a Concord precipitation station (two missing Concord station records of annual readings were taken from nearby Bedford/Hanscom field).

This annual precipitation chart was also annotated by HEA to depict annual documented years of cyanoHAB blooms and pollen (on the pond surface) as noted on records reviewed by HEA (William Walker files, White Pond's Soundings Newsletter, and a partial set of White Pond lay monitoring records). HEA also included a horizontal bar chart reference indicating the historic duration timeframe of nitrate and sulfate "acid rain" wet and dry deposition. Sulfate deposition decreased significantly after the passage of the 1990 Clean Air Act Amendment. Previous to 1990, this area of New England annually had approximately 8 pounds and greater of total sulfur deposition and 6 pounds and greater of total nitrogen per acre/year according to reports from U.S. EPA and National Atmospheric Deposition Program (NADP) (https://cfpub.epa.gov/roe/indicator.cfm?i=1#4) . Evidence of sulfur impacts at White Pond (noted by hydrogen sulfide-like odors when water samples at depth were retrieved) are also annotated on the chart. This chart can be further improved by adding other water quality indicators and pond condition data such as from paleolimnological records obtained by Stager *et. al.* 2020. If lay monitoring records prior to 2018 become available (*i.e.*, are found), other instances of documented tree pollen and cyanoHAB blooms can be added. This annual precipitation chart documents that cyanoHAB blooms have occurred irrespective of "wet" or "dry" annual precipitation years and that tree pollen events have been recurring annually since 2018.

Chart 1 provides a graphic depiction of 2023 field data summarized on **Table 1** for the amount and timing of tree pollen accumulation and removal with corresponding PC and Chl-a sonde field data from the A-Pod traps, the C-Pod and open waters.

Charts (2-12) provide summaries of sonde data (including from Walden as a reference station). HEA has also tabulated and charted (included in the body of this report) HEA data since 2021 with previously collected historical water quality data (dissolved oxygen, temperature and laboratory results for total phosphorus) from others (Walker, Friends of White Pond, ESS) since 1987 or earlier (back to 1949 for temperature). These historical charts preference display of data (historical and current) collected seasonally from late August to October (with preference for data collected in September, if available). September data (including some from late August or October when no September data was available in a given year) were chosen as White Pond has its primary phytoplankton (which includes cyanobacteria) biological productivity (as measured by monthly sonde BGA-PC and Chl-a surveys) in September with cyanoHAB blooms historically noted as occurring primarily from September to October "autumnal cyanoHAB blooms". Note: since 2015, cyanoHAB blooms and Board of Health advisories have begun to occur earlier (July) and at times later in the season (November to early-December). Seasonal changes in cyanoHAB blooms at White Pond and at quite a few other lakes and ponds in New England are likely related to documented climate changes.

During 2023, HEA completed additional sampling and laboratory analysis of surface water (multi-depth, vertical profile sampling) for nutrients as summarized on **Table 2 - Surface Water Sampling Results**. Additional sampling and analytical results for samples of A-Pod trapped and removed tree pollen (pine and oak), trap residue (forest particulates), and sediment samples are summarized on **Table 3 - Benthic Macroalgae (*Nitella*), Recovered CyanoHABs, A-Pod Residue and Sediment Sampling Results**. During surface water sampling, HEA also collected samples of surface water (composite of 8 and 30 feet depth, and at 50 feet) using a discrete water sampler with analysis for phytoplankton including cyanobacteria enumeration, identification, biomass and biovolume. Phytoplankton (cyanobacteria) identification results from 2022 and 2023 are summarized on Charts 2 and 4 and on a chart provided in **Section 3.5** of this report.

The following sections outline assessment methods and findings by HEA in 2023. Previous field and laboratory results obtained by HEA in 2021 and 2022 are included within summary tables and charts in this report as well as discussed further in HEA's previous Year 2022 report.

3.1 Shallow and Vertical Sonde Profiling

<u>Material, Methods and Equipment Utilized</u>:

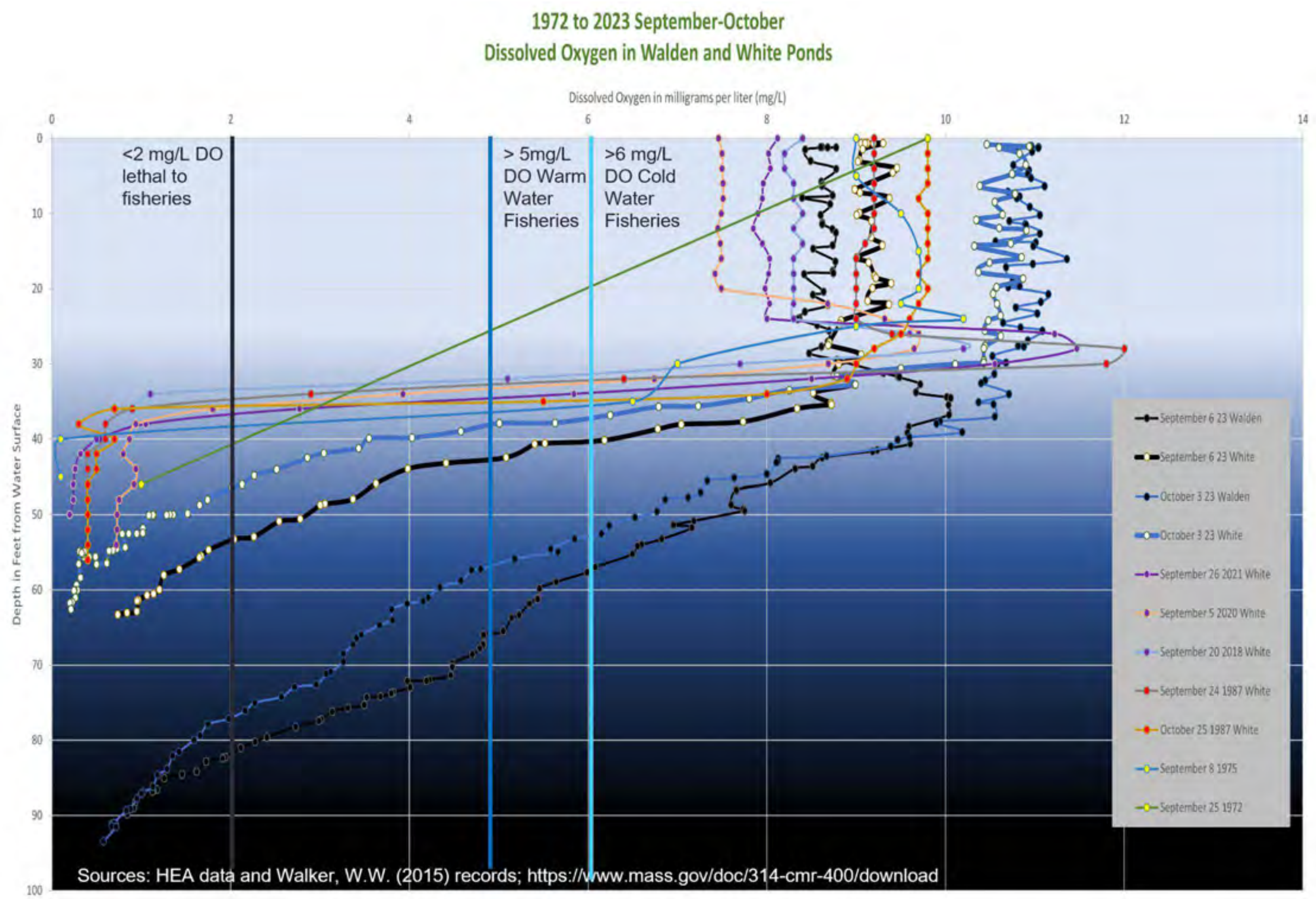
Shallow and vertical profile and snapshot (*i.e.*, discrete water samples or locations) testing of water quality at White Pond were completed using an In-Situ AquaTroll 500 sonde fitted with probes for measurement for pH, temperature, dissolved oxygen, blue-green algae phycocyanin (BGA-PC), chlorophyll-a (Chl-a), oxidation-reduction potential, turbidity, depth, barometric pressure, hydrostatic pressure, specific conductivity, salinity, resistivity, density, total dissolved solids, and recording of longitude and latitude for each sonde sampling location.

In 2023, vertical profile sonde surveys were completed on a monthly basis (May to November) within each of White Pond's three primary deep basins (East, Center and West Holes), **Figure 2**. In 2023, HEA also included Walden Pond, as a comparative reference location for work at White Pond, for monthly (May to October at Walden) vertical sonde surveys (western-most deep basin up to approximately 100 feet deep). Sonde measurements in survey mode are collected and recorded every few seconds. Sonde snapshots were also collected in discrete areas of the White Pond, most often within and around A-Pods. Sonde survey records were then reviewed, processed (*i.e*., selected results removed) to correct for instances where the water quality probe likely entered soft sediments at depth or in several instances where very shallow water column readings (top 1 foot) were recorded as near non-detectable for BGA-PC or Chl-a when compared to readings from one to three feet below the water surface at the same water quality survey profile location.

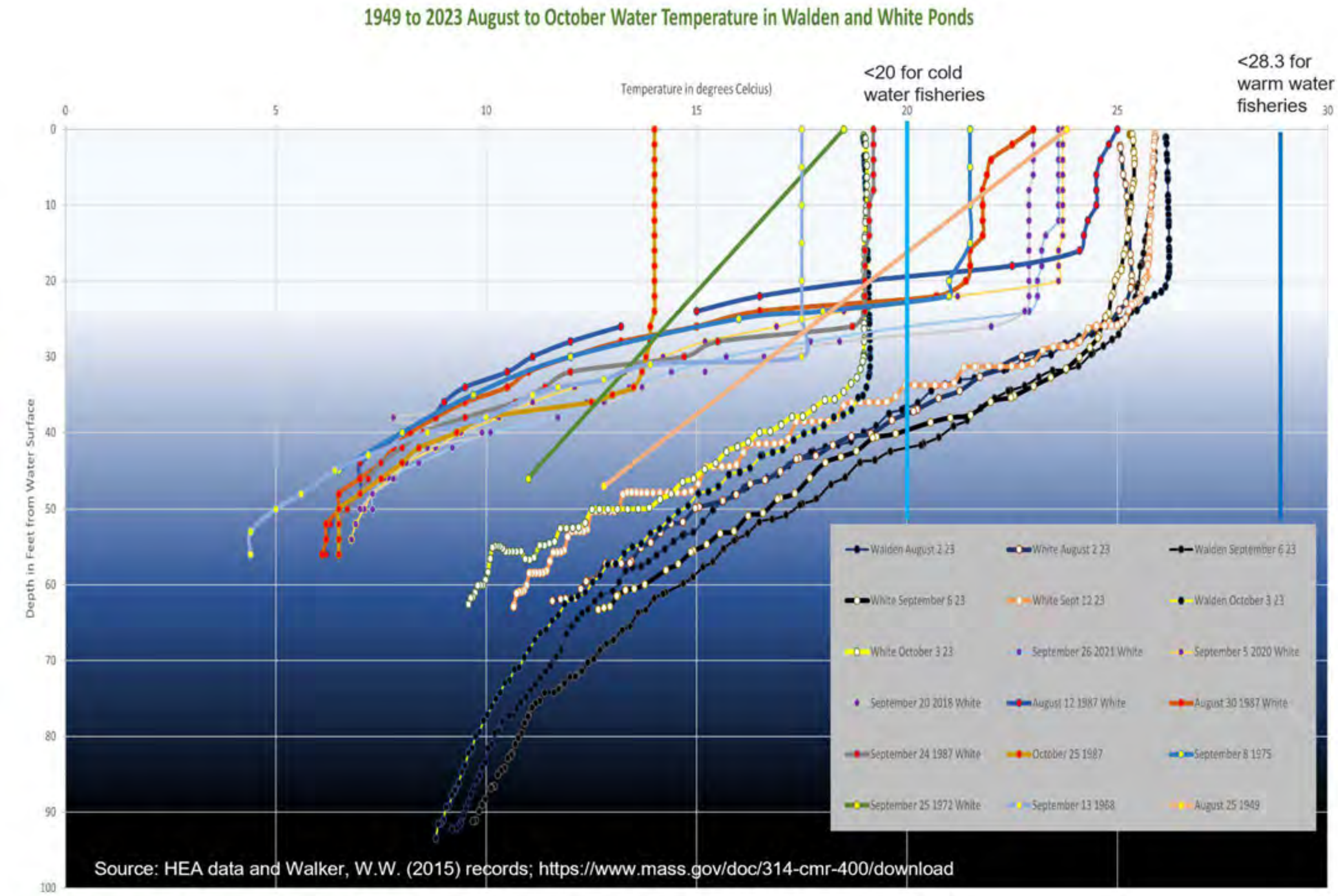
Sonde probes are factory-calibrated, have ongoing internal calibration for BGA-PC and Chl-a, and are field checked by HEA for consistency of readings between field use by using reference standards including: deionized water blanks and office and field benchmarks (*e.g*., rain water filled buckets, and at White Pond, a second bucket filled with pond water, all kept in the shade) to check for daily field variance of a fixed sample (the containers of water) from one survey event to the next. In 2023, following manufacturer's calibration specifications, BGA-PC and Chl-a probes were calibrated with reference to deionized water (essentially a zero value for both BGA-PC and Chl-a). Rain and pond water buckets at White Pond were occasionally changed out if tree pollen, forest particulates or visual evidence of algae formation was observed. The office bucket of rainwater (out of the sun, lightly covered) remained unchanged throughout 2023 sonde surveys as a reference benchmark. There were only very minor reading variance in rain water bucket readings in 2023 likely due to seasonal temperature fluctuations. Walden Pond monthly vertical sonde surveys (same day and within one hour of similar surveys at White Pond) were used as another field reference location to help evaluate sonde readings relative to surface water quality at White Pond.

<u>Sonde PC Data</u>:

Vertical sonde monthly data records and charts of cyanoHAB data measured in PC are summarized on **Table 1 - Monthly Field Data Summaries for White Pond Restoration with A-Pods - Emphasis on CyanoHAB Data**, on **Chart 2 - 2023 Monthly White Pond and Walden BGA-PC Population Variance** and on **Chart 3 - October in Years 2021 to 2023 Changes in BGA-PC Biomass and Biovolume (PC) in White Pond**. Remaining sonde survey data for Walden and White Ponds (Chl-a, pH, temperature, etc.) are presented on **Charts 4** through **12**. HEA also tabulated and charted historical water quality depth profile data for temperature, dissolved oxygen and total phosphorus. The following two charts are for dissolved oxygen and temperature readings over time. Charts for total phosphorus and other nutrients are provided in **Section 3.2**.



This chart of dissolved oxygen over time shows a marked improvement (increase in dissolved oxygen with depth) in 2023 (lines with “white” circles) compared to historical data (1972 to 2021). In 2023, Walden (lines with “black” circles) had a similar dissolved oxygen profile but at greater depths for that 100-foot deep pond. Deeper depth intervals of higher dissolved oxygen essentially provide more favorable water volume for fisheries and biogeochemical cycles including degradation of organic seston and detritus by aerobic bacteria and photoheterotrophic cyanobacteria. HEA attributes the increase in dissolved oxygen content with depth to improvements in water clarity, reduction of prior years’ cyanoHAB biomass, and increases in oxygenic phytoplankton diversity with depth achieved since 2022 with passive harvesting of cyanoHABs from White Pond. The extent of pre-2021 anoxic waters (DO <1 mg/L) and as toxic to fisheries (DO < 2 mg/L) were reduced by approximately 15-17 feet.



This chart of water temperature records back to 1949 at White Pond shows that water temperature has been consistently increasing at all depths since 1949. Increasing temperature is likely related to climate change. Otherwise, the environmental setting around and in White Pond's watershed/ground water contributing area, based our knowledge and review of records, has not changed much since the 1950s when many of the current home lots were initially developed. Forest canopy and tree species around the pond also has not changed much since the early 1800s based on observations recorded by Emerson and Thoreau. A report by Stager (2020) provides additional information on changes at White Pond over time based on paleolimnological records and an assessment of diatoms in particular. In 2023, temperature and profile shape with depth at White Pond were very similar to Walden Pond.

Sonde Findings for BGA-PC and Chl-a:

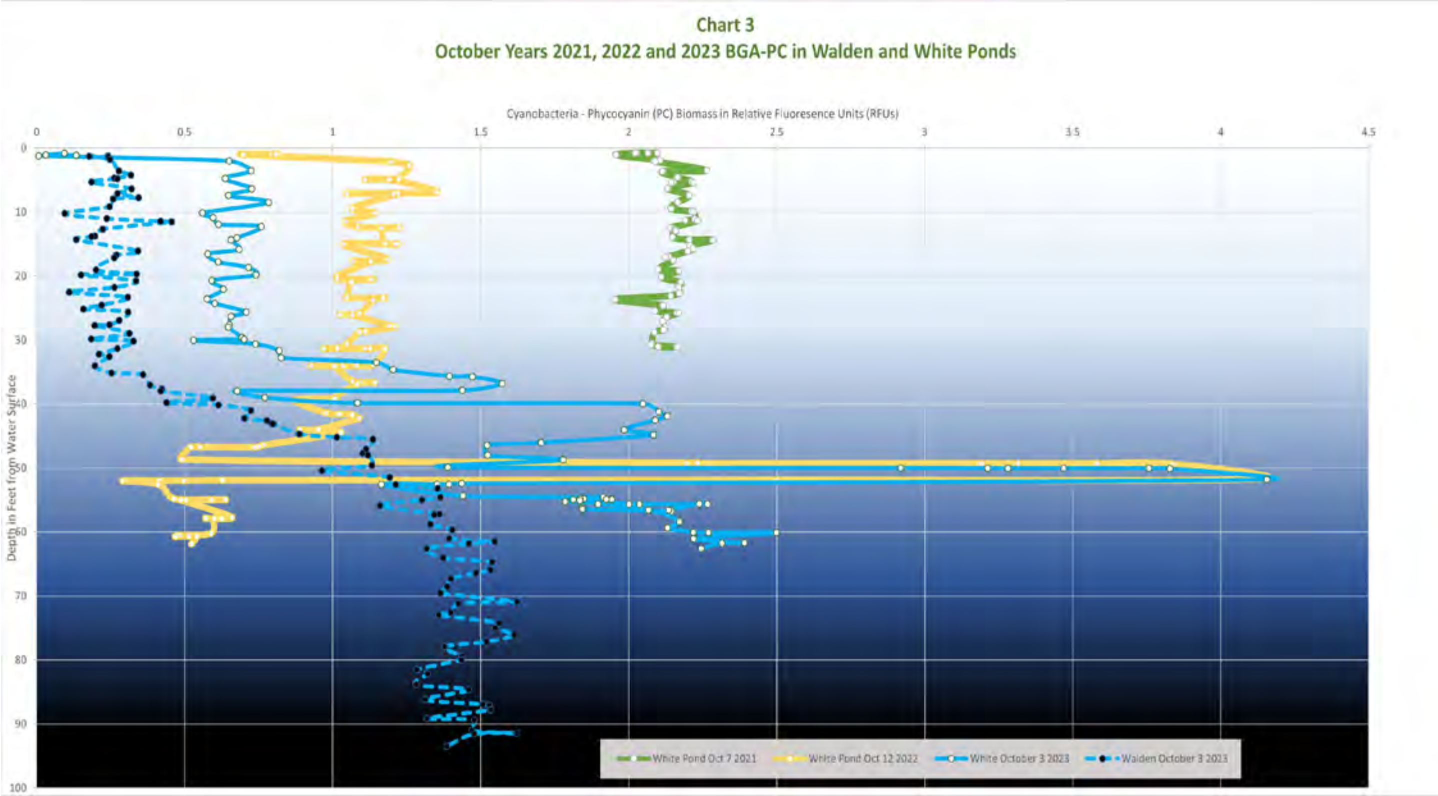
Unlike in 2022 when BGA-PC (a measure of cyanobacteria biomass) sonde vertical profile data at White Pond documented a tight range and dominance of one to two types of cyanoHABs (*Microcystis* and *Dolichospermum*) (also confirmed by microscopic and laboratory analysis) throughout the season, in 2023, profile data for BGA-PC were very similar between White Pond and Walden Pond and showed a great deal of vertical and seasonal variance (a measure of cyanobacteria composition and biomass diversity with depth (also confirmed by laboratory analysis at White Pond in September 2023).

In 2023, similar to Year 2022 BGA-PC (in October and early November), sonde profile data in September and October of 2023 at White Pond's deepest basin, right at about 50 feet deep had a tight lens or layer of more BGA-PC and Chl-a biomass than immediately above or below this depth layer. This discrete BGA-PC layer was not present (or readily apparent) in September or late November of 2022 or in July or November of 2023. Based on discrete surface water sampling at 50 feet in September 2023 and laboratory analysis of phytoplankton/cyanobacteria identification, this brief, seasonal and thin layer of phytoplankton was dominated by Chl-a forms (Cryptophytes and Euglenoids) and slightly lower biomass by the cyanobacteria *Limnothrix* (a rarely detected photoheterotroph that can utilize nitrate and sulfates in addition to very low levels of sunlight to gain energy and biodegrade organic matter (seston and detritus). Phytoplankton/cyanobacteria sampling and findings are discussed later in **Section 3.5** of this report.

Similar to 2022, comparison of vertical sonde BGA-PC monthly surveys in year 2023 between each of White Pond's three deep holes documented that phytoplankton biomass and biovolume did not vary much between deep stations.

The reference pond, Walden, had similar seasonal distribution and growth patterns of BGA-PC but slightly lower values compared to White Pond month to month but Walden Pond had much lower values of Chl-a (Chart 4) than White Pond in 2023. The much lower values for Chl-a at Walden Pond may be related to an active bloom of invasive fresh water jellyfish at Walden Pond (based on visual assessment by HEA, possibly a type called "Peach Blossom"). Fresh water jellyfish have not been observed or documented in records reviewed by HEA at White Pond. Peach Blossom jellyfish are considered by some to be an indicator species of climate change as they are originally a tropical species from Asia. They have been documented in more northerly regions of North America for a decade or more.

The following chart depicts changes in cyanobacteria (cyanoHABs in 2021 and 2022 and non-PTOX cyanobacteria in 2023) for White and Walden Ponds.



Overall, since 2021 and use of the A-Pods to target, passively-harvest and remove cyanoHABs, cyanobacteria biomass (BGA-PC) in upper waters (top 30 feet) has decreased significantly at White Pond and now approximate Walden Pond which has not had documented cyanoHAB blooms or scums like White Pond since the 1980s. Based on laboratory analysis, cyanobacteria biomass that increases with depth are naturally-occurring oxygenic (*i.e.*, oxygen producing) cyanobacteria that provide important biogeochemical functions and biological diversity to sustain healthy water quality. Not shown on this chart but discussed in Section 3.5, in 2023, White Pond also had a diverse community of photoautotrophic (gain energy from sunlight) and photoheterotrophic (gain energy from both or either sunlight or oxidation of organic matter coupled with nitrate and sulfate reduction) phytoplankton and cyanobacteria.

3.2 Surface Water Sampling and Analysis

<u>Material, Methods and Equipment Utilized</u>:

In consultation with Concord, HEAs originally (April 2023) proposed a single round of shallow water samples (trap, in-A-Pod collection area; and outside A-Pod area in open water) which was replaced with a vertical profile set of discrete samples from 10, 30, 50 and 55 feet deep in the eastern-deep basin. The proposed scope was modified as there were no cyanoHAB bloom or concentration areas in 2023 and the vertical profile, discrete sampling would allow for a comparison of 2023 surface water quality laboratory results to data collected by others at White Pond since 1987.

HEA's surface water samples were collected using a discrete sampler (Van Dorn type) from the eastern deep basin on September 27, 2023 and designated as WP-10, WP-30, WP50 and WP-55 (##s) corresponding to discrete sampling depth. Each sample was visibly clear with no suspended solids or discoloration. Surface water samples were placed directly upon sampling into pre-preserved, laboratory-supplied containers, cooled to less than 4 degrees Celsius, and kept under chain of custody documentation through laboratory analysis. Each sample was submitted for laboratory analysis for the nutrients: nitrate and nitrite as nitrogen, total nitrogen, kjeldahl nitrogen, total phosphorus, total organic carbon, total iron, and total sulfur.

Field and Laboratory Data:

Field sonde BGA-PC and Chl-a and corresponding laboratory data (PC and cyanotoxins) are summarized on **Table 1 - Monthly Field Data Summaries for White Pond Restoration with A-Pods - Emphasis on CyanoHAB Data** and laboratory results of surface water samples for nutrient analysis from 2021 to 2023 are summarized on **Table 2 - Surface Water Sample Results**. Laboratory data sheets for surface water samples for nutrient analysis in 2023 are attached for reference.

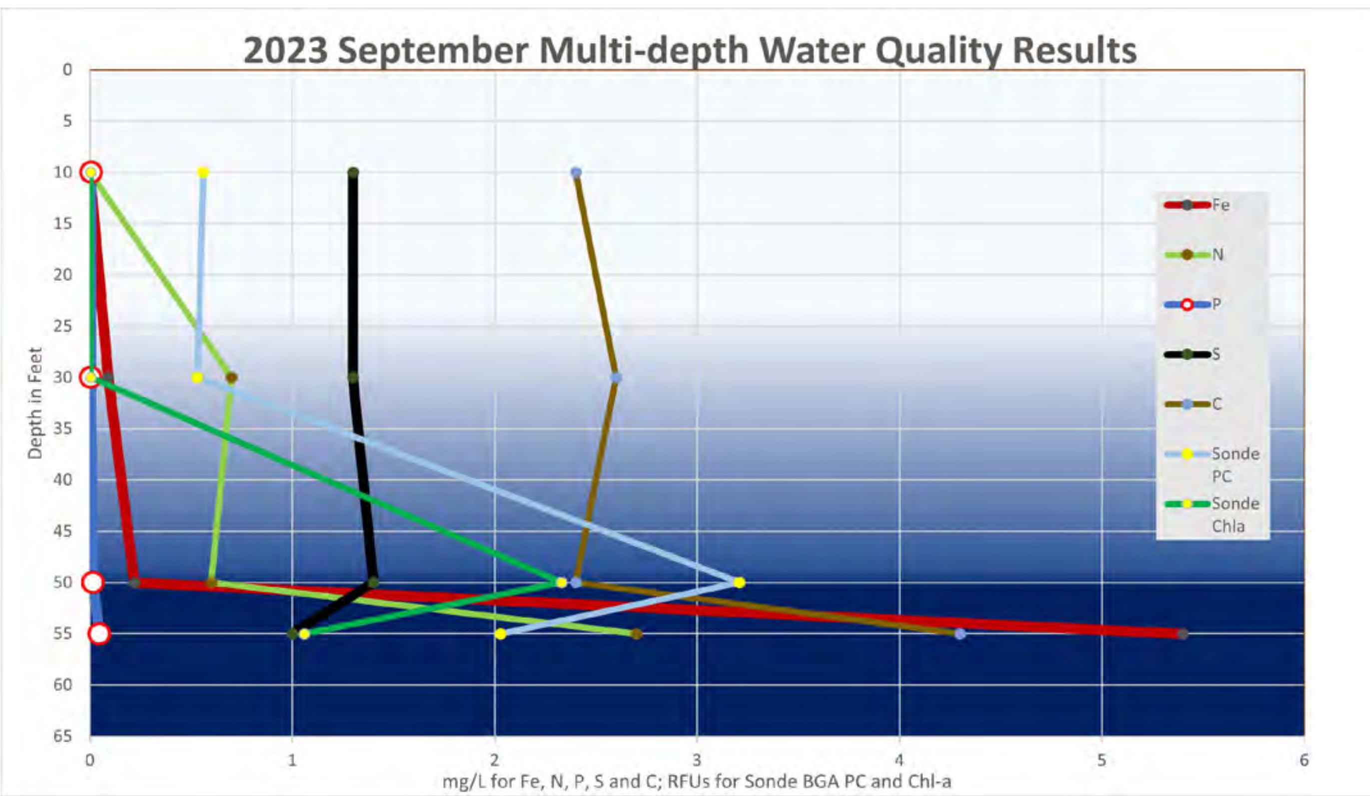
Surface Water Sample Analytical Findings:

In 2023, surface water laboratory results for nutrients (carbon, iron, nitrogen, phosphorus and sulfur) for samples collected at 10, 30 and 50 feet were (with specific reference to total phosphorus) consistent with an oligotrophic water body, an improvement over historical results which were within the oligotrophic to mesotrophic range.

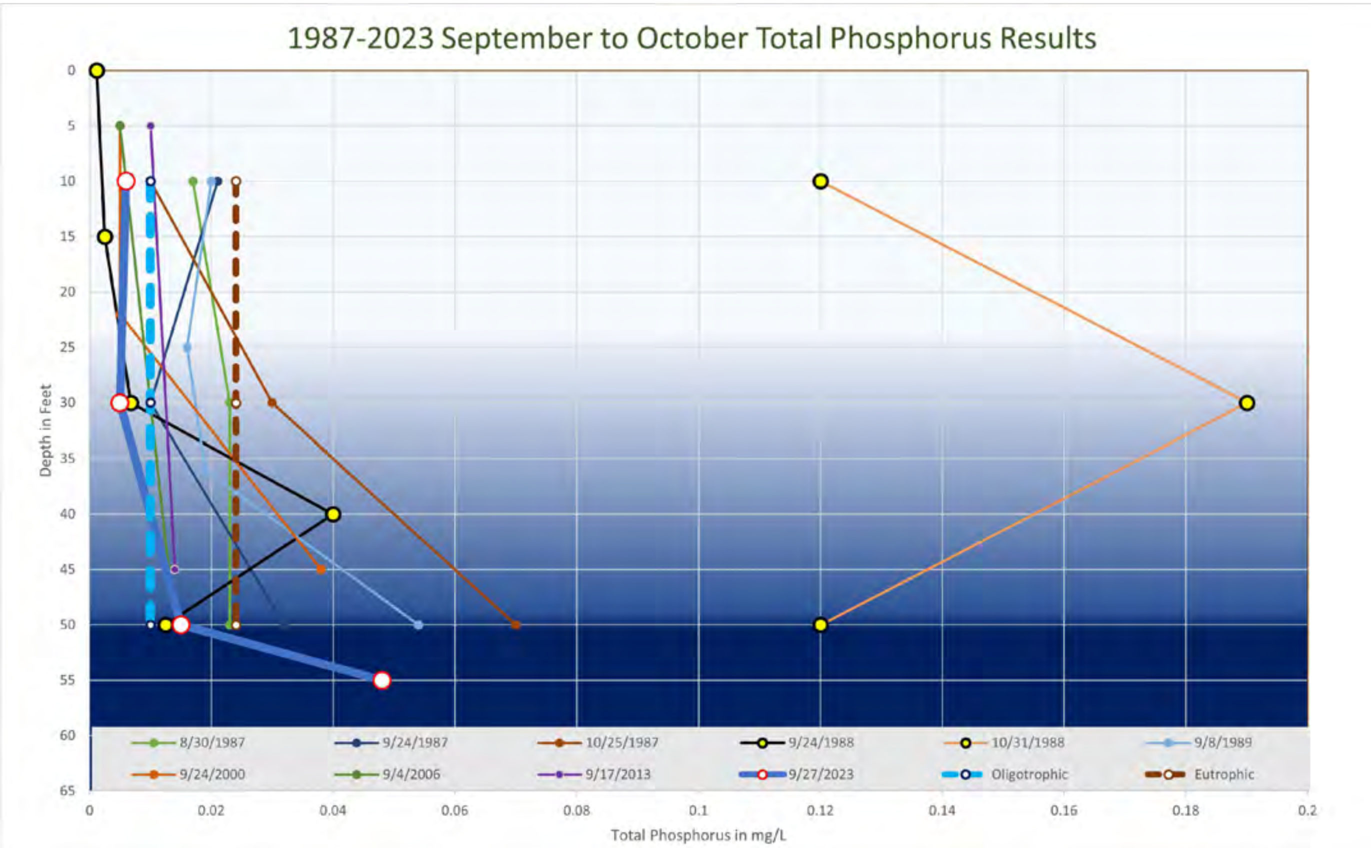
In 2023, surface water results for total phosphorus at 55 feet were greater than the oligotrophic (EPA 2001) criteria of <0.010 mg/l but due to the high concentration of iron and low concentration of sulfur (by ratio comparison to iron and phosphorus content), diversity of oxygenic phytoplankton and increased dissolved oxygen content immediately overlying this sampling depth interval, this result is considered a normal result of biogeochemical activity and biodegradation of organic matter without (as documented by shallower water quality) having an impact on overlying water quality. HEA's interpretation (normal conditions without overlying water quality impairment) is supported by radiocarbon dating of sediment (Stager, 2020) and soft sediment vertical profile sampling and laboratory analysis completed by HEA in 2021 (**Table 3**, Sample SED-3 WP5) for nutrient content which documented both a fairly constant concentration for total phosphorus in White Pond over the past, approximately 2,000 years of soft sediment deposition and very little seasonal variance

(May to November) in phosphorus content of upper sediments (top 1 to 2 inches). The uniform concentration of phosphorus with sediment depth is another indicator of an oligotrophic water body (Carey and Rydin, 2011).

Total phosphorus results of surface water in 2023 were also lower in concentration (at the same sampling depths) than all historical sample results collected since 1987 except one sample collected on September 24, 1988 (which also corresponded to reports by the samplers of hydrogen-sulfide like odors during sampling on this date and later on October 31, 1988). Sulfur tends to increase the availability and release of phosphorus that would otherwise be bound in sediment, even under anoxic conditions (Caraco et al, 1989, 1991, 1993). As such, HEA considers sulfur as a "controlling" nutrient that can make the "limiting" nutrient phosphorus more available to phytoplankton and cyanoHABs. Two charts of HEA's data are presented as follows with the



se cond chart breaking out historical total phosphorus results in milligrams per liter (to make it easier for the reader to view phosphorus data). Laboratory results of HEA's samples (2021 to 2023) are summarized on **Table 2**. Laboratory datasheets for 2023 samples are attached.

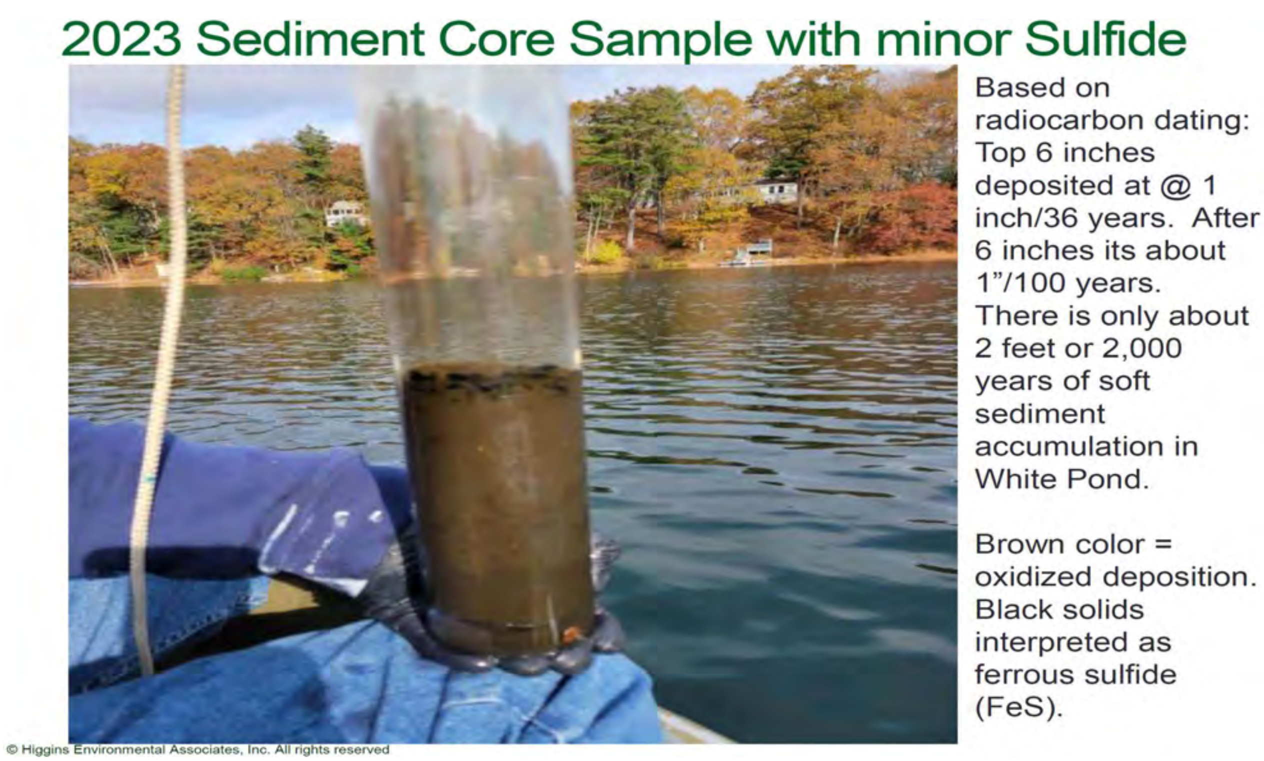


3.3 Sediment Sampling and Laboratory Analysis

Material, Methods and Equipment Utilized:

Sediment quality assessments and sampling (total of six samples for this report) were collected from May 16, September 27 and November 6, 2023 from profundal sediments in White Pond's deepest basin (east hole) using either gravity-core sampler and for very fine, easily disturbed sediments (top 1 to 2 inches) a discrete (Van Dorn style) water sampler and use of a fine filter (12 micron) to separate discrete sampled solids from water. Samples collected by the gravity corer were designated as ##-core whereas the discrete samples were designated as T2". The May and November sampling included top 1-2 inch samples by both the gravity core and discrete Van Dorn sampler for comparative purposes and recognizing that use of a Van Dorn for sampling the very top, most easily disturbed sediment surface is not something many (if any) other people have done. It is also difficult, without repeated core sampling, to obtain a sufficient amount of "sediment" from the top 1 inch of these easily disturbed, deep profundal sediments for laboratory analysis. This upper 1 inch sediment layer is often, technically, more liquid than solid (a "solid" sediment sample is defined as having 15 percent or greater solids content by laboratory analysis). These easily suspended, more liquid than solid samples are also difficult to sample with dredges (such as either Ponar or Ekman) due to pressure waves associated with dropping and closure of dredges. In any event, the top 1 to 2 inches of sediment will contain the most actively-utilized, available and deposited suspended solids and nutrients from phytoplankton, seston, detritus and biogeochemically-active nutrient recycling. HEA included both discrete and core sample (top 1 to 2 inches) samples for the benefit of some readers of this report that may have concerns about use of a Van Dorn sampler for collecting top 1-2 inch soft sediment samples. As discussed later, laboratory results were significantly different (greater) for nutrients collected with the discrete Van Dorn sampler versus the top 2 inch core sample in May 2023 but comparable for samples (Van Dorn and Core) in November 2023. Sample designation and laboratory data summaries are provided on **Table 3**. Sediment samples were cooled to less than 4 degrees Celsius upon sampling, frozen back at the office and kept under chain of custody documentation through laboratory analysis.

Laboratory analysis of sediment included the nutrients: total organic carbon; iron, nitrogen (total, and for one sample (WP-EH-6"-CORE) also for: nitrate and nitrite as N, and Kjeldahl N), phosphorus and sulfur. Four of the six samples were collected from the top 2 inches of soft sediment (as core or discrete samples) and two samples were collected at depths from zero to six inches with the gravity core sampler. A photograph of a gravity core sample (September 2023) and a Van Dorn discrete sample (November 2022) follows:



Field and Laboratory Data:

Sample results including reference to sampling location and sampling depths are summarized on **Table 3**. Laboratory data sheets for sediment samples collected in 2023 are attached for reference. Based on field observations, soft sediments consisted of a light grey-brown, organic-rich silt with visible layering of sediment in core samples. The upper one inch of sediment was very loose and easily disturbed. As noted in the preceding sediment core sample, dark grey-black mottling was observed near at the surface of several core samples in 2023 and is interpreted by HEA as possibly ferrous-sulfide mineralization/precipitates. The November 2023 0-6 inch gravity core sample (WP-EH-6"-CORE) had the highest concentration of sulfur than any other sediment sample collected by HEA to date (since 2021). HEA interprets this to be natural variability in sediment quality combined with concentration of sulfur over time possibly though kinetic and geochemical properties and some physical alteration of the sediment surface where ferrous-sulfide precipitates may tend to collect; e.g., an anchor depression or similar. Anchor depressions are actually quite common in profundal sediments (soft sediments more often at depth) in water bodies with boaters and give the appearance of craters in the sediment surface when viewed while diving. In any event, the preceding core sample photograph is the same sample that had the highest sulfur content to date. Similar dark-colored precipitates (interpreted as ferrous-sulfide) were visually apparent in a separate core sample collected on November 16, 2023 from the same location (eastern-deep basin) - as noted in this photograph. On this photograph, the upper 1 inch or so of sediment appears porous, an indication of how loose and easily disturbed these upper (top 1 inch) layers of sediment can be.

<u>Sediment Sample Findings</u>:

In 2023, the A-Pods were used to remove 349 pounds of tree pollen, an external, terrestrial loading nutrient source to the pond. As such, sediment sample results in 2023 help to document seasonal and sediment-depth variation in nutrient content after removal of legacy nutrients and cyanoHABs from October 2021 to 2022. Laboratory results for sediment samples collected from May to November 2023 are summarized in the following chart. Laboratory results for sediment samples collected by HEA from 2021 to 2023 are summarized in **Table 3**.

	2023		2023		2023		2023		2023		2023		
	Top 2" Core		Top 6" Core		Top 2" Discrete		Top 6" Core		Top 2" Core		Top 2" Discrete		
Sample ID:	EH-T2"-Core		EH-6"-CORE		EH-62'-T2"		WP-EH-6"-CORE		EH-T2"-Core		EH-62'-T2"		
Lab Sample Number:	3E18042-01		3E18042-02		3E18042-03		3I28075-05		3K09056-02		3K09056-03		
Date Sampled:	5/16/2023		5/16/2023		5/16/2023		9/27/2023		11/6/2023		11/6/2023		
Parameter	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Units
General Chemistry													
Nitrate and Nitrite as N	Not Tested		Not Tested		Not Tested		**3.24**	2.25	Not Tested		Not Tested		mg/kg
Total Nitrogen	**1360**	10	**5510**	10	**17700**	10	**798**	10	**16000**	10	**24200**	10	mg/kg
Kjeldahl Nitrogen	Not Tested		Not Tested		Not Tested		**795**	110	Not Tested		Not Tested		mg/kg
Total Phosphorous	**2250**	2.57	**2520**	3.87	**3190**	6.4	**2040**	6.4	**3440**	3.78	**2140**	1.6	mg/kg
Total Organic Carbon	**49**	0	**50**	0	**51**	0	**21**	0	**22**	0	**25**	0	Percent (%)
Total Metals													
Iron	**28000**	26	**10100**	39	**36000**	64.6	**7450**	64.6	**30000**	38.2	**19600**	16.2	mg/kg
Sulfur	**11800**	260	**4720**	390	**13200**	646	**20200**	646	**10800**	382	**7110**	162	mg/kg

Notes:
1. Samples including "Core" were collected using a gravity core sampler; Samples with a "Discrete" were collected using a Van Dorn sampler to help capture easily disturbed sediments.
2. Year 2021 to 2023 sediment laboratory results for samples collected by HEA are summarized on Table 3.

Laboratory results in 2023 show seasonal variations in nutrient content and also help to show differences in nutrient content related to the choice of sampling devices (gravity core or Van Dorn discrete, in this instance) for sampling the top, upper 1-2 inches of sediment. The CORE top 2 inch (T2") samples would include a larger proportion (by unit volume and weight of solids) of deeper, older sediments (1-2 inches) than the discrete Van Dorn samples which include more of the upper, almost liquid top 1-inch, easily suspended, more recently deposited sediments. There may or will be (in the future) other types of sampling approaches that others may or could use, to sample the upper, most recently deposited sediment such as by repeated gravity core sampling to obtain sufficient 0-1" sample by weight and volume or use of divers and hand sampling with another form of discrete sampler. At White Pond, depths of 63 feet to sediment favored use of a Van Dorn sampler as a substitute for sampling by a diver or by multiple core sampling. At the end of this section, HEA has included a bar and pie chart combination to depict laboratory results for sediment nutrient concentrations by depth, core and discrete sampling methods. The November 2021 sediment sample (SED 3-WP5), is a vertical depth/nutrient profile sample that documents nutrient concentrations over time (past 2,000 years). Note, some nutrients such as carbon and total nitrogen are to varying degrees, lost by biogeochemical reactions (gaseous release) and not retained in sediments over time. Gravity core samples remain the preferred soft sediment sampling method for obtaining relatively undisturbed sediment profile samples for laboratory analysis, especially, the more consolidated soft sediments at depths below the top one inch or so (varies by water body and sedimentation rates). Core sampling also needs about 6 inches or more of soft sediment to be ‘retrievable” by core sampling at greater sampling depths like at White Pond. White Pond actually has minimal and limited thicknesses of “littoral” soft sediment at depths shallower than about 20 feet. Dense meadows of *Nitella* (5-10 to 45 foot interval) also limit the ability to take and retrieve soft sediment samples shallower than 45 feet at White Pond. Similar limitations for gravity core sampling of sediment at Walden Pond within its benthic meadows of *Nitella* were noted by others (USGS, 2001). HEA has also sampled benthic meadow, macroalga-*Nitella in-situ* at White Pond for laboratory analysis for nutrients (carbon, iron, nitrogen, phosphorus and sulfur) as summarized on **Table 3**.

Sampling and laboratory analysis for nutrient content of the very loose, easily suspended sediments on the upper-most sediment surface (the youngest sediment deposition layer) help to document seasonal (spring, summer, fall, winter) annual flux (gaining and losing) of nutrients. Underlying sediments (1" or deeper) at White Pond stratigraphically represent older deposits. A recent study by Stager, et al (2020) used radiocarbon dating of sediment and evaluation of changes in diatom assemblages over time to evaluate the quality of White Pond as documented by its sediment quality over time. That study found that each inch of sediment depth represented approximately 36 years down to a depth of 6 inches, then 100 years per inch to the base of the soft sediments (approximately 24 inches or a total of 2,000 years of soft sediment accumulation).

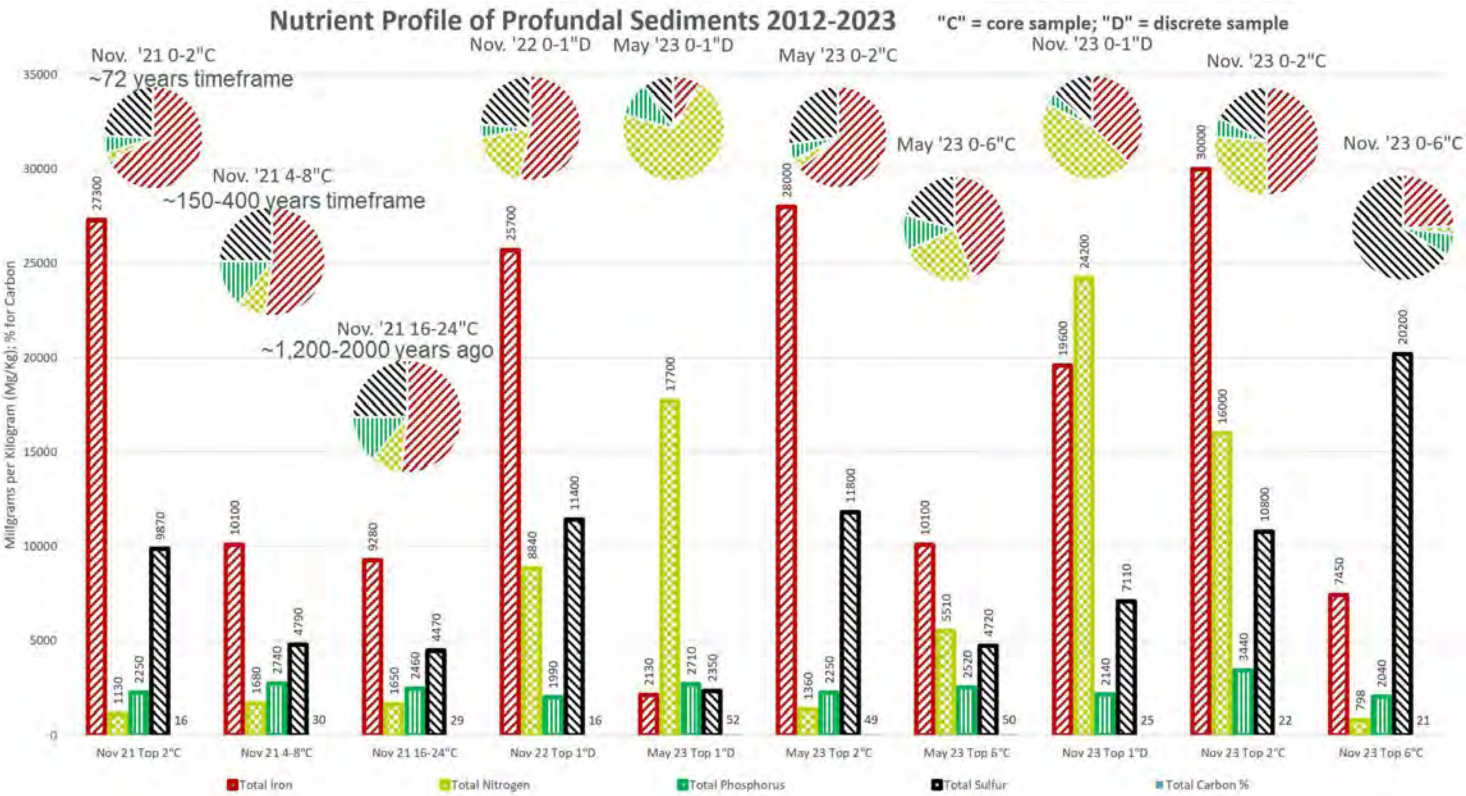
To evaluate 2023 results to historical changes in sediment quality, discrete sample results (preference top 1 inch) should be compared with sediment samples (core samples) collected at depths from 4 inches or greater, depending upon age comparison of interest. The following chart depicts percent nutrient difference between recent and older (4-8 inches and 16-24 inches) sediments at White Pond.

			2023 Top 2" Discrete				
Sample ID:	SED 3 -WP5	SED 3 -WP5	EH-62'-T2"			Percent Difference (+ or -) of 2023 Top 2 inches Discrete compared to 2021 by depth from core samples	
Lab Sample Number:	1K10047-01	1K10047-01	3K09056-03				
Date Sampled:	11/9/21	11/9/21	11/6/2023				
Parameter	Sample Results	Sample Results	Result	Limit	Units		
General Chemistry	4-8 inches	16-24 inches	Top 2 inches			**4-8 inches**	**16-24 inches**
Nitrate and Nitrite as N	Not Tested	Not Tested	Not Tested		mg/kg		
Total Nitrogen	**1680**	**1650**	**24200**	10	mg/kg	**+93%**	**+93%**
Kjeldahl Nitrogen	Not Tested	Not Tested	Not Tested		mg/kg		
Total Phosphorous	**2740**	**2460**	**2140**	1.6	mg/kg	**-28%**	**-15%**
Total Organic Carbon	**30**	**29**	**25**	0	Percent (%)	**-20%**	**-16%**
Total Metals							
Iron	**10100**	**9280**	**19600**	16.2	mg/kg	**+48%**	**+53%**
Sulfur	**4790**	**4470**	**7110**	162	mg/kg	**+33%**	**+37%**

Notes:

1. Nitrogen in older sediments at depth would be lost over time to denitrification and off-gasing compared to more recent "fresh detrital" sediment
2. Iron and sulfur are both oxidation-reduction sensitive elements and tend to remain more concentrated in upper most sediments, than deposited over time with deeper sediments.
3. Reduction in phosphorus in 2023 compared to historical results may be related to just differences in seasonal deposition rates compared to long term (mult-year) historical results. Removal of tree pollen in 2023 using the A-Pods may also help explain this, as tree pollen was historically present around and in White Pond but at lower volumes, duration and frequency than more recent, climate change altered tree pollen events.
   Decrease in phosphorus results in 2023 compared to historical results are also likely related to increases in sulfate deposition over time (past 200 years with acid rain deposition of nitrates and sulfates) as sulfate/sulfide promotes phosphorus release into overlying waters rather than sedimentation.

The next chart is a bar and pie chart of sediment samples collected by HEA since 2021. Samples collected with the gravity core sampler are noted with a “C”, discrete (Van Dorn type) by a “D”. Pie charts for each sediment sample visually depict the percent ratio of each nutrient (except carbon) relative each other nutrient, out of 100 percent (*i.e.*, percent total for all nutrients {except carbon} per sample). Percent carbon for each sample is noted as a number in the last "bar" of the bar chart. November 2021 samples are annotated with corresponding dates of deposition.



It may also be helpful to compare 2023 results (May to November) with deeper sediment core results from 4-8 inches (144 to 416 years ago) and 16-24 inches (greater than 1,200 years ago) as noted in the November 2021 vertical profile sample chart.

The pie chart has ratios of each nutrient per sample out of 100% (*i.e.*, to 100% fill the round pie area). The bar chart displays actual nutrient concentrations by sample depth and data. Total carbon is presented on the bar charts only as a percent (# on right side of sulfur bar) and has no separate column.

Note that the nutrients carbon and nitrogen will be lost by biogeochemical processes (gaseous releases) over time during sedimentation. Otherwise, phosphorus concentrations have remained fairly stable in the profundal, soft sediment stratigraphic section for the past 2,000 years. Iron and sulfur are both oxidation-reduction (redox) reactive elements that in addition to burial and use as nutrients, tend to stay concentrated within the upper one inch or so of the upper, more biogeochemically-active sediments. Higher iron to sulfur and iron to phosphorus ratios at the sediment surface (top 1-2 inches) documents that phosphorus tends be bound and lost (*i.e*., buried) to sedimentation over time, consistent with deeper sediment core results at White Pond. It is also important to note that phosphorus concentrations in sediment (recently and historically deposited) are consistent with the phosphorus content of tree pollen and cyanoHABs (Table 3).

In surface water, the iron to phosphorus and importantly, iron to sulfur ratios regulate the availability, release and sedimentation of phosphorus in aquatic systems (Caraco *et. al*, 1989-1993). In September 2023, total sulfur concentrations in surface water at intervals of 30 feet (oxygen rich) and 55 feet (anoxic) were 40.55 micromols/liter (umol/l) and 31 umol/l, respectively which would tend to limit phosphorus release from sediment as sulfate concentrations were 60 umol/l or less (Caraco et al, 1989). Iron to sulfur and iron to phosphorus ratios (by umol) are much greater than one (#1) except for one water sample, the iron to sulfur ratio at 30 feet with a ratio of 0.12. However, the most important ratio relative to sedimentation and whether "internal loading" from sediment is occurring would be the water sample from 55 feet which in September 2023 had an iron to sulfur mol ratio of 9 and an iron to phosphorus ratio of 183. Iron to sulfur and iron to phosphorus ratios at 55 feet under anoxic conditions indicate that phosphorus is being retained in these bottom waters and consistent with historical phosphorus sediment profile concentrations with depth, phosphorus is being retained in sediment year by year more than it is being released to overlying waters. Increasing sulfur content in White Pond could reverse this (*i.e*., more phosphorus release than exported into sediment over time).

For both CORE and discrete samples from May to November 2023, the nutrient carbon decreased by approximately 50% and iron remained fairly constant for CORE samples (reduction of 7%) but the discrete samples (top 1-2 inches) had a 46% reduction in iron from May to November 2023.

HEA has not observed hydrous iron minerals in oxic or anoxic sediments of White Pond. If present, the anoxic forms of hydrous iron-phosphorus minerals (including the minerals strengite and vivianite) would occur within the anoxic sediment-pore water space of buried sediment. Hydrous iron minerals (oxic and anoxic) can be significant natural sinks for the nutrients iron and phosphorus (up to 40,000 milligrams per kilogram). Additional information on this topic is provided in a separate presentation by HEA at www.higginsenv.com on lake iron nodules and the impact by sulfur and also in a paper by Hansel, C., Lentini, C., Tang, Y. *et al.* (2015).

In 2023, HEA visually observed concentrations of a dark-colored precipitate, interpreted as iron sulfide in sediment samples and cores. Concentrations of the nutrient/element sulfur were also noted in laboratory results. Based on this review (see preceding chart), iron and sulfur are typically at greater concentrations in the upper sediment layers, than deeper and for some reason, the 0-6 inch core sample of sediment in November 2023 which had the highest concentration of sulfur in sediment to date. Based on mechanisms supporting hydrous iron mineral formation, hydrous sulfur minerals may similarly be present as concentrated masses and sediment areas/depths of White Pond. In any event, both iron and sulfur are biogeochemically-active nutrients and elements that interact with each other and tend to transition from dissolved (biogeochemically-reduced) to solid (biogeochemically-oxidized) forms at the sediment-surface water interface (profundal and littoral) of many fresh water lakes and ponds. A high iron to sulfur and phosphorus ratio is important in order to sustain the biologic integrity of fresh water lakes and ponds. High iron, low sulfur ratios help to maintain a net positive (*i.e*., export or sink) sedimentation rate for phosphorus, as has been the case for White Pond for the past 2,000 years. Sulfide is also an oxygen-scavenger and is both a toxin and potent phytotoxin to eukaryotes and prokaryotes (animals, phytoplankton, benthic macroalgae and macrophytes, etc.) (Kushkevych *et al*, 2021; Lamers *et al*, 2013; Miller *et al*, 2004). White Pond likely has anoxygenic heterotrophic prokaryotes (cyano, green and purple bacteria) at the deep water-profundal sediment interface that can oxidize and to some extent, decrease the availability and toxicity of sulfide.

3.4 Tree Pollen, Forest Particulates and A-Pod Trap Residue Sampling and Laboratory Analysis

Material, Methods and Equipment Utilized:

In 2023, cyanoHABs were not present at recoverable volumes, other than initial co-location/association with tree pollen (oak and white pine primarily) and forest particulates (collectively "tree pollen"). Tree pollen began to collect at the A-Pod traps in mid-May through early July. During this time, cyanoHABs were observed (visually, by microscopy, PC sonde and lab analysis) to be colonizing (by zonation) and rapidly growing (confirmation of substrate growth of cyanoHABs off of tree pollen and pond water under ambient conditions in an enclosed C-Pod) on tree pollen. As such, tree pollen deposited on White Pond was removed from A-Pod trap areas, dried out on land, and then sampled for laboratory analysis of nutrient content by compositing several grab samples (first from oak pollen, then from white pine pollen and later from A-Pod trap residue of forest particulates). Note: Oak pollen occurred earlier in the season (mid-May) prior to white pine pollen (late May through early July) (as confirmed visually and by microscopy). After sampling of tree pollen solids, these were biodegraded on land in a controlled manner similar to cyanoHABs in 2022. A total of 326 pounds of dry to moist tree pollen and 23 pounds of forest particulate residue (total of 349 pounds) were removed from the A-Pod trap area in 2023. Laboratory results are summarized on **Table 3**. This table also includes sediment samples (2021-2023) and a 2021 grab sample of benthic macro-algae (*Nitella*) collected off the sediment surface (in about 30 feet of water).

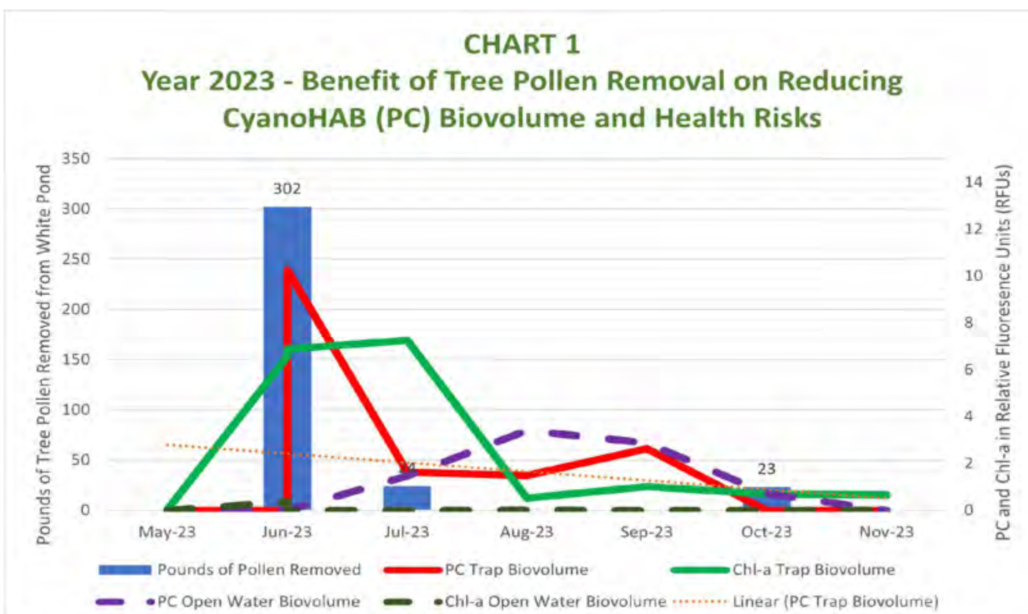
Tree pollen and trap residue solid samples were submitted for the same laboratory analysis for nutrients as surface water and sediment samples. Similar to previous cyanoHAB sample results, as living organic matter, the total nitrogen results for both benthic algae, tree pollen and trap residue solids should be primarily organic (kjeldahl) nitrogen. Tree pollen and trap residue samples collected in 2023 were frozen after sampling and kept under chain of custody documentation through laboratory analysis.

Field and Laboratory Data:

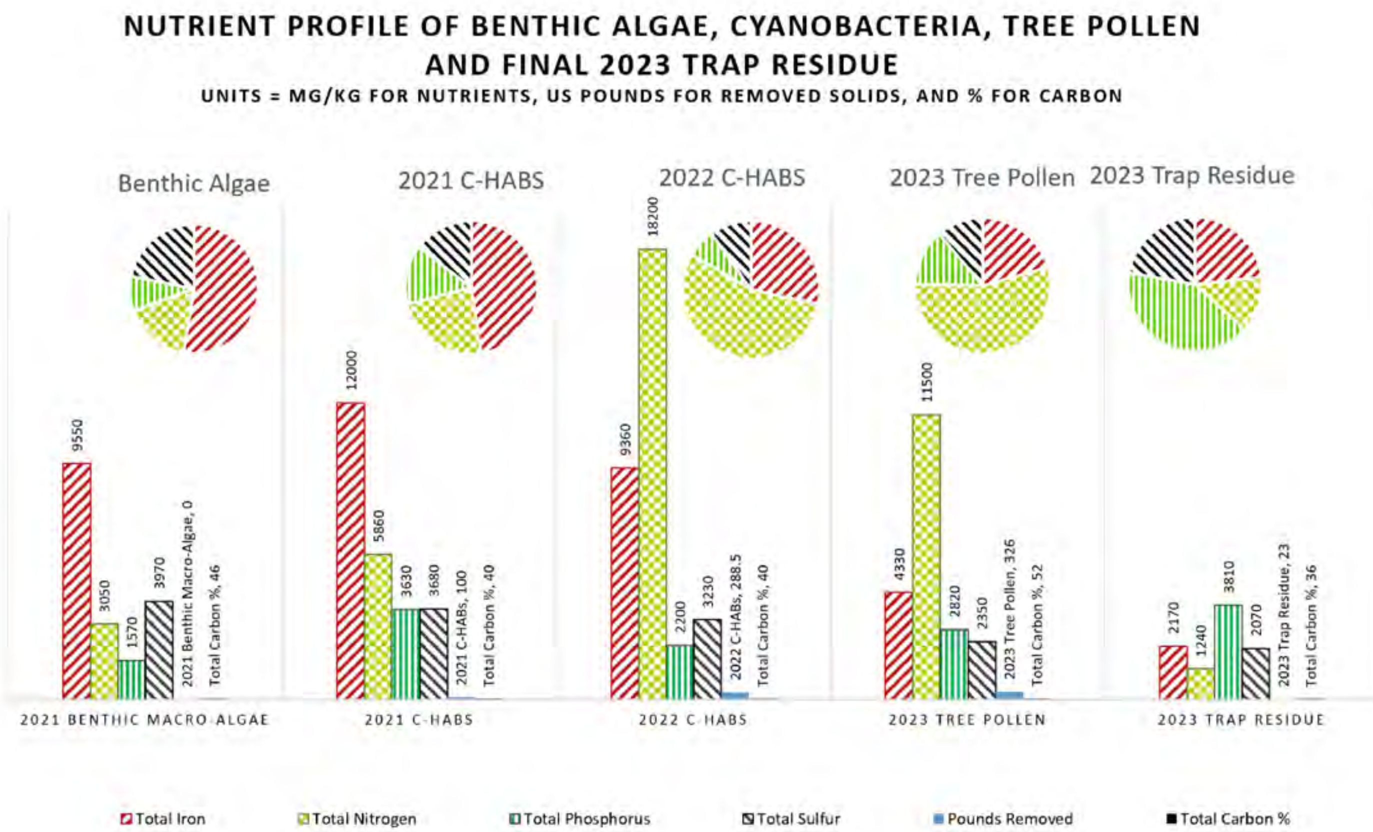
Field Sonde PC and Chl-a, and corresponding laboratory cyanotoxin data (from the tree pollen-cyanoHAB control in C-Pod) are summarized on **Table 1**. Laboratory results for 2023 of tree pollen and trap residue are summarized on **Table 3**. Laboratory data sheets for 2023 tree pollen samples are attached for reference.

Tree Pollen Sample Findings:

Field PC and Chl-a correlated well with visual observations of tree pollen accumulation and growth of cyanoHABs on tree pollen. The Chl-a (a photosynthetic pigment used to assess phytoplankton biomass) sonde probe apparently was responding, positively, to the relative amount of tree pollen (tree pollen is not an aquatic phytoplankton but likely contains the same or very similar photosynthetic pigment - Chl-a). In the month of June, 302 (dry to moist) pounds of tree pollen were removed from the A-Pod traps and the C-Pod control (mesocosm) sample. On July 7, 2023, an additional 24 pounds of tree pollen and detritus were removed from the A-Pod traps. On June 20th the tree pollen and visibly/microscopy apparent cyanoHAB colonization biomass in the A-Pods were transferred to an enclosed C-Pod placed adjacent to the A-Pod traps. Initial field PC and laboratory sample results for cyanotoxin from the contents (pond water, tree pollen and cyanoHABs) of the C-Pod on June 20th had a PC of 54.755 Relative Fluoresence Units (RFUs) and a microcystin (MC) cyanotoxin content of 7.9 ug/l. Four days later, on June 24th, the C-Pod contents were sampled again and had a field PC of 185.995 RFUs and an MC cyanotoxin content of 52.9 ug/l. Field PC and laboratory results documented a rapid growth of *Microcystis* CyanoHABs and related toxin (MC) content rapidly, under ambient but controlled pond conditions when present with tree pollen. On June 24, the contents of the C-Pod were removed from the pond along with ongoing, routine removal of tree pollen and similar suspended solids (cyanoHABs, forest particulates, etc.) from the A-Pod traps. A chart of monthly tree pollen removal amounts (U.S. dry to moist pounds), A-Pod trap and open water (approximately 3 feet deep, center of pond) PC and Chl-a readings follows (note, the PC Trap biovolume results include C-Pod mesocosm testing results):



Elevated concentrations for PC and Chl-a corresponded to volumes of tree pollen trapped (in the A-Pod and separately, placed in the C-Pod mesocosm). Open water PC and Chl-a results (dashed lines on the chart) remained much lower in concentration than A-Pod trap and C-Pod results. All results (trap and open water) decreased after the tree pollen season was over (by mid-July) though forest particulates (pine sap flakes, insects, small flowers, leaves, sticks and similar) continued to accumulate in and before the A-Pod traps from mid-July to October (total of 23 pounds of "trap residue" mostly forest particulates). The season ending, October 2023 trap residue sample contents contained the highest concentration of phosphorus to date (2021-2023 of any solid sample) at 3,810 mg/kg. During weekly-monthly field inspections, HEA removed "floaters" (mostly sticks, leaves and pine needles) of forest particulates from before and in the A-Pod traps and placed these in an upland area (not biodegraded or included in "pounds removed" similar to other solids). Otherwise, these forest particulate floaters would reduce the flow of suspended solids into the A-Pod traps. Tree pollen and trap residues contained similar amounts and types of nutrients as previously removed cyanoHABs. A chart of nutrient content for *in-situ* benthic macroalgae (*Nitella*), tree pollen, trap residue and cyanoHABs follows. Tree pollen results on this chart are the average results between oak and pine tree pollen, both very similar in nutrient content. Laboratory results are summarized on **Table 3**.



3.5 Phytoplankton and Zooplankton Assessments and Laboratory Analysis

Material, Methods and Equipment Utilized:

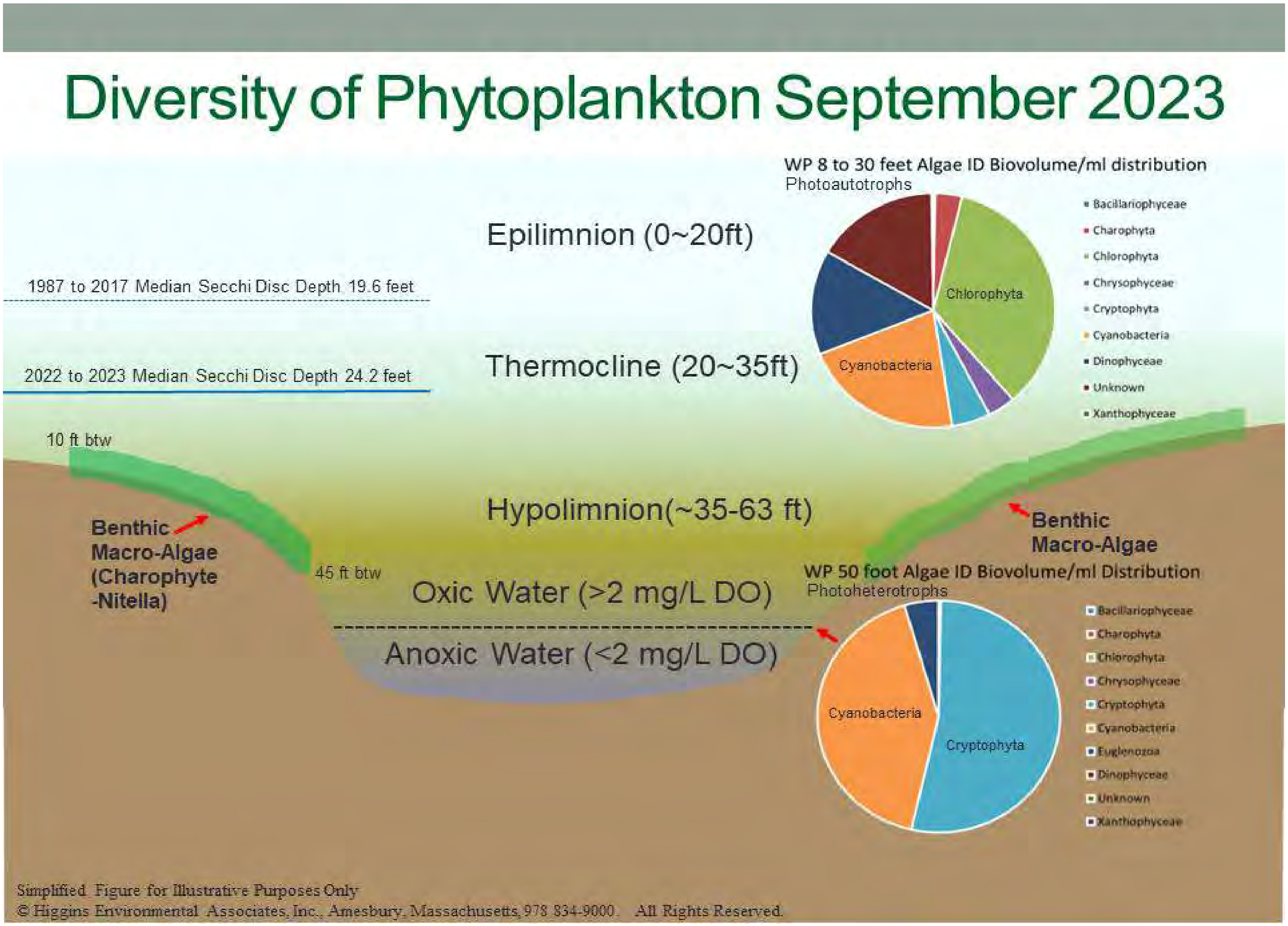
On September 12, 2023, to provide additional supporting information for passive harvesting and removal of cyanoHABs from October 2021 to October 2022, HEA collected three discrete water samples at 8 feet, 30 feet and 50 feet from the eastern-most deep basin. Each sample was visibly clear with no suspended solids or discoloration. Samples from 8 and 30 feet were mixed together in a clean container then placed, as a composite sample, directly into laboratory bottles. The sample from 50 feet was collected and placed directly into laboratory bottles. Samples were packed on ice and shipped overnight to GreenWater Laboratories in Florida for algae (phytoplankton and cyanobacteria) enumeration, biovolume and biomass determination, laboratory datasheets are attached.

An aliquot of each sample was also placed in a separate 8-ounce wide-mouth glass jar and field tested for BGA-PC and Chl-a. Each of these non-laboratory aliquots were also viewed without concentration procedures for suspended solids using a microscope.

On October 2023, a vertical zooplankton tow (20 cm x 60 cm by 50 micron mesh) profile sample from a depth of 40 feet to the surface was collected in the deep hole sampling stations at both Walden and White Pond. Samples were placed in 8-ounce glass jars and assessed with a microscope back at the office.

Field and Laboratory Data:

Field BGA-PC and Chl-a and corresponding laboratory data are summarized on **Table 1 - Monthly Field Data Summaries for White Pond Restoration with A-Pods - Emphasis on Cyanobacteria Data**. Laboratory data sheets for phytoplankton/ cyanobacteria enumeration analysis are attached for reference. Laboratory results for phytoplankton/cyanobacteria are also summarized on the following schematic diagram of White Pond.



<u>Phytoplankton and Zooplankton Findings</u>:

In 2021-2022, White Pond cyanoHABs were predominantly (85-90 %) *Microcystis* sp. with lesser occurrence or dominance by *Dolichospermum* sp. (Leland, 2022). In 2023, low concentrations of *Microcystis* sp. were detected early in the season (June to July) by independent Board of Health sampling off the swimming beach and in several open water sample locations, including from Thoreau's Cove where A-Pods have been placed. These early season, open water and beach area sampling results were less than health-based guidance criteria.

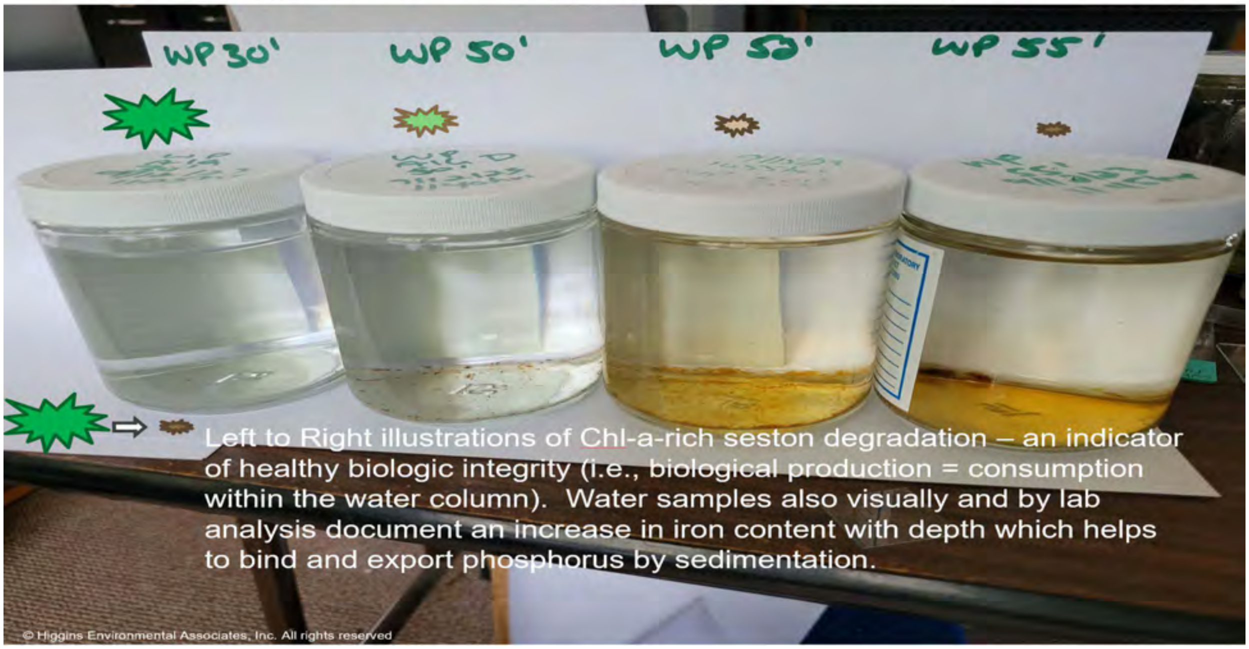
In HEA's September 2023 water samples (8-30 feet and from 50 feet), no *Microcystis* sp. or *Dolichospermum* sp. were identified and the dominant species of phytoplankton changed from previously dominant cyanoHABs (2021-2022) to green algae (Chlorophyta 8-30 feet) and Cryptophyta (considered a primitive heterotroph with chloroplasts similar to green algae at 50 feet). Cyanobacteria species were less dominant than green algae or cryptophyta and from 8-30 feet were all non-toxic species. At 50 feet, the laboratory identified the cyanobacteria species as primarily *Limnothrix* (a rarely detected PTOX species (based on immunoassay testing (Daniels, 2012) but later genomic analysis (Lima, 2018) could not locate toxin producing structures in *Limnothrix*). In any event, field BGA-PC testing of water from 50 feet placed in a bucket and tested the next day had very little remaining BGA-PC signatures so it appears that this extreme environment (deep, dark waters) cyanobacteria species cannot survive very long under ambient, essentially shallow water conditions.

Based on HEA's research, only four specie variants of *Limnothrix* have been identified globally. In part this may relate to people/scientists, just not sampling and evaluating water from otherwise extreme niche environments. In any event, based on the temporary-seasonal, only deep water occurrence of *Limnothrix*, this oxygen producing (*i.e*., oxygenic) photoheterotrophic cyanobacteria specie is probably serving an important function as an organic carbon (seston and detritus) biodegrader. The laboratory also thought that *Limnothrix* could possibly be another very similar species of cyanobacteria called *Pseudanabaena* sp. but they preferenced *Limnothrix*.

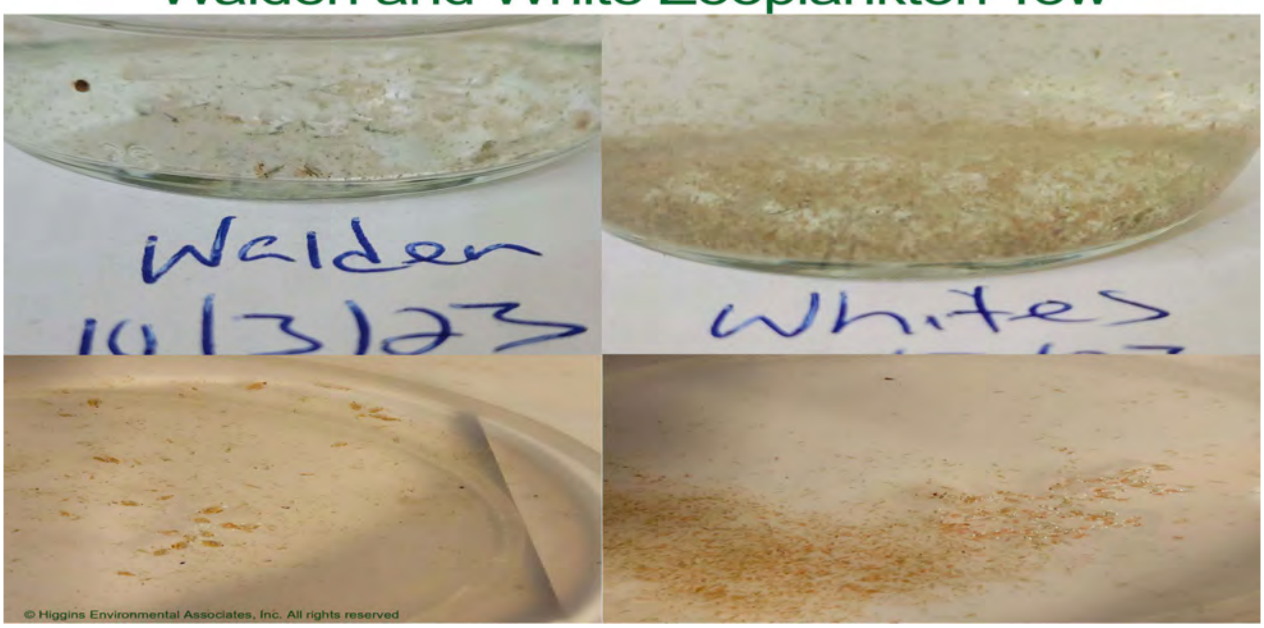
Diversity of phytoplankton including cyanobacteria is an important measure of biological integrity. The following annotated photograph is of water samples from 30, 50, 52 and 55 feet. This photograph helps to illustrate microscopic analysis of each water sample (by depth) - documenting the biogeochemical reduction/breakdown of seston size and loss of chlorophyll-rich content (green color) with depth. This microscopy evaluation indicates that (in September 2023 during sampling) White Pond had a healthy biodiversity of both oxygenic photoautophs (green algae), oxygenic photoheterotrophs (deeper cyanobacteria species) and by inference, aerobic bacteria to both produce a healthy and diverse population of phytoplankton and to fully degrade same as it settles to the pond bottom. The light brown coloration of soft sediment cores from White Pond are also consistent with oxidized deposition with limited amounts of reducing agents like sulfur.

The following photograph documents zooplankton tow sample contents from Walden and White Pond on October 3, 2023. A more detailed analysis of zooplankton and cyanobacteria populations at White Pond was completed by Leland (2022), as noted in the Reference section of this report. In 2023, zooplankton biomass was visually greater at White Pond than Walden, and contained species identified by Leland (2022). Walden likely had less zooplankton biomass than White Pond in 2023 due to predation by the invasive jellyfish, Peach Blossom, discussed previously in this report.

September 2023 Water Samples



Walden and White Zooplankton Tow



3.6 Water Clarity

Material, Methods and Equipment Utilized:

In addition to sonde turbidity measurements, water clarity was measured around noon on calm days using a secchi disc without the use of a view scope. Use of a view scope reduces light interference at the water surface and likely would have increased HEA's interpreted water clarity depths. A view scope as historically used by others to obtain the 30 year median (1987-2017) secchi water clarity depth of 19.6 feet.

Field Data and Findings:

HEA had a maximum secchi disc water clarity reading of 28.3 feet (approximately 9 meters) on July 7, 2023. The year 2023 median secchi disc water clarity was determined to be 24.2 feet (May to November) versus the 1987-2017 year historic median of approximately 19.6 feet (approximately 6 meters, typically measured between June and August of each year). Year 2022 secchi disc median (during cyanoHAB recovery using the A-Pods) was also 24.2 feet.

Turbidity sonde data, provided as an attached chart, were generally low and indicative of high water clarity. Seasonally (July to November) at depths of approximately 45 plus feet, turbidity increased (from approximately 1 to 8 nephelometric units (NTUs)). This increase in turbidity at depth also corresponded to the thin layer of more concentrated phytoplankton noted later in the season (September to early November) at approximately 48 to 51 feet.

There are three parts to consider about water clarity:1) the part that humans see when looking down into the water; this is vertical-column visual measurement using a secchi disc of turbidity and dissolved organic matter; 2) the transmission of light needed for photoautotrophic phytoplankton and macro algae; referred to as part of the photic zone, extends down to about 45-50 feet; and, 3) the extremely limited extent of the photic zone where the photoheterotrophic organisms such as *Limnothrix* and Cryptophytes at White Pond thrive at 50 plus feet. Below this photic zone, there are other photic-capable prokaryotes known as green and purple sulfur bacteria and some anoxygenic photoheterotrophs and non-photosynthetic bacteria that utilize nitrate and sulfate/sulfides, carbohydrates and chlorophyll from seston and likely ferric iron to obtain energy under extremely limited to no light conditions. Degradation of chlorophyll-rich seston with depth was documented at White Pond by microscopic analysis of the September 2023 water samples, as noted in the preceding photograph. This process, a form of water-column internal loading or more appropriately "recycled production" (Caraco *et. al.*, 1992; Dugdale and Goering, 1967) helps to maintain a healthy ecosystem without promoting anoxic conditions due to aerobic biodegradation of "excess" undegraded or un-recycled organic matter and nutrients at greater depth; closer or on the profundal sediment-water interface (*i.e.*, internal loading from sediments).

White Pond now has a very diverse group of phytoplankton and zooplankton communities that function better (more light, less cyanotoxins, higher dissolved oxygen content with depth) without the previously dominant, light limiting, cyanoHABs removed in 2021 and 2022.

4.0 DISCUSSION OF FINDINGS FROM MAY TO NOVEMBER 2023

In 2023, after removing the previously dominant cyanoHABs in 2021 and 2022, it became readily apparent that terrestrial, external loading (*i.e.*, new production source) of tree pollen to White Pond was serving as an important nutrient substrate for growth of *Microcystis*. Based on ambient condition, controlled field assessments *Microcystis* biomass (PC) and cyanotoxin (MC) content increased significantly within a four-day period (in a mesocosm; a closed off C-Pod placed next to the A-Pods). As such, passive trapping and removal of tree pollen using the A-Pod technology continued as a health-prudent measure to limit growth of cyanoHABs and impact to health and water quality in 2023. The majority of tree pollen external loading to White Pond decreased substantially by mid-July with lessor amounts of forest particulates (pine sap flakes, insects, flowers, seeds and similar suspended solids) continuing to accumulate in A-Pod traps until A-Pods and their trap residue contents were removed in October 2024.

As documented by field and laboratory analysis, biologic integrity and water quality throughout White Pond since use of the A-Pods to remove cyanoHABs in 2021 and 2022 and tree pollen in 2023, as measured primarily by dissolved oxygen, total phosphorus, phytoplankton and zooplankton biomass and diversity, water clarity and decreases in cyanoHAB occurrence improved relative to historical water quality data (1940s through 2021). September 2023 vertical profile sampling and analysis of surface water for phytoplankton documented a lack of previously detected and dominant cyanoHAB species (*Microcystis* sp. and at times *Dolichospermum* sp.) (Leland, 2022). Zooplankton vertical tow nets (to 40 feet) at Walden and White Pond in October 2023 had visually more abundant (approximately two to three times as much) zooplankton at White Pond than Walden (likely related predation by the invasive jellyfish, Peach Blossom, at Walden Pond).

The 2023 findings have documented that climate change is likely the cause for increases in water temperature over time, and more recently, by increasing air temperature and carbon dioxide content, to increases in tree pollen production, deposition and volume impacting White Pond. Laboratory analysis of tree pollen (oak and white pine pollen samples) had elevated concentrations of the same nutrients as documented for cyanoHAB in 2021 and 2022. Walden Pond had visually less abundant tree pollen impacts in 2023 than White Pond but Walden also has a higher percentage of oak trees compared to white pines that are common around and near (within the "air-shed") of White Pond. White pine tree pollen also seems to transport further by air than oak pollen (early research and observations by the report author), particularly as White pines extend above the forest canopy more than oak trees do, where winds are greater. Tree pollen generation since approximately 2015 is also occurring over much larger areas and more frequently (recurring annually) in Southern New

England (south of Stowe Vermont and Portland Maine) than the author has observed prior to 2015. It used to be that tree pollen production would skip areas and years (frequency off-on around 3 to 5 years; some readers may be familiar with the term “mast” years for tree pollen and related tree nut production), this is no longer the case and based on the authors observations and research, increased tree pollen production is an indicator of climate change, our “new normal” with a related increase of early season, external nutrient source loading available to support cyanoHAB growth and dominance. Removal of this early-season, external nutrient source (tree pollen) using the A-Pods in sentinel-mode, likely served to sustain biologic integrity of the pond and prevent the previously dominant forms of cyanoHABs from recurring (*i.e.*, being the dominant specie) in 2023.

5.0 RECOMMENDATIONS

Based upon our findings to date, HEA recommends the following:

1. As a health prudent preventative measure, similar to other watershed-water quality best management practices like stormwater controls, limitation on fertilizer use near water bodies, etc., A-Pods (as sentinel versions) should be available for use at White Pond to be deployed where and as needed to passively trap and remove external nutrient loading to the pond by tree pollen and forest particulates and as a precautionary tool to prevent or limit a future cyanoHAB condition. Tree pollen biomass production, duration and annual frequency of occurrence has been increasing, likely due to climate change. This appears to be our “new normal” for southern New England and other parts of the globe.

2. Similar to HEA’s 2022 report recommendations, HEA recommends that residents of Concord, particularly those close to or hydrogeologically-connected by drainage area to White Pond take measures to limit use of the element and nutrient sulfur. Sulfur can negatively impact otherwise, natural, biogeochemical conditions, nutrient cycling in fresh water bodies like White Pond. It may help to think of sulfur as the “controlling nutrient” that actually determines whether the “limiting nutrient” phosphorus remains more available than it otherwise would be. White Pond has a 2,000 year record of fairly uniform, phosphorus content in soft sediment with depth with currently only limited amounts of sulfur impacts; despite many years of nitrate and sulfate deposition by industrial pollution (aka “acid precipitation” since the mid-1800s). White Pond’s glacial kettle hole, seepage fed versus large drainage area fed condition (*i.e.*, streams entering a water body from larger watershed areas) may have limited historical impacts by sulfur to White Pond compared to other drainage-fed water bodies.

   Sulfur is a component of many common residential and commercial use products and practices including within detergents, water treatment chemicals, lawn care products and fertilizers. So, residents near the pond can make informed decisions about which products to use or not.

   Excess sulfur/sulfide can negatively impact (sulfide is a potent phytotoxin, Lamers *et. al*, 2013) phytoplankton, macrophytes, benthic macro-algae (the benthic meadows of *Nitella* at White and Walden

Ponds). Loss or impairment of White Pond's benthic meadows of macro-algae, a significant natural sink for most "active" nutrients in the pond and of beneficial phytoplankton communities could be a tipping point for sustainable water quality beyond controlling/removing external nutrient loading such as from tree pollen.

3. Purchase and maintain basic water quality equipment (a vertical profile capable sonde for pH, dissolved oxygen, temperature), secchi disc, discrete water sampler. Set up, maintain and archive weekly-monthly monitoring records. Weekly data collection for the last two weeks of August and first two weeks in September will be particularly helpful over time.

   As times change, circumstances and importantly, the degree and source(s) of external nutrient loading to the pond may change; either by intent (*i.e.*, development, infrastructure choices, over use, etc.) or by essentially uncontrollable conditions (*i.e.*, climate change, land use cover changes due to pests or disease, etc.). Consistent, annual monitoring records and observations help to document these changes and provide supporting information to respond accordingly.

4. Water temperature throughout White Pond (top to bottom) has been increasing since records were first documented in August 1949. Increasing water temperatures also affect cold water fisheries by decreasing the volume and duration of suitable water temperatures (less than 20 degrees Celsius or 68 degrees Fahrenheit). Fortunately, dissolved oxygen content has increased with depth at the pond since use of the A-Pods to trap and remove cyanoHABs. However, at some point due to climate change, White Pond may lose its cold-water fisheries habitat and status. One possible improvement could be made by implementing watershed management actions such as:
   A. Limiting the amount of paved (heat producing) surfaces around and near the pond.
   B. Reducing tree cover to foster an increase in understory shrub and healthy soil land use coverage around and near the pond. Allowing sunlight to reach the ground surface (limited in closed forest canopies) can increase understory plant diversity and growth which in turn supports an increase in soil microbial biomass and diversity (leading to healthy soil). Healthy soil sequesters a significant amount of carbon and supports more favorable hydrologic conditions *i.e.*, less storm water runoff, more infiltration and less evaporation which could increase ground water base flow to White Pond and help to ameliorate higher surface water temperatures in the summer to early fall season. Healthy soil actually can be a greater carbon sink than terrestrial plants including trees. Unlike trees, soil and its carbon are "stackable", *i.e.*, soil layers build up each year without the same limits on growth or carbon capture per biomass experienced by terrestrial plants. For more information, HEA has a side-bar paper on Healthy Soils downloadable at www.higginsenv.com that appeared (an edited version pp 28-29) in Massachusetts' Resilient Lands Initiative - Healthy Soils Action Plan https://www.mass.gov/info-details/resilient-lands. Promoting healthy soil is something that people and communities can do to mitigate some climate change impacts.

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ATTACHMENTS

Figures

Figure 1 - General Location of White and Walden (2023 Reference site) Ponds in Concord, Massachusetts
Figure 2 - MassWildlife Bathymetric Map for White Pond

Tables

Table 1 - Monthly Field Data Summaries for White Pond - Emphasis on CyanoHAB data
Table 2 - Surface Water Sampling Results
Table 3 - Recovered CyanoHAB and Sediment Sample Results

Charts

Chart 1 - 2023 Benefit of CyanoHAB Removal
Chart 2 - 2023 Monthly Walden and White Pond BGA-PC Population Variance
Chart 3 - October in Years 2021 to 2023 Changes in BGA-PC Biomass and Biovolume in White Pond
Charts 4-12 - 2023 Monthly Profiles for: Chl-a, Temperature, Dissolved Oxygen, Turbidity, pH, Oxidation-Reduction Potential, Specific Conductance, Resistivity, Salinity

Laboratory Data Sheets - Concord's Year 2023 Tree Pollen, Trap Residue, Sediment and Surface Water samples.

As a courtesy, HEA has included laboratory data sheets and results for phytoplankton samples discussed in this report but completed as part of HEA's technology supporting research and development program. Chart 1 -

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FIGURES

YEAR 2023 SUMMARY REPORT
RESTORATION OF WHITE POND'S WATER

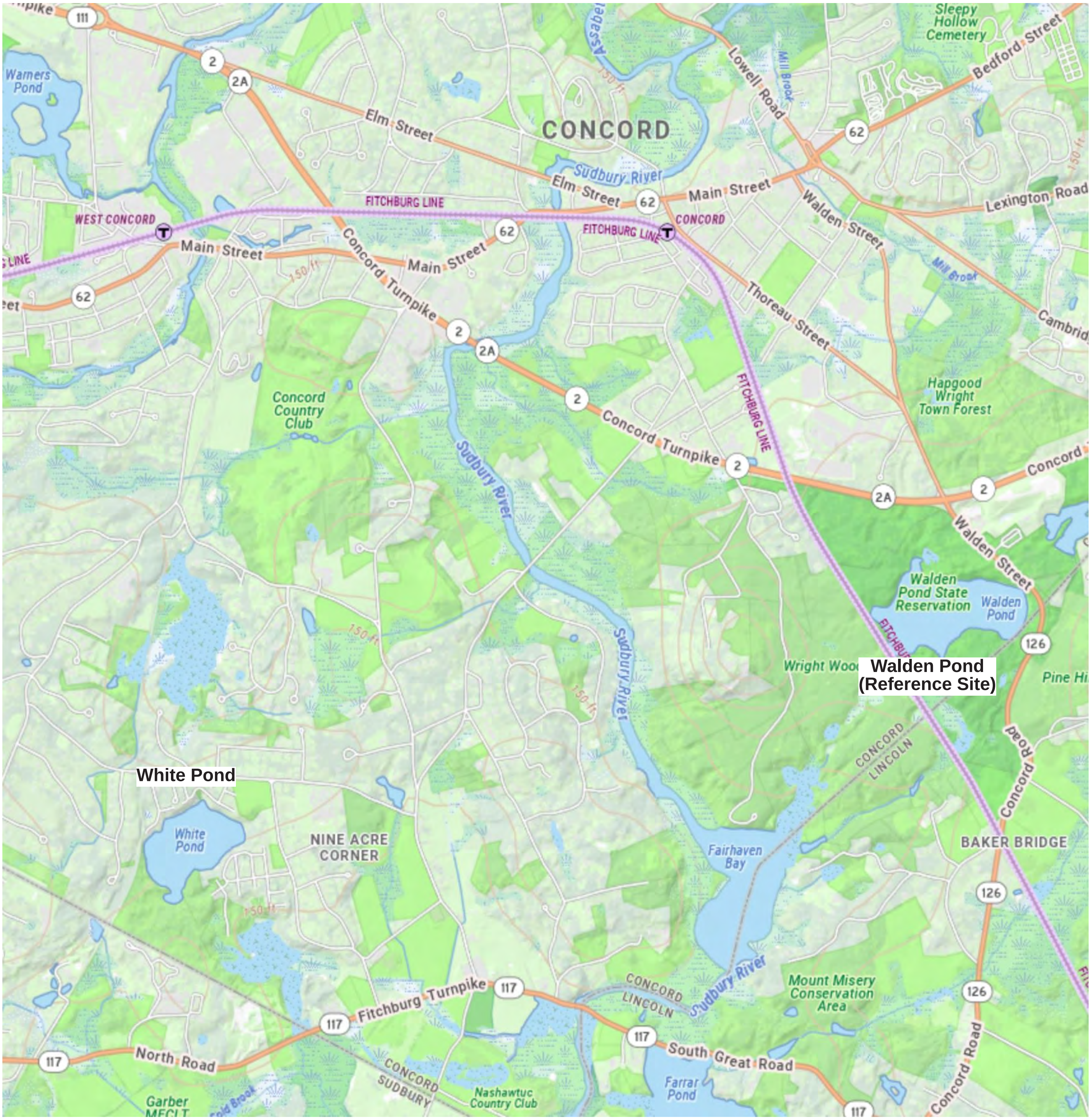


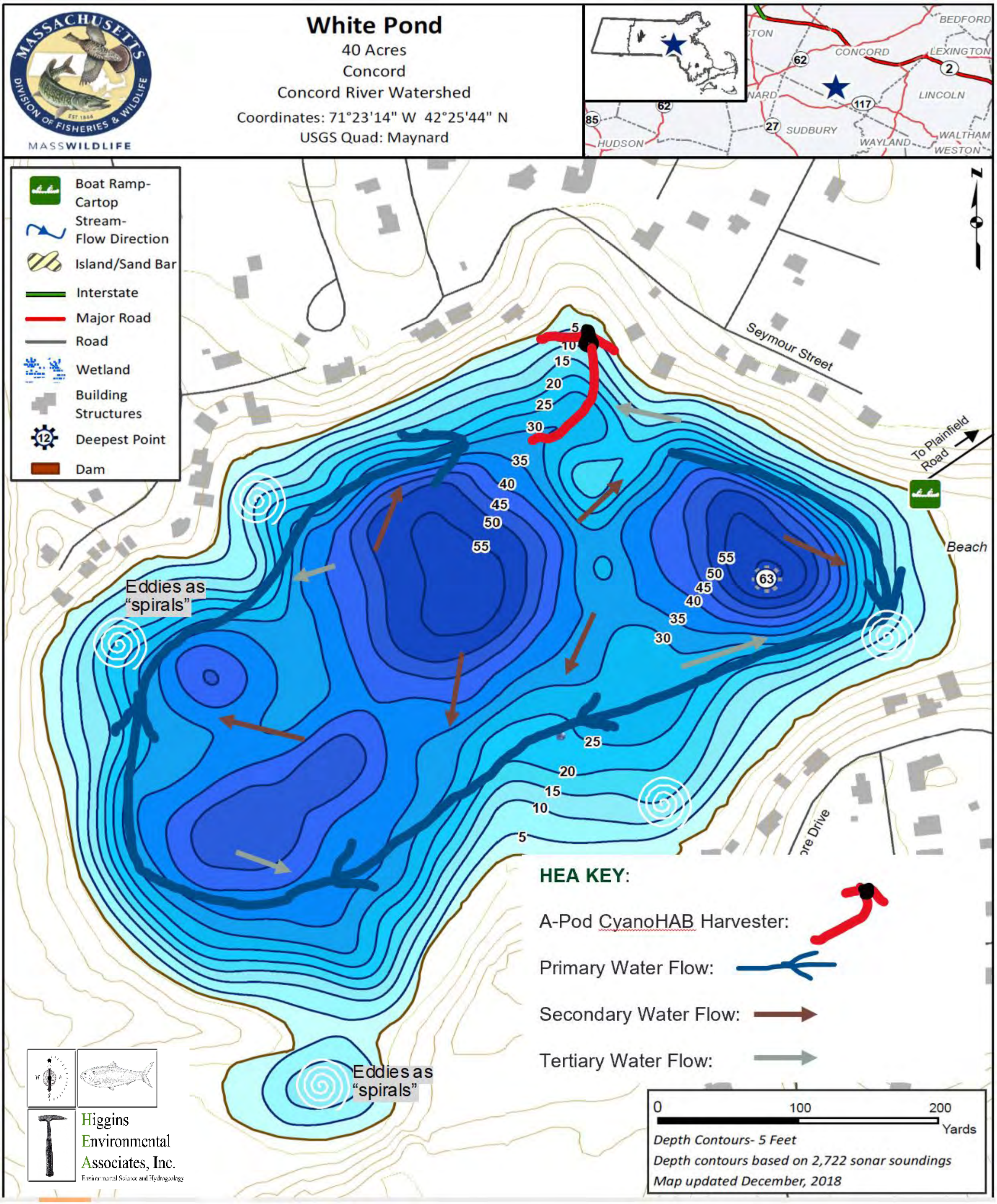
Figure 1 - General Location of White and Walden Ponds in Concord, Massachusetts

NORTH

Scale = 2100 feet

Prepared on April 8, 2024 from MassGIS MassMapper
Locations and dimensions are for illustrative purposes only.

Higgins
Environmental
Associates, Inc.
Environmental Science and Hydrogeology



White Pond
40 Acres
Concord
Concord River Watershed
Coordinates: 71°23'14" W 42°25'44" N
USGS Quad: Maynard
MASSWILDLIFE
Boat Ramp-Cartop
Stream-Flow Direction
Island/Sand Bar
Interstate
Major Road
Road
Wetland
Building Structures
Deepest Point
Dam
CONCORD
BEDFORD
LEXINGTON
LINCOLN
SUDBURY
WAYLAND
WALTHAM
WESTON
HUDSON
Seymour Street
To Plainfield Road
Beach
Eddies as "spirals"
Eddies as "spirals"
HEA KEY:
A-Pod CyanoHAB Harvester:
Primary Water Flow:
Secondary Water Flow:
Tertiary Water Flow:
0 100 200 Yards
Depth Contours- 5 Feet
Depth contours based on 2,722 sonar soundings
Map updated December, 2018
Higgins Environmental Associates, Inc.

HEA

TABLES

YEAR 2023 SUMMARY REPORT
RESTORATION OF WHITE POND'S WATER

TABLE 1 - MONTHLY FIELD DATA SUMMARIES FOR WHITE POND RESTORATION with A-Pods - EMPHASIS ON CYANOBACTERIA DATA

White Pond	Toxic Cyanobacteria Data	Maximum Field BGA-PC	Maximum Field Chl-a	C-Pod Field PC and Cyanotoxins		Field BGA-PC (Chla)	Open Water lab PC and Cyanotoxins		Walden - Water Clarity	White P. - Water Clarity	Depth to Sediment	CyanoHAB Scums
Monthly Records	Pounds Recovered (monthly)	A-Pod Trap	A-Pod Trap	Field Sonde PC	Lab Cyanotoxins	Open Water - @ 3 feet	Lab PC	Lab Cyanotoxins	(Secchi depth in Feet)	(Secchi depth in Feet)	Deepest Basin	In Pond?
Units of Measurement	U.S Pounds	RFUs	RFUs	ug/L	ug/L	RFUs	ug/L	ug/L	Feet	Feet		Visual
1987-2014 Data (by others)	None	Not Measured		Not Appicable	Not Applicable	Not Measured	Not Measured	Not Measured		Median of 6 Meters(19.6ft)		Yes
2021 HEA White Pond Data												
July (7/16/21 East Hole)	No A-Pod	No A-Pod		No A-Pod	No A-Pod	2.32				Not measured		Yes
August (8/26/21 East Hole)	No A-Pod	No A-Pod		No A-Pod	No A-Pod	2.39				Not measured		Yes
October (10/7 Center Hole)	40	9.7 (Oct. 7)		221.03		2.14	4.27			Not measured		Yes
October (10/14 Trap)	60	131.6 (Oct. 14)		8689	35.9 Microcystin					Not measured		Yes
Year 2021	100 (estimate)	131.6		8689	35.9 Microcystin	2.28	4.27					Yes
2022 HEA White Pond Data												
May (5/5 East Hole)	None					1.69				31	61.9	No-Pollen
June (6/2 Center Hole)	75	13.46 (Jun. 14)		7.23	Not Detected	1.96	1.92	Not Detected		Not measured		Yes-spotty
July (7/13 East Hole)	110	24.86 (Jul. 5)				2.68				16.5 to 18.3	62.6	Yes-thin
August (8/16 East Hole)	35.5	18.57(Aug. 20)		17.2	0.08 Anatoxin	1.88	2.38	Not Detected		18.3 to 20.1	60.2	Yes-thin-spotty
September(9/8 East Hole)	8	10.32 (Sept.27)				1.55				19.6 to 22.5	58.7	No
October (10/12 East Hole)	40	53 (Oct. 16)		113.24	0.802 Microcystin	1.07	2.61	Not Detected		32.6	61.9	No
November (11/9 East Hole)	20	7.76 (Nov. 2)				1.20				20 to 27.6	60.4	No
December (12/5 East Hole)	A-Pod removed 11/22/22	Not applicable		Not applicable	Not applicable	1.05				Not measured	59.2	No
Year 2022	288.5	53		113.24	0.802 Microcystin	1.64	2.61	Not Detected		Median of 24.2	60.4	No - Sept +

2023 HEA White Pond Data	A-Pod Setup May 11-12											
May (5/8-12 East Hole)	None (Tree Pollen increasing)	0	0.0244			0(0.0)			33.7	19.9	62.14	No
June (6/6 East Hole)	302 (pollen has Microcystis zoning)	0	6.558			0(0.359)			15.6	21.8	61.78	No
June 20th A-Pod	Pollen with cyanoHABs	0.385	6.811									
June 20th C-Pod	Pollen, Pond Water and cyanoHAB	54.755 [12]	6.31 [12]	54.755 RFUs[12]	7.9 Microcystin[12]							
June 24th C-Pod	Pollen, Pond Water and cyanoHAB	185.955 [12]	6.796 [12]	185.955 RFUs[12]	52.9 Microcystin[12]							
June 24th A-Pod	Pollen with cyanoHABs	10.26	6.885									
July (7/5 East Hole)	24 (pollen and detritus)	1.626	7.253			1.46(0.0)			25.1	28.3	63.16	No
August (8/2 East Hole)		1.48 (Aug 9th)	0.516 (Aug 9th)			3.40 (0.004518313)			20.4	24.2	62.1	No
September(9/6 East Hole)		2.63	1.008			2.87(0.0)	Sep 12th lab samples algae ID		26.6	26	63.28	No
October (10/3 East Hole)	23 A-Pod trap residue (no HABs)	0	0.6901			0.72(0.0)			25.5	25.1	62.57	No
November (11/6 East Hole)		0	0.653			0.0(0.000664315)				23	62.93	No
Year 2023	349 pollen and detritus in traps	10.26 (Apod) 186(Cpod)[1]	3.955	max. 185.955	max. 52.9	mean 0.89(0.052)	Concord BOH testing low	BOH low	Median 25.3	Median 24.2	Median 62.57	No

Note:

1. Year 2022 monthly records represent by month: dry-moist pounds of cyanobacteria removed with the A-Pods; maximum BGA-PC in the A-Pod Trap; lab results when available; water clarity by secchi disc; PC and Cyanotoxin results on dates noted in "()" in column or by Monthly Records Column date.
2. 2021 data is from Higgins Environmental Associates National Science Foundation (NSF) funded field trail with dates noted in "()". Sonde fitted with 30 foot cable for measurements (correction value applied of +1.54893 for 100 foot cable comparison). In 2022, sonde fitted with 100 foot cable.
3. Monthly records maintained by Higgins Environmental Associates field scientist unless noted otherwise; 1987-2014 data from W.Walker 2015 Summary of White Pond Data (http://www.wwwalker.net/whitepond/)
4. Field BGA-PC = field measurements using a multiparameter sonde (Insitu AquaTroll 500) fitted with a blue-green algae (BGA) - phycocyanin (PC) probe with measurements in Relative Flouresence Units (RFUs)
   Most data is from vertical sonde surveys taken monthly and during lab sampling. Sonde snapshots were collected more frequently from A-Pod Trap areas. Other vertical sonde surveys were collected throughout the pond to assess water body quality variance.
5. Lab PC data results provided by the University of New Hamphire. Field BGA-PC at same time/day/location noted in "()". Lab PC is reported in micrograms per liter (ug/L).
6. Average Field Open Water BGA-PC represents the average of vertical sonde survey results from the corresponding date and location noted in the Monthly Records column. Based on multiple vertical surveys, this data also represents the biovolume of PC for the pond as a whole on that day.
7. BGA = blue green algae; PC = phycocyanin; PC is a measure of cyanobacteria biomass at each sample and when correlated to water body volume, serves to represent pond PC biovolume.
8. Water clarity as reported was measured with a secchi disc without the use of a view scope. 1987-2017 secchi disc data utilized a view scope. As such, 2022 results are considered conservative.
   A median secchi disc depth (i.e., water clarity) reading from 1987 to 2017 was calculated at approximately 6 meters (19.7 feet). This has been referred to as the historic baseline secchi disc depth reference.
   Most of the historic mean secchi readings were obtained between June to August of each year when the sunlight angle is higher than earlier or later months of the year for this latitude. Our median values in both 2022 and 2023 were each 24.2 feet (approx. 8 meters).
9. May 11 to 12, 2023, A-Pods set up in Thoreau's cove. May 20, 2022 main A-Pod set up in Thoreau's cove. November 22, 2022 main A-Pod removed from Thoreau's Cove. In 2021, main A-Pod set up in Thoreau's cove on August 30th and removed on October 20th, 2021.
10. A total of 288.5 (dry-moist) pounds of cynobacteria were removed in Year 2022 using the A-Pod and were composted on land in a controlled manner. Approximately 100 (moist to wet) pounds were removed in 2021 and composted as part of our NSF-funded trial.
11. On September 28, 2022 water velocity in White Pond calculated using depth specific drogues to be: 8 feet/minute at 2 feet deep; 6 to 7.5 feet/minute at 4 feet deep; negligible at 10 feet deep. Drogue flow patterns in 2022 indicate clockwise flow pattern with eddies near some shore/structure areas.
12. On June 20 and 24th, field PC readings within the C-Pod after addition of trap contents ranged from 54.755 to 185.955 RFUs; Chl--a ranged from 6.31 to 6.796 RFUs; and cyanotoxins (MC) ranged from 7.9 to 52.9 ug/l, respectively. C-Pod contents removed on June 24, 2023 after sampling.

Table 2 - Surface Water Sample Results - White Pond, Concord, MA

Horizontal Water Quality Profiles

Sample ID:	WP-Trap		WP-Trap		WP-Trap		WP-In		WP-In		WP-In		WP-Out		WP-Out		WP-Out		
Lab Sample Number:	2F03025-01		2H17031-01		2J13028-01		2F03025-02		2H17031-02		2J13028-02		2F03025-03		2H17031-03		2J13028-03		
Date Sampled:	6/2/2022		8/16/2022		10/12/2022		6/2/2022		8/16/2022		10/12/2022		6/2/2022		8/16/2022		10/12/2022		
Parameter	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Units
General Chemistry																			
Nitrate and Nitrite as N	ND	0.03	ND	0.03	ND	0.03	**0.03**	0.03	**0.08**	0.03	**0.04**	0.03	**0.03**	0.03	**0.04**	0.03	ND	0.03	mg/L
Total Nitrogen	**0.6**	0.1	**0.8**	0.1	**1.1**	0.1	**0.23**	0.1	**0.38**	0.1	**0.54**	0.1	**0.13**	0.1	**0.34**	0.1	**0.5**	0.1	mg/L
Kjeldahl Nitrogen	**0.6**	0.1	**0.8**	0.1	**1.1**	0.1	**0.2**	0.1	**0.3**	0.1	**0.5**	0.1	**0.1**	0.1	**0.3**	0.1	**0.5**	0.1	mg/L
Total Phosphorous	**0.05**	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	ND	0.02	mg/L
Total Organic Carbon	**3.7**	0.5	**3.1**	0.2	**4**	0.2	**2.7**	0.5	**2.7**	0.2	**2.4**	0.2	**2.7**	0.5	**2.7**	0.2	**2.5**	0.2	mg/L
Total Metals																			
Iron	**0.17**	0.05	**0.49**	0.05	**0.4**	0.05	ND	0.05	ND	0.05	**0.08**	0.05	ND	0.05	ND	0.05	**0.05**	0.05	mg/L
Sulfur	**1.5**	0.5	**1.3**	0.5	**1.2**	0.5	**1.4**	0.5	**1.3**	0.5	**1.2**	0.5	**1.3**	0.5	**1.4**	0.5	**1.2**	0.5	mg/L
Field Measured Phycocyanin at Sampling																			
Phycocyanin	**1.87**		**1.95**		**4.02**		**0.251**		**1.91**		**0.87**		**2.09**		**1.74**		**1.1**		RFUs
Phycocyanin and Cyanotoxins by Laboratory Analysis																			
Phycocyanin	**7.23**		**17.2**		**113.24**		**4.46**		**2.51**		**1.69**		**1.92**		**2.38**		**2.61**		ug/L
Cyanotoxin	**ND**		see below		see below		**ND**		see below		**ND**		**ND**		**ND**		**ND**		ug/L
Microcystin					**0.802**														ug/L
Anatoxin			**0.08**						**0.11**										ug/L

Vertical Water Quality Profiles

Sample ID:	WP-10		WP-30		WP-50		WP-55		
Lab Sample Number:	3I28075-01		3I28075-02		3I28075-03		3I28075-04		
Date Sampled:	9/27/2023		9/27/2023		9/27/2023		9/27/2023		
Parameter	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Units
General Chemistry									
Nitrate and Nitrite as N	ND	0.25	ND	0.25	ND	0.25	ND	0.25	mg/L
Total Nitrogen	ND	0.1	**0.7**	0.1	**0.6**	0.1	**2.7**	0.1	mg/L
Kjeldahl Nitrogen	ND	0.1	**0.7**	0.1	**0.6**	0.1	**2.7**	0.1	mg/L
Total Phosphorous	**0.006**	0.005	**0.005**	0.005	**0.015**	0.005	**0.048**	0.005	mg/L
Total Organic Carbon	**2.4**	0.2	**2.6**	0.2	**2.4**	0.2	**4.3**	0.2	mg/L
Total Metals									
Iron	ND	0.05	**0.09**	0.05	**0.22**	0.05	**5.4**	0.05	mg/L
Sulfur	**1.3**	0.5	**1.3**	0.5	**1.4**	0.5	**1**	0.5	mg/L
Additional Historical Testing by Others									
Chlorophyll-a									ug/L
Secchi Depth (during sampling 9/27/24)	24.5		24.5		24.5		24.5		feet
									ug/L
Field Measured Phycocyanin and Chlorophyll-a in RFUs									
Phycocyanin	0.56		0.53		3.21		2.03		RFUs
Chlorophyll-a	0.004		0.004		2.33		1.06		RFUs
Phycocyanin and Cyanotoxins by Laboratory Analysis									
Phycocyanin (WLW PC to low on field RFUs)									ug/L
Cyanotoxin (refer to Concord BOH files									ug/L
Microcystin									ug/L
Anatoxin									ug/L

Notes for Table 2:

1. All samples collected as discrete (grab) samples.
2. All results reported as total on a wet weight basis. mg/L = milligrams per liter; RFUs = relative fluoresence units; ug/L = micrograms per liter.
3. ND = not detected at or above reporting limit noted.
4. Detected results are highlighted in yellow with bold typeface. Cyanotoxin non-detect data also highlighted in yellow and bold typeface given its importance.
5. Preservatives - laboratory pre-preserved bottles per Standard Methods and Analytes (HNO3 for Fe, S; H2SO4 for N and C; none for P and N; all cooled to less than 4 degrees Celcius from collection to analysis).

Table 3 - Benthic Macroalgae (Nitella), Recovered CyanoHABs, A-Pod Residue and Sediment Sample Results - White Pond

	Benthic Algae		2021 to 2022 Cyanobacteria (HAB) Samples						2023		2023		2023		
Sample ID:	BPLNT-1		APOD HAB		HAB1-22		HAB-2-22		WP-Oak Pollen		WP-Pine Pollen		A-Pod Residue		
Lab Sample Number:	1I15020-03		1J15038-04		2H17029-06		2J13027-01		3E18042-04		3F06024-01		3K09056-01		
Date Sampled:	9/14/2021		10/14/2021		7/5/2022		10/7/22		5/16/2023		6/1/2023		10/24/2023		
Parameter	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Units
General Chemistry															
Nitrate and Nitrite as N	Not Tested		Not Tested		**492**	23	ND	7	Not Tested		Not Tested		Not Tested		mg/kg
Total Nitrogen	**3050**	10	**5860**	0.1	**12400**	10	**18200**	10	**11500**	10	**10500**	10	**1240**	10	mg/kg
Kjeldahl Nitrogen	Not Tested		Not Tested		**11900**	440	**18200**	1490	Not Tested		Not Tested		Not Tested		mg/kg
Total Phosphorous	**1570**	1.39	**3630**	2.39	**2200**	1.62	**2040**	2.53	**2710**	4.33	**2820**	3.71	**3810**	1.23	mg/kg
Total Organic Carbon	**46**	0	**40**	0	**36**	0	**40**	0	**52**	0	**52**	0	**36**	0	Percent (%)
Total Metals															
Iron	**9550**	14	**12000**	24.1	**9360**	16.3	**7320**	25.6	**2130**	58.8	**4330**	37.4	**2170**	12.4	mg/kg
Sulfur	**3970**	140	**3680**	241	**3230**	163	**2690**	256	**2350**	588	**1930**	374	**2070**	124	mg/kg

	2021 to 2022 Sediment Samples													
Sample ID:	SED1 WHTS		SED2 WP		SED 3 -WP5	WP-ED-6"		WP-CD-6"		WP-WD-6"		WP-EH-62'		
Lab Sample Number:	1G21034-01		1H31016-01		1K10047-01	2H17028-03		2H17028-04		2H17028-05		2K10018-03		
Date Sampled:	7/16/2021		8/26/2021		11/9/21	8/10/2022		8/10/2022		8/10/2022		11/7/2022		
Parameter	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Results East Hole	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	
General Chemistry	East Hole top 6"		Thoreaus Cove 6"		EH Vert Profile to 24" Top 2"/4-8"/16-	East Hole to 6"		Center Hole to 6"		West Hole to 6"		East Hole Top 2"		
Nitrate and Nitrite as N	Not Tested		Not Tested		Not Tested	**153**	7	**224**	11	**504**	24	**204**	10	
Total Nitrogen	**7620**	0.1	**229**	10	**1130/1680/1650**	**10500**	10	**14500**	10	**22400**	10	**8840**	10	
Kjeldahl Nitrogen	Not Tested		Not Tested		Not Tested	**10300**	154	**14300**	236	**21900**	443	**8640**	985	
Total Phosphorous	**580**	2.39	**899**	1.47	**2250/2740/2460**	**2100**	0.55	**2410**	0.91	**2390**	1.22	**1990**	1.6	
Total Organic Carbon	**3**	0	**10**	0	**16/30/29**	**16**	0	**23**	0	**26**	0	**16**	0	
Total Metals														
Iron	**8600**	24.1	**10500**	14.8	**27300/10100/9280**	**18100**	5.5	**10500**	9.1	**11000**	12.3	**25700**	16.2	
Sulfur	**2370**	241	**3030**	148	**9870/4790/4470**	**6000**	55.4	**5280**	91.4	**6180**	123	**11400**	162	

	2023		2023		2023		2023		2023		2023		
Sample ID:	EH-T2"-Core		EH-6"-CORE		EH-62'-T2"		WP-EH-6"-CORE		EH-T2"-Core		EH-62'-T2"		
Lab Sample Number:	3E18042-01		3E18042-02		3E18042-03		3I28075-05		3K09056-02		3K09056-03		
Date Sampled:	5/16/2023		5/16/2023		5/16/2023		9/27/2023		11/6/2023		11/6/2023		
Parameter	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Sample Result	Reporting Limit	Units
General Chemistry	East Hole with Core		East Hole with Core		East Hole Disc. Samp.		East Hole with Core		East Hole with Core		East Hole Disc. Samp.		
Nitrate and Nitrite as N	Not Tested		Not Tested		Not Tested		**3.24**	2.25	Not Tested		Not Tested		mg/kg
Total Nitrogen	**1360**	10	**5510**	10	**17700**	10	**798**	10	**16000**	10	**24200**	10	mg/kg
Kjeldahl Nitrogen	Not Tested		Not Tested		Not Tested		**795**	110	Not Tested		Not Tested		mg/kg
Total Phosphorous	**2250**	2.57	**2520**	3.87	**3190**	6.4	**2040**	6.4	**3440**	3.78	**2140**	1.6	mg/kg
Total Organic Carbon	**49**	0	**50**	0	**51**	0	**21**	0	**22**	0	**25**	0	Percent (%)
Total Metals													
Iron	**28000**	26	**10100**	39	**36000**	64.6	**7450**	64.6	**30000**	38.2	**19600**	16.2	mg/kg
Sulfur	**11800**	260	**4720**	390	**13200**	646	**20200**	646	**10800**	382	**7110**	162	mg/kg

Notes for Table 3:

1. HAB = harmful algae bloom; HAB1-22 sample is a composite of 35 pounds of partially-dried HAB removed from main A-Pod Trap "A" on June 29, 2022; HAB2-22 is a composite of 40 pounds of partially-dried HABs removed from A-Pod "A" in Oct 2022.
2. All HAB samples collected as composite samples on date sampled. Sediment samples collected as discrete samples over specified interval (either top 2 inches; top 6 inches; or at 6 inch intervals at SED3-WP5 from a 0 to 24 inch core sample).
3. All results reported as total on a dry weight basis.
4. ND = not detected at or above reporting limit noted.
5. Detected results are highlighted in yellow with bold typeface.
6. Preservatives - samples frozen after collection until laboratory analysis.
7. APOD HAB sample from 10/14/21 was part of our NSF funded work; and serves as a Year 2021 year end "background sample" for Concord's Year 2022 work and results for HAB solids.
8. Most sediment samples were collected and analyzed as part of HEA's National Science Foundation (NSF) work; presented results are summarized for informational purposes only.
9. Sample SED3-WP5 was collected using a gravity corer with intact recovery of 24 inches (60 centimeters) of soft sediment. Discrete sediment samples were collected and results reported from the core as follows: top 2 inches/ 4 to 8 inches / 16 to 24 inches.
10. Sample WP-EH-62 was collected in the east hole (deep basin off beach) using a discrete water sampler which is helpful for collecting the very loose, almost smoke-like top 2 inches of sediment. This sample was primarily green-colored detritus with active microbial populations.
11. BPLNT1 = benthic macroalgae (Nitella) sample collected as part of HEA's NSF work from a grab sample approximately 30 feet deep south of Thoreau's cove.
12. 2023 A-Pod residue sample is a sample of residue collected within the A-Pod trap over the July to October 2023 season (a brown organic-rich material). May-July trap contents were previously removed as tree pollen solids with some cyanoHAB colonization.
13. 2023 EH-T6" AND T2"-CORE samples collected as an insitu gravity core sample with top six inches and top two inches respectively. Core sediments were visually undisturbed and overlying core water was not turbid. Sediment layering noted and top included black mottling (interpreted as sulfides).
14. 2023 EH-62'-T2" sample collected using a discrete water sampler of the very fine, easily suspended sediments (top 2 inches and less) at 62 feet (east deep hole); same location as EH-T2"-CORE. This sample would include more recent detritus/seston by volume than the CORE sample.

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CHARTS

YEAR 2023 SUMMARY REPORT
RESTORATION OF WHITE POND’S WATER

CHART 1
Year 2023 - Benefit of Tree Pollen Removal on Reducing CyanoHAB (PC) Biovolume and Health Risks at White Pond

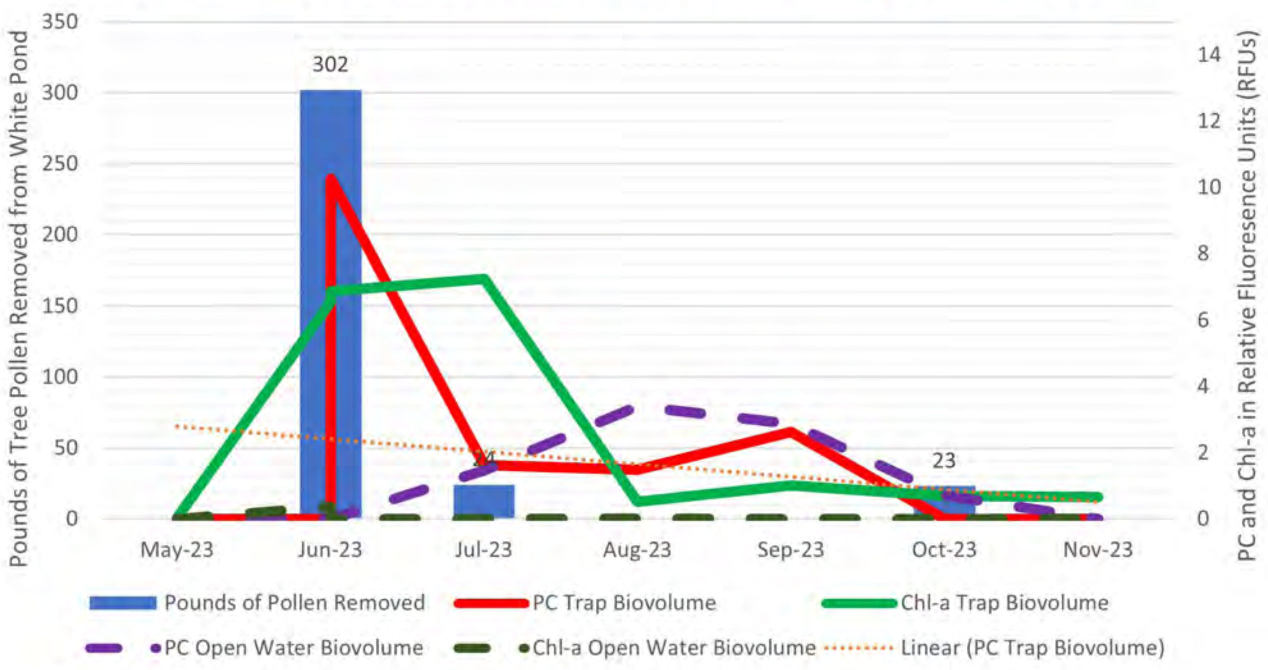


Chart 2
Year 2023 BGA-PC in Walden and White Ponds

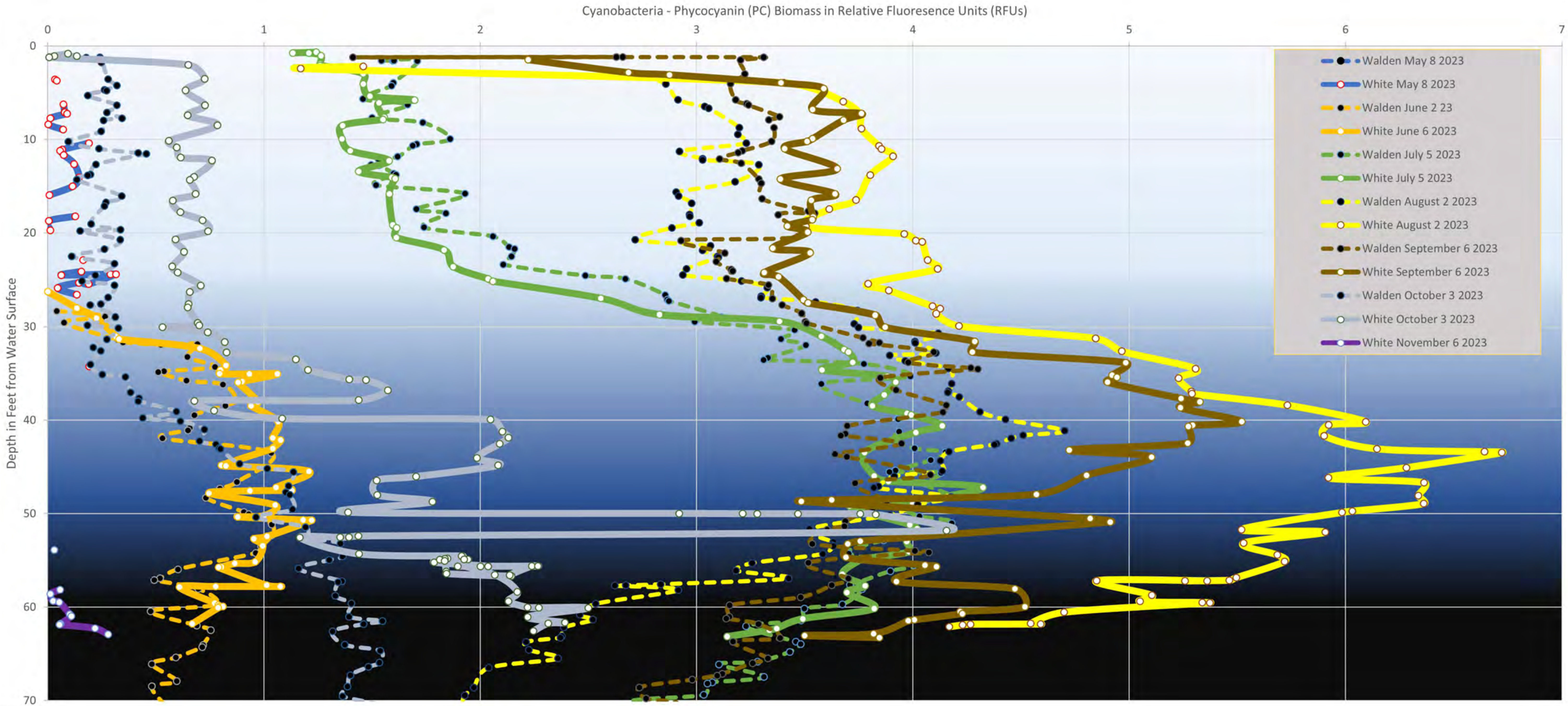


Chart 3
October Years 2021, 2022 and 2023 BGA-PC in Walden and White Ponds

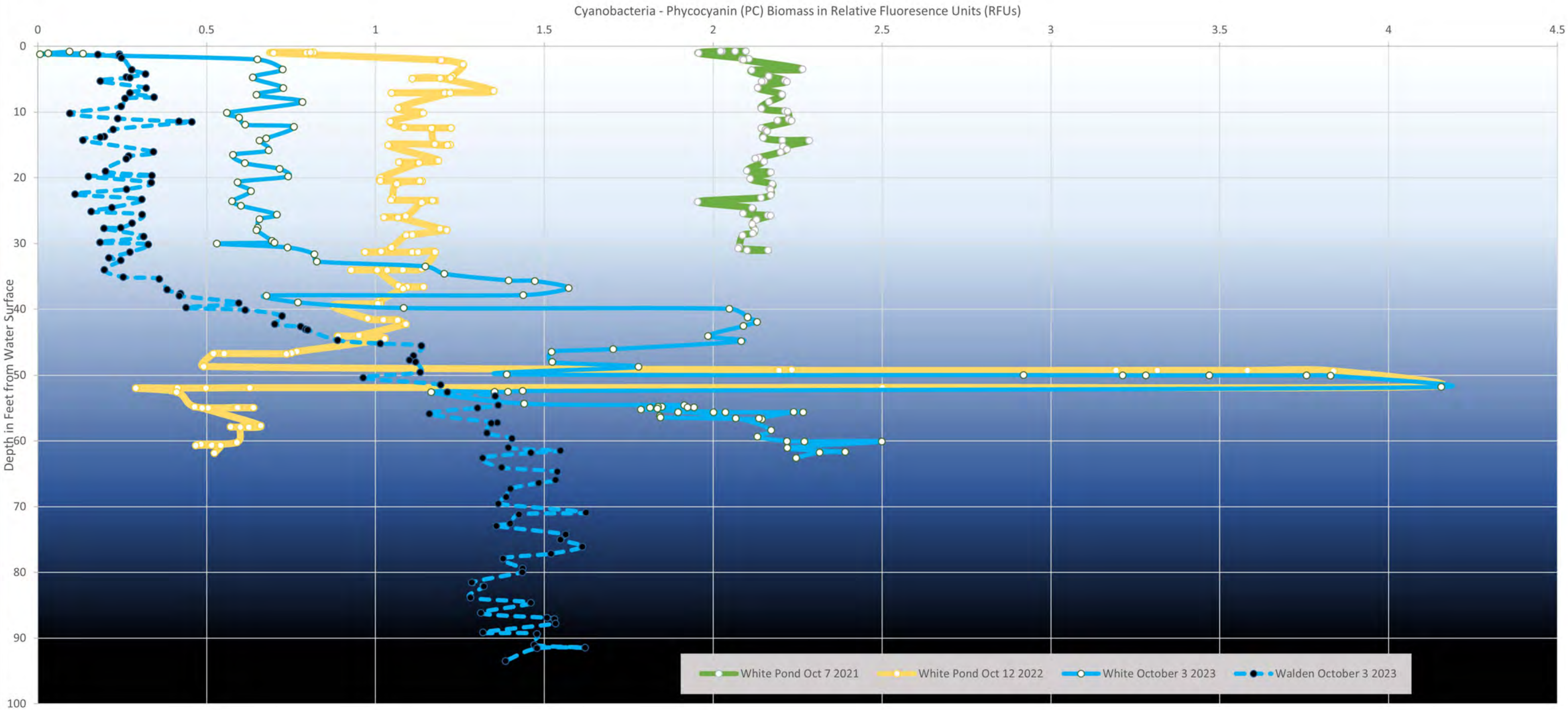


Chart 4
Years 2023 Chlorophyll-a in White and Walden Ponds

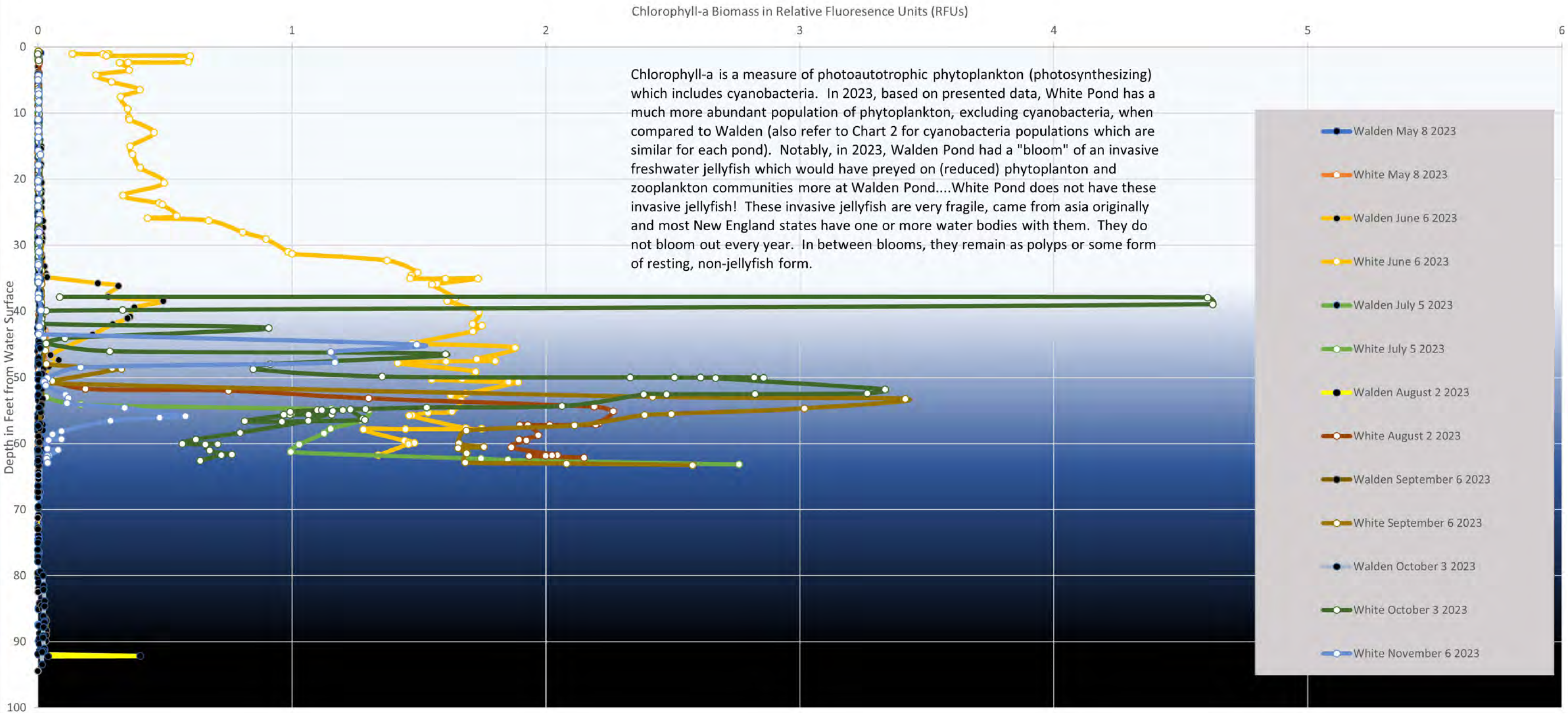
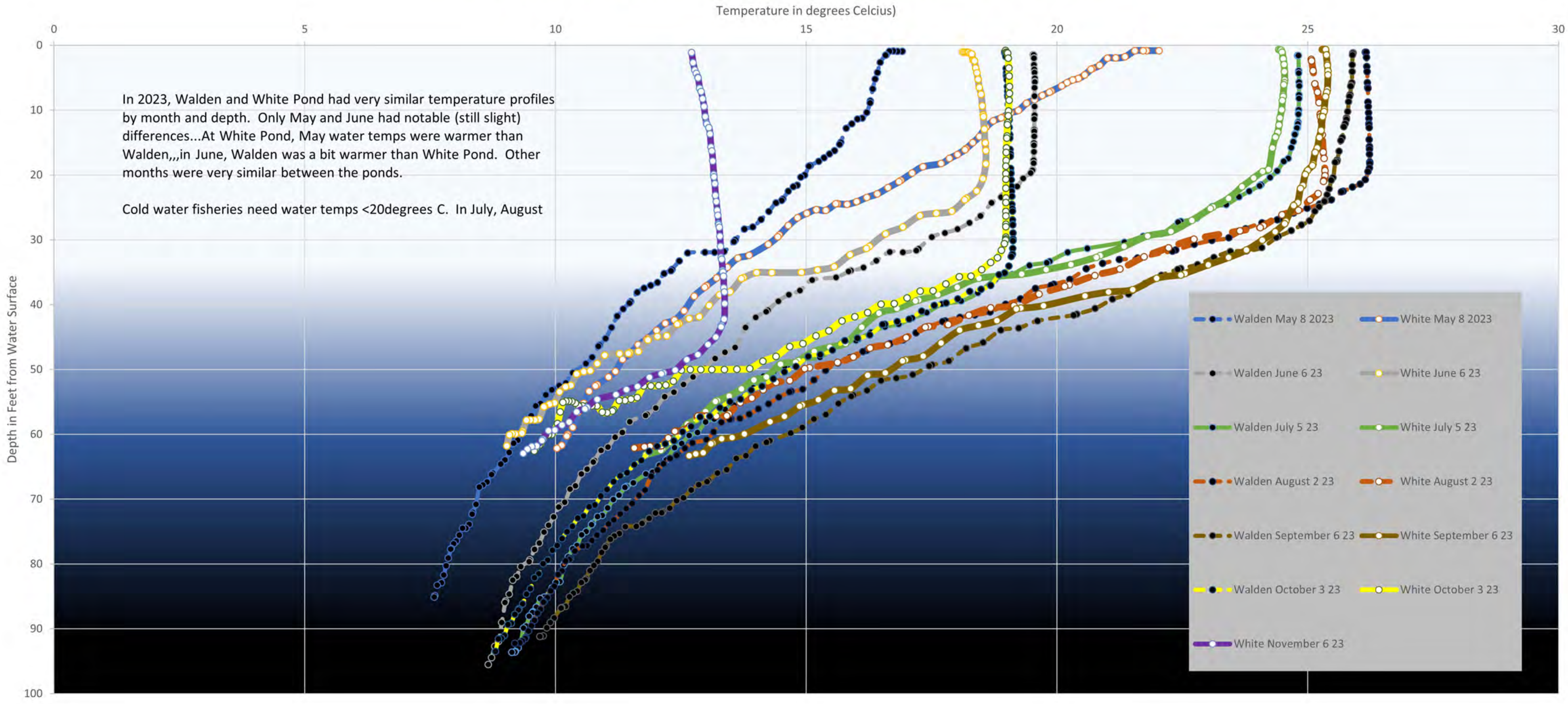


Chart 5
Year 2023 Water Temperature Monthly Profiles for Walden and White Ponds



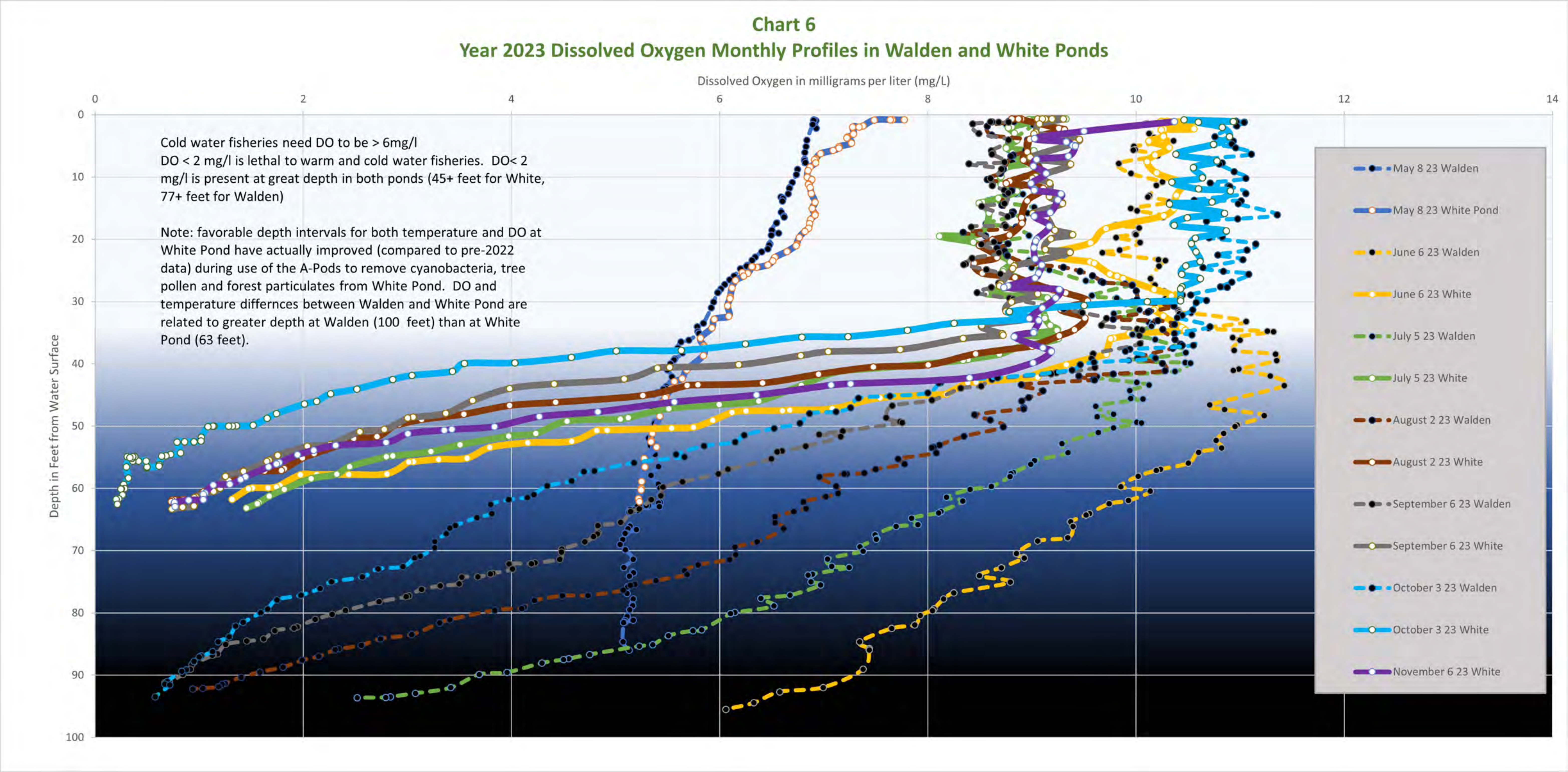


Chart 6
Year 2023 Dissolved Oxygen Monthly Profiles in Walden and White Ponds
Dissolved Oxygen in milligrams per liter (mg/L)
0
2
4
6
8
10
12
14
Depth in Feet from Water Surface
0
10
20
30
40
50
60
70
80
90
100
Cold water fisheries need DO to be > 6mg/l
DO < 2 mg/l is lethal to warm and cold water fisheries. DO< 2 mg/l is present at great depth in both ponds (45+ feet for White, 77+ feet for Walden)
Note: favorable depth intervals for both temperature and DO at White Pond have actually improved (compared to pre-2022 data) during use of the A-Pods to remove cyanobacteria, tree pollen and forest particulates from White Pond. DO and temperature differnces between Walden and White Pond are related to greater depth at Walden (100 feet) than at White Pond (63 feet).
May 8 23 Walden
May 8 23 White Pond
June 6 23 Walden
June 6 23 White
July 5 23 Walden
July 5 23 White
August 2 23 Walden
August 2 23 White
September 6 23 Walden
September 6 23 White
October 3 23 Walden
October 3 23 White
November 6 23 White

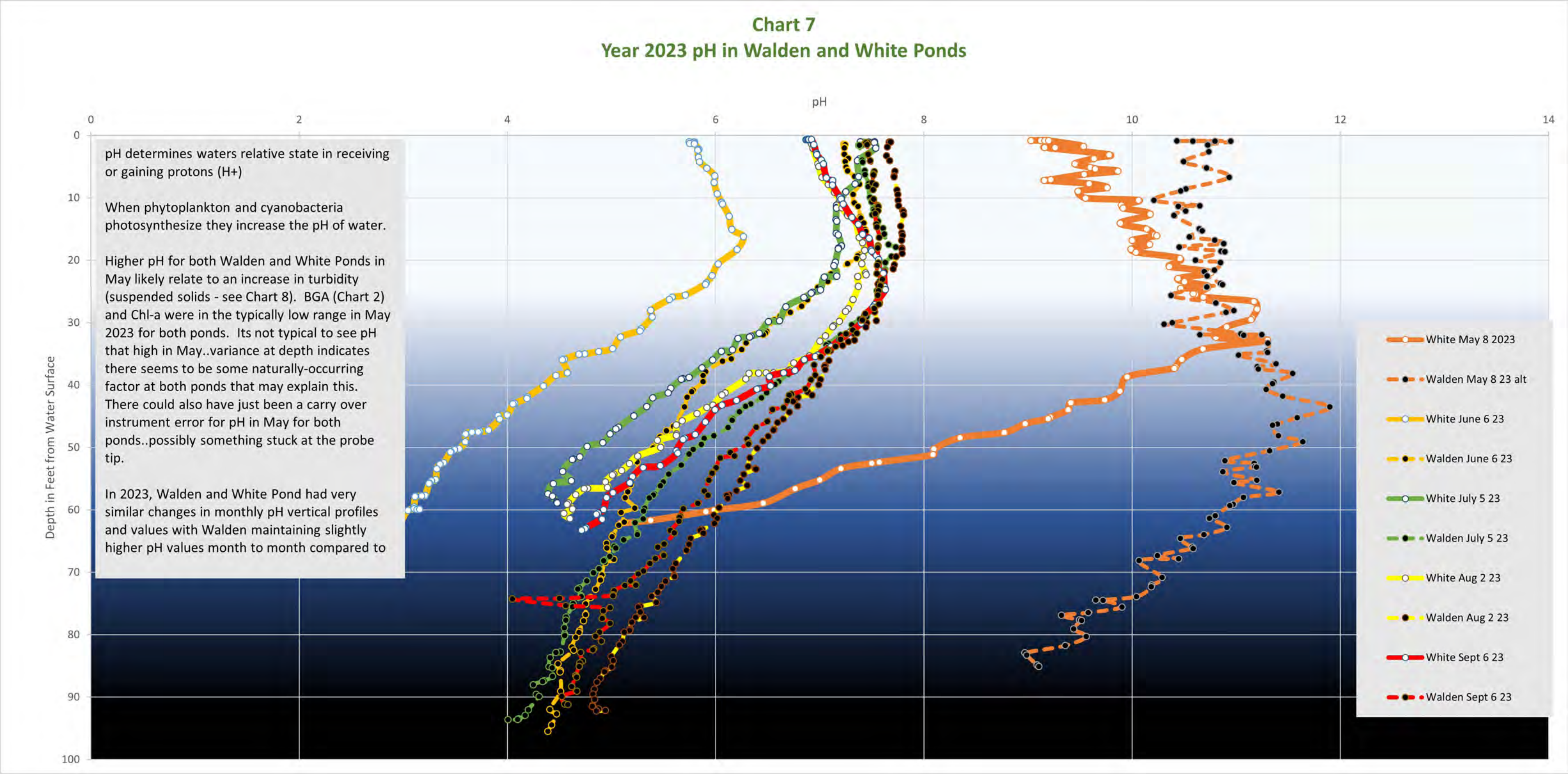


Chart 7
Year 2023 pH in Walden and White Ponds
pH
0
2
4
6
8
10
12
14
Depth in Feet from Water Surface
0
10
20
30
40
50
60
70
80
90
100
pH determines waters relative state in receiving or gaining protons (H+)
When phytoplankton and cyanobacteria photosynthesize they increase the pH of water.
Higher pH for both Walden and White Ponds in May likely relate to an increase in turbidity (suspended solids - see Chart 8). BGA (Chart 2) and Chl-a were in the typically low range in May 2023 for both ponds. Its not typical to see pH that high in May..variance at depth indicates there seems to be some naturally-occurring factor at both ponds that may explain this. There could also have just been a carry over instrument error for pH in May for both ponds..possibly something stuck at the probe tip.
In 2023, Walden and White Pond had very similar changes in monthly pH vertical profiles and values with Walden maintaining slightly higher pH values month to month compared to
White May 8 2023
Walden May 8 23 alt
White June 6 23
Walden June 6 23
White July 5 23
Walden July 5 23
White Aug 2 23
Walden Aug 2 23
White Sept 6 23
Walden Sept 6 23

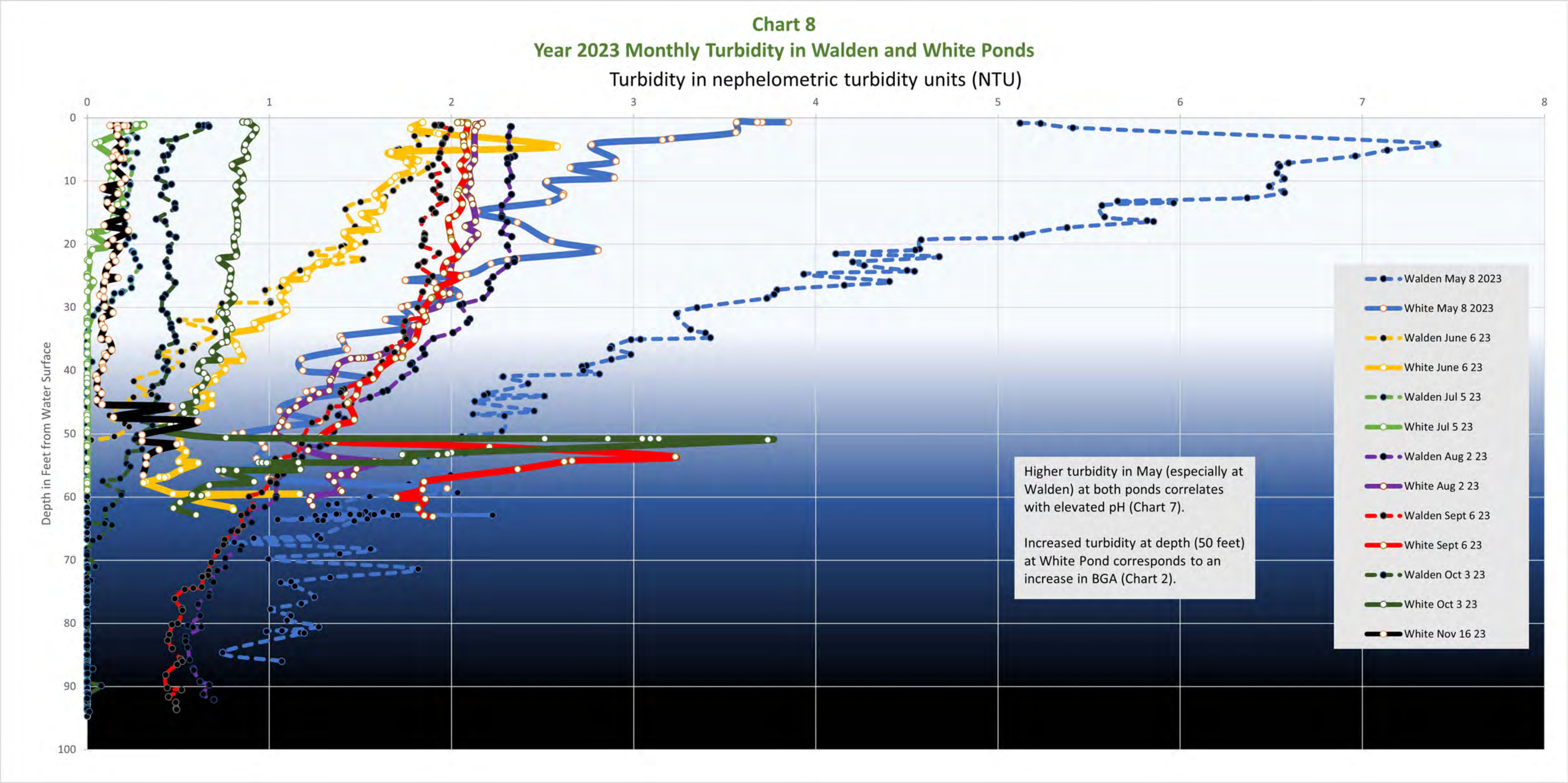


Chart 8
Year 2023 Monthly Turbidity in Walden and White Ponds
Turbidity in nephelometric turbidity units (NTU)
0
1
2
3
4
5
6
7
8
Depth in Feet from Water Surface
0
10
20
30
40
50
60
70
80
90
100
Walden May 8 2023
White May 8 2023
Walden June 6 23
White June 6 23
Walden Jul 5 23
White Jul 5 23
Walden Aug 2 23
White Aug 2 23
Walden Sept 6 23
White Sept 6 23
Walden Oct 3 23
White Oct 3 23
White Nov 16 23
Higher turbidity in May (especially at Walden) at both ponds correlates with elevated pH (Chart 7).
Increased turbidity at depth (50 feet) at White Pond corresponds to an increase in BGA (Chart 2).

Chart 9
Year 2023 Monthly Oxidation-Reduction Potential (ORP) in Walden and White Ponds

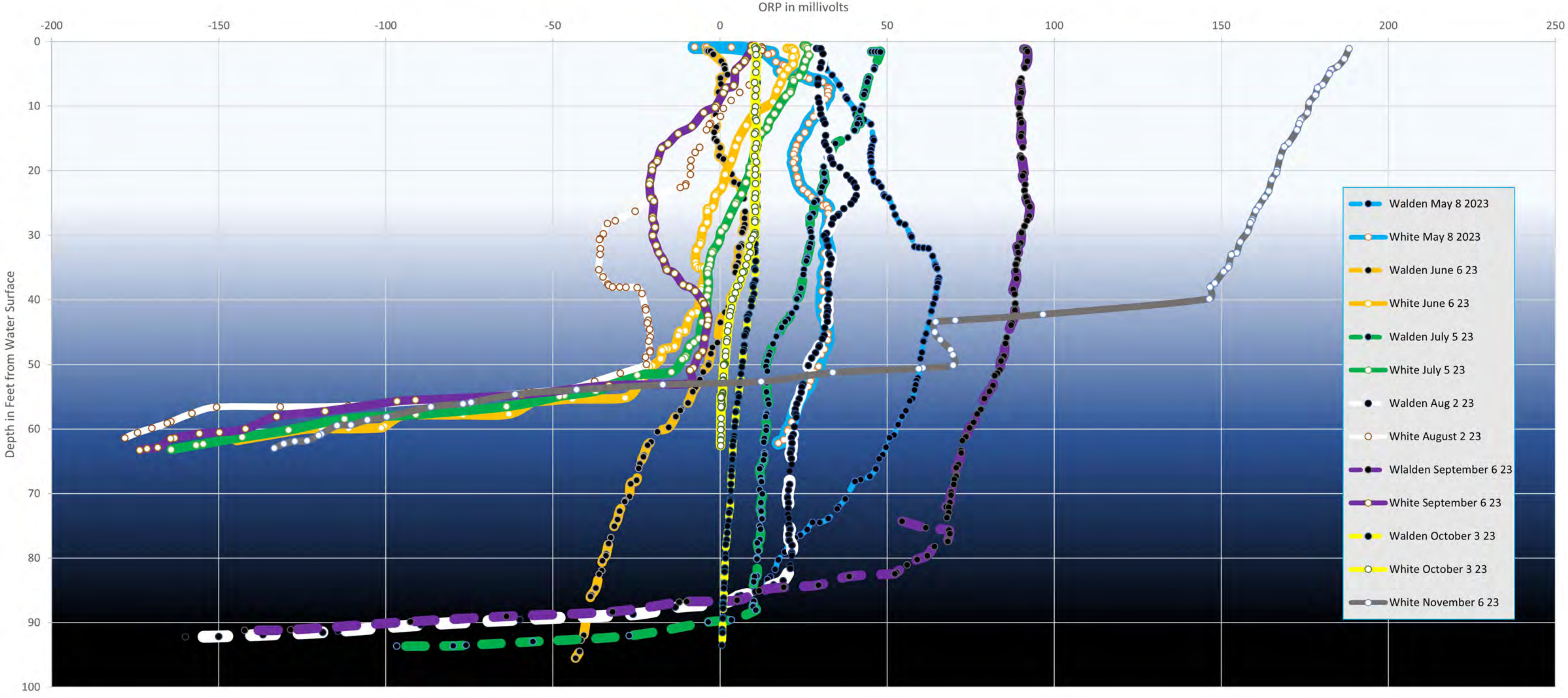
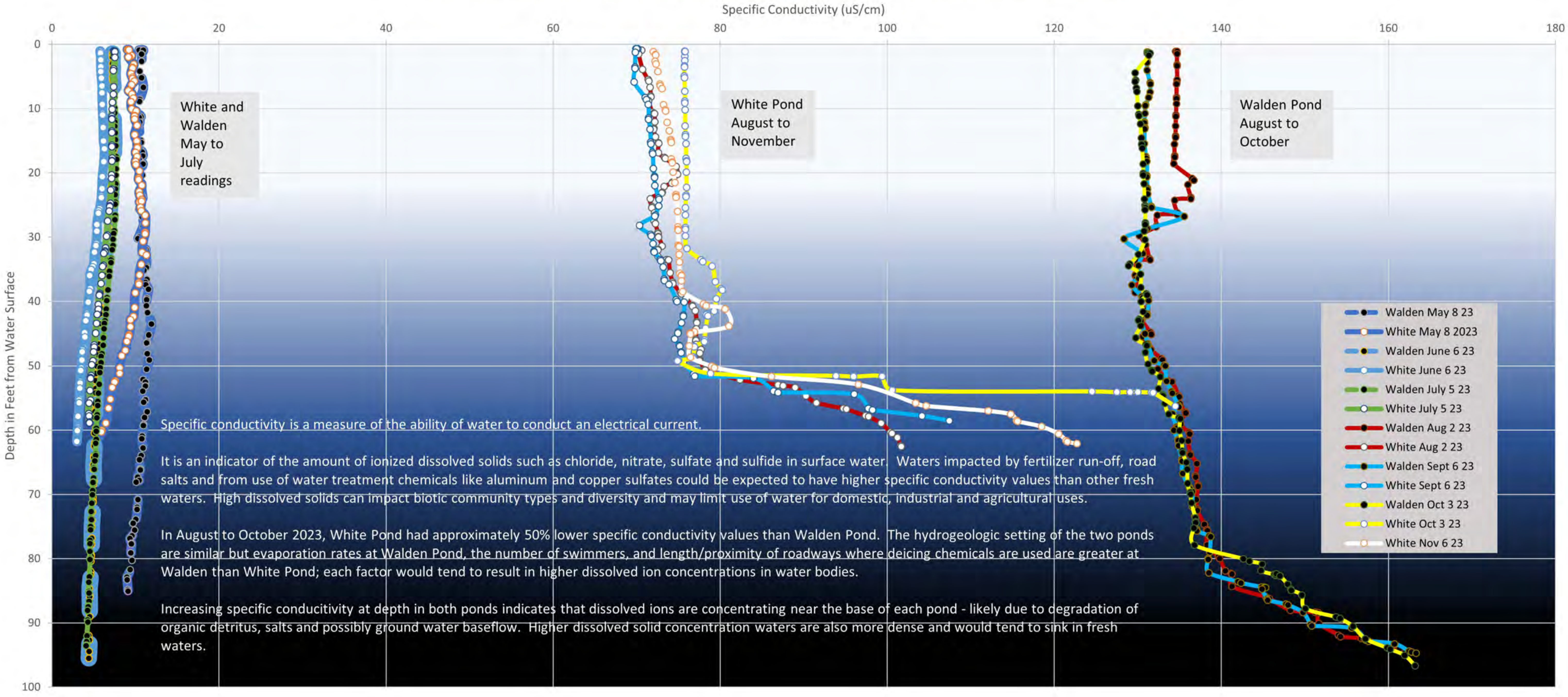


Chart 10

Year 2023 Monthly Specific Conductivity (uS/cm) in Walden and White Ponds



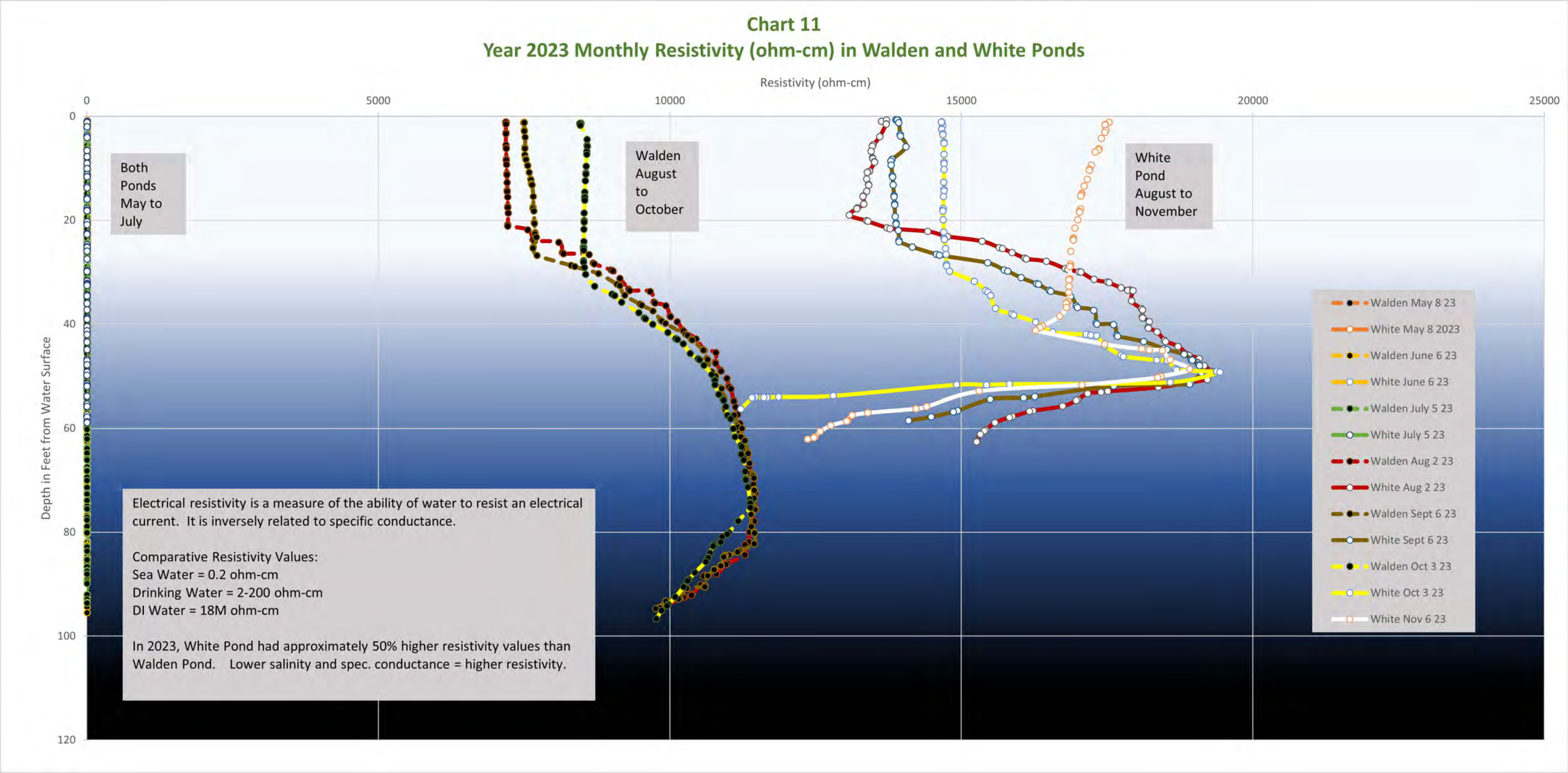


Chart 11
Year 2023 Monthly Resistivity (ohm-cm) in Walden and White Ponds
Resistivity (ohm-cm)
0
5000
10000
15000
20000
25000
Depth in Feet from Water Surface
0
20
40
60
80
100
120
Both Ponds May to July
Walden August to October
White Pond August to November
Electrical resistivity is a measure of the ability of water to resist an electrical current. It is inversely related to specific conductance.
Comparative Resistivity Values:
Sea Water = 0.2 ohm-cm
Drinking Water = 2-200 ohm-cm
DI Water = 18M ohm-cm
In 2023, White Pond had approximately 50% higher resistivity values than Walden Pond. Lower salinity and spec. conductance = higher resistivity.
Walden May 8 23
White May 8 2023
Walden June 6 23
White June 6 23
Walden July 5 23
White July 5 23
Walden Aug 2 23
White Aug 2 23
Walden Sept 6 23
White Sept 6 23
Walden Oct 3 23
White Oct 3 23
White Nov 6 23

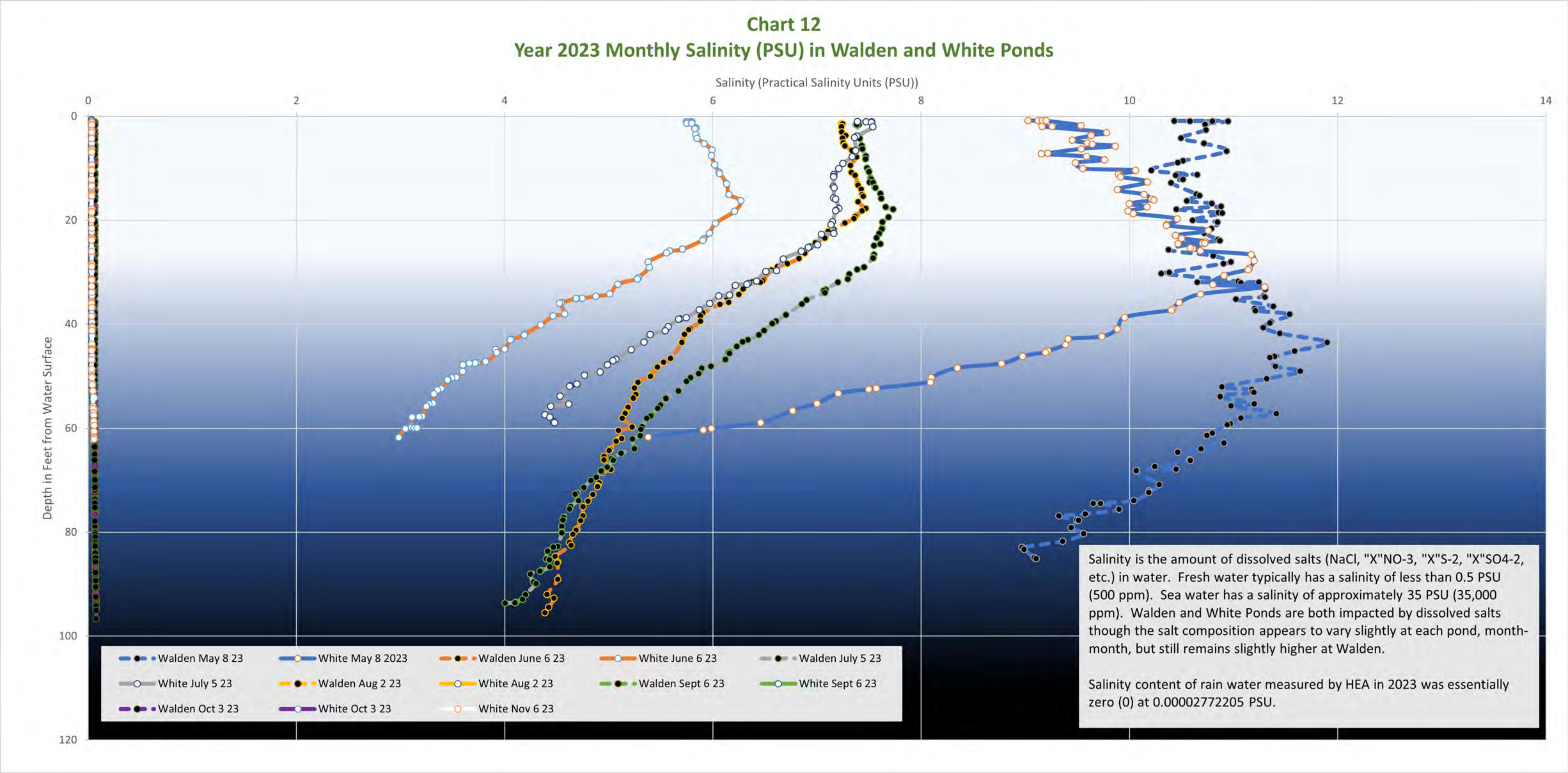


Chart 12
Year 2023 Monthly Salinity (PSU) in Walden and White Ponds
Salinity (Practical Salinity Units (PSU))
0
2
4
6
8
10
12
14
Depth in Feet from Water Surface
0
20
40
60
80
100
120
Walden May 8 23
White May 8 2023
Walden June 6 23
White June 6 23
Walden July 5 23
White July 5 23
Walden Aug 2 23
White Aug 2 23
Walden Sept 6 23
White Sept 6 23
Walden Oct 3 23
White Oct 3 23
White Nov 6 23
Salinity is the amount of dissolved salts (NaCl, "X"NO-3, "X"S-2, "X"SO4-2, etc.) in water. Fresh water typically has a salinity of less than 0.5 PSU (500 ppm). Sea water has a salinity of approximately 35 PSU (35,000 ppm). Walden and White Ponds are both impacted by dissolved salts though the salt composition appears to vary slightly at each pond, month-month, but still remains slightly higher at Walden.
Salinity content of rain water measured by HEA in 2023 was essentially zero (0) at 0.00002772205 PSU.

HEA

LABORATORY DATA SHEETS

YEAR 2023 SUMMARY REPORT
RESTORATION OF WHITE POND’S WATER

New England Testing Laboratory, Inc.
(401) 353-3420

REPORT OF ANALYTICAL RESULTS

NETLAB Work Order Number: 3E18042
Client Project: 03136 - White Pond

Report Date: 26-May-2023

Prepared for:

Jon Higgins
Higgins Environmental
19 Elizabeth Street
Amesbury, MA 01913

Richard Warila, Laboratory Director
New England Testing Laboratory, Inc.
59 Greenhill Street
West Warwick, RI 02893
rich.warila@newenglandtesting.com

Samples Submitted :

The samples listed below were submitted to New England Testing Laboratory on 05/18/23. The group of samples appearing in this report was assigned an internal identification number (case number) for laboratory information management purposes. The client's designations for the individual samples, along with our case numbers, are used to identify the samples in this report. This report of analytical results pertains only to the sample(s) provided to us by the client which are indicated on the custody record. The case number for this sample submission is 3E18042. Custody records are included in this report.

Lab ID	Sample	Matrix	Date Sampled	Date Received
3E18042-01	EH-T2"-Core	Soil	05/16/2023	05/18/2023
3E18042-02	EH-6"-Core	Soil	05/16/2023	05/18/2023
3E18042-03	EH-62'-T2"	Soil	05/16/2023	05/18/2023
3E18042-04	WP- Oak Pollen	Soil	05/16/2023	05/18/2023

Request for Analysis

At the client's request, the analyses presented in the following table were performed on the samples submitted.

EH-62'-T2" (Lab Number: 3E18042-03)

Analysis	Method
Iron	EPA 6010C
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Nitrogen	Calculation
Total Organic Carbon	EPA 9060

EH-6"-Core (Lab Number: 3E18042-02)

Analysis	Method
Iron	EPA 6010C
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Nitrogen	Calculation
Total Organic Carbon	EPA 9060

EH-T2"-Core (Lab Number: 3E18042-01)

Analysis	Method
Iron	EPA 6010C
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Nitrogen	Calculation
Total Organic Carbon	EPA 9060

WP- Oak Pollen (Lab Number: 3E18042-04)

Analysis	Method
Phosphorus	EPA 6010C

Method References

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, USEPA

Soil Survey Laboratory Methods Manual, USDA/NCRS, 2014

Case Narrative

Sample Receipt:

The samples associated with this work order were received in appropriately cooled and preserved containers. The chain of custody was adequately completed and corresponded to the samples submitted.

Exceptions: None

Analysis:

All samples were prepared and analyzed within method specified holding times and according to NETLAB's documented standard operating procedures. The results for the associated calibration, method blank and laboratory control sample (LCS) were within method specified quality control requirements and allowances. Results for all soil samples, unless otherwise indicated, are reported on a dry weight basis.

Exceptions: None

Results: General Chemistry

Sample: EH-T2''-Core
Lab Number: 3E18042-01 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Total Organic Carbon	**49**		0	Percent	05/19/23	05/22/23
Total Nitrogen	**1360**		10.0	mg/kg	05/22/23	05/22/23

Results: General Chemistry

Sample: EH-6''-Core

Lab Number: 3E18042-02 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Total Organic Carbon	**50**		0	Percent	05/19/23	05/22/23
Total Nitrogen	**5510**		10.0	mg/kg	05/22/23	05/22/23

Results: General Chemistry

Sample: EH-62'-T2"
Lab Number: 3E18042-03 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Total Organic Carbon	**51**		0	Percent	05/19/23	05/22/23
Total Nitrogen	**17700**		10.0	mg/kg	05/22/23	05/22/23

Results: Total Metals

Sample: EH-T2''-Core

Lab Number: 3E18042-01 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Phosphorous	**2250**		2.57	mg/kg	05/23/23	05/24/23
Sulfur	**11800**		260	mg/kg	05/23/23	05/23/23
Iron	**28000**		26.0	mg/kg	05/23/23	05/24/23

Results: Total Metals

Sample: EH-6''-Core

Lab Number: 3E18042-02 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Phosphorous	**2520**		3.87	mg/kg	05/23/23	05/24/23
Sulfur	**4720**		390	mg/kg	05/23/23	05/23/23
Iron	**10100**		39.0	mg/kg	05/23/23	05/24/23

Results: Total Metals

Sample: EH-62'-T2"
Lab Number: 3E18042-03 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Phosphorous	**3190**		6.40	mg/kg	05/23/23	05/24/23
Sulfur	**13200**		646	mg/kg	05/23/23	05/23/23
Iron	**36000**		64.6	mg/kg	05/23/23	05/24/23

Results: Total Metals

Sample: WP- Oak Pollen

Lab Number: 3E18042-04 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Phosphorous	**2710**		4.33	mg/kg	05/23/23	05/24/23

Quality Control

Total Metals

Analyte	Result	Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch: B3E1143 - Metals Digestion Soils										
Blank (B3E1143-BLK1)					Prepared & Analyzed: 05/23/23					
Sulfur	ND		33.3	mg/kg						
Phosphorous	ND		0.33	mg/kg						
Iron	ND		3.3	mg/kg						
LCS (B3E1143-BS1)					Prepared & Analyzed: 05/23/23					
Phosphorous	97.5		0.33	mg/kg	100		97.5	85-115		
Iron	1040		3.3	mg/kg	1000		104	85-115		

Notes and Definitions

Item	Definition
Wet	Sample results reported on a wet weight basis.
ND	Analyte NOT DETECTED at or above the reporting limit.

NEW ENGLAND TESTING LABORATORY, INC.
59 Greenhill Street
West Warwick, RI 02893
1-888-863-8522

3 E 1 80421

CHAIN OF CUSTODY RECORD

PROJ. NO.: 03136
PROJECT NAME/LOCATION: White Pond
CLIENT: HEA
REPORT TO: Jon Hihins
INVOICE TO: Jon Hihins

DATE	TIME	COMP	GRAB	SAMPLE I.D.	AQUEOUS	SOIL	OTHER	NO. OF CONTAINERS	PRESERVATIVE	Totals: Carbon	Iron	Nitrogen	Phosphorus	Sulfur	REMARKS
5/16/23	1130		✓	EH - T2"-Core		✓		1	<4°	✓	✓	✓	✓	✓	~~Dry Samples @ 110°F if need be to increase % solids~~
5/16/23	1135		✓	EH-6"-Core		✓		1	"	✓	✓	✓	✓	✓	
5/16/23	1230		✓	EH - 62' -T2"		✓		1	"	✓	✓	✓	✓	✓	
5/16/23	1240		✓	WP - Oak Pollen			✓	1	"				✓		

Sampled by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[signature]	5/16/23 1240	[signature]	5/16/23 1240
Relinquished by: (Signature)	**Date/Time**	**Received by: (Signature)**	**Date/Time**
[signature]	5/18/23 1348	[signature]	5/18/23 1400
Relinquished by: (Signature)	**Date/Time**	**Received for Laboratory by: (Signature)**	**Date/Time**
[signature]	5/19/23 1710	[signature]	5-18-23 1910

Laboratory Remarks:
Temp. received: 6
Cooled ☐

Special Instructions:
List Specific Detection
Limit Requirements:

Turnaround (Business Days)________

**Netlab subcontracts the following tests: Radiologicals, Radon, Asbestos, UCMRs, Perchlorate, Bromate, Bromide, Sieve, Salmonella, Carbamates, CT ETPH

New England Testing Laboratory, Inc.
(401) 353-3420

REPORT OF ANALYTICAL RESULTS

NETLAB Work Order Number: 3F06024
Client Project: 03136 - White Pond

Report Date: 14-June-2023

Prepared for:

Jon Higgins
Higgins Environmental
19 Elizabeth Street
Amesbury, MA 01913

Richard Warila, Laboratory Director
New England Testing Laboratory, Inc.
59 Greenhill Street
West Warwick, RI 02893
rich.warila@newenglandtesting.com

Samples Submitted :

The samples listed below were submitted to New England Testing Laboratory on 06/06/23. The group of samples appearing in this report was assigned an internal identification number (case number) for laboratory information management purposes. The client's designations for the individual samples, along with our case numbers, are used to identify the samples in this report. This report of analytical results pertains only to the sample(s) provided to us by the client which are indicated on the custody record. The case number for this sample submission is 3F06024. Custody records are included in this report.

Lab ID	Sample	Matrix	Date Sampled	Date Received
3F06024-01	WP- Pine Pollen	Soil	06/01/2023	06/06/2023

Request for Analysis

At the client's request, the analyses presented in the following table were performed on the samples submitted.

WP- Pine Pollen (Lab Number: 3F06024-01)

Analysis	Method
Iron	EPA 6010C
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Nitrogen	Calculation
Total Organic Carbon	EPA 9060

Method References

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, USEPA

Soil Survey Laboratory Methods Manual, USDA/NCRS, 2014

Case Narrative

Sample Receipt:

The samples associated with this work order were received in appropriately cooled and preserved containers. The chain of custody was adequately completed and corresponded to the samples submitted.

Exceptions: None

Analysis:

All samples were prepared and analyzed within method specified holding times and according to NETLAB's documented standard operating procedures. The results for the associated calibration, method blank and laboratory control sample (LCS) were within method specified quality control requirements and allowances. Results for all soil samples, unless otherwise indicated, are reported on a dry weight basis.

Exceptions: None

Results: General Chemistry

Sample: WP- Pine Pollen

Lab Number: 3F06024-01 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Total Organic Carbon	**52**		0	Percent	06/08/23	06/08/23
Total Nitrogen	**10500**		10.0	mg/kg	06/12/23	06/12/23

Results: Total Metals

Sample: WP- Pine Pollen
Lab Number: 3F06024-01 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Phosphorous	**2820**		3.71	mg/kg	06/07/23	06/09/23
Sulfur	**1930**		374	mg/kg	06/07/23	06/08/23
Iron	**4330**		37.4	mg/kg	06/07/23	06/09/23

Quality Control

Total Metals

Analyte	Result	Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch: B3F0303 - Metals Digestion Soils										
Blank (B3F0303-BLK1)					Prepared: 06/07/23 Analyzed: 06/08/23					
Sulfur	ND		33.3	mg/kg						
Phosphorous	ND		0.33	mg/kg						
Iron	ND		3.3	mg/kg						
LCS (B3F0303-BS1)					Prepared: 06/07/23 Analyzed: 06/09/23					
Phosphorous	95.7		0.33	mg/kg	100		95.7	85-115		
Iron	1020		3.3	mg/kg	1000		102	85-115		

Notes and Definitions

Item	Definition
Wet	Sample results reported on a wet weight basis.
ND	Analyte NOT DETECTED at or above the reporting limit.

NEW ENGLAND TESTING LABORATORY, INC.
59 Greenhill Street
West Warwick, RI 02893
1-888-863-8522

3 F 0 6024 Y

CHAIN OF CUSTODY RECORD

PROJ. NO.: 03136
PROJECT NAME/LOCATION: White Pond
CLIENT: HEA
REPORT TO: Jon Higgins
INVOICE TO:

TESTS: Total Carbon, Iron, Nitrogen, Phosphorus, Sulfur

DATE	TIME	COMP	GRAB	SAMPLE I.D.	AQUEOUS	SOIL	OTHER	NO. OF CONTAINERS	PRESERVATIVE	Total Carbon	Iron	Nitrogen	Phosphorus	Sulfur	REMARKS
6/1/23		✓		WP - Pine Pollen			✓	2	<4°C	✓	✓	✓	✓	✓	

Sampled by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[signature]	6/1/23 1130	[signature]	6/1/23 1130
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[signature]	6/6/23 1125	[signature]	6/6/23 1125
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time
[signature]	6/6/23 1550	[signature]	6/6/23 1550

Laboratory Remarks:
Temp. received: 8°
Cooled ☒
On ice

Special Instructions:
List Specific Detection Limit Requirements:

Turnaround (Business Days)________

**Netlab subcontracts the following tests: Radiologicals, Radon, Asbestos, UCMRs, Perchlorate, Bromate, Bromide, Sieve, Salmonella, Carbamates, CT ETPH

New England Testing Laboratory, Inc.
(401) 353-3420

REPORT OF ANALYTICAL RESULTS

NETLAB Work Order Number: 3I28075
Client Project: 03136 - White Pond

Report Date: 11-October-2023

Prepared for:

Jon Higgins
Higgins Environmental
19 Elizabeth Street
Amesbury, MA 01913

Richard Warila, Laboratory Director
New England Testing Laboratory, Inc.
59 Greenhill Street
West Warwick, RI 02893
rich.warila@newenglandtesting.com

Samples Submitted :

The samples listed below were submitted to New England Testing Laboratory on 09/28/23. The group of samples appearing in this report was assigned an internal identification number (case number) for laboratory information management purposes. The client's designations for the individual samples, along with our case numbers, are used to identify the samples in this report. This report of analytical results pertains only to the sample(s) provided to us by the client which are indicated on the custody record. The case number for this sample submission is 3I28075. Custody records are included in this report.

Lab ID	Sample	Matrix	Date Sampled	Date Received
3I28075-01	WP-10	Water	09/27/2023	09/28/2023
3I28075-02	WP-30	Water	09/27/2023	09/28/2023
3I28075-03	WP-50	Water	09/27/2023	09/28/2023
3I28075-04	WP-55	Water	09/27/2023	09/28/2023
3I28075-05	WP-EH-6"-CORE	Soil	09/27/2023	09/28/2023

Request for Analysis

At the client's request, the analyses presented in the following table were performed on the samples submitted.

WP-10 (Lab Number: 3I28075-01)

Analysis	Method
Iron	EPA 6010C
Nitrate and Nitrite Combined	EPA 300.0
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Kjeldahl Nitrogen	SM4500-N-C (11)
Total Nitrogen	Calculation
Total Organic Carbon	SM5310-C

WP-30 (Lab Number: 3I28075-02)

Analysis	Method
Iron	EPA 6010C
Nitrate and Nitrite Combined	EPA 300.0
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Kjeldahl Nitrogen	SM4500-N-C (11)
Total Nitrogen	Calculation
Total Organic Carbon	SM5310-C

WP-50 (Lab Number: 3I28075-03)

Analysis	Method
Iron	EPA 6010C
Nitrate and Nitrite Combined	EPA 300.0
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Kjeldahl Nitrogen	SM4500-N-C (11)
Total Nitrogen	Calculation
Total Organic Carbon	SM5310-C

WP-55 (Lab Number: 3I28075-04)

Analysis	Method
Iron	EPA 6010C
Nitrate and Nitrite Combined	EPA 300.0
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Kjeldahl Nitrogen	SM4500-N-C (11)
Total Nitrogen	Calculation
Total Organic Carbon	SM5310-C

WP-EH-6''-CORE (Lab Number: 3I28075-05)

Analysis	Method
Iron	EPA 6010C
Nitrate and Nitrite Combined	EPA 300.0
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Kjeldahl Nitrogen	SM4500-N-C (11)-Mod
Total Nitrogen	Calculation
Total Organic Carbon	EPA 9060

Method References

Standard Methods for the Examination of Water and Wastewater, 20th Edition, APHA/ AWWA-WPCF, 1998

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, USEPA

Soil Survey Laboratory Methods Manual, USDA/NCRS, 2014

Case Narrative

Sample Receipt:

The samples associated with this work order were received in appropriately cooled and preserved containers. The chain of custody was adequately completed and corresponded to the samples submitted.

Exceptions: None

Analysis:

All samples were prepared and analyzed within method specified holding times and according to NETLAB's documented standard operating procedures. The results for the associated calibration, method blank and laboratory control sample (LCS) were within method specified quality control requirements and allowances. Results for all soil samples, unless otherwise indicated, are reported on a dry weight basis.

Exceptions: None

Results: General Chemistry

Sample: WP-10

Lab Number: 3I28075-01 (Water)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Nitrate and Nitrite as N	ND		0.25	mg/L	09/29/23 8:35	09/29/23 8:35
Kjeldahl Nitrogen	ND		0.1	mg/L	10/03/23	10/03/23
Total Organic Carbon	**2.4**		0.2	mg/L	10/04/23	10/04/23
Total Nitrogen	ND		0.100	mg/L	10/03/23	10/03/23

Results: General Chemistry

Sample: WP-30

Lab Number: 3I28075-02 (Water)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Nitrate and Nitrite as N	ND		0.25	mg/L	09/29/23 8:48	09/29/23 8:48
Kjeldahl Nitrogen	**0.7**		0.1	mg/L	10/03/23	10/03/23
Total Organic Carbon	**2.6**		0.2	mg/L	10/04/23	10/04/23
Total Nitrogen	**0.700**		0.100	mg/L	10/03/23	10/03/23

Results: General Chemistry

Sample: WP-50

Lab Number: 3I28075-03 (Water)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Nitrate and Nitrite as N	ND		0.25	mg/L	09/29/23 9:02	09/29/23 9:02
Kjeldahl Nitrogen	**0.6**		0.1	mg/L	10/03/23	10/03/23
Total Organic Carbon	**2.4**		0.2	mg/L	10/04/23	10/04/23
Total Nitrogen	**0.600**		0.100	mg/L	10/03/23	10/03/23

Results: General Chemistry

Sample: WP-55

Lab Number: 3I28075-04 (Water)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Nitrate and Nitrite as N	ND		0.25	mg/L	09/29/23 9:16	09/29/23 9:16
Kjeldahl Nitrogen	**2.7**		0.5	mg/L	10/03/23	10/03/23
Total Organic Carbon	**4.3**		0.2	mg/L	10/04/23	10/04/23
Total Nitrogen	**2.70**		0.100	mg/L	10/03/23	10/03/23

Results: General Chemistry

Sample: WP-EH-6''-CORE

Lab Number: 3I28075-05 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Nitrate and Nitrite as N	**3.24**		2.25	mg/kg	10/03/23	10/03/23
Kjeldahl Nitrogen	**795**		110	mg/kg	10/03/23	10/03/23
Total Organic Carbon	**21**		0	Percent	10/05/23	10/06/23
Total Nitrogen	**798**		10.0	mg/kg	10/03/23	10/03/23

Results: Total Metals

Sample: WP-10

Lab Number: 3I28075-01 (Water)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Iron	ND		0.05	mg/L	09/29/23	10/11/23
Phosphorous	**0.006**		0.005	mg/L	09/29/23	10/11/23
Sulfur	**1.3**		0.5	mg/L	09/29/23	10/02/23

Results: Total Metals

Sample: WP-30

Lab Number: 3I28075-02 (Water)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Iron	**0.09**		0.05	mg/L	09/29/23	10/05/23
Phosphorous	**0.005**		0.005	mg/L	09/29/23	10/05/23
Sulfur	**1.3**		0.5	mg/L	09/29/23	10/02/23

Results: Total Metals

Sample: WP-50
Lab Number: 3I28075-03 (Water)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Iron	**0.22**		0.05	mg/L	09/29/23	10/05/23
Phosphorous	**0.015**		0.005	mg/L	09/29/23	10/05/23
Sulfur	**1.4**		0.5	mg/L	09/29/23	10/02/23

Results: Total Metals

Sample: WP-55

Lab Number: 3I28075-04 (Water)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Iron	**5.40**		0.05	mg/L	09/29/23	10/05/23
Phosphorous	**0.048**		0.005	mg/L	09/29/23	10/05/23
Sulfur	**1.0**		0.5	mg/L	09/29/23	10/02/23

Results: Total Metals

Sample: WP-EH-6''-CORE
Lab Number: 3I28075-05 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Phosphorous	**2040**		4.24	mg/kg	09/29/23	10/03/23
Sulfur	**7450**		428	mg/kg	09/29/23	10/02/23
Iron	**20200**		42.8	mg/kg	09/29/23	10/03/23

Quality Control

General Chemistry

Analyte	Result	Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch: B3J0087 - Ion Chromatography										
Blank (B3J0087-BLK1)					Prepared & Analyzed: 10/03/23					
Nitrate and Nitrite as N	ND		0.21	mg/kg						
LCS (B3J0087-BS1)					Prepared & Analyzed: 10/03/23					
Nitrate and Nitrite as N	5.44			mg/L	5.00		109	0-200		
Matrix Spike (B3J0087-MS1)		Source: 3I28075-05			Prepared & Analyzed: 10/03/23					
Nitrate and Nitrite as N	1460		2.25	mg/kg dry	67.5	3.24	NR	0-200		
Matrix Spike Dup (B3J0087-MSD1)		Source: 3I28075-05			Prepared & Analyzed: 10/03/23					
Nitrate and Nitrite as N	1460		2.25	mg/kg dry	67.5	3.24	NR	0-200	0.0538	200
Batch: B3J0140 - TOC										
Blank (B3J0140-BLK1)					Prepared & Analyzed: 10/04/23					
Total Organic Carbon	ND		0.2	mg/L						
LCS (B3J0140-BS1)					Prepared & Analyzed: 10/04/23					
Total Organic Carbon	5.0		0.2	mg/L	5.00		99.9	90-110		
LCS Dup (B3J0140-BSD1)					Prepared & Analyzed: 10/04/23					
Total Organic Carbon	5.0		0.2	mg/L	5.00		101	90-110	0.894	20
Batch: B3J0145 - TKN										
Blank (B3J0145-BLK1)					Prepared & Analyzed: 10/03/23					
Kjeldahl Nitrogen	ND		0.1	mg/L						

General Chemistry (Continued)

Analyte	Result	Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch: B3J0145 - TKN (Continued)										
Blank (B3J0145-BLK2)					Prepared & Analyzed: 10/03/23					
Kjeldahl Nitrogen	ND		0.1	mg/L						
Batch: B3J0149 - TKN										
Blank (B3J0149-BLK1)					Prepared & Analyzed: 10/03/23					
Kjeldahl Nitrogen	ND		10	mg/kg						

Quality Control
(Continued)

Total Metals

Analyte	Result	Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch: B3I1268 - Metals Digestion Waters										
Blank (B3I1268-BLK1)					Prepared: 09/29/23 Analyzed: 10/02/23					
Sulfur	ND		0.5	mg/L						
Phosphorous	ND		0.005	mg/L						
Iron	ND		0.05	mg/L						
LCS (B3I1268-BS1)					Prepared: 09/29/23 Analyzed: 10/04/23					
Phosphorous	0.973		0.005	mg/L	1.00		97.3	85-115		
Iron	9.91		0.05	mg/L	10.0		99.1	85-115		

Notes and Definitions

Item	Definition
Wet	Sample results reported on a wet weight basis.
ND	Analyte NOT DETECTED at or above the reporting limit.

NEW ENGLAND TESTING LABORATORY.
59 Greenhill Street
West Warwick, RI 02893
1-888-863-8522

3 I 2 8075 _

PROJ. NO.: 03136
PROJECT NAME/LOCATION: WP
CLIENT: HEA
REPORT TO: Jon Hilins
INVOICE TO: Jon Hilins

DATE	TIME	COMP	GRAB	SAMPLE I.D.	AQUEOUS	SOIL	OTHER	NO. OF CONTAINERS	PRESERVATIVE (see remarks)	Total Iron	Total Sulfur	Total Nitrogen	Total Carbon	Total Phosphorus	REMARKS
9/27/23	0920		✓	WP10	✓			5	1-5	✓	✓	✓	✓	✓	
9/27/23	0930		✓	WP30	✓			5	"	✓	✓	✓	✓	✓	preservatives
9/27/23	0940		✓	WP50	✓			5	"	✓	✓	✓	✓	✓	① HNO_3 for Fe, S
9/27/23	0955		✓	WP55	✓			5	"	✓	✓	✓	✓	✓	② NaN for N, P
9/27/23	1020		✓	WP-EH-6"-CORE		✓		1	5	✓	✓	✓	✓	✓	③ H_2SO_4 for N
															④ H_2SO_4 VOAs for C
															⑤ all < 4°C

Sampled by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Laboratory Remarks:	Special Instructions: List Specific Detection Limit Requirements:
[signature]	9/27/23 /1030	[signature]	9/27/23/1030	Temp. received: 3	Det. limits for Tot. Phosphorus in water should be ≤ 10ug/l
Relinquished by: (Signature) [signature]	Date/Time 9/28/23 ~~1030~~ 1420	Received by: (Signature) Chr M	Date/Time 9/27/23 1420	Cooled ☒ on ice	
Relinquished by: (Signature) Chr M	Date/Time 9/28/23 1750	Received for Laboratory by: (Signature) Shyenne Temmy	Date/Time 9/28/23 1750		Turnaround (Business Days)

**Netlab subcontracts the following tests: Radiologicals, Radon, Asbestos, UCMRs, Perchlorate, Bromate, Bromide, Sieve, Salmonella, Carbamates, CT ETPH

Higgins Environmental Associates, Inc.
Algal ID, Enumeration and Biovolume Report

Prepared: November 28, 2023
Prepared By: GreenWater Laboratories

Samples: 2 (Collected on 9/12/23)

1. WP ALG
2. WP ALG D

Sample 1: WP ALG

Total cell numbers in the WP ALG sample collected on 9/12/23 were 18,386 cells/mL. Blue-green algae (Cyanobacteria; 16,350 cells/mL) was the dominant algal group in the sample accounting for 88.9% of total cell numbers. Other algal groups observed in the sample were diatoms (Bacillariophyta; 0.4 cells/mL), desmids (Charophyta; 1 cell/mL), green algae (Chlorophyta; 1,802 cells/mL), golden-brown algae (Chrysophyceae; 36 cells/mL), cryptophytes (Cryptophyta; 16 cells/mL), dinoflagellates (Dinophyceae; 0.5 cells/mL), unknown algae (Unknown; 165 cells/mL) and yellow-green algae (Xanthophyceae; 16 cells/mL). The most abundant species in the sample was the cyanophyte *Anathece* sp. (12,016 cells/mL; Fig. 1).

Total biovolume in the WP ALG sample collected on 9/13/23 was 125,908 μm^3/mL. Green algae (Chlorophyta; 43,934 μm^3/mL) was the dominant algal group in the sample in terms of biovolume, accounting for 34.9% of total biovolume. Other algal groups in the sample included diatoms (Bacillariophyta; 370 μm^3/mL), desmids (Charophyta; 4,421 μm^3/mL), golden-brown algae (Chrysophyceae; 4,659 μm^3/mL), cryptophytes (Cryptophyta; 6,436 μm^3/mL), blue-green algae (Cyanobacteria; 26,974 μm^3/mL), dinoflagellates (Dinophyceae; 18,147 μm^3/mL), unknown algae (Unknown; 20,658 μm^3/mL) and yellow-green algae (Xanthophyceae; 309 μm^3/mL). The algal species in the sample with the highest biomass was the dinoflagellate *Ceratium hirundinella* (16,113 μm^3/mL; Fig. 2).

Total numbers and biovolume of potentially toxigenic cyanobacteria (PTOX Cyano) were 589 cells/mL and 4,031 μm^3/mL respectively. PTOX Cyano taxa observed in the sample included *Radiocystis* sp. (361 cells/mL; 2,710 μm^3/mL; Fig. 3), cf. *Anagnostidinema* sp. (226 cells/mL; 1,060 μm^3/mL; Fig. 4), *Lyngbya/Oscillatoria* sp. (1 cell/mL; 243 μm^3/mL; Fig. 5) and *Raphidiopsis raciborskii* (1 cell/mL; 18 μm^3/mL; Fig. 6).

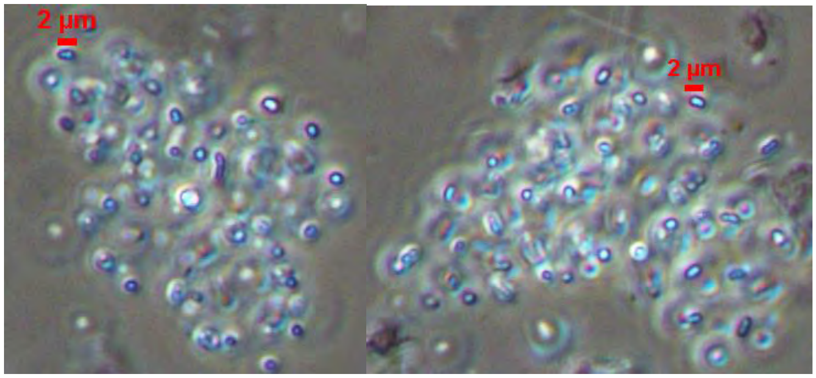


Fig. 1 *Anathece* sp. 400X (scale bar = 2µm)

Fig. 2 *Ceratium hirundinella* 400X (scale bar = 10µm)

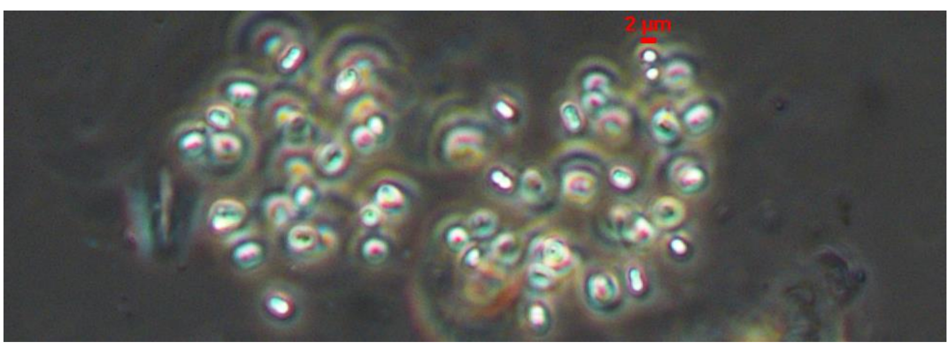


Fig. 3 *Radiocystis* sp. 400X (scale bar = 2µm)

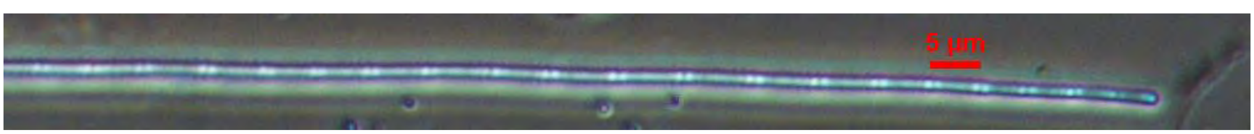


Fig. 4 cf. *Anagnostidinema* sp. 400X (scale bar = 5µm)

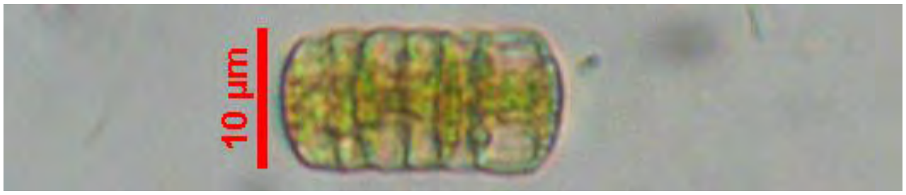


Fig. 5 *Lyngbya/Oscillatoria* sp. 400X (scale bar = 10µm)

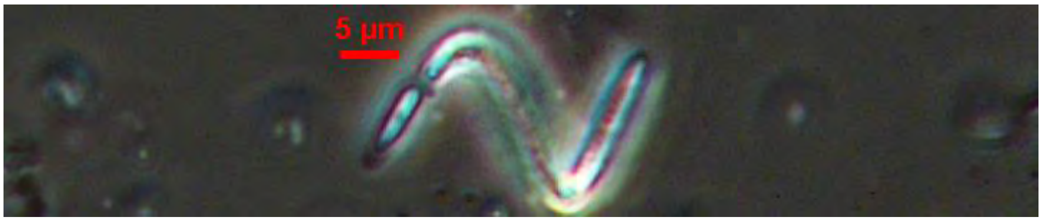


Fig. 6 *Raphidiopsis raciborskii* 400X (scale bar = 5µm)

Sample 2: WP ALG D

Total cell numbers in the WP ALG D sample collected on 9/12/23 were 80,969 cells/mL. Blue-green algae (Cyanobacteria; 74,313 cells/mL) was the dominant algal group in the sample accounting for 91.8% of total cell numbers. Other algal groups observed in the sample were diatoms (Bacillariophyta; 0.2 cells/mL), desmids (Charophyta; 1 cell/mL), green algae (Chlorophyta; 145 cells/mL), cryptophytes (Cryptophyta; 6,197 cells/mL), euglenoids (Euglenozoa; 280 cells/mL) and unknown algae (Unknown; 31 cells/mL). The most abundant species in the sample was the cyanophyte *Limnothrix*/*Pseudanabaena* sp. (73,355 cells/mL; Figs.7-8).

Total biovolume in the WP ALG D sample collected on 9/12/23 was 3,204,987 µm^3/mL. Cryptophytes (Cryptophyta; 1,708,946 µm^3/mL) and blue-green algae (Cyanobacteria; 1,340,770 µm^3/mL) were the dominant algal groups in the sample in terms of biovolume, accounting for 53.3% and 41.8% of total biovolume respectively. Other algal groups in the sample included diatoms (Bacillariophyta; 88 µm^3/mL), desmids (Charophyta; 3,245 µm^3/mL), green algae (Chlorophyta; 6,471 µm^3/mL), euglenoids (Euglenozoa; 144,877 µm^3/mL) and unknown algae (Unknown; 591 µm^3/mL). The dominant algal species in the sample in terms of biomass were cryptophyte sp./spp. (1,691,458 µm^3/mL; Fig. 9) and *Limnothrix/Pseudanabaena* sp. (1,335,072 µm^3/mL; Figs. 7-8).

Total numbers and biovolume of potentially toxigenic cyanobacteria (PTOX Cyano) were 73,401 cells/mL and 1,336,213 µm^3/mL respectively. PTOX Cyano taxa observed in the sample included *Limnothrix*/*Pseudanabaena* sp. (73,355 cells/mL; 1,335,072 µm^3/mL; Figs. 7-8) and *Pseudanabaena* sp. (46 cells/mL; 1,141 µm^3/mL; Fig. 10).

Fig. 7 *Limnothrix*/*Pseudanabaena* sp. 400X (scale bar = 5µm)

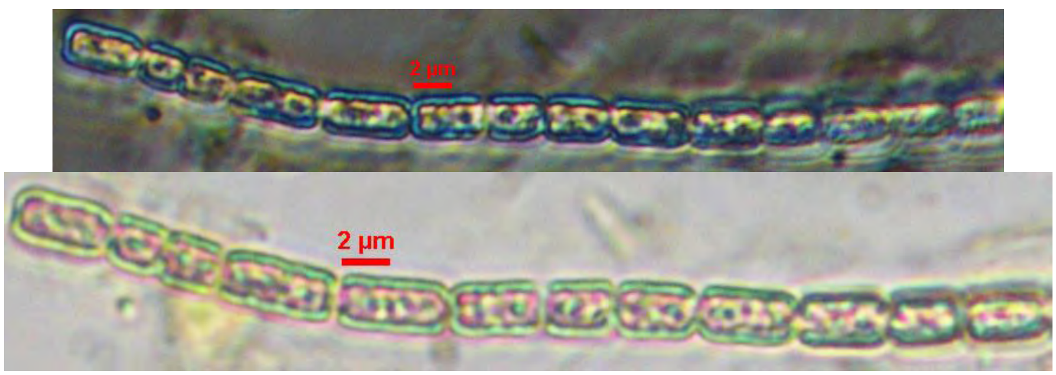


Fig. 8 *Limnothrix*/*Pseudanabaena* sp. 1000X (scale bar = 2µm)

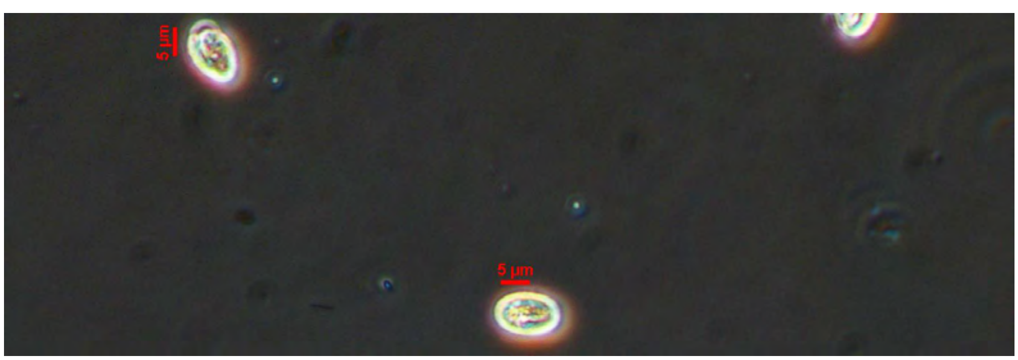


Fig. 9 cryptophyte sp. 400X (scale bar = 5µm)

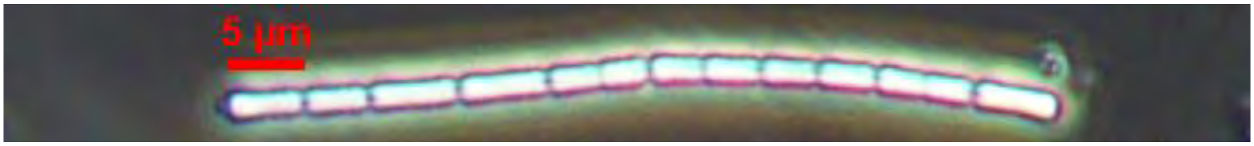


Fig. 10 *Pseudanabaena* sp. 400X (scale bar = 2µm)

Submitted by:

Andrew D. Chapman, M.S.

Date: 11/28/2023

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New England Testing Laboratory, Inc.
(401) 353-3420

REPORT OF ANALYTICAL RESULTS

NETLAB Work Order Number: 3K09056
Client Project: 03136 - White Pond

Report Date: 17-November-2023

Prepared for:

Jon Higgins
Higgins Environmental
19 Elizabeth Street
Amesbury, MA 01913

Richard Warila, Laboratory Director
New England Testing Laboratory, Inc.
59 Greenhill Street
West Warwick, RI 02893
rich.warila@newenglandtesting.com

Samples Submitted :

The samples listed below were submitted to New England Testing Laboratory on 11/09/23. The group of samples appearing in this report was assigned an internal identification number (case number) for laboratory information management purposes. The client’s designations for the individual samples, along with our case numbers, are used to identify the samples in this report. This report of analytical results pertains only to the sample(s) provided to us by the client which are indicated on the custody record. The case number for this sample submission is 3K09056. Custody records are included in this report.

Lab ID	Sample	Matrix	Date Sampled	Date Received
3K09056-01	APOD Residue	Soil	10/24/2023	11/09/2023
3K09056-02	EH-T2"-Core	Soil	11/06/2023	11/09/2023
3K09056-03	EH-62'-T2"	Soil	11/06/2023	11/09/2023

Request for Analysis

At the client's request, the analyses presented in the following table were performed on the samples submitted.

APOD Residue (Lab Number: 3K09056-01)

Analysis	Method
Iron	EPA 6010C
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Nitrogen	Calculation
Total Organic Carbon	EPA 9060

EH-62'-T2'' (Lab Number: 3K09056-03)

Analysis	Method
Iron	EPA 6010C
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Nitrogen	Calculation
Total Organic Carbon	EPA 9060

EH-T2''-Core (Lab Number: 3K09056-02)

Analysis	Method
Iron	EPA 6010C
Phosphorus	EPA 6010C
Sulfur	EPA 6010C
Total Nitrogen	Calculation
Total Organic Carbon	EPA 9060

Method References

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, USEPA

Soil Survey Laboratory Methods Manual, USDA/NCRS, 2014

Case Narrative

Sample Receipt:

The samples associated with this work order were received in appropriately cooled and preserved containers. The chain of custody was adequately completed and corresponded to the samples submitted.

Exceptions: None

Analysis:

All samples were prepared and analyzed within method specified holding times and according to NETLAB's documented standard operating procedures. The results for the associated calibration, method blank and laboratory control sample (LCS) were within method specified quality control requirements and allowances. Results for all soil samples, unless otherwise indicated, are reported on a dry weight basis.

Exceptions: None

Per client request, samples "EH-T2"-CORE"and "EH-62'-T2"" were allowed to filter to remove free liquids prior to analysis.

Results: General Chemistry

Sample: APOD Residue

Lab Number: 3K09056-01 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Total Organic Carbon	**36**		0	Percent	11/16/23	11/16/23
Total Nitrogen	**1240**		10.0	mg/kg	11/13/23	11/13/23

Results: General Chemistry

Sample: EH-T2''-Core
Lab Number: 3K09056-02 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Total Organic Carbon	**22**		0	Percent	11/16/23	11/16/23
Total Nitrogen	**16000**		10.0	mg/kg	11/13/23	11/13/23

Results: General Chemistry

Sample: EH-62'-T2"

Lab Number: 3K09056-03 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Total Organic Carbon	**25**		0	Percent	11/16/23	11/16/23
Total Nitrogen	**24200**		10.0	mg/kg	11/13/23	11/13/23

Results: Total Metals

Sample: APOD Residue

Lab Number: 3K09056-01 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Phosphorous	**3810**		1.23	mg/kg	11/10/23	11/15/23
Sulfur	**2070**		124	mg/kg	11/10/23	11/15/23
Iron	**2170**		12.4	mg/kg	11/10/23	11/15/23

Results: Total Metals

Sample: EH-T2''-Core
Lab Number: 3K09056-02 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Phosphorous	**3440**		3.78	mg/kg	11/13/23	11/15/23
Sulfur	**10800**		382	mg/kg	11/13/23	11/15/23
Iron	**30000**		38.2	mg/kg	11/13/23	11/15/23

Results: Total Metals

Sample: EH-62'-T2"

Lab Number: 3K09056-03 (Soil)

Analyte	Result	Qual	Reporting Limit	Units	Date Prepared	Date Analyzed
Phosphorous	**2140**		2.53	mg/kg	11/13/23	11/15/23
Sulfur	**7110**		256	mg/kg	11/13/23	11/15/23
Iron	**19600**		25.6	mg/kg	11/13/23	11/15/23

Quality Control

Total Metals

Analyte	Result	Qual	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch: B3K0472 - Metals Digestion Soils										
Blank (B3K0472-BLK1)					Prepared: 11/10/23 Analyzed: 11/15/23					
Sulfur	ND		33.3	mg/kg						
Batch: B3K0514 - Metals Digestion Soils										
Blank (B3K0514-BLK1)					Prepared: 11/13/23 Analyzed: 11/15/23					
Phosphorous	ND		0.33	mg/kg						
Iron	ND		3.3	mg/kg						
LCS (B3K0514-BS1)					Prepared: 11/13/23 Analyzed: 11/15/23					
Phosphorous	94.2		0.33	mg/kg	100		94.2	85-115		
Iron	1020		3.3	mg/kg	1000		102	85-115		

Notes and Definitions

Item	Definition
Wet	Sample results reported on a wet weight basis.
ND	Analyte NOT DETECTED at or above the reporting limit.

NEW ENGLAND TESTING LABORA
59 Greenhill Street
West Warwick, RI 02893
1-888-863-8522

3K0 9056

D

PROJ. NO.	PROJECT NAME/LOCATION															
03136	White Pond (WP)															
CLIENT: HEA																
REPORT TO: Jon Hitchins																
INVOICE TO: Jon Hitchins																
DATE	TIME	COMP	GRAB	SAMPLE I.D.	AQUEOUS	SOIL	OTHER	NO. OF CONTAINERS	PRESERVATIVE	TESTS:** Totals Carbon	Iron	Nitrogen	Phosphorus	Sulfur		REMARKS
10/24/23	1030	✓		APOD Residue		✓		1.	24°C	✓	✓	✓	✓	✓		
11/6/23	1050		✓	EH-T2"-CORE		✓		1.	<4°C	✓	✓	✓	✓	✓		
11/6/23	1115		✓	EH-62'-T2"		✓		1.	<4°C	✓	✓	✓	✓	✓		

Sampled by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Laboratory Remarks:	Special Instructions: List Specific Detection Limit Requirements:
[signature]	10/24/23 11:40	[signature]	11/6/23 1340	Temp. received: 5 Cooled ✗	"EH" Samples: filter or air dry at room temperature to reduce water content
Relinquished by: (Signature) [signature]	11/9/23 1410	Received by: (Signature) [signature]	11/9/23 1415	on ice	
Relinquished by: (Signature) [signature]	11/9/23 1730	Received for Laboratory by: (Signature) [signature]	11/9/23 1730		Turnaround (Business Days)

**Netlab subcontracts the following tests: Radiologicals, Radon, Asbestos, UCMRs, Perchlorate, Bromate, Bromide, Sieve, Salmonella, Carbamates, CT ETPH