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GEOTECHNICAL
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January 26, 2024
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Duncan Kruse
West Hill Pond Association
PO Box 1057
New Hartford, CT

Re: Summary Report for 2023 Annual Limnological Study of West Hill Pond
West Hill Pond – New Hartford and Barkhamsted, CT

Dear Mr. Kruse,

This Summary Report provides diagnostic interpretation of the reservoir monitoring results from the West Hill Pond 2023 season. Field data and water samples were jointly collected by GZA personnel and West Hill Pond Association (WHPA) volunteers. Water samples collected for chemical analysis were sent to UCONN's CESE Lab in Storrs, CT. Additionally, GZA performed fluorometric analysis of organic parameters and phytoplankton pigments and sent subsamples to a professional taxonomist for phytoplankton identification and enumeration. Suggested ongoing monitoring and management actions follow the diagnostic interpretations. This report and our recommendations above are subject to the Limitations attached in **Appendix A**. Full size images referenced in the text as Figures are attached in Appendix B.

BACKGROUND – WEST HILL POND

West Hill Pond (WHP) is a 261-acre waterbody located in New Hartford and Barkhamsted, CT with a maximum depth of 63 ft (20 m). WHP's deepest location, where sampling is conducted, is near the southern end of the waterbody (**FIGURE 1**). Over the past half century, many waterbodies in Connecticut have undergone eutrophication as a result of increased shoreline development, urbanization, and agricultural activity within their watersheds. Further, climate change trends have exacerbated New England lake eutrophication by increasing intensity and duration of thermal stratification, resulting in greater internal loading of nutrients. Despite these regional trends, WHP has not experienced significant degradation, and is in fact classified as one of the cleanest, least productive lakes in Connecticut.

It's GZA's pleasure to submit this report to the WHPA. We look forward to the discussion this will generate with its members. In the short time GZA has been working with the WHPA, we have witnessed the passionate and management-oriented attitudes of its members that demonstrate their seriousness to these commitments. This is not as common as one might expect among lake associations, and so we would like to take this opportunity to identify it, congratulate the WHPA, and communicate that it is a great opportunity to work in collaboration with its members.

LAKE MONITORING

West Hill Pond's (WHP) 2023 monitoring involved a cooperative field effort between GZA staff and West Hill Pond Association (WHPA) volunteers. In addition, West Hill Pond was sampled 7 times in 2023, with monitoring occurring from early April to mid-October. Field staff performed vertical water column tests in meter increments to assess the lake's physical and chemical composition. For more detailed chemical analyses, water samples were collected at 2m, 7m, 10m, 14m, and 18m below the surface of the lake using a van-Dorn water sampler. A 5-meter sampling straw was used to collect phytoplankton samples, which were preserved with Lugol's solution and shipped to a taxonomist for enumeration. A zooplankton net with a 15 cm diameter mouth was used to collect zooplankton samples. Samples were preserved with Lugol's solution and enumerated by GZA personnel. A set of 5 miniDOTs were deployed during the first sampling event at the deepest point of the lake and subsequently collected during the last sampling event (**FIGURE 2**). These miniDOTs recorded hourly snapshots of temperature and dissolved oxygen concentrations, and the data were used to calculate stratification intensity through the water column.

RESULTS

Climatic variability in rainfall and air temperature influence lake ecosystems in a variety of ways. For instance, increased rainfall results in increased watershed connectivity, which could mean external inputs of nutrients or organic material. **Temperature**, which can be assessed by growing degree days (GDD), determines water temperature and the duration and intensity of lake thermal stratification (where warm water is located at the surface, and colder, denser water is located deep on the bottom). Throughout the 2023 season, WHP experienced considerable rain, which was very reminiscent of the 2021 season. Furthermore, the largest rain events occurred in the middle of July. GDD is a cumulative metric, calculated by subtracting the minimum temperature threshold for crop productivity (in this case 55 deg. F) by mean daily temperature. The residual is the daily GDD. WHP's 2023 season had the lowest GDD when compared to the previous 3 seasons, indicating it was a relatively cool summer.

Thermal stratification, where warm water is located at the surface, and colder, denser water is located deep, had just initiated, albeit weakly, at WHP Lake during the first field monitoring trip in April, with water temperatures ranging from 11.1 °C to 6.0 °C from the top to the bottom of the water column, respectively (**FIGURE 3**). Stratification is measured by RTRM (relative thermal resistance to mixing; **FIGURE 4**). RTRM is a ratio, so it does not have units, but RTRM below 30-50 at any given depth, or below 100 when summed across the water column, is considered weak. In June, the thermocline was observed at 7 meters below the surface, with stronger stratification overall (261 RTRM total). Throughout peak summer, the thermocline gradually ascended in the water column until it was 5 m deep in late July. Beginning in August, the thermocline gradually deepened its location in the water column until it was 10 m deep in October (which was the last sampling date). In October, WHP's thermal stratification was weak but still present, even though surface temperatures had cooled to 16.4 °C. In summary, WHP's thermal stratification structure this season was typical of a deep temperate lake. It was perhaps surprisingly strong and shallow, considering the cooler temperatures and rain CT experienced this summer. For instance, RTRM remained above 300 through July and August. Because strong stratification stably compartmentalizes the top of the water column from the bottom of the water column (below the thermocline), stratification can exacerbate the depletion of oxygen at deep depths by preventing oxygen diffusion and replenishment from the surface.

Dissolved oxygen (DO) is critical for lakes as it allows organisms to conduct aerobic respiration. DO is diffused across the lake surface from the atmosphere or produced by plants, algae, or phytoplankton within the lake. After lakes experience stratification, DO in the deepest hypolimnetic layer can become exhausted by biological processes (mainly, microbial respiration). This leads to anoxia (DO < 1.0 mg/L) and reduced conditions (low oxidation-reduction potential). Such conditions can promote the release and transport of problematic nutrients such as total phosphorus (TP), iron (Fe), and manganese (Mn) from the lake sediments into the water column. TP and Fe are key nutrients for cyanobacteria growth, while Mn is more of a concern to drinking water due to the treatment process required to remove it. Hence, the water at the bottom of the lake during the summer may not only be cold and dense, but if anoxic and reduced, it may also be very nutrient and metal rich.

Throughout 2023, WHP's Epilimnion (upper layer) down through the metalimnion (middle layer that contains the thermocline) remained well oxygenated, with DO concentrations remaining above 4 mg/L (**FIGURE 5**) and exceeding well above 100% saturation just below the thermocline in June, July, and August (likely due to phytoplankton productivity; **FIGURE 6**). The hypolimnion (lower layer) remained aerobic (> 1 mg/L DO) until July, with anoxia initiating directly in the over bottom water parcel (17 m) and eventually ascending to 14 m deep by late August. Anoxia was therefore contained below the metalimnion, entirely within the hypolimnion. This was beneficial, as anoxic water—which is potentially nutrient-rich—was partitioned to the deepest part of the water column, separate from the productive areas of the lake. Throughout the season, observed ORP values remained relatively high, generally above the threshold for Fe and TP release (120 mV) at shallow depths (**FIGURE 7**). Low, even negative ORP was recorded at those depths that corresponded to anoxia, indicating deep conditions favorable to Fe and TP release from lake sediments, and even anaerobic respiration of organic material (methanogenesis) and sulfate reduction (-75 mV). There were no ORP recordings during the late July and August samplings.

A lake feature that likely maintained aerobic conditions through the metalimnion and contained anoxia to deep depths, is WHP's **water clarity**, measured by Secchi disk depth (**FIGURE 8**). Water clarity determines where in the water column photosynthesis may occur and WHP's euphotic zone (the depth to where photosynthesis can occur; calculated from the Secchi disk depth) spanned through most of the water column throughout the summer (11 m to 14 m). This means that photosynthesis and oxygen production could occur throughout WHP's water column down to those depths and likely contributed, at least in part, to the well-oxygenated conditions and even supersaturated conditions observed from 6 m – 9 m. Turbidity values were low (**FIGURE 9)** and provide further demonstration of WHP's water clarity.

MiniDOT instruments provided measurements of hourly temperature and DO at five depths (2 m to 18 m) throughout the season (**FIGURES 10-13**). The results of these hourly records are striking: WHP's temperature peaked in the high 20's (°C) through July at the surface, while the rest of the water column warmed more gradually with depth. The bottom of the lake remained cool, only increasing from 6 °C to 7 °C (**FIGURE 10**). Peak surface temperature corresponded with shallow stratification through July at 8 m – 7 m, before dropping to 12 m (**FIGURE**

11). A clear 'zone', or parcel, of oxygen demand (roughly below 6 mg/L DO), developed over bottom starting in May and ascended into the water column until the beginning of August. Eventually this parcel also developed anoxia starting at the end of June which ascended to about 14 m (corroborating the hand-collected data). The zone, or parcel, of oxygen demand eventually stabilized through August and September, with anoxia contained below the metalimnion, and hypoxia (1 mg/L DO – 6 mg/L DO) reaching up to the top of the metalimnion (**FIGURE 12**). Anoxia was persistent up to the point of the last sampling date when the miniDOTs were extracted, and the lake was still stratified. This suggests a longer deployment in future years would be necessary to evaluate anoxic duration and timing of lake turnover. Supersaturation, exceeding 100%, was observed around 8 m, which often had higher DO concentration and saturation values than the surface (**FIGURE 13**). As described above, this is likely due to photosynthetic productivity by phytoplankton.

TP is a key nutrient for biological productivity in New England Lakes. A threshold of 0.20 mg/L (20 ug/L) TP indicates favorable nutrient conditions for cyanobacteria, at which blooms can initiate and be sustained in fresh waterbodies. TP concentrations in the epilimnion layer ranged from 1 ug/L to 14 ug/L, with a mean of 8 ug/L (**FIGURE 14**). Mid-depth (7 m to 14 m) TP was higher, ranging from 3 ug/L to 20 ug/L (the mean was 12 ug/L). These were favorable conditions, suggesting that WHP was not susceptible to cyanobacteria blooms. Over bottom TP concentrations were highest, continually increasing throughout the season (probably due to internal loading during anoxia) and peaking in October at 151 ug/L, though conditions beyond October are unknown.

Ammonia-N is an important source of inorganic nitrogen to cyanobacteria and can accumulate near the bottom of lakes and reservoirs resulting from organic decomposition and anoxia. Ammonia-N concentrations throughout the water column were minimal throughout the season (**FIGURE 15**) but did accumulate over bottom to 748 ug/L and could have continued to accumulate beyond our sampling dates.

Nitrate is an important nutrient for eukaryotic phytoplankton such as diatoms, chlorophytes ("greens"), and chrysophytes, which can readily compete with cyanobacteria when conditions are favorable. Typically, temperate waterbodies are enriched with nitrate in early spring following ice off, snow melt, and spring rains. Spring diatom blooms often track nitrate availability, and "bust" when nitrate is exhausted. Following nitrate exhaustion, lakes may experience a 'clear-water phase,' where diatoms senesce and settle to the bottom of the lake. When nitrate becomes unavailable in surface waters, N-fixing cyanobacteria can gain a competitive advantage over eukaryotic algae. In 2023, WHP's nitrate concentrations were low throughout the season (**FIGURE 16**), resulting in low eukaryotic algae density, but low TP ensured cyanobacteria remained low density as well (as discussed below). 2023 nitrate was different than some historical data. Though nitrate trends are variable in WHP from year to year, it has been measured at enriched concentrations through the spring and beginning of summer throughout the past decade. This year, we did not measure nitrate above 4 ug/L. It will be a matter of interest to closely monitor nitrate measurements in future years to understand these findings and determine if they are representative of a long-term change.

In the absence of oxygen, **Fe and Mn** can become reduced and mobilized from sediments into the water column by anaerobic microbial respiration. When anoxia occurs for a duration of time, Fe and Mn can accumulate to high concentrations in over-bottom water. WHP's total Fe was high from internal loading, reaching a maximum concentration of 7.8 mg/L in October (**FIGURE 17**). WHP's total Mn was lower than total Fe, which is typical for most New England Lakes, but still accumulated to high concentrations over bottom (2.1 mg/L Mn in late August, **FIGURE 18**). As with TP and Ammonia-N which accumulate in anoxic conditions, it is possible that Fe and Mn could have continued to accumulate beyond our last sampling date.

Fluorometric analysis of pigments and organic matter (colored dissolved organic matter (cDOM), and UV254 absorbance) was performed on monthly water samples. Colored dissolved organic matter (cDOM) is the fraction of organic material that can give water a 'tea-stained' coloration. It consists of reactive organic molecules such as tannins and humic acids and is typically considered to represent allochthonous sources—that is, derived from outside the reservoir, i.e., terrestrial watershed habitat. As WHP has a relatively small watershed, cDOM was low at the beginning of the season but increased throughout the season in response to the frequent rain events flushing the watershed (**FIGURE 19**). cDOM was also highest over bottom, which is typical as it settles out and decomposes more slowly in an anoxic environment. UVA254 quantifies the aromatic (6-carbon ring) fraction of dissolved organic material which can be more refractory than cDOM. WHP's UVA254 was low down to 14 m, rarely exceeding 0.044 abs cm^{-1} (**FIGURE 20**). Like cDOM, highest UVA254 was recorded over bottom (0.265 abs cm^{-1}), but was still low. In sum, WHP generally appears to have low amounts of organic matter compared to many soft-water New England waterbodies.

Chlorophyll-a is a photosynthetic pigment that indicates the standing biomass of phytoplankton in the water column. WHP's chlorophyll-a concentrations remained below 10 µg/L on most dates, indicating very low phytoplankton densities, though it did reach 18 ug/L in June (**FIGURE 21**). In June, July, and August, highest chlorophyll-a was recorded at 10 m, suggesting the presence of a deep-water phytoplankton layer. Phycocyanin concentrations (a cyanobacteria-specific pigment and indicator of cyanobacteria biomass) were minimal throughout all samples, but the highest readings were recorded from the bottom of the reservoir (65 ug/L in July; **FIGURE 22**). This could indicate increased cyanobacteria due to settling out of the water column. Alternatively, rather than indicating deep, over bottom accumulation of cyanobacteria biomass, this could be a confoundment due to high Fe or cDOM accumulation.

Monthly **phytoplankton samples** collected from the top of the water column, 0-5 m, were enumerated to cells/mL by a taxonomist (**FIGURE 23**). WHP exhibited low densities of eukaryotic phytoplankton throughout the season (743 cells/mL to 2,492 cells/mL), perhaps attributable to the lack of available nitrate (indeed, GZA did not even observe a spring diatom bloom). The assemblage was very diverse, with no one group exhibiting clear dominance. Cyanobacteria were minimal, peaking at 97 cell/mL in July. Deep, depth-discrete samples that corresponded to depths of DO supersaturation were collected in June, July, and August (**FIGURE 24**). Surprisingly, total phytoplankton density was similar to that of 0-5 m samples (ranging from 1,665 cells/mL to 2,183 cells/mL), though cyanobacteria constituted a greater portion of the assemblage in July and August (consisting of *Dolichospermum* spp., *Lygbya* spp., and *Gomphosphaeria* spp.). Even so, highest cyanobacteria density was 986 cell/mL and August and did not warrant any concern.

DISCUSSION AND RECOMMENDATIONS

2023 was the first year of GZA services for WHP and its association. Within this year, we have characterized WHP extensively. Not only did we conduct annual monitoring, the results of which are summarized above, GZA also conducted a historical analysis and brief watershed analysis, both produced as separate reports that have been provided the WHPA. The historical data review we determined that recent trends indicate trophic state and metabolic processes are remaining at historical levels (some are even improving, i.e., indicating the lake is becoming slightly more oligotrophic since the 1970s), and GZA suggested WHP does not yet need any in-lake management intervention beyond regular annual lake monitoring and watershed monitoring. Lake monitoring would provide data that will indicate any future trends or deviations from historical baseline conditions—and data from this year do not indicate such deviations. The watershed study highlighted the fact that WHP's catchment is small (watershed area : lake area is about 3:1) and high quality. Much of the shoreline remains undeveloped, and though there were sites of potential erosion or unbuffered stormwater runoff, there are also active projects underway to improve watershed and drainage function. From these reports, and with supporting data from monitoring this year, the overall message is clear: WHP is a healthy ecological system, and management should be maintenance-focused to keep WHP among the least eutrophic waterbodies in CT. As GZA stated in the watershed study: The goal for the WHPA, New Hartford, and Barkhamsted is to maintain WHP in its current condition into the future. Proactive preservation is much easier, more effective, and more affordable compared to reactive rehabilitation/restoration efforts to a compromised system. This goal is given even more urgency, perhaps, considering future climate change with projected New England lake impacts, and current trends in invasive macrophyte colonization in CT (there have been several newly reported cases of *Hydrilla verticillata* across the state, which was previously only recorded in a handful of places).

Monitoring data from this summer addressed the ongoing question of deep water DO production and supersaturation at 6 – 9 m. This is a trend that has been observed historically, not just this year. While this may seem like a trivial detail, the most common reason for this to occur in other CT waterbodies is the occurrence of a dense, cyanobacteria layer that concentrates at or below the thermocline. Because cyanobacteria pose a human health risk, this was noted as a potential management concern that needed attention and better characterization. Though our deep phytoplankton samples collected at depths that coincided with supersaturated DO did have higher densities of cyanobacteria, those densities were not high enough to be a management concern, and the community also consisted of greens, cryptophytes, and chrysophytes.

The miniDOT data were a new addition to WHP's monitoring this year and are very valuable. They provide a detailed record of lake conditions and allow for evaluation of normal seasonal lake trends such as warming and cooling, stratification, and the development of anoxia. Perhaps most striking was the consistency of the overall seasonal progression of these trends in WHP. Many lakes exhibit variability in their warming, stratification, and DO profiles that are controlled by daily light/dark and warming cycles and weather events; despite 2023 experiencing many individual extreme weather events that delivered high amounts of precipitation, the miniDOT data record did not register any real disturbance to its seasonal cycle. Future miniDOT data will be a nice comparison and helpful in diagnosing what environmental factors WHP responds to, and year-round (under ice) deployment would be useful to understand WHP dynamics through the late autumn, winter, and early spring seasons.

In summary, GZA recommends continued monitoring in 2024. The cooperative sampling model between GZA and the WHPA was successful this year and will be leveraged more in the coming year. We do recommend initiating the sampling season again in April, though we did not sample late enough in the 2023 season to capture complete lake turnover. Thus, we recommend scheduling be altered to allow for the final sampling to occur in November rather than October, as we did in 2023. Due to the success of the miniDOT data collection in 2023, we recommend the continuation of this remote monitoring in 2024; as we collect multiple years of miniDOT data, they will prove very useful to compare the impact of climate and weather variability on WHP. Lastly, we recommend the WHPA begin the process of developing an EPA-approved 9-element Watershed Based Plan. The involvement and import of this project have been outlined by us in the historical and watershed studies, as it is the central and most crucial piece of an overall maintenance/preventative management scheme.

It has been a pleasure working on WHP, and alongside the passionate individuals that constitute the WHPA and volunteer sampling team. GZA very much looks forward to working with the WHPA in 2024 and coming years.

The GZA team appreciates the opportunity to provide these services to the WHPA and we look forward to continuing to serve you in the future. If you have any questions regarding the information presented, please feel free to contact Benjamin Burpee directly at 207-887-0358.

Very truly yours,
GZA, GeoEnvironmental, Inc.

Benjamin Burpee, PhD, CLM
Project Limnologist

Robert Kortmann, PhD
Senior Consultant

Stephan Roy, PG
Principal

Attachments: **APPENDIX A—LIMNOLOGY REPORT LIMITATIONS**
APPENDIX B—DATA PLOTS AND GRAPHS

USE OF REPORT

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of our client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the agreement, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

STANDARD OF CARE

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in the Proposal for Services and/or Report and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. Conditions other than described in this report may be found at the subject location(s).

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made. Specifically, GZA does not and cannot represent that the Site contains no hazardous material, oil, or other latent condition beyond that observed by GZA during its study. Additionally, GZA makes no warranty that any response action or recommended action will achieve all of its objectives or that the findings of this study will be upheld by a local, state or federal agency.

4. In conducting our work, GZA relied upon certain information made available by public agencies, Client and/or others. GZA did not attempt to independently verify the accuracy or completeness of that information. Inconsistencies in this information which we have noted, if any, are discussed in the Report.

SUBSURFACE CONDITIONS

5. The generalized profile(s) provided in our Report are based on widely spaced locations and are intended only to convey trends in subsurface conditions. The boundaries between depths are approximate and idealized and were based on our assessment of subsurface conditions. The composition of depths, and the transitions between depths, may be more variable and more complex than indicated. For more specific information on conditions at a specific location refer to the data summaries. The nature and extent of variations between these locations may not become evident until further exploration or construction. If variations or other latent conditions then become evident, it will be necessary to reevaluate the conclusions and recommendations of this report.

6. Water readings have been made, as described in this Report, at monitoring locations at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this report. Fluctuations in the readings however occur due to temporal or spatial variations of many types.

COMPLIANCE WITH CODES AND REGULATIONS

7. We used reasonable care in identifying and interpreting applicable codes and regulations necessary to execute our scope of work. These codes and regulations are subject to various, and possibly contradictory, interpretations. Interpretations and compliance with codes and regulations by other parties is beyond our control.

SCREENING AND ANALYTICAL TESTING

8. GZA may have collected samples at the locations identified in the Report. These samples were analyzed for the specific parameters identified in the report. Additional constituents, for which analyses were not conducted, may be present in soil, groundwater, surface water, sediment and/or air. Future Site activities and uses may result in a requirement for additional testing.

9. Our interpretation of field screening and laboratory data is presented in the Report. Unless otherwise noted, we relied upon the laboratory's QA/QC program to validate these data.

10. Variations in the types and concentrations of constituents observed at a given location or time may occur due to release mechanisms, disposal practices, changes in flow paths, and/or the influence of various physical, chemical, biological or radiological processes. Subsequently observed concentrations may be other than indicated in the Report.

INTERPRETATION OF DATA

11. Our opinions are based on available information as described in the Report, and on our professional judgment. Additional observations made over time, and/or space, may not support the opinions provided in the Report.

ADDITIONAL SERVICES

12. GZA recommends that we be retained to provide services during any future investigations, design, implementation activities, construction, and/or property development/ redevelopment at the Site. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

NUMERICAL MODELS

13. Actual conditions are likely more complex than indicated in this Report. If a mathematical model is refenced in this report, it is by its very nature, a simplification of actual conditions. Except as noted in the report, we did not validate the code used in the model. In constructing the model, point specific data was generalized and extrapolated across the study area. In addition, in areas where field data was not available, we used professional judgment, based on experience and regional information, to construct the model. Model assumptions are provided in this report**.** Actual flow patterns, etc. may be other than simulated. As additional field data becomes available our numerical model can be modified to better reflect conditions of possible interest.

COST ESTIMATES

14. Unless otherwise stated, our cost estimates are only for comparative and general planning purposes. These estimates may involve approximate quantity evaluations. Note that these quantity estimates are not intended to be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we may have no control over either when the work will take place or the labor and material costs required to plan and execute the anticipated work, our cost estimates were made by relying on our experience, the experience of others, and other sources of readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

15. A firm cost estimate, if requested, has been described and qualified herein, or submitted under separate cover.

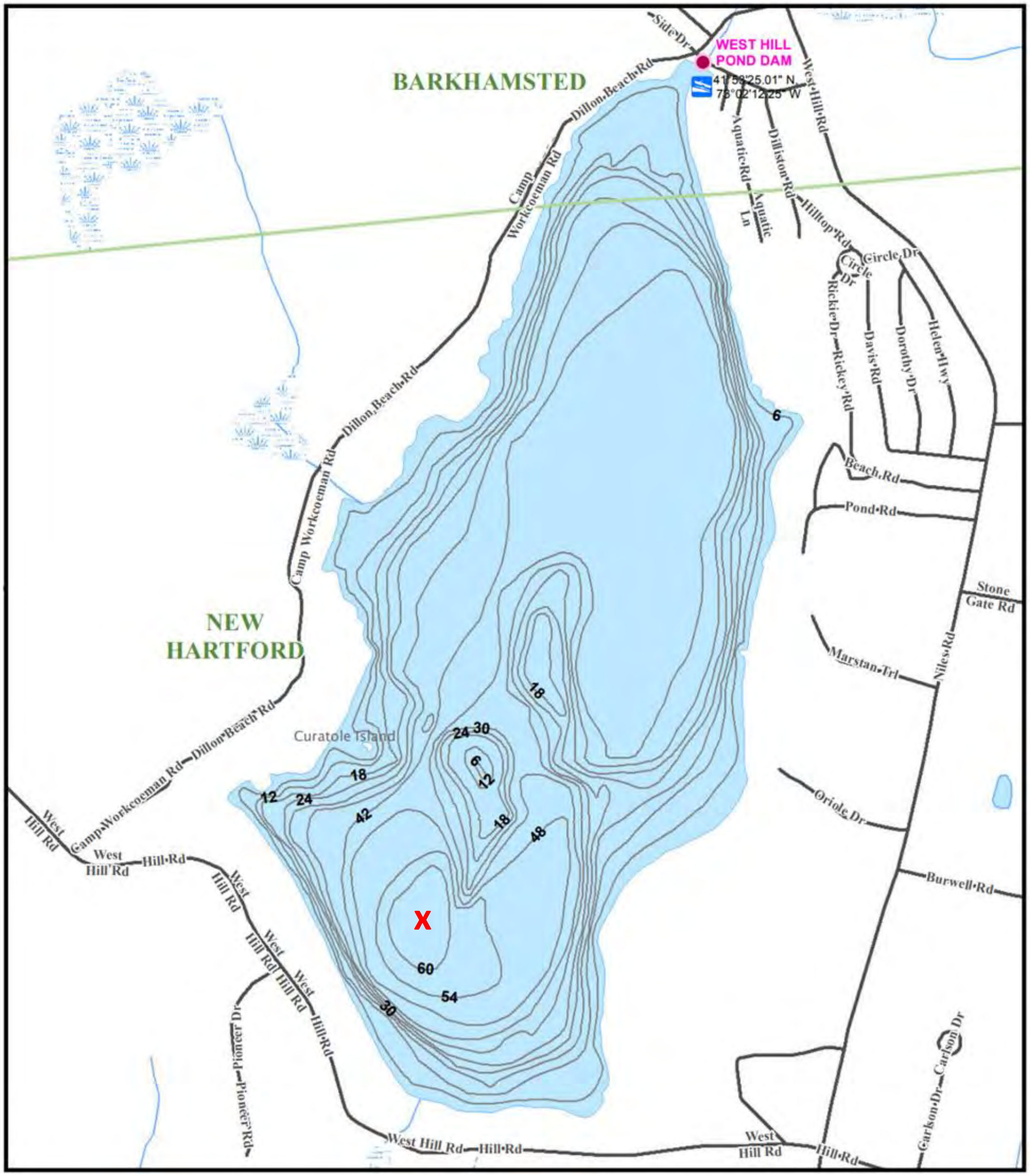

Figure 1: Bathymetric map of West Hill Pond (DEEP, 2011).
Red "X" demarcates maximum depth (Z_{max}) at 21 m.

FIGURE 2. Example of a datalogging buoy, though instrumentation and depths vary. In WHP, the top of the buoy remained submerged, was anchored at 20 m depth, and had five miniDOTs at 2, 7, 10, 14, and 18 m deep.

West Hill Temperature (deg C)-2023

	Staff	PG/BB	BB	SH	WHP	SH	WHP	PG&SH
	Date	4/20	6/20	7/11	7/28	8/17	8/24	10/12
depth (m)	0.0	11.1	21.9	25.3	26.1	23.8	23.3	16.4
	0.5	11.1	21.6	25.3	26.0	23.8	23.4	16.4
	1.0	11.1	21.4	25.3	26.0	23.8	23.4	16.4
	2.0	11.0	21.0	25.1	25.9	23.8	23.4	16.4
	3.0	11.0	20.8	25.0	25.6	23.8	23.4	16.4
	4.0	11.0	20.7	24.8	22.7	23.7	23.3	16.4
	5.0	10.9	20.4	21.9	16.5	23.7	23.4	16.3
	6.0	10.8	18.4	18.6	14.4	23.3	23.3	16.3
	7.0	8.5	15.0	15.4	12.3	18.6	19.2	16.3
	8.0	7.7	12.8	12.5	10.2	14.5	15.2	16.3
	9.0	7.1	10.7	10.2	9.0	11.9	12.4	15.5
	10.0	6.8	9.3	9.1	8.5	10.2	10.7	12.9
	11.0	6.7	8.2	8.0	8.1	9.0	9.3	11.2
	12.0	6.6	7.8	7.7	7.8	8.4	8.7	10.2
	13.0	6.5	7.4	7.5	7.7	8.1	8.4	9.1
	14.0	6.4	7.3	7.3	7.2	7.9	8.0	8.6
	15.0	6.3	7.0	7.1	7.1	7.6	7.8	8.1
	16.0	6.2	6.9	6.9	7.0	7.4	7.7	7.7
	17.0	6.1	6.6	6.7	6.9	6.9	7.4	7.3
	18.0	6.0	6.5	---	6.9	---	7.1	7.1

FIGURE 3. Temperature profiles collected from the deepest point in WHP.

West Hill RTRM-2023							
Staff	PG/BB	BB	SH	WHP	SH	WHP	PG&SH
Date	4/20	6/20	7/11	7/28	8/17	8/24	10/12
0.0	0	0	0	0	0	0	0
0.5	0	6	0	0	0	0	0
1.0	0	5	0	0	0	0	0
2.0	0	13	6	3	0	0	0
3.0	0	3	3	10	0	0	0
4.0	1	5	3	89	0	3	0
5.0	0	5	86	152	0	0	0
6.0	1	52	87	40	15	3	0
7.0	24	69	66	34	122	110	0
8.0	6	37	51	27	87	84	0
9.0	4	30	29	12	41	47	18
10.0	1	15	11	4	21	23	45
11.0	1	9	9	3	12	15	24
12.0	0	4	2	2	5	6	11
13.0	0	2	1	1	2	3	11
14.0	0	1	1	3	1	3	5
15.0	0	2	1	1	2	1	4
16.0	1	1	2	1	1	1	3
17.0	0	2	1	0	2	2	2
18.0	0	0	---	0	---	2	1
Sum	41	261	361	382	313	303	124

depth (m)

FIGURE 4. Relative thermal resistance to mixing (RTRM) profiles, which indicate intensity and location of stratification and the thermocline. The total RTRM across the water column is reported on the bottom row.

West Hill DO (mg/L)-2023							
Staff	PG/BB	BB	SH	WHP	SH	WHP	PG&SH
Date	4/20	6/20	7/11	7/28	8/17	8/24	10/12
depth (m) 0.0	10.0	7.9	7.3	8.5	7.4	9.1	8.3
0.5	10.0	8.0	7.3	8.4	7.4	9.1	8.3
1.0	10.0	8.1	7.3	8.4	7.4	9.1	8.3
2.0	10.0	8.1	7.3	8.4	7.4	9.1	8.3
3.0	10.0	8.1	7.3	8.2	7.4	9.1	8.3
4.0	9.9	8.1	7.3	8.0	7.4	8.9	8.3
5.0	9.9	8.1	8.0	9.1	7.3	8.9	8.2
6.0	9.9	8.9	8.9	12.7	7.2	8.9	8.2
7.0	10.6	10.7	9.9	13.3	8.5	11.6	8.2
8.0	11.1	11.7	12.1	1.9	10.1	12.5	8.2
9.0	11.1	11.8	12.1	9.1	9.9	11.1	7.9
10.0	11.0	10.9	11.1	5.8	8.8	8.2	6.6
11.0	10.8	9.3	8.0	4.4	5.9	4.4	4.3
12.0	10.7	8.0	6.7	3.5	4.0	2.5	3.0
13.0	10.4	6.7	4.9	2.6	2.6	1.6	1.8
14.0	10.4	6.4	3.4	2.1	2.2	0.1	0.9
15.0	10.2	5.3	3.1	0.2	1.6	0.1	0.5
16.0	9.7	4.5	2.4	0.1	0.9	0.1	0.3
17.0	9.5	2.5	0.4	0.1	0.3	0.1	0.2
18.0	9.0	1.0	---	0.1	---	0.1	0.1

FIGURE 5. Dissolved oxygen profiles in terms of concentration (mg/L).

West Hill DO % Saturation-2023

Staff	PG/BB	BB	SH	WHP	SH	WHP	PG&SH
Date	4/20	6/20	7/11	7/28	8/17	8/24	10/12
depth (m) 0.0	95	89	87	105	87	107	88
0.5	95	91	87	104	87	107	88
1.0	95	91	87	104	87	107	88
2.0	95	90	87	103	87	107	88
3.0	95	90	87	100	87	107	88
4.0	94	90	87	92	87	104	88
5.0	94	89	90	93	86	105	88
6.0	94	95	95	124	83	104	88
7.0	95	106	99	125	91	126	88
8.0	97	111	113	17	99	124	88
9.0	96	107	108	79	92	104	82
10.0	94	96	96	49	78	74	65
11.0	93	80	67	37	52	38	41
12.0	92	68	56	29	34	21	28
13.0	89	57	42	22	23	14	16
14.0	89	54	29	17	19	1	8
15.0	87	44	26	2	13	1	5
16.0	83	38	20	1	7	1	3
17.0	81	21	4	1	2	1	2
18.0	76	8	---	1	---	1	1

FIGURE 6. Dissolved oxygen profiles in terms of % saturation, which is water temperature-dependent.

West Hill ORP (mV)-2023

depth (m)							
Staff	PG/BB	BB	SH	WHP	SH	WHP	PG&SH
Date	4/20	6/20	7/11	7/28	8/17	8/24	10/12
0.0	166	143	108	---	147	---	189
0.5	162	138	111	---	147	---	188
1.0	166	138	111	---	145	---	188
2.0	162	141	95	---	128	---	184
3.0	159	135	86	---	120	---	179
4.0	186	130	80	---	116	---	174
5.0	191	125	76	---	111	---	170
6.0	195	109	72	---	109	---	166
7.0	175	89	58	---	108	---	161
8.0	146	72	47	---	106	---	158
9.0	123	75	53	---	109	---	156
10.0	107	86	58	---	114	---	160
11.0	98	92	69	---	120	---	157
12.0	86	96	71	---	123	---	122
13.0	87	94	73	---	121	---	3
14.0	71	92	74	---	118	---	-55
15.0	62	91	72	---	81	---	-83
16.0	53	89	71	---	-24	---	-116
17.0	46	7	-17	---	-158	---	-149
18.0	39	-53	---	---	---	---	-173

FIGURE 7. Oxidation reduction potential (ORP), measured in mV.

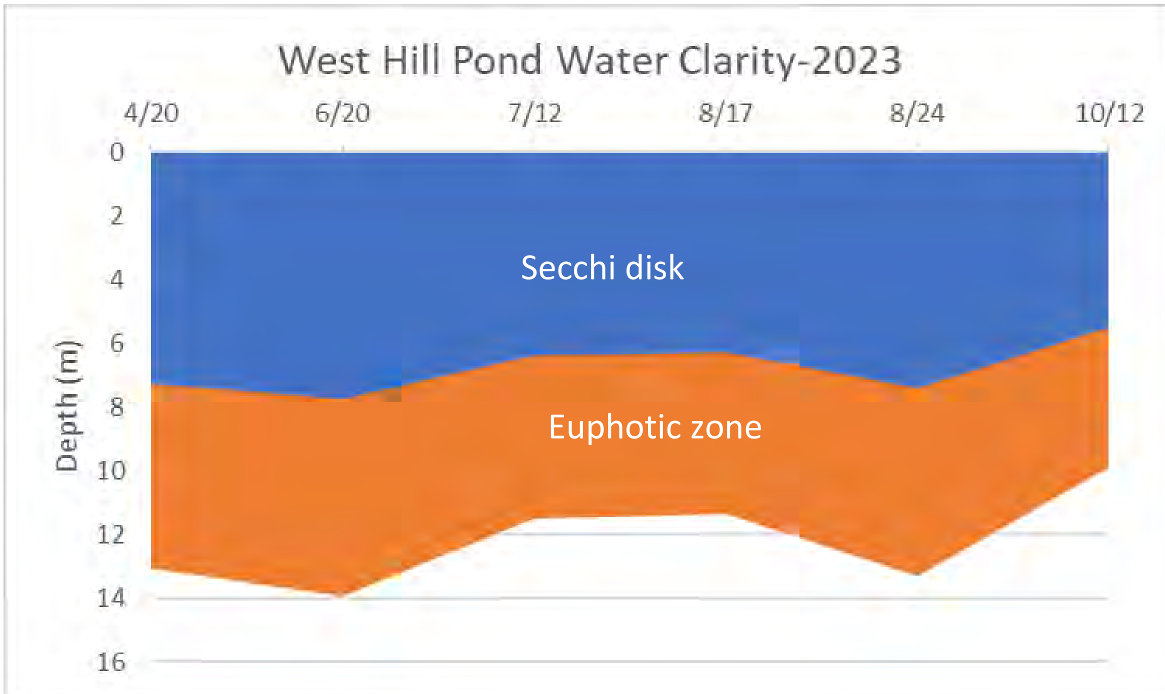

FIGURE 8. Water clarity in WHP, assessed by Secchi disk depth and euphotic zone depth, which corresponds to the section of the water column that supports photosynthesis.

	West Hill Turbidity (NTU)-2023						
Staff	PG/BB	BB	SH	WHP	SH	WHP	PG&SH
Date	4/20	6/20	7/11	7/28	8/17	8/24	10/12
depth (m) 0.0	0.00	0.00	0.00	---	0.00	---	0.000
0.5	0.01	0.00	0.00	---	0.00	---	0.000
1.0	0.00	0.00	0.00	---	0.00	---	0.000
2.0	0.00	0.00	0.00	---	0.00	---	0.000
3.0	0.04	0.00	0.00	---	0.00	---	0.000
4.0	0.00	0.00	0.00	---	0.00	---	0.000
5.0	0.01	0.00	0.00	---	0.00	---	0.000
6.0	0.00	0.00	0.00	---	0.00	---	0.000
7.0	0.00	0.00	0.00	---	0.00	---	0.000
8.0	0.00	0.00	0.00	---	0.00	---	0.000
9.0	0.00	0.00	0.00	---	0.00	---	0.000
10.0	0.00	0.00	0.00	---	0.02	---	0.000
11.0	0.00	0.00	0.00	---	0.00	---	0.000
12.0	0.03	0.00	0.00	---	0.00	---	0.000
13.0	0.00	0.00	0.00	---	0.00	---	0.168
14.0	0.10	0.00	0.42	---	0.00	---	0.000
15.0	0.13	0.00	0.18	---	0.00	---	0.346
16.0	0.57	0.00	1.86	---	0.00	---	0.079
17.0	0.34	2.09	6.18	---	0.25	---	0.402
18.0	0.66	20.23	---	---	---	---	0.661

FIGURE 9. West Hill Pond turbidity profiles.

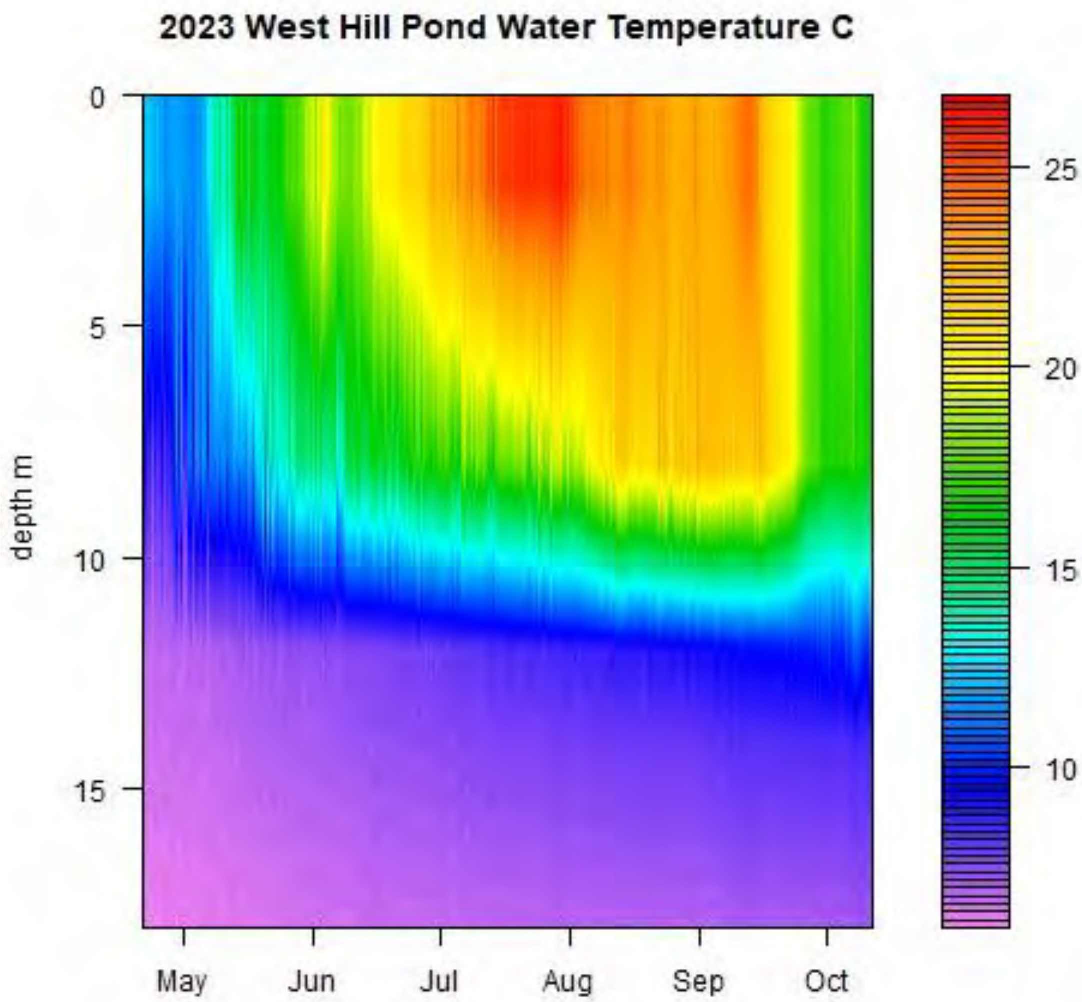

FIGURE 10. West Hill Pond hourly temperature from miniDOTs deployed at 2, 7, 10, 14, and 18 m.

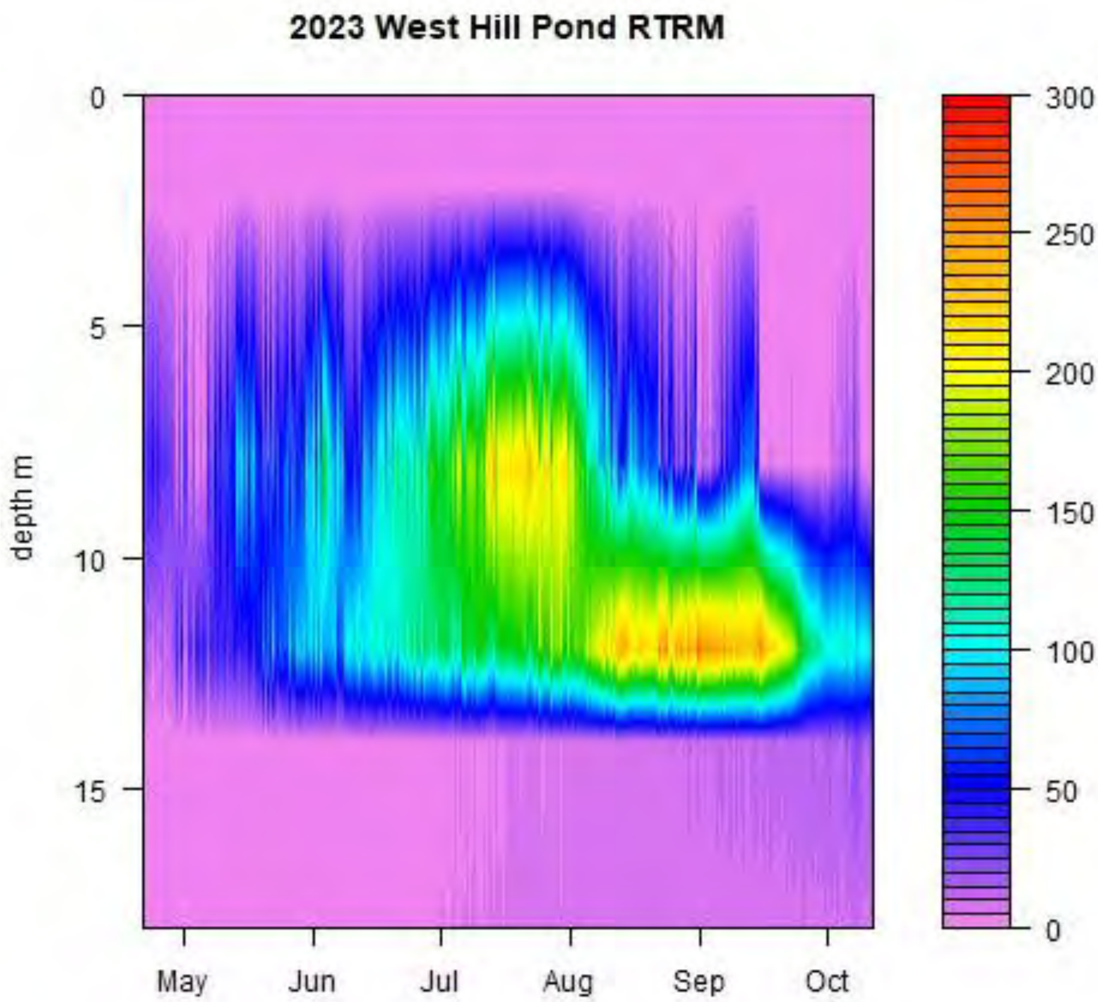

FIGURE 11. West Hill Pond hourly RTRM from miniDOTs deployed at 2, 7, 10, 14, and 18 m.

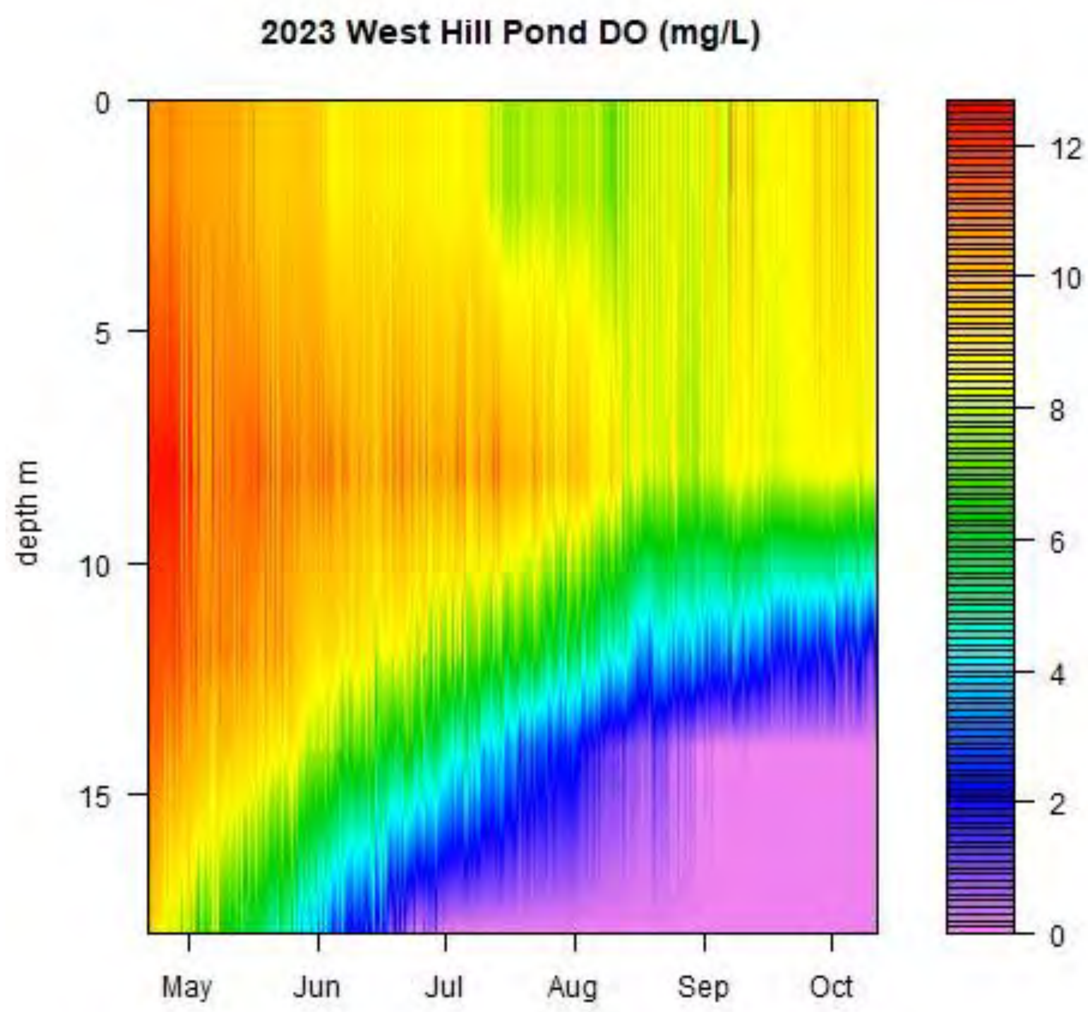

FIGURE 12. West Hill Pond hourly DO concentration from miniDOTs deployed at 2, 7, 10, 14, and 18 m.

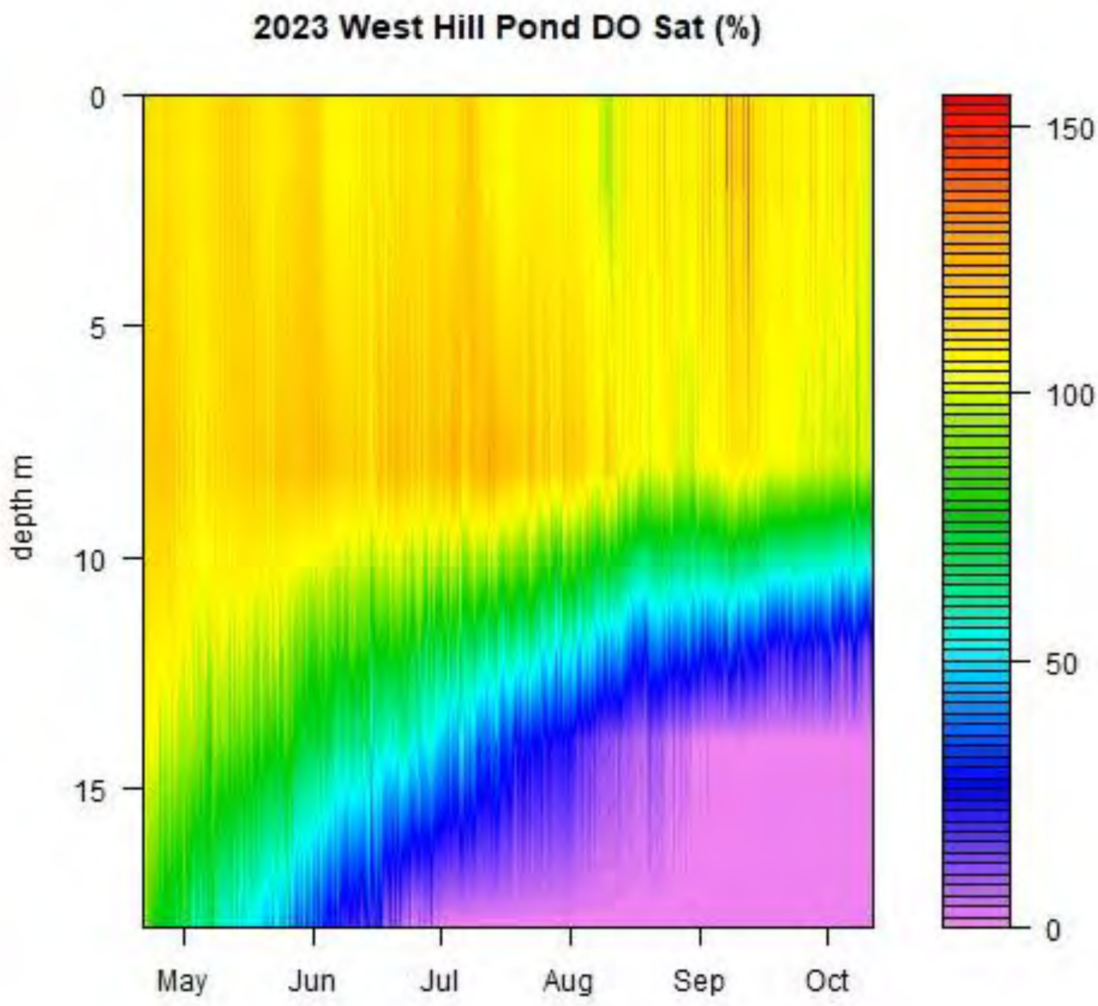

FIGURE 13. West Hill Pond hourly DO saturation from miniDOTs deployed at 2, 7, 10, 14, and 18 m.

FIGURE 14. WHP Total Phosphorus (TP).

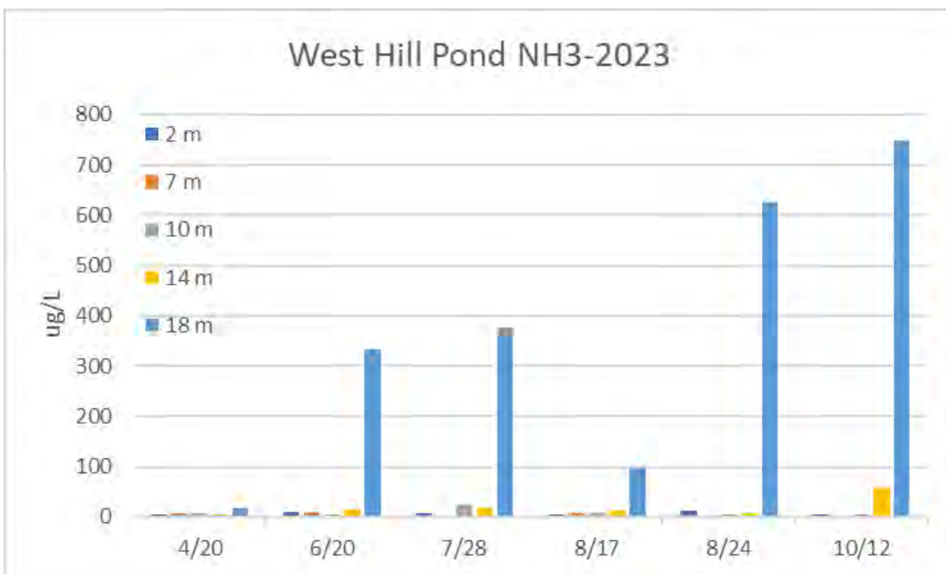

FIGURE 15. WHP Ammonia (NH3).

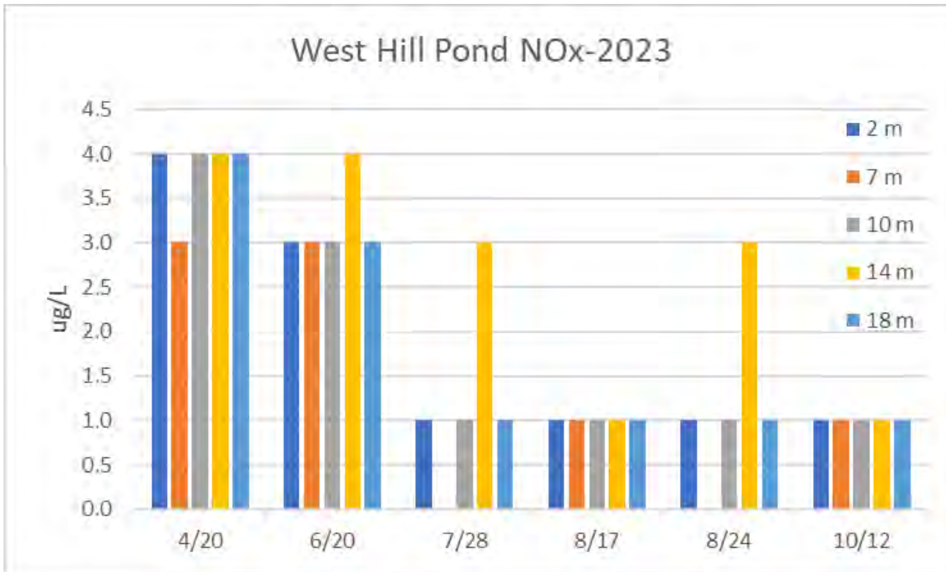

FIGURE 16. WHP Nitrate (NO3).

FIGURE 17. WHP Iron (Fe).

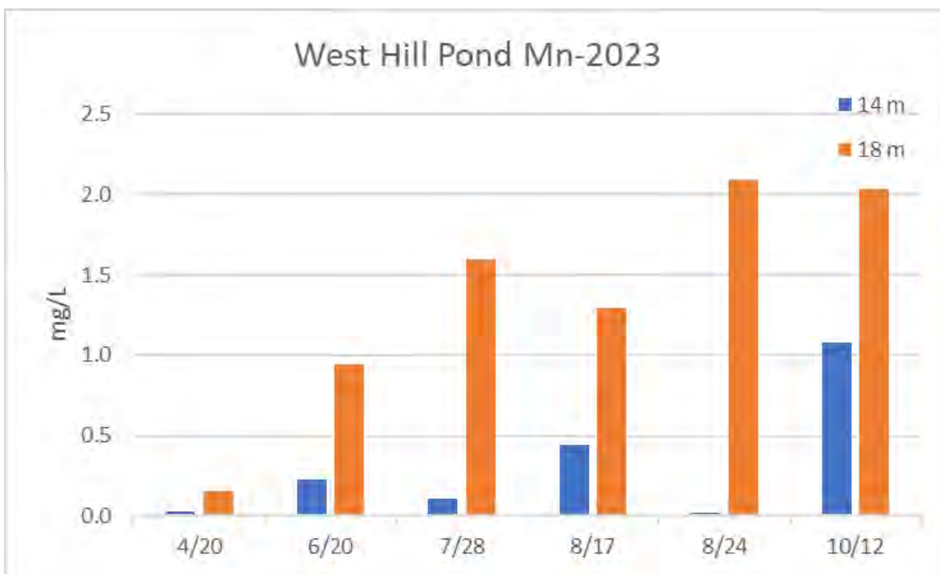

FIGURE 18. WHP Manganese (Mn).

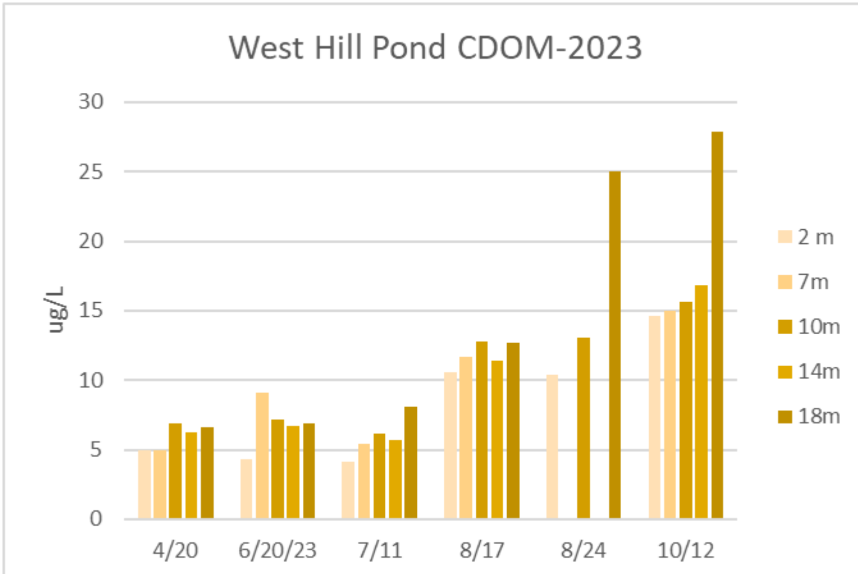

FIGURE 19. WHP colored dissolved organic matter (cDOM).

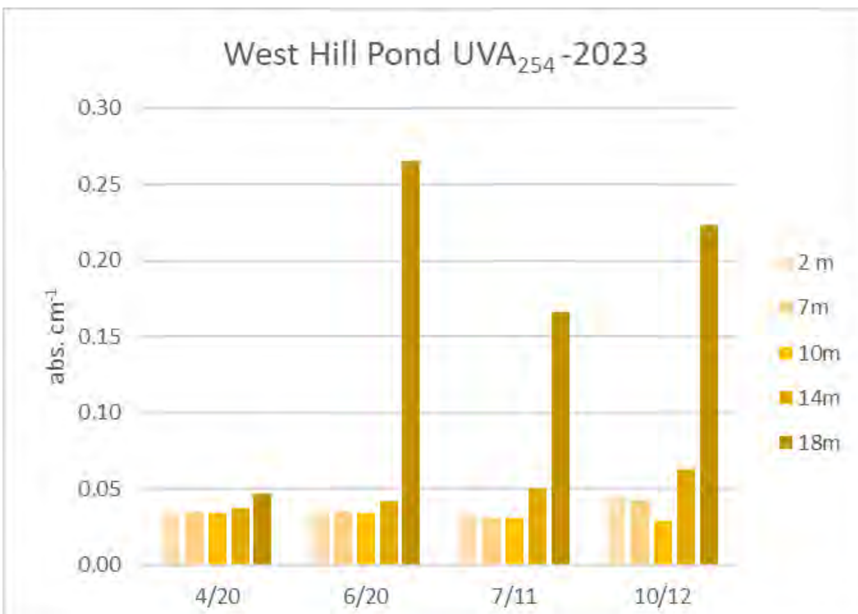

FIGURE 20. WHP UV light absorbance at 254 nm wavelength (UVA254).

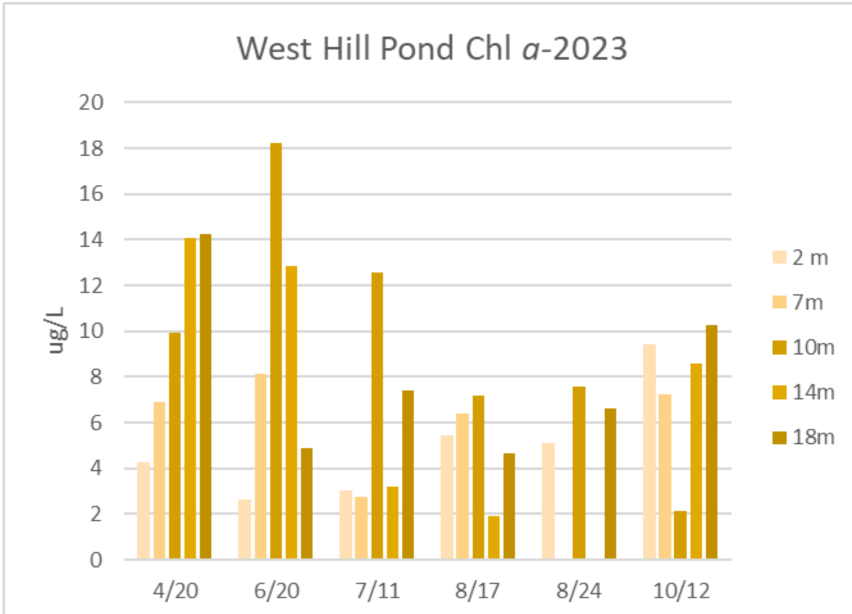

FIGURE 21. WHP chlorophyll-*a* (Chl *a*).

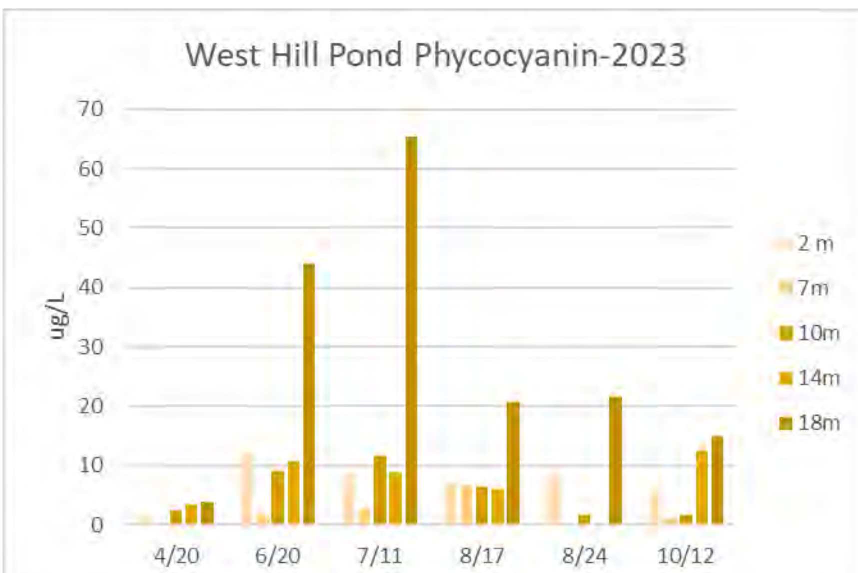

FIGURE 22. WHP phycocyanin (PC).

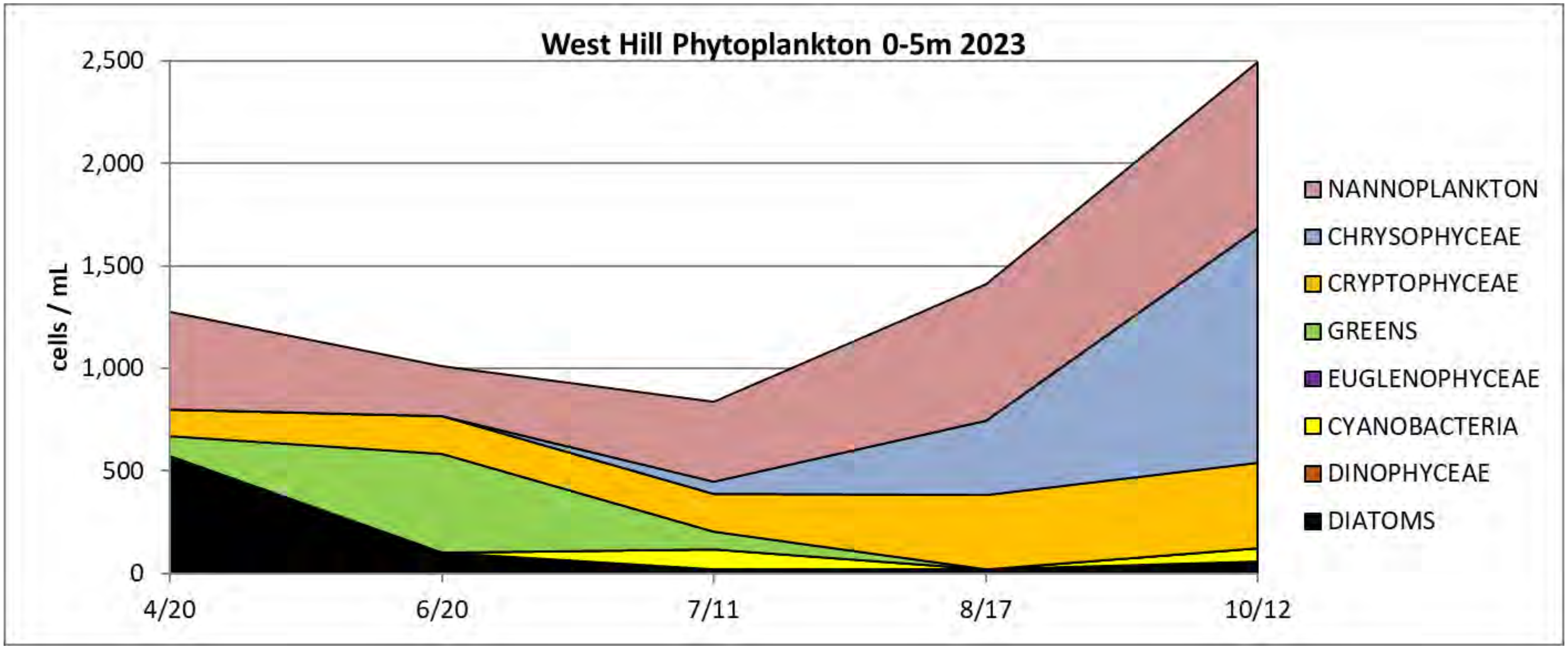

FIGURE 23. WHP phytoplankton community enumeration.

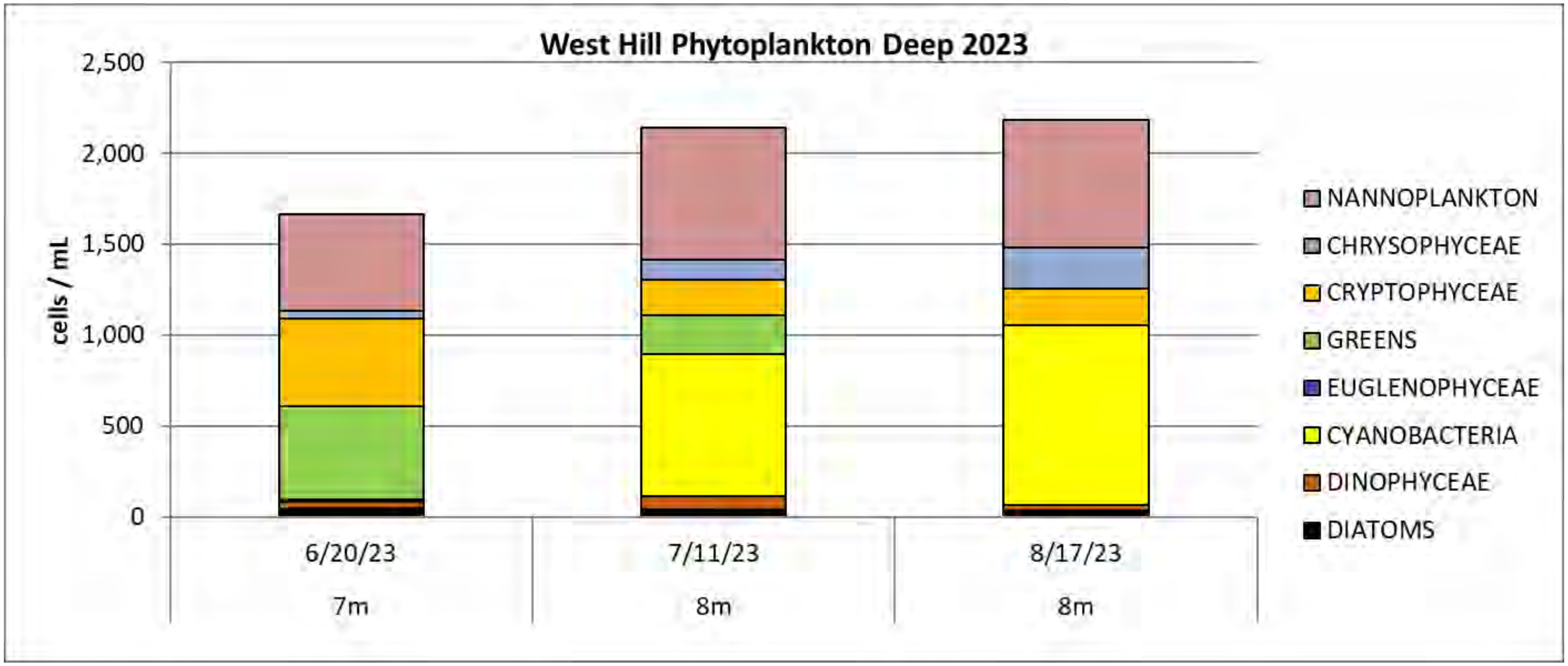

FIGURE 24. WHP phytoplankton community enumeration.