2023

ECOSYSTEM MONITORING REPORT

WATCHA POND

GREAT POND FOUNDATION

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GREAT POND foundation®

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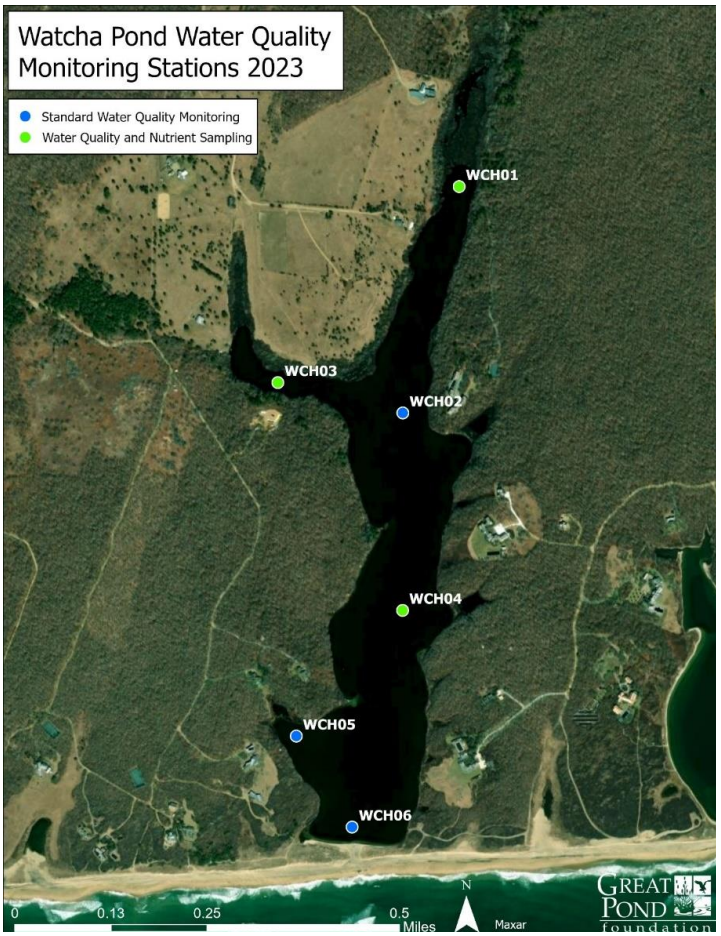
Executive Summary

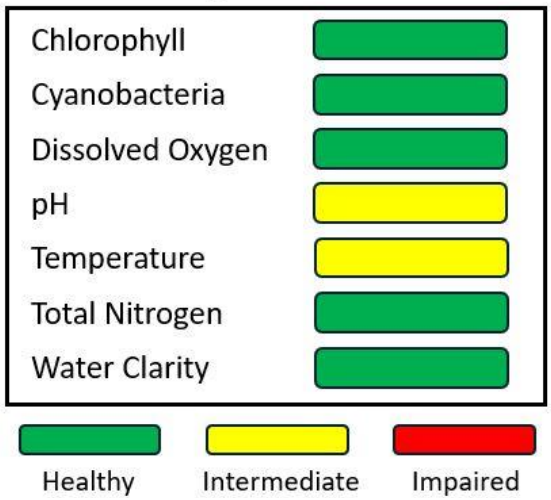
2023

Study Area

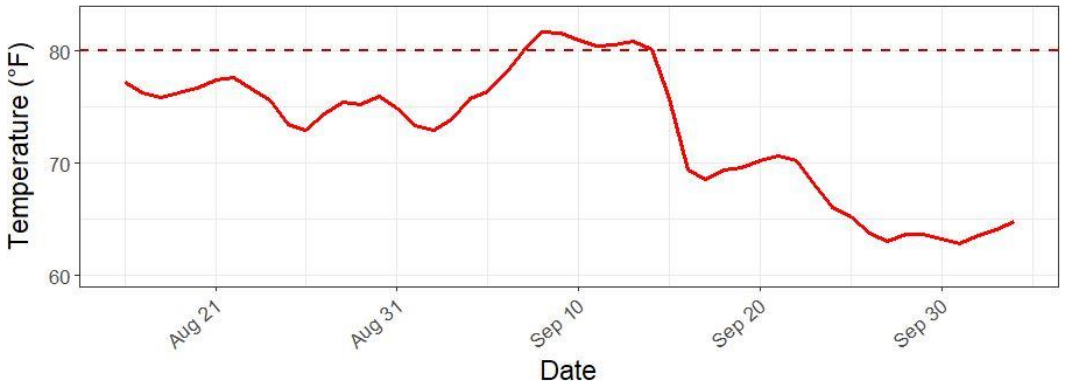
Watcha Pond is a 65-acre coastal freshwater pond located on the southern shoreline of Martha's Vineyard in the Town of West Tisbury, MA. Its contributing watershed encompasses a land area of roughly 1,087 acres containing minimal development. Due to a lack of surface water inputs, the Pond is primarily groundwater fed.



Summary of Metrics, 2023



*Refer to the *Appendix* for info on how rankings were assigned.



TEMPERATURE

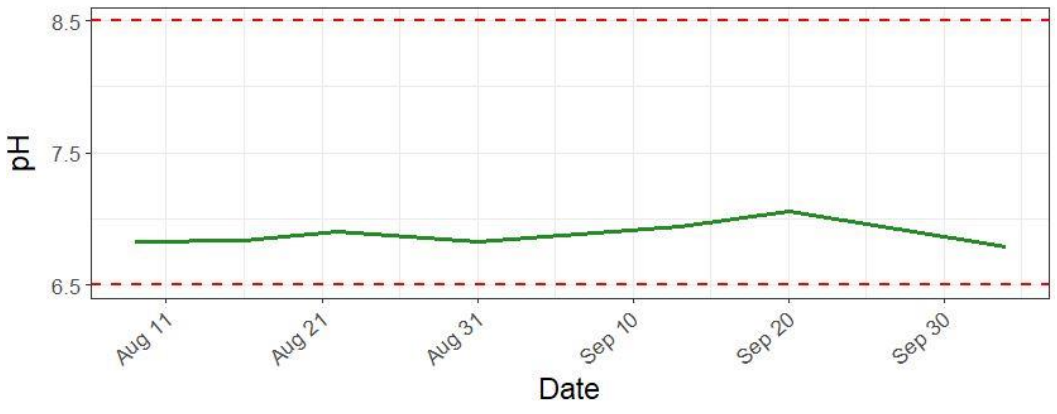
Daily mean water temperature in Watcha Pond is shown for 2023.

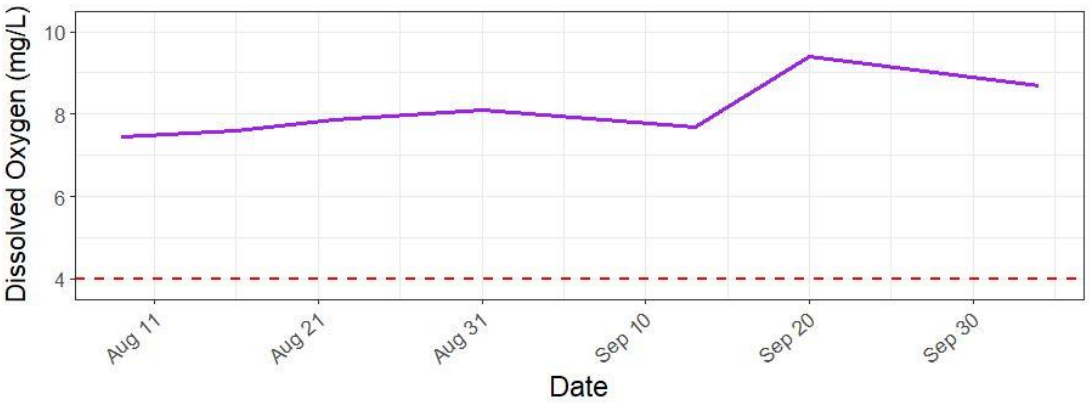
Mean temperature rose above 80 °F for seven consecutive days in mid-September.

pH

Pond-wide mean pH is shown for 2023.

Mean pH remained within the target zone (6.5-8.5) for the entire sampling season.





DISSOLVED OXYGEN

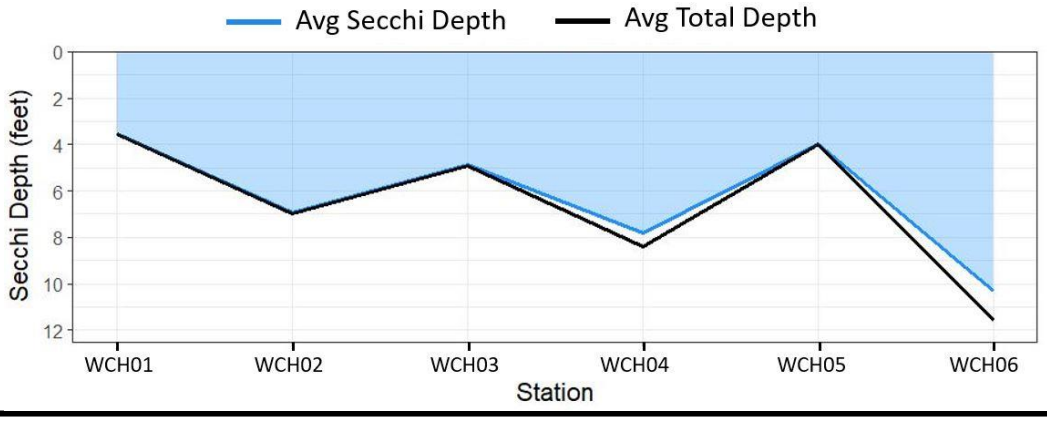
Pond-wide mean bottom-depth dissolved oxygen (DO) is shown for 2023.

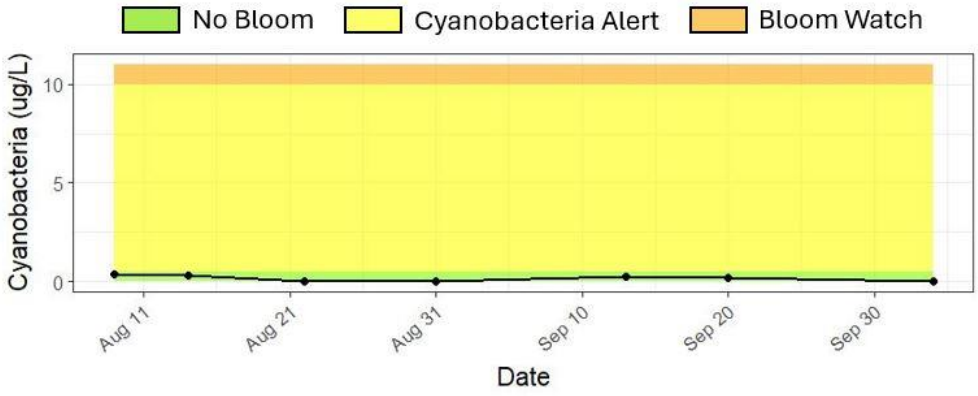
Mean bottom-depth DO remained above the critical threshold (4 ug/L) for the entire sampling season.

WATER CLARITY

Average visibility into the water column in 2023 is shown for all 6 stations.

Visibility consistently reached the bottom at all stations apart from the 2 deepest.





CYANOBACTERIA

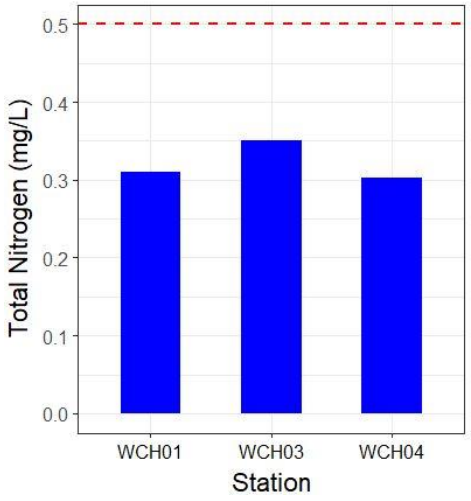
Pond-wide mean cyanobacteria concentrations remained low in 2023 (< 0.5 ug/L).

Concentrations did not approach bloom conditions.

TOTAL NITROGEN

Total nitrogen concentrations were measured at 3 locations on 9/20/23.

All measured concentrations were below the 0.5 mg/L management threshold.



Pond Summary

Watcha Pond exhibited excellent water quality in 2023. DO levels throughout the water column consistently remained above the critical threshold, while water clarity remained high, with visibility generally reaching the bottom. Cyanobacteria concentrations were low and did not approach bloom conditions, likely as a result of low nitrogen and phosphorus concentrations within the Pond. Water temperature and pH readings periodically fell outside of their respective management ranges. GPF recommends continued monitoring moving forward.

Introduction

Watcha Pond is a unique coastal ecosystem whose health is expected to become increasingly threatened by the impacts of climate change and continued development within its watershed. Given that little research has been conducted on Watcha Pond, Great Pond Foundation (GPF) implemented a pilot monitoring program during the summer of 2023 to obtain baseline data on the Pond's ecosystem health. GPF's Ecosystem Monitoring Program follows the methodology and standards established by the Massachusetts Department of Environmental Protection (MassDEP) for "Class SA" waters, pursuant of the MA Department of Environmental Protection, MA Surface Water Quality Standards, 314 CMR 4 (MassDEP, 2021). Class SA waters are defined as those waters: "...designated as excellent habitat for fish, other aquatic life and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation". Class SA waters retain several water quality standards for maintaining a functioning and healthy ecosystem, including:

- Dissolved Oxygen (DO) – Shall not be less than 6.0 mg/L, unless observed natural background conditions are lower.
- Temperature – Shall not exceed 85˚F nor a maximum daily mean of 80˚F.
- pH – Shall be in the range of 6.5 through 8.5 standard units and not more than 0.2 standard units outside of the natural background range.

GPF has also established a chlorophyll management target of 10 ug/L and a total nitrogen management target of 0.5 mg/L in accordance with the standards established by the Massachusetts Estuaries Project (MEP) for Edgartown Great Pond, Tisbury Great Pond, and Chilmark Pond (Howes et al., 2008; Howes et al., 2013; Howes et al., 2015).

Study Area

Watcha Pond (WCH) is a roughly 65-acre coastal freshwater pond situated along the southern coastline of Martha's Vineyard in the Town of West Tisbury, MA. Its contributing watershed is approximately 1087 acres in size and exists within the Vineyard's extensive outwash plain (**Figure 1**), a soil region characterized by sand and gravel sediment deposited by the meltwater streams of receding glaciers roughly 18,000 years ago (Dukes County Intelligencer, 1997). The WCH watershed retains a relatively low level of development compared to neighboring ponds along the Island's southern shore. 2021 roof print data supplied by the Martha's Vineyard Commission indicate that the WCH watershed encompasses approximately 142 homes, of which 15 are located within 300 feet of the Pond edge or adjacent wetlands.

Despite its proximity to the Atlantic Ocean, Watcha Pond can be characterized as a freshwater ecosystem, with average salinity levels ranging near zero across all stations and depths during the normal field season (May-Oct). As such, WCH is home to a large variety of freshwater flora and fauna. Historical records list WCH as habitat for Chain Pickerel and White Perch, as well as a variety of native amphibian, bird, and wetland plant species (Martha's Vineyard Commission, 2015). There is evidence that the Pond may experience intermittent periods of brackish water conditions due to the influx of saline water from over-wash and percolation through the barrier beach during storm events (see "Salinity" section). However, the long-term impacts of these events on ecosystem health have yet to be documented.

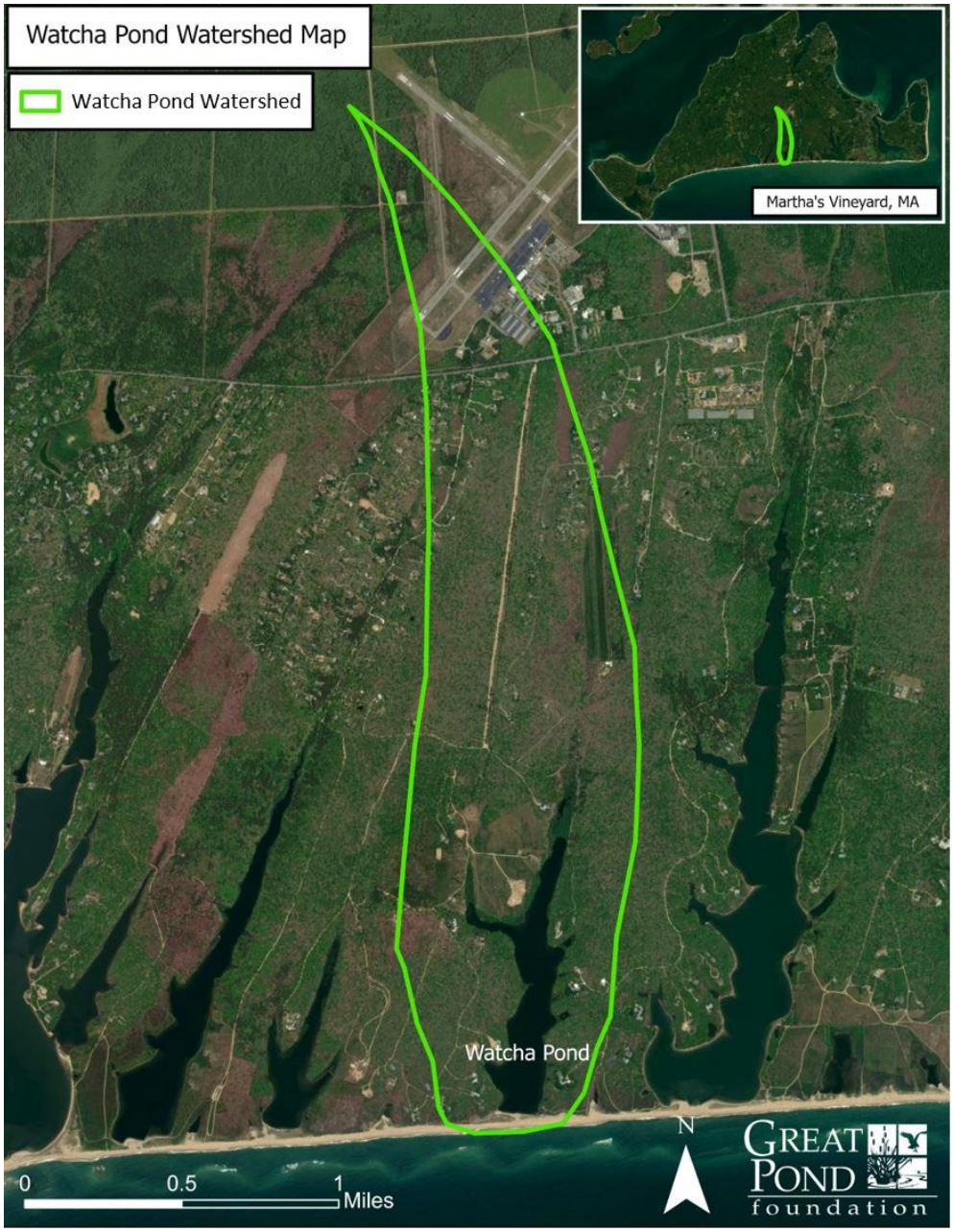


Figure 1. *Watcha Pond and its contributing watershed. Watershed model developed by the Martha's Vineyard Commission (MVC, 2023).*

Scope of Work

Great Pond Foundation (GPF) conducted bi-weekly water quality and cyanobacteria monitoring on Watcha Pond during the late summer of 2023. Six monitoring stations were established at the start of the season (**Figure 2**). A total of seven monitoring trips were conducted between August 9th and October 4th, most of which took place in the morning hours between 7-11 AM. In-situ water quality data was obtained by measuring the following metrics with a YSI Pro DSS multiparameter probe: water

temperature, salinity, dissolved oxygen, pH, and turbidity. Water clarity was measured using a Secchi Disk. Bottom-depth continuous light and temperature data were collected from a stationary logger deployed at station WCH02 from 8/16/24 to 10/4/24. Cyanobacteria testing was conducted during each sampling trip through the MV CYANO program, a collaborative initiative between GPF and the Island Boards of Health. A total of 42 cyanobacteria samples were collected from Watcha Pond and processed in 2023. Additionally, 3 nutrient samples were collected on September 20th and analyzed by GPF's partners at Marine Biological Laboratory (MBL) in Woods Hole.

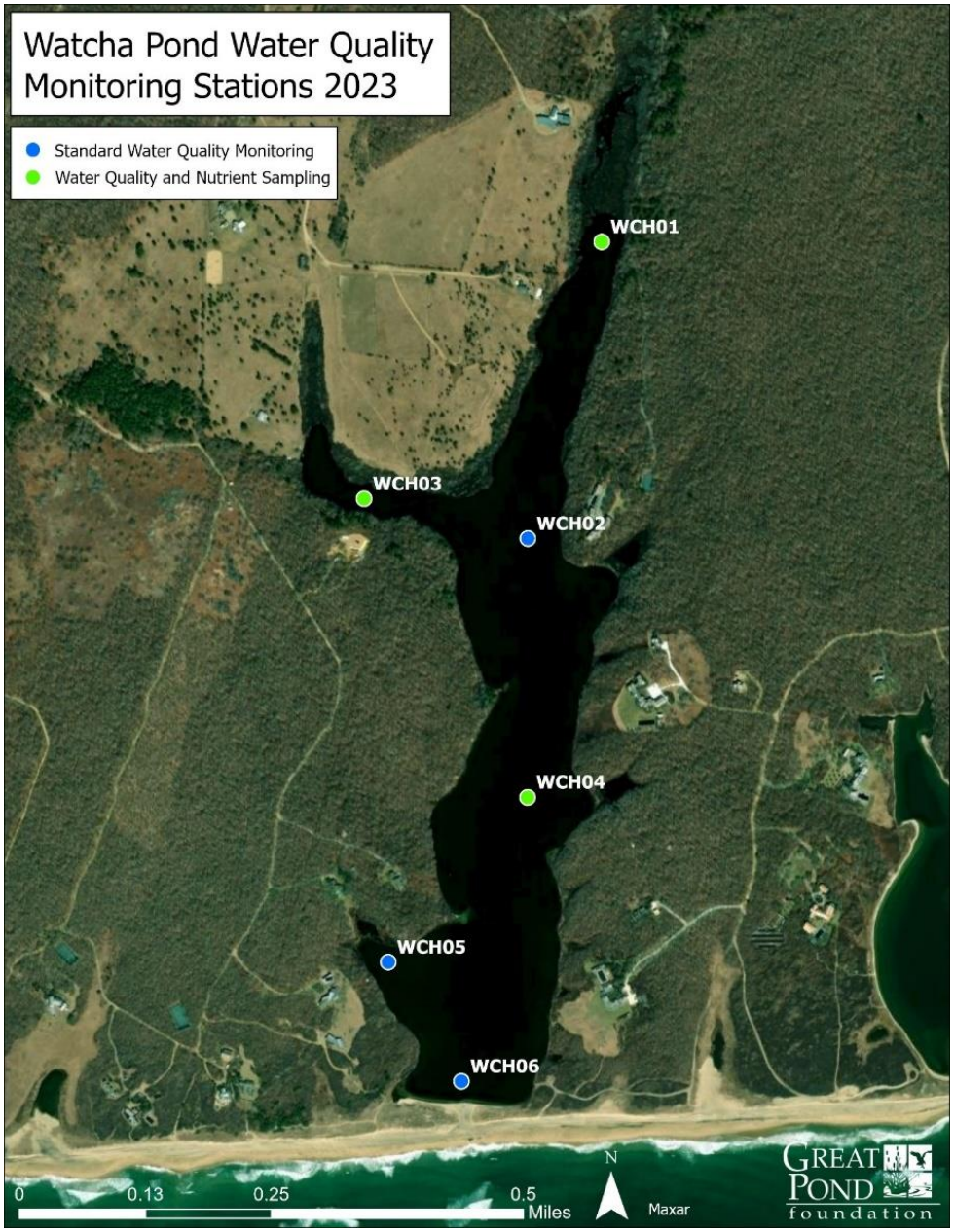


Figure 2. *The locations of the 6 monitoring stations used by GPF in 2023. Biweekly water quality monitoring was conducted at all stations (blue and green), while nutrient samples were collected solely at the green stations.*

Water Quality Metrics

Temperature

In-situ measurements of water temperature collected during GPF's standard monitoring visits from August to October did not rise above 80°F, with measurements ranging from 62.6 to 79.7°F (**Figure 3**). Most monitoring stations experienced little to no stratification in water temperature between different depths, indicating that Watcha Pond is relatively well-mixed.

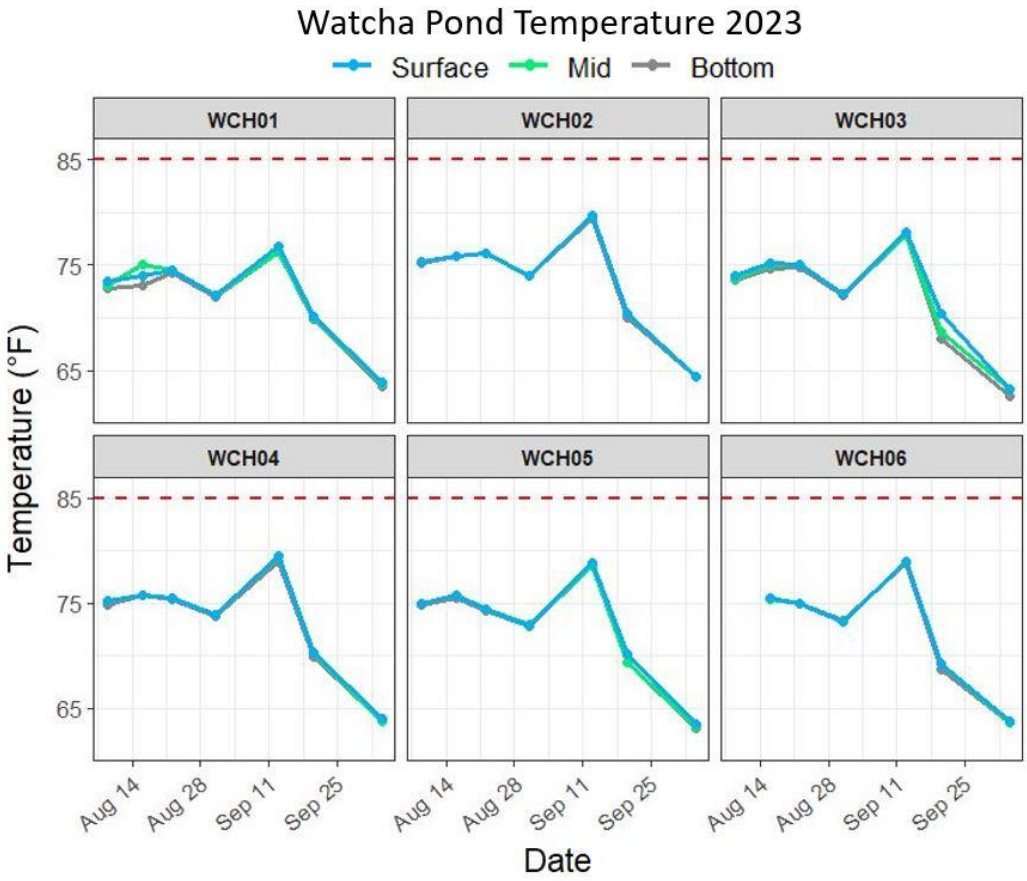


Figure 3. *Water temperature (in °F) at Watcha Pond's 6 monitoring stations during the 2023 field season. Data was measured using a handheld probe at three depths (surface, mid-depth, and bottom). The dashed red line represents the MassDEP management threshold (85 °F).*

Water temperatures peaked across all stations in early September alongside a short-lived heat wave followed by a sustained period of cooling as the summer/fall seasonal transition began. Additional continuous temperature measurements collected by the deployed logger at station WCH02 help to describe the 24-hour cycle of temperature fluctuations in the Pond (**Figure 4**). Near-bottom trends at this location show mean daily water temperature exceeding the 80°F average threshold for heat stress on seven consecutive days during the September heat wave between 9/8/23 and 9/14/23. However, the highest maximum daily temperature recorded at this site was 83.3°F on 9/8/23, below the 85°F maximum threshold for a single day.

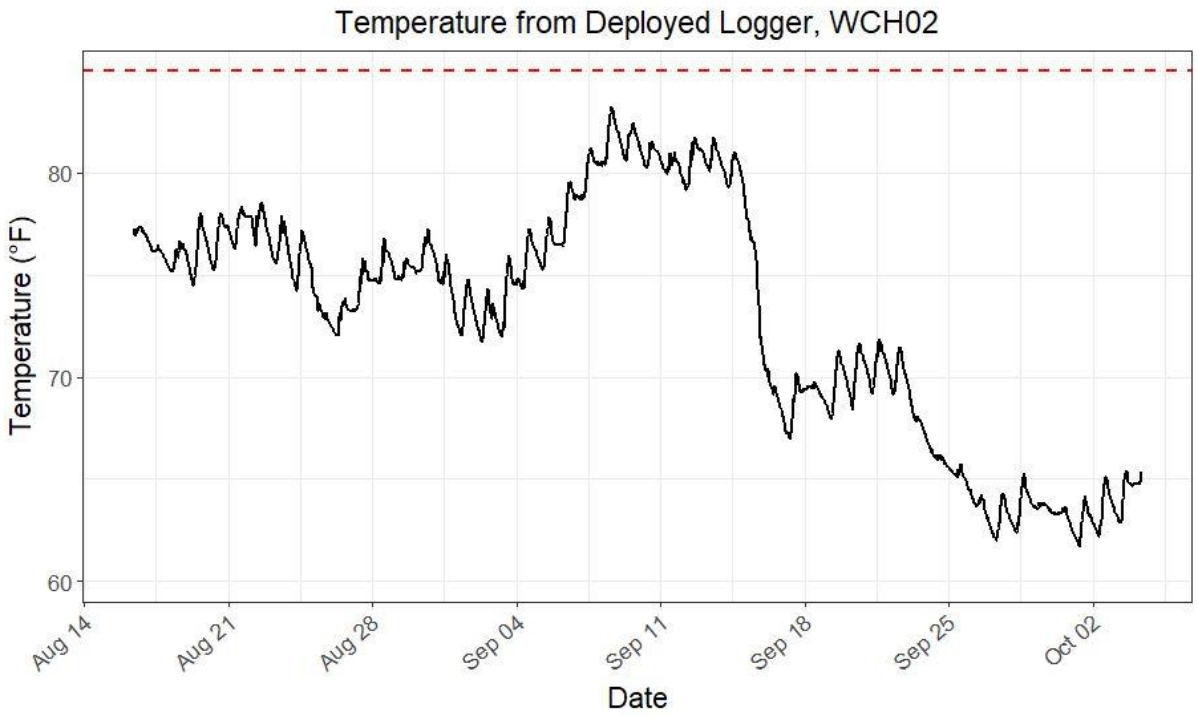


Figure 4. *Continuous water temperature data (in °F) during the 2023 field season. Data was obtained from a temperature data logger deployed on the pond bottom at station WCH02. The dashed red line represents the MassDEP management threshold (85°F).*

Salinity

Salinity levels remained near zero (< 0.1 parts per thousand (ppt)) across all stations for the duration of the 2023 regular sampling period (**Figure 5**). Watcha Pond does not maintain a connection with the Atlantic Ocean and is fed almost entirely via groundwater, surface runoff, and direct rainfall deposition. As such, it can be considered a freshwater pond and ecosystem.

During the winter season of 2023-24, severe winter storms, high winds and high tides resulted in a moderate amount of ocean water entering the Pond via over wash and infiltration across the barrier beach. On 1/4/24, roughly 17 days after a significant over wash event, variable salinity concentrations between 2 and 11 ppt were recorded at station WCH02. These readings were vertically stratified throughout the water column, with greater density saline waters occupying the bottom depths. Salinity readings to the north at station WCH01 yielded a similar trend of vertical stratification and salinity concentrations ranging between 2 and 6.5 ppt, suggesting a north-south gradient of fresh to brackish conditions following the storm. During this sampling trip, GPF deployed a bottom-depth continuous conductivity logger at station WCH02 to record the change in salinity at this location in the weeks and months following these storm events.

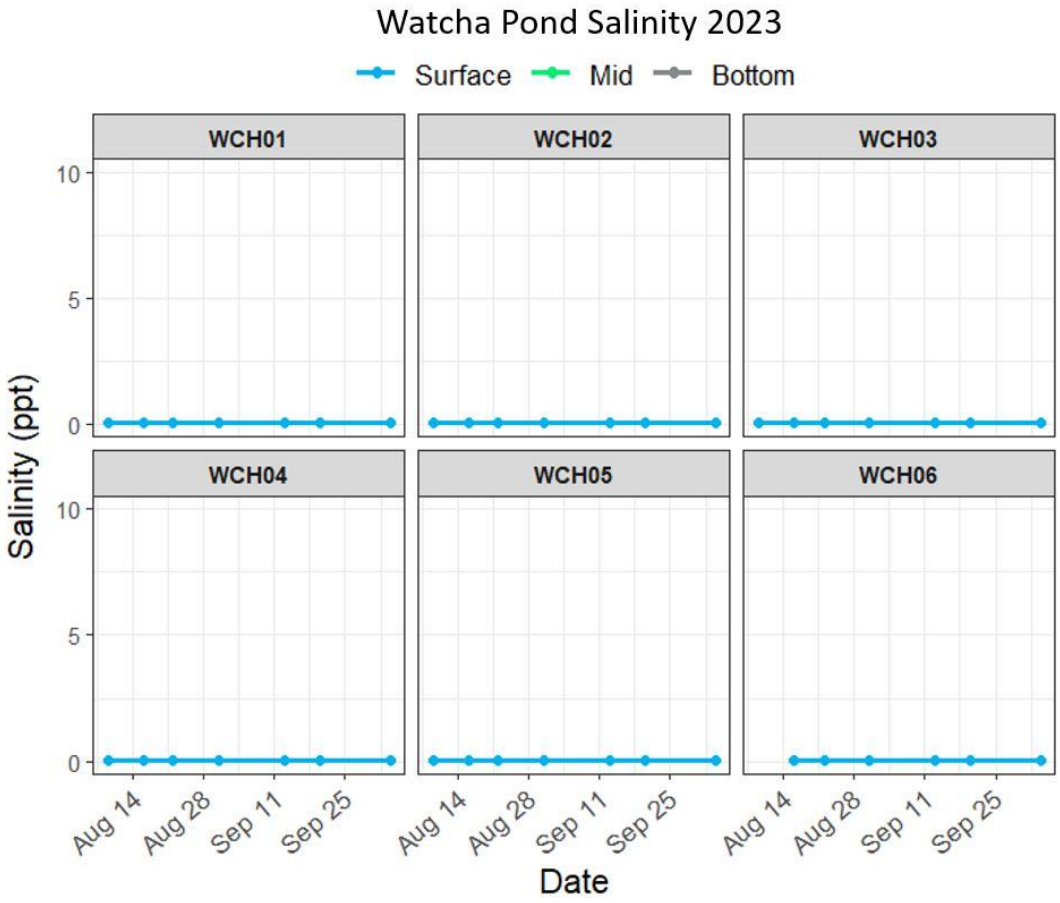


Figure 5. *Salinity in parts per thousand (ppt) at Watcha Pond's 6 monitoring stations during the 2023 field season. Data was measured using a handheld probe at three depths (surface, mid-depth, and bottom).*

This continuous salinity data shows that consecutive storm events that occurred on 1/10/24 and 1/13/24 again resulted in significant over wash of ocean water into Watcha Pond, effectively raising salinity at the pond bottom from 4 to 22 ppt (**Figure 6**). In the weeks following these storm events, salinity gradually declined as the addition of groundwater diluted salt concentration within the Pond. However, it appears that subsequent smaller over wash events, and parallel increases in salinity, occurred over this same period. Salinity at the pond bottom was variable through 2/11/24, which may be indicative of wind-driven mixing dynamics between the freshwater of the Pond and the salty ocean water brought in by the storms. Upon GPF's retrieval of its deployed conductivity logger on 4/2/24, salinity throughout the northern extent of the Pond (WCH01, WCH02, WCH03) had dropped to roughly 6.8 ppt and was consistent throughout the water column, implying that any saltwater previously added had become fully distributed.

It is unclear how the rapid rise in salinity and sustained brackish conditions in WCH will affect ecosystem health and overall water quality. It is possible that these events are not uncommon, and that the Pond is adapted to periods of brackish conditions following over wash and ocean water influx. Use of continuous conductivity loggers throughout the winter months could help to confirm this dynamic. Regular monitoring of water quality and ecosystem health during the 2024 spring and summer growing

seasons will help to ascertain any long-term impacts from the overall increase in Pond salinity that has been observed.

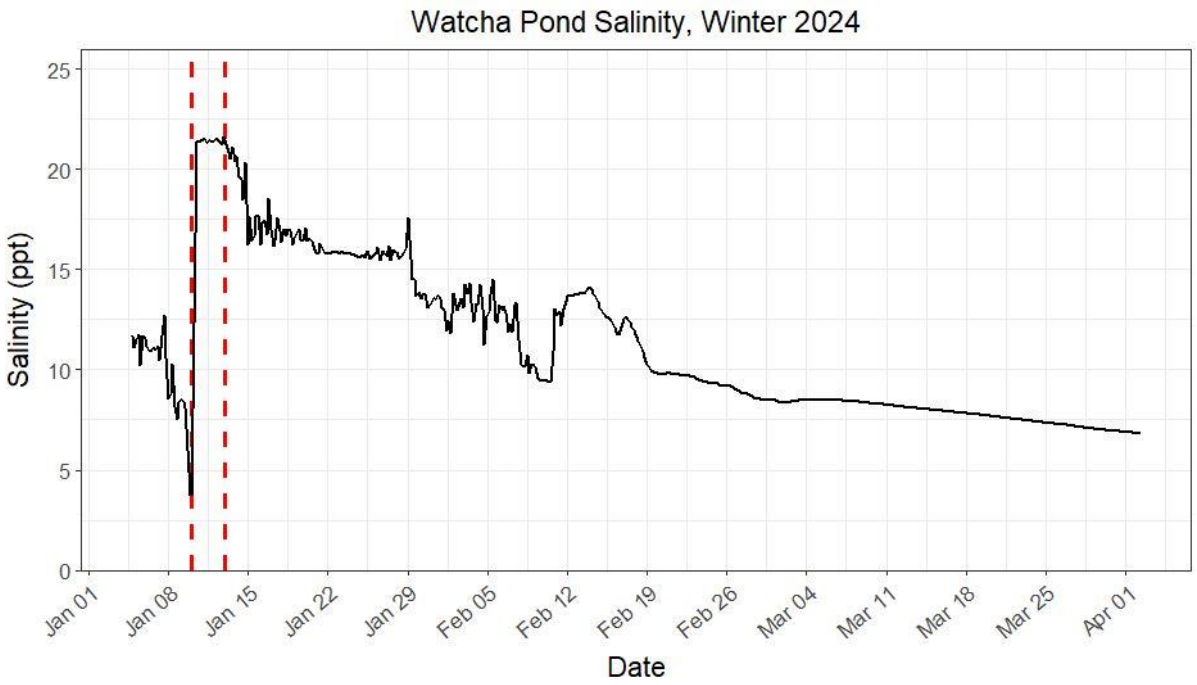


Figure 6. *Salinity in parts per thousand (ppt) in Watcha Pond from 1/4/24 to 4/2/24. Continuous salinity data was obtained from a logger deployed on the pond bottom at station WCH02. The dashed red lines represent the two major storm events that occurred on 1/10/24 and 1/13/24, respectively.*

Dissolved Oxygen

Dissolved oxygen (DO) concentrations were measured in-situ using a YSI Pro DSS handheld multiparameter meter and probe. All monitoring stations located in the main basin of Watcha Pond (WCH02, WCH04, WCH05, WCH06) exhibited relatively uniform DO levels throughout the water column (**Figure 7**). Station WCH03 exhibited ambient DO concentrations near or below the 6 milligram per liter (mg/L) management threshold, which could be an indication of impairment in this region of the Pond. This station is characterized by a greater density and abundance of aquatic vegetation, is shallow, and retains a layer of loose decomposing organic matter at the bottom, which is favorable for enhanced bacterial activity and oxygen consumption. Four of the six stations experienced a predictable drop in bottom-depth DO during a heat wave between 9/8/23 and 9/14/23, with levels falling into possible oxygen stress (<4 mg/L) at station WCH03.

This dataset illustrates that DO concentrations in Watcha Pond generally remained within healthy and tolerable levels. DO is commonly used as an early indicator of impairment in an aquatic ecosystem, as an imbalance of bacterial growth and consumption of nutrients can destabilize the natural rhythm of daytime photosynthesis and nighttime respiration. Incorporating a continuous DO sensor into the monitoring framework will help to better understand the diurnal fluctuations experienced in Watcha. Continued monitoring of station WCH03 and WCH01 for signs of impairment and eutrophication is also advised.

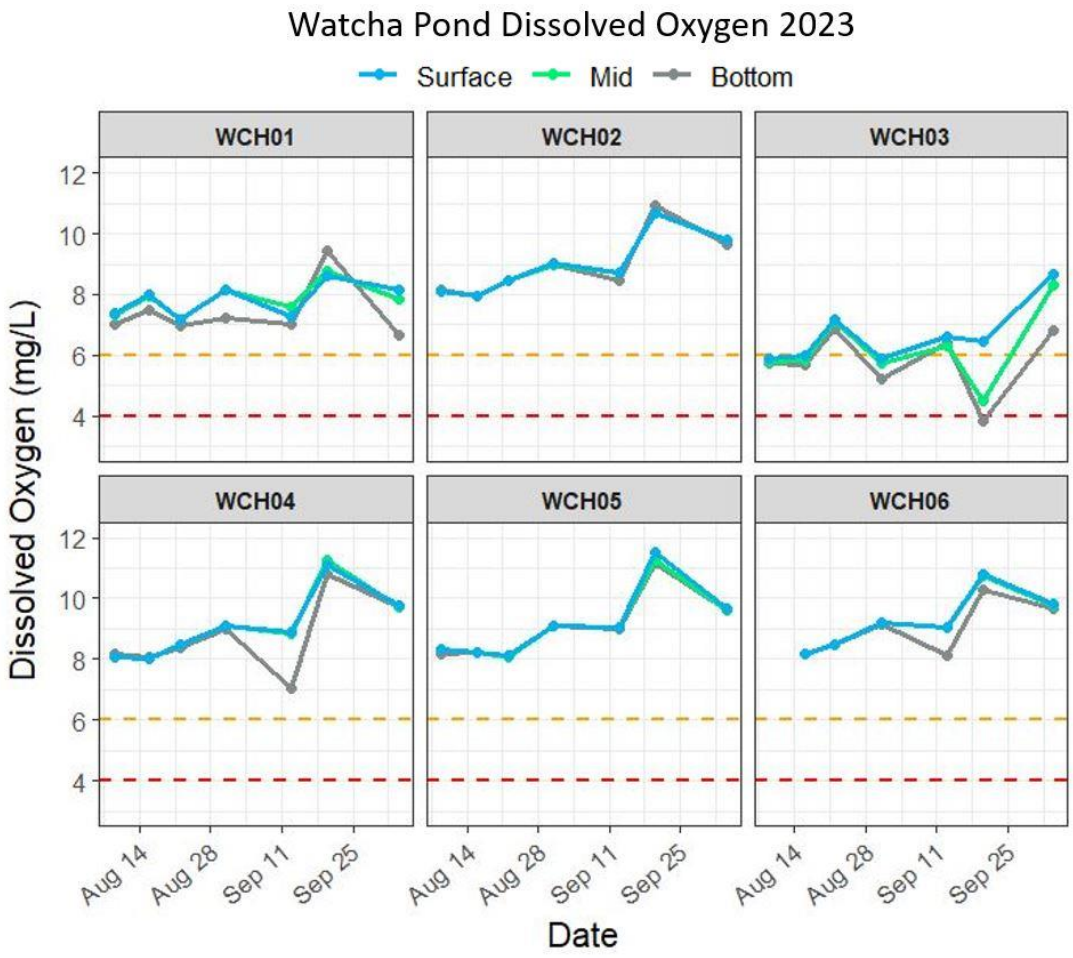


Figure 7. *Dissolved oxygen (DO) in milligrams per liter (mg/L) at Watcha Pond's 6 monitoring stations during the 2023 field season. Data was measured using a handheld probe at three depths (surface, mid-depth, and bottom). The dashed yellow line indicates the MassDEP management threshold (6 mg/L), while the dashed red line indicates when DO dropped to a critically low level (<4 mg/L).*

pH

pH, or Potential of Hydrogen, is a measure of acidity in a solution. Neutral pH is 7, while any pH above 7 is basic and any pH below 7 is acidic. It's important that freshwater ponds maintain a near neutral pH, as overly basic or acidic conditions can have detrimental effects on ecosystem health. Class SA waters retain an optimal pH management range of between 6.5 and 8.5. Overall, measurements in Watcha Pond during the 2023 sampling period ranged from 5.8 to 7.7, with four of the six stations falling within the target range (**Figure 8**). Stations WCH01 and WCH03 exhibited concentrations consistently at or below the 6.5 low threshold. These lower values may be indicative of the amount of available organic material present for decomposition processes and respiration at these locations.

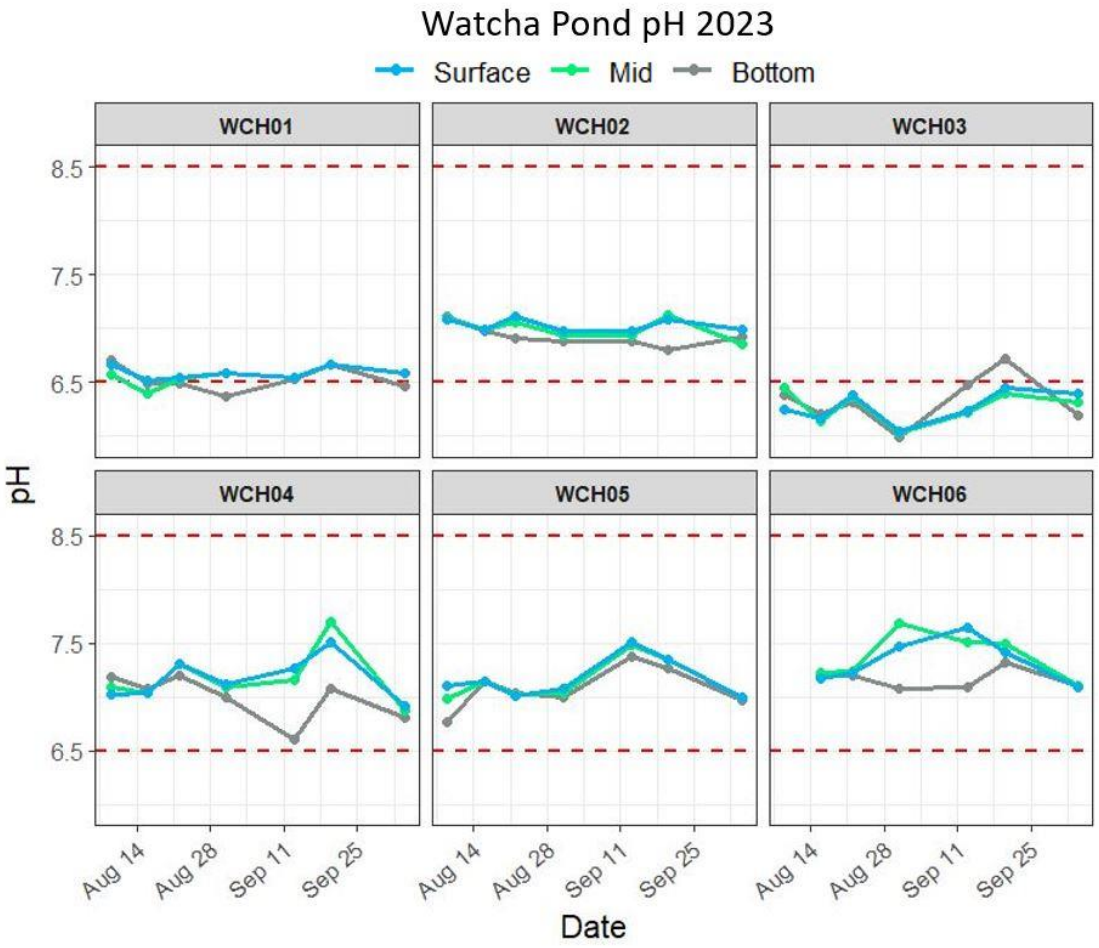


Figure 8. *pH for Watcha Pond's 6 monitoring stations during the 2023 field season. Data was measured using a handheld probe at three depths (surface, mid-depth, and bottom). The two dashed red lines represent the upper and lower bounds of the pH management target (6.5-8.5).*

Water Clarity

Water clarity in Watcha Pond was measured using a Secchi Disk, a standardized black and white disk that is lowered through the water column with a measuring tape. The depth at which the disk disappears represents the point at which turbidity restricts light from penetrating any deeper into the water column. As such, Secchi depth describes the maximum visibility through the water column. Watcha Pond exhibited high water clarity across all stations during the 2023 field season (**Figure 9**). Visibility through the water column ranged from 3.3 to 12.1 feet, with an average visibility of 6.2 feet. Visibility to the bottom was predictably consistent at the shallower stations, WCH01, WCH03, and WCH05. The deeper stations, WCH02, WCH04, and WCH06, experienced some variability in bottom-depth visibility, but overall water clarity throughout Watcha Pond was high. Good water clarity is a sign of low levels of turbidity, or the amount of suspended organic matter and particles within the water column and is typically an indication of good ecosystem health.

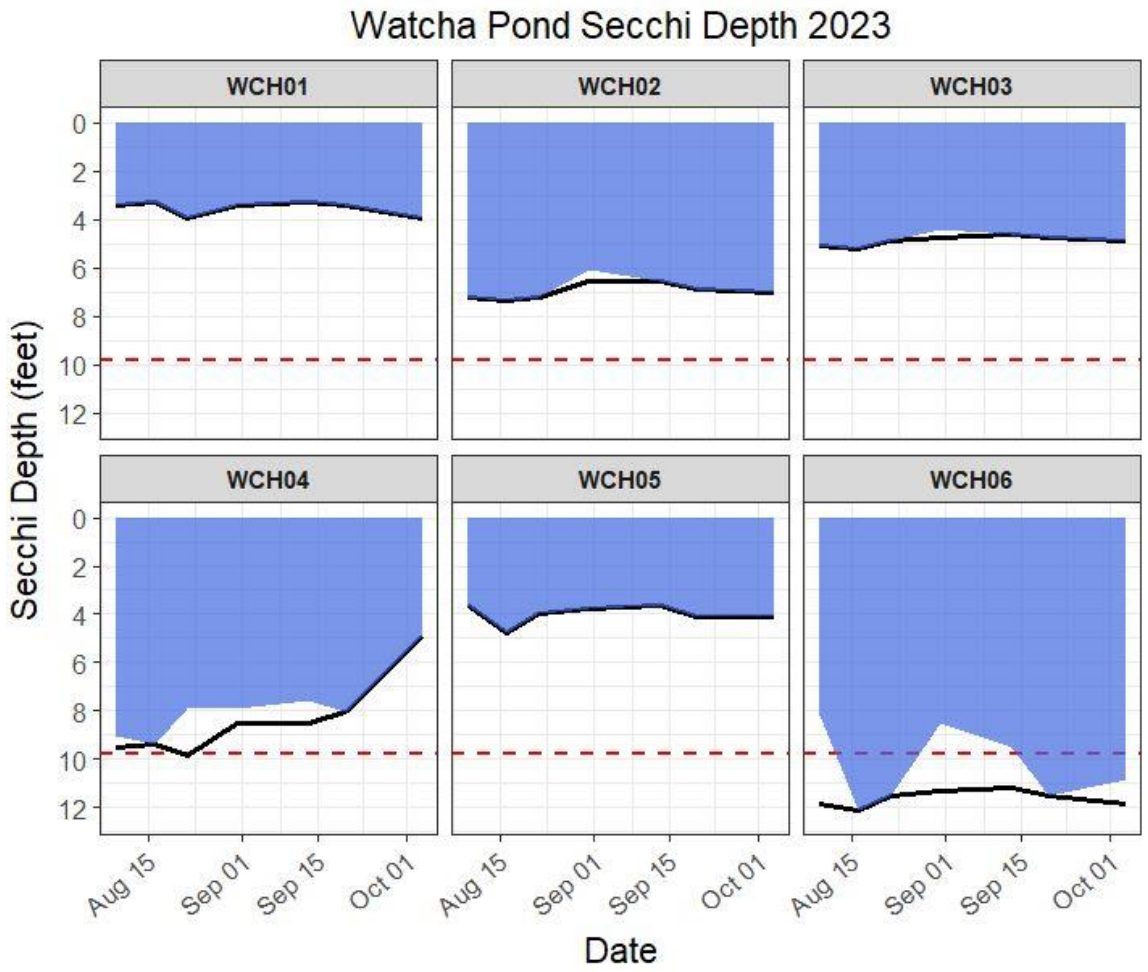


Figure 9. *Secchi depth and total depth (in feet) for Watcha Pond's 6 monitoring stations during the 2023 field season. Secchi depth is the depth at which a standardized disk disappears, effectively representing visibility into the water column. Total depth at each station is represented by a black line, while secchi depth is represented by the overlying blue shaded area. Any point where secchi depth is equal to bottom depth indicates that visibility was to the bottom. The management target is for secchi depth to either equal total depth or reach 9.8 feet, which is represented by the dashed red line on the graph.*

Continuous light intensity data was also obtained for Watcha Pond from a stationary logger deployed on the pond bottom at station WCH02. This data is complimentary to the Secchi observations, illustrating a trend of high light penetration through the water column. Light intensity at the bottom of Watcha Pond is shown for the first two weeks of September in **Figure 10**. Bottom-depth light intensity consistently rose above 1,500 lumens per square foot (lum/ft^2) on most days during this period, with the period's sunniest days seeing light intensity rise above 2,000 lum/ft^2. As a comparison, Watcha Pond's westward neighbor Chilmark Pond, a pond which experienced high turbidity in 2023, rarely saw light intensity at the bottom rise above 200 lum/ft^2 over this same period. Watcha Pond's high level of light penetration through the water column may be partially responsible for its thriving community of submerged aquatic vegetation (SAV) present at the pond bottom.

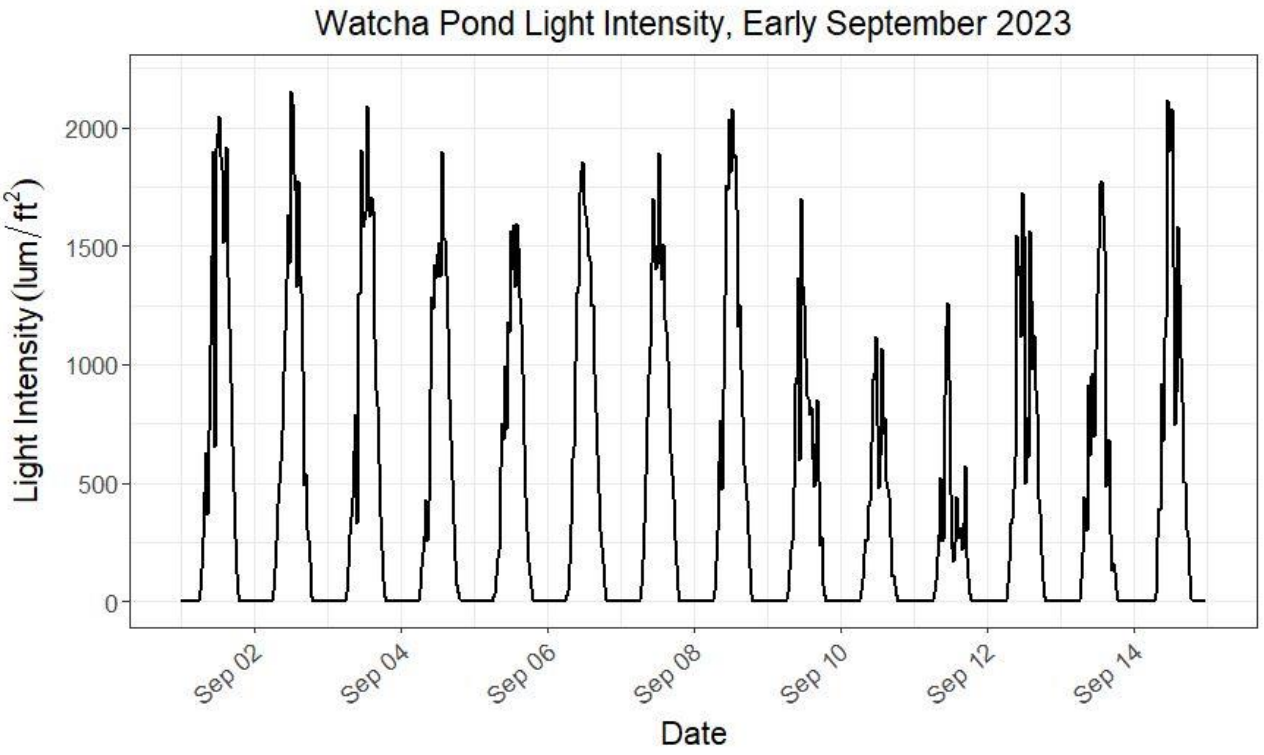


Figure 10. *Light intensity in lumens per square foot (lum/ft^2) at the bottom of Watcha Pond from 9/1/23 to 9/14/23. Data was obtained from a continuous logger deployed at station WCH02. Light intensity can be seen rising during the day before falling to zero at night.*

Nutrients

Excessive nutrient inputs into aquatic ecosystems, particularly that of nitrogen and phosphorus, can lead to the development of eutrophic conditions, in which nutrient-fueled algal and phytoplankton growth act to deplete oxygen reserves and reduce overall ecosystem health. MA Surface Water Quality Standards do not set a management goal for total nitrogen (TN) or phosphorus concentrations in Class SA waters. The Massachusetts Estuaries Project (MEP) management plans developed for several Martha's Vineyard ponds recommend a TN management target of <0.5 milligrams per liter (mg/L). The US Environmental Protection Agency and MADEP recommend a management threshold for total phosphorus in lakes and streams of 0.02 mg/L.

Baseline nutrient sampling was conducted at three monitoring stations (WCH01, WCH03, & WCH04) on 9/20/23. Concentrations of TN were low across all three stations, with no measurements exceeding the 0.5 mg/L management threshold (**Figure 11**). TN concentrations were similar at each station, with station WCH03 slightly higher than WCH01 and WCH04. Measured concentrations of phosphate, the most common form of phosphorus in natural aquatic systems, were below the 0.02 mg/L threshold at all three stations on 9/20/23 (**Figure 11**).

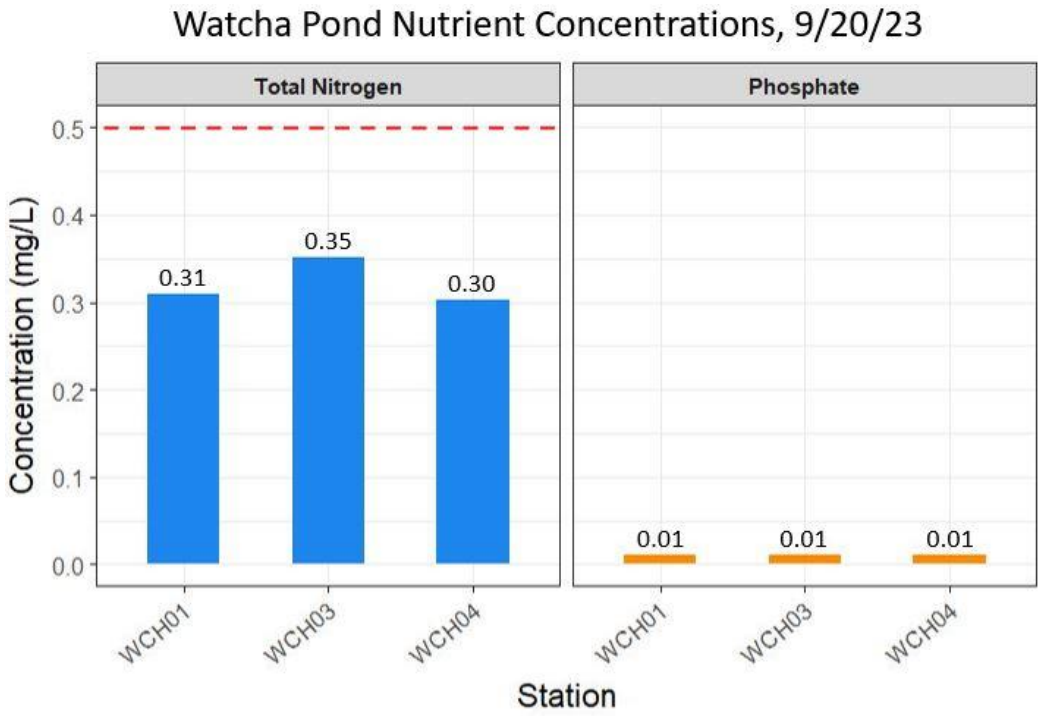


Figure 11. *Total nitrogen and phosphate concentrations in milligrams per liter (mg/L) measured on 9/20/23 for monitoring stations WCH01, WCH03, and WCH04. The dashed red line represents the total nitrogen management threshold (0.5 mg/L).*

Chlorophyll

Chlorophyll is used to measure algal growth, with higher concentrations indicating greater phytoplanktonic and algal activity within the water column. Phytoplankton and algae, like all primary producers, respond rapidly to changes in light availability, temperature, and nutrient availability within the water column. As any number of these factors increases, so does the potential for primary producers to grow at an accelerated rate, resulting in an algal "bloom". In general, higher densities of phytoplankton/algae support the growth of bacteria and other grazing organisms. As such, chlorophyll is often used as an indication of overall ecosystem balance and health.

GPF monitored total chlorophyll concentrations in WCH on a biweekly basis as part of the MV CYANO$_{TM}$ program. Estimates of total chlorophyll were derived via analysis of surface samples collected in the field and measured the same day using the bbe Moldaenke FluoroProbe, a spectral fluorometer that can estimate phytoplankton abundance through fluorescence of pigments unique to individual algal groups. MA Surface Water Quality Standards do not set a management goal for chlorophyll in Class SA waters. However, the Massachusetts Estuaries Project (MEP) management plans developed for several Martha's Vineyard ponds recommend a management target of <10 micrograms per liter (ug/L).

Total chlorophyll concentrations in WCH measured via biweekly fluorometry ranged from 2.9 to 11.7 µg/L in 2023, with concentrations remaining below the 10 µg/L management threshold for most of the monitoring period (**Figure 12**). The stations located in Watcha Pond's main basin (e.g. WCH02, WCH04, WCH05, WCH06) exhibited similar trends in total chlorophyll, with concentrations peaking

during the mid-September heat wave then decreasing for the remainder of the monitoring season. The northern-most stations (e.g. WCH01 and WCH03) experienced lower and more variable total chlorophyll concentrations relative to the main basin. This may be attributed to increased pressure from grazing by heterotrophic organisms at these locations. Lower DO concentrations and pH levels also observed at these stations may further indicate higher rates of respiration and decomposition. Continued sampling throughout future growing seasons will help to understand these dynamics. Overall, Watcha Pond maintained a healthy range for total chlorophyll, with only two separate observations of concentrations slightly above the 10 µg/L management threshold at stations WCH02 and WCH04 on individual days.

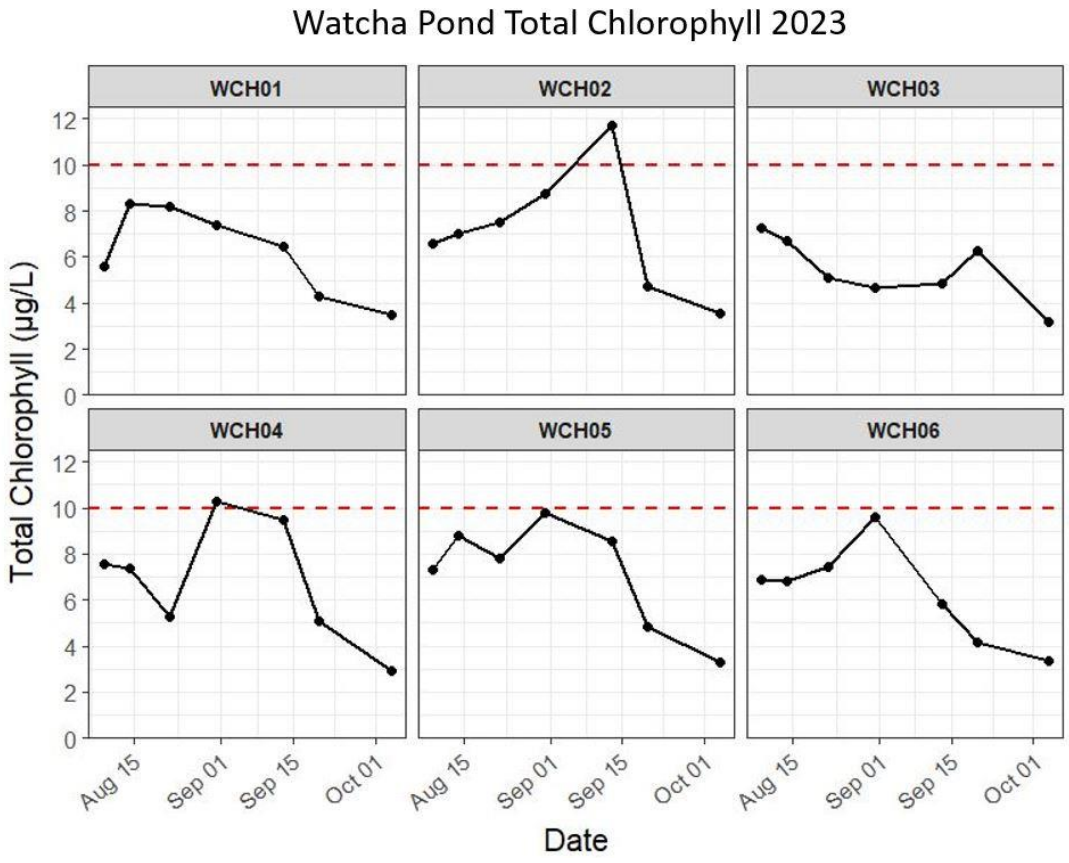


Figure 12. *Total chlorophyll concentrations in micrograms per liter (µg/L) at Watcha Pond's 6 monitoring stations during the 2023 season. Samples were taken at the surface and measurements were obtained via a fluorometer.*

Phytoplankton and Cyanobacteria

In addition to estimating total chlorophyll concentrations, GPF's biweekly fluorometry analysis of samples collected from WCH also provides estimated concentrations of individual phytoplankton classes present within the water column. The following four phytoplankton classes were routinely monitored on WCH during 2023 as part of the MY CYANO$_{TM}$ program: cyanobacteria, green algae, cryptophyta, and diatoms. Green algae were the most abundant phytoplankton class across all stations in 2023, followed closely by diatoms (**Figure 13**). However, the difference in concentrations between the different

phytoplankton classes were minimal, indicating that no one phytoplankton type dominated the community in 2023.

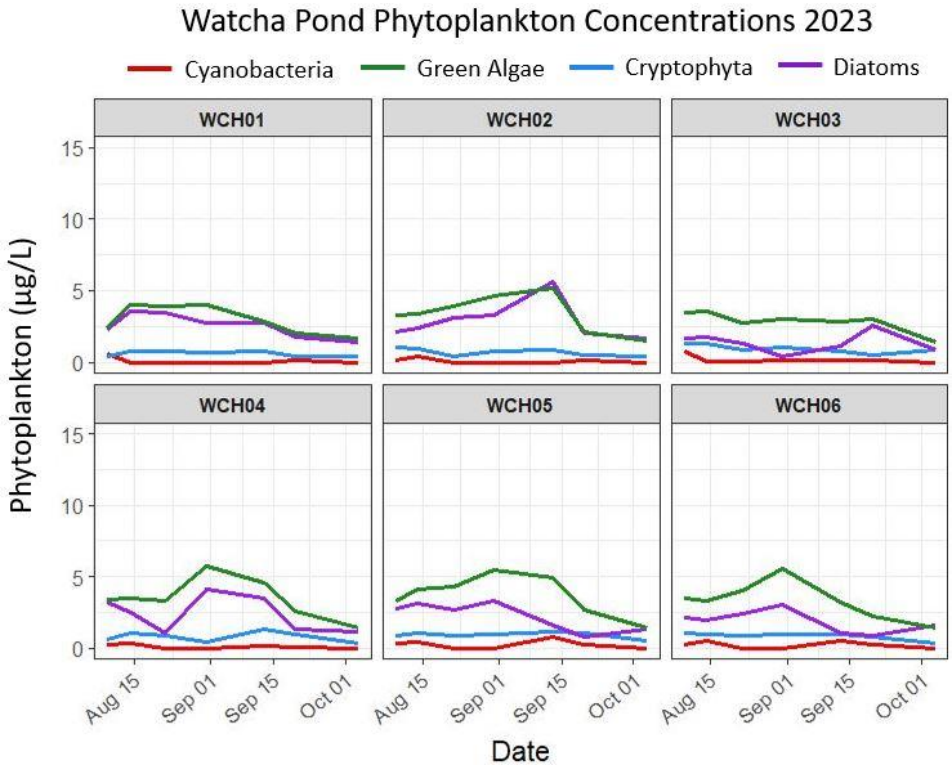


Figure 13. *Phytoplankton concentrations in micrograms per liter (ug/L) for Watcha Pond's 6 monitoring stations are shown for 2023. Each phytoplankton class corresponds to a different color on the graph.*

Of the many types of phytoplankton that exist within the island's coastal ponds, cyanobacteria are of particular concern as multiple species can produce toxins harmful to humans and animals. Cyanobacteria concentrations ranged from 0 to 0.78 micrograms per liter (µg/L) during the 2023 field season, with levels generally remaining within the MV CYANO$_{TM}$ program's "bloom not present" category (**Figure 14,** refer to **Figure 15** for MV CYANO$_{TM}$ key). Concentrations at stations WCH01, WCH03, WCH05, and WCH06 did periodically rise into the lower end of the "cyanobacteria alert" category but were always short-lived. Watcha Pond's low cyanobacteria concentrations in 2023 are likely due in part to the Pond's low nutrient concentrations, preventing the development of excessive phytoplankton growth of all types.

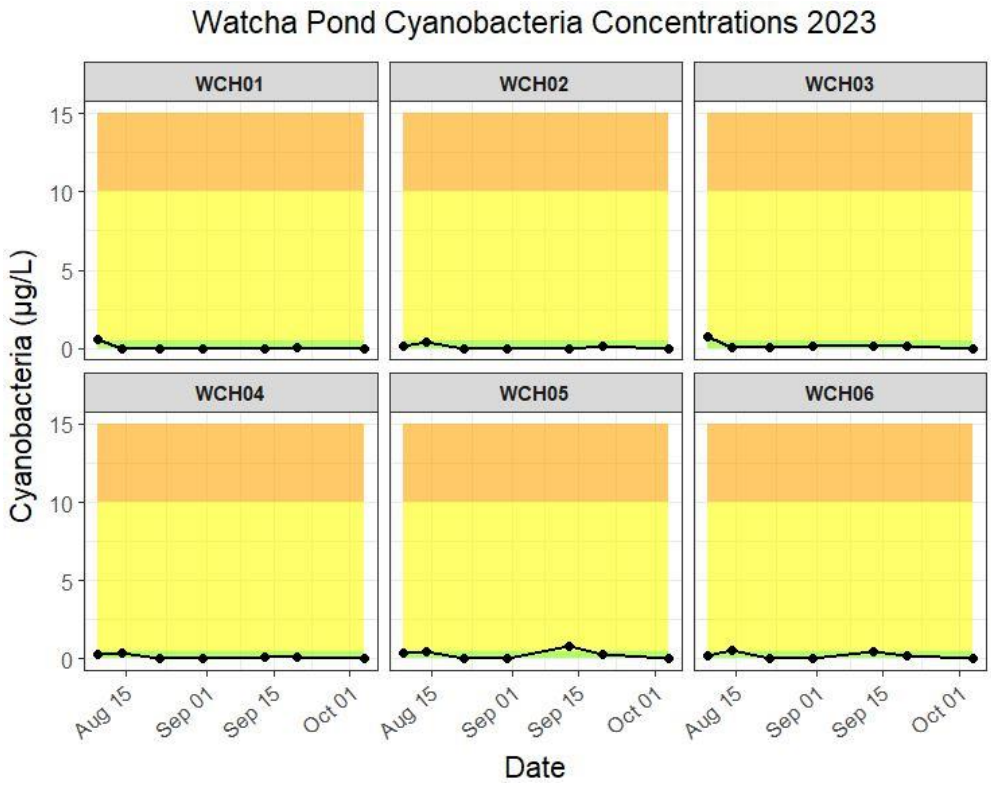


Figure 14. *Cyanobacteria concentrations in micrograms per liter (µg/L) at Watcha Pond's 6 monitoring stations during the 2023 season. Samples were taken at the surface and measurements were obtained via a fluorometer. Background colors pertain to the color-coded messaging used by the MV CYANO™ monitoring program (see* ***Figure 15****).*

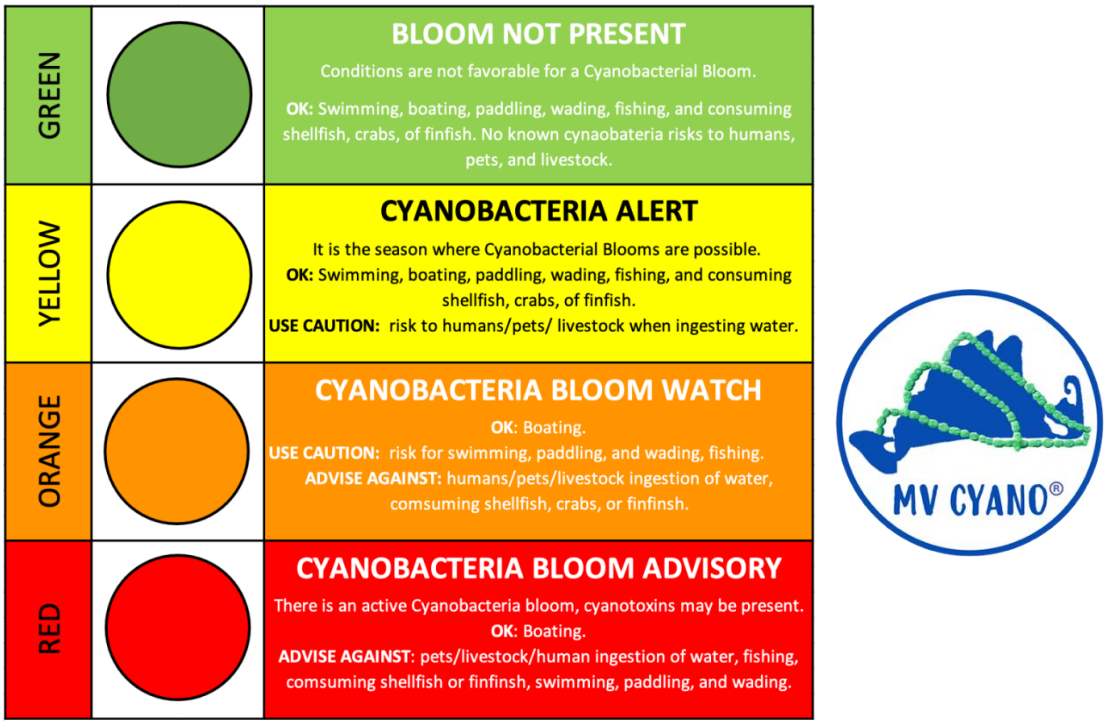


Figure 15. *The color-coded messaging & logo used by the MV CYANO™ monitoring program.*

Discussion

Watcha Pond exhibited excellent water quality during GPF's 2023 monitoring period. The metrics collected for assessing overall ecosystem health exceeded management thresholds for Class SA Waters at most of the monitoring locations within Pond. Low levels of turbidity and phytoplankton density allow for enhanced light penetration to the benthos, enhancing the productivity of submerged aquatic vegetation (SAV) which covers the bottom of Watcha pond in high densities. This healthy community of SAV increases DO concentrations through photosynthesis and can buffer against high temperature-induced declines. Additionally, SAV canopies and root systems help to trap sediments and particulate matter, making them less available for algal growth, while providing habitat and food for resident fish and aquatic/amphibious species.

Station WCH03 showed signs of possible impairment, specifically with regards to observed DO concentrations consistently at or below the recommended management levels. Station WCH03 can be characterized by shallow depth, high concentration of submerged aquatic plants, and abundance of loose organic matter accumulated on the bottom. These factors may drive increased decomposition processes which consume water column oxygen. Additionally, station WCH03 is situated in a small, enclosed cove jutting northwest from the main basin of Watcha Pond. These physical characteristics may reduce the amount of wind-driven circulation within the water column and increase water residence time in this section, providing better conditions for oxygen-consuming processes.

Development pressure within the Watcha Pond watershed is low which more than likely contributes to the low levels of nutrient input and good health of the Watcha Pond ecosystem. The majority of terrain within 1000 feet of the Pond edge is composed of natural wooded or grassland habitat, which reduces surface runoff and buffers against excess nutrient inputs. The low incidence of agricultural and residential development within the riparian area means there is less pressure from septic systems and fertilizers that contribute nitrogen-rich groundwater into the Pond.

It remains unclear how the 2023-24 winter storm events and subsequent and sustained salinity increase will impact overall ecosystem health in the Pond. Rapid shifts in water chemistry such as this can lead to shifts in biological community structure at both the microscopic and macroscopic level. Tolerance to these shifts is species dependent and may not be fully observable until the 2024 spring-summer growing season.

Recommendations

1. Continue monitoring of Watcha Pond water quality and ecosystem health.

   Watcha Pond was in good condition during the 2023 monitoring period. Continued monitoring of water quality and ecosystem health metrics will help identify any existing or emerging stressors to this ecosystem while simultaneously building a baseline of data for long-term study and management of the Pond. Specific monitoring targets include:

   - Regular in-situ measurements of water quality metrics at all monitoring stations throughout growing season (limited monitoring during off-season)
   - Regular monitoring of cyanobacteria and other phytoplankton concentrations during growing season (limited off-season monitoring)
   - Monthly or quarterly nutrient samples at established stations

- Deployment of continuous DO and temp/conductivity sensors at station WCH02 (summer and off-season configurations)
- Monitoring/survey of submerged aquatic vegetation community composition and density
- Installation of elevation sensor to monitor influence of rainwater, stormwater, and ocean over wash (year-round)
- Monitoring of barrier beach dune habitat health, integrity, migration

2. Limit and reduce development pressure within the watershed.

   Development pressure within Watcha Pond's watershed and riparian areas is low, and future projects should carefully consider potential impacts to water quality and Pond health. Mitigation of new development and reductions to existing impacts can be attained by limiting fertilizer use, maintaining buffer habitats within riparian zones, promoting adjacent native terrestrial ecosystems and wetlands, and by employing nitrogen-fixing or reducing wastewater technologies on residential properties.

3. Protect and monitor health of barrier dune habitat.

   The winter of 2023-24 hosted 3 large storm events that resulted in a significant amount of seawater over wash and infiltration through Watcha Pond's barrier beach. This may not be an abnormal event, however, it underlines the importance of maintaining integrity and health of the barrier dune habitat. A true failure of the barrier beach and a tidal breach to the ocean could result in large long-term shifts in the community structure of this predominantly freshwater ecosystem. While this dynamic is historically a natural process in coastal pond habitats and not preventable, continued limitation of human derived negative impacts to dune integrity (i.e. vehicle traffic, expansion of foot trails, development across habitat) might help to decrease the likelihood of its occurrence.

Works Cited

Howes, B., Samimy, R., Schlezinger, D., Ramsey, J., & Eichner, E. (2008, December). *Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Threshold for the Edgartown Great Pond System, Edgartown, MA*. SMAST/MassDEP Massachusetts Estuaries Project, Massachusetts Department of Environmental Protection. https://www.mass.gov/doc/edgartown-great-pond-system-edgartown-ma-2008/download

Howes, B., Eichner, E., Samimy, R., Schlezinger, D., Kelley, S., Ramsey, J., & Detjens, P. (2013, May). *Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Threshold for the Tisbury Great Pond/Black Point Pond System, Town of Chilmark and West Tisbury, MA*. SMAST/MassDEP Massachusetts Estuaries Project, Massachusetts Department of Environmental Protection. https://www.mass.gov/doc/tisbury-great-pondblack-point-pond-system-dennis-ma-2013/download

Howes, B., Samimy, R., Schlezinger, D., Eichner, E., Kelley, S., Ramsey, J., & Simmons, G. (2015, April). *Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Threshold for the Chilmark Pond System, Town of Chilmark, MA*. SMAST/MassDEP Massachusetts Estuaries Project, Massachusetts Department of Environmental Protection. https://www.mass.gov/doc/chilmark-pond-embayment-system-chilmark-ma-2015/download

MacKenzie, Clyde, L., Jr, Andrews, Thomas, J. (1997, November). *Origin of Fresh and Brackish-Water Ponds and Fishes on the Vineyard.* The Dukes County Intelligencer, Martha's Vineyard Historical Society. Vol 32, No.2, pages 59-76.

Martha's Vineyard Commission. (2015, December 29). *Pond Summary*. https://www.mvcommission.org/sites/default/files/docs/PondSummary_0.pdf

Martha's Vineyard Commission. (2023, September 26). *Major Watersheds (Water Quality Rating)*. Dukes County, MA GIS. https://data-dukescountygis.opendata.arcgis.com/datasets/ea128d3f3c67493b9ecabf3468b9c380_0/explore

Massachusetts Department of Environmental Protection. (2021, December 10). *314 CMR: Division of Water Pollution Control*. Commonwealth of Massachusetts. https://www.mass.gov/doc/314-cmr-400/download

Appendix

Summary of Metrics Explanation

Introduction to the Summary of Metrics Index

The "Summary of Metrics" health index was first developed by the Great Pond Foundation (GPF) in early 2024 as a means of visually summarizing the water quality data collected through its ecosystem monitoring program in simple terms. GPF regularly collected data on the following five coastal ponds during the 2023 summer season: Chilmark Pond, Crackatuxet Pond, Edgartown Great Pond, Tisbury Great Pond, and Watcha Pond. As such, the Summary of Metrics grading system was first applied to the 2023 water quality data collected for each of these ponds.

Assigning Grades to Metrics

The index works by assigning one of the following three grades to each water quality metric measured for a specific pond ecosystem: "Healthy," "Intermediate," or "Impaired". This is done by comparing data collected by GPF to management thresholds set by two primary bodies of work. These include the Massachusetts Department of Environmental Protection's (MassDEP) MA Surface Water Quality Standards, 314 CMR 4 for "Class SA" waters (MassDEP, 2021), to which all Martha's Vineyard ponds belong, as well as the Massachusetts Estuaries Project's (MEP) reports on Chilmark Pond, Edgartown Great Pond, and Tisbury Great Pond (Howes et al., 2008; Howes et al., 2013; Howes et al., 2015), all of which establish the same management thresholds. The management thresholds used by GPF are summarized below in **Table A1**.

Table A1. The management thresholds used by GPF to assess the health of water quality metrics.

Water Quality Metric	Management Threshold	Establishing Work
Chlorophyll	< 10 ug/L	MEP Reports
Dissolved Oxygen	> 6 mg/L	MassDEP Class SA Waters
pH	6.5-8.5	MassDEP Class SA Waters
Total Nitrogen	< 0.5 mg/L	MEP Reports
Water Clarity	$\geq$ 3 meters (or to bottom)	MEP Reports
Water Temperature	< 80 °F	MassDEP Class SA Waters

Following a thorough review of the water quality data collected across all five ponds in 2023, GPF established a set of criteria for assigning grades to individual water quality metrics (see **Table A2**). Grades are assigned to metrics based on the percentage of total measurements falling within a given metric's management target range. For example, in order for a pond to receive a "Healthy" grade in relation to chlorophyll, at least 90% of all chlorophyll measurements taken by GPF during the summer season would have to fall within the management target range (i.e. be less than 10 ug/L in concentration). Alternatively, if 65% or less of chlorophyll measurements fell within the target range, chlorophyll would receive an "Impaired" grade, while any percentage between 65% and 90% would warrant an "Intermediate" grade.

Table A2. GPF's criteria for assigning grades to individual water quality metrics. Percent values refer to the percentage of total measurements falling within the management target range.

Water Quality Metric	Healthy	Intermediate	Impaired
Chlorophyll	≥ 90%	65.01-89.99%	≤ 65%
Dissolved Oxygen (Bottom-depth)	≥ 90%	70.01-89.99%	≤ 70%
pH	≥ 90%	65.01-89.99%	≤ 65%
Water Temperature	≥ 90%	65.01-89.99%	≤ 65%
Total Nitrogen	≥ 90%	65.01-89.99%	≤ 65%
Water Clarity	≥ 75%	65.01-74.99%	≤ 65%

Cyanobacteria Grading

GPF has also included cyanobacteria in its Summary of Metrics health index; however, a different method of assigning grades is used for cyanobacteria concentrations relative to all other water quality metrics. The cyanobacteria criteria used in the index was modeled after the cyanobacteria risk assessment standards used by the MV CYANO program, a collaborative initiative between GPF and the Island Boards of Health that monitors cyanobacteria in various ponds across Martha's Vineyard (Great Pond Foundation, 2024).

In order for a pond to receive a "Healthy" grade for cyanobacteria, concentrations must remain within the program's "bloom not present" category for the duration of the summer. Alternatively, if any sampling station on a given pond enters the program's "cyanobacteria alert" and/or "bloom watch" categories during the summer, an "Intermediate" grade is automatically assigned to the pond. Similarly, if any sampling station enters the program's "bloom advisory" category during the summer, an "Impaired" grade is automatically assigned to the pond.

Final Product – Summary Figure

Once grades have been assigned to each water quality metric measured for a given pond, these grades are incorporated into a Summary of Metrics figure to visually convey a pond's general ecosystem health during a particular summer season. "Healthy" grades are designated in green, "Intermediate" grades are designated in yellow, and "Impaired" grades are designated in red. GPF's Summary of Metrics figure for Watcha Pond during the 2023 summer season is shown below in **Figure A1** as an example.

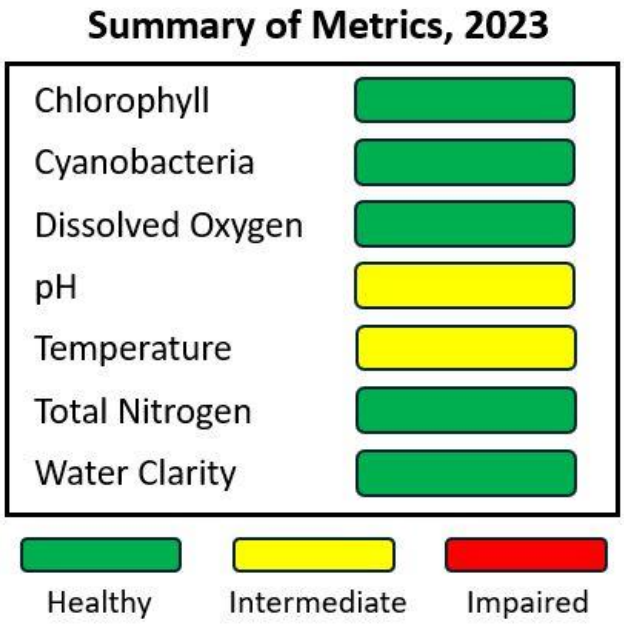


Figure A1. *Watcha Pond's Summary of Metrics figure for the 2023 summer season.*

Data Used in Index

GPF has opted to use continuous readings obtained from its stationary logger at station WCH02 for all temperature and dissolved oxygen analyses. This was done under the assumption that continuous readings logged every 30 minutes throughout the course of the day are more representative than handheld probe readings logged once every 2 weeks. All pH and water clarity analyses were performed using data collected on a biweekly basis using a YSI multiparameter probe and Secchi disk, respectively. All chlorophyll and cyanobacteria analyses were performed using data obtained on a biweekly basis using a bbe Moldaenke FluoroProbe. Finally, all total nitrogen analyses were performed using data obtained from nutrient samples collected on 9/20/23 and subsequently processed at Marine Biological Laboratory in Woods Hole, MA.

Watcha Pond Site Visits in 2023

Table A3.

Dates of Watcha Pond Site Visits: 2023		
August	**September**	**October**
8/9	9/13	10/4
8/16	9/20*	
8/22		
8/31		

*Nutrient samples collected